Ohio River Valley Water Sanitation Commission

Pollution Control Standards

for discharges to the Ohio River

1990 Revision

NOTICE OF REQUIREMENTS

You are hereby notified that, having considered all the evidence presented at public hearings, the Ohio River Valley Water Sanitation Commission, at its regularly held meeting on October 18, 1990, acting in accordance with and pursuant to the authority contained in Article VI of the Ohio River Valley Water Sanitation Compact, adopted and promulgated, subject to revision as changing conditions require, Pollution Control Standards 1990 Revision for the modification or treatment of all sewage from municipalities or other political subdivisions, public or private institutions, corporations, or watercraft, and for the modification or treatment of all industrial wastes discharged or permitted to flow into the Ohio River from the point of confluence of the Allegheny and Monongahela Rivers at Pittsburgh, Pennsylvania, designated as Ohio River mile point 0.0, to Cairo Point, Illinois, located at the confluence of the Ohio and Mississippi Rivers, and being 981.0 miles downstream from Pittsburgh, Pennsylvania.

Under terms and provisions of the Ohio River Valley Water Sanitation Compact all sewage from municipalities or other political subdivisions, public or private institutions, corporations or watercraft and all industrial wastes discharged or permitted to flow into the Ohio River will be required to be modified or treated to the extent specified in the standards established as above set forth.

To the extent that Pollution Control Standards (September 10, 1987 Revision), which were established by Commission action September 10, 1987, have been amended or restated by virtue of Pollution Control Standards 1990 Revision, the Pollution Control Standards 1987 Revision, including any definitions and application procedures appended to or incorporated therein, are rescinded.

Alan H. Vicory, Jr.

Executive Director and Chief Engineer

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Ohio River Valley Water Sanitation Commission

An interstate Commission created by compact among: • Illinois • Indiana • Kentucky • New York • Ohio • Pennsylvania • Virginia • West Virginia

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I. PREAMBLE [1]

Pollution control standards implement many decisions affecting water quality of the Ohio River and the uses made thereof. The Ohio River Valley Water Sanitation Compact provides the basis for assuring multipurpose uses of the Ohio River, and authorizes the Commission to promulgate standards for the treatment of sewage and industrial wastes. It also states that: "The guiding principle of this Compact shall be that pollution by sewage or industrial wastes originating within a signatory state shall not injuriously affect the various uses of the interstate waters as hereinbefore defined."

The purpose of these regulations, therefore, is to recognize those uses to be protected in the Ohio River, establish stream criteria to assure that the uses will be achieved, and set Wastewater Discharge Requirements needed to attain the established stream criteria. These regulations also implement the formal decisions of the Commission as they are concerned with pollution control activities, provide for the granting of variances upon justification and recognize that individual states may adopt more stringent regulations.

Article IX of the Compact grants the Commission certain enforcement powers. These regulations must be implemented in the issuance of any permit to a discharger to the main stem of the Ohio River (unless the state or the Federal government has a more stringent regulation).

II. DEFINITIONS

A. *"Compact,"* as used in these regulations, means the Ohio River Valley Water Sanitation Compact and is an agreement entered into by and between the states of Indiana, West Virginia, Ohio, New York, Illinois, Kentucky, Pennsylvania, and Virginia, which pledges each to the other of the signatory states faithful cooperation in the control of existing and future pollution of the waters in the Ohio River basin. This compact created the Ohio River Valley Water Sanitation Commission (ORSANCO).

B. *"Cooling Water"* means water used as a heat transfer medium for once-through cooling or cooling tower blowdown to which no Industrial Wastes, Toxic Wastes, Residues from Potable Water Treatment Plants, untreated Sewage, or Other Wastes, exclusive of anti-fouling agents approved by the appropriate regulatory agencies, are added prior to discharge.

C. *"Contact Recreation"* means recreational activities where the human body may come in direct contact with water of the Ohio River.

D. *"Industrial Wastes"* means any liquid, gaseous, solid materials or waste substances or combination thereof other than Cooling

[1] Specific Wastewater Discharge Requirements are established in these regulations and must be incorporated into discharge permits issued under the authority of the National Pollutant Discharge Elimination System or state discharge permitting programs when they are more stringent than:
1) applicable U.S. EPA technology-based effluent guidelines required under Sections 301, 304, 306, and 307 of the Federal Clean Water Act, or
2) any state treatment requirements, effluent standards, or water quality based effluent limits.
In the absence of promulgated Federal effluent guidelines pursuant to Sections 301, 304, 306, and 307 of the Clean Water Act, the Compact signatory states have the responsibility to establish effluent limitations to be included in any discharge permit, consistent with the standards contained herein using Best Professional Judgement on a case by case basis.

Water as herein defined, resulting from any process or operation including storage and transportation, manufacturing, commercial, agricultural, and government operations.

E. *"Mixing Zone"* means that portion of the water body receiving a discharge where effluent and receiving waters are not totally mixed and uniform with the result that the zone is not representative of the receiving waters and may not meet all ambient water quality standards or other requirements of any signatory state applicable to the particular receiving waters.

F. *"Net Discharge"* is determined by excluding the amount of pollutant in an intake water when determining the quality of a discharge if both the intake and discharge are from and to the same body of water.

G. *"96 hour LC_{50}"* as used in these regulations means the concentration of a substance that kills 50 percent of the test organisms within 96 hours. The test organisms shall be representative important species indigenous to the Ohio River or standard test organisms.

H. The *"Ohio River,"* as used in these regulations, extends from the point of confluence of the Allegheny and Monongahela Rivers at Pittsburgh, Pennsylvania, designated as Ohio River mile-point 0.0 to Cairo Point, Illinois, located at the confluence of the Ohio and Mississippi Rivers and being 981.0 miles downstream from Pittsburgh.

I. *"Ohio River Valley Water Sanitation Commission"* (Commission) means a body corporate created by authority of the Compact and is the operating agency established to implement the Compact. It consists of three (3) representatives of each signatory state and three (3) representatives of the Federal government.

J. *"Other Wastes"* means any waste other than Sewage, Cooling Water, Residues from Potable Water Treatment Plants, Industrial Wastes or Toxic Wastes, which if discharged to the Ohio River could cause or contribute to any violations of these regulations, or of any water quality standards of any signatory state or which may be deleterious to the designated uses.

K. *"Persistent Substances"* means those substances which have a half-life for degradation under natural environmental conditions of more than 4 days. All other substances are non-persistent.

L. *"Representative Important Species"* means those species of aquatic life whose protection and propagation will assure the sustained presence of a balanced indigenous community. Such species are representative in the sense that maintenance of suitable water quality conditions will assure the overall protection and sustained propagation of the balanced indigenous community.

M. *"Residues from Potable Water Treatment Plants"* means those wastes emanating from processes used in water purification. Such processes may include sedimentation, chemical coagulation, filtration, iron and manganese removal, softening and disinfection.

N. *"Sewage"* means water-carried human or animal wastes from such sources as residences; industrial, commercial or governmental establishments; public or private institutions; or other places. The admixture of Sewage with Industrial Wastes, Toxic Wastes or Other Wastes, in amounts detrimental to the quality of the combined effluent shall also be regarded as Sewage.

O. *"Substantially Complete Removal"* means removal to the lowest practicable level attainable with current technology.

P. *"Toxic Wastes"* means wastes containing substances or combinations of substances in

concentrations which might reasonably be expected to cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions, including malfunctions in reproduction, or physical deformations in fish, other aquatic life, wildlife, livestock, or humans.

Q."*Wastewater*" means sewage and/or industrial wastes as herein defined.

III. DESIGNATED USES

The Ohio River, as hereinbefore defined, has been designated by the Compact as available for safe and satisfactory use as public and industrial water supplies after reasonable treatment, suitable for recreational usage capable of maintaining fish and other aquatic life and adaptable to such other uses as may be legitimate.

IV. STREAM CRITERIA

A. The minimum conditions which the wastewater discharge requirements (Section V) are intended to achieve in the receiving waters outside the Mixing Zone are as follows:

- 1.Freedom from anything that will settle to form objectionable sludge deposits which interfere with designated water uses.
- 2.Freedom from floating debris, scum, oil and other floating material in amount sufficient to be unsightly or deleterious.
- 3.Freedom from materials producing color or odors in such a degree as to create unaesthetic conditions or a nuisance.
- 4.Freedom from substances in concentrations which are toxic or harmful to humans, animals, or fish and other aquatic life; which would in any manner adversely affect the flavor, color, odor, or edibility of fish and other aquatic life, wildlife, or livestock; or which are otherwise detrimental to the designated uses specified in Section III.

B. To assure that the foregoing conditions will be attained, the following criteria shall be met outside the Mixing Zone:

- 1.DISSOLVED OXYGEN:Concentrations shall average at least 5.0 mg/L per calendar day and shall not be less than 4.0 mg/L at any time provided that a minimum of 5.0 mg/L at any time is maintained during the April 15-June 15 spawning season.

2. TEMPERATURE: Allowable stream temperatures are:

Month/Date	Period Average		Instantaneous Maximum	
January 1-31	45°F	7.2°C	50°F	10.0°C
February 1-29	45	7.2	50	10.0
March 1-15	51	10.6	56	13.3
March 16-31	54	12.2	59	15.0
April 1-15	58	14.4	64	17.8
April 16-30	64	17.8	69	20.6
May 1-15	68	20.0	73	22.8
May 16-31	75	23.9	80	26.7
June 1-15	80	26.7	85	29.4
June 16-30	83	28.3	87	30.6
July 1-31	84	28.9	89	31.7
August 1-31	84	28.9	89	31.7
September 1-15	84	28.9	87	30.6
September 16-30	82	27.8	86	30.0
October 1-15	77	25.0	82	27.8
October 16-31	72	22.2	77	25.0
November 1-30	67	19.4	72	22.2
December 1-31	52	11.1	57	13.9

3. pH: No value below 6.0 nor above 9.0.

4. BACTERIA:

- a. Maximum allowable level of fecal coliform bacteria for use as a source of public water supply -- For the months of November through April, content shall not exceed 2,000/100 ml as a monthly geometric mean based on not less than five samples per month.
- b. Maximum allowable level of fecal coliform bacteria for Contact Recreation -- For the months of May through October, content shall not exceed 200/100 ml as a monthly geometric mean based on not less than five samples per month; nor exceed 400/100 ml in more than ten percent of all samples taken during the month.
- c. Maximum allowable level of Escherichia coli bacteria for Contact Recreation -- For the months of May through October, measurements of Escherichia coli bacteria may be substituted for fecal coliform. Content shall not exceed 130/100 ml as a monthly geometric mean, based on not less than five samples per month, nor exceed 240/100 ml in any sample.

5. DISSOLVED SOLIDS: Not to exceed 500 mg/L as a monthly average value, nor exceed 750 mg/L at any time. (Equivalent 25°C specific conductance values are 800 and 1,200 micromhos/cm, respectively.)

6. AMMONIA: The concentration of un-ionized ammonia (as NH_3) shall not exceed 0.05 mg/L; un-ionized ammonia shall be determined from values for total ammonia-N, pH and temperature, by means of the following equation:

$$Y = \frac{1.2\ (\text{Total ammonia-N})}{[1 + 10^{(pk_a - pH)}]}$$

$$pka = 0.092 + \frac{2730}{(273.2 + T_C)}$$

Where:

T_C = Temperature, degrees Centigrade

Y = Un-ionized ammonia, milligrams per liter

Combinations of values for total ammonia-N, pH, and temperature which yield an un-ionized ammonia concentration of 0.05 mg/L are shown in Appendix A.

7. CHEMICAL CONSTITUENTS

Not to exceed the following concentrations:

Constituents	Concentration mg/L
Arsenic	.05
Barium	1.0
Chloride	250
Fluoride	1.0
Nitrite + Nitrate Nitrogen	10.0
Nitrite Nitrogen	1.0
Phenolics	.005
Selenium	.01
Silver	.05
Sulfate	250

Constituent[2]	Chronic Criteria Concentration ug/L	Acute Criteria Concentration ug/L
Cadmium	$e^{(.7852[\ln \text{Hard.}] - 3.490)}$	$e^{(1.128[\ln \text{Hard.}] - 3.828)}$
Chromium (hexavalent)	11	16
Copper	$e^{(.8545[\ln \text{Hard.}] - 1.465)}$	$e^{(.9422[\ln \text{Hard.}] - 1.464)}$
Cyanide (free)	5	22
Lead	$e^{(1.273[\ln \text{Hard.}] - 4.705)}$	$e^{(1.273[\ln \text{Hard.}] - 1.460)}$
Mercury	.012	2.4
Zinc	$e^{(.8473[\ln \text{Hard.}] + .7614)}$	$e^{(.8473[\ln \text{Hard.}] + .8604)}$

(Note: Concentrations for metals are total recoverable except hexavalent chromium which is dissolved.)

[2]Wastewater discharge requirements for these constituents shall be calculated based on the chronic criteria concentrations, the in-stream concentration above the point of discharge, and the minimum 7-day, 10-year stream flow as contained in Appendix B. The acute criteria concentrations shall not be exceeded in the stream at any time. Criteria for cadmium, copper, lead, and zinc at specific hardness values are listed in Appendix C.

8. RADIONUCLIDES:

Gross total alpha activity (including radium-226 but excluding radon and uranium) shall not exceed 15 picocurie per liter (pCi/L) and combined radium-226 and radium-228 shall not exceed 4 pCi/L. Concentration of total gross beta particle activity shall not exceed 50 pCi/L; the concentration of tritium shall not exceed 20,000 pCi/L; the concentration of total Strontium-90 shall not exceed 8 pCi/L.

9. OTHER TOXIC SUBSTANCES:

Stream criteria for substances not otherwise specified in this section shall be derived based on the following:

a.For the protection of aquatic life:

i. Non-Persistent Substances - not to exceed an average of one-twentieth (0.05), nor at any time exceed one-tenth (0.1) of the 96 hour LC_{50} of representative important species indigenous to the Ohio River or standard test organisms.

ii. Persistent Substances - not to exceed an average of one one-hundredth (0.01), nor at any time exceed one-twentieth (0.05) of the 96 hour LC_{50} of representative important species indigenous to the Ohio River or standard test organisms.

b. For the protection of human health, criteria published by the United States Environmental Protection Agency pursuant to Section 304(a) of the Federal Clean Water Act shall be used.

i. For substances identified as human carcinogens, wastewater discharge requirements shall be developed based on the instream concentration above the point of discharge, and calculated so as to prevent one additional cancer per one million population at the harmonic mean stream flow (see Appendix B).

ii. For substances not identified as human carcinogens, wastewater discharge requirements shall be developed based on the instream concentration above the point of discharge and calculated to meet the stream criteria at the minimum seven-day, ten year flow (see Appendix B).

c. Limiting concentrations other than those derived from paragraphs a. and b. above may be used for the protection of human health or aquatic life when justified on the basis of scientifically defensible evidence.

V. WASTEWATER DISCHARGE REQUIREMENTS

A. ***General***

1. No discharge of any Sewage, Industrial Wastes, Toxic Wastes, Other Wastes, Cooling Water or Residues from Potable Water Treatment Plants shall cause or contribute to a violation of these Wastewater Discharge Requirements, shall preclude the attainment of any designated use of the mainstem waters of the Ohio River or shall interfere with the attainment of the stream criteria set forth in Section IV.

2. All discharges of Sewage, Industrial Wastes, Toxic Wastes, Other Wastes, Cooling Water or Residues from Potable Water Treatment Plants shall be treated or otherwise modified so as to provide:

a. Substantially Complete Removal of settleable solids, which may form sludge deposits;

b. Substantially Complete Removal of oil, debris, scum and other floating material;

c. Reduction of total suspended solids and other materials to such a degree that the discharge will not produce a substantial negative visible contrast to natural conditions in turbidity, color or odor of the river, or impart taste to the potable water supplies or cause tainting of fish flesh;

d. Reduction of all substances in amounts which, when concentrated or combined in the receiving stream, would result in conditions toxic or harmful to humans, animals, or fish and other aquatic life; which would in any manner adversely affect the flavor, color, odor, or edibility of fish and other aquatic life, wildlife, or livestock; or which are otherwise detrimental to the designated water uses specified in Section III.

B. ***Sewage***

1. MINIMUM LEVEL OF TREATMENT

Sewage shall be treated, prior to discharge, to meet the following effluent limitations in addition to contained in the requirements of Section V.A.

a. Biochemical Oxygen Demand

i. Five day Biochemical Oxygen Demand (BOD_5) - the arithmetic mean of the values for effluent samples collected during a month shall not exceed 30 mg/L, and the arithmetic mean of the values for effluent samples collected during a week shall not exceed 45 mg/L.

ii. Five-day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) may be substituted for Five-Day Biochemical Oxygen Demand provided that the arithmetic mean of the values for effluent samples collected during a month shall not exceed 25 mg/L, and the arithmetic mean for the values of effluent samples collected during a week shall not exceed 40 mg/L.

b. Suspended Solids

The arithmetic mean of the values for effluent samples collected during a month shall not exceed 30 mg/L, and the arithmetic mean of the values for effluent samples collected during a week shall not exceed 45 mg/L.

c. pH

The effluent values for pH shall be maintained within the limits of 6.0 to 9.0.

d. Bacteria

i. During the months of November through April, the geometric mean of the fecal coliform bacteria content of effluent samples collected during a month shall not exceed 2000/100 ml.

ii. During the months of May through October, the geometric mean of the fecal coliform bacteria content of effluent samples collected during a month shall not exceed 200/100 ml, and no more than 10 percent of the values shall exceed 400/100 ml.

iii. During the months of May through October, Escherichia coli may be substituted for fecal coliform provided that the geometric mean of the values for effluent samples collected during a month shall not exceed 130/100 ml, and no more than 10 percent of the values shall exceed 240/100 ml.

2. ALTERNATIVE TREATMENT

Such facilities as waste stabilization ponds and trickling filters shall be deemed to provide effective treatment of sewage provided that the requirements of Sections V.A., V.B.1.(c) and (d) are met, that the effluent does not cause any violations of applicable states' water quality standards or Sections III and IV of these regulations, and that the following requirements are met.

a. Biochemical Oxygen Demand

i. Five-day Biochemical Oxygen Demand (BOD_5) -- the arithmetic mean of the values for effluent samples collected during a month shall not exceed 45 mg/L; the arithmetic mean of the values for effluent samples collected during a week shall not exceed 65 mg/L; and the average percent removal for any month shall not be less than 65 percent.

ii. Five-day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) may be substituted for BOD_5, provided that the levels are not less stringent than the following: the arithmetic mean of the values for effluent samples collected during a month shall not exceed 40 mg/L; the arithmetic mean of the values for effluent samples collected during a week shall not exceed 60 mg/L; and the average percent removal for any month shall not be less than 65 percent.

b. Suspended Solids

The arithmetic mean of the values for effluent samples collected during a month shall not exceed 45 mg/L; the arithmetic mean of the values for effluent samples collected during a week shall not exceed 65 mg/L; and the average percent removal for any month shall not be less than 65 percent.

C. ***Industrial Wastes, Including Toxic Wastes***

1. The minimum level of treatment for Industrial Wastes including Toxic Wastes, prior to discharge shall be in accordance with national effluent limitations and guidelines adopted by the Administrator of the United States Environmental Protection Agency pursuant to Sections 301 and 302 of the Federal Clean Water Act, national standards of performance for new sources adopted pursuant to Section 306 of the Federal Clean Water Act, and national toxic and pretreatment effluent limitations, adopted pursuant to Section 307 of the Federal Clean Water Act.

2. In addition, the net discharge of the following toxic pollutants is prohibited:

a. Aldrin(1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1, 4-endo-5, 8-exo-dimethanonaphthalene)

b. Dieldrin (1,2,3,4,10,10-hexachloro-6, 7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1, 4-endo-5, 8-exo-dimethanonaphthalene)

c. DDT, including DDD and DDE

i. DDT means 1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane and some o,p'-isomers

ii. DDD (TDE) means 1,1-dichloro-2, 2-bis(p-chlorophenyl) ethane and some o,p'-isomers

iii. DDE means 1,1-dichloro-2, 2-bis(p-chlorophenyl) ethylene

d. Endrin (1,2,3,4,10,10-hexachloro-6, 7-epoxy-1, 4,4a,5,6,7,8,8a-octahydro-1, 4-endo-5, 8-endo-dimethanonaphthalene)

e. Toxaphene - a material consisting of technical grade chlorinated camphene having the approximate formula of $C_{10}H_{10}Cl_8$ and normally containing 67-69 percent chlorine by weight

f. Benzidine - the compound benzidine and its salts as identified by the chemical name 4,4-diaminobiphenyl

g. Polychlorinated Biphenyls (PCB) - a mixture of compounds composed of the biphenyl molecule which has been chlorinated to varying degrees

D. ***Residues from Potable Water Treatment Plants***

The use of controlled discharge for Residues from Potable Water Treatment Plant processes of sedimentation, coagulation and filtration may be authorized provided that as a minimum the discharge meets all the requirements of Section IV.A. and V.A.

VI. MIXING ZONE DESIGNATION

A. A Mixing Zone shall be deemed to exist for each discharge. When required, the specific numerical limits for any Mixing Zone shall be determined on a case by case basis, and shall include considerations for existing uses, linear distance (i.e., length and width) from the point of discharge, surface area involved, and volume of receiving water within the defined zone.

B. Conditions within the Mixing Zone shall not be injurious to human health, in the event of a temporary exposure.

C. Conditions within the Mixing Zone shall not be lethal to aquatic life or wildlife that may enter the zone.

D. The Mixing Zone shall be free from substances attributable to Sewage, Industrial Wastes, Toxic Wastes, Other Wastes, Cooling Water, or Residues from Potable Water Treatment Plants in quantities which:

1. Settle to form sludge deposits;

2. Float as debris, scum, or oil;

3. Contaminate natural sediments so as to cause or contribute to a violation of:

a. appropriate stream criteria outside the Mixing Zone, or

b. any condition of the designated uses of the water.

4. Impart a disagreeable flavor or odor to flesh of fish or other aquatic life, wildlife or livestock which are consumed by man and which acquire such a flavor because of passage through or ingestion of the waters from the Mixing Zone.

E. The Mixing Zone shall be located so as not to interfere significantly with migratory movements and passage of fish, other aquatic life, and wildlife. No waste discharge related to the Mixing Zone shall, outside the limits of the Mixing Zone interfere with potable water supply intakes, bathing areas, reproduction of fish, other aquatic life and wildlife; or adversely affect fish or aquatic life normally inhabiting waters prior to addition of waste discharged; or result in any other violations of appropriate stream criteria relating to the designated use at or above the appropriate critical river flow as shown in Appendix B.

VII. LIMITATION

Nothing contained in these regulations shall be construed to limit the powers of any state signatory to the Compact to promulgate more stringent criteria, conditions and restrictions to further lessen or prevent the pollution of waters within its jurisdiction.

VIII. VARIANCE

A. The Commission may grant a variance from the provisions of Section V of these regulations, provided that the uses set forth in Section III are maintained. The applicant for a variance shall adhere to the following:

1. The specific reasons for the variance shall be clearly stated in writing;

2. The burden of proof is upon the applicant to assure that the uses set forth in Section III are maintained;

3. Prior concurrence of the state where the applicant's discharge is located and those state(s) which may be affected must be obtained;

4. Such additional information shall be provided to the Commission as it may request.

B. A variance may be granted for a period not to exceed the life of the applicable discharge permit; the applicant may apply for a variance renewal prior to the expiration of the permit.

IX. ANALYTICAL METHODS

Tests or analytical determinations to determine compliance or non-compliance with the Wastewater Discharge Requirements and stream criteria established herein shall be made in accordance with accepted procedures such as those contained in the (a) latest edition of Standard Methods for the Examination of Water and Wastewater prepared and published jointly by the American Public Health Association (APHA), American Water Works Association (AWWA), and Water Pollution Control Federation (WPCF); (b) Annual Book of ASTM Standards, Part 31 - Water published by the American Society for Testing and Materials: (c) Guidelines Establishing Test Procedures for the Analysis of Pollutants (40 CFR 136) by the U.S. Environmental Protection Agency; or (d) by such other methods as are approved by the Commission equal to or superior to or not available within methods in documents listed above, provided such other test methods are available to the public.

X. SEVERABILITY CLAUSE

Should any one or more of the Pollution Control Standards hereby established or should any one or more provisions of the regulations herein contained be held or determined to be invalid, illegal or unenforceable, for any reason whatsoever, all other Standards and other provisions shall remain effective.

APPENDIX A

Combinations of Values for Total Ammonia-N,
Temperature, and pH Which Yield an
Un-ionized Ammonia Concentration of .05 mg/L

pH	T_F	41	45	50	55	59	64	68	70	72	75	77	80	84	86	89
	T_C	5	7.2	10	12.8	15	17.8	20	21.1	22.2	23.9	25	26.7	28.9	30	31.7
6.5		106	89	71	58	48	39	33	31	28	25	24	20	18	16	14
6.6		84	71	56	46	38	31	27	25	23	20	19	16	14	13	12
6.7		67	56	46	36	30	25	21	20	18	16	15	13	11	10	9.2
6.8		53	45	36	29	24	20	17	16	14	13	12	10	9.0	8.2	7.3
6.9		42	36	28	23	19	16	13	12	11	10	9.4	8.2	7.2	6.5	5.8
7.0		33	28	22	18	15	12	11	9.8	9.0	8.0	7.5	6.5	5.7	5.2	4.6
7.1		27	22	18	14	12	9.8	8.4	7.8	7.2	6.3	5.9	5.3	4.5	4.1	3.7
7.2		21	18	14	12	9.7	7.8	6.7	6.2	5.7	5.1	4.7	4.1	3.6	3.3	2.9
7.3		17	14	11	9.2	7.7	6.2	5.3	4.9	4.5	4.0	3.8	3.3	2.9	2.6	2.3
7.4		13	11	8.9	7.3	6.1	4.9	4.2	3.9	3.6	3.2	3.0	2.6	2.3	2.1	1.9
7.5		11	8.9	7.1	5.8	4.9	3.9	3.4	3.1	2.9	2.6	2.4	2.1	1.8	1.7	1.5
7.6		8.4	7.1	5.7	4.6	3.9	3.1	2.7	2.5	2.3	2.0	1.9	1.7	1.5	1.3	1.2
7.7		6.7	5.7	4.6	3.7	3.1	2.5	2.1	2.0	1.8	1.6	1.5	1.3	1.2	1.1	.95
7.8		5.3	4.5	3.6	2.9	2.5	2.0	1.7	1.6	1.5	1.3	1.2	1.1	.94	.85	.77
7.9		4.2	3.6	2.9	2.3	2.0	1.6	1.4	1.3	1.2	1.0	.97	.85	.76	.69	.62
8.0		3.4	2.9	2.3	1.9	1.6	1.3	1.1	1.0	.94	.84	.79	.69	.61	.55	.50
8.1		2.7	2.3	1.8	1.5	1.3	1.0	.88	.82	.76	.67	.63	.55	.49	.45	.40
8.2		2.1	1.8	1.5	1.2	1.0	.82	.71	.66	.61	.54	.51	.45	.40	.37	.33
8.3		1.7	1.5	1.2	.94	.81	.66	.57	.53	.49	.44	.41	.37	.33	.30	.27
8.4		1.4	1.2	.93	.76	.65	.53	.46	.43	.40	.36	.34	.30	.27	.25	.22
8.5		1.1	.93	.75	.62	.52	.43	.38	.35	.33	.29	.28	.25	.22	.20	.19
8.6		.88	.75	.60	.50	.43	.35	.31	.29	.27	.24	.23	.20	.18	.17	.16
8.7		.71	.60	.49	.40	.35	.29	.25	.24	.22	.20	.19	.17	.16	.14	.13
8.8		.57	.49	.40	.33	.28	.24	.21	.20	.18	.17	.16	.14	.13	.12	.11
8.9		.46	.40	.32	.27	.23	.20	.17	.16	.16	.14	.14	.12	.11	.11	.10
9.0		.38	.32	.27	.22	.19	.17	.15	.14	.13	.12	.12	.11	.10	.09	.09

T_F - Temperature in degrees Fahrenheit
T_C - Temperature in degrees Centigrade

APPENDIX B

CRITICAL FLOW VALUES

River Reach			
From	To	Min. 7-day, 10 yr. Low Flow in cfs*	Harmonic Mean Flow in cfs**
Pittsburgh	Montgomery Dam (MP 32.4)	4,800	20,600
Montgomery	Willow Island Dam (MP 161.8)	5,800	24,900
Willow Island	Gallipolis Dam (MP 279.2)	6,800	29,200
Gallipolis	Greenup Dam (MP 341.0)	8,500	36,500
Greenup	Meldahl Dam (MP 436.2)	9,800	42,100
Meldahl	McAlpine Dam (MP 605.8)	11,000	47,300
McAlpine	Uniontown Dam (MP 846.0)	13,000	55,900
Uniontown	Smithland Dam (MP 918.5)	18,800	80,800
Smithland	Cairo Point (MP 981.0)	46,300	199,000

* *Minimum 7-day, 10-year low flow (in cubic feet per second) based on calculations by the U.S. Corps of Engineers.*
** *Harmonic mean flow (in cubic feet per second) based on analysis of stream flow data from U.S. Geological Survey.*

APPENDIX C

COMBINATIONS OF VALUES FOR TOTAL AMMONIA-N, TEMPERATURE AND pH WHICH YIELD AN UN-IONIZED AMMONIA CONCENTRATION OF .05 MG/L

	CADMIUM		COPPER		LEAD		ZINC	
Hardness mg/L	Chronic Criterion ug/L	Acute Criterion ug/L	Chronic Criterion ug/L	Acute Criterion ug/L	Chronic Criterion ug/L	Acute Criterion ug/L	Chronic Criterion ug/L	Acute Criterion ug/L
50	0.7	1.8	7	9	1.3	34	59	65
100	1.1	3.9	12	18	3.2	82	106	117
150	1.6	6.2	17	26	5.3	137	149	165
200	2.0	8.6	21	34	7.7	197	191	211
250	2.3	11.0	26	42	10	262	230	254
300	2.7	13.5	30	50	13	331	269	297

Ohio River Valley Water Sanitation Commission
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