ORSANCO

TOXIC SUBSTANCES CONTROL PROGRAM

RECOMMENDATION REPORT

DEVELOPMENT OF A RECOMMENDED PROGRAM TO IDENTIFY SOURCES OF TOXIC SUBSTANCES IN THE OHIO RIVER BETWEEN MILE POINTS 462.8 AND 625.9

An Inventory and Assessment of Existing Information on Potential Point Sources Together with Analysis of Stream and Ground Water Data to Identify Possible Sources of Toxic Substances

The Ohio River Valley Water Sanitation Commission
Cincinnati, Ohio

January 1989

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Report Objective:

The objective of this report is to compile, analyze and interpret existing toxic substances data on the Ohio River segment from Cincinnati, Ohio to West Point, Kentucky (M.P. 462.8 to 625.9), and to recommend a follow-up field survey program to further identify questionable or unknown sources of toxic pollutants.

1.2 Background: The Toxic Substances Control Program

Since the mid-1970's, the Ohio River Valley Water Sanitation Commission has accumulated toxic substances data on Ohio River water quality from certain of its monitoring programs: the Organics Detection System (ODS); manual sampling system; and fish tissue contaminant surveys. The data have indicated that ambient levels of certain toxic substances and levels of pesticides and polychlorinated biphenols (PCB's) in fish have occasionally exceeded criteria established to protect human health and aquatic life. Continued low-level exposure to

these substances may have long-term negative effects on both the environment and public health.

A Toxic Substance Control Strategy was adopted by the Commission in May 1983 to address the growing concern over detections of low levels of toxic substances in the Ohio River. For the purposes of the strategy, toxic substances are defined as "...substances or combination of substances which might reasonably be expected to cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions in reproduction, or physical deformations in fish, other aquatic life, wildlife, livestock or humans (ORSANCO, 1983)." In this report, toxic substance refers to those specific compounds identified as such in current environmental laws. For example, when discussing surface water toxic substances, "priority pollutants" refers to the group of 126 organic and inorganic chemicals and heavy metals classified as toxic pollutants as defined by Section 307(a) of the Clean Water Act.

The goal of the Toxic Substances Control Strategy is "to protect and enhance the water quality of the Ohio River Basin so that the designated uses of its waters, including protection of public health and aquatic life, and as a source of supply for potable uses after reasonable treatment will not be adversely impacted by toxic substances (ORSANCO, 1983)." A Toxic

Substances Control Program was adopted as part of the Commission's FY87 Program Plan in order to implement this strategy. The program is implemented in phases that include several tasks designed to identify sources, both point and nonpoint, of toxic substances found in the Ohio River and to administer a cooperative program with state and federal agencies to eliminate or reduce the discharge of these substances.

In 1987, the first phase of the Toxic Substances Control Program was completed with the publication of the report The Presence of Toxic Substances in the Ohio River. The objective of the report was to summarize all Commission data on toxics in order to:

1. identify those toxic substances which exceed established criteria;
2. identify portions of the river where criteria are exceeded most frequently; and
3. provide the basis for additional analysis.

The second phase of the control program involves the identification of potential point and nonpoint sources of toxic discharge to the river that leads to the development of a recommended control program through detailed investigations of distinct segments. A study area from Wheeling, West Virginia, to Parkersburg, West Virginia was selected as the first study segment. Intensive field investigations were implemented in October 1987 with a final report available in January 1989.

Follow up investigations are being scheduled for the Pittsburgh, Pennsylvania to Wheeling, West Virginia study area. The current study area from Cincinnati, Ohio to West Point, Kentucky is the subject of this report. Subsequent segments of the Ohio River will be investigated and addressed in separate reports.

1.3 Program Methodology

The study methodology is presented graphically in Figure 1. It is divided into four tasks: preliminary assessment, field study, final report, and implementation. Parameters of concern for each study area were identified in the Commission report The Presence of Toxic Substances in the Ohio River and through the 1988 305(b) Report process.

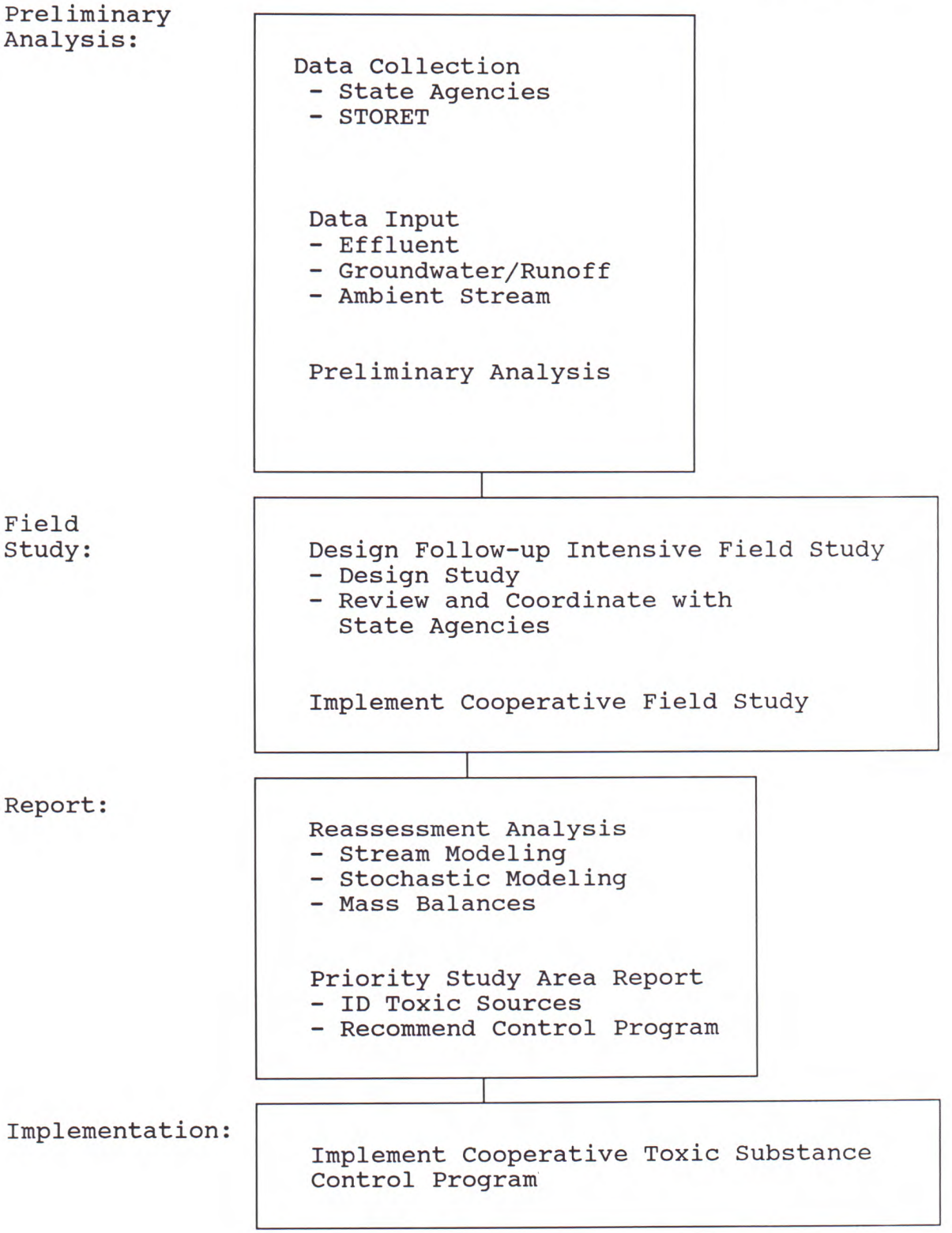
Available data on toxic substances were collected from Commission and state monitoring programs and from wastewater, solid waste, groundwater, hazardous materials, and water supply program offices of the Ohio Environmental Protection Agency (OEPA), Kentucky Department for Environmental Protection (KDEP), and the Indiana Department of Environmental Management (IDEM).

Commission and state data were analyzed to determine probable point and nonpoint source impacts in the study area. Point source impacts were investigated by calculating mass

loadings and by performing conservative modeling. In-stream non-point source impacts were investigated by correlating ambient water quality data with river flow. Areas with significant ground water impacts were identified and their probable impact on Ohio River surface waters were investigated.

Based on the results of this preliminary analysis, an intensive field survey has been designed to further define toxic substance impacts and identify their probable location in the study area. The field survey is expected to be implemented in cooperation with the appropriate state and federal agencies. Results of this investigation will be used to develop a state/Commission cooperative Toxic Substances Control Program for the study area.

Figure 1: Toxic Substances Control Program Methodology



2.0 DEFINITION OF THE STUDY AREA

2.1 Description of the Study Area

The Ohio River is formed at Pittsburgh, Pennsylvania by the confluence of the Allegheny and the Monongahela Rivers. The river flows 981 miles to the confluence with the Mississippi River near Cairo, Illinois. The study area is the stretch of the river extending from Cincinnati, Ohio (mile point 462.8) to West Point, Kentucky (mile point 625.9). The first 27.2 miles are bordered by the States of Ohio and Kentucky. The remaining 135.9 miles are bordered by the states of Indiana and Kentucky.

The total drainage are of the Ohio River basin at Cincinnati, Ohio is approximately 72,000 square miles. The total drainage area of the Ohio River basin at West Point, Kentucky is approximately 92,000 square miles. Four major tributaries (drainage area > 1000 mi^2) drain in to the Ohio River in this segment; the Little Miami River, the Licking River, the Great Miami River, and the Kentucky River.

There are two locks and dams within the study area (Markland mile point 531.5 and McAlpine mile point 606.8). These facilities, operated by the Louisville District of the U.S. Army Corps of Engineers, maintain year round navigation.

Under normal pool conditions, the average depth of the study segment is approximately 28 feet and the average width is approximately 1800 feet. The average slope of the Ohio River in the study segment is approximately 0.4 feet per mile. Critical flow (minimum 7 consecutive day low flow occurring once in 10 years, 7Q10) is 11,000 cubic feet per second (cfs) from mile point 462.8 to mile point 606.9. The 7Q10 for the remaining part of the study segment (mp 606.9 to 625.9) is 13,000 cfs.

Two Standard Metropolitan Statistical Areas, as identified by the U.S Department of Commerce, are adjacent to the study segment. These areas are the Cincinnati-Hamilton, OH-KY-IN area (population 1,412,000 in 1987) and the Louisville, KY-IN area (population 964,000 in 1987).

There are ten ORSANCO sampling sites, seven Ohio River and 3 tributary (Little Miami, Licking and Great Miami Rivers), within the study area which provide data on the incidence of toxics substances (Table 1). These sites include 14 stations from three monitoring networks (manual, ODS, and fish) maintained by ORSANCO.

There are eight manual monitoring network stations. There are five manual stations an the Ohio River and one each on the Little Miami River, the Licking River and the Great Miami River. Samples are collected monthly and analyzed for routine water

chemistry parameters, phenolics, cyanide and heavy metals. The manual monitoring system has been in operation since 1975.

There are two Organics Detection System (ODS) stations in the study area (Cincinnati and Louisville). Samples are collected daily at each of the ODS stations and analyzed for 16 volatile organics. The two stations in the study area came on line in 1983.

There are four fish sampling sites in the study area. Fish are collected for fish tissue at all locations. The fish tissue is analyzed for PCB's, chlordane, certain heavy metals and other pesticides. At two of these stations fish population data is collected as well as fish tissue.

Table 1
ORSANCO MONITORING STATIONS
MILE POINT 462.8 - 625.9

RIVER MILE	STATION	SYSTEM	STORET CODE
462.8	Cincinnati Water Works	Manual ODS	OR5182M OR518.2
7.5*	Little Miami River	Manual	LM-7.5M
4.5*	Licking River	Manual	LR-4.5M
472.5	Confluence Mill Creek	Fish Tissue	
490.0	North Bend	Manual	OR4910M
5.5*	Great Miami River	Manual	GM-5.5M

Table 1 (CONTINUED)

RIVER MILE	STATION	SYSTEM	STORET CODE
531.1	Markland Lock	Manual Fish	OR4495M
600.6	Louisville Water Works	Manual ODS	OR3804M OR380.4
605.0	McAlpine Lock	Fish	
625.9	West Point	Manual Fish Tissue	OR3551M

* Tributary River Mile - Miles from confluence with the Ohio River

2.2 Inventory of Facilities

Commercial activity along the Ohio River is diverse due to the abundant supply of water, available transportation and geographical location. Power generation, chemical manufacture, and materials handling are the major activities along the Ohio River in the study segment.

2.2.1 NPDES Facilities

There are 90 National Pollutant Discharge Elimination System (NPDES) permitted facilities discharging to the Ohio River in the study segment. These include 57 in Kentucky, 12 in Ohio, and 21 in Indiana. Table 2 summarizes the type and numbers of type of permitted facilities in the study area.

Table 2
NPDES Facility Summary

Facility Type	Number
Municipal WWTPs > 5.0 mgd	7
Municipal WWTPs ≤ 5.0 mgd	13
Private WWTP	10
Water Treatment Plants	9
Chemical Manufacture	12
Power Stations	10
River Terminals	19
Quarries/Resource Extraction	3
Distillers	2
Leather Tanneries	1
Manufacturing	1
Other	3
TOTAL NPDES Facilities	90

Adequate treatment capability is available for most municipal and industrial facilities. The Commission tracks those facilities providing less than adequate treatment and those discharges experiencing compliance problems. Additional concerns includes combined sewer overflows (CSOs) and municipal plants management and implementation of pretreatment programs.

Combined sewer overflows contribute to degraded water quality during storm events through direct discharge of untreated wastes and reduction of treatment plant efficiency. Table 3 displays those communities with combined sewer systems.

Table 3
Communities with Combined Sewer Systems

Mile Point	Municipality
470.0	Newport, KY
472.5	Cincinnati, OH
545.0	Carrollton, KY
604.1	Jeffersonville, IN
605.0	Louisville, KY
609.5	New Albany, IN

Of particular concern is the Mill Creek Valley in Cincinnati. The Mill Creek valley is the center of the industrial base of Cincinnati. Many of these industries are pretreating wastes and discharging to the Cincinnati MSD Mill Creek Plant. Combined sewer overflows in this area implies the discharge of industrial waste into Mill Creek to be conveyed to the Ohio River. It would be expected that during overflow events in this area that Mill Creek could be contributing a significant load of toxic substances to the Ohio River.

40 CFR 403.8 outlines the requirement for the establishment of pretreatment programs by publicly owned treatment works (POTW's). POTW's required to have a pretreatment program are defined as:

> "Any POTW (or combination of POTW's operated by the same authority) with a total design flow greater that 5 million gallons per day (mgd) and receiving from Industrial Users pollutants which Pass Through or Interfere with the operation of the POTW or are otherwise subject to Pretreatment Standards.." (40 CFR 403.8)

While the requirement of a pretreatment program does not infer discharge of high levels of toxic substances it does mean that POTW's will be handling industrial wastes. The proper management and enforcement of the pretreatment programs will insure that the levels of toxics introduced to the POTW are treatable and that the levels discharged to the receiving stream will not cause water quality degradation. Table 4 displays those POTW's in the study area which required to have pretreatment programs:

Table 4
POTW's Required to Have Pretreatment Programs

River Mile	POTW	State	Flow
464.5	Little Miami Plant Hamilton Co. MSD	OH	38.0
472.5	Mill Creek Plant Hamilton Co. MSD	OH	120.0
477.4	Dry Creek Plant Campbell/Kenton Co. San. Dist. #1	KY	30.0
482.0	Muddy Creek Plant Hamilton Co. MSD	OH	15.0
558.6	City of Madison	IN	3.6
604.1	City of Jeffersonville	IN	4.0
609.5	City of New Albany	IN	8.3
612.0	Morris Forman Plant Louisville/Jeff. Co. MSD	KY	105.0
623.3	West End Plant Louisville/Jeff. Co. MSD	KY	15.0

In 1980 the Louisville and Jefferson County Metropolitan Sewer District (Louisville MSD) implemented a pretreatment program to control industrial discharges to the MSD system. Louisville MSD recently completed a study of the impact of the program. The study shows an overall reduction in the loading of toxic

program. The study shows an overall reduction in the loading of toxic substances to the Louisville MSD treatment works and a corresponding reduction in loading of toxic substances to the Ohio River.

2.2.2 Power Generating Facilities

There are eleven (11) power generating facilities along the main stem of the Ohio River in the study area with a generating capacity of approximately 10,000 megawatts. While the major concern with power plants has been the impact of thermal loads, there is an increasing concern over the discharge from ash ponds (at the coal burning facilities) and the impact of the ash ponds on the ground water associated with the Ohio River. Table 5 shows the power generating facilities along the main stem of the Ohio River.

Table 5
POWER GENERATING FACILITIES

River Mile	Station Name	Capacity (MW)	Fuel
490.0	Miami Fort	1535	Coal/gas
495.5	Tanners Creek	995	Coal
510.0	East Bend	650	Coal
531.5	Markland	81	Hydro
536.0	Ghent	2116	Coal
560.0	Clifty Creek	1304	Coal
606.8	Ohio Falls	75	Hydro
610.0	Gallagher	600	Coal
613.6	Paddy's Run	75	Coal
616.8	Cane Run	1003	Coal
626.0	Mill Creek	1631	Coal

2.3 Water Use - Drinking Water

One of the increasing concerns of the Commission is the suitability of the water in the Ohio River for use as a public water supply. Controls of discharges to the Ohio River and treatment prior to distribution has essentially eliminated the risk of spreading waterborne disease through use of the Ohio River water as a public water supply. The concern is now with the long term health effects such as cancer. The presence of carcinogenic compounds, such as arsenic, methylene chloride and chloroform, in the water column validate these concerns. Table 6 shows the location of five public water supplies with Ohio River surface water intakes in the study area. These communities are concentrated at the up and down stream ends of the study segment.

Table 6
Surface Water Intakes

River Mile	Public Water Supply
462.8	Cincinnati
462.9	Kenton County (KY)
463.5	Newport
594.5	Louisville
600.6	Louisville
609.0	Indiana Cities

2.4 Special Resource Areas

The Commission has compiled information on special resource areas along the Ohio River at the request of the member states.

These areas include wetlands, unique geologic formations, location of endangered species, and other natural areas. These areas are of interest because of their importance to the terrestrial and aquatic life in the Ohio Valley. The presence of toxic substances at sufficient levels could cause long term impact on these communities. The following special resource areas have been identified in the study area:

Confluence of the Little Miami River and the Ohio River - This area has been identified as providing habitat to 6 species of state (Ohio) endangered mollusks, 6 additional species of rare mollusks and 1 species of rare bird.

Oxbow Area - This area is a wetland at the confluence of the Great Miami and the Ohio Rivers. It has been identified "..one of the most significant areas for migrating birds within 100 miles." by Art Wiseman (an ornithologist from the Cincinnati Museum of Natural History).

Goose Creek Ecological Area (river mile 569.9)

Six Mile Island State Nature Preserve (river mile 598)

Falls of the Ohio National Wildlife Conservation Area (river mile 606.8)

2.5 Special Toxic Substances Concerns

Human activity and industrialization of the Ohio Valley has resulted in negative impact on the environment. Four specific problems are the bioaccumulation of toxicants in the fish tissue, the contribution of toxic substances from ground water,

the impact of oil brine disposal practices, and a PCB spill to the Great Miami that occurred on April 3, 1987.

2.5.1 Fish Tissue

Bioaccumulation of pesticides, PCB's and certain metals in fish tissue provides a direct route of exposure for humans consuming the fish. In the case of PCB's and pesticides the concentrations in the water column and the sediments are typically below laboratory detection level. Analysis of fish tissue allows an evaluation of the levels of these compounds which humans are exposed to and it also provides a means for monitoring the presence of these compounds. In 1978 ORSANCO began to perform fish tissue analysis on an irregular basis as part of the Commission lock chamber fish population study.

PCB's and chlordane have been identified as parameters of concern due to occasional exceedances of action levels established by the United States Food and Drug Administration (FDA). These action levels were established for the regulation of interstate commerce. Tables 7 and 8 summarize the exceedances.

There have been occasional exceedances of both the PCB and the chlordane action levels. At the McAlpine Locks and Dam (mp 606.8) there have been a total of 5 exceedances of the PCB

Table 7
Number of Fish Samples Exceeding FDA Action Levels
PCB - 2.0 mg/kg

Year	MP 472.8 NS	MP 472.8 N>FDA	MP 531.5 NS	MP 531.5 N>FDA	MP 606.8 NS	MP 606.8 N>FDA	MP 625.9 NS	MP 625.9 N>FDA
1978								
CATFISH	-	-	5	2	1	0	-	-
CARP								
1979								
CATFISH	-	-	4	0	-	-	-	-
CARP	-	-	4	0	-	-	-	-
1981								
CATFISH	-	-	-	-	3	2	-	-
CARP	-	-	-	-	3	1	-	-
1983								
CATFISH	-	-	-	-	3	2	3	2
CARP	-	-	-	-	3	0	3	0
1985								
CATFISH	-	-	-	-	3	0	-	-
CARP	-	-	-	-	3	0	-	-
1987*								
CATFISH	1	1	1	0	1	0	1	1
CARP	1	0	1	0	1	0	1	0
GAME FISH	1	1	1	0	1	0	1	1

\- Not Sampled
* 1987 Samples were a five fish composite
NS Number of Samples
N>FDA Number of Samples Exceeding FDA action Levels

Table 8
Number of Fish Samples Exceeding FDA Action Levels
Chlordane - 0.3 mg/kg

Year	MP 472.8 NS	MP 472.8 N>FDA	MP 531.5 NS	MP 531.5 N>FDA	MP 606.8 NS	MP 606.8 N>FDA	MP 625.9 NS	MP 625.9 N>FDA
1978								
CATFISH	-	-	1	0	1	1	-	-
CARP	-	-	-	-	-	-	-	-
1979								
CATFISH	-	-	4	2	-	-	-	-
CARP	-	-	4	0	-	-	-	-
1981								
CATFISH	-	-	-	-	3	1	-	-
CARP	-	-	-	-	3	0	-	-
1983								
CATFISH	-	-	-	-	3	0	3	2
CARP	-	-	-	-	3	0	3	0
1985								
CATFISH	-	-	-	-	3	0	-	-
CARP	-	-	-	-	3	0	-	-
1987*								
CATFISH	1	0	1	0	1	0	1	1
CARP	1	0	1	0	1	0	1	1
GAME FISH	1	0	1	0	1	0	1	0

\- Not Sampled
* 1987 Samples were a five fish composite
NS Number of Samples
N>FDA Number of Samples Exceeding FDA action Levels

action level and 2 exceedances of the chlordane action level in 22 samples analyzed since 1978.

Caution should be used in using these data. Prior to 1987 there was no established protocol for collection of the fish tissue samples. Differences in age classes and the size of the fish may have a profound effect on the results. These data are used for screening the presence of PCB's, chlordane, and other bioaccumulative compounds. The fish tissue samples were also analyzed for other pesticides and certain heavy metals. PCB's and chlordane were the only compounds which exceeded established levels of concern.

In 1981 the U.S Fish and Wildlife Service collected fish for whole fish analysis. As would be expected, PCB and chlordane levels were substantially higher than those reported for the fillets collected at the same time.

Fish samples have also been collected from the Licking River on occasion (1983 & 1987). Catfish samples in both 1983 and 1987 showed exceedances of the FDA action levels. A five fish composite of white bass also showed an exceedance of the FDA action limit. Exceedances of the chlordane action level were observed in the 1987 samples of catfish and carp from the Licking River.

2.5.2 Ground Water

The alluvial aquifer associated with the Ohio River is extensive. The aquifer is a source of water for both public water supplies and industrial supplies. Unfortunately these areas are also prime locations for the siting of industrial facilities, due to available water and transportation.

There is concern that the industrial activity has adversely impacted the ground water associated with this alluvium through improper disposal of wastes, process leaks, and spills. Because the Ohio River is a gaining stream there is potential for this contamination to be transported to the Ohio River.

The alluvial materials in the study area can be characterized as poorly sorted sand and gravel overlain by a layer of silt and clay. There is indication that the sand and gravel deposits are partially exposed at many points across the river (Walker 1957). This indicates free communication between the aquifer and the surface water.

The width of the alluvial materials range from about a half mile wide, southwest of Cincinnati to about three miles wide in Louisville. The alluvial thickness varies from 0 - 150 feet thick. Fine grained materials overlying the glacial deposits are up to 50 feet thick.

Quality of the water found in the alluvium is generally good. It does tend to be very hard with elevated iron levels. There is some belief that the natural ground water quality may contribute a substantial quantity of metals to the Ohio River.

There are 24 public water supplies using the Ohio Valley Aquifer as the primary source of water in the study area. Total average daily use of the of the Ohio Valley Aquifer for domestic use in the study area is approximately 19 million gallons per day (mgd).

Review of topographic maps, NPDES files and personal interviews with state agency personnel a data base was established identifying sites along the river which have or may be contributing toxic substances to the ground water. A list of sites compiled through this method are shown in Table 9. Forty one (41) sites have been identified for the study area. Of these sites eight have been identified as the most severe and are targeted for follow up with the appropriate state personnel.

Suspect pollutants include inorganic and organic chemicals. It would be expected that the organics would be more mobile through the alluvium.

TABLE 9

SUMMARY OF GROUND WATER CONTAMINATION POTENTIAL
RIVER MILE 462.8 TO 625.9

SITES WITH POTENTIAL FOR GROUND WATER CONTAMINATION

RIVER MILE	SITE NAME	STATE	CONTAMINATION TYPE
465.8	ARCADIAN CHEMICAL	OH	ORGANICS
468.5	UNITED AMERICAN FUELS	OH	FUELS
474.0	UNION OIL	OH	FUEL
474.2	BORON OIL	KY	FUELS
475.0	CONRAIL	OH	FUEL CONTAMINATION
475.5	CHEVRON USA	KY	FUELS
476.5	ASHLAND PETROLEUM	OH	ORGANICS
479.0	SHELL ASPHALT	OH	ORGANICS
484.0	MONSANTO CHEMICAL	OH	ORGANICS
490.0	MIAMI FORT STATION	OH	INORGANICS
495.0	TANNERS CREEK	IN	INORGANICS
511.0	EAST BEND POWER STATION	KY	INORGANICS
536.0	GHENT POWER STATION	KY	INORGANICS
541.0	DOW CORNING	KY	ORGANICS
543.5	M&T CHEMICALS	KY	ORGANICS,PESTICIDES
544.0	CHEVRON	KY	ORGANICS
552.8	KAWNEER COMPANY	KY	METALS
560.0	CLIFTY CREEK STATION	IN	ORGANICS
601.5	CONVENIENT ENERGY, INC.	KY	INORGANICS
602.6	ASHLAND PETROLEUM CO.	KY	FUELS,HEAVY ORGANIC
602.7	SHELL OIL	KY	FUELS
603.0	CHEVRON USA	KY	ORGANICS
604.0	COLGATE PALMOLIVE	IN	ORGANICS,INORGANICS
604.5	ASHLAND PETROLEUM	KY	ORGANICS
606.5	MOSER LEATHER	IN	METALS,ORGANICS
607.0	YOUNGSTOWN YARDS	KY	FUEL
610.0	GALLAGHER PLANT	IN	ORGANICS
612.5	CHEVRON USA	KY	FUEL
612.6	TEXACO, INC.	KY	FUELS
613.0	ASHLAND PETROLEUM	KY	FUEL
613.1	BF GOODRICH CHEMICAL	KY	ORGANICS
613.3	ROHM & HAAS	KY	ORGANICS
613.5	AMERICAN SYNTHETIC RUBBER	KY	ORGANICS
613.6	PADDY'S RUN STATION	KY	INORGANICS
613.8	E.I. DUPONT	KY	ORGANICS
614.9	STAUFFER CHEMICAL	KY	ORGANICS
615.2	BORDEN CHEMICAL	KY	ORGANICS
616.2	CANE RUN STATION	KY	INORGANICS
616.8	CANE RUN PLANT	KY	INORGANICS
620.5	EXXON COMPANY	KY	FUELS
625.9	MILL CREEK STATION	KY	INORGANICS
	TOTAL NUMBER OF FACILITIES:	41	

Of particular interest is the area southwest of Louisville known as Rubbertown where five of the eight sites judged most severe are located. A study conducted by the USGS identified the extent of chloroform contamination, due to a spill event, in one site of this area. During this investigation carbon tetrachloride was also detected. This indicates that a widespread problem may be present.

The Stauffer Chemical site (mp 614.9) has been investigated as part of the CERCLA (Superfund) program administered by the KDEP. These studies indicated that contaminants have migrated from ground water to the surface water. A more in depth review of available data is required to better define the extent of this contribution.

2.5.3 Impact of Oil Brine Disposal Methods

The KDEP, Division of Water (KDEP DOW) has identified oil field brine wastes as causing a major impact to water quality in the Kentucky and Licking River basins (KDEP DOW, 1988) . These wastes can cause toxic impacts to aquatic life due to excessive chloride levels. Bromide, heavy metals (barium, chromium and mercury) and some heavy organics are also associated with these wastes.

The Louisville Water Company has expressed concern with regards to increasing level of sodium in the Ohio River raw water. Water quality surveys on the Ohio River and the Kentucky River indicate that the increased level of sodium observed at the intake may be due to increasing levels of sodium in the Kentucky River. Sodium in drinking water is regulated under the Safe Drinking Water Act (SDWA). Increased human intake of sodium contributes to an age related increase in hypertension in susceptible individuals (48 FR 45502). Control of sodium levels in water treatment is expensive and the technology (reverse osmosis) is not typically in place at water treatment plants. The Louisville Water Company is concerned that if the trend continues they may not be able to meet a maximum contaminant level established.

2.5.4 PCB Spill to the Great Miami River

On April 3, 1987 a spill of polychlorinated biphenyls (PCBs) was reported to the Commission. The spill occurred south of Dayton, Ohio into Wolf Creek, a tributary of the Great Miami River, which enters the Great Miami River approximately 60 river miles upstream of the confluence of the Great Miami and the Ohio Rivers. The cause of the spill was identified as leaking transformers at an abandoned warehouse.

Water column samples taken from the Great Miami were analyzed and the lab reported 1.6 ppb of PCBs. The water sample was taken approximately 0.75 miles downstream of the spill site. Sediment samples and soil samples were also analyzed and reported as 11.8 ppm PCBs and 25 ppm respectively (The solubility of PCBs in water is low, therefore the majority of the PCBs spilled would be expected to be found in the sediments).

The most likely route of exposure to PCBs would be through consumption of fish tissue (EPA 1980). Sampling and analysis performed by the Ohio EPA (OEPA) on fish samples collected from the Great Miami revealed PCB levels in excess of the FDA action level (2.0 mg/l). These data led to the issuance of a fish consumption advisory for catfish and carp for the lower 60 miles of the Great Miami. OEPA also did some analysis of historical data which revealed regular exceedances of the current FDA action level (2.0 mg/kg). It is believed that the PCB levels found in the fish during the most recent sampling is typical of past levels and would not necessarily be due to the most recent event. The most recent event will only exacerbate the problem.

3.0 AMBIENT STREAM WATER QUALITY

Two recent Commission publications, The Presence of Toxic Substances in the Ohio River and Assessment of Water Quality Conditions: Ohio River 1986 - 1987, are compilations and assessments of water quality data collected by ORSANCO. These publications identify parameters present in the water column which are of concern due to exceedances of criteria established for the protection of aquatic life and human health.
Analysis of the detection rates and exceedances of criteria are presented in this section.

3.1 Parameters of Concern

The 1987 Commission report, The Presence of Toxic Substances in the Ohio River, used four categories were applied to identify parameters of concern by the Commission; percent detection, percent exceedances of applicable criteria, increase in occurrence from upstream location to downstream location and increasing trend over the period of record.

The following parameters of concern were identified, by category, for the Cincinnati to Louisville segment[1]:

---

[1] The study segment was originally from mp 462.8 to mp 600.6. The area was expanded to include the reach from mp 600.6 to 625.9 at the May 1988 Technical Committee meeting.

Criteria Exceedance:
Copper
Mercury
Phenolics

Frequent Detections:
1,1,1-Trichloroethane

Increase from Upstream Location:
Trichlorofluoromethane

Increasing Trend:
Methylene Chloride

PCBs and chlordane were identified as parameters of concern for the segment of the Ohio River from M.P. 605.0 to 791.5 due to elevated levels found in fish tissue. A majority of the data used for this determination was collected at McAlpine Lock (M.P. 605.0) and West Point (M.P. 625.9).

The Commission's 1988 305(b) Report, Assessment of Water Quality Conditions: Ohio River 1986 - 1987, applied some of the same criteria to evaluate water quality conditions for water years 1986 and 1987. Support of designated uses, (warm water aquatic habitat, drinking water supply and recreation), were evaluated through evaluation of exceedances of applicable criteria. Criteria used were the Ohio River Valley Water Sanitation Commission Pollution Control Standards, 1987 Revision and the recommended U.S. EPA cancer risk levels. For the study area the following parameters were identified as causing less than full support of designated uses:

Arsenic	Mercury
Lead	Copper
Phenolics	Fecal Coliform
Nickel	Chloroform

Copper, lead, and mercury levels exceeded criteria designed to protect aquatic life; phenolics exceeded criterion designed to not impart a taste on fish flesh; arsenic and chloroform exceeded cancer risk levels; nickel exceeded criterion developed to protect human health; and fecal coliform exceeded criterion developed to protect against incidence of gastrointestinal illness in persons involved in contact recreation.

3.2 Detection Rates

Detection rates for the parameters of concern are presented in tables 10 and 11. The data are presented by year for calender years 1980 - 1987. A detection, for the purposes of this report, is defined as when the concentration of the parameter in the water column is greater than the level of quantification. A nondetection therefore does not mean the parameter analyzed was not present, only that the level present was below the laboratory level of quantification. Detection rates give an indication of how often the parameter is present in the water column above the level of detection.

TABLE 10

DETECTION RATES - MANUAL DATA 1980 - 1987

RIVER MILE	STATION	YEAR	COPPER		LEAD		MERCURY		PHENOLICS		ARSENIC		NICKEL	
			ND	%DET	ND	%DET	ND	%DET	ND	%DET	ND	%DET	ND	%DET
462.8	CINCINNATI	80	12	100.0	6	50.0	4	33.3	8	66.7	1	12.5	4	50.0
		81	10	83.3	2	16.7	3	25.0	7	58.3	0	0.0	1	16.7
	Cincinnati	82	12	100.0	1	8.3	3	25.0	1	8.3	1	25.0	1	25.0
	Water Works	83	11	100.0	9	81.8	8	72.7	4	36.4	1	25.0	3	75.0
		84	12	100.0	9	75.0	2	16.7	8	66.7	4	100.0	2	50.0
		85	10	100.0	9	90.0	4	40.0	9	90.0	4	100.0	3	75.0
		86	11	100.0	11	100.0	6	54.6	9	81.8	3	75.0	3	75.0
		87	11	91.7	10	83.3	5	41.7	7	58.3	3	75.0	1	25.0
464.1	LITTLE MIAMI	80	12	100.0	6	50.0	6	50.0	10	83.3	1	12.5	4	50.0
	RIVER	81	11	100.0	6	54.6	3	27.3	10	90.9	0	0.0	0	0.0
		82	10	90.9	0	.	2	18.2	1	9.1	0	0.0	3	75.0
	Newtown Bridge	83	11	100.0	8	72.7	6	54.6	7	63.6	2	50.0	1	25.0
	mp 4.5	84	12	100.0	11	91.7	8	66.7	10	83.3	4	100.0	2	50.0
		85	10	100.0	10	100.0	3	30.0	9	90.0	4	100.0	1	25.0
		86	11	100.0	11	100.0	8	72.7	11	100.0	3	100.0	2	50.0
		87	11	91.7	10	83.3	5	41.7	9	75.0	3	75.0	2	50.0
470.2	LICKING	80	11	100.0	1	9.1	4	36.4	7	63.6	0	0.0	3	42.9
	RIVER	81	12	100.0	1	8.3	3	25.0	8	66.7	0	0.0	1	16.7
		82	11	100.0	0	.	4	36.4	2	18.2	0	0.0	2	50.0
	Kenton Co.	83	11	100.0	7	63.6	6	54.6	3	27.3	1	25.0	1	25.0
	Water Works	84	12	100.0	10	83.3	5	41.7	9	75.0	4	100.0	2	50.0
	mp 4.5	85	10	100.0	6	60.0	2	20.0	9	90.0	4	100.0	1	25.0
		86	11	100.0	11	100.0	6	54.6	9	81.8	3	75.0	2	50.0
		87	10	100.0	7	70.0	5	50.0	7	70.0	3	75.0	2	50.0
490.0	NORTH BEND	80	12	100.0	4	33.3	9	75.0	6	50.0	0	0.0	4	50.0
		81	12	100.0	4	33.3	8	66.7	10	83.3	0	0.0	1	16.7
	Miami Fort	82	12	100.0	2	16.7	5	41.7	1	8.3	0	0.0	2	50.0
	Power Station	83	10	100.0	6	60.0	0	.	2	20.0	0	0.0	1	25.0
		84	9	75.0	12	100.0	0	.	0	.	0	0.0	1	25.0
		85	7	87.5	7	87.5	2	25.0	5	62.5	2	50.0	2	50.0
		86	11	100.0	10	90.9	7	63.6	11	100.0	3	75.0	2	50.0
		87	12	100.0	11	91.7	6	50.0	5	41.7	3	75.0	3	75.0

Key: ND = Number of Detections %DET = Percent Detections

DETECTION RATES - MANUAL DATA 1980 - 1987

RIVER MILE	STATION	YEAR	COPPER ND	COPPER %DET	LEAD ND	LEAD %DET	MERCURY ND	MERCURY %DET	PHENOLICS ND	PHENOLICS %DET	ARSENIC ND	ARSENIC %DET	NICKEL ND	NICKEL %DET
491.1	GREAT MIAMI RIVER	80	12	100.0	6	50.0	10	83.3	11	91.7	0	0.0	4	50.0
		81	12	100.0	2	16.7	7	58.3	9	75.0	0	0.0	2	33.3
		82	12	100.0	1	8.3	4	33.3	2	16.7	0	0.0	2	50.0
	Lost Bridge	83	7	77.8	5	55.6	1	11.1	1	11.1	1	25.0	1	25.0
	rm 5.5	84	7	63.6	9	81.8	0	0	0	0.0	1	25.0	0	0.0
		85	8	100.0	5	62.5	3	37.5	5	62.5	2	50.0	1	25.0
		86	11	100.0	10	90.9	7	63.6	11	100.0	3	75.0	3	75.0
		87	11	100.0	10	90.9	5	45.4	9	81.8	4	100.0	4	100.0
531.5	MARKLAND	80	12	100.0	3	25.0	10	83.3	8	66.7	0	0.0	4	50.0
		81	11	100.0	3	27.3	11	100.0	7	63.6	0	0.0	0	0.0
	Markland Hydro	82	11	100.0	2	18.2	10	90.9	2	18.2	0	0.0	2	50.0
		83	9	90.0	5	50.0	5	50.0	1	10.0	0	0.0	0	0.0
		84	6	54.6	9	81.8	2	18.2	0	.	0	0.0	1	25.0
		85	7	87.5	7	87.5	4	50.0	5	62.5	3	75.0	2	50.0
		86	11	100.0	10	90.9	9	81.8	9	81.8	3	75.0	3	75.0
		87	12	100.0	10	83.3	7	58.3	5	41.7	4	100.0	2	50.0
600.6	LOUISVILLE	80	11	91.7	5	41.7	8	66.7	1	8.3	0	0.0	4	50.0
		81	12	100.0	3	25.0	11	91.7	8	66.7	0	0.0	1	25.0
	Louisville	82	12	100.0	2	16.7	4	33.3	2	16.7	0	0.0	1	25.0
	Water Works	83	10	90.9	4	36.4	2	18.2	1	9.1	0	0.0	0	0.0
		84	12	100.0	8	66.7	0	.	1	8.3	1	25.0	0	0.0
		85	10	90.9	9	81.8	2	18.2	5	45.5	2	50.0	0	0.0
		86	12	100.0	10	83.3	9	75.0	9	75.0	4	100.0	3	75.0
		87	12	100.0	8	66.7	8	66.7	6	50.0	4	100.0	1	25.0
625.9	WEST POINT	80	12	100.0	8	66.7	11	91.7	7	58.3	0	0.0	4	50.0
		81	11	91.7	5	41.7	10	83.3	9	75.0	0	0.0	3	42.9
	Mill Creek	82	11	91.7	3	25.0	4	33.3	2	16.7	0	0.0	2	50.0
	Power Station	83	8	72.7	8	72.7	1	9.1	2	18.2	1	25.0	1	25.0
		84	10	83.3	10	83.3	0	.	1	8.3	0	0.0	0	0.0
		85	10	83.3	11	91.7	1	8.3	6	50.0	2	50.0	2	50.0
		86	11	100.0	11	100.0	9	81.8	8	72.7	4	100.0	3	75.0
		87	12	100.0	10	83.3	8	66.7	8	66.7	4	100.0	1	25.0

Key: ND = Number of Detections %DET = Percent Detections

TABLE 10 (Cont.)

TABLE 11

DETECTION RATES - ODS DATA 1980 - 1987

PARAMETER:			METHYLENE CHLORIDE		TRICHLOROFLUORO-METHANE		CHLOROFORM		1,1,1-TRICHLORO-ETHANE	
YEAR		NS	ND	%DETS	ND	%DETS	ND	%DETS	ND	%DETS
CINCINNATI	1980	358	55	15%	0	0%	349	97%	63	18%
MP 462.8	1981	360	104	29%	0	0%	221	61%	13	4%
	1982	364	110	30%	0	0%	277	76%	33	9%
Cincinnati	1983	365	191	52%	0	0%	316	87%	17	5%
Water Works	1984	366	261	71%	0	0%	344	94%	41	11%
	1985	365	55	15%	0	0%	203	56%	23	6%
	1986	356	24	7%	0	0%	164	46%	22	6%
	1987	365	5	1%	0	0%	198	54%	48	13%
LOUISVILLE	1980	357	3	1%	1	0%	196	55%	255	71%
MP 600.6	1981	357	12	3%	5	1%	250	70%	275	77%
	1982	272	18	7%	7	3%	126	46%	83	31%
Louisville	1983	361	235	65%	166	46%	321	89%	243	67%
Water Works	1984	366	77	21%	36	10%	307	84%	207	57%
	1985	353	90	25%	0	0%	56	16%	23	7%
	1986	364	101	28%	3	1%	77	21%	46	13%
	1987	360	51	14%	1	0%	108	30%	1	0%

Key: NS = Number of Samples, ND = Number of Detections, %DETS = Number of Detections

Table 12 shows the current laboratory reporting level (level of quantification) for the parameters of concern. It should be noted that the reporting level for arsenic was lowered from 10 to 0.5 ug/l in 1983 for the Cincinnati area stations and in 1985 for the other stations, and the reporting level for lead has been variable over the period of record (1980 - 1987).

TABLE 12

LABORATORY REPORTING LEVEL
ORSANCO

Parameter	Reporting Level
Arsenic	0.5 ug/l
Chloroform	0.1 ug/l
Copper	5.0 ug/l
Lead	10.0 ug/l
Mercury	0.1 ug/l
Methylene Chloride	0.1 ug/l
Nickel	1.0 ug/l
Phenolics	1.0 ug/l
Trichlorofluoromethane	0.1 ug/l
1,1,1-Trichloroethane	0.1 ug/l

The data shows that arsenic, copper and lead are detected virtually 100 % of the time, after 1983. As previously stated this is more a result of increased analytical sensitivity than an increase in levels in the water column of the Ohio River and tributaries. Nickel, mercury, phenolics, and chloroform (at Cincinnati) are detected in excess of 50% of the samples analyzed, and methylene chloride, trichlorofluoromethane, and 1,1,1-trichloroethane are detected in less than 10% of the samples analyzed.

3.3 Criteria Exceedances

Water quality criteria are developed to protect aquatic life and human health concerns. The Commission has developed stream criteria to apply to the Ohio River to protect the designated uses. Criteria for protection of human health concerns has been developed by the U.S. EPA. Data for the parameters of concern were compared against applicable criteria and the rates of exceedances of the criteria are reported here. Table 13 displays the criteria used for this evaluation.

TABLE 13

CRITERIA FOR TOXIC SUBSTANCES

Aquatic Life Criteria

Parameter	Criteria	Chronic	Acute
Arsenic	50	N/A	N/A
Copper	N/A	14.8*	22.7*
Lead	N/A	4.4*	114.0*
Mercury	N/A	0.12	2.4
Phenolics[@]	5	N/A	N/A

All values in ug/l
* = Value is hardness dependent, value reported is for hardness = 130 mg/l
@ = Value developed so that phenolics would not impart a taste and odor in fish flesh
N/A Not applicable

U.S. EPA Cancer Risk Levels

Parameter	10^{-5}	10^{-6}
Arsenic*	0.22	0.022
Chloroform	1.9	0.19
Methylene Chloride	1.9	0.19
Trichlorofluoromethane	1.9	0.19

All values in ug/l
* = Value reflects recommendation of U.S. EPA Science Advisory Board (EPA 1987)

U.S. EPA Human Health Criterion

Parameter	Criterion
Nickel	13.4 ug/l

Tables 14, 15, 16, and 17 display the rates of exceedances of the applicable criteria. Exceedances of acute criteria and 10^{-5} cancer risk levels (CRL) are now shown. For all parameters, but lead, exceedances of the acute criteria were essentially zero. For carcinogens, except arsenic, the exceedances of the 10^{-5} were essentially zero. In the case of arsenic a detection was an exceedance of the 10^{-5} CRL, therefore the rate of detection is equal to the rate of exceedance of both the 10^{-5} and 10^{-6} cancer risk levels.

The following are discussions of exceedance rates by parameter:

Arsenic: All detections (virtually 100%) exceed the 10^{-5} CRL level developed by the U.S. EPA (0.22 ug/l). Because arsenic is detected in virtually 100% of all samples analyzed, there is no apparent trend in the exceedance rate over time.

Chloroform: It appears that the rate of exceedance of the 10^{-6} CRL at both Cincinnati and Louisville is declining.

Copper: The rate of exceedance of the chronic criteria established for copper appears to be decreasing at Markland

TABLE 14

EXCEEDANCES OF CHRONIC CRITERIA - MANUAL DATA 1980 - 1987

RIVER MILE	STATION	YEAR	COPPER NE	COPPER %EXCEED	COPPER MAX	LEAD NE	LEAD %EXCEED	LEAD MAX	MERCURY NE	MERCURY %EXCEED	MERCURY MAX
462.8	CINCINNATI	80	12	100.0	650	6	50.0	14	4	33.3	0.5
		81	6	50.0	1200	2	16.7	36	3	25.0	1
	Cincinnati	82	2	16.7	26	1	8.3	18	3	25.0	0.5
	Water Works	83	4	36.4	30	9	81.8	24	8	72.7	143
		84	8	66.7	380	9	75.0	24	2	16.7	0.5
		85	7	70.0	2240	9	90.0	100	4	40.0	0.3
		86	9	81.8	2230	11	100.0	28	6	54.6	0.1
		87	4	33.3	295	10	83.3	20	5	41.7	0.2
464.1	LITTLE MIAMI	80	4	33.3	62	5	41.7	24	6	50.0	0.5
	RIVER	81	1	9.1	20	4	36.4	26	3	27.3	0.1
		82	0	.	.	0	.	.	2	18.2	0.6
	Newtown Bridge	83	2	18.2	42	7	63.6	36	6	54.6	9.2
	mp 4.5	84	4	33.3	440	11	91.7	34	8	66.7	9.6
		85	1	10.0	29	10	100.0	24	3	30.0	0.2
		86	1	9.1	22	11	100.0	34	8	72.7	0.2
		87	0	.	.	10	83.3	20	5	41.7	0.2
470.2	LICKING	80	6	54.6	1210	0	.	.	4	36.4	0.3
	RIVER	81	3	25.0	34	1	8.3	10	3	25.0	0.4
		82	3	27.3	28	0	.	.	4	36.4	0.6
	Kenton Co.	83	1	9.1	27	7	63.6	18	6	54.6	0.8
	Water Works	84	2	16.7	1340	10	83.3	30	5	41.7	0.7
	mp 4.5	85	1	10.0	22	6	60.0	20	2	20.0	0.1
		86	6	54.6	280	11	100.0	20	6	54.6	0.1
		87	2	20.0	72	7	70.0	18	5	50.0	0.2
490.0	NORTH BEND	80	3	25.0	42	4	33.3	32	9	75.0	1.1
		81	4	33.3	28	4	33.3	34	8	66.7	5
	Miami Fort	82	4	33.3	26	2	16.7	18	5	41.7	0.3
	Power Station	83	4	40.0	64	4	40.0	18	0	.	.
		84	5	41.7	125	3	25.0	11	0	.	.
		85	1	12.5	80	5	62.5	16	2	25.0	0.2
		86	1	9.1	23	10	90.9	20	7	63.6	0.2
		87	5	41.7	336	11	91.7	16	6	50.0	0.3

Key: NE = Number of Exceedances, %EXCEED = Percent Exceedances, MAX = maximum ug/l

EXCEEDANCES OF CHRONIC CRITERIA - MANUAL DATA 1980 - 1987

RIVER MILE	STATION	YEAR	COPPER NE	COPPER %EXCEED	COPPER MAX	LEAD NE	LEAD %EXCEED	LEAD MAX	MERCURY NE	MERCURY %EXCEED	MERCURY MAX
491.1	GREAT MIAMI RIVER	80	1	8.3	46	6	50.0	120	10	83.3	1.5
		81	1	8.3	42	1	8.3	40	7	58.3	0.7
		82	1	8.3	24	1	8.3	12	4	33.3	0.4
	Lost Bridge	83	0	.	.	2	22.2	336	1	11.1	0.2
	rm 5.5	84	0	.	.	0	.	.	0	.	.
		85	1	12.5	115	5	62.5	24	3	37.5	0.3
		86	1	9.1	38	10	90.9	26	7	63.6	0.3
		87	1	9.1	22	10	90.9	30	5	45.5	0.3
531.5	MARKLAND	80	5	41.7	72	3	25.0	18	10	83.3	2.5
		81	9	81.8	84	3	27.3	26	11	100.0	2.7
	Markland Hydro	82	6	54.6	22	2	18.2	14	10	90.9	0.8
		83	4	40.0	30	3	30.0	270	5	50.0	0.8
		84	5	45.5	235	3	27.3	12	2	18.2	0.3
		85	1	12.5	60	6	75.0	64	4	50.0	0.3
		86	3	27.3	62	10	90.9	18	9	81.8	0.3
		87	3	25.0	23	9	75.0	14	7	58.3	0.2
600.6	LOUISVILLE	80	4	33.3	30	5	41.7	40	8	66.7	0.4
		81	9	75.0	220	3	25.0	14	11	91.7	0.7
	Louisville	82	8	66.7	26	2	16.7	12	4	33.3	0.5
	Water Works	83	5	45.5	40	3	27.3	19	2	18.2	0.6
		84	9	75.0	50	4	33.3	8	0	.	.
		85	8	72.7	30	6	54.6	20	2	18.2	0.2
		86	9	75.0	83	10	83.3	18	9	75.0	0.2
		87	9	75.0	54	8	66.7	16	8	66.7	0.5
625.9	WEST POINT	80	4	33.3	20	8	66.7	50	11	91.7	0.3
		81	3	25.0	40	5	41.7	20	10	83.3	0.6
	Mill Creek	82	6	50.0	32	3	25.0	20	4	33.3	0.5
	Power Station	83	3	27.3	40	7	63.6	32	1	9.1	0.2
		84	2	16.7	20	5	41.7	16	0	.	.
		85	3	25.0	20	8	66.7	20	1	8.3	0.3
		86	1	9.1	14	11	100.0	22	9	81.8	0.2
		87	1	8.3	13	10	83.3	20	8	66.7	0.3

TABLE 14 (Cont.)

Key: NE = Number of Exceedances, %EXCEED = Percent Exceedances, MAX = maximum ug/l

EXCEEDANCES OF 10-6 CANCER RISK LEVEL - ODS 1980 - 1987

PARAMETER:			METHYLENE CHLORIDE			TRICHLOROFLUOROMETHANE			CHLOROFORM		
STATION:	YEAR	NS	NE	%EXCEED	MAX	NE	%EXCEED	MAX	NE	%EXCEED	MAX
CINCINNATI	1980	358	55	15%	0.6	0	0%	0	349	97%	6.7
MP 462.8	1981	360	104	29%	4.3	0	0%	0	221	61%	13
	1982	364	110	30%	1.5	0	0%	0	277	76%	33
Cincinnati	1983	365	148	41%	7.5	0	0%	0	238	65%	17
Water Works	1984	366	195	53%	9.7	0	0%	0	261	71%	41
	1985	365	18	5%	0.8	0	0%	0	51	14%	23
	1986	356	17	5%	2.7	0	0%	0	112	31%	22
	1987	365	5	1%	0.3	0	0%	0	127	35%	48
LOUISVILLE	1980	357	1	0%	0.5	1	0%	0.3	77	22%	0.8
MP 600.6	1981	357	8	2%	10.3	3	1%	0.9	143	40%	2
	1982	272	10	4%	0.8	2	1%	0.2	63	23%	1.1
Louisville	1983	361	153	42%	3.1	30	8%	0.5	201	56%	1.4
Water Works	1984	366	16	4%	0.3	14	4%	0.6	152	42%	1.7
	1985	353	57	16%	2.9	0	0%		16	5%	0.7
	1986	364	70	19%	0.9	3	1%	0.3	37	10%	0.8
	1987	360	32	9%	2.4	1	0%	0.3	28	8%	0.6

Key: NS = Number of Samples, NE = Number of Exceedances, %EXCEED Percent Exceedances, MAX = Maximum ug/l

TABLE 15

EXCEEDANCES OF HUMAN HEALTH CRITERIA - MANUAL DATA 1980 - 1987

RIVER MILE	STATION	YEAR	ARSENIC NE	ARSENIC %EXCEED	ARSENIC MAX	NICKEL NE	NICKEL %EXCEED	NICKEL MAX
462.8	CINCINNATI	80	1	12.5	100	2	25.0	26
		81	0	.	.	1	16.7	20
	Cincinnati	82	1	25.0	10	1	25.0	16
	Water Works	83	1	25.0	7	2	50.0	30
		84	4	100.0	4	2	50.0	30
		85	4	100.0	6	3	75.0	136
		86	3	75.0	4.8	2	50.0	30
		87	3	75.0	3	0	.	.
464.1	LITTLE MIAMI	80	1	12.5	13	1	12.5	14
	RIVER	81	0	.	.	0	.	.
		82	0	.	.	2	50.0	30
	Newtown Bridge	83	2	50.0	18	1	25.0	26
	mp 4.5	84	4	100.0	3	1	25.0	18
		85	4	100.0	3.2	0	.	.
		86	3	75.0	2	0	.	.
		87	3	75.0	2.1	0	.	.
470.2	LICKING	80	0	.	.	1	14.3	16.0
	RIVER	81	0	.	.	0	.	.
		82	0	.	.	2	50.0	60.0
	Kenton Co.	83	1	25.0	28	0	.	.
	Water Works	84	4	100.0	5	2	50.0	580
	mp 4.5	85	4	100.0	2	0	.	.
		86	3	75.0	1.6	1	25.0	20
		87	3	75.0	2.9	0	.	.
490.0	NORTH BEND	80	0	.	.	3	37.5	30
		81	0	.	.	0	.	.
	Miami Fort	82	0	.	.	1	25.0	20
	Power Station	83	0	.	.	1	25.0	20
		84	0	.	.	1	25.0	50
		85	2	50.0	2	1	25.0	14
		86	3	75.0	1.4	0	.	.
		87	3	75.0	1.4	1	25.0	16

Key: NE = Number of Exceedances, %EXCEED = Percent Exceedances, MAX = Maximum ug/l

TABLE 16

EXCEEDANCES OF HUMAN HEALTH CRITERIA - MANUAL DATA 1980 - 1987

RIVER MILE	STATION	YEAR	ARSENIC NE	ARSENIC %EXCEED	ARSENIC MAX	NICKEL NE	NICKEL %EXCEED	NICKEL MAX
491.1	GREAT MIAMI RIVER	80	0	.	.	3	37.5	28
		81	0	.	.	2	33.3	24
		82	0	.	.	2	50.0	20
	Lost Bridge rm 5.5	83	1	25.0	4	0	.	.
		84	1	25.0	3	0	.	.
		85	2	50.0	3	1	25.0	28
		86	3	75.0	3.2	1	25.0	16
		87	4	100.0	9.2	1	25.0	32
531.5	MARKLAND	80	0	.	.	3	37.5	20
		81	0	.	.	0	.	.
	Markland Hydro	82	0	.	.	2	50.0	20
		83	0	.	.	0	.	.
		84	0	.	.	1	25.0	30
		85	3	75.0	4	2	50.0	110
		86	3	75.0	1.1	0	.	.
		87	4	100.0	2.2	1	25.0	16
600.6	LOUISVILLE	80	0	.	.	1	12.5	24
		81	0	.	.	0	.	.
	Louisville Water Works	82	0	.	.	1	25.0	20
		83	0	.	.	0	.	.
		84	1	25.0	2	0	.	.
		85	2	50.0	1.2	0	.	.
		86	4	100.0	1.6	1	25.0	20
		87	4	100.0	3.2	0	.	.
625.9	WEST POINT	80	0	.	.	4	50.0	32
		81	0	.	.	2	28.6	16
	Mill Creek Power Station	82	0	.	.	0	.	.
		83	0	.	.	0	.	.
		84	0	.	.	0	.	.
		85	2	50.0	2.5	1	25.0	40
		86	4	100.0	1.7	2	50.0	16
		87	4	100.0	2.6	0	.	.

TABLE 16 (Cont.)

Key: NE = Number of Exceedances, %EXCEED = Percent Exceedances, MAX = Maximum ug/l

EXCEEDANCES OF STREAM CRITERION - 1980-1987

RIVER MILE	STATION	YEAR	PHENOLICS NE	%EXCEED	MAX
462.8	CINCINNATI	80	2	16.7	5
		81	4	33.3	41
	Cincinnati	82	0	.	.
	Water Works	83	0	.	.
		84	0	.	.
		85	2	20.0	6
		86	2	18.2	8
		87	1	8.3	5
464.1	LITTLE MIAMI RIVER	80	2	16.7	6
		81	6	54.5	31
		82	1	9.1	7
	Newtown Bridge	83	0	.	.
	mp 4.5	84	4	33.3	10
		85	6	60.0	6
		86	6	54.5	11
		87	3	25.0	7
470.2	LICKING RIVER	80	3	27.3	24.0
		81	2	16.7	40
		82	1	9.1	11.0
	Kenton Co.	83	0	.	.
	Water Works	84	3	25.0	6
	mp 4.5	85	3	30.0	7
		86	3	27.3	8
		87	1	10.0	7
490.0	NORTH BEND	80	2	16.7	41
		81	5	41.7	33
	Miami Fort	82	1	8.33	15
	Power Station	83	2	20.0	20
		84	0	.	.
		85	3	37.5	6
		86	3	27.7	10
		87	1	8.3	5

Key: NE = Number of Exceedances, %EXCEED = Percent Exceedances, MAX = Maximum ug/l

TABLE 17

EXCEEDANCES OF STREAM CRITERION - 1980-1987

RIVER MILE	STATION	YEAR	PHENOLICS NE	PHENOLICS %EXCEED	PHENOLICS MAX
491.1	GREAT MIAMI RIVER Lost Bridge rm 5.5	80	4	33.3	15
		81	7	58.3	45
		82	2	16.7	18
		83	1	11.1	16
		84	0	.	.
		85	4	50.0	12
		86	8	72.7	9
		87	4	36.4	7
531.5	MARKLAND Markland Hydro	80	2	16.7	14
		81	3	27.3	36
		82	1	9.1	9
		83	1	10.0	10
		84	0	.	.
		85	2	25.0	6
		86	2	18.2	5
		87	0	.	.
600.6	LOUISVILLE Louisville Water Works	80	1	8.3	14
		81	6	50.0	32
		82	2	16.7	5
		83	1	9.1	16
		84	1	8.3	18
		85	2	18.2	6
		86	1	8.3	10
		87	0	.	.
625.9	WEST POINT Mill Creek Power Station	80	1	8.3	7
		81	4	33.3	76
		82	2	16.7	5
		83	1	9.1	10
		84	1	8.3	14
		85	1	8.3	6
		86	2	18.2	6
		87	0	.	.

TABLE 17 (Cont.)

Key: NE = Number of Exceedances, %EXCEED = Percent Exceedances, MAX = Maximum ug/l

and West Point. There is no apparent trend for the other stations analyzed.

Lead: It appears from the data presented that the rate of exceedance of the chronic criteria is increasing at all stations. Two things should be clarified regarding this:

1) The detection level has varied over the period of record. The detection level has generally lowered.

2) The chronic criterion is generally below the detection level, therefore any detection is an exceedance of the criterion. The increase in exceedances of the chronic criterion implies that the detection rate is increasing, which leads back to the above argument. Caution should be used with regard to these data.

Methylene Chloride: Exceedance of the 10^{-6} CRL at Cincinnati has declined over the period of record. It appears that the rate of exceedance at Louisville has increased.

Mercury: The rate of exceedance of the chronic criterion for mercury appears to have not changed for all stations in the study area.

Phenolics: The rate of exceedance of the criterion for phenolics appears to have not changed for all stations in the study area. It should be noted that the data indicate that the rate of exceedance of the phenolics criterion is higher for the Little Miami and the Great Miami Rivers than for the other stations in the study area.

Nickel: No conclusions can be made with regard to the rate of exceedance of the human health criterion established for nickel based on limited observations.

4.0 PRELIMINARY ANALYSIS

Two Commission reports, The Presence of Toxic Substances in the Ohio River, and Assessment of Water Quality Conditions: Ohio River 1986 - 1987, identified both point and non point sources as causing impacts to Ohio River water quality in the study area. Methylene chloride, chloroform, phenolics and metals have been attributed to point sources while copper, and lead have been attributed to nonpoint sources. Further analysis is presented here to better define the relative contributions between point and nonpoint sources and to assess trends in the data.

4.1 Loading Analysis

An evaluation of flowing loads versus discharge loads was performed to assess the impact of point source discharges on water quality in the study area. Flowing loads were calculated using flow and concentration data for each station. Average flowing loads were used for this analysis. The following relation was used to determine average flowing load:

$$\text{flowing load} = (\Sigma(\text{conc}*\text{flow}))/n$$

Where:

conc - parameter concentration
flow - stream flow
n - number of observations

Discharge loads were determined using data in the Commission Toxic Substance data base. These data were obtained from member State files for all main stem dischargers. The effluent data is typically data from the NPDES application (Form 2C) submitted to the states. The data is not current. Discharge sampling, conducted as part of the Toxic Substance Control Program investigation of the Wheeling to Parkersburg segment, accented the deficiencies of these data. Data obtained in that study agreed with the 2C data at less than 50% of the facilities. In most cases the more recent effluent data showed the parameter concentrations to be less than previously reported. It would be expected that any analysis based on the data in the Commission data base would over emphasize any problems.

Table 18 displays the results of the loading calculations. The table shows the calculated flowing loads at each of the monitored stations, the cumulative discharge load between monitoring stations and the tributary contribution. It is obvious that, for most parameters, the relative contribution due to point sources is minimal compared to the instream flowing load. Figure 2 displays the total load, based on available data, contributed by major dischargers (flow >10 mgd) in the study area. The largest discharger (Mill Creek Plant, Cincinnati MSD) contributes less than 200 lbs/day of the parameters of concern combined. It should also be pointed out

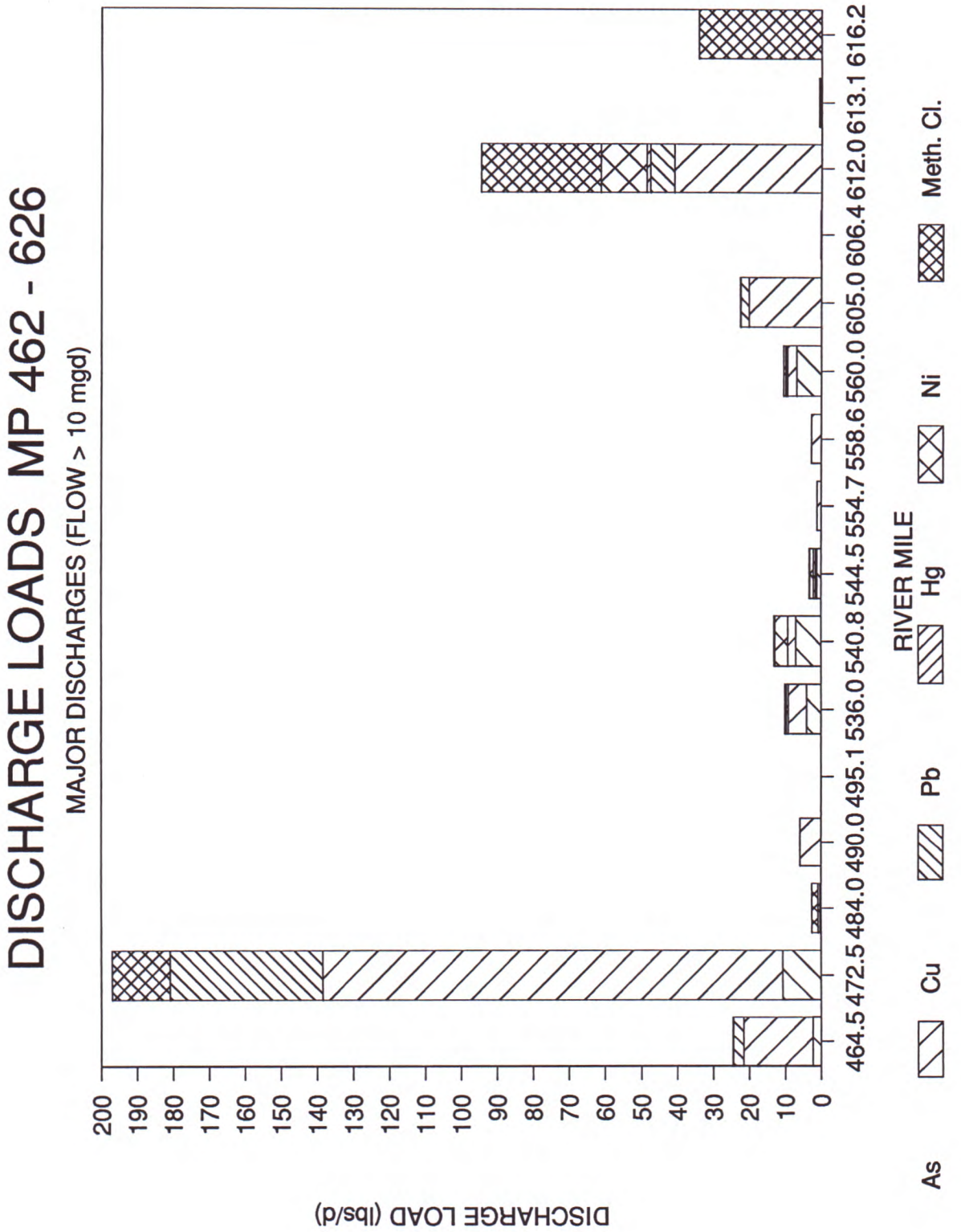
TABLE 18

FLOWING LOADS AND DISCHARGE LOADS OF PARAMETERS OF CONCERN

RIVER SEGMENT	ARSENIC			COPPER		
	FLOW LOAD	DIS. LOAD	TRIB LOAD	FLOW LOAD	DIS. LOAD	TRIB LOAD
CINCINNATI 462.8	1722.2			52337.0		
462.8 - 490.0	343.2	13.2	123.0	11604.0	147.2	576.0
490.0 - 531.5	1222.6	0.0	109.0	12956.0	5.8	488.0
531.5 - 600.6	1122.4	19.1		13521.0	14.1	
600.6 - 625.9	743.7	0.1		9169.0	61.2	
	LEAD			MERCURY		
	FLOW LOAD	DIS. LOAD	TRIB LOAD	FLOW LOAD	DIS. LOAD	TRIB LOAD
CINCINNATI 462.8	10661.0			9288.1		
462.8 - 490.0	6728.0	45.0	529.0	185.0	0.1	5.9
490.0 - 531.5	8609.0	0.0	529.0	133.0	0.0	8.9
531.5 - 600.6	6705.0	1.0		126.0	0.1	
600.6 - 625.9	6970.0	9.1		93.0	1.1	
	NICKEL			PHENOLICS		
	FLOW LOAD	DIS. LOAD	TRIB LOAD	FLOW LOAD	DIS. LOAD	TRIB LOAD
CINCINNATI 462.8	14380.4			1618.0		
462.8 - 490.0	8920.5	0.1	1247.0	3837.0	0.6	117.0
490.0 - 531.5	19146.2	0.0	470.0	2703.0	0.0	240.0
531.5 - 600.6	3329.2	0.1		3475.0	5.8	
600.6 - 625.9	8063.3	1.1		3285.0	13.1	
	CHLOROFORM			METHYLENE CHLORIDE		
	FLOW LOAD	DIS. LOAD		FLOW LOAD	DIS. LOAD	
CINCINNATI 462.8	120.0			171.0		
462.8 - 490.0		1.2			17.9	
490.0 - 531.5		0.1			0.0	
531.5 - 600.6	119.0	0.4		246.0	0.8	
600.6 - 625.9		5.8			33.5	

FLOW LOAD - FLOWING LOADS MEASURED AT MAIN STEM STATIONS
(mp 462.8, 490.0, 531.5, 600.6, and 625.9)
DIS. LOAD - TOTAL DISCHARGE LOAD FROM POINT SOURCES BETWEEN MONITORING STATIONS
TRIB LOAD - TRIBUTARY FLOWING LOAD

FIGURE 2


DISCHARGE LOADS MP 462 - 626
MAJOR DISCHARGES (FLOW > 10 mgd)
DISCHARGE LOAD (lbs/d)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
464.5 472.5 484.0 490.0 495.1 536.0 540.8 544.5 554.7 558.6 560.0 605.0 606.4 612.0 613.1 616.2
RIVER MILE
As
Cu
Pb
Hg
Ni
Meth. Cl.

that the Mill Creek data was obtained prior to reaching compliance with permit limits established by the Ohio EPA. While point sources should not be ignored, less emphasis will be placed on the impact due to point sources.

The loading calculations also indicate that there may be a problem with the data from the Cincinnati station. Flowing loads for copper, mercury and lead are inconsistent with data from the other stations. These data also indicate that there is little overall gain in flowing load through the study segment, for the parameters of concern. This indicates the contribution of these parameters from upstream sources.

4.2 Trend Analysis

Evaluation of trends in water quality data was performed for the parameters of concern at all stations in the study area. The Seasonal Kendall Tau Test (Hirsch, et.al., 1982) has been identified as the most appropriate methodology for evaluating trends in water quality data. The Seasonal Kendall Tau Test is a nonparametric test which has been applied by the State of Pennsylvania Department of Environmental Resources.

Table 19 summarizes the result of the trend analysis. The table displays each station and the parameters of concern along with summary information for the period of record, 1978 - 1987.

TABLE 19

TREND ANALYSIS: SEASONAL KENDALL TEST

STATION: Cincinnati MP 462.8
PERIOD OF RECORD: 1978 - 1987

PARAMETER	NUMBER OF OBSER.	MEAN	RANGE	TREND
CHLOROFORM	96*	0.15	0.1 - 0.8	-
COPPER	117	132	5 - 2240	0
LEAD	77	12	5 - 100	-
METHYLENE CHLORIDE	96*	0.1	0.1 - 1.0	-
MERCURY	52	0.1	0.1 - 1.7	0
PHENOLICS	77	3	1 - 68	0

TREND ANALYSIS: SEASONAL KENDALL TEST

STATION: Little Miami River MP 464.1
PERIOD OF RECORD: 1978 - 1987

PARAMETER	NUMBER OF OBSER.	MEAN	RANGE	TREND
COPPER	115	15	5 - 440	-
LEAD	87	15	5 - 110	-
MERCURY	57	0.2	0.1 - 9.6	0
PHENOLICS	88	5	1 - 45	0

* - average monthly value used
mean and range expressed as ug/l
trend - - Decreasing Trend. Probability > 95%
0 No trend. Probability < 95%
+ Increasing trend. Probability > 95%

TABLE 19 (Cont.)

TREND ANALYSIS: SEASONAL KENDALL TEST

STATION: Licking River MP 470.2
PERIOD OF RECORD: 1978 - 1987

PARAMETER	NUMBER OF OBSER.	MEAN	RANGE	TREND
COPPER	113	12	5 - 280	-
LEAD	61	8	5 - 80	-
MERCURY	50	0.1	0.1 - 0.8	0
PHENOLICS	78	5	1 - 81	-

TREND ANALYSIS: SEASONAL KENDALL TEST

STATION: North Bend MP 490.0
PERIOD OF RECORD: 1978 - 1987

PARAMETER	NUMBER OF OBSER.	MEAN	RANGE	TREND
COPPER	111	19	5 - 336	-
LEAD	81	10	5 - 59	-
MERCURY	56	0.2	0.1 - 5	0
PHENOLICS	61	5	1 - 47	-

mean and range expressed as ug/l
trend - - Decreasing Trend. Probability > 95%
0 No trend. Probability < 95%
+ Increasing trend. Probability > 95%

TABLE 19 (Cont.)

TREND ANALYSIS: SEASONAL KENDALL TEST

STATION: Great Miami River MP 491.1
PERIOD OF RECORD: 1978 - 1987

PARAMETER	NUMBER OF OBSER.	MEAN	RANGE	TREND
COPPER	107	13	10 - 115	-
LEAD	76	17	5 - 336	-
MERCURY	52	0.1	0.1 - 1.5	0
PHENOLICS	72	5	1 - 45	0

TREND ANALYSIS: SEASONAL KENDALL TEST

STATION: Markland Locks and Dam MP 531.5
PERIOD OF RECORD: 1978 - 1987

PARAMETER	NUMBER OF OBSER.	MEAN	RANGE	TREND
COPPER	107	17	5 - 235	0
LEAD	76	15	5 - 300	-
MERCURY	74	0.2	0.1 - 2.7	-
PHENOLICS	59	5	1 - 76	0

mean and range expressed as ug/l
trend - - Decreasing Trend. Probability > 95%
0 No trend. Probability < 95%
+ Increasing trend. Probability > 95%

TABLE 19 (Cont.)

TREND ANALYSIS: SEASONAL KENDALL TEST

STATION: Louisville MP 600.6
PERIOD OF RECORD: 1978 - 1987

PARAMETER	NUMBER OF OBSER.	MEAN	RANGE	TREND
CHLOROFORM	96*	0.08	0.1 - 0.4	-
COPPER	113	31	5 - 340	0
LEAD	72	11	5 - 220	-
METHYLENE CHLORIDE	96*	0.1	0.1 - 0.7	-
MERCURY	55	0.1	0.1 - 1	0
PHENOLICS	40	2	1 - 32	-

TREND ANALYSIS: SEASONAL KENDALL TEST

STATION: West Point MP 625.9
PERIOD OF RECORD: 1978 - 1987

PARAMETER	NUMBER OF OBSER.	MEAN	RANGE	TREND
COPPER	105	13	5 - 100	-
LEAD	90	13	5 - 70	-
MERCURY	60	0.1	0.1 - 1	0
PHENOLICS	51	3	1 - 76	-

* - average monthly value used
mean and range expressed as ug/l
trend - - Decreasing Trend. Probability > 95%
0 No trend. Probability < 95%
+ Increasing trend. Probability > 95%

The data presented includes the number of observations, mean value, the range of values and trend of the data for the period of record. Trends were evaluated for a 95% significance level.

There were no cases where a significant increasing trend was indicated. In most cases the a significant decreasing trend was indicated.

The trend analysis at Cincinnati indicated a decreasing trend in concentration of chloroform, lead, and methylene chloride. The analysis indicated no trend in concentrations of copper, mercury and phenolics.

The trend analysis for the Little Miami River indicated a decreasing trend in levels of copper and lead. No trend was observed for mercury and phenolics.

The trend analysis for the Licking River indicated decreasing trends in levels of copper, lead and phenolics. No trend was observed in mercury levels.

Trend analysis at North Bend indicated decreasing trends in the concentrations of copper, lead and phenolics. No trend was indicated for mercury.

Trend analysis for the Great Miami River indicated decreasing trends in levels of copper and lead. No trend was indicated for mercury and phenolics.

Trend analysis at Markland indicated decreasing trends in levels of lead and mercury. No trends were detected for copper and phenolics.

Trend analysis at Louisville indicated decreasing trends in levels of chloroform, lead, methylene chloride, and phenolics. No trends were detected for copper and mercury levels.

Trend analysis at West Point indicated decreasing trends in copper, lead, and phenolics. No trend was detected in mercury.

The Commission has committed to investigate trends in water quality as part of its water quality assessment program. A final and separate report on that activity is anticipated in 1989.

4.3 Nonpoint Source Assessment

Inspection of flowing loads vs. discharge loads indicates that the relative contribution of toxics from point sources is minimal. This implies that the toxic substances found in the water column are not point source related. Therefore, the

influences of nonpoint, upstream and ground water sources must be significant.

In order to evaluate the influence of non point source pollution in the study area correlations between stream flow and parameter concentrations were evaluated. A positive correlation with flow would indicate that the parameter was contributed from non point sources. A negative correlation with flow indicates point source contribution and/or ground water contribution.

The Commission monitoring data was analyzed through use of the Statistical Analysis System (SAS) procedure PROC CORR. The data were log transformed due to the non normal distribution and the variability of the data. The Pearson Product Moment correlations were determined after the logged data were tested for normality (Shapiro-Wilk, 1965 or Kolomgrov-D, (Stephens, 1974) tests). Those data which did not pass these tests at the 95% confidence level were not included in the analysis.

Table 20 displays the summary of this analysis. The table displays which parameters at each station correlate with flow. There were no instances of a negative correlation with flow, indicating minimal point source or ground water impact in the study area. The following is a summary of the analysis by parameter:

TABLE 20

Correlation Of Concentration With Flow

+ Positive Correlation - Negative Correlation No correlation

Period of Record: 01/01/78 - 01/01/88

STATION \ PARAMETER		As	Cu	Pb	Hg	Ni	Phen.
Cincinnati	462.8			+			
Little Miami	464.1		+				
Licking	470.2			+			
North Bend	490.0		+	+			
Great Miami	491.1		+				
Markland	531.5						+
Louisville	600.6	+					
West Point	625.9		+			+	

Arsenic - Positively correlated with flow at Louisville.

Copper - Positively correlated with flow at North Bend and West point and for the Little Miami and the Great Miami Rivers.

Lead - Positively correlated with flow at Cincinnati, and North Bend and for the Licking River.

Mercury - No significant correlations at any station.

Nickel - Positively correlated with flow at West Point.

Phenolics - Positively correlated with flow at Markland.

5.0 CONCLUSIONS

Based on the analysis presented in the previous sections the following conclusions can be reached:

1) Commission data indicates that, for all parameters of concern at all stations within the study area, constituent concentrations have decreased significantly or have held constant for the period of record 1978 - 1987.

2) Point source loadings will at the most cause only site specific toxic problems.

3) Ground water contribution is at most site specific.

4) Flowing loads do not appear to increase through the study area, indicating influence from upstream sources.

5) Further investigation is needed to characterize the impact of PCBs from the Great Miami basin on the Ohio River.

6) A characterization of the impact of combined sewer overflows in the Mill Creek Valley is needed.

7) An evaluation of the Cincinnati manual station is needed.

8) Updated toxic substance data are needed for the major discharges in the study area, in particular those facilities which were identified in the 304(l) process.

9) Additional data and evaluation are needed characterize the impact of oil brine disposal practices on the Licking and Kentucky Rivers.

10) Additional data and evaluation are needed to characterize the extent and nature of contamination of ground water in the study area.

6.0 PROPOSED FIELD STUDY

Based on the data analysis presented a five-part field study is proposed to better detect sources of toxic substances to the Ohio River in the Cincinnati to Louisville study area.

1) Water quality transect samples at six Ohio River main stem sites and tributary sites.

2) Sediment samples from five Ohio River main stem sites and five tributary sites.

3) A sampling program to characterize the impact of combined sewer overflows (CSOs) on the Mill Creek Valley on the Ohio River main stem.

4) Fish samples collected from the Ohio River main stem and the Great Miami River to characterize the impact of urban runoff on contaminants in fish tissue.

5) Effluent analysis at 14 Ohio River main stem NPDES facilities.

Table 21 outlines what parameters each sample is to be analyzed for. The analyses will concentrate on the parameters of concern, with the exception being basic water quality parameters

which provide a better understanding of the chemistry (Total Dissolved Solids, Total Suspended Solids, Temperature, pH, Dissolved Oxygen, Conductivity, and Total Hardness).

Table 21

Parameters for Analysis

Analyte/Sample	Water	Sed	Fish
Temperature	X		
pH	X		
Dissolved Oxygen	X		
Conductivity	X		
Hardness	X		
Total Suspended Solids	X		
Arsenic	X	X	
Copper	X	X	
Lead	X	X	
Mercury	X	X	
Nickel	X	X	
Phenolics	X	X	
Volatile Organics	X*		
Pesticides		X	X
PCBs		X	X

*Only at selected stations, see Table 22

6.1 Water Quality Transects

Table 22 displays the locations where transect samples are to be collected, the parameters to be analyzed and the rationale for sampling. At each site vertical composite samples will be collected at three points across the waterbody, at the centerline, and at the left and right quarter points. The vertical composites will consist of water samples collected at one meter depth, mid-depth and bottom. Volatile organic samples will be collected from each quarter point at mid-depth of the river channel. The recommended transect locations will provide data on the influence (ground water infiltration and direct discharge) of ash ponds on main stem water quality, provide data on the Kentucky River downstream of the NASQAN station, provide data on the possible contribution from contaminated ground water in the area known as "Rubbertown" in southwest Louisville, Kentucky, and to characterize water quality of the up and downstream ends of the study segment.

Quality Assurance Cross Sections

Intensive review of the data demonstrated a deficiency in the data obtained at the Cincinnati Station (M.P. 467.8). Loading analysis raised specific questions with regard to reported values of copper, lead and mercury. Therefore it is recommended that as

TABLE 22

PROPOSED WATER COLUMN SAMPLING LOCATIONS
CINCINNATI-LOUISVILLE SEGMENT

SITE ID		RIVER MILE	PARAMETERS	RATIONALE
Cincinnati Water Works	ORWC1	462.8	Metals, conventionals, VOCs	Upstream end of study segment Questions regarding monitoring station data
Kentucky River	KRWC1	*4.0	Metals, conventionals	Characterization of contribution to Ohio River
Madison, Indiana	ORWC2	559.0	Metals, conventionals	Background sample for Hanover Beach sample
Hanover Beach, Indiana	ORWC3	563.0	Metals, conventionals	Characterize the impact of ash ponds to Ohio River
Louisville, Kentucky	ORWC4	611.0	Metals, conventionals, VOCs	Background sample for RM 615.6 sample
Louisville, Kentucky	ORWC5	615.6	Metals, conventionals, VOCs	Characterize the impact of Louisville industry on Ohio River
West Point, Kentucky	ORWC6	625.9	Metals, conventionals	Downstream end of the study segment

* - River miles from the confluence with the Ohio River - Upstream of Lock #1

Three depth integrated samples to be collected at each site 21 samples for each parameter set

Metals include: Arsenic, Copper, Lead, Mercury, Nickel
Volatile Organics by EPA method 502.2
Conventionals to include field parameters (temperature, pH, conductivity, and dissolved oxygen) + total suspended solids and hardness

part of the field survey a full quality assurance cross section analysis be performed at the Cincinnati manual monitoring station.

6.2 Sediment Samples

Collection of sediment samples will provide data to characterize the distribution of toxic substances. Many of the parameters of concern have low solubilities and higher concentrations would be expected in the sediments. Also, it has been demonstrated that many of the parameters are runoff related and therefore will be associated with sediment loads. Collection of sediment samples downstream of major tributaries and major dischargers will provide data on the behavior of these parameters as they mix with the flow of the main stem. Used in conjunction with water column samples much can be learned with regard to the fate of these parameters.

Sediment samples would also provide information or interaction of surface water and ground water. It would be expected that in areas of contaminated ground water the sediments reflect the types and concentration of contamination in the ground water reaching the surface water. The sediments provide the interface between the surface and ground water. Table 23 lists the sediment sampling sites. Locations for sampling sites are for general reference. It is recognized that field conditions will dictate the availability of sediment samples.

TABLE 23

PROPOSED SEDIMENT SAMPLING LOCATIONS
CINCINNATI-LOUISVILLE SEGMENT

SITE ID		RIVER MILE	PARAMETERS	RATIONALE
Little Miami River	LMS1	*****	Metals, pesticides, PCBs	Characterization of contribution from Little Miami River
Licking River	LRS1	*4.5	Metals, pesticides, PCBs	Characterization of contribution from Licking River
Ohio River	ORS1	472.0	Metals, pesticides, PCBs	Downstream of Mill Creek & Mill Creek WWTP
Mill Creek	MCS1	@@@@@	Metals, pesticides, PCBs	Characterization of contribution from Mill Creek
Ohio River	ORS2	474.0	Metals, pesticides, PCBs	Downstream of Mill Creek & Mill Creek WWTP
Great Miami	GMS1	*****	Metals, pesticides, PCBs	Characterization of contribution from Great Miami River
Ohio River	ORS3	491.0	Metals, pesticides, PCBs	Downstream of confluence of Great Miami River
Kentucky River	KRS1	*4.0	Metals, pesticides, PCBs	Characterization of contribution from Kentucky River
Ohio River	ORS4	611.0	Metals, pesticides, PCBs	Upstream of Louisville industrial area
Ohio River	ORS5	615.6	Metals, pesticides, PCBs	Downstream of Louisville industrial area

***** - To be determined in the field
@@@@@ - Upstream of the barrier dam

Metals include: Arsenic, Copper, Lead, Mercury, Nickel

For Ohio River Samples - discreet samples to be collected from each side of the river

6.3 Mill Creek Study

Combined sewer overflows into Mill Creek is an area of particular concern in the study area. These sewers carry a significant load of industrial waste to the Mill Creek WWTP (Hamilton County and Cincinnati MSD). It is recommended that an extended study be performed to quantify the loading contributed by Mill Creek to the Ohio River. It is recommended that samples be collected twice a month for six months, beginning in March 1989. Sampling during this time period will provide an opportunity to sample during the full range of flows expected. All samples should be analyzed for the parameters of concern and basic physical and chemical constituents (Temperature, Conductivity, Total Dissolved Solids, Total Suspended Solids, Hardness, and pH). The results of this sampling effort will then be incorporated into the recommended control program report for the study area.

6.4 Fish Sampling

Levels of PCBs and chlordane in fish tissue are of concern to the Commission. Exceedances of the FDA action levels at locations downstream of Cincinnati and Louisville demonstrate the need for additional sample collection and analysis to provide a better understanding of the extent of contamination. In particular, PCB loadings from the Great Miami River are of primary

concern in the study area. A PCB spill in the Dayton area exacerbated the problem and provided a greater emphasis on the problem in this basin. It is recommended that fish be collected, for tissue analysis, from the Great Miami and the Ohio Rivers for tissue analysis.

Sampling sites will be determined in the field but general sampling areas are shown on Table 24. It is recommended that fish be collected: (1) The Great Miami; well upstream of the confluence within the Ohio River to provide background on PCB levels in fish tissue in fish primarily habitating in the Great Miami River; (2) In the Oxbow area of the Great Miami River to assess PCB levels in fish which move in and out of the Great Miami River; (3) The Ohio River; upstream of Cincinnati; (4) The Ohio River; well upstream of the confluence with the Great Miami to provide background levels in the Ohio River; (5) The Ohio River; downstream of the confluence with the Great Miami River to assess the impact of the loadings from the Great Miami on fish which live primarily in the Ohio River; (6) The Ohio River; upstream of Louisville; and (7) The Ohio River; downstream of Louisville. It is recommended that five fish composites of two species be collected at each site. The species should be catfish and a game fish.

TABLE 24

PROPOSED FISH SAMPLING LOCATIONS
CINCINNATI-LOUISVILLE SEGMENT

SITE ID		RIVER MILE	PARAMETERS	RATIONALE
Ohio River	ORF1	460.0	Pesticides, PCBs	Upstream of Cincinnati
Ohio River	ORF2	480.0	Pesticides, PCBs	Downstream of confluence of the Great Miami River
Great Miami River	GMF1	*****	Pesticides, PCBs	Characterization of fish inhabiting the Great Miami River
Great Miami River	GMF2	+++++	Pesticides, PCBs	Characterization of fish inhabiting the Great Miami and the Ohio River
Ohio River	ORF3	492.0	Pesticides, PCBs	Downstream of the confluence with the Great Miami River
Ohio River	ORF4	593.0	Pesticides, PCBs	Upstream of Louisville
Ohio River	ORF5	625.9	Pesticides, PCBs	Downstream of Louisville metropolitan area

***** - Determined in the field
+++++ - Determined in the field

Two species to be collected at each station. Samples to be five fish (fillet) composites
1 - Channel Catfish
1 - Game Fish

6.5 Effluent Sampling

Effluent sampling is recommended for 14 dischargers on the main stem. These sites are recommended due to (1) volume of flow, (2) analyses carried out as part of the requirements of Section 304(l) of the Clean Water Act, and; (3) to update the toxic substances data base maintained by ORSANCO.

Table 25 lists those facilities which are recommended for sampling. In all cases all discharges, including noncontact cooling water, should be sampled at each facility.

TABLE 25

FACILITIES RECOMMENDED FOR EFFLUENT SAMPLING

RIVER MILE	FACILITY	NPDES
464.1	Little Miami WWTP	OH0025453
472.5	Mill Creek WWTP	OH0025461
477.4	Dry Creek WWTP	KY0021466
484.0	Monsanto	OH0009946
490.0	CG&E, Miami Fort Station	OH0009873
495.0	I&MEC, Tanner's Creek Station	IN0002160
495.1	Joseph Seagram and Sons	IN0003131
536.0	KY Utilities, Ghent Station	KY0002038
544.5	M&T Chemicals, Inc.	KY0001431
560.0	IN-KY Electric Co., Clifty Creek	IN0001759
605.0	Colgate-Palmolive	IN0003638
612.0	Morris Forman WWTP	KY0022411
613.6	LG&E, Paddy's Run Station	KY0002071
613.8	E.I. duPont	KY0001350

In all cases end-of-pipe effluent samples will be collected by state personnel as part of a compliance sampling inspection. Additional samples for analysis of the parameters of concern will be requested by ORSANCO.

6.6 Scheduling

Due to varied toxic substances concerns there is no one time to schedule sampling. Low flow conditions provide the best time for sampling sediments and collecting fish samples. Low flow will also provide better conditions for evaluating the impact of ground water or the surface waters. Low temperature conditions provide a greater probability of detecting certain parameters in the water column.

Low flow conditions are typically observed from August through October, with the lowest flow being in September. The Commission fish population studies will be conducted during September 1989 and Commission personnel and equipment will not be available at that time. Therefore, it is recommended that the field study be conducted by the end of October 1989.

6.7 Analytical Costs

During the May 1988 meeting of the Technical Committee it was recommended that all laboratory analyses be conducted at one laboratory to provide consistent detection levels and quality control/quality assurance. In order to provide adequate funding in the 1990 fiscal year budget an estimate of analytical costs is presented. These costs are based on the bids received for analytical costs for the 0-85 segment of the river. It is proposed that all samples taken during the field study be sent to one laboratory. It is also proposed that samples collected as part of the Mill Creek study be sent to the West Virginia Department of Natural Resources (WVDNR) laboratory for analyses with the organic analyses being performed by a contract laboratory. The use of the WVDNR laboratory for the Mill Creek samples is recommended because the samples will be collected by manual sampling personnel and can be sent along with other samples as an additional station.

Estimated Costs Are As Follows

Field Sampling Survey	$10,000
Mill Creek Survey	3,500
Fish Samples	3,000
	$16,500

References

Hirsch, R.M., Slack, J.R. & Smith, R.A., "Techniques of Trend Analysis for Monthly Water Quality Data." Water Resources Research, Vol. 18, No. 1, 102-121. Feb. 1982.

ORSANCO, Ohio River Water Quality Fact Book - 1986 (Ohio River Valley Water Sanitation Commission, 49 E. Fourth Street, Cincinnati, Ohio 45202). 1986.

ORSANCO, Pollution Control Standards: 1987 Revision. (Ohio River Valley Water Sanitation Commission, 49 E. Fourth Street, Cincinnati, Ohio 45202). 1987.

ORSANCO, The Presence of Toxic Substances in the Ohio River. (Ohio River Valley Water Sanitation Commission, 49 E. Fourth Street, Cincinnati, Ohio 45202). 1987.

ORSANCO, Assessment of Water Quality Conditions: Ohio River, 1986-87. (Ohio River Valley Water Sanitation Commission, 49 E. Fourth Street, Cincinnati, Ohio 45202). 1988.

ORSANCO, "Toxic Substances Control Strategy." (Ohio River Valley Water Sanitation Commission, 49 E. Fourth Street, Cincinnati, Ohio 45202). 1983.

Stephens, M.A., "EPF Statistics for Goodness of Fit and Some Comparisons." Journal of the American Statistical Association, Vol. 69, 730-737. 1974.

Shapiro, S.S. and Wilk, M.B., "An Analysis of Variance Test for Normality (complete samples)." Biometrika, Vol. 52, 591-611. 1965.

U.S. Doc, Statistical Abstract of the United States, 1987, 107th Edition. U.S. Department of Commerce, Bureau of the Census. 1987.

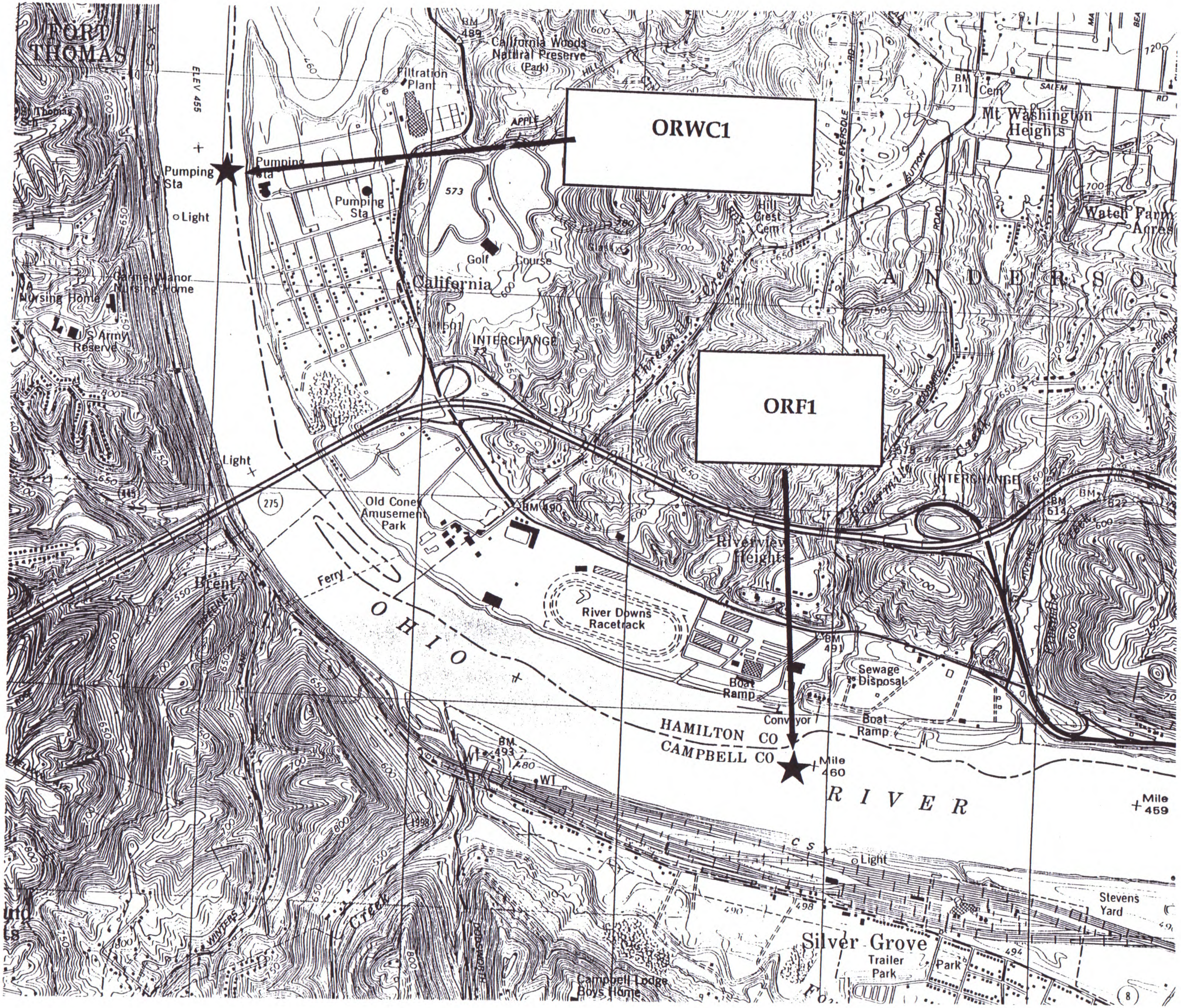
U.S. EPA, Ambient Water Quality Criteria for Polychlorinated Biphenyls, EPA 440/5-80-068, October 1980.

48 FR 45502

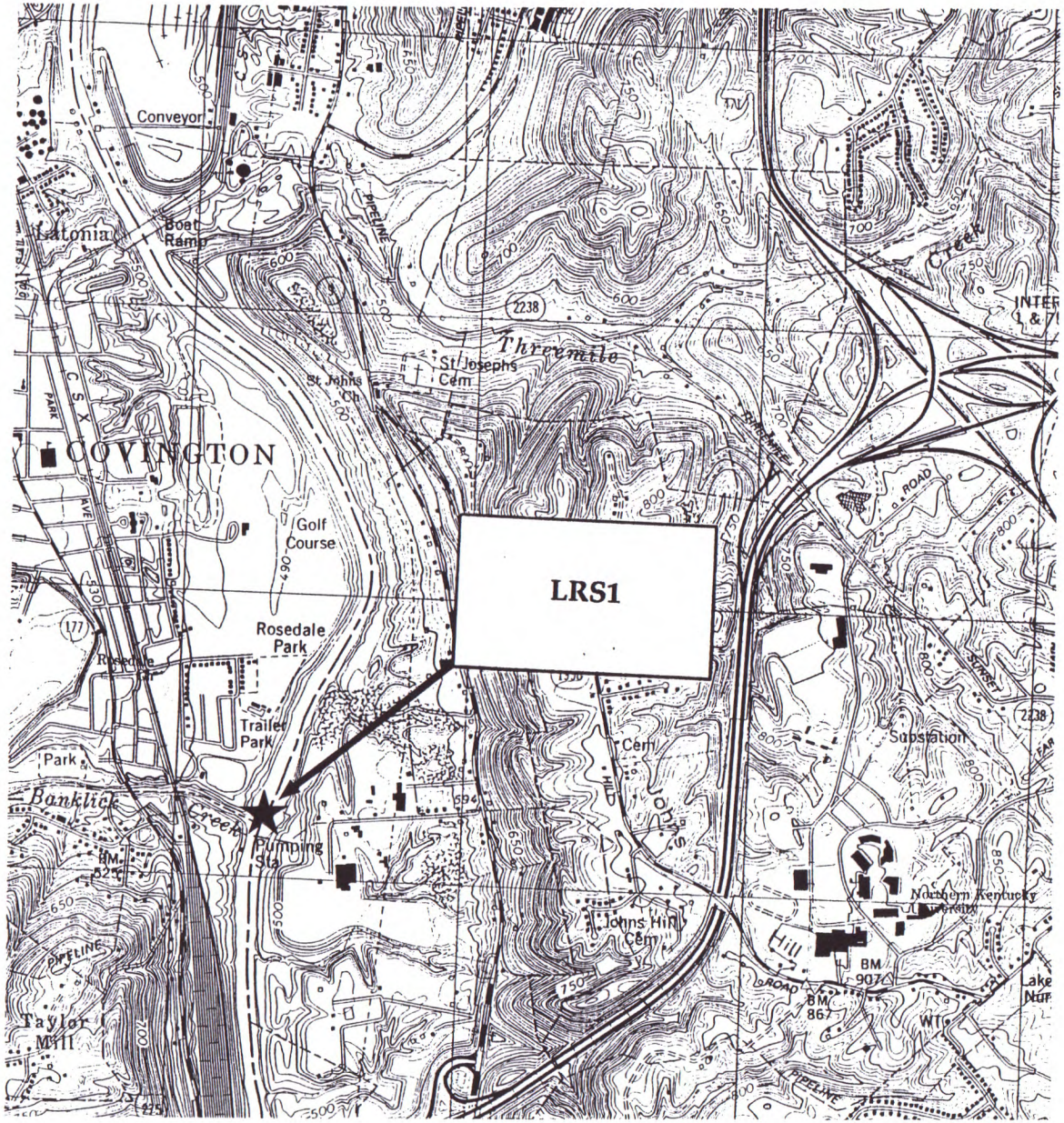
40 CFR 403.8

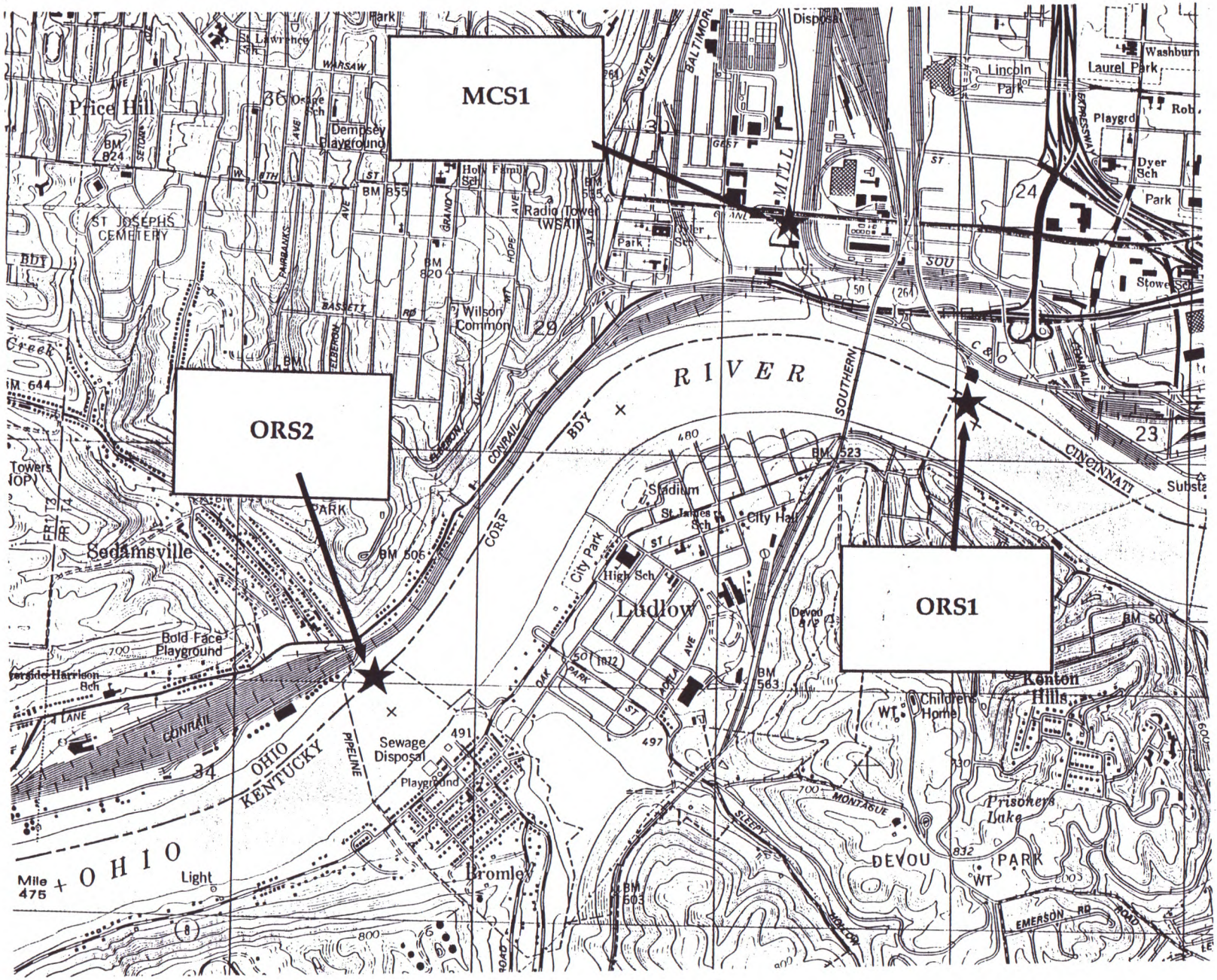
APPENDIX 1

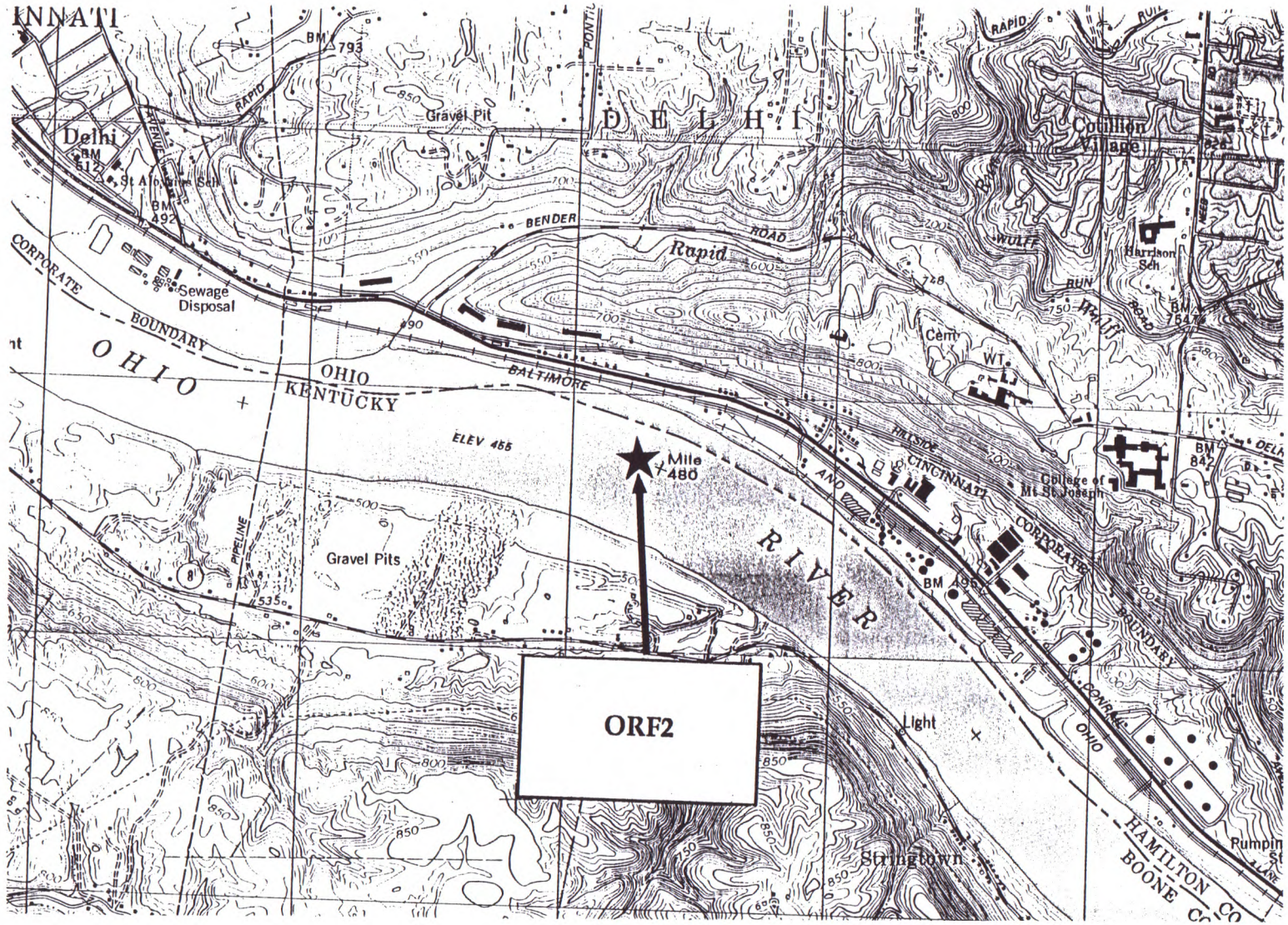
SAMPLING LOCATIONS

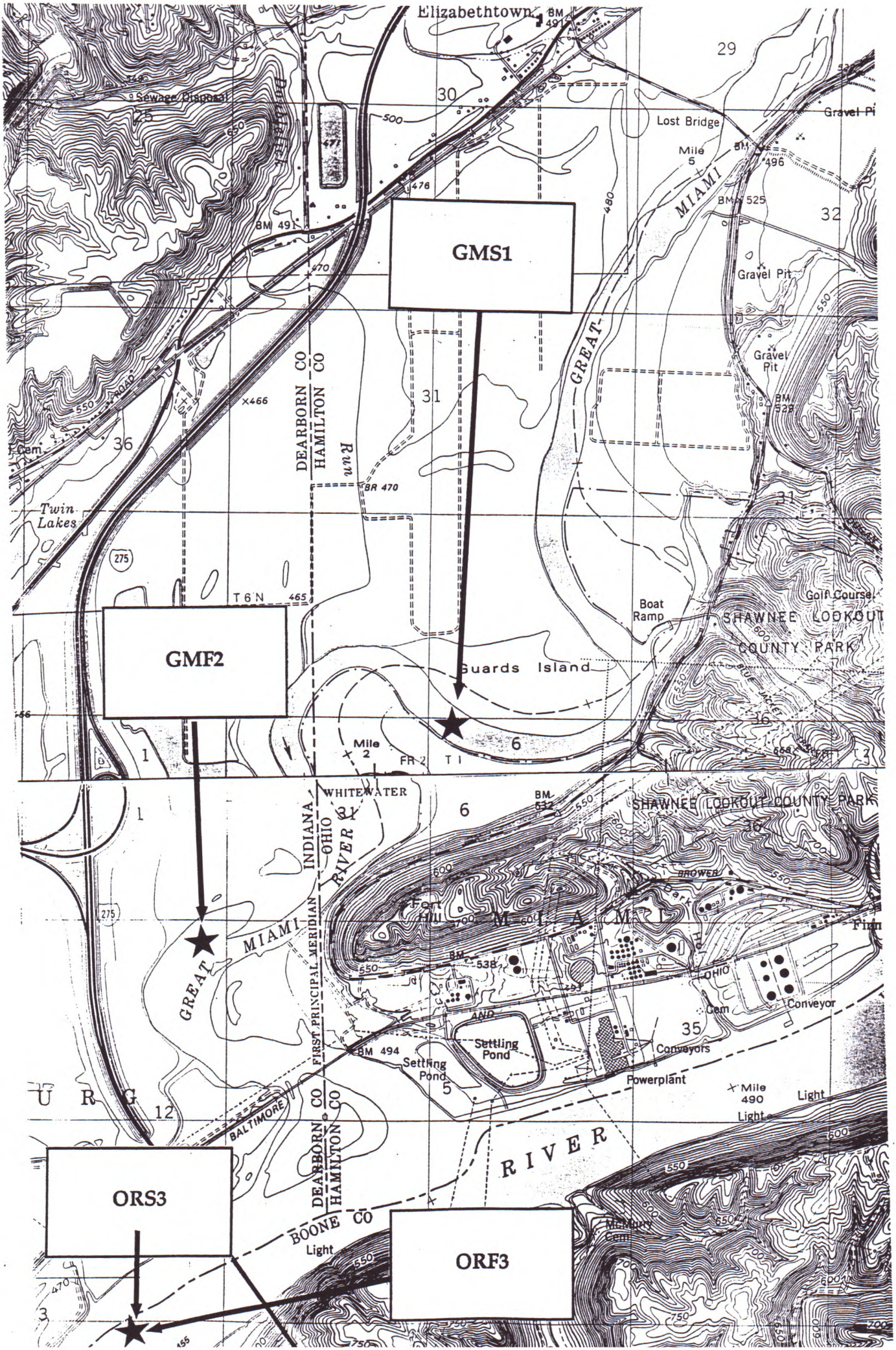


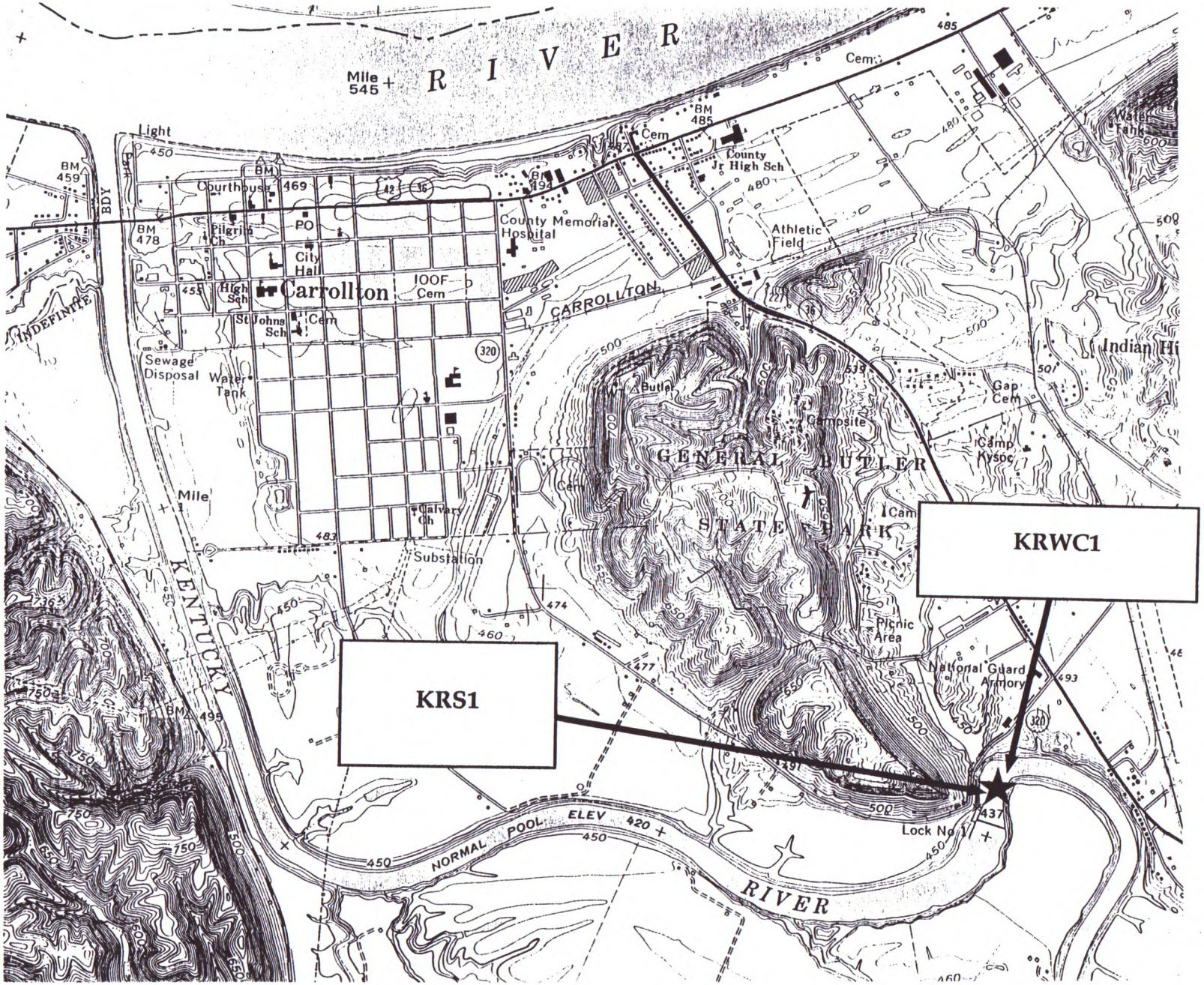
ORWC1
ORF1
FORT THOMAS
Pumping Sta
Light
Filtration Plant
California Woods Natural Preserve (Park)
Pumping Sta
Golf Course
California
INTERCHANGE 72
Carmel Manor Nursing Home
Nursing Home
Army Reserve
Old Coney Amusement Park
Ferry
OHIO
River Downs Racetrack
Boat Ramp
Conveyor
Sewage Disposal
Boat Ramp
HAMILTON CO
CAMPBELL CO
Mile 460
RIVER
Mile 459
Riverview Heights
INTERCHANGE
Hill Crest Cem
Mt Washington Heights
Watch Farm Acres
ANDERSO
Brent
Silver Grove
Trailer Park
Park
Stevens Yard
Campbell Lodge Boys Home
C S X
ELEV 455

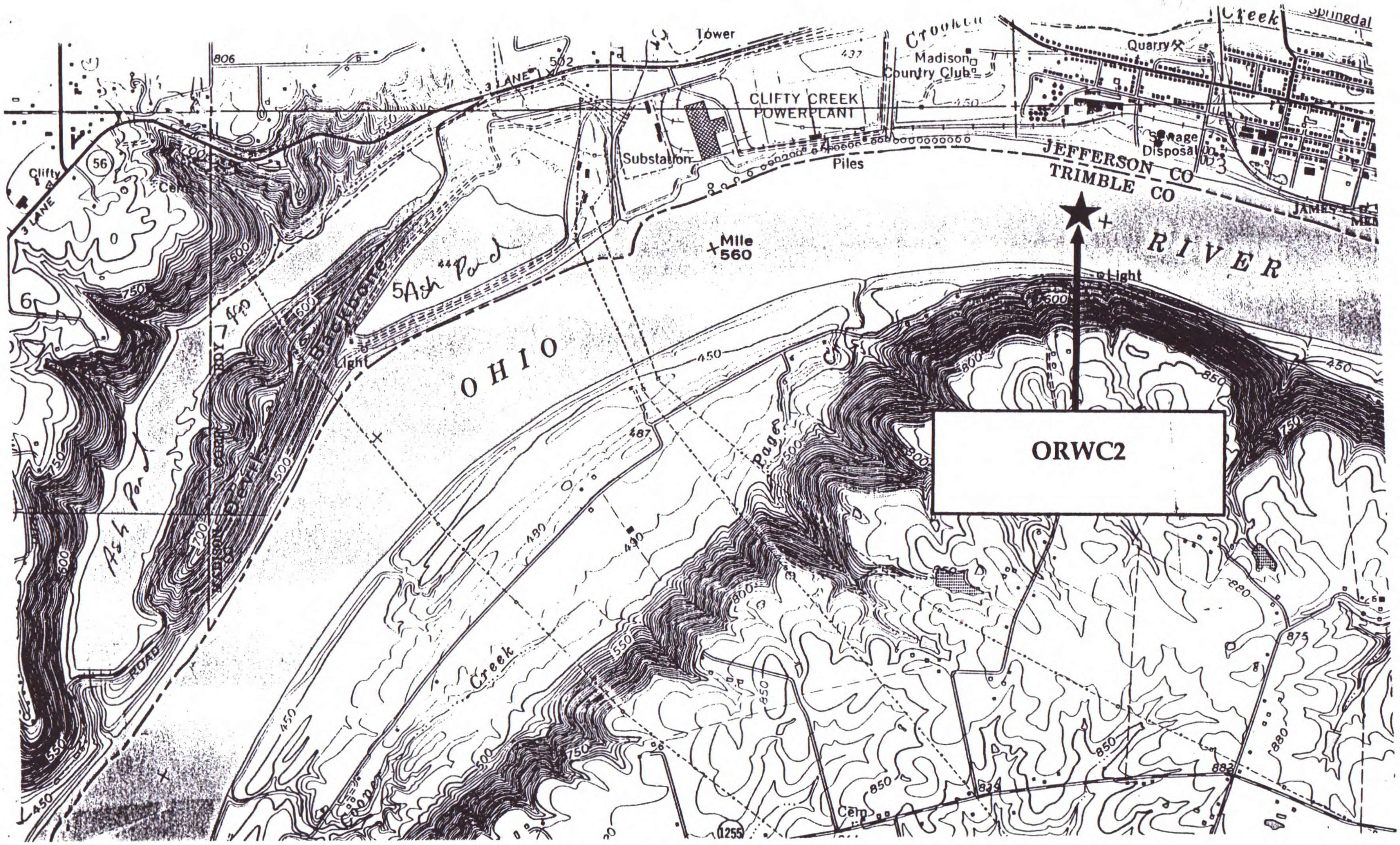

LRS1
COVINGTON
Latonia
Boat Ramp
Conveyor
Golf Course
Rosedale Park
Trailer Park
Park
Banklick Creek
Pumping Sta
St Joseph's Cem
St John's Ch
Threemile
Cem
Substation
Johns Hill Cem
Northern Kentucky
Taylor Mill
BM 907
BM 867
PIPELINE
C S X
ROAD
Hill
INTER 1 & 7
Lake Nur


MCS1
ORS2
ORS1
Price Hill
ST JOSEPHS CEMETERY
Dempsey Playground
Radio Tower (WSAI)
Wilson Common
Sedamsville
Bold Face Playground
Sewage Disposal
Playground
Bromley
Ludlow
City Park
High Sch
Stadium
St James Sch
City Hall
Lincoln Park
Laurel Park
Dyer Sch
Park
Kenton Hills
Children's Home
Prisoners Lake
DEVOU PARK
RIVER
OHIO
KENTUCKY
CONRAIL
SOUTHERN
CINCINNATI
BALTIMORE
MILL
PIPELINE
EMERSON RD
MONTAGUE
Mile 475
Light

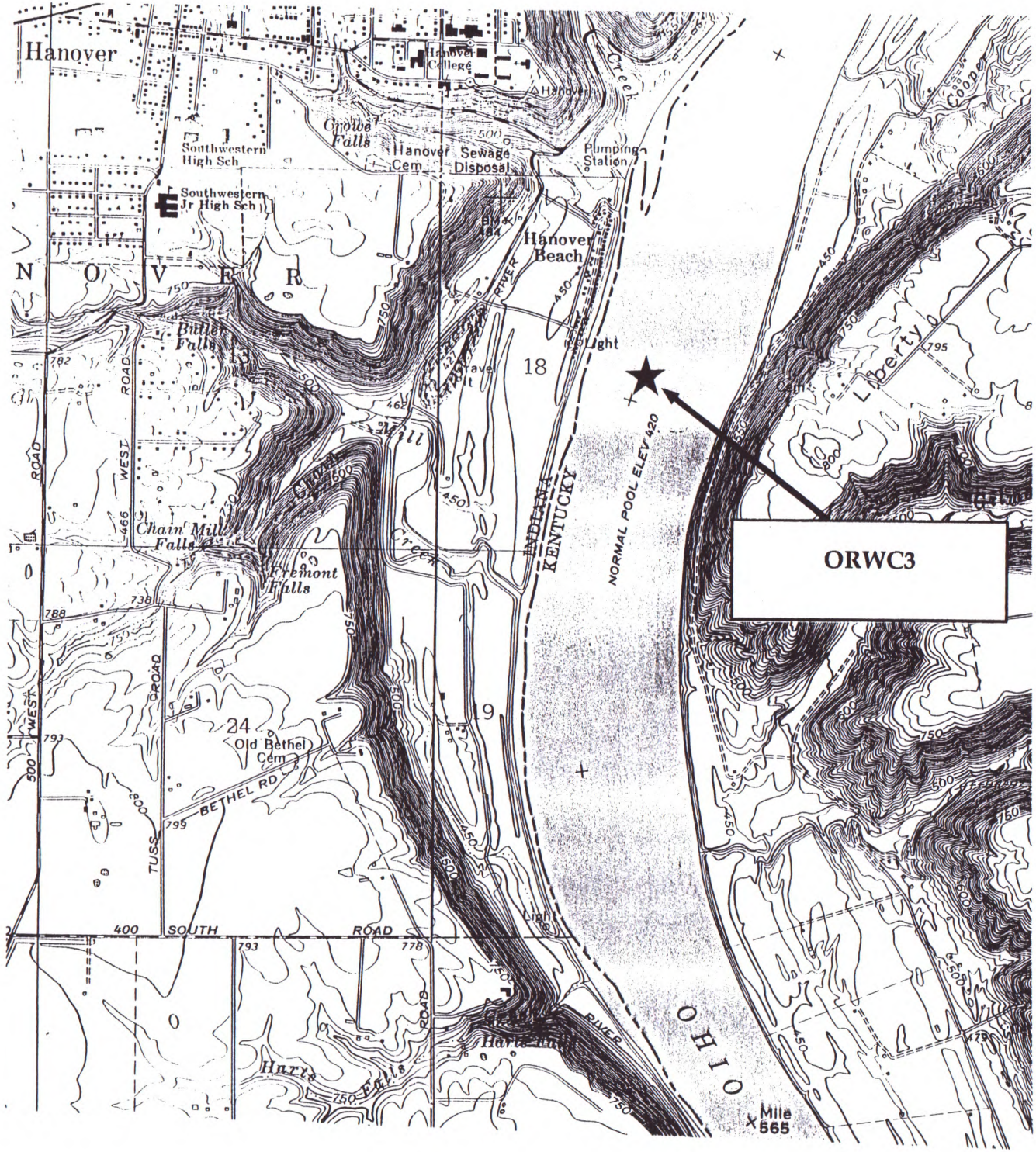

INNATI
Delhi
BM 512
St Aloysius Sch
BM 492
BM 793
Gravel Pit
D E L H I
Cotillion Village
RAPID
BENDER ROAD
Rapid
WULFF RUN ROAD
Harrison Sch
BM 754
Sewage Disposal
CORPORATE BOUNDARY
OHIO
KENTUCKY
BALTIMORE
Cem
WT
ELEV 455
Mile 480
RIVER
College of Mt St Joseph
CINCINNATI
Gravel Pits
PIPELINE
BM 842
BM 495
ORF2
light
Stringtown
HAMILTON CO
BOONE

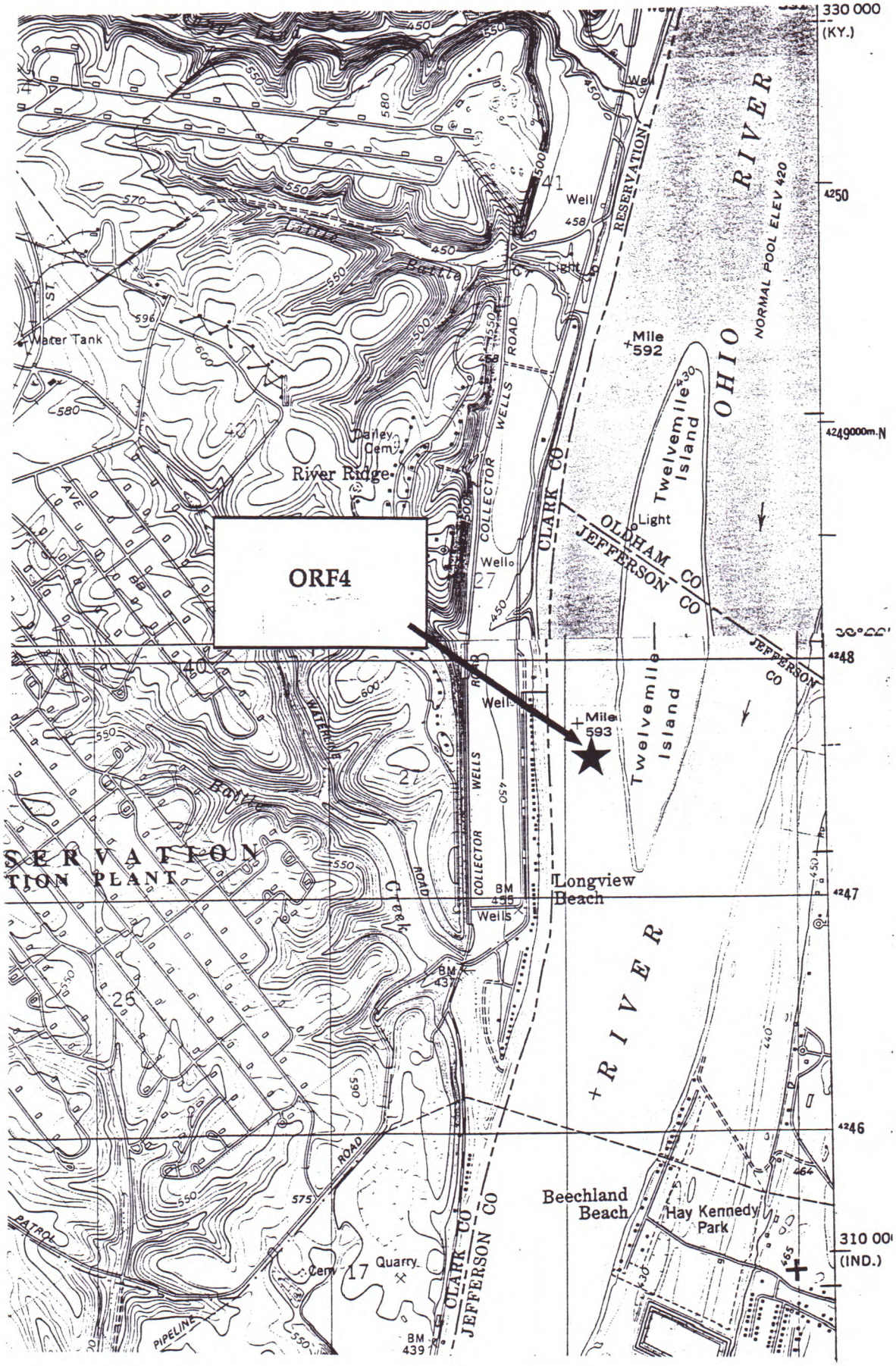

GMS1
GMF2
ORS3
ORF3
Elizabethtown
Lost Bridge
Gravel Pit
Gravel Pi
Sewage Disposal
Mile 5
BM 496
BM 525
BM 491
GREAT MIAMI
DEARBORN CO
HAMILTON CO
Run
Twin Lakes
Boat Ramp
Golf Course
SHAWNEE LOOKOUT COUNTY PARK
Guards Island
Mile 2
WHITEWATER
INDIANA
OHIO
RIVER
FIRST PRINCIPAL MERIDIAN
BALTIMORE
BOONE CO
Fort Hill
BROWER
BM 538
BM 532
Settling Pond
BM 494
Conveyors
Powerplant
Conveyor
Mile 490
Light
McMurry Cem
RIVER

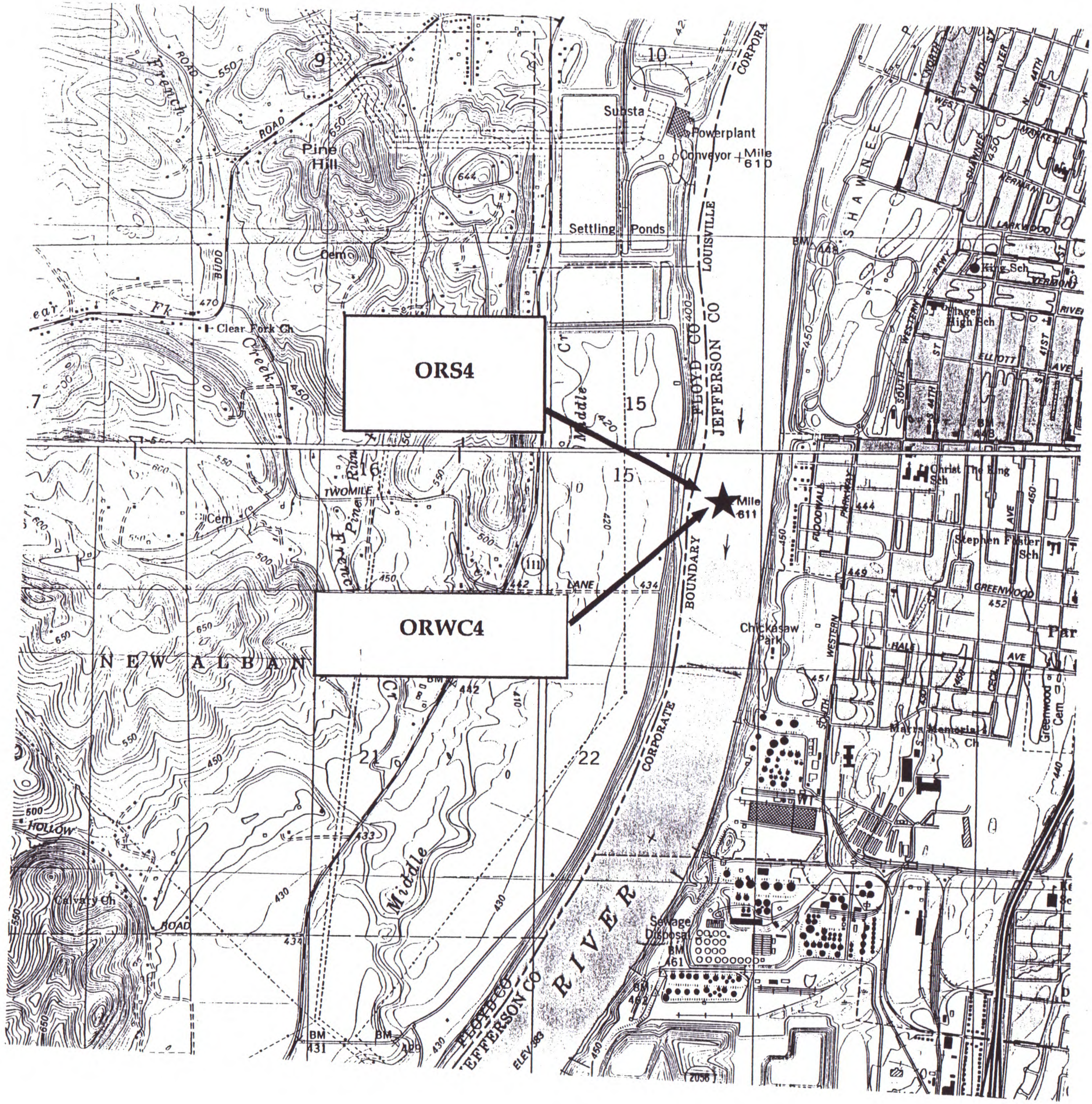

KRWC1
KRS1
R I V E R
Mile 545
Carrollton
CARROLLTON
GENERAL BUTLER
STATE PARK
KENTUCKY
RIVER
NORMAL POOL ELEV 420
Lock No 1
County Memorial Hospital
Athletic Field
County Jr High Sch
Courthouse
City Hall
Pilgrim Ch
PO
High Sch
St Johns Sch
Cem
IOOF Cem
Sewage Disposal
Water Tank
Substation
Calvary Ch
Campsite
Gap Cem
Camp Kysoc
Picnic Area
National Guard Armory
Light
BDY
INDEFINITE
Mile 1

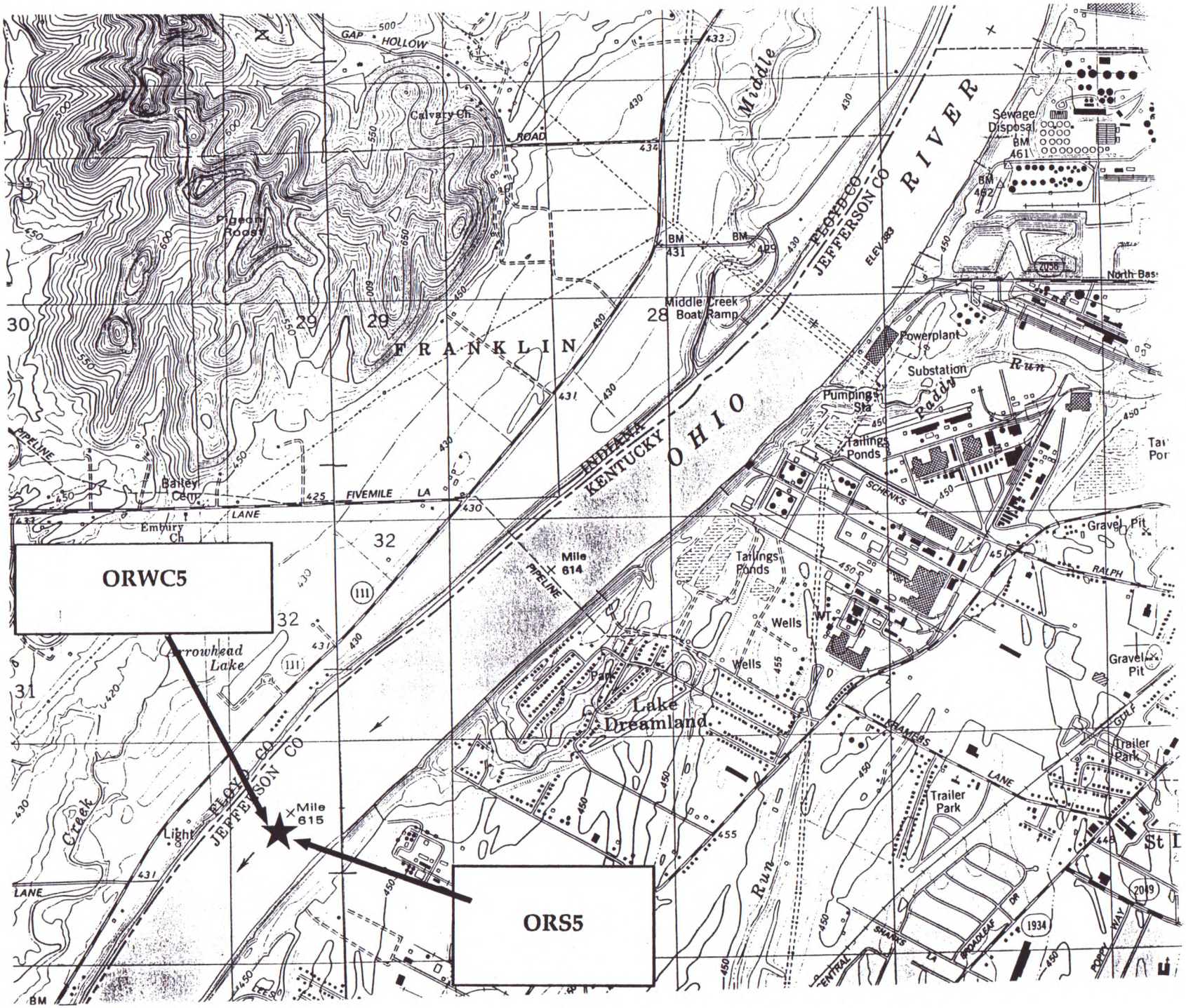


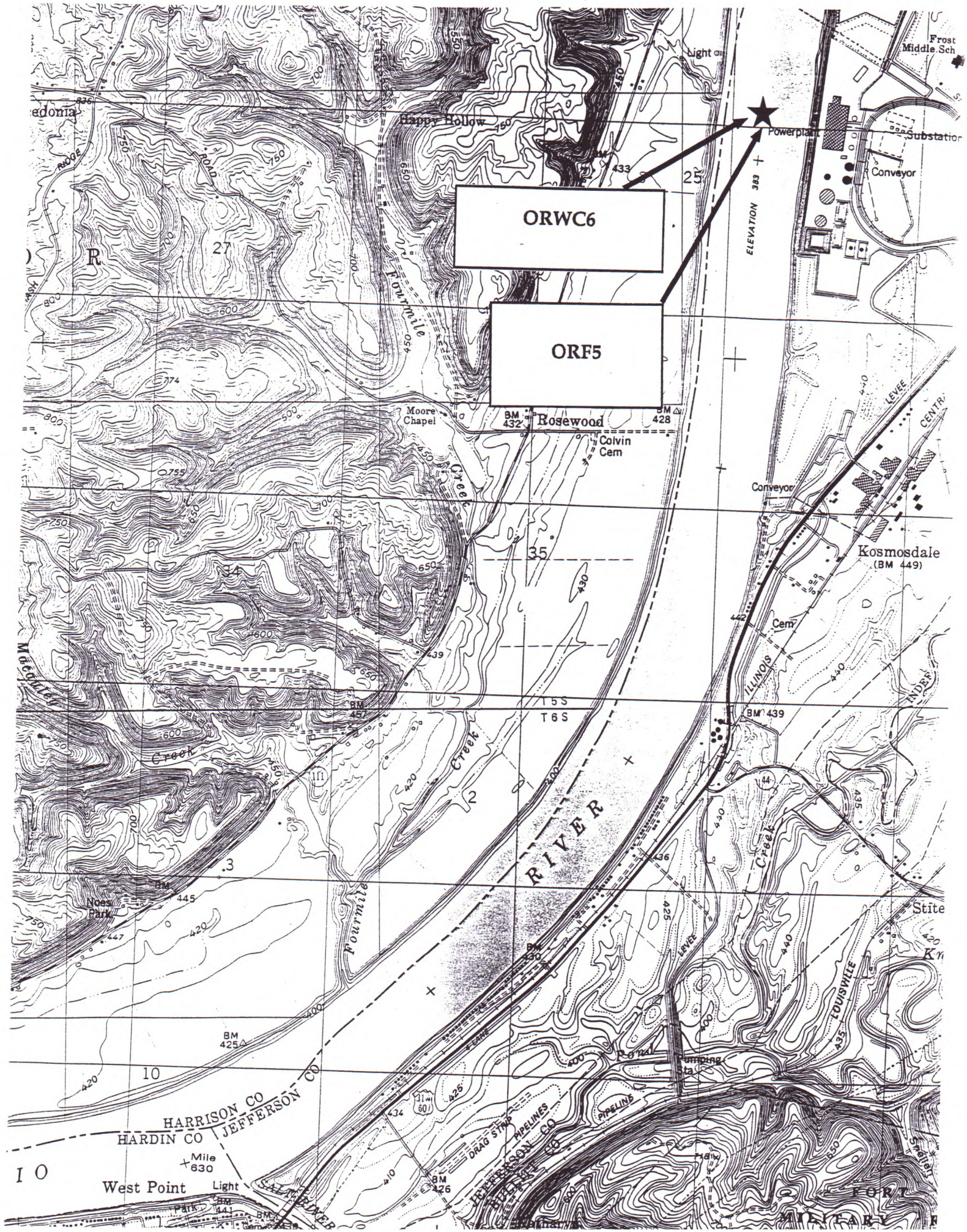
ORWC2
OHIO
RIVER
CLIFTY CREEK
POWERPLANT
Substation
Piles
Mile
560
JEFFERSON CO
TRIMBLE CO
Madison
Country Club
Quarry
Sewage
Disposal
Tower
Light
Devils Backbone
Ash Pond
5Ash "Pond
Creek
Page
3 LANE
Clifty


Hanover
Hanover College
Crowe Falls
Southwestern High Sch
Hanover Cem
Sewage Disposal
Plumping Station
Southwestern Jr High Sch
Hanover Beach
NOVER
Butler Falls
Mill
Chain Mill Falls
Fremont Falls
Old Bethel Cem
BETHEL RD
400 SOUTH ROAD
Harris Falls
INDIANA
KENTUCKY
OHIO
NORMAL POOL ELEV 420
ORWC3
Liberty
Mile 565


ORF4
OHIO RIVER
NORMAL POOL ELEV 420
RESERVATION
Twelvemile Island
Mile 592
Mile 593
Light
Water Tank
River Ridge
Bailey Cem.
COLLECTOR WELLS ROAD
CLARK CO
OLDHAM CO
JEFFERSON CO
WATERLINE
Longview Beach
Beechland Beach
Hay Kennedy Park
Quarry
Cem
PATROL
PIPELINE
BM 435
BM 439
330 000 (KY.)
4250
4249000m.N
4248
4247
4246
310 000 (IND.)


ORS4
ORWC4
Mile 611
Mile 610
Powerplant
Substa
Conveyor
Settling Ponds
Pine Hill
Cem
Clear Fork Ch
BUDD
ROAD
French
Pine Run
TWOMILE
Middle
Middle Cr
NEW ALBAN
FLOYD CO
JEFFERSON CO
LOUISVILLE
CORPORATE
BOUNDARY
RIVER
Sewage Disposal
Chickasaw Park
SHAWNEE
SOUTH WESTERN PARKWAY
FLOODWALL
Christ The King Sch
Stephen Foster Sch
Greenwood Cem
King Sch
Calvary Ch
HOLLOW
LANE
ELEV 383


ORWC5
ORS5
Mile 615
Mile 614
Lake Dreamland
Arrowhead Lake
Middle Creek Boat Ramp
Powerplant
Substation
Pumping Sta
Tailings Ponds
Sewage Disposal
Gravel Pit
Trailer Park
Wells
Pigeon Roost
Calvary Ch
Embury Ch
Bailey Cem
FRANKLIN
INDIANA
KENTUCKY
OHIO
RIVER
PIKE CO
JEFFERSON CO
FLOYD CO
PIPELINE
FIVEMILE LA
SCHENKS LA
RALPH
KRAMERS
LANE
Run
Creek


ORWC6
ORF5
Powerplant
Substation
Conveyor
Frost Middle Sch
Happy Hollow
Rosewood
Colvin Cem
Moore Chapel
Kosmosdale
(BM 449)
Cem
Conveyor
Noes Park
West Point
Light
Mile 630
HARRISON CO
HARDIN CO
JEFFERSON CO
Pumping Sta
PIPELINES
DRAG STRIP
RIVER
Fourmile Creek
Goose Creek
Muddy Creek
ILLINOIS
LOUISVILLE
LEVEE
ELEVATION 383
BM 439
BM 457
BM 425
BM 426
BM 428
BM 432
BM 441
BM 445
T5S
T6S