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THERMAL DISCHARGES TO THE OHIO RIVER

An Evaluation of River Temperature Relationships

1964 - 1974

December, 1975

OHIO RIVER VALLEY
WATER SANITATION COMMISSION

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414 Walnut Street
Cincinnati, Ohio 45202

Price $5.00

T A B L E O F C O N T E N T S

SUMMARY AND CONCLUSIONS

There are presently in operation on the Ohio River 34 power generating facilities having a generating capacity of just under 27,000 megawatts (MW). Eighty percent of this capacity is operated with once-through cooling facilities. There are eight facilities under construction. Facilities under construction or proposed have a total generating capacity of 23,245 MW. Ninety-nine percent of this capacity is programmed for off-stream cooling (1% is hydroelectric).

An appraisal of maximum consumptive water use (at critical flow) for seven reaches of the river from mile points 0 through 981 varies from .05% (MP 918-981) to 2.7% (MP 162) of the river flow for power generating facilities in operation, under construction and in the planning stage. The average consumptive water use in the seven reaches varies from .04 to 0.5 percent respectively.

Graphic analysis of stream flow and ORSANCO electronic monitor temperature data revealed no apparent long-term trend toward increasing or decreasing water temperatures during the 11-year period of record. However, there is a long-term trend toward increasing river flow during this period. Cumulative deviations of flow show an identical pattern at all monitor locations -- with below normal flows from January 1964 to about December 1969, near normal flows during 1970 and 71 and above normal flows from 1971 through 1974. Comparison of the cumulative deviation of water temperature and flow curves indicate there is no significant relationship between deviations of temperature and flow except at South Heights, Pa. (mile point 15.8). At this location water temperature is determined by the relative flow and temperature of the Allegheny and Monongahela rivers.

During the 1964-74 period, analysis of daily average air temperatures -- Pittsburgh, Huntington, Cincinnati, Louisville and Evansville -- showed no long-term trend toward increasing or decreasing temperature. The lowest water and air temperatures were observed at South Heights and Pittsburgh respectively. In general, water and air temperatures increased from upstream to downstream with changes in water temperature paralleling changes in air temperature. Comparison of cumulative deviation curves and statistical analysis showed a very high level of correlation between water and air temperatures.

Statistical analysis was used to determine the correlation between daily average water temperatures at South Heights (MP 15.8) and the corresponding daily average temperature at downstream monitoring locations. The analysis indicates there is no significant accumulation of added heat and that for base temperatures used for study purposes (40.0, 60.0 and 80.0 deg. F) maximum temperatures do not occur during the periods of below normal river flows. The added heat is dissipated within 40 to 45 miles downstream from the thermal discharge.

Significantly, data collected during an intensive October 1973 Ohio River Temperature Survey by the West Virginia Department of Water Resources showed that thermal discharges raise the temperature of the top few feet of the river but generally did not significantly increase temperatures at the 10 foot and lower levels. The surface area affected was determined to depend on the volume of the thermal discharge and river flow characteristics. Downstream surface and overall temperatures of the river were found to return to normal levels within 5 to 20 miles of the discharge. The West Virginia field survey data supports the conclusion derived from the analysis of long-term ORSANCO monitor data that there is no buildup of excess temperatures resulting from existing thermal discharges.

The present evaluation of thermal discharges to the Ohio River is based on the effect on river temperature relative to accepted stream temperature standards and the degree to which individual discharges comply with applicable effluent limitations in the 11-year period 1964-1974. Daily average temperatures at ORSANCO's 11 electronic monitors on the Ohio River were analyzed and the temperature limits specified in state stream standards were exceeded on four of over 34,000 days of record during the 11-year period, a compliance rate of 99.99 percent.

Under the final U. S. EPA effluent guidelines for steam electric power plants there are three plants which are required to provide cooling facilities or file for an exemption under Section 316(a) of the Federal Water Pollution Control Act. The 650 MW number 7 unit of the W. H. Sammis Plant (MP 54.0) was placed in service in 1971. Units 1, 2 and 3 of the J. M. Stuart Plant (MP 405.7) were placed in service in 1970, 71 and 72 respectively. Each of these units is rated at a capacity of 610 MW, 110 MW more than the U. S. EPA guidelines exemption for units in service prior to January 1, 1974. A 265 MW unit was placed in service in 1974 by the Owensboro Municipal utility at mile 753.5.

Fifteen of the plants with once-through cooling can cause a calculated river temperature rise of one or more deg. F (7.2 deg. F maximum rise) at rated capacity and critical river flow. The temperature rise from 12 of these plants is one or more deg. F at the normal operating rate.

With reference to the ORSANCO Pollution Control Standards No. 1-70, 2-70, the study indicates that at normal river flows, the W. H. Sammis Plant is the only discharge which results in a calculated river temperature more than a few tenths of a degree above the maximum allowable temperature for summer and fall months. Therefore, it appears that the ORSANCO standards may have been exceeded during the period of record at the Sammis Plant.

Because the highest temperature in the critical mixing zones of the river have been observed to occur near the water surface, a real potential for the application of remote sensing techniques is suggested for determining thermal mixing zones (rather than using intensive manual methods in a continuing monitoring program).

The removal of SO_2 from generating facilities stack discharges does not appear to present a water pollution problem since the flue gas desulfurization processes must be a closed cycle. The problem of sludge disposal, and associated runoff and seepage to the stream is an area that will require adequate planning and surveillance in order to prevent dissolved mineral or sludge materials from entering the stream.

The study indicates that thermal discharges to the Ohio River, during the period 1964-1974, had a relatively localized influence on the river temperature. This conclusion is based on data from electronic monitoring devices located on the basis of need for data for multi-parameter stream quality evaluation. It reflects a macro evaluation of overall thermal quality of the Ohio River. Evaluation of the impact of thermal discharges in the mixing zone area will require more detailed data on a case by case basis.

INTRODUCTION

The need to meet present and projected energy requirements has created a crisis atmosphere; one in which environmental controls have come under much closer scrutiny from a cost effective perspective.

Water for cooling of thermal electric plants is by far the largest category of water use in the energy industry. It was reported to total about 170-billion gallons per day in 1970.* Cooling water is essential to the generation of electricity by steam that drives the turbine generator and there is every indication that the great bulk of electric generation is, and will continue to be, by steam power.

Cooling water is used to remove the waste heat of vaporization of spent steam leaving the turbine exhaust. Waste heat generated in the cooling process and the cooling water must be processed either through a natural or man-made system or a combination of the two to facilitate radiation of the heat to the atmosphere.

Since waste heat, when released to the water environment, may become a pollutant in terms of man-caused deleterious changes in the normal temperature of the receiving water, thermal discharges must be controlled. How this control is manifested in a cost-effective manner with minimal insult to the environment is a primary concern of water pollution control agencies and the industry.

PL 92-500, the 1972 Amendments to the Federal Water Pollution Control Act, provides the national goal that "the discharge of pollutants into the navigable waters be eliminated by 1985." The Act provides that not later than July 1, 1977 the best practicable control technology (BPCT) currently available be applied to industrial point source discharges; and that the best available technology economically achievable (BATEA) shall be used by July 1, 1983. The Act also requires that stream quality standards be met by July 1, 1977.

However, the Act, in Section 316(a), singles out effluent limitations proposed for the control of the thermal component of any discharge. It provides that "if the owner or operator of that source after opportunity for public hearing demonstrates to the (U. S. EPA) administrator's satisfaction (or, if applicable, the state) that any effluent limitation

*Water Demands for Expanding Energy Development", George H. Davis and Leonard A. Wood, Geological Survey Circular. 703, 1974 proposed for the control of the thermal component of any discharge from such source requires effluent limits more stringent than is necessary to assure the protection and propagation of a balanced indigenous population of shellfish, fish and wildlife in and on the body of water into which the discharge is to be made, then the administrator (or State) may impose an effluent limitation with respect to the thermal component, taking into account its interaction with other pollutants, that will assure the protection and propogation..." thus a vital discretionary power is set forth as a responsibility of the regulatory agency as it acts in its capacity of administering permits for effluent discharges under the National Pollution Discharge Elimination System (NPDES).

Significantly effluent regulations promulgated by the U. S. EPA (October 8, 1974 Issue of the Federal Register) requires installation of closed cycle cooling but exempts from this regulation all operating plants placed on line before January 1, 1974 except for units of 500 megawatts or greater. The latter units are subject to the regulation if placed into service after January 1, 1970. A 1974 ORSANCO inventory established that there are 34 presently operating power facilities on the Ohio main stem; only three of this number have generating units which will be subject to the U. S. EPA regulations promulgated October 8. This same inventory revealed 8 power generation facilities under construction, 7 proposed new facilities and 7 additional sites under consideration or a total of 22 such facilities in some advanced stage of planning or construction.

Actually, the inventory was an outgrowth of a discussion introduced to the ORSANCO Engineering Committee by a member of the Commission from Indiana who voiced concern with the number of power generating facilities planned for construction along the Ohio River from below Madison, Indiana to Cincinnati, Ohio. It was noted that similar developments are occurring along other sections of the Ohio River and major tributaries and that potential problems should not be resolved on a case-by-case basis. The problems cited included thermal and other waste discharges to the river, consumptive water use, air pollution and the disposal of solid wastes associated with air pollution control facilities.

It was recognized by the Commission that an evaluation of the present and potential thermal discharges on the main stem of the Ohio in terms of heat impact from the existing and planned facilities is essential to any consideration by the several State Regulatory Agencies and the U. S. EPA of requests for variances under Section 316(a) of the Federal Water Pollution Control Act.

The present report has been prepared using already-available information. This includes data from the ongoing ORSANCO water pollution surveillance system as well as special study or survey results from the several states. The inventory of existing, planned and future power generating facilities was developed through the ORSANCO Power Industry Advisory Committee. Special assistance in the preparation of the chapter on aquatic life considerations was received from Dr. William Clay, Professor Emeritus of Biology, University of Louisville. Dr. Clay was project director of the 1957-60 ORSANCO Aquatic Life resources study which has served as the basis for recent biological evaluations.

Because of the need to consider consumptive use of water as an integral part of the generating facility plans on the Ohio River, one chapter of this report is devoted to the production of substitute natural gas from coal. Similarly, it was deemed essential to consider the impact of emission control of SO_2 under the Federal Air Pollution Control Act to further characterize consumptive water use and the implications of the production of solids in this process on river quality.

This study is based primarily on the appraisal of historic river temperature data obtained over a period of eleven years (1964-1974) from the ORSANCO electronic monitoring network. Continuous electronic measurement of water quality is a key element of the Commission's water quality surveillance program.

The locations for electronic monitoring devices were selected on the basis of need for data for multi-parameter stream quality evaluation. Comparable long-term temperature data from the thermal mixing zones or from river reaches immediately downstream from the mixing zones are not available. Information from a limited number of intensive field surveys was utilized.

The present study reflects a macro evaluation of overall thermal water quality in the Ohio River. Evaluation of the impact of thermal discharges in the mixing zone areas will require more detailed data on a case by case basis.

INVENTORY OF POWER GENERATING FACILITIES

Thermal electric power generating facilities are the major sources of heat discharged to the Ohio River. Earlier studies, part of the 1968-70 development of the ORSANCO Pollution Control Standards, showed that the largest of other industrial cooling water discharges were of minor significance compared to the discharges from the power plants. To determine the magnitude of power plant thermal discharges, data on existing, under construction and proposed generating facilities was compiled in cooperation with the ORSANCO Power Industry Advisory Committee. A map showing the size, type of cooling and location of the generating plant is included at the end of this chapter.

Power Plant Inventory

Complete inventory data is tabulated in Appendix A. Information in this compilation includes plant location, operating company, station name, generating capacity with once-through or off-stream cooling, heat rejection rate, fuel, operating status, date generating units were or will be placed in service, classification under U. S. EPA guidelines, and consumptive water use. Except for heat rejection rate, EPA classification and consumptive water use, these entries are self-explanatory.

Heat Rejection Rates -- To insure comparability of data from the various power plants, the following standard equation was used for calculating the heat rejection rate for fossil fuel generating facilities.

$$\underset{(\text{BTU / KW-HR})}{\text{Heat Rejection Rate}} = \frac{\text{Gross Heat Rate of The Coal Burned (BTU)}}{\text{KW-HR Generated}} \times \underset{(0.85)}{\text{Assumed Boiler Efficiency}} - \frac{3413 \text{ BTU}}{\text{KW-HR}}$$

The equation assumes that 15 percent of the heat generated is discharged through the stacks (85% is converted to electricity by the turbine or rejected to the condensers), 3413 BTU/KW-HR is converted to electrical energy in the generation process, and the remaining heat content of the steam is rejected to the river or to off-stream cooling facilities. For the proposed nuclear units a heat rejection rate of 6,800 BTU/KW-HR was used for estimating consumptive water use. Off-stream cooling facilities are included in the design of all under construction or proposed nuclear plants.

U. S. EPA Classification -- The U. S. EPA promulgated "Effluent Guidelines and Standards for Steam Electric Power Generating" effective November 7, 1974 (40 CFR 423; October 8, 1974 Federal Register). The inventory classifies plants in two categories: "A" which includes EPA designations "small unit" and "old unit"; and "B" corresponding to the guideline "generating unit". The guidelines do not establish thermal limits for units in the "A" class. Best practicable treatment, defined as no discharge of heat, is established as the effluent limitation for plants in the "B" category. Section 316(a) of P.L. 92-500 provides a mechanism for requesting exemption from thermal limitations in NPDES permits for both class "B" plants or class "A" plants where thermal limitations may be included in the permit on the basis of compliance with stream standards.

Consumptive Water Use -- Consumptive use, evaporation of water as part of the cooling process, is of concern since it could result in significant reduction in stream flow. Estimates of the consumptive water use in the inventory were based on water consumption data for once-through and mechanical draft cooling towers in the Ohio Basin in the report," Consumptive Water Use Implications of the Proposed U. S. EPA Effluent Guidelines for Steam-Electric Power Generation ," by Epsey, Huston and Associates, dated May 31, 1974.

The report estimates water consumption rates for once-through and mechanical draft cooling towers for the Ohio River Basin as:

WATER CONSUMPTION RATE FOR ONCE THROUGH COOLING
(Pounds Per Thousand BTU's Rejected)

Annual Average	0.43
January	0.31
April	0.43
July	0.50
October	0.43

WATER CONSUMPTION RATE FOR MECHANICAL DRAFT COOLING TOWERS
(Pounds Per Thousand BTU's Rejected)

Annual Average	0.72
January	0.65
April	0.71
July	0.78
October	0.73

The annual factors of 0.43 and 0.72 pounds of water consumed per 1,000 BTU's rejected were used for all calculations. The report indicates that there is minimal difference in the consumptive rates between natural draft cooling towers and mechanical draft cooling towers. It should also be noted that Epsey, Huston and Associates investigated several methods for determining consumption use of water and reported that all methods result in similar values.

For units under construction or planned, a heat rejection rate of 4100 BTU's/KW-HR for fossil fueled plants with off-stream cooling, and 6800 BTU's/KW-HR for nuclear plants with off-stream cooling was used to calculate the consumptive use of water. Available information from the Power Industry inducates these rates are typical for current technology.

All of the inactive plants listed in the inventory except the Shippingport Atomic Power Plant, which is being converted to a light-water breeder reactor, are not expected to be returned to service on a regular basis.

Plant Operating Rate -- An average level of electrical generation during the mid-summer period was determined from daily electrical generation data furnished by the ORSANCO PIAC for the week of August 5-11, 1974. This data provides information on plant utilization and also provides a basis for comparing consumptive water use for that week with consumption at rated capacity.

This week was selected as representative of normal summer utilization of generating facilities. Because the Ohio River and other generating plants in the basin are part of an interconnected regional electric distribution network, there are frequent changes in utilization of generating units at any one plant. These changes compensate for units out of service for maintenance or repair, fuel availability, individual unit efficiency and other factors. For example,during and prior to the reference week, system plants were supplying the power normally generated at the Clifty Creek station which was severely damaged by tornadoes earlier in 1974. Other factors which influence plant operating rate include the local and regional level of industrial activity and weather conditions. Therefore, the week of August 5-11, 1974 represents a normal or typical rather than maximum power generating period.

Summary of Inventory Data

The following pages summarize the status and type of cooling utilized at the present and future generating facilities along the Ohio River and estimates of consumptive water use.

It should be noted that presently available information indicates that the completion of planned generating facilities may be delayed or abandoned in some locations because of decreased power demands and financing difficulties. Additionally, the thermal discharge requirements of ORSANCO Pollution Control Standard No. 2-70 are applicable to all existing and future generating plants.

SUMMARY of inventory of power generating facilities on the Ohio River in operation, under construction and in the planning stage *

Status:

Facilities in operation	34
New facilities under construction	8
Proposed new facilities	7
Additional sites under consideration	7
Inactive facilities	4
Total number of facilities	60
Existing facilities under modification or expansion	5

Generating Capacity and type of cooling

Status	Type of cooling		Megawatt (MW) Generating Capacity
In operation			
	Once through		21,675
	Off stream **		5,039
	Hydroelectric		156
		Total	26,870
Under construction			
	Once through		0
	Off stream **		13,595
		Total	13,595
Proposed	Once through		0
	Off stream **		9,468
	Hydroelectric		182
		Total	9,650
Inactive			630
		Grand Total	50,745

* Compiled by Staff in cooperation with ORSANCO Power Industry Committee

** Off-stream MW capacity includes gas turbine units that are a part of steam generating facilities

SUMMARY of water consumption of power generating facilities on the Ohio River in operation under construction, and in the planning stage--(continued)

Maximum Consumptive Rate Of Water

Range of Reach (Miles)	Critical Flow ++ For Reach	Consumption Rate (CFS) Existing Plants	Under Const. & Proposed	Total	Total % of Critical Flow/ Consumed ++
0-162	6,500	77.4	95.2	172.6	2.7
162-279	7,400	36.2	54.6	90.8	1.2
279-436	9,700	20.7	27.6	48.3	.5
436-605	11,900	43.3	155.7	199.0	1.7
605-846	14,200	49.0	19.4	68.4	.5
846-918	19,500	0	0	0	
918-981	48,100	25.0	0	25.0	.05
Total		251.6	352.5	604.1	

Average Consumptive Rate Of Water For Week Of 8-5 - 8-11 '74

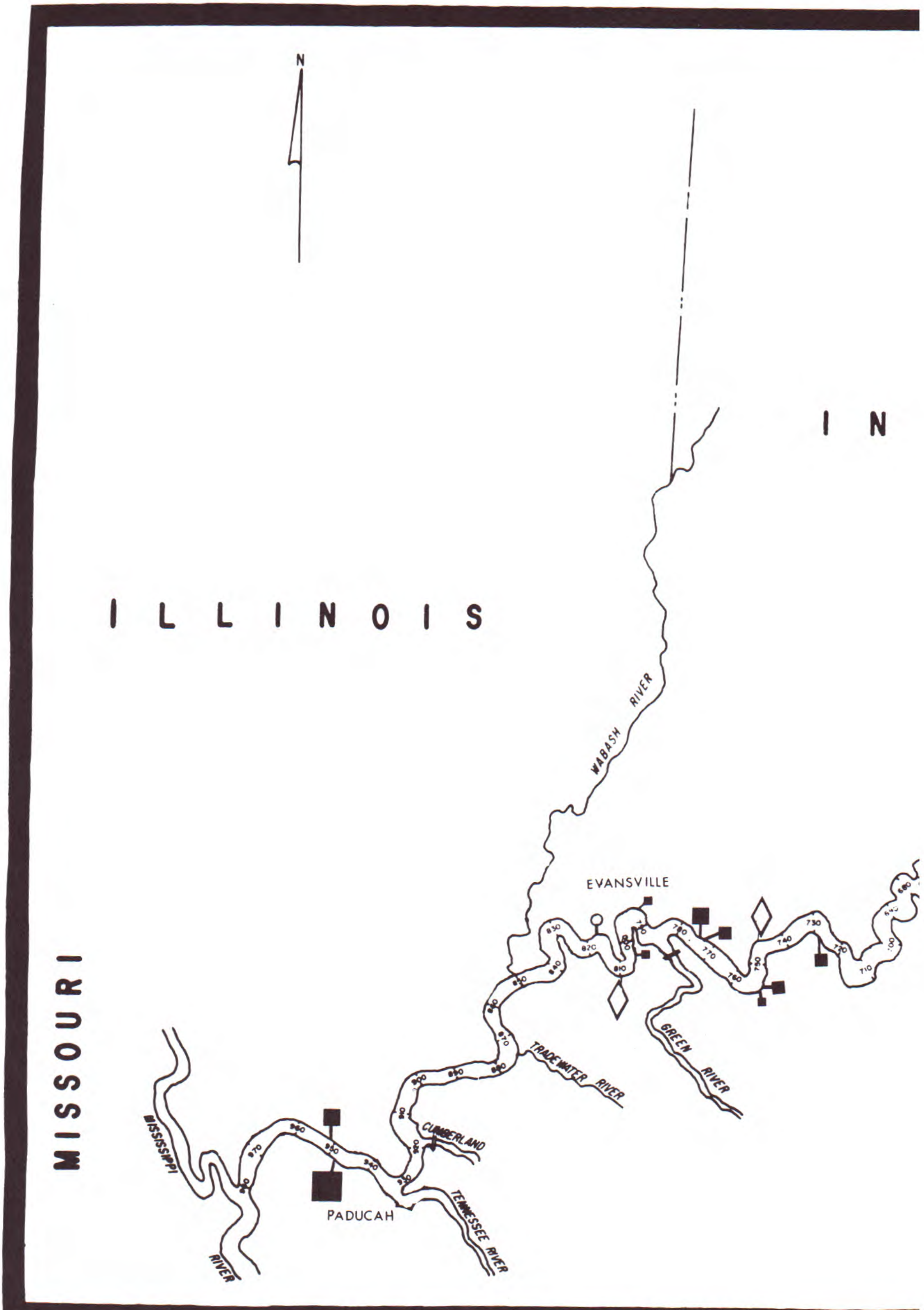
Range of Reach (Miles)	Critical Flow ++ (CFS)	Avg. Rate of Generation For Week (MW)	PerCent Of General Capacity	Avg. Rate Of Consumption (CFS)	PerCent Of Critical Flow ++
0-162	6,500	3633	62	32.8	.5
162-279	7,400	1969	84	16.5	.2
279-436	9,700	1245	51	10.2	.1
436-605	11,900	3162	67	28.6	.2
605-846	14,200	2817	57	28.6	.2
846-918	19,500	0		0	
918-981	48,100	2178	76	19.1	.04

++ Minimum Daily Flow Once In Ten Years (From ORSANCO POLLUTION CONTROL STANDARD 1-70 and 2-70).

Notes:

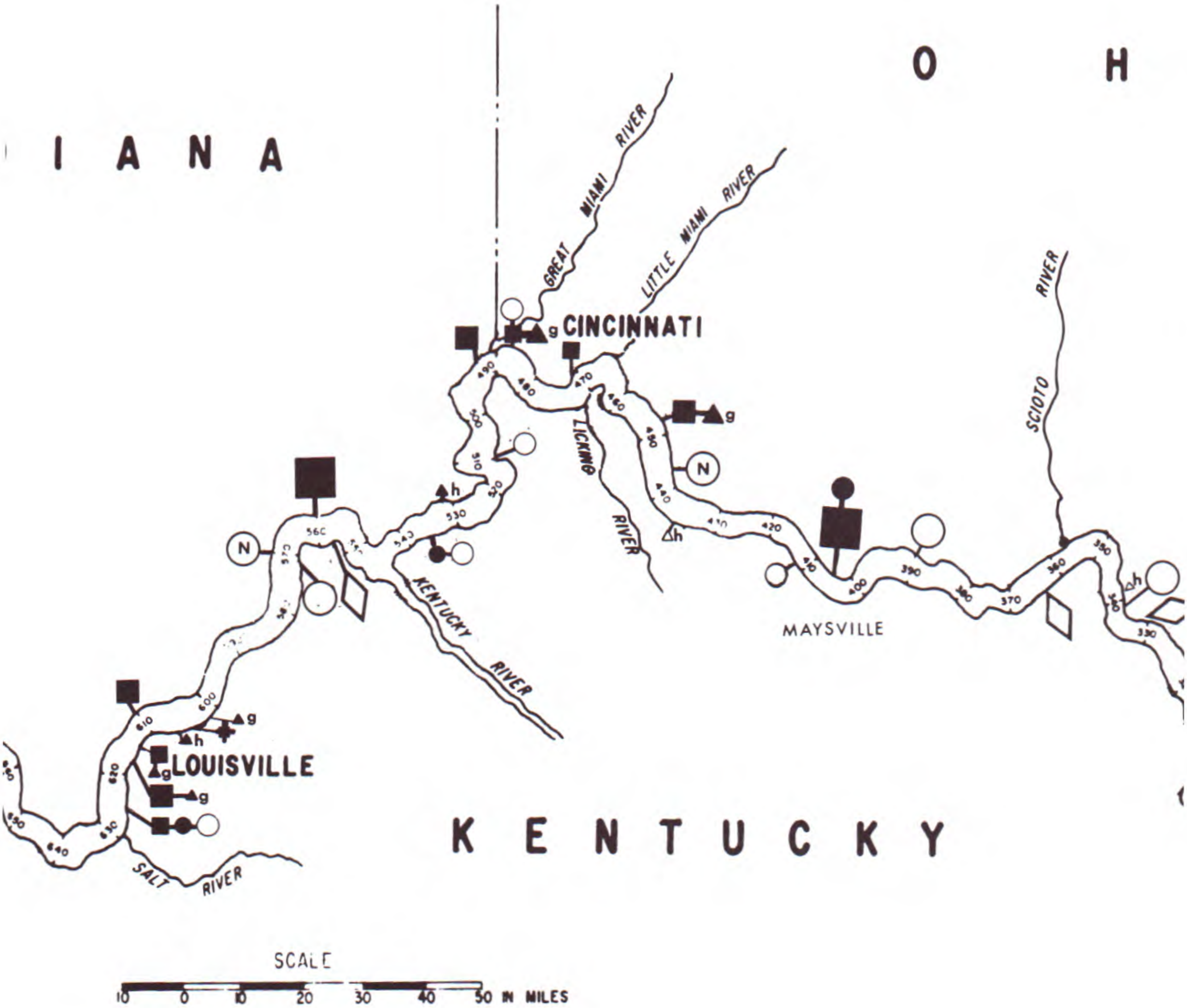
1. Heat Rejection Rates Assumed: 4100 BTU/KW-HR for new coal fired plants with off-stream cooling and 6800 BTU/KW-HR for nuclear plants with off-stream cooling .

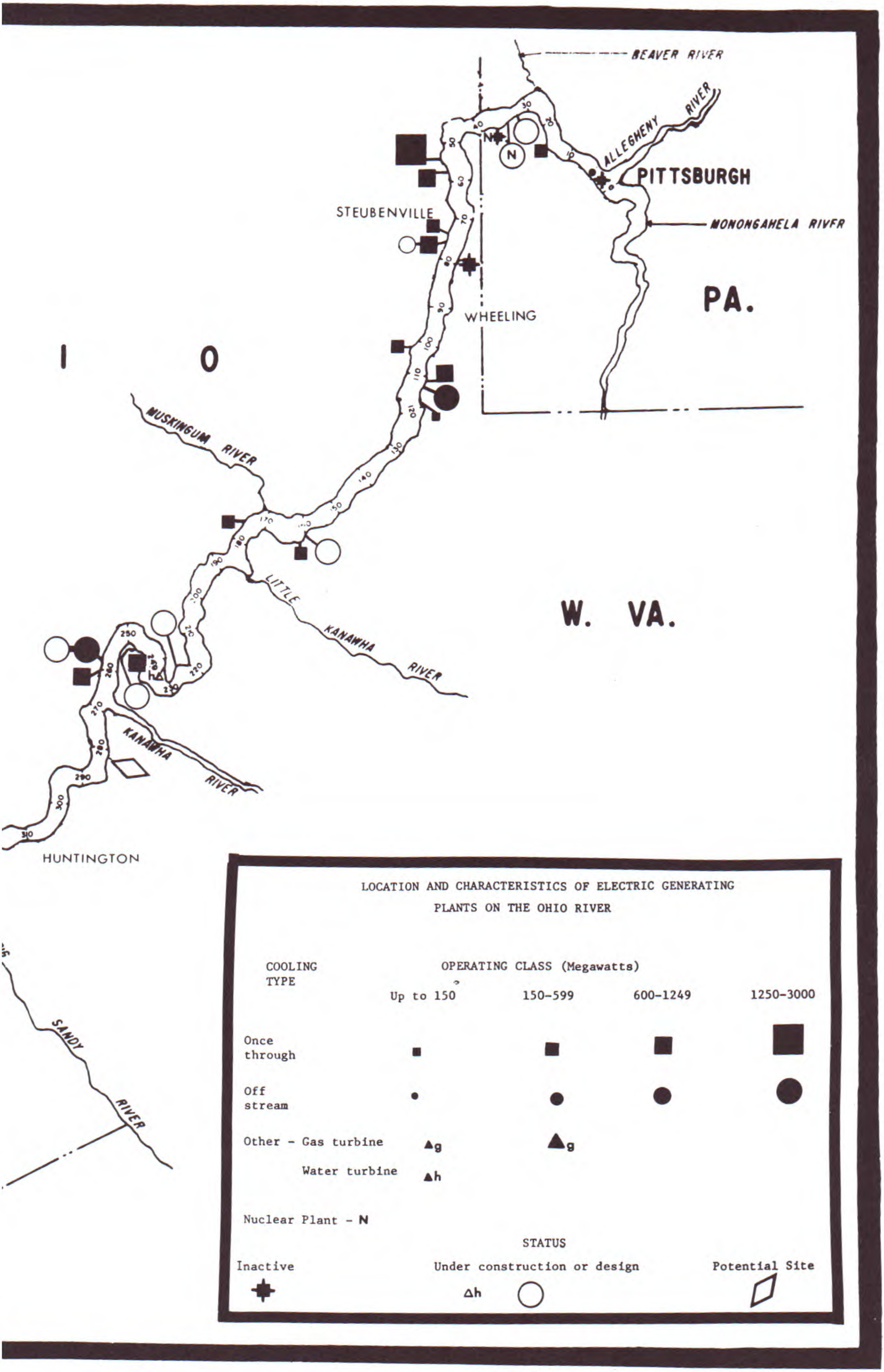
2. Consumptive use of water calculated from factors contained in the report "Consumptive Water Use Implications Of The Proposed Effluent Guidelines For Steam - Electric Power Generation" by Espey, Huston & Associates Austin, Texas dated May 31, 1974.



N
ILLINOIS
IN
MISSOURI
WABASH RIVER
EVANSVILLE
TRADEWATER RIVER
GREEN RIVER
CUMBERLAND
MISSISSIPPI RIVER
TENNESSEE RIVER
PADUCAH

FIGURE 7


IANA
OH
KENTUCKY
CINCINNATI
LOUISVILLE
MAYSVILLE
GREAT MIAMI RIVER
LITTLE MIAMI RIVER
SCIOTO RIVER
LICKING RIVER
KENTUCKY RIVER
SALT RIVER
SCALE
10 0 10 20 30 40 50 IN MILES



LOCATION AND CHARACTERISTICS OF ELECTRIC GENERATING PLANTS ON THE OHIO RIVER

STATISTICAL ANALYSIS OF TEMPERATURE AND FLOW DATA

The evaluation of the impact of thermal discharges on Ohio River temperatures requires analysis of available water and air temperature and river flow information. Statistical studies establish the long-term relationships between water temperature, river flow, and air temperature and provide the basis for estimating the effect of thermal discharges.

Data Sources

Information on the location and magnitude of thermal discharges is derived from the power plant inventory detailed in the preceding chapter. Hourly values of water temperature, as well as pH, dissolved oxygen, conductivity and chloride, are provided by the ORSANCO electronic monitor system. The first monitor was placed in service at the Cincinnati water plant in 1960. This hourly data from eleven Ohio River and nine tributaries is transmitted to the control station at ORSANCO headquarters, computer edited, stored and processed. Most of the monitors are installed on the water intake systems of water treatment or power generating plants; therefore, temperature readings are not directly affectd by thermal discharges.

River flow data is a composite of the U. S. Geological Survey flow measurements and the National Oceanic and Atmospheric Administration's Cincinnati Flow Forecast Center. U. S. Geological Survey flow data for the Ohio River is incomplete because of problems with measurements of low river flows; for example, in the Markland Pool river flows below about 40,000 cfs cannot be measured. Missing data in the Geological Survey records is filled in by Flow Forecast Center estimates. These daily estimates are also used for current flow data since Survey data is compiled and published annually.

Air temperature and other meteorological data for Pittsburgh, Huntington Cincinnati, Louisville and Evansville for 1964 through October 1974 was provided on punch cards by the National Oceanic and Atmospheric Administration's Environmental Data Services, Ashville, North Carolina.

Other sources of temperature information included the West Virginia Division of Water Resources and the ORSANCO Water Users Committee.

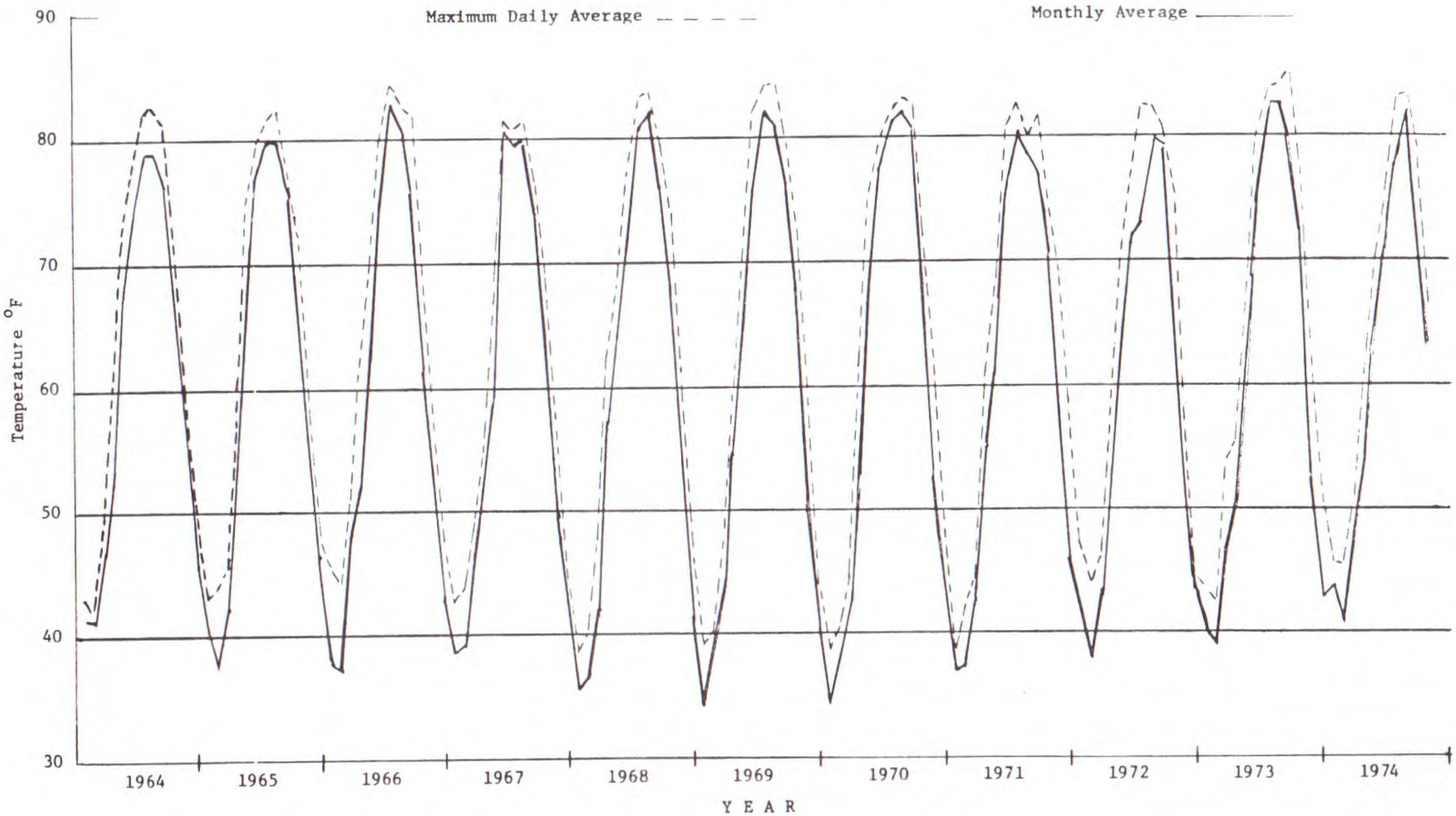
Time Series Analysis

Time series analysis utilizes data in chronological order to determine one or more of the significant types of relationships -- cyclical movements, periodic movements, trends and irregular variations. Cyclical movements are fluctuations which have a long duration. For example, study of Ohio River flows at Louisville since the early 1930's indicate a drought-to-drought cycle of approximately 11 years. Similar 11-year periods are reported for water level in the Great Lakes and some meteorological data. Continuous river temperature data is not available for a period extensive enough for analysis of possible long-term movements.

Periodic movements are defined as cyclic movements which recur with some degree of regularity. River temperature has a recurring annual cyclic or seasonal variation which is shown in Figure 1 for monthly average (solid line) and maximum daily average temperatures each month (broken line) at Cincinnati for the period January 1964 through October 1974. Since the seasonal variation in river temperature at other monitor locations is identical, only the Cincinnati temperatures are presented graphically. Summaries of river temperature, air temperature and river flows are presented in Appendices B, C and D, respectively. The seasonal variations in air temperature would show the same pattern except that the range from minimum to maximum values would be greater. River flows show a similar seasonal variation with the maximum occurring in March or April and the minimum in September or October.

The seasonal variations can be removed from the data by expressing each data item as the deviation from its mean or normal value. The seasonal cycle is removed when each monthly average January temperature is expressed as the difference between it and the mean January temperature -- the average January temperature for the period of record being considered. Since time-series analysis requires a complete data set, missing monthly and monthly average data from a significantly incomplete set of daily average temperatures was replaced by values estimated from the regression equations discussed later in this section. Another factor in time-series studies is that all of the records must cover the same time period. This limits the analysis to the five monitors with periods of record from January 1964 through October 1974 -- South Heights, Stratton, Huntington, Cincinnati and Louisville.

Figure 1: Seasonal Temperature Variation
Monthly Average Temperature at Cincinnati
1964 - 1974



Deviations of the monthly average values from the corresponding mean for each month were used to determine possible inter-station relationships and to determine whether there was a significant trend in temperature.

A preliminary estimate of inter-station relationships can be obtained from the graphical comparison of curves of the cumulative deviation from the mean (for example the January and February 1964 values are added to give a cumulative value for February 1964, addition of the March deviation gives the March 1964 value, etc.) vs time in months. These curves for water temperature are shown in Figure 2 (South Heights, Stratton and Huntington), Figure 3 (Huntington, Cincinnati and Louisville) and Figure 4 (Allegheny, Monongahela and Ohio rivers -- South Heights), for river flow in Figure 5 (South Heights and Louisville) and air temperature in Figure 6 (Pittsburgh, Huntington and Louisville). Since it is the direction of variations rather than magnitude which is being compared, all of the values are normalized to a scale of plus or minus seven. A rising line segment shows that a series of values was greater than normal; an approximately horizontal line segment shows a series of values varying about normal;and a falling line segment indicates a series of values below normal.

For the three stations shown in Figure 2, the curves are almost identical except for the period from March to December 1970. During this period temperatures were below normal at South Heights, near normal at Stratton and above normal at Huntington. The pattern at Cincinnati and Louisville is very similar to Huntington -- Figure 3 -- during the entire 11-year period,showing that with the exception of the 10-month period in 1970, essentially the same temperature variations occurred concurrently at the five monitor locations. Figure 4 -- Cumulative deviations for the Allegheny River at Oakmont, Monongahela River at Charleroi and Ohio River at South Heights -- shows that throughout the 11-year period curves for the Allegheny and Ohio rivers are almost identical. During 1970, when the temperatures were below normal at these locations, the temperature of the Monongahela River was consistently above normal and showed a variation comparable to that at Huntington and downstream locations. It is apparent that, to a great extent, the temperature at South Heights is determined by the temperature of the Allegheny River. During the 1970 period, the pattern at Stratton represents a transition from the below normal temperature at South Heights to the above normal temperatures at Huntington and other downstream locations.

Figure 2: Cumulative Deviation of Monthly Average Water Temperature from Mean for Month

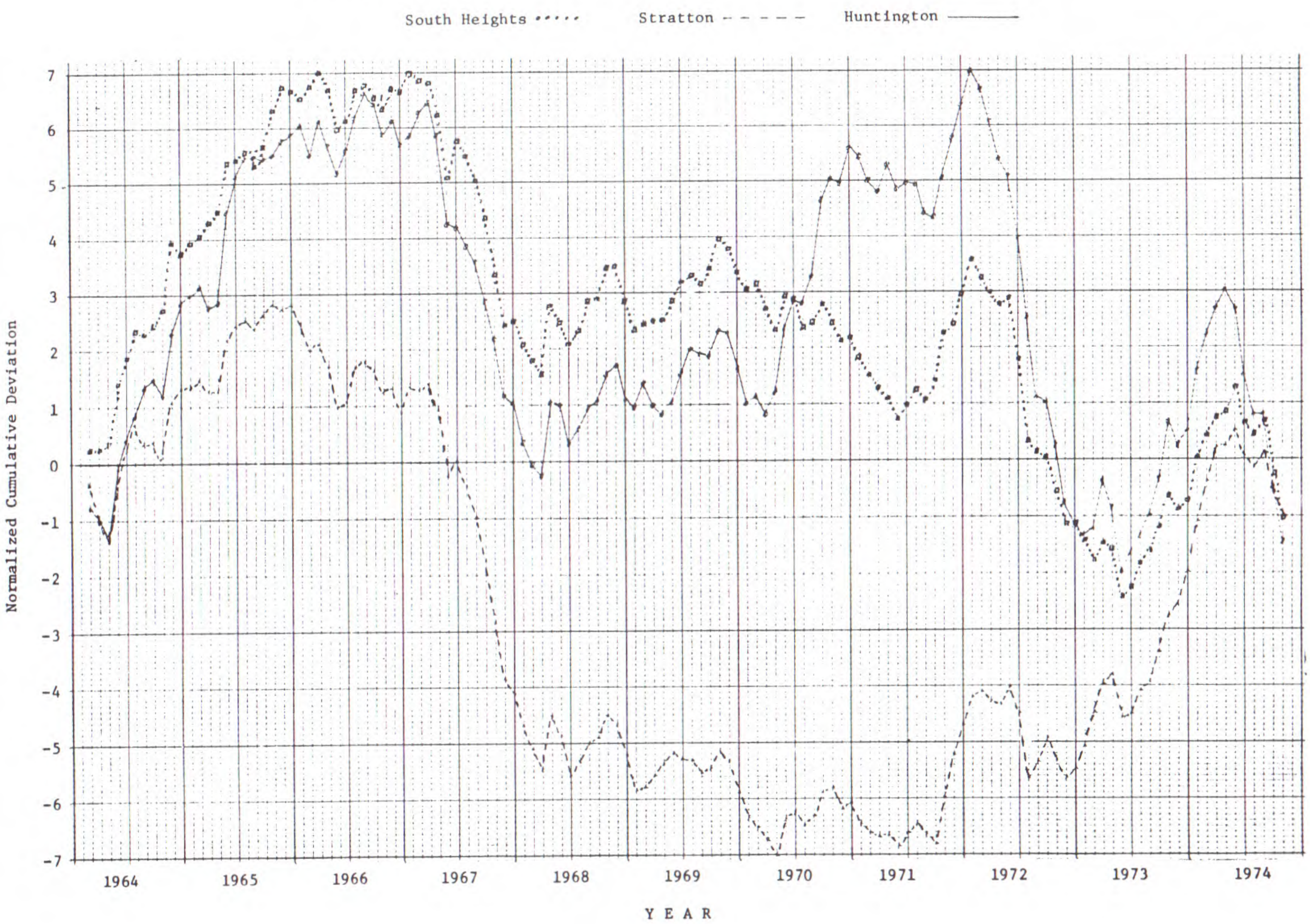


Figure 3: Cumulative Deviation of Monthly Average Water Temperature from Mean for Month

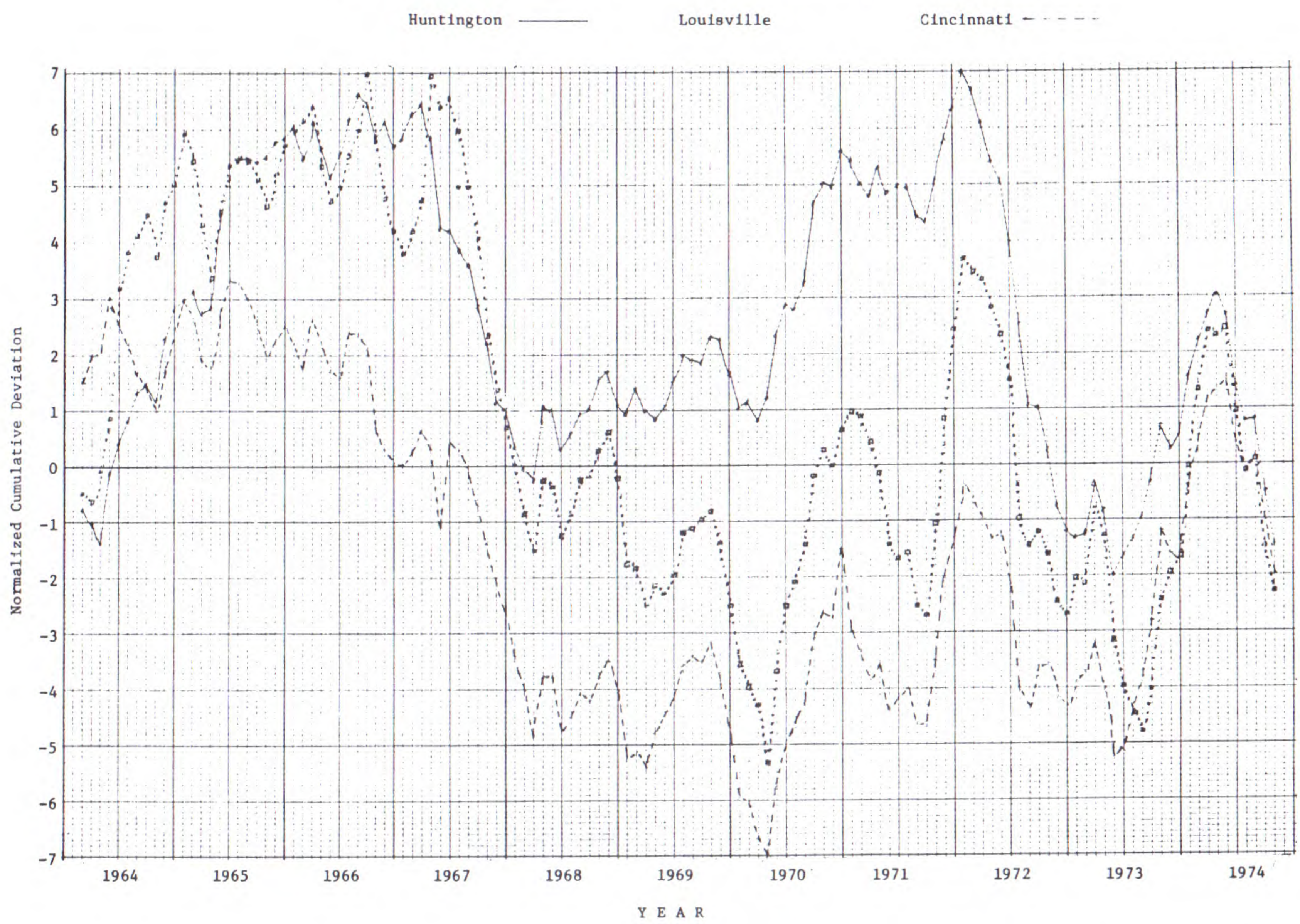


Figure 4: Cumulative Deviation of Monthly Average Water Temperature from Mean for Month

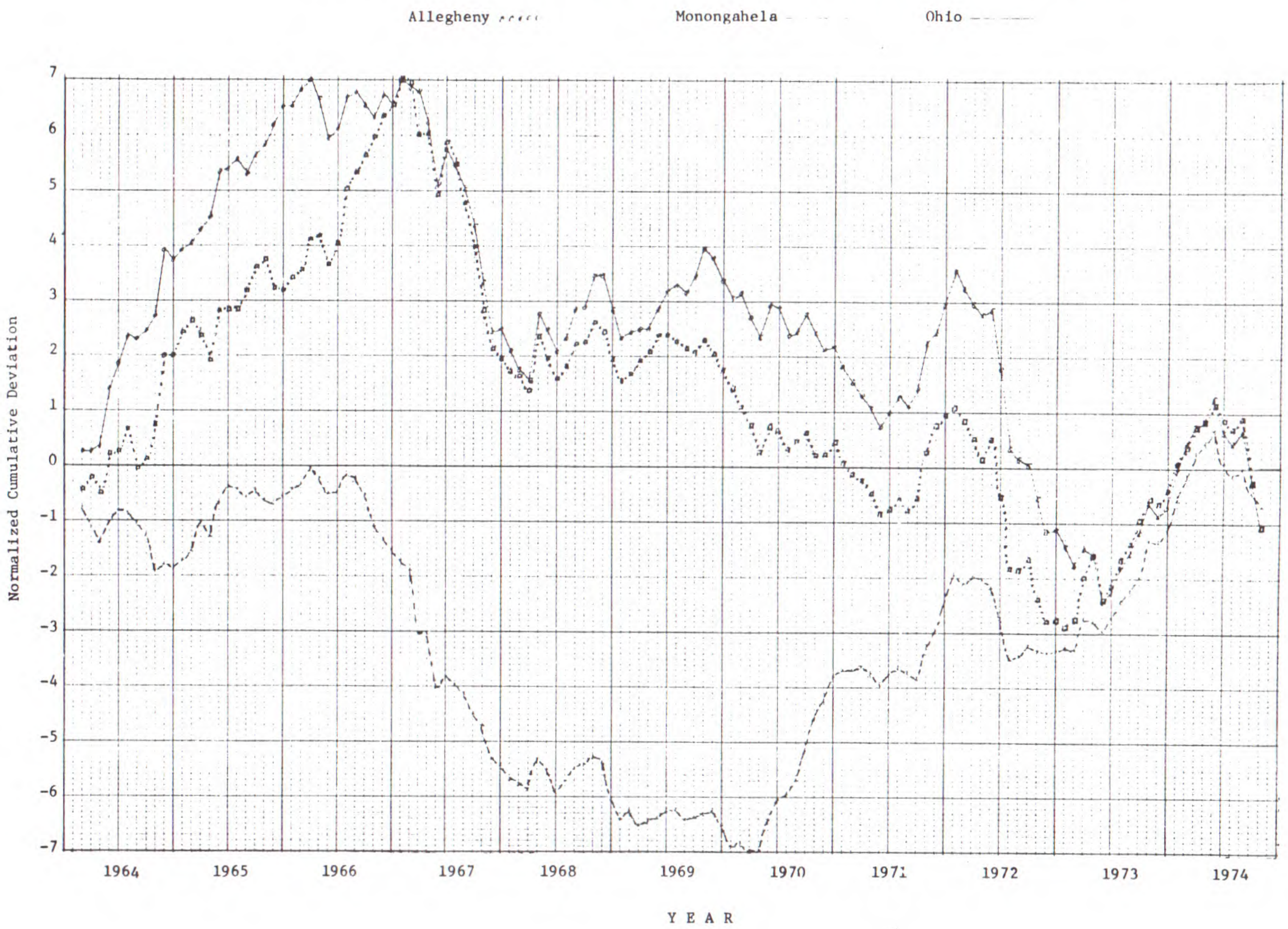


Figure 5 shows the cumulative deviations from the mean river flow at South Heights and Louisville; the curves for the other locations are identical to these two. Those curves show below normal flows from January 1964 to about December 1969, near normal flows for 1970 and 1971 and above normal flows for 1972 through 1974.

Cumulative deviations of monthly-average air temperature at Pittsburgh, Huntington and Louisville are shown in Figure 6. Data plots for air temperature at Cincinnati and Evansville are identical.

Inter-parameter relationships at South Heights and Louisville are shown in Figures 7 and 8. At South Heights the cumulative deviation curve for river flow (dotted line) indicates a possible inverse relationship to river temperature (solid line) and no relationship to air temperature (broken line). At Louisville river flow does not appear to be related to variations in water or air temperature. Comparing the pattern of water and air temperature variations at South Heights and Louisville shows South Heights temperatures do not follow the Pittsburgh air temperatures as closely as the corresponding curves at Louisville. Comparisons at Huntington and Cincinnati show relationships very similar to those at Louisville.

Variance analyses show that the relationship between water temperature and river flow at South Heights is statistically significant at the 99.9 percent level -- less than one in a thousand that the result is due to chance. At Huntington, Cincinnati and Louisville the relationship between water temperature and river flow is not statistically significant. The covariations of water and air temperature at all four locations is statistically significant at the 99.9 percent level.

The river temperatures at South Heights are determined by the temperatures and flows of the Allegheny and Monongahela rivers. Since the monthly average temperature of the Allegheny at Oakmont is normally one to four degrees lower than the corresponding Monongahela temperature at Charleroi, the temperature at South Heights will vary in a manner related to the flows from the tributaries.

The testing for the presence of long-term trends in the temperature and flow data is based on the use of the relationship of the deviations from the monthly means with time. The general regression equation for trend is:

$$\text{Variable} = A + B \times \text{time}$$

Figure 5: Cumulative Deviation of Monthly Average Flow from Mean for Month

South Heights - - - - - - - Louisville ————

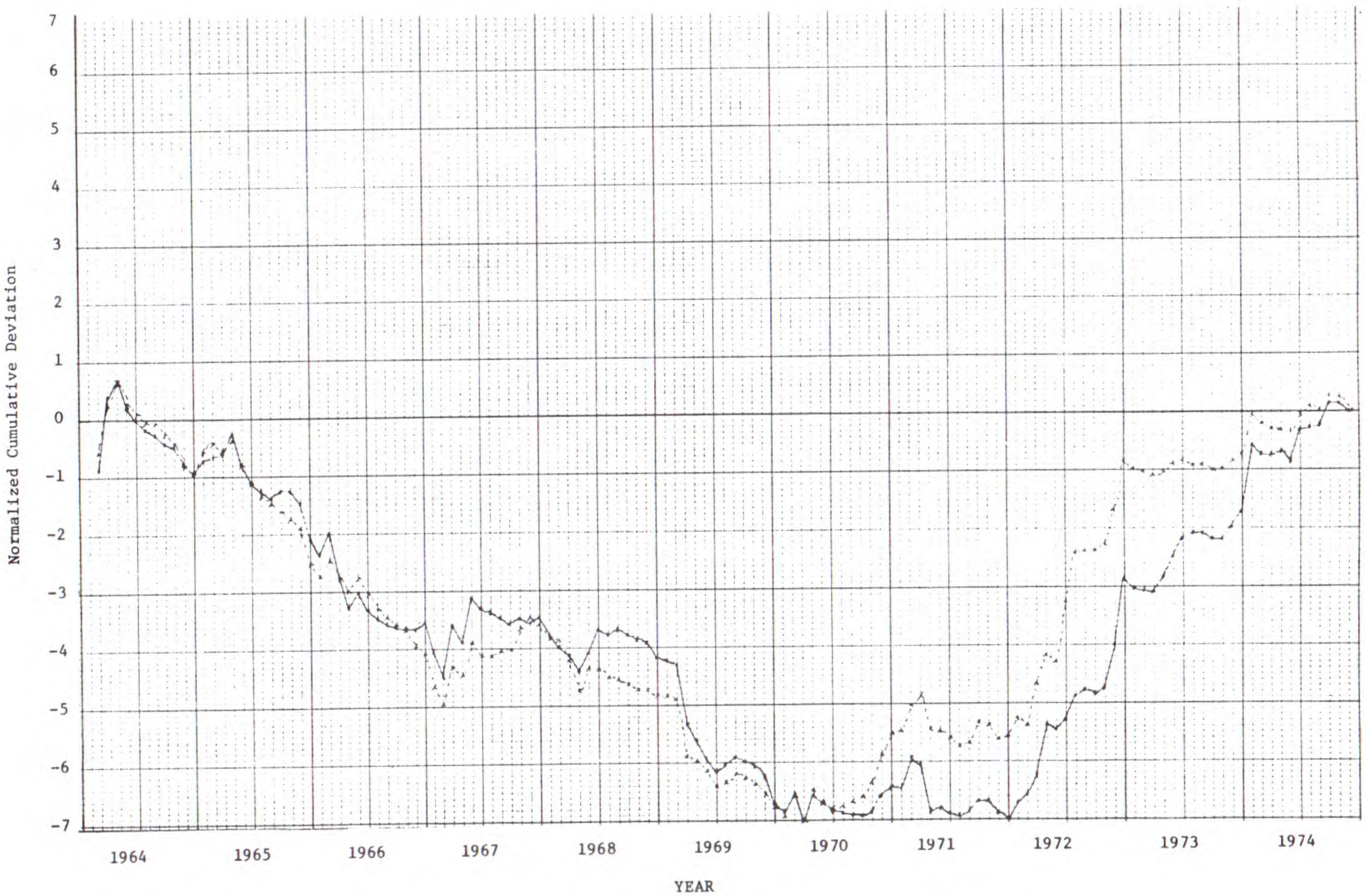


Figure 6: Cumulative Deviation of Monthly Average Air Temperature from Mean for Month

South Heights ———— Huntington - - - - - - Louisville ....

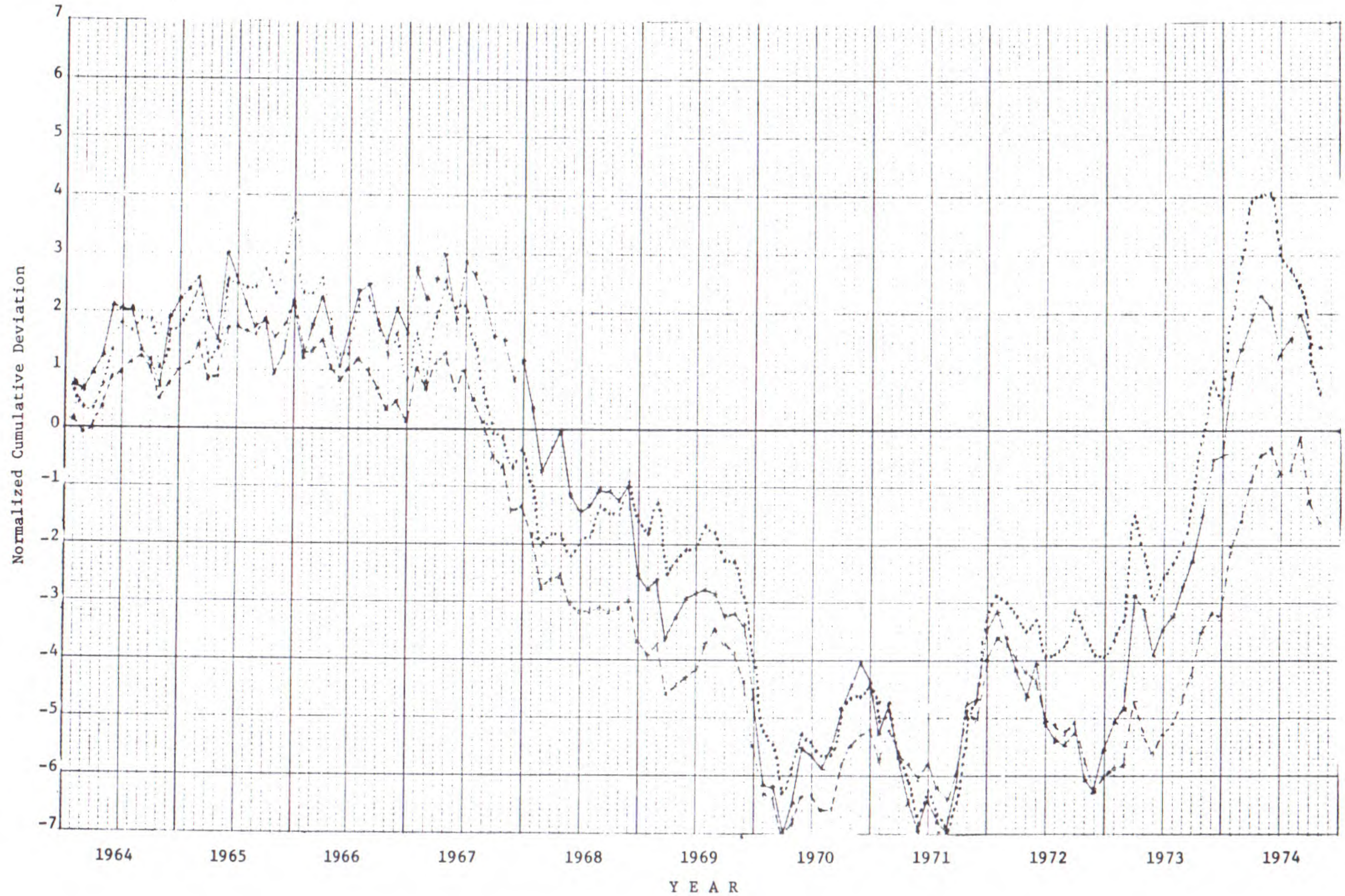


Figure 7: Cumulative Deviations of Monthly Average from Mean for Month at South Heights

Water temperature ———— Air temperature -------- Flow ·········

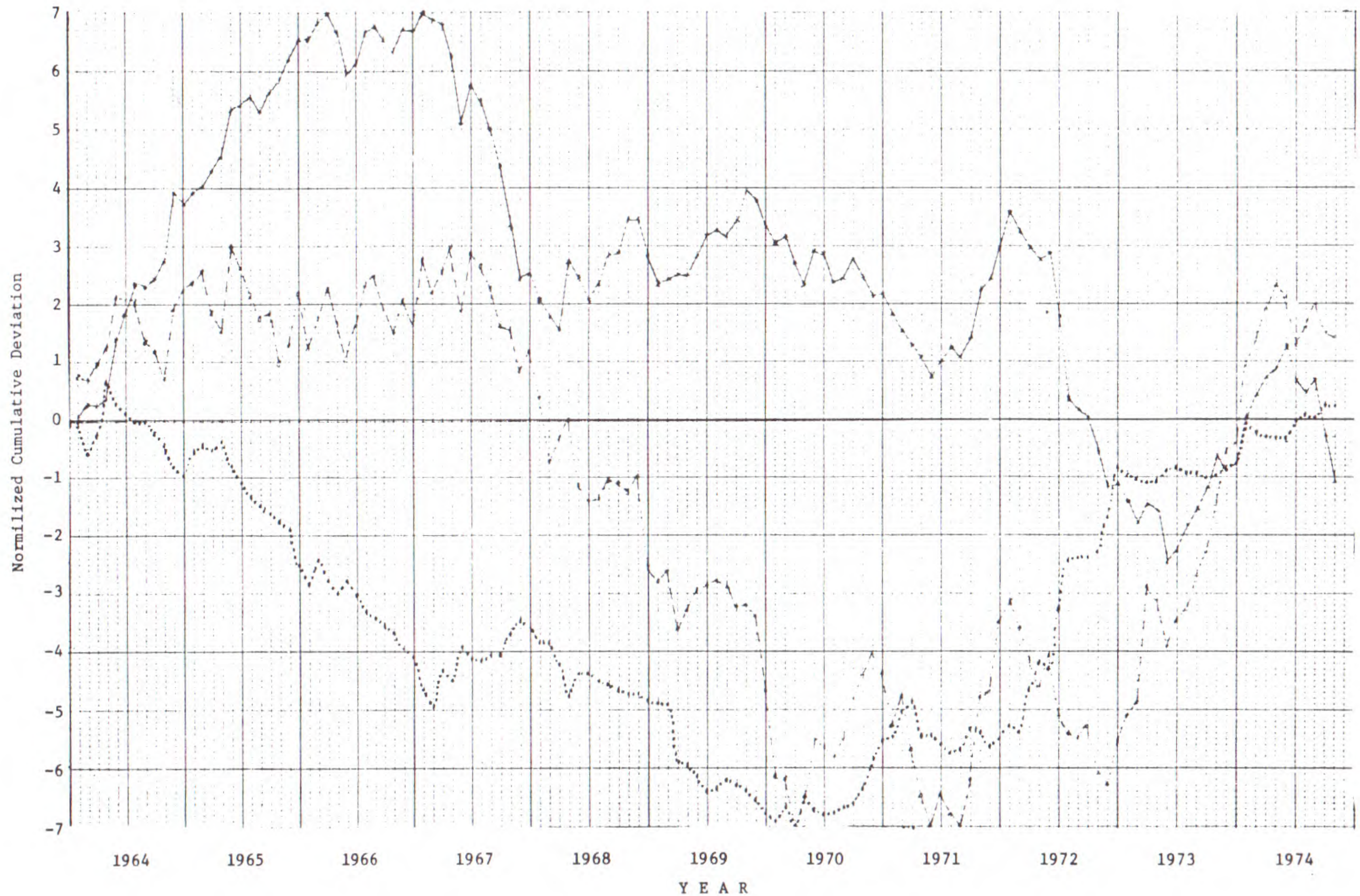
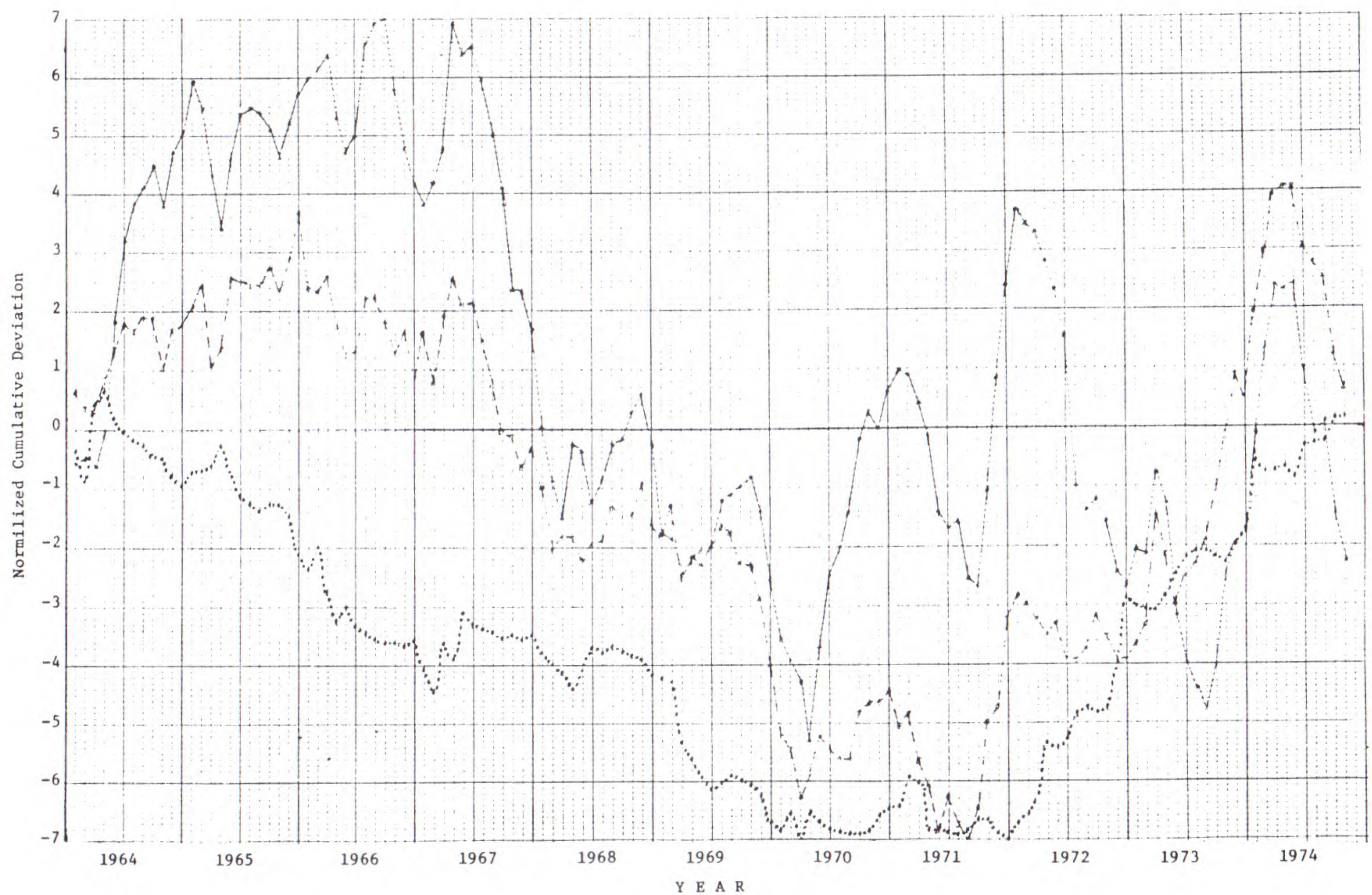


Figure 8: Cumulative Deviations of Monthly Average from Mean for Month at South Heights

Water temperature ———— Air Temperature - - - - - Flow ....



where the variable is expressed as the deviation from the mean and time is expressed in months for month 1 to month N or, for a centered time series, from month -N to month +N. A and B are constants determined by least squares regression analysis.

A summary of the trend analysis for water and air temperature and river flow is presented in Table 1 which tabulates the number of months of record, A and B coefficients, regression coefficients and statistical significance (Sigma). The regression coefficient is a measure of the degree of association between the variables and ranges from plus or minus one when the equation provides a perfect correlation of the dependent variable (temperature or flow) with the independent variable (time) to zero when there is no relationship.

For both water and air temperatures the analysis shows that there is no statistically significant trend with time. For flow the analysis indicates that the trends toward increasing flow from the start to end of the 131 months of record is statistically significant. However, the use of the regression coefficient as a measure of statistical significance is based on the assumption that the value of each data item is not affected by the values of any of the other data items. This assumption does not apply for analysis of time series or other sequential data. Considering the high level of statistical significance confirmed by the curves of cumulative deviations (Figure 5), it is apparent that there has been a real trend toward increasing flows during the 1964-74 period. Since this 11-year period represents only one phase -- drought to peak -- of the long-term cycle, the trend line which describes the data for this period should not be used to predict future flows or to estimate flow prior to 1964.

In summary, time-series or chronological appraisal of monthly-average temperature and flow data for the Ohio River from January 1964 through October 1974 shows:

1. The normal seasonal pattern in monthly average water and air temperatures is the dominant factor in month-to-month temperature variations. Year-to-year variations in maximum and minimum values do not significantly influence the seasonal pattern.

2. The annual cycle can be eliminated from the data set by conversion to deviations of the monthly average from the corresponding overall monthly mean.

Table 1: Trend Analysis -- Air and River Temperature and River Flow

January 1974 through October 1974

Station	Number of Months	A Coefficient	B Coefficient	Regression Coefficient	Statistical Significance*
		WATER TEMPERATURE			
South Heights	130	-0.046	-0.006	-0.183	NS
Stratton	130	-0.048	+0.005	0.122	NS
Huntington	130	-0.051	-0.005	-0.150	NS
Cincinnati	130	-0.054	+0.001	0.021	NS
Miami Fort	125	+0.050	-0.001	-0.032	NS
Louisville	130	-0.051	-0.002	-0.068	NS
Cane Run	112	-0.088	-0.001	-0.037	NS
		AIR TEMPERATURE			
Pittsburgh	131	-0.0496	0.0010	0.0237	NS
Huntington	131	-0.0450	0.0047	0.1170	NS
Cincinnati	131	-0.0488	-0.0010	-0.0488	NS
Louisville	131	-0.0473	0.0006	0.0142	NS
Evansville	131	-0.0542	0.0036	0.0924	NS
		RIVER FLOW			
South Heights	131	-0.042	52.08	0.273	0.01
Stratton	131	-0.039	63.75	0.306	0.01
Huntington	131	-0.017	143.76	0.324	0.001
Cincinnati	131	0.001	202.34	0.321	0.001
Louisville	131	0.001	196.34	0.271	0.01

*Based on normal statistical procedures for random numbers and a 0.05 level of significance

3. Graphic analysis of the sequential cumulative deviations from the mean shows that, with the exception of South Heights and Stratton during 1970, water temperature variations occur in a nearly identical pattern -- short term trends -- at 11 of the electronic monitor locations. The marked deviation from this pattern at South Heights during 1970 was due to below normal temperatures in the Allegheny River. This analysis also indicates that there is no apparent long-term trend toward increasing or decreasing water or air temperatures during the 11-year period of record.
4. Graphic analysis of cumulative deviations of flow shows an identical pattern at all monitor locations -- with below normal flows from January 1964 to about December 1969, near normal flows during 1970 and 1971 and above normal flows from 1972 through 1974. This pattern indicates a trend toward increasing flows during the period of record.
5. Statistical analysis and comparison of the cumulative deviation curves for water temperature and river flow indicate that, with the exception of South Heights, there is no significant correlation between water temperature and river flow. The South Heights water temperature is determined by the relative temperature and flow of the Allegheny and Monongahela rivers.
6. Trend analysis confirmed that there was no significant trend in water or air temperature but that the increase in flow with time during the period of record was probably statistically significant.

Interstation Temperature Relationships

The impact of thermal discharges on river temperatures can be determined by field surveys to measure short-term temperature variations downstream from a major thermal discharge or by analysis and interpretation of long-term temperature records at fixed locations. Field surveys studies will be discussed in the next section. Long-term temperature records are available from the ORSANCO electronic monitor network. Five of the monitor stations have continuous records over at least 10 years and records for all eleven Ohio River monitor include the January 1969 through October 1974 period. These records involve over 31,000 daily average temperature values based on hourly readings.

Regression analysis was used to determine the relationship between monitor locations. To provide a common baseline, daily average water temperatures at each downstream monitor were used as the dependent variable and temperatures at South Heights were taken as the independent variable. For example, the temperature at South Heights for each day was paired with the temperature at Stratton for the same day. Since only pairs of data could be used, days with missing data at either monitor were deleted from the analysis. It was assumed that the data would fit a linear equation

$$Tm = A + B \times Ts.h.$$

where Tm is the temperature at a specified downstream monitor, Ts.h. is the corresponding temperature at South Heights and A and B are constants. The determination of A, B, regression coefficient and standard deviation was completed for each year of record at each monitor location. These regression equations were used to calculate the downstream monitor temperature for South Heights temperatures of 40.0, 60.0 and 80.0 deg. F.

The statistical parameters and calculated temperatures are listed in Table 2 for each year of record. Table 3 presents the same information for the regression between the South Heights monitor and Wheeling and Natrium water user stations.

All of the 108 annual equations are statistically significant at a level such that there is considerably less than 1 chance in 1,000 that the relationship resulted from random factors. This is not a cause and effect relationship, since it is obvious that the temperature at South Heights on a given day does not determine the temperature at Evansville some 775 miles downstream on the same day. Instead the equations show the dominant concurrent effect of a third variable -- meteorological conditions -- on river temperatures. The correlation coefficient decreases slightly as the distance from South Heights increases -- from about 0.995 at Stratton to about 0.985 at Evansville -- and the standard deviation increases from about 1.5 at Stratton to 3.6 at Evansville.

Although Tables 2 and 3 allow year-to-year comparison of temperatures calculated from constant temperatures at South Heights, they do not permit comparison between stations in any one year. To provide for this comparison, the calculated temperatures are tabulated by station and year in Table 4, for South Heights, temperatures of 40, 60 and 80 deg. F.

Table 2: Regression Between Daily Average Water Temperature at South Heights (mile 15.8) and Temperature at Indicated Downstream Electronic Monitor Station

Year	Number of Values	Coefficient		Standard Deviation	Regression Coefficient	South Heights Temperature		
		Alpha	Beta			40	60	80
Stratton (mi 55.8)								
1964	284	-2.234	1.035	3.13	0.984	39.1	59.8	80.6
1965	325	-2.690	1.058	1.84	0.994	39.6	60.7	81.9
1966	195	-4.276	1.074	2.11	0.994	38.6	60.1	81.6
1967	276	1.294	0.984	1.66	0.995	40.6	60.3	80.0
1968	354	-1.269	1.027	1.49	0.997	39.8	60.3	80.9
1969	333	0.542	1.000	1.50	0.996	40.5	60.5	80.5
1970	322	-1.697	1.056	1.76	0.995	40.5	61.6	82.7
1971	316	1.416	1.002	1.45	0.996	41.4	61.5	81.5
1972	279	0.352	1.034	1.74	0.992	41.7	62.3	83.0
1973	313	6.741	0.932	1.77	0.994	44.0	62.6	81.3
1974	249	2.378	0.988	1.44	0.995	41.8	61.6	81.4
Willow Island (mi 160.6)								
1969	332	3.074	0.993	1.63	0.996	42.7	62.6	82.4
1970	321	2.744	1.017	2.22	0.991	43.4	63.7	84.1
1971	334	6.374	0.936	1.97	0.992	43.8	62.5	81.2
1972	315	1.355	1.020	1.84	0.993	42.1	62.5	82.9
1973	290	3.855	0.980	1.92	0.994	43.0	62.6	82.2
1974	162	2.518	0.982	2.22	0.986	41.8	61.4	81.1

Table 2 : Regression Between Daily Average Water Temperature at South Heights (mile 15.8) and Temperature at Indicated Downstream Electronic Monitor Station

Cont'd (2)

Year	Number of Values	Coefficient		Standard Deviation	Regression Coefficient	South Heights Temperature		
		Alpha	Beta			40	60	80
New Haven (mi 241.6)								
1967	154	0.790	1.028	2.16	0.990	41.9	62.4	83.0
1968	355	2.467	0.978	1.65	0.995	41.5	61.1	80.6
1969	340	2.661	0.979	2.01	0.992	41.8	61.4	81.0
1970	329	0.418	1.046	2.37	0.991	42.2	63.1	84.0
1971	328	3.587	0.965	2.18	0.991	42.1	61.4	80.7
1972	339	0.446	1.035	2.30	0.989	41.8	62.5	83.2
1973	274	6.389	0.913	1.96	0.991	42.8	61.1	79.4
1974	Insufficient data							
Huntington (mi 304.2)								
1964	319	0.839	1.006	2.41	0.990	41.0	61.2	81.3
1965	320	0.804	1.022	2.57	0.988	41.6	62.1	82.5
1966	210	0.633	1.019	2.89	0.987	41.4	61.7	82.1
1967	277	4.338	0.962	2.86	0.984	42.8	62.0	81.2
1968	353	4.970	0.966	1.95	0.993	42.6	61.9	81.2
1969	329	3.493	0.974	2.46	0.989	42.4	61.9	81.4
1970	317	2.106	1.035	2.71	0.988	43.5	64.2	84.9
1971	295	6.842	0.918	2.41	0.989	43.5	61.9	80.2
1972	331	3.969	0.949	2.60	0.984	41.9	60.9	79.8
1973	318	4.693	0.964	1.82	0.994	43.2	62.5	81.8
1974	182	4.576	0.941	1.72	0.992	42.2	61.0	79.8

Table 2 : Regression Between Daily Average Water Temperature at South Heights (mile 15.8) and Temperature at Indicated Downstream Electronic Monitor Station Cont'd (3)

Year	Number of Values	Coefficient		Standard Deviation	Regression Coefficient	South Heights Temperature		
		Alpha	Beta			40	60	80
Cincinnati (mi. 462.8)								
1964	323	8.409	0.868	2.22	0.988	43.1	60.5	77.8
1965	326	1.133	0.986	2.76	0.985	40.5	60.2	80.0
1966	250	1.807	0.982	2.64	0.988	41.0	60.7	80.3
1967	238	2.096	1.006	2.69	0.988	42.3	62.4	82.5
1968	355	3.046	0.962	2.40	0.990	51.5	60.7	80.0
1969	329	0.864	1.002	2.27	0.991	40.9	61.0	81.0
1970	350	-1.136	1.065	2.71	0.988	41.4	62.7	84.0
1971	331	4.473	0.944	2.49	0.988	42.2	61.1	80.0
1972	361	1.696	1.012	2.79	0.984	42.1	62.4	82.6
1973	340	3.178	0.979	2.69	0.987	42.3	61.9	81.5
1974	258	2.904	0.969	2.05	0.989	41.6	61.0	80.3
Miami Fort (mi. 490.0)								
1965	322	2.024	0.989	2.88	0.983	41.5	61.3	81.1
1966	243	3.212	0.976	2.88	0.986	42.2	61.8	81.3
1967	227	4.611	0.992	2.84	0.984	44.2	64.1	83.9
1968	323	4.740	0.945	2.39	0.990	42.5	61.4	80.3
1969	319	4.442	0.970	2.76	0.986	43.2	62.6	82.0
1970	315	2.865	1.025	2.45	0.989	43.8	64.3	84.8
1971	321	4.891	0.950	2.68	0.986	42.8	61.8	80.8
1972	355	3.030	0.989	2.39	0.987	42.5	62.3	82.1
1973	316	6.224	0.943	2.24	0.990	43.9	62.7	81.6
1974	265	3.649	0.977	2.00	0.990	42.7	62.2	81.8

Table 2: Regression Between Daily Average Water Temperature at South Heights (mile 15.8) and Temperature at Indicated Downstream Electronic Monitor Station

Cont'd (4)

Year	Number of Values	Coefficient		Standard Deviation	Regression Coefficient	South Heights Temperature		
		Alpha	Beta			40	60	80
Markland (mi. 531.5)								
1969	200	7.373	0.921	1.91	0.992	44.2	62.6	81.0
1970	329	1.661	1.034	2.67	0.988	43.0	63.7	84.3
1971	310	4.629	0.950	2.88	0.984	42.6	61.6	80.5
1972	288	5.300	0.964	2.93	0.982	43.8	63.1	82.3
1973	308	7.425	0.928	2.47	0.988	44.5	63.1	81.6
1974	231	7.399	0.918	2.44	0.981	44.1	62.5	80.8
Louisville (mi. 600.6)								
1964	311	2.272	0.987	2.46	0.988	41.7	61.4	81.2
1965	325	1.304	0.995	2.97	0.983	41.1	61.0	80.9
1966	249	0.051	1.024	2.65	0.989	41.0	61.4	81.9
1967	288	4.054	0.971	3.43	0.978	42.9	62.3	81.7
1968	343	2.881	0.976	2.32	0.990	41.9	61.4	80.9
1969	319	0.965	1.001	2.41	0.990	41.2	61.3	81.5
1970	318	1.556	1.035	2.46	0.989	42.9	63.6	84.3
1971	315	9.419	0.874	2.76	0.982	44.3	61.8	79.3
1972	363	4.525	0.968	2.51	0.985	43.2	62.5	81.9
1973	330	9.869	0.870	2.42	0.987	44.6	62.0	79.4
1974	260	7.130	0.912	2.15	0.987	43.5	61.8	80.0

Table 2 : Regression Between Daily Average Water Temperature at South Heights (mile 15.8) and Temperature at Indicated Downstream Electronic Monitor Station

Cont'd (5)

Year	Number of Values	Coefficient		Standard Deviation	Regression Coefficient	South Heights Temperature		
		Alpha	Beta			40	60	80
Cane Run (mi. 616.8)								
1966	219	6.032	0.942	2.11	0.992	43.7	62.5	81.3
1967	269	7.903	0.927	3.48	0.974	45.0	63.5	82.1
1968	353	5.170	0.950	2.31	0.990	43.1	62.1	81.2
1969	336	3.592	0.979	2.19	0.992	42.7	62.3	81.9
1970	314	1.843	1.038	2.82	0.985	43.3	64.1	84.8
1971	323	4.964	0.955	2.73	0.986	43.1	62.2	81.3
1972	353	2.851	1.006	2.68	0.985	43.0	63.1	83.3
1973	324	7.991	0.922	2.65	0.985	44.8	63.2	81.7
1974	265	4.731	0.957	2.16	0.988	42.9	62.1	81.2
Evansville (mi. 791.5)								
1969	301	1.878	1.008	2.39	0.990	42.2	62.3	82.5
1970	319	0.113	1.055	2.61	0.988	42.3	63.4	84.5
1971	283	4.726	0.957	2.96	0.982	43.0	62.1	81.3
1972	326	0.502	1.050	3.18	0.981	42.4	63.4	84.4
1973	278	8.506	0.903	2.25	0.990	44.6	62.6	80.7
1974	200	7.244	0.928	2.59	0.982	44.3	62.9	81.4

Table 3 : Regression Between Daily Average Water Temperature at South Heights (mile 15.8) and Temperature of Indicated Downstream Manual (Water User) Monitor Station

Year	Number of Values	Coefficient		Standard Deviation	Regression Coefficient	South Heights Temperature		
		Alpha	Beta			40	60	80
Wheeling, W.Va. (Mi. 86.8)								
1964	332	0.164	0.994	2.23	0.991	39.9	59.7	79.6
1965	299	-0.963	1.015	3.00	0.983	39.6	59.9	80.2
1966	234	1.573	0.981	2.35	0.991	40.8	60.4	80.0
1967	287	3.779	0.961	2.67	0.986	42.2	61.4	80.6
1968	354	1.086	0.996	2.58	0.989	40.9	60.8	80.7
1969	343	2.290	0.980	2.07	0.992	41.5	61.1	80.7
1970	353	-0.938	1.036	2.27	0.991	40.5	61.2	81.9
1971	335	1.193	0.987	2.56	0.998	40.6	60.3	80.1
1972	365	-1.077	1.040	2.35	0.989	40.5	61.3	82.1
1973	343	3.136	0.971	2.06	0.992	41.9	61.3	80.8
Natrium, W. Va. (mi. 119.4)*								
1964	49	-0.918	1.037	2.14	0.993	40.5	61.2	82.0
1965	48	-2.860	1.074	2.86	0.987	40.1	61.5	83.0
1966	39	-0.766	1.054	2.25	0.993	41.4	62.5	83.5
1967	43	5.768	0.976	2.30	0.990	44.7	64.3	83.8
1968	50	1.574	1.026	2.27	0.992	42.5	63.1	83.6
1969	49	2.868	1.010	2.90	0.987	43.2	63.4	83.6
1970	51	-1.198	1.064	2.19	0.992	41.3	62.6	83.9
1971	46	1.596	1.008	2.32	0.991	41.8	62.0	82.1
1972	52	-2.438	1.090	2.18	0.992	41.1	62.9	84.7
1973	49	4.567	0.972	1.94	0.994	43.4	62.8	82.2

* One value per week

Table 4 : Summary of Calculated Water Temperatures Based on Indicated Temperature at South Heights

Station	YEAR											Average	
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	11-yr.	6-yr
South Heights	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Stratton	39.1	39.6	38.6	40.6	39.8	40.5	40.5	41.4	41.7	44.0	41.8	40.7	41.6
Wheeling*	39.9	39.6	40.8	42.2	40.9	41.5	40.5	40.6	40.5	41.9	--	40.8	41.0
Natrium*	40.5	40.1	41.4	44.7	42.5	43.2	41.3	41.8	41.1	43.4	--	42.0	42.2
Willow Island						42.7	43.4	43.8	42.1	43.0	41.8	--	42.8
New Haven						41.8	42.2	42.1	41.8	42.8	--	--	41.9
Huntington	41.0	41.6	41.4	42.8	42.6	42.4	43.5	43.5	41.9	43.2	42.2	42.4	42.8
Cincinnati	43.1	40.5	41.0	42.3	41.5	40.9	41.4	42.2	42.1	42.3	41.6	41.7	41.8
Miami Fort*		41.5	42.2	44.2	42.5	43.2	43.8	42.8	42.5	43.9	42.7	42.9	43.2
Markland						44.2	43.0	42.6	43.8	44.5	44.1	--	43.7
Louisville	41.7	41.1	41.0	42.9	41.9	41.2	42.9	44.3	43.2	44.6	43.5	42.6	43.3
Cane Run						42.7	43.3	43.1	43.0	44.8	42.9	--	43.3
Evansville						42.2	42.3	43.0	42.4	44.6	44.3	--	43.1
Average Long-Term	40.9	40.6	40.9	42.8	41.7	41.8	42.0	42.4	41.8	43.3	42.4		
All						42.2	42.3	42.6	42.2	43.6	42.8		

*10-Year

Table 4 : Summary of Calculated Water Temperatures Based on Indicated Temperature at South Heights

Cont'd (2)

Station	YEAR											Average	
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	11-yr.	6-yr
South Heights	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Stratton	59.8	60.7	60.1	60.3	60.3	60.5	61.6	61.5	62.3	62.6	61.6	61.0	61.7
Wheeling*	59.7	59.9	60.4	61.4	60.8	61.1	61.2	60.3	61.3	61.3	--	60.7	61.0
Natrium*	61.2	61.5	62.5	64.3	63.1	63.4	62.6	62.0	62.9	62.8	--	62.6	62.7
Willow Island						62.6	63.7	62.5	62.5	62.6	61.4		62.6
New Haven						61.4	63.1	61.4	62.5	61.1	--		61.9
Huntington	61.2	62.1	61.7	62.0	61.9	61.9	64.2	61.9	60.9	62.5	61.0	61.9	62.1
Cincinnati	60.5	60.2	60.7	62.4	60.7	61.0	62.7	61.1	62.4	61.9	61.0	61.3	61.7
Miami Fort*		61.3	61.8	64.1	61.4	62.6	64.3	61.8	62.3	62.7	62.2	62.4	62.6
Markland						62.6	63.7	61.6	63.1	63.1	62.5		62.8
Louisville	61.4	61.0	61.4	62.3	61.4	61.3	63.6	61.8	62.5	62.0	61.8	61.9	62.2
Cane Run						62.3	64.1	62.2	63.1	63.2	62.1		62.8
Evansville						62.3	63.4	62.1	63.4	62.6	62.9		62.8
Average Long-Term	60.6	61.0	61.2	62.4	61.4	61.7	62.9	61.5	62.1	62.2	61.5		
All						61.9	63.2	61.7	62.4	62.4	61.8		

on Indicated Temperature at South Heights

Cont'd (3)

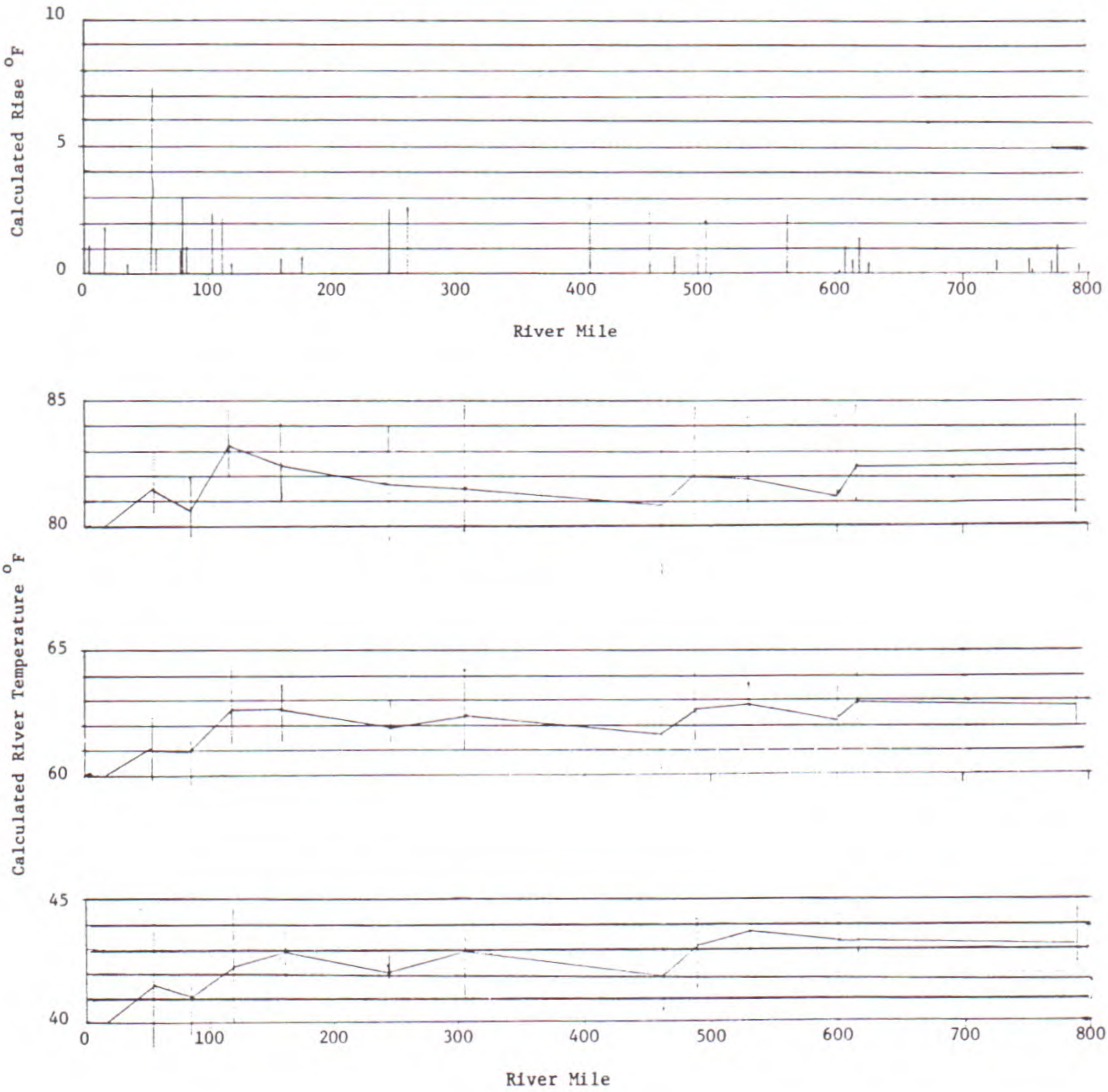
Station	YEAR 1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	Average 11-yr.	6-yr
South Heights	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
Stratton	80.6	81.9	81.6	80.0	80.9	80.5	82.5	81.5	83.0	81.3	81.4	81.4	81.7
Wheeling	79.6	80.2	80.0	80.6	80.7	80.7	81.9	80.1	82.1	80.8	--	80.7	81.1
Natrium	82.0	83.0	83.5	83.8	83.6	83.6	83.9	82.1	84.7	82.2	--	83.2	83.3
Willow Island						82.4	84.1	81.2	82.9	82.2	81.1		82.3
New Haven						81.0	84.0	80.7	83.2	79.4	--		81.7
Huntington	81.3	82.5	82.1	81.2	81.2	81.4	84.9	80.2	79.8	81.8	79.8	81.5	81.3
Cincinnati	77.8	80.0	80.3	82.5	80.0	81.0	84.0	80.0	82.6	81.5	80.3	80.9	81.6
Miami Fort		81.1	81.3	83.9	80.3	82.0	84.8	80.8	82.1	81.6	81.8	82.0	82.2
Markland						81.0	84.3	80.5	82.3	81.6	80.8		81.8
Louisville	81.2	80.9	81.9	81.7	80.9	81.5	84.3	79.3	81.9	79.4	80.0	81.2	81.1
Cane Run						81.9	84.8	81.3	83.3	81.7	81.2		82.4
Evansville						82.5	84.5	81.3	84.4	80.7	81.4		82.5
Average Long-Term	80.4	81.4	81.5	82.0	81.1	81.5	83.8	80.6	82.3	81.2	80.7		
All						81.6	84.0	80.8	82.7	81.2	80.9		

Within each year there is an apparent trend for temperatures to increase downstream with the greatest increase occurring at 40 deg. F. The ranges from minimum to maximum for the 1969-1974 period is 2.7, 1.7 and 1.4 deg. F for 40, 60 and 80 degree temperatures at South Heights. The maximum winter temperature average of 43.6 deg. F occurred in 1973. The maximum spring-fall and summer temperatures of 63.2 and 84.0 (average of all stations) occurred in 1970 when the observed temperature pattern at South Heights was distinctly different from the pattern at the other monitor locations. In general, winter and spring flows would be high (40 and 60 deg. values) As noted in the previous section, flows were generally below normal from 1964 through 1969, near normal during 1970 and 1971, and above normal from 1972 through 1974. Essentially all of the maximum winter temperatures (40 deg. F) occurred in 1973 whereas, the maximums for the 60 and 80 Deg. F curves occurred in 1970.

If thermal discharges resulted in the accumulation of excess heat (increased river temperatures) the effect should be most apparent between Stratton and Willow Island, and between New Haven and Huntington during the high temperature period. Except in 1970 there are no significant differences between the temperatures at Stratton, Willow Island, New Haven and Huntington. The lower three curves of Figure 9 show the average, maximum and mimimum calculated temperature at each station for the period of record. The upper graph shows the calculated river temperature rise at 100 percent of rated capacity and critical flow for each power plant with once-through cooling.

Between mile 55 (Stratton) and mile 161 (Willow Island) temperatures on the 80 deg. F curve show a drop at mile 86 (Wheeling), a rise at mile 111 (Natrium) and a drop at Willow Island. The marked drop between Stratton and Wheeling, a segment receiving multiple thermal discharges, may be due to differences in temperature measurement. Electronic monitor temperature sensors are calibrated against sensitive (0.1 deg. F) thermometers which are standardized against a U. S. Bureau of Standards standard thermometer; therefore, monitor temperature readings should be comparable. On the other hand, there is no information regarding the accuracy or sensitivity of the thermometers used at Wheeling and Natrium. Therefore, there is some doubt that the temperature drop at Wheeling and rise at Natrium indicate actual changes in river conditions.

Figure 9: Calculated Temperature Rise for Thermal Discharges and Calculated River Temperatures from Annual Regression Equations



In a similar manner, regression analysis was used to determine the relationship between daily average air temperature at Pittsburgh and the corresponding air temperature at Huntington, Cincinnati, Louisville or Evansville. The statistical parameters -- A and B coefficients, standard deviation (Sigma) and regression coefficient -- and the calculated temperatures for 40, 60 and 80 degree F values at Pittsburgh are shown in Table 5. All of the regression equations are statistically significant at the 99.9 percent level (less than 1 chance in 1,000 that the relationship is due to random variations). Station-to-station variations in air temperatures calculated for 40, 60 and 80 degree F at Pittsburgh and water temperatures calculated for 40, 60 and 80 degree F at South Heights are summaried below for the 11-year period.

Station	Air Temperature -- deg. F			Water Temperature -- deg. F		
Pittsburgh	40.0	60.0	80.0	40.0	60.0	80.0
Huntington	45.5	63.4	81.2	42.4	61.9	81.5
Cincinnati	43.4	62.8	82.2	41.7	61.3	80.9
Louisville	46.3	65.0	83.6	42.6	61.9	81.2
Evansville	45.9	64.8	83.8	only 6 years of record		

At both 40 and 60 degree base temperatures, calculated air and water temperatures at Cincinnati are lower than corresponding values at Huntington and Louisville. At 80 degrees,Cincinnati water temperatures are slightly lower than values at Huntington and Louisville,although the Cincinnati air temperature is higher than Huntington's and lower than Louisville's.

As shown in Table 6, the linear regression

T water = A + B T air

at the five monitor locations is significant at the 99.9 percent level, even after adjusting for the non-randomness of the data sets. The regression coefficients are somewhat lower than the coefficients determined for the water temperature at South Heights with downstream monitor values or the corresponding air temperature relationships. Two reasons can be identified:

1. The river flows from east to west whereas the weather generally moves from west to east. This countercurrent movement means that the water temperatures at a given location have been determined by the air temperatures for one or more preceding days.

Table 5. Regression Daily Average Air Temperature [illegible]
and Air Temperature at Indicated Downstream Station

Year	Number of Values	Alpha Coefficient	Beta Coefficient	Sigma	Regression Coefficient	Pittsburgh Air Temperature		
						40	60	80
				HUNTINGTON				
1964	318	5.156	0.970	3.547	0.966	44.3	63.6	83.0
1965	316	9.138	0.921	3.228	0.970	45.9	64.4	82.8
1966	305	9.584	0.888	3.248	0.970	44.9	62.6	80.3
1967	305	11.376	0.853	3.456	0.959	45.5	62.5	79.6
1968	292	10.205	0.888	2.944	0.972	45.7	63.4	81.2
1969	294	5.560	0.967	3.132	0.976	44.2	63.5	82.9
1970	301	11.885	0.860	3.681	0.959	46.3	63.5	80.7
1971	306	14.470	0.821	3.210	0.963	47.3	63.7	80.1
1972	315	9.340	0.891	3.375	0.966	45.0	62.8	80.6
1973	319	7.319	0.937	2.928	0.976	44.8	63.5	82.2
1974*	276	13.986	0.825	3.674	0.949	46.9	63.4	79.9
				CINCINNATI				
1964	315	1.440	1.028	3.936	0.963	42.5	63.1	83.7
1965	309	5.474	0.958	3.916	0.958	43.7	62.9	82.0
1966	299	2.567	1.000	3.834	0.967	42.5	62.5	82.5
1967	300	6.430	0.939	3.499	0.964	43.9	62.7	81.5
1968	290	7.772	0.936	3.635	0.961	45.2	63.9	82.6
1969	294	2.425	1.011	3.350	0.975	42.8	63.0	83.3
1970	301	6.146	0.960	4.021	0.960	44.5	63.7	82.9
1971	307	6.168	0.954	3.801	0.962	44.3	63.4	82.4
1972	312	2.683	0.996	3.697	0.966	42.5	62.4	82.3
1973	315	4.176	0.955	3.388	0.969	42.3	61.4	80.6
1974*	275	6.456	0.928	3.683	0.958	43.5	62.1	80.6

* 10 months

Table 5: Regression Daily Average Air Temperature at Pittsburgh and Air Temperature at Indicated Downstream Station

Year	Number of Values	Alpha Coefficient	Beta Coefficient	Sigma	Regression Coefficient	Pittsburgh Air Temperature		
						40	60	80
				LOUISVILLE				
1964	318	4.748	1.009	4.482	0.951	45.1	65.3	85.4
1965	316	8.357	0.961	4.788	0.941	46.7	66.0	85.2
1966	305	7.966	0.943	4.197	0.957	45.6	64.5	83.4
1967	301	13.014	0.860	4.520	0.932	47.4	64.5	81.7
1968	292	8.870	0.949	4.252	0.950	46.8	65.8	84.8
1969	295	6.636	0.968	3.945	0.963	45.3	64.7	84.0
1970	301	10.741	0.898	4.458	0.945	46.6	64.6	82.5
1971	307	10.748	0.905	3.834	0.957	46.9	65.0	83.1
1972	315	7.105	0.977	4.313	0.954	46.1	65.7	85.2
1973	317	7.581	0.955	3.866	0.960	45.7	64.9	84.0
1974*	277	14.191	0.831	4.096	0.939	47.4	64.0	80.6
				EVANSVILLE				
1964	316	3.653	1.025	5.427	0.933	44.6	65.1	85.6
1965	310	8.869	0.949	5.150	0.931	46.8	65.8	84.8
1966	304	7.430	0.939	5.144	0.937	44.9	63.7	82.5
1967	300	12.571	0.853	4.979	0.918	46.7	63.7	80.8
1968	290	7.970	0.958	4.946	0.934	46.3	65.4	84.6
1969	291	5.045	0.986	4.605	0.951	44.5	64.2	83.9
1970	300	8.581	0.924	5.320	0.928	45.5	64.0	82.5
1971	305	7.257	0.979	5.205	0.934	46.4	65.9	85.5
1972	308	6.136	0.977	5.349	0.931	45.2	64.7	84.3
1973	315	6.723	0.973	4.730	0.944	45.6	65.0	84.5
1974*	275	13.812	0.856	5.212	0.910	48.0	65.1	82.3

Table 6: Relationship Between Air and Water Temperatures at Same Location

Year	Number of Values	Alpha Coefficient	Beta Coefficient	Sigma	Regression Coefficient
	Pittsburgh Air -- South Heights Water				
1964	301	8.692	0.976	8.254	0.848
1965	292	14.527	0.876	8.093	0.832
1966	211	7.080	0.956	7.432	0.892
1967	241	6.572	0.976	6.802	0.895
1968	289	12.377	0.919	7.623	0.856
1969	274	10.632	0.933	7.180	0.886
1970	289	9.448	0.918	6.698	0.893
1971	283	6.825	0.992	6.442	0.911
1972	314	11.874	0.874	7.022	0.868
1973	300	5.221	0.992	7.932	0.867
1974*	254	15.578	0.831	7.055	0.847
	Huntington Air -- Huntington Water				
1964	306	8.635	0.936	8.785	0.845
1965	319	9.994	0.917	8.740	0.831
1966	245	9.233	0.931	8.657	0.830
1967	256	9.807	0.924	7.798	0.857
1968	306	9.928	0.931	8.220	0.837
1969	313	12.113	0.891	7.602	0.875
1970	286	5.936	0.997	7.821	0.879
1971	274	6.965	0.958	7.643	0.871
1972	304	11.935	0.840	7.837	0.832
1973	315	7.311	0.947	8.407	0.859
1974*	202	11.583	0.877	7.424	0.822

*10 months

Table 6: Relationship Between Air and Water Temperatures at Same Location

Year	**Number of Values**	**Alpha Coefficient**	**Beta Coefficient**	**Sigma**	**Regression Coefficient**
		Cincinnati Air -- Cincinnati Water			
1964	303	17.631	0.780	7.403	0.848
1965	309	11.746	0.878	8.266	0.831
1966	292	13.902	0.838	7.469	0.863
1967	197	7.789	0.967	7.922	0.875
1968	310	11.052	0.888	8.120	0.846
1969	306	11.214	0.898	7.274	0.892
1970	312	7.330	0.947	7.524	0.888
1971	320	10.154	0.897	7.453	0.870
1972	318	14.439	0.833	8.108	0.838
1973	327	7.291	0.960	8.774	0.845
1974*	273	16.848	0.792	7.995	0.792
		Louisville Air -- Louisville Water			
1964	305	9.416	0.913	7.509	0.878
1965	331	11.433	0.862	7.807	0.864
1966	304	10.042	0.891	7.725	0.869
1967	310	11.071	0.866	8.403	0.826
1968	307	9.942	0.888	7.588	0.870
1969	313	9.132	0.916	6.986	0.902
1970	303	5.829	0.976	7.176	0.896
1971	321	13.684	0.829	7.015	0.866
1972	335	12.684	0.822	6.800	0.879
1973	331	12.013	0.835	7.378	0.861
1974*	272	14.085	0.825	7.311	0.820

* 10 months

Table 6: Relationship Between Air and Water Temperatures at Same Location

Year	Number of Values	Alpha Coefficient	Beta Coefficient	Sigma	Regression Coefficient
	Evansville Air -- Evansville Water				
1969	288	11.275	0.909	6.320	0.913
1970	297	8.690	0.930	7.330	0.887
1971	287	9.965	0.879	6.985	0.888
1972	294	9.433	0.906	7.542	0.879
1973	276	9.164	0.898	6.704	0.897
1974*	194	11.065	0.865	7.439	0.832

* 10 months

2. The weather stations used for this study are located at sites which may be at a higher elevation and up to several miles distance from the electronic monitor. This difference in location could affect not only air temperature (dry-bulb) but also such meteorological variables as wet-bulb temperature, humidity, wind velocity and wind direction.

In summary, these statistical studies of daily water and air temperatures confirm the more general relationships derived from analysis of the deseasonalized monthly average data. Some conclusions:

1. The highly significant correlation between daily average water temperatures at South Heights and the corresponding daily average values at downstream monitor locations parallels the equally significant correlation between air temperatures at Pittsburgh and corresponding daily values at downstream weather stations.
2. For both water and air temperatures this high level of correlation is not a cause and effect relationship. That is the temperature on a given day does not affect the corresponding temperature at a downstream location on the same day.
3. The correlation between daily water and daily air temperatures at a given monitoring location shows that air temperature (and possibly other meteorological parameters) is the major determinant of water temperatures.
4. Evaluation of the statistical studies indicates that there is no significant build-up of excess temperature as the result of thermal discharges to the river. Since the electronic monitor locations are from 15 miles (Cincinnati) to 40 or 45 miles downstream from significant thermal discharges, temperature rise due to thermal discharges is dissipated within some 40 river miles.

Field Surveys

Temperature data from the monitor network provides long-term continuous records at fixed locations but, except by inference, does not provide data on the downstream die-away of excess heat from thermal discharges. Most river surveys were designed to study other parameters -- DO, coliform, nutrients, etc. -- rather than temperature. For example the U. S. EPA September 1970 report "Water Quality of the Ohio River, Louisville, Ky. -- Evansville, Ind." reports on data collected during October 1967 when river flow was about 50,000 cfs. The report states "Water temperature averaged 20 deg. C in the Louisville reach and 19 deg. C in the Evansville reach."

Another U. S. EPA report "Ohio River -- McAlpine Pool" June 1973 presents data collected during a five day survey from Markland Dam to Louisville during September 1972. Average river flow during the survey was 30,400 cfs. With reference to temperature the report states:

"Ohio River water temperatures ranged from 24°C to 27°C with a noticeable and consistent cooling of water temperature occurring during the study. No significant temperature variations were observed below any waste discharge or in the lateral or vertical cross-sections of the river. No measureable temperature change was observed from above (Station 561.0) to below (Station 566.3) the Indiana-Kentucky Clifty Creek Power Plant. The power company discharges approximately 960,000 gpm of cooling water with an 11°F temperature rise which would amount to a calculated 0.42°F river temperature increase based on a river flow of 30,000 cfs and fully mixed. No variation was observed during the survey since the dial thermometers used were sensitive only to ± 0.5°C. Temperatures in the Kentucky River ranged between 24°C to 26°C." (It should be noted that the calculated 0.42°F rise in river temperature in the above statement should have been 0.42°C rise.)

Specific field surveys have generally been conducted by or for the electric power companies to define the mixing zone in the vicinity of individual thermal discharges and generally have not extended more than two miles downstream. Although these surveys generally show a very rapid decrease in excess river temperatures (compared to upstream values) it is not possible to distinguish between mixing and heat transfer to the atmosphere. Similar information has been obtained by infrared aerial photograph and imagery. One of these studies conducted by Purdue University in the Louisville area indicated that there was no detectable accumulation of heat over a 13-mile section of river receiving discharges from three power plants.

In October 1973 the West Virginia Division of Water Resources conducted an intensive river temperature-DO survey from mile 40 (state line) to mile 261.7, 1.5 miles downstream from the Kyger Creek power plant. Temperatures were measured at the surface and at 10, 20, 30 and 40 foot depths. For each cross-section surface samples were collected at four to five equidisant locations across the width of the river. The number of samples at the other depths varied with the shape of the channel. A summary of this data is presented in Table 7 which shows the average temperature for each depth and the average of all temperatures for the cross-section. Typical cross-section data at the thermal discharge shows, for mile 102.5 at the Burger plant:

Surface	82.4	70.5	70.5	70.5
10 ft.	77.0	70.3	70.2	70.2

The average temperatures are 73.5 and 71.9 deg. F at the surface and 10 foot depth respectively.

This survey shows that, in most instances, the effect of a thermal discharge is to raise the temperature of the surface layer of water without increasing temperatures at the 10 foot and deeper levels significantly. This excess surface temperature decreases rapidly by water to air transfer of the excess heat. Although the thermister accuracy is given as ±0.7 deg. C (1.3 deg. F), daily calibration of the instruments at the river temperature probably improves the accuracy of the temperature readings. The reported river flows are 2 to 3 times greater than the critical (1-day in 10-year) flows.

In summary the West Virginia surveys shows:

1. In most cases thermal discharges raise the temperature of the top few feet of the river but do not significantly increase temperatures at the 10 foot and lower levels. The surface area affected depends on the volume of the thermal discharge and downstream flow characteristics.

2. Downstream surface and overall temperatures of the river return to normal levels within a few (5 to 20) miles of the discharge.

3. This field survey data supports the conclusion derived from the analysis of long-term monitor data that there is no buildup of excess temperatures resulting from the thermal discharges.

Table 7 : October 1973 Ohio River Temperature Survey
West Virginia Department of Water Resources

Mile Point	Survey Date	River Flow cfs	Surface	10	20	30	40	Overall
			Average Cross-Section Temperature -- deg. F Depth in Cross-Section -- ft.					
40.0	10/3	27,000	70.9	71.2	71.2	71.0		71.0
45.2			71.4	71.4	71.5	71.2		71.4
53.0			71.3	70.3	70.2	70.2	70.2	70.5
54.0	Sammis Discharge							
54.0			74.5	72.9	70.9	70.2		72.5
54.3	New Cumberland L & D							
55.0			71.6	71.3	71.5			71.5
57.5			71.6	71.2	71.3			71.4
57.6	Toronto Power Plant Discharge							
57.6			74.3	71.5	71.4			72.7
57.7			71.7	71.7				71.7
60.5			71.2	70.9	71.0			71.0
61.8	National Steel Discharge							
61.9			74.0	71.4				72.7
64.0	10/4	27,000	71.4	71.3	71.6			71.3
66.8	Harmon Creek							
66.8			75.2	71.4	71.2			73.0
67.1			71.8	71.2	70.8			71.4
69.8			71.6	71.2	71.2			71.3
76.6	Cardinal Discharge							
76.6			79.8	71.6	71.0			74.4
76.9			75.6	72.6	71.2	71.2	71.2	72.6
77.4			76.0	71.7	71.4	71.4		72.7
78.0			74.7	72.0	71.5	71.4		72.6
79.8			73.2	72.0	71.5	71.4		72.2
84.2	Pike Island L & D							
86.4	10.5	30,000	71.6	71.6				71.6
87.4	L & D #12							
91.8			71.8	71.8				71.2
96.1	L & D #13							
102.2	10/8	17,500	70.2	69.9	70.0			70.0
102.5	Burger Discharge							
102.5			73.5	71.9				72.7
102.9			71.9	71.4				71.7
103.5			73.7	71.1	70.2			72.0
104.2	10/8	17,500	71.0	70.5				70.8
105.4			71.2	70.8	70.2			70.9
111.1	Kammer Discharge							

Table 7 : October 1973 Ohio River Temperature Survey
West Virginia Department of Water Resources

Cont'd (2)

Mile Point	Survey Date	River Flow cfs	Average Cross-Section Temperature -- deg. F Surface	Depth in Cross-Section -- ft. 10	20	30	40	Overall
111.1			74.2	74.1	71.1			73.5
111.7			73.9	71.4	71.2			72.2
112.3			71.6	71.3	71.4			71.4
114.0	L & D #14							
114.5			71.4	71.2				71.3
120.0	10/19	17,500	71.3	70.6				70.9
128.6			71.4	70.8				71.0
129.1	L & D #15							
131.1			71.5	71.2	71.1			71.3
146.5	L & D #16							
160.5	Willow Island Discharge							
160.5	10/10	22,000	73.6	70.2				72.1
161.0			73.1	70.2				71.6
161.6			71.1	70.4				70.7
162.1			71.0	70.4	70.5			70.7
167.5	L & D #17							
172.6			71.3	70.8	70.7			71.0
176.8	Union Carbide Discharge							
176.8			74.2	71.1	70.9			72.5
177.2			72.7	71.2	71.2			71.8
191.1	10/11	20,000	71.6	70.4	70.5			70.9
203.9	Belleville L & D							
237.2	Racine L & D							
240.9	10/12	20,000	71.8	71.2	71.4			71.5
241.6	Phillip Sporn Discharge							
241.6			74.8	74.3	71.5			73.9
242.1			76.8	71.6	71.5			73.6
242.5			76.1	72.0				74.0
243.5			75.0	72.7	72.0			73.7
244.5			73.8	73.0	72.5			73.3
246.0			74.8	73.3	73.1	73.0	73.0	73.7
260.0	Kyger Creek Discharge							
260.0			75.6	75.2	72.3	72.5		74.4
260.6			76.2	73.4	72.8			74.1
261.7			75.2	74.1	73.2	73.0	72.8	73.8
279.2	Gallipolis L & D							

TEMPERATURE AND THERMAL DISCHARGE STANDARDS

The evaluation of thermal discharges to the Ohio River is based on the impact on river temperatures relative to accepted stream temperature standards and the degree to which individual discharges comply with applicable effluent limitations.

Stream Standards

The Ohio River flows through the western part of Pennsylvania and forms the boundary between Illinois, Indiana and Ohio on the north and West Virginia and Kentucky on the south. All of the states have adopted temperature criteria which have been approved by the U. S. EPA as state-federal water quality standards. These are:

Pennsylvania -- Pittsburgh (mile 0.0) to Pennsylvania-Ohio-West Virginia state line (mile 40.0): not more than 5 deg. F. rise above ambient temperature (upstream temperature at a sampling point unaffected by any sources of waste heat) or a maximum of 87 deg. F., whichever is less; not to be changed by more than 2 deg. F. during any one-hour period.

Illinois, Indiana, Kentucky, Ohio, West Virginia -- (mile 40.0 to mouth): maximum rise above natural temperature shall not exceed 5 deg. F.; allowable maximum temperature during any month shall not exceed:

Month	Temperature deg. F	Month	Temperature deg. F
January	50	July	89
February	50	August	89
March	60	September	87
April	70	October	78
May	80	November	70
June	87	December	57

In addition the Illinois standards provide that water temperatures shall not exceed the maximum limits in the above table during more than one percent of the hours in the 12-month period ending with any month and at no time shall the water temperature at such locations exceed the maximum limits in the table by more than 3 deg. F.

These stream criteria establish maximum allowable instantaneous temperature limits for the Ohio River. Evaluation of compliance with these criteria, based on hourly monitor records, shows:

Date	Monitor	Temperature -- deg. F: Maximum Hour	Temperature -- deg. F: Maximum Daily Average	% of hours during month criteria met
November 1971	Stratton	71	70	99
	Cane Run	71	71	96
September 1973	Willow Island	88	87	98
October 1973	Cincinnati	79	78	98
	Markland	79	78	98
	Cane Run	79	78	98

All of the values above the temperature limits occurred on the first and second days of the month. At midnight on September 30 the limit changes from 87 to 78 degree F and at midnight on October 31 the criteria changes from 78 to 70 degree F. During 1971 and 1973 September and October air temperatures were unusually high. This was reflected in the water temperatures which, although following the normal seasonal pattern, were also very high. Since water temperatures at the other monitor locations were only slightly lower than those noted above, it is apparent that most, if not all, thermal discharges resulted in violations of the state stream standards immediately downstream from the mixing zone. This type of standards violation was the basis for the exception provided in the Illinois temperature standard.

The above evaluation of compliance with stream standards is based on hourly temperature readings; however, daily average values are used for further assessment of the impact of thermal discharges on river temperatures. Some of the reasons are:

1. Because of the small diurnal temperature variation in the Ohio River individual hourly values which exceed the limits by a few tenths of a deg. F may be affected by the accuracy and sensititivity of the measuring system;

2. Temperatures near or above the maximum allowable temperatures have generally been observed in early October and early November, when the allowable temperature drops from 87 deg. F in September to 78 deg. F

in October and 70 deg. F in November. Above normal fall air temperatures result in high river temperatures during the transition from one month to the next;

3. Temperature data from water users and field surveys represent only one or two determinations per day;

4. Thermal discharge loads and river flows are available only on a daily or daily average basis.

Daily average temperatures at the 11 electronic monitors on the Ohio River exceeded the monthly limits in the above table on four days -- 78.2 deg. F at Cincinnati on October 3, 1973; 70.3 and 70.8 at Cane Run on November 1 and 2, 1971; and 78.4 at Cane Run on October 1, 1973. The temperature limits were exceeded on four days out of over 34,000 days of record or a compliance rate of approximately 99.99 percent. Table 8 shows the maximum daily average temperature recorded each month at the monitor stations, the date on which this temperature was observed and the river flow on that date. More detailed temperature and flow data are presented in Appendices B and D.

Mixing Zones

The state stream standards include definitions of mixing zones -- The area immediately adjacent to an outfall. Stream standards for temperature and other water quality paramaters do not apply within the mixing zone. Following are the state mixing zone standards for the Ohio River:

Illinois: determined on a case-by-case basis; generally the area shall not exceed that of a circle with a radius of 600 feet, nor include more than 25 percent of the cross-sectional area or volume of flow.

Indiana: determined on a case-by-case basis; generally limited to no more than 25 percent of the cross-sectional area and/or volume of flow nor more than 50 percent of the stream width.

Table 8 : Maximum Daily Average Temperature of Electronic Monitor Stations, Date of Occurrence and River Flow

Station	Mile Point	Period of Record	Parameter		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
					MONTH											
South Heights	15.8	1/64-10/74	Temp.	°F	45.9	44.5	51.1	66.4	75.3	83.2	86.6	85.4	83.9	73.7	65.6	47.6
			Date		31/74	16/66	29/68	23/68	25/64	30/71	29/64	24/68	4/73	1/65	3/71	5/73
			Flow	1,000cfs	69.7	165.	69.0	12.0	11.0	10.7	14.0	10.0	6.4	5.0	11.0	40.5
Stratton	53.8	1/64-10/74	Temp.	°F	47.1	46.3	53.8	65.9	75.9	86.0	86.9	86.9	84.1	76.2	69.8	51.4
			Date		31/74	1/74	31/73	29/68	28/65	30/64	24/68	14/73	7/71	1/65	1/71	4/73
			Flow	1,000cfs	76.6	66.5	48.5	20.0	16.0	10.2	7.2	8.7	9.6	6.0	11.5	50.4
Willow Island	160.6	11/68-10/74	Temp.	°F	43.8	45.7	54.9	63.1	74.7	83.9	86.1	85.9	86.9	77.2	69.4	51.8
			Date		2/72	3/74	15/73	21/71	31/69	30/69	25/69	9/73	4/73	1/73	1/71	2/68
			Flow	1,000cfs	85.1	68.9	54.5	30.6	21.8	16.0	27.0	8.4	7.1	25.0	11.6	45.0
New Haven	241.6	7/67-3/74	Temp.	°F	47.6	45.3	53.0	65.2	75.6	82.6	85.6	86.0	83.1	75.5	67.9	49.2
			Date		1/72	2/69	31/73	23/68	25/70	30/69	27/72	24/68	5/72	3/70	2/71	6/72
			Flow	1,000cfs	91.1	35.9	74.9	21.0	38.6	22.0	23.6	15.0	13.7	23.2	17.9	83.4
Huntington	304.2	1/64-10/74	Temp.	°F	46.5	46.4	56.5	65.6	78.8	84.1	86.7	86.9	85.0	77.1	67.0	51.1
			Date		2/72	1/74	16/73	24/68	31/65	30/69	19/66	2/64	4/73	1/73	2/71	3/70
			Flow	1,000cfs	124.	157.	127.	62.0	22.0	30.0	19.0	13.0	11.5	33.6	30.9	92.0
Cincinnati	462.8	1/64-10/74	Temp.	°F	47.5	45.6	54.0	62.9	75.6	82.3	84.4	84.4	85.8	78.2*	69.4	50.8
			Date		1/72	1/74	16/73	30/68	31/70	30/69	2/66	15/69	5/73	3/73	2/71	1/73
			Flow	1,000cfs	115.	232.	139.	59.0	40.4	42.0	11.0	70.0	15.0	45.3	180.	388.

Table 8 : Maximum Daily Average Temperature of Electronic Monitor Stations, Date of Occurrence and River Flow

Cont'd (2)

Station	Mile Point	Period of Record	Parameter		MONTH Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Miami Fort	490.0	6/64-10/74	Temp.	°F	48.4	45.5	55.0	63.2	77.4	84.2	86.3	86.7	84.2	77.1	66.8	51.3
			Date		1/72	1/74	19/73	30/68	31/70	30/66	29/64	3/64	4/73	1/73	4/71	1/6[illegible]
			Flow	1,000cfs	116.	232.	335.	59.0	40.4	14.0	18.0	15.0	14.8	41.9	53.4	45.0
Markland Dam	531.1	5/69-10/74	Temp.	°F	50.0	47.7	54.8	62.9	75.5	82.2	83.9	84.4	85.3	78.0	69.3	52.9
			Date		1/72	2/74	16/73	29/70	27/70	29/71	14/69	3/70	4/73	2/73	2/71	1/73
			Flow	1,000cfs	122.	230.	142.	293.	64.4	62.1	105.0	55.9	15.1	67.8	26.2	393.
Louisville	600.6	1/64-10/74	Temp.	°F	47.9	47.8	56.6	64.5	77.0	84.9	87.2	85.4	82.5	77.5	68.7	50.8
			Date		5/66	2/74	17/67	17/67	27/64	29/66	14/66	24/68	9/70	1/73	1/71	1/71
			Flow	1,000cfs	210.	234.	530.	128.	31.0	17.0	47.0	21.0	30.9	40.5	29.7	77.6
Cane Run	616.8	7/65-10/74	Temp.	°F	47.4	47.1	55.7	64.7	76.5	82.1	87.8	85.9	85.0	78.4*	70.8*	53.[illegible]
			Date		1/66	2/74	16/73	27/68	29/70	29/71	14/77	21/65	5/73	1/73	2/71	4/7[illegible]
			Flow	1,000cfs	52.0	234.	144.	82.0	43.7	58.7	47.0	12.0	14.6	40.5	24.8	240.
Evansville	791.5	10/68-10/74	Temp.	°F	48.3	47.8	54.1	64.2	76.5	83.4	87.9	85.7	85.1	76.7	68.7	50.[illegible]
			Date		27/74	2/74	16/63	30/70	29/70	30/71	19/69	31/73	1/73	1/71	1/71	2/7[illegible]
			Flow	1,000cfs	380.	198.	200.	435.	80.2	73.6	29.9	30.8	28.6	67.6	72.1	79.5

* Exceeds monthly maximum

Kentucky: The aquatic use standards shall not apply to areas immediately adjacent to outfalls. Areas immediately adjacent to outfalls shall be as small as possible, be provided for mixing only, and shall not prevent the free passage of fish and drift organisms.

Ohio: not more than one-half of the width nor more than one-third of the cross sectional area; not extend downstream a distance more than five times the width of the stream, nor exceed 23 acres of horizontal area of the Ohio River; not include spawning or nursery areas nor interdict the migratory routes of any indigenous aquatic species; not include a drinking water supply intake.

Quality standards within the mixing zone are:

(a) concentration of pollutants of combinations thereof shall not exceed the 96-hour median tolerance limit for any indigenous species.

(b) water temperature shall not exceed the upstream temperature by more than 15 deg. F during months of May through October or by more than 23 deg. F during November through April

Pennsylvania: A fishway shall be required in streams receiving heated discharges where it is essential for the preservation of migratory pathways of game fish or for the preservation of important aquatic life. The dimensions of the fishway shall be prescribed in each case, dependent upon the physical characteristics of individual streams when necessary.

West Virginia: not more than 50 percent of the width, one-third of the cross-sectional area, nor include more than one-third of the stream flow; length shall not exceed ten times the average width of the mixing zone; not exceed a horizontal area of 23 acres on the Ohio River; not include spawning or nursery areas nor interdict the migratory routes of indigenous aquatic life; not overlap a drinking water supply intake. Within the mixing zones water quality for warm-water fisheries shall not:

(a) be lethal to indigenous aquatic organisms

(b) contain chemical constituents or combination thereof which exceed, at any time, one-tenth of the 96-hour median tolerance limit for indigenous fish and their food organisms.

Thermal Effluent Limitations

Regulations and standards for the control of thermal discharges to the Ohio River have been adopted by the U. S. Environmental Protection Agency and ORSANCO. The U. S. EPA Effluent Guidelines and Standards for the Steam Electric Power Generating Point Source Category became effective on November 9, 1974 (Part III, Federal Register, October 8, 1974). These guidelines established three classes of power generating plants:

I. Small unit -- generating units of less than 25 megawatts net rated capacity or any unit which is a part of an electric utility system with a total generating capacity of less than 150 megawatts.

II. Old unit -- any generating unit of more than 500 megawatts capacity placed in service before January 1, 1970, and any generating unit of less than 500 megawatts capacity placed in service before January 1, 1974.

III. Generating unit -- any generating unit except those defined as small or old units.

No thermal discharge limitations are established for either the small unit or old unit classes. For "Generating Units" (Class III) and small units which are "new sources", the thermal limitation "no discharge of heat from the main condensers" is, with some exceptions, effective on July 1, 1981. Under Section 316(a) of PL 92-500, the owner or operator responsible for a thermal discharge may apply for exemption from the thermal limitation by demonstrating that this effluent limitation is more stringent than necessary to protect fish and other aquatic life.

The ORSANCO Pollution Control Standards No. 1-70 and 2-70, adopted November 1970, apply to all non-contact cooling water and other discharges of heated water to the Ohio River. These standards are:

> All sewage, industrial wastes and cooling water from municipalities or political subdivisions, public or private institutions, or installations, or corporations discharged or permitted to flow into the Ohio River from the point of confluences of the Allegheny and Monongahela rivers at Pittsburgh, Pennsylvania, designated as Ohio River mile point 0.0 to Cairo Point, Illinois, located at the confluences of the Ohio and Mississippi rivers, and being 981.0 miles downstream from Pittsburgh, Pennsylvania, shall be so regulated or controlled as to provide for reduction of heat content to such degree that the aggregate heat-discharge rate from the municipality, subdivision, institution, installation or corporation, as calculated on the basis of discharge volume and temperature differential (temperature of discharge minus upstream river temperature) does not exceed the amount calculated by the following formula, provided, however, that in no case shall the aggregate heat-discharge rate be of such magnitude as will result in a calculated increase in river temperature of more than 5 deg. F.:
>
> Allowable heat-discharge rate (Btu/sec) =
> 62.4 x river flow (cfs) x $(T_A - T_R)$ x 90%
>
> Where:
>
> T_A = Allowable maximum temperature (deg. F.) in the river as specified in the following table:

	T_A		T_A
January	50	July	89
February	50	August	89
March	60	September	87
April	70	October	78
May	80	November	70
June	87	December	57

T_R = River temperature (daily average in deg. F) upstream from the discharge

River flow = measured flow but not less than critical flow values specified in the following table:

River Reach From	To	Critical flow in cfs*
Pittsburgh, Pa. (mi. 0.0)	Willow Is. Dam (161.7)	6,500
Willow Is. Dam (161.7)	Gallipolis Dam (279.2)	7,400
Gallipolis Dam (279.2)	Meldahl Dam (436.2)	9,700
Meldahl Dam (436.2)	McAlpine Dam (605.8)	11,900
McAlpine Dam (605.8)	Uniontown Dam (846.0)	14,200
Uniontown Dam (846.0)	Smithland Dam (918.5)	19,500
Smithland Dam (918.5)	Cairo Point (981.0)	48,100

* Minimum daily flow once in ten years

At its May 24, 1973 meeting the Commission adopted the following guideline for administrative and enforcement purposes with regard to the thermal discharge provisions of ORSANCO Pollution Control Standards No. 1-70 and 2-70:

> "The foregoing requirement (thermal discharge provisions of Standards No. 1-70 and 2-70) shall be deemed to be met if the aggregate heat-discharge rate does not exceed the calculated allowable heat-discharge rate during more than two percent of the days in the 12-month period ending with any month and in no case result in a calculated river temperature more than 3 deg. F above the corresponding allowable maximum temperature; the variance is applicable only in those instances when the daily-average river temperature upstream from the discharge approaches or exceeds the specified allowable maximum temperature as the result of meteorological conditions. In no case shall the aggregate heat-discharge rate be of such magnitude as will result in a calculated increase in river temperature of more than 5 deg. F"

The critical flows specified in the ORSANCO Standard are based on U. S. Corps of Engineers estimates of probable 1-day in 10-year minimum flows to be expected after 1975. Recently these values, especially in the upper Ohio River have been questioned because some of the authorized tributary reservoirs may not be constructed. The major impact of not constructing these reservoirs will occur in the first 25 miles of the river (upstream from the Beaver River).

Impact of Thermal Discharges

The inventory of Power Generating Stations on the Ohio River (Appendix A) includes information for preliminary evaluation of current status of compliance with the Federal and ORSANCO standards. With regard to the federal effluent guidelines for steam electric power plants, generating units in three plants will be required to provide cooling facilities or file for an exemption under Section 316(a). The 650 MW number 7 unit at the W. H. Sammis plant (mile 54.0) was placed in service in 1971. Units 1, 2 and 3 of the J. M. Stuart Plant (mile 405.7) were placed in service in 1970, 1971 and 1972. Since each unit has a capacity of 610 MW the requirements of the U. S. EPA guidelines for "generating units" (Class III) will apply. The 265 MW unit at the Elmer Smith Station of the Owensboro Municipal Utilities was placed in operation after January 1, 1974. The U. S. EPA or state agency issuing the NPDES permits may require submission of 316(a) reports for some of the other power plants.

Estimation of compliance with ORSANCO Pollution Control Standards (effluent) must be based on calculated values and observed river temperature and flow conditons. Compliance with the five degree temperature rise limitations can be readily estimated on the basis of river flow and generating plant capacity and heat rejection rate. As shown in the following table, at critical river flow thermal discharges from 15 of the 35 plants with once-through cooling, as tabulated in Appendix A, can result in a calculated temperature rise of at least one degree F at rated capacity and the discharge from 12 of these plants would result in a rise of at least one degree F at the normal operating rate. Because of the 90 percent factor in the ORSANCO Standard, a 4.5 rather than 5 degree rise should be considered as the limiting value for comparing with the calculated values in the tabulation with the ORSANCO requirement.

				Calculated Rise °F at Critical Flow	
Mile Point	Plant	Critical Flow, cfs	*5-11 Aug 74 Operating Rate, Percent	100 Percent Rated Capacity	5-11 Aug 74 Operating Rate
15.3	F.R. Phillips	6,500	61	1.8	1.1
54.0	W.H. Sammis	6,500	63	7.2	4.6
76.5	Cardinal	6,500	77	3.1	2.4
79.6	Windsor	6,500	67	1.2	0.8
102.5	R.E. Burger	6,500	45	2.2	1.0
111.1	Kammer	6,500	48	2.1	1.0
241.6	Philip Sporn	7,400	84	2.5	2.1
260.0	Kyger Creek	7,400	92	2.6	2.4
405.7	J.M. Stuart	9,700	70	3.0	2.1
453.0	W.C. Beckjord	11,900	58	2.4	1.4
495.5	Tanners Creek	11,900	75	2.0	1.5
560.0	Clifty Creek	11,900	54**	2.4	1.3
610.0	Gallagher	14,200	60	1.0	0.6
616.8	Cane Run	14,200	50	1.4	0.7
773.5	Warrick	14,200	83	1.2	1.0

* operating rate reported by companies for week of Aug. 5-11, 1974
** may not be operating at normal rate because of Spring 1974 tornado damage

At critical flow and total rated plant capacity, the thermal discharge from the W.H. Sammis plant results in a 7.25 deg. F calculated temperature rise in the Ohio River; at the 63 percent operating rate reported by the operating company for the week of August 5-11, 1974, the calculated rise would be 4.6 degree F. Because of the location of this discharge immediately upstream from the New Cumberland Dam, the mixing zone probably includes the dam structure. Field surveys, including the West Virginia survey discussed in the preceding chapter, show that a significant (up to 50 percent) part of this added heat is dissipated at the dam.

The temperature contours within the mixing zones, as defined in the state standards, are determined by the depth, size and location of the outfall, volume and temperature at the cooling water discharge, and river flow temperature and channel geometry. As a result the size and shape of the mixing zone is continuously changing. Under these dynamic conditions there is no practical method for frequent monitoring of compliance with mixing zone standards and periodic field surveys or remote infrared sensing and interpretation must be used.

The calculated temperature rise at critical flow and rated or normal generating capacity provide an estimate of the maximum impact of a thermal discharge on river temperatures downstream from the mixing zone. These calculated values do not compensate for heat loss in the mixing zone and, therefore, overestimate the temperature increase.

The calculated temperature rise at actual river flow for the thermal discharges at or nearest to the monitor locations and the maximum monitor temperature (Table 1) provides information to estimate if stream standards might be exceeded at the discharge location. Not considering the heat loss at New Cumberland Dam, the W.H. Sammis plant is the only thermal discharge which results in an estimated downstream temperature more than one degree F above the stream standard during the summer and fall months. Except for September and October 1973 when above normal air temperatures resulted in water temperatures which approached or exceeded the standards, estimated maximum temperatures downstream from the other power plants may have occasionally exceeded the temperature standards by not more than a few tenths of a degree. Since it is reported that all future facilities will be constructed with off-stream cooling, currently operating on-stream cooling facilities represent the probable maximum of thermal discharges to the Ohio River.

Data and Monitoring Requirements

NPDES and other permit applications and effluent limitations and monitoring requirements specified in the permits provide information regarding existing thermal discharges. However, this information may not be adequate for the evaluation of compliance with effluent and stream standards, for evaluation of temperature conditions downstream from the discharge, or for projection of future control requirements and continuing planning. Determination of compliance with effluent limitations or estimation of compliance with stream standards could be based on requiring that self-monitoring reports for each thermal discharge include the daily average actual and calculated maximum allowable heat discharge rate or daily average upstream or intake temperature and the calculated downstream river temperature. With reference to future water temperature conditions and planning, additional information on present and future generating facilities is required.

Generating facilities -- The type of desirable information on generating facilities (in operation, under construction or in the planning stage) is exemplified by the inventory of power generating facilities detailed in Appendix A. This inventory, which tabulates the status of individual plants and each generating unit within the plant as of December 1974, should be revised annually to insure a current record of this information. One form for a standard status inventory update is presented on page III-14.

Although the emphasis of this form is on the thermal component of the discharge from power generating facilities, more detailed information on the volume and characteristics of other wastewater discharges, disposal of solid wastes and facilities for air pollution control could be acquired at the same time by appropriate expansion of the questionnaire.

The ORSANCO pollution control standards are applicable to all discharges of heated wastewater to the Ohio River and the U. S. EPA is currently developing effluent guidelines for other industrial discharges of non-contact cooling water.

Monitoring Requirements -- In addition to effluent limitations NPDES permits include detailed monitoring requirements. A summary of the parameter and monitoring frequency for once-through condenser cooling water specified in NPDES permits proposed or issued by U. S. EPA Regions III, IV and V is presented on page III-15. Monitoring requirements by the Ohio EPA could not be included since copies of their NPDES permits were not available for evaluation.

There are region-to-region differences in monitoring requirements not only for once-through condenser cooling water but for other characteristics of power plant wastewater discharges. For thermal discharges the monitoring requirements should include determination and reporting of the daily average heat rejection in BTU/hr. from each plant. In addition all of the agencies issuing NPDES permits should coordinate their monitoring requirements so that appropriate information will be available for the preparation of the annual water quality inventory reports required by PL 92-500.

Thermal Discharge Information

Plant name: ______________________ Operating Company ______________

Location: City or county __________ State __________ Zip Code ______

Total plant generation: Rated ________MW: Normal operating rate ______%

Generating Unit No: ________NPDES outfall No. ________

Status: Inactive _____ in service ______ under construction ________
Being planned ________

Site only ____________;

In-service or planned operating date ____________

Type: Hydropower ________; Gas Turbine ____________

Thermal _____ Fuel; Coal _____; Oil _____ Gas _____; Nuclear _______

Generating capacity: Rated -- Gross _____MW; Net _____MW;

Condenser heat rejection rate: ________BTU/KWH

Cooling water source: Ohio ________M.P.; Other River _____________;

Name ______________ MP ______________

Pond, Lake or Reservoir: Name ____________ Groundwater ____________

Condenser Cooling: Once through ______; Off-stream: Natural Draft Tower ______

Forced draft: ____________ Cooling Pond ____________

Discharge to: Ohio ______MP; Other river __________name; __________MP

Pond, Lake or Reservoir, Recirculating __________; flow through ________

Ash pond ________; sub-surface ________; No discharge __________

Elevation of outfall: Top ______ft. MSL; Bottom ________ft. MSL

Type of Discharge: End of Pipe ____; Flume ____; Diffuser ______

Direction of axis of discharge relative to shoreline:

0° (Parallel) ____; 30° ____; 40° _____; 90° _____ Other ______

Control of Biological Growth (condenser and/or cooling facilities)

Mechanical __________:

Chemical: Chlorine _____ feed rate _____16/hr; Duration ______

Frequency __________

Other (identify active constituents: ______________________________

____

Completed by ____________ Title ____________ Date __________

Monitoring

Once Through Condensor Cooling Water

CHARACTERISTIC	FREQUENCY	SAMPLE	REGION
Flow	1/week	measured	III
Flow	continuously	recorded or pump logs	IV
Flow	continuously	daily	V
Temperature	continuous	recorded	III
Temperature	continuous	recorded	IV
Temperature	continuously	daily	V
Heat Rejection (Btu/hr)	continuously	recorded	III
Heat Rejection (Btu/hr)	daily	calculated	IV
Heat Rejection (Btu/hr)	monthly average		V
Chlorine (free available)	1/week	grab during chlorination	III
Chlorine (free available)	1/week	multiple grab	IV
Chlorine (free available)	daily	grab	V

Remote Sensing

The U. S. EPA and the state stream quality criteria all recognize that it is necessary to provide for a mixing zone for the area adjacent to an outfall where the criteria will not apply. Illinois, Indiana, Ohio and West Virginia have specified the limits of a mixing zone in some detail. NPDES permits issued by U. S. EPA Region V for power generating facilities include a requirement that the temperature characteristics and the 5 deg. F temperature rise contour of the mixing zone be determined at least once every quarter. Available information indicates that the highest temperatures generally occur near the water surface.

Remote temperature sensing procedures -- determination of water temperatures or temperature differences -- with airborne equipment were evaluated. These temperature sensing procedures are based on measurement of the infrared radiation from the water surface. Such procedures can be classified as infrared radiation (radiometer) sensing from orbiting satellites, infrared photography from aircraft and radiometer measurements from aircraft.

The ERTS (Environmental Resources Technology Satellite) provides information for production of computer prepared images in several spectral ranges including the infrared band. Each image covers an area of 10,000 square miles (100 miles x 100 miles) with a resolution of approximately one acre. Evaluation of several ERTS infrared images indicate that, because of the large area, they are not suitable for defining thermal discharges and the associated mixing zone. However, images from other spectral bands might be of value for appraisal of land use and, over a period of time, changes in land use.

Black and white images in the infrared band can be obtained by photographing the area from aircraft. The U. S. EPA operates two aircraft for thermal and other photo-surveillance (based in Las Vegas and Denver). Arrangments for aircraft operations in a specified area can be made through the Monitoring and Surveillance Sections of the appropriate U. S. EPA Region. These services can include analysis and interpretation of the images. Similar services are available through consultants and aerial survey firms. The images show temperature gradients by the varying shades of gray through black. This procedure is of value for determining thermal gradients and the size and limits of the mixing zone. However, if actual temperatures are to be determined, a field survey is necessary to measure river temperatures in the area.

Infrared photography can be replaced with infrared sensor and radiometer equipment to provide an electronic record of water temperature. Computer analysis results in a computer generated map showing iostherms (line of equal temperature) which delineate the mixing zone and the return to normal river temperature. Appropriate temperature scaling results in the generation of a color television type image which can be photographed for visual analysis and as a permanent record. This technique, demonstrated by the Purdue University Laboratory for the Application of Remote Sensing, provides the most complete depiction of temperatures within the mixing zones and an estimate of the rate of dissipation and mixing of the excess heat without the need for concurrent river surveys. Because electronic rather than photographic temperature sensing is used, separate daylight and night flights can provide measurement of diurnal temperature variations and greater temperature sensitivity can be obtained by night flights. This technique can provide an estimate of water temperature and of the rate of dissipation and mixing of excess heat without the need for extensive river surveys. Within the mixing zone it is not possible to distinguish between mixing and heat transfer to the atmosphere.

The aircraft techniques are more applicable to the study of river temperature conditions than satellite observation. Additional cameras with selected filter and film combination can be used to provide information such as the identification of areas of extensive algae and other aquatic plant growth with false-color infrared film and the development of more specific land use information.

Because such aerial survey techniques can provide information for long reaches of the river at a cost which is probably less than the cost of an equivalent field survey, their potential applications should be studied in more detail. If such techniques have the expected applicability, institutional arrangements should be developed to coordinate and possibly conduct such surveys to obtain the maximum information per flight and to provide a single agency to compile, evaluate and distribute the information.

Sulfur Dioxide Removal Requirements

In accordance with requirements contained in the Clean Air Act of 1970, some sources producing emissions of sulfur dioxide that exceed the ambient air quality standards may be required to reduce emissions to acceptable levels by July 1, 1975. In some states an extension of this deadline has been grated until July 1, 1977. However, discussions with air pollution control agencies indicate that most facilities will not be in compliance until the 1980's. The following discussion provides an overview of potential water quality problems relating to SO_2 control and is not intended as a review of control requirements for air quality control.

The Federal ambient air quality standards for SO_2 are divided into the following primary and secondary classifications:

1. Primary (Health related)
   A. Not to exceed:
      a. yearly average -- 80 micrograms/cubic meter
      b. 24-hour maximum -- 365 micrograms/cubic meter
2. Secondary (Welfare related: effect on vegetation)
   A. Levels not to be exceeded more than once a year -- 1300 micrograms/cubic meter

It should be noted that some states and counties may have regulations that are more stringent than the federal standards.

With regard to new sources, the federal regulations require that the emissions shall not exceed 1.2 lbs. SO_2 per million BUT's. Compliance with the standard requires gas desulfurization or use of coal containing not more than about 0.5 to 0.7 percent of sulfur. A great deal of the flue gas desulfurization activity is in conjunction with new plants, where for one reason or another low-sulfur fuel is not a feasible alternative.

As far as existing sources are concerned, the emissions must not violate ambient air quality standards that have been established for the region in which the emission is located, and control may be necessary only if the standards are violated. In a number of instances, the states and counties have specified more stringent controls by requiring all emissions to have SO_2 controls. The requirements vary widely within the states, and there is no particular pattern in the requirements for desulfurization other than they are usually more applicable to existing plants than new sources.

Wastewater discharge systems employed for the scrubbing of flue gas must be closed systems, and under such conditions no discharge is permitted to the stream. Utilities have been hesitant to adopt some form of sulfur recovery processes because of the marketing problem and the additional expense of installation. The capability of the sulfuric acid and sulfur markets to absorb large volumes of products from recovery processes needs to be established. Utilities management, on the other hand, has fewer reservations about coping with the sludge disposal problems. It should be recognized, however, that solids disposal could be a very difficult and expensive operation that requires continuing surveillance to prevent any discharge to stream. This is particularly so for plants located in an area that has a limited number of suitable disposal sites.

An example of the estimated quantities of sludge resulting from a desulfurization process, is the new East Bend Power Generating Station (Unit 2) of the Cincinnati Gas and Electric Company, and the Dayton Power and Light Company that is planned for the Ohio River below Cincinnati.

Unit Generating Capacity	600,000 KW (net)	
Life of Unit	35 years	
Lifetime Unit Capacity Factor	50%	
Unit Heat Rate	9,800 BTU/KWh	
Sulfur Content of Coal	3.2% sulfur (dry) or 2.8% as received	
Type of Scrubber:	Lime	Limestone
Cu yd of sludge	12,365,000	9,974,000
Acre/ft of sludge	7,846	6,330
Total cu yds of solids wastes (wet)	18,425,000	16,034,000
Total acre/ft of solids wastes (wet)	11,690	10,174

As can be seen from the above estimates, the amount of solids from a single scrubbing unit is substantial.

The lime-limestone scrubbing method is by far the leading method at the present time. Other scrubbing methods being employed are magnesia, double-alkali and catalytic oxidation. Some reduction can also be achieved using fly ash, but not to levels needed for the average 90% removal anticipated. In the Ohio Valley, all full scale installations operating, under construction or in the planning phase employ lime-limestone gas desulfurization to remove the SO_2. The status of these plants in the Ohio Basin is shown in the table below:

	Operating Company	Lime and/or limestone scrubbing Plant	Size MW	Scrubbers No.	Status
1)	Louisville Gas & Electric	Paddy's Run	70	2	0
2)	Louisville Gas & Electric	Mill Creek	1,650	--	P,C
3)	Louisville Gas & Electric	Cane Run	998	--	P,C
4)	Kentucky Utilities	Green River	70	1	UC
5)	Duquesne Light	Phillips	100	1	0
6)	Ohio Edison	Mansfield	2 x 880	12	UC
7)	Columbus & Southern Oil	Conesville	2 x 375	--	P
8)	Allegheny River	Pleasants	2 x 625	--	C
9)	Central Illinois Public Service	Newton	600	--	P
10)	Cincinnati Gas & Electric	East Bend	600	--	C
11)	Cincinnati Gas & Electric	Miami Fort	500		P
12)	Indianapolis Power and Light	Stuart	125	1	P
13)	Indianapolis Power and Light	Petersburg	530	--	P
14)	Tennessee Valley Authority	Shawnee	550	1	0
15)	Central Illinois Light	Duck Creek	100	1	UC
16)	Public Service, Indiana	Gibson	75	1	UC
17)	Penns. Power & Light	Holtwood	80	1	0

0 - Operating, UC - Under Construction P - Planned

C - Considering only FGD systems

Source: November 1974 Status Report by Pedco Environmental

Certain utilities have resisted installation of desulfurization facilities on the basis that the technology should be allowed to mature before the very large investments required for full plant systems are incurred. It is represented by these utilities that in many cases, such equipment is not necessary to meet ambient air quality standards, and that a combination of tall stacks and low sulfur coal during adverse weather conditions would permit them to meet the standards 100% of the time. In some cases, a compromise has been reached with the regulatory agency in which the utility has been allowed to build a full-scale test unit and carry out a test program before committing the entire plant or power production system. This question is still unresolved.

From a water pollution standpoint, it would appear that the flue gas desulfurization processes should not present a problem, since they must be closed cycle. It should be recognized, however, that most of the processes use water as a transport medium, and there is always the possibility of accidental discharge. In addition, there is an evaporative loss of water in the process, which is a consumptive use. A review of the above with members of the ORSANCO Power Industry Advisory Committee indicates that these losses would be minimal and of no consequence, in comparison with losses incurred with cooling towers. The problem of sludge disposal, and associated runoff to the stream is another area that will require adequate planning and surveillance in order to prevent these waste materials from entering the stream.

AQUATIC LIFE CONSIDERATIONS

The first sections of this report present information on the significant sources of thermal discharges to the Ohio River -- thermal electric generating plants -- and, based on evaluation of 11-year water and air temperature and river flow data, an assessment of thermal discharges or temperatures in the Ohio River. Information pertinent to aquatic life considerations include the following:

1. Current plans of the power companies are to utilize off-stream cooling for essentially all generating units under construction or in the planning stage. As a result, thermal discharges to the Ohio River will decrease as currently operating units are down rated from base load, to cyclic, to peaking service and finally removed from service.
2. The greatest impact of thermal discharges on river temperature is within the mixing zone.
3. Downstream,after mixing is completed,river temperature increases would generally be less than two deg. F at critical flow. At near normal river flows the estimated temperature increase is considerably lower.
4. The heat added to the river is dissipated within a 40 to 45 mile distance downstream.

The following section relates this information to aquatic life changes in the environment of the Ohio River.

Background

The species composition and relative abundance of biological organisms in the Ohio River today differs considerably from that found and recorded by the first white settlers. The regime of the river has changed and has caused significant biological changes.

The change in the character of the Ohio River, which has reduced the variety of fish habitats and food organisms has been influential ecologically and must be taken into account when evaluating the effects of other ecological factors. The effects of added heat for instance, must be viewed against this historical background, the consequences of which are still unfolding. For example, channelization coupled with the installation of navigation dams and other improvement has changed the river from a free-flowing stream to a series of lake settings. As a result, many species that previously were abundant, such as the Sturgeon and Paddlefish are now reduced in number and their distribution in the Ohio River is limited. Some species of fish have increased in abundance for the lakes created by the dams favor such fish as the deep-bodied Suckers, the Gizzard Shad and perhaps some of the smaller Sunfishes.* The introduced Carp is another example of a species that shows strong preference for quiet waters as furnished by the dams.

This section of the report primarily considers the possible effects of heat on the fish of the Ohio River. Although three broad categories of aquatic organisms are considered in the review of the biological community (phytoplankton, zooplankton and fish) most attention is focused on fish and their species composition and abundance in upper, middle and lower sections respectively -- of the Ohio River. Experience has indicated that the biological community, and in particular the species composition and abundance of fish, provide a good indicator for judging overall water quality changes. The fish reflect the effect of changing habitat on the entire biological community in the Ohio River because they represent the highest order of organisms found in the water.

Spawning, Reproduction and Growth

The Ohio River is characteristized by a gravelly bottom, and a paucity of shallow water and riffles or weeds suitable for nesting. Shoreline in many localities shows the effects of bank erosion caused by the large variations in river flow and to a more minor degree the back-wash of commercial and recreational boats navigating the river. As a result, the number of areas suitable for spawning in the main stream of the Ohio River is limited, and a great deal of the spawning takes place in the small creeks and other tributaries to the Ohio River. Sampling performed during the course

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* Aquatic Life Resources of the Ohio River: ORSANCO, 1962 pp 3-16

of the 1957-60 Aquatic Life Resources Study (ALRP) revealed that a large number of species requiring shallow water, weeds and riffles to reproduce were in fact spawning in the small tributaries, and then returning to the main river. The Sauger, Roundbodied Suckers (redhorses), Large and Small Mouth Bass, and Golder Shiner are examples of fish that prefer the small tributaries with shallow-gravel bars and weeds for spawning purposes. At the same time these same species are found throughout the main river as both fingerlings and mature fish.

Maintenance of correct seasonal variations in temperature for bringing about the spawning conditions as well as temperatures suitable for incubation are crucial for reproduction. A review of daily average river temperatures for eleven years (1964-74) (Figures 10, 11 and 12) reveals that at the electronic monitor locations the Ohio River maintains a natural pattern of gradual temperature changes not perceptively raised by thermal discharges. The range of temperature within any one month for this period results from variation in meteorological conditions from year to year. A review of thermal discharge and river flow and temperature indicates that the added heat could not account for any delay or advancement of river temperature in the spring and early summer spawning season. For example, the maximum, average and minimum temperatures in the middle portion of the river were 45.7^{o} F and 43.5^{o} F and 40.4^{o} F respectively during March 1972, and during March 1973 were 55.1^{o} F, 48.3^{o} F, and 39.7^{o} F or substantially elevated over the previous year. Volume of flow during this same period ranged from 100,000 to over 300,000 cu ft/sec in 1972 and from 65,000 to 370,000 cu ft/sec in 1973. Data shows the thermal loads during both years were about equal and that the same amount of heat added could influence the temperature of the river by less than 0.5^{o} F at these flows. Thus the significant year-to-year variation in river temperature during the spring and early summer period resulted from year-to-year differences in meteorological conditions and not changes in thermal loads to the river.

At these elevated flows during the spawning period, the mixing zone of a thermal dishcarge is probably very restricted and limited to the shoreline area due to the high flow and velocity of the river. Velocities at

Figure 10: Seasonal Temperature Variations and Temperature Ranges For Fish

Upper River: -- South Heights, Pa. (1964-74)........Stratton, O. (1964-74)

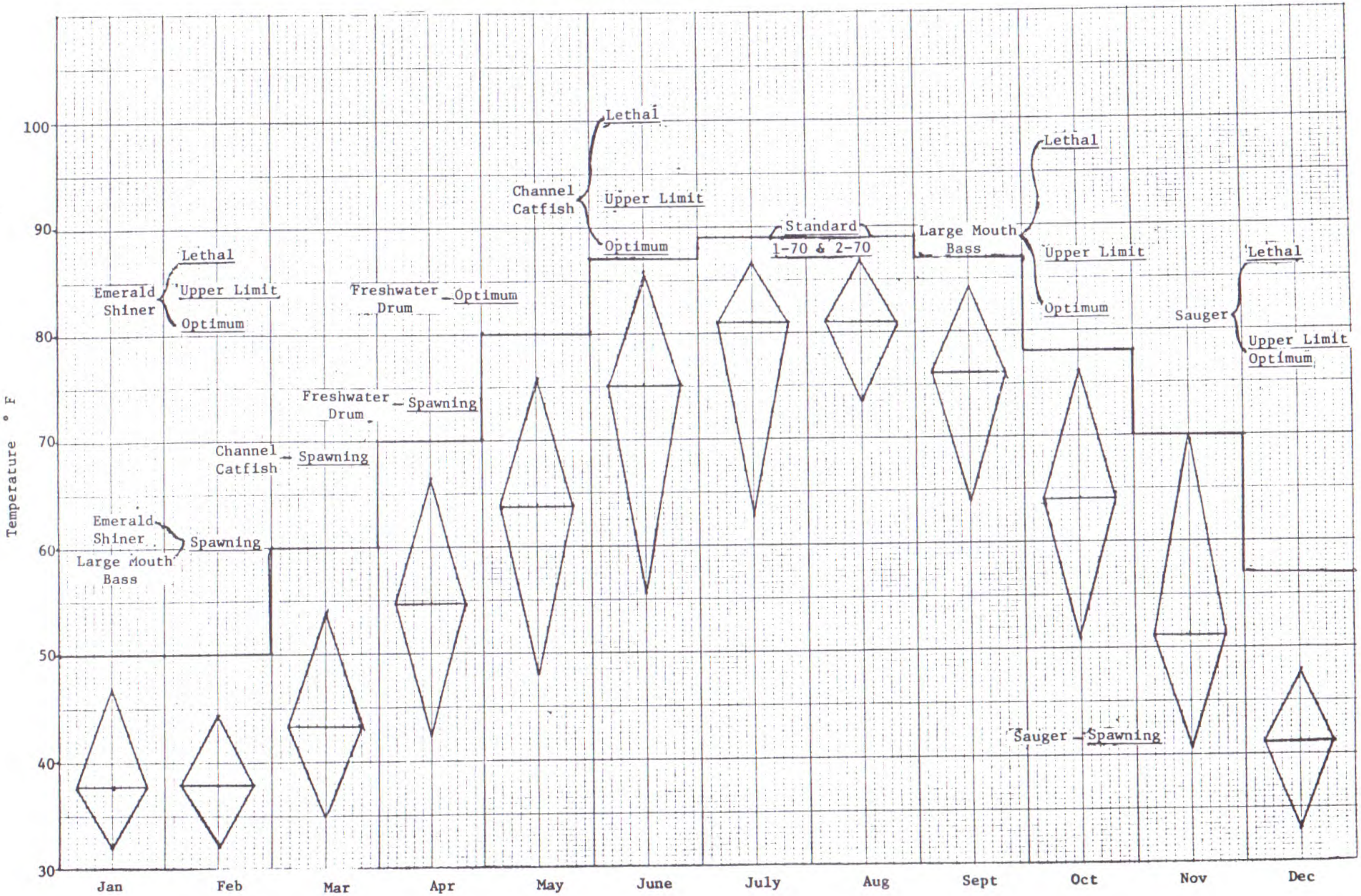


Figure 11: Seasonal Temperature Variations and Temperature Ranges For Fish

Middle River: -- Huntington, W. Va. (1964-74).....Cincinnati, O. (1964-74)

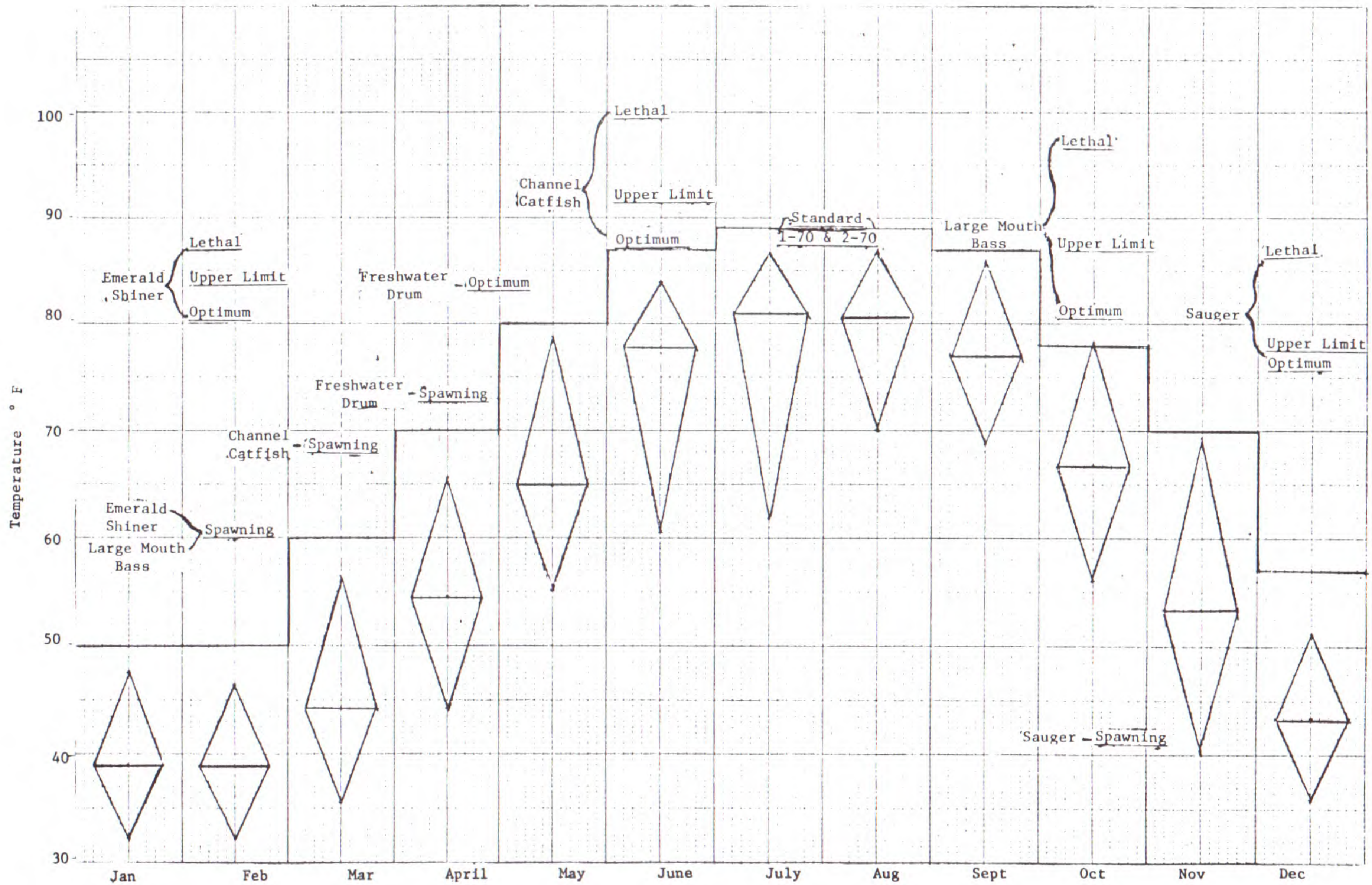
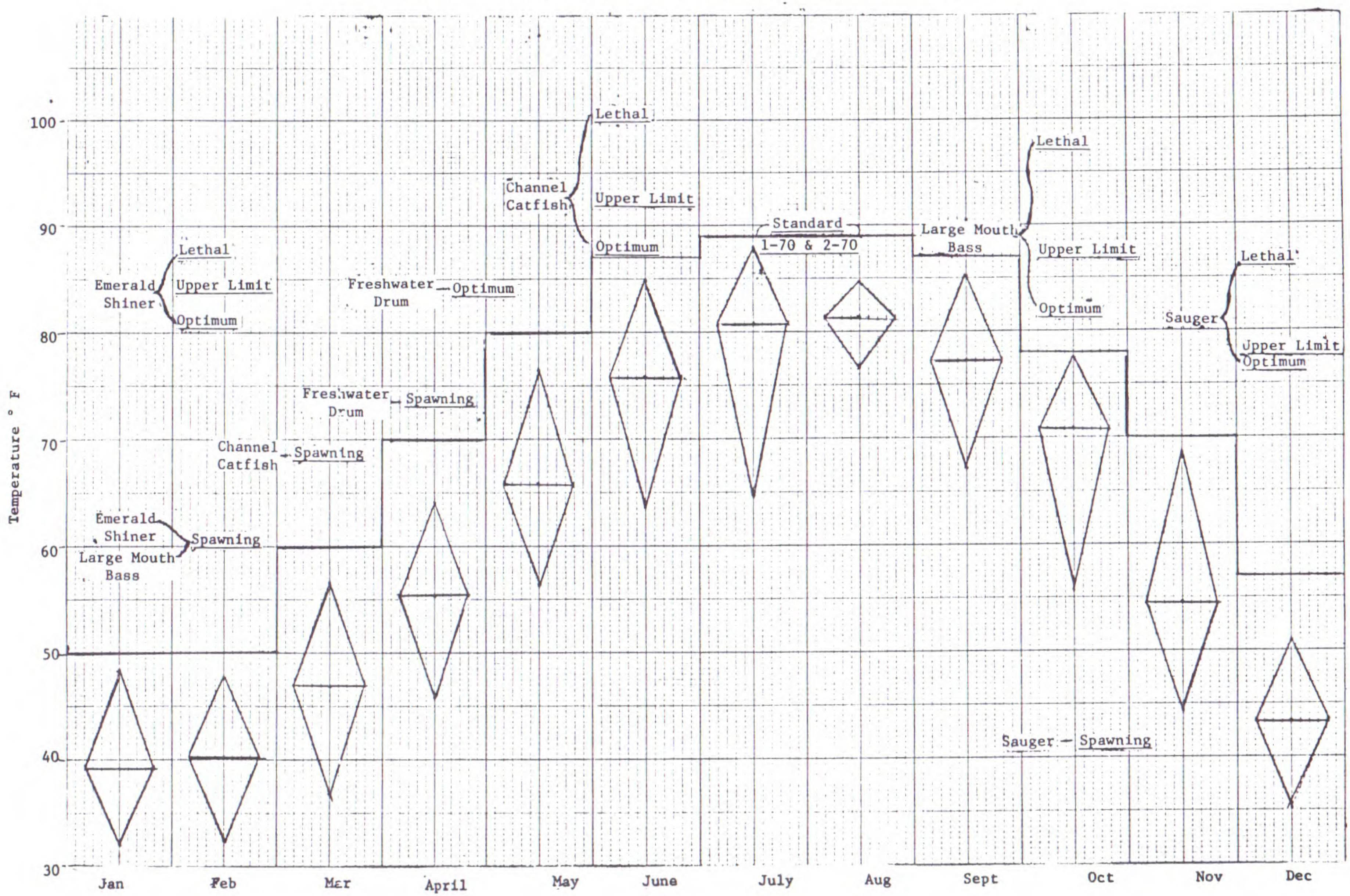


Figure 12: Seasonal Temperature Variations and Temperature Ranges For Fish

Lower River: -- Louisville, Ky. (1964-74).......Evansville, Ind. (1969-74)



flows greater than 100,000 cu. ft./sec. are approximately 3-4 mph, in comparison to river velocities of 0.1 mph at the minimum daily flow expected once in ten years, as specified in ORSANCO Pollution Control Standards No. 1-70 and 2-70. This rapid mixing and high dilution of added heat would appear to preclude any blockage of spawning migrations.

Table 9, Figures 10, 11 and 12 also indicate the optimum, upper limit, upper incipient lethal and spawning temperatures for a number of species* found in abundance in the Ohio River and shows that the temperature regime of the Ohio River is suitable for spawning by the Emerald Shiner, Channel Catfish, Largemouth Bass, Freshwater Drum and Blue Catfish. The Sauger appears to be borderline for spawning, depending on year-to-year temperature fluctuations.

With regard to the summer temperatures, it would appear that growth of some species such as the Channel Catfish would be enhanced by higher temperatures, and the Sauger limited by existing or higher temperature. The temperature range for the Largemouth Bass and Emerald Shiner appears suitable for optimum growth. Based on this information one may conclude that some species might be restricted by an overall increase in temperature, while others would have increased growth potential, provided the natural seasonal variations are maintained.

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* Water Quality Criteria - 1972; U. S. EPA - R3-73-033 March 1973; Appendix II-C

Table 9: Recommended Temperature Limits for Fish

Species	Spawning		Ontium		Ultimate Upper Incipient Lethal Temperature		Maximum Weekly Average Temperature	
	C	F	C	F	C	F	C	F
Black Crappie	20.0	68.0						
Bluegill	19.4	66.9	22.0	71.6	33.8	92.8	25.9	78.6
Carp	19.0	66.2						
Channel Catfish	26.7	80.1	30.0	86.0	38.0	100.4	32.7	90.7
Emerald Shiner	15.6	60.1	27.0	80.6	30.7	87.3	28.2	82.8
Freshwater Drum	23.0	73.4						
Largemouth Bass	15.6	60.1	27.5	81.5	36.4	97.5	30.5	86.7
Sauger	5.0	41.0						
Smallmouth Buffalo	18.9	66.0						
Gizzard Shad	16.7	62.1			34.5	94.1		

** Water Quality Criteria - 1972, EPA-R3-73-033, Appendix II-C

With respect to plankton, counts are typically low in the winter and spring periods, and are mostly diatoms. Blue-green and green algae are more plentiful in the summer and fall months. Recent information would indicate that the predominant blue-green algae formerly found in the river during the warmer months has given way to green algae. Just how much effect improvements in water quality and the newer deeper pools have had in this shift from the blue-greens to green has not been ascertained. It should be noted, however, that the Ohio River has not experienced algal blooms in the longer, deeper pools, whereas such blooms occurred under the wicket-dam system. During these incidents, which were prevalent in the late 1950's to early 1960's, the predominant organisms were diatoms and blue-green algae, with counts of more than 20,000 per ml being recorded. Members of the ORSANCO water users committee have reported that algal counts have been relatively low (typically under 2000) for the last five years and taste and odors due to aquatic organisms have not presented water treatment problems.

With regard to temperature effects on plankton after being entrained in the cooling water systems of a power generating plant, studies have revealed the percent of organisms killed increases with increasing temperature differential. For example, the kill is estimated to be about 25% with a temperature differential of 15° F and 100% for one of about 40° F. The percentage of organisms affected tends to vary with the time of the year and ambient temperatures. At the same time, the studies have revealed that there is no effect on the overall plankton population of the river from thermal discharges.

With regard to the zooplankton, these organisms react in much the same manner as plankton. Consequently, for the purposes of this discussion, they will not be covered separately.

Composition and Abundance Fish

The composition and abundance of the ten most abundant fish found in sample collections are summarized in Tables 9, 10 and 11. A total of 136 kinds of fish were taken during the 1957-60 Aquatic Life Resources Study which used a variety of sampling methods (rotenone, nets, seives, electric shocker, other trawls, and Pole and line). During the late 1960's additional collections were made in the lock chambers using rotenone in a joint venture by the state,

Table 10

Fish Population Composition - Ten Most Predominate Species

Ohio River - Mile 0-300

(By number and weight of species - all collections)

Number		Weight	
1957-60	1968	1957-60	1968
Emerald Shiner	Emerald Shiner	Emerald Shiner	Emerald Shiner
Mimic Shiner	Mimic Shiner	Carp	Carp
Brown Bullhead	Brown Bullhead	Channel Catfish	Channel Catfish
Channel Catfish	Channel Catfish	Gizzard Shad	Gizzard Shad
Gizzard Shad	Gizzard Shad	Brown Bullhead	Brown Bullhead
Sand Shiner	Sand Shiner	Skipjack Herring	Mimic Shiner
Carp	Carp	Black Bullhead	Largemouth Bass
Bluntnose Minnow	Black Crappie	Golden Redhorse	Black Crappie
Black Bullhead	Spotted Bass	White Suckers	Sauger
Golden Shiner	Largemouth Bass	Golden Shiner	Walleye and Freshwater Drum

Table 11

Fish Population Composition - Ten Most Predominate Species

Ohio River - Mile 300-600

(Bv number and weight of species - all collections)

Number		Weight	
1957-60	1968	1957-60	1968
Emerald Shiner	Emerald Shiner	Channel Catfish	Channel Catfish
Channel Catfish	Channel Catfish	Gizzard Shad	Gizzard Shad
Gizzard Shad	Gizzard Shad	Freshwater Drum	Freshwater Drum
Freshwater Drum	Freshwater Drum	Carp	Carp
Carp	Carp	Flathead Catfish	Sauger
Skipjack Herring	Skipjack Herring	Emerald Shiner	Skipjack Herring
Mimic Shiner	Mimic Shiner	Buffalo	Crappie
Silver Chub	Blue Gill	Largemouth Bass	Blue Gill
Longear Sunfish	Crappie	Spotted Sucker	Longnose Gar
Blue Catfish	Sauger	Skipjack Herring	Smallmouth Buffalo

Table 12

Fish Population Composition - Ten Most Predominate Species

Ohio River - Mile 600-891

(By number and weight of species - all collections)

Number		Weight	
1957-60	1968	1957-60	1968
Emerald Shiner	Emerald Shiner	Freshwater Drum	Freshwater Drum
Gizzard Shad	Gizzard Shad	Gizzard Shad	Gizzard Shad
Freshwater Drum	Freshwater Drum	Channel Catfish	Channel Catfish
Channel Catfish	Channel Catfish	Emerald Shiner	Emerald Shiner
Silver Chub	Silver Chub	Carp	Carp
Carp	Carp	River Carpsucker	River Carpsucker
Blue Catfish	Sauger	Flathead Catfish	Sauger
Threadfin Shad	Crappies	Smallmouth Buffalo	Crappies
Mimic Shiner	Skipjack Herring	Blue Catfish	Buffalos
Bluegill	Buffalos	Skipjack Herring	Largemouth Bass

federal and interstate agencies to determine the extent of any changes in species composition and abundance of fish. The locations selected were the same ones used in the earlier Aquatic Life Resources Study. In comparing the results of the studies it should be kept in mind that the 1968-70 studies were both limited in number and in type of sampling (rotenone only). Since all sampling methods have a certain amount of bias, and the lock chambers were only sampled once during each of three summers, the number of species recovered was less than the number reported in the original study. For example, the Sturgeon and Paddlefish have rarely been recovered from a lock chamber, yet commercial fishermen report they are caught quite regularly in the lower river.

An examination of the data resulting from the collections indicates a close similarity of results. As might be expected, the species composition varied somewhat throughout the river. In the upper third of the river, the most abundant species taken were the Shiners, Bullhead and Channel Catfish. In the middle section, the leading species were Emerald Shiner, Channel Catfish, Gizzard Shad and Freshwater Drum- with the Blue Catfish abundant downstream. The other Shiners and Black Bullhead were not as abundant in this section. In the lower third the Freshwater Drum, Gizzard Shad, Blue Catfish and Threadfin were most abundant with the Emerald Shiner occurring in smaller numbers. None of the game and pan fishes rank high either in weight or in numbers in these samples, a finding which is substantiated by the Creel census data. Of the most abundant species, six are forage fish, three are species sought by both sport and commercial fishermen and one species, the Black Bullhead, is of interest primarily to the angler. Of those species contributing the greatest weight, two are forage fish, five are of interest to both sport and commercial fishermen and one, the Black Bullhead is of interest only to the angler.

Temperature is recognized as an important factor in determining the species of fish present in the waters of a given geographical area. The 1964 to 1974 electronic monitor temperature data indicated only limited temperature variation along the length of the Ohio River. During any given month year-to-year temperature variations at all locations were greater than the temperature differences between monitoring stations. Based on a standing crop that is estimated to be between 155 and 300 pounds per surface acre, the data shows the river supports a diverse and large population of fish. However, the nature of the long-term data presented in this report precludes specific conclusions as to whether or not thermal discharges to the Ohio River have altered reproduction or growth of any fish species.

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PRODUCTION OF SYNTHETIC NATURAL GAS BY COAL GASIFICATION

The quest for national sources of energy has greatly increased the emphasis placed on the potential application of systems to convert coal to substitute natural gas SNG. In addition processes for low BTU gas, as well as solvent extraction and liquification of coal for the production of alternate clean fuels are in the pilot plant stage. An example is the recent announcement that a coal liquification plant will be constructed by the Ashland Oil Company in cooperation with the Commonwealth of Kentucky at Catlettsburg, Kentucky. For purposes of this report consideration will be limited to coal gasification processes.

Three factors are important in siting a coal gasification plant: a long-term source of coal, an adequate source of water and a demand for the product, SNG. The Ohio River Basin provides a desirable setting for coal gasification programs because of the abundance of coal and water and the availability of river transport facilities. Of these, water may be the most important factor in selecting a plant site. Large volumes of water are required for SNG production and process cooling, and if the coal is slurried for transportation to a plant site by pipeline, an additional 200 gallons of water per ton of coal is required. To better understand the process and the implication of such plants for the Ohio River, the following information has been assembled. It is important to note that even established processes continue in a highly developmental stage and critical process design criteria may be expected to change accordingly.

Coal - Coal resources in the compact area are estimated to be among the largest known deposits in the world. According to the U. S. Bureau of Mines, bituminous reserves in the area amount to a total of 459,392 million tons, as of January 1, 1972.

The coal reserves (remaining as of January, 1972) in each of the signatory states is as follows:

1. Illinois 139,124 million tons
2. Indiana 34,577 million tons
3. Kentucky 64,840 million tons
4. Ohio 41,360 million tons

5.	Pennsylvania	69,166 million tons
6.	Virginia	9,697 million tons
7.	West Virginia	100,628 million tons
8.	New York	Nil
Total -		459,392 million tons

About half or 225,000 million tons of this reserve is recoverable using present mining methods. However, it is postulated that about 185 million tons may be added by future exploration.

Potential increases of mine drainage from the anticipated increased mining activity is of concern since mine drainage already constitutes a major water pollution source in the basin. Present information indicates that the most feasible and economical coal gasification unit is one capable of producing about 250 million cubic feet of pipeline quality Synthetic Natural Gas (SNG) per day. Such a plant will require some six million tons of coal per year. In the Ohio basin a typical coal seam is about four feet thick and yields about 7200 tons per acre (1800 tons/acre foot). To supply such a plant would require the mining of about one and a half square miles of four feet thick coal per year. With a 40-year life expectancy this would require 60 square miles of coal to be available for a plant of this size. Mining of multiple coal seams, where practical, would decrease the overall area affected.

Water - Coal gasification processes require large quantities of water. All present techniques require menthanation or an additional process to convert the low BTU product (400 BTU cu. ft.) to pipeline (high) quality gas (1000 BTU cu. ft.). The Lurgi process presently under consideration is only one of several capable of producing CO:H2 ratio), gas cooling, gas purification and methane synthesis, all of which require water for processing and cooling (see attached diagram). A coal gasification plant of the 250 million cu. ft. size requires 16 to 18,000 tons of coal/day (depending on quality), and water consumption can be expected to range from 10 million gallons per day (MGD) where water is at a premium to 40 MGD where abundant water is available. This is a consumptive use, based on using water as a source in the reaction. Additional water is required for cooling purposes. The principal reasons for the differences are in the evaporative cooling requirements and relate to the extent to which air cooling is employed and greater wastewater disposal required because of low quality input water. Using the 10 mgd value (40 gallons of water per 1000 cu. ft. gas produced), one ton of coal will produce 14,000 cu.ft. of gas and require 560 gallons consumptive use of water. The large consumptive use of water in the conversion process is the result of water being used as a hydrogen source, which can be simply illustrated by the reactions or combinations that occur in a coal gasification reactor.

$$C + O_2 \text{ -- } CO_2$$

$$C + CO_2 \text{ -- } 2\ CO$$

$$C + H_2O \text{ -- } CO + H_2$$

$$C + 2H_2 \text{ -- } CH_4$$

$$C + 2H_2O \text{ -- } CO_2 + H_2$$

$$H_2 + 1/2\ O_2 \text{ - } H_2O$$

In the reactions the C combines with the H_2 to form CH_4 (methane) and the excess C combines with the O_2 to form CO_2.

A certain amount of water is present in the coal, but as the reaction progresses in the methanation process, and carbon hydrogen ratio increases, the hydrogen from the water must increase, which causes the high consumptive water use. A large amount of carbon dioxide (CO_2) also generated in the process; it must be scrubbed out and released to the atmosphere. Carbon dioxide production has been estimated to be about 2.1 million pounds per hour from a 250 M cu.ft. plant. Whether or not the CO_2 will be a problem has not been determined.

Although the methanation process does produce water as a product, this result is by far offset by the large comsumptive use of water (70% or more) for cooling (air or water), water treatment, ash disposal and related operations. The type of cooling will influence the amount of water consumed in the gasification process.

With regard to thermal discharges (to air or water), it would appear that a 250 million cu.ft. plant (1000 BTU/cu.ft.) would have a potential BTU/sec. heat rejection rate equivalent to a 1200 MW power generating plant. This is based on the assumption that a plant of this size would consume about 18,000 tons/day of coal which had an average content of 10,000 BTU/lb.

Although data on complete heat balance is not available, the thermal discharge to the environment could be significantly less than this amount because many of the steps taking place in the gasification process are exothermic and endothermic reactions. Compliance with ORSANCO Pollution Control Standards 1-70 and 2-70 will have to be determined on a case by case basis.

Solids Disposal - The disposal of solids remaining after completion of the coal gasification is a problem that requires consideration. Estimates would indicate that from 30 to 50% of the 16-18,000 tons of incoming coal per day must be disposed of as ash or char. The disposal of such large amounts will undoubtedly pose problems, particularly if the plant were located in a heavily populated area and suitable disposal sites were not available in close proximity to the plant site.

References:

1) "Breathing Space", Exxon Publication, New York, N. Y.

2) "Clean Energy from Coal Technology", U.S. Dept. of the Interior, Office of Coal Research,

3) "Consumptive Use of Water by Coal Gasification-Liqufaction Processes", by Clarence Klassen, Minutes of Reservoir Operations Coordinating Group, July 24-25, 1974.

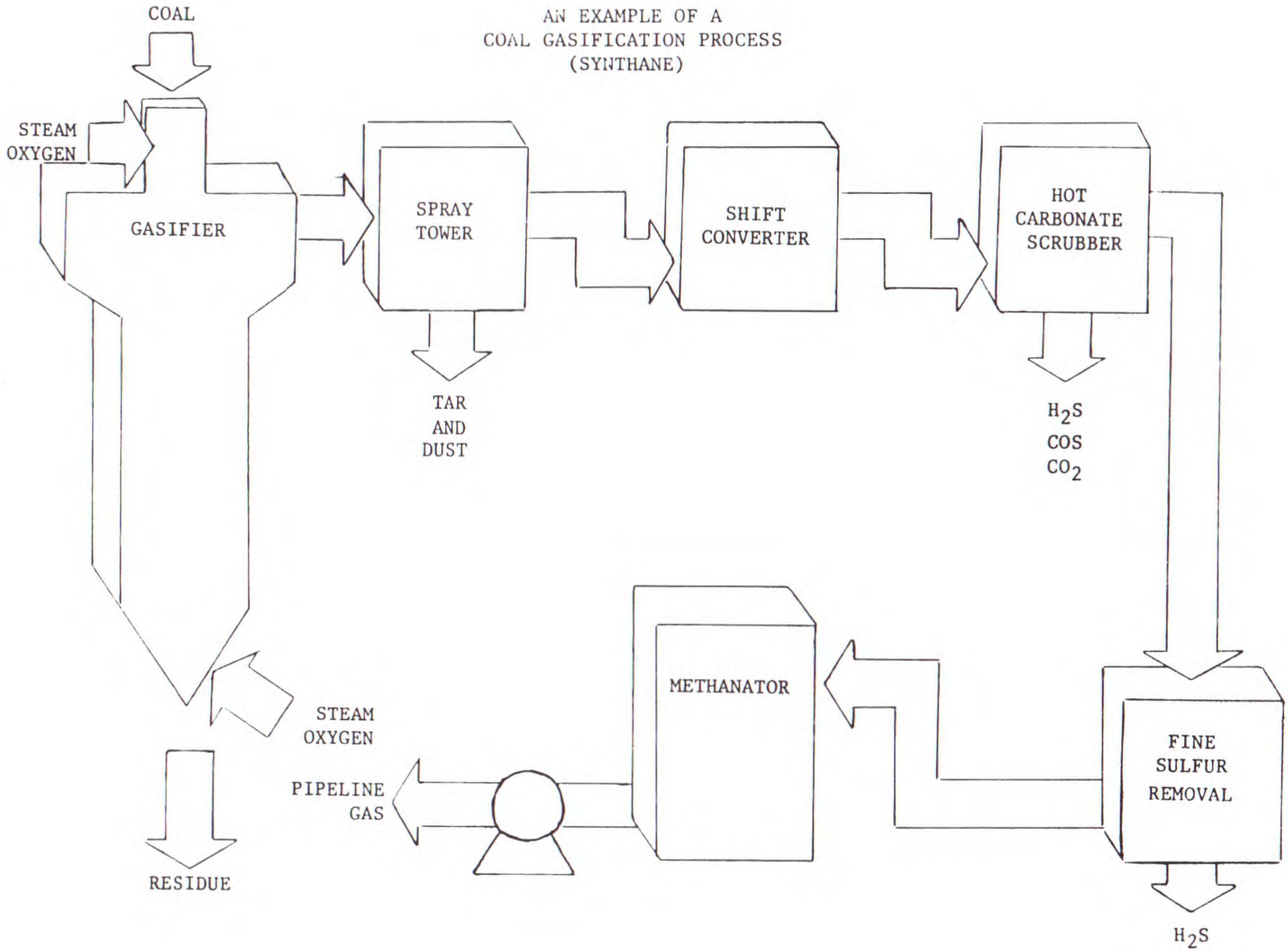
4) "The Gasification of Coal", by L.K. Mudge, G.F. Schiefelbein, C.T. Li, and R.H. Moore, BATTELLE, Pacific Northwest Laboratories,

5) "Gasification or Liquefaction: Where We Stand", by Harold D. Levene, COAL: NOW AND IN THE FUTURE,

6) "Ready for Big-Scale Coal Gasification", BUSINESS WEEK, August 17, 1974,

7) "Water Demands for Expanding Energy Development", by George H. Davis and Leonard A. Wood, GEOLOGICAL SURVEY CIRCULAR 703,

AN EXAMPLE OF A
COAL GASIFICATION PROCESS
(SYNTHANE)



Source: Clean Energy from Coal Technology
U. S. Department of the Interior
Office of Coal Research

APPENDIX A

INVENTORY OF POWER GENERATING FACILITIES ON THE OHIO RIVER

December 1975

SUMMARY of inventory of power generating facilities on the Ohio River in operation, under construction and in the planning stage *

Status:

Facilities in operation	34
New facilities under construction	8
Proposed new facilities	7
Additional sites under consideration	7
Inactive facilities	4
Total number of facilities	60
Existing facilities under modification or expansion	5

Generating Capacity and type of cooling

Status	Type of cooling		Megawatt (MW) Generating Capacity
In operation			
	Once through		21,675
	Off stream **		5,039
	Hydroelectric		156
		Total	26,870
Under construction			
	Once through		0
	Off stream **		13,595
		Total	13,595
Proposed	Once through		0
	Off stream **		9,468
	Hydroelectric		182
		Total	9,650
Inactive			630
		Grand Total	50,745

* Compiled by Staff in cooperation with ORSANCO Power Industry Committee

** Off-stream MW capacity includes gas turbine units that are a part of steam generating facilities

SUMMARY of water consumption of power generating facilities on the Ohio River in operation under construction, and in the planning stage *

Maximum Consumptive Rate Of Water

Range of Reach (Miles)	Critical Flow ++ For Reach	Consumption Rate (CFS) Existing Plants	Under Const. & Proposed	Total	Total % of ++ Critical Flow/Consumed
0-162	6,500	77.4	95.2	172.6	2.7
162-279	7,400	36.2	54.6	90.8	1.2
279-436	9,700	20.7	27.6	48.3	.5
436-605	11,900	43.3	155.7	199.0	1.7
605-846	14,200	49.0	19.4	68.4	.5
846-918	19,500	0	0	0	
918-981	48,100	25.0	0	25.0	.05
Total		251.6	352.5	604.1	

Average Consumptive Rate Of Water For Week Of 8-5 - 8-11 '74

Range of Reach (Miles)	Critical Flow ++ (CFS)	Avg. Rate of Generation For Week (MW)	PerCent Of General Capacity	Avg. Rate Of Consumption (CFS)	PerCent Of Critical Flow ++
0-162	6,500	3633	62	32.8	.5
162-279	7,400	1969	84	16.5	.2
279-436	9,700	1245	51	10.2	.1
436-605	11,900	3162	67	28.6	.2
605-846	14,200	2817	57	28.6	.2
846-918	19,500	0		0	
918-981	48,100	2178	76	19.1	.04

++ Minimum Daily Flow Once In Ten Years (From ORSANCO POLLUTION CONTROL STANDARD 1-70 and 2-70).

Notes:

1. Heat Rejection Rates Assumed: 4100 BTU/KW-HR for new coal fired plants with off-stream cooling and 6800 BTU/KW-HR for nuclear plants with off-stream cooling .

2. Consumptive use of water calculated from factors contained in the report "Consumptive Water Use Implications Of The Proposed Effluent Guidelines For Steam - Electric Power Generation" by Espey, Huston & Associates Austin, Texas dated May 31, 1974.

ORSANCO Inventory
Power Generating Facilities
on the Ohio River

STATE	MILE POINT	OPERATING COMPANY	STATION NAME	ONCE THRU GEN CAP MW	HEAT REJ. RATE BTU/WK-HR	OFF STREAM GEN CAP MW	FUEL	STATUS	SERVICE DATE GEN UNITS	EPA CLASS	ASH DISPOSAL	CONSUMPTIVE USE OF WATER* CFS 1000 MW.	MILLION CU FT/YR MAX	MAX CFS	AVG CFS 8/5-11/74
Pa.	2.3	Duquesne	J.H. Reed	180	12,100		Coal	INA	No Data	A*					
Pa.	2.5	Duquesne	Brunot Island			140	Oil	OP	No Data			13.0*	57*	1.8*	No D[illegible]
Pa.	15.3	Duquesne	F.R. Phillips	408	6,792		Coal	OP OP OP OP	#1-1942 #2-1949 #3-1950 #4-1956	A A A A	Landfill	13.0	167	5.3	2.[illegible]
Pa.	33.7	Pennsylvania Power	Bruce Mansfield			825 825 825	Coal Coal Coal	UC UC UC	1975 1976 1978		Ponds	13.0*	1,015*	32.2*	
Pa.	34.9	Duquesne	Beaver Valley			852 852	Nuclear Nuclear	UC PROP	1975 198?			22.0*	1,183*	37.5*	
Pa.	35.0	Duquesne (AEC)	Shippingport	100	5,300		Nuclear	INA	1976			10.1	32	1.0	
Ohio	54.0	Ohio Edison	W.H. Sammis	2,392	4,570		Coal	OP OP OP OP OP OP OP	#1-1959 #2-1960 #3-1961 #4-1962 #5-1967 #6-1969 #7-1971	A A A A A A B	Fly Ash Dry Bottom Ash Wet	8.7	659	20.8	13.1
Ohio	57.5	Ohio Edison	Toronto	172	8,620		Coal	OP OP OP	#5-1940 #6-1949 #7-1949	A A A	Ponds	16.5	89	2.8	1.4
Ohio	76.3	Ohio Power	Tidd	215	5,860		Coal	OP OP	#1-1945 #2-1948	A A	Wet Handling	11.2	76	2.4	1.5
Ohio	76.5	Cardinal Op. Co. (Ohio Power)	Cardinal	600	3,844		Coal	OP	1967	A	Wet Handling	7.3	139	4.4	3.5
Ohio	76.5	Cardinal Op. Co. (Buckeye)	Cardinal	600	3,844	 615	Coal Coal	OP UC	1967 1976	A	Wet Handling	 7.3	 139	 4.4	 3.5
W.Va.	79.6	Beech Bottom	Windsor	300	6,000		Coal	INA		A*		13.0*	252*	8.0*	

ORSANCO Power Generating Facilities Inventory

STATE	MILE POINT	OPERATING COMPANY	STATION NAME	ONCE THRU GEN CAP MW	HEAT REJ. RATE BTU/WK-HR	OFF STREAM GEN CAP MW	FUEL	STATUS	SERVICE DATE GEN UNITS	EPA CLASS	ASH DISPOSAL	CONSUMPTIVE USE OF WATER * CFS 1000 MW.	MILLION CU FT/YR MAX	MAX CFS	AVG CFS 8/5-11/74
Ohio	102.5	Ohio Edison	R.E. Burger	557	6,021		Coal	OP OP OP OP OP	#1-1944 #2-1947 #3-1950 #4-1955 #5-1955	A A A A A	Ponds	11.5	202	6.4	3.0
W. Va.	111.1	Ohio Power	Kammer	675	4,425		Coal	OP OP OP	#1-1958 #2-1958 #3-1959	A A A	Wet Hand-ling	8.5	180	5.7	2.7
W. Va.	111.5	Ohio Power	Mitchell			1,600	Coal	OP			Wet Hand-ling	13.0*	663*	20.8*	No Data
W. Va.	119.5	Pitts. Plate Glass	New Martins-ville	124	3,640		Coal	OP	No Data		Ponds-Landfill	7.0	27	0.9	No Data
W. Va.	160.0	Monongahela	Pleasants			626 626	Coal Coal	UC UC	1978 1979		Drainage Basin	13.0*	513*	16.5*	
W. Va.	160.5	Monongahela	Willow Island	215	4,237		Coal	OP OP	#1-1949 #2-1960	A A	Landfill	8.1	55	1.7	1.3
Ohio	176.8	Union Carbide	Marietta	200	6,130		Coal	OP OP OP OP	#1-1951 #2-1951 #3-1952 #4-1953	A A A A	Ponds and Landfill	11.7	74	2.3	1.8
Ohio	225	Columbus & Southern				800 800	Coal Coal	PROP PROP	1981 1985			13.0*	665*	20.8*	
Ohio	237.5	Ohio Power	Racine			40	Hydro	PROP License Granted	1977						
W. Va.	241.6	Central Op. Co. (Appalachian)	Philip Sporn	1,050	4,115		Coal	OP OP OP OP OP	#1-1950 #2-1950 #3-1951 #4-1952 #5-1960	A A A A A	Wet Hand-ling	7.9	261	8.3	6.9
W. Va.	243.0	Appalachian	Project 1301			1,300	Coal		1978		Wet Hand-ling	13.0*	532*	16.9*	
Ohio	258	Ohio Electric	Gen. J.M. Gavin			1,300 1,300	Coal Coal	OP UC	 1975		Wet Hand-ling	13.0* 13.0*	532* 532*	16.9* 16.9*	No Data
Ohio	260.0	OVEC	Kyger Creek	1,097	4,140		Coal	OP	#1-5-1955	All A	Wet Hand-ling	7.9	274	8.7	7.8

ORSANCO Power Generating Facilities Inventory

STATE	MILE POINT	OPERATING COMPANY	STATION NAME	ONCE THRU GEN CAP MW	HEAT REJ. RATE BTU/WK-HR	OFF STREAM GEN CAP MW	FUEL	STATUS	SERVICE DATE GEN UNITS	EPA CLASS	ASH DISPOSAL	CONSUMPTIVE USE OF WATER *			
												CFS 1000 MW.	MILLION CU FT/YR MAX	MAX CFS	AVG CFS 8/5-11/74
W.Va.	282	AEP	Potential Site (Undeveloped)												
Ohio	332	AEP	Potential Site (Undeveloped)												
Ohio	339	Columbus &Southern	Optional Site for Plant at Mi. 225			800	Coal	PROP	1981						
						800	Coal	PROP	1985						
Ohio	341	City of Vanceburg, Ky.	Greenup			72	Hydro	PROP							
Ky.	364	AEP	Potential Site (Undeveloped)												
Ohio	390	Dayton Power & Light	Killen			660	Coal	UC	1979		Wet Handling	13.0*	542*	17.2*	
						660	Coal	UC	1980						
Ohio	405.7	Dayton Power & Light	J. M. Stuart	1,830	3,737			OP	#1-1971	B		7.1	413	13.0	7.1
								OP	#2-1970	B					
								OP	#3-1972	B					
						610		OP	#4-1974			12.6	242	7.7	3.1
Ky.	412.5	Eastern Ky. RECC	Charleston Bottoms			300	Coal	UC	1976			13.0*	328*	10.4*	
						500	Coal	PROP	1981						
Ky.	436.2	City of Vanceburg, Ky.	Meldahl			70	Hydro	PROP							
Ohio	443.2	Cinti.Gas. & Elec.	W. H. Zimmer			840	Nuclear	UC	1978			22.0*	1,380*	43.8*	
						1,150	Nuclear	UC	1984						
Ohio	453.0	Cinti.Gas & Elec.	W.C. Beckjord	1,221	4,457		Coal	OP	#1-1952	A	Fly Ash Dry or Wet Bottom Ash Wet	8.5	328	10.4	6.0
							Coal	OP	#2-1953	A					
							Coal	OP	#3-1954	A					
							Coal	OP	#4-1958	A					
							Coal	OP	#5-1962	A					
							Coal	OP	#6-1969	A					
						245	Gas Turbine	OP							
Ohio	471.4	Cinti.Gas & Elect.	West End	219	7,700		Nat. Gas	OP (To be De-activated)	#1-1954	A		14.7	102	3.2	1.0
									#2-1954	A					
									#3-1957	A					
									#4-1956	A					
									#5-1937	A					
									#6-1948	A					

ORSANCO Power Generating Facilities Inventory

STATE	MILE POINT	OPERATING COMPANY	STATION NAME	ONCE THRU GEN CAP MW	HEAT REJ. RATE BTU/WK-HR	OFF STREAM GEN CAP MW	FUEL	STATUS	SERVICE DATE GEN UNITS	EPA CLASS	ASH DISPOSAL	CONSUMPTIVE USE OF WATER* CFS 1000 MW.	MILLION CU FT/YR MAX	MAX CFS	AVG CFS 8/5-11/74
Ohio	490.0	Cinti. Gas & Elect.	Miami Fort	412	5,017		Coal	OP	#3-1938	A	Wet Handling Fly Ash Dry or Wet Bottom Ash Wet	9.6	125	4.0	2.2
							Coal	OP	#4-1942	A					
							Coal	OP	#5-1949	A					
							Coal	OP	#6-1960	A					
						500	Coal	UC	1975			13.0*	410*	13.0*	
						500	Coal	UC	1977						
						207	Gas Turbine	OP							
Ind.	495.5	Indiana & Michigan	Tanner's Creek	1,040	4,365		Coal	OP	#1-1951	A	Wet Handling	8.3	274	8.6	6.5
							Coal	OP	#2-1952	A					
							Coal	OP	#3-1954	A					
							Coal	OP	#4-1964	A					
Ky.	510	Cinti. Gas & Elect.	East Bend			600	Coal	PROP	1979		Fly Ash Dry Bottom Ash Wet	13.0*	491*	15.6*	
						600	Coal	PROP	1981						
Ind.	531.5	Public Service of Ind.	Markland			81	Hydro	OP							
Ky.	536.0	Kentucky Utilities	Ghent			511	Coal	OP	1973		Ash Pond	13.1	211	6.7	5.2
						511	Coal	UC	1977			13.0*	419*	13.3*	
						511	Coal	PROP	1981						
Ky.	555	AEP	Potential Site (Undeveloped)												
Ind.	560.0	Ind.-Ky. Elect. Corp.	Clifty Creek	1,331	4,085		Coal	OP	#1-1955	A	Wet Handling	7.8	328	10.4	7.7
							Coal	OP	#2-1955	A					
							Coal	OP	#3-1955	A					
							Coal	OP	#4-1955	A					
							Coal	OP	#5-1955	A					
							Coal	OP	#6-1956	A					
Ind.	570	Public Service of Ind.	Marble Hill			1,000	Nuclear	PROP	1981			22.0*	1,386*	44.0*	
						1,000	Nuclear	PROP	1983						
Ky.	571	Louisville Gas & Elect.	(Proposed Site)			500 (Ultimate station size - 2,000 MW)	Coal	PROP	198?			13.0*	819*	26.0*	

ORSANCO Power Generating Facilities Inventory

STATE	MILE POINT	OPERATING COMPANY	STATION NAME	ONCE THRU GEN CAP MW	HEAT REJ. RATE BTU/WK-HR	OFF STREAM GEN CAP MW	FUEL	STATUS	SERVICE DATE GEN UNITS	EPA CLASS	ASH DISPOSAL	CONSUMPTIVE USE OF WATER* CFS 1000 MW.	MILLION CU FT/YR MAX	MAX CFS	AVG CFS 8/5-11/74
Ky.	603.8	Louisville Gas & Elect.	Waterside			45	Gas Turbine	OP							
Ky.	605.0	Louisville Gas & Elect.	Canal	50	7,800		Coal	INA		A*					
Ky.	605.9	Louisville Gas & Elect.	McAlpine			75	Hydro	OP							
Ind.	610.0	Public Service of Ind.	Gallegher	600	5,614		Coal Coal Coal Coal	OP OP OP OP	#1-1958 #2-1959 #3-1960 #4-1961	A A A A		10.7	203	6.4	3.8
Ky.	613.6	Louisville Gas & Elect.	Paddy's Run	338	5,843	 30	Coal Coal Coal Coal Coal Coal Gas Turbine	OP OP OP OP OP OP OP	#1-1942 #2-1942 #3-1947 #4-1949 #5-1950 #6-1952	A A A A A A		11.2	119	3.8	0.8
Ky.	616.8	Louisville Gas & Elect.	Cane Run	998	4,534	 16	Coal Coal Coal Coal Coal Coal Gas Turbine	OP OP OP OP OP OP OP	#1-1954 #2-1956 #3-1958 #4-1962 #5-1966 #6-1969	A A A A A A		8.7	273	8.7	4.2
Ky.	626.0	Louisville Gas & Elect.	Mill Creek	335	3,948	 335 425 550	Coal Coal Coal Coal	OP OP UC PROP	#1-1972 #2-1974 #3-1977 #4-1979	A		7.6 12.5 13.0 *	79 132 400*	2.5 4.2 12.7*	1.2 2.0
Ky.	728.4	Big Rivers RECC	Coleman	460	4,600		Coal Coal Coal	OP OP OP	#1-1969 #2-1970 #3-1972	A A A	Ponds	8.8	127	4.0	3.7
Ind.	744	AEP	Potential Site (Undeveloped)												

ORSANCO Power Generating Facilities Inventory

STATE	MILE POINT	OPERATING COMPANY	STATION NAME	ONCE THRU GEN CAP MW	HEAT REJ. RATE BTU/WK-HR	OFF STREAM GEN CAP MW	FUEL	STATUS	SERVICE DATE GEN UNITS	EPA CLASS	ASH DISPOSAL	CONSUMPTIVE USE OF WATER * CFS 1000 MW.	MILLION CU FT/YR MAX	MAX CFS	AVG CFS 8/5-11/74
Ky.	753.5	Owensboro Mun. Util.	Elmer Smith	151 265	4,728		Coal	OP OP	#1-1964 #2-1974	A B	To Mine Pit	9.1	118	3.8	2.4
Ky.	755.5	Owensboro Mun. Util.	OMU #1	45	7,981		Coal	OP OP OP	#1-1939 #2-1939 #3-1954	A A A		15.3	22	0.7	0.2
Ind.	773.0	So. Ind. Gas & Elect.	F.B. Culley	397	5,450		Coal	OP OP OP	#1-1955 #2-1966 #3-1973	A A A	Pond	10.4	130	4.1	2.8
Ind.	773.5	Alcoa	Warrick	720	5,682		Coal	OP OP OP OP	#1-1960 #2-1964 #3-1965 #4-1970	A A A A*	Pond	10.9	246	7.8	6.2
Ind.	793.5	So. Ind. Gas & Elect.	Ohio River	121	9,287		Gas & Oil	OP OP OP OP OP OP OP	#1-1929 #2-1929 #3-1936 #4-1938 #5-1945 #6-1949 #7-1951	A A A A A A A		17.8	68	2.2	1.1
Ky.	804.0	Henderson	Henderson	40	8,184		Coal	OP OP	#5-1956 #6-1968	A A		15.7	20	0.6	0.2
Ky.	810	AEP	Potential Site (Undeveloped)												
Ind.	817	So. Ind. Gas & Elect.	A.B. Brown		No Dis-charge or Intake	255 255	Coal Coal	UC PROP	1978 1981		Pond	13.0*	211*	6.7*	
Ky.	948.0	TVA	Shawnee	1,750	4,577		Coal	OP OP OP OP OP OP OP OP OP OP	#1-1953 #2-1953 #3-1953 #4-1954 #5-1954 #6-1954 #7-1954 #8-1955 #9-1955 #10-1956	A A A A A A A A A A	Ponds	8.8	484	15.4	10.9

STATE	MILE POINT	OPERATING COMPANY	STATION NAME	ONCE THRU GEN CAP MW	HEAT REJ. RATE BTU/WK-HR	OFF STREAM GEN CAP MW	FUEL	STATUS	SERVICE DATE GEN UNITS	EPA CLASS	ASH DISPOSAL	CONSUMPTIVE USE OF WATER * CFS 1000 MW.	MILLION CU FT/YR MAX	MAX CFS	AVG CFS 8/5-11/74
Ill.	951.2	Electric Energy Co.	Joppa	1,100	4,557		Coal	OP	#1-6 - 1955	All A		8.7	302	9.6	8.2

* Assumed or Calculated

STATUS
OP - Operating
UC - Under Construction
PROP - Proposed
INA - Inactive

EPA Classifications For On Stream Cooling
A- Unit Placed In Service Prior to Jan. 1, 1970 Or Less Than 500 M.W. Capacity Placed In Service Between Jan. 1, 1970 and Dec. 31, 1973.
B- Other On Stream Units

APPENDIX B

SUMMARY OF OHIO RIVER TEMPERATURES

Monthly Average and Maximum-Minimum
Daily Average Temperatures

December 1975

INDEX

Ohio River Temperature

(Electronic Monitor Stations)

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

8 OHIO RIVER AT SOUTH HEIGHTS MILE 15.8

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	29.0	31.0	30.0	31.0	16.0	31.0	31.0	30.0	31.0	28.0	30.0
	MAX	40.3	44.0	48.1	61.1	75.3	76.1	86.6	84.6	79.3	73.0	61.4	46.0
1964	AVG	37.0	40.0	44.3	53.5	68.9	72.0	82.1	79.6	76.0	65.0	57.5	39.5
	MIN	33.6	37.0	39.9	44.1	60.0	68.4	77.4	76.7	70.3	61.0	47.0	34.1
	N	29.0	28.0	31.0	30.0	31.0	29.0	31.0	29.0	29.0	31.0	20.0	17.0
	MAX	44.9	43.3	49.5	56.6	74.1	79.2	82.8	80.8	81.2	73.7	56.0	44.9
1965	AVG	38.5	38.9	45.5	54.2	67.8	74.8	80.3	78.2	77.3	64.5	52.7	40.7
	MIN	33.9	32.1	40.2	48.9	57.0	70.6	78.1	75.1	73.8	56.6	46.1	36.7
	N	24.0	22.0	30.0	26.0	24.0	27.0	24.0	31.0	8.0	4.0	10.0	31.0
	MAX	40.9	44.5	50.4	58.3	70.7	82.3	84.0	81.5	80.5	65.9	50.7	44.4
1966	AVG	37.5	39.3	45.1	51.3	59.3	75.5	82.5	80.1	79.2	65.5	49.0	40.5
	MIN	33.6	35.2	39.4	45.0	53.2	68.4	81.0	78.4	76.5	65.0	47.5	34.8
	N	31.0	26.0	2.0		26.0	29.0	29.0	31.0	28.0	31.0	30.0	31.0
	MAX	44.0	40.7	36.1		69.9	82.7	80.5	80.6	73.8	63.0	52.4	43.8
1967	AVG	39.1	37.4	35.7		56.5	78.2	78.1	77.1	71.8	58.0	45.7	41.0
	MIN	36.9	33.8	35.3		48.0	68.7	75.7	75.0	68.3	50.8	40.6	36.0
	N	24.0	29.0	29.0	29.0	31.0	30.0	31.0	31.0	30.0	30.0	30.0	31.0
	MAX	38.9	40.3	51.1	66.4	65.1	77.4	83.5	85.4	78.0	72.6	57.3	44.7
1968	AVG	35.2	36.4	43.2	59.7	61.7	72.5	80.7	82.5	75.5	66.6	50.9	37.2
	MIN	32.1	33.2	37.4	53.3	56.8	59.1	76.4	78.3	72.8	56.5	44.6	33.0
	N	31.0	27.0	30.0	30.0	30.0	30.0	27.0	29.0	30.0	15.0	30.0	31.0
	MAX	38.0	42.4	49.8	57.1	71.7	82.5	82.7	81.9	81.6	71.9	57.3	42.7
1969	AVG	34.6	38.6	44.7	53.0	65.2	76.3	79.8	79.6	76.6	67.1	49.9	38.5
	MIN	32.3	35.6	40.7	45.5	57.8	72.1	75.6	77.2	71.8	57.1	41.9	34.4

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

8 OHIO RIVER AT SOUTH HEIGHTS MILE 15.8

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	21.0	30.0	29.0	30.0	31.0
	MAX	38.5	41.2	44.4	62.2	70.0	78.2	79.5	83.7	80.3	70.5	57.1	46.5
1970	AVG	35.8	38.6	41.8	51.2	66.3	74.4	76.8	79.9	77.2	61.6	49.1	41.0
	MIN	33.4	34.6	39.7	43.1	60.8	69.4	74.0	77.2	71.5	54.9	38.8	35.5
	N	31.0	24.0	30.0	30.0	31.0	29.0	31.0	31.0	22.0	20.0	27.0	29.0
	MAX	39.6	42.8	46.8	57.6	68.2	83.2	83.4	81.0	83.4	69.9	65.6	47.1
1971	AVG	35.4	36.6	43.0	51.9	61.4	76.0	80.9	78.6	77.2	68.1	51.7	43.6
	MIN	32.1	32.3	39.3	46.1	51.8	68.5	78.6	76.4	67.7	66.8	44.0	39.2
	N	31.0	29.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	29.0	30.0	31.0
	MAX	43.1	41.6	45.6	56.9	72.4	73.9	81.2	81.3	79.7	70.4	56.8	43.1
1972	AVG	40.7	36.5	42.8	51.9	63.8	68.6	71.4	78.8	74.8	60.1	47.7	40.7
	MIN	35.3	34.0	39.9	45.4	56.7	55.5	62.6	76.3	71.7	52.2	39.8	36.8
	N	30.0	28.0	31.0	30.0	31.0	30.0	26.0	21.0	30.0	30.0	26.0	30.0
	MAX	41.1	39.6	50.5	61.6	64.5	79.9	82.8	83.7	83.9	72.7	55.3	47.6
1973	AVG	35.8	36.2	46.0	52.4	58.6	75.6	81.7	81.1	77.3	66.6	49.4	41.5
	MIN	32.0	33.0	39.6	45.5	53.8	64.9	80.1	77.0	72.3	57.4	46.2	36.9
	N	30.0	21.0	23.0	30.0	31.0	21.0	31.0	30.0	30.0	31.0	28.0	31.0
	MAX	45.9	44.4	48.9	61.1	71.5	76.3	81.5	82.3	79.4	62.6	58.6	39.8
1974	AVG	41.6	40.2	46.1	53.5	65.6	71.2	78.2	81.1	69.9	58.3	49.1	38.0
	MIN	37.2	36.1	41.8	44.8	60.5	66.3	69.6	79.8	64.0	54.9	39.9	36.1

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

5 OHIO RIVER AT STRATTON MILE 53.8

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	22.0	22.0	28.0	29.0	30.0	25.0	30.0	31.0	28.0	13.0	19.0	21.0
	MAX	43.9	36.6	46.2	59.5	75.6	86.0	86.7	83.9	79.8	71.9	62.0	49.6
1964	AVG	39.1	35.2	40.3	51.9	69.1	80.4	83.8	79.8	76.2	63.4	58.2	43.3
	MIN	34.6	33.0	35.5	42.4	58.0	74.0	80.6	78.2	70.9	60.2	51.3	39.6
	N	25.0	26.0	31.0	30.0	30.0	29.0	31.0	30.0	29.0	31.0	28.0	30.0
	MAX	43.9	41.6	46.5	56.7	75.9	80.8	83.4	82.8	80.6	76.2	58.7	45.4
1965	AVG	38.7	38.7	43.0	53.2	70.0	77.6	81.6	80.8	77.9	65.9	51.7	42.2
	MIN	35.1	34.0	39.8	47.3	57.7	75.7	80.3	79.0	76.5	59.2	44.5	37.9
	N	31.0	25.0	1.0	11.0	31.0	30.0	29.0	31.0	30.0	30.0	19.0	20.0
	MAX	41.2	38.4	42.0	58.5	70.7	84.2	86.3	83.5	82.0	67.9	58.3	44.4
1966	AVG	36.5	35.2	42.0	56.4	59.8	76.6	85.0	82.1	75.4	62.6	52.5	41.3
	MIN	33.5	32.4	42.0	54.1	52.6	69.4	83.4	80.2	68.7	57.9	47.3	37.2
	N	31.0	26.0	2.0		31.0	25.0	29.0	31.0	28.0	29.0	24.0	24.0
	MAX	46.9	41.2	36.1		70.5	80.9	80.0	81.4	73.8	66.0	52.7	42.8
1967	AVG	41.3	37.8	36.0		56.9	77.8	78.2	78.4	71.6	58.0	46.1	40.2
	MIN	37.7	36.0	35.9		48.9	70.6	75.6	74.3	65.3	53.0	41.1	36.3
	N	27.0	29.0	29.0	29.0	31.0	30.0	31.0	31.0	30.0	31.0	29.0	31.0
	MAX	38.2	37.5	49.7	65.9	65.9	75.6	86.9	86.6	79.9	75.2	58.7	45.4
1968	AVG	35.2	35.4	42.0	59.1	62.0	71.7	82.8	83.5	76.9	67.3	51.2	38.4
	MIN	32.1	32.7	36.4	51.8	57.0	59.7	77.6	80.3	74.6	58.2	43.9	34.5
	N	31.0	27.0	29.0	30.0	30.0	30.0	31.0	23.0	29.0	31.0	30.0	31.0
	MAX	38.6	41.3	53.3	57.5	71.7	82.0	83.6	82.1	82.1	72.4	59.1	42.4
1969	AVG	34.8	38.5	45.8	54.1	65.2	75.5	81.0	80.2	77.0	66.8	50.9	38.4
	MIN	32.7	36.4	41.3	47.0	58.0	71.5	77.5	74.5	71.6	58.4	42.3	33.9

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

5 OHIO RIVER AT STRATTON MILE 53.8

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	27.0	28.0	28.0	27.0	19.0	30.0	30.0	31.0	25.0	31.0	30.0	30.0
	MAX	39.5	39.5	46.2	63.3	73.1	79.3	82.3	84.2	82.3	70.6	58.8	48.4
1970	AVG	35.6	37.2	42.9	52.8	70.7	76.7	79.8	82.5	78.9	65.3	49.9	42.5
	MIN	33.0	33.5	39.1	46.0	67.7	74.1	77.2	79.6	72.1	59.4	41.6	35.3
	N	31.0	28.0	30.0	30.0	24.0	29.0	28.0	31.0	23.0	25.0	30.0	29.0
	MAX	39.4	43.5	48.1	60.0	69.4	84.6	84.7	82.0	84.1	73.6	69.8	47.9
1971	AVG	36.3	37.1	43.8	53.5	64.2	77.5	82.3	80.4	75.3	70.0	56.9	45.1
	MIN	32.4	32.1	39.3	47.9	59.0	70.2	79.9	78.5	68.6	67.8	47.2	42.1
	N	30.0	29.0	31.0	30.0	31.0	27.0		7.0	23.0	21.0	30.0	20.0
	MAX	44.2	41.0	45.9	58.1	73.6	76.5		84.0	83.6	66.2	57.4	44.9
1972	AVG	41.4	38.6	43.1	53.0	66.1	73.1		83.4	78.8	61.1	50.1	43.1
	MIN	37.6	36.7	38.9	46.4	60.1	65.4		82.8	75.0	57.4	42.5	40.3
	N	31.0	28.0	22.0	30.0	31.0	30.0	29.0	27.0	26.0	23.0	28.0	25.0
	MAX	45.2	44.7	53.8	62.4	65.0	81.3	85.0	86.9	84.0	74.4	60.5	51.4
1973	AVG	41.0	41.6	47.5	54.1	59.5	76.4	83.7	82.6	79.6	68.7	53.5	45.2
	MIN	36.4	38.6	43.7	47.7	54.4	65.5	78.5	75.8	74.5	62.9	50.0	39.6
	N	31.0	28.0	29.0	27.0	31.0	30.0	31.0	15.0	30.0	27.0	30.0	23.0
	MAX	47.1	46.3	52.7	61.8	71.3	76.5	83.8	85.8	78.9	63.5	62.1	42.0
1974	AVG	44.0	42.5	47.9	53.5	65.7	73.3	79.9	83.1	72.4	61.0	54.1	41.6
	MIN	40.4	39.3	43.5	48.1	60.8	69.2	71.2	79.3	66.4	57.7	44.2	40.9

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

16 OHIO RIVER AT WILLOW ISLAND MILE 160.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N											21.0	16.0
	MAX											64.2	51.8
1968	AVG											55.5	41.9
	MIN											49.2	38.4
	N	29.0	25.0	30.0	30.0	26.0	30.0	31.0	31.0	30.0	31.0	27.0	31.0
	MAX	42.5	44.1	52.1	60.5	74.7	83.9	86.1	84.4	82.4	74.7	60.1	43.0
1969	AVG	38.2	42.0	47.0	55.2	67.0	78.2	83.6	82.8	78.2	67.8	53.1	40.1
	MIN	35.5	40.3	42.8	48.0	58.1	73.5	79.3	79.2	73.9	59.5	45.0	36.3
	N	28.0	28.0	29.0	26.0	31.0	27.0	31.0	31.0	30.0	31.0	21.0	18.0
	MAX	41.2	43.2	46.4	62.2	74.4	80.0	83.8	85.4	82.9	74.3	61.7	47.3
1970	AVG	38.1	41.1	44.5	52.5	70.0	78.4	81.3	83.0	80.9	68.2	57.3	45.0
	MIN	35.6	38.1	42.7	45.0	64.6	76.0	78.7	80.3	74.7	61.9	54.7	41.3
	N	31.0	28.0	31.0	30.0	31.0	29.0	31.0	31.0	29.0	31.0	30.0	25.0
	MAX	42.2	43.1	48.9	63.1	69.3	83.8	84.2	82.3	82.6	74.2	69.4	49.4
1971	AVG	39.2	38.7	45.4	56.8	63.7	78.3	82.0	80.5	76.1	69.4	57.9	47.0
	MIN	36.5	35.0	41.6	48.7	57.9	71.3	79.5	79.1	69.5	65.8	48.9	44.5
	N	11.0	29.0	29.0	21.0	31.0	30.0	20.0	31.0	30.0	30.0	21.0	30.0
	MAX	43.5	42.2	46.7	59.5	73.2	78.3	84.3	84.0	82.6	72.5	60.9	44.1
1972	AVG	41.7	39.5	43.4	54.6	65.5	71.4	73.7	80.8	78.4	64.8	53.4	41.8
	MIN	38.8	37.2	38.5	46.8	60.4	58.0	62.6	78.7	74.4	58.4	45.3	37.3
	N	29.0	28.0	31.0	30.0	30.0	30.0	31.0	31.0	30.0	15.0		12.0
	MAX	43.8	41.9	54.9	60.2	65.6	82.7	85.8	85.9	86.9	77.2		43.0
1973	AVG	39.2	39.6	48.3	53.5	59.9	77.7	83.7	83.8	80.2	73.8		41.9
	MIN	35.1	36.2	42.1	47.8	54.2	65.8	80.3	79.7	75.3	69.4		39.9

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

16 OHIO RIVER AT WILLOW ISLAND MILE 160.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	9.0	15.0	17.0	24.0	22.0	30.0	29.0	13.0	14.0	12.0	16.0	31.0
	MAX	42.9	45.7	50.4	62.1	70.7	75.2	82.2	83.6	76.2	64.8	58.3	41.8
1974	AVG	42.2	42.3	46.9	53.8	66.0	72.4	79.8	82.1	72.8	63.2	51.2	39.4
	MIN	41.2	39.7	41.1	47.6	61.4	67.6	72.6	80.2	67.9	61.9	43.0	38.4

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

14 OHIO RIVER AT NEW HAVEN MILE 241.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N							5.0	31.0	28.0	29.0	30.0	31.0
	MAX							82.6	82.5	76.4	69.4	55.3	47.5
1967	AVG							82.1	79.8	73.6	62.9	47.8	42.0
	MIN							81.7	76.8	66.9	56.0	40.7	38.4
	N	30.0	29.0	29.0	29.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	39.9	40.6	49.5	65.2	67.5	77.9	85.2	86.0	80.6	74.1	60.3	47.1
1968	AVG	36.7	37.1	44.4	59.0	63.5	72.1	82.7	82.6	76.6	67.9	53.8	39.2
	MIN	33.6	34.6	38.0	54.4	58.5	59.4	78.3	80.0	73.3	60.0	46.2	34.6
	N	28.0	27.0	30.0	30.0	30.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	39.3	45.3	49.9	60.1	73.6	82.6	84.4	82.3	81.3	72.0	59.0	44.2
1969	AVG	35.1	41.3	45.5	55.1	66.3	77.3	81.7	80.5	76.7	67.5	52.3	40.5
	MIN	32.1	38.5	41.9	48.2	58.1	73.6	77.2	76.6	71.8	59.3	44.8	36.4
	N	29.0	28.0	31.0	30.0	31.0	30.0	31.0	21.0	28.0	26.0	21.0	31.0
	MAX	39.6	41.1	45.9	63.6	75.6	79.7	83.6	84.3	82.5	75.5	61.6	46.6
1970	AVG	37.6	38.5	43.8	53.0	70.2	77.7	80.3	82.5	81.2	68.5	51.2	43.3
	MIN	34.4	35.9	41.1	45.2	65.0	74.7	78.3	80.4	78.2	61.5	43.0	38.1
	N	31.0	28.0	31.0	29.0	31.0	29.0	31.0	31.0	24.0	31.0	30.0	29.0
	MAX	39.1	40.5	49.2	60.8	69.6	82.6	83.2	81.3	81.4	73.8	67.9	48.6
1971	AVG	37.3	36.0	43.4	55.5	63.5	77.4	81.5	79.2	76.5	69.2	57.1	46.6
	MIN	33.7	32.6	39.0	48.4	57.4	70.5	78.0	75.4	69.4	66.6	46.2	44.1
	N	31.0	29.0	30.0	30.0	31.0	26.0	28.0	31.0	24.0	30.0	30.0	19.0
	MAX	47.6	41.4	45.8	59.0	72.7	78.0	85.6	83.5	81.6	74.1	59.7	44.5
1972	AVG	42.8	37.5	43.3	52.5	64.6	73.9	76.1	80.1	79.4	65.3	51.8	42.7
	MIN	38.8	34.5	39.0	45.2	56.7	62.3	65.0	77.5	75.6	58.4	42.9	37.8

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

14 OHIO RIVER AT NEW HAVEN MILE 241.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N		28.0	12.0	25.0	31.0	30.0	29.0	31.0	22.0	30.0	30.0	26.0
	MAX		42.1	53.0	60.3	67.8	78.9	80.7	82.6	83.1	73.6	55.9	49.2
1973	AVG		40.3	48.6	53.2	61.9	75.4	79.5	80.9	77.3	67.5	48.2	43.0
	MIN		37.4	44.3	46.9	56.8	68.2	77.0	79.3	72.2	57.0	44.5	38.8
	N	19.0	10.0	19.0		15.0					12.0	30.0	31.0
	MAX	45.6	44.3	47.9		70.6					62.3	61.2	42.7
1974	AVG	42.0	40.8	45.4		63.1					58.8	54.2	39.3
	MIN	38.8	38.4	41.0		60.9					58.0	43.7	38.2

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

2 OHIO RIVER AT HUNTINGTON MILE 304.2

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	27.0	28.0	30.0	22.0	29.0	30.0	22.0	30.0	31.0	27.0	26.0
	MAX	41.0	39.6	48.8	62.6	75.2	82.7	86.1	86.9	81.2	73.6	62.0	48.7
1964	AVG	37.0	38.5	44.8	53.6	70.5	78.5	83.2	83.0	77.6	65.6	58.4	46.2
	MIN	34.6	37.0	40.1	45.2	62.7	72.9	81.3	79.7	72.0	61.6	50.2	41.6
	N	25.0	28.0	27.0	27.0	30.0	29.0	31.0	29.0	29.0	31.0	30.0	31.0
	MAX	43.1	44.9	48.3	61.7	78.8	80.7	85.3	82.7	78.6	76.6	58.9	45.6
1965	AVG	39.8	40.1	44.3	55.4	72.3	78.8	83.0	80.7	76.9	67.2	54.6	44.2
	MIN	36.7	34.4	39.8	48.4	61.0	76.5	80.3	78.7	73.6	58.8	45.9	43.0
	N	31.0	28.0	27.0	26.0	31.0	30.0	29.0	26.0	16.0	29.0		3.0
	MAX	46.4	40.9	53.9	62.6	73.7	84.0	86.7	83.3	76.5	68.6		40.6
1966	AVG	40.0	37.1	48.4	53.1	62.8	77.9	84.2	82.5	73.8	64.7		40.1
	MIN	32.3	32.1	40.8	47.3	55.6	72.4	82.1	81.4	70.3	60.6		39.8
	N	22.0	19.0	2.0		31.0	29.0	29.0	31.0	28.0	31.0	30.0	31.0
	MAX	41.7	40.4	35.6		69.3	82.5	83.1	81.7	76.3	70.3	56.3	46.0
1967	AVG	39.8	38.1	35.6		58.1	75.9	80.0	79.6	74.0	64.0	49.0	43.3
	MIN	36.1	35.8	35.6		53.4	67.6	78.6	77.5	68.6	57.0	43.4	39.2
	N	30.0	27.0	29.0	29.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	39.9	41.7	51.6	65.6	69.1	78.5	85.5	84.7	80.8	75.2	61.6	48.0
1968	AVG	36.4	37.6	45.3	60.7	64.9	73.0	82.8	82.1	77.5	69.1	54.2	41.2
	MIN	32.5	35.1	37.7	56.5	59.6	61.3	79.3	79.1	74.7	60.9	46.2	35.8
	N	22.0	27.0	30.0	27.0	30.0	30.0	31.0	31.0	30.0	31.0	30.0	29.0
	MAX	42.9	43.0	49.6	60.2	73.5	84.1	86.1	83.3	81.3	73.0	61.6	44.8
1969	AVG	38.7	41.4	44.1	54.4	66.0	78.3	83.3	80.4	77.0	68.7	53.4	41.2
	MIN	32.2	38.8	39.2	44.3	57.4	74.4	79.8	77.2	72.1	60.9	46.7	37.1

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

2 OHIO RIVER AT HUNTINGTON MILE 304.2

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	27.0	26.0	23.0	28.0	31.0	31.0	28.0	21.0	30.0	27.0
	MAX	40.7	42.1	46.2	64.3	76.9	80.0	83.7	84.7	84.6	74.1	61.7	51.1
1970	AVG	36.5	40.1	44.4	56.8	70.2	78.2	81.3	82.7	83.1	68.5	54.3	46.3
	MIN	34.1	37.7	41.9	48.4	65.6	75.3	79.7	80.6	79.6	64.3	45.9	39.5
	N	31.0	24.0	26.0	30.0	14.0	27.0	31.0	31.0	21.0	31.0	30.0	26.0
	MAX	40.6	42.7	48.4	63.9	64.6	82.3	84.8	80.1	81.8	73.4	67.0	48.3
1971	AVG	38.5	37.8	45.1	57.2	61.5	76.4	81.5	78.4	77.0	69.9	56.6	46.3
	MIN	35.9	35.0	41.6	48.6	59.8	66.6	77.2	76.3	70.6	66.1	47.9	44.3
	N	31.0	27.0	20.0	27.0	31.0	30.0	24.0	30.0	25.0	30.0	30.0	26.0
	MAX	46.5	41.4	45.4	58.0	70.6	77.0	81.7	80.0	78.1	74.1	55.7	44.4
1972	AVG	42.0	38.2	43.4	52.0	63.7	71.2	75.3	74.3	77.0	63.5	49.1	41.8
	MIN	37.3	35.2	40.4	45.0	57.5	60.5	67.7	70.0	75.3	56.0	40.4	38.3
	N	31.0	28.0	29.0	29.0	15.0	30.0	31.0	31.0	30.0	30.0	30.0	25.0
	MAX	43.3	42.5	56.5	60.0	66.2	81.6	84.3	84.0	85.0	77.1	61.1	51.1
1973	AVG	38.9	39.8	49.7	53.0	60.0	77.5	82.8	82.4	79.9	71.3	51.8	44.9
	MIN	35.0	37.0	41.9	46.7	55.1	65.4	80.7	80.8	76.4	61.7	47.4	38.2
	N	7.0	28.0	11.0	3.0	18.0	25.0	27.0	31.0	30.0	28.0	23.0	28.0
	MAX	45.7	46.4	52.0	57.5	68.2	75.2	81.2	81.7	79.4	63.9	60.5	41.2
1974	AVG	43.8	41.5	47.9	56.4	63.7	70.4	78.8	80.8	71.3	61.0	54.3	39.4
	MIN	40.7	37.2	40.6	55.5	61.8	64.4	68.9	79.5	67.0	57.6	41.8	36.9

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

1 OHIO RIVER AT CINCINNATI MILE 462.8

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	30.0	27.0	30.0	17.0	31.0	29.0	30.0	31.0	30.0	30.0	28.0	24.0
	MAX	43.3	42.2	49.3	59.7	72.5	77.8	82.2	82.7	81.3	72.1	59.8	50.2
1964	AVG	41.4	41.2	46.4	53.8	67.5	73.6	78.9	78.8	76.4	65.2	56.2	45.7
	MIN	39.7	39.9	40.2	47.3	60.1	69.0	76.8	76.1	71.1	59.4	51.8	41.3
	N	31.0	22.0	29.0	30.0	31.0	29.0	30.0	30.0	29.0	31.0	28.0	31.0
	MAX	43.4	43.7	45.6	56.9	74.6	79.8	81.6	82.5	77.2	72.5	58.2	47.7
1965	AVG	40.3	37.5	42.4	53.2	67.8	77.1	79.8	79.6	75.6	64.7	54.7	44.1
	MIN	37.0	33.8	38.3	46.3	56.9	75.1	77.8	77.3	72.1	59.0	48.0	42.6
	N	19.0	27.0	29.0	26.0	30.0	30.0	29.0	30.0	30.0	31.0	27.0	31.0
	MAX	46.0	42.5	51.0	61.8	70.3	80.0	84.4	82.5	82.0	67.7	56.9	47.4
1966	AVG	37.6	36.8	47.6	52.2	62.5	74.9	82.7	80.6	76.1	61.8	52.4	42.5
	MIN	32.5	32.8	40.2	46.9	57.2	68.0	81.4	77.9	68.9	56.7	47.8	36.8
	N	31.0	28.0	2.0			8.0	29.0	31.0	28.0	31.0	21.0	31.0
	MAX	42.9	43.7	35.9			78.8	80.9	81.5	76.5	69.5	57.7	44.9
1967	AVG	38.6	39.3	35.7			77.7	79.5	79.6	74.5	64.6	50.2	42.7
	MIN	36.4	35.5	35.5			76.9	78.1	77.4	67.8	57.9	43.9	39.4
	N	30.0	29.0	29.0	29.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	38.6	40.5	48.0	62.9	68.1	77.0	83.4	83.6	79.5	74.2	61.9	46.9
1968	AVG	35.6	36.6	42.1	57.4	64.3	71.8	80.8	82.1	76.5	68.4	54.5	41.3
	MIN	32.6	33.9	34.2	52.3	61.2	61.6	76.9	79.4	73.9	60.6	47.4	37.2
	N	30.0	27.0	31.0	29.0	30.0	29.0	31.0	24.0	29.0	30.0	29.0	30.0
	MAX	39.3	40.4	48.7	60.5	72.0	82.3	84.2	84.4	79.9	72.9	59.6	44.2
1969	AVG	34.5	39.1	43.9	55.8	65.3	76.2	82.1	81.1	76.6	68.0	51.2	40.5
	MIN	32.2	37.6	39.7	48.2	60.3	71.4	80.7	79.2	72.8	59.5	45.3	36.6

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

1 OHIO RIVER AT CINCINNATI   MILE 462.8

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	30.0	30.0	28.0	30.0	31.0
	MAX	38.8	41.0	44.8	62.5	75.6	79.9	82.3	83.3	82.9	72.7	62.8	48.2
1970	AVG	34.4	38.3	42.8	52.6	68.6	77.9	81.1	81.9	80.8	68.4	53.3	44.0
	MIN	32.3	35.5	40.8	45.3	63.1	75.3	79.7	79.6	76.8	63.3	45.7	38.3
	N	30.0	28.0	31.0	30.0	31.0	30.0	31.0	30.0	30.0	31.0	30.0	27.0
	MAX	38.7	42.6	44.7	61.0	68.9	80.9	82.7	80.2	81.8	75.1	69.4	48.4
1971	AVG	37.1	37.5	43.1	54.5	61.6	75.8	80.5	78.6	76.9	70.9	58.4	45.8
	MIN	35.6	33.4	41.8	44.6	57.7	69.4	77.9	76.2	70.8	68.9	49.2	43.8
	N	31.0	29.0	31.0	30.0	27.0	30.0	31.0	31.0	30.0	30.0	30.0	31.0
	MAX	47.5	44.2	46.1	58.0	70.9	76.8	82.5	82.5	81.0	75.6	59.2	44.6
1972	AVG	41.9	37.9	43.6	52.4	64.7	72.0	73.3	79.7	79.5	66.9	51.5	42.9
	MIN	38.0	35.1	40.3	45.7	59.0	60.9	61.9	76.2	76.2	59.2	42.8	40.4
	N	31.0	28.0	31.0	30.0	31.0	30.0	28.0	31.0	30.0	30.0	30.0	31.0
	MAX	43.8	42.5	54.0	55.8	65.7	80.0	83.8	84.1	85.8	78.2	61.6	50.8
1973	AVG	40.1	39.1	46.8	50.8	60.1	75.4	82.6	82.6	80.4	72.4	52.2	42.9
	MIN	38.0	35.3	37.5	46.5	52.7	66.3	80.8	80.8	76.4	63.3	48.7	38.9
	N	18.0	28.0	29.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	29.0	31.0
	MAX	46.0	45.6	50.7	60.6	69.8	75.1	82.5	83.1	79.2	66.9	60.8	44.2
1974	AVG	43.7	40.8	47.6	54.1	65.2	70.9	78.2	81.8	72.8	62.4	53.9	40.0
	MIN	41.0	38.7	43.4	47.8	61.4	66.1	70.3	80.4	67.7	58.3	45.1	38.8

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

7 OHIO RIVER AT MIAMI FORT MILE 490.0

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N						20.0	30.0	31.0	30.0	31.0	28.0	30.0
	MAX						83.9	86.3	86.7	83.7	72.7	63.6	51.3
1964	AVG						81.4	83.2	82.6	79.2	66.7	58.5	46.1
	MIN						79.3	80.0	80.0	73.1	61.7	52.2	42.0
	N	26.0	22.0	29.0	30.0	30.0	29.0	31.0	30.0	29.0	31.0	28.0	31.0
	MAX	46.2	42.3	45.9	58.5	76.0	80.4	83.8	82.4	78.9	74.2	59.0	49.0
1965	AVG	41.8	40.0	42.8	54.0	69.7	78.3	80.7	80.6	76.5	66.8	55.7	45.3
	MIN	37.6	36.8	39.1	46.7	59.1	75.2	78.8	79.1	72.6	60.6	48.6	42.8
	N	29.0	28.0	30.0	24.0	28.0	28.0	29.0	31.0	29.0	30.0	20.0	30.0
	MAX	46.0	44.4	51.5	61.7	70.4	84.2	85.8	83.5	82.4	69.8	58.0	48.9
1966	AVG	40.2	38.7	47.3	52.9	61.8	77.0	83.6	81.6	76.7	63.9	52.7	44.9
	MIN	34.0	32.3	40.0	47.7	57.5	69.0	82.6	79.9	70.4	58.0	48.9	40.1
	N	31.0	26.0	2.0		9.0		13.0	31.0	28.0	30.0	27.0	31.0
	MAX	43.5	45.4	38.0		64.3		81.8	85.4	76.6	69.9	60.7	47.7
1967	AVG	40.3	41.2	37.9		61.3		80.8	80.5	74.7	65.2	51.8	44.4
	MIN	38.5	37.8	37.7		57.7		78.2	77.1	68.4	59.0	45.6	41.0
	N	28.0	28.0	29.0	29.0	31.0	30.0	31.0	31.0	30.0	28.0	5.0	30.0
	MAX	40.4	42.2	50.0	63.2	68.2	78.5	84.6	85.1	79.5	75.0	56.6	48.2
1968	AVG	37.0	37.5	43.6	58.0	64.8	72.4	81.2	82.8	76.5	70.5	51.7	42.9
	MIN	33.8	34.9	36.5	53.4	61.7	62.3	78.0	79.4	74.3	66.0	48.9	37.9
	N	27.0	21.0	31.0	30.0	23.0	30.0	31.0	30.0	30.0	31.0	30.0	21.0
	MAX	43.0	43.3	49.6	62.2	73.1	82.5	85.6	83.7	81.5	73.1	61.1	48.6
1969	AVG	36.7	41.4	44.4	57.2	68.2	77.4	83.7	82.0	76.6	68.2	54.7	43.9
	MIN	33.3	39.2	40.9	49.3	61.2	74.4	81.2	80.1	72.6	61.4	49.4	39.7

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

7 OHIO RIVER AT MIAMI FORT MILE 490.0

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	22.0	20.0	16.0	19.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	39.8	42.0	48.2	62.4	77.4	82.4	83.9	84.3	83.6	75.5	64.3	48.9
1970	AVG	37.6	40.2	44.9	54.5	70.6	79.8	81.7	82.6	81.3	69.7	54.4	44.8
	MIN	35.2	37.6	42.2	48.5	64.7	76.7	79.7	80.3	76.3	65.3	46.6	39.1
	N	31.0	27.0	24.0	30.0	31.0	30.0	29.0	30.0	30.0	31.0	27.0	27.0
	MAX	39.0	41.2	46.0	61.7	70.2	81.9	83.8	81.0	82.1	75.6	66.8	49.1
1971	AVG	37.4	36.2	43.6	55.6	63.8	77.3	80.5	78.8	77.6	71.4	57.8	46.9
	MIN	34.4	32.6	40.8	47.3	59.1	71.2	77.7	75.9	71.3	69.4	49.8	45.4
	N	31.0	29.0	17.0	30.0	31.0	30.0	31.0	31.0	30.0	30.0	30.0	29.0
	MAX	48.4	45.1	47.2	59.7	73.5	78.4	82.3	82.0	79.8	72.3	57.3	42.9
1972	AVG	43.0	39.1	44.7	53.5	66.3	72.8	73.7	79.4	77.4	64.5	49.6	41.6
	MIN	39.5	36.8	41.1	46.1	58.2	61.2	62.0	75.2	74.4	57.7	41.3	39.8
	N	31.0	28.0	23.0	30.0	31.0	19.0	26.0	31.0	30.0	30.0	28.0	28.0
	MAX	43.7	44.2	55.0	59.8	68.2	81.7	83.2	83.7	84.2	77.1	62.0	49.0
1973	AVG	40.5	41.1	48.3	53.5	62.9	75.9	81.8	82.1	79.9	71.1	53.2	42.2
	MIN	37.0	38.1	41.5	48.3	56.5	68.9	79.6	79.4	75.8	62.5	49.7	37.5
	N	27.0	28.0	29.0	30.0	31.0	27.0	31.0	30.0	30.0	31.0	29.0	27.0
	MAX	45.7	45.5	51.6	62.4	71.9	75.4	82.9	83.9	79.6	67.8	61.8	44.3
1974	AVG	42.2	42.1	49.0	56.3	67.8	72.5	80.0	82.0	73.4	63.4	55.2	40.6
	MIN	38.8	40.2	43.0	51.3	64.0	68.6	72.3	79.6	68.8	60.4	46.9	38.9

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

22 OHIO RIVER AT MARKLAND DAM MILE 531.1

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N					15.0	29.0	31.0	31.0	30.0	25.0	24.0	31.0
	MAX					72.8	80.6	83.9	82.0	81.4	72.5	61.4	47.3
1969	AVG					68.7	76.5	82.5	80.9	77.1	67.8	53.9	41.9
	MIN					66.4	73.6	79.9	79.6	72.8	61.6	47.7	37.5
	N	28.0	24.0	23.0	30.0	31.0	30.0	31.0	31.0	28.0	29.0	28.0	29.0
	MAX	38.4	41.7	46.8	63.8	75.5	80.5	83.3	84.4	82.2	75.8	64.4	50.0
1970	AVG	36.2	39.1	44.6	54.7	69.7	78.3	81.7	82.1	81.1	69.7	54.8	44.5
	MIN	34.7	36.7	41.2	48.0	64.6	75.7	80.0	80.4	79.2	65.5	46.5	39.2
	N	31.0	22.0	25.0	30.0	26.0	25.0	31.0	30.0	30.0	31.0	30.0	27.0
	MAX	40.4	39.3	45.6	60.8	68.8	82.2	83.1	80.6	79.3	75.3	69.3	49.8
1971	AVG	38.0	35.4	42.8	54.4	61.7	77.4	81.3	78.9	76.5	71.0	59.3	46.9
	MIN	33.5	32.2	39.6	45.7	58.7	71.3	78.4	76.8	71.1	68.9	50.3	44.7
	N	31.0	29.0		10.0	14.0	30.0	20.0	31.0	30.0	30.0	30.0	29.0
	MAX	50.0	45.6		49.6	70.6	77.1	81.8	82.4	80.8	74.1	59.9	43.5
1972	AVG	44.6	40.2		48.0	67.5	72.3	74.3	80.4	78.2	66.5	51.7	42.3
	MIN	39.9	37.9		46.8	63.2	62.9	63.2	77.8	75.2	60.0	43.7	40.3
	N	31.0	28.0	30.0	4.0	31.0	30.0	31.0	31.0	30.0	30.0	27.0	25.0
	MAX	43.1	42.1	54.8	58.2	66.0	80.9	82.9	83.4	85.3	78.0	64.1	52.9
1973	AVG	39.4	40.0	48.7	57.8	61.4	75.8	81.3	82.0	80.7	72.5	56.4	45.8
	MIN	36.9	38.2	40.1	57.6	56.1	66.5	76.0	80.4	77.2	66.0	52.6	39.7
	N	9.0	28.0	10.0	29.0	31.0	30.0	31.0	31.0	30.0	31.0	29.0	31.0
	MAX	44.6	47.7	51.2	62.7	70.1	75.1	81.3	84.2	80.0	69.6	62.6	47.3
1974	AVG	42.4	43.9	49.1	56.1	66.2	71.2	78.6	82.3	74.0	64.6	55.9	43.0
	MIN	40.8	41.9	44.7	49.8	63.0	67.7	70.0	81.1	70.3	60.8	48.1	41.6

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

11 OHIO RIVER AT LOUISVILLE MILE 600.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	28.0	27.0	7.0	25.0	31.0	30.0	30.0	31.0	30.0	31.0	30.0	28.0
	MAX	39.4	42.4	48.1	63.1	77.0	83.6	85.5	84.5	82.0	71.8	60.8	48.1
1964	AVG	37.5	40.4	45.0	57.5	70.6	79.1	82.5	82.0	77.8	64.6	57.0	44.5
	MIN	34.9	39.0	41.5	51.2	62.4	73.6	80.6	79.3	71.0	59.9	49.5	40.8
	N	31.0	28.0	31.0	20.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	47.2	42.7	45.1	59.3	76.1	79.2	83.2	83.2	79.0	71.7	59.1	47.8
1965	AVG	41.7	38.9	42.1	52.9	69.0	77.5	81.0	81.1	75.9	65.4	55.9	45.1
	MIN	36.2	33.8	41.0	46.2	58.2	74.7	78.8	79.4	72.3	59.3	48.9	42.2
	N	31.0	18.0	31.0	29.0	31.0	30.0	31.0	31.0	29.0	25.0	30.0	27.0
	MAX	47.9	42.1	51.5	61.9	71.9	84.9	87.2	84.2	82.1	68.7	57.8	46.5
1966	AVG	39.8	37.6	45.9	52.4	64.1	76.1	85.1	82.3	77.0	63.2	51.5	42.0
	MIN	32.2	32.4	39.2	47.9	59.5	69.8	83.0	80.2	70.1	58.4	47.6	35.9
	N	31.0	28.0	25.0	30.0	20.0	30.0	30.0	31.0	28.0	31.0	30.0	31.0
	MAX	43.1	43.4	56.6	64.5	69.6	81.4	83.3	82.0	75.5	69.7	57.6	44.3
1967	AVG	38.1	41.3	46.8	61.7	64.1	75.7	80.9	79.5	74.0	64.1	49.5	41.8
	MIN	35.3	37.6	36.9	55.5	60.1	65.5	78.6	76.7	67.2	57.7	43.7	37.9
	N	26.0	29.0	29.0	29.0	31.0	30.0	31.0	24.0	30.0	30.0	30.0	29.0
	MAX	38.4	40.6	49.8	63.3	66.9	78.0	84.9	85.4	80.9	74.3	62.2	49.0
1968	AVG	34.5	37.6	43.5	59.0	65.2	73.1	81.7	82.9	77.0	68.0	55.2	41.2
	MIN	32.3	35.1	36.7	53.4	62.5	63.6	77.7	80.9	74.1	59.1	49.8	36.0
	N	29.0	15.0	31.0	28.0	30.0	29.0	31.0	31.0	30.0	26.0	28.0	31.0
	MAX	41.5	42.5	48.8	59.7	72.8	80.0	85.3	82.3	82.0	73.1	59.7	45.7
1969	AVG	34.9	40.0	43.6	56.3	65.2	76.3	82.8	81.4	77.2	67.0	52.8	40.4
	MIN	32.1	38.4	38.2	49.4	58.5	72.4	80.5	79.6	72.6	59.8	45.5	35.1

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

11 OHIO RIVER AT LOUISVILLE MILE 600.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	26.0	24.0	31.0	23.0	29.0	30.0	29.0	31.0	27.0	31.0	30.0	30.0
	MAX	37.8	41.4	46.4	60.0	76.4	81.2	83.8	84.7	82.5	74.4	62.1	48.8
1970	AVG	35.1	39.2	44.3	52.7	70.2	78.6	81.9	83.1	80.2	68.0	53.6	45.4
	MIN	33.3	36.7	42.3	46.6	63.8	75.5	79.6	81.5	74.8	62.4	45.3	42.8
	N	21.0	24.0	28.0	30.0	31.0	30.0	31.0	30.0	30.0	31.0	30.0	27.0
	MAX	42.0	43.0	45.9	60.9	65.9	80.6	82.6	80.1	79.9	75.9	68.7	50.8
1971	AVG	40.0	40.1	44.0	53.8	62.0	74.7	80.9	78.6	76.5	71.2	59.7	48.1
	MIN	37.8	37.2	41.6	46.1	59.2	66.5	78.3	76.7	71.4	68.6	51.6	45.7
	N	31.0	29.0	31.0	28.0	31.0	30.0	31.0	31.0	30.0	30.0	30.0	31.0
	MAX	47.3	44.3	47.8	58.9	71.8	77.2	81.0	81.3	80.5	73.2	60.1	44.8
1972	AVG	42.7	39.6	45.0	54.1	64.3	73.1	73.5	80.1	77.3	65.6	51.9	43.1
	MIN	38.5	37.6	41.5	46.7	59.0	64.9	64.7	77.8	74.4	59.4	44.2	40.9
	N	31.0	24.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	30.0	30.0	22.0
	MAX	44.3	43.5	53.6	59.5	64.1	77.4	81.8	81.2	82.1	77.5	62.9	49.9
1973	AVG	40.9	40.1	49.0	54.1	60.2	73.2	79.4	80.3	79.0	71.1	55.7	44.3
	MIN	38.3	37.8	39.8	50.1	56.4	63.6	75.7	78.9	76.1	62.5	52.4	40.9
	N	31.0	28.0	19.0	30.0	27.0	30.0	31.0	31.0	30.0	31.0	25.0	28.0
	MAX	47.6	47.8	49.4	59.9	70.3	73.7	82.2	83.5	80.8	67.7	63.0	47.0
1974	AVG	43.7	44.2	48.3	55.3	65.8	71.2	77.6	82.0	72.2	63.7	54.2	41.5
	MIN	40.4	41.7	45.3	50.3	60.8	69.3	71.8	80.1	68.2	60.5	47.9	39.6

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

12 OHIO RIVER AT CANE RUN MILE 616.8

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N							24.0	27.0	30.0	17.0	23.0	30.0
	MAX							85.2	85.9	80.5	72.6	60.4	49.1
1965	AVG							83.1	82.6	76.7	66.2	57.9	46.9
	MIN							81.4	80.2	73.1	61.0	50.5	44.0
	N	11.0	9.0	29.0	25.0	20.0	30.0	31.0	31.0	30.0	31.0	30.0	30.0
	MAX	47.4	42.4	53.0	61.1	61.9	81.2	87.8	83.5	82.3	69.7	59.2	48.4
1966	AVG	45.0	40.6	47.7	53.6	60.6	75.4	85.4	81.7	77.1	64.7	53.4	44.0
	MIN	40.3	39.0	41.6	48.6	59.1	68.8	83.4	80.6	70.8	59.6	50.1	37.7
	N	25.0	14.0	7.0	29.0	27.0	29.0	30.0	30.0	28.0	31.0	30.0	30.0
	MAX	43.9	44.4	49.8	64.2	67.8	80.8	82.0	82.4	78.6	71.6	59.8	46.9
1967	AVG	40.3	42.6	47.9	60.2	61.4	76.1	80.8	80.3	75.7	65.9	52.3	43.6
	MIN	38.0	40.9	46.1	54.0	58.6	67.0	78.1	78.0	69.2	59.5	46.7	40.6
	N	30.0	29.0	29.0	28.0	31.0	30.0	31.0	31.0	30.0	31.0	29.0	31.0
	MAX	40.8	41.9	49.0	64.7	69.0	80.2	85.4	85.0	80.6	75.5	62.4	50.0
1968	AVG	37.2	39.0	43.8	58.2	66.0	73.4	82.8	82.8	77.1	69.2	56.1	42.5
	MIN	35.1	36.6	38.5	53.0	61.9	62.6	79.5	79.8	74.3	61.1	50.5	37.3
	N	30.0	26.0	31.0	30.0	27.0	29.0	31.0	31.0	30.0	31.0	29.0	31.0
	MAX	40.9	43.1	50.0	60.1	69.9	80.3	86.5	82.9	82.9	74.5	60.6	47.2
1969	AVG	36.1	41.1	45.8	56.3	65.4	76.2	83.7	81.8	78.1	68.4	53.7	42.5
	MIN	33.3	39.1	40.3	48.3	60.1	72.1	81.2	80.2	73.6	60.6	45.8	37.5
	N	15.0	27.0	29.0	27.0	30.0	30.0	31.0	29.0	28.0	28.0	30.0	31.0
	MAX	39.2	40.8	45.9	63.0	76.5	81.8	83.8	84.3	83.5	74.4	64.9	51.0
1970	AVG	37.3	38.0	44.4	54.2	69.5	78.9	82.3	83.4	81.5	69.6	54.5	45.8
	MIN	35.5	35.6	42.4	47.0	63.2	76.1	79.6	81.7	77.6	65.3	45.8	40.2

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

12 OHIO RIVER AT CANE RUN MILE 616.8

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	30.0	28.0	29.0	30.0	31.0	30.0	30.0	31.0	30.0	23.0
	MAX	41.3	41.0	48.1	62.4	68.5	82.1	83.9	83.3	81.4	76.7	70.8	50.9
1971	AVG	38.2	36.9	43.6	55.5	62.8	77.2	81.9	79.9	77.7	72.2	59.5	48.0
	MIN	34.3	33.1	40.1	47.1	58.6	69.3	78.8	77.4	71.6	69.3	51.2	45.0
	N	31.0	29.0	24.0	25.0	31.0	30.0	31.0	31.0	30.0	30.0	30.0	31.0
	MAX	46.9	43.5	47.9	58.6	72.3	78.1	82.4	82.3	81.5	74.2	61.1	44.6
1972	AVG	42.4	39.0	45.2	52.9	65.3	74.0	74.4	81.1	78.8	66.7	52.2	43.0
	MIN	38.1	37.4	43.6	46.5	59.1	65.4	64.8	79.0	74.6	60.2	44.2	40.8
	N	31.0	27.0	31.0	30.0	30.0	25.0	23.0	29.0	30.0	30.0	29.0	28.0
	MAX	44.5	42.2	55.7	59.3	65.5	80.6	83.0	84.2	85.0	78.4	63.9	53.2
1973	AVG	41.1	40.3	50.1	53.7	61.5	74.9	81.3	82.9	80.6	72.5	57.6	44.5
	MIN	38.8	38.3	42.1	49.8	56.4	65.2	78.9	81.0	77.0	64.2	53.3	39.6
	N	30.0	28.0	29.0	30.0	30.0	28.0	31.0	31.0	29.0	28.0	26.0	28.0
	MAX	46.8	47.1	52.9	61.9	71.7	74.8	82.5	83.9	80.4	67.7	62.7	46.8
1974	AVG	42.7	43.6	49.0	55.3	66.8	72.1	79.3	82.2	72.6	64.2	54.8	41.2
	MIN	39.0	41.4	43.7	49.2	62.9	69.7	72.2	80.0	68.6	61.2	47.7	38.8

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

15 OHIO RIVER AT EVANSVILLE MILE 791.5

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N										22.0	29.0	31.0
	MAX										69.5	59.2	49.7
1968	AVG										64.4	53.6	42.1
	MIN										55.6	50.1	38.0
	N	23.0	4.0	28.0	30.0	27.0	28.0	30.0	31.0	30.0	31.0	27.0	31.0
	MAX	37.9	42.2	50.5	61.2	75.2	81.1	87.9	83.8	83.6	73.8	56.4	43.9
1969	AVG	35.5	41.5	45.9	57.5	66.8	77.3	84.9	82.4	77.7	66.6	50.8	41.2
	MIN	32.9	41.1	40.2	49.9	60.8	73.0	81.7	80.6	72.9	57.5	45.2	37.0
	N	20.0	28.0	30.0	30.0	31.0	30.0	23.0	21.0	30.0	30.0	30.0	28.0
	MAX	38.9	41.0	45.8	64.2	76.5	82.1	84.0	84.6	83.5	73.0	62.7	51.2
1970	AVG	35.8	37.6	44.4	54.5	70.3	78.3	81.6	82.8	80.6	67.1	53.8	45.4
	MIN	33.5	34.5	42.0	47.0	63.7	74.2	78.1	81.1	75.0	62.8	44.4	40.8
	N	21.0	20.0	31.0	30.0	27.0	30.0	31.0	11.0	29.0	31.0	24.0	26.0
	MAX	39.7	44.7	47.0	63.5	67.6	83.4	85.3	80.3	81.5	76.7	68.7	49.0
1971	AVG	37.8	40.0	43.6	55.8	63.2	78.3	81.8	78.8	78.1	70.9	59.3	46.8
	MIN	36.0	34.3	41.5	45.7	59.8	68.9	77.7	77.5	73.9	67.2	50.5	44.5
	N	31.0	29.0	31.0	23.0	30.0	29.0	28.0	29.0	30.0	30.0	8.0	28.0
	MAX	46.4	41.6	46.9	59.4	71.8	79.5	83.3	85.5	82.9	74.8	61.5	44.5
1972	AVG	41.7	38.5	44.6	54.4	65.6	75.6	76.1	82.3	79.3	66.9	54.5	41.8
	MIN	37.0	36.7	42.2	46.2	59.8	69.7	66.7	79.6	73.8	59.9	44.9	38.8
	N	31.0	23.0	26.0	24.0	24.0	29.0	31.0	31.0	30.0	27.0	16.0	4.0
	MAX	43.2	43.1	54.1	56.6	67.1	80.1	83.3	85.7	85.1	75.5	60.9	41.9
1973	AVG	40.7	41.8	50.1	51.8	63.8	75.6	81.4	82.7	79.1	69.8	56.6	41.7
	MIN	37.9	39.9	43.3	49.4	59.1	66.6	78.8	79.7	73.9	59.0	51.6	41.5

ANNUAL SUMMARY OF ROBOT MONITOR TEMPERATURES
MONTHLY AVERAGES - DEGREE F.

15 OHIO RIVER AT EVANSVILLE MILE 791.5

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	23.0	18.0	10.0	29.0	24.0	30.0	25.0	26.0	17.0	1.0	26.0	14.0
	MAX	48.3	47.8	52.7	63.3	71.5	76.4	83.5	83.7	81.0	62.3	61.7	47.6
1974	AVG	44.4	45.0	50.6	56.7	66.5	72.9	80.0	82.2	74.7	62.3	55.1	43.6
	MIN	39.0	42.1	48.3	51.6	62.1	71.0	74.7	79.8	70.4	62.3	49.3	40.1

APPENDIX C

SUMMARY OF MONTHLY AIR TEMPERATURE

Monthly Average and Maximum-Minimum
Daily Average Dry Bulb Temperature

December 1975

INDEX

Dry Bulb Air Temperature

ANNUAL SUMMARY OF METEOROLOGICAL DATA
MONTHLY AVERAGES - DRY BULB TEMPERATURES

4623 PITTSBURGH, PA.

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	47.5	39.9	55.6	67.5	74.6	77.4	78.9	75.3	75.6	62.9	61.0	58.0
1964	AVG	31.3	27.7	39.8	51.7	63.3	68.5	71.9	67.1	63.4	50.2	45.6	34.7
	MIN	7.3	16.6	22.5	26.5	50.9	54.8	64.4	54.3	48.5	37.8	18.0	16.6
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	57.4	52.3	49.4	59.4	74.5	76.0	78.0	80.5	74.8	60.3	56.0	59.6
1965	AVG	20.6	28.9	35.2	48.8	66.1	67.0	69.8	68.5	64.6	48.3	41.5	37.5
	MIN	[illegible]	8.1	19.3	33.9	52.5	55.0	61.4	53.5	48.4	29.4	26.0	22.4
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	45.3	49.4	64.0	66.1	70.6	81.9	84.5	75.9	76.1	65.9	62.4	62.8
1966	AVG	23.3	30.5	40.7	47.6	56.6	71.2	75.4	70.9	61.3	50.7	42.7	31.3
	MIN	.4	12.3	22.4	35.4	36.1	50.3	66.5	60.8	49.5	35.9	27.5	10.3
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	56.1	51.1	64.6	68.6	68.0	80.1	79.1	76.1	70.3	68.4	58.3	55.8
1967	AVG	33.0	25.6	40.0	52.3	54.3	73.2	71.0	68.5	61.1	52.1	37.1	34.6
	MIN	11.0	7.3	13.8	36.5	45.6	62.1	60.1	59.9	46.6	37.8	23.6	17.6
	N	31.0	[illegible]	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	42.1	42.8	59.9	63.4	64.5	79.8	79.5	81.5	71.5	68.4	55.9	49.9
1968	AVG	24.2	22.9	40.4	51.6	54.2	67.5	72.3	71.5	64.1	51.7	41.2	26.1
	MIN	1.1	2.6	17.3	36.9	41.8	54.3	60.5	58.9	52.5	37.3	29.1	-3.0
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	53.0	57.4	54.5	66.1	76.0	83.5	78.8	74.4	73.6	70.6	57.4	37.9
1969	AVG	[illegible]	[illegible]	33.8	51.9	60.9	69.0	72.2	70.1	62.4	52.5	39.2	27.5
	MIN	[illegible]	14.4	15.1	38.0	43.3	52.5	65.0	62.8	50.5	33.0	19.6	14.5

ANNUAL SUMMARY OF METEOROLOGICAL DATA
MONTHLY AVERAGES - DRY BULB TEMPERATURES

4823 PITTSBURGH, PA.

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	44.3	42.6	47.1	75.4	76.8	77.5	81.6	76.0	78.3	67.1	55.4	51.0
1970	AVG	21.0	27.9	34.8	52.7	63.7	68.1	71.2	71.5	67.4	54.2	42.0	31.6
	MIN	-2.1	5.3	20.5	37.3	41.6	59.8	61.6	65.0	48.1	40.0	15.6	16.1
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	42.8	50.1	55.3	62.6	73.1	83.9	76.4	74.8	76.0	69.4	64.8	58.4
1971	AVG	23.8	30.5	34.2	46.6	57.2	71.0	70.4	69.5	67.7	58.9	40.5	38.8
	MIN	4.2	1.3	21.1	34.0	42.0	61.4	65.3	60.1	54.6	47.8	21.0	22.1
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	44.4	43.9	58.6	64.0	71.9	74.5	81.5	76.9	75.3	60.5	59.4	55.8
1972	AVG	29.4	25.9	35.9	48.3	61.9	63.8	70.7	70.1	65.0	48.6	39.2	36.7
	MIN	-2.1	8.1	19.5	24.3	48.6	50.9	57.0	60.6	50.9	33.0	26.6	15.1
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	46.3	46.0	61.5	69.1	66.9	79.1	80.8	82.5	80.9	66.4	62.5	54.1
1973	AVG	29.9	27.1	47.6	49.2	55.8	70.6	73.0	72.8	66.0	56.0	44.4	33.6
	MIN	13.0	5.8	28.5	32.3	40.6	63.4	62.9	62.1	50.9	40.8	29.3	18.5
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	3.0	
	MAX	54.8	47.5	64.4	72.6	71.0	73.0	81.1	76.1	72.9	65.8	30.4	
1974	AVG	34.3	30.1	40.9	52.1	58.5	64.9	73.1	72.3	61.8	52.2	27.0	
	MIN	14.4	16.9	22.4	30.3	41.8	57.6	66.6	65.3	47.1	36.3	21.0	

ANNUAL SUMMARY OF METEOROLOGICAL DATA
MONTHLY AVERAGES - DRY BULB TEMPERATURES

3860 HUNTINGTON, W.VA.

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	52.1	41.6	62.1	72.6	75.4	81.5	81.8	82.5	76.4	66.4	65.0	66.4
1964	AVG	34.2	32.1	45.8	57.7	66.5	71.8	75.5	73.1	65.7	51.9	47.8	40.0
	MIN	11.5	23.3	24.9	34.3	53.5	56.8	68.9	60.1	51.3	39.5	21.6	16.6
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	51.9	61.3	56.9	67.6	77.4	79.1	82.3	81.9	76.6	67.9	63.1	61.3
1965	AVG	34.0	36.2	40.6	55.9	68.9	71.5	73.8	72.2	68.4	53.6	47.5	41.2
	MIN	6.7	10.4	22.8	39.6	57.3	63.5	67.6	56.6	49.5	36.4	27.8	28.0
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	55.6	56.1	72.6	70.3	73.9	80.6	81.9	77.0	76.0	68.0	65.3	63.6
1966	AVG	27.0	34.1	45.9	52.4	61.7	72.6	75.4	71.4	64.6	53.3	47.0	36.0
	MIN	.7	17.8	23.3	38.0	41.6	56.4	68.6	62.9	54.6	41.6	30.6	19.6
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	62.9	60.0	68.9	71.8	75.3	80.9	78.8	76.3	70.8	70.4	57.9	63.3
1967	AVG	39.4	31.5	47.8	56.8	58.9	73.2	71.1	69.8	62.5	54.7	40.8	39.1
	MIN	17.1	7.4	22.0	43.3	48.3	56.4	63.3	61.4	43.8	38.6	28.4	19.3
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	53.6	54.4	65.9	67.6	70.3	81.3	82.5	83.0	72.6	70.8	67.0	51.8
1968	AVG	29.5	27.6	45.8	56.0	59.9	70.3	74.3	72.7	66.4	56.2	46.9	33.8
	MIN	7.3	11.5	24.6	42.1	46.5	57.9	65.1	59.3	60.5	42.3	29.1	18.6
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	59.0	44.0	60.1	71.3	73.0	85.3	86.0	80.3	76.1	70.9	60.5	42.8
1969	AVG	31.3	35.3	38.7	56.6	64.2	72.0	77.4	74.1	65.0	54.9	42.5	31.0
	MIN	11.8	22.5	23.4	42.1	46.4	58.9	70.5	68.6	53.3	36.4	24.6	22.1

ANNUAL SUMMARY OF METEOROLOGICAL DATA
MONTHLY AVERAGES - DRY BULB TEMPERATURES

3860 HUNTINGTON, W.VA.

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	52.3	49.8	56.8	74.9	75.6	81.5	83.6	78.8	78.8	72.0	60.0	60.8
1970	AVG	27.3	33.5	40.6	56.8	66.1	71.5	72.6	72.6	71.8	58.2	47.0	39.2
	MIN	2.0	10.7	25.1	39.1	46.5	63.0	60.9	66.8	51.9	42.8	17.3	18.3
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	53.9	59.1	61.9	67.4	74.4	80.1	77.9	78.0	75.8	73.3	67.1	65.6
1971	AVG	29.7	37.4	41.9	54.5	61.4	72.9	71.6	71.1	69.9	63.1	45.0	45.8
	MIN	11.5	7.1	26.0	42.5	45.9	63.5	62.9	65.5	60.5	51.9	26.9	22.4
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	57.8	55.1	65.0	72.5	71.3	77.0	82.3	77.8	76.4	61.0	66.0	59.4
1972	AVG	35.6	33.3	43.1	54.2	62.1	66.2	74.0	71.5	68.0	51.1	42.5	40.2
	MIN	.8	16.0	24.8	29.8	50.9	53.5	60.6	62.1	52.3	35.8	29.1	15.3
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	52.6	51.4	68.5	71.0	72.4	78.6	82.3	82.3	80.4	71.5	65.8	58.5
1973	AVG	34.1	34.1	52.4	51.9	60.9	73.3	75.5	74.9	70.2	60.7	48.4	37.8
	MIN	17.0	13.5	32.8	34.1	50.8	64.5	68.3	65.1	55.9	43.5	31.1	20.0
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	2.0	
	MAX	60.1	53.4	70.0	73.9	76.1	78.9	78.9	75.3	75.1	68.9	52.5	
1974	AVG	41.9	37.1	49.3	58.5	64.2	68.0	74.6	72.8	62.9	53.0	51.5	
	MIN	24.8	21.1	30.5	36.0	47.5	58.1	70.6	66.5	47.8	36.9	50.4	

ANNUAL SUMMARY OF METEOROLOGICAL DATA
MONTHLY AVERAGES - DRY BULB TEMPERATURES

3814 CINCINNATI, OHIO

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	50.8	40.4	60.3	71.3	77.8	81.8	80.9	87.9	77.1	67.0	64.4	62.9
1964	AVG	32.4	30.3	42.3	56.1	66.5	72.4	73.9	73.4	67.0	51.9	47.3	36.5
	MIN	8.5	21.0	25.4	33.4	54.6	53.6	64.9	58.4	51.5	40.1	18.5	10.1
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	62.6	59.1	56.3	65.5	73.8	77.8	83.9	80.9	76.4	68.4	59.6	59.0
1965	AVG	31.5	32.8	36.9	53.1	67.5	71.1	73.0	71.5	66.9	53.3	44.4	38.4
	MIN	4.3	4.0	20.3	34.6	52.4	63.8	65.1	56.3	48.3	36.3	24.4	26.0
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	[illegible]	31.0
	MAX	50.0	51.9	68.5	67.4	73.1	82.9	84.5	79.3	80.4	64.6	62.5	62.6
1966	AVG	24.1	31.5	42.6	50.1	61.1	73.3	78.4	74.2	66.0	50.6	44.7	33.4
	MIN	-3.5	12.1	22.4	33.9	41.4	57.4	69.6	66.3	49.1	38.1	26.9	15.9
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	[illegible]	31.0
	MAX	61.4	53.1	63.9	70.0	74.8	81.3	80.1	78.4	75.5	69.5	57.4	61.1
1967	AVG	35.4	27.5	44.5	55.4	60.3	73.1	73.0	70.6	64.9	55.5	[illegible]	37.4
	MIN	12.4	4.1	23.6	40.3	49.9	59.6	63.8	63.0	47.3	39.6	27.0	17.9
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	[illegible]	31.0
	MAX	50.6	54.9	64.9	67.5	73.0	82.1	80.8	83.0	74.5	70.6	[illegible]	48.3
1968	AVG	27.0	[illegible]	45.3	55.5	60.8	73.1	74.8	74.9	66.7	55.5	[illegible]	33.4
	MIN	4.3	9.6	24.4	39.4	49.0	59.3	64.3	62.6	58.9	40.4	26.3	18.9
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	[illegible]	31.0
	MAX	33.3	40.8	56.9	68.9	74.8	83.5	85.0	78.0	76.4	73.3	[illegible]	40.5
1969	AVG	27.7	33.3	37.1	55.3	64.7	71.7	76.7	73.7	65.4	55.8	40.4	30.9
	MIN	9.5	23.8	22.3	43.1	47.0	56.5	68.6	68.5	55.5	35.8	26.3	22.1

ANNUAL SUMMARY OF METEOROLOGICAL DATA
MONTHLY AVERAGES - DRY BULB TEMPERATURES

3814 CINCINNATI, OHIO

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	51.8	43.8	54.8	75.8	77.8	82.3	85.5	82.9	80.5	70.5	59.5	63.4
1970	AVG	24.5	30.4	38.6	56.5	67.0	72.3	75.1	74.5	72.6	58.3	44.9	38.2
	MIN	-.6	10.0	23.3	40.9	49.3	62.3	63.8	68.6	53.8	43.1	17.3	21.1
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	44.1	54.5	59.0	66.3	73.5	85.9	82.0	78.4	78.0	70.6	65.6	59.3
1971	AVG	28.3	33.7	40.3	53.6	61.4	75.6	74.3	72.1	69.5	60.7	42.9	41.3
	MIN	9.0	7.0	26.4	40.3	49.4	65.6	66.3	66.0	56.0	47.0	23.8	20.6
	N	30.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	48.8	49.5	61.8	70.9	74.6	75.3	83.0	82.0	76.8	62.3	62.4	55.4
1972	AVG	31.5	29.1	39.9	52.3	63.4	65.8	74.8	72.7	68.0	51.8	4[illegible]	35.8
	MIN	-2.4	10.4	24.9	26.8	47.0	52.9	63.5	63.1	48.0	38.3	28.1	12.1
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	51.3	46.5	64.9	69.9	65.9	76.6	79.0	80.1	79.5	68.5	62.4	56.0
1973	AVG	31.6	32.4	50.2	50.9	58.5	72.0	74.2	72.8	68.8	58.1	46.0	33.7
	MIN	13.0	13.0	33.8	32.3	46.5	63.0	67.8	64.1	52.8	41.4	28.5	17.9
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	3.0	
	MAX	56.4	51.0	67.1	72.1	74.4	77.9	79.6	77.5	73.6	67.9	39.6	
1974	AVG	35.8	33.5	45.7	54.[illegible]	62.1	68.0	74.8	73.7	61.6	52.7	31.6	
	MIN	14.6	16.5	19.8	35.9	47.1	59.4	69.3	66.6	48.0	36.8	26.2	

ANNUAL SUMMARY OF METEOROLOGICAL DATA
MONTHLY AVERAGES - DRY BULB TEMPERATURES

3821 LOUISVILLE, KY.

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	29.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	54.5	44.0	62.3	71.3	77.1	83.9	83.5	88.6	78.9	65.8	67.4	64.3
1964	AVG	36.3	33.3	45.3	57.1	67.6	75.5	76.2	76.1	69.1	53.3	48.5	39.0
	MIN	15.0	23.6	29.3	39.8	54.6	59.9	65.3	61.3	53.4	42.0	21.0	13.1
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	63.6	50.8	55.6	73.4	77.1	79.5	88.5	82.3	79.9	69.8	63.4	64.0
1965	AVG	34.7	36.2	39.2	58.6	70.3	73.4	76.3	75.2	70.4	55.3	47.9	42.4
	MIN	6.3	8.1	24.6	41.0	56.4	66.4	68.0	63.3	50.4	41.5	28.4	30.0
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	56.0	55.1	71.1	68.8	75.0	82.5	89.8	80.4	77.9	68.1	65.5	64.0
1966	AVG	27.6	34.3	46.6	53.4	63.0	73.6	80.8	75.3	67.2	54.7	47.2	35.3
	MIN	-.9	13.4	25.6	40.1	44.8	60.5	73.3	66.6	55.3	43.5	30.8	19.8
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	62.3	54.0	68.0	75.3	77.3	81.8	81.3	79.4	75.9	69.5	57.9	61.9
1967	AVG	36.8	30.8	50.4	60.1	63.0	73.6	73.9	71.8	65.5	56.9	43.3	40.0
	MIN	13.3	10.6	27.6	46.4	50.9	57.3	64.5	64.1	47.5	41.4	32.1	22.3
	N	31.0	29.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	52.8	57.3	62.0	69.8	76.6	83.0	83.0	85.4	75.4	72.5	67.9	51.8
1968	AVG	30.6	29.9	46.3	57.1	63.6	74.7	76.8	77.5	68.5	57.2	46.0	35.7
	MIN	6.6	15.4	27.5	40.0	51.4	59.9	67.0	63.0	61.6	43.4	31.8	22.0
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	54.4	44.9	60.5	70.5	74.1	84.6	85.1	80.3	77.6	74.0	56.5	42.1
1969	AVG	32.5	36.8	39.9	58.2	66.0	73.6	78.5	74.5	67.0	57.1	42.9	33.8
	MIN	10.4	27.4	25.5	47.3	51.4	60.1	72.5	68.1	56.7	38.5	27.4	25.0

ANNUAL SUMMARY OF METEOROLOGICAL DATA
MONTHLY AVERAGES - DRY BULB TEMPERATURES

3821 LOUISVILLE, KY.

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	56.8	44.6	55.6	77.0	76.4	82.3	86.5	81.4	79.3	69.5	60.5	63.8
1970	AVG	28.1	33.5	41.6	57.1	67.8	72.8	75.8	75.2	72.6	57.8	45.6	39.7
	MIN	2.7	12.3	29.0	43.9	51.6	64.4	66.0	68.1	55.3	45.1	17.6	23.6
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	47.4	55.3	58.3	67.0	71.8	85.8	81.8	80.6	78.8	75.3	67.3	62.5
1971	AVG	30.7	35.2	41.9	55.2	61.7	76.3	74.5	74.1	71.4	63.8	46.7	45.4
	MIN	11.1	8.3	28.4	39.1	50.5	67.3	64.6	68.1	58.3	51.0	26.3	24.3
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	55.8	55.4	66.5	74.3	73.6	80.1	84.0	83.6	80.0	68.4	66.4	57.5
1972	AVG	35.1	33.9	44.3	56.1	65.9	70.8	76.7	75.8	71.7	55.5	44.0	38.6
	MIN	5.4	15.9	27.9	32.1	53.6	60.0	65.0	67.3	51.3	40.8	32.6	16.1
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	[illegible]	31.0
	MAX	53.1	49.5	66.1	72.5	67.8	80.9	83.4	83.0	82.4	73.6	66.0	59.1
1973	AVG	34.8	35.9	53.5	54.2	61.6	75.4	77.7	76.6	72.8	61.7	49.1	37.1
	MIN	16.4	16.9	36.5	33.0	51.1	67.3	70.9	67.9	58.5	44.4	31.8	20.5
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	[illegible]	
	MAX	60.3	56.3	71.3	73.6	76.5	79.6	81.0	78.5	76.0	67.1	46.9	
1974	AVG	40.0	39.0	49.7	57.0	65.2	68.8	75.6	74.0	63.2	54.8	36.5	
	MIN	19.8	22.6	25.5	33.9	50.1	61.0	69.5	67.6	49.0	40.0	26.2	

ANNUAL SUMMARY OF METEOROLOGICAL DATA
MONTHLY AVERAGES - DRY BULB TEMPERATURES

3817 EVANSVILLE, IND.

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	57.9	42.4	62.8	72.4	77.0	84.1	83.4	89.9	78.6	66.1	66.9	56.6
1964	AVG	35.2	33.2	45.8	60.1	68.2	75.8	77.3	75.7	67.7	52.3	47.6	36.6
	MIN	13.3	22.3	31.1	35.6	56.0	62.5	67.5	61.1	53.9	38.8	13.1	12.1
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	63.1	56.9	54.6	74.3	78.5	84.3	87.0	81.8	79.3	67.9	63.6	61.4
1965	AVG	33.0	34.0	37.2	57.9	70.5	73.9	76.4	74.6	69.5	55.4	46.5	41.4
	MIN	-.8	4.0	20.5	40.0	55.5	67.6	67.4	60.8	52.0	41.9	26.0	29.1
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	53.3	55.8	70.5	67.8	74.4	83.0	91.4	77.4	76.3	71.5	65.0	62.8
1966	AVG	26.6	33.6	46.4	53.2	62.2	73.9	81.4	73.8	65.1	53.4	46.2	34.6
	MIN	1.6	9.0	25.3	39.8	44.8	59.5	70.9	64.9	53.6	43.9	31.6	19.8
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	62.7	55.9	68.8	72.7	77.6	80.8	81.3	77.9	76.8	72.0	56.9	59.6
1967	AVG	30.8	31.8	48.6	59.8	62.3	73.5	72.9	69.8	65.5	56.7	42.1	38.3
	MIN	13.6	6.0	26.3	44.5	49.5	59.6	64.6	60.4	46.8	40.4	25.9	20.9
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	52.7	58.6	67.8	72.8	77.4	83.1	82.9	84.5	75.3	74.4	64.5	50.8
1968	AVG	29.1	30.4	46.2	57.0	63.5	75.1	77.1	77.0	67.9	56.9	45.9	34.2
	MIN	1.5	16.6	26.1	39.1	52.0	59.8	66.3	63.9	61.8	41.9	30.9	19.8
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	52.5	43.9	59.1	67.3	78.1	85.5	85.6	79.5	77.5	74.1	54.5	40.9
1969	AVG	31.6	36.4	38.5	56.7	65.1	74.3	78.5	73.7	67.2	56.2	41.5	31.9
	MIN	9.9	26.5	24.5	45.6	49.1	60.5	70.1	69.0	56.9	37.9	24.4	18.4

ANNUAL SUMMARY OF METEOROLOGICAL DATA
MONTHLY AVERAGES - DRY BULB TEMPERATURES

3817 EVANSVILLE, IND.

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	56.9	46.3	56.5	78.6	77.6	82.6	85.4	82.6	81.0	69.6	63.8	63.3
1970	AVG	24.8	32.8	41.4	58.5	69.0	72.0	75.2	74.8	72.8	56.6	44.5	38.1
	MIN	1.6	6.6	30.0	42.5	51.7	61.9	64.0	67.8	54.6	43.0	16.3	24.0
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	44.0	55.1	61.5	71.4	74.7	88.0	86.8	81.6	81.8	74.0	64.6	60.5
1971	AVG	27.3	34.2	42.2	56.6	61.9	79.4	77.1	76.1	71.8	63.0	45.6	42.6
	MIN	12.5	7.8	25.3	35.0	52.0	68.9	65.9	68.5	56.5	50.6	27.0	23.5
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	53.3	53.4	67.1	72.7	74.9	81.9	82.3	80.9	80.1	66.8	67.3	54.5
1972	AVG	32.7	33.2	44.4	58.7	66.2	72.1	75.5	73.9	70.0	53.7	41.7	34.1
	MIN	1.8	16.9	27.7	33.1	54.0	57.6	63.4	63.6	48.6	38.8	27.0	11.8
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
	MAX	50.9	52.4	65.8	71.7	70.4	81.6	83.8	82.8	81.8	73.0	67.1	58.9
1973	AVG	32.5	34.7	53.7	55.4	62.8	76.0	78.8	77.2	72.5	61.3	49.7	34.6
	MIN	15.5	17.3	37.1	33.4	53.6	67.6	71.9	69.8	58.3	44.1	29.4	7.1
	N	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	3.0	
	MAX	61.3	57.3	71.0	73.5	80.6	80.6	85.3	77.0	76.4	69.1	49.0	
1974	AVG	37.6	40.0	50.0	57.4	67.8	71.2	79.2	73.7	63.1	55.9	40.3	
	MIN	16.1	21.8	17.5	40.0	52.5	62.8	72.0	67.1	48.5	40.6	33.7	

APPENDIX D

SUMMARY OF OHIO RIVER FLOW

Monthly Average and Maximum-
Minimum Daily Flow

December 1975

INDEX

Ohio River Flows

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

860 OHIO RIVER AT SEWICKLEY, PENN.

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	92000.	44000.	276000.	109000.	72800.	33000.	24500.	20800.	8070.	11000.	27600.	87600.
1964	AVG	39477.	22190.	108452.	70817.	24608.	13941.	8694.	9779.	4442.	5326.	8571.	40761.
	MIN	8800.	13200.	12500.	30000.	8100.	7820.	4840.	5400.	3200.	4110.	3410.	15600.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	109000.	107000.	92800.	79000.	40400.	19300.	6740.	5480.	13500.	14200.	41000.	32500.
1965	AVG	60377.	50418.	58277.	60247.	22259.	8822.	4618.	3977.	5931.	8194.	20513.	21384.
	MIN	20000.	19000.	35400.	39700.	9220.	5160.	3690.	2780.	3550.	5160.	5700.	13300.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	72700.	236000.	73800.	92800.	128000.	17400.	5760.	8510.	11200.	16300.	35500.	95300.
1966	AVG	27964.	61123.	47394.	45367.	49671.	8840.	3892.	5189.	5556.	7427.	15303.	39697.
	MIN	5600.	5550.	29000.	22700.	11900.	4720.	3120.	3080.	3620.	4080.	4880.	14200.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	34500.	59800.	203000.	72600.	127000.	26700.	29500.	26000.	49300.	41700.	63200.	66800.
1967	AVG	17005.	30993.	91416.	46530.	65035.	10999.	13844.	13866.	12247.	30461.	35363.	40797.
	MIN	7080.	15200.	19700.	27600.	17700.	7120.	6760.	7560.	6150.	8650.	20700.	22500.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	142000.	125000.	79400.	61200.	161000.	71600.	13100.	10600.	10300.	14800.	53400.	120000.
1968	AVG	31271.	41728.	45399.	29047.	52790.	23390.	8479.	8252.	7144.	7855.	26687.	41942.
	MIN	19400.	11000.	7020.	11400.	12000.	10700.	5160.	6040.	5560.	5480.	8300.	22400.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	114000.	120000.	49600.	104000.	57200.	12800.	34200.	50700.	14200.	13200.	36500.	103800.
1969	AVG	40445.	41168.	18666.	53263.	31052.	9850.	17565.	15306.	7652.	10216.	19070.	39142.
	MIN	17500.	13700.	7500.	30100.	15300.	7700.	8000.	6700.	5800.	8500.	9500.	16800.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

107 OHIO RIVER AT SOUTH HEIGHTS MILE 16.0

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	98000.	47000.	235000.	120000.	80000.	34000.	25000.	21000.	9000.	12000.	30000.	100000.
1964	AVG	40484.	23103.	103871.	74700.	25129.	15033.	9387.	10903.	4800.	5613.	9900.	43065.
	MIN	10000.	14000.	12000.	32000.	9000.	9000.	6000.	2000.	3000.	4000.	5000.	17000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	115000.	113000.	100000.	85000.	40000.	20000.	7000.	6000.	12000.	15000.	44000.	33000.
1965	AVG	63677.	52571.	61097.	62667.	22839.	9233.	5226.	4677.	6267.	8742.	20833.	22194.
	MIN	20000.	19000.	35000.	40000.	10000.	5000.	4000.	4000.	5000.	5000.	7000.	15000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	80000.	250000.	77000.	97000.	135000.	20000.	10000.	9000.	15000.	20000.	38000.	108000.
1966	AVG	28387.	65571.	49581.	46900.	52484.	9800.	4613.	5629.	6617.	8597.	16320.	42742.
	MIN	6000.	6000.	30000.	24000.	14000.	5000.	4000.	4000.	4000.	4500.	5000.	17000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	33000.	68000.	201000.	82000.	131000.	30000.	33000.	26000.	44000.	44000.	72000.	69000.
1967	AVG	18452.	33679.	94323.	49033.	68613.	12630.	15452.	14871.	12933.	32097.	38100.	43806.
	MIN	8000.	17000.	21000.	25000.	18000.	7000.	7000.	7000.	8000.	10000.	22000.	22000.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	131000.	128000.	83000.	73000.	170000.	84000.	14000.	14000.	12000.	18000.	62000.	123000.
1968	AVG	33355.	46310.	48452.	32067.	58419.	23267.	9742.	9935.	8533.	9210.	29167.	44948.
	MIN	22000.	12000.	9000.	11000.	14000.	11000.	6000.	7000.	7000.	7000.	9000.	22000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	105000.	120000.	51000.	106000.	60000.	16000.	42000.	52000.	16500.	13200.	36500.	103800.
1969	AVG	43419.	44250.	19971.	54283.	32606.	11310.	19600.	17219.	9777.	10216.	19070.	39142.
	MIN	20000.	13000.	8100.	29800.	17000.	9000.	9700.	9300.	7400.	8500.	9500.	16800.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

107 OHIO RIVER AT SOUTH HEIGHTS MILE 16.0

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	102805.	101805.	100900.	204100.	59100.	41600.	32600.	32100.	21900.	43300.	82000.	117400.
1970	AVG	38043.	57632.	51226.	79677.	32803.	19000.	16897.	15065.	16563.	27100.	51063.	64342.
	MIN	18300.	34300.	27700.	40100.	18200.	11600.	10500.	9000.	10600.	14200.	33900.	41800.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	122200.	133000.	113800.	42700.	96200.	29600.	14200.	33000.	113500.	23000.	51100.	109000.
1971	AVG	45890.	67529.	72806.	30417.	40048.	17267.	9848.	14090.	29177.	12361.	16857.	53739.
	MIN	20700.	17500.	40100.	17600.	13900.	9700.	7600.	7700.	8000.	7600.	10600.	27100.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	77300.	95000.	176000.	127200.	61300.	355200.	137500.	17400.	24600.	41400.	82500.	156800.
1972	AVG	56371.	40831.	100768.	76793.	37603.	70907.	53335.	12752.	12607.	20239.	54957.	89968.
	MIN	32500.	19100.	45500.	31000.	13300.	12000.	11600.	10400.	8400.	12100.	20000.	42100.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	58700.	86900.	112300.	106700.	78000.	43500.	14200.	21100.	18600.	36700.	80000.	119200.
1973	AVG	35855.	44811.	62577.	58450.	49316.	26690.	10406.	12277.	8607.	15787.	34667.	54048.
	MIN	17900.	23400.	28900.	25900.	29400.	14200.	6900.	6500.	5900.	8900.	18600.	24000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	14.	
	MAX	157200.	56500.	113800.	88400.	114600.	105000.	72800.	24800.	48300.	21300.	24000.	
1974	AVG	75697.	39600.	61529.	55340.	42281.	36690.	21755.	9161.	23073.	13258.	16700.	
	MIN	42400.	30300.	38200.	24100.	21000.	11600.	7600.	5100.	13100.	9100.	10400.	

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

104 OHIO RIVER AT STRATTON MILE 55.0

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	112000.	50000.	292000.	139000.	99000.	35000.	29000.	23000.	9000.	14000.	31000.	105000.
1964	AVG	43726.	24817.	116645.	81550.	29477.	16513.	10990.	12565.	5820.	6535.	10083.	45368.
	MIN	11000.	15000.	12500.	5000.	10400.	10200.	6000.	7500.	3900.	5000.	5500.	18000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	138000.	122000.	115000.	90000.	44000.	23500.	8000.	7200.	16500.	16500.	50000.	36500.
1965	AVG	71806.	59054.	70419.	66100.	24494.	10653.	6123.	5635.	7547.	10258.	23627.	24652.
	MIN	24000.	23000.	41000.	41000.	13000.	5900.	5400.	4500.	5000.	6000.	8000.	16500.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	90000.	256000.	81800.	109000.	148000.	20000.	70000.	11000.	15500.	22000.	42500.	113000.
1966	AVG	34465.	69414.	53513.	51697.	57694.	10977.	7648.	6935.	7323.	9648.	18350.	46187.
	MIN	6600.	6800.	34000.	26000.	15600.	6000.	4900.	5000.	4500.	5400.	6000.	18600.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	36500.	76000.	213000.	90000.	150000.	31000.	34000.	27000.	66000.	46200.	71000.	73000.
1967	AVG	20065.	37704.	103048.	53897.	74710.	13820.	16813.	16152.	15540.	33819.	38997.	47590.
	MIN	9200.	19000.	23000.	32000.	20500.	8500.	8400.	8500.	9400.	11200.	23800.	25000.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	153000.	160000.	95000.	78000.	118000.	95000.	15600.	15000.	15000.	20000.	68000.	140000.
1968	AVG	36994.	50824.	52919.	35357.	60584.	28847.	10968.	11110.	9613.	10800.	32187.	50806.
	MIN	23500.	13400.	10200.	14000.	15800.	12500.	7200.	7400.	7000.	8000.	10000.	27000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	125000.	142000.	55500.	125000.	69000.	19000.	45000.	49000.	18000.	14300.	40500.	108700.
1969	AVG	49003.	48850.	22139.	60373.	38097.	13677.	23516.	19397.	11197.	11594.	21590.	42239.
	MIN	20300.	18900.	9500.	35000.	19500.	11000.	11600.	11200.	8700.	9500.	10700.	19600.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

104 OHIO RIVER AT STRATTON MILE 55.0

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	114905.	119305.	119300.	218100.	60900.	45500.	33200.	39700.	22900.	53200.	89100.	123500.
1970	AVG	41137.	64964.	57339.	85797.	36535.	22140.	19106.	17748.	18213.	30426.	57463.	70848.
	MIN	19600.	38005.	31600.	43100.	21100.	13200.	12500.	10700.	12100.	16000.	38800.	47400.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	131800.	162400.	129700.	100000.	102100.	33600.	15200.	33200.	105900.	25900.	48300.	121700.
1971	AVG	49513.	77125.	81029.	35613.	43542.	20263.	11590.	15661.	30367.	13797.	17923.	58787.
	MIN	23300.	21000.	44600.	20400.	16300.	11400.	9200.	9100.	9400.	9200.	11500.	31500.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	83600.	95700.	183600.	145100.	64800.	365200.	142100.	18900.	35300.	46900.	91600.	169400.
1972	AVG	60461.	44086.	109752.	84510.	41487.	75517.	58855.	14832.	15650.	22474.	62053.	99529.
	MIN	34000.	21200.	49600.	37500.	15100.	14400.	14100.	12300.	10100.	13500.	20700.	49600.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	68900.	102500.	128700.	125800.	94000.	54900.	17500.	27000.	24700.	46500.	88700.	132700.
1973	AVG	40990.	50196.	73374.	68507.	57968.	31680.	12232.	14345.	10143.	18000.	39243.	60087.
	MIN	20300.	25600.	32100.	31200.	36100.	16200.	8100.	7200.	6800.	10000.	21000.	26500.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	14.	
	MAX	161400.	66700.	142100.	102800.	137600.	101300.	97800.	33700.	63300.	23700.	30700.	
1974	AVG	85729.	45943.	72761.	65133.	50539.	40063.	26281.	11781.	27627.	15426.	20557.	
	MIN	46400.	33700.	44400.	27500.	25200.	14000.	9600.	6700.	15400.	11200.	11800.	

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

109 OHIO RIVER AT DAM 15 MILE 126.9

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	116000.	154000.	56000.	130000.	75000.	21000.	53000.	50000.	18200.	14200.	43800.	99100.
1969	AVG	49484.	51832.	23368.	62783.	41145.	14720.	26132.	20116.	11330.	11326.	22657.	43597.
	MIN	22000.	18000.	10000.	39000.	21300.	12000.	13000.	11900.	8900.	9200.	10500.	20900.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	129405.	127005.	124100.	222100.	59400.	46000.	32700.	45100.	23500.	75000.	91500.	132800.
1970	AVG	43760.	70378.	60871.	91683.	39419.	23623.	19681.	19226.	18727.	32223.	61430.	75861.
	MIN	20700.	40805.	30100.	45900.	23800.	13500.	13000.	10900.	12700.	16100.	41600.	50700.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	138300.	180800.	139100.	48400.	115300.	40400.	17400.	35300.	94000.	27900.	45300.	127000.
1971	AVG	53271.	84489.	87752.	35293.	47823.	21920.	12116.	16255.	31867.	14316.	18073.	61419.
	MIN	25400.	23300.	49100.	21600.	17300.	11600.	9500.	9300.	9600.	9400.	11500.	34800.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	89500.	92000.	205800.	161700.	66200.	329200.	145800.	23300.	34500.	47900.	92600.	179600.
1972	AVG	63748.	47417.	117500.	90997.	44719.	75860.	62432.	16777.	15747.	22597.	62463.	104865.
	MIN	35500.	22700.	59700.	41000.	16200.	15100.	15000.	12900.	9400.	13500.	20200.	51500.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	74100.	106400.	135400.	138900.	101000.	59400.	19500.	28500.	20800.	48900.	91500.	126800.
1973	AVG	44394.	54204.	77548.	74660.	63661.	34457.	12855.	14352.	10023.	18290.	41983.	61381.
	MIN	20800.	29300.	34000.	36800.	39100.	17500.	8200.	7200.	6500.	9800.	22100.	27800.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	14.	
	MAX	160400.	77400.	144100.	112700.	150700.	97800.	88800.	42800.	76000.	27300.	34400.	
1974	AVG	91681.	50607.	77645.	72157.	54103.	44347.	28523.	12387.	31497.	16268.	21243.	
	MIN	50100.	36100.	47500.	32000.	28700.	15000.	10200.	6900.	15700.	11600.	12000.	

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

1150 OHIO RIVER AT SAINT MARYS, WEST VIRGINIA

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	103000.	61200.	374000.	143000.	108000.	53900.	29200.	23400.	8210.	12800.	28500.	106000.
1964	AVG	44212.	28072.	139406.	91843.	33138.	18700.	11613.	12084.	5306.	6185.	10086.	49494.
	MIN	9460.	15100.	15700.	38200.	8420.	8890.	7110.	6150.	3940.	4850.	4050.	15700.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	149000.	128000.	120000.	103000.	58200.	21400.	8080.	7160.	20300.	23000.	46900.	39500.
1965	AVG	80577.	69339.	78887.	76323.	26258.	10743.	5901.	5031.	8437.	11898.	23672.	24523.
	MIN	24300.	25600.	45400.	52800.	12900.	6510.	4680.	3990.	5490.	5960.	7710.	14900.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	97900.	291000.	84700.	124000.	150000.	17200.	9500.	10900.	12000.	17100.	37100.	106000.
1966	AVG	37506.	83096.	56235.	56473.	64571.	10547.	5707.	6254.	6373.	8117.	17058.	45729.
	MIN	9280.	11200.	34200.	27000.	15800.	6310.	3950.	3960.	4660.	5490.	6100.	16300.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	36600.	76300.	252000.	93200.	164000.	30100.	29500.	26200.	46200.	46100.	69500.	74100.
1967	AVG	18414.	38346.	116119.	59280.	83965.	13413.	14470.	14001.	12407.	30158.	38370.	46839.
	MIN	6450.	19200.	22900.	31900.	15400.	8150.	7850.	7340.	7770.	5930.	21300.	26300.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	160000.	180000.	109000.	78800.	180000.	100000.	17200.	18300.	15900.	17200.	59100.	147000.
1968	AVG	35374.	61355.	56671.	36660.	71887.	30403.	10913.	10733.	8789.	9732.	31083.	48958.
	MIN	20100.	12600.	7710.	11700.	13600.	13800.	7150.	7450.	6970.	7200.	11000.	23800.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	102000.	149000.	60000.	110000.	82300.	21000.	39600.	53900.	18200.	14200.	44000.	109800.
1969	AVG	46561.	52979.	24245.	62300.	40839.	15163.	24448.	20274.	11300.	11348.	23073.	45587.
	MIN	19600.	18000.	11000.	35000.	20100.	12000.	14100.	11900.	8900.	9200.	10500.	21200.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

115 OHIO RIVER AT WILLOW ISLAND MILE 160.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	159900.	179900.	108900.	78700.	179900.	99900.	17200.	18300.	15800.	17200.	68000.	151000.
1968	AVG	35274.	61259.	56574.	36560.	71800.	30330.	10887.	10713.	8743.	9732.	33167.	53606.
	MIN	20000.	12500.	7700.	11600.	13500.	13700.	7100.	7400.	6900.	7200.	11000.	30000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	118000.	147000.	58000.	123000.	86000.	21000.	55000.	50000.	18200.	14200.	44000.	109800.
1969	AVG	51713.	54511.	24181.	65103.	42961.	15163.	27165.	20574.	11337.	11348.	23073.	45587.
	MIN	23000.	18000.	11000.	40000.	21800.	12000.	14100.	11900.	8900.	9200.	10500.	21200.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	136605.	131205.	123500.	238300.	62100.	46100.	32900.	46200.	25000.	92900.	111600.	135300.
1970	AVG	45827.	74578.	64729.	95947.	41123.	23993.	20119.	20465.	19280.	33226.	64510.	79332.
	MIN	22200.	42605.	34500.	47700.	25200.	13600.	13100.	11000.	13200.	16300.	43400.	53000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	133500.	193700.	141200.	55000.	114900.	45700.	21600.	41900.	87700.	28300.	48700.	123900.
1971	AVG	56745.	89107.	93377.	36353.	50458.	22800.	12565.	17071.	33107.	14455.	18510.	64116.
	MIN	26900.	24400.	51000.	21900.	17500.	11800.	9600.	9400.	9600.	9500.	11600.	35500.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	92100.	89800.	196500.	160800.	66700.	290000.	158000.	24400.	35800.	50200.	89700.	187000.
1972	AVG	66932.	50876.	121513.	95907.	46539.	69417.	67006.	16590.	16100.	23055.	64647.	109139.
	MIN	36200.	23900.	68400.	43100.	16600.	15300.	15700.	13000.	10300.	14000.	21400.	53000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	75700.	104500.	137700.	141600.	126700.	64000.	22600.	29000.	23400.	48500.	93900.	120600.
1973	AVG	47597.	57125.	80229.	77653.	68416.	35977.	13339.	14635.	10220.	18468.	43757.	62200.
	MIN	21500.	30500.	36000.	39300.	40600.	17600.	8400.	7300.	6900.	10000.	22400.	28200.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

115 OHIO RIVER AT WILLOW ISLAND MILE 160.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	14.	
	MAX	166500.	87500.	138300.	115200.	141900.	100100.	85600.	46700.	82500.	28400.	35000.	
1974	AVG	96671.	54171.	79932.	75067.	56277.	47267.	28984.	12829.	33427.	16426.	21436.	
	MIN	56500.	37300.	48400.	32700.	29000.	15300.	10400.	7200.	16200.	11800.	12000.	

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

1510 OHIO RIVER AT PARKERSBURG, WEST VIRGINIA

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	100000.	59800.	416000.	174000.	131000.	62300.	30100.	25400.	8810.	15600.	30900.	113000.
1964	AVG	45867.	26890.	168452.	118800.	43746.	23540.	13132.	13146.	6250.	7135.	11405.	53581.
	MIN	9650.	16200.	16900.	47200.	9830.	11800.	7610.	6810.	4260.	5050.	4400.	17500.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	165000.	150000.	132000.	132000.	71900.	23900.	10700.	9350.	22500.	25800.	53100.	45000.
1965	AVG	86294.	80971.	92319.	92073.	30355.	12273.	7366.	6286.	10849.	14781.	26988.	27419.
	MIN	22100.	25700.	50500.	68500.	15900.	7080.	5610.	5020.	6580.	7220.	9190.	18000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	123000.	322000.	88000.	151000.	175000.	19300.	15600.	13700.	13000.	20000.	46900.	127000.
1966	AVG	45752.	99357.	62087.	62363.	76597.	12557.	7810.	7514.	7566.	9215.	20965.	53848.
	MIN	12300.	14000.	37900.	28200.	19400.	6800.	4900.	4560.	5420.	5930.	6120.	18700.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	40300.	88500.	273000.	117000.	182000.	48000.	33400.	29900.	47000.	48000.	74000.	80300.
1967	AVG	20189.	43936.	141890.	72660.	103671.	17512.	16918.	16367.	13567.	31828.	40933.	51816.
	MIN	7670.	21200.	27000.	45700.	28300.	8810.	9150.	7080.	6130.	7560.	22400.	28000.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	170000.	220000.	130000.	96000.	250000.	140000.	22000.	27900.	15100.	21000.	78000.	167000.
1968	AVG	38674.	70797.	67484.	46833.	92732.	45960.	13470.	13545.	10486.	12048.	37633.	61003.
	MIN	22600.	15000.	10000.	20000.	20000.	19000.	8860.	7870.	8550.	7000.	13000.	32000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	139000.	179000.	66000.	135000.	105000.	29000.	79000.	57000.	20600.	17300.	54900.	113200.
1969	AVG	62639.	69136.	28265.	75707.	53532.	20333.	46832.	27581.	13457.	13297.	27073.	49777.
	MIN	26000.	23000.	14000.	46000.	28000.	15000.	17800.	14700.	10900.	10800.	10000.	24400.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

106 OHIO RIVER AT NEW HAVEN MILE 241.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	40300.	68500.	273000.	117000.	182000.	41000.	35000.	30000.	40000.	51000.	74000.	78000.
1967	AVG	20184.	43936.	141890.	72660.	103671.	18967.	19323.	18355.	14550.	35806.	43000.	55806.
	MIN	7600.	21200.	27000.	45700.	28300.	12000.	12000.	10000.	7000.	15000.	27000.	33000.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	149000.	205000.	140000.	95000.	250000.	120000.	21300.	35000.	20000.	21000.	78000.	167000.
1968	AVG	45032.	74345.	70429.	47253.	94052.	50720.	15655.	16745.	12220.	12048.	37633.	61474.
	MIN	29000.	18000.	14300.	21000.	21000.	21000.	11800.	12000.	9500.	7000.	13000.	32000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	139000.	179000.	66000.	135000.	105000.	29000.	79000.	57000.	20600.	17300.	54900.	113200.
1969	AVG	62639.	69136.	28265.	75707.	53532.	20333.	46832.	27581.	13497.	13297.	27073.	49777.
	MIN	26000.	23000.	14000.	46000.	28000.	15000.	17800.	14700.	10900.	10800.	10000.	24400.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	152305.	152705.	136500.	241300.	90000.	60600.	37600.	49900.	28600.	88000.	105900.	152700.
1970	AVG	50695.	91403.	75455.	116790.	54177.	31497.	24923.	23397.	21733.	35677.	72660.	91506.
	MIN	24600.	48105.	39100.	63900.	31800.	17200.	16700.	13100.	15000.	18000.	49900.	61700.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	148600.	214100.	171300.	58000.	139500.	51800.	23700.	45500.	97300.	29700.	57500.	132100.
1971	AVG	64558.	104350.	111987.	40590.	60003.	26103.	14448.	18739.	35003.	15606.	20370.	68945.
	MIN	30700.	27500.	60200.	24600.	21100.	13600.	11400.	10200.	10500.	10600.	12700.	38900.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	105900.	103000.	215700.	190000.	82700.	288000.	158400.	30600.	33900.	51300.	114600.	216800.
1972	AVG	73597.	58417.	137861.	116837.	55694.	76333.	71148.	20158.	19133.	28126.	81140.	127477.
	MIN	40300.	26800.	76000.	51200.	20100.	17500.	18600.	14900.	12900.	17200.	24400.	61900.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

108 OHIO RIVER AT NEW HAVEN MILE 241.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	95800.	131200.	166700.	171400.	143800.	73800.	26400.	31100.	22400.	52900.	125600.	150400.
1973	AVG	58426.	71257.	97065.	97860.	80710.	46163.	18184.	17542.	11607.	20594.	51930.	74197.
	MIN	28500.	40000.	41400.	54300.	50500.	23500.	10800.	9600.	8400.	11400.	25800.	41000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	14.	
	MAX	187400.	102400.	151600.	147400.	162400.	125400.	91100.	60100.	99900.	31300.	41500.	
1974	AVG	112732.	64600.	93706.	94433.	65910.	54987.	32206.	16348.	41950.	19184.	25407.	
	MIN	59800.	46200.	57000.	40500.	36100.	18500.	12100.	8900.	20300.	14200.	14600.	

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

1600 OHIO RIVER AT POMEROY, OHIO

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	18.	16.	31.	30.	19.	5.						31.
	MAX	110000.	68000.	403000.	203000.	139000.	57000.						118000.
1964	AVG	70156.	39600.	186471.	135537.	65284.	47000.						58997.
	MIN	35000.	24700.	23000.	50900.	35000.	36000.						19400.
	N	31.	28.	31.	30.	17.						15.	7.
	MAX	182000.	166000.	149000.	175000.	92000.						53400.	45900.
1965	AVG	99374.	95179.	108342.	112967.	49127.						41967.	36857.
	MIN	34100.	30600.	66100.	83100.	31100.						22800.	31000.
	N	13.	20.	31.	30.	31.						8.	31.
	MAX	130000.	332000.	95400.	170000.	220000.						56000.	150000.
1966	AVG	88338.	153820.	67397.	70847.	89984.						45738.	61516.
	MIN	27900.	28900.	38600.	30000.	21000.						35000.	22000.
	N	1.	28.	31.	30.	31.	5.			1.	21.	22.	31.
	MAX	35000.	96000.	333000.	134000.	210000.	56000.			47000.	54000.	79100.	86000.
1967	AVG	35000.	51954.	170171.	85303.	125342.	48400.			47000.	43162.	50564.	58645.
	MIN	35000.	27000.	37800.	53300.	32000.	35000.			47000.	34000.	30600.	30000.
	N	31.	16.	21.	21.	20.	17.		1.				
	MAX	180000.	240000.	160000.	108000.	286000.	187000.		38300.				
1968	AVG	48258.	134269.	117524.	69319.	152790.	82435.		38300.				
	MIN	26000.	38000.	42000.	36000.	50000.	34000.		38300.				

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

2015 OHIO RIVER AT POINT PLEASANT, WEST VIRGINIA

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	20.	29.	31.	30.	19.	5.					6.	31.
	MAX	130000.	86000.	459000.	237000.	144000.	58700.					61100.	139000.
1964	AVG	90585.	50107.	237806.	158890.	69411.	48080.					45450.	71926.
	MIN	33000.	21800.	27000.	72100.	35400.	37000.					23500.	21000.
	N	31.	28.	31.	30.	17.						14.	9.
	MAX	232000.	213000.	280000.	271000.	108000.						55000.	48000.
1965	AVG	123984.	112979.	139581.	145220.	56206.						44357.	35767.
	MIN	40300.	30900.	78000.	98600.	31900.						31500.	25400.
	N	14.	28.	31.	30.	31.					2.	14.	31.
	MAX	140000.	416000.	134000.	249000.	352000.					45600.	81300.	209000.
1966	AVG	90743.	144768.	84103.	93920.	117706.					39050.	52407.	79926.
	MIN	29200.	17400.	45100.	48900.	24900.					32500.	33800.	27100.
	N	31.	28.	31.	30.	31.	5.	5.		2.	20.	30.	31.
	MAX	81700.	114000.	450000.	153000.	309000.	67900.	40700.		61700.	60700.	89100.	122000.
1967	AVG	42110.	70446.	230303.	102430.	163468.	58320.	28960.		44800.	47915.	49987.	82516.
	MIN	20500.	38000.	58900.	70000.	34300.	41100.	18800.		27900.	35700.	29000.	33000.
	N	31.	17.	21.	30.	31.	25.		5.		1.	15.	31.
	MAX	207000.	270000.	220000.	163000.	350000.	215000.		80000.		40000.	100000.	197000.
1968	AVG	70590.	144165.	146476.	75297.	126552.	78000.		51800.		40000.	70807.	73558.
	MIN	40000.	36000.	54000.	32000.	29000.	33000.		36000.		40000.	45000.	33700.
	N	24.	20.	10.	30.	26.	1.	22.	9.				
	MAX	164000.	235000.	116000.	171000.	136000.	46600.	84500.	121000.				
1969	AVG	94038.	121610.	85260.	102903.	73938.	46600.	61118.	75211.				
	MIN	44300.	30400.	53100.	63700.	32700.	46600.	41300.	38600.				

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

110 OHIO RIVER AT HUNTINGTON MILE 304.2

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	155000.	85000.	455000.	243000.	153000.	64000.	38000.	41000.	26000.	39000.	83000.	155000.
1964	AVG	74452.	57379.	241484.	167100.	56161.	29633.	17032.	18290.	9067.	17548.	21767.	77968.
	MIN	14000.	26000.	34000.	73000.	17000.	17000.	9000.	12000.	5000.	8000.	7000.	20000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	230000.	220000.	310000.	270000.	125000.	29000.	25000.	15000.	32000.	35000.	65000.	52000.
1965	AVG	132968.	122357.	161226.	165967.	48806.	18000.	13387.	10323.	16067.	21161.	32800.	31935.
	MIN	40000.	40000.	75000.	110000.	22000.	12000.	9000.	7000.	10000.	11000.	15000.	20000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	148000.	400000.	155000.	260000.	350000.	33000.	32000.	35000.	45000.	50000.	85000.	225000.
1966	AVG	57774.	143536.	89097.	96900.	123903.	18800.	13742.	14258.	16300.	25484.	40300.	91806.
	MIN	16000.	14000.	47000.	50000.	24000.	9000.	8000.	7000.	7000.	14000.	16000.	36000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	90000.	130000.	425000.	176000.	305000.	70000.	52000.	40000.	38000.	65000.	101000.	138000.
1967	AVG	46806.	78000.	239387.	114767.	173065.	30600.	26645.	24806.	18333.	46000.	55833.	92258.
	MIN	23000.	40000.	56000.	75000.	50000.	18000.	17000.	13000.	10000.	17000.	35000.	38000.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	141000.	280000.	230000.	169000.	360000.	247000.	33000.	90000.	24000.	53000.	110000.	194000.
1968	AVG	72355.	105276.	122258.	83800.	138806.	80300.	21484.	29710.	15967.	20742.	52033.	77713.
	MIN	42000.	25000.	23000.	34000.	36000.	31000.	17000.	12000.	13000.	13000.	17000.	40000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	180000.	220000.	125000.	170000.	147000.	48000.	93000.	140000.	30700.	24300.	72400.	178600.
1969	AVG	86090.	102546.	50671.	111100.	72535.	29827.	57145.	46384.	19087.	16674.	36503.	70081.
	MIN	32000.	36000.	26000.	65000.	31200.	24000.	20500.	17700.	11500.	10300.	15000.	25700.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

110 OHIO RIVER AT HUNTINGTON MILE 304.2

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	251500.	204305.	181700.	304300.	150700.	68100.	53500.	53700.	34700.	120000.	161100.	269500.
1970	AVG	88718.	145600.	111949.	164963.	72042.	39830.	34561.	31016.	27137.	42248.	101830.	127784.
	MIN	33800.	68405.	58800.	92900.	42000.	22200.	21900.	18400.	18500.	18200.	60900.	73000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	237300.	291900.	226900.	84300.	227100.	90100.	61200.	123200.	154600.	64800.	74800.	209300.
1971	AVG	101339.	170175.	155045.	57387.	102158.	42057.	25468.	31452.	54340.	28945.	31973.	95732.
	MIN	54000.	50300.	81900.	29400.	34700.	21500.	15900.	13300.	13700.	16300.	18200.	45100.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	206800.	287400.	303700.	296900.	147500.	331600.	205400.	105000.	40600.	83900.	165700.	362800.
1972	AVG	130642.	127531.	189555.	186230.	90984.	102163.	97826.	43487.	23760.	41100.	128347.	211884.
	MIN	55200.	48400.	105300.	66700.	30800.	20100.	22100.	20000.	14700.	23900.	49000.	92800.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	134400.	221600.	274800.	286600.	291200.	145700.	48000.	43200.	41100.	107100.	248200.	239700.
1973	AVG	84461.	170350.	149274.	163843.	132494.	70317.	30000.	26219.	16737.	29339.	82123.	122142.
	MIN	41700.	57100.	64900.	87900.	66600.	33400.	18800.	16100.	10900.	13000.	35800.	59300.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	14.	
	MAX	346000.	156800.	245500.	242900.	244200.	225800.	116900.	100200.	136800.	55300.	53800.	
1974	AVG	198342.	100543.	151397.	138370.	101106.	102397.	43726.	27626.	59750.	28252.	34050.	
	MIN	107700.	74600.	86600.	48000.	49800.	28600.	19500.	12900.	26400.	18100.	22000.	

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

2060 OHIO RIVER AT HUNTINGTON, WEST VIRGINIA

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	156000.	93100.	453000.	240000.	156000.	70400.	21700.	31100.	20100.	31600.	66000.	155000.
1964	AVG	76268.	57183.	242671.	169143.	60087.	28817.	16490.	16894.	9943.	16579.	21603.	78019.
	MIN	13700.	21800.	28000.	73700.	19100.	17600.	12700.	9950.	5880.	9760.	9760.	23000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	232000.	220000.	301000.	272000.	120000.	26900.	20800.	15000.	28900.	33100.	58000.	50600.
1965	AVG	138213.	123650.	155735.	165900.	46235.	17078.	13994.	10163.	14511.	21700.	30867.	31235.
	MIN	42700.	40600.	84800.	114000.	17600.	9580.	9700.	7620.	7840.	12000.	12000.	18900.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	151000.	406000.	140000.	249000.	351000.	29200.	21200.	20000.	35000.	44000.	86100.	217000.
1966	AVG	59174.	150661.	89913.	101757.	127384.	16959.	12127.	11965.	16588.	23365.	37330.	88800.
	MIN	16600.	18600.	46000.	48200.	26000.	9370.	7000.	4620.	9460.	12100.	16200.	26300.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	87300.	131000.	474000.	173000.	290000.	76200.	41300.	39400.	47500.	67800.	100000.	130000.
1967	AVG	46223.	77868.	247365.	113727.	172777.	30537.	23939.	24477.	18477.	41903.	53637.	88652.
	MIN	20700.	34000.	61000.	78000.	47100.	15000.	15000.	14200.	12000.	11000.	30700.	33700.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	194000.	295000.	248000.	186000.	375000.	229000.	35000.	85000.	22000.	49400.	115000.	198000.
1968	AVG	76110.	109224.	123568.	87377.	143245.	79640.	19581.	27939.	14333.	20494.	51890.	76165.
	MIN	41200.	22100.	20400.	34900.	31300.	31500.	9500.	12000.	12000.	13000.	17000.	32800.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	183000.	234000.	120000.	179000.	150000.	42600.	88000.	149000.	30700.	24300.	72400.	178600.
1969	AVG	88955.	103954.	49823.	113843.	72958.	29647.	54768.	46235.	19140.	16674.	36503.	70081.
	MIN	32000.	36000.	26000.	65200.	32900.	24000.	20500.	17700.	11500.	10300.	15000.	25700.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

2160 OHIO RIVER AT ASHLAND, KENTUCKY

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.							12.
	MAX	150000.	95000.	470000.	285000.	155000.							163000.
1964	AVG	76703.	62862.	260674.	183157.	62258.							124958.
	MIN	15000.	25300.	32000.	73900.	40000.							80000.
	N	31.	28.	31.	30.	1.							
	MAX	234000.	218000.	389000.	313000.	144000.							
1965	AVG	144129.	130786.	180677.	183467.	144000.							
	MIN	50000.	45000.	95000.	128000.	144000.							
	N	10.	28.	31.	30.	31.						30.	31.
	MAX	147000.	456000.	156000.	288000.	448000.						81700.	226000.
1966	AVG	116440.	163771.	91974.	104560.	144797.						42537.	96397.
	MIN	68000.	18000.	43200.	47500.	35000.						28000.	31600.
	N	31.	28.	31.	30.	31.							31.
	MAX	91200.	142000.	568000.	176000.	389000.							148000.
1967	AVG	51097.	62007.	282639.	122287.	193329.							95832.
	MIN	35000.	37400.	66100.	78500.	65000.							45000.
	N	31.	29.	31.	30.	31.	7.					6.	31.
	MAX	193000.	322000.	324000.	216000.	444000.	285000.					99500.	194000.
1968	AVG	82694.	112448.	136839.	93390.	148890.	198571.					86433.	76677.
	MIN	40000.	28000.	25000.	45000.	35000.	119000.					74500.	46000.
	N	31.	28.	31.	30.	31.		8.	8.				
	MAX	176000.	227000.	131000.	181000.	153000.		88000.	145000.				
1969	AVG	89110.	111076.	53587.	118440.	76168.		73800.	88663.				
	MIN	38000.	42000.	32000.	65000.	40000.		60400.	44300.				

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

2380 OHIO RIVER NEAR MAYSVILLE, KENTUCKY

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.							5.
	MAX	155000.	97900.	559000.	298000.	155000.							181000.
1964	AVG	77897.	66107.	299774.	201020.	66129.							157600.
	MIN	25000.	35000.	34000.	88400.	25000.							134000.
	N	31.	28.	31.	30.	2.							
	MAX	242000.	251000.	360000.	332000.	181000.							
1965	AVG	159452.	145107.	197839.	218467.	167500.							
	MIN	55000.	50000.	105000.	159000.	154000.							
	N	11.	28.	31.	30.	31.							31.
	MAX	188000.	477000.	183000.	293000.	442000.							283000.
1966	AVG	150655.	182429.	107600.	116610.	161761.							119781.
	MIN	85400.	20000.	65000.	65000.	40000.							38000.
	N	31.	26.	31.	30.	31.							31.
	MAX	113000.	169000.	560000.	190000.	429000.							163000.
1967	AVG	57445.	96632.	311800.	137567.	215623.							110574.
	MIN	36000.	50000.	80000.	103000.	70000.							56000.
	N	31.	29.	31.	30.	31.	8.					5.	31.
	MAX	191000.	313000.	311000.	255000.	478000.	376000.					108000.	205000.
1968	AVG	86787.	119772.	159123.	111167.	166287.	234225.					92060.	81468.
	MIN	45000.	30000.	27000.	50000.	45000.	97800.					73000.	48000.
	N	31.	28.	31.	30.	31.		1.	6.				
	MAX	210000.	260000.	150000.	200000.	173000.		92600.	148000.				
1969	AVG	102232.	126139.	59777.	131787.	85923.		92600.	100917.				
	MIN	40000.	45000.	34000.	70000.	45000.		92600.	62400.				

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

117 OHIO RIVER AT MELDAHL MILE 436.2

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	217900.	274800.	143000.	193600.	155000.	65000.	90000.	140000.	36600.	27900.	84400.	166900.
1969	AVG	109371.	136061.	62413.	132827.	81290.	35500.	59116.	50335.	21503.	18571.	40570.	72010.
	MIN	44200.	49100.	36500.	78900.	39000.	23000.	15000.	17000.	8800.	8100.	14800.	29100.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	310200.	257900.	224100.	395200.	241200.	72800.	57400.	57800.	46400.	104000.	176300.	312500.
1970	AVG	103477.	165743.	134671.	212780.	96855.	46840.	39019.	34526.	31377.	45284.	109963.	142500.
	MIN	38600.	72900.	68800.	109400.	46400.	30200.	25500.	16400.	20400.	20300.	65900.	73800.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	264400.	334200.	280300.	98700.	308100.	93000.	87700.	143600.	154500.	72200.	67800.	238600.
1971	AVG	117903.	204518.	186023.	66220.	130397.	53330.	33845.	38342.	60513.	32597.	33970.	110090.
	MIN	59700.	64300.	89700.	38500.	39300.	33900.	19600.	13700.	16600.	16800.	18100.	54400.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	259000.	365900.	355400.	393200.	179300.	327600.	260600.	101400.	43600.	85400.	199700.	428600.
1972	AVG	161935.	160603.	231535.	250240.	118810.	102327.	108500.	48987.	24550.	46084.	159553.	257748.
	MIN	74000.	65400.	141700.	77900.	33900.	22300.	29700.	22600.	15500.	24400.	54800.	114100.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	167500.	249600.	349800.	354800.	384000.	185000.	64200.	51000.	38900.	96600.	350400.	351500.
1973	AVG	101213.	145675.	181371.	202820.	173774.	89230.	38913.	30865.	18313.	30781.	94853.	149742.
	MIN	49900.	66400.	71800.	123500.	79300.	41900.	21900.	14800.	11000.	14300.	38800.	70200.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	14.	
	MAX	411800.	220000.	302100.	311800.	265600.	283900.	122000.	109900.	154800.	63700.	54300.	
1974	AVG	254184.	127936.	187003.	173270.	115497.	127227.	49523.	30113.	69300.	30477.	38414.	
	MIN	144900.	88600.	101100.	59300.	53100.	32900.	21200.	15500.	28500.	19100.	24200.	

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

111 OHIO RIVER AT CINCINNATI MILE 462.8

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	155000.	115000.	660000.	315000.	173000.	70000.	40000.	40000.	22000.	53000.	90000.	180000.
1964	AVG	81258.	76172.	344935.	209333.	70097.	34767.	18194.	18387.	9767.	21161.	22433.	102903.
	MIN	14000.	38000.	46000.	110000.	22000.	20000.	11000.	6000.	5000.	10000.	10000.	25000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	255000.	318000.	380000.	348000.	195000.	38000.	47000.	16000.	80000.	58000.	65000.	63000.
1965	AVG	167194.	161143.	214226.	227967.	61484.	22500.	19548.	11645.	26900.	28387.	35400.	36000.
	MIN	50000.	40000.	125000.	155000.	30000.	12000.	13000.	9000.	10000.	17000.	15000.	18000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	218000.	450000.	165000.	304000.	425000.	32000.	44000.	30000.	55000.	70000.	105000.	322000.
1966	AVG	85419.	189786.	98419.	114400.	164903.	21500.	20032.	19871.	20233.	29194.	52733.	132419.
	MIN	19000.	19000.	49000.	50000.	32000.	14000.	10000.	8000.	6000.	17000.	19000.	50000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	115000.	162000.	565000.	210000.	408000.	100000.	55000.	45000.	50000.	75000.	103000.	175000.
1967	AVG	62548.	100107.	329903.	149433.	238774.	38867.	31355.	27242.	18933.	45129.	58633.	124677.
	MIN	33000.	52000.	72000.	115000.	70000.	17000.	18000.	13000.	9000.	18000.	38000.	55000.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	185000.	325000.	320000.	277000.	515000.	412000.	45000.	108000.	30000.	56000.	113000.	205000.
1968	AVG	91323.	127000.	165710.	122533.	189677.	113367.	29645.	46613.	18567.	23484.	57667.	90965.
	MIN	50000.	30000.	25000.	45000.	41000.	38000.	21000.	14000.	14000.	15000.	18000.	45000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	280000.	288000.	136000.	210000.	175000.	69000.	102000.	147000.	36200.	28100.	91300.	171400.
1969	AVG	119290.	142625.	59952.	139060.	90690.	36767.	61484.	50881.	22157.	18990.	43260.	74787.
	MIN	38000.	45000.	33000.	78000.	40400.	25000.	17000.	18000.	9800.	8700.	15100.	29800.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

111 OHIO RIVER AT CINCINNATI MILE 462.8

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	337100.	289900.	243100.	428100.	281700.	74200.	61700.	58400.	49900.	107600.	179700.	349400.
1970	AVG	111501.	202507.	147636.	244470.	108039.	48897.	40135.	35648.	32717.	46668.	113150.	154606.
	MIN	40500.	77705.	75000.	117000.	52600.	32100.	26000.	17400.	21200.	21400.	67700.	75400.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	280500.	382500.	298500.	101900.	341000.	95500.	101000.	154200.	161600.	73200.	70700.	247100.
1971	AVG	127487.	230471.	200216.	68970.	143442.	56057.	38877.	42303.	65067.	33790.	34857.	119616.
	MIN	63000.	68900.	92700.	41300.	42000.	36700.	21300.	14800.	19600.	18000.	18800.	60700.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	277800.	399700.	380800.	437900.	197000.	334000.	281700.	111300.	47900.	87300.	218700.	465800.
1972	AVG	178932.	175762.	254797.	281273.	129606.	104807.	113148.	52203.	25713.	48306.	177027.	282290.
	MIN	79600.	70200.	147400.	85700.	33500.	24000.	30900.	23600.	16000.	25600.	64100.	126000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	186400.	257300.	369800.	388400.	406100.	192600.	87900.	57300.	39600.	102100.	378600.	379600.
1973	AVG	110097.	155100.	198939.	226840.	184729.	97767.	47671.	34384.	19417.	33103.	103673.	161139.
	MIN	52900.	69800.	74900.	149400.	85000.	49400.	24500.	16300.	12700.	14900.	39900.	71700.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	14.	
	MAX	462300.	231700.	331500.	343000.	270300.	312600.	125200.	126600.	176400.	64900.	57200.	
1974	AVG	281716.	135671.	205587.	189667.	121277.	141987.	52694.	35603.	77340.	32981.	40979.	
	MIN	166700.	99000.	110200.	60000.	52600.	36300.	22500.	16700.	33600.	21000.	27500.	

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

2550 OHIO RIVER AT CINCINNATI, OHIO

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	140000.	115000.	643000.	313000.	167000.	70000.	40000.	40000.	22000.	53000.	79700.	181000.
1964	AVG	77548.	73883.	336581.	201667.	68284.	34767.	18194.	18387.	9767.	21161.	23453.	101387.
	MIN	20000.	39300.	36000.	104000.	20000.	20000.	11000.	6000.	5000.	10000.	10000.	40000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	248000.	298000.	389000.	352000.	181000.	38000.	47000.	16000.	76200.	58000.	65000.	63000.
1965	AVG	163600.	154111.	203871.	228067.	61845.	22500.	19548.	11645.	27533.	28387.	35400.	36000.
	MIN	56000.	53000.	114000.	144000.	30000.	12000.	13000.	9000.	10000.	17000.	15000.	18000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	210000.	464000.	169000.	300000.	442000.	32000.	44000.	30000.	55000.	70000.	99500.	327000.
1966	AVG	86039.	193046.	104890.	119990.	169365.	21500.	20032.	19871.	20233.	29194.	54973.	130606.
	MIN	24000.	24000.	50000.	67600.	31500.	14000.	10000.	8000.	6000.	17000.	25000.	38500.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	123000.	165000.	558000.	204000.	396000.	112000.	55000.	45000.	50000.	75000.	103000.	168000.
1967	AVG	61826.	102461.	318484.	147000.	231032.	40037.	32323.	27145.	19567.	44871.	59733.	119542.
	MIN	35000.	55000.	85500.	114000.	70000.	17000.	18000.	13000.	9000.	18000.	38000.	62400.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	187000.	330000.	330000.	284000.	505000.	416000.	45000.	108000.	30000.	56000.	115000.	201000.
1968	AVG	90358.	127462.	173090.	127440.	189403.	110513.	29645.	46613.	18567.	23484.	57687.	89587.
	MIN	48500.	32000.	30000.	55000.	40400.	43000.	21000.	14000.	14000.	15000.	18000.	50000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	232000.	278000.	145000.	196000.	165000.	87200.	98700.	122000.	36200.	28100.	91300.	171400.
1969	AVG	113377.	139132.	63490.	134900.	92223.	37987.	62568.	50303.	22157.	18990.	43260.	74787.
	MIN	45000.	50000.	37000.	80000.	40000.	25000.	15000.	18000.	9800.	8700.	15100.	29800.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

123 OHIO RIVER AT MARKLAND MILE 531.5

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	269000.	291000.	146000.	214000.	177000.	85000.	105000.	150000.	39600.	28500.	92800.	174900.
1969	AVG	123142.	148807.	65458.	143660.	97052.	37967.	63387.	53581.	22713.	19284.	43603.	74800.
	MIN	43500.	51700.	37900.	81700.	33000.	23000.	17000.	16000.	9400.	8600.	14600.	30000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	343400.	289800.	243200.	456700.	295200.	75100.	62800.	55900.	51400.	91500.	173400.	352100.
1970	AVG	113710.	208693.	150126.	249827.	113494.	50133.	40571.	34465.	31053.	46852.	113390.	155797.
	MIN	39700.	80200.	75800.	117100.	53200.	33900.	27700.	16000.	20200.	21900.	63800.	73200.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	281900.	410400.	296400.	106400.	347900.	96500.	95000.	148000.	158700.	78300.	64800.	252800.
1971	AVG	130726.	240325.	205635.	72260.	148019.	59563.	41071.	42916.	66250.	33771.	34857.	122139.
	MIN	61500.	68000.	95500.	42700.	43300.	39500.	21800.	13300.	21200.	17900.	20500.	61100.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	278000.	408400.	395500.	476200.	206900.	330100.	284500.	103400.	46300.	98300.	231000.	484400.
1972	AVG	178623.	177679.	261929.	296150.	137461.	105850.	114316.	51894.	26177.	50203.	183527.	292184.
	MIN	79200.	74900.	154900.	87100.	38200.	28400.	27900.	22900.	15500.	25800.	63200.	122900.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	190300.	265800.	395000.	368600.	407900.	207300.	104600.	68600.	33300.	84000.	385900.	392800.
1973	AVG	114526.	162771.	210784.	232810.	198403.	109917.	53829.	37506.	20080.	32774.	104237.	165548.
	MIN	57600.	74900.	75200.	159300.	91200.	52600.	25800.	16200.	13700.	14300.	42100.	76200.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	14.	
	MAX	456600.	261600.	342600.	351800.	273900.	313000.	127500.	137300.	188600.	65300.	60600.	
1974	AVG	294858.	145582.	212268.	200300.	124832.	148110.	54829.	36403.	85900.	33842.	45421.	
	MIN	167000.	101900.	116400.	66500.	60600.	37100.	22900.	18400.	34900.	18500.	30100.	

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

112 OHIO RIVER AT LOUISVILLE MILE 600.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	163000.	142000.	790000.	365000.	215000.	75000.	35000.	34000.	30000.	53000.	80000.	192000.
1964	AVG	86935.	86655.	428548.	238533.	80161.	36100.	19323.	18710.	10400.	22935.	23300.	114129.
	MIN	17000.	40000.	45000.	125000.	23000.	21000.	12000.	7000.	5000.	8000.	8000.	34000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	272000.	365000.	440000.	385000.	243000.	40000.	60000.	18000.	340000.	57000.	67000.	63000.
1965	AVG	175903.	173179.	236419.	259000.	67871.	23267.	21645.	12194.	56150.	31484.	36067.	37903.
	MIN	60000.	48000.	136000.	175000.	32000.	12000.	10000.	6000.	11000.	18000.	15000.	20000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	275000.	484000.	180000.	335000.	467000.	40000.	53000.	40000.	63000.	73000.	145000.	385000.
1966	AVG	103742.	222857.	107258.	122233.	191516.	22400.	21065.	22613.	21933.	31710.	61800.	152613.
	MIN	22000.	19000.	56000.	55000.	38000.	11000.	6000.	8000.	6000.	16000.	19000.	50000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	168000.	170000.	600000.	218000.	455000.	117000.	55000.	43000.	58000.	65000.	105000.	195000.
1967	AVG	66613.	106071.	359194.	158700.	274290.	42233.	30097.	24935.	17533.	40903.	57367.	149613.
	MIN	31000.	50000.	57000.	120000.	40000.	18000.	15000.	12000.	9000.	15000.	35000.	80000.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	195000.	345000.	415000.	370000.	555000.	505000.	63000.	120000.	33000.	56000.	110000.	218000.
1968	AVG	95316.	136241.	204290.	158067.	200871.	136700.	29097.	50742.	17533.	22484.	57333.	96123.
	MIN	45000.	32000.	24000.	53000.	42000.	32000.	16000.	11000.	9000.	9000.	12000.	38000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	365000.	342000.	140000.	252000.	175000.	80000.	102000.	150000.	37000.	26700.	86300.	156500.
1969	AVG	134935.	159000.	63419.	156433.	98194.	40100.	62839.	53065.	20800.	17374.	40190.	70535.
	MIN	37000.	47000.	37000.	80000.	42000.	23000.	10000.	15000.	9600.	8300.	13800.	26600.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

112 OHIO RIVER AT LOUISVILLE MILE 600.6

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	372000.	333700.	249600.	494100.	399000.	88000.	54800.	51000.	53500.	80000.	166300.	385800.
1970	AVG	115398.	217889.	155336.	272123.	128803.	49423.	37132.	31906.	30260.	45503.	109433.	163029.
	MIN	28000.	85305.	80600.	111700.	54000.	32100.	25700.	16000.	20500.	19100.	58800.	65500.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	290500.	444900.	310100.	99500.	375400.	86400.	91700.	157200.	145300.	73000.	56600.	242800.
1971	AVG	137968.	251996.	210145.	70220.	160365.	56087.	42168.	45042.	63243.	31800.	32220.	117397.
	MIN	59200.	70700.	93800.	42000.	40500.	37400.	21200.	12600.	20600.	16500.	18000.	61400.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	300300.	449600.	447700.	534700.	205400.	308800.	284900.	102300.	45800.	87000.	236700.	504500.
1972	AVG	191771.	192659.	280068.	337060.	139787.	96483.	110206.	48616.	23950.	46352.	187330.	313652.
	MIN	81400.	81800.	152500.	96900.	39100.	26000.	26400.	19500.	12500.	24700.	68100.	134600.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	203700.	245800.	403500.	374100.	409700.	217000.	118900.	59900.	26100.	75600.	416500.	428100.
1973	AVG	116235.	162925.	222381.	245513.	205381.	114767.	59355.	35771.	18540.	30900.	106783.	175506.
	MIN	54500.	74600.	70400.	162600.	89800.	49200.	26100.	13000.	11800.	12200.	40300.	75700.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	14.	
	MAX	496600.	270400.	361100.	372900.	262000.	348300.	127400.	149500.	201900.	61200.	57200.	
1974	AVG	321029.	145143.	226961.	209550.	121335.	156613.	52990.	39597.	94283.	32274.	44100.	
	MIN	199500.	160000.	114600.	66700.	59900.	38100.	20700.	17500.	35700.	17500.	29800.	

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

2945 OHIO RIVER AT LOUISVILLE, KENTUCKY

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	160000.	140000.	780000.	367000.	211000.	75300.	38500.	33700.	27500.	50800.	80200.	198000.
1964	AVG	85761.	86276.	424494.	239033.	81023.	36900.	19371.	19055.	11098.	23243.	24686.	114632.
	MIN	16100.	43700.	38900.	126000.	21700.	16000.	9370.	8600.	6400.	9000.	8690.	34400.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	288000.	389000.	463000.	392000.	245000.	44300.	73400.	22400.	121000.	60500.	61800.	67500.
1965	AVG	181161.	177257.	242000.	272033.	70648.	23582.	23126.	12412.	35883.	35642.	36560.	38519.
	MIN	59800.	55100.	139000.	182000.	33300.	8370.	9220.	5110.	10100.	15600.	14700.	24000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	269000.	515000.	187000.	347000.	504000.	39700.	53200.	39700.	69200.	74900.	148000.	400000.
1966	AVG	104077.	228911.	110629.	132863.	199935.	22763.	20883.	24015.	23626.	35597.	64980.	158100.
	MIN	26300.	20300.	61200.	59300.	41100.	10500.	7600.	8660.	8770.	17700.	18400.	51600.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	168000.	176000.	637000.	229000.	487000.	115000.	56100.	44500.	55500.	80300.	108000.	195000.
1967	AVG	71977.	111700.	378090.	161267.	281832.	45250.	34284.	29781.	19610.	43694.	60377.	145900.
	MIN	37100.	62900.	74800.	124000.	53600.	20100.	14500.	12300.	10900.	14300.	37400.	71200.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	26.	16.
	MAX	206000.	362000.	421000.	375000.	585000.	563000.	62800.	121000.	34400.	559000.	986000.	973000.
1968	AVG	98839.	141897.	207661.	156837.	210719.	142970.	30903.	52384.	17816.	230948.	516000.	706438.
	MIN	51200.	34200.	25600.	56200.	46900.	38100.	15200.	12000.	9770.	78400.	138000.	441000.
	N		12.	25.	3.								
	MAX		869000.	890000.	909000.								
1969	AVG		696833.	528880.	886333.								
	MIN		552000.	396000.	850000.								

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

114 OHIO RIVER AT EVANSVILLE MILE 792.0

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	210900.	375900.	475900.	434900.	564900.	590900.	44900.	125900.	24900.	59000.	120000.	195000.
1968	AVG	110548.	169321.	237190.	235477.	188448.	206877.	35223.	58816.	20900.	26710.	63033.	109861.
	MIN	65000.	44900.	39900.	85900.	63900.	54900.	29900.	19900.	15900.	15900.	23000.	55000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	355000.	428000.	165000.	305000.	173000.	128000.	123000.	145000.	51000.	32700.	100300.	167800.
1969	AVG	171323.	221429.	79274.	201433.	120435.	59100.	82742.	63216.	26170.	23945.	57063.	80387.
	MIN	50000.	70000.	42000.	108000.	56000.	27000.	30000.	21000.	15900.	15300.	21600.	35000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	380100.	391305.	294000.	525000.	481800.	125700.	65600.	61000.	69200.	89400.	184000.	419500.
1970	AVG	144785.	276125.	192832.	314150.	198265.	68080.	44152.	39690.	38493.	58997.	135953.	187552.
	MIN	55600.	135005.	112800.	141100.	73700.	42900.	28500.	22100.	23600.	26000.	78500.	78700.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	313100.	489200.	476500.	125600.	400800.	94800.	110200.	155300.	161600.	78300.	64800.	265000.
1971	AVG	190190.	296296.	289610.	89697.	201603.	71520.	55552.	62619.	78077.	41929.	41970.	135237.
	MIN	84800.	84500.	129100.	54100.	59600.	49500.	31200.	22300.	31100.	22800.	25900.	63400.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	330000.	448200.	553400.	621900.	375000.	312300.	333100.	98900.	53400.	95500.	280600.	585300.
1972	AVG	224919.	226603.	366106.	383390.	186316.	92070.	142200.	58123.	28880.	58448.	218510.	370606.
	MIN	103500.	107800.	200000.	129200.	55700.	35300.	30200.	24600.	17600.	35100.	65100.	176200.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	290000.	270500.	441600.	343000.	424000.	266900.	193100.	69300.	31000.	87100.	369200.	459400.
1973	AVG	163848.	202771.	262923.	297713.	255442.	152370.	91748.	47155.	22110.	36629.	114363.	222439.
	MIN	76600.	98300.	90100.	227000.	117400.	81900.	41900.	19100.	15400.	16400.	48900.	103600.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

114 OHIO RIVER AT EVANSVILLE MILE 792.0

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	14.	
	MAX	580000.	370000.	395000.	413000.	285400.	390000.	160000.	139300.	241700.	74300.	76200.	
1974	AVG	404565.	191471.	265581.	251020.	138261.	191470.	65452.	49535.	132357.	49177.	59536.	
	MIN	335000.	120000.	142000.	89100.	81300.	57000.	27000.	25500.	45500.	34800.	38700.	

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

3220 OHIO RIVER AT EVANSVILLE, INDIANA

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	154000.	151000.	909000.	375000.	316000.	88900.	35000.	30000.	21000.	52000.	90500.	232000.
1964	AVG	87645.	98400.	540110.	263067.	107387.	44797.	23226.	21194.	14333.	27677.	29123.	136606.
	MIN	23000.	50000.	40000.	172000.	40000.	35000.	20000.	12000.	10000.	18000.	15000.	46400.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	296000.	401000.	446000.	486000.	296000.	42000.	46000.	16000.	119000.	62000.	62000.	72400.
1965	AVG	203968.	215221.	258774.	322867.	92997.	29667.	29065.	14387.	44523.	42903.	42500.	43123.
	MIN	76400.	56200.	177000.	211000.	45000.	18000.	19000.	11000.	18000.	32000.	27000.	35000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	311000.	535000.	202000.	294000.	525000.	37000.	45000.	38000.	45000.	76000.	161000.	414000.
1966	AVG	136535.	268714.	125761.	148533.	253919.	26333.	24484.	27742.	27333.	40890.	75133.	180548.
	MIN	40000.	30000.	70000.	75000.	55000.	14000.	14000.	18000.	14000.	28000.	45000.	61500.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	189000.	187000.	665000.	234000.	515000.	125000.	114000.	81800.	25000.	65000.	128000.	234000.
1967	AVG	85561.	127586.	415019.	176500.	337868.	54123.	64755.	45577.	20333.	48065.	69273.	189806.
	MIN	43400.	70400.	99000.	136000.	94900.	30000.	45000.	25000.	16000.	25000.	50000.	112000.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	211000.	376000.	476000.	435000.	565000.	591000.	45000.	126000.	25000.	49000.	121000.	187000.
1968	AVG	110645.	169417.	237290.	235573.	188548.	206967.	35323.	58916.	21000.	26645.	65340.	110810.
	MIN	65000.	45000.	40000.	86000.	64000.	55000.	30000.	20000.	16000.	16000.	30000.	60000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	338000.	410000.	157000.	298000.	178000.	131000.	123000.	146000.	38000.	32700.	100300.	167800.
1969	AVG	163910.	220843.	81626.	193100.	122668.	58967.	81674.	63606.	25167.	23945.	57063.	80387.
	MIN	60000.	71600.	55000.	105000.	65000.	38000.	35000.	35000.	20000.	15300.	21600.	35000.

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

3845 OHIO RIVER AT GOLCONDA, ILLINOIS

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	31.	30.	31.	7.					1.	31.
	MAX	149000.	146000.	956000.	464000.	473000.	105000.					78300.	238000.
1964	AVG	86887.	102928.	614097.	340600.	178784.	95271.					78300.	141242.
	MIN	25000.	55000.	45000.	228000.	50000.	83800.					78300.	70000.
	N	31.	28.	31.	30.	31.				9.			3.
	MAX	320000.	463000.	401000.	490000.	371000.				118000.			78600.
1965	AVG	224016.	274971.	310065.	403500.	136568.				89844.			75367.
	MIN	93500.	81300.	223000.	289000.	60000.				71200.			70100.
	N	31.	28.	31.	30.	31.						12.	31.
	MAX	362000.	564000.	241000.	332000.	576000.						155000.	497000.
1966	AVG	164755.	303514.	156016.	169220.	328071.						112808.	249048.
	MIN	45000.	45000.	79500.	75200.	78800.						75200.	89500.
	N	31.	28.	31.	30.	31.	10.	10.	6.			6.	31.
	MAX	224000.	255000.	708000.	390000.	604000.	142000.	126000.	83900.			112000.	324000.
1967	AVG	104448.	167907.	478613.	234400.	423161.	123610.	101870.	77783.			87783.	265871.
	MIN	50000.	93700.	117000.	169000.	197000.	88900.	66300.	70500.			75000.	132000.
	N	31.	29.	31.	30.	31.	30.	2.	15.			11.	31.
	MAX	251000.	498000.	529000.	526000.	561000.	732000.	79600.	142000.			124000.	232000.
1968	AVG	158881.	273724.	262432.	340300.	199974.	313797.	77100.	106320.			104300.	131032.
	MIN	88200.	65000.	60000.	137000.	75000.	70000.	74600.	77400.			84200.	80000.
	N	31.	28.	31.	30.	31.	9.	31.	11.				
	MAX	420000.	598000.	190000.	400000.	261000.	164000.	172000.	151000.				
1969	AVG	223519.	384500.	100661.	269033.	166006.	128811.	122190.	111691.				
	MIN	75000.	105000.	70000.	140000.	70000.	85300.	70000.	70200.				

ANNUAL SUMMARY OF OHIO RIVER FLOWS
MONTHLY AVERAGES - CFS

6115 OHIO RIVER AT METROPOLIS, ILLINOIS

YEAR		JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	N	31.	29.	18.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	290000.	314000.	956000.	728000.	658000.	185000.	122000.	100000.	99500.	133000.	203000.	394000.
1964	AVG	184303.	212897.	627111.	555000.	306429.	119857.	93835.	83535.	61797.	98545.	106027.	297323.
	MIN	64000.	124000.	131000.	346000.	98300.	93300.	64000.	61100.	38200.	77100.	81500.	181000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	509000.	711000.	814000.	864000.	445000.	162000.	143000.	86100.	172000.	120000.	121000.	135000.
1965	AVG	372742.	437393.	471032.	617500.	211419.	113997.	108897.	73671.	99337.	91468.	95343.	94119.
	MIN	213000.	158000.	330000.	382000.	118000.	65100.	80100.	56200.	44300.	62300.	71700.	78000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	412000.	679000.	380000.	389000.	678000.	135000.	112000.	130000.	113000.	136000.	254000.	586000.
1966	AVG	221716.	405086.	236903.	201300.	444452.	89627.	78084.	95035.	84133.	98203.	151700.	364774.
	MIN	84500.	96800.	130000.	109000.	131000.	70300.	56500.	73400.	63600.	71700.	82100.	146000.
	N	31.	28.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	352000.	341000.	786000.	453000.	752000.	276000.	332000.	222000.	133000.	137000.	211000.	634000.
1967	AVG	205129.	273071.	608710.	272100.	558452.	149103.	200194.	153671.	101603.	114071.	157933.	480419.
	MIN	122000.	149000.	230000.	200000.	309000.	88500.	116000.	94800.	81400.	88000.	122000.	226000.
	N	31.	29.	31.	30.	31.	30.	31.	31.	30.	31.	30.	31.
	MAX	500000.	586000.	682000.	683000.	622000.	711000.	140000.	215000.	72100.	98700.	209000.	300000.
1968	AVG	394806.	363138.	364548.	474433.	310806.	393933.	112135.	139497.	60930.	74203.	116130.	193387.
	MIN	272000.	111000.	87500.	210000.	160000.	129000.	89600.	53400.	45300.	57300.	69900.	104000.
	N	31.	28.	31.	30.	31.	30.	31.	31.				
	MAX	563000.	853000.	260000.	536000.	321000.	261000.	229000.	215000.				
1969	AVG	303270.	585373.	186000.	395167.	233516.	140953.	168032.	125916.				
	MIN	98000.	230000.	130000.	231000.	143000.	86100.	119000.	68100.				

OHIO RIVER VALLEY WATER SANITATION COMMISSION

APPENDIX E

OHIO RIVER CROSS SECTION DATA

December 1975

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
0.0	PITTSBURGH, PA.	18.55	1988	34750.3	710.0
1.0		24.32	922	20776.6	710.0
2.0		16.82	1648	25290.1	710.0
2.3	REED				
3.0		22.32	1208	24930.5	710.0
3.1	ALCOSAN				
4.0		21.19	1160	22652.9	710.0
5.0		19.02	1722	29249.0	710.0
5.2	USS CHEMICAL				
6.0		21.50	1546	30421.4	710.0
6.2	EMSWORTH LD				
7.0	DIXMONT HOSP.	11.25	1642	16629.5	692.0
8.0	SHENANGO STEEL	15.07	1274	17215.3	692.0
9.0		12.27	1652	18276.4	692.0
10.0		12.27	1930	21819.6	692.0
10.2	CORAPOLIS				
11.0		22.84	1202	25303.1	692.0
11.8	SEWICKLEY				
12.0		22.12	1114	22935.0	692.0
13.0		16.52	1456	22916.7	692.0
13.3	DASHIELDS LD				
13.9	LEETSDALE				
14.0		13.84	984	12703.2	682.0
15.0		15.63	1348	19967.9	682.0
15.8	SOUTH HEIGHTS				
16.0	F.R.PHILLIPS	17.54	1256	20420.3	682.0
17.0	HOPEWELL	19.60	1032	17940.7	682.0
18.0		19.41	1158	20745.5	682.0
19.0		16.33	1172	17624.1	682.0
20.0	ALIQUIPPA	16.52	1228	18212.4	682.0
21.0		21.74	1642	33540.8	682.0
22.0		19.77	1556	28891.6	682.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
23.0		22.41	1248	26134.5	682.0
24.0		22.62	1392	29727.2	682.0
25.0	ROCHESTER AUTH.	24.04	1510	34137.7	682.0
25.6	BEAVER RIVER				
26.0		22.35	1256	26298.1	682.0
27.0		22.22	1414	29800.6	682.0
28.0		27.65	1450	37639.4	682.0
29.0		26.79	1312	33209.7	682.0
29.7	SINCLAIR-KOPPERS				
30.0		27.21	1696	43344.8	682.0
31.0		26.71	2118	53421.1	682.0
31.7	MONTGOMERY LD				
32.0		17.81	1578	26087.7	664.5
33.0		20.40	1244	23581.6	664.5
33.8	SHIPPINGPORT				
34.0		19.32	1188	21234.2	664.5
35.0		11.21	2192	23244.4	664.5
36.0		19.94	1208	22714.3	664.5
36.3	CRUCIBLE STEEL				
37.0		23.91	1126	24935.4	664.5
38.0		19.83	1384	25674.3	664.5
39.0		21.16	1294	24431.1	664.5
40.0	STATE LINE	24.74	1386	32229.0	664.5
41.0		20.33	1782	33945.1	664.5
42.0		20.56	1672	31333.2	664.5
42.3	CHESTER				
43.0		27.62	1280	33304.8	664.5
43.5	EAST LIVERPOOL				
44.0		28.85	1018	26894.4	664.5
45.0		26.71	1318	33107.5	664.5
46.0		25.04	1224	27774.8	664.5
46.3	NEWELL,WELLSVILLE				

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
47.0		21.35	1294	25964.8	664.5
48.0		25.85	1370	32328.4	664.5
49.0		23.55	1482	32807.2	664.5
50.0		30.59	1126	32791.8	664.5
51.0		31.35	1072	31614.8	664.5
52.0		25.61	2516	61521.5	664.5
53.0		30.59	1332	38543.5	664.5
53.9	STRATTON				
54.0	W.H.SAMMIS PP	30.04	2014	55866.0	664.5
54.4	NEW CUMBERLAND LD				
55.0		18.08	1324	22575.4	644.0
56.0		13.57	1098	13634.1	644.0
57.0		12.66	1238	14467.5	644.0
58.0		14.39	1268	16718.8	644.0
59.0		20.74	1086	20044.5	644.0
59.1	TORONTO,NEWCUMB.				
60.0	TORONTO PP	13.93	1182	15281.8	644.0
61.0		10.82	1506	14917.3	644.0
62.0		12.10	1762	19289.2	644.0
62.2	NATIONAL STEEL				
63.0	WEIRTON	13.44	1646	20392.4	644.0
64.0		17.91	1368	22213.9	644.0
65.0		25.80	1216	28276.9	644.0
66.0		18.93	1230	20859.3	644.0
67.0		17.65	1302	20596.7	644.0
68.0	STEUBENVILLE	23.42	1082	23180.5	644.0
68.8	WHEELING STEEL STB.				
69.0		24.82	940	20602.3	644.0
70.0		19.98	1214	21673.0	644.0
70.4	WHEELING STEEL FOLL				
71.0	MINGO JUNCTION-IND.	24.28	1272	27614.1	644.0
72.0		26.44	1006	23704.1	644.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
73.0		22.93	1520	31890.3	644.0
74.0		29.36	1102	27963.7	644.0
75.0	TIDD	25.56	1408	33292.9	644.0
76.0	CARDINAL	25.32	1498	34606.2	644.0
77.0		26.40	1354	32775.8	644.0
78.0		23.80	1664	37265.1	644.0
79.0		25.15	1588	36627.3	644.0
79.8	WINDSOR				
80.0		27.80	1292	32504.5	644.0
81.0		28.85	1216	32543.6	644.0
82.0		25.44	1596	36992.4	644.0
83.0		30.16	1274	34956.3	644.0
84.0		26.88	1894	46334.1	644.0
84.2	PIKE ISLAND LD				
86.0		10.53	1318	12744.7	623.0
87.1		12.02	1182	13208.3	623.0
87.5		11.51	1478	16158.6	623.0
88.8	WHEELING STEEL-MF,BE				
89.0		15.02	1286	17913.5	623.0
90.0		13.36	1518	18467.7	623.0
90.3	WHEELING				
91.0		12.76	1448	16954.5	623.0
92.0		17.28	772	12003.0	623.0
93.0		16.03	1258	18844.0	623.0
94.0		20.84	896	17358.4	623.0
95.0	BELMONT COUNTY AUTH	17.37	1240	19956.0	623.0
96.0		18.68	1014	17687.7	623.0
96.1	DAM 13				
97.0		23.90	1050	23514.7	623.0
98.0	SHADYSIDE GLENDALE	23.83	936	20804.7	623.0
99.0		24.11	1014	23013.0	623.0
100.0		23.28	960	20832.7	623.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
101.0		19.41	1428	26069.6	623.0
101.5	MOUNDSVILLE GLEN DA				
102.0		24.78	1034	24210.5	623.0
102.5	R.E.BURGER PP				
103.0		25.32	950	22372.9	623.0
104.0		25.34	1296	30641.9	623.0
105.0	ALLIED CHEM.N&S	23.93	1106	24631.5	623.0
106.0		25.29	1064	25105.5	623.0
107.0		27.99	936	24353.6	623.0
108.0		25.30	1178	27919.5	623.0
109.0		31.29	800	23231.5	623.0
109.8	POWHATIN POINT				
110.0		30.77	1110	30570.4	623.0
111.0		31.96	1044	31285.5	623.0
111.1	KAMMER				
112.0		31.72	1014	30048.3	623.0
113.0		25.65	2000	48652.1	623.0
114.0		29.99	1100	30778.9	623.0
115.0		33.19	1224	39627.8	623.0
116.0		33.78	1134	35909.6	623.0
117.0		39.29	920	35266.4	623.0
118.0		31.49	1008	29723.0	623.0
119.0	MOBAY CHEMICAL	35.00	1064	34913.0	623.0
120.0		30.28	1204	34497.9	623.0
121.0		36.76	1048	36520.6	623.0
122.0		36.46	1040	36997.3	623.0
123.0		33.46	1334	42023.5	623.0
124.0		38.49	1106	39870.4	623.0
125.0		39.50	912	33621.6	623.0
126.0		38.86	1014	37113.6	623.0
127.0		17.79	1176	19565.8	602.0
128.0		14.67	1090	14732.5	602.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
129.0		14.90	1040	14334.4	602.0
129.1	DAM 15				
130.0	NEW MARTINSVILLE,PAD	18.37	986	16626.9	602.0
131.0		22.20	674	13543.7	602.0
132.0		16.34	1242	17816.2	602.0
133.0		16.38	1006	14126.0	602.0
134.0		16.55	1218	17539.2	602.0
135.0		17.28	1510	23147.2	602.0
136.0		19.00	1154	19782.9	602.0
137.0		19.72	1120	20289.5	602.0
138.0		20.92	1196	22934.0	602.0
139.0		15.41	1664	22752.4	602.0
140.0	SISTERVILLE,NEW METM	23.33	1134	24357.3	602.0
141.0		18.80	1364	23626.1	602.0
142.0		21.49	1364	27025.1	602.0
143.0		20.86	1456	27110.3	602.0
144.0		19.61	1296	23497.6	602.0
145.0		22.59	1234	25539.3	602.0
146.0		21.20	1238	24035.2	602.0
146.5	DAM 16				
147.0		25.35	1140	26654.0	602.0
148.0		25.72	1134	26815.0	602.0
149.0		25.47	1152	26978.2	602.0
150.0		25.78	1044	24826.0	602.0
151.0		25.67	1240	29409.0	602.0
152.0		24.14	1344	28876.9	602.0
153.0		24.56	1140	25812.9	602.0
154.0		28.23	1008	26172.3	602.0
155.0		32.76	938	27881.0	602.0
156.0		32.35	832	24622.0	602.0
157.0	ST.MARYS,COL.AND.BEL	29.77	1240	34205.4	602.0
158.0		28.50	1036	27003.0	602.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
159.0		22.02	1536	30055.2	602.0
160.0		24.40	1540	33344.2	602.0
160.2		23.93	1310	27742.3	602.0
160.6	WILLOW ISLAND PP				
161.0	AMERICAN CYANAMID	26.02	1172	27872.6	602.0
172.2	MUSKINGUM RIVER				
184.6	PARKERSBURG				
191.0	SHELL,DUP.,MARBORN				
203.9	BELLEVILLE LD				
221.0	RAVENSWOOD,KAISER AL				
237.5	RACINE LD				
241.5	NEW HAVEN				
241.6	SPORN PP				
251.5	POMEROY,MIDDLEPORT				
260.0	KYGER CREEK PP				
265.6	KANAWHA RIVER				
270.0	STAUFFER CHEM				
279.0	GALLIPOLIS LD				
280.0		19.23	880	15433.8	515.0
281.0		19.96	1002	15711.4	515.0
282.0		25.50	1146	23961.3	515.0
283.0		22.85	1066	20117.2	515.0
284.0		17.36	1050	16316.0	515.0
285.0		14.60	940	11197.9	515.0
286.0		22.15	756	14931.2	515.0
287.0		17.15	1182	18095.3	515.0
288.0		17.14	1260	19380.9	515.0
289.0		15.79	1164	16245.0	515.0
290.0		17.36	960	13598.2	515.0
291.0		18.68	812	13399.8	515.0
292.0		23.54	954	20063.8	515.0
293.0		24.38	770	16621.4	515.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
294.0		23.01	996	20407.0	515.0
295.0		24.44	742	15968.7	515.0
296.0		24.67	854	19555.4	515.0
297.0		22.21	872	17050.6	515.0
298.0		25.54	836	18434.9	515.0
299.0		24.13	834	17551.6	515.0
300.0		26.05	1000	23456.3	515.0
301.0		19.58	1274	24181.3	515.0
302.0		19.90	986	18027.9	515.0
303.0		21.24	1058	19800.4	515.0
304.0		20.03	1256	23321.0	515.0
304.2	HUNTINGTON WW				
305.0		19.39	1198	21500.7	515.0
306.0		21.75	1306	25245.2	515.0
307.0		25.02	966	21495.4	515.0
307.5	PROCTERVILLE,CHESAPE				
308.0		23.74	1470	31557.3	515.0
308.3	HUNTINGTON STP				
309.0		24.52	1344	29496.5	515.0
310.0		27.08	1364	33278.6	515.0
311.0		23.84	1414	30186.0	515.0
312.0		24.63	1244	28116.7	515.0
313.0		25.14	1222	27672.4	515.0
314.0		24.91	1274	28954.6	515.0
315.0	CEREDO,KENOVA	27.21	1332	32417.3	515.0
316.0		28.11	1056	26601.6	515.0
317.0	BIG SANDY RIVER	29.88	1300	35110.7	515.0
317.1	S.POINT,CATLETTSBURG				
318.0		31.34	1014	28734.4	515.0
319.0	ALLIED CHEM.NIT.	31.35	1056	29701.7	515.0
320.0		34.27	972	29791.1	515.0
321.0		33.86	1222	37468.4	515.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
322.0		33.86	840	25479.4	515.0
322.6	ASHLAND				
323.0		44.28	800	31325.0	515.0
324.0		32.17	1400	40950.8	515.0
324.2	ALLIED CHEM.PLASTICS				
324.6	ARMCO				
325.0		33.55	1116	33576.7	515.0
326.0		34.85	1260	39523.3	515.0
327.0		35.84	1022	32601.4	515.0
327.2	IRONTON				
328.0		32.61	1078	31793.5	515.0
328.3	FLATWOODS,WORTHINGTO				
329.0		31.65	1258	36315.9	515.0
330.0		41.18	930	33898.3	515.0
331.0		40.08	1154	41437.8	515.0
332.0	USS CHEM.DUPONT,DOW	33.41	1364	41354.0	515.0
333.0		33.91	1344	40991.7	515.0
334.0		33.84	1364	41635.7	515.0
335.0		35.03	1458	46298.4	515.0
336.0		36.28	1116	36282.3	515.0
337.0		40.82	1086	39490.6	515.0
338.0		41.48	1034	37562.1	515.0
339.0		38.36	1364	47552.6	515.0
340.0		39.90	1372	49983.2	515.0
341.0	GREENUP LD	12.39	1168	13282.0	485.0
342.0		12.94	1176	13459.1	485.0
343.0		11.57	1162	11991.5	485.0
344.0		15.69	1116	15464.5	485.0
345.0		13.80	1110	13452.7	485.0
346.0		14.49	1158	14937.7	485.0
347.0		10.60	1358	12579.5	485.0
348.0		12.74	1230	13689.9	485.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
349.0		10.33	1338	12050.4	485.0
350.0		10.58	1346	12503.3	485.0
351.0	PORTSMOUTH WW	14.18	1204	15097.7	485.0
351.1	DETROIT STEEL				
351.8	NEW BOSTON				
352.0		9.99	1498	13134.3	485.0
353.0		9.39	1644	13766.1	485.0
354.0		12.17	1592	17507.8	485.0
355.0		14.98	1432	19225.2	485.0
356.0	PORTSMOUTH STP	19.05	1226	20718.9	485.0
356.5	SCIOTO RIVER				
357.0		13.41	1544	17745.5	485.0
358.0		12.52	1436	15924.9	485.0
359.0		17.45	1398	21894.8	485.0
360.0		16.67	1454	21681.7	485.0
361.0		17.68	1440	23097.3	485.0
362.0		16.58	1630	24543.0	485.0
363.0		18.02	1454	23451.4	485.0
364.0		17.22	1552	23998.6	485.0
365.0		18.97	1482	25408.8	485.0
366.0		21.03	1518	29073.9	465.0
367.0		18.36	1362	22669.1	485.0
368.0		19.41	1282	22225.3	485.0
369.0		19.90	1454	25968.5	485.0
370.0		23.22	1258	26206.5	485.0
371.0		21.20	1378	26047.6	485.0
372.0		21.75	1468	28763.1	485.0
373.0		23.33	1338	27983.5	485.0
374.0		22.64	1296	26685.1	485.0
375.0		27.12	1092	26652.0	485.0
376.0		27.32	1208	29780.7	485.0
377.0		26.28	1162	27336.9	485.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
378.0		25.61	1080	24728.1	485.0
379.0		26.67	1080	25764.3	485.0
380.0	VANCEBURG,ABERDEEN	29.37	1274	33927.3	485.0
381.0		27.08	1098	26292.1	485.0
382.0		22.65	1558	31556.7	485.0
383.0		25.63	1572	36780.2	485.0
384.0		21.77	1618	32043.7	485.0
385.0		21.12	1798	34705.9	485.0
386.0		26.00	1694	39944.0	485.0
387.0		23.95	1728	37784.3	485.0
388.0		25.77	2162	49559.8	485.0
389.0		28.80	1410	37048.5	485.0
390.0		31.47	1290	37112.5	485.0
391.0		24.38	1726	38185.0	485.0
392.0		24.39	2142	47940.0	485.0
393.0		26.25	1900	46102.9	485.0
394.0		28.87	1564	41524.0	485.0
395.0		23.85	2604	58151.5	485.0
396.0		25.19	2582	57603.7	485.0
397.0		26.71	1842	45415.5	485.0
398.0		25.21	1870	43279.4	485.0
399.0		28.57	1550	41958.6	485.0
400.0		32.54	1456	42845.2	485.0
401.0		30.56	1358	37774.6	485.0
402.0		32.26	1440	42695.3	485.0
403.0		30.52	1598	44983.0	485.0
404.0		36.73	1118	34459.7	485.0
405.0		33.31	1482	44705.5	485.0
405.7	J.M.STUART PP				
406.0		25.89	1998	47423.1	485.0
407.0		30.60	1468	40714.1	485.0
408.0		27.95	1680	43050.6	485.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
409.0		28.88	1504	39843.3	485.0
410.0		38.76	1364	48625.5	485.0
411.0		40.37	1500	55574.0	485.0
411.8	MAYSVILLE				
412.0		34.26	1842	58297.1	485.0
413.0		39.54	1232	44374.7	485.0
414.0		33.99	1806	56031.9	485.0
415.0		33.61	2404	77521.1	485.0
416.0		39.71	1442	52447.0	485.0
417.0		40.16	1442	52620.0	485.0
418.0		35.07	1834	58458.6	485.0
419.0		36.75	1620	54610.0	485.0
420.0		36.65	1890	64022.2	485.0
421.0		33.99	1888	59036.8	485.0
422.0		33.42	2178	67429.7	485.0
423.0		40.70	1504	56423.5	485.0
424.0		37.54	2090	72399.8	485.0
425.0		34.50	1940	62148.0	485.0
426.0		40.93	1782	66254.2	485.0
427.0		36.97	1972	67453.1	485.0
428.0		33.95	2396	75107.1	485.0
429.0		35.05	2144	69249.5	485.0
430.0		38.12	2112	74282.4	485.0
431.0		36.86	2124	72674.5	485.0
432.0		34.73	2394	77185.3	485.0
433.0		35.79	2244	74271.2	485.0
434.0		38.61	2240	79014.7	485.0
435.0		41.97	2250	86812.8	485.0
436.0		43.45	2088	84318.7	485.0
436.2	MELDAHL LD				
436.4		11.43	1996	21693.2	455.0
436.5		10.32	1668	16260.4	455.0

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
436.6		9.33	1658	14537.7	455.0
436.8		9.58	1920	17330.3	455.0
436.9		11.26	1964	20943.0	455.0
437.0		10.19	2028	19493.7	455.0
437.1		9.99	1920	18121.1	455.0
437.2		10.00	1890	17793.2	455.0
437.4		10.60	1904	19145.5	455.0
437.5		11.86	1938	21871.2	455.0
437.6		13.59	1794	23382.4	455.0
437.7		13.83	1706	22706.3	455.0
437.9		14.96	1766	25504.5	455.0
438.0		14.46	1684	23541.0	455.0
438.1		13.73	1750	21942.1	455.0
438.2		13.75	1716	22597.8	455.0
438.3		15.76	1840	27921.4	455.0
438.5		13.06	1768	22126.9	455.0
438.6		14.01	1804	24246.8	455.0
438.7		14.02	1722	23180.6	455.0
439.0		19.19	1452	27019.3	455.0
439.2		18.66	1458	26391.8	455.0
439.5		19.18	1474	27513.5	455.0
439.7		19.36	1470	27599.2	455.0
440.0		19.20	1484	27697.1	455.0
440.3		20.35	1410	27966.9	455.0
440.5		20.30	1350	26580.3	455.0
440.7		20.65	1428	28577.7	455.0
441.0		19.02	1548	28582.1	455.0
441.2		16.39	1640	25910.7	455.0
441.5		16.75	1660	26731.3	455.0
441.7		17.12	1658	27379.5	455.0
442.0		19.29	1562	29078.0	455.0
442.3		21.11	1464	29978.9	455.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
442.5		19.50	1536	29134.7	455.0
442.8		19.63	1498	28394.9	455.0
443.0		18.82	1604	29216.9	455.0
443.2		17.74	1640	28151.4	455.0
443.5		16.23	1706	26656.1	455.0
443.8		15.42	1736	25755.5	455.0
444.2		15.38	1812	26769.4	455.0
444.5		15.38	1792	26503.2	455.0
444.7		14.46	1788	24684.5	455.0
445.0		13.43	1870	24051.7	455.0
445.2		14.90	1846	26244.3	455.0
445.5		14.88	1738	24841.5	455.0
445.7		14.89	1772	25323.0	455.0
446.0		18.85	1548	28213.8	455.0
446.2		19.04	1558	28578.7	455.0
446.5		19.38	1596	27989.4	455.0
446.7		19.15	1618	30009.9	455.0
447.0		16.52	1774	28168.1	455.0
447.2		15.70	1864	28228.7	455.0
447.5		14.19	1838	25073.5	455.0
447.7		14.29	1800	24722.4	455.0
448.0		14.75	1812	25689.5	455.0
448.3		14.71	1874	26497.5	455.0
448.5		12.82	2022	24776.2	455.0
448.7		12.60	2030	24344.9	455.0
448.8		13.04	2046	25530.2	455.0
448.9		13.45	1994	25686.4	455.0
449.0		13.78	2118	26405.9	455.0
449.2		14.33	2022	27794.5	455.0
449.3		15.33	1916	28131.2	455.0
449.4		15.11	1902	27615.6	455.0
449.5		15.11	1804	26159.6	455.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
449.7		14.89	1836	26287.3	455.0
449.8		15.14	1900	27668.9	455.0
449.9		15.34	1792	26312.7	455.0
450.0	NEW RICHMOND	15.42	1858	27537.2	455.0
450.2		16.97	1834	29928.5	455.0
450.5		17.22	1768	29419.6	455.0
450.7		18.51	1698	30399.5	455.0
451.0		24.54	1626	38632.6	455.0
451.1		22.66	1704	37337.1	455.0
451.2		19.25	1778	33162.4	455.0
451.4		18.70	1692	30720.1	455.0
451.5		17.45	1692	28471.3	455.0
451.6		17.99	1626	28199.0	455.0
451.7		19.09	1632	30100.6	455.0
451.8		17.85	1728	29821.0	455.0
452.0		17.59	1780	30267.8	455.0
452.1		17.55	1782	30306.4	455.0
452.2		17.81	1780	30635.4	455.0
452.3		17.53	1776	30124.7	455.0
452.5		16.55	1902	30363.1	455.0
452.6		16.06	1862	28560.2	455.0
452.7		17.45	1902	32057.9	455.0
452.9	BECKJORD PP				
453.0		16.76	1892	30446.6	455.0
453.3		15.95	1860	28462.5	455.0
453.6		17.30	1832	30536.8	455.0
453.7		16.45	1858	29445.7	455.0
454.0		16.62	1862	29699.8	455.0
454.3		18.37	1722	30217.2	455.0
454.5		18.37	1768	31290.3	455.0
454.7		17.68	1838	31206.0	455.0
455.0		17.17	1882	31194.4	455.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
455.2		16.66	1878	29990.0	455.0
455.5		15.43	2008	29561.2	455.0
455.6		14.93	2132	30547.7	455.0
455.7		15.04	2188	31590.3	455.0
455.8		14.77	2190	30998.7	455.0
456.0		16.37	2016	31772.5	455.0
456.1		15.20	2050	29704.2	455.0
456.2		15.12	2114	30716.1	455.0
456.3		15.11	2040	29486.7	455.0
456.5		16.20	2092	32415.8	455.0
456.6		16.01	2072	31823.5	455.0
456.7		16.39	2014	31761.6	455.0
456.8		16.95	1980	32130.2	455.0
457.0		17.65	1940	33122.1	455.0
457.2		17.83	1926	33201.8	455.0
457.3		18.45	1924	34344.7	455.0
457.4		18.62	1876	33632.5	455.0
457.5		22.92	1562	34719.4	455.0
457.7		20.23	1716	33613.9	455.0
458.0		19.74	1732	33022.4	455.0
458.2		19.83	1674	31848.4	455.0
458.5		19.17	1768	32632.7	455.0
458.7		19.31	1922	35741.8	455.0
459.0		18.19	1954	34118.3	455.0
459.2		18.29	1968	34681.1	455.0
459.3		18.98	1894	34815.3	455.0
459.5		19.64	1692	32009.4	455.0
459.6		20.15	1676	32645.3	455.0
459.7		20.67	1710	34271.3	455.0
460.0		18.72	1920	34769.3	455.0
460.2		19.04	1932	35669.4	455.0
460.4		19.19	1936	35985.6	455.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
460.7		21.35	1776	36759.1	455.0
461.0		34.92	1600	53289.2	455.0
461.2		26.58	1700	43067.3	455.0
461.4		26.61	1416	36738.1	455.0
461.5		26.78	1530	38159.7	455.0
461.7		27.62	1460	38195.6	455.0
462.0		27.15	1480	38855.3	455.0
462.2		29.31	1248	35160.8	455.0
462.5		30.62	1250	36397.9	455.0
462.7	CINCINNATI WW	31.28	1178	35736.6	455.0
463.0		30.49	1360	39603.4	455.0
463.2		29.05	1340	37362.7	455.0
463.5	LITTLE MIAMI R	26.98	1540	39656.7	455.0
463.7		27.84	1410	35832.6	455.0
464.0		25.89	1450	35539.9	455.0
464.2		25.78	1460	34672.7	455.0
464.5		28.21	1340	36278.4	455.0
464.7		28.07	1400	36948.8	455.0
465.0		28.66	1360	37189.3	455.0
465.1	LITTLE MIAMI STP				
465.2		32.28	1270	38455.0	455.0
465.5		29.93	1320	37679.8	455.0
465.7		28.78	1420	39241.3	455.0
466.0		26.96	1410	34650.3	455.0
466.1		26.47	1420	35869.2	455.0
466.2		26.61	1450	36534.9	455.0
466.3		24.58	1510	34151.3	455.0
466.5		24.38	1450	33175.6	455.0
466.6		25.40	1428	35037.1	455.0
466.7		25.43	1410	33819.0	455.0
466.9		25.56	1370	33284.7	455.0
467.0		26.21	1350	32978.6	455.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
467.1		26.18	1380	33912.9	455.0
467.2		26.19	1370	34403.3	455.0
467.5		24.68	1430	33598.0	455.0
467.7		30.07	1220	35206.9	455.0
468.0		35.20	1110	37168.1	455.0
468.2		32.00	1160	34378.5	455.0
468.5		32.77	1150	34898.2	455.0
468.7		27.75	1280	33280.4	455.0
469.0		27.38	1320	33612.2	455.0
469.2		28.87	1340	36846.9	455.0
469.5		29.61	1240	34946.6	455.0
469.7		29.29	1360	37705.8	455.0
470.0		27.16	1340	34667.6	455.0
470.2	LICKING RIVER	27.37	1480	38356.3	455.0
470.5		38.67	1200	42749.4	455.0
470.7		31.54	1310	39090.3	455.0
471.0		36.22	1270	43582.7	455.0
471.2	WEST END PP	34.49	1260	41074.7	455.0
471.5		30.44	1220	35059.7	455.0
471.7		29.51	1110	30732.9	455.0
472.0		33.64	1130	34804.6	455.0
472.2		33.90	1120	35380.3	455.0
472.5		34.95	1230	40346.8	455.0
472.6	MILL CREEK STP				
472.7		38.46	1230	44771.1	455.0
473.0		40.11	1170	44823.4	455.0
473.2		34.10	1080	34274.3	455.0
473.5		28.35	1250	31225.2	455.0
473.7		31.81	1240	36916.9	455.0
474.0	CAMPBELL-KENTON CO.	31.36	1400	41666.0	455.0
474.2		29.71	1430	39783.4	455.0
474.5		34.73	1380	44819.4	455.0

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
474.7		40.38	1160	43564.9	455.0
475.0		35.82	1280	42763.1	455.0
475.2		31.34	1500	44395.5	455.0
475.5		28.51	1650	43736.0	455.0
475.7		27.88	1750	46258.4	455.0
476.0		26.13	1840	45674.9	455.0
476.2		29.44	1550	43066.7	455.0
476.4		35.37	1360	45378.4	455.0
476.7		36.72	1270	43269.9	455.0
477.0		36.88	1350	46649.7	455.0
477.2		35.17	1460	48600.1	455.0
477.5		28.73	1580	42703.1	455.0
477.7		38.03	1360	48456.8	455.0
478.0		34.87	1478	48568.3	455.0
478.2		38.02	1390	49594.1	455.0
478.5		33.55	1510	47278.6	455.0
478.7		34.70	1480	49655.4	455.0
479.0		36.45	1380	46712.2	455.0
479.2		36.14	1430	48712.2	455.0
479.5		33.37	1560	47584.3	455.0
479.7		32.21	1640	49690.7	455.0
480.0		31.21	1660	48470.8	455.0
480.2		32.80	1630	49701.5	455.0
480.5		33.05	1640	50051.5	455.0
480.7		27.19	1520	38329.6	455.0
481.0		37.62	1320	43423.4	455.0
481.2	MUDDY CREEK STP	36.91	1400	45539.7	455.0
481.5		35.41	1550	51338.2	455.0
481.7		34.21	1510	48190.2	455.0
482.0		37.80	1300	44096.1	455.0
482.2		41.96	1250	46478.5	455.0
482.5		38.82	1400	50177.0	455.0

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
482.7		34.22	1600	51602.1	455.0
483.0		32.64	1640	50424.7	455.0
483.2		32.14	1570	47716.3	455.0
483.5		32.84	1570	49109.2	455.0
483.7		32.67	1560	48124.8	455.0
484.0		32.68	1720	53405.3	455.0
484.2		31.66	1720	50130.2	455.0
484.4		31.07	1760	50313.7	455.0
484.7		30.99	1720	49661.3	455.0
485.0		31.93	1670	49883.8	455.0
485.2		32.50	1650	50501.0	455.0
485.5		34.40	1570	51122.2	455.0
485.7		32.71	1600	49569.3	455.0
486.0		30.50	1730	49445.0	455.0
486.2		30.51	1690	48578.9	455.0
486.5	CLEVES,MONS.KOP.CHEV	31.75	1630	48086.0	455.0
486.7		35.33	1400	46280.3	455.0
487.0		39.17	1240	44849.9	455.0
487.2		41.14	1180	45156.6	455.0
487.5		42.38	1220	48588.9	455.0
487.7		39.87	1310	49128.0	455.0
488.0		38.58	1360	49514.1	455.0
488.2		36.89	1450	49831.3	455.0
488.5		35.36	1570	51561.6	455.0
488.7		32.99	1710	52938.9	455.0
489.0		31.98	1770	53446.8	455.0
489.2		31.66	1780	52290.5	455.0
489.5		33.05	1740	52769.1	455.0
489.7		36.10	1510	50554.1	455.0
490.0		37.82	1400	49685.0	455.0
490.2		39.45	1390	51455.2	455.0
490.4	MIAMI FORT PP				

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
490.5		37.68	1570	54711.9	455.0
490.7		35.85	1590	53744.2	455.0
490.9		29.50	1474	40248.5	455.0
491.1	GREAT MIAMI RIVER				
491.2		33.56	1230	38432.3	455.0
491.5		29.78	1514	41359.6	455.0
491.7		28.46	1698	45266.5	455.0
492.0		26.86	1750	44688.0	455.0
492.2		29.94	1570	43855.2	455.0
492.5		30.45	1510	43709.3	455.0
492.7		33.80	1510	47346.3	455.0
493.0		33.56	1590	46021.5	455.0
493.2	SOUTH DEARBORN REGI	31.62	1680	49510.4	455.0
493.5		32.38	1640	49404.5	455.0
493.7		35.41	1500	48548.0	455.0
494.0		36.39	1440	46269.1	455.0
494.2	TANNERS CREEK	40.70	1250	45940.2	455.0
494.5		38.49	1320	46144.7	455.0
494.7		38.97	1380	48543.0	455.0
495.0		36.45	1480	49040.9	455.0
495.2		35.91	1530	49989.7	455.0
495.4	AURORA	37.43	1510	53999.4	455.0
495.7		38.48	1500	53194.6	455.0
496.0		37.89	1610	56167.1	455.0
496.2		37.93	1600	55803.7	455.0
496.4		38.77	1540	55132.6	455.0
496.7		38.81	1620	55186.1	455.0
497.0		39.45	1320	46867.4	455.0
497.2		50.21	960	42856.7	455.0
497.5		46.04	1150	48352.5	455.0
497.7		43.19	1300	50822.9	455.0
498.0		37.01	1570	55764.5	455.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
498.2		31.26	1770	52579.7	455.0
498.4		29.27	1630	46632.3	455.0
498.7		32.34	1560	46504.9	455.0
499.0		32.60	1580	50348.1	455.0
499.2		35.61	1630	52349.7	455.0
499.5		40.21	1420	55682.1	455.0
499.7		38.94	1490	55416.4	455.0
500.0		47.99	1210	52799.3	455.0
500.2		46.23	1250	54508.2	455.0
500.4		41.85	1460	55964.1	455.0
500.7		38.10	1600	58319.0	455.0
501.0		35.44	1720	58673.5	455.0
501.2		32.99	1790	55573.5	455.0
501.5		26.78	2360	60504.1	455.0
501.7		25.51	2500	59316.6	455.0
502.0		31.52	1910	54597.9	455.0
502.2		34.18	1900	60216.7	455.0
502.5		33.50	1710	53106.7	455.0
502.7		36.43	1650	57498.3	455.0
503.0		36.64	1750	60244.1	455.0
503.2		36.75	1690	59107.2	455.0
503.4		39.43	1740	64538.7	455.0
503.7		35.95	1770	59252.6	455.0
504.0		35.20	1700	54558.0	455.0
504.2		37.43	1550	56945.8	455.0
504.5		37.43	1640	60162.2	455.0
504.7		37.35	1670	60430.3	455.0
505.0		37.03	1600	57308.6	455.0
505.2		36.18	1720	59069.0	455.0
505.5		31.96	2000	60879.8	455.0
505.7		29.21	2210	61660.0	455.0
506.0	RISING SUN	33.53	2070	65588.7	455.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
506.2		34.72	1830	61153.2	455.0
506.5		34.28	1840	60370.2	455.0
506.7		34.75	1840	60915.7	455.0
507.0		36.85	1680	59955.3	455.0
507.2		36.01	1830	61689.4	455.0
507.5		33.88	1930	62009.7	455.0
507.7		35.91	1800	61226.3	455.0
508.0		37.27	1680	60583.2	455.0
508.2		38.55	1630	60084.2	455.0
508.5		38.48	1660	61428.1	455.0
508.7		39.89	1630	61370.7	455.0
509.0		41.82	1390	56534.3	455.0
509.2		42.77	1390	56270.1	455.0
509.5		41.81	1460	58242.9	455.0
509.7		41.81	1644	66169.5	455.0
510.0		39.87	1600	61742.6	455.0
510.2		38.81	1560	58525.8	455.0
510.5		37.74	1570	56635.2	455.0
510.7		41.73	1380	54716.7	455.0
511.0		47.96	1160	52629.3	455.0
511.2		49.76	1180	54664.4	455.0
511.5		50.39	1240	59386.2	455.0
511.7		45.57	1460	62660.9	455.0
512.0		42.97	1630	67421.6	455.0
512.2		43.78	1620	67530.0	455.0
512.5		40.42	1740	68098.3	455.0
512.7		39.39	1840	68818.7	455.0
513.0		36.99	1860	66019.1	455.0
513.2		39.48	1750	65901.7	455.0
513.5		37.61	1790	64182.8	455.0
513.7		38.44	1780	65642.9	455.0
514.0		39.55	1720	65245.2	455.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
514.2		38.86	1760	65926.9	455.0
514.5		40.67	1720	66630.6	455.0
514.7		41.44	1720	68265.7	455.0
515.0		48.04	1350	61354.3	455.0
515.2		50.18	1210	56718.4	455.0
515.5		45.65	1350	58264.2	455.0
515.7		45.77	1380	60309.4	455.0
516.0		46.71	1450	64700.4	455.0
516.2		44.67	1550	66304.7	455.0
516.5		39.35	1900	72184.9	455.0
516.7		36.03	2300	78703.8	455.0
517.0		33.75	2100	65280.8	455.0
517.2		37.52	1890	66883.9	455.0
517.4		39.43	1810	69236.6	455.0
517.7		41.22	1630	64762.5	455.0
518.0		43.57	1610	68078.3	455.0
518.2		41.12	1800	71483.1	455.0
518.5		39.90	1990	75620.1	455.0
518.7		38.80	2000	75008.4	455.0
519.0		38.64	1920	70868.5	455.0
519.2		36.94	1940	69175.9	455.0
519.5		39.78	1740	66727.6	455.0
519.7		41.10	1610	63334.0	455.0
520.0		47.29	1280	57167.6	455.0
520.2		46.56	1290	57624.8	455.0
520.4		47.41	1250	55493.9	455.0
520.7		47.09	1340	58776.3	455.0
521.0		47.91	1370	61772.4	455.0
521.2		46.06	1490	64414.7	455.0
521.5		47.34	1500	67129.7	455.0
521.7		45.89	1620	70060.7	455.0
522.0		44.93	1700	72553.9	455.0

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
522.2		43.11	1830	75087.7	455.0
522.5		43.57	1878	77915.5	455.0
522.7		41.24	1772	66959.4	455.0
523.0		45.96	1440	63286.4	455.0
523.2		52.67	1200	60139.5	455.0
523.5		50.50	1280	61121.5	455.0
523.7		48.47	1310	60598.4	455.0
524.0		47.57	1420	62781.4	455.0
524.2		46.58	1430	64658.9	455.0
524.4		48.20	1510	68793.7	455.0
524.7		46.75	1610	72238.4	455.0
525.0		43.04	1980	77495.1	455.0
525.2		42.93	2000	80881.4	455.0
525.5		41.09	2000	78191.1	455.0
525.7		45.86	1850	76160.3	455.0
526.0		43.29	1730	73602.5	455.0
526.2		44.35	1770	73187.0	455.0
526.5		42.13	1900	76150.7	455.0
526.7		40.03	2170	84028.0	455.0
527.0		39.29	2376	90864.5	455.0
527.2		40.31	2250	87931.1	455.0
527.5		40.27	2030	78652.9	455.0
527.7		45.13	1770	76260.1	455.0
528.0		42.72	1810	74286.1	455.0
528.2		41.70	1870	74490.9	455.0
528.5		42.38	1880	75293.0	455.0
528.7		43.43	1940	79762.2	455.0
529.0		39.99	2120	81618.9	455.0
529.2		40.00	2190	83610.9	455.0
529.5		39.28	2190	82196.9	455.0
529.7		38.73	2148	81130.3	455.0
530.0		40.20	2220	86660.5	455.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
531.5	MARKLAND LD	43.32	1848	77968.3	455.0
533.8		20.66	1254	22336.0	420.0
535.2		8.92	1940	15615.3	420.0
536.1		22.21	1014	21292.6	420.0
538.1		6.53	2220	13246.0	420.0
541.0	DOW CORNING				
541.2		13.24	1754	21887.3	420.0
542.4		13.68	1664	21095.3	420.0
543.5	MTT CHEMICALS				
545.9	CARROLTON	16.05	1904	28758.6	420.0
548.5		17.90	1764	30077.3	420.0
550.6		20.79	1830	36210.0	420.0
552.9		20.28	1870	36265.3	420.0
555.1		14.74	2210	30969.3	420.0
557.2		17.20	2094	34543.3	420.0
558.8	MADISON				
558.9		23.88	1554	35182.0	420.0
560.0	CLIFTY CREEK PP				
561.0		22.54	1970	42719.3	420.0
563.2		19.36	2020	37304.6	420.0
565.5		29.06	1540	43342.0	420.0
567.7		21.77	2014	42403.3	420.0
570.0		22.45	2094	45085.3	420.0
570.0		22.39	2094	44981.0	420.0
572.5		21.82	2090	42937.3	420.0
575.0		20.71	2304	45714.0	420.0
577.3		26.47	1854	47158.6	420.0
579.9		29.84	1594	46125.3	420.0
582.1		20.96	2440	49136.0	420.0
584.1		27.80	1944	52301.3	420.0
586.4		21.64	2640	55134.6	420.0
588.1		29.93	2030	59126.0	420.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
590.5	CHARLESTON	27.26	2204	58266.0	420.0
592.5		22.75	2754	60278.0	420.0
592.8	IND. ARMY AMMO.				
594.2		27.51	2270	59860.6	420.0
595.9	HITE ISLAND LMSD				
596.4		24.35	2710	63905.3	420.0
596.6		30.51	2150	63304.0	420.0
600.5		33.73	2004	65610.6	420.0
601.0	LOUISVILLE WW				
602.8		29.55	2160	61859.3	420.0
603.1		27.59	2254	60024.6	420.0
603.5		19.58	3280	62050.0	420.0
605.0	MCALPINE LD				
605.1	CLARKSVILLE 1				
605.4	PADDYS RUNN PP				
606.4	CLARKSVILLE 2				
607.0	CANAL PP LG&E				
607.5		9.15	1758	15039.7	383.0
608.0		10.55	1572	15494.0	383.0
608.5		11.06	1416	14294.8	383.0
609.0	GALLAGER PP	10.91	1522	15315.3	383.0
609.4	NEW ALBANY				
609.5		12.49	1410	16488.0	383.0
610.0		11.31	1644	17394.0	383.0
610.5		13.61	1264	16090.9	383.0
611.0		15.47	1296	18874.7	383.0
611.5		16.33	1232	19068.6	383.0
611.8	ASHLAND OIL				
612.0	LOUISVILLE MSD	17.16	1426	22988.7	383.0
612.5		18.98	1432	25661.8	383.0
613.0	AIR REDUCTION	18.95	1412	25476.8	383.0
613.1	B.F. GOODRICH				

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
613.2	DUPONT				
613.5		15.73	1458	21834.0	383.0
613.6	ROHM&HAAS,AM.SYNTH.				
614.0		14.96	1508	21256.4	383.0
614.5		12.16	1626	18775.6	383.0
615.0	STAUFFER 2	15.20	1524	21875.8	383.0
615.4	SHIVELY				
615.5		18.69	1436	24218.6	383.0
616.0		19.78	1376	25963.2	383.0
616.5		18.15	1448	24930.5	383.0
616.6	CANE RUN				
616.7	CAN RUN PP				
617.0		18.10	1452	25125.1	383.0
617.5		18.42	1438	25543.7	383.0
618.0		17.80	1480	25280.2	383.0
618.5		16.48	1496	23534.1	383.0
619.0		15.88	1534	23336.7	383.0
619.5		14.67	1606	22497.9	383.0
620.0		15.60	1546	23058.2	383.0
620.5		17.94	1520	25708.2	383.0
621.0		17.73	1476	25069.9	383.0
621.5		16.93	1572	24080.8	383.0
622.0		16.53	1530	24204.4	383.0
622.5		14.88	1634	23134.6	383.0
623.0		16.56	1588	25029.5	383.0
623.5		17.35	1550	25628.6	383.0
624.0		16.49	1548	24458.9	383.0
624.5		15.44	1736	25239.9	383.0
625.0		16.91	1602	25710.3	383.0
625.5		16.01	1640	24770.4	383.0
626.0		17.01	1598	25809.8	383.0
626.5		15.63	1644	24071.9	383.0

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
627.0		17.53	1598	26622.9	383.0
627.5		18.15	1586	27715.3	383.0
628.0		20.05	1558	29980.3	383.0
628.5		17.73	1584	26866.6	383.0
629.0		18.10	1568	27115.3	383.0
629.5		15.56	1802	26393.3	383.0
630.0		14.12	1912	25839.1	383.0
630.5		17.93	1650	28202.3	383.0
631.0		19.25	1658	30518.7	383.0
631.4	WEST POINT				
631.5		18.54	1772	31301.3	383.0
632.0		17.68	1748	29470.5	383.0
632.5		17.70	1788	29870.0	383.0
633.0		17.39	1792	29140.2	383.0
633.5		19.32	1734	32409.2	383.0
634.0		20.97	1622	32919.0	383.0
634.5		24.17	1600	37205.7	383.0
635.0		27.55	1274	34088.8	383.0
635.5		25.11	1284	31312.6	383.0
636.0		27.10	1224	32286.6	383.0
636.5		33.38	1284	41663.6	383.0
637.0		31.84	1366	42363.6	383.0
637.5		30.54	1070	31772.6	383.0
638.0		25.84	1122	28159.8	383.0
638.5		30.78	1162	34811.6	383.0
639.0		30.78	1294	38757.9	383.0
639.5		23.27	1642	37082.7	383.0
640.0		18.88	1764	32217.8	383.0
640.5		18.79	1906	34504.1	383.0
641.0		24.67	1652	39606.0	383.0
641.5		29.76	1386	39821.8	383.0
642.0		29.92	1304	37613.7	383.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
642.5		26.51	1488	37951.2	383.0
643.0		26.00	1478	37005.3	383.0
643.5	OLIN	24.66	1570	37246.9	383.0
644.0		22.80	1580	34611.3	383.0
644.5		18.87	1764	32169.3	383.0
645.0		17.95	1916	33000.0	383.0
645.5		20.32	1744	34373.0	383.0
645.8	BRANDENBURG				
646.0		20.03	1850	35959.6	383.0
646.5		28.39	1498	41762.8	383.0
647.0		30.77	1294	39117.0	383.0
647.5		30.07	1406	41474.7	383.0
648.0		25.30	1724	42506.2	383.0
648.5		22.83	1744	38781.0	383.0
649.0		19.99	1988	38642.9	383.0
649.5		21.64	1814	38334.2	383.0
650.0		21.96	1866	39871.7	383.0
650.5		22.75	1836	40639.4	383.0
651.0		26.20	1590	40189.9	383.0
651.5		24.80	1724	41578.5	383.0
652.0		22.08	1938	41613.9	383.0
652.5		23.48	1876	43048.2	383.0
653.0		28.56	1530	42692.6	383.0
653.5		28.17	1550	42661.2	383.0
654.0		28.35	1600	44486.7	383.0
654.5		24.77	1744	42144.2	383.0
655.0		23.46	1866	42626.7	383.0
655.5		22.43	1948	42495.4	383.0
656.0		26.49	1866	48247.7	383.0
656.5		26.07	1734	44129.7	383.0
657.0		25.08	1876	45768.2	383.0
657.5		26.96	1724	45290.1	383.0

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
658.0		27.28	1734	46079.5	383.0
658.5		28.65	1580	43735.7	383.0
659.0		31.87	1326	41202.9	383.0
659.5		30.24	1488	43396.9	383.0
660.0		23.31	1938	43953.5	383.0
660.5		18.24	2386	42045.4	383.0
661.0		21.14	2162	44383.3	383.0
661.5		20.75	2142	43133.6	383.0
662.0		20.28	2202	43025.2	383.0
662.5		18.44	2550	45534.8	383.0
663.0		26.64	1988	51317.8	383.0
663.5		32.58	1580	50334.4	383.0
664.0		29.63	1724	49776.4	383.0
664.5		25.60	1932	47756.9	383.0
665.0		27.40	1828	48472.3	383.0
665.5		37.24	1268	46169.4	383.0
666.0		31.23	1246	37613.9	383.0
666.5		36.02	1236	42950.2	383.0
667.0		32.13	1402	43487.6	383.0
667.5		32.16	1486	46545.9	383.0
668.0		37.41	1288	46612.6	383.0
668.5		36.13	1194	41779.2	383.0
669.0		35.79	1314	45966.1	383.0
669.5		30.79	1600	48086.6	383.0
670.0		29.75	1850	53850.8	383.0
670.5		42.73	1684	70710.2	383.0
671.0		38.72	1204	45650.9	383.0
671.5		35.90	1256	44171.0	383.0
672.0		37.68	1268	46847.0	383.0
672.5		35.94	1340	47211.6	383.0
673.0		39.53	1204	46697.6	383.0
673.5		36.29	1330	47321.9	383.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
674.0		34.38	1496	50424.4	383.0
674.5		28.99	1954	55372.2	383.0
675.0		27.24	2058	54679.5	383.0
675.5		34.47	1672	55897.8	383.0
676.0		41.63	1256	51230.2	383.0
676.5		38.57	1278	48373.1	383.0
677.0		44.64	1434	62971.3	383.0
677.5		51.36	1236	62352.7	383.0
678.0		36.90	1268	45886.3	383.0
678.5		38.06	1590	59509.9	383.0
679.0		30.90	1964	59361.7	383.0
679.5		26.47	2182	56353.7	383.0
680.0		32.98	1776	56993.3	383.0
680.5		38.05	1548	57781.4	383.0
681.0		40.96	1256	50435.9	383.0
681.5		36.91	1412	50879.7	383.0
682.0		37.45	1360	49859.7	383.0
682.5		35.39	1412	48970.4	383.0
683.0		34.92	1392	47442.9	383.0
683.5		37.28	1308	47594.2	383.0
684.0		47.16	1210	56118.9	383.0
684.5		49.35	1268	61525.8	383.0
685.0		48.33	1216	57843.3	383.0
685.5		42.04	1216	50253.2	383.0
686.0		39.73	1464	57128.7	383.0
686.5		33.70	1662	54797.7	383.0
687.0		37.35	1476	54100.0	383.0
687.5		33.64	1808	59545.9	383.0
688.0		26.89	2244	58872.7	383.0
688.5		24.56	2442	58528.3	383.0
689.0		26.81	2120	55547.9	383.0
689.5		26.57	2316	60043.3	383.0

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
690.0		24.15	2588	60961.9	383.0
690.5		28.20	2264	62495.0	383.0
691.0		28.40	2400	66685.1	383.0
691.5		31.43	2192	67347.2	383.0
692.0		38.88	1402	53371.2	383.0
692.5		32.90	1600	51598.3	383.0
693.0		34.85	1620	55103.3	383.0
693.5		35.38	1870	64550.4	383.0
694.0		31.40	2088	64170.5	383.0
694.5		28.94	2276	64427.2	383.0
695.0		28.83	2244	63053.3	383.0
695.5		29.84	2172	63449.6	383.0
696.0		33.08	1890	61216.4	383.0
696.5		31.58	2098	64883.1	383.0
697.0		30.66	2150	64405.0	383.0
697.5		29.76	2244	64847.6	383.0
698.0		35.43	1756	60989.5	383.0
698.5		42.72	1506	62762.1	383.0
699.0		42.79	1652	69538.5	383.0
699.5		40.92	1610	64504.1	383.0
700.0		46.07	1340	60258.4	383.0
700.5		41.40	1454	59189.3	383.0
701.0		35.57	1890	65767.9	383.0
701.5		33.06	2016	65325.9	383.0
702.0		33.96	1902	63320.8	383.0
702.5		38.13	1782	66896.1	383.0
703.0		44.97	1942	85423.1	383.0
703.5		40.36	1778	70429.1	383.0
704.0		36.26	2130	75734.8	383.0
704.5		41.32	1788	72077.8	383.0
705.0		42.41	1502	62567.3	383.0
705.5		41.50	1576	64213.5	383.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
706.0		43.44	1448	61676.7	383.0
706.5		46.80	1406	64679.0	383.0
707.0		46.58	1532	69713.1	383.0
707.5		38.71	2108	80087.7	383.0
708.0		33.88	2470	81821.9	383.0
708.5		36.81	2162	78199.4	383.0
709.0		39.79	1906	74524.6	383.0
709.5		44.63	1586	69730.4	383.0
710.0		42.32	1666	69283.1	383.0
710.5		39.47	2066	80179.6	383.0
711.0		33.93	2492	82986.4	383.0
711.5		34.38	2396	80971.0	383.0
712.0		36.00	2236	79054.7	383.0
712.5		40.59	1852	74174.5	383.0
713.0		45.73	1438	64662.5	383.0
713.5		44.15	1544	67053.3	383.0
714.0		45.46	1618	72521.5	383.0
714.5		43.97	1628	70443.9	383.0
715.0		44.17	1800	77998.4	383.0
715.5		39.54	2098	81240.0	383.0
716.0		35.86	2332	82105.1	383.0
716.5		33.25	2630	85689.1	383.0
717.0		35.11	2748	94648.7	383.0
717.5		38.75	2338	88443.1	383.0
718.0		48.32	1438	68055.2	383.0
718.5		44.90	1480	65238.2	383.0
719.0		42.87	1948	81188.1	383.0
719.5		41.62	1874	76403.3	383.0
720.0		48.16	1544	72991.7	383.0
720.5		46.30	1768	80253.0	383.0
720.7	CANNELTON				
720.8	WESTERN KRAFT				

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
721.0		18.62	2010	33172.9	358.0
721.5		15.52	2142	31111.7	358.0
721.7	WESCOR				
722.0		10.76	2532	25626.5	358.0
722.5		22.77	1662	36525.5	358.0
723.0		24.33	1290	30343.5	358.0
723.5		39.88	1152	44288.7	358.0
724.0		23.05	1744	38167.0	358.0
724.5		14.27	2288	30887.5	358.0
725.0		10.50	2460	24175.8	358.0
725.5		10.02	2402	22460.0	358.0
726.0		11.23	2306	24208.5	358.0
726.5		13.30	2292	28836.2	358.0
727.0		12.99	2294	28399.4	358.0
727.5		11.93	2444	27665.9	358.0
728.0	TELL CITY	9.92	2560	23808.3	358.0
728.2	COLEMAN PP				
728.5		9.79	2648	24233.0	358.0
729.0		11.13	2568	27175.1	358.0
729.5		11.70	2504	27755.0	358.0
730.0		12.71	2532	30586.8	358.0
730.5		21.14	1812	36873.0	358.0
731.0		20.08	1832	34958.9	358.0
731.5		18.05	2030	35070.5	358.0
732.0		19.61	1638	30784.5	358.0
732.5		35.65	1138	38422.4	358.0
733.0		36.89	1274	44833.4	358.0
733.5		22.76	1902	41335.8	358.0
734.0		13.69	2386	30861.3	358.0
734.5		9.80	2782	25469.3	358.0
735.0		9.45	2980	26349.2	358.0
735.5		11.91	2596	28439.5	358.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
736.0		12.58	2474	29543.9	358.0
736.5		16.04	2186	33105.5	358.0
737.0		15.90	2396	36042.6	358.0
737.5		13.21	2592	32184.0	358.0
738.0		13.36	2598	32975.2	358.0
738.5		14.25	2480	33665.0	358.0
739.0		13.14	2540	31735.2	358.0
739.5		12.79	2540	30736.6	358.0
740.0		12.78	2502	30211.0	358.0
740.5		12.57	2570	30608.0	358.0
741.0		14.75	2600	36467.2	358.0
741.5		15.86	2482	37810.5	358.0
742.0		15.88	2450	37105.5	358.0
742.5		16.58	2330	36963.0	358.0
743.0		18.29	2070	36375.6	358.0
743.5		17.98	2200	37926.7	358.0
744.0		15.30	2382	34881.0	358.0
744.5		15.98	2306	35098.8	358.0
745.0		15.88	2476	37722.7	358.0
745.5		14.60	2658	36903.4	358.0
746.0		14.23	2736	36825.5	358.0
746.5		14.51	2834	38678.0	358.0
747.0		16.77	2416	38909.7	358.0
747.5		21.95	1810	37899.9	358.0
748.0		26.24	1748	43438.1	358.0
748.5		26.65	1926	47224.7	358.0
749.0		19.15	2378	43402.5	358.0
749.5		16.73	2572	41124.2	358.0
750.0		15.58	2814	41775.8	358.0
750.5		14.67	2972	41636.6	358.0
751.0		14.72	2912	40881.3	358.0
751.3	W.R.GRACE				

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
751.5		15.60	3046	45249.8	358.0
752.0		13.86	3216	42589.5	358.0
752.5		15.94	2780	42513.9	358.0
753.0		17.81	2606	44351.2	358.0
753.5		18.03	2740	47048.5	358.0
754.0		19.28	2580	47782.3	358.0
754.5		20.10	2424	46896.4	358.0
755.0		24.10	2314	53851.3	358.0
755.3	OMU SMITH				
755.5		23.28	2226	50137.7	358.0
756.0		24.64	2184	51836.9	358.0
756.5		23.28	2228	49413.9	358.0
757.0		20.16	2564	49361.8	358.0
757.3	DAM 46				
757.5		36.53	2550	91361.1	358.0
757.6	GLENMORE,MEDLEY,FLEI				
758.0		19.77	2756	52922.3	358.0
758.5	OWENSBORO	20.19	2530	49512.0	358.0
759.0		24.74	2030	48984.0	358.0
759.5		29.55	2036	58923.3	358.0
760.0		23.73	2478	57319.4	358.0
760.5		21.61	2694	56675.1	358.0
761.0		22.39	2530	55063.8	358.0
761.5		20.97	2746	55914.5	358.0
762.0		20.75	2910	58569.4	358.0
762.5		19.46	2838	53528.9	358.0
763.0		22.01	2170	46350.6	358.0
763.5		28.33	1902	52714.0	358.0
764.0		25.76	2230	55822.9	358.0
764.5		23.59	2560	58936.5	358.0
765.0		18.43	3300	58834.6	358.0
765.5		16.65	4328	69559.9	358.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
766.0		21.32	2940	60897.6	358.0
766.5		24.22	2386	56305.9	358.0
767.0		23.86	2704	62883.3	358.0
767.5		20.87	2900	58787.3	358.0
768.0		21.18	2828	58188.5	358.0
768.5		19.45	2890	54480.6	358.0
769.0		19.43	3208	60384.1	358.0
769.5		20.50	3084	61346.4	358.0
770.0		22.73	2806	61929.8	358.0
770.5		23.40	2652	60209.5	358.0
771.0		26.88	2180	57161.6	358.0
771.5		26.64	2334	60701.3	358.0
772.0		30.61	2066	61565.9	358.0
772.5		28.93	2262	63992.1	358.0
772.7	F.B.CULLEY PP				
773.0		26.47	2652	68489.4	358.0
773.5	ALCOA	22.72	3146	69666.7	358.0
773.5	WARRICH PP				
774.0		18.87	3670	67274.2	358.0
774.5		21.72	3136	66308.9	358.0
775.0		21.74	3362	71111.8	358.0
775.5		21.19	3414	70290.7	358.0
776.0		24.66	2652	63629.0	358.0
776.5		10.28	2190	19621.3	342.0
777.0		14.21	2004	27107.2	342.0
777.5		14.49	2100	29056.0	342.0
777.7	DAM 47				
778.0		21.57	2338	48947.7	342.0
778.5		19.71	2288	43717.7	342.0
779.0		18.38	1914	33708.9	342.0
779.5		19.65	1934	36264.8	342.0
780.0		20.26	1844	35898.4	342.0

1974 OHIO RIVER CROSS SECTIONS

MILE	LOCATION	DEPTH (FT.)	WIDTH (FT.)	AREA (SQ. FT.)	ELEV. ABOVE MSL
780.5		21.50	1774	36730.6	342.0
781.0		19.12	1964	35896.8	342.0
782.0		13.06	2398	29770.6	342.0
782.5		12.34	2520	29567.8	342.0
783.0		12.62	2438	29127.9	342.0
783.5		13.25	2478	31226.8	342.0
784.0		14.52	2312	32066.2	342.0
784.5		19.13	2056	38003.0	342.0
785.0		19.24	1984	36819.0	342.0
785.5		16.48	2348	37158.0	342.0
786.0		18.82	2176	39404.3	342.0
786.5		27.25	1784	47404.1	342.0
787.0		27.35	1798	47848.4	342.0
787.5		20.61	2030	40480.4	342.0
788.0		18.63	2348	42238.8	342.0
788.5		17.68	2236	38289.8	342.0
789.0		15.05	2368	34149.7	342.0
789.5		22.49	2288	50087.8	342.0
790.0		25.71	1768	44276.5	342.0
790.5		27.90	1572	42701.9	342.0
791.0		20.18	1864	36354.2	342.0
791.5	EVANSVILLE WW				