1980

KENTUCKY

305(b)

REPORT TO CONGRESS

ON

WATER QUALITY

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VOLUME I.

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The following pages contain the Kentucky 1980 Water Quality Report to Congress, as required by Section 305(b) of the Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500, 86 Stat. 816, as ammended by the Clean Water Act of 1977, Public Law 95-217, 91 Stat. 1566, 33 USC Sec. 1315 (b). This report reflects the current interpretations of the conditions of the Commonwealth of Kentucky and the resources needed to achieve the goals of the Clean Water Act of 1977. Some of the main topics of discussion include: ambient and biological monitoring, lakes inventory, wetlands, groundwater, shellfish, drinking water supplies, point and non-point source pollution, problems and recommendations, and a chapter summary of the history of the Division of Water Quality.

This report is compiled in two volumes. Volume I is the main body containing all summaries, descriptions, and conclusions for each subject. Volume II contains the tabulated data which supports the conclusions and statements made in Volume I. The monitoring data, presented in Volume II, represents a qualitative translation of the raw data that was collected in the field. It is hoped this type of format will be most meaningful to the non-technical reader. This technical data used to develop this report is available upon request.

Of Kentucky's thirteen river basins, one has very good water quality, five have good water quality, and seven have fair water quality. (Refer to Chapter 2, Under Existing Conditions, for an explanation of these subjective water quality assessments.)

Estimated water quality trends within the basins are basically all stable with the exceptions of two reporting degradation and one improvement. The seven biological monitoring stations indicated the respective streams capable of supporting some form of aquatic life. Water quality at these seven stations varied from a clean water stream to a stream impacted heavily by surface mining. During 1979, fifteen fish kills were reported to the Division of Water Quality. Of this number, three were assessed as total kills, five as heavy, and three as moderate. The majority of the Commonwealth's seventeen major lakes have good water quality. Exceptions are mostly related to aesthetic degradation due to turbidity. The worst problems occur in the Huntington Corps of Engineers District where mining activities in two watersheds are the major contributors to excessive turbidity in the lakes.

The projected costs to meet point source treatment levels (advanced secondary and advanced wastewater) and to arrest non-point source pollution are .3 and 2.1 billion dollars respectively. Non-point source pollution assessments are continuing while the initial voluntary NPS improvement program is being implemented. The control of non-point source pollution may plan a decisive role in determining the quality of Kentucky's streams. The success or failure of point and non-point source pollution abatement programs will be affected by the amount of federal funding, and the effective management of it in Kentucky.

The main stem of the Ohio River has not been addressed in this report. The Ohio River Valley Water Sanitation Commission

(ORSANCO) has compiled a report to be used as a supplement to the 305(b) Reports submitted by the member states of the Commission. Copies of ORSANCO's 1980 305(b) Report may be obtained from the:

Ohio River Vally Water
Sanitation Commission
414 Walnut Street
Cincinnati, Ohio 45202
(513) 421-1151

Table I on river basin populations and Table 2 on the average discharge for each major river in cubic feet per second (cfs) provide the reader with an introduction of the priorities of this report: people and water. Protecting water for use by the people of Kentucky and insuring its quality for aquatic life, recreation, agriculture, and public consumption is the function of the Division of Water Quality. The following pages expand and verify this statement.

TABLE 1

RIVER BASIN POPULATIONS

Big Sandy	220,717
Upper Cumberland	342,213
Green	497,471
Kentucky	706,366
Licking	211,986
Little Sandy	59,936
Mississippi	51,550
Ohio	868,538
Tennessee	62,668
Tradewater	64,038
Tygarts	27,028
Salt	446,469
Lower Cumberland	90,112
	3,649,092

Note: Calculations based on the University of Louisville study, completed in 1979.

TABLE 2

AVERAGE DAILY FLOWS *

Big Sandy River	4,450 cfs
Upper Cumberland River	9,100 cfs
Green River	11,000 cfs
Kentucky River	7,200 cfs
Licking River	4,150 cfs
Little Sandy River	***
Mississippi River	**
Ohio River at:	
Huntington	70,000 cfs
Cincinnati	98,000 cfs
Louisville	106,000 cfs
Evansville	135,000 cfs
Metropolis	265,000 cfs
Tennessee River	64,000 cfs
Tradewater River	***
Tygarts Creek	***
Salt River	3,300 cfs
Lower Cumberland River	27,000 cfs

* Flows measured at or near the mouths of the streams.

** Kentucky contribution to the Mississippi River not available.

*** Included within the Ohio River flow.

CHAPTER I

CURRENT CONDITIONS AND RECENT TRENDS IN STREAM WATER QUALITY

AMBIENT MONITORING PROGRAMS

The Division of Water Quality's primary ambient monitoring network has been in full operation since June of 1979. The network consists of 30 stations distributed across the state as shown in Figure 1. Monthly samples are collected by the respective field office (see Figure 2) and analyzed according to the parameter list shown in Table I.

Three other agencies maintain monitoring networks in Kentucky in cooperation with the Division of Water Quality (DWQ): The Ohio River Valley Water Sanitation Commission (ORSANCO) maintains eleven main stem Ohio River stations and five major tributary stations. (For more information, refer to ORSANCO's 1980 305(b) Report.) 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 Army Corps of Engineers maintains surveillance at its fifteen major lakes in the Commonwealth. The information on Lakes Inventory contributed by the Corps is included in Chapter 2. The raw data compiled from these four programs are presented in Volume II of this report.

The DWQ is also participating in the U. S. Environmental Protection Agency's Basic Water Monitoring Program (BWMP) (see Figure I). This is a nationwide ambient monitoring network implemented in FY 78. Kentucky's commitment to the core network consists of 7 of the Division's 30 Primary Network stations and 9 from ORSANCO's 16 Kentucky stations.

MONITORING STATIONS

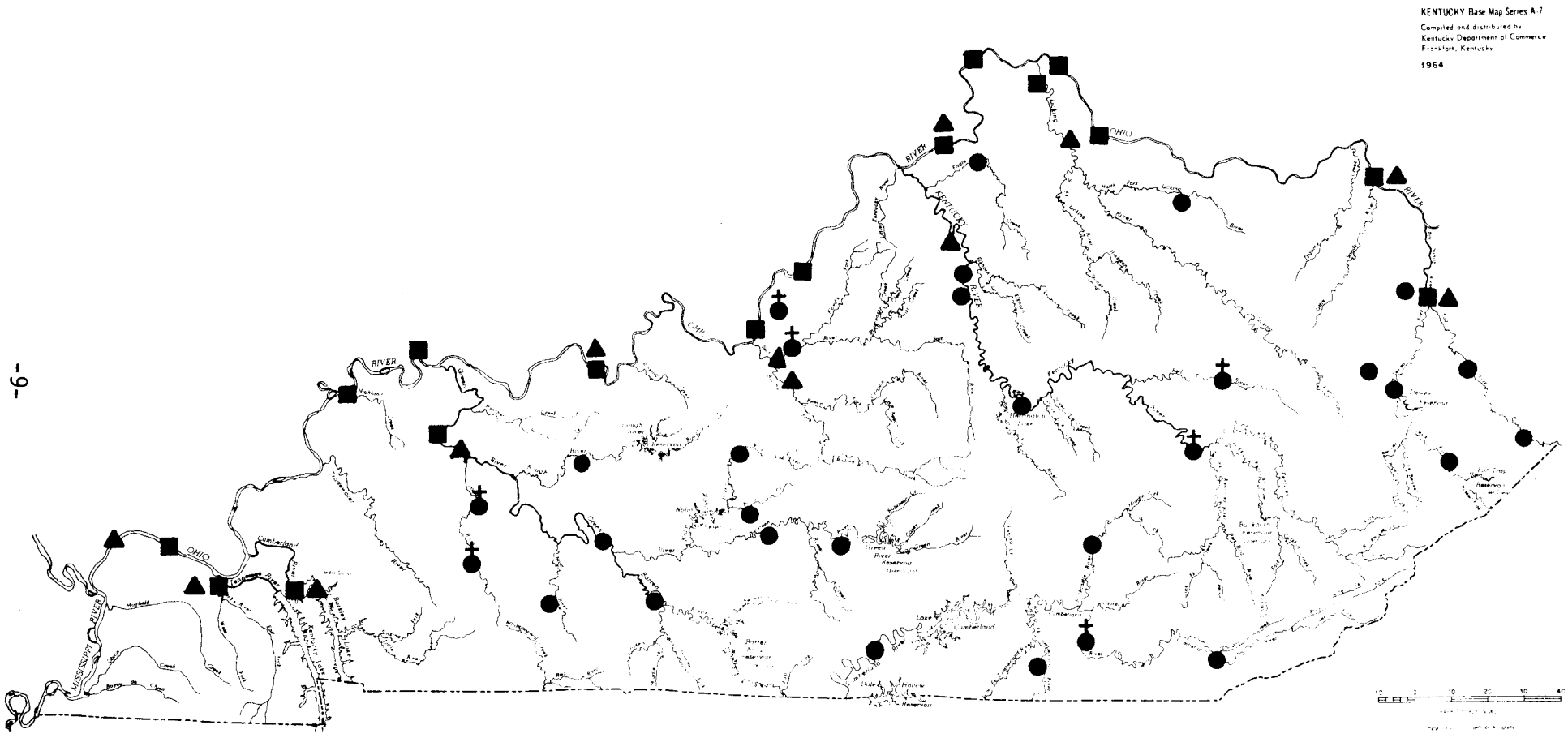


FIGURE 1

- ● DWQ Primary Network
- ■ ORSANCO Network
- ▲ USGS NASQAN Stations
- ✚● DWQ Primary Network And BWMP

FIELD OFFICE AREAS

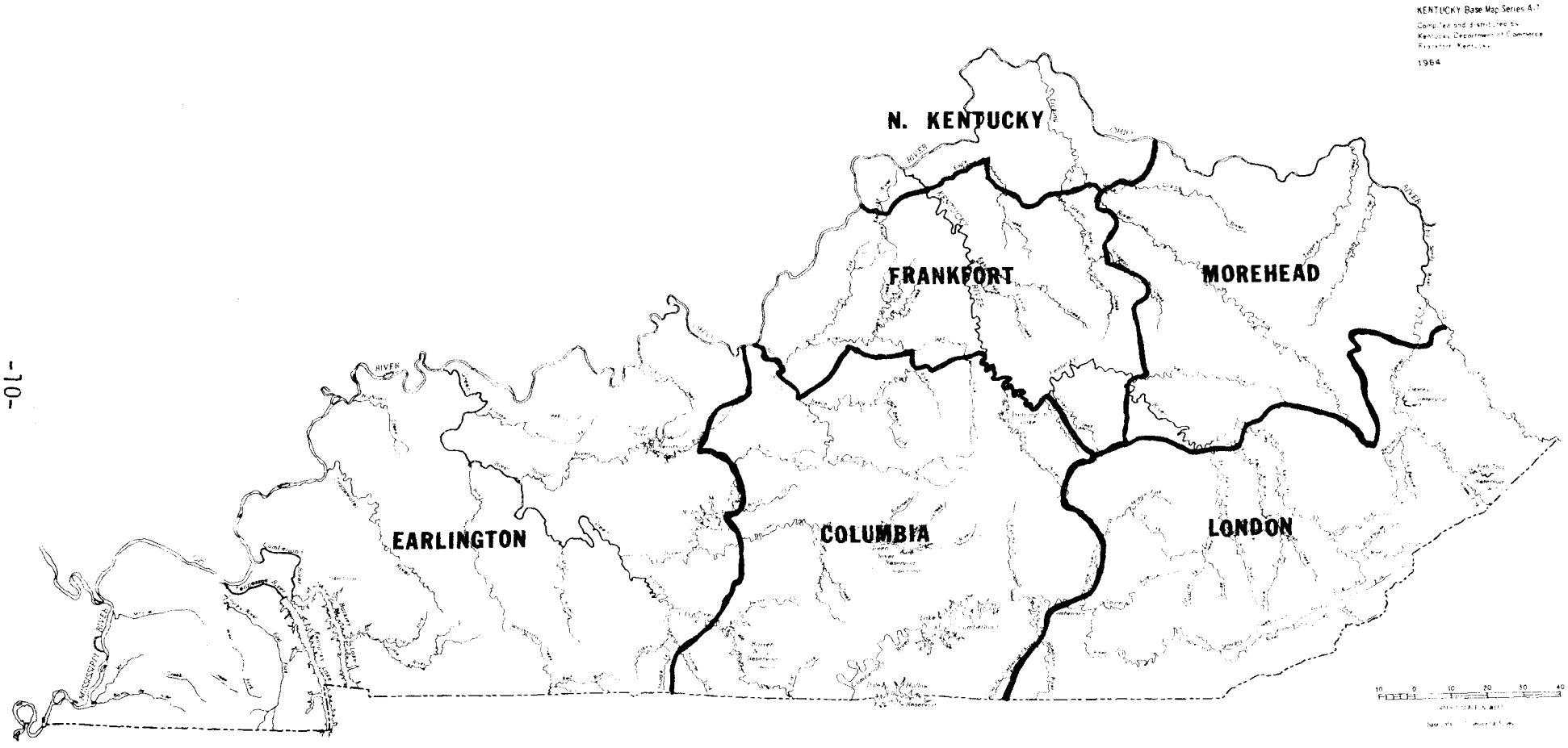


FIGURE 2

TABLE 3

MONITORING PARAMETER LIST

Lab Parameters

Acidity
Alkalinity
Hardness Total
Sulfates
Specific Conductance
Dissolved Solids
Suspended Solids
Silica, Dissolved
Chloride
Fluoride, Electrode
Arsenic, Total
Copper
Chromium, Total
Chromium, Hex
Mercury, Total
pH
BOD, 5 day/20 deg. C.
COD
TOC
TKN
NH_3-N
MBAS

Lead, Total
Turbidity
Total Phosphorus
$NO_2 + NO_3 - N$
Dissolved Cadmium
Dissolved Chromium
Dissolved Calcium
Dissolved Potassium
Dissolved Manganese
Dissolved Arsenic
Dissolved Barium
Dissolved Copper
Dissolved Iron
Dissolved Lead
Dissolved Mercury
Dissolved Nickel
Dissolved Selenium
Dissolved Silver
Dissolved Zinc
Dissolved Sodium
Dissolved Magnesium

Field Parameters

Air Temperature
Water Temperature
Field pH
Field DO
Field Conductivity
Field Turbidity

Transparency (Secchi disk)
Depth
Flow
Stage, Stream
%RB

EXISTING CONDITIONS

A general picture of the existing stream conditions in Kentucky can be formed using the monitoring data described in the Ambient Monitoring Programs section and two other sources. These consist of the intensive survey studies and the field office surveys. The intensive survey studies were implemented in FY 78 and concentrated primarily on wasteload allocation investigations and trophic assessments of lakes. Eleven studies have been conducted to date in six of the thirteen river basins. Parameter summaries are grouped under ten general categories: thermal, oxygen depletion, nutrients, bacteria, suspended solids, dissolved solids, pH, oil and grease, heavy metals, and, pesticides and toxics. The raw data are presented in Volume II of this report.

The DWQ conducted a survey among the six field offices (See Figure 2) during the months of December 1979, and January 1980. Personnel within each field office responded to the ten categories previously mentioned above. These categories were assessed as follows: degree of problem, point sources, non-point sources, and trends. Survey forms were completed for 90% of Kentucky's four hundred eighty-two 303(e) segments. In some river basins, the field office surveys were the only source of data available to the Division to assess the existing stream conditions. These data are presented in Volume II of this report.

In the following paragraphs, a brief summary of the water quality in each of the 13 river basins is presented. All

conclusions are based upon the monitoring data from the DWQ's 30 primary stations, USGS's eight tributary NASQAN stations, ORSANCO's five tributary stations, eleven intensive stream surveys, and the field office survey. General quality assessments of very good, good, and fair correspond to the number of reported Kentucky Water Quality Standards violations, as indicated by the sources of monitoring data previously listed. Any trend reporting was based on the subjective assessments of field and central office personnel.

BIG SANDY RIVER BASIN

The quality of the Big Sandy River Basin is generally fair. Few to no violations of the Kentucky Water Quality Standards (KWQS) occurred. A minor problem was reported with suspended solids. This was due primarily to point source discharges from municipalities and combined sewer overflows. There are insufficient data to determine any long term trends.

UPPER CUMBERLAND RIVER BASIN

The quality of the Upper Cumberland River Basin is generally good. Few violations of the KWQS occurred. A minor problem was reported with suspended solids levels due primarily to non-point source runoff from mining. The Laurel Reservoir intensive survey reported problems with tributary oxygen depletion and nutrient levels (localized nuisance algal blooms) due to point source municipal discharges, and non-point source agricultural loadings. The Middlesboro Yellow Creek intensive survey reported major problems of physical and chemical stress due to the Middlesboro sewage treatment plant and to tannery discharges. Data are insufficient to determine any long term trends.

GREEN RIVER BASIN

The quality of the Green River Basin is generally fair. The Barren Reservoir intensive survey indicated moderate problems with nutrient levels due to point source and non-point source contributions from Glasgow and agricultural runoff. Moderate oxygen depletion problems occurred in other segments due to point source municipal discharges and non-point source runoff from urban and agriculture areas. Moderate problems with pH occurred due to mining activities in the watershed. A survey conducted by the Earlington Field Office in 1978 revealed that numerous pH violations occurred in smaller streams due to acid mine drainage. High levels of mercury were reported in the Green River at Sebree in April, 1978 by ORSANCO. The resultant Division of Water Quality intensive survey did not verify the existence or the potential source of elevated mercury concentrations. The water quality trend is estimated as stable.

KENTUCKY RIVER BASIN

The quality of the Kentucky River Basin is generally fair. Minor problems with respect to oxygen depletion, suspended solids, bacteria, and nutrient levels were reported. These were due to point source discharges from municipalities and combined sewers, and non-point source runoff from agriculture and mining areas. The water quality trend is estimated as stable.

LICKING RIVER BASIN

The quality of the Licking River Basin is generally fair. Moderate violations of the KWQS with bacteria levels were found. This was due primarily to point source discharges from municipalities and non-point source runoff from septic tanks and agriculture. Minor problems were reported with respect to oxygen depletion, nutrient levels, and suspended solids.

These were due to the same sources listed for bacteria. The water quality trend is estimated as stable.

LITTLE SANDY RIVER BASIN

The quality of the Little Sandy River Basin is generally fair. Available data comes only from the field office survey. Major violations of the KWQS occurred with bacteria levels due to point source discharges from municipalities and non-point source runoff from agriculture and septic tanks. The water quality trend is estimated as stable.

MISSISSIPPI RIVER BASIN

The quality of the Mississippi River Basin is generally good. Available data comes only from the field office survey. Minor violations of the KWQS occurred with bacteria levels due to point source discharges from municipalities and non-point source runoff from agriculture. Moderate problems with sedimentation concentrations occurred due to non-point source runoff from agriculture. The water quality trend is estimated as stable.

OHIO RIVER BASIN

The quality of the Ohio River Basin is generally good. Water quality problems were reported from the Gunpowder Creek intensive survey with oxygen depletion, bacteria, and nutrient levels. These were due to point source discharges from municipalities and non-point source runoff from agriculture. Minor violations in bacteria levels occurred in other watersheds due primarily to point source discharges from municipalities and non-point source runoff from agriculture and urban areas. An acid mine drainage survey conducted in 1978 by the Earlington Field Office reported pH violations in the lower Ohio drainage area. The water quality trend is estimated as stable. Detailed information is available from ORSANCO's 305(b) Report.

TENNESSEE RIVER BASIN

The quality of the Tennessee River is generally very good. No violations of the KWQS were reported. The water quality trend is estimated as stable.

TRADEWATER RIVER BASIN

The quality of the Tradewater River Basin is generally fair. Available data comes from the field office survey and from an acid mine drainage survey conducted in 1978 by the Earlington Field Office. Moderate violations of the KWQS occurred in pH due to non-point source runoff from mining. There was a slight trend towards degradation.

TYGARTS CREEK BASIN

The quality of the Tygarts Creek Basin is generally fair. Available data comes only from the field office survey. Moderate problems occurred with oxygen depletion, nutrients, bacteria, suspended solids, and pH. These were due primarily to point source discharges from municipalities and combined sewers and non-point source runoff from agriculture and septic tanks. There is a slight trend towards degradation.

SALT RIVER BASIN

The quality of the Salt River Basin is generally good. The McNeely Lake intensive survey reported significant problems with oxygen depletion and nutrient levels due primarily to point source discharges from residential treatment facilities. Minior problems with oxygen depletion and nutrients were reported by the field offices in other watersheds in the basin due primarily to point source discharges from municipalities. There is a slight trend towards water quality improvement.

LOWER CUMBERLAND RIVER BASIN

The quality of the Lower Cumberland River Basin is generally good. Minor water quality problems occurred with oxygen depletion, nutrient levels, bacteria, suspended solids, and dissolved solids. These were due primarily to point source discharges from municipalities and non-point source runoff from agriculture. The water quality trend is estimated as stable.

EVALUATING WATER QUALITY TRENDS

The Division of Water Quality is unable to make any quantitative trend analysis, at this time, for the following reasons:

(1) The DWQ Primary Ambient Monitoring Network Stations have only been in full operation since June of 1979. This is insufficient time for trend analysis.

(2) Although data from the ORSANCO and the USGS NASQAN stations have been available for several years, these tributary stations are located primarily at the mouths of the major rivers. Sufficient data are not available from the headwaters to the mouths.

Although the Division of Water Quality recognizes the need for quantitative trend analysis, the Division is hesitant to make conclusions on insufficient data. Sufficient information can be collected to rank the change of point and non-point contributions to streams and to supplement our understanding of stream based information. Without an effective understanding of the total water system, trends of water quality change cannot be developed. Information available for the 1982 305(b) Report will allow complete understanding of the trends in water quality changes in Kentucky.

RIVER BASINS

01 Big Sandy River
02 Upper Cumberland River
03 Green River
04 Kentucky River
05 Licking River
06 Little Sandy River
07 Mississippi River
08 Ohio River
09 Tennessee River
10 Tradewater River
11 Tygarts Creek
12 Salt River
20 Lower Cumberland River

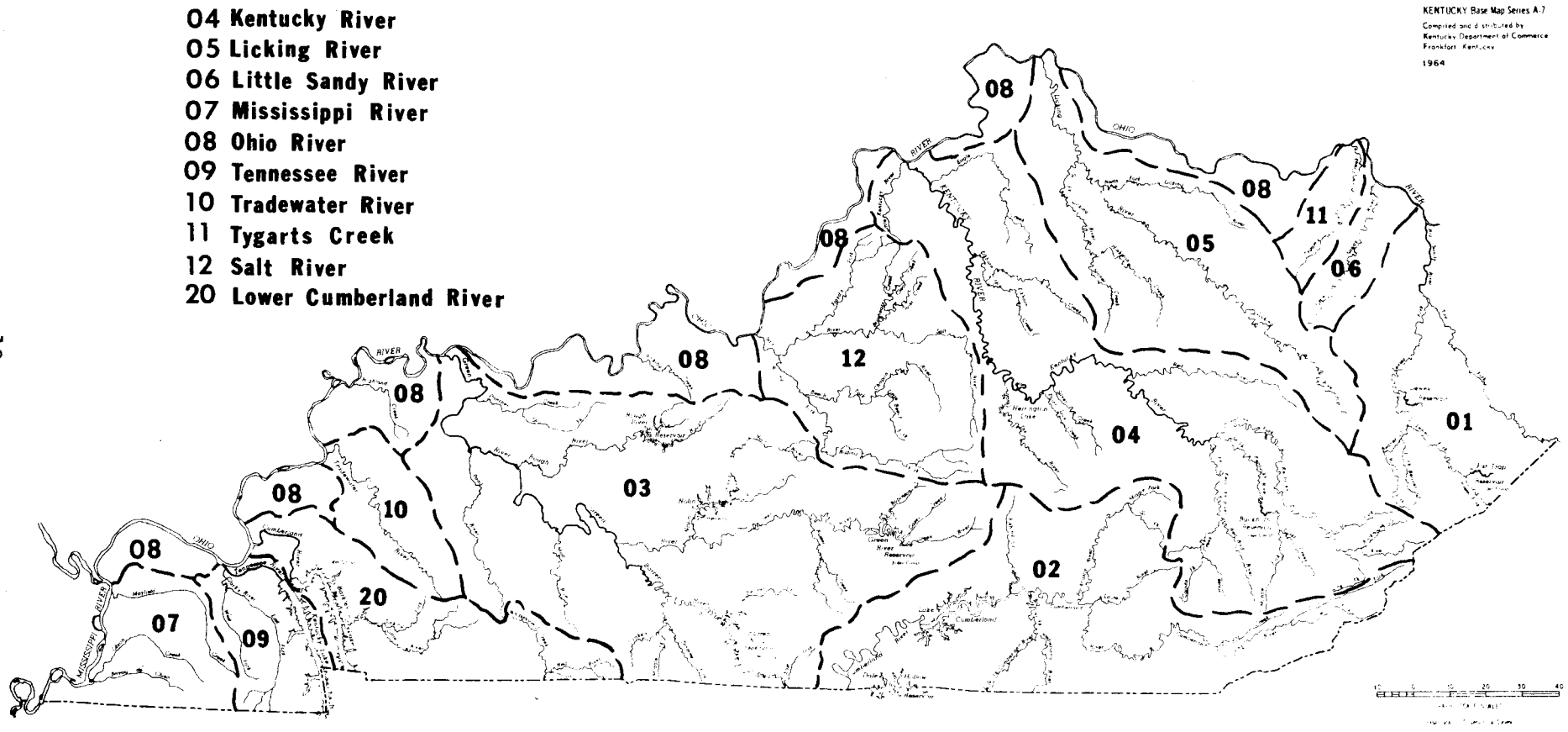


FIGURE 3

USGS HYDROLOGIC SEGMENTS

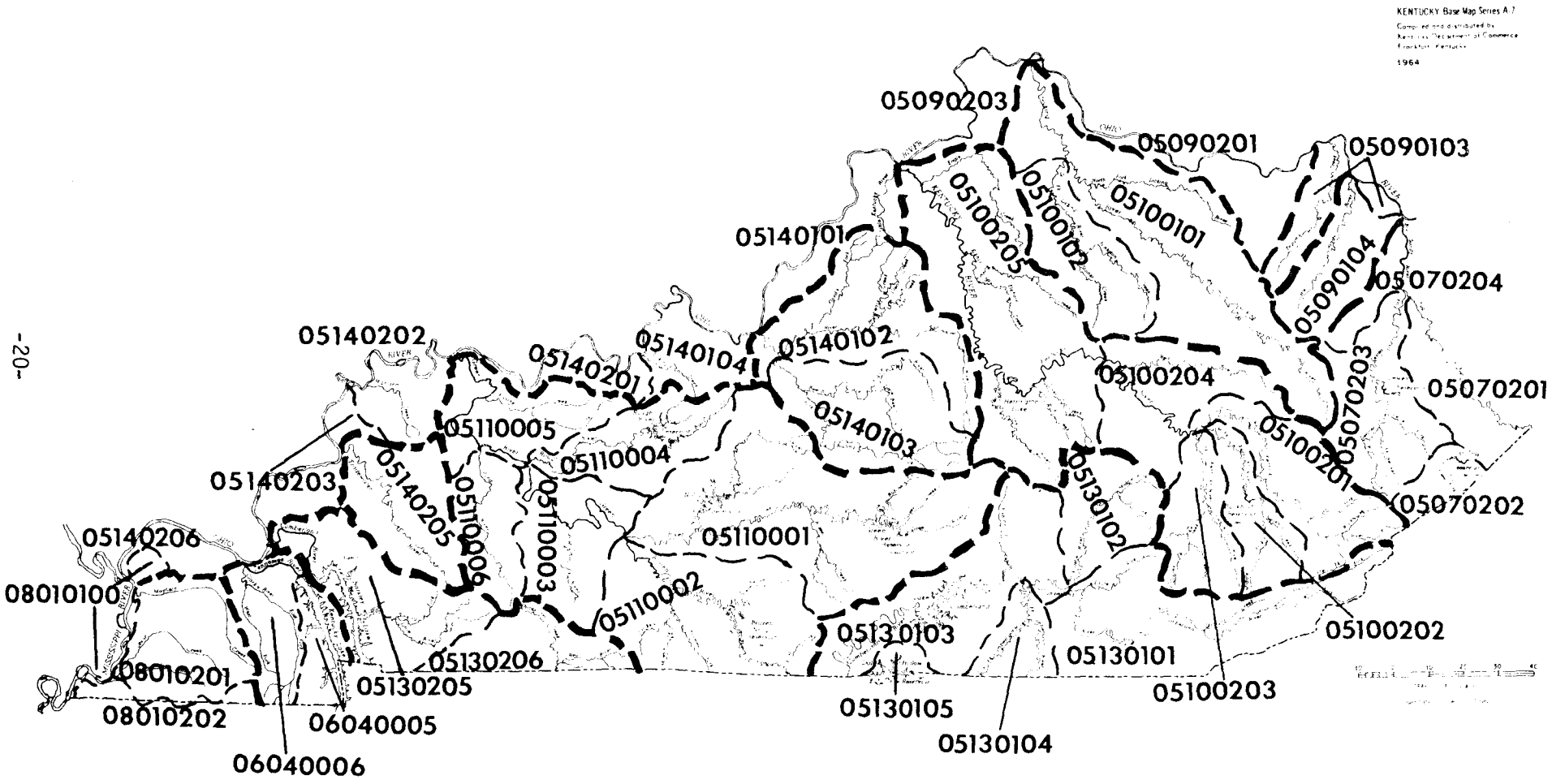


FIGURE 4

Segment Boundry

River Basin Boundry

BIOLOGICAL MONITORING

Section 106(e) of the Clean Water Act of 1972, as amended, 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 Quality developed an ambient and biological monitoring program. The main objectives of this program are to develop a baseline of biological and physiochemical data, to meet the Environmental Protection Agency's Basic Water Monitoring Program (BWMP) requirements, to detect trends in water quality, and to determine the general efficiency of pollution abatement programs.

The intent of this portion of the 305(b) report is to characterize the aquatic biota and the water quality of the seven BWMP stations in Kentucky. The period of data collection at these stations is brief. Therefore, the characterization of these stream stations depends on the biologists interpretation of data collected and streamside observations.

Generally, the water quality of the seven stations monitored ranged from a clean water stream to a stream impacted heavily by surface mining. All monitored streams were capable of supporting some form of aquatic life to some extent, but the composition and productivity of the aquatic biota were dependent on the type and severity of impact.

Glossary

Hypolimnion -	the uniformly cool and deep layer of a lake when it is thermally stratified in summer.
Macroinvertebrates -	By definition are those organisms that are retained on a U.S. Standard No. 30 sieve. This includes approximately 7 orders of insects and representatives from Decapoda and Mollusca.
Hexagenia -	A genus of burrowing mayflies.
Facultative -	organisms having a wide range of tolerance and frequently are associated with moderate levels of organic contamination.
Tolerant -	organisms frequently associated with gross organic contamination and are generally capable of thriving under anaerobic conditions.
Intolerant -	organisms that are not found associated with even moderate levels of organic contaminants and are generally intolerant of even moderate reductions in dissolved oxygen.
Nacre -	Nacreous layer, mother of pearl, innermost lustrous layer of the shell of mollusks, especially in gastropods and pelecypods; secreted by mantle epithelium.

Glossary

RMI - River Mile Index (RMI). A linear measurement of stream distance. A stream's confluence is considered the zero milepoint, and enumeration proceeds upstream to headwaters.

Stream Order - A stream classification. It is based on branching patterns as determined from topographic maps. Extreme headwaters are categorized as order I, the union of two such streams produces an order II stream, the joining of two of the latter gives rise to an order III stream, and so on.

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 Coalfield

Station Information

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

Impacts

This station has been channelized, has been cleared of trees, and is affected by surface mining and oil well operations. Agricultural practices also impact this station although probably to a lesser extent than surface and oil mining ones.

Water Quality Evaluation

Biological: This segment of Pond River supports a good assemblage of aquatic biota. Fish sampling yielded large-mouth bass, crappie, channel catfish and bowfin. While bowfin are characteristic of turbid waters with low dissolved oxygen and high temperature, the presence of game species of fish in a stream with poor habitat indicates better water quality than what might be expected. This is in agreement with the algal data which showed an above average number of species. Several unique diatom and blue-green algae were collected as well as several algal species characteristic of clean, well oxygenated waters. The macroinvertebrate species collected were generally facultative, but it should be noted that three mayfly larvae were collected here where none were collected at the downstream station (#03004901).

Chemical: Elevated levels were noted for manganese, barium, copper, lead, cadmium, chromium, and chloride. The elevated chloride values are indicative of oil drilling operations in the watershed although a corresponding increase in conductivity levels was not noted. Dissolved oxygen, pH, temperature, and alkalinity generally remained favorable for aquatic life.

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
DOWQ Map No: 9 - 50
Topo Quad Name: Heidelberg, Ky.
Physiographic Region: Eastern Coalfield

Station Information

Period of Record: 5/77 to date
Type of Sampling: Chemical & Biological
Stream Order: VI
Stream Width: 80 - 100m
Stream Depth: 2 - 5m
Stream Morphology: impounded pool
Substrate: silt & debris; limestone rock ledges

Impacts

The chief 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 (pop. 1500) is 16 miles upstream.

Water Quality Evaluation

Biological: The Kentucky River supports a fair diversity of aquatic organisms. Fish collections included bluegill, channel catfish, suckers, and minnows. The river supports a sports fishery and a limited commercial fishery. Macroinvertebrate organisms were generally comprised of facultative taxa although several species collected are somewhat sensitive. Algal collections were less diverse than many of the biological stations. The assemblage of green algae seems to indicate moderate nutrient enrichment although chemical data shows low nutrient levels.

Chemical: Elevated levels were noted for copper, mercury, lead, and cadmium. Average values for total mercury were the highest seen of the seven biological stations. Values for dissolved oxygen, pH, alkalinity, and temperature were favorable for aquatic organisms.

Green River Basin
Station #03004900
Pond River below Isaac Creek

Location

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

Station Information

Period of Record: 3/78 to date
Type of Sampling: Chemical and Biological
Stream Order: V
Stream Width: 2m (low flow), 2 miles (high flow)
Stream Depth: 0.5 - 3m (low flow), 10m+ (high flow)
Stream Morphology: riffle, pool
Substrate: sandstone bedrock, silt

Impacts

Pond River is impacted by acid mine drainage. At this station, the river flows through a wide floodplain which is inundated from late fall through spring forming a Type I periodically flooded wetland. During the summer, the floodplain is intensively cultivated.

Water Quality Evaluations

Biological: Pond River supports a poor diversity of aquatic organisms despite suitable habitat. This station produced the fewest number of algal species of any of the biological stations. Over half the species collected were indicative of acidic pH. Few green or blue-green algae were collected despite an adequate nutrient supply. Collections of macroinvertebrate organisms were limited to tolerant and facultative species. This is the only station where no mayfly larvae were collected. It is possible that toxic quantitites of heavy metals have accumulated in the sediments excluding burrowing forms such as *Hexagenia* (collected upstream at #03004901). Fish collections were not attempted due to high water conditions.

Chemical: Values for acidity, conductivity, turbidity, sulfates, dissolved solids, manganese, iron, nickel,

zinc, and magnesium were the highest seen of the seven biological stations. Elevated levels for lead, TKN, and NH_3-N were noted. Low values were recorded for alkalinity, pH, and dissolved oxygen. These values indicate severely degraded water quality. Mercury values at this station were twice what was recorded at the upstream station (#03004901)

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
DOWQ Map No: 11 - 53
Topo Quad Name: Hazel Green, Ky.
Physiographic Region: Eastern Coalfield

Station Information

Period of Record: 12/1/76 to date
Type of Sampling: Chemical & 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

Impacts

Current impacts are limited to agricultural and domestic septic tank runoff. Future impact from surface mining is possible as a permit has been issued for mining on the Lacy Creek and Gilmore Creek watersheds. An oil spill was reported on this segment on July 6, 1979.

Water Quality Evaluation

Biological: Red River supports a good assemblage of aquatic organisms. Fish collections included many top line predators and game species including three species of bass. Collections are in agreement with and exceed historical fish data. This diversity of fish, particularly in a fourth order stream, is indicative of good water quality. This is in agreement with data for macroinvertebrates. The presence of clams, stoneflies, caddisflies, and sensitive mayflies, each occupying a different niche, indicates good water quality and abundant, diverse microhabitats. The diversity of macroinvertebrates explains the good diversity of fish - much food is available. Likewise, a diverse population of algae was noted consisting of many pollution sensitive species of desmid and diatom algae. The

presence of the red alga Lemanea indicated good water quality. Blue-green and green algal species indicate low level nutrient enrichment.

Chemical: Elevated values were noted for copper, mercury, lead, and cadmium. Many parameters showed the lowest values for any of the seven biological stations. Values for dissolved oxygen, pH, temperature, and alkalinity were favorable for aquatic life.

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
DOWQ Map No: 12 - 35
Topo Quad Name: Shepherdsville, Ky.
Physiographic Region: Knobs

Station Information:

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

Impacts

This segment of the Salt River is affected by agricultural runoff and urban effluence from the upstream municipal wastewater treatment plant. An impoundment of the river at Taylorsville will be completed in the near future.

Water Quality Evaluation

Biological: Salt River has a fair assemblage of aquatic organisms. Fish collections in 1979 produced sauger and crappie while collections in 1978 yielded only "rough" fish such as buffalo and carpsucker. Many of the macroinvertebrate organisms collected are considered facultative to tolerant; however, the burrowing mayfly, *Potamanthus*, was collected only at this station. Algal collections indicated nutrient enrichment and elevated conductivity levels. While algal species diversity was above average, most forms collected were either tolerant or facultative to pollution.

Chemical: Values for copper, mercury, lead, cadmium, and iron were elevated. Nutrient values were elevated except for ammonia nitrogen which were low. Above average values were noted for conductivity, dissolved solids, suspended solids, chlorides, BOD and COD. Dissolved oxygen, pH, temperature, and alkalinity generally remained favorable for aquatic life.

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)
DOWQ Map No: 13 - 34
Topo Quad Name: Valley Station, Ky.
Physiographic Region: Ohio River Alluvium

Station Information

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

Impacts

Pond Creek drains a heavily industrialized section of Jefferson County including three landfills and over 160 point source discharges. Wilson Creek, a tributary to Pond Creek, is the stream impacted by the infamous Valley of the Drums. The watershed is 88% industrial and urban.

Water Quality Evaluation

Biological: Pond Creek supports a poor assemblage of aquatic organisms. Fish collections were limited to sunfish and minnows while collections of macroinvertebrate organisms produced only tolerant forms. Algal collections indicated severe nutrient enrichment and high conductivity levels. The potential for nuisance algal growth is high, particularly during low flow periods.

Limiting factors to aquatic life include poor habitat and degraded water quality. Much of Pond Creek is cleared and channelized or has been in the past. Stream bottom sediments consist of clay, sand, and shale particles leaving little area for macroinvertebrate colonization. Toxic concentrations of heavy metals may be present in the sediments (water column values are elevated). Pond Creek probably once had good potential as a fish nursery for the Salt and Ohio Rivers but is now limited by water quality degredation and the physical structure of the stream.

Chemical: Values for suspended solids, BOD, COD, chlorides, fluorides, and nutrients were the highest observed of all of the biological stations. Values for chromium, lead, cadmium, zinc, and mercury are elevated. Above average values for conductivity, turbidity, and sulfates were noted.

Cumberland River Basin
Station #02018900
Cumberland River above Cumberland Falls

Location

Coordinates: 36° 50' 13"N, 84° 20' 38"W
County: Whitley/McCreary
Kentucky RMI: 58.9, 562.3
DOWQ Map No: 3 - 46
Topo Quad Name: Cumberland Falls, Ky.
Physiographic Region: Eastern Coalfields

Station Information

Period of Record: 10/77 to present
Type of Sampling: Chemical & Biological
Stream Order: VI
Stream Width: 100m
Stream Depth: 0.5 - 2m
Stream Morphology: riffle - run
Substrate: sandstone bedrock, boulders

Impacts

Cumberland River is impacted by siltation from surface mining and agricultural practices. The area is sparsely populated. The town of Williamsburg (pop. 4000) is located 18 miles upstream. A potential problem exists for the Cumberland Falls State Park water treatment plant in the form of total and dissolved lead levels in excess of the Domestic Water Supply Standards.

Water Quality Evaluation

Biological: Cumberland River supports a good diversity of aquatic organisms. While fish collections were not made in 1979, collections in 1978 produced channel catfish and spotted (Kentucky) bass. Historical data cited smallmouth bass, rock bass, sunfish, suckers, and various minnows. The diversity of game species of fish, particularily in a stream with rather limited habitat, is indicative of good water quality. Macroinvertebrate collections yielded many caddisfly and mayfly larvae despite limited microhabitat. The caddisfly genus *Neureclipsis* is listed as silt intolerant although physiochemical data shows elevated suspended and dissolved solids values at this station. Several species collected are indicative of well oxygenated waters. Algal collections yielded many unique diatom

and desmid algae indicative of clean waters. The presence of the red alga Lemanea is also indicative of this condition. The abundance of green algae collected is indicative of moderate nutrient enrichment which is confirmed by chemical data.

Chemical: Elevated values were noted for suspended solids, chromium, mercury, lead, cadmium, and total phosphorous. Average values for total phosphorous were twice what the EPA recommends as a maximum value for streams entering a lake system. Suspended solids values over 400 mg/l have a deleterious effect on benthic macroinvertebrates. Maximum values at this station were in excess of 500 mg/l. The total and dissolved lead problems for the drinking water supply at the state park has been mentioned previously. Dissolved oxygen, pH, alkalinity, and temperature values are favorable for aquatic organisms.

Fish Kills 1979

Pollution caused fish kills are investigated by the Kentucky Department of Fish and Wildlife and reported to the Division of Water Quality. During 1979, fifteen reports of fish kills were received by the Division. Of this number, three were assessed as total kills, five as heavy, three as moderate and four as light kills. Very few of the reports contained actual counts of dead fish, generally in the light category of 50-100 fish.

The causes of fish kills were varied, however, petroleum spills were the most frequent. Five kills (one-third of the total) were attributed to petroleum, either from broken pipelines or accidental spills. Of these five, one was total, three were heavy kills and one was moderate. Manure or feedlot runoff were blamed for four fish kills in 1979, only one of which was heavy. Two moderate fish kills were attributed to release of black water from coal mining operations. A light kill on Drennon Creek in Henry County was caused by release of hypolimnetic water from a water treatment plant pond.

A total fish kill in Wymers Branch (Jessamine Co) occurred when a tank truck carrying chlordane and heptachor overturned, spilling its contents.

The causes of the other two kills could not be determined due to the time elapsed between the occurrance and the investigation.

TABLE 4

REPORTED FISH KILLS IN 1979

Date	Location	Estimated Damage	Suspected Cause
March 14	Line Fork (Letcher Perry Co)	Moderate to Heavy	Petroleum
March 16	Leatherwood Creek (Perry Co)	Moderate	Mining
April 13	Johns Creek (Pike Co)	Moderate to Heavy	Mining
April 24	Farm Pond (Woodford Co)	Light	Unknown
June 26	Sinking Creek (Laurel Co)	Total	Unknown
July 15	Hinkston Creek (Bourbon Co)	Light	Manure
July 25	U. T. Cabin Creek (Lewis Co)	Heavy	Manure
August 3	Rockhouse Creek (Letcher Co)	Heavy	Petroleum
August 3	Little Leatherwood Creek (Perry Co)	Total	Petroleum
August 10	Poor Fork (Harlan Co)	Moderate	Petroleum
August 10	Drennon Creek (Henry Co)	Light	Water System
August 10	N. Fork Little River (Christian Co)	Light	Manure
August 11	Frogonery Branch (Johnson Co)	Moderate	Manure
August 27	Wymers Branch (Jessamine Co)	Total	Pesticides
Oct. 24	Wilson Creek (Bullitt/Nelson Co)	Heavy	Petroleum

Petroleum	5
Manure/ Feedlot	4
Mining	2
Water Treatment	1
Pesticides	1
Unknown	2

SHELLFISH

The freshwater mussel harvest in Kentucky for 1977 and 1978 was confined to the Ohio, Tennessee, and Green Rivers. Data provided by the Department of Fish and Wildlife Resources indicate a harvest of eighty-four tons of shells for the two years.

The shells are consumed by foreign markets (primarily Japan) and used in the manufacture of cultured pearls. It is interesting to note that only mussels in the Mississippi River drainage are used in manufacture of cultured pearls. This is due primarily to the nacre characteristics inherent to the species occurring within the drainage. These characteristics allow tiny spheres to be formed from the nacre and then implanted within the host oyster.

In recent years there has been a marked decline in the mussel fauna of Kentucky. This is due in part to the loss of suitable habitat, which can be directly related to stream impoundments. Siltation, degraded water quality, and over-harvesting have also depleted the indigenous fauna of Kentucky.

The Kentucky Nature Preserves Commission has placed a total of twenty-seven species of indigenous mussels on the endangered list. Of these, nine species are on the

Federally Endangered List with an additional seven species that are extirpated from the state and considered to be extinct. The Federally Endangered List of mussels that occur in Kentucky are listed on the following page.

TABLE 5

SHELLFISH

Federally Endangered

Mussels List for Kentucky

1. Dromus dromas - Dromdary Pearly Mussel

   Restricted to the Tennessee and Cumberland systems.

2. Epioblasma florentina - Yellow - blossom Pearly Mussels

   Cumberland River system - probably now extinct.

3. Epioblasma torulosa torulosa - Tuberculated - blossom Pearly Mussel

   Distributed in the Tennessee and Ohio River drainages.

4. Epioblasma walkeri - Tan Riffle Shell

   Tennessee and Cumberland River drainage.

5. Lampsilis orbiculata orbiculata - Pink Mucket Pearly Mussel

   Tennessee and Cumberland river system Ohio River, not collected in Kentucky in approximately thirty (30) years.

6. Plethobasus cicatricosus - No common name.

   Originally found in Tennessee River and the Ohio River.

7. Plethobasus cooperianus - Orange-footed Pimpleback Pearly Mussel; Cumberland Pigtoe

   Originally found in Cumberland, Tennessee, Ohio, Green drainages. No specimen reported in Kentucky in over thirty (30) years.

8. Pleurobema plenum - Rough Pigtoe Pearly Mussel

   Originally this species was taken in Ohio, Cumberland, and Green River systems.

9. Villosa trabalis - Cumberland Bean Pearly Mussel

   Originally reported from Cumberland river system, Rockcastle River, Buck and Beaver Creeks.

CHAPTER 2.

LAKES INVENTORY

LAKES

This section contains a summary of the water quality in the seventeen major lakes which comprise 95% of the lake surface area in the Commonwealth of Kentucky. Information on major watershed activities, the impact of these activities on water quality, and specific pollution sources is given for each of these lakes and is presented in Volume II.

In general, the lakes in the Nashville Corps of Engineers District have good water quality but exhibit some degree of lowered aesthetic quality due to excessive turbidity from nonpoint source influences and mining activity. Dale Hollow Lake has the best water quality of all of the lakes reported. The upper Laurel River Arm of Laurel Lake has poor water quality due to excessive algal growth in the summer. It is the only lake in this report that has this type of problem.

The lakes in the Louisville Corps of Engineers District have generally good water quality with fewer turbidity problems than those in the Nashville District.

The lakes in the Huntington Corps of Engineers District have the worst water quality problems in relation to lowered aesthetic quality due to excessive turbidity. Grayson Lake is an exception because its watershed has not been as disturbed by mining activities.

The other two major lakes not operated by the Corps of Engineers have good water quality with the exception of some lowered aesthetic quality in Kentucky Lake due to turbidity from nonpoint sources.

The tables in Volume II present the latest information available from the various U.S. Army Corps of Engineers Districts which responded to our request for updated assessments of water quality conditions. The summary on Kentucky Lake was partially updated by the Tennessee Valley Authority and the Herrington Lake summary by the Kentucky Department of Fish and Wildlife Resources. The trophic state of most of the lakes was assessed by data collected by the U.S. Environmental Protection Agency in their National Eutrophication Survey and, in the case of Laurel Reservoir, by an analysis of Corps of Engineers data by the Kentucky Division of Water Quality. Future efforts concerning lake water quality will be directed at developing a trophic lake inventory program for other lakes in the Commonwealth.

CHAPTER 3.

SPECIAL WATER QUALITY PROBLEMS

WETLAND STATUS

Kentucky's inventory and classification of wetlands was patterned after the U. S. Department of the Interior Fish and Wildlife Service's Circular 39. The Commonwealth's classification and inventory was conducted in the early 1950's by the Kentucky Department of Fish and Wildlife. Since that time, regional updates have taken place, but have not been compiled into a comprehensive document.

Wetlands in Kentucky occur as periodically overflowed, timbered and open areas, as permanently waterlogged wooded swamps, and as open freshwater in natural lakes and impoundments. In the early 1950's, the state had an estimated 273,000 acres of wetlands. This figure was based on wetlands which provided suitable habitat for use by waterfowl. Since that time, the most readily drainable wetlands of Kentucky were reclaimed for agriculture. The acreage of remaining wetlands appears to be decreasing with increased pressure for agricultural land.

The natural wetlands of Kentucky occur primarily in the alluvial flood plains of the Ohio and Mississippi River and along their tributaries in the Western Kentucky - Southern Indiana Sandstone-Shale area and the Gulf Coastal Plain. In the mountainous and bluegrass provinces, the natural wetlands are confined to the narrow valleys of small streams. Multiple-purpose and water supply reservoirs

have added to the acreage of wetlands. But in other areas of the state, the small size and variability of individual tracts has resulted in many of the wetland areas having not been mapped.

The wetlands in Kentucky were classified into the following eight freshwater types:

I - Seasonally flooded basins or flats

II - Inland Fresh Meadows

III - Inland shallow Fresh Marshes

IV - Inland deep Fresh Marshes

V - Inland open Freshwater

VI - Shrub swamps

VII - Wooded swamps

VIII - Bogs

Type I. Seasonally Flooded Basins or Flats

The majority of Kentucky's wetlands occur as wooded bottomland along the Mississippi and Ohio Rivers and their tributaries within the Western Kentucky-Southern Indiana Sandstone-Shale area and the Gulf Coastal Plain. The remaining Type I wetlands occur as sandbars in or along the major rivers and as scattered small wooded tracts along the upper Ohio River and other streams, in limestone solution basins, and in zones subject to inundation by multiple purpose reservoirs.

Type II. Fresh Meadows. Type III - Shallow Fresh Marshes
Type IV. Deep Fresh Marshes.

Since the bottomland overflow lakes and draw-down reservoirs are not conducive to the development of marsh vegetation, these types are restricted to farm ponds and sinks scattered throughout the region of karst topography. Usually individual marsh tracts are less than one acre in size and fewer than one-fourth of these areas inclusive of the sinks could be classified as fresh meadow or marsh.

These type of wetlands are difficult to assess in Kentucky due to the topography and any assessment is in generalized terms.

Type V. Open Freshwater

This type is represented in Kentucky by impoundments, sinks, and natural lakes. Streams, rivers, and farm ponds are excluded from the inventory. Due to their small size and seasonable nature, many water areas were not distinguishable on aerial photography and were not delineated in the inventory.

Type VI. Shrub Swamps Type VII. Wooded Swamps
Type VIII. Bogs

There is little information available for these types of wetlands.

GROUNDWATER

The Division of Water Quality has concentrated efforts in four groundwater quality related areas during the past two years. They are the Surface Impoundment Assessment, the water well drilling program, the 208 Continuing Planning Process, and the Underground Injection Control program.

On August 15, 1978, the EPA awarded the DWQ a $115,000 grant to perform a Surface Impoundment Assessment (SIA), as provided by the Safe Drinking Water Act of 1973, Public Law 93-523, (42 USC Sec. 300j-1(a)). The objectives of this assessment were to obtain and organize data on:

(1) the pollution potential (LeGrand Number) for each impoundment;

(2) existing state regulations, legislation, and programs;

(3) existing groundwater monitoring programs; and

(4) documented pollution cases involving surface impoundments.

This information has been submitted to EPA, for use in the formation of a national policy on surface impoundments.

A surface impoundment is defined as any natural topographic depression, artificial excavation,or dike arrangement which is used for the storage, treatment,or disposal of liquid wastes. Sediment control basins, storm water basins, concrete lined basins, and holding tanks are not considered as surface impoundments. Surface impoundments are basically lagoons used by wastewater treatment plants. The main conclusion of this assessment is the location of wastewater treatment lagoons will have to be reevaluated in the future.

Currently the Commonwealth of Kentucky has no water well drillers licensing program. This situation enables drillers who may be unqualified, incompetent, or negligent, to operate in Kentucky, and allows no recourse by people whose wells were drilled improperly. The National Water Well Association (NWWA), the Kentucky Water Well Association (KWWA), and the DWQ have been working together to develop regulations to control the construction of water wells, which protect both the driller and the general public.

The licensing program proposed by the KWWA would be run by a commission made up of three drillers, two hydrologists, a DWQ representative, and a Kentucky Geological Survey representative. The Commission would be authorized to publish rules and regulations as it deems reasonable and necessary to carry out the program with overview by the DWQ. Proposed areas of regulation would include: licensing, bonding, location, materials, construction standards, testing, abandonment, and logging of wells.

On July 28, 1979, EPA awarded the DWQ a $144,000 grant to begin work on an Underground Injection Control Program (UIC), as mandated under the Safe Drinking Water Act of 1973,Pub. Law 93-523, 42 USC 300j-2(b). The objectives of this program are to:

(1) identify and characterize all aquifers with a total dissolved solids (TDS) of 10,000 ppm or less, which serve as or could serve as a source of drinking water;

(2) to develop an inventory of injection wells as defined in the regulations;

(3) to assess the pollution potentials of these wells;

(4) to develop a program for permitting, inspecting, and regulating these wells; and

(5) to close all those wells which inject hazardous wastes into or above an underground source of drinking water.

An injection well is defined as a well which is drilled, dug, bored, jetted, or driven, whose depth exceeds its largest surface dimension and which is used for the emplacement of fluid by any method. The program specifically excludes all residential septic systems except for multifamily housing. Septic systems for industries are included in the program.

The DWQ has applied for, and been offered, a grant for FY 80, which would fund initial aquifer mapping. The grant requires that the Commonwealth of Kentucky accept primacy for this program. This decision is not expected to be made until June of 1980.

Currently the only agency in Kentucky that keeps records on injection wells is the Kentucky Geological Survey, which maintains records on oil and gas wells. The DWQ estimates there are 8000 oil and gas related injection wells, of which 7000 use enhanced recovery operations (where fluids are injected to the well to force oil out), and 1000 are used as saltwater disposal sites.

Problems in ground water are handled on a case-by-case basis. An example of a current problem is the Mammoth Cave area. The Hidden River Cave has odor problems due mainly to the City of Horse Cave's sewage treatment plant discharge. Because of industrial contributions, the Horse Cave plant is operating poorly. The DWQ has approached the problem through the Construction Grants and Enforcement programs. A 201 Facilities Plan and an Environmental Impact Statement have been completed. Correction of the problem is expected to take another three to five years.

Sources of data to determine the quality of Kentucky's ground water remain sparse. Other problem areas, such as the monitoring of leachate from sanitary landfills, remain unaddressed. The importance of ground water becomes evident when it is noted that one-third of all Kentuckians depend on ground water as their only source of drinking water. With the completion of the Groundwater Quality Standards in the next two years and the completion of the programs mentioned earlier in this section, the DWQ will be in a much more desirable position than at present to assess and protect the quality of the Commonwealth's groundwater.

DRINKING WATER SUPPLIES

Relatively few spills adversely affected water treatment plant intakes in 1978 and 1979. Those spills reported are illustrated in Table 7. In all cases reported in Table 7, the respective treatment plants were notified by the Division of Sanitary Engineering for possibly dangerous levels of concentration.

Table 6 illustrates the total number of reported spills, which includes the number of spills affecting water treatment plants. The Division of Water Quality's (DWQ) spill response program responded to all spills of any magnitude. Reports were compiled on a monthly basis with the most significant spills described in detail.

The most severe spill of the past two years occured on January 30, 1978, near Grayson, Kentucky. A train derailment sent ten tank cars carrying various hazardous substances off the tracks. Four of the tank cars contained acrylonitrile (ACN), of which approximately 70,000 gallons burned, leaving 40,000 gallons spilled. The spill occured approximately 700 feet from the Little Sandy River. The City of Grayson's water intake is three miles downstream from the accident scene; and water treatment was ceased immediately. The City of Greenup, located 15 miles downstream, shut down its water treatment plant the next day. The EPA, along with the DWQ and other state agencies, responded to the spill immediately and supervised the cleanup and countermeasure operations. Both water treatment plants were brought on line again on February 9th with a notice issued to inhabitants to boil all water before use.

TABLE 6

SPILLS AND BYPASSES FROM APRIL 1978 TO JANUARY 1980

FIELD OFFICE	OIL PRODUCTS	HAZARDOUS	OTHERS	BYPASSES	TOTAL
Earlington	437	16	44	43	540
Columbia	19	4	17	196	236
London	62	2	111	57	232
Morehead	85	10	38	39	172
N. Kentucky	43	8	26	235	312
Frankfort	80	10	72	143	305
TOTAL	726	50	308	713	1797

TABLE 7

SPILLS AFFECTING WATER INTAKES FROM DECEMBER 1977 TO JANUARY 1980

FIELD OFFICE	OIL PRODUCTS	HAZARDOUS	OTHERS	BYPASSES	TOTAL
Earlington	9	2	2	1	14
Columbia	2	0	1	0	3
London	14	3	11	2	30
Morehead	11	20	1	1	33
N. Kentucky	1	1	2	0	4
Frankfort	4	2	4	0	10
TOTAL	41	28	21	4	94

This policy remained in effect until April 18th, when it was rescinded by the Division of Sanitary Engineering. A private consulting firm, O. H. Materials, Inc., was hired in February to set up monitoring stations at various locations around the site. Monitoring continued until September 12, 1978, when the incident was officially closed. The incident clearly demonstrated the effectiveness of the spill response team and reaffirmed its necessity.

AREAS OF WATER DEPLETION

The Commonwealth of Kentucky had no reported violations of water quality standards due to the consumptive use of water. There are two possible problem areas in the future: the City of Lexington and various Eastern Kentucky mining communities. The watersheds may not be able to provide enough water for the use of the increasing populations in these areas. Corrective actions are well within the abilities of these individual communities.

The Division of Water Quality in cooperation with the Division of Water Resources of the Department for Natural Resources and Environmental Protection will develop mechanisms to coordinate these now independent programs which obligate stream resources. Through the use of a common information source, these divisions will be able to allocate Kentucky's water resource in the most equitable manner for the citizens being served.

CHAPTER 4.

WATER POLLUTION CONTROL PROGRAMS

POINT SOURCE POLLUTION

The total costs for meeting point source treatment levels of advanced secondary treatment (AST) and advanced wastewater treatment (AWT) are illustrated in Table 8. These costs were generated using the Division of Water Quality's wasteload allocation (WLA) file, and the 1980 Needs Survey cost curves (see Table 8). All treatment plants in the WLA file were assumed to be meeting secondary level requirements, so that the figures in Table 8 represent the costs to achieve the higher levels of AST and AWT. The AST cost curve was used for all plants with a WLA requirement in ammonia effluent concentration of less than or equal to 15 mg/l. The AWT curve was used for all plants with a WLA requirement in ammonia of less than or equal to 1 mg/l. The deduction for existing secondary treatment cost curve was used for all facilities.

The costs listed in Table 8 represent a "ballpark" estimate approximately 400 existing facilities have not been incorporated into the WLA file and these costs have been interpolated. This estimate includes only existing facilities; no facilities planned for the future were included. Table 8 represents, at the very least, the minimum costs necessary to attain AST and AWT levels.

The equations used are given in Table 9. A summary of the construction grants for each step is shown in Table 10.

TABLE 8

TOTAL COSTS FOR MEETING POINT SOURCE TREATMENT LEVELS

TYPE OF FACILITY	#STP	FLOW (mgd)	AST COSTS (10^6 dollars)	AWT COSTS (10^6 dollars)
Municipal	247	369	207	0
Industrial	101	18	8	0
Subdivision	249	14	1	0
School	368	2	11	0
Small Sewage	1229	9	33	0
Recreation Area	155	3	5	0
TOTALS	2349	415	265	0

TABLE 9

NEEDS SURVEY COST EQUATIONS

Deduction for Existing Secondary Treatment	$C = 1.79 \times 10^6 \, Q^{0.82}$
Advanced Secondary Treatment	$C = 2.76 \times 10^6 \, Q^{0.75}$
Advanced Wastewater Treatment	$C = 3.52 \times 10^5 \, Q^{1.08}$

NOTE: C = cost in January 1979 Dollars
Q = plant capacity in mgd

TABLE 10

CONSTRUCTION GRANTS SUMMARY

Step I	139 Projects
Step II	46 Projects
Step III	45 Projects
Step IV (II+III)	24 Projects
Pub. L 660 of 1948	14 Projects

Note: This is the status at the beginning of FY 80. This list includes projects that have just received a grant and/or final payment.

NON-POINT SOURCE POLLUTION

The Division of Water Quality accepted a grant from the EPA on June 10, 1976, to study and evaluate non-point sources of pollution and develop management strategies to correct them (208 Planning). The Kentucky Water Quality Management Plan (KWQMP) was generated from this study, completed, and submitted to EPA for review in December,1979. The following paragraphs will briefly summarize subjects addressed in greater detail in the KWQMP. The reader is referred to this plan, for additional information.

Non-point pollution in Kentucky is divided into six categories: agriculture, construction, mining, silviculture, septic tank malfunctions, and solid waste/litter disposal. The major pollutant, by volume, is sediment from eroding soils. Sediment affects ecological balance of receiving waters by reducing light penetration, modifying the habitat for aquatic life, stressing aquatic life, and smothering stream bottom organisms. Soil particles transported in water carry attached nutrients, organic materials, heavy metals, pathogens, and pesticides.

Estimates of gross soil erosion from cropland are illustrated in Figure 5. The dots indicate the number of acres having gross erosion rates of 5 tons or more per acre per year. At this rate

more soil is being eroded than is being replaced by natural processes. Estimates of sedimentation loads are difficult to assess for the remaining five categories. For construction activities nine areas of likely or most severe problems have been identified. These include the Louisville and Lexington areas, the Lake Barkley and Kentucky Lake regions, and the three northern Kentucky counties across the river from Cincinnati. Areas in the eastern and western coalfields with the highest mining and silviculture activity have the greatest potential for sedimentation problems. Refer to Figures 6, 7, and 8 for further details.

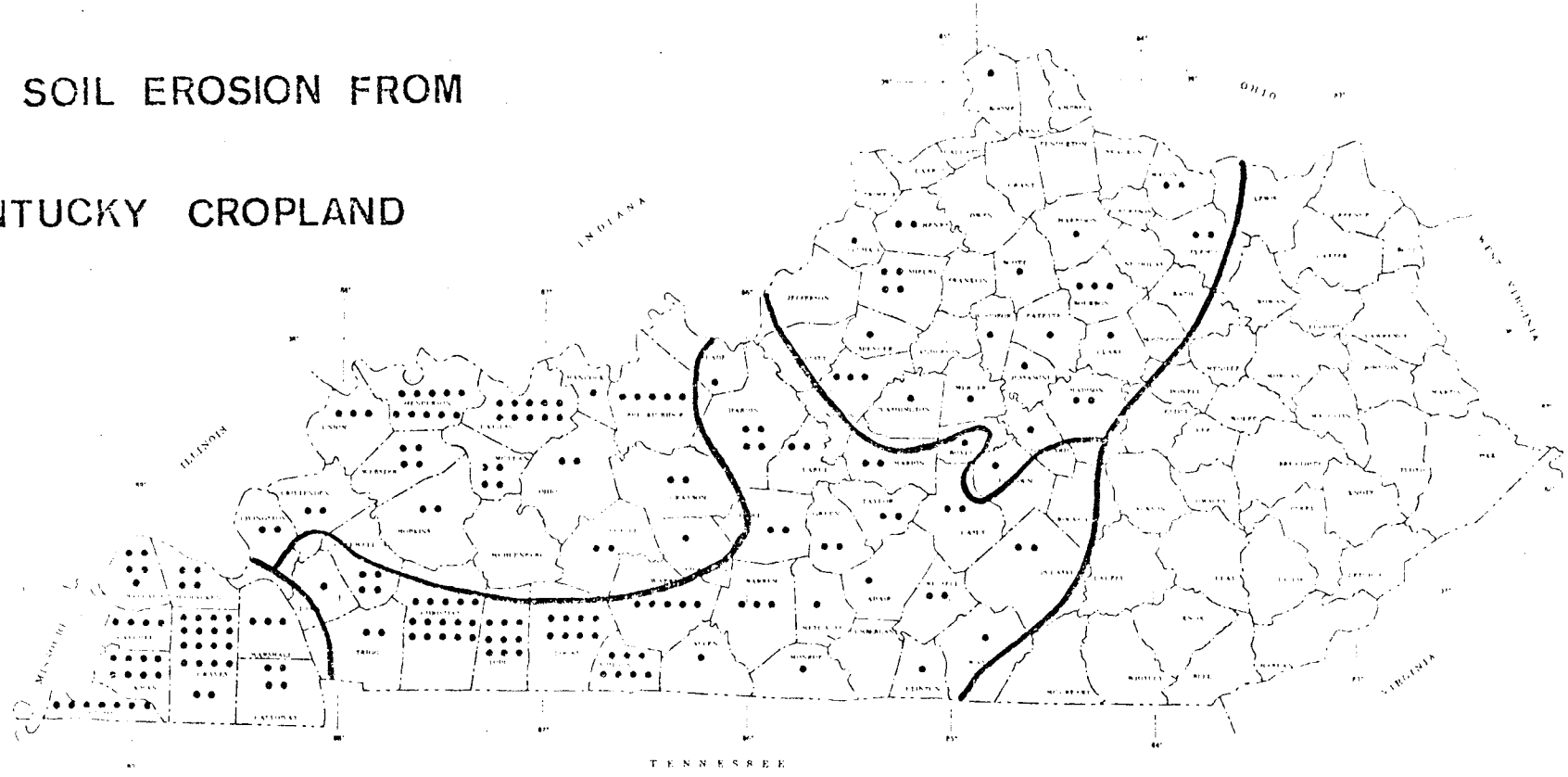
A voluntary plan for control has been proposed by the DWQ's agricultural, construction, and silvicultural task forces, which concentrate primarily on controlling sediment. It includes program development in the following areas: (1) Education, (2) Incentives, (3) Technical Assistance, (4) Agency Cooperation, (5) Evaluation of Best Management Practices Effectiveness, (6) Mechanism for Evaluating the Technical Guide Manual, and (7) Manpower and Funds Necessary for Implementation Milestones. The other categories of non-point source pollution have also been addressed using these seven programs. The reader is again referred to the WQMP for a detailed description of each program.

The costs to arrest these problems are presented in Table 11. Sources and descriptions of these cost calculations are all presented in the WQMP except for the surface and underground mines categories. These costs were calculated by the Joint National Coal Association-American Mining Congress Committee on Surface Mining Regulations and were included in the Office of Surface Mining Regulations.

All of the figures listed in Table 11 represent the best calculations possible from the available data; actual values may vary greatly.

U.S. DEPARTMENT OF AGRICULTURE

GROSS SOIL EROSION FROM KENTUCKY CROPLAND



• 5000 ACRES OF CROPLAND WITH GROSS EROSION RATE OF 5 TONS OR MORE PER ACRE ANNUALLY

208 WQMP

DIVISION OF WATER QUALITY

FIGURE 5

TABLE 11

PROJECTED COSTS TO ARREST NON-POINT SOURCE POLLUTION

Non-Point Source	Acreage	Cost($)
Agriculture		
Cropland	3,200,000	130,000,000
Grassland	870,000	76,000,000
Construction		
Commercial and Residential	66,000	10,000,000
Highway	4,000 mi.	2,400,000
Stream Banks	24,000 mi.	23,000,000
Roadbanks	2,600 mi.	2,100,000
Orphaned Lands	110,000	860,000,000
Surface Mines		
Permit Preperation	----------	47,000,000
Mine Plan Prep.	----------	1,900,000
Haul Road Upgrade	----------	31,000,000
Surface Water Diversion	----------	8,500,000
Stream Channel Diversion	----------	19,000,000
Sedimentation Pond	----------	100,000,000
Groundwater Monitoring	----------	15,000,000
Surface Water Monitoring	----------	34,000,000
Other Monitoring	----------	900,000
Underground Mines		
Permit Preperation	----------	6,000,000
Mine Plan Prep.	----------	2,700,000
Haul Road Upgrade	----------	2,500,000
Surface Water Diversion	----------	21,000,000
Stream Channel Diversion	----------	----------
Sedimentation Pond	----------	268,000,000
Groundwater Monitoring	----------	12,000,000
Surface Water Monitoring	----------	16,000,000
Other Monitoring	----------	9,000,000
Silviculture		
Woodland Grazing	440,000	35,000,000
Logging Operation	83,000	9,400,000
Wildfire	39,000	2,400,000
Septic Tank Malfunction	----------	360,000,000
Solid Waste/Litter Disposal	----------	680,000
TOTAL		2,100,000,000

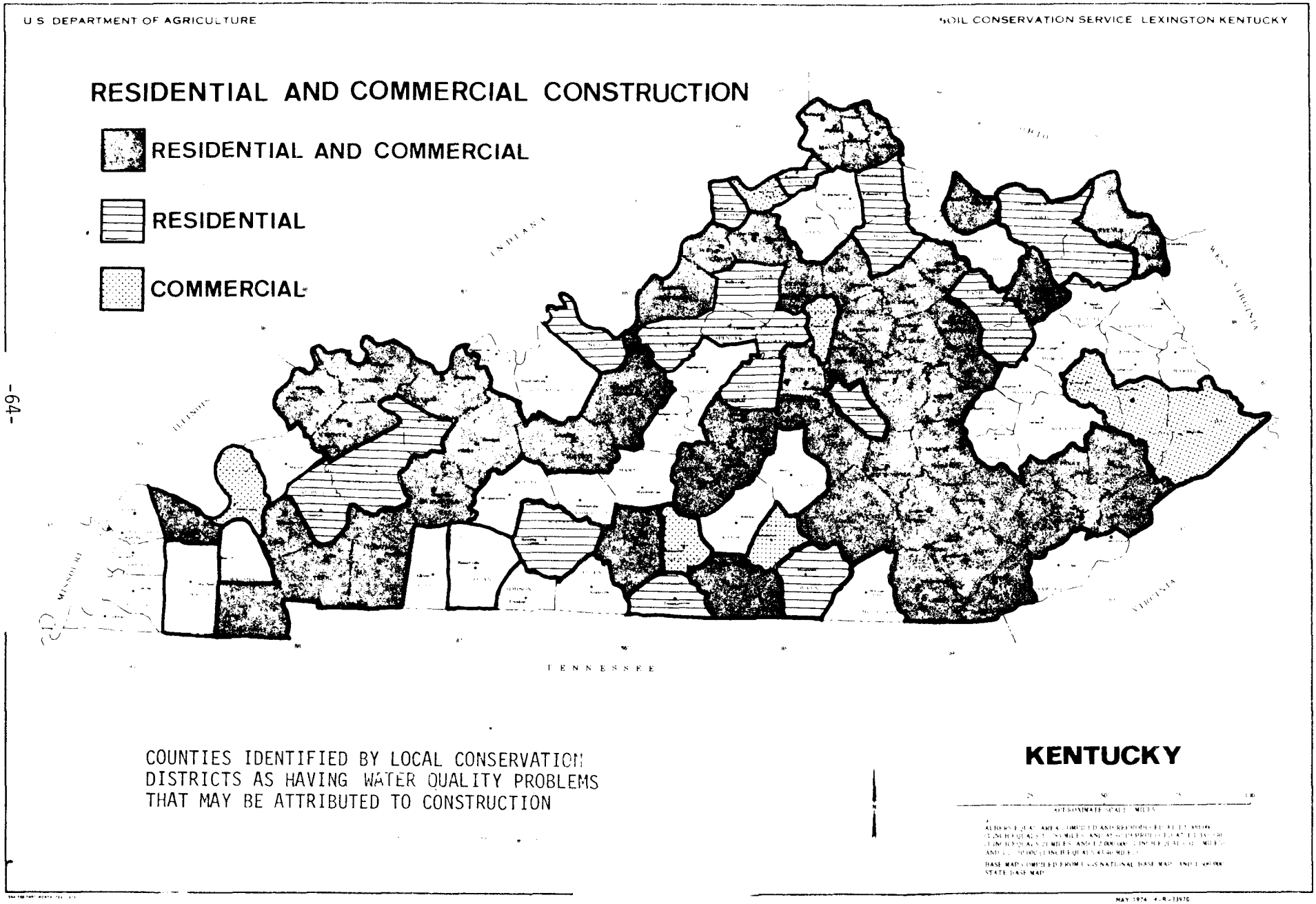

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE LEXINGTON KENTUCKY
RESIDENTIAL AND COMMERCIAL CONSTRUCTION
RESIDENTIAL AND COMMERCIAL
RESIDENTIAL
COMMERCIAL
INDIANA
ILLINOIS
MISSOURI
TENNESSEE
VIRGINIA
WEST VIRGINIA
COUNTIES IDENTIFIED BY LOCAL CONSERVATION DISTRICTS AS HAVING WATER QUALITY PROBLEMS THAT MAY BE ATTRIBUTED TO CONSTRUCTION
KENTUCKY

FIGURE 6

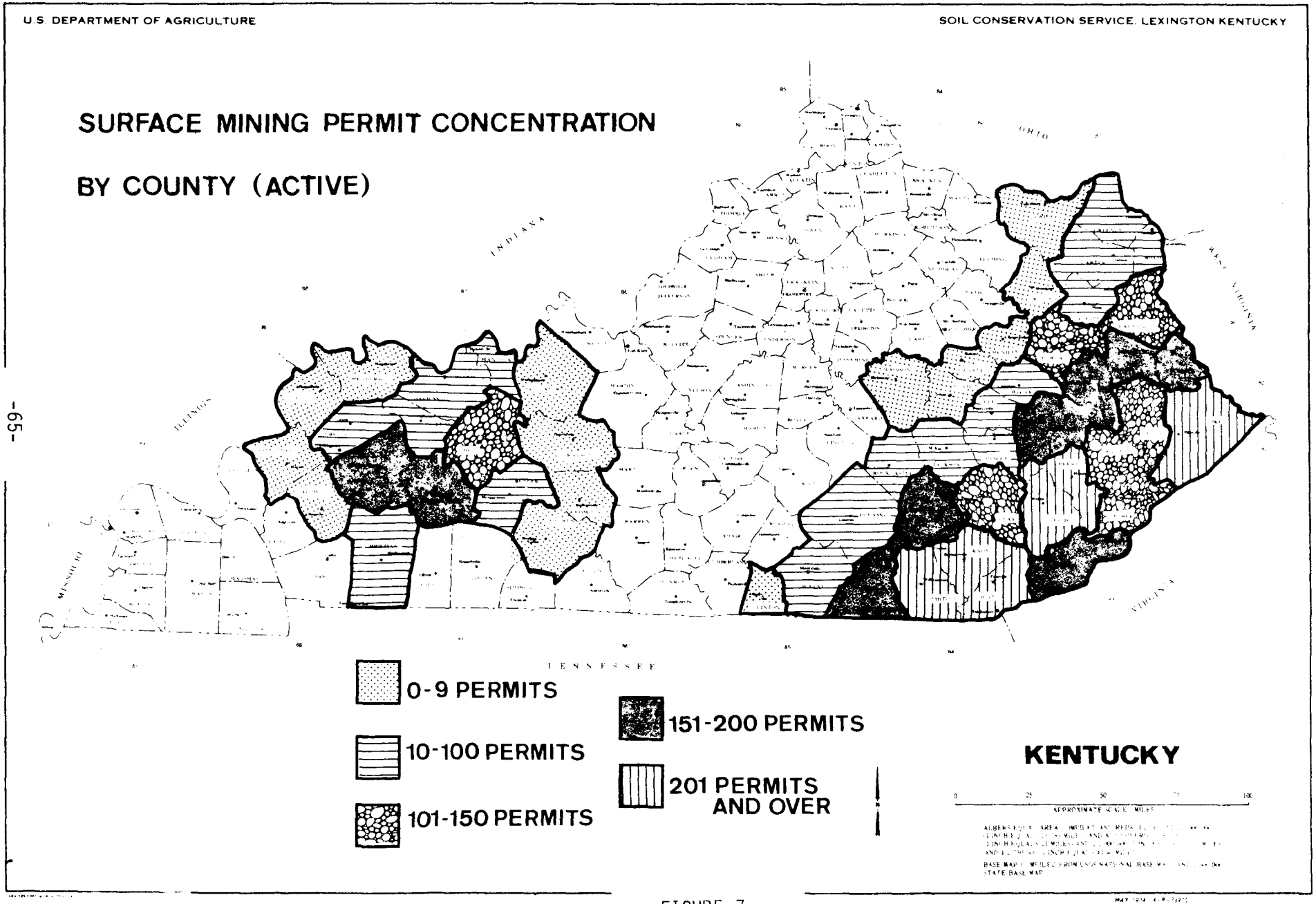

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE, LEXINGTON KENTUCKY
SURFACE MINING PERMIT CONCENTRATION
BY COUNTY (ACTIVE)
INDIANA
OHIO
ILLINOIS
MISSOURI
TENNESSEE
VIRGINIA
0-9 PERMITS
10-100 PERMITS
101-150 PERMITS
151-200 PERMITS
201 PERMITS AND OVER
KENTUCKY
APPROXIMATE SCALE MILES

FIGURE 7

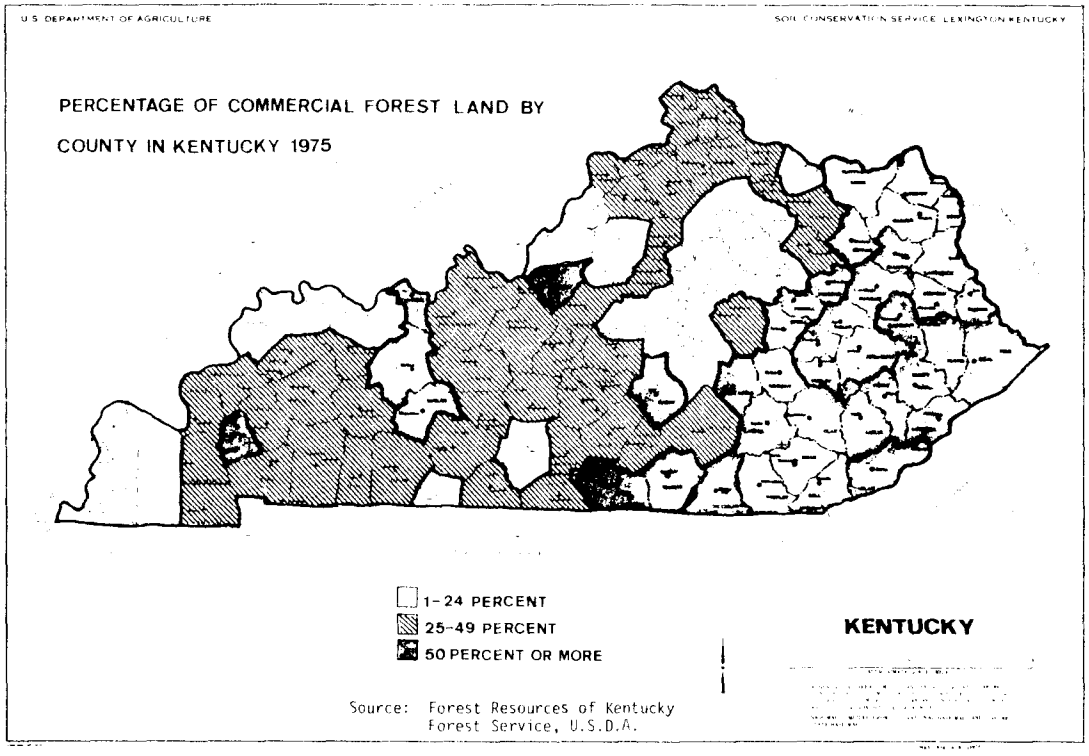

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE LEXINGTON KENTUCKY
PERCENTAGE OF COMMERCIAL FOREST LAND BY
COUNTY IN KENTUCKY 1975
1-24 PERCENT
25-49 PERCENT
50 PERCENT OR MORE
KENTUCKY
Source: Forest Resources of Kentucky
Forest Service, U.S.D.A.

FIGURE 8

DESIGNATED AREAWIDE 208 PLANNING AREAS

Kentucky participated with two designated areawide 208 planning agencies: the Kentuckiana Regional Planning and Development Agency (KIPDA), serving the Louisville - Jefferson County area, and the Ohio Kentucky Indiana Regional Council of Governments (OKI), serving the Cincinnati area. Both agencies have completed and submitted Water Quality Management Plans (WQMP) to EPA. The KIPDA plan has been conditionally approved by the Commonwealth of Kentucky and has been forwarded to the U. S. EPA for review and approval.

The KIPDA WQMP determined that all the streams and waterways in the planning area suffer from some degree of pollution occurring mainly from suspended solids and coliform bacteria. Recommended controls for non-point sources are primarily land management techniques such as: retention of buffer zones, minimization of soil disturbance during construction, use of vegetative methods or retaining walls, retention basins, and best management practices (BMP) for agricultural sites. It was recommended that the Division of Water Quality take over responsibility for continuing planning in the KIPDA area. EPA has acknowledged that responsibility.

The Water Quality Advisory Board (WQAB) was formed by the Department for Natural Resources and Environmental Protection to advise the Division of KIPDA region's water quality problems, coordinate the activities of agencies in the region, encourage communication among these agencies, serve as a focus for public education on water pollution, and set priorities for projects in the region. Present priority projects include the Floyd's Fork watershed to test the effectiveness of BMP's and a project to assess the McNeely Lake problems.

OKI has found that the main source of pollution is point source and that the control of non-point runoff should be a long term goal. BMP's were recommended for agricultural lands. Urban areas were recommended to investigate the enforcement or development of local ordinances to control sediment erosion from construction sites and to improve street sweeping practices in communities with storm sewer systems.

OKI will retain continuing planning responsibilities for its region. However, other areas of planning, such as waste load allocation, will remain the Division's responsibility. At the present time, the OKI plan has been forwarded to Governor Brown for conditional certification in Kentucky. Both Ohio and Indiana Governors have certified the OKI plan.

PROBLEMS AND RECOMMENDATIONS

The following paragraphs describe briefly the major problems, within the Nation and Kentucky water pollution control programs, and recommendations for addressing them.

PROBLEMS

The National Pollutant Discharge Elimination System (NPDES) regulations are changing at such a rapid rate so as to hinder greatly the effectiveness of the program.

An excessive amount of time is required by the U. S. Environmental Protection Agency (EPA) to review final effluent limits for municipalities seeking an advanced level of sewage treatment within the Construction Grants Program. This causes a major delay in the design process of the Sewage Treatment Program (STP).

The Construction Grants Program, as defined by Pub. L. 92-500, is a very complex and laborious system. The amount of time required to build a STP, from conception to operation, is generally five to eight years. STP's funded from the 92-500 program, which started in 1972, came on line in late 1979.

The EPA review of advanced secondary treatment (AST) and advanced wastewater treatment (AWT) levels within the Construction Grants Program is overly time consuming and has resulted in a major slowdown in the construction of STP's.

There has been a lack of appreciation of the positive role that water pollution treatment plays in the economic development in Kentucky. This has been demonstrated by the State's reluctance to assume a primacy role in the NPDES and 205(g) (Construction Grants) programs.

Alterations in the major program emphases of the Water Pollution Control Act have occurred as a result of court rulings. These court rulings appear to be at variance with the intentions set forth by the Congress in the Act.

A lack of consistency exists with water quality standards and the enforcement of them on streams that border other states. An example of this is the Ohio river.

The DWQ is lacking in key resources, money and manpower, to administer effectively the Water Pollution Control Program.

RECOMMENDATIONS

Reduce the rate at which the regulations for the NPDES are changing.

Reduce the amount of processing time required by the EPA to build a STP within the Construction Grants Program. Two possible areas for time reduction are the review of advanced secondary and advanced wastewater treatment, and the review of final effluent guidelines.

Establish consistent water quality standards and enforcement actions on streams bordering more than one state.

Approach the Water Pollution Control Program with stability and consistency.

Create a clear focus on the goals to meet the Act.

Develop a program which addresses the problems of operations and maintenance of the sewage treatment plants after they have been built and are on line.

Decentralize control and emphasize delegation of program with increased 106 funding to the states.

Reemphasize the construction of municipal sewage plants as opposed to collector systems.

CHAPTER 5.

HISTORY OF THE DIVISION OF WATER QUALITY

THE DIVISION OF WATER QUALITY: LOOKING BACK

Wastewater treatment has been in existence in Kentucky since 1911, when the first municipal sewage treatment plant became operational at Winchester. The number of treatment plants grew to 70 by 1948, when the Federal Government passed the Water Pollution Control Act, Public Law 80-845, c. 758, 62 Stat. 1155. Prior to this time there were no state or federal laws specifically governing the quality of our public waters. The 70 sewage treatment plants were built with funds provided by each individual city. Public Law 80-845 marked the first time the Federal Government became involved with the funding of sewage treatment plants by providing money for municipalities to borrow at a low interest rate (2%). The cities were limited to $250,000 or one-third of the project cost.

Kentucky had no specific agency at this time to deal with this federal program. As a result of this and the formation of the Ohio River Valley Water Sanitation Commission (ORSANCO) in 1948, certain individuals in Kentucky (among them Henry Ward, Earl Wallace, and Bruce Underwood) saw the need for an organization created specifically to handle water pollution control programs.

The Kentucky Legislature responded in 1950, by passing the Kentucky Water Pollution Control Act, 1950 Ky. Acts c. 69 This Act established the Kentucky Water Pollution Control Commission (WPCC), located in Louisville, within the Department

of Health, and housed in the Division of Sanitary Engineering. The Commission was required to meet at least once every two months. The first Commission was made up of six members including: Bruce Underwood, M.D., Commissioner of Health, Henry Ward, Commissioner of Conservation, Earl Wallace, Director of the Division of Fish and Game, A. E. Funk, Attorney General, H. D. Zimmerman, representing industry and Newton Neel, representing municipalities. The Commission was assigned personnel from the technical section within the Division of Sanitary Engineering. This technical section was responsible for carrying out the programs and policies initiated by the WPCC.

It was not until 1952 that the technical section was removed from the Division of Sanitary Engineering and the Commission authorized to employ an Executive Director and any technical people necessary to carry out the Water Pollution Control Act. The first staff consisted of eight people and had an operating budget of $5,000. The budget was expanded to approximately $25,000 in 1953, and $127,000 in 1954.

The WPCC remained at or under ten employees throughout the 1950's. Tasks consisted mainly of managing the construction loan program with the Federal Government, reviewing plans and specifications for sewer lines and sewage treatment plants, conducting any field surveys and necessary sampling, and accounting for and issuing sewage discharge permits for all cities and industries in Kentucky.

The WPCC was required, "To develop a comprehensive program for the prevention, control, and abatement of water pollution throughout the Commonwealth." The Commission responded by requiring all dischargers to have at least primary treatment and to initiate discharge permitting system. All cities were required to obtain a permit to discharge whether they had a sewage treatment plant or not. Cities which did not have treatment facilities were required to draw up a compliance schedule subject to WPCC approval.

The majority of cities at that time had no sewage treatment facilities at all. No city with direct discharge to the Ohio River had a treatment plant prior to 1950. Of those cities that had plants, the majority of them consisted only of primary treatment and the remainder usually had trickling filters.

A technological breakthrough occurred in 1953 when the first extended aeration type treatment plant became operational in Middletown, Kentucky, near Louisville. This type of plant was simple to operate and opened the door for small cities to obtain a practical and effective plant, well fitted to the needs of these communities.

The Water Pollution Control Act Amendments of 1956, Public Law 84-660 c. 518, 70 Stat. 498, popularly known as "Public Law 660", changed the Federal policy from loans to grants for building municipal sewage treatment plants and interceptor sewers. A limit of 30% or $250,000 per project was set and a minimum of primary treatment required. In FY 1957, Kentucky received $1,067,255 for projects. Funding continued throughout the rest of the 1950's at approximately the same level.

By 1958, a major oil pollution problem had developed in Green County near Greensburg. The Green River was being severely polluted by brine water that was being pumped out simultaneously with crude oil. The brine being dumped into the Green River, was creating a high chlorides concentration problem, which affected the drinking water and fish and wildlife downstream.

The WPCC responded by sending engineers to the area to study the situation and determine a practical solution. Due to the severity of the problem, WPCC personnel lived in Greensburg during the work week and set up a field office from which to work. The problem was alleviated by requiring the injection of the brine solution underground in areas that would not affect the potable groundwater supply. In order to assure compliance, numerous legal suits were filed. Countersuits also were challenging the legal authority of the Commission.

The courts decided in the Commission's favor. A staff was maintained in Greensburg to continue to monitor the situation until 1962 when the incident was officially closed.

In 1960 the WPCC moved to Frankfort, where its successor remains to this day. The 1960's were a period of growth for the Commission. The number of employees expanded to just under 20. A laboratory, responsible solely to the Commission, was equipped and in operation in 1960. Prior to this time, any chemical analysis work was done in the Health Department's lab. In 1962 two permanent field offices were established

splitting the state into two areas: the eastern and western coal fields with offices located in Harlan and Earlington, respectively. Originally, their primary concern was pollution problems created by oil drilling operations similar to the brine problems in Green County. Later, they expanded into the coal and finally into the sanitary pollution problems. They remained the only field offices within the WPCC until 1972.

The Public Law 660 construction grants program continued throughout the 1960's. Grants were increased under the Clean Water Restoration Act, Public law 89-753, 80 Stat. 1246. Grants were available to municipalities for 30%, 40%, 44%, 50%, and 55% if certain conditions were met by both the state and city involved. Kentucky's funding increased in 1962 to $1,691,578 and rose steadily in the following years to $3,843,000 in 1969.

Industry was also growing in Kentucky during this period. Responding to this in 1961, the WPCC separated the industrial program from the municipal and formed a new branch. This branch was responsible for expanding the permitting system, reviewing plans and specifications, and conducting any necessary on-site surveys.

In 1962, President Kennedy initiated an Accelerated Public Works program (APW), which made funds available to municipal areas where unemployment or underemployment was prevalent. Water pollution control was included in the eligible public works projects.

Grants were available from 50% to 75% and low interest loans available for the remaining cost. During 1962 and 1964, Kentucky received $9.2 million and built approximately 70 projects, consisting of sewage treatment plants or sewers. A great many of these projects were located in the mountain towns of eastern Kentucky. The APW and Public Law 660 programs were responsible for nearly every town receiving a sewage treatment plant and/or sewers. This was instrumental, along with the federal highway program, in opening up the eastern part of the state to economic and industrial growth as well as providing the necessary foundation for the outstanding Kentucky partk system present today.

Construction under the Public Law 660 program continued until 1972. During the 15 years this program existed (1957-1972), Kentucky received $84.3 million and built 254 projects.

The number of DWQ field offices continued to grow in the early 1970's. In 1972, the Columbia and Morehead offices were added. Frankfort and Northern Kentucky offices followed in 1973. This brought the total to six, the present number.

The Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500, 86 Stat. 816, produced many changes on both the federal and state levels. The Act was completely rewritten, in effect repealing the legislation of 1948, 1952, 1956, and 1966. The Environmental Protection Agency (EPA), which in 1970 had all Federal environmentally related programs placed within its jurisdiction, was named lead agency to carry out the Act. The minimum treatment level required to qualify for Federal funds was changed from primary to secondary. This was defined by EPA as treated effluent levels of BOD_5 at 30 mg/l and suspended solids at 30 mg/l. A National Pollutant Discharge Elimination System (NPDES) was set up requiring all treatment plants to obtain a permit.

Congress set aside $18,000,000,000 for fiscal years 1972-1977 to be made available for municipalities who applied through the construction grants program. The emphasis of this program changed from that of emphasizing construction under the Public Law 660 era to preconstruction planning. The change in policy was felt necessary in order to better achieve the goals of best practical and best available treatment in 1977 and 1983, respectively.

Kentucky responded to the Federal legislation by completely reorganizing its evironmentally related departments. In 1972, the Department for Natural Resources and Environmental Protection (DNREP) was established, 1972 Ky. Acts, 1st Ex. Secs. c. 3. Shortly thereafter, in January 1973, Executive Order 73-1 created the Division of Water Quality and the Environmental Quality Commission. The WPCC was abolished and its duties were transferred to the Division of Water Quality and the Environmental Quality Commission. The present Division of Water Quality (DWQ) was created by Executive Order 76-544 in June of 1976 to separate water resources and water quality activities.

During the first few years of 92-500, the main energies of the DWQ were concentrated in four areas: construction grants, NPDES permits and enforcement, planning assessments, and existing stream quality condition.

EPA funding under the construction grants program was increased dramatically. Appropriations to Kentucky rose from $13,625,800 in FY 1973 to $90,430,800 in FY 1976. Total money appropriated to the present time to implement Public Law 92-500 (FY 80) is approximately $390,000,000 and includes 69 Step III projects. A direct comparison of funding versus number of projects built between the Public Law 660 program ($84.3 million of 254 projects) and the 92-500 program cannot be made without considering certain major differences. Grants under 92-500 range from 75% to 85% of the project

cost where Public Law 660 ranged from 30% to 55%. The minimum level of treatment required under 92-500 is secondary versus primary under Public Law 660. Additional preconstruction planning, in the form of 201 planning Steps I and II, exists under 92-500 and not under Public Law 660. Finally, inflation rates between the two periods have been accountable for sizably increased costs.

The DWQ has maintained a discharge permitting program since the early years of the WPCC. When the NPDES program was initiated in 1972, the Division decided to continue its own permitting system. Facilities are issued DWQ operational permits as well as NPDES permits. The two permits are based upon the same criteria and are almost identical in format. Effluent limitations are determined on a case-by-case basis and are stated on each permit. Facilities are subject to enforcement actions by both the DWQ and the EPA.

One of the main consequences of the NPDES program was the requirement that all industrial dischargers provide secondary level treatment for their wastes by 1977. The DWQ had been emphasizing increased treatment levels for industries since the late 1960's. As a direct result of this, Kentucky reached this goal in 1975. This remains as a major accomplishment by the DWQ and the Permits and Enforcement Branch.

The DWQ anticipates receiving full responsibility from EPA for carrying out the NPDES program at some time in the future. When this has occurred, the two permits will be consolidated into one.

Prior to 92-500 in 1972, water quality monitoring programs among agencies in Kentucky lacked coordination and were developed on the basis of priorities set by the individual agencies. In the years that followed, the DWQ initiated efforts to consolidate these individual programs.

In June, 1974, the Kentucky Water Quality Monitoring Strategy Team composed of representatives from agencies conducting water monitoring

programs in the state, was organized. The primary goal of this group was the uniting of current and future State and Federal monitoring activities. To date, this organization has remained basically intact.

One of the principal products of the Strategy Team was the development of a primary ambient monitoring network and recommendations for a support network of secondary stations. Implementation resulted in the current primary network composed of thirty DWQ stations, sixteen ORSANCO stations, and twelve U. S. Geological Survey National Stream-Quality Accounting Network stations (NASQAN). The Army Corps of Engineers is committed to maintain monitoring at each of their fifteen major lake projects in the Commonwealth.

In December of 1975, the EPA established a Standing Work Group on Water Monitoring for the purpose of developing cost-effective water monitoring programs. This resulted in the Basic Water Monitoring Program (BWMP) being implemented in FY 78. Kentucky's commitment to the network consists of 7 of the Division's primary stations and 9 from ORSANCO's 16 stations in Kentucky. In FY 79, the Division implemented the BWMP pilot Biological Monitoring Program in conjunction with its 7 core stations.

A considerable planning effort was undertaken by DWQ starting in 1973. The Division's major concerns were concentrated in four areas: Area Development Districts, 303(e) River Basin Plans, 208 Areawide Planning, and 208 Statewide Planning.

In January of 1973, the Area Development District (ADD) planning was initiated. The Commonwealth was divided into 15 districts. Private consultants in each district were hired to perform the study. The goal of each study was to determine the water and sewer systems needed within the district to support development and still protect the environment.

The reports were completed in June of 1973. The conclusions for each district were based on inconsistent criteria so that DWQ had 15 unrelated reports to evaluate. As a result of this, DWQ and EPA rejected the reports.

Section 303(e) of the Water Pollution Control Act, 33 USC Sec. 1313(e), was designed to meet the need for a comprehensive study on the effects of treated wastewater effluent on the streams. Private consulting firms were hired to study the 10 major river basins in Kentucky. The results of these studies were published in June of 1975 and proved to play a vital role in the development of the Division. Major achievements included: a segmentation system for each river basin, the wasteload allocation system (assigns specific effluent limitations for each facility discharge), the priority list used within the construction grants program to determine which city receives grant money first creating a framework from which to organize information for planning and management, and the use of a geographic information system (ADAPT) which when complete will enable revision of water quality management plans at low cost.

The 208 Areawide Planning started in 1974. The goal was to develop a comprehensive water quality management plan for urban and industrial areas. Two locations were chosen: the greater Louisville and Cincinnati metropolitan areas. The Louisville area is the Kentuckiana Regional Planning and Development Area (KIPDA), and the Cincinnati, the Ohio Kentucky Indiana Regional Council of Governments (OKI) Area. All pollution problems were considered. The majority of the money appropriated was channeled to these two areas with a small percentage (20%) remaining for the rest of the Commonwealth.

In 1975, the program was changed to Statewide 208 Planning. The entire Commonwealth was included along with the KIPDA and OKI areas. The detailed level of study possible within KIPDA and OKI was not feasible on a statewide basis. Therefore only major pollution problems could be studied. Major areas of concern were: non-point source pollution (runoff from agriculture, surface mines, construction, and silviculture), stream standards revision methodology, and initiating a groundwater protection program.

Currently, the Division of Water Quality has approximately 125 state employees. The operational budget for FY 1980 is $3,330,077 of which $1,500,036 is Federal and $1,830,041 is State. This does not include any money within the construction grants program that goes directly from EPA to the municipality.

The Division is made up of six branches, including: the Director's office, Construction, Permits and Enforcement, Operations and Training, Programs, and Finance and Administration. Additional growth is expected through the 1980's due to EPA's delegation of the construction grants and NPDES programs to the DWQ.

The Division of Water Quality, and the Water Pollution Control Commission before it, have been in operation for nearly 30 years. Many water pollution problems have been solved and many still remain. The EPA goal of eliminating the discharge of pollutants into the nation's waters will require a massive effort by all the states in this country. Assessing the impact of non-point pollution sources and developing an effective program to deal with this problem remain priorities in Kentucky. Many cities are still in need of sewage treatment facilities and sanitary sewers. As a direct consequence of these needs and many others, the Division of Water Quality will continue to play a vital role in the development of the Commonwealth of Kentucky.

TABLE 12

Water Pollution Control Commission and Division of Water Quality Directors

F. C. Dugan	1950-1952	Director, Division of Sanitary Engineering in the Health Dept.
Louis F. Birkel	1952-June 1960	Director WPCC
Ralph C. Pickard	June 1960-Oct. 1970	Director WPCC
W.W. Smither	Oct. 1970-Dec. 1971	Acting Director WPCC
Herman D. Regan Jr.	Jan. 1972-April 1973	Acting Director WPCC
Harold Snodgrass	May 1973-July 1975	Director DWQ
Clyde Baldwin	July 1975-Aug. 1975	Acting Director DWQ
William Forester	Aug. 1975-Nov. 1977	Director DWQ
Jack Wilson	Nov. 1977-Aug. 1978	Acting Director DWQ
Robert E. Blanz	Aug. 1978-Aug. 1980	Director DWQ
Thomas L. Grissom	Aug. 1980-	Acting Director DWQ