KENTUCKY REPORT TO CONGRESS ON WATER QUALITY

1980 - 1981

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND
ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION

DIVISION OF WATER

KENTUCKY

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EXECUTIVE SUMMARY

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This report has been prepared pursuant to Section 305(b) of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500), as amended by the Clean Water Act of 1977 (PL 95-217). This biennial report covers the period January 1, 1980, through December 31, 1981, and addresses the current conditions and trends in water quality in the Commonwealth of Kentucky, special water quality problems of concern, and the status of certain water pollution control programs.

I. Current Conditions and Trends in Ambient Water Quality

The Kentucky Division of Water's ambient monitoring network consists of 30 stations that are sampled monthly for a variety of physical and chemical parameters. The data produced from these stations and from the U.S. Geological Survey's network are used to determine water quality conditions for most of the major river basins in the Commonwealth. The main stem of the Ohio River is not addressed in this report, because it is addressed by the Ohio River Valley Water Sanitation Commission's 305(b) report.

The primary activities affecting water quality in Kentucky are surface coal mining, oil and gas operations, agriculture, and domestic waste discharges.

The parameters that violate standards most frequently are fecal coliform bacteria, iron, manganese, and lead. Other parameters that show occasional violations are mercury, chromium, and cadmium. These violations occur randomly throughout the state with no discernible trends. Chronic pH violations are associated with streams impacted by acid mine drainage, most notably in the Tradewater River and Green River basins.

Data on organic chemicals in the Commonwealth's waters are very limited at this time.

Fish kills are reported by the Kentucky Department of Fish and Wildlife Resources. During the 1980-81 reporting period, 50 fish kills affecting a total of 127 stream miles were investigated.

Biological integrity was monitored at seven stations in four river basins. Conditions are reported as good at 2 stations, fair at 3 stations, and poor at 2 stations. The rationale for the rating is based on periphyton, macroinvertebrate, and fish community structure; stream physical habitat conditions; and water quality. Additional information is reported on fish tissue levels of toxic materials. Four stations had levels of chlordane in fish tissue which exceeded the FDA action level for this pesticide.

Two grant awards under Section 314 of the Clean Water Act were obtained by the Kentucky Department for Natural Resources and Environmental Protection since the last 305(b) Report submittal. One award was for a Phase 1 Diagnostic/Feasibility Study on McNeely Lake in Jefferson County, Kentucky. The other was for a lake classification and prioritization study to determine the trophic state of Kentucky's public lakes and their need for restoration.

The classification study has enabled the Division of Water to undertake its first comprehensive assessment of the general condition of lakes in the state. Forty-five lakes have been classified to date. Of the 353,353 total surface acres presently classified, 74,204 acres are eutrophic, 233,213 acres are mesotrophic, and 45,936 are oligotrophic. There is documentation of impaired uses of 10 lakes. Symptoms include excessive algal blooms, extreme oxygen depletion, excessive aquatic weed growth, turbid water, elevated iron and manganese levels, and taste and odor problems.

Kentucky's wetlands are presently not being monitored as a part of a formalized program; therefore, the severity of generalized impacts and the extent of wetland loss is unknown. The major threat to wetlands appears to be their destruction due to competing land use activities and poor land management practices.

While groundwater does not provide a large portion of the total water withdrawn in the state, it is an extremely important local and regional resource because it is most often used in areas where surface supplies are not physically or economically available. Approximately one-third of Kentucky's rural population still relies on private wells for its domestic or household supply.

Though the data base is incomplete and inadequate, a number of earlier studies have served to point out existing groundwater quality problems in the Commonwealth. The failure of on-site wastewater disposal systems (especially septic tanks and tile fields) probably represents the major source of groundwater quality degradation. Other known causes of groundwater contamination include waste landfills, surface disposal lagoons, oil and gas drilling and reinjection, diminished aquifer recharge, and nonpoint source pollution.

II. Special Water Quality Problems

Pursuant to the National Interim Primary Drinking Water Regulations (NIPDWR) promulgated June 24, 1975, the amended NIPDWR promulgated August 27, 1980, and Kentucky's Public and Semipublic Drinking Water Supplies Regulations (401 KAR 6:015), the Division of Water must supervise the collection and analysis of samples taken from its community and non-community public drinking water supplies.

Data generated from 1980-81 monitoring and surveillance activities indicated elevated sodium levels in community water supplies statewide. The results of trihalomethane monitoring at the state's three community water supplies serving populations greater than 75,000 indicated that two of these systems had averages of total trihalomethane concentrations in excess of the promulgated 0.100 mg/l maximum contaminant level. A better perspective of the extent of potential trihalomethane problems in Kentucky community water supplies will develop as surveillance proceeds for the systems serving from 10,000 to 75,000 persons.

A moderate number of Kentucky's smaller communities experienced water shortages during 1980 and 1981. The principal natural cause of short-term shortages was reduced precipitation. Other contributing factors include inefficient water use and inadequate planning.

Regional surface water availability is not generally a problem in the state with the possible exception of the Ohio River sub-basin. It is reported that the critical flow for water quality already exceeds the existing 7 day 10 year low flow in three Ohio River reaches, totaling 285 stream miles, which border Kentucky. This problem is projected to worsen due to additional consumption for municipal, industrial, and power cooling uses.

A study completed in 1981 by the Division of Water made an assessment of the impact of coal mining on the water quality of streams in the coalfields of Kentucky. This study revealed that river basins in the western coalfield have a more serious acid mine drainage problem than those in the eastern coalfield. The Green River basin has the greatest number of miles of streams impacted by acid mine drainage (271 miles), while the Tradewater River basin has the greatest percentage impacted (79%).

Two major clean-up operations were funded in 1981 under the Federal "Superfund" Program at hazardous waste sites (the "Valley of the Drums" in Bullitt County and the "old Hardin County Brickyard" near West Point) posing potential problems to surface and/or groundwater quality.

III. Water Pollution Control Programs

In 1981, the Division of Water initiated a comprehensive statewide stream use classification and regulatory designation program. Where current criteria are found to be inappropriate, site-specific criteria will be recommended for approval by the state, EPA, and the public through the state's public hearing process. This effort will contribute to the mandatory triennial review and revision of the state's water quality standards and will provide a basis for future permitting, compliance assurance, and enforcement decisions. The ultimate product will be the promulgation of surface water use designations and associated criteria for the entire state.

In accordance with Section 208 of the Federal Water Pollution Control Act, PL 92-500 as amended, the Division of Water of the Kentucky Department for Natural Resources and Environmental Protection was designated as the lead agency to develop a statewide plan for the control of nonpoint source (NPS) pollution. To date, an initial plan, which is currently undergoing major revision, has been developed and was partially approved by Region IV of the U.S. Environmental Protection Agency (EPA). The plan, at this time, proposes a non-regulatory framework for implementing best management practices to address agriculture, silviculture, and construction nonpoint sources of pollution. The portion of the plan that addresses surface mining, however, is intended to be implemented within the regulatory authority granted to the Kentucky Bureau of Surface Mining Reclamation and Enforcement through acceptance of primacy for the Federal Surface Mine Control Program.

All of the state's nonpoint source assessment activities are expected to be evaluated or compared against the stream survey information being obtained through the stream use designation program. In this manner, land-based erosion information can be compared against the potential or actual use impairment of the Commonwealth's streams. The state intends on using both information sources to generate watershed treatment priorities and segment-specific water quality standards. This priority scheme is intended to identify watershed treatment priorities by the seriousness of erosion or sedimentation impacts against the relative value (in terms of beneficial use) of the Commonwealth's streams.

Kentucky signed a cooperative agreement with EPA on July 27, 1980, initiating the process of assuming primary responsibility for the Construction Grants Program in the Commonwealth. Since that time, 12 of 20 functions have been executed by the Secretary of the Department and the Regional Administrator of EPA, Region IV. Over the past two years, there have been 82 new projects initiated, which account for nearly $76 million, including: 23 Step 1 projects, 21 Step 2 projects, 30 Step 3 projects, and 8 Step 4 projects.

IV. Summary of State Problems and Needs

Recommendations were made relative to (1) continued support and development of monitoring programs to provide the necessary data base, (2) addressing special water quality problems and (3) the development and implementation of a more effective water pollution control program.

CHAPTER I

CURRENT CONDITIONS AND TRENDS IN AMBIENT WATER QUALITY

RIVERS AND STREAMS

Introduction

The Commonwealth of Kentucky comprises an approximate area of 40,598 square miles. The northern boundary is formed by the low water mark of the northern shore of the Ohio River and extends along the river from Catlettsburg in the east to the Ohio's confluence with the Mississippi River near Wickliffe in the west. The southern boundary is formed by an extension of the Virginia-North Carolina 1780 Walker Line which extends due west to the Tennessee River. Following the acquisition of the Jackson Purchase in 1818, the 30°36' parallel was accepted as the southern boundary from the Tennessee River to the Mississippi River.

Kentucky's eastern boundary begins at the confluence of the Big Sandy River with the Ohio River at Catlettsburg and follows the main stem of the Big Sandy and Tug Fork southeasterly to Pine Mountain; then follows the ridge of Pine and Cumberland mountains southwest to the Tennessee line. The western boundary follows the middle of the Mississippi River and includes several of the islands in the Mississippi channel.

Kentucky is comprised of three major physiographic provinces; the Appalachian Plateaus, the Interior Low Plateaus and the Coastal Plain. The major drainage basins in the Commonwealth from east to west are the Big Sandy, Little Sandy, Tygarts, Licking, Kentucky, Upper Cumberland, Salt, Green, Tradewater, Lower Cumberland, Tennessee, and Mississippi. Most of the major rivers flow in a northwesterly direction, many of them traversing more than one major physiographic region, thus influencing the aqueous geochemistry.

The climate of Kentucky is classified as continental temperate humid. A wide range of temperatures is observed between summer and winter. Annual precipitation averages about 45 inches but varies from between 40 to 50 inches across the state. Maximum precipitation occurs during winter and spring with minimum precipitation occurring in late summer and fall. The heaviest precipitation, as well as the precipitation of longest duration, is normally associated with low pressure disturbances moving in a general southwest to northeast direction through the Ohio valley. Prolonged droughts are rarely experienced. Summers are warm and humid with an average temperature of 76°F, while winters are moderately cold with an average temperature of 34°F. Maximum snowfalls usually occur during January.

Ambient Monitoring

The Division of Water routinely monitors ambient water quality at designated sites to establish baseline data. This data is used to characterize trends in physical, chemical, and biological conditions and to provide information for decision-making by pollution control agencies.

For the reporting period (1980-1981), the physicochemical network consisted of 30 stations located in six river basins

(Figure 1). Water samples collected monthly at each station are analyzed according to the parameter list shown in Table 1. In addition, the Division supports and uses data collected by the Ohio River Valley Water Sanitation Commission (ORSANCO) at eleven main stem Ohio River stations and five major tributary stations. The United States Geological Survey maintains a National Stream Quality Accounting Network (NASQAN) composed of four main stem Ohio River stations and eight major tributary stations. The Division is also participating in the U.S. Environmental Protection Agency's Basic Water Monitoring Program (BWMP) (Figure 1). Kentucky's commitment to the BWMP network consists of 7 of the Division's 30 primary network stations. In addition, 9 BWMP stations on the Ohio River are maintained by ORSANCO, for a total of 16 stations in the state.

The data generated from these monitoring efforts were analyzed and used in the development of the basin discussions and the water quality matrix, as detailed in the following section.

Existing Physicochemical Conditions

The Water Quality Index uses the following nine categories: temperature, oxygen, pH, bacteria, trophic nutrients, aesthetics, solids, and organic and inorganic toxicants. These categories were applied to the matrix for each of the major river basins. The physicochemical stations are grouped by basin and evaluated to give the overall trend and condition. The water quality parameters are assessed for standards violations.

MONITORING STATIONS

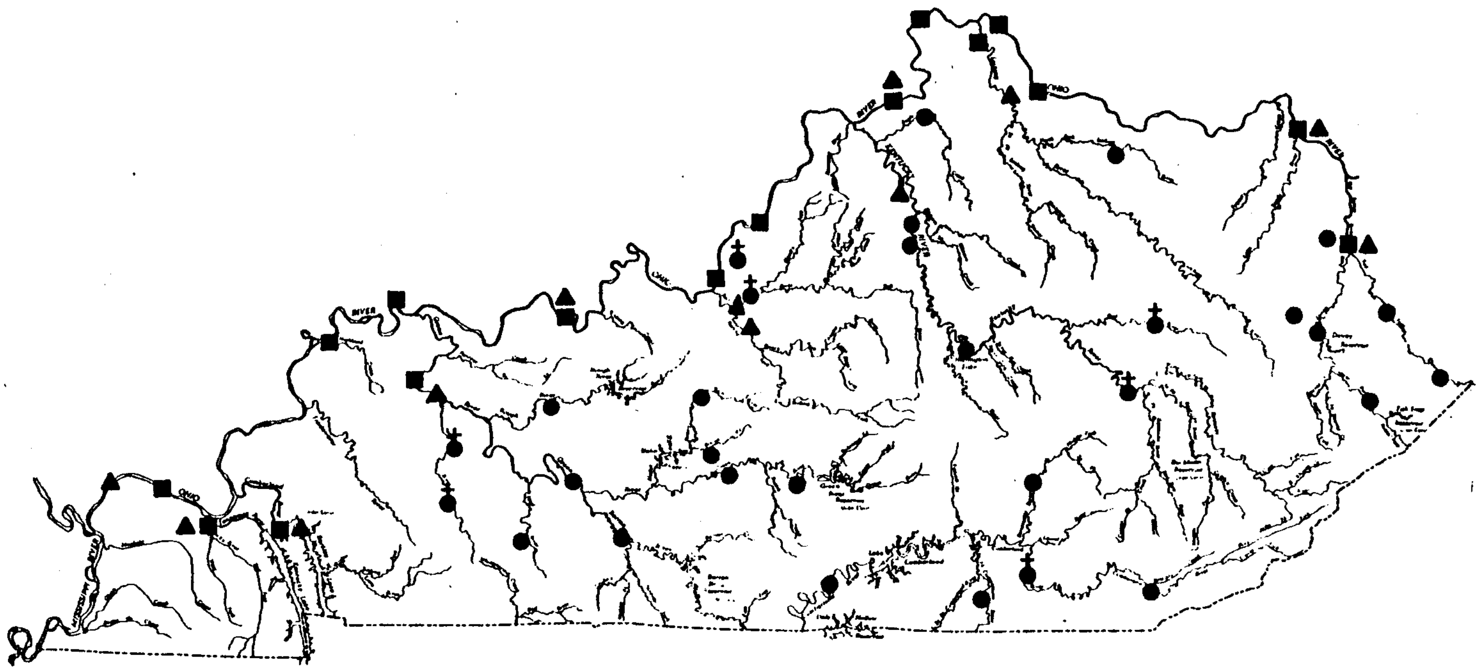

FIGURE 1

Table 1

Ambient Monitoring Parameters

Monthly

Air Temperature
Water Temperature
Dissolved Oxygen
pH
Secchi disk transparency
Conductivity
Flow
Stream Stage
Turbidity

Monthly

Turbidity
Conductivity
Suspended Solids
NH_3-N
NO_2+NO_3-N
Total Kehldahl Nitrogen (TKN)
Phosphorus (total)
Acidity
Alkalinity
Biochemical Oxygen Demand (BOD)
Chemical Oxygen Demand (COD)
Dissolved Solids
Fluoride
Chloride
pH
Total Hardness
Sulfates
Arsenic, total
Cadmium, total and dissolved
Chromium, total and dissolved
Copper, total and dissolved
Iron, total and dissolved
Lead, total and dissolved
Manganese, total and dissolved
Mercury, total and dissolved
Zinc, total and dissolved

Monthly

Fecal Coliform/100ml

Quarterly

Barium, total
Beryllium, total
Selenium, total
Silver, total

The scope and severity of violations of the specific physicochemical parameters composing the categories used in the matrix were determined for each river basin. Scope is defined as the percentage of the basin impacted by a specific pollutant. This is a subjective rating based on existing physicochemical data. The severity of the impact is also a subjective classification based on the percentage of standards violations at each ambient station during the sampling period 1980-1981.

In each basin the water quality ratings for the nine categories were determined as good, fair, and poor. These determinations are defined as follows:

Good: Water quality standards for selected parameters were exceeded in less than 10% of samples, with the violations occurring in less than 25% of the basin.

Fair: Water quality standards for selected parameters were exceeded in 10% to 33% of the samples, with violations occurring in 25% to 75% of the basin.

Poor: Water quality standards for selected parameters exceeded in 33% or more of the samples, with violations occurring in 75% or more of the basin.

Unknown: No data available.

In the few instances where the combination of scope and severity did not fit into the above criteria, the severity factor was given the most weight in the final determination of the overall water quality rating. The scope of the impacts was considered to be of secondary importance, due to limited station coverage in most river basins.

It should be noted that in some cases, particularily with regards to toxic pollutants, the fact that a problem is not identified may be due to limited monitoring data and not because the problem does not exist.

Due to the Division of Water's limited period of data collection (2 1/2 years), it is difficult to properly assess water quality trends. Trends were estimated by reviewing previous Kentucky 305(b) Reports, assessment of available ambient data, and judgement of personnel experienced in water quality conditions.

Table 2 is a matrix summary of water quality conditions for all major basins in Kentucky. This summary was compiled from a basin-by-basin assessment of water quality conditions and trends for Kentucky for the period 1980-81. The individual basin assessments consist of a basin map, water quality matrix, and a general basin discussion.

Table 2

RIVER BASIN SUMMARY

RIVER BASIN SUMMARY WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Big Sandy													
7 stations	1980	G	G	G	P	F	Δ	F	P	Δ	F	P	FC, P, Fe.
	1981	G	G	G	F	F	Δ	P	P	Δ	F	NP	Hg, Cd
Hydrologic Unit #050702(01-04)	TREND	→	→	→	↑	→	Δ	↓	→	Δ	→		
Little Sandy													
0 stations	1980	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	1981	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Hydrologic Unit #05090104	TREND	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Tygarts Creek													
0 stations	1980	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	1981	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Hydrologic Unit #05090103	TREND	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Licking River													
2 stations	1980	G	G	G	P	P	Δ	P	F	Δ	P	P	Hg, Mn, SS,
	1981	G	G	G	P	P	Δ	F	F	Δ	F	NP	P, Fe,
Hydrologic Unit #051001 (01,02)	TREND	→	→	→	→	→	Δ	↑	→	Δ	↑		NO_2+NO_3-N

WATER QUALITY: G = Good
F = Fair
P = Poor
Δ = Unknown

TREND: ↑ = Improving Quality
↓ = Degrading Quality
→ = No detectable Trend
Δ = Unknown

CAUSES: P = Point Source(s)
NP = Non-point
N = Natural
Δ = Unknown

Table 2

RIVER BASIN SUMMARY CONTINUED

RIVER BASIN SUMMARY (continued)

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Kentucky River													
6 stations	1980	G	G	G	F	F	Δ	P	P	Δ	F	P	NO_2+NO_3-N,
	1981	G	G	G	P	P	Δ	P	P	Δ	P	NP	Pb
Hydrologic Unit #051002(01-05)	TREND	→	→	→	↓	↓	Δ	→	→	Δ	↓		
Upper Cumberland													
5 stations	1980	G	G	G	G	G	Δ	P	F	Δ	G		P, Fe, Mn
	1981	G	G	G	G	G	Δ	P	F	Δ	G		
Hydrologic Unit #051301(01-05)	TREND	→	→	→	→	→	Δ	→	→	Δ	→		
Salt River													
3 stations	1980	G	G	G	P	P	Δ	P	P	P	P	P	NO_2+NO_3-N,
	1981	G	G	G	F	P	Δ	P	P	P	P	NP	Pb, Hg, Cd, Fe,
Hydrologic Unit #051401(02,03)	TREND	→	→	→	↑	→	Δ	→	→	→	→		FC
Green River													
11 stations	1980	G	G	G	F	P	Δ	P	F	Δ	F	P	NO_2+NO_3-N,
	1981	G	G	G	F	P	Δ	P	F	Δ	F	NP	Pb, Cd, Hg,
Hydrologic Unit #051100(01-06)	TREND	→	→	→	→	→	Δ	→	→	Δ	→		Fe, P

WATER QUALITY: G = Good
F = Fair
P = Poor
Δ = Unknown

TREND: ↑ = Improving Quality
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→ = No detectable Trend
Δ = Unknown

CAUSES: P = Point Source(s)
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N = Natural
Δ = Unknown

Table 2

RIVER BASIN SUMMARY CONTINUED

RIVER BASIN SUMMARY WATER BODY	YEAR	TEMPERATURE	OXYGEN	PH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Lower Cumberland													
1 station	1980	G	G	G	G	F	Δ	P	G	Δ	G	P	P, Fe, Mn,
	1981	G	G	G	G	F	Δ	F	G	Δ	G	NP	Cd, Hg
Hydrologic Unit #051307(05,06)	TREND	→	→	→	→	→	Δ	↑	→	Δ	→		
Tradewater													
0 stations	1980	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	1981	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Hydrologic Unit #05140205	TREND	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Tennessee													
1 station	1980	G	G	G	G	F	Δ	F	G	Δ	G	P	P, Fe, Mn,
	1981	G	G	F	G	F	Δ	G	G	Δ	G	NP	
Hydrologic Unit #060400(05,06)	TREND	→	→	↓	→	→	Δ	↑	→	Δ	→		
Mississippi													
0 stations	1980	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	1981	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Hydrologic Unit 080102(01,02)	TREND	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

Ohio River Main Stem

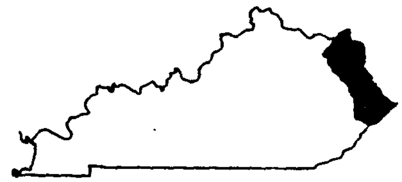
The Ohio River forms the northern border of the Commonwealth of Kentucky for 664 miles. The river receives impacts from all the major drainages as well as numerous minor basins within the state. In addition, the Ohio receives drainage from a large portion of Pennsylvania, Ohio, West Virginia, Indiana and Illinois.

The Division of Water maintains no water quality monitoring stations on the main stem of the Ohio River. Monitoring of the Ohio main stem and lower reaches of major tributaries is the responsibility of the Ohio River Valley Water Sanitation Commission (ORSANCO), a compact of eight states in the Ohio River drainage basin. Information on water quality of the Ohio River main stem is contained in ORSANCO's Water Quality Report to Congress for the same reporting period.

Big Sandy River Basin

Includes Little Sandy and Tygarts Creek

FIGURE 2



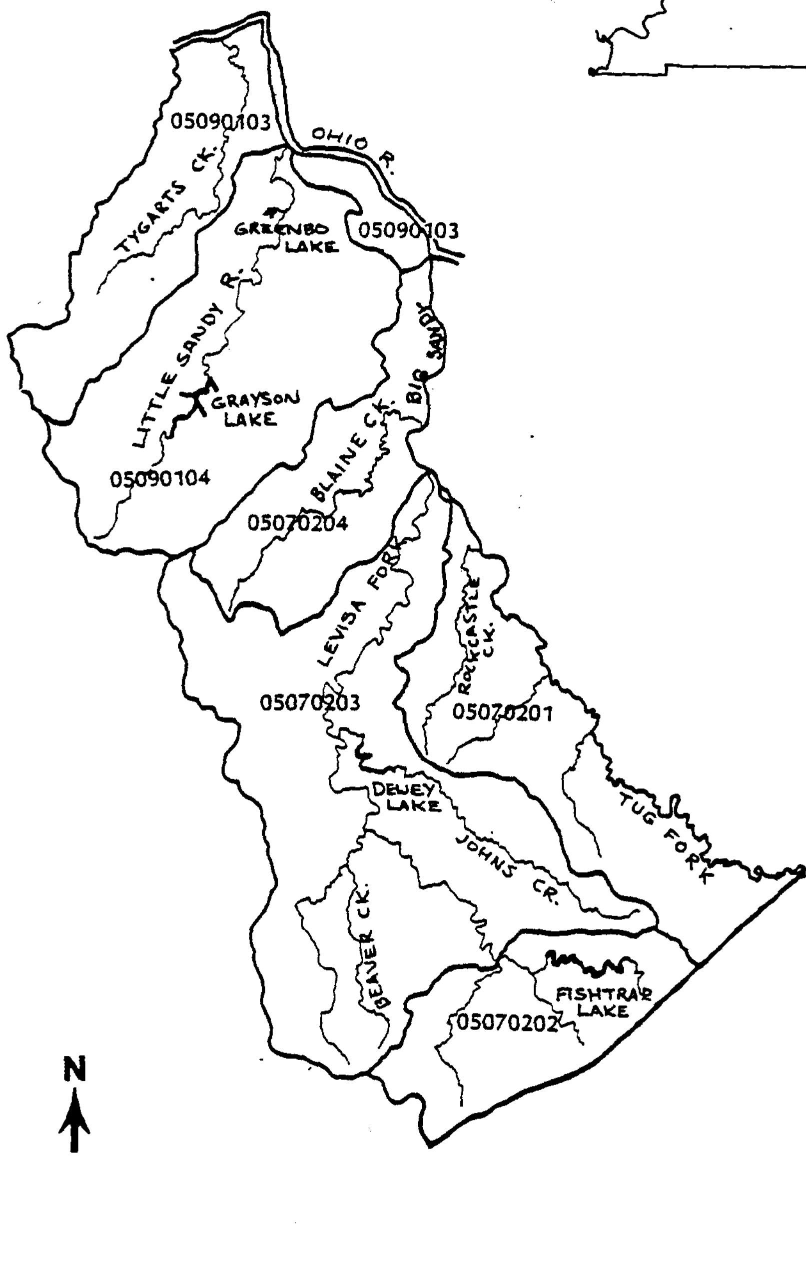


Table 3

Big Sandy River Basin

BIG SANDY RIVER BASIN

WATER BODY	YEAR	TEMPERATURE	OXYGEN	PH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Tug Fork													
Hydrologic Unit #05070201	1980	G	G	G	P	F	Δ	F	P	Δ	F	N	Cd, Hg,
	1981	G	G	G	G	F	Δ	P	P	Δ	F	P	Fe, P,
KY Primary Station #01004901	TREND	→	→	→	↑	→	Δ	↓	→	Δ	→	NP	FC
Tug Fork													
Hydrologic Unit #05070201	1980	G	G	G	P	F	Δ	G	P	Δ	F	NP	Hg, Fe,
	1981	G	G	G	F	F	Δ	F	P	Δ	F	N	P, FC
KY Primary Station #01004900	TREND	→	→	→	↑	→	Δ	↓	→	Δ	→	P	
Levisa Fork													
Hydrologic Unit #05070203	1980	G	G	G	F	F	Δ	F	P	Δ	F	P	Cd, Hg,
	1981	G	G	G	G	F	Δ	P	P	Δ	F	NP	Fe, P,
KY Primary Station #01020900	TREND	→	→	→	↑	→	Δ	↓	→	Δ	→	N	FC
Levisa Fork													
Hydrologic Unit #05070203	1980	G	G	G	G	G	Δ	F	P	Δ	G	P	Pb, Cd,
	1981	G	G	G	F	F	Δ	P	P	Δ	F	NP	Hg, Fe,
KY Primary Station #01016901	TREND	→	→	→	↓	↓	Δ	↓	→	Δ	↓		P, FC.

WATER QUALITY: G = Good
F = Fair
P = Poor
Δ = Unknown

TREND: ↑ = Improving Quality
↓ = Degrading Quality
→ = No detectable Trend
Δ = Unknown

CAUSES: P = Point Source(s)
NP = Non-point
N = Natural
Δ = Unknown

Table 3

Big Sandy River Basin continued

BIG SANDY RIVER BASIN (continued)

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Paint Creek													
Hydrologic Unit #05070203	1980	G	G	G	G	G	Δ	G	G	Δ	G	P	Hg, Fe,
	1981	G	G	G	G	G	Δ	F	F	Δ	G	NP	
KY Primary Station #01015900	TREND	→	→	→	→	→	Δ	↓	↓	Δ	→	N	
Blaine Creek													
Hydrologic Unit #05070204	1980	G	G	G	F	G	Δ	F	P	Δ	F	P	Hg, Fe,
	1981	G	G	G	G	G	Δ	F	F	Δ	G	NP	SS, FC
KY Primary Station #01003900	TREND	→	→	→	↑	→	Δ	→	↑	Δ	↑		
Big Sandy River													
Hydrologic Unit #05070204	1980	G	G	G	P	F	Δ	F	P	Δ	F	P	Hg, Fe, Mn,
	1981	G	G	G	P	F	Δ	F	P	Δ	F	NP	SS, P, FC
NASQAN #03215000	TREND	→	→	→	→	→	Δ	→	→	Δ	→		
	1980												
	1981												
	TREND												

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

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CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ - Unknown

Big Sandy River Basin

050702 (01, 02, 03, 04)

The Big Sandy River basin lies in the rugged mountains of the Cumberland Plateau in eastern Kentucky and adjacent West Virginia and Virginia. The basin is underlain by sandstone deposits of Pennsylvanian age. The total drainage area is 4,280 square miles, 2,885 of which are in Kentucky.

The main stem of the Big Sandy River originates at the confluence of the Levisa and Tug Fork at Louisa, Kentucky, and flows north 27 miles to enter the Ohio River (mile 317.1) at Catlettsburg, Kentucky. Levisa Fork flows 130 miles in Kentucky with a drainage area of 1,471 square miles. Principal tributaries of the Levisa Fork include Paint Creek, Russell Fork, Beaver Creek, and Johns Creek. Tug Fork forms the boundary between Kentucky and West Virginia for about 94 miles and has a drainage area within the state of 476 square miles. Principal tributaries to the Tug Fork within the state include Rockcastle Creek, Wolf Creek, and Big Creek.

The elevation of the Big Sandy River ranges from 2,400 feet above mean sea level (m.s.l.) at the head of Levisa Fork and 2,200 feet above m.s.l. at the head of Tug Fork to 498 feet above m.s.l. at its confluence with the Ohio River. The average main stem slope of the Big Sandy is 9.9 feet/mile while many of its tributaries have average slopes of over 50 feet/mile.

Steep terrain and shallow soil depths account for the limited agriculture in the basin. Localized silviculture operations also occur throughout the drainage. The mainstay of the economy lies in the vast coal reserves underlying the basin. Both surface and deep mining, and to a lesser extent several small petroleum fields, provide jobs for most of the residents.

Impacts

The principal impacts to the streams in Big Sandy River basin are increased siltation and to a lesser extent increased nutrient enrichment. Acid mine drainage is limited to a few localized areas in the upper half of the drainage. The lower 12 miles of the main stem receive at least 5 industrial discharges which impact this section of the stream. Oil and gas drilling have degraded the water quality in the Blaine Creek and Johnson Creek subbasins. Other impacts are road construction, domestic sewage, urban runoff and agriculture.

The aquatic biota has been adversely affected by surface mine runoff over a large portion of the drainage. Essentially every major watershed has been impacted to some degree by surface mining. Water quality perturbations have been so extensive in some localized areas as to virtually eliminate the aquatic fauna. One fish kill was reported for each year (1980, 1981) in the Kentucky portion of the drainage.

o Flow

The average discharge for the period of record (53 years) is 2,514 cfs for the Levisa Fork at Paintsville river mile 65.2. Mean discharge for water year 1980 was slightly below the annual average discharge (-3%). However, during water year 1981, the mean discharge was 34% below the annual average. The concentration effect of flow reduction during the reporting period was a contributing factor to observed increases in certain physicochemical parameters.

° Dissolved Oxygen (DO) and Temperature

There were no water quality violations for these parameters during the report period. DO levels averaged 8.7 mg/l throughout the basin, with a maximum of 17.0 and a minimum of 4.5 mg/l.

° Acidity, Alkalinity and pH

There were no violations of pH standards during the reporting period. Average pH throughout the basin was 7.25. Acidity averaged 4.4 mg/l and alkalinity 70.1 mg/l.

° Conductivity

An elevated mean conductivity value of 408 μmhos/cm was recorded, reflecting the impact of mining and oil drilling activities within the basin.

° Chlorides and Sulfates

Chloride levels were elevated at two stations, Blaine Creek (mean = 261.7 mg/l) and Paint Creek (mean = 55.8 mg/l). These levels may be attributed to the oil drilling operations in the basin. Sulfate levels are also elevated at four stations, probably due to the extensive mining in the drainage.

° Fecal Coliform

Fecal coliform standards were exceeded 62% of the time in both 1980 and 1981. The Levisa Fork near Pikeville had 100% violations in both 1980 and 1981, while the Tug Fork station near Kermit had 100% violations in 1980 and 87.5% violations in 1981. All stations showed at least one violation. This appears to be a severe and widespread problem and would preclude primary contact recreation in most streams.

o Heavy Metals

Violations of public water supply and aquatic life standards for manganese, iron and lead were both severe and widespread. Cadmium and mercury violations were moderate in both severity and scope.

Little Sandy River Basin

05090104

The Little Sandy River basin is located in the northeastern portion of the state, lying within the Unglaciated Appalachian Plateau. The area is underlain with Pennsylvanian age sandstone deposits. The river arises near Sandy Hook, Kentucky, and flows 87 miles to its confluence with the Ohio River at Greenup, Kentucky (Ohio River mile 336.4). Principal tributaries to the Little Sandy include the Little Fork, East Fork and Big Sinking Creek. The major impoundment of this area is Grayson Lake near Grayson, Kentucky. The basin drains an area of 721 square miles.

The topography in the headwater section is generally rugged, with no flat or undulating land present. Closer to the mouth, the terrain becomes less rugged with more bottomland available for agricultural practices.

Elevations range from 1,300 feet above mean sea level (m.s.l.) in the headwater region near Sandy Hook to 479 feet above m.s.l. at the river's confluence with the Ohio. Average slope for the Little Sandy is 8.3 feet/mile.

Impacts

The major impact in the Little Sandy River basin is coal mining which contributes increased sediment loads to the receiving streams. Domestic sewage and agricultural runoff are minor impacts. Siltation resulting from coal mining operations have adversely affected the aquatic biota in the Little Sandy basin. One fish kill was reported in 1980, and none in 1981.

o Flow

The annual average discharge for the period of record (42 years) is 482 cfs for Little Sandy at Grayson, mile point 38.05. Mean discharge for water year 1980 was slightly below the annual average discharge (-4%). However, during water year 1981, mean discharge was 42% below annual average.

Tygarts Creek Basin

05090103

The Tygarts Creek basin is located in the northeastern portion of the state, lying within the Unglaciated Allegheny Plateau region of the Appalachian Plateaus Province. The bedrock in the headwaters is Pennsylvanian sandstone but as the stream flows northward it cuts into Mississippian limestone deposits. Tygarts Creek originates in southwestern Carter County, Kentucky and flows in a northeasterly direction for its 89.3 miles, where it empties into the Ohio River at South Shore, Kentucky (mile point 353.2). The principal tributary is Buffalo Creek with a drainage area of 54 square miles. The entire basin has a drainage area of 339 square miles.

The topography for the watershed varies from steep hillsides and narrow valleys in the headwaters to broad, wide valleys near the mouth. Elevations range from 485 feet above mean sea level (m.s.l.) at its confluence with the Ohio River to 1300 feet above m.s.l. at the source. The average slope of Tygarts Creek is 6.9 feet/mile. The average stream channel width ranges from about 30 feet in the headwater reaches to over 200 feet near the mouth.

Impacts

Municipal sewage from the city of Olive Hill is the main impact on Tygarts Creek, with some minor impacts from mining and oil drilling operations.

Tygarts Creek supports a diverse assemblage of aquatic organisms throughout the drainage. No fish kills occurred during the reporting period.

o Flow

The annual average discharge for the period of record (40 years) is 310 cfs for Tygarts Creek at Olive Hill at mile point 78.0. Mean discharge for water year 1980 was slightly below the annual average discharge (-6%). However, during water year 1981, mean discharge was 43% below annual average.

Licking River Basin

FIGURE 3

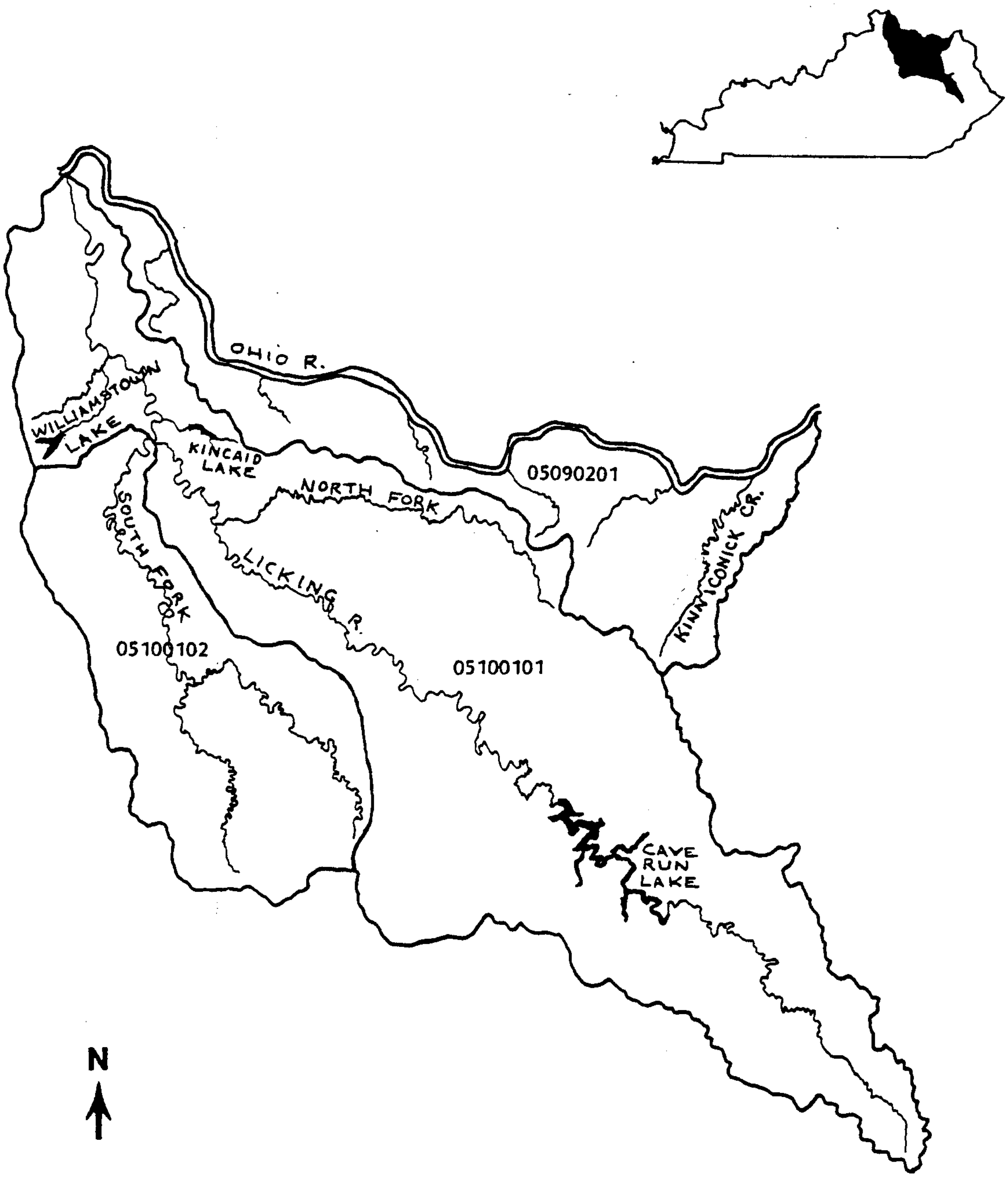

Table 4

Licking River Basin

LICKING RIVER BASIN

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
North Fork Licking													
Hydrologic Unit #05100101	1980	G	G	G	F	P	Δ	P	F	Δ	F	NP	NO_2+NO_3-N,
	1981	G	G	G	G	P	Δ	F	F	Δ	F	N	Hg, Fe, P,
KY Primary Station #05023900	TREND	→	→	→	↑	→	Δ	↑	→	Δ	→		
Licking River													
Hydrologic Unit #05100101	1980	G	G	G	P	P	Δ	P	F	Δ	P	P	SS, P, Fe,
	1981	G	G	G	P	P	Δ	F	F	Δ	F	NP	NO_2+NO_3-N,
NASQAN #03254000	TREND	→	→	→	→	→	Δ	↑	→	Δ	↑		Mn
	1980												
	1981												
	TREND												
	1980												
	1981												
	TREND												

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

Licking River Basin

051001 (01, 02)

The Licking River basin is located within the eastern portion of Kentucky in two major physiographic provinces, the Allegheny Plateaus and Interior Low Plateaus. It rises in southeastern Kentucky and flows northwesterly to the confluence with the Ohio River in the Covington-Newport, Kentucky area at an elevation of 420 feet above mean sea level (m.s.l.). The total drainage area of the basin is 3,700 square miles. Principal tributaries are the North Fork and South Fork of the Licking. The major impoundment of this area is Cave Run Lake near Farmers, Kentucky.

The topography of the headwaters area is characteristic of the unglaciated region of the Appalachian Plateaus. This area is dissected into narrow ridges and steep sided valleys by a network of streams. The underlying rocks are Pennsylvanian age sandstone. Maximum elevation in the headwaters is 1000 feet above m.s.l. Average slope for the Licking River main stem is 2.26 feet/mile.

Upon leaving the Appalachian Plateaus, the Licking flows through sections of the Interior Low Plateaus known as the Knobs and the Blue Grass. The Knobs are characterized by conical and flat-topped hills with broad valleys. The Blue Grass topography ranges from an area of gently rolling hills adjacent to the Knobs, to an area highly dissected by a network of streams which have formed V-shaped valleys and narrow ridges. Mississippian and Ordovician limestones underlie most of this section.

Impacts

In the upper portion of the drainage, coal mining and gas and oil drilling operations are the major impacts. These operations contribute increased silt loads and brines to the streams. In the lower river, agricultural runoff and domestic sewage increase nutrient levels. The last few miles drain a heavily industrialized area.

The aquatic biota above Cave Run Reservoir has been impacted by coal mining and oil and gas operations; however, below the reservoir the river supports a diverse and complex group of organisms. The stability of biotic communities below the reservoir may change as oil and gas drilling increase in the drainage. Seven fish kills were reported in the drainage for 1980; only two occurred in 1981.

o Flow

The annual average discharge for the period of record (54 years) is 4,192 cfs for the Licking River at mile point 48.0. Mean discharge for water year 1980 was slightly below the annual average discharge (-4%). However, during water year 1981, mean discharge was 36% below annual average. The concentration effect of flow reduction during the reporting period was a contributing factor to observed increases in certain physicochemical parameters.

- Dissolved Oxygen (DO) and Temperature

There were no recorded violations of these parameters during the reporting period. The DO ranged from a high of 14.2 mg/l to a minimum of 6.0 mg/l with an average concentration of 9.8 mg/l.

- Acidity, Alkalinity and pH

The pH standard was not violated during the reporting period; it ranged from 8.5 to 6.4 with an average of 7.8. Total alkalinity values averaged 134 mg/l and are typical of alkaline streams in Kentucky. Acidity ranged from 16.2 to 0 mg/l with an average of 6.4 mg/l.

- Conductivity

A mean conductivity value of 315.3 μmhos/cm was recorded and is typical of alkaline streams in Kentucky.

- Fecal Coliform

The two stations in this drainage were in standard violation 28% of the time in 1980. In 1981, the percentage dropped to 23%. Septic tank and agricultural runoff are the probable cause.

- Heavy Metals

The Division of Water ambient station (North Fork Licking River) showed severe violations of public water supply standards for lead, manganese and iron. Violations for mercury were moderate and for cadmium minor. U.S.G.S. data from the main stem of the Licking indicate severe violations of standards for mercury and iron.

Table 6

Upper Cumberland River Basin

UPPER CUMBERLAND RIVER BASIN WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Cumberland River													
Hydrologic Unit #05130101	1980	G	G	G	F	F	Δ	F	P	Δ	F	P	Pb, Cd,
	1981	G	G	G	G	F	Δ	P	P	Δ	F	NP	Hg, Fe,
KY Primary Station #02038900	TREND	→	→	→	↑	→	Δ	↓	→	Δ	→		P
Cumberland River													
Hydrologic Unit #05130101	1980	G	G	G	G	G	Δ	Δ	G	F	G	P	Hg, Fe,
	1981	G	G	G	F	G	Δ	F	G	F	G	NP	
KY Primary Station #02018900	TREND	→	→	→	↓	→	Δ	Δ	→	→	→		
Rockcastle River													
Hydrologic Unit #05130102	1980	G	G	G	G	G	Δ	F	G	Δ	G	P	Pb, Cd,
	1981	G	G	G	F	G	Δ	P	G	Δ	G	NP	Hg, Fe
KY Primary Station #02020900	TREND	→	→	→	↓	→	Δ	↓	→	Δ	→		
Cumberland River													
Hydrologic Unit #05130103	1980	G	G	G	G	G	Δ	F	F	Δ	G	P	Hg
	1981	G	G	G	G	G	Δ	G	P	Δ	G	NP	
KY Primary Station #02001900	TREND	→	→	→	→	→	Δ	↑	↓	Δ	→		

WATER QUALITY:
- G = Good
- F = Fair
- P = Poor
- Δ = Unknown

TREND:
- ↑ = Improving Quality
- ↓ = Degrading Quality
- → = No detectable Trend
- Δ = Unknown

CAUSES:
- P = Point Source(s)
- NP = Non-point
- N = Natural
- Δ = Unknown

Table 5

Kentucky River Basin

KENTUCKY RIVER BASIN

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Kentucky River													
Hydrologic Unit #05110204	1980	G	G	G	F	G	Δ	F	F	G	G	P	Hg, Fe,
	1981	G	G	G	P	F	Δ	F	P	G	F	NP	P, FC
KY Primary Station #04039900	TREND	→	→	→	↓	↓	Δ	→	↓	→	↓		
Red River													
Hydrologic Unit #05110204	1980	G	G	G	G	F	Δ	F	P	G	G	P	Pb, Hg, Fe,
	1981	G	G	G	F	G	Δ	P	P	G	F	NP	FC
KY Primary Station #04043900	TREND	→	→	→	↓	↑	Δ	↓	→	→	↓		
Kentucky River													
Hydrologic Unit #05100205	1980	G	G	G	G	F	Δ	P	F	Δ	F	P	Cu, Pb, Cd,
	1981	G	G	G	G	P	Δ	P	F	Δ	F	NP	Hg, Fe, P
KY Primary Station #04020900	TREND	→	→	→	→	↓	Δ	→	→	Δ	→		
Kentucky River													
Hydrologic Unit #05100205	1980	G	G	G	F	F	Δ	P	F	Δ	F	P	NO_2+NO_3-N,
	1981	G	G	G	F	P	Δ	P	G	Δ	F	NP	Pb, Cd, Hg,
KY Primary Station #04013900	TREND	→	→	→	→	↓	Δ	→	↑	Δ	→		Fe, P

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

Table 5

Kentucky River Basin continued

KENTUCKY RIVER BASIN (continued)

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Kentucky River													
Hydrologic Unit #05100205	1980	G	F	G	F	F	Δ	P	F	Δ	F	P	NO_2+NO_3-N,
	1981	G	G	G	F	P	Δ	P	G	Δ	F	NP	Pb, Cd, Ag,
KY Primary Station #04012900	TREND	→	↑	→	→	↓	Δ	→	↑	Δ	→		Fe, P

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Eagle Creek													
Hydrologic Unit #05100205	1980	G	G	G	G	F	Δ	P	F	Δ	F	NP	NO_2+NO_3-N,
	1981	G	G	G	F	F	Δ	P	P	Δ	F	N	Pb, Hg, Fe,
KY Primary Station #04007900	TREND	→	→	→	↓	→	Δ	→	↓	Δ	→		P, FC

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
	1980												
	1981												
	TREND												

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
	1980												
	1981												
	TREND												

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

Kentucky River Basin

051001 (01, 02, 03, 04, 05)

The Kentucky River basin drains 7,033 square miles in the Cumberland Plateau and Blue Grass sections. The main stem of the Kentucky River is formed by the confluence of the North Fork, Middle Fork, and South Fork in the Beattyville, Kentucky area. Flowing northwesterly 254.8 miles, the river joins the Ohio River at Carrollton, Kentucky (Ohio River mile 435.6). A series of 14 U.S. Army Corps of Engineers Locks and Dams impound the river from the mouth to Beattyville. Principal tributaries to the Kentucky River are the Red River, Dix River, Elkhorn and Eagle Creeks. Major impoundments of this basin are Herrington, Buckhorn and Carr Fork Lakes.

Watershed topography varies considerably. The upper third of the drainage lies on Pennsylvanian sandstone in the Cumberland Plateau. This area is characterized by deeply dissected valleys, narrow ridge tops, and steep slopes. Average slope of the tributaries in that section ranges from 3 feet/mile to 7.2 feet/mile with the main stem averaging 0.9 feet/mile. The highest elevation in the basin is Pine Mountain, 2,273 feet above mean sea level (m.s.l.).

Adjacent to the mountainous area is the Interior Low Plateaus in which the Blue Grass and Knobs sections lie. These plateaus are underlain by limestones of the Ordovician, Devonian and Silurian periods. The Knobs form a narrow crescent separating the Blue Grass from the Cumberland Plateau and are characterized by hills with steep slopes. Topography of the Blue Grass varies from gently rolling terrain, to areas highly dissected by dendritic drainage systems with V-shaped valleys and narrow ridges, to broad undulating peneplains marked by karst areas. Average slope of the tributaries in the Blue Grass ranges from 3 feet/mile to 32 feet/mile. The main stem of the Kentucky averages 0.7 feet/mile. Maximum elevation in the Blue Grass approaches 1,000 feet above m.s.l.

Impacts

The main impacts to the Kentucky River drainage are mining and agricultural practices. Demand for fossil fuels in the past decade has greatly increased surface mining within the basin causing a further increase in siltation of downstream areas. Cultivation of the narrow floodplains in the highlands and intensive farming throughout the Knobs and Blue Grass Sections contribute to nutrient and sediment loading of the drainage.

Numerous municipal treatment plant effluent discharges affect the water quality of the streams in the basin, primarily by nutrient enrichment and oxygen depletion.

Improper oil and gas drilling operations have recently become a serious water quality problem in portions of the drainage. The South Fork of the Red River has been extensively impacted by these operations, resulting in localized elimination of the aquatic fauna. Perturbations are so severe that they have adversely affected public water supplies as far downstream on the Kentucky River as Lexington.

The aquatic biota is generally good throughout most of the basin except in some coal field tributaries that have been impacted by mining or oil drilling. Some Blue Grass streams have been impacted by municipal treatment plant effluents. There were four fish kills reported in 1980 and seven in 1981.

- Flow

The annual average discharge for the period of record (55 years) is 8,405 cfs for the Kentucky River at mile point 31.0. Mean discharge for water year 1980 was slightly below the annual average discharge (-5%). However, during water year 1981, mean discharge was 35% below annual average. The concentration effect of flow reduction during the reporting period was a contributing factor to observed increases in certain physicochemical parameters.

- Dissolved Oxygen (DO) and Temperature

There were no violations for these parameters during the report period. D.O. levels averaged 9.4 mg/l throughout the basin.

- Acidity, Alkalinity and pH

There were no pH violations within the drainage for the report period; average pH was 7.5. Acidity averaged 4.95 mg/l and alkalinity averaged 65.2 mg/l.

- Conductivity

A mean value of 270.5 µmho/cm was reported for the drainage basin.

- Fecal Coliform

The six stations of the Kentucky River and two of its tributaries were in violation of standards 25% of the time in 1980. That percentage dropped to 15% in 1981, except for one station (Red River) that remained in violation 45% of the time for both years. The Red River violations can be attributed to agricultural practices and localized septic tank runoff, while the others are due primarily to municipal discharges.

- Heavy Metals

Water quality standards for aquatic life were violated by the following heavy metals: lead, cadmium, mercury, iron, and copper. The copper violation was localized and of minor severity. Violations of the remaining four heavy metals were widespread. Lead severity was variable throughout the drainage ranging from moderate to non-existent. Cadmium violations were moderate in the basin except on the Kentucky River at Camp Nelson which exhibited major severity. Mercury exhibited major severity throughout the drainage, while iron violations ranged from moderate to major at the various ambient stations.

State public drinking water standards were exceeded for lead, cadmium, mercury, iron and manganese. All heavy metal problems were widespread. Iron and manganese exhibited major severity throughout the drainage while mercury violations were moderate at all sampling locations. Lead and cadmium severity varied throughout the basin.

Upper Cumberland River Basin

FIGURE 5

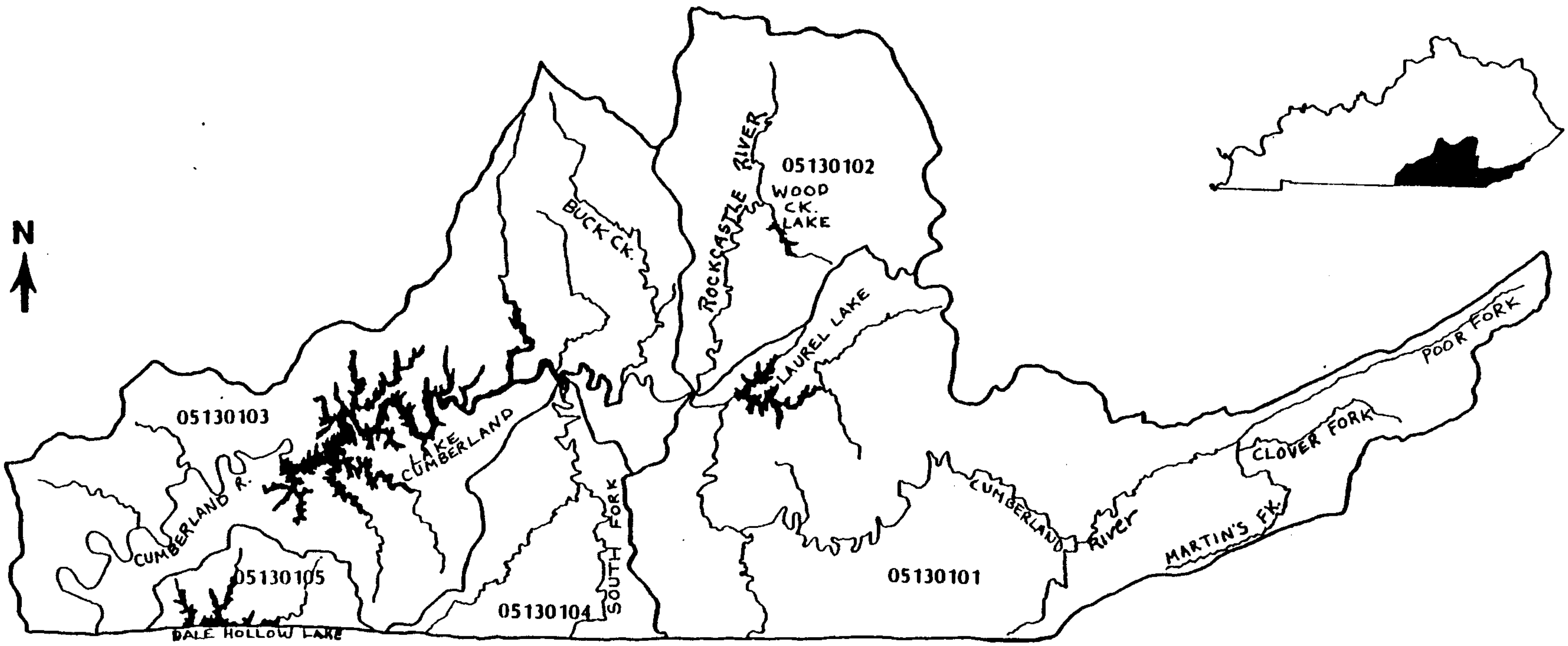

Table 6

Upper Cumberland River Basin

UPPER CUMBERLAND RIVER BASIN WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Cumberland River													
Hydrologic Unit #05130101	1980	G	G	G	F	F	Δ	F	P	Δ	F	P	Pb, Cd,
	1981	G	G	G	G	F	Δ	P	P	Δ	F	NP	Hg, Fe,
KY Primary Station #02038900	TREND	→	→	→	↑	→	Δ	↓	→	Δ	→		P
Cumberland River													
Hydrologic Unit #05130101	1980	G	G	G	G	G	Δ	Δ	G	F	G	P	Hg, Fe,
	1981	G	G	G	F	G	Δ	F	G	F	G	NP	
KY Primary Station #02018900	TREND	→	→	→	↓	→	Δ	Δ	→	→	→		
Rockcastle River													
Hydrologic Unit #05130102	1980	G	G	G	G	G	Δ	F	G	Δ	G	P	Pb, Cd,
	1981	G	G	G	F	G	Δ	P	G	Δ	G	NP	Hg, Fe
KY Primary Station #02020900	TREND	→	→	→	↓	→	Δ	↓	→	Δ	→		
Cumberland River													
Hydrologic Unit #05130103	1980	G	G	G	G	G	Δ	F	F	Δ	G	P	Hg
	1981	G	G	G	G	G	Δ	G	P	Δ	G	NP	
KY Primary Station #02001900	TREND	→	→	→	→	→	Δ	↑	↓	Δ	→		

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

Table 6

Upper Cumberland River Basin continued

UPPER CUMBERLAND RIVER BASIN (continued)

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
South Fork Cumberland River													
Hydrologic Unit #05130104	1980	G	G	G	F	G	Δ	P	G	Δ	G	P	Cd, Hg, Fe
	1981	G	G	G	G	G	Δ	P	G	Δ	G	NP	
KY Primary Station #02008900	TREND	→	→	→	↑	→	Δ	→	→	Δ	→		
	1980												
	1981												
	TREND												
	1980												
	1981												
	TREND												
	1980												
	1981												
	TREND												

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

Upper Cumberland River Basin

051301 (01, 02, 03, 04, 05)

The Upper Cumberland River basin is located in southeastern Kentucky in the Appalachian Plateaus and Interior Low Plateaus Provinces, with the headwaters draining slopes of the Cumberland Mountains and the Pine Mountain overthrust. The river drains Pennsylvanian sandstone in the Appalachian Plateaus and Mississippian limestone deposits in the Interior Low Plateaus. The mainstem of the river is formed at the junction of Clover Fork, Martins Fork, and Poor Fork at Harlan, Kentucky. Flowing in a generally westward direction, the river cuts across the Cumberland Plateau and Pottsville Escarpment to enter the Interior Low Plateaus Province before turning south to enter Tennessee. There are four major impoundments in the basin, these include Cumberland, Dale Hollow, Laurel River and Martins Fork reservoirs. Total basin drainage area in Kentucky is 5,077 square miles. Principal tributaries are the Big South Fork of the Cumberland River with a drainage area of 1382 square miles and the Rockcastle River with a drainage area of 763 square miles. Other major tributaries include Clear Fork, Buck Creek, and the Laurel River.

Topography of the basin varies greatly. The eastern portion lies in the steep, rugged terrain of the Cumberland Mountains. The central portion lies in the Cumberland Plateau region which is characterized by steep undulating to rolling land. The northwestern tip of the basin is located in the Knobs region, an area of large hills with steep slopes. Extreme western portions of the basin are within the Pottsville Escarpment and the eastern subsection of the Highland Rim, which are generally upland plains with low relief and karst topography.

Average slope of the streams throughout the basin is 14 feet/mile with the main stem above Lake Cumberland averaging approximately 7 feet/mile.

Impacts

The Upper Cumberland River basin has been impacted by a variety of man's activities. The Cumberland Plateau portion of the basin has been heavily impacted by both deep and surface coal mining operations. Localized acid mine drainage, generally attributed to deep mining practices, has diminished in recent years due to an increase in surface mining. Acid mine drainage is now most prominent in portions of the Big South Fork of the Cumberland River.

Oil and natural gas drilling has occurred in the Big South Fork drainage since the late 1800's. In recent years, these operations have increased substantially in Big South Fork subbasin and adjacent areas, resulting in an increase in brine impacts.

Impacts resulting from agricultural operations are limited on the Cumberland Plateaus due to the lack of suitable land, but increase substantially as the river flows westward through the Interior Low Plateaus. Localized silvicultural operations are scattered through the basin, but are most abundant on the Cumberland Plateaus in and adjacent to the Daniel Boone National Forest. Silvicultural operations are also common in association with surface coal mining.

Domestic sewage pollution originates from small municipalities throughout the basin. These towns usually discharge treated effluents to small tributary streams that have flows approaching zero. Generally, these streams are incapable of properly assimulating waste loads without a degradation of water quality. A notable example of this is Yellow Creek which flows through Middlesboro. This small stream is heavily impacted by a tannery and municipal treatment plant waste.

Coal mining operations, oil and gas drilling, and municipal effluent discharges have impacted the aquatic biota throughout a major portion of the drainage. However, in some areas the aquatic life is quite diverse. A number of endangered species of fish and freshwater mussels are found in the basin. During 1980, four fish kills were reported from the basin while two were observed in 1981.

o Flow

The annual average discharge for the period of record (41 years) is 9,214 cfs for the Upper Cumberland at mile point 460.85. Mean discharge for water year 1980 was slightly below the annual average discharge (-4%). However, during water year 1981, mean discharge was 38.5% below annual average. The concentration effect of flow reduction during the reporting period was a contributing factor to observed increases in certain physico-chemical parameters.

- Dissolved Oxygen (DO) and Temperature

There were no violations of temperature during the sampling period. However, there were two violations of the DO standard (5 mg/l), one at Yamacraw on the Big South Fork of the Cumberland River (4.9 mg/l) and the other on the Cumberland River at Cumberland Falls (3.5 mg/l). These violations were probably due to natural causes and apparently had no significant effect on the aquatic biota. The DO ranged from 14.8 to 3.5 mg/l within the basin and averaged 8.6 mg/l.

- Acidity, Alkalinity and pH

There were no violations of pH, which averaged 7.2. This is reflected in the alkalinity and acidity averages, 53.7 mg/l and 4.2 mg/l respectively.

- Conductivity

An average of 210.5 μmhos/cm was reported for the basin.

- Fecal Coliform

Fecal coliform standard violations were exceeded in 23.8% of the samples during 1980 and 26.3% in 1981. The major problem area is the Cumberland River at Pineville which had violations 85.7% of the time for both years.

- Heavy Metals

Severe and widespread violations of manganese, iron and lead standards occurred during the reporting period. Mercury and cadmium violations were moderate in severity and scope.

Salt River Basin

FIGURE 6

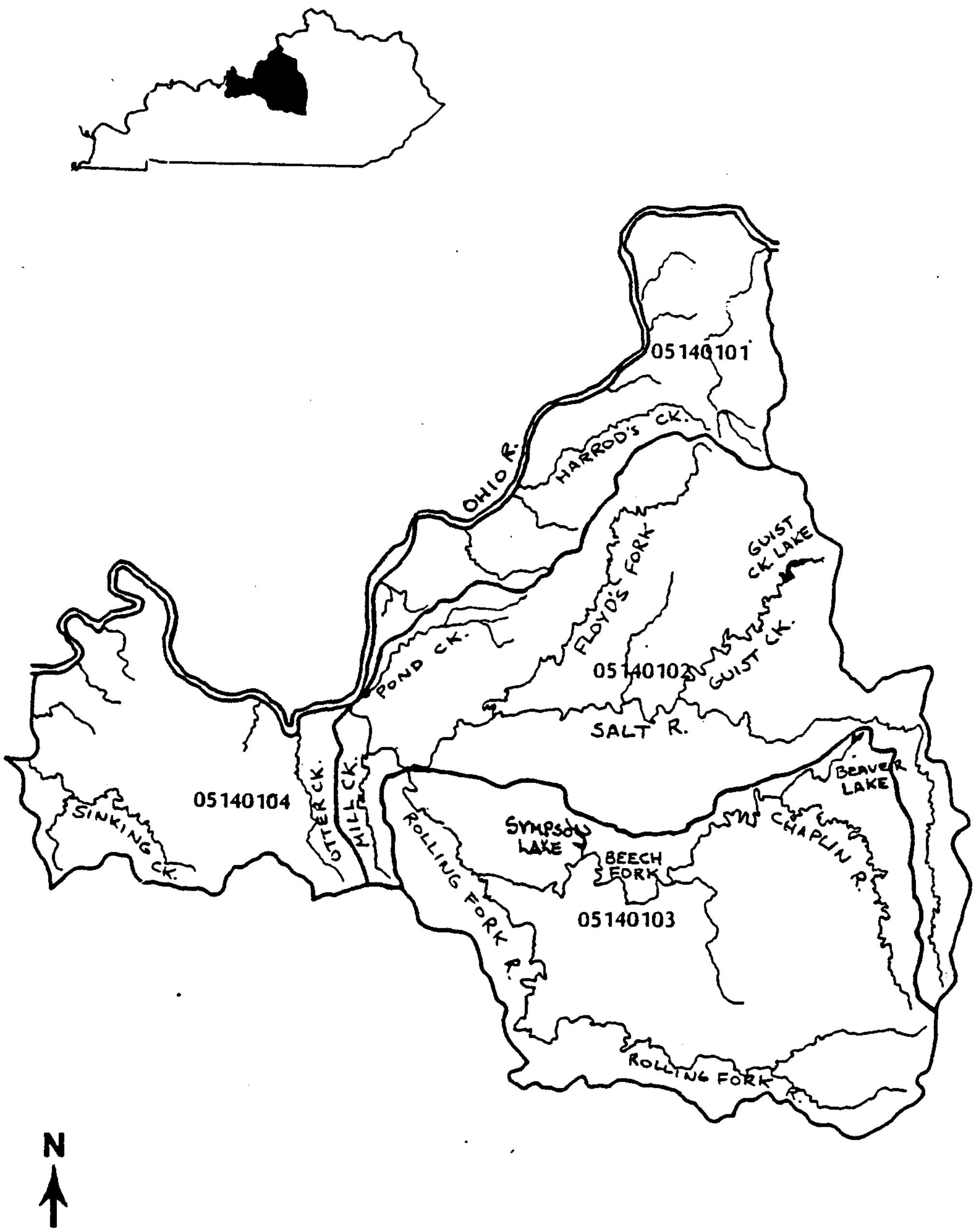

Table 7

Salt River Basin

SALT RIVER BASIN

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Salt River													
Hydrologic Unit #05140102	1980	G	G	G	F	P	Δ	P	P	F	P	P	NO_2+NO_3-N,
	1981	G	G	G	G	P	Δ	P	F	F	F	NP	Pb, Cd, Hg,
KY Primary Station #12002900	TREND	→	→	→	↑	→	Δ	→	↑	→	↑		Fe, P
Pond Creek													
Hydrologic Unit #05140102	1980	G	G	G	P	P	Δ	P	P	P	P	P	NO_2+NO_3-N,
	1981	G	G	G	G	P	Δ	P	P	P	P	NP	Pb, Cd, Hg,
KY Primary Station #12032900	TREND	→	→	→	↑	→	Δ	→	→	→	→		Fe, P, FC
Rolling Fork													
Hydrologic Unit #05140103	1980	G	G	G	P	P	Δ	P	P	Δ	P	P	SS, P, Hg, Fe,
	1981	G	G	G	P	P	Δ	P	P	Δ	P	NP	NO_2+NO_3-N,
NASQAN #03301630	TREND	→	→	→	→	→	Δ	→	→	Δ	→		Mn, FC
	1980												
	1981												
	TREND												

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

Salt River Basin

051401 (02, 03)

The Salt River basin is the most centrally located basin in Kentucky. The main stem of the Salt River originates in central Boyle County, Kentucky, and flows northward for 30 miles to the vicinity of Lawrenceburg. From there, the river flows in a westerly direction about 95 miles to its confluence with the Ohio River at West Point, Kentucky (Ohio River mile point 351). Principal tributaries are Rolling Fork, Floyds Fork, Beech Fork, and Brashears Creek. Drainage area for the basin is 2,920 square miles.

The Salt River basin lies primarily within the Blue Grass section of the Interior Low Plateaus Province with a small portion occurring in the Highland Rim section. The stream drains mainly Ordovician age limestone. Basin topography varies from irregular, steep-sided hills with V-shaped valleys to gently rolling hills with broad floodplains.

Average slope of the main stem of Salt River is 5.0 feet/mile, while Rolling Fork averages 6.0 feet/mile, Beech Fork averages 4.0 feet/mile, Brashears Creek averages 6.0 feet/mile, and Floyds Fork averages 7.0 feet/mile.

Impacts

Major impacts upon the Salt River are agricultural runoff, including fertilizer and pesticides, and domestic sewage.

This has led to high nutrient loads in some areas. If planned oil shale operations in the Knobs area become reality, segments of the Salt River drainage could be impacted.

Many portions of the Salt River drainage support a diverse assemblage of aquatic organisms. Fish kills occurred twice in 1980 and three times in 1981.

- Flow

The annual average discharge for the period of record (42 years) is 3,418 cfs for the Salt River at mile point 22.9. Mean discharge for water year 1980 was slightly below the annual average discharge (-3.5%). However, during water year 1981, mean discharge was 41% below annual average. The concentration effect of flow reduction during the reporting period was a contributing factor to observed increases in certain physicochemical parameters.

- Dissolved Oxygen (DO) and Temperature

No violations of these parameters occurred during the reporting period. While DO averaged 8.8 mg/l at the two stations, the Pond Creek station was somewhat lower than the main Salt River.

- Acidity, Alkalinity and pH

No violations of pH occurred during the reporting period. Average alkalinities were the highest of any basin (145.3 mg/l) reflecting the limestone lithology of the drainage. This is also seen in the average pH of 7.6. Acidity averaged 7.5 mg/l.

- Conductivity

Conductivity averages are also high, 463.7 μmhos/cm, again reflecting the limestone lithology.

- Chlorides and Sulfates

Although no problems occurred with chlorides, sulfate levels averaged 98.1 mg/l at the Pond Creek station. This is probably attributable to urban runoff from the city of Louisville.

- Fecal Coliform

Fecal coliform standard violations occurred in 70% of the samples from Pond Creek in 1980 and in 80% during 1981. The Salt River station had 50% violations in 1980, dropping to 25% in 1981.

- Heavy Metals

Violations of public water supply standards for manganese, iron and lead were severe and widespread. Cadmium violations were also widespread but moderate. Mercury violations of both public water supply and aquatic life standards were of major severity but moderate in scope.

Green River Basin

FIGURE 7

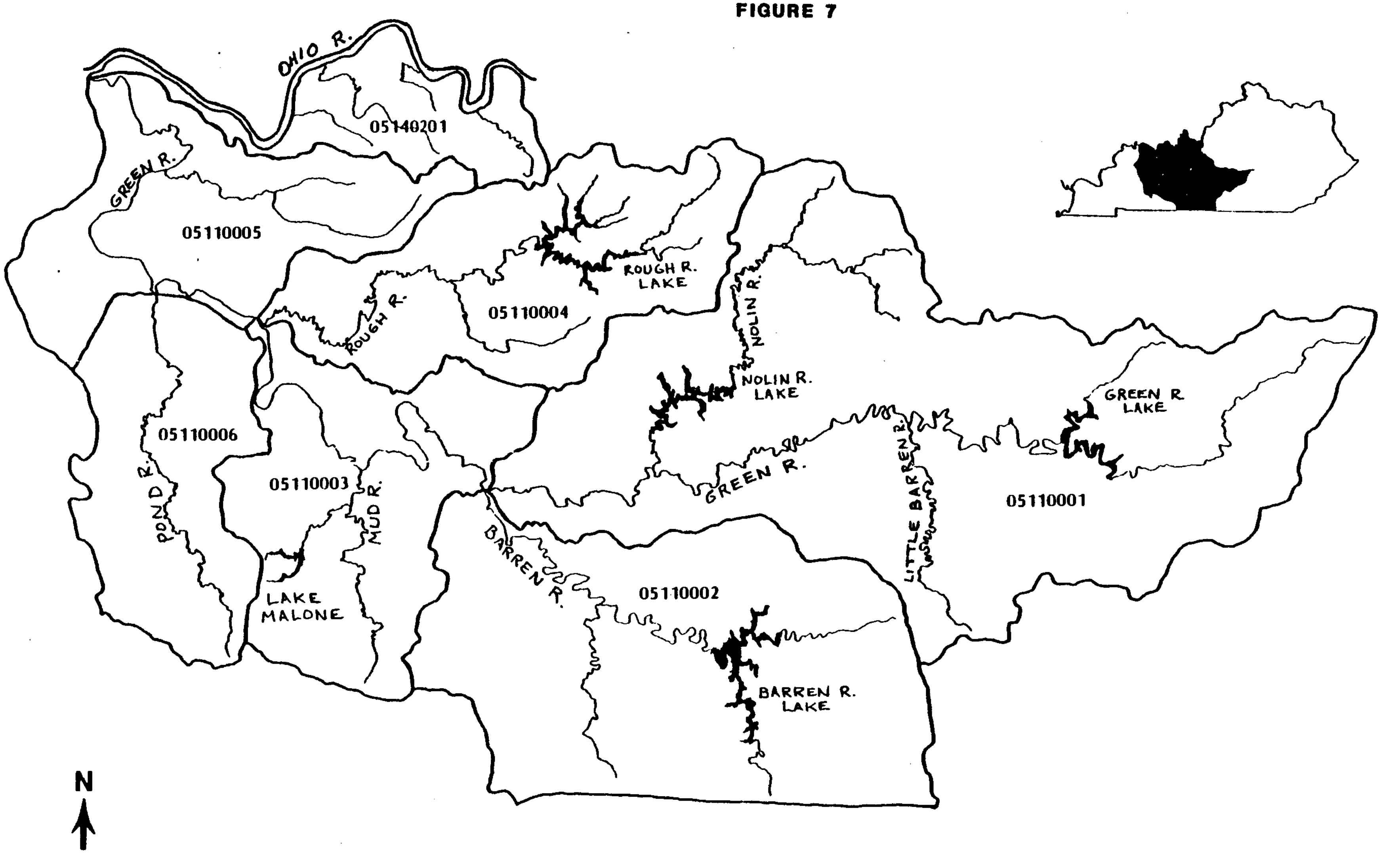

Table 8

Green River Basin

GREEN RIVER BASIN WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Green River													
Hydrologic Unit #05110001	1980	G	G	G	G	G	Δ	F	G	Δ	G	P	NO_2+NO_3-N,
	1981	G	G	G	F	P	Δ	P	P	Δ	P	NP	Cd, Hg,
KY Primary Station #03024902	TREND	→	→	→	↓	↓	Δ	↓	↓	Δ	↓		Fe, FC
Green River													
Hydrologic Unit #05110001	1980	G	G	G	F	F	Δ	F	F	Δ	F	P	NO_2+NO_3-N,
	1981	G	G	G	F	P	Δ	P	F	Δ	F	NP	Pb, Cd, Hg,
KY Primary Station #03024900	TREND	→	→	→	→	↓	Δ	↓	→	Δ	→		Fe, P
Nolin River													
Hydrologic Unit #05110001	1980	G	G	G	F	P	Δ	F	F	Δ	F	P	NO_2+NO_3-N,
	1981	G	G	G	F	P	Δ	F	P	Δ	F	NP	Hg, Fe,
KY Primary Station #03026900	TREND	→	→	→	→	→	Δ	→	↓	Δ	→	N	P
Bacon Creek													
Hydrologic Unit #05110001	1980	G	G	G	F	P	Δ	F	F	Δ	F	P	NO_2+NO_3-N,
	1981	G	G	G	G	F	Δ	P	F	Δ	F	NP	Pb, Cd, Hg,
KY Primary Station #03025900	TREND	→	→	→	↑	↑	Δ	↓	→	Δ	→		P

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

Table 8

Green River Basin continued

GREEN RIVER BASIN (continued)

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Barren River													
Hydrologic Unit #05110002	1980	G	G	G	G	F	Δ	P	G	Δ	G	P	NO_2+NO_3-N
	1981	G	G	G	F	P	Δ	P	Δ	Δ	F	NP	Pb, Cd, Hg,
KY Primary Station #03017901	TREND	→	→	→	↓	↓	Δ	→	Δ	Δ	↓		Fe, P
Green River													
Hydrologic Unit #05110003	1980	G	G	G	G	F	Δ	F	G	Δ	G	P	NO_2+NO_3-N,
	1981	G	G	G	G	P	Δ	P	Δ	Δ	F	NP	Pb, Cd, Hg
KY Primary Station #03013900	TREND	→	→	→	→	↓	Δ	↓	Δ	Δ	↓	P	
Mud River													
Hydrologic Unit #05110003	1980	G	G	G	G	P	Δ	F	P	Δ	F	P	DO, NO_2+NO_3-N,
	1981	G	P	G	G	P	Δ	P	Δ	Δ	P	NP	Pb, Cd, Hg, Fe,
KY Primary Station #03012900	TREND	→	↓	→	→	→	Δ	↓	Δ	Δ	↓		P
Rough River													
Hydrologic Unit #05110004	1980	G	G	G	G	G	Δ	P	F	Δ	G	P	NO_2+NO_3-N,
	1981	G	G	G	P	P	Δ	F	Δ	Δ	F	NP	Hg,
KY Primary Station #03007900	TREND	→	→	→	↓	↓	Δ	↑	Δ	Δ	↓		Fe, P

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

Table 8

Green River Basin continued

GREEN RIVER BASIN (continued)

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Green River													
Hydrologic Unit #05110005	1980	G	Δ	G	F	P	Δ	F	G	Δ	F		P,
	1981	G	Δ	G	F	P	Δ	Δ	G	Δ	F		NO_2+NO_3-N
NASOAN #03321230	TREND	→	Δ	→	→	→	Δ	→	→	Δ	→		
Pond River													
Hydrologic Unit #05110006	1980	G	G	G	F	F	Δ	F	F	F	F	P	NO_2+NO_3-N,
	1981	G	G	G	G	P	Δ	F	G	F	G	NP	Hg, Fe
KY Primary Station #03004901	TREND	→	→	→	↑	↓	Δ	→	↑	↓	↑	N	
Pond River													
Hydrologic Unit #05110006	1980	G	F	G	P	F	Δ	P	G	P	P	P	NO_2+NO_3-N,
	1981	G	F	G	F	P	Δ	P	G	P	P	NP	Pb, Hg, Mn,
KY Primary Station #03004900	TREND	→	→	→	↑	↓	Δ	→	→	→	→		Cd, Fe, TDS
	1980												
	1981												
	TREND												

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

GREEN RIVER BASIN

051100 (01, 02, 03, 04, 05, 06)

The Green River basin has the largest surface drainage area of the river basins in the Commonwealth of Kentucky. Flowing approximately 330 miles in a northwesterly direction from its headwaters to its confluence with the Ohio River (mile point 636.4) above Henderson, Kentucky, the river drains an area of 8,821 square miles of west-central Kentucky and 408 square miles in north-central Tennessee. Principal tributaries include the Nolin, Barren, Mud, Rough and Pond rivers. Major impoundments of this basin include Nolin, Barren, Rough and Green River reservoirs.

The Green River basin lies in the Interior Low Plateaus Province. The major section within this physiographic region is the Highland Rim or Pennyroyal. This area is generally a plateau of low relief, crossed by deeply entrenched streams and includes high, somewhat isolated, hills or outliers of rocks of adjoining sections or provinces. Karst topography and cavern networks are a common characteristic of the section, although normal surface drainage is predominant for most of the area. The Highland Rim is underlain by Mississippian limestone. The remainder of the basin lies in the Shawnee Hills or Western Kentucky Coal Field and is underlain by strata of Pennsylvanian age. This section can be generally characterized as an area with hills and ridges on an upland terrain with expansive, nearly flat floodplains occurring along the lower Green River and its main tributaries.

The main stem of the Green River flows into the Ohio River at 338 feet above mean sea level (m.s.l.) and is controlled by a series of six locks and dams for navigational purposes. Upstream of these structures the river rises at an average slope of 1.6 feet/mile, with tributaries having average slopes ranging from 0.8 feet/mile to 7.7 feet/mile and having a maximum elevation of 1,040 feet above m.s.l.

Impacts

Since a large portion of the Green River lies in the Western Kentucky Coal Field, silt and acid from coal mining operations are the major impacts. These impacts can be locally heavy, rendering some streams severely degraded. Agricultural runoff, including livestock feeding operations, contribute nutrient loading to some streams. Brine from oil drilling has caused increased chloride levels in portions of the river for many years.

The aquatic biota of the coalfields has been degraded by siltation and acid mine drainage. Brines have also impacted the aquatic biota of the oil and gas regions of the basin. However, many sub-basins of the drainage support a diverse assemblage of aquatic organisms. Four fish kills occurred in each of the two years of the reporting period.

o Flow

The annual average discharge for the period of record (50 years) is 11,210 cfs for the Green River at mile point 63.4. Mean discharge for water year 1980 was slightly above the annual average discharge. However, during water year 1981, mean discharge was 26% below annual average. The concentration effect of flow reduction during the reporting period was a contributing factor to observed increases in certain physicochemical parameters.

- Dissolved Oxygen (DO) and Temperature

No water quality violations for these parameters occurred during the reporting period. DO averaged 8.7 mg/l in the basin.

- Acidity, Alkalinity and pH

Although no pH violations occurred at monitoring stations during the reporting period, some streams in the basin, particularly in the Western Kentucky Coal Field, are consistently acidic (pH 3-4). Average pH at the ambient stations was 7.3. Acidity averaged 9.2 mg/l and alkalinity 103.9 mg/l at the monitoring stations.

- Conductivity

Conductivity averaged 294.5 µmhos/cm in the basin. This is within the expected range of streams flowing in the Interior Low Plateaus.

- Chloride and Sulfate

Sulfate levels were elevated at two locations, both on the Pond River. This reflects extensive mining in the Pond River drainage. Elevated chloride concentrations were not observed at any of the monitoring stations. However, chlorides are occasionally elevated in the oil and gas regions.

° Fecal Coliform

Violations of fecal coliform standards occurred 22.7% of the time in 1980 and 24.6% in 1981 for all stations.

° Heavy Metals

Public water supply and aquatic life standards violations were widespread and severe for manganese, iron and lead. Moderate violations of cadmium and mercury standards occurred through the basin. Chromium violations were minor and localized (Mud River).

Lower Cumberland and Tradewater River Basins

FIGURE 8

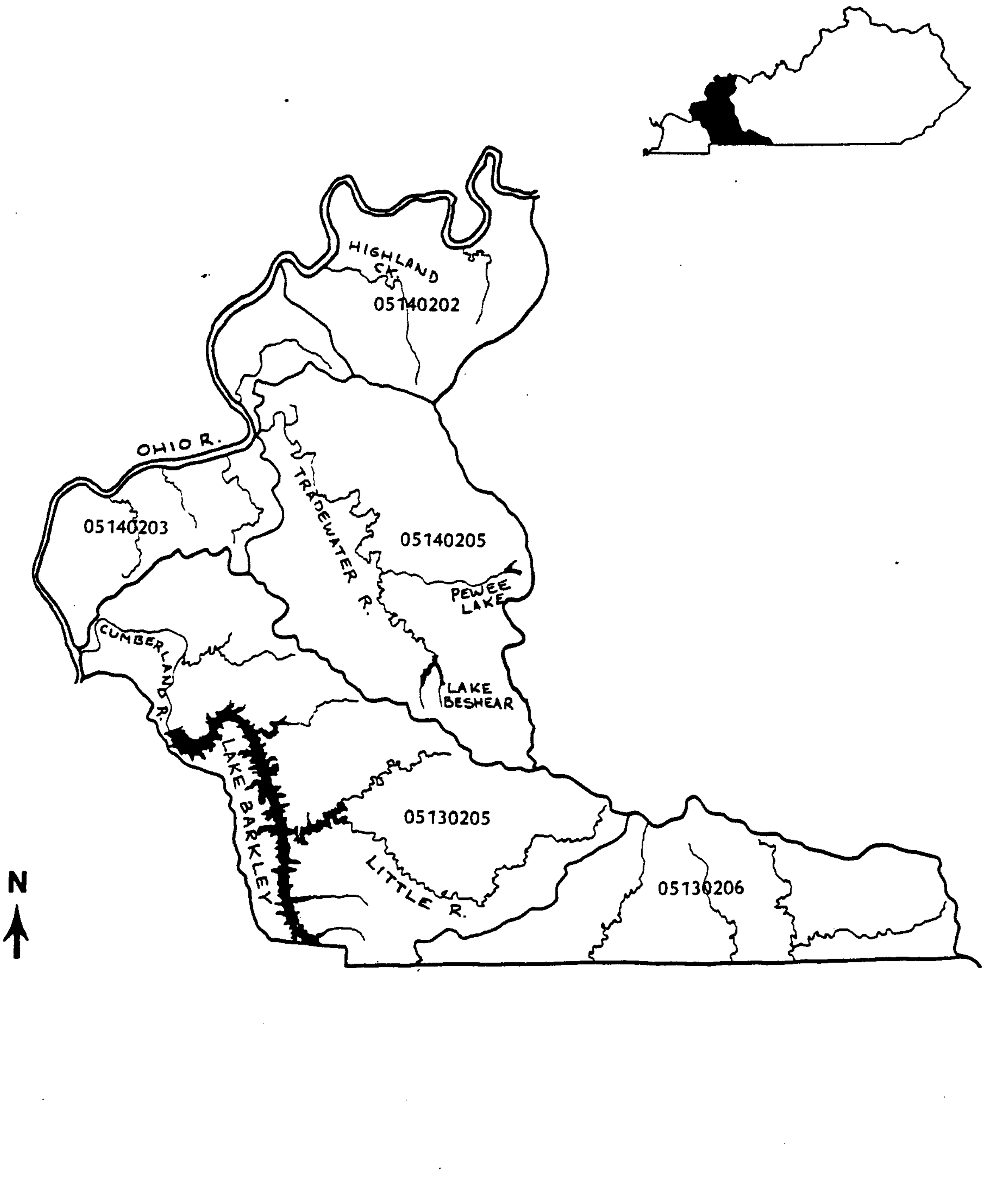

Table 9

Lower Cumberland River Basin

LOWER CUMBERLAND RIVER BASIN

WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Cumberland River													
Hydrologic Unit #05130205	1980	G	G	G	G	F	Δ	P	G	Δ	G	P	P, Fe, Mn
	1981	G	G	G	G	F	Δ	F	G	Δ	G	NP	Cd, Hg,
NASQAN #03438220	TREND	→	→	→	→	→	Δ	↑	→	Δ	→		

	1980												
	1981												
	TREND												

	1980												
	1981												
	TREND												

	1980												
	1981												
	TREND												

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

Lower Cumberland River Basin

051302 (05, 06)

The Lower Cumberland River basin lies in the Highland Rim Section of the Interior Low Plateaus Province in southwestern Kentucky. The low to moderate gradient streams in the Kentucky portion of the basin drain Mississippian limestones. The river in Kentucky flows northwesterly for 75 miles from the Tennessee border to the Ohio River (mile 920.4) near Smithland, Kentucky. Barkley Dam, near Lake City, Kentucky, impounds 118 miles of the river, 44 miles of which are in Kentucky. There are two major subbasins in this region, the Little River with 601 square miles and the Red River with a total drainage area of 1,460 square miles, of which 688 are in Kentucky. The Lower Cumberland River drains 2,084 square miles in Kentucky and receives drainage from another 15,830 square miles of the Cumberland River in Tennessee and southeastern Kentucky.

The basin lies in two subsections of the Highland Rim, the Pennyroyal Plain and the Western Highland Rim. The Pennyroyal area is a well known karst region consisting of rough and hilly topography, with sinkholes, subsurface drainage, and limestone caverns. The Western Highland Rim subsection consists of a dissected upland plateau with some karst topography, but sinkhole plains are absent. Generally, this subsection is a ridge and valley area characterized by long, somewhat steep, slopes.

Elevations in the basin range from 302 feet above mean sea level (m.s.l.) at the confluence of the Cumberland and Ohio rivers to 863 feet at Pine Knob in Christian County. Slope of the main stem of the Cumberland River below Barkley Lake is 5.7 feet/mile to the point where Livingston Creek enters. The slope from Livingston Creek to the Ohio River is 2 feet/mile or less.

Impacts

Principal impacts to water quality of the basin include municipal effluent disposal and nonpoint source agricultural runoff. Mining impacts within the basin are limited to runoff from abandoned fluorspar mines and limestone quarries. Impacts from limestone quarries generally involve slight downstream increases in siltation and alkalinity. Industrial discharges have impacted the drainage, particularly in the Hopkinsville area.

The Kentucky portion of the Cumberland River supports a diverse aquatic biota typical of large rivers. No fish kills were reported in the drainage in 1980, while a single kill occurred in 1981.

Physicochemical data for the Lower Cumberland is provided by the USGS gaging station located near Grand Rivers, Kentucky. Data is reported from October 1980 through September 1981.

o Flow

Mean discharge for water year 1980 was slightly above the annual average discharge (+1.11%). However, during water year 1981, mean discharge was 31% below annual average. The concentration effect of flow reduction during the reporting period was a contributing factor to observed increases in certain physicochemical parameters.

o Dissolved Oxygen (DO) and Temperature

There were no violations of these parameters during the aforementioned reporting period. The DO ranged from 15.9 to 8.1 mg/l with a mean of 10.9 mg/l.

o Acidity, Alkalinity and pH

Acidity was not analyzed by the USGS at this location. Alkalinity ranged from 85 to 48 mg/l, with an average value of 66.8 mg/l. The pH standards were not exceeded (mean = 7.95), however, it did reach the maximum (9.0) in January 1981.

o Conductivity

A mean conductivity value of 207.1 μmhos/cm was recorded, which is consistent with moderately alkaline streams in this portion of the Commonwealth.

Tradewater River Basin

051402 (05)

The Tradewater River basin is located in the western portion of the state within the Shawnee Hills Section of the Interior Low Plateaus Province. This area also contains the Western Kentucky Coal Field. The Tradewater River originates in northwestern Christian County and flows northwesterly for 132 miles to enter the Ohio River at mile 873.4, near Caseyville, Kentucky. Some of the principal tributaries to the river are Caney Creek, Buffalo Creek, Piney Creek, Flynn Fork, Donaldson Creek, Clear Creek, Craborchard Creek (=Vaughn Ditch) and Cypress Creek (=Smith Ditch). Lake Beshear is the major impoundment of this area. The Tradewater River drains an area of 943 square miles.

The main stem of the Tradewater originates near the Dripping Springs Escarpment and flows primarily through the deep alluvial and Pennsylvanian deposits of the interior lowlands. The eastern tributaries, which also lie in Pennsylvanian stratas, comprise some of the largest wetlands in the state. In contrast, smaller western tributaries are more upland in nature and flow through Mississippian deposits.

The basin is roughly elliptical in shape and averages approximately 32 miles in width. Elevations range from 320 feet above mean sea level (m.s.l.) at the mouth of the Tradewater River to 806 feet above m.s.l. just north of Hopkinsville, Kentucky.

The main stem has an average slope of 0.6 feet/mile from its mouth to mile 73 at Olney. From Olney to its source the average slope is 5.4 feet/mile. In areas where the gradient is slight, wide floodplains and swampy conditions are common.

Impacts

Portions of the Tradewater River system have been heavily impacted by acid and silt from coal mining in the watershed. Many streams consistently exhibit pH in the range of 3-4 and are heavily silted. Agricultural runoff and domestic sewage discharges from small municipalities are secondary impacts.

The aquatic biota of the eastern tributaries and the mainstem of the Tradewater below Dawson Springs has been severely degraded by acid mine drainage and siltation. The western tributaries are presently serving as a refugia for the aquatic biota for the basin. Although no fish kills were officially reported during the 1980-1981 period, residents in the area indicated that localized fish kills frequently occur.

o Flow

The annual average discharge for the period of record (40 years) is 334 cfs for the Tradewater River at mile point 72.65. Mean discharge for water year 1980 was slightly above the average annual discharge (+1.03%). However, during water year 1981, mean discharge was 20% below annual average.

Tennessee and Mississippi
River Basins

FIGURE 9

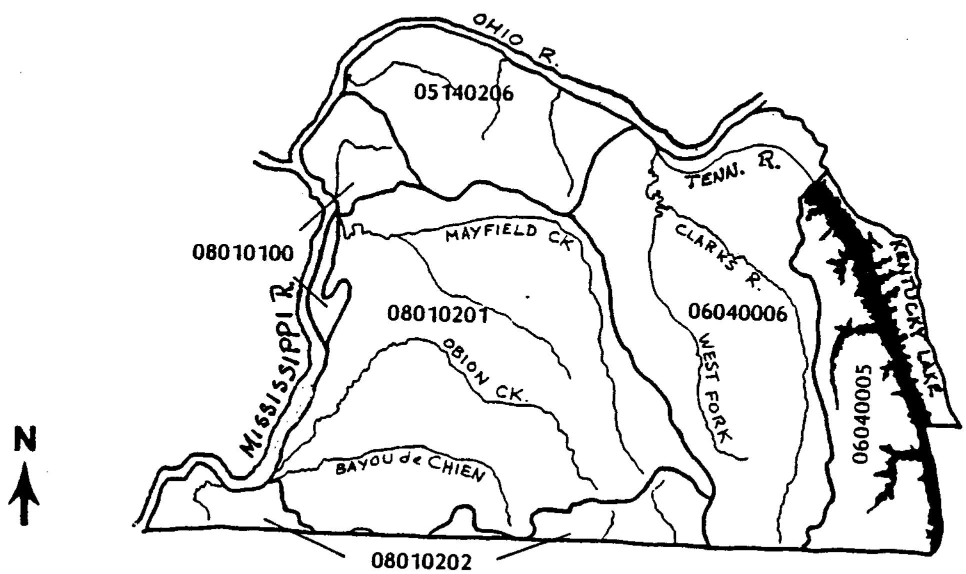

Table 10

Tennessee River Basin

TENNESSEE RIVER BASIN WATER BODY	YEAR	TEMPERATURE	OXYGEN	pH	AESTHETICS	TROPHIC NUTRIENTS	ORGANIC TOXICANTS	INORGANIC TOXICANTS	BACTERIA	BIOLOGICAL QUALITY	OVERALL	CAUSE(S)	PROBLEM PARAMETERS
Tennessee River													
Hydrologic Unit #06040006	1980	G	G	G	G	F	Δ	F	G	Δ	G	P	P, Fe, Mn
	1981	G	G	F	G	F	Δ	G	G	Δ	G	NP	
NASQAN #03609750	TREND	→	→	↓	→	→	Δ	→	→	Δ	→		

	1980												
	1981												
	TREND												

	1980												
	1981												
	TREND												

	1980												
	1981												
	TREND												

WATER QUALITY: G = Good, F = Fair, P = Poor, Δ = Unknown

TREND: ↑ = Improving Quality, ↓ = Degrading Quality, → = No detectable Trend, Δ = Unknown

CAUSES: P = Point Source(s), NP = Non-point, N = Natural, Δ = Unknown

Tennessee River Basin

060400 (05, 06)

The Tennessee River basin drains the eastern half of the Jackson Purchase region in the far western corner of the state. Of its total drainage area, 40,330 square miles, the Tennessee River has only 1,000 square miles in Kentucky. Most of the 62 miles of the Tennessee River that lie in Kentucky are impounded within Kentucky Lake. The principal tributary in Kentucky is Clarks River, which has a total drainage area of 530 square miles.

The basin lies in the Eastern Gulf Coastal Plain area of the Coastal Plain Province. Underlying bedrock is composed of a variety of shales, clays and sandstones of Tertiary and Cretaceous age. Basin topography is characterized by strongly rolling to nearly flat terrain; the uplands are variable and often wooded, while valleys are generally wide with extensive cultivation; slopes are steep in some areas along Kentucky Lake.

Elevations in the basin vary from 325 feet above mean sea level (m.s.l.) south of Paducah to 640 feet above m.s.l. in southwestern Calloway County. The East Fork of Clarks River has an average slope of 4.6 feet/mile and the West Fork averages 7.0 feet/mile. The mainstem of the Tennessee River to Kentucky Dam is influenced by the Lock and Dam 52 on the Ohio River with a pool elevation of 302 ft. above m.s.l.

Impacts

Impacts to water quality within the Tennessee River basin include nutrient loading from domestic effluents, urban runoff and agricultural activities. Increased silt loads from cultivation of marginal hilly land immediately west of Kentucky Lake represents a threat to the aquatic life of streams in this area.

Industrial impacts are of special concern on the Tennessee River below Kentucky Lake where a large chemical manufacturing complex has developed. Industrial impacts have also influenced water quality in the Paducah area of the lower Tennessee and in the East Fork of Clarks River below Benton and Murray. Industrial discharges from a chemical plant near Murray, Kentucky, on the East Fork of Clarks River, were implicated in a major fish kill in January of 1981 (refer to Fish Kill section). High levels of heavy metals have been found in sediments of the East Fork Clarks River and pose a threat to the aquatic ecosystem. Physicochemical data for the lower portion of the Tennessee River is provided by the USGS station near Paducah. The data is reported from October 1980 to September 1981. One additional fish kill was reported in 1981, none during 1980.

o Flow

The annual average discharge for the period of record (15 years) is 67,380 cfs for the Tennessee River at mile point 5.3. Mean discharge for water year 1980 was slightly above the annual average discharge (+1.2%). However, during water year 1981, adjusted mean discharge was 48% below annual average. The concentration effect of flow reduction during the reporting period was a contributing factor to observed increases in certain physicochemical parameters.

- Dissolved Oxygen (DO) and Temperature

Dissolved oxygen ranged from 5.9 mg/l to 14.8 mg/l with an average of 10.2 mg/l. No violations were reported.

- Acidity, Alkalinity and pH

Although pH averaged 7.9, several incidences of pH above 9 were reported. Alkalinity averaged 52.4 mg/l.

- Conductivity

Conductivity values ranged from 160 to 207 μmhos/cm^2 with an average of 183 μmhos/cm^2.

- Fecal Coliform

No fecal coliform standard violations were reported. The fecal coliform values reported for 1980 and 1981 were extremely low.

- Heavy Metals

Standards violations were severe for mercury, iron and manganese. Cadmium violations were moderate.

Mississippi River Basin

08010 (01, 02)

The Mississippi River reaches its confluence with the Ohio River at Mississippi river mile 953.8 near Wickliffe, Kentucky and flows southward some 70 miles, forming the state boundary between Kentucky and Missouri. The basin drains a northern extension of the Mississippian Embayment within the far southwestern corner of the state, a physiographic province known as the Coastal Plain. The basin drains approximately 1,200 square miles of the state. Geology of the region is somewhat youthful, being composed of Tertiary age sands, gravels, and clays deposited during a recent subsidence of the Mississippi Embayment. Wind-blown deposits of loess blanket these Tertiary deposits and are especially well developed as bluffs just east of the river. Principal tributaries to the Mississippi include Mayfield Creek, Obion Creek, and Bayou de Chien. The Ohio River, the major tributary to the Mississippi River in this region, is discussed in another section.

Topography of the basin varies from strongly rolling to nearly flat terrain. Highest elevations occur along a northwest-southeast ridge which runs from western Calloway County to Ballard County and forms the divide between the Ohio, Mississippi, and Tennessee rivers. Uplands within the basin are smooth to rough, greatest variations in elevation occurring near streams. Extensive floodplain bottoms have developed along the principal tributaries and the Mississippi itself.

Impacts

Intensive cultivation of the basin area has led to serious sediment loadings to streams. Additional impacts to streams within the basin include agricultural nutrient runoff, domestic effluent discharges, logging, channelization, and, to a lesser extent, industrial waste influences. The tributary stream's aquatic biota have been impacted by siltation. A localized mercury problem occurred at the Hickman Harbor embayment during harbor dredging in 1980, but subsided once that operation had ended. No fish kills were reported from this basin during the reporting period (1980-1981).

Biological Monitoring

Section 106(e) of the Clean Water Act of 1971 (Pub. Law 92-500, 33 USC Sec. 1256(e)), requires each state to monitor the quality of its surface waters. In accordance with the Act, the Kentucky Division of Water developed a biological monitoring program in addition to its physicochemical monitoring program. The main objectives of this program are to develop a baseline of biological, as well as physicochemical data, to meet the Environmental Protection Agency's Basic Water Monitoring Program (BWMP) requirements, to detect trends in water quality, and to determine the efficiency of pollution abatement programs.

This portion of the 305(b) report characterizes the aquatic biota and the water quality of the seven BWMP stations in Kentucky (Figure 1). The period of data collection at these stations is brief; therefore, the characterization of the stream depends on available data, stream side observations and the biologist's interpretation.

Generally, the water quality of the streams monitored at these stations ranges from clean water to heavily impacted streams. All monitored streams were capable of supporting some form of aquatic life, but the composition and productivity of the aquatic biota were dependent on the type and severity of impact.

Biological data for analyses of the periphyton, macroinvertebrate and fish communities have been collected annually during 1980 and 1981 at the seven BWMP stations. The various parameters used as a basis for the biological assessment are all or a portion of the following:.

A. Species diversity, richness and pollution tolerance
B. Community structure
C. Biomass determination
D. Productivity
E. Biotic index

Periphyton quantitative sampling was accomplished by use of the Design Alliance Periphytometer. Qualitative samples were acquired by scraping selected stream substrates.

Macroinvertebrate sampling consisted of deploying modified Hester-Dendy multiplate samplers for quantitative analyses. Select pickings from various stream habitats comprised the qualitative analyses.

Stream size dictated the type(s) of fish collection methods. A variety of methods were used, including seining, passive netting, and electrofishing.

The water quality at the seven BWMP stations is ranked as either good, fair or poor. These terms are defined as follows:

Good: Waters that possess healthy, indigenous communities of aquatic organisms, high diversity and species richness, and balanced trophic levels. These aquatic communities are under no apparent stress from pollution.

Fair: Waters that possess moderately healthy, indigenous communities of aquatic organisms, moderate diversity and species richness, and trophic levels dominated by facultative organisms. These aquatic communities are exhibiting some signs of stress due to pollution.

Poor: Waters that possess generally unhealthy communities of aquatic organisms, low diversity and species richness, and trophic levels dominated by tolerant and facultative organisms. These aquatic communities are obviously under stress from pollution.

Attempts were made to determine if the aquatic communities at each BWMP station were degrading, improving or showing no detectable trend during the sample period (1980-1981). However, it should be recognized that climatological conditions have created sampling problems. On the other hand, the addition of personnel and improvement of the staff's taxonomic skills have improved data interpretation. These factors, plus the lack of a historical data base, limits accurate trend analysis; however, these problems will be resolved with continued data collection at these locations.

The rankings for the seven biological stations are as follows:

Basin	Condition
<u>Salt River Basin</u>	
Salt River - Shepherdsville	Fair
Pond Creek - Louisville	Poor
<u>Cumberland River Basin</u>	
Cumberland River - Cumberland Falls	Fair

Kentucky River Basin

Kentucky River - Lock and Dam 14	Good
Red River - Hazel Green	Good

Green River Basin

Pond River - Isaac Creek	Poor
Pond River - Apex	Fair

The rationale for these determinations is contained in the following station discussions.

Salt River Basin
Station #12002900
Salt River - Shepherdsville

Location

Coordinates:	37° 59' 05" N, 85° 43' 01" W
County:	Bullitt
Kentucky RMI:	351.5, 22.87
DOW Map No:	12 - 35
Topo Quad Name:	Shepherdsville, Ky.
Physiographic Region:	Knobs

Station Information

Period of Record:	12/77 to date
Type of Sampling:	Physicochemical & Biological
Stream Order:	V
Stream Width:	50 - 60m
Stream Depth:	1 - 5m
Stream Morphology:	pool
Substrate:	limestone bedrock, silt, detritus

Salt River is a fifth order stream at this station in Bullitt County. The biological station is located one mile upstream of the physicochemical station at Shepherdsville and extends from the confluence with Floyd's Fork downstream to the I-65 bridge (1.6 miles). At the station, the Salt River drains nearly 1,200 square miles of forested and agricultural lands with urban influence from the towns of Harrodsburg, Lawrenceburg, Taylorsville, and Mount Washington. An impoundment of the river at Taylorsville (approximately 33 miles upstream of the station) will be completed in the near future. The main impacts to Salt River appear to be siltation and excessive nutrient loading.

The Salt River upstream of Shepherdsville sustains a moderately diverse algal community composed of taxa characteristic of nutrient rich, organically impacted waters. The community is adaptable to a wide range of environmental conditions. Several of the more commonly occurring diatoms require organic nitrogenous compounds such as amino acids for abundant growth. A number of diatom taxa present at this station are associated with elevated conductivity and turbidity although the community as a whole is fairly typical of central Kentucky streams. A possible trend towards increased nutrient enrichment exists, particularily in reference to the presence of centric diatoms, which are generally abundant in eutrophic lakes. However, algal productivity, as indicated by chlorophyll-a and ash-free weight values, is limited by turbidity due to siltation from agricultural activities occurring in the upstream watershed.

The benthic macroinvertebrates collected from this deep water station are associated with sluggish impounded streams, and are largely tolerant of suspended silt. The dominant habitat is the bottom substrate of mud and silt. As a result, two species of burrowing mayflies are among the invertebrates occupying that habitat. The remaining invertebrates are found in the shoal areas and on submerged objects such as snags, stumps and root mats along the banks. The organisms found there include three species of mayflies and two species of caddisflies. Only relict shells of several species of aquatic snails and freshwater mussels have been collected in shoal areas. This represents a reduction in macroinvertebrate diversity and a degradation of the aquatic environment.

Although collection methods are limited to nets by access problems, collections include a wide variety of game and commercial fish. These include crappie, sauger, flathead and channel catfish, drum, carp and suckers. The area is used extensively by sport fishermen.

The physicochemical data indicates an increase in conductivity with slight increases in chlorides and dissolved solids. Water quality standards for aquatic life were exceeded for iron, mercury, lead and cadmium. Significant levels of nutrients, both total nitrogen and total phosphorus, were reported.

Fish for tissue analysis were collected at this station during the period 1979-1981. A sample of redhorse suckers collected in 1980 showed only chlordane levels (0.42 mg/kg) above the U.S. FDA action levels. A channel catfish collected in 1981 and analyzed by EPA Region IV did not confirm this and the remainder of the 1981 analyses are not completed.

Salt River Basin
Station #12032900
Pond Creek - Louisville

Location

Coordinates:	38° 07' 12" N, 85° 47' 48" W
County:	Jefferson
Kentucky RMI:	351.5, 0.4, 15.4 (7.8B)
DOW Map No:	13 - 34
Topo Quad Name:	Valley Station, Ky.
Physiographic Region:	Outer Blue Grass

Station Information

Period of Record:	12/77 to date
Type of Sampling:	Physicochemical & Biological
Stream Order:	IV
Stream Width:	3 - 6m
Stream Depth:	0.5 - 3m
Stream Morphology:	riffle, run, pool
Substrate:	limestone boulders, rubble, sand, silt

Pond Creek is a fourth order stream in the Salt River drainage system. For most of its length, it has been channelized and the banks cleared of trees except below mile point 8.5, where it is meandering and partially shaded by riparian vegetation. Substrate varies from silt and detritus to sand, rubble, and boulders below mile 8.5. The biological station is located in the vicinity of the Blevins Gap Road bridge. The upper watershed drains 64 square miles of a heavily industrialized section of Louisville, which includes three landfills and over 160 point source discharges.

Pond Creek sustains a moderately diverse algal community consisting of species generally associated with nutrient and organic enrichment. The community as a whole is adaptable to a wide variety of environmental conditions. The diatom community is dominated by tolerant species which are abundant in the presence of organic pollution due to their physiological requirements for organic nitrogen. Many taxa are associated with waters of high mineral content and are stimulated by the presence of dissolved salts. Conductivity and total dissolved solids values are consistently elevated at this station.

Although nutrient values are high (notably total phosphorous) and the algal community is relatively diverse, algal productivity is somewhat less than what might be expected. This is supported by the depressed values for chlorophyll-a and ash free weight. Limitations to algal productivity at this station include excessive turbidity and potential toxicity due to elevated concentrations of heavy metals in water column and sediment samples. Increases in species diversity over the past three years are due more to the occurrence of previously unreported "tolerant" taxa (particularily in regard to conductivity, nutrients, and other parameters) than any real improvement in water quality.

The aquatic invertebrate organisms are dominated by tolerant mayfly, blackfly, and midge fly larvae. Other macroinvertebrates collected include a tolerant species of caddisfly and crayfish. Although there is sufficient habitat available for macroinvertebrate colonization, the community lacks diversity and consists mainly of filter feeders and scavengers. This is indicative of poor water quality, due to toxic stresses and nutrient enrichment.

The fish fauna at this station continues to be dominated by rough and forage species. Although an occassional game fish is encountered (largemouth bass or bluegill), the majority of fish collections consist of species tolerant to organic enrichment and low dissolved oxygen such as carp, suckers, bullheads, and minnows. No intolerant species, such as darters, have been collected here.

The physicochemical data indicates an increase in conductivity, sulfates, chlorides and dissolved solids. Water quality standards for aquatic life are exceeded for iron, mercury, cadmium and lead.

A sample of channel catfish collected here in 1979 showed chlordane levels near the U.S. FDA action level of 0.3 mg/kg. In 1980, both carp and largemouth bass had tissue concentrations of Chlordane (1.42 mg/kg and 1.98 mg/kg respectively) well above the action level. This was confirmed in 1981 samples sent to EPA Region IV (Carp - 1.04 mg/kg). Although the extent of sport and food fishing in this area is not great, the situation should be closely monitored. Since Pond Creek drains a highly urbanized area, the source of chlordane may be from termite control practices. No other excessive levels of toxic chemicals or metals in fish tissue were found.

Cumberland River Basin
Station #02018900
Cumberland River above Cumberland Falls

Location	
Coordinates:	36^{o} 50' 13"N, 84^{o} 20" 38"W
County:	Whitley/McCreary
DOWQ Map No:	3 - 46
Topo Quad Name:	Cumberland Falls, Ky.
Physiographic Region:	Cumberland Plateau
Station Information	
Period of Record:	10/77 to present
Type of Sampling:	Physicochemical & Biological
Stream Order:	VI
Stream Width:	100m
Stream Depth:	0.5 - 2m
Stream Morphology:	riffle - run
Substrate:	sandstone bedrock, boulders

The Cumberland River at this location is a sixth order stream which forms the boundary between Whitley and McCreary counties. This segment of the Cumberland River is included in the Kentucky Wild Rivers System. The biological station is located upstream of the KY 90 bridge and extends approximately 2km upstream from the Cumberland Falls State Park water treatment plant. The stream substrate consists of sandstone bedrock and boulders which are scattered along each bank. The banks are forested, but much of the river is fully exposed due to its width (approx. 100m). The primary impact to the river appears to be siltation from surface mining. The river is turbid most of the year except during low flow periods. Although, the immediate area is sparsely populated, the town of Williamsburg (pop. 4000) is located approximately 18 miles upstream of the station. Drainage area at this station is 1,977 square miles.

The Cumberland River, upstream of Cumberland Falls, supports a diverse algal community consisting mainly of species characteristic of waters with moderate to elevated nutrients, total dissolved solids, salinity and alkalinity concentrations. The community is tolerant of a wide range of environmental conditions. Periphyton, exclusive of diatoms, is dominated by filamentous green algae and non-filamentous algae which are characteristic of nutrient enriched waters. Blue-green algae are also common at this station. The red alga, Lemanea, which covers large areas of the bedrock substrate providing habitat for aquatic invertebrates, was generally abundant at this station although none was found during the most recent sampling period.

The diatom community is dominated by typical stream diatoms characteristic of moderate to high dissolved oxygen and moderate nutrient enrichment. There seems to be a trend towards halophilic (salt-loving) species. This is supported by physicochemical data, where average conductivity values have nearly doubled during the past three years. Values for metals have increased during the same time period. This is reflected in the diatom community structure by the presence of various species which are tolerant to metals. Chlorophyll-a and ash-free weight values are elevated at this station indicating elevated nutrient concentrations.

Collections of the macroinvertebrates from this station reflect a complex community structure that is typical of large, shallow, free-flowing waters. Those characteristics make it possible for extensive partitioning of the available habitats, allowing many closely related forms to co-exist. The only component of the benthic community that appears to be stressed at this time is the freshwater mussel fauna. Only two species have been collected from the limited habitat (cracks in the sandstone bedrock) at the station. All of the mussels observed at this station were mature individuals with severely eroded shells. Apparently there is little or no recruitment of young native mussels in this area of the stream; however, the Asiatic clam Corbicula is abundant in the adult and juvenile stages at this station.

A total of 21 fish species are known at this station, including 3 species of bass, 2 species of catfish, sunfish, redhorse suckers, various minnows and 3 darter species. Numerous young of the year channel catfish and Kentucky bass were also noted. The diversity of fish seen at this station is somewhat remarkable, considering the turbidity and limited fishery habitat. Sport fishing is extensive both above and below the falls.

The physicochemical data indicates an increase in conductivity and a slight increase in sulphates, with significant suspended solid loads observed during runoff events. Water quality standards for aquatic life were exceeded for iron, manganese and mercury. Nutrient levels are stable, with occasional excursions beyond the EPA recommendation of 50 ug/l of total phosphorus for streams entering lakes.

Although no U.S. FDA action levels were exceeded in any fish from this station, tissue levels in redhorse suckers were approaching action levels for chlordane. This was not reflected in either channel catfish or spotted bass. More data will be needed before any definite trend can be seen.

Kentucky River Basin
Station #04039900
Kentucky River, Heidelberg Lock & Dam #14

Location	
Coordinates:	37° 33' 8" N, 83° 46' 11" W
County:	Lee
Kentucky RMI:	435.6, 249.0
DOW Map No:	9 - 50
Topo Quad Name:	Heidelberg, Kentucky
Physiographic Region:	Cumberland Plateau
Station Information	
Period of Record:	5/77 to date
Type of Sampling:	Physicochemical & Biological
Stream Order:	VI
Stream Width:	80 - 100m
Stream Depth:	2 - 5m
Stream Morphology:	impounded pool
Substrate:	silt & detritus; limestone rock ledges

The Kentucky River is a sixth order stream at this station with a total drainage area above Lock #14 of 2657 square miles. The biological station is located in the impounded pool upstream of Lock 14 from mile 249 to mile 254. The primary impact to the river appears to be siltation from surface mining (especially on the North and Middle Fork watersheds) and agricultural practices. The town of Beattyville (1500 pop.) is 16 miles upstream from this station.

The Kentucky River sustains a moderately diverse algal community consisting of taxa generally associated with well oxygenated waters of moderate nutrient content. Although most of the community is adaptable to a wide variety of environmental conditions, recent collections indicate a trend toward species associated with elevated conductivity and salinity levels. The presence of many planktonic species is reflective of the lentic nature of the river. The occurrence of an extensive blue-green algal bloom in 1980 suggests elevated nutrient levels, which is supported by chlorophyll- data.

The benthic macroinvertebrate community is well established with different feeding types for the available habitats. Apparently, there have been no recent alterations in the community structure.

Two habitats are available for invertebrates at this station. A bottom substrate of mud and silt is the primary habitat for a burrowing mayfly and several dipteran (mosquitoes & midge flies) larvae. Three other mayflies, two stoneflies and two caddisfly genera are routinely collected from submerged objects such as stumps, snags and root mats along the stream banks. Those areas comprise the other habitat at this station.

The fish fauna of the Kentucky River is typical of a large river. It supports a sport fishery as well as a limited commercial fishery. The diversity is good and some large specimens of commercial and food fish (suckers, drum and catfish) have been collected, in addition to game species such as bass (three species), bluegill and rock bass.

The physicochemical data indicates significant suspended solids levels. Water quality standards for aquatic life were exceeded for iron, lead and mercury. Nutrient levels are elevated for total nitrogen and phosphorus during runoff events, leading to occasional algal blooms.

Collections of fish for tissue analyses have been made at this station since 1979. No excessive levels of toxic chemicals or metals have been found through 1980.

Kentucky River Basin
Station #04043900
Red River - Hazel Green

Location

Coordinates:	37° 48' 43" N, 83° 27' 35" W
County:	Wolfe
Kentucky RMI:	435.6, 190.75, 72.6
DOW Map No:	11 - 53
Topo Quad Name:	Hazel Green, Ky.
Physiographic Region:	Cumberland Plateau

Station Information

Period of Record:	12/1/76 to date
Type of Sampling:	Physicochemical & Biological
Stream Order:	IV
Stream Width:	3 - 5m
Stream Depth:	0.5 - 1.5m
Stream Morphology:	riffle, pool
Substrate:	sandstone bedrock, shingles, boulders, rubble, gravel, and sand

The Red River at this station is a fourth order stream in the Kentucky River drainage system. The biological station is located at the USGS gauging station off highway 1010 approximately 4.5 miles from Hazel Green, in Wolfe County. At the biological station, the river is comprised of riffles, runs, and pools and is partially shaded by riparian vegetation. The land adjacent has been cleared for pasture and row crop production. The upstream watershed drains 65.8 square miles of small to moderate size farms and woodlands. The main impacts to the stream seem to be increased land disturbance, agricultural, and septic tank runoff.

Biological collections have shown that this segment contains a diverse population of algae, invertebrate organisms, and fish. The benthic algal flora consists of a diverse assemblage of taxa characteristic of highly oxygenated, slightly acidic streams of low mineral content. The algal community is typical of many high quality eastern Kentucky streams, although there seems to be a trend towards species associated with nutrient enrichment which partially accounts for the high algal diversity noted at this station. This trend is also indicated by elevated chlorophyll-a and ash-free weight values. Significant non-algal plant components of the stream include aquatic mosses and vascular plants which provide abundant habitat for algae, macroinvertebrates and fishes.

The macroinvertebrate data has revealed a drastic reduction in the available benthic habitats for this segment of stream. The reduction in habitats is attributed to a change in the percentage and composition of the bottom substrate. The riffle areas and exposed bedrock have been throughly covered with sand, creating a uniform substrate and habitat from bank to bank. Many of the macroinvertebrates have been eliminated from the aquatic community, particularly those organisms occurring on and under rocks in the riffle areas. In past years the freshwater mussels at this station consisted of a few scattered individuals established around riffles and depositional areas. During the 1981 collections a substantial increase in the numbers of mussels was observed in the pool areas above the U.S.G.S. dam. That increase is attributed to the downstream migration of the mussels in response to the loss of habitat in upstream areas. The movement of sediments and mussels to downstream areas is expedited during storm events in the headwaters.

The abundance of fish at this station is due to good water quality, a variety of trophic levels, and a richness in fishery habitat. Despite recent low flows and siltation noted at this station, the fish fauna exhibits excellent diversity. Six species of darters, which as riffle dwellers are sensitive to siltation, were collected here. In addition, six species of sunfish were taken, including such game species as smallmouth and spotted bass, bluegill and rock bass. The presence of many game species and top line predators plus the overall richness in diversity is indicative of good water quality, particularly in a fourth order stream. However, the present trend toward siltation and nutrient enrichment may eventually have an adverse impact on the fish community.

The physicochemical data indicates good water quality with minor violations of water quality standards for aquatic life for iron, mercury, lead and cadmium. Nutrient levels are increased for both total nitrogen and phosphorus.

Collections of fish for tissue analyses have been made at this station since 1979. No excessive levels of toxic chemicals or metals have been found through 1980.

Green River Basin
Station #03004900
Pond River below Isaac Creek

Location

Coordinates:	37° 21' 16" N, 87° 19' 3" W
County:	McLean/Hopkins
Kentucky RMI:	197.2, 55.1, 12.4
DOW Map No:	8 - 22
Topo Quad Name:	Millport, Ky. & Sacramento, Ky.
Physiographic Region:	Western Kentucky Coalfield

Station Information

Period of Record:	3/78 to date
Type of Sampling:	Physicochemical and Biological
Stream Order:	V
Stream Width:	5m (low flow)
Stream Depth:	0.5-3m (low flow)
Stream Morphology:	riffle, pool
Substrate:	sandstone bedrock, silt

Pond River at this location is a fifth order stream in the Green River basin with a watershed of 523 square miles. The biological station, located near the junction of the boundaries of Muhlenberg, Hopkins, and McLean counties (at the highway 85 bridge), is impacted by surface mining and agricultural practices. At this site, the river flows through a wide floodplain which is inundated by flood waters from late fall to spring nearly every year forming a periodically flooded wetland. During the summer, the river is rather shallow and meandering with abundant habitat for aquatic organisms. Stream banks are tree-lined and marsh areas are present. A large portion of the floodplain has been cleared for cultivation of row crops. The main limitations to aquatic life appear to be turbidity, suspended and dissolved solids, metals, and pH fluctuations in a stream which has little buffering capacity.

Pond River below Isaac Creek contains an algal community comprised mainly of epipelic (growing on mud) and planktonic species. The community as a whole is adaptable to a wide variety of environmental conditions.

Although nutrient values are elevated, most likely due to agricultural fertilizer runoff, chlorophyll-*a* and ash-free weight values are low except during low flow periods when the water is less turbid. During these periods, chlorophyll values are indicative of a productive algal community. Limitations to algal productivity include excessive turbidity, elevated metal concentrations, and fluctuations in pH and dissolved oxygen concentrations. A considerable amount of surface mining is occurring in the upstream watershed which is seen as the major impact to water quality at this station. This is reflected in the algal community structure by the presence of species associated with elevated conductivity, salinity, and heavy metal concentrations. Algal community structure has not significantly changed during the three years this station has been sampled.

The invertebrate fauna collected from this station is largely the same in composition as that from the other Pond River station. However, slight differences in environmental requirements between two closely related caddisflies were observed. A species occurring at the upper station in slow moving waters was replaced by another species that requires a steady slight to moderate current. The same physical characteristic makes it possible for two other genera of net spinning caddisflies to exist here.

Two species of freshwater mussels have been collected at this station. Evidently, the occurrence of mussels at this station is not limited by water quality but is limited by the available habitat.

The fish fauna at this station is very similar to that of the other Pond River station, although the habitat is somewhat more diverse. This area is used by sport fishermen, with drum, flathead and channel catfish, bass and crappie being the main food fish present.

The physicochemical data indicates increases in conductivity, dissolved solids, chlorides and significant increases in sulfates. Water quality standards for aquatic life were exceeded for iron, manganese and mercury. The data also indicates elevated nutrient levels of total phosphorus and total nitrogen.

Chlordane levels in tissue of both carp (0.70 mg/kg) and bluegill (0.50 mg/kg) collected in 1980 exceed U.S. FDA action levels. Both areas on Pond River appear to be used extensively by sport fishermen. Although 1981 data are not available at this time, the situation should be monitored closely. The source of contamination cannot be determined at this time. The main use of chlordane at the present time is for purposes of termite control.

U.S. EPA has suspended registration for all food crops and home and garden use. Limited usage as an agricultural pesticide continued through 1980. Since Pond River drains mainly rural agricultural and mined land, residues from previous agricultural usage may be the source.

Green River Basin
Station #03004901
Pond River - Apex

Location

Coordinates:	37° 7' 20" N, 87° 19' 10" W
County:	Muhlenberg/Christian
Kentucky RMI:	197.2, 55.1, 62.8
DOWQ Map No:	5 - 22
Topo Quad Name:	Haley's Mill, Ky.
Physiographic Region:	Western Kentucky Coal Field

Station Information

Period of Record:	3/78 to date
Type of Sampling:	Physicochemical & Biological
Stream Order:	IV
Stream Width:	15m
Stream Depth:	0.5 - 2.0m
Stream Morphology:	pool (run)
Substrate:	silt & detritus

Pond River at this location is a fourth order stream in the Green River drainage. The biological station is in the vicinity of the USGS gauging station on the KY 189 bridge at the Muhlenberg - Christian County line. The stream has been channelized and cleared of trees throughout the length of this segment. The stream bottom consists of silt and detritus with few rocks, providing rather limited habitat for aquatic organisms. Additionally, the stream is impacted by surface mining, which is expanding in the watershed, and oil drilling operations. The latter contributes to benthic accumulation of oil in tributary streams, as well as slightly elevated levels of chlorides. Other uses of the watershed include silviculture and agriculture, mainly pasture land. The water is turbid even during low flow periods, which limits primary production in the stream.

Biological collections at this station show a much greater diversity of aquatic organisms than one might expect given the habitat limitations of the site. Pond River near Apex sustains a moderately diverse algal community consisting of species which can withstand a wide variety of environmental conditions. Much of the community is composed of epipelic (occurring on mud) taxa that can adapt to extreme variations of dissolved oxygen, temperature, and salinity. Many species are characteristic of sluggish, nutrient rich waters although chlorophyll-a values are somewhat depressed, limited by excessive turbidity and other factors.

Periphyton, exclusive of diatoms, is dominated by filamentous blue-green algae and green algae. Non-filamentous taxa consist of green and blue-green algae which are often found in nutrient rich, alkaline waters. The diatom community is dominated by species (40-50%) which, as a group, are tolerant to adverse environmental conditions. A number of additional species not present prior to 1980 were noted in recent samples, many of which are associated with elevated salinity and conductivity values and oil brine impacts.

It appears that Pond River is being impacted by brine water from oil drilling operations. Impacts from brine water are probably most severe during storm runoff periods. These periodic slugs of brine are limiting to algal community structure and productivity as evidenced by depressed chlorophyll-a values and the presence of many halophilic (salt-loving) taxa in the diatom community.

Taxonomically, a paucity exists in the benthic macro-invertebrate community that is directly related to the obvious alterations and pertubations at the station. The reduction in available habitats has restricted the composition of the benthic community into three groups of organisms according to their mode of existence. Of those groups, the organisms that cling to objects in the water column appear to have the least amount of available habitat. In that group are two mayflies which are tolerant of high water temperatures and siltation in general. A species of burrowing mayfly dominates the bottom substrate (the most abundant habitat at the station), along with several midge fly larvae. Those organisms are most likely to contribute considerably to the ecology of the stream. The other persistent group of invertebrates are predatory in function and includes dragonfly and damselfly larvae and a single species of caddisfly, which are better able to cope with the warm, sluggish conditions. In the 1981 collections a viable population of freshwater mussels was discovered living among the rip-rap under Highway 189 bridge. Apparently, that area represents the only available habitat for mussels at the station. This is an indication of a severe reduction in habitat rather than degraded water quality. The collections included several young adults which indicates the recruitment of young mussels is occurring within the segment.

The fish community at this station is dominated by rough fish (carp, bowfin, gars and suckers) and forage fish (minnows and shad) and tolerant darters. These fish are tolerant of low D.O. and high turbidity. In addition, some sport and food fishes are present, such as largemouth bass, sunfish, crappie and catfishes. Despite the physical limitations of this segment, Pond River supports a moderately diverse fishery at present. It seems probable that fish are moving up into tributary streams when environmental conditions on Pond River are adverse. The maintenance of fish diversity, including game species, will depend on the availability of these refugia. The impact of oil well and mining operations on some of the tributary streams in the area may reduce or eliminate those refugia.

The physicochemical data indicates significant increases in conductivity values and dissolved solids and a slight increase in total phosphorus. Water quality standards for aquatic life were exceeded for iron, mercury, and lead.

Carp collected at this station in 1980 had tissue chlordane levels of 0.63 mg/kg which is well above FDA action levels (0.3 mg/kg). Crappie from the same area did not show these levels. For a further discussion of the chlordane problem refer to the Pond River-Issac Creek station. No other excessive levels of toxic chemicals or metals were found.

LAKES

Two grant awards under Section 314 of the Clean Water Act were obtained by the Kentucky Department for Natural Resources and Environmental Protection since the last 305(b) Report to Congress was submitted. One award was for a Phase 1 Diagnostic/Feasibility Study on McNeely Lake in Jefferson County, Kentucky. The other was for a lake classification and prioritization study to determine the trophic state of Kentucky's public lakes and their need for restoration.

The classification study has enabled the Division of Water to undertake its first comprehensive assessment of the general condition of lakes in the state. The project is now in its second and final year of field data collection. A total of forty-nine (49) lakes are planned to be classified. The twenty-eight (28) lakes sampled in the first year's effort in 1981 are discussed in this report. The other lakes will be discussed in the next 305(b) report. An evaluation of water quality conditions in the fifteen (15) reservoirs operated by the U.S. Army Corps of Engineers (COE) in Kentucky, one reservoir operated by Kentucky Utilities (Herrington Lake), and Kentucky Lake which is managed by the Tennessee Valley Authority is also included in this report. The general locations of the lakes that have been classified by trophic state are listed in Table 11. The larger lakes are shown on the river basin maps included in the Rivers and Streams Chapter.

Table 11

Location of Trophically Classified Lakes

River Basin	Lake	Hydrologic Unit	County
Mississippi and Tennessee	Kentucky	06040005	Calloway, Marshall, Lyon, Trigg
Lower Cumberland, Tradewater, and Lower Ohio	Barkley	05130205	Lyon, Trigg
	Energy	05130205	Trigg*
	Hematite	05130205	Trigg*
	Honker	05130205	Trigg*
	Mauzy	05140202	Union
	Beshear	05140205	Caldwell, Christian
	Grapevine	05140205	Hopkins
	Loch Mary	05140205	Hopkins
	Peewee	05140205	Hopkins
	George	05140203	Crittenden
	Carpenter	05140201	Daviess
Green	Campbellsville	05110001	Taylor
	Freeman	0511001	Hardin
	Green River	0511001	Taylor, Adair
	Nolin River	0511001	Edmonson, Grayson, Hart
	Shanty Hollow	0511001	Warren
	Barren River	05110002	Allen, Barren
	Lewisburg	05110003	Logan
	Luzerne	05110003	Muhlenberg
	Malone	05110003	Muhlenberg, Todd, Logan
	Spa	05110003	Logan
	Rough River	05110004	Breckinridge, Grayson
Salt	Reformatory	05140101	Oldham
	Guist Creek	05140102	Shelby
	McNeely	05140102	Jefferson
	Beaver	05140103	Anderson
	Marion County	05140103	Marion
	Willisburg	05140103	Washington
Upper Cumberland	Martins Fork	05130101	Harlan
	Laurel River	05130102	Laurel
	Cumberland	05130103	Clinton, Pulaski, Russell, Wayne
	Dale Hollow	051301051	Clinton, Cumberland

Table 11 continued

River Basin	Lake	Hydrologic Unit	County
Kentucky	Carr Fork	05100201	Knott
	Buckhorn	05100202	Perry, Leslie
	Boltz	05100205	Grant
	Bullock Pen	05100205	Grant
	Corinth	05100205	Grant
	Elmer Davis	05100205	Owen
	Herrington	05100205	Boyle, Garrard, Mercer
Licking	Cave Run	05100101	Bath, Menifee, Morgan, Rowan, Grant
	Williamstown	05100101	Grant
Big Sandy	Fishtrap	05070202	Pike
	Dewey	05070203	Floyd
Little Sandy	Grayson	05090104	Carter, Elliott

*Located in Land Between the Lakes area

Monitoring Program - State Lake Classification

Each lake in the classification study is sampled once in the spring, summer, and fall. During each of the three samplings a depth profile at the deepest site is made to record temperature, pH, conductivity, and dissolved oxygen. A submarine photometer is used to measure the depth of the euphotic zone. A composite water sample is then taken from this zone to measure chlorophyll-*a* , total phosphorus, total filtrable phosphorous, orthophosphate (filtrable reactive phosphorus), total kjeldahl nitrogen, ammonia and nitrate-nitrite nitrogen. A Secchi disc measurement is also taken. Some lakes because of their configuration and size, have more than one sampling site. All sites are sampled as described above. Field observations are made during the lake visits to note any excessive development of aquatic macrophytes.

The trophic status of the lakes is determined by converting the chlorophyll-*a* concentrations to Carlson trophic state index (TSI) values. A mean index value is derived from all the samples from each lake and the lakes are then ranked as to trophic state.

Monitoring Program - COE and other Agency Operated Lakes

Current and long term data from the COE operated lakes were obtained in the form of computer printouts from COE District Offices. Monthly chlorophyll-*a* data for the spring through fall seasons were used to determine TSI values as described above.

Stream Mileages Known to be Affected
by Coal Mining Activities

Name of Stream	Source[1.] of Information	Miles Affected	Acid Mine Drainage Impact
TRADEWATER RIVER BASIN (continued)			
Whiteside Creek	2	2.8	-
Vaughn Ditch and			
Craborchard Creek	3	18.7	-
Unnamed tributaries(2)	2	3.9	-
Slover Creek	2	5.5	-
Unnamed tributary	2	2.4	*
Wynn Ditch	2	2.4	-
GREEN RIVER BASIN			
Green River near Beechgrove to Pond River	3	5.9	-
Muddy Creek	2	17.5	-
Persimmon Creek	2	2.0	-
Unnamed tributary	2	0.7	*
Mud River			
Hazel Creek	1	6.0	-
Little Hazel Creek	2	3.9	*
Jacobs Creek	1	4.8	-
Pond Creek	2,3	20.0	*
Unnamed tributaries(4)	2	10.3	*
Caney Creek	2	7.0	*
Beech Creek	2	3.4	*
Unnamed tributaries(2)	2	1.7	*
Nelson Creek	2	4.3	-
Pond River	2,3	57.0	*
Cypress Creek	2	33.3	*
Unnamed tributaries(2)	2	5.9	*
Little Cypress Ck.	1,2	10.4	*
Harris Branch	2	2.4	*
Brier Creek	2	4.7	*
Isaacs Creek	2	5.8	*
Unnamed tributary	2	2.1	*

Table 12

Lakes in State Classification Program

Lake	TSI chl-a*	Trophic State	Acres
McNeely	74	Hypereutrophic	51
Reformatory	72	Hypereutrophic	54
Carpenter	66	Eutrophic	64
Marion County	65	Eutrophic	21
Willisburg	64	Eutrophic	126
Bullock Pen	64	Eutrophic	134
Guist Creek	63	Eutrophic	317
Honker	62	Eutrophic	190
Mauzy	61	Eutrophic	84
Boltz	61	Eutrophic	92
Energy	60	Eutrophic	370
Elmer Davis	60	Eutrophic	149
Shanty Hollow	59	Eutrophic	135
Grapevine	58	Eutrophic	50
Beaver	58	Eutrophic	158
Corinth	57	Eutrophic	96
Hematite	56	Eutrophic	95
Spa	56	Eutrophic	240
Malone	55	Eutrophic	826
Williamstown	52	Eutrophic	300
Campbellsville City	51	Eutrophic	63
Luzerne	50	Eutrophic	55
Peewee	49	Mesotrophic	360
Freeman	48	Mesotrophic	160
George	47	Mesotrophic	53
Beshear	47	Mesotrophic	760
Loch Mary	47	Mesotrophic	135
Lewisburg	42	Mesotrophic	51

*Scale:

0 - 40	Oligotrophic
41 - 50	Mesotrophic
51 - 70	Eutrophic
70 - 100	Hypereutrophic

Table 13

Lakes Managed by the Corps of Engineers
and Other Agencies

Lake	TSI chl-a*	Trophic State	Acres
Barkley	55	Eutrophic	57,920
Herrington	52	Eutrophic	2,940
Kentucky	47	Mesotrophic	154,800
West Sandy Crk. Embayment	64	Eutrophic	1,020
Big Sandy Crk. Embayment	59	Eutrophic	4,480
Rough River	44	Mesotrophic	5,100
Nolin River	44	Mesotrophic	5,790
Barren River	42	Mesotrophic	7,205
Beaver Crk. Arm	60	Eutrophic	1,565
Skaggs Crk. Arm	52	Eutrophic	1,230
Green River	41	Mesotrophic	8,210
Cumberland	40	Mesotrophic	50,250
Grayson	40	Mesotrophic	1,512
Dale Hollow	39	Oligotrophic	27,700
Martins Fork	38	Oligotrophic	334
Carr Fork	36	Oligotrophic**	710
Buckhorn	36	Oligotrophic	1,230
Cave Run	35	Oligotrophic	8,270
Dewey	35	Oligotrophic	1,100
Fishtrap	34	Oligotrophic	1,143
Laurel River	34	Oligotrophic	4,990
Midlake-Laurel Arm	47	Mesotrophic	754
Headwaters-Laurel Arm	62	Eutrophic	316

*Scale: 0 - 40 Oligotrophic
41 - 50 Mesotrophic
51 - 100 Eutrophic

**Eutrophic in 1981 due to lake fertilization program.

and the available data indicates that two embayments in Tennessee are eutrophic. Carr Fork has historically been oligotrophic and is listed as such. In 1981, a cooperative effort between the Corps and the Kentucky Department of Fish and Wildlife Resources was undertaken to increase fish production by fertilizing the lake. This resulted in an increase in phytoplankton biomass which caused the lake to become eutrophic.

In summary, Kentucky has forty-five (45) lakes with a combined area of 353,353 acres that have been classified by trophic state. Sixty-six percent of these acres are mesotrophic, twenty-one percent are eutrophic, and thirteen percent are oligotrophic. Twenty additional lakes with a combined area of 3011 acres will be classified by October, 1982.

Existing Problems

Table 14 lists lakes where certain uses are known to be impaired. McNeely Lake is being studied under a current Phase I Diagnostic/Feasibility Clean Lakes Grant. A plan is being developed which will address the best method to restore the lake. Since no new funding is available from the Clean Lakes Program for implementation of restoration plans, it is unlikely that the lake will be restored in the near future. Local resources are currently not available to fund the restoration costs.

Reformatory Lake is impacted by nutrients from livestock operations within its watershed. Sixty percent of its volume has an oxygen content of less than 4 mg/l in the late summer, which reduces its carrying capacity for fish.

Table 14

Lakes with Impaired Uses

Lake	Impaired Use	Symptom	Cause
McNeely	Fishing, Secondary contact recreation	Algal blooms Duckweed growth Oxygen depletion	Nutrient inflows from package sewage treatment plants
Reformatory	Fishing	Oxygen depletion	Accelerated eutrophication due to runoff from livestock operations
Carpenter	Fishing, Secondary contact recreation	Excessive macrophytic growth	Shallow lake basin
Loch Mary	Domestic Water Supply	Elevated Fe, Mn and hardness	Acid mine drainage
Sympson	Domestic Water Supply	Taste and odor problems	Algal blooms
Martins Fork	Recreation	Turbid water after storm events	Surface Mining
Dewey	Recreation	Turbid water after storm events	Surface Mining
Fishtrap	Recreation	Turbid water after storm events	Surface Mining
Carr Fork	Recreation	Turbid water after storm events	Surface Mining
Laurel River (headwaters of Laurel River Arm)	Recreation	Algal blooms	Point and nonpoint nutrient inflows

Extensive aquatic macrophytic growth (*Potamogeton crispus* in particular) in the spring and early summer in Carpenter Lake has been the subject of citizens complaints for several years. Attempts have been made to chemically treat the macrophytes but have not been permanently successful. Dredging the lake to make it deeper would probably decrease the macrophyte growth, but there are no present plans to do so as it is very expensive.

Loch Mary is a drinking water supply reservoir that has been impacted by drainage from abandoned surface mines. Treatment costs are above normal due to noncarbonate hardness. Part of the watershed has been reclaimed by a Rural Abandoned Mine Program project. The remainder of the watershed is now being reclaimed by the state Division of Abandoned Lands. Changes in water quality are being monitored under a joint agreement between the Division of Abandoned Lands and the Division of Water. The project will be monitored until October 1983. At that time an assessment will be made as to whether the reclamation efforts have been successful in improving the water quality of Loch Mary.

Extensive growths of lotus or water-chinquapin *Nelumbo lutea* developed in the upper-third of Loch Mary in the early 1970s. Sediment deposited from past surface mining activities provided a substrate that fostered the spread of the plant. The upper section of the lake was subsequently dredged to increase the lake depth and discourage further encroachment of lotus. The area of its growth was reduced but not eliminated. Since the seeds of this plant have been reported to remain viable for nearly 200 years, there is a possibility that lotus growth may increase to nuisance proportions in the future. Stabilization and revegetation of the abandoned surface mine lands by the reclamation projects previously mentioned may reduce the potential spread of lotus by decreasing the sediment loading to the lake.

Sympson Lake, another drinking water supply reservoir, has had taste and odor problems due to the species of algae that develop in the spring. This problem is currently under study by the University of Louisville. Chemical treatment of the lake with an algicide has been initiated to combat the problem. Other solutions will be recommended when the one year study is completed.

Martins Fork, Dewey, Fishtrap, and Carr Fork lakes have historically been impacted by sediment loadings from surface mining activities in their watersheds. Sediment dams on the major tributaries at Carr Fork have been installed to prevent sediment from reaching the lake. Their effectiveness is currently being evaluated.

The upper end of Laurel River Lake is eutrophic and experiences nuisance algal blooms. Nutrients from nonpoint sources in the relatively large watershed and from point source municipal sewage treatment plants are the contributing causes of the algal blooms. A preliminary assessment of the relative contribution of nutrients from both sources has shown that with point source nutrient removal an eutrophic condition would still remain. As a result, nutrient removal has not been recommended for the point sources. The impacted area represents about five percent of the total lake area. This restricted area minimizes the importance of the eutrophication problem.

There have been historical water quality problems at some of the lakes managed by the Corps of Engineers that relate to domestic water supply. During some years the high iron and manganese concentrations in their release water has caused treatment problems for downstream users. Barren River and Cave Run lake releases have caused such problems at Bowling Green and Morehead, respectively. There were no complaints, however, in 1980 and 1981. The Corps is planning structural modifications at Cave Run so that a selective withdrawal capability will be available to minimize the problem for the Morehead water treatment facility. The city of Leitchfield withdraws water directly from Rough River Lake and has had problems with high manganese concentrations. The problem is not always continuous or recurring.

High concentrations of iron and manganese and hydrogen sulfide can be released under stratified conditions at Martins Fork Lake. The selective withdrawal system is operated to improve the water quality of the release at those times.

WETLANDS

Wetlands are defined as areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The importance of these lands is just being fully understood. Their value lies in several aspects, which when taken either partially or as a whole, often exceeds the apparent economic value of the land itself. Wetlands are among the most productive of all ecosystems. They are vital for the existence of many species of fish, wildlife, and plants. A summary of primary values includes: (1) Natural Moderation of Floods, (2) Erosion Control, (3) Water Quality Enhancement, (4) Groundwater Recharge, (5) Fish and Wildlife Habitat, (6) Recreation, (7) Education and Scientific Research, (8) Aesthetic and Open Space and (9) Food and Fiber Productivity.

Little research has been conducted on Kentucky wetlands. The Commonwealth's first estimates of wetland acreage came in the early 1950's. This work by the U.S. Fish and Wildlife Service was not field checked and its purpose was limited to locating water-fowl habitat (as specified from U.S. Fish and Wildlife's Circular 39). From aerial photos a total of 273,000 acres were estimated to be wetland in Kentucky. In 1977, the Ohio River Basin Commission, Fish and Wildlife Work Group, in cooperation with Kentucky Department of Fish and Wildlife, released a report on wetlands along the Ohio River and its tributaries in Kentucky. Their work, which was field checked, revealed 73,000 remaining wetland acres for this area. In 1979, the U.S. Fish and Wildlife Service documented wetland losses along the Mississippi Alluvial Plain. Kentucky has four counties in the Mississippi Valley which in 1957 accounted for 54,000 acres of wetlands. In 1977, the total wetlands of these counties dropped to 34,000 acres, a 37 percent reduction in 20 years. Combining the total acres in 1977 for the two reports, a good representation of total acres can be determined. Of the estimated 273,000 acres in Kentucky in the early 50's, only 106,500 acres (39%) of wetlands remain along the Ohio and Mississippi rivers and their tributaries.

There has been no extensive inventory on a statewide basis of Kentucky wetlands. From the limited sources mentioned above, wetlands in Kentucky can be very generally classed into the following categories by utilizing the most recent (1979) U.S. Fish and Wildlife Service classification system.

The majority of Kentucky's wetlands fall into the Palustrine System. Areas lying shoreward of rivers and lakes, including floodplains, oxbows, ponds, marshes, and swamps, are members of this category. The broad alluvial floodplains of the Ohio and Mississippi rivers and their tributaries in western Kentucky comprise the vast majority of Kentucky wetlands. Small ponds are common throughout the state and their area is difficult to assess. They are, however, very important and have value as ecological epicenters. The Riverine System includes all wetlands and deepwater habitats contained within a channel that experiences continuous or periodic moving water or connects two bodies of standing water. While wetlands of this type are not extensive, they do provide unique habitat for many rare or endangered species and are very important ecologically. Lacustrine Systems in Kentucky are limited to man-made lakes, their shorelines, and spillways. The Lacustrine Systems are the least ecologically significant of the Kentucky wetlands.

The major threat to Kentucky wetlands is their destruction due to competing land use activities and poor land management practices. Both coal mining and agricultural practices are depleting this unique habitat. Strip mining operations in the western Kentucky coalfield are either totally destroying, by actually stripping coal from wetland areas, or drastically altering, by siltation and acid mine drainage, much of Kentucky's wetlands.

Logging and agricultural practices such as channelizing, draintiling, burning, and otherwise altering the water regime to render the land tillable are rapidly changing wetland ecosystems. Other agricultural practices which cause erosion and chemical fertilizer and pesticide runoff are also having an adverse effect on the natural system.

To a lesser extent and generally in localized situations, domestic and industrial sewage discharge, oil brine discharge, and urbanization are having detrimental effects on Kentucky wetlands.

At the present time there is no monitoring program for Kentucky wetlands. A monitoring program is needed and would be an invaluable tool toward good management of this resource. To initiate a monitoring program, an intensive survey and classification of Kentucky's wetlands is needed. The survey would yield considerable useful quantitative and qualitative baseline data. From this data, continual ambient monitoring of strategic wetland areas could be established to show losses of wetland acreage and trends in chemical and biological parameters. Knowledge of these parametric trends could then be used to make sound managerial decisions about our environment. Other needs of Kentucky wetlands are an increased public awareness of the value of these ecosystems; regulations to acquire and protect strategic wetlands; and regulations to require permits and mitigation funds for altering wetland systems.

GROUNDWATER

Groundwater Use in Kentucky

Based on 1975 estimates, groundwater withdrawals constituted 5.1 percent of all water withdrawn for public supply, rural domestic, livestock, irrigation, thermoelectric power, and industrial uses in Kentucky. The 1975 percentage represented increases of 1.1 percent and 0.6 percent over 1970 and 1965 groundwater withdrawal percentages, respectively.

While groundwater does not provide a large portion of the total water withdrawn in the Commonwealth, it is an extremely important local and regional resource because it is most often used in areas where surface supplies are not physically or economically available. Table 15 summarizes the volume (in mgd) of groundwater used and the percentage of groundwater to total use withdrawals for 1965, 1970, and 1975.

An analysis of the estimates contained in Table 15 indicates volumetric increases in the use of groundwater for public supply, thermoelectric power generation, and livestock watering over the ten-year period. These increases have been accompanied by volumetric decreases in the use of groundwater for rural domestic supply, supplement irrigation, and industrial use.

While approximately one-third of Kentucky's rural population still relies on private wells for its domestic or household supply, it appears evident from the 1965-1975 trend that, as public and private water systems have expanded, rural

Table 15

Estimated Groundwater Withdrawal Use in MGD,
1965-1975*

Year	Public Supply Use	Rural Domestic Use	Livestock Use	Irrigation Use	Thermo-Electric Power Use	Industrial Use	Total Use
1965	22.0 (11.0)	49.0 (75.4)	3.4 (8.9)	1.8 (20.2)	0.0 (0)	78.6 (30.1)	154.8 (4.5)
1970	24.0 (13.3)	48.0 (87.3)	3.7 (9.2)	0.4 (5.6)	1.9 (0.1)	102.0 (27.6)	180.0 (4.0)
1975	30.0 (14.6)	34.0 (89.5)	4.6 (10.0)	0.1 (3.7)	1.8 (0.1)	75.0 (26.8)	145.5 (5.1)

*Groundwater percentage of total use shown in parenthesis.

Source: Murray, 1977, 1972, and 1968

reliance on individual wells has decreased. At the present time, 846 community and non-community systems or 64 percent of the state's 1,319 public water supplies rely on groundwater as their sole source of water to meet public demand. Collectively, the groundwater systems serve approximately 193,000 persons or about 6.5 percent of the total state population served by public water supplies.

State developed projections on future groundwater use have not been prepared in Kentucky. For the most part, only the projections developed during the Second National Water Assessment are used in macro-level use planning and forecasting. Despite the absence of formal groundwater use projections, it is anticipated that groundwater use will continue to grow at an expanding rate. Two principle causes for the expected increase in groundwater demand are surface water contamination and competing uses for available surface water supplies. A certain result of both surface water trends will be additional groundwater management problems.

Existing Groundwater Problems

The quantification of statewide, regional, and local groundwater problems is not possible in Kentucky because of an incomplete and inadequate data base. With the exception of two ongoing state-sponsored local investigations, the only source of information available on a continuing basis is groundwater quality data from the U.S. Geological Survey's observation well monitoring network. Nevertheless, a number of earlier studies have served to point out the major types of existing groundwater quality problems affecting the Commonwealth.

A major problem affecting groundwater quality is septic tank contamination. This problem is particularly evident in Kentucky's karst areas, which represent nearly one-third of the state. Bacteriological and nitrate contamination is not confined to only karst regions, however. EPA, in its recent Mill Creek Environmental Impact Statement for Southwestern Jefferson County (a county which is a part of the Louisville SMSA), documented extensive fecal coliform and nitrate contamination of the Ohio Valley alluvial aquifer. While usually considered to be only a local problem, the failure of on-site wastewater disposal systems (especially septic tanks and tile fields) probably represents the major source of groundwater quality degradation in the state.

Waste landfills and surface disposal lagoons, pits, and ponds are a second known source of groundwater contamination, as documented through Kentucky's Surface Impoundment Assessment (SIA) report and a groundwater monitoring study funded in part through Kentucky's FY 80 Title III Water Resources Planning Grant. In the case of both investigations, it is clear that poor siting, construction, and operating practices have resulted in groundwater contamination. However, in the case of the three non-random sites that were sampled as a part of the National Groundwater Supply

Survey conducted by EPA, all of which were picked because of a concern for potential landfill contamination, all groundwater appeared "relatively clean."

A third known cause of groundwater contamination, as identified in Kentucky's FY 79 and 80 Underground Injection Control (UIC) study, is oil and gas drilling and reinjection. The major cause of contamination appears to be the upward migration of saline water into freshwater zones. As a consequence of past well drilling, casing, and closure practices, freshwater aquifers located in the western and south central production fields of the state have been contaminated. The areal extent of identified contamination has yet to be determined, however.

A fourth quality problem that has been documented during the past two years is an increase in salt concentrations (particularly sodium) because of diminished aquifer recharge. It is believed, however, that this represents only a transient problem associated with reduced precipitation during 1980 and 1981.

Nonpoint source (NPS) pollution is a fifth important cause of groundwater quality problems. Nonpoint source pollution impacts on groundwater quality are currently being studied through Kentucky's ongoing 208 program.

Potential Groundwater Problems

Groundwater quality problems that may emerge or that may currently exist but produce impacts which are unknown or undocumented include hydrogeologic (aquifer) consequences associated with energy extraction (coal, oil, and gas), localized groundwater use competition and depletion, and destruction of recharge areas by development. Furthermore, groundwater problems resulting from the preceding activities may also adversely impact surface waters. It will remain impossible to quantify existing and potential problems until a comprehensive groundwater management program that includes creating an adequate data base and integrating surface water and groundwater programs is established at the state level.

State Responses

Kentucky's response to groundwater quality problems and needs has been two-fold. First, the state is making every attempt to identify and utilize all available information in decision-making. Second, two direct responses are being pursued.

Currently, Kentucky relies extensively on information published by other agencies when making decisions that may affect groundwater quality. A list of the principal information sources includes:

- U.S.G.S. 7.5 minute geologic maps for the entire state;
- a series of U.S.G.S. hydrologic atlases on groundwater availability for the entire state;
- U.S.G.S. water supply papers;
- U.S.G.S. Open File Report 80-685 entitled, "A Compilation of Groundwater Quality for Kentucky" which presents almost all of the groundwater quality data in the Geological Survey's files from 1950-1979;

- U.S.G.S. annual "Water Resources Data for Kentucky" reports;
- original data reported in environmental impact statements, assessments, and reports;
- the FY 79 and FY 80 Underground Injection Control (UIC) funded report entitled, "Evaluation of Selected Geologic Units for Potential Use in Underground Storage of Wastes;"
- groundwater information provided through the state's water withdrawal permitting program; and
- Kentucky's initial 208 Water Quality Management (WQM) Plan submittal which presented a characterization of groundwater quality by physiographic province.

While a considerable variety of information sources appears to exist, the state has not attempted to consolidate and analyze the information contained in the reports.

In addition to existing information, the state is actively engaged in two other activities intended to supplement the existing groundwater quality data base. First, a cooperative effort with the Kentucky Water Well Drillers Association is underway to establish a well drillers certification and licensing program. As a part of the program, well logs would be filed on all new water wells that are drilled. Such a requirement does not now exist, and its absence has resulted in a paucity of local area data and information. Second, as a part of Kentucky's continuing 208 WQM planning program, the state has undertaken an effort to characterize and generally locate groundwater quality problems at the physiographic province and river basin level. This second step in the 208 groundwater problem analysis should also serve as a basis for designing a corrective program. Also as a part of 208, the state has funded two groundwater quality studies. The first study, which examines the Rio Springs aquifer in south central Kentucky is intended to identify the relationship between pollutant inputs and groundwater quality and to determine whether the study aquifer will qualify for sole source designation. The second study is taking place in the karst area surrounding Bowling Green, Kentucky. The purpose of the second study is to determine the extent and degree of use impairment occurring as a result of agricultural, construction, urban runoff, and septic tank nonpoint pollution sources.

Kentucky's formal state-level responses to groundwater quality problems have been limited to two direct activities. First, the state is in the process of developing a program to obtain Class II UIC primacy under Part 1425 regulations. Second, draft groundwater quality standards are being prepared for possible state adoption in the future. Indirect activities that support direct efforts to protect and maintain groundwater quality include receipt of primacy for operating the federal surface mining control program, continuing attempts to obtain RCRA implementation authority, and local public health programs to ensure the integrity of on-site wastewater disposal systems.

CHAPTER II

SPECIAL WATER QUALITY PROBLEMS

DRINKING WATER

Pursuant to the National Interim Primary Drinking Water Regulations (NIPDWR) promulgated June 24, 1975, the amended NIPDWR promulgated August 27, 1980 and Kentucky's Public and Semipublic Drinking Water Supplies Regulations (401 KAR 6:015), the Division of Water must supervise the collection and analyses of samples taken from its community and non-community public drinking water supplies.

Contaminant groups involved are those which effect the public health and welfare of the consuming and domestic users, whether resident or transient, within the state. Contaminant groups include microbiological, inorganic (8 heavy metals), organic (pesticides, herbicides, and total trihalomethanes), nitrate, gross alpha radioactive particulates, sodium, and secondary contaminants (contaminants that affect aesthetic quality).

Data generated from 1980-81 monitoring and surveillance activities indicate high sodium levels in community water supplies statewide. Table 16 shows that of the supplies analyzed over the two year period, approximately 61% exceeded the EPA Red Book recommended 20 mg/l criteria for restricted sodium diets. The elevated sodium levels may be associated with reduced precipitation during the period. Trends will be closely monitored to determine the extent of the problem.

Table 16
Summary of Sodium Analyses for
Community Water Supplies

Year	Number of Supplies	Number of Supplies with Sodium > 20 mg/l
1980	212	128 (Surface - 50, Ground - 78)
1981	399	243 (Surface -110, Ground -133)

The Division of Water implemented the state's trihalomethane (THM) monitoring program in November 1980 in order to begin compliance with the Ammended National Interim Primary Drinking Water Regulations. The initial supplies monitored, Louisville, Kenton County and Lexington, were those serving populations greater than 75,000. At the end of four quarters of sampling, the Lexington and Kenton County Water Systems had averages of TTHM concentrations in excess of the promulgated 0.100 mg/liter maximum contaminant level (MCL).

Trihalomethanes are formed by the reaction of chlorine with an organic precursor. In the Lexington system, the THM levels were skewed towards the more brominated THM compounds. After chlorination, shifts in THMs toward the more brominated compounds have been shown to be caused by (1) contaminates in the raw water due to elevated saline levels with corresponding elevated bromide concentrations, or (2) the presence of bromide salts in the chemicals (chlorine) used for processing water through water treatment plants. Examination of three years of data compiled by Kentucky-American Water Company on the chloride levels in the Kentucky River, the major source of Lexington's drinking water, revealed widely fluctuating chloride levels in the river.

Controlling THM levels in drinking water supplies is a subject of much concern for the state. Due to the seasonal complexity of the conditions in the state's rivers, other Kentucky water supply systems may experience problems with meeting the THM standard in the future. A better perspective of the extent of potential problems will develop as surveillance proceeds for the 42 systems serving from 10,000 to 75,000 persons.

WATER DEPLETION

Kentucky has experienced localized water shortage problems over the past two years and anticipates both local and regional or sub-basin level water availability problems in the future. The nature of existing and future problems and the state's responses are detailed in the following subsections.

Localized Water Availability

A moderate number of Kentucky's smaller communities experienced water shortages during 1980 and 1981. While the principal natural cause of the short-term shortages was reduced precipitation, at least two anthropogenic factors contributed to shortage development. The two include inefficient water use, such as not using conservation measures, and inadequate planning. In the case of the latter contributing cause, communities which have experienced shortages, as well as those approaching the limits of their surface water and groundwater supplies, have not initiated efforts to locate and obtain new or supplemental supply sources or expand treatment, storage, and distribution capability sufficiently in advance of growth-induced and per capita increases in demand. As a consequence of this problem, local community shortages will continue to develop and recur, with water availability being further constrained during drought periods. Unfortunately, the water quality impacts resulting from these causes have not been determined.

A second activity which has undoubtedly contributed to localized water availability problems involves alteration of the hydrologic regime by land disturbance and development. While as yet unquantified, both surface water and groundwater flow and, in turn, the use of these resources, including waste assimilation, has unquestionably been affected. It is anticipated, however, that implementation of the federal surface mining control program and continuing 208 and 314 planning work leading to eventual implementation will help in alleviating present availability problems associated with some types of hydrologic alterations.

Sub-basin Water Availability

At the present time, regional water availability is not generally a problem in most of the state's 13 basins. The one sub-basin that is an exception, however, is the Ohio River. As originally reported by the Title II Ohio River Basin Commission in 1977 and as restated in Volume 4 of the Second National Water Assessment, the critical flow for water quality (based on ORSANCO information) already exceeds the existing 7 day, 10 year low flow (7q10) in three major reaches, totaling about 285 stream miles, of the Ohio River bordering Kentucky. Table 17 provides further locational and flow volume information on this existing water problem.

Table 17 Ohio River 7q10
Deficiency (in cfs)

Reach Description	River Mile Range	Approximate Existing 7q10	Approximate Water Quality 7q10	Approximate Deficit
Huntington to Scioto River confluence	310 to 360	8,500	9,700	1,200
Maysville, Ky to Great Miami River confluence (includes Cincinnati)	440 to 490	10,500	12,000	1,500
Louisville to Green River confluence	605 to 790	13,000	14,000	1,000

Further, the Second National Water Assessment projected that the deficit problem will worsen during the periods 1975-2000 and 2000-2020. By the year 2000, the U.S. Water Resources Council projected that additional consumption for municipal, industrial, and power cooling uses, despite the increased use of in-plant recycling, will result in existing dry weather flows being less than required water quality 7q10 needs throughout the entire 664 mile reach of the Ohio River bordering Kentucky. From 2000 to 2020, the situation is projected to deteriorate even further.

Compared to the Ohio River depletion problem, anticipated flow or availability problems for the Green River Basin and the Kentucky River Basin are somewhat less immediate. Future availability difficulties in both basins, occurring largely as a result of consumption related to energy development (synthetic fuel facilities, oil shale extraction, fresh water injection associated with enhanced oil and gas production, coal slurry lines, etc.), have the potential to cause moderately serious to serious water quality problems. Potential water quality standards violations and use impairment may develop as flow depletion changes the current basis for wasteload allocations and TMDLs. This could result in significant additional costs associated with more stringent wastewater treatment requirements for both the private and the public sectors. Municipal wastewater treatment facilities constructed or upgraded through the Construction Grants Program may be required to provide more advanced levels of treatment.

While the prospective instream (fish and wildlife, recreation, and waste assimilation uses) water quality impacts associated with surface water depletion are predictably apparent, the paucity of reliable groundwater quality and quantity information for the state makes it impossible, at this time, to quantitatively discern potential groundwater and conjunctive surface water quality problems associated with groundwater mining or aquifer dewatering. Without intentional management, however, potential impacts include the loss of aquifer capacity and changes to the chemical characteristics of groundwater. These potential consequences apply to both regional and localized aquifers.

Kentucky's Responses

Presently, a state water withdrawal permit, which awards a temporal use priority, is required for surface water or groundwater withdrawals in excess of 10,000 gpd. Unfortunately, three major consumptive uses are exempted from permitting under state law. The three exempted uses include water for all agricultural enterprises (general farmstead, livestock watering, and irrigation), cooling water for steam electric power production, and injection water used for oil and gas production. Not only are the three uses exempted from permitting, but they are not required to report on actual water use. In order to obtain control over the use and potential depletion of all public waters in the state, efforts to revise Kentucky's water law to remove critical exemptions and decrease permitting volumes to 5,000 gpd are continuing.

In the absence of statutory changes, Kentucky has initiated a joint program with the U.S. Geological Survey to inventory all water use in the state. After obtaining use information, individual basin water budget mass balance models will be prepared that will incorporate all withdrawals, consumption, return flows, and imports and exports. These models, which will include 7q10 flow information developed through the WLA process, a U.S. Geological Survey ten-year small watershed (less than 10 square miles) hydrology study of approximately 90 basins throughout the state, and U.S. Geological Survey homogeneous stream flow reports for the Green and Kentucky Rivers, will be used as a partial basis for permitting surface water withdrawals. It is believed that use of the individual basin models, as well as a statewide model, will be a major contributing factor in controlling future depletions.

The state intends to develop a formalized water conservation, reuse, and recycling technical assistance program to improve water use efficiency. Regretably, there are no independent initiatives underway that are intended to separately address groundwater depletion. At best, the only activity mentioned in the preceding paragraph that may indirectly contribute to groundwater quantity management involves including change in storage information in the planned water budget models.

POLLUTION CAUSED FISH KILLS

Fish kills are investigated by the Kentucky Department of Fish and Wildlife Resources and reported to the Division of Water.

During 1980, 24 kills attributed to pollution were reported (See Table 18). Of the reports containing counts of dead fish, three were light (less than 100), seven were moderate (100-1000), and eleven were major (more than 1000). Mining or oil drilling operations were responsible for six kills, agricultural wastes for four kills, oil or chemical spills for six kills and sewage for four kills. The causes of the additional seven kills were undetermined.

During 1981, 26 kills attributed to pollution were reported (See Table 18). Of the reports containing counts of dead fish, four were light, six were moderate, and seven were major. The causes of the kills were varied. Sewage (9) and wastes from oil drilling or mining operations (6) were the most frequent. The largest kill was caused by wastes from a hog feeding operation. However, the heavy kill on Clarks River below Murray, Kentucky, has the greatest potential of long term effects. This kill was attributed to chemical wastes. Subsequent investigations of the river downstream have revealed high levels of metals (iron, zinc, lead, copper, and chromium) in the sediments. Additional information on fish kills can be found in Appendix B.

Table 18

Fish Kill Summary

		1980	1981
Severity:	Light	3	4
	Moderate	7	6
	Major	10	7
	Unknown	4	9
	TOTAL	24	26
Cause:	Mining or Oil Operation	5	6
	Agricultural Operation	4	3
	Oil or Chemical Spill	5	5
	Sewage	3	9
	Unknown	7	3
	TOTAL	24	26
By River Basin:	Big Sandy	2	1
	Little Sandy	1	0
	Tygarts Creek	0	0
	Licking	7	2
	Kentucky	4	7
	Salt	2	3
	Green	4	4
	Tradewater	0	0
	Upper Cumberland	4	2
	Lower Cumberland	0	1
	Tennessee	0	2
	Ohio	0	4
	TOTAL	24	26
Approximate Number of Stream Miles Affected		53.21	74.33
Estimated Number of Fish Killed		224,163	81,266

ACID MINE DRAINAGE IMPACTS

A study completed in 1981 by the Division of Water made an assessment of the impact of coal mining on the water quality of streams in the coalfields of Kentucky. Water quality was determined to be affected by past and present coal mining activities according to the following criteria:

Parameter	Value
pH	Less than 6.0 standard units
Acidity	Greater than alkalinity
Sulfate	Greater than 60 mg/l
Total Iron	Greater than 0.5 mg/l
Total Manganese	Greater than 0.5 mg/l
Specific Conductance	Greater than 350 µS/cm @ 25°C

Current water quality data were given the most importance in determining affected streams. Sources for the most current data included the USGS Coal Hydrology Study conducted for water year 1979, Kentucky Nature Preserves Commission studies conducted in 1978 and 1979 and Division of Water studies conducted in 1978 and 1980. Where current data were not available, less current studies were used.

Table 19 is a summary of the known stream miles that are affected by coal mining activities in the major river basins within Kentucky's coalfields. It is evident from the data in Table 19 that the river basins in the western coalfield have a more serious problem with acid mine drainage (AMD) than those in the eastern coalfield. The Green River basin has the greatest number of miles of streams impacted by AMD, while the Tradewater River basin has the greatest percentage (79%) of its known affected stream miles impacted by AMD. A list of streams and the number of affected miles in each river basin is included in Appendix C.

Table 19

Summary of Stream Mileages Known to be Affected by Coal Mining Activities in Major River Basins of Kentucky

River Basin	Total Miles Affected	Miles Affected by Acid Mine Drainage
Western Coalfield		
Tradewater	309.9	244.1
Green	538.6	271.2
Lower Ohio	60.4	16.0
Eastern Coalfield		
Kentucky	673.0	18.5
Upper Cumberland	667.2	27.3
Big Sandy	749.4	31.3
Little Sandy	48.6	0
Licking	38.9	0

Problems Associated with Streams Affected by Coal Mining Activities

The major problems in the affected streams are associated with violations of Kentucky's water quality standards. The water uses most susceptible to impairment are aquatic life and domestic water supply. Specific numerical criteria most likely to be violated are alkalinity, pH, and total iron for aquatic life and total manganese, total sulfate, and total dissolved solids for domestic water supply (see Table 20).

Table 20
Numerical Water Quality Criteria Most
Likely to be Violated by Coal Mining Activities

Maximum Levels Not to be Exceeded			
Aquatic Life Criteria		Domestic Water Supply Criteria	
Alkalinity:	No more than 25% reduction of natural alkalinity*	Total Manganese:	.05 mg/l
pH:	6.0 - 9.0	Total Sulfate:	250 mg/l
Total Iron:	1 mg/l**	Total Dissolved Solids:	750 mg/l

*If natural alkalinity is below 20 mg/l, no reduction is allowed.
**3.5 mg/l for low flow streams when it is established that aquatic life is not damaged

Another potential pollutant is suspended solids. Land disturbing activities associated with mining have a potential to release sediments into streams which can destroy aquatic habitat and smother certain forms of aquatic life. There is not a numerical criterion established for suspended solids in the Kentucky standards. As a result, a violation of the existing narrative criterion has to be dealt with on a case-by-case basis.

The following discussion addresses water quality problems associated with coal mining activities in the major river basins within the western and eastern coalfields.

Tradewater River Basin. Previous reports have stated that the major water quality problems in this area are low pH, high sulfate and total dissolved solids, and increasing sedimentation. This has led to the destruction of fish and other aquatic life and has made much of the water resource undesirable for public, industrial, or domestic use.

Present conditions indicate that the above problems have been persistent and are still the major problems in the river basin. The Tradewater River is intermittently affected by low pH. The Clear Creek sub-basin is the most seriously AMD impacted drainage in the basin. Of the total of 310 miles of streams affected by coal mining activities, 244 stream miles were affected by AMD. The Tradewater River Basin is the most severely AMD impacted basin in the Commonwealth.

Green River Basin. Acid mine drainage is a significant problem in this river basin. It has previously been reported that AMD and sedimentation were the major pollutants associated with coal mining activities.

The Pond River sub-basin has been reported to be one of the most severely impacted areas in the basin. It has been affected continuously by low pH, extreme acidity, high iron and sulfate concentrations, and high sediment loadings. At present, a total of 584 miles of streams in the Green River Basin are known to be affected by coal mining activities. AMD impacts a total of 271 miles of streams in the basin.

Lower Ohio River Basin. The major problems previously reported in this area's streams that were attributed to coal mining activity were low pH and high sulfate concentrations.

Pup Creek was previously impacted by AMD, but has now recovered except for one small unnamed tributary. The Blackford Creek sub-basin still has AMD problems, especially in Caney Creek and Butchers Branch. The other affected streams have elevated sulfate concentrations but do not generally exceed the domestic water supply criterion.

A total of 60 miles of streams are known to be affected by coal mining activities in the lower Ohio River basin. AMD impacts 16 miles of streams in the basin.

Kentucky River Basin. Previous reports have indicated that the major water pollution problems associated with coal mining activities in this area were AMD and sedimentation. Sedimentation has been reported to be a more serious problem than acidity. Coal haul roads have been a major source of the sediment.

Present water quality data indicate that acid problems are still found in the basin, but the extent is not as severe as was reported in the late 1960's. This is partly due to fewer acid producing coal seams being mined from that period to the present. Sedimentation is still a persistent problem.

A total of 673 miles of streams are known to be affected by coal mining activities in the Kentucky River basin. Present data indicates that approximately 19 miles of streams are impacted by AMD. Sedimentation, high total dissolved solids, and sulfate concentrations are a potential threat to drinking water supplies.

Upper Cumberland River Basin. Sediment has been reported to be the most extensive mining related water quality problem in the basin. AMD is a minor problem due to neutralization by naturally present alkaline materials found in the soils.

A total of 667 miles of streams are known to be affected by coal mining activities. AMD impacts 27 miles of streams in the basin.

Big Sandy River Basin. It has been reported that sedimentation is a major mining induced problem in this basin. Recreational uses have been impaired at Dewey and Fishtrap Lakes due to sedimentation and turbidity. The Levisa Fork and Tug Fork sub-basins contribute sediment loadings to the Big Sandy River which increases treatment costs to downstream domestic water supply users and increases dredging costs for channel maintenance in the lower Big Sandy navigational pool.

A total of 749 miles of streams are known to be affected by coal mining activities in the Big Sandy River basin. AMD impacts 31 miles of streams in the basin.

Little Sandy River Basin. The East Fork sub-basin is the only drainage in the basin that is known to be affected by coal mining activities. Higher than natural sulfate, total iron, and manganese concentrations have been detected. The concentrations are not high enough to adversely affect domestic water supply uses.

Approximately 49 miles of streams are known to be affected by coal mining activities in the basin. Current data indicates that AMD problems do not occur.

Licking River Basin. There is a limited amount of coal mining in this basin. Approximately 39 miles of streams are known to be affected by mining activities, largely by an increase in sulfate levels. Sedimentation has been reported to be of increasing concern. No AMD problems have been found in the basin.

Tygarts Creek Basin. A small amount of coal mining has taken place in this area. At present it appears that the streams in the basin are not adversely affected by coal mining activities.

Hazardous Wastes

The state of Kentucky screened over 105 potential uncontrolled hazardous waste sites during 1981 and early 1982. Of these, there are 25 sites in the Commonwealth that are currently being considered as potential candidate sites for Federal "Superfund" Program remedial response. These sites may present hazards to surface waters and/or groundwater.

Two major clean-up operations were funded during the current fiscal year under the "Superfund" program. These operations occurred in Bullitt County at the "Valley of the Drums" ($450,000) and near West Point at the "old Hardin County brickyard" ($300,000).

The "Valley of the Drums" was identified as a top priority hazardous waste site in EPA-Region IV and has received significant national attention. The collection and transport of drums to this site in Bullitt County near Louisville began in 1967 and continued until 1977. A survey of the area revealed approximately 17,000 drums were stored above ground and an unknown quantity of drums and liquid pits buried underground. Eventually, weather conditions deteriorated the stored drums and the contents were spilled onto the ground and contaminated Wilson Creek via surface runoff and leachate from subsurface drainage.

In 1979, Section 311(K) funds were used to relieve the environmental emergency. An intensive chemical and biological evaluation was conducted in the drum storage area and the impacted Wilson Creek drainage basin. Several organic compounds were detected in water and sediment samples, including benzene, xylene, styrene, toluene, phthalate esters, and PCB. Low concentrations of these compounds were also found in benthic organisms. A total of 142 chemical compounds were identified in various samples collected at this site. In order to relieve the emergency situation, a temporary on-site treatment system was constructed.

An intensive effort was initiated by the State to stimulate voluntary retrieval of the drums by the known generators. As a result, approximately 30% of the original liquid and solid content drums were removed. Subsequently, "Superfund" monies have been utilized for the removal of all remaining surface drums on the site. Site closure is contingent upon the implementation of the final remedial action plan to remove all buried drums and remove or contain contaminated earth.

The "old Hardin County brickyard" site had been utilized as a surface drum storage facility. No contamination of surface water or groundwater was observed from the drums stored at the brickyard. "Superfund" monies have been utilized for the removal of drums on the site resulting in the alleviation of the potential environmental hazard.

Nuclear Wastes

Effective with Executive Order 79-170, dated February 1979, the State was given responsibility to decommission the Maxey Flats Nuclear Waste Disposal Facility in Fleming County. This order was later incorporated into Chapter 211.898 of the Kentucky Revised Statutes. Since that time, the State has mounted a vigorous and positive effort to undertake this responsibility.

A short list of tasks accomplished at Maxey Flats would include : rebuilding the drainage pathways to direct rainfall off-site as quickly as possible while holding erosion to a minimum; rebuilding the trench cover to inhibit rainfall infiltration; cleaning up radioactively contaminated soil spots; installing a movable trench cover over an open waste-containing trench; eliminating an old tank farm and its pond (about 500,000 gallons); eliminating a small pond (about 500,000 gallons); eliminating a large pond (about 1,125,000 gallons); reducing evaporator sludge from 180,000 to about 80,000 gallons; and covering about 14 acres with short-lived plastic membrane to prevent rainfall infiltration into the trenches. All of these projects are directed at removing liquid from the trenches and processing the liquid by volume reduction. Also, a good deal of time and effort has been directed at preventing rainfall from entering the trenches in order to discontinue the cycle of liquid pumping, processing, and solidification. The goal is to process the existing trench liquid and prevent the entry of additional new rainfall.

The State has obtained a contract from the U.S. Nuclear Regulatory Commission to study the water flow off the site and in the valleys below. Four off-site gauging and sampling stations are maintained and two stations are maintained on-site. The contract is an attempt to correlate precipitation, evaporation, runoff, as well as radionuclide information, so that it would be applicable at other waste disposal sites. In addition to this contract, the Department for Natural Resources and Environmental Protection and the Department for Human Resources, Radiation Control Branch, analyze water and sediment samples in streams, ponds, drinking wells, and rivers surrounding Maxey Flats.

The objectives of the State in the immediate future are to provide for the installation of a durable plastic membrane to cover the trench areas, to provide for the solidification and disposal of the evaporator sludges, and to remove and process the liquid remaining in the trenches.

CHAPTER III

WATER POLLUTION CONTROL PROGRAMS

STREAM USE DESIGNATIONS

The Division of Water is responsible for classifying the waters of the Commonwealth as set forth in the state's water quality regulations (401 KAR 5:026 and 401 KAR 5:031) that were adopted as federal regulations on September 10, 1980. Waters classified under these regulations are currently designated for all legitimate uses listed in KRS 224.020(1) with the exception of domestic water supply use, which applies at the point of withdrawal. The Division's interpretation of this regulation is that, at a minimum, all streams are classified for warmwater aquatic habitat use, secondary contact recreation use, and domestic water supply use at an existing point of withdrawal.

Realizing that natural conditions, irretrievable person-induced conditions, or technological and/or economic limitations may preclude the attainment of certain water uses, the Division of Water has initiated a comprehensive statewide stream use classification and regulatory designation program. Where current criteria are found to be inappropriate, site-specific criteria will be recommended for approval by the state, EPA, and the public through the state's public hearing process.

The Division's highest priorities for the implementation of stream classification surveys correlate with the most recent Construction Grants Program priorities for POTW projects discharging into "water quality limited" stream segments. In FY 81, a methodology for recommending use designations was developed, approved by EPA-Region IV, and successfully applied on a pilot watershed-South Elkhorn Creek in the Kentucky River basin. Subsequent surveys have been completed in 12 priority stream segments.

The Division also anticipates promulgating regulations which recommend segments for outstanding resource water, coldwater aquatic habitat, and primary contact recreation designations. Under a Memorandum of Agreement with the Division of Water, the Kentucky Nature Preserves Commission (KNPC) is responsible for determining and recommending boundaries, buffer areas, values, and applicable numerical criteria for Outstanding Resource Waters. The KNPC recommendations will focus on threatened and endangered species segments, Wild Rivers segments, and segments identified under the Kentucky Nature Preserves Act.

In addition, the Stream Use Designation effort will contribute to the mandatory triennal review and revision of the State's Water Quality Standards and will serve as the guide for future permitting, compliance monitoring, and enforcment decisions of the State's water pollution control programs. It is the Division's intention to utilize 205(j) monies, when available, to support the continuation of this effort. The ultimate product will be the promulgation of surface water use designations and associated criteria for the entire state (to eventually include lakes and wetlands).

208 WATER QUALITY MANAGEMENT PROGRAM

Background

In accordance with Section 208 of the Federal Water Pollution Control Act, PL 92-500 as amended, the Division of Water of the Kentucky Department for Natural Resources and Environmental Protection was designated as the lead agency to develop a statewide plan for the control of nonpoint source (NPS) pollution. To date, a plan has been developed and was conditionally approved by Region IV of the U.S. Environmental Protection Agency (EPA). The plan, at this time, proposes a non-regulatory framework for implementing Best Management Practices to address agriculture, silviculture, and construction nonpoint sources of pollution. The portion of the plan that addresses surface mining, however, is intended to be implemented within the regulatory authority granted to the Kentucky Bureau of Surface Mining Reclamation and Enforcement through acceptance of primacy for the Federal Surface Mine Control program.

To take into account EPA's review comments on the Commonwealth's preliminary plan and additional legal requirements necessary for plan completion and full plan approval, the Commonwealth of Kentucky amended its 1980 Continuing Planning Grant in May of 1981. Since the Division of Water is still essentially in a planning mode, implementation activities have not progressed very far. The Division, however, is optimistic that substantive planning will progress and be completed within the next 12-19 months and that accelerated implementation of the plan's recommendations will occur within the next two years. The completion of planning and initiation of implementation efforts are, however, highly dependent on budget reduction and efficiency initiatives at both the state and federal levels, on legislative support (enabling legislation), and more specifically in the short-run on the availability of qualified personnel at the state level.

Impaired Use Assessment

Pertinent published and unpublished information concerning soil erosion, sedimentation, landuse and landcover practices, and their relationship to water quality has been reviewed by Division staff. Based on this review, the Division has concluded that there is a paucity of Kentucky watershed-specific information relating to these topics. The U.S. Soil Conservation Service reports pertaining to these subjects generally characterize the extent of soil erosion around the State; however, they do so only at the broad Major Land Resource Area or Technical Guide Region level. This level of data, although useful for generalizing about State conditions, is inadequate for the purpose of assigning watershed treatment priorities on the basis of impact severity (the objective of the State's assessment activity). Secondly, none of the information relates to the impairment of stream uses that results from the deposition of sediment and other nonpoint source pollutants.

To date, a revised general soils map, a 303(e) and PL 566 watershed map, and a map of sediment sources identified by the State's 121 Conservation District's have been prepared. Gross and potential erosion maps (based on calculations of the USLE with limited verification) and a landuse map are being prepared. At this juncture in time, the State is utilizing the Department for Natural Resources and Environmental Protection's Geographic Information System's existing software and hardware at a marginal investment to produce computer generated erosion hazard maps. A sediment yield map for selected Kentucky streams is to be produced by the U.S. Geological Survey and Kentucky Geological Survey.

Field reconnaissance in the context of the impaired use assessment element has yet to be undertaken. After receipt of preliminary computer map products, the Division will identify critical areas for field reconnaissance and watershed appraisal. Field work is to occur from June through December of 1982, and watershed assessment will be done in conjunction with Stream Use Designation studies of priority stream segments and watersheds.

The Kentucky Nature Preserves Commission, under a Memorandum of Agreement with the State Division of Water, has drafted an assessment document of the aquatic life impact of surface coal mining in the Western Kentucky Coal Field. The assessment document identifies high impact/high value segments for the future dedication of implementation resources. The assessment represented an intensive investigation of the aquatic biota and water quality, as well as the landuse of selected watersheds in the western coal producing region of the state. The watersheds included the Tradewater River Sub-basin, the Rough River Sub-basin, and the Ohio River tributaries in the region.

All of the State's nonpoint source assessment activities are expected to be evaluated or compared against the stream survey information being obtained through the Stream Use Designation element. In this manner, land-based erosion information can be compared against the potential or actual use impairment of the Commonwealth's streams. The State intends on using both sets of information in order to generate watershed treatment priorities and segment specific water quality based standards. This priority scheme is intended to identify watershed treatment priorities by the seriousness of erosion or sedimentation impacts against the relative value (in terms of beneficial use) of the Commonwealth's streams. Further implementation funding will then be programmed to improve heavily impacted segments where the greatest relative benefit to Kentucky's citizens will occur.

NPS Control Needs

Other activities occurring as a part of the State's 208 planning effort include preliminary development of construction and mining BMP Guideline Manuals. A construction manual has been drafted by the state's construction liaison and is currently under review.

A mining BMP manual is currently being discussed between federal and state surface mining and water quality specialists. Several BMP manuals of neighboring states and the federal OSM have been reviewed and pertinent information for Kentucky has been identified.

Regulatory/Non-regulatory Program Development

Through an MOA with the State's Division of Conservation, a construction industry liaison, with the primary responsibility of developing and implementating an education program for construction contractors and supervisors, has been hired. An informational brochure and slide tape program, which are under preparation, are currently being reviewed.

In addition to developing educational material, the State's construction liaison is expected to attend and participate in each of the upcoming Kentucky Homebuilders Association (HBA) summer meetings. A significant portion of the agenda of these meetings will be devoted to familiarizing construction contractors and supervisors throughout the state with Kentucky's voluntary nonpoint source program and on the correct planning and design of erosion and sediment controls as they pertain to the light construction and home building industry. It has been estimated by the HBA that one-half of the home builders and general contractors in Kentucky can be reached through these summer meetings. Another planned activity under the construction education program is the presentation of a construction workshop at the location of a building site incorporating Best Management Practices.

Work on the Silviculture Education Program has essentially been delayed until such time as the University of Kentucky, Department of Forestry, has a chance to review the national education package developed between EPA and U.S. Forest Service.

Phase I of the Silviculture Education Program took place in the summer of 1980. A Forestry Water Quality Workshop for Kentucky Division of Forestry personnel was held. The primary objective of the workshop was to increase participant competence in the selection of Best Management Practices needed to manage water quality during silviculture activities.

The Agriculture Education Program has begun. A Memorandum of Agreement which assigns $40,000 in continuing planning funds to the University of Kentucky, College of Agriculture, Cooperative Extension Service, has been finalized. The College of Agriculture proposes to first conduct an extensive literature search of the educational techniques, materials, and content applicable to Kentucky that have been utilized by other states to inform their respective agricultural communities about nonpoint sources of water pollution. The content of the material to be reviewed has been narrowed to livestock waste management, agrichemical use, and erosion and sediment control measures. Based on this activity, a multi-media education program consisting of a variety of education techniques and extension activities will be developed.

Demonstration and Evaluation of Best Management Practices

The Division of Water intends to cooperate with federal and state agencies and private sector associations on agriculture and silviculture Best Managment Practice demonstration projects.

The Division is actively considering demonstration projects which have the manpower and funding support of state and USDA agencies in Kentucky. Currently, two (2) silviculture and four (4) agriculture demonstrations are being pursued. These projects are also expected to positively contribute and support three essential components of the State's 208 planning and implementation: (1) education and technical assistance, (2) NPS assessment and BMP effectiveness evaluation, and (3) economic and social impacts of applied BMPs.

Municipal and Industrial Waste Treatment Needs

The State is currently revising its 20-year projections for municipal and industrial waste treatment needs as part of the current 208 Continuing Planning Process Grant. The revised projection will, however, not be complete within the FY 82 period and will, as a result, require an extension of the grant into FY 83. During the process of revising the needs inventory, the Division's 208 staff will increase the review and approval of 201 Facility Plans to assure compatibility with the 208 Areawide Waste Management Plan and to document legitimate municipal and industrial waste treatment needs.

The state annually participates with EPA and the public to develop a construction grant funding priority list for municipal wastewater treatment systems. As the inventory for total municipal and industrial wastewater treatment system needs is updated, the state priority list for municipal grants will be revised accordingly.

The state has already revised population projections for the major metropolitan areas and adjacent counties for Louisville and Cincinnati. Revised population projections for the entire state will be completed as part of the current 208 Continuing Planning Grant. The revised population projects will be compatible with 1980 census information.

Until such time as 303(e) revisions are completed, statements of municipal and industrial waste treatment needs (as well as population projections for the state, except the City of Louisville, and Boone, Kenton, and Campbell Counties), will continue to be those that were initially identified in the Division's 1975 point source 303(e) River Basin Management Plans. Those need statements are continuously updated through the Division's ongoing WLA program. The updated projections of waste treatment needs and statewide stream pollution assessments now underway are intended to contribute to the formal revision and publication of new 303(e) documents. When completed, these new documents will constitute the point source management framework portion of the entire State Water Quality Management (WQM) Plan.

Total Maximum Daily Loads

The state conducts Wasteload Allocation modeling for conventional oxygen demanding pollutants and revises the WLA process on the basis of an expanding information base. Revised velocity and reaeration equations were incorporated in the state's WLA model during 1981. Total Maximum Daily Loads have not been developed for the Commonwealth, but development will be considered through the Continuing Planning Process (CPP) provided federal 205(j) funding support can be obtained.

Dredge and Fill

The state does not currently operate or intend to operate a Kentucky managed Section 404 Dredge and Fill program. The existing program operated by the U.S. Army Corp of Engineers (COE) operates to the Commonwealth's satisfaction. The Division of Water influences this program by certifying COE permits and public notices; by reviewing EIS, FNSI, GDM, and other related environmental documents; and by recommending appropriate technological practices. Current procedures are adequate for overseeing the discharge of dredge and fill material.

CONSTRUCTION GRANTS

Kentucky's participation in the Construction Grants Program under Public Law 92-500 during the decade of the 70's was principally through the use of the priority system and the list developed as a result of implementing the system. During these years, over three hundred and thirty million dollars was appropriated for use in Kentucky. Two points that characterize Kentucky's approach to the distribution of those monies are (1) to concentrate the eligibilities on interceptor sewers and sewage treatment plants, thus, avoiding spending money on collection systems and combined sewer overflow problems; and (2) to arrange the priority list in such a way that the number of Step 1's, Step 2's, and Step 3's were staggered so that monies were authorized and appropriated to be spent in Kentucky rather than carrying large balances of unobligated funds over from year to year.

The theoretical impact of discharges from publicly-owned treatment works (POTWs) on water quality in the state is shown in Table 21. This table was developed utilizing a modified version of the Division's dissolved oxygen wasteload allocation model. Where available, 1980-81 discharge monitoring report (DMR) data was used to estimate representative pollutant loadings from POTWs. If insufficient or no DMR information was available, the Division's "facility file" description of the existing level of treatment was utilized as the basis for developing estimates of

Table 21
Theoretical Water Quality Standards Violations
Due to Discharges from Publicly-Owned
Treatment Works in Kentucky
During 1980-1981

River Basin*	Total River Miles	No. Of POTWs	Miles of Dissolved Oxygen Violations	Miles of Un-ionized Ammonia Violations
Big Sandy	959.6	13	16.9	26.9
Upper Cumberland	1748.0	22	64.0	60.9
Green River	2652.0	29	128.2	94.6
Kentucky River	2802.5	37	172.8	181.7
Licking River	1549.5	20	85.0	64.4
Little Sandy	215.7	3	0	0
Mississippi	533.9	13	66.0	45.2
Tennessee	368.1	10	45.6	30.5
Tradewater	342.8	4	29.8	17.8
Tygarts Creek	129.7	1	10.5	9.9
Salt River	1297.6	31	72.9	58.1
Lower Cumberland	656.2	11	62.9	49.7
TOTALS	13255.6	194	754.6	639.7

*Main stem of Ohio River not included

probable loadings. It was also assumed that other categories of dischargers were meeting permit requirements and that instream flow approached the 7-day 10-year low flow conditions (a valid assumption for 1980-81 in most areas in Kentucky).

This assessment (though not field verified) suggests that at least 5-6% of Kentucky's waters probably experienced oxygen depletion and elevated un-ionized ammonia levels during 1980-81 due to discharges from POTWs. This does not include impairment due to bacteriological or other toxic substances contamination. Relative to previous years' estimates, this assessment indicates that the Construction Grants Program has resulted in significant improvements in the waters of the Commonwealth.

There are 276 active construction grants (PL 92-500 projects) which have been awarded some $392,693,146 of EPA funds, including 162 Step 1 projects for nearly $15 million, 67 Step 2 projects for $27 million, 15 Step 3 projects for $314 million, and 32 Step 4 projects for almost $37.5 million, as of April 19, 1982. Over the past two years there have been 82 new projects initiated which account for nearly $76 million: 23 Step 1 projects, 21 Step 2's, 30 Step 3's, and 8 Step 4's. Appendix D lists the municipal facilities in Kentucky that during 1980-1981, as a result of the Construction Grants Program, (1) were placed in operation, (2) were under construction, (3) had a Step 3 grant bid pending, or (4) were in design.

Kentucky signed a cooperative agreement with EPA on July 27, 1980, initiating the process of assuming primary responsibility for the Construction Grants Program in the Commonwealth. Since that time, 12 of 20 functions have been executed by the Secretary of the Department and the Regional Administrator of EPA - Region IV. Of these 12, the State has achieved a 10 percent overview status on 6 of those functions.

The future of the program, as depicted by Public Law 97-117, poses a number of additional challenges and problems in Kentucky:

- Less money is available than at any point in the last ten years of the program's history.
- It is still a very long wait between the time an application is made and the point at which the sewage treatment plant actually goes into service.
- The new law provides an opportunity for additional pressures to be placed on funding combined sewer overflows and their collection systems, which would be quite disastrous to the overall interest of the Commonwealth in terms of pollution abatement.
- The innovative and alternative portion of the program is set up in such a way as to encourage small, unsophisticated communities to take on the burden of fairly sophisticated treatment technology and techniques. In many instances these facilities are

poorly maintained, and thus, pollution abatement goals are thwarted.

- The problem of timely appropriation of funds and allottment of those funds among the states precludes managing the program in the way it was intended and the way it should be managed.
- The seven options for setting aside Kentucky's roughly thirty plus million dollars anticipated annually is such that there is the opportunity for very little money to be left over to fund conventional sewage treatment facilities.
- The time it takes to go through the laborious, complex, and changing process to bring needed facilities under construction and in service is still far too long. It is anticipated, however, that Kentucky's assumption of primary responsibility and the delegation of all functions under the law will serve to cut this time down and facilitate other economies.

CHAPTER IV

SUMMARY OF STATE PROBLEMS AND NEEDS

SUMMARY AND RECOMMENDATIONS

There is a definite need for the continued support of monitoring programs to provide a sufficient data base for use in assessing water quality conditions and trends in the waters of the Commonwealth, specifically in the areas of:

- Expansion of the ambient network into watersheds with insufficient or no water quality information.
- Expansion or modification of the biological monitoring program in order to develop a broader data base. This modification could be in the form of station addition or rotation.
- Initiation of a program for the identification of toxic pollutant problems, with initial emphasis focused in areas of greatest potential human health impacts.
- Continuation of the Clean Lakes Program to the extent necessary to (1) provide Phase I and II monies needed to plan and implement lake restoration projects and (2) continue monitoring activities for the evaluation and assessment of lake quality in the state.
- Development of a more comprehensive inventory of wetlands resources in the state.
- Establishment at the state level of a comprehensive groundwater management program to quantify existing and potential problems. Components would include the development of groundwater quality standards, the creation of an adequate data base, and the integration of surface water and groundwater programs.

Certain special water quality problems should be monitored and addressed during the next two years, such as:

- The sources and extent of elevated levels of sodium and total trihalomethanes in drinking water supplies across the state.
- Localized water quality and quantity problems due to short-term water shortages.
- The potential for reclamation or restoration of waters significantly impaired by acid mine drainage.

The development and implementation of more effective Water Pollution Control Programs should be pursued in an effort to:

- Support the continuation of the stream use designation element beyond 208 funding currently assigned to the activity. When available, a portion of the 205(j) monies should be utilized to support the stream use designation effort which in turn will provide the rational basis for issuance and reissuance of NPDES permits and the development of Construction Grants priorities.
- Assess the need for revisions in Kentucky's water quality standards that more closely reflect site-specific conditions and economically attainable uses.

- Finalize and implement a 208 Water Quality Management Plan to control nonpoint and point source pollutants in the Commonwealth.
- Focus Construction Grants priorities on areas producing the most discernable and cost-effective environmental improvement.
- Redefine the appropriate institutional roles and technical contributions of the primary water pollution control activities (ambient monitoring; planning; water quality standards; permitting and construction grants, including pretreatment; and compliance assurance, including enforcement) in order to effectively address the priority needs enumerated in the previous sections.

APPENDIX

Appendix A

AMBIENT MONITORING STATIONS

	Location
Big Sandy River Basin	
01004901	Tug Fork, State Line
01004900	Tug Fork, Kermit
01020900	Levisa Fork, Pikeville
01016901	Levisa Fork, Paintsville
01015900	Paint Creek near mouth
01003900	Blaine Creek, Fallsburg
Licking River Basin	
05023900	North Fork Licking River
Kentucky River Basin	
04039900	Kentucky River, Heidelberg
04043900	Red River, Hazel Green
04020900	Kentucky River, Camp Nelson
04013900	Kentucky River above Frankfort
04012900	Kentucky River below Frankfort
04007900	Eagle Creek, Glencoe
Cumberland River Basin	
02038900	Cumberland River, Pineville
02018900	Cumberland River, Falls
02020900	Rockcastle River, Billows
02001900	Cumberland R., Burkesville
02008900	South Fork Cumberland River
Salt River Basin	
12002900	Salt River, Shepherdsville
12032900	Pond Creek, Louisville
Green River Basin	
03024902	Green River, Greensburg
03024900	Green River, Munfordville
03026900	Nolin River, White Mills
03025900	Bacon Creek, Priceville
03017901	Barren River, Bowling Green
03013900	Green River, Aberdeen
03012900	Mud River, Eplys
03007900	Rough River, Dundee
03004901	Pond River, Apex
03004900	Pond River, 85 Bridge

Appendix B

Fish Kill Summary

1980

County	Stream	Date	Miles Affected	Cause	Fish Number Killed
Allen	Buck Creek	May 3-4	0.90	Hog feeding operational wastes	9,794
Allen	Middle Fork Drakes Creek	July 18	2.52	Wastes from cattle feeding operation	20,548
Allen	Buck Creek	Aug. 11-13	Approx. 1.0	Brine from oil drilling	59,465
Barren	South Fork Beaver Creek	Sept. 29	Approx. 1.0	Unknown	301
Bell	Yellow Creek	June 30	3.6	Municipal sewage	7,220
Bell	Yellow Creek and Cumberland R.	Aug. 2	Approx. 14	Sewage	Approx. 25
Bourbon	Townsend Ck.	May 13-16	1.5	Dairy operational wastes	26,808
Bourbon	Stoner Ck.	May 30	-	Unknown	Approx. 60
Bullitt	Long Lick Ck.	Sept.9	Approx. 1.0	500 gallons of alcohol	Approx. 800 - 1,000

Appendix B continued

County	Stream	Date	Miles Affected	Cause	Fish Number Killed
Bullitt	Knob Ck.	July 12-14	2.84	Wastes from cattle feeding operation	77,000
Campbell	Licking River	Aug. 29	Approx. 2.25	Suspected Anhydrous ammonia	Approx. 500
Clay	Big Sexton Creek	July 7	5.2	Unknown	2,726
Cumberland	Wells Creek Kettle Creek	June 30	1.5	Brine from oil drilling	1,244
Greenup	Cane Creek	June 15-16	-	Unknown	Unknown
Harlan	Clover Fork	May 10	-	Unknown	Unknown
Harrison	South Fk., Licking River	Oct. 16	-	Sewage	Approx. 500
Johnson	Hood Ck. and Caudill Br.	June 18	3.0	Drainage from day-lighted deep mine	9,862
Leslie	Long Branch Ck.	Mar. 30-31	2.3	Acid drainage	5,217
Letcher	Line Fork	May 30	Approx. 3.0	Petroleum	Approx. 40
Letcher	Elkhorn Creek	June 11-12	2.6	Rock fines and silt	353

Appendix B continued

County	Stream	Date	Miles Affected	Cause	Fish Number Killed
Magoffin	State Rd. Br.	June 6	Approx. 1.0	Crude oil	Approx. 500
Nicholas	Licking River	July 28	Approx. 2.0	Unknown	Unknown
Owen	Stephens Creek	June 30	Approx. 2.0	Unknown	Approx. 500 - 1,000
Rowan	Unnamed tributary of Cave Run Lake	May 16	-	No. 2 kerosene	Unknown
			1981		
Allen	Buck Creek	July 2	2.69	Wastes from hog feeding operation	44,153
Boyd	Hoods Creek	Aug. 28	-	Unknown	-
Breathitt	Colt Fork and Twin Fork Creeks	June 17	Approx. 0.7	Limestone sediment and petroleum from oil drilling operation	-

Appendix B continued

County	Stream	Date	Miles Affected	Cause	Fish Number Killed
Bullitt	Wilson Creek	June 24	-	Wastes from hog feeding operation	-
Calloway	Bee Ck., East Fork Clarks River	Sept. 9	Approx. .5	Municipal sewage	Less than 100
Campbell	Phillips Creek	Aug. 31	Approx. .5	Municipal sewage	Approx. 30
Christian	South Fk., Little River	Sept. 9	-	Natural eutrophication	-
Fleming	Fleming Creek	Dec. 3	Approx. 2.0	Municipal sewage	Approx. 6,000
Franklin	Unnamed tributary of South Fork Benson	Sept. 21	.23	Sewage	338
Greenup	Kennedy Hollow Creek	Sept. 3	-	Municipal sewage	Approx. 3,000
Hardin	Freeman Creek	July 27	Approx. .25	Discharge from water treatment facility	Approx. 200 - 300
Harlan	Catrons Creek and Martins Fork, Cumberland River	June 24	Approx. 10	Mining wastes	-

Appendix B continued

County	Stream	Date	Miles Affected	Cause	Fish Number Killed
Harlan	Martins Fork	Aug. 24	Approx. .05	Herbicide	Approx. 75
Jefferson	Mud Creek	Aug. 24	.3	Sewage	2,537
Jefferson	Slop Ditch Creek	Jan. 25-30	-	Unknown	Approx. 200
Johnson	Frogonery Creek	June 16	Approx. 1.5	Wastes from chicken feeding operation	-
Larue	North Fork, Nolin River	Oct. 7	.91	Municipal sewage	2,745
Leslie	Cutshin Creek	July 8	Approx. 2.0	Crude oil	-
Leslie	Beech Fk. Creek	July 16	Approx. 2.0	Petroleum based chemical	Approx. 8
Madison	Otter Creek	May 4	-	Municipal sewage	Approx. 500
Marshall,	East Fork Clarks River	Dec. 30, 1980 - Jan. 14, 1981	40.95	Chemical waste	14,643

Appendix B continued

County	Stream	Date	Miles Affected	Cause	Fish Number Killed
Mason	Ohio River back-water and Cabin Creek	April 11	-	Mining sediment from limestone operation	Several hundred
Metcalfe	Lake Metcalfe	June 6	-	Unknown	-
Oldham	South Fork of Currys Fork	Nov. 3	.5	Sewage	889
Owsley	Buffalo Creek	March 13	4.75	Brine from oil drilling operation	5,548
Perry	Montgomery Creek	June 19	Approx. 4.5	Petroleum and petroleum drilling chemicals	-

Appendix C

Stream Mileages Known to be Affected by Coal Mining Activities

Name of Stream	Source[1.] of Information	Miles Affected	Acid Mine Drainage Impact
	TRADEWATER RIVER BASIN		
Tradewater River	3	109.2	*
Castleberry Creek	3	9.0	-
Unnamed tributary	2	0.8	-
Buffalo Creek	2	8.6	*
Cany Creek	2	11.3	*
Unnamed tributaries(2)	2	1.4	*
Fox Run	2	2.1	*
Unnamed tributary	2	1.0	*
Cane Run	2	3.4	*
Unnamed tributary	2	1.7	-
Copperas Creek	2	3.6	*
Unnamed tributaries(2)	2	3.3	-
Hurricane Creek	2	3.3	*
Brooks Creek	1	4.3	*
Clear Creek	2,3	25.8	*
Unnamed tributaries(2)	2	2.9	*
Sugar Creek	2	5.3	*
Richland Creek	2	7.4	-
Copper Creek	2	2.7	*
Greasy Creek	2	6.2	-
Pogue Creek	2	4.6	*
Unnamed tributaries(3)	2	1.2	*
Lamb's Creek	2	4.8	*
Unnamed tributary	2	1.6	*
Pond Creek	2	4.6	*
Unnamed tributary	2	1.3	*
Lick Creek	1,2,3	18.1	*
Unnamed tributaries(6)	2	10.2	*
Unnamed tributaries(4)	2	6.8	*
Owens Creek	2	4.1	-
Unnamed tributaries(3)	2	3.6	*

* Streams known to be continuously or periodically impacted by AMD.
\- Streams exhibiting no adverse impacts from AMD.
1. Information sources listed at the end of Appendix C.

Stream Mileages Known to be Affected
by Coal Mining Activities

Name of Stream	Source[1.] of Information	Miles Affected	Acid Mine Drainage Impact
TRADEWATER RIVER BASIN (continued)			
Whiteside Creek	2	2.8	-
Vaughn Ditch and			
Craborchard Creek	3	18.7	-
Unnamed tributaries(2)	2	3.9	-
Slover Creek	2	5.5	-
Unnamed tributary	2	2.4	*
Wynn Ditch	2	2.4	-
GREEN RIVER BASIN			
Green River near Beechgrove to Pond River	3	5.9	-
Muddy Creek	2	17.5	-
Persimmon Creek	2	2.0	-
Unnamed tributary	2	0.7	*
Mud River			
Hazel Creek	1	6.0	-
Little Hazel Creek	2	3.9	*
Jacobs Creek	1	4.8	-
Pond Creek	2,3	20.0	*
Unnamed tributaries(4)	2	10.3	*
Caney Creek	2	7.0	*
Beech Creek	2	3.4	*
Unnamed tributaries(2)	2	1.7	*
Nelson Creek	2	4.3	-
Pond River	2,3	57.0	*
Cypress Creek	2	33.3	*
Unnamed tributaries(2)	2	5.9	*
Little Cypress Ck.	1,2	10.4	*
Harris Branch	2	2.4	*
Brier Creek	2	4.7	*
Isaacs Creek	2	5.8	*
Unnamed tributary	2	2.1	*

Stream Mileages Known to be Affected
by Coal Mining Activities

Name of Stream	Source[1.] of Information	Miles Affected	Acid Mine Drainage Impact
GREEN RIVER BASIN (continued)			
Flat Creek	2	10.6	-
Unnamed tributaries(2)	2	1.7	*
Unnamed tributary to Pond River	2	2.6	-
Unnamed tributary to Pond River	2	3.4	-
Drakes Creek	2,3	20.7	*
Unnamed tributaries(8)	2	12.1	*
Pleasant Run	2	7.9	*
Unnamed tributaries(3)	2	5.2	*
Craborchard Creek	2	7.6	*
Unnamed tributary to Pond River	2	3.4	-
Thompson Creek	2	6.0	*
Unnamed tributaries(2)	2	4.3	*
West Fork Pond River	3	26.0	-
Grays Branch McFarland Creek	1	4.3	-
Long Creek to East Fork Fork Pond River	3	12.2	-
Nolin River			
Dismal Creek	1	2.3	-
Little Reedy Creek	3	12.0	-
Rough River	2	44.3	-
Muddy Creek	2,3	14.1	-
Unnamed tributary	2	2.8	*
Unnamed tributary to Pigeon Creek	2	2.7	*
Three Lick Fork	2	6.1	-
North Fork	1	7.9	-
Bens Lick Creek	2	2.6	-
Barnett Creek	3	13.4	-
North Fork	3	6.1	-
Slaty Creek	2	4.1	-
Unnamed tributary	2	2.1	*
Bull Run Creek	2	4.6	-

Stream Mileages Known to be Affected
by Coal Mining Activities

Name of Stream	Source[1.] of Information	Miles Affected	Acid Mine Drainage Impact
GREEN RIVER BASIN (continued)			
Unnamed tributary	2	0.1	-
Spur Creek	1	6.1	-
Pond Run Creek	2	4.4	-
Unnamed tributary	2	0.7	-
Lewis Creek	2,3	11.0	*
Unnamed tributaries(3)	2	2.7	*
Render Creek	2	3.3	*
Unnamed tributaries(3)	2	2.4	-
Southards Creek	2	1.8	*
Williams Creek	2+	5.3	*
Unnamed tributary to East Fork	2+	0.1	*
Buck Creek	3	11.0	-
Long Falls Creek	3	11.7	-
Brush Fork	2	4.0	-
Panther Creek	3	22.0	-
North Fork	3	18.2	-
Joes Run Creek	2	4.3	*
Unnamed tributary to South Fork	2	1.0	*
Old Panther Creek	1	8.5	-
Unnamed tributary to Flat Lick Creek	2	0.8	-
Unnamed tributary to Crooked Creek	2	0.6	*
Knoblick Creek	3	2.0	-
LOWER OHIO RIVER BASIN			
Highland Creek			
Casey Creek	3	5.5	-

Stream Mileages Known to be Affected
by Coal Mining Activities

Name of Stream	Source[1.] of Information	Miles Affected	Acid Mine Drainage Impact
LOWER OHIO RIVER BASIN (continued)			
Pup Creek			
Unnamed tributary	2	2.3	*
Blackford Creek	2	28.7	-
Unnamed tributary	2	2.8	*
Caney Creek	2	7.3	*
Unnamed tributary	2	1.3	*
Driskell Branch	2	2.4	-
Butchers Branch	2	2.3	*
Yellow Creek	2	5.8	-
South Fork	2	2.0	-
KENTUCKY RIVER BASIN			
North Fork Kentucky River			-
above Hazard, KY	3,6	65.2	
Yonts Fork	6	4.4	-
Boone Fork	6	2.4	-
Wright Fork	6	4.7	-
Millstone Creek	6	4.6	-
Smoot Creek	6	7.4	*
Rockhouse Creek	1,3,6	24.2	-
Camp Branch	1	4.6	-
Leatherwood Creek	3	12.0	-
Clover Fork	1	3.8	-
Right Fork Maces Creek	3	7.1	-
Carr Fork	4,6	27.1	-
Little Carr Fork	1	4.8	-
Irishman Creek	6	4.0	*
North Fork Kentucky River			
above Jackson, KY	3	52.5	-
Upper Second Creek	1	4.4	-
Lotts Creek	3	13.1	-
Big Creek	3	8.9	-
Big Willard Creek	1	4.3	-
Grapevine Creek	3	8.4	-
Troublesome Creek	3,4	31.5	-
Clear Creek	1	5.1	-
Balls Fork	3	19.4	-
Buckhorn Creek	3	13.9	-
Lost Creek	1,3	18.7	-
South Fork Quicksand Ck.	3,7	15.1	-

Stream Mileages Known to be Affected
by Coal Mining Activities

Name of Stream	Source[1.] of Information	Miles Affected	Acid Mine Drainage Impact
	KENTUCKY RIVER BASIN (continued)		
North Fork Quicksand Ck.			
Spring Fork	3,7	17.8	-
Middle Fork	3	18.6	-
Beech Fork	3	14.4	-
Rockhouse Creek	3	8.5	-
Cutshin Creek	3,4	26.6	-
Polls Creek	1	4.9	-
Wooton Creek	1	6.8	-
Squabble Creek	4	6.8	-
South Fork			
Red Bird River	1,3	87.7	-
Upper Jacks Creek	1	4.1	-
Big Creek	3	4.3	-
Bobs Fork	1	3.2	-
Ulysses Creek	1	3.6	-
Goose Creek	3,4	21.7	-
Horse Creek	6	5.5	*
Little Goose Creek	1,6	14.6	-
Urban Fork	1	1.9	-
Grays Fork	1	4.7	-
Rader Creek	1	8.4	-
Sexton Creek	3	22.5	-
Huckleberry Branch	10	1.6	*
Buck Creek	4	7.6	-
Little Sturgeon Creek	1	5.6	-
	UPPER CUMBERLAND RIVER BASIN		
Poor Fork	1,3	41.7	-
Franks Creek	1	4.7	-
Colliers Creek	4	3.8	-
Looney Creek	6	8.9	-
Clover Fork	1,3	34.0	-
Yocum Creek	1	7.5	-
Martins Fork	3,6	7.1	-
Cranks Creek	4	13.0	-
Crummines Creek	1	6.4	-

Stream Mileages Known to be Affected
by Coal Mining Activities

Name of Stream	Source[1.] of Information	Miles Affected	Acid Mine Drainage Impact
UPPER CUMBERLAND RIVER BASIN (continued)			
Cumberland River above Pineville, KY	1,3	39.7	-
Wallins Creek	1	6.4	-
Puckett Creek	3	11.0	-
Brownies Creek	3	16.2	-
Yellow Creek	3,6	17.5	-
Bennetts Fork	6	6.3	-
Stoney Fork	6	8.7	*
Clear Fork	4	8.6	-
Little Clear Creek	3	7.0	-
Straight Creek	1,6	24.0	-
Left Fork	1,6	13.3	-
Cumberland River above Barbourville, KY	3	19.4	-
Stinking Creek	5	18.8	-
Middle Fork	3	7.1	-
Road Fork Creek	3	9.1	-
Brush Creek	1	13.1	-
Cumberland River above Williamsburg, KY	3	44.8	-
Big Indian Creek	1,4	15.3	-
Little Indian Creek	3	6.2	-
Four Mile Branch Little Popular Creek	3	0.9	-
Maple Creek	1	5.5	-
Patterson Creek	1	7.7	-
Rose Creek	6	2.6	-
Clear Fork	1,3	26.6	-
Laurel Fork	1	17.1	-
Cumberland River above Cumberland Falls	3	30.2	-
Watts Creek	3	12.7	-
Jellico Creek	3,6	17.9	-
Indian Creek	6	2.4	*
Jacks Creek	6	2.5	*
Marsh Creek	3,5,6	17.5	-
Barren Fork Indian Creek	1	5.3	*
Cane Creek to Laurel River	1	3.3	-
Negro Creek to Lynn Camp Creek	1	2.0	-
South Fork Rockcastle River	3	28.5	-
Raccoon Creek	1,6	7.4	-

Stream Mileages Known to be Affected
by Coal Mining Activities

Name of Stream	Source[1] of Information	Miles Affected	Acid Mine Drainage Impact
UPPER CUMBERLAND RIVER BASIN (continued)			
Gravel Lick Branch Horse Lick Creek	1	3.0	-
Woods Creek	6	5.1	-
Powder Mill Creek to Sinking Creek	1	4.6	*
Big South Fork	3,5	29.2	-
Devils Creek	1	2.4	*
Roaring Paunch Creek	1,8	1.4	*
Rock Creek	4,6	4.0	-
BIG SANDY RIVER BASIN			
Levisa Fork	3	112.0	-
Feds Creek	1	4.3	-
Lick Creek	1	4.6	-
Grapevine Creek	3	6.5	-
Russell Fork	3	16.0	-
Elkhorn Creek	1,3,4	27.4	-
Marrowbone Creek	3	11.9	-
Greasy Creek	3	7.3	-
Shelby Creek	1	27.3	-
Beefhide Creek	1	4.9	-
Long Fork	3	7.4	-
Caney Creek	1	5.8	-
Robinson Creek	3	7.8	-
Mud Creek	3	17.0	-
Toler Creek	3	6.9	-
Island Creek	1	6.7	-
Beaver Creek	3	7.0	-
Left Fork	3	27.0	*
Spurlock Creek	4	4.0	-
Right Fork	3	36.8	-
Caney Fork	3	11.4	-
Arkansas Creek	1	3.3	-
Middle Creek	9	3.6	-
Left Fork	3,9	5.3	-
Lick Fork	1	2.0	*
Johns Creek	1,3	52.1	-
Stinking Branch	1	2.3	*
Brushy Fork	1	18.5	-
Buffalo Creek	3	11.0	-
Daniels Creek	3	2.1	-

Stream Mileages Known to be Affected
by Coal Mining Activities

Name of Stream	Source[1] of Information	Miles Affected	Acid Mine Drainage Impact
	BIG SANDY RIVER BASIN (continued)		
Paint Creek			
Jenny Creek	4	10.9	-
Mudlick Creek	1	11.2	-
Toms Creek	1,3	11.4	-
Nats Creek	1	7.1	-
Left Fork	1	3.1	-
Tug Fork	3	94.0	-
Peter Creek	3	5.5	-
Left Fork	3	7.1	-
Right Fork	3	4.0	-
Pond Creek	3	14.6	-
Big Creek	1,3	16.0	-
Wolf Creek	3	20.5	-
Emily Creek	1	6.9	-
Rockcastle Creek	4	16.7	-
Middle Fork	1,3	16.4	-
Rockhouse Creek	3	17.0	-
Big Sandy River below Louisa, KY	3,9	26.8	-
	LITTLE SANDY AND LICKING RIVER BASINS		
Little Sandy River	1,3,4	30.0	-
East Fork			
Williams Creek	1,3	14.2	-
Culp Creek	1	4.4	-
Licking River	3,4	34.2	-
Big Half Mountain Creek	1	4.7	-

Sources of Information for Coalfield Stream Assessments

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Appendix D

CONSTRUCTION GRANTS SUMMARY

1980 - 1981

1. Plants in Operation

   Ashland
   Bardstown
   Campbellsville
   Cynthiana
   Danville
   Frankfort
   Greenup County Environmental Commission
   Hite Creek (Louisville MSD)
   Jeffersontown
   Madisonville
   Morehead
   Morganfield
   Mt. Sterling
   Wickliffe
   Winchester

2. Plants under Construction

   Albany
   Bowling Green
   Brandenburg
   Corbin
   Crab Orchard
   Crofton
   Fancy Farm
   Guthrie
   Harrodsburg
   Hopkinsville (2 plants)
   Jamestown
   Leitchfield
   Livermore
   Millersburg
   Nicholasville
   Nortonville
   Richmond (2 plants)

3. Step 3 Grant - Bid Pending

   Georgetown
   Lawrenceburg
   Letcher County Sanitation District No. 1
   Louisa
   Montgomery County Sanitation District #2
   Murray
   Salem
   Shepherdsville
   West Hickman (Lexington)

4. <u>Plants in Design</u>

Caneyville
Carrollton
Columbia
Drakesboro
Elizabethtown
Flemingsburg
Florence
Fordsville
Fountain Run
Hickman
Jenkins
LaGrange
Middlesboro
Midway
Milton
Mt. Vernon
New Castle
Owensboro
Princeton
Russellville
Sadieville
Scottsville
Shelbyville
Stanford
Sturgis
Town Branch (Lexington)
Waverly
West County (Louisville MSD)
Whitesville