ORSANCO

OHIO RIVER VALLEY
WATER SANITATION COMMISSION
AN INTERSTATE AGENCY
ESTABLISHED JUNE 30, 1948

1965

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OHIO RIVER VALLEY WATER SANITATION COMMISSION

an interstate compact agency
created jointly in 1948 by the

State of Illinois
State of Indiana
Commonwealth of Kentucky
State of New York
Commonwealth of Pennsylvania
Commonwealth of Virginia
State of West Virginia
State of Ohio

with approval of the
Congress of the United States

respectfully submit their

SEVENTEENTH ANNUAL REPORT 1965

HEADQUARTERS: 414 Walnut St., Cincinnati, Ohio 45202 Telephone: 421-1151

PROMISE AND PERFORMANCE

SEVENTEEN YEARS AGO a crusade for clean streams was inaugurated in the Ohio Valley by eight states. The purpose: Abate existing pollution and prevent new pollution. The method: Motivate communities and industries — by persuasion where possible and by compulsion if necessary — to finance and build sewage and waste-control facilities.

The states pledged to each other in 1948, under the terms of an interstate compact approved by the Congress of the United States, to cooperate faithfully in this regional pollution-control effort. To coordinate this program they established the Ohio River Valley Water Sanitation Commission (ORSANCO). The ORSANCO district, which embraces portions of these eight states, includes an area of 154,000 square miles and a sewered population of 11,400,000. It is drained by the 981-mile Ohio River and nineteen major tributaries.

This 17th annual report is designed to provide the basis for an appraisal of the program. It reflects the situation during the fiscal year 1964-65, during which Barton A. Holl, one of the commissioners from the State of Ohio, served as chairman of ORSANCO. Mr. Holl has reviewed the report and approved it for transmittal to the Governors of the signatory states and for general distribution.

INVESTMENT IN RIVER CLEANUP

The Ohio River is at least $370 million cleaner than it was in 1948. And on the tributaries another $748 million has been invested by communities for installation of sewage-treatment facilities during the past seventeen years.

Local funds have financed nine-tenths of this capital outlay for stream cleanup. Federal grants-in-aid to municipalities, which did not become available until 1956, account for the remainder.

Expenditures by industries for pollution abatement are not a matter of public record. The states report that 1,560 of the 1,723 establishments discharging effluents to streams have installed control facilities. On one tributary, the Kanawha in West Virginia, nine companies have reported costs aggregating $18 million to complete the first phase of a two-stage control program.

MORE TO BE DONE

These local expenditures of more than a billion dollars represent a measure of response thus far in advancing aspirations of the Ohio River Valley Water Sanitation Compact. The result is that 93 percent of the sewered population in the valley is now served by sewage disposal works, half of which provide secondary treatment and another quarter employ intermediate processing.

In addition, 90 percent of the industrial establishments are listed as having made provisions for waste control that meet minimum interstate requirements or better. However, because this figure makes no differentiation between large and small plants, it should not be construed to mean that 90 percent of the pollutional load has been abated. A detailed inventory of municipal and industrial facilities is given on page 6.

These statistics furnish one index of progress with respect to pollution abatement. However, they do not suffice for making an appraisal of stream cleanliness.

For this purpose the Commission maintains a river-monitor network for the measurement of quality characteristics. This data is evaluated with respect to certain criteria of quality. Beginning on page 9 a substantial part of this report is devoted to the presentation of these findings. For comparative purposes current conditions are matched with those that prevailed ten years ago.

Findings from the monitoring network reveal general improvement in several quality characteristics. But they also confirm that more control needs to be exercised — through the installation of additional facilities and also in the improvement of performance of existing treatment works. There are stretches of streams in the valley, notably on the tributaries, that cannot yet qualify as being clean enough to satisfy necessities.

Assessment of this quality data is providing the factual basis to aid decision-making on how much more treatment of wastes should be required and where. By virtue of this knowledge the Commission is prepared to promulgate establishment of additional control requirements tailored to quality criteria and stream uses.

PROGRAM DEFICIENCIES

Two deficiencies can be identified in the current program. One of these is the continued delinquency of some 10 percent of the industries in complying with basic requirements established by interstate agreement. This situation has been under frequent review by the Commission because progress in some of the signatory states has not matched expectations in curbing pollution from these few — but in some cases relatively large — sources of obvious pollution.

The second deficiency that must be a matter of concern is the limited capability of the state regulatory agencies to gear their operations to an increasing burden of inspection and surveillance necessities. Each year a greater number of sewage-treatment plants and industrial-control facilities lay claim for performance auditing.

Budgetary and other constraints have handicapped the states in assignment of staff for this vital function. Meantime, evidence of faulty operation of facilities is accumulating, not only from visual observation of river conditions but also in the more subtle revelations from robot-monitor data. There are reasons to believe that carelessness — and sometimes even callous disregard of regulations — may explain why stream cleanliness in some areas is not measuring up to anticipations based on capital investments already made for control facilities.

BUDGET CONSIDERATIONS

It would be fair to say that the level of state appropriations has never been realistically matched to the operating obligations and desires of ORSANCO. Currently the demands on available funds are much greater than they were in 1954 when an appropriation level of $130,000 was established. During the intervening decade basic operating expenses have reflected the impact of changes in the expanding national economy. Travel costs are higher, postage rates have been upped, rent has increased and salaries have been adjusted in accord with merit-increase schedules.

Since 1956 financial resources available to the Commission have been supplemented with federal administrative grants — these have averaged $103,370 annually. But even with these funds — which are earmarked for specific purposes — certain activities that could be justified as forming part of Commission responsibility are not receiving appropriate consideration.

For example, a staff vacancy created by a resignation last year has not been filled. A contract project for evaluation of radioactivity levels in the sediment, biota and fishes of the Ohio River that was initiated in 1958 has been discontinued. Public-affairs activity associated with the production of documentary films has been curtailed. And extension of the robot monitor system for improving river-quality surveillance potentials has been postponed. Funds not available for these purposes totalled $52,000.

MAHONING RIVER CONFERENCE

On February 16 and 17, 1965, ORSANCO along with two of its signatory states — Ohio and Pennsylvania — participated in a conference at Youngstown, Ohio, called by the Secretary of Health, Education and Welfare. Purpose of these proceedings was to review the adequacy of measures taken to abate pollution of the Mahoning River.

On the evidence submitted the ORSANCO conferees concluded that the comprehensive program pursued by the State of Ohio since 1954 (which had been approved by the Surgeon General of the U. S. Public Health Service as meeting objectives of the Federal Water Pollution Control Act) by now had been virtually completed. For example, every municipality on the Mahoning River has constructed treatment works, and with completion of the Youngstown plant early in the summer of 1965, all sewage discharges situated in Ohio are expected to meet requirements set forth in the 1954 program.

With respect to industrial pollution it was noted that 70 percent of the establishments were now meeting requirements and that complete compliance was scheduled for the end of 1966, with the exception of a few cases involving control of spent acid-pickle liquor.

The ORSANCO conferees concluded that in view of the progress being made there appeared to be no practical or legal basis at this time for intervention by the federal Department of Health, Education and Welfare. The conferees representing the states of Ohio and Pennsylvania reached parallel conclusions.

Although the federal conferee gave cognizance to "significant progress in pollution abatement in the Mahoning basin" he concluded that in order to adequately prevent damage to water uses in Pennsylvania additional requirements should be implemented. Among these the federal conferee listed: Immediate chlorination of all municipal sewage effluents throughout the year; utilization of the full capacity of existing waste-treatment facilities the year around; addition of secondary treatment for all municipal wastes within three years; treatment of industrial waste to essentially remove all oil, eliminate discharge of toxic wastes and eliminate acid discharges.

The viewpoints of all the conferees were referred to the Secretary of Health, Education and Welfare for his deliberation and recommendations. (On November 15, 1965, as this report was going to press, the Secretary released his recommendations; they sustained the conclusions of the federal conferee.)

COMPLIANCE PROCEEDINGS

Under enforcement provisions (Article IX) of the Compact, the Commission undertook proceedings related to compliance from six municipalities in four states. With completion of the Huntington, West Virginia, sewage-treatment plant, in July 1964, only one case, that of Middleport, Ohio, now remains on the active docket.

On May 14, 1964, following a hearing, the Commission ordered the Village of Middleport, Ohio, to adopt a schedule for the completion of intercepting sewers and sewage-treatment facilities not later than April 30, 1966. Because of delays associated with purchase of an appropriate site for the treatment plant, Middleport recently requested an extension of time for completion of the project. On May 13, 1965, the Commission amended the original order to change the project-completion date to July 1, 1966.

OTHER ACTIVITIES

An educational film was completed in collaboration with the ORSANCO industry advisory committees to demonstrate how careless actions within a plant may result in river pollution and what steps can be taken to guard against such situations. Member companies of the committees financed half the cost of the production. The film is being used as an in-plant training aid to solicit employee and supervisor alertness in preventing accidental spills. Titled "OOPS! Or Why Did Broad Shoulders Pollute the River," the film is the eighth of a series of documentary films produced in the ORSANCO public-affairs program.

River-litter prevention — Another public-affairs project — an effort to generate support of boaters in prevention of river-littering — was advanced with the production and distribution of some 30,000 plastic litter bags. This represented a follow-up on the poster campaign initiated last year under the slogan "Literally Speaking — Don't go Overboard." This message was printed on the litter bags.

ORSANCO purchased 10,000 bags and two oil companies — Ashland and Sohio — each purchased a similar number and made them available for distribution by their marine-fuel dealers along the Ohio River. The ORSANCO allotment was distributed at marinas and boat-launching ramps by the U. S. Coast Guard and by state boating agencies.

An additional 20,000 bags was purchased by a boat-accessory dealer. Other companies have expressed interest in ordering the bags, and ORSANCO has offered use of its color plates at no cost.

Boat sewage treatment — A final draft of an ORSANCO regulation to prevent discharge of inadequately treated sewage from all watercraft, river terminals and other floating facilities is being reviewed by the signatory states. The Commission has already issued a notice of intent that such a regulátion is to be made effective on January 1, 1967.

The Ohio Valley regulation has been under development with a committee of barge-line operators, builders of marine equipment and pleasure-boat interests. A federal regulation is now under consideration and care is being exercised to insure compatibility of the ORSANCO requirements with the federal proposals.

This, in brief, outlines the promise and performance of the eight-state program being conducted under auspices of the Ohio River Valley Water Sanitation Compact. More detailed information on this undertaking will be found in the pages that follow.

It is with appreciation that the commissioners acknowledge the devotion of state personnel, the helpfulness of advisory committees, the responsiveness of municipal and industrial entities and the support provided by federal agencies — notably that from the Public Health Service, the Geological Survey, the Corps of Engineers, the Weather Bureau and the Coast Guard — in advancing this regional clean-streams program.

FEDERAL AID PROGRAM

In July of 1956 grants-in-aid for the construction of community sewage-treatment plants became available to municipalities under provisions of the Federal Water Pollution Control Act. Between September 1962 and July 1964 supplemental grants were authorized under the federal Public Works Acceleration Act.

Following is a summarization of current and past annual allocations of federal funds to communities in the Ohio Valley compact district. This summary was derived from the June 30, 1965, Project Register of the U. S. Public Health Service. The designation WPC refers to grants emanating from the Water Pollution Control Act, and APW indicates grants from the Public Works Acceleration Act.

Year	No. of Projects	Estimated Cost of Projects	Federal Grants
1956-57	30	$13,846,400	$3,616,200
1957-58	51	27,421,300	5,907,900
1958-59	47	29,298,300	6,564,300
1959-60	46	24,464,100	5,557,400
1960-61	46	21,733,300	4,787,500
1961-62	67	29,726,600	6,892,000
1962-63			
WPC	71	27,695,600	6,417,100
APW	38	12,996,200	6,343,200
WPC & APW	20	12,260,800	5,868,600
1963-64			
WPC	57	23,608,400	6,097,500
APW	98	26,927,500	12,466,200
WPC & APW	18	10,582,000	5,994,700
1964-65			
WPC	49	22,405,500	6,273,900
Total	638	$282,966,000	$82,786,500

TALLY FOR THE VALLEY

EACH YEAR A REVIEW is made of the status of sewered communities and industries in the Ohio Valley district with respect to installation of facilities for the control of river pollution. This inventory is based on information supplied by the signatory states. A summary of the status on July 1, 1965, for each state and for the entire district, is presented in the accompanying tabulations. Following is an appraisal of the current situation.

Municipal Status — On the Ohio River main stem, treatment facilities in operation service 99 percent of the 3,700,000 sewered population, and those currently under construction will provide treatment for another 0.4 percent. Degree of treatment provided is 41 percent primary, 56 percent intermediate and 3 percent secondary.

For the entire drainage district treatment facilities now in operation serve 93 percent of the 11,400,000 sewered population, 3 percent more than last year. Facilities are under construction to service an additional 1.4 percent. Degree of treatment provided is 25 percent primary, 25 percent intermediate and 48 percent secondary; the remaining 2 percent are unclassified.

Construction of sewage-treatment plants was started this year at 39 communities with a combined population of 61,000. In addition, improvements to existing facilities were initiated at 21 communities serving 1,108,000.

During the year new works were placed in operation at 102 communities with a combined population of 405,000. Improvements to 40 existing plants serving 490,000 were completed.

Industrial Status — There are 1,723 industrial establishments in the district whose effluents are discharged directly to streams. Of these 90 percent (1,560) have installed facilities that are reported to comply at least with minimum control requirements established by ORSANCO.

The states report that 1,450 of these industries are meeting all requirements prescribed by them for the local protection of the receiving streams.

Basin Status — Following is a tabulation that provides a comparative basin-by-basin inventory of the current status of installation of facilities for pollution control. The percentage of population receiving treatment and the industries providing control are not to be interpreted as a measure of ultimate adequacy of the facilities; in the case of industrial establishments, for example, the percentage refers to the number recorded as complying at least with minimum requirements.

Basin	Municipal		Industrial	
	Population (Thousands)	% Receiving Treatment	No. of Plants	% Control Facilities
Ohio River	3,677	99.4	188	92.0
Allegheny	722	83.4	266	87.2
Monongahela	677	66.6	203	85.2
Beaver	644	99.7	142	93.7
Muskingum	572	97.8	119	96.6
Little Kanawha	11	82.4	6	66.7
Hocking	71	96.0	5	80.0
Kanawha	368	90.1	90	78.9
Guyandot	21	92.8	42	95.2
Big Sandy	57	62.7	81	91.4
Scioto	790	99.3	38	89.5
Little Miami	192	99.5	8	100.0
Licking	45	95.4	5	80.0
Miami	795	98.1	62	93.5
Kentucky	162	99.5	28	96.4
Salt	42	94.2	21	76.2
Green	117	99.3	27	92.6
Wabash	1,850	95.2	234	94.9
Cumberland	104	100.0	20	90.0
Tennessee	107	81.2	21	95.2
Minor tributaries	370	95.7	117	93.2
Total	11,394	94.7	1,723	90.5

MUNICIPAL AND INSTITUTIONAL SEWAGE-TREATMENT FACILITIES — July 1, 1965

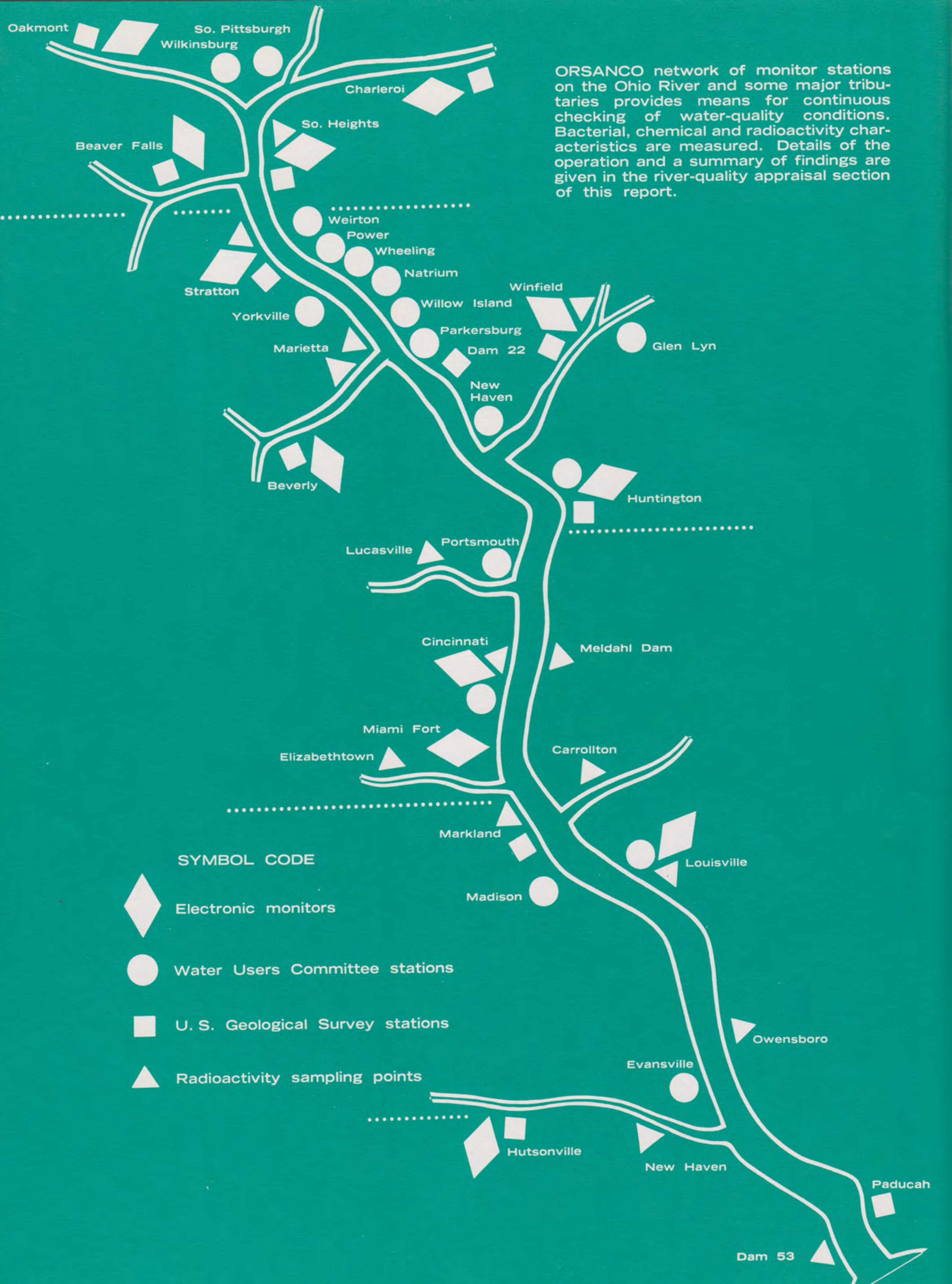
Number of communities (top number) and population served (bottom number)

STATUS	ILL.	IND.	KY.	N. Y.	OHIO	PA.	VA.	W. VA.	TOTAL	% of TOTAL
Control currently acceptable	**64** 282,635	**172** 1,186,067	**226** 1,260,588	**10** 87,040	**298** 3,474,844	**283** 2,546,997	**40** 133,894	**74** 377,220	**1,167** 9,349,285	**68.5** 82.0
Treatment provided, improvements under construction	**0** 0	**7** 519,749	**5** 38,553	**0** 0	**5** 35,978	**0** 0	**0** 0	**3** 109,678	**20** 703,958	**1.2** 6.2
Treatment provided; not adequate	**4** 64,032	**14** 97,310	**10** 22,091	**4** 11,019	**30** 188,970	**13** 81,858	**20** 16,723	**17** 104,331	**112** 586,334	**6.6** 5.1
New treatment works under construction	**1** 4,370	**9** 11,009	**12** 20,370	**0** 0	**11** 13,143	**14** 35,989	**8** 15,031	**20** 56,133	**75** 156,045	**4.4** 1.4
No treatment; construction not started	**2** 2,680	**75** 85,060	**12** 13,645	**4** 11,493	**34** 50,702	**100** 249,379	**20** 23,648	**82** 161,483	**329** 598,090	**19.3** 5.3
Total	**71** 353,717	**277** 1,899,195	**265** 1,355,247	**18** 109,552	**378** 3,763,637	**410** 2,914,223	**88** 189,296	**196** 808,845	**1,703** 11,393,712	**100.0** 100.0

STATUS OF INDUSTRIAL WASTE-CONTROL FACILITIES — July 1, 1965

STATUS	ILL.	IND.	KY.	N. Y.	OHIO	PA.	VA.	W. VA.	TOTAL	% of TOTAL
Control currently acceptable	10	216	149	18	308	510	45	194	1,450	84.2
Control facilities inadequate, improvements in progress	0	0	7	0	11	3	0	3	24	1.4
Control provided, but not adequate	8	27	14	7	49	16	3	31	155	8.9
New control facilities under construction	0	13	3	0	3	11	0	4	34	1.9
Planning treatment facilities or preparing to connect to municipal sewers	0	9	1	6	1	24	1	7	49	2.9
No action by company	0	0	0	5	0	0	1	5	11	0.7
Total number of industries	18	265	174	36	372	564	50	244	1,723	100.0
Complying with ORSANCO minimum requirements	18	251	159	20	355	511	48	198	1,560	90.5

ORSANCO network of monitor stations on the Ohio River and some major tributaries provides means for continuous checking of water-quality conditions. Bacterial, chemical and radioactivity characteristics are measured. Details of the operation and a summary of findings are given in the river-quality appraisal section of this report.



RIVER QUALITY CONDITIONS

QUALITY CHARACTERISTICS of the Ohio River and its tributaries are detailed in this section with respect to current conditions and those that prevailed a decade ago. The findings provide one of the bases to aid decision-making on how much more control should be exercised and where.

Chemical and biological quality indicators have been evaluated by matching findings against certain standards and criteria. The latter include: Bacterial-quality objectives adopted by ORSANCO in 1951; the 1962 Public Health Service drinking water standards, which contain recommended or mandatory limits for some twenty-five chemical constituents in potable water supplies; and recommendations of the ORSANCO Aquatic-Life Advisory Committee concerning quality requirements for the maintenance of fish and other forms of aquatic life.

Sources of data — Quality data for this appraisal has been derived from a Commission-sponsored monitor network. The network includes 40 sampling locations on the Ohio River and its tributaries (see map). Quality analyses at each location are made through one or more of the following arrangements:

17 locations are monitored by managers of municipal and private water-treatment plants. Fourteen are located on the Ohio River main stem; others are on the Allegheny, Monongahela and New rivers. This voluntary service is coordinated by the ORSANCO Water Users Committee.

11 locations are monitored under contract arrangements with the U. S. Geological Survey. Six are on the Ohio River, and five are on tributaries. Data assembled by the Geological Survey supplements that from locations monitored by the Water Users Committee and, in addition, includes analyses for mineral constituents that are not routinely measured at water-treatment plants.

12 locations are served by ORSANCO robot monitor units. Six of these electronic sentinels are located on the Ohio River and six are located on tributaries.

15 locations are monitored for radioactivity under contract arrangements with the University of Louisville. Nine are on the Ohio River and six on tributaries.

Monitoring operations also include assembly of data on river flows. The primary supplier of this information is the Geological Survey, which maintains a network of stream-gaging stations. Supplementary flow data is obtained from the Cincinnati River Forecast Center of the U. S. Weather Bureau. Daily forecasts are provided for twelve locations along the Ohio River and its tributaries. The forecasts include estimates on volume and velocity of flow not only for the current day but for the next three days as well. This service makes possible prompt integration of flow information with quality data from the robot-monitor system.

Findings in brief — Conditions in the Ohio River during 1963-64 may be summarized in this fashion: Quality characteristics were such as to satisfy drinking water standards for dissolved solids, chlorides, fluorides, nitrates, methylene-blue active substance (an indicator of the apparent concentration of synthetic detergents) and radioactive materials.

Bacterial concentrations (measured by coliform-organism counts) met the monthly average objective for water-supply purposes of 5,000 per 100 ml or less 100 percent of the time at Wheeling. At other stations this objective was recorded 92 percent of the time at Cincinnati, 67 percent at Louisville, 60 percent at Huntington and 39 percent at Evansville. The coliform objective for recreational purposes — daily values less than 2,400 and monthly-average values less than 1,000 — is close to realization during the recreational season in the Wheeling, Huntington and Cincinnati areas. At other locations additional improvement in river conditions is required to meet this objective.

Conditions related to the maintenance of fish life, as measured in terms of temperature, pH and dissolved oxygen, were these: River temperatures were satisfactory in all reaches; pH levels were within recommended limits except for a small percentage of time in a short stretch of the upper Ohio River; dissolved-oxygen concentrations met levels of 4.0 mg/l or higher 100 percent of the time at Cincinnati; 100 percent of the time at South Heights (mile 16), at Stratton (mile 55) and at Huntington; 89 percent of the time at Louisville. Just below Cincinnati (at Miami Fort — mile 490) this level was met only 77 percent of the time.

Concentrations of nitrates and phosphates have shown no appreciable increase since 1954, when the monitoring of these constituents was initiated. These constituents have a fertilizing influence on the growth of algae and other aquatic life; however, no precise relationship between concentrations of these substances and algae productivity has been established.

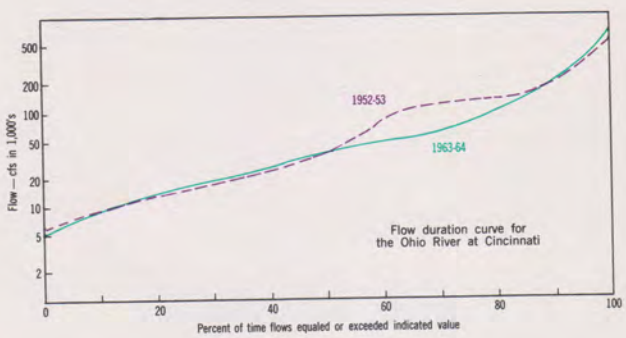
In terms of hardness content, Ohio River water may be classified in accordance with designations employed by the Geological Survey as "moderately hard" to "very hard." In 1963-64, monthly-average concentrations varied from 80 to 230 mg/l, with an average of 139 mg/l. These values may be compared to a range of 68 to 270 mg/l and an average of 151 mg/l in 1952-53.

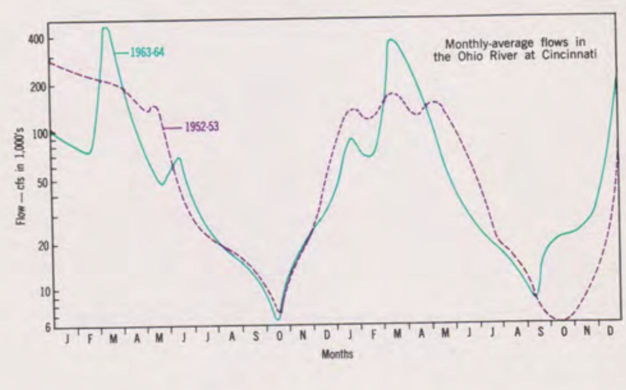
Iron and manganese concentrations in the upper portion of the river exceed limits recommended for drinking water. There has been no appreciable reduction in concentration levels of these substances over the past eleven years.

Sulfate concentrations, in terms of monthly-average values, at times exceed the drinking water standard of 250 mg/l in the reach upstream from Parkersburg. However, in most reaches, particularly downstream from Parkersburg, there has been a reduction in sulfate content during the past eleven years.

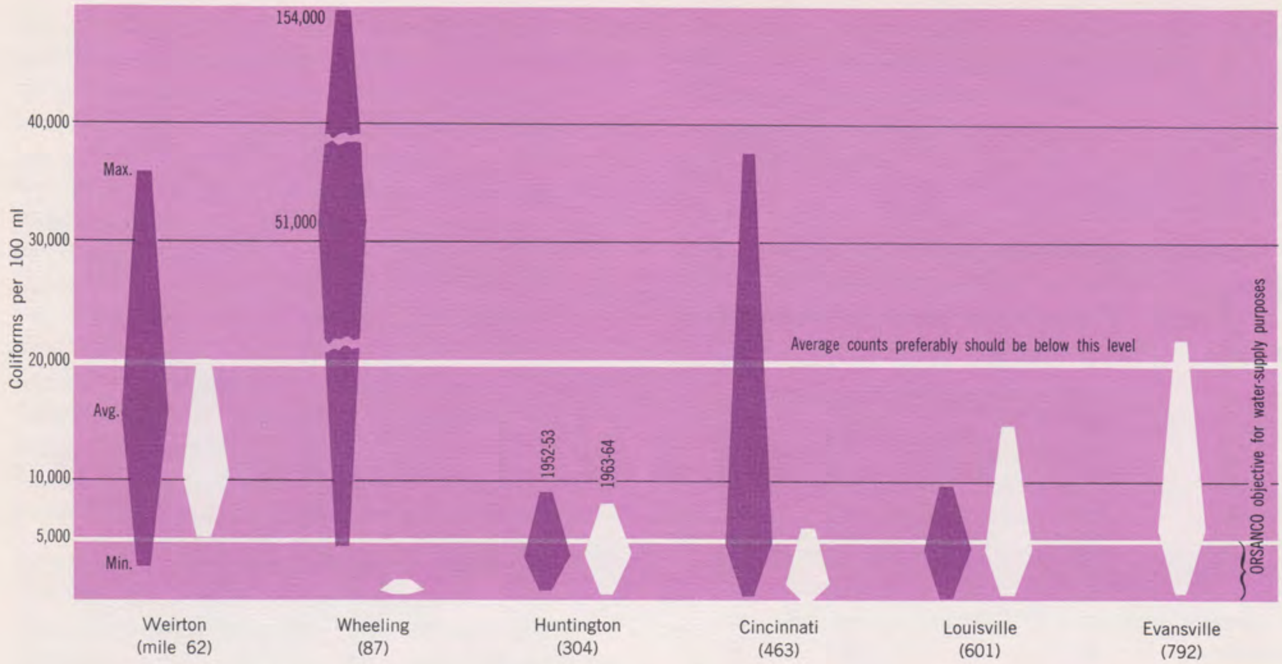
These are the highlights of the findings. Further details on quality levels in the Ohio River and an analysis of changes in conditions are given in the following pages.

RIVER FLOW — Quality conditions in a stream are profoundly influenced by hydrologic variability, not only in relation to volume of flow but also with regard to the rate at which changes in flow occur. As a consequence, when making comparisons of conditions the most meaningful relationships are those that can be referenced to periods of similar hydrologic pattern.





Hydrologic variability and flow-frequency patterns of the Ohio River at Cincinnati in 1963-64 and 1952-53 showing similarity between the two periods for which quality comparisons have been made.



COLIFORM COUNTS — The objective of 5,000 per 100 ml or less for water supply purposes thus far has been achieved only at Wheeling. In 1963-64, the objective was met 92 percent of the time at Cincinnati, 67 percent of the time at Louisville, 60 percent of the time at Huntington, and 39 percent of the time at Evansville (4,280 analyses).

It would be appropriate to characterize 1963 and 1964 as "dry" years. This designation pertains to the situation prevailing during the summer-fall season, and means that flows then were of a lesser magnitude than "normal" or average flows for the same season over the period of record.

However, during the winter-spring periods of both 1963 and 1964, there were floods in the Ohio Valley. In fact, the longest (21 days), although not the highest flood of record was registered on the main stem at Cincinnati in March 1963.

It is the dry-weather season, of course, that presents the greatest concern with respect to pollution-control needs. Water for dilution is limited and river-quality conditions may be expected to be at their worst. Flow records for the Ohio River reveal the occurrences of droughts in cycles of about eleven years. Since 1927, when continuous gaging of the Ohio River was initiated at Louisville, droughts of greatest severity and duration have occurred in 1930-31, 1941-42, 1952-53 and 1963-64.

Because of this cyclic pattern the period 1952-53 was selected as a basis for comparison with conditions found in 1963-64. Suitable quality data for 1952-53 is available because the ORSANCO monitoring program was inaugurated a year earlier. The accompanying charts reveal the similarity of hydrologic variability in 1952-53 and 1963-64 periods. This similarity is exhibited not only in the monthly hydrographs, but in the frequency-distribution curves as well.

COLIFORM BACTERIA COUNTS — As measured by numbers of coliform organisms (a group of indicator bacteria associated with sewage contamination), conditions in the Ohio River reflect improvement in a number of areas. At Wheeling, for example, yearly-average coliform densities have been reduced 98 percent (from 51,000 to 950 per 100 ml) in the past eleven years. Records from five other stations show an average concentration of 4,600 in 1963-64 compared with 16,000 in 1952-53, which represents a 71 percent reduction. The accompanying chart portrays the situation at all stations.

The significance attached to coliform levels may be judged on the basis of the following statistically evaluated criteria: Concentrations exceeding 20,000 coliforms per 100 ml as a monthly average are considered unsuitable if the water is used as a source of raw supply for production of potable water; the desirable range for water to be treated prior to distribution is a count not exceeding 5,000 as a monthly average. For water used for recreational purposes, the preferred goal is lower — coliforms should not exceed 1,000 per 100 ml as a monthly average nor exceed 2,400 on any day.

Conformance of river conditions with these criteria during 1963-64 at the six Ohio River stations where coliforms are monitored continuously is summarized in the following tabulation:

Station	Monthly-average values			Percent daily values less than 2,400 (May-Sept.)
	Percent less than 20,000	Percent less than 5,000	Percent less than 1,000 (May-Sept.)	
Weirton	96	0	0	19
Wheeling	100	100	80	98
Huntington	100	60	80	94
Cincinnati	100	92	90	97
Louisville	100	67	20	73
Evansville	96	39	10	72

These findings lead to the conclusion that while bacterial-quality conditions are meeting statistically desired expectations in some stretches there is need for additional improvement in others. The desirable range for water-supply purposes, 5,000 or less, was met at Wheeling for the entire twenty-four months, and at Cincinnati for twenty-two of the twenty-four months. At Weirton, where the highest counts were experienced, there were no monthly-average values less than 5,000 although they were below 10,000 for about half the time.

With respect to meeting recreational requirements, bacterial conditions in the Cincinnati, Huntington and Wheeling areas were at or near desired levels throughout the 1963 and 1964 seasons. At other places the findings reflect opportunities for improvement.

Reduction in coliform counts is brought about through sewage treatment. However, there are factors that may exert a greater influence on concentration levels at a particular point than can be attributed to the performance of treatment plants. At Louisville, for example, maximum concentrations (not the average) observed in 1963-64 were greater than those recorded in 1952-53 despite the completion of upstream sewage-treatment plants during this period. It appears probable that this atypical condition will be traceable to a new source of sewage discharge, perhaps of only comparatively minor magnitude, in the vicinity of the sampling point.

A similar situation may account for unanticipated conditions at Evansville, upstream from which all major discharges are now treated and are too far removed to account for the higher counts observed in 1963-64. This conjecture is strengthened by experience at the Wheeling monitor station several years ago, where high counts following installation of upstream treatment works were ultimately traced to the discharge of a sewer near the sampling point that had not been connected to an interceptor.

DISSOLVED OXYGEN CONDITIONS — Ranges in daily-average dissolved-oxygen (DO) concentrations are shown in the following tabulation (values are for calendar 1964 at all stations except Miami Fort, for which the period of record is June 1964 to June 1965):

Station	Range (values in mg/l)			Percent time values equaled or exceeded:			
	Max	Avg	Min	1 mg/l	2 mg/l	3 mg/l	4 mg/l
South Heights	17.1	9.1	4.0	100	100	100	100
Stratton	18.1	8.8	3.2	100	100	100	94
Huntington	18.0	8.7	1.1	100	99	99	95
Cincinnati	13.1	8.5	4.0	100	100	100	100
Miami Fort	13.8	7.1	0.5	98	94	84	77
Louisville	12.0	7.1	2.0	100	100	93	89

Values vary from a high of 18.1 mg/l, which occurred at Stratton (mile 55), to a low of 0.5 mg/l, which was observed at Miami Fort (mile 490). The lowest values generally occur in late September or early October, although minimum values were observed at some places as early as June and as late as November.

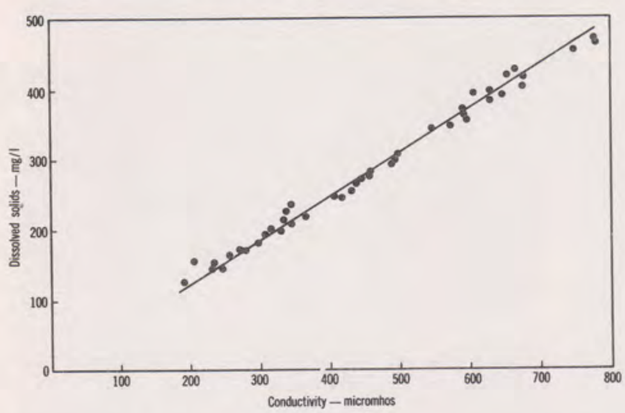
For maintenance of harvestable crops of fish the ORSANCO Aquatic-Life Advisory Committee recommended that: "The dissolved oxygen content of warm-water fish habitats shall be not less than 5 ppm [equivalent to 5 mg/l for practical purposes] during at least 16 hours of any 24-hour period. It may be less than 5 ppm for a period not to exceed 8 hours within any 24-hour period, but at no time shall the oxygen content be less than 3 ppm. To sustain a coarse fish population the dissolved oxygen concentration may be less than 5 ppm for a period of not more than 8 hours out of any 24-hour period, but at no time shall the concentration be below 2 ppm."

It might be noted that the 24-hour average DO content of a stream in which 5 mg/l is maintained for 16 hours and 3 mg/l for 8 hours would be 4.3 mg/l. For all practical purposes, therefore, an average DO content of 4.0 mg/l, would appear compatible with the advisory committee recommendations. Monitor records reveal that conditions at all stations on the Ohio River are such that whenever average DO values are 4.0 mg/l or greater, minimum hourly values are never less than 3.0 mg/l.

Information is presented in the foregoing tabulation showing the amount of time oxygen concentrations equalled or exceeded varying levels. The data show, for example, that DO levels at Cincinnati (at the waterworks intake upstream from the city) and at South Heights were at or above 4.0 mg/l at all times. Conditions at other stations did not match those at these places, a situation that requires attention if DO concentrations are to be maintained at levels meeting aquatic-life criteria.

CONDUCTIVITY RELATIONSHIPS — Conductivity is a measure of the capability of water to convey an electric current. This property is related, in most natural waters, to the content of dissolved mineral solids in the water.

Data collected in 1963 and 1964 at four stations (South Heights — mile 16, Stratton — mile 55, Huntington — mile 304 and Markland Dam — mile 532) provide a basis for defining the relationship between dissolved-solids content and conductivity of Ohio River water. The nature of this relationship is shown graphically for the Markland Dam station in an accompanying chart. Conductivity is measured in terms of micromhos at 25 deg. C., and dissolved-solids content is the total residue on evaporation.



Relationship between dissolved-solids concentrations and conductivity of Ohio River water at Markland Dam. The relationship is expressed by the equation: Dissolved solids = 0.62 times *conductivity.*

There is close correlation between these characteristics at all four stations. The correlation coefficients (based on a scale wherein zero means no correlation and a value of one means perfect correlation) are 0.992, 0.994, 0.996 and 0.995.

The relationship of dissolved-solids content to conductivity may be expressed by an equation of the form $y = Ax + B$. Regression lines using this equation have been determined for each station using the method of least squares. If the term "B" in the equation is considered equal to zero, which it is in theory, the equations become:

South Heights:
Dissolved solids = 0.64 *times* conductivity
Stratton:
Dissolved solids = 0.64 *times* conductivity
Huntington:
Dissolved solids = 0.61 *times* conductivity
Markland Dam:
Dissolved solids = 0.62 *times* conductivity

The range in the conversion factor relating concentrations of the two characteristics in Ohio River water — 0.61 to 0.64 — may be compared with a range of 0.55 to 0.70, which is reported as applicable to "most natural waters" (see page 35, *Standard Methods for the Examination of Water and Wastewater,* Eleventh Edition, 1960, published by American Public Health Association).

Since conductivity may be used as a surrogate measure for dissolved-solids content, together with the fact that it is a measurement that has been automated, the conductivity test is of great usefulness in monitoring river-quality conditions. Measurement of conductivity minimizes the need for monitoring certain specific constituents, particularly those of a mineral nature.

For example, if at a certain station the conductivity values follow a consistent pattern, the additional monitoring of chloride and sulfate characteristics might be eliminated. Only when there is a significant change in conductivity values, would it be necessary to analyze for chloride, sulfate and perhaps other mineral constituents to determine the precise reason for change. The possibility of operating in such a fashion and thus reducing costs of the monitor program is one reason for incorporating equipment for conductivity measurements in the ORSANCO robot-monitor system.

Ranges in monthly-average values of conductivity at Ohio River stations are shown in the following tabu-

(continued on page 19)

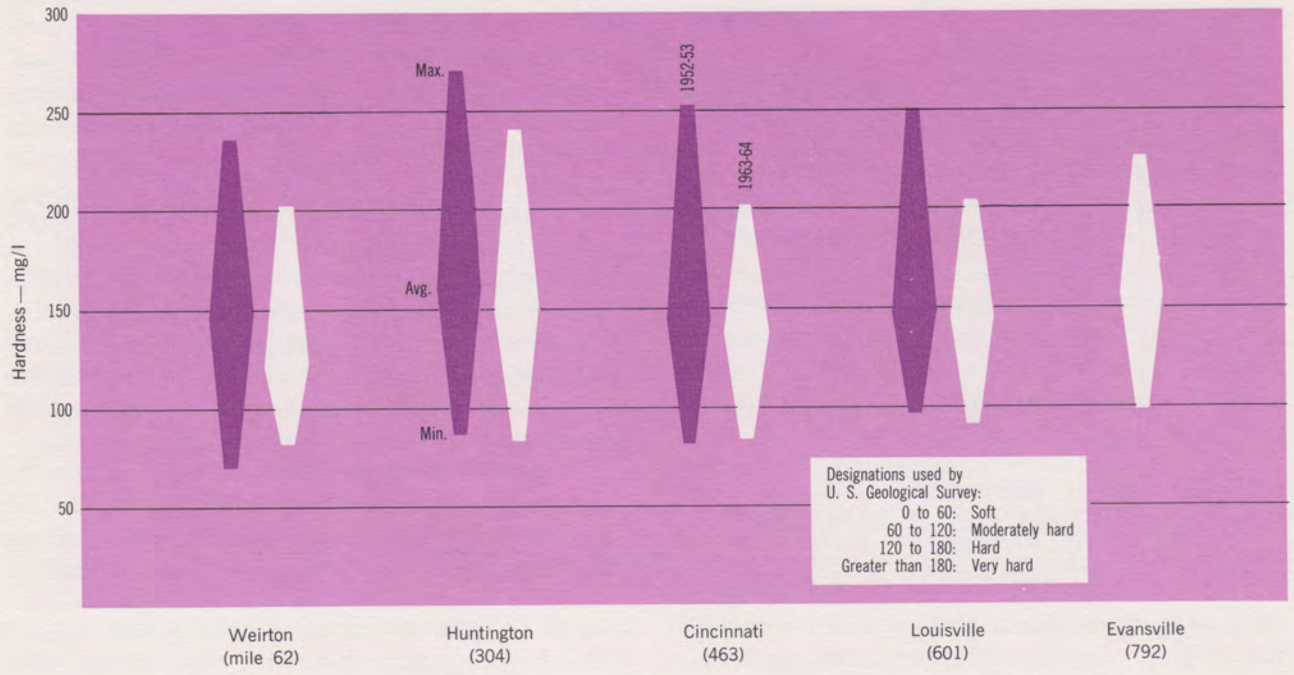
PORTRAYAL OF QUALITY VARIATIONS — *On this and succeeding pages is presented a pictorial representation of nine quality characteristics of the Ohio River at various locations.*

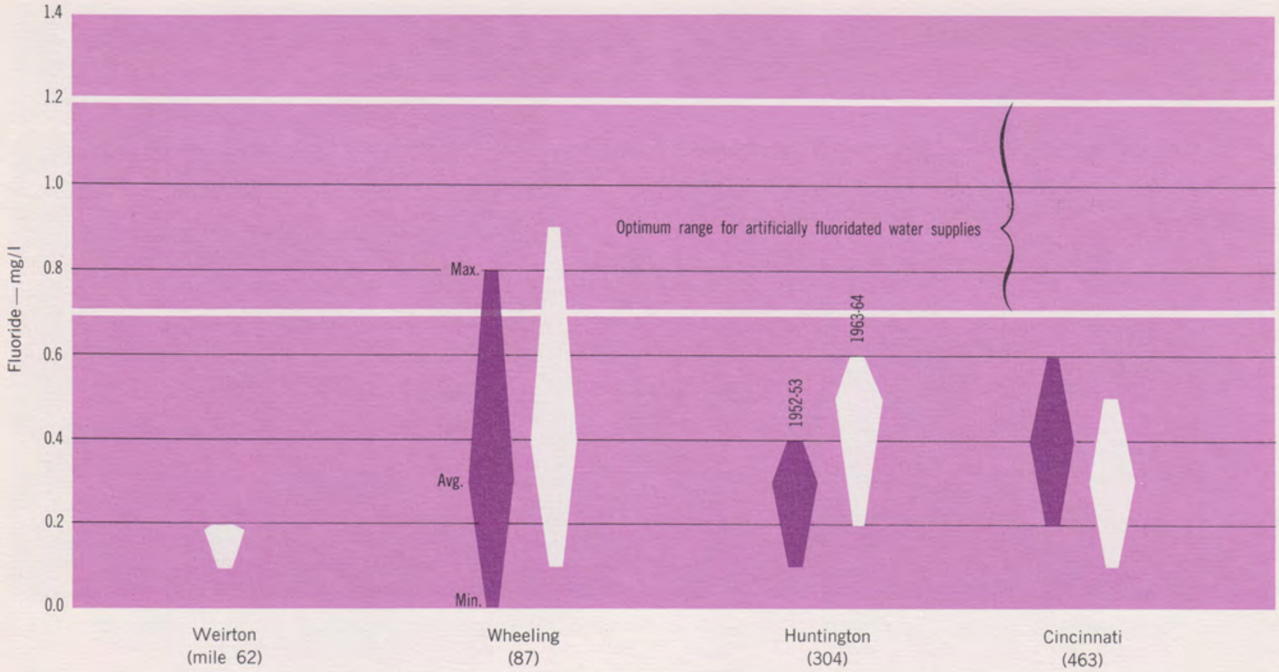
These pictographs are designed to serve several purposes. First they show the maximum, minimum and average values that occurred during a given period of time. Values are expressed in terms of monthly average concentrations for all characteristics except pH and temperature, for which daily values are shown.

In addition, conditions revealed from the most recent findings (1963-64) are contrasted with those obtained a decade ago. The current data is depicted in white. Data for 1952-53 is shown in color. This arrangement facilitates comparative appraisal of changes.

Finally, criterion or "standards" reference lines are provided by means of which the findings may be matched for evaluation purposes. The number of analyses on which the findings have been based is also noted.

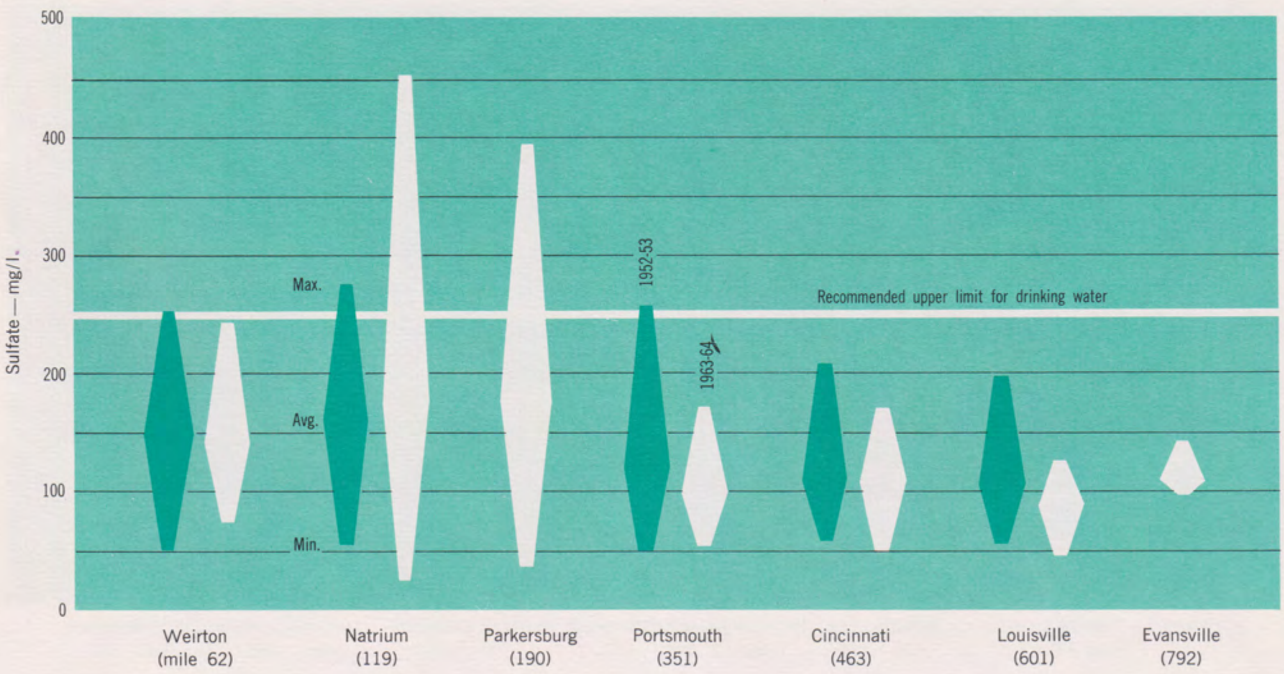
HARDNESS — Ohio River water varied from "moderately hard" to "very hard" in terms of U. S. Geological Survey designations (Water-Supply Paper No. 1812, *1962). At Louisville, the only city on the river with water-softening facilities, the practice is to prevent the hardness level of treated water from exceeding 100 mg/l (4,660 analyses).*

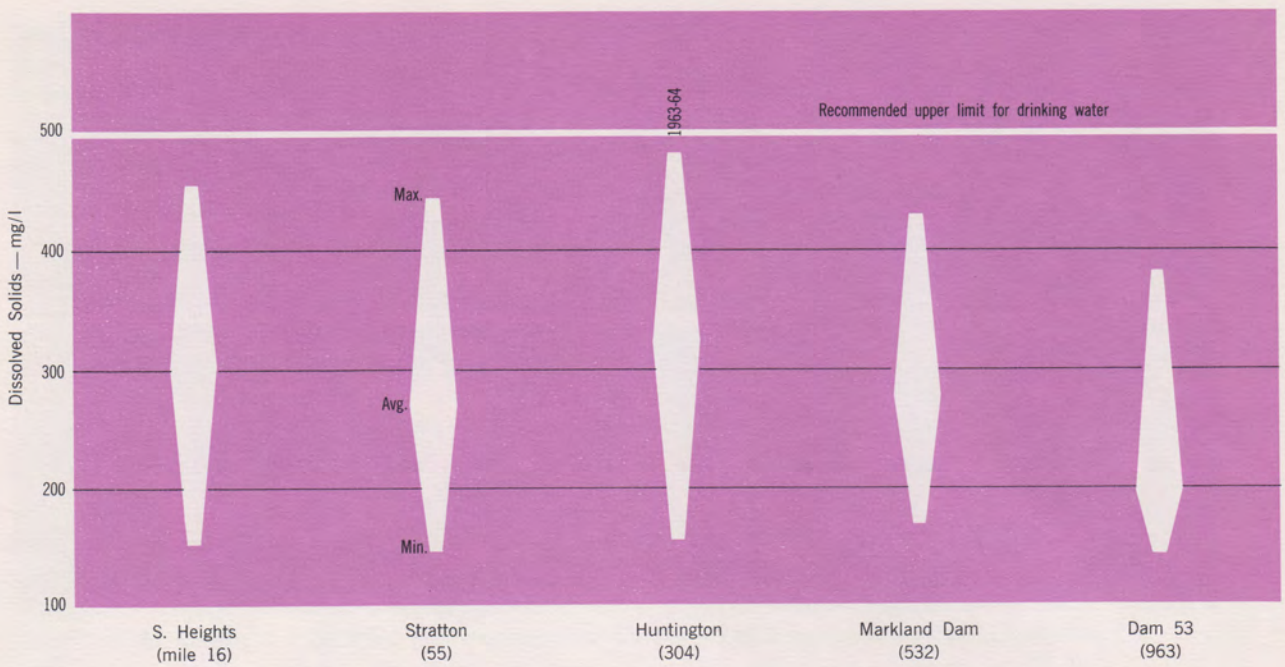




FLUORIDE — Levels were less than the limiting range of 0.8 to 1.7 mg/l recommended in Public Health Service standards for natural waters. At some stations and at various times during the year, concentrations approached the range considered optimum for dental health, which is 0.7 to 1.2 mg/l, depending on temperture (2,370 analyses).

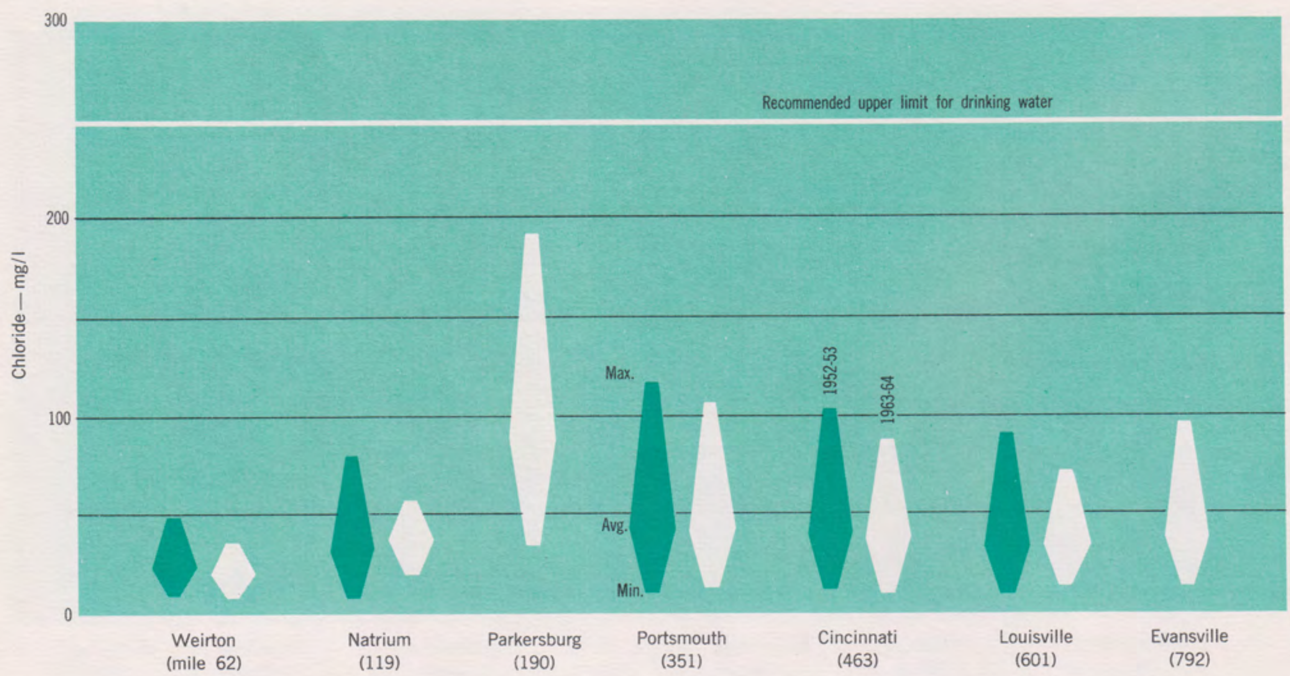
SULFATE — Concentrations were highest in the stretch between Natrium and Parkersburg, where the monthly-average values in 1963-64 exceeded the drinking water standard 18 percent of the time. At other stations, values were less than 250 mg/l at all times (4,370 analyses).

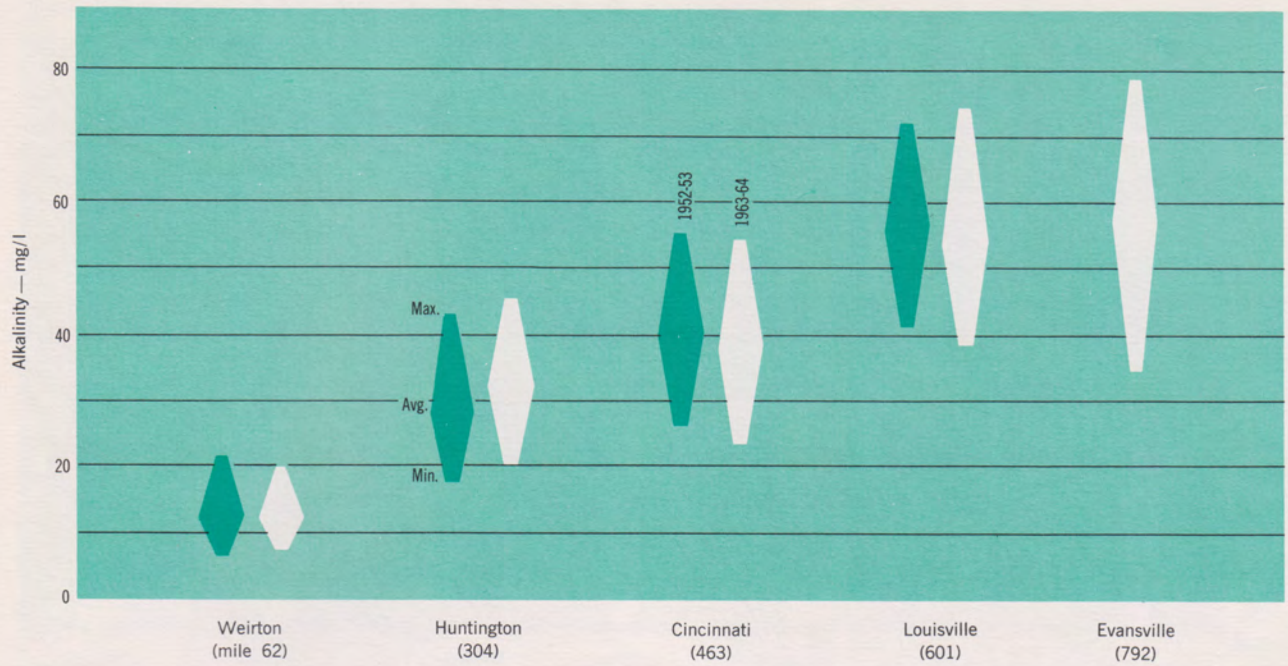




DISSOLVED SOLIDS — Concentrations were less than 500 mg/l, the recommended limiting value for drinking water, at all locations (180 analyses).

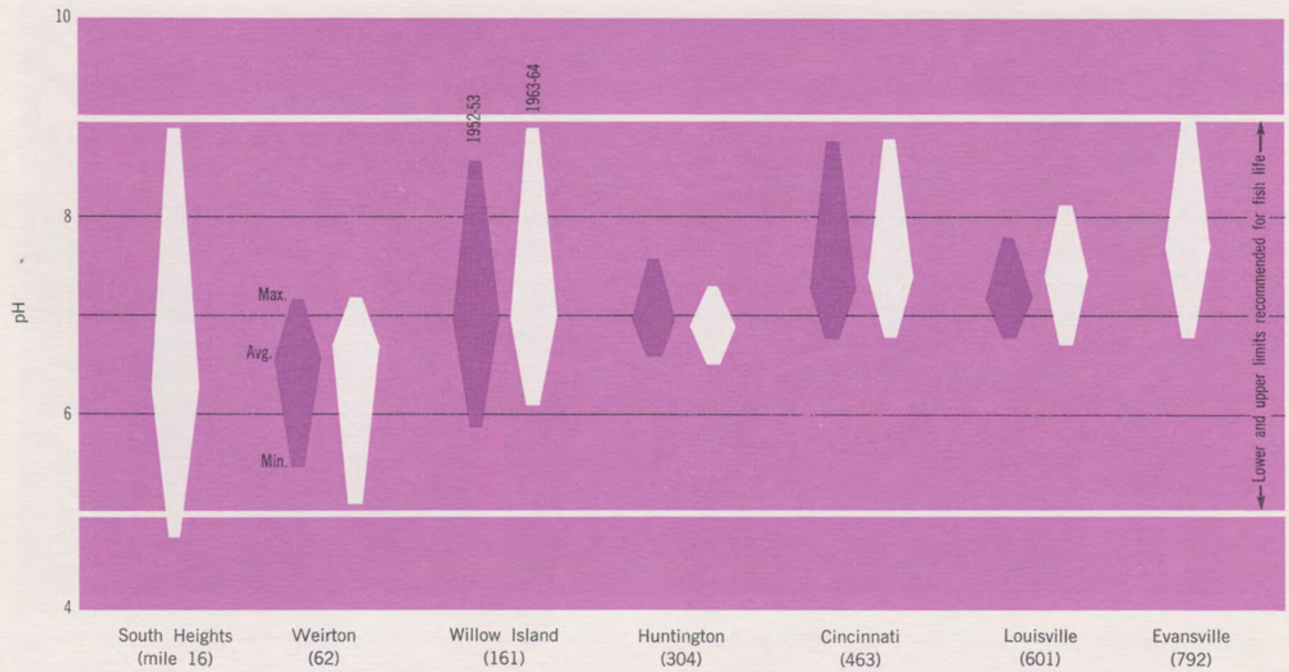
CHLORIDE — Concentrations were less than 250, the recommended limiting value for drinking water, at all stations. Values at Parkersburg reflected the influence of a heavy salt load carried by the Muskingum River. Peak chloride values at most Ohio River stations were less in 1963-64 than they were a decade ago (5,660 analyses).

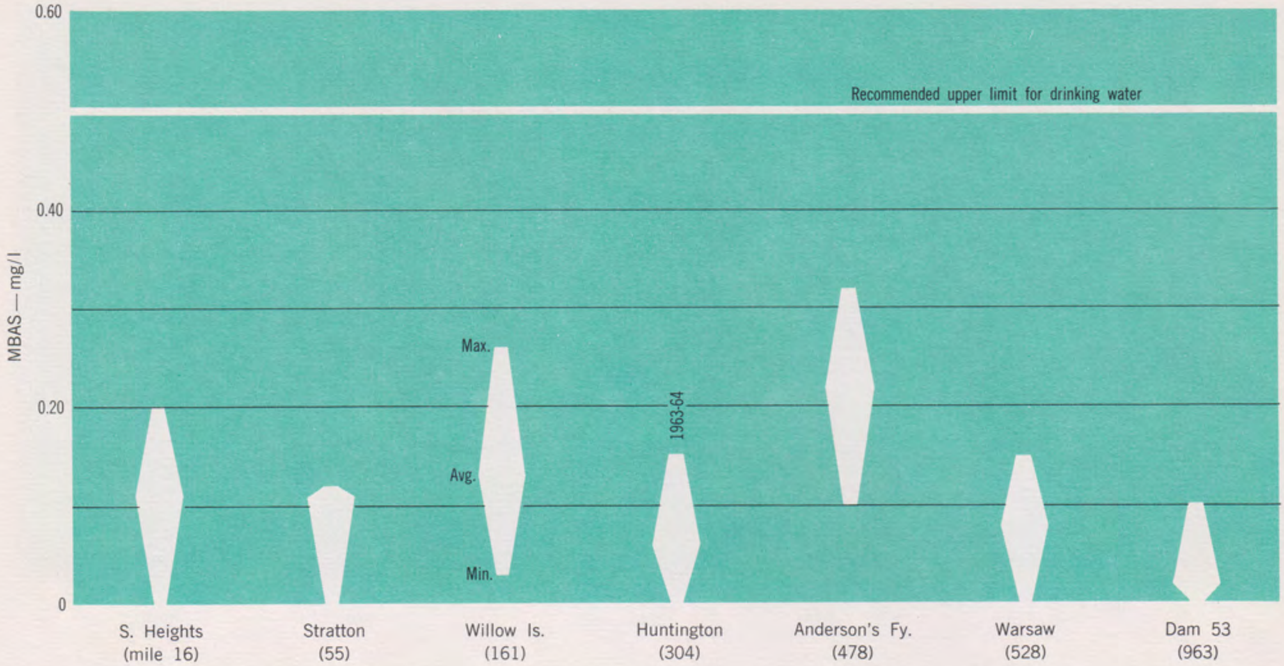




ALKALINITY — Acid mine drainage accounts for the low values at Weirton; improvement downstream is the result of dilution from tributaries whose waters are naturally alkaline (4,620 analyses).

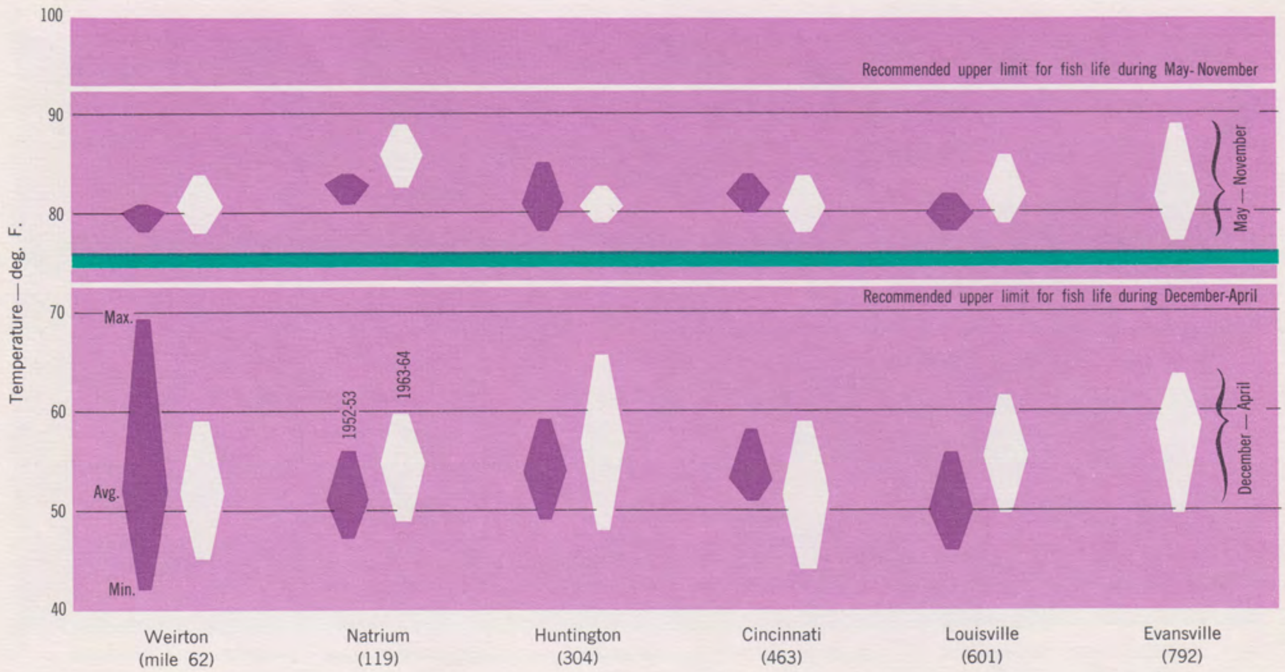
pH — Levels in the upper river reflect conditions of low alkalinity. Peak values at South Heights and Willow Island were of short duration and are attributed to algae growths. Levels throughout the river remained in the range of 5.0 to 9.0, which is considered suitable for the maintenance of fish life (12,700 analyses).





MBAS — The test for MBAS (methylene-blue active substance) is a measure of the apparent concentration of synthetic detergents. Concentrations at all stations were below 0.5 mg/l, the recommended limiting value for drinking water (400 analyses).

TEMPERATURE — Charted here are ranges in months when the highest temperatures occurred. Conditions at all stations met recommended tolerance limits for fish, which specify that temperatures should not exceed 93 deg. F. at any time, nor exceed 73 deg. F. during the months of December through April (44,700 measurements).



lation. The period of record is calendar 1964 for all stations except Miami Fort, for which the period is June 1964 to June 1965. Data for 1963 is not included because records are incomplete at some stations.

Station	Maximum (micromhos)	Average (micromhos)	Minimum (micromhos)
South Heights	646	485	216
Stratton	663	386	196
Huntington	691	440	197
Cincinnati	694	478	236
Miami Fort	832	505	230
Louisville	584	414	236

Conductivity results translated into dissolved-solids values lead to the conclusion that dissolved-solids concentrations in the Ohio River are within acceptable limits prescribed for drinking water. These specify that dissolved-solids concentrations preferably should not exceed 500 mg/l, a value comparable to a conductivity range in the Ohio River of 780 to 820 micromhos.

Conductivity values were less than 780 at all times at all stations except for one month at Miami Fort, where a maximum of 832 was observed.

IRON AND MANGANESE — Concentrations of iron and manganese remained at undesirable levels in some reaches. In the upper river (above Wheeling), monthly-average concentrations of iron in 1964 ranged from 0.46 to 2.77 mg/l. Monthly-average concentrations of manganese in the same reach in 1964 were 0.23 to 3.40 mg/l. These values were essentially the same as those observed during previous years. Limits for drinking water are 0.30 mg/l for iron and 0.05 mg/l for manganese.

From Wheeling downstream the iron content was at such low levels that water plants did not find it necessary to measure it routinely. The same cannot be said about manganese. Records from the Cincinnati monitor station (the only place where manganese is continuously monitored) show that monthly-average levels in 1964 ranged from 0.10 to 1.00 mg/l, with an average of 0.21 mg/l.

NITRATES AND PHOSPHATES — There has been no apparent increase in nitrates nor in phosphates in the Ohio River in recent years. In 1964 the monthly-average levels of nitrates ranged from 1.5 to 12.3 mg/l. Phosphates (measured as PO_4) were 0.06 to 1.15 mg/l. These levels are of the same order of magnitude as those noted since 1954 when monitoring for these constituents was initiated.

Nitrates and phosphates have a fertilizing influence on the productivity of algae and other aquatic plant life. However, direct relationships between concentrations of these constituents and the abundance and variety of aquatic life cannot be demonstrated. This is the conclusion reached by the Potamological Institute of the University of Louisville, based on a research project sponsored by ORSANCO and the Commonwealth of Kentucky.

With respect to nitrates, the limiting value for potable water supplies is 45 mg/l. The maximum observed value in the Ohio River in 1964 was only 14.8 mg/l.

THRESHOLD-ODOR NUMBERS — Threshold-odor numbers of water in the upper third of the river (down to the mouth of the Kanawha River), ranged from 1 to 4 in 1964. This desirable low level was in the same range as that recorded during the past several years.

At Huntington, the range in odor numbers was 14 to 90, with an average value of 29. At Cincinnati the range was 6 to 140, with an average of 24. Odor levels at these places have been consistently higher over the years than those reported at other Ohio River stations. Conditions in 1964 at these stations, however, were better than in 1963. At Huntington, for example, the maximum observed value this year was 90 compared with 200 the year before. At Cincinnati, the maximum value in 1964 was 140 compared with 1,000 last year, and the average was 24 compared with 142.

At Portsmouth, Louisville and Evansville, threshold-odor numbers in 1964 averaged 4 to 6. Maximum values were 64 at Louisville, 50 at Portsmouth and 6 at Evansville. Threshold numbers were less than 20 at these stations on all except one day at Portsmouth and twenty days at Louisville.

The ORSANCO Water Users Committee has concluded that if the threshold-odor number of river water does not exceed 20 it may be considered acceptable for water-supply treatment purposes. Committee members who operate treatment plants report that if odor levels in raw water do not exceed this number they have little difficulty in producing a palatable product.

RADIOACTIVITY — Levels of radioactivity in the Ohio River in 1964 were far below the maximum permissible limit of 1,000 micro-microcuries per liter ($\mu\mu c/l$) of gross beta activity specified for drinking water.

Gross beta activity for water samples ranged from zero to 33.2 $\mu\mu c/l$. The range in 1963 was zero to 63.0 $\mu\mu c/l$, and in 1962 it varied from 2 to 172 $\mu\mu c/l$. Current radioactivity levels are close to natural background.

Radioactivity of plankton, fish and silt samples were analyzed routinely from 15 locations, providing information relating to possible accumulations of radioactivity in sediments and stream biota. Findings (in terms of gross beta activity) for the last three years are tabulated below. Although there are numerical differences in the ranges, the differences are not regarded as significant.

	Plankton	Fish	Silt
1964	0 to 1.5 $\mu\mu c/l$	0 to 155 $\mu\mu c/g$	0 to 69 $\mu\mu c/g$
1963	0 to 1.3	0 to 50	0 to 205
1962	0 to 2.4	0 to 380	1 to 71

In addition to the above determinations, radioactivity analyses were performed on rain water to assess the contribution of "fallout" to the Ohio River. Ranges for the past three years were: 306 to 3,552 in 1962; 6.7 to 1,008 in 1963; and 4.4 to 2,190 in 1964. A trend toward lower radioactivity is indicated although one high value did occur in 1964.

FINDINGS ON TRIBUTARIES

Highlights of findings on quality conditions in certain streams tributary to the Ohio River are presented here.

COLIFORM COUNTS — Monthly-average counts (coliforms per 100 ml) in the Allegheny at Wilkinsburg and the Monongahela at South Pittsburgh revealed the following ranges:

	1963 (max, avg, min)			1964 (max, avg, min)		
Allegheny (Wilkinsburg)	6,000	3,000	1,200	7,700	2,500	130
Monongahela (South Pittsburgh)	3,700	630	22	3,400	1,800	360

Counts at South Pittsburgh met the water-supply objective of 5,000 or less in all months. At Wilkinsburg the counts were less than 5,000 in all except one month in 1963 and one month in 1964.

pH AND ALKALINITY — In all tributaries except the Allegheny and Monongahela rivers, pH values were generally between levels of 5.0 and 9.0, which is within the range recommended as satisfactory for the maintenance of fish life. Ranges in daily-average pH values in 1963-64 are shown in the following tabulation:

	1963 (max, avg, min)			1964 (max, avg, min)		
Allegheny (Oakmont)	7.9	6.6	4.9	9.4	6.5	4.8
Allegheny (Wilkinsburg)	7.3	6.5	4.6	7.3	6.3	3.0
Monongahela (Charleroi)	6.4	4.4	3.1	6.3	4.5	3.1
Monongahela (South Pittsburgh)	7.5	5.6	3.8	7.0	5.5	4.1
Beaver	10.4	7.1	6.3	8.9	6.9	5.9
Muskingum	8.5	7.5	7.0	9.2	7.5	6.4
Kanawha	9.0	6.9	5.9	8.0	6.9	5.4
Wabash	9.4	8.1	7.3	9.0	7.8	6.2

Where values higher than pH 9.0 were recorded on occasion this condition was generally of brief duration and associated with growths of algae.

Values of pH lower than 5.0 were encountered quite often in the Monongahela, but with less frequency in the Allegheny. Such conditions are attributed for the most part to the influence of acid mine drainage. The presence of acid conditions is also shown by low levels of alkalinity, the yearly average values of which in 1964 were 3 mg/l in the Monongahela and 15 mg/l in the Allegheny.

Acid conditions were most evident at Charleroi, where in 1963 and 1964 yearly-average values of pH of 4.4 and 4.5 were recorded. However, in the stretch of the Monongahela downstream from Charleroi conditions showed improvement. This is attributed to the fact that industries add lime to river water withdrawn for cooling purposes and thus neutralize its acidity. As a result by the time the river reaches South Pittsburgh, its acid character has been mitigated to a considerable degree.

Records show that there has been no substantial change in the pattern of pH and alkalinity variations in either the Monongahela or Allegheny rivers during the past several years.

DISSOLVED OXYGEN — Dissolved oxygen was measured hourly by means of robot monitors at six locations on the tributaries. Ranges in daily-average values (in mg/l) were:

	1963 (max, avg, min)			1964 (max, avg, min)		
Allegheny (Oakmont)	12.7	8.2	1.4	15.4	9.0	4.8
Monongahela (Charleroi)	16.6	8.6	2.2	13.1	7.7	1.0
Beaver	11.5	6.2	1.2	14.5	7.5	1.8
Muskingum	16.0	7.7	1.6	17.3	8.1	1.7
Kanawha	14.4	3.9	0.0	15.8	5.6	0.0
Wabash	12.5	7.8	3.0	16.8	7.2	2.8

Levels of DO less than 4.0 mg/l were observed on some days in 1964 at all stations except Oakmont on the Allegheny. Thus, conditions in tributaries other than the Allegheny fell short of meeting recommended criteria for the maintenance of fish life. Oxygen values were never less than 1.0 mg/l on any of the tributaries except the Kanawha, where values of zero were recorded in both 1963 and 1964. Regarding the Kanawha, average and maximum values in 1964 showed that conditions were improved over what they were in 1963.

CONDUCTIVITY — Ranges in monthly-average values of conductivity (in micromhos) at robot-monitor stations were:

	1963 (max, avg, min)			1964 (max, avg, min)		
Allegheny (Oakmont)	556	329	155	594	288	58
Monongahela (Charleroi)	631	379	202	801	411	151
Beaver	674	540	350	622	475	299
Muskingum	1,448	933	454	1,495	939	541
Kanawha	722	322	68	629	324	132
Wabash	703	581	476	664	560	434

On the basis of relationships between conductivity and dissolved solids established for the Ohio River, it may be concluded that dissolved-solids concentrations in all tributaries except the Muskingum were within the range recommended for drinking water (500 mg/l or less). The high conductivity levels in the Muskingum reflect the chloride load imposed on the upper reaches of this tributary.

CHLORIDE — Monthly-average concentrations of chloride (in mg/l), based on hourly measurements by robot-monitor units, were:

	1963 (max, avg, min)			1964 (max, avg, min)		
Allegheny (Oakmont)	45	26	10	45	24	14
Monongahela (Charleroi)	9	5	3	15	8	4
Beaver				74	34	20
Muskingum	526	277	71	475	304	80
Kanawha	120	72	18	115	52	12
Wabash	28	22	16	32	25	18

Except for the Muskingum, the concentrations were less than 250 mg/l, which is the recommended limiting value for drinking water. Monthly-average values in the Muskingum exceeded 250 mg/l for 50 percent of the time in 1963-64.

SULFATE — Monthly-average values of sulfate (in mg/l) were:

	1963 (max, avg, min)			1964 (max, avg, min)		
Allegheny (Oakmont)	189	151	91	211	116	71
Allegheny (Wilkinsburg)	187	118	71	208	120	79
Monongahela (Charleroi)	307	178	87	370	190	90
Beaver				202	146	91
Muskingum				194	148	79
Wabash				60	43	28

Except for the Monongahela, the concentrations were less than 250 mg/l, which is the recommended limiting value for drinking water. Monthly-average values in the Monongahela exceeded 250 for three months in 1963 and two months in 1964.

IRON — Concentrations in the Allegheny and Monongahela, the only tributaries on which iron is routinely monitored, exceeded the recommended limit of 0.30 mg/l for drinking water. Ranges in monthly-average concentrations in 1964 were: 0.26 to 1.70 mg/l at Oakmont, 0.35 to 3.93 mg/l at Wilkinsburg, and 0.33 to 2.30 mg/l at Charleroi.

MANGANESE — Concentrations exceeded the recommended limit of 0.05 mg/l for drinking water at four stations where manganese is monitored. Ranges in 1964 were: 0.43 to 5.50 mg/l at Oakmont, 0.82 to 3.31 mg/l at Wilkinsburg, 0.41 to 2.40 mg/l at Charleroi, and 0.07 to 0.99 at Beaver Falls.

TEMPERATURE — Daily-average temperatures, based on hourly readings at robot-monitor stations, met recommended tolerance limits for fish, which specify that temperatures should not exceed 93 deg. F. at any time, nor exceed 73 deg. F. during the months of December through April. Maximum recorded temperatures were: 92 deg. F. in 1963 (observed in the Muskingum), and 90 deg. F. in 1964 (observed in the Kanawha and Wabash).

HARDNESS — Hardness was monitored at Wilkinsburg and South Pittsburgh. Ranges in monthly-average values in 1964 were: 77 to 192, with an average of 119 mg/l at Wilkinsburg; 72 to 193, with an average of 131 mg/l at South Pittsburgh. There has been no significant change in hardness content of these rivers in recent years.

RADIOACTIVITY — Concentrations of gross beta activity were far below the limiting value of 1,000 $\mu\mu c/l$ recommended for drinking water. Maximum value observed in 1963 was 164 $\mu\mu c/l$ in the Kanawha; maximum in 1964 was 26 $\mu\mu c/l$ in the Kentucky River at Carrollton.

ADMINISTRATIVE AFFAIRS

EACH YEAR THE chairmanship of the Commission is rotated among the states. During the period covered by this report, starting July 1, 1964, Barton A. Holl, one of the three commissioners representing Ohio, served as chairman. Long active in state water-resources developments, he has served as a member of the Ohio Water Pollution Control Board since 1951. In 1944 Mr. Holl was one of the Ohio delegates to the negotiating committee that drafted the ORSANCO compact.

Dr. A. C. Offutt, Chairman 1965-66

Elected chairman for the year beginning July 1, 1965, was Dr. A. C. Offutt, health commissioner for the state of Indiana and a member of ORSANCO since 1954. During World War II Dr. Offutt served as logistics officer and later became Chief of Medical Plans for the European Theater of Operations. Returning to Indiana in 1951 he joined the staff of the State Board of Health. In 1964 he was a United States delegate to the World Health Assembly in Geneva, Switzerland. Dr. Offutt is active in the affairs of the Association of State and Territorial Health Officers, of which he is a past president, and is a member of the faculty of Indiana University.

Elected to serve as vice-chairman for the current year is J. O. Matlick. Mr. Matlick is Commissioner of the Kentucky Department of Natural Resources and a member of the Kentucky Water Pollution Control Commission. Continuing to serve as officers are: F. H. Waring, secretary; Verna B. Ballman, treasurer; Edward J. Cleary, executive director and chief engineer; and Leonard A. Weakley, legal counsel.

During the year ending June 30, 1965, there were no changes in membership. The Commission is composed of twenty-seven members, three from each of the eight signatory states, appointed by the Governor, and three appointed by the President of the United States to represent the Army Corps of Engineers, the Public Health Service and the Department of the Interior.

STAFF — Commission operations are administered by a staff of eleven headquartered in Cincinnati, Ohio. In July, 1965, C. Scott Clark joined the staff after receiving his doctorate from The Johns Hopkins University where he was engaged in research on mine drainage control. Dr. Clark previously worked at the ORSANCO office for two summers as an engineer-in-training.

On October 1, 1965, Mrs. Donna Nickerson replaced Mrs. Jane Renaldo as a member of the secretarial staff. Mrs. Renaldo resigned after a seven-year tenure.

FINANCIAL — Appropriations from the member states for operation of the Commission have totalled \$130,000 annually since 1955; prior to this the annual budget was \$100,000. The contribution from each state represents a prorating of a weighted average, one-half of which is computed in proportion to population and the other in proportion to land area in the compact district. Under this allocation the respective percentages are: New York 1.10; Virginia 3.50; Illinois 5.10; West Virginia 11.35; Pennsylvania 15.20; Indiana 18.10; Kentucky 20.75 and Ohio 24.90.

In 1956 administrative grants-in-aid to state and interstate agencies became available under provisions of the Federal Water Pollution Control Act. For fiscal 1964-65, the period covered in this report, the grant to ORSANCO was \$104,654.

A detailed financial report for the year ending June 30, 1965, will be found on page 28.

COMMISSION COMMITTEE ASSIGNMENTS

(for year ending June 30, 1966)

Executive Committee

Chairman	A. C. Offutt, M.D.
Vice-chairman	J. O. Matlick
Past-chairman	Barton A. Holl
Illinois	Clarence W. Klassen
Indiana	Blucher A. Poole
Kentucky	Minor Clark
New York	Joseph R. Shaw
Ohio	Emmett W. Arnold, M.D.
Pennsylvania	Karl M. Mason
Virginia	Ross H. Walker
West Virginia	Bern Wright
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CHAIRMEN OF INDUSTRY AND ADVISORY COMMITTEES

(as of December 1, 1965)

Aquatic-Life Advisory Committee — Lloyd L. Smith, Jr., University of Minnesota, St. Paul, Minnesota

Chemical Industry Committee — J. Floyd Byrd, Procter and Gamble Company, Cincinnati, Ohio

Coal Industry Advisory Committee — Larry Cook, Ohio Reclamation Association, Columbus, Ohio

Metal-Finishing Industry Action Committee — W. H. Toller, Jr., Houdaille Industries, Huntington, West Virginia

Petroleum Industry Committee — Alex S. Chamberlain, Louisville Refining Company, Louisville, Kentucky

Pulp and Paper Industry Action Committee — W. C. Mathews, Mead Corporation, Chillicothe, Ohio

Steel Industry Action Committee — DeYarman Wallace, The Youngstown Sheet and Tube Company, Youngstown, Ohio

Water Users Committee — S. A. Savage, E. I. DuPont DeNemours and Company, Parkersburg, West Virginia

TECHNICAL and RESEARCH REPORTS

An annotated bibliography of publications and special reports related to investigations and research projects of the Ohio River Valley Water Sanitation Commission and its Advisory Committees (1948-1965).

COMMISSION PUBLICATIONS

ACID-MINE DRAINAGE, PRINCIPLES AND GUIDE TO PRACTICES

Sept. 1963 — A handbook prepared by the Coal Industry Advisory Committee and published by ORSANCO, for the use of coal-mine operators and the guidance of regulatory agency personnel. It describes in simplified fashion the fundamental principles underlying control measures promulgated by ORSANCO and the manner in which they can be applied. The case histories describe how situations at various types of mines have been dealt with.

BACTERIAL-QUALITY OBJECTIVES FOR THE OHIO RIVER

June 1951 — Development of recommendations on bacterial-quality objectives for waters used for potable supplies and recreational purposes. The study provides background information in support of the recommended objectives, and describes how the objectives are to be applied and interpreted.

BRINE CONTAMINATION IN THE MUSKINGUM RIVER

Aug. 1951 — Determination of the nature and magnitude of brine-waste discharges from salt-processing operations and their effect on quality conditions in a river basin. (Loan copy available)

DISPOSAL OF SPENT SULFATE PICKLING SOLUTIONS

Oct. 1952 — An analysis of methods for treating spent solutions resulting from sulfuric acid pickling to reduce stream pollution. Compiled by the Steel Industry Action Committee. (Loan copy available)

DUST RECOVERY PRACTICE AT BLAST FURNACES

Jan. 1958 — An evaluation of settleable solids formation and recovery at mills in the Ohio Valley and a suggested procedure for defining performance of waste-water clarifiers. Compiled by Steel Industry Action Committee. (Price $1.00)

FISH-KILL HANDBOOK

March 1956 — A practical outline of what to do and how to do it, designed for the agency or individual charged with responsibility for investigating a fish-kill. Contains bibliography on bioassays, toxicity and biological indicators of pollution. (Price 50¢)

METHODS FOR TREATING METAL-FINISHING WASTES

Jan. 1953 — An evaluation of various disposal methods and their applicability to specific waste control conditions. Compiled by Metal-Finishing Industry Action Committee. (Price $1.00)

MONONGAHELA RIVER SEWAGE-TREATMENT CONSIDERATIONS

Jan. 1959 — Staff report outlining quality conditions in the river, the status of control facilities and recommendations for remedial action. (Loan copy)

OHIO RIVER POLLUTION PATTERNS — 1950

June 1951 — Water-quality conditions and changes revealed by a simultaneous sampling of the 963-mile stretch of the Ohio River from Pittsburgh to Cairo.

OHIO RIVER POLLUTION-ABATEMENT NEEDS — CINCINNATI POOL

Jan. 1949 — Investigations leading to recommended treatment standards for organic wastes discharged to the Cincinnati Pool for establishment of Treatment Standard No. 1. (Loan copy available)

OHIO RIVER POLLUTION-ABATEMENT NEEDS — HUNTINGTON TO CINCINNATI STRETCH

Feb. 1952 — Staff findings with respect to existing conditions and recommendations for remedial measures used as a basis for the conduct of a public hearing for establishment of Treatment Standard No. 2.

OHIO RIVER POLLUTION-ABATEMENT NEEDS — PITTSBURGH TO HUNTINGTON STRETCH

March 1953 — Staff findings with respect to existing conditions and recommendations for remedial measures used as a basis for the conduct of a public hearing for establishment of Treatment Standards No. 3 and 4. (Limited supply)

OHIO RIVER POLLUTION-ABATEMENT NEEDS — CINCINNATI TO CAIRO STRETCH

Nov. 1953 — Staff findings with respect to existing conditions and recommendations for remedial measures used as a basis for the conduct of a public hearing for establishment of Treatment Standards No. 5, 6 and 7. (Limited supply)

OIL PIPELINE BREAKS

Sept. 1950 — A guidebook prepared by the staff on the development of preventive measures and the organization of emergency crews to cope with oil pipeline breaks. Pollution control procedures are described including methods for recovering lost oil. (Loan copy available)

PHENOL WASTES TREATMENT BY CHEMICAL OXIDATION

June 1951 — Report on a cooperative research project showing how phenols can be destroyed by three methods of chemical oxidation (chlorine, ozone and chlorine dioxide). (Price $1.00)

PLANNING AND MAKING INDUSTRIAL WASTE SURVEYS

April 1952 — Detailed instructions for measuring volume of waste flow, obtaining representative samples and calculating waste loads. Compiled by Metal-Finishing Industry Action Committee. (Price $1.00)

PLATING-ROOM CONTROLS FOR POLLUTION ABATEMENT

July 1951 — A guidebook of principles and practices for curbing losses of solutions and metals that otherwise might find their way into water courses. Compiled by Metal-Finishing Industry Action Committee. (Price 50¢)

PROCEDURES FOR ANALYZING METAL-FINISHING WASTES

Aug. 1954 — Methods designed to screen out interfering substances and selected for accuracy and reproducibility of results. Compiled by Metal-Finishing Industry Action Committee. (Price $1.00)

REDUCING PHENOL WASTES FROM COKE PLANTS

Jan. 1953 — Sources, volumes and concentrations of phenolic wastes and methods for reduction by process changes or treatment. Compiled by Steel Industry Action Committee. (Price $1.00)

REGULATORY ACTIONS

Jan. 1961 (revised Jan. 1963) — A compendium of regulatory actions adopted by the Commission for the control of sewage, industrial wastes and other substances.

RESERVOIRS AND POLLUTION CONTROL BENEFITS

Jan. 1953 — Description and status of the 80-unit reservoir program of the U. S. Corps of Engineers in the Ohio River Basin with reference to its present and anticipated effects on pollution abatement.

RIVER-QUALITY CONDITIONS DURING A 16-WEEK SHUTDOWN OF UPPER OHIO VALLEY STEEL MILLS

Sept. 1961 — Closure of the mills because of a labor strike presented a unique opportunity to appraise the condition of streams that were relieved of a burden of industrial effluents. Staff report includes the data and describes evaluation methods. (Loan copy)

SEWAGE TREATMENT WORKS

June 1952 — A manual describing step-by-step engineering and financial procedures for cities or villages undertaking construction of a sewage-works project. Report issued by ORSANCO and the Ohio Health Department. (Price $1.00)

WABASH RIVER POLLUTION-ABATEMENT NEEDS

Aug. 1950 — Staff findings on conditions in one stretch of the Wabash River with recommendations for remedial measures between Terre Haute, Ind., and Mt. Carmel, Ill. (Loan copy available)

WATER QUALITY AND FLOW VARIATIONS IN THE OHIO RIVER — 1951-55

March 1957 — A compilation of chemical and bacteriological analyses coupled with flow-discharge records from a network of monitor stations. Includes a hydrographic study of the flow-variability pattern, particularly with regard to minimum flows. (Price $2.00)

WATER QUALITY AND FLOW VARIATIONS — OHIO RIVER AND TRIBUTARIES — 1956-57

April 1959 — A compilation of chemical and bacteriological analyses at 44 locations on the Ohio River and tributary streams. Included are qualigrams which show observed range and frequency of occurrence at five locations on the Ohio River for alkalinity, pH, total hardness, sulfate, chloride, dissolved solids, temperature and turbidity; also flow duration curves for 18 of the major tributaries of the Ohio River. (Price $2.00)

REPORTS ON CONTRACT INVESTIGATIONS

Acid Mine-Drainage

May 1961 — A report prepared by Ohio State University under Commission sponsorship for the purpose of developing guidelines for the conduct of future research on acid mine-drainage control. (Loan copies available)

Aquatic-Life Resources of the Ohio River

Jan. 1962 — An inventory of the aquatic-life resources of the Ohio River based on a three-year study by the University of Louisville, sponsored by ORSANCO and the Kentucky Division of Fish and Wildlife Resources. (Loan copies available)

Physiological Aspects of Water Quality

An evaluation of information on the physiological aspects of substances in water conducted by The Kettering Laboratory of the University of Cincinnati under contract with ORSANCO. Findings, which are presented in some twenty-six reports issued by The Kettering Laboratory during the period 1952-59, are part of the Commission archives. Substances included in the study are: Acrylonitrile, ammonium, arsenic, cadmium, carbon tetrachloride, chloride, chromium, cobalt, copper, cresol, cyanide, detergents, fluoride, inorganic salts, iron, lead, manganese, naphthalene, nickel, nitrate, phenol, pyridine, sodium arsenite, sulfur, tin, zinc.

Phytoplankton

A study of the composition of phytoplankton in a portion of the Ohio River and the effect of these organisms on water-quality conditions conducted in 1960 by the Potamological Institute of the University of Louisville under a contract arrangement with ORSANCO. Purpose of the work was to evaluate factors affecting phytoplankton blooms and their relationship to taste-and-odor occurrences.

Radioactivity

From 1959 to 1964, the Potamological Institute of the University of Louisville, under contract with ORSANCO, conducted investigations to develop information on the accumulation of radio-materials by fish, aquatic organisms and in river sediments at selected stations along the Ohio River; also included are evaluation on radioactivity levels revealed from monitoring data. Findings are set forth in a series of annual reports, copies of which are available on a loan basis.

Taste-and-Odor

Examination of Ohio River samples to identify substances contributing to taste-and-odor problems and the development of improved techniques (e.g. chloroform extraction of carbon filter residue), for analysis of these substances. The study was conducted under contract at The Kettering Laboratory of the University of Cincinnati, April 1957 to December 1959.

ADVISORY COMMITTEE REPORTS PUBLISHED IN TECHNICAL JOURNALS

Aquatic-Life Advisory Committee

Findings and recommendations on quality requirements suitable for the maintenance of a harvestable fish crop. Documented in three reports published in **Sewage and Industrial Wastes*: First Report — March 1955 — page 321. Discusses influence of dissolved oxygen and hydrogen-ion concentrations and outlines bioassay procedures. 2nd Report — May 1956 — page 678. Presents conclusions with regard to temperature, dissolved solids, settleable solids, color, chloride and fluoride ions. 3rd Report — January 1960 — page 65. Deals with effect of radioactivity, detergents, cyanides, phenolic compounds, iron and manganese on aquatic life.

Chemical Industry Advisory Committee

"Current Practices in Municipal Treatment of Industrial Wastes" — **Sewage and Industrial Wastes,* June 1957, p. 672. A survey of practices at 100 sewage-treatment plants analyzed with respect to their handling of industrial wastes.

"Site Selection for Chemical Industry Plants" — *Industrial Wastes,* Jan.-Feb. 1957, p. 24. Originally titled "Operation and Design Practice as Related to Pollution Control in the Chemical Industry," this report deals specifically with treatment and disposal of water-borne wastes.

"Selecting Sites for Chemical Plants" — *Industrial Wastes,* March-April 1958, p. 46. Waste disposal considerations as they relate to the location of new processing facilities.

"Detergents in Sewage and Surface Water" — *Industrial Wastes,* July-Aug. 1956, p. 212. A report on development of analytical procedures and research activities.

"Components of Household Synthetic Detergents in Water and Sewage" — *American Water Works Association Journal,* March 1963, p. 369. A report on sanitary-engineering aspects of detergents.

Petroleum Industry Committee

(formerly Oil Refining Industry Committee)

"Foul Condensate Treatment and Disposal" — **Sewage and Industrial Wastes,* Feb. 1958, p. 185. Experiences and operating data relating to the treatment, disposal and re-use of foul-condensate waters.

*published by Water Pollution Control Federation

ARTICLES AND REPORTS OF REFERENCE INTEREST

"Creating Public Awareness and Motivation for Clean Streams" by Edward J. Cleary, *American Journal of Public Health,* June, 1959, p. 757. Analysis of methods used by ORSANCO to create public support to promote construction of waste-treatment facilities.

"Ohio River Water Quality and Flow" — by Edward J. Cleary and David A. Robertson, Jr., *American Water Works Association Journal,* March, 1958, p. 399. Experiences of the Ohio River Valley Water Sanitation Commission in pioneering the establishment of a river-quality monitor program. Methods of operation, evaluation of data and costs are discussed.

"Robot Monitor System for the Ohio Valley" by Edward J. Cleary, *American Water Works Journal.* Nov. 1962, p. 1347. Description of an electronic sentinel system designed to provide automatic and continuous surveillance of river-quality variations in the Ohio River Valley.

"Evaluation of Membrane Filter Technique for Appraising Ohio River Water Quality" by Harold W. Streeter and David A. Robertson, Jr., **Sewage and Industrial Wastes,* Feb. 1960. An evaluation of a 20-month study by the Water Users Committee of the Commission comparing the membrance filter and standard dilution methods for enumerating coliform organisms in raw waters.

"Reuse of Ohio River Water" — by Edward J. Cleary, Robert K. Horton, and Robert J. Boes, *American Water Works Association Journal,* June, 1963, p. 683. An investigation into reuse of Ohio River water, showing relationship of water used by industries and municipalities to river flow.

"An Electronic Monitor System for River-Quality Surveillance and Research" by Edward J. Cleary, *International Conference on Water Pollution Research,* London, Sept. 1962. Detailed description of design features of analyzer units, telemetry and data-logging equipment of the ORSANCO robot monitor system.

"Barge Transport of Hazardous Material" — *ORSANCO 1960 Annual Report.* Findings and recommendations resulting from a staff inquiry of the risks involved in barge transport of chemical compounds on the Ohio River.

"Instrumentation for Water Quality Management in the Ohio Valley," *ASTM National Forum on the Control of Water Quality,* May 12-13, 1965, Philadelphia (Wm. L. Klein). A discussion of the methods used for collecting, processing and evaluating data obtained from the ORSANCO robot monitor system.

*published by Water Pollution Control Federation

ORSANCO DOCUMENTARY FILMS

Following is a list of ORSANCO films produced to illustrate various aspects of pollution abatement in the Ohio Valley. These 16 mm movies, in color and with sound, may be borrowed for group showings by addressing the state agencies listed on the inside back cover, or by request to Commission headquarters.

GOOD RIDDANCE This fast-moving, omnibus film depicts the progress made and the tasks that still remain in curbing water pollution in the Ohio Valley. This offers a general introduction on the regional crusade for clean streams undertaken by eight states. (29½ minutes)

BEARGRASS CREEK The story of what can happen to a stream when people along its banks disregard their obligation to prevent pollution. Of particular interest is the work being done by the University of Louisville in conducting the ORSANCO-sponsored study of aquatic-life resources. (19½ minutes)

OIL ON THE RIVER Beginning with the story of the discovery of oil in the Ohio Valley, this film shows the unhappy consequence of carelessness in handling, transportation, storage and use of oil products and then depicts preventive measures. (20½ minutes)

CRISIS ON THE KANAWHA A portrayal of industrial growth and the failure to keep pace with it in terms of river protection is the opening theme of this film. Then follows a detailed description of the remedial steps that are being taken to deal with the situation. (22 minutes)

RIVER WATCHERS Safeguarding streams from pollution hazards calls for constant vigilance. This is the story of the sentinels in the eight states who are engaged in checking sewage plant operations, aerial surveillance, virus identification, sampling of streams, forecasting river flow and evaluating the results from robot monitors. (18½ minutes)

THE FIRST FIFTEEN YEARS ORSANCO commissioners describe progress in the fifteen-year crusade for clean streams in the Ohio Valley. A highlight of the film is a visit to The Kettering Laboratory where toxicity studies are documented. (26 minutes)

COAL AND WATER A penetrating look at pollution problems created by the coal industry and the steps being taken to solve those problems. Included is a description of sealing operations in an underground mine to curb acid mine-drainage. (23 minutes)

"OOPS!" An educational film which demonstrates how careless actions within a plant may result in river pollution and steps to take to guard against such situations. Designed as an in-plant training aid to solicit employee and supervisor alertness in preventing accidental spills. (22 minutes)