

**WATER QUALITY CRITERIA FOR TOXIC POLLUTANTS
FOR ZONES 2 - 6 OF THE DELAWARE ESTUARY**

Basis and Background Document



DELAWARE RIVER BASIN COMMISSION

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EXECUTIVE SUMMARY

The Delaware River Basin Commission (DRBC) proposes to update stream quality objectives for human health and aquatic life in the tidal portion of the Delaware River Basin from the head of tide at Trenton, NJ to the Delaware Bay (Zones 2 through 5) and to adopt stream quality objectives for toxic pollutants to uniformly apply in the estuary to the mouth of the Delaware Bay (Zone 6). The objectives for Zones 2 through 5 appear in Section 3.30 of the Delaware River Basin Commission's Administrative Manual Part III - Water Quality Regulations (18 CFR Part 410). The specific subsections of this regulation include Section 3.30.2 for Zone 2, Section 3.30.3 for Zone 3, Section 3.30.4 for Zone 4, and Section 3.30.5 for Zone 5. Tables 3 through 7 of the regulations include the numeric values of the objectives for the protection of the taste and odor of ingested water and fish, aquatic life and human health from the ingestion of water and fish. Section 3.30.6 is proposed to be modified to include references to the marine criteria in Tables 4 through 7 for Zone 6. Table 3 is not referenced in Section 3.30.6 since it only applies to Zones where drinking water is a designated use. Stream quality objectives (also referred to as water quality criteria) are specifications of the condition of ambient water which are designed to assure the protection of the designated use of a water body. The changes in criteria reflect new scientific information and harmonize DRBC criteria with basin states' criteria.

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INTRODUCTION

The Delaware River Basin Commission (DRBC) proposes to update stream quality objectives for human health and aquatic life in the tidal portion of the Delaware River Basin from the head of tide at Trenton, NJ to the Delaware Bay (Zones 2 through 5) and to adopt stream quality objectives for toxic pollutants to uniformly apply in the estuary to the mouth of the Delaware Bay at the Atlantic Ocean (Zone 6).

The Toxics Advisory Committee (TAC) of the DRBC charged their Toxics Criteria Subcommittee to evaluate recent data and methodologies for establishing water quality criteria with the following objectives:

- To review the basis for existing DRBC water quality criteria and develop recommendations regarding revisions as needed to reflect the current science and risk assessment procedures.
- To develop uniform criteria in shared waters of the basin that harmonizes DRBC criteria with basin states criteria.

Aquatic Life Criteria revisions are based on a review of current EPA recommended national criteria and standards adopted by basin states. Proposed changes in criteria reflect new scientific information and harmonize DRBC criteria with basin states criteria. A principal change is the updating of aquatic life criteria that are related to hardness values. Proposed criteria that differ from current DRBC stream quality objectives include 17 freshwater acute criteria, 13 freshwater chronic criteria, 16 marine acute criteria; and 7 marine chronic criteria.

Human Health Criteria revisions included proposed changes to all current DRBC human health stream quality objectives, except PCBs, in freshwater and marine waters including criteria for carcinogens (consumption of organisms only and consumption of water and organisms) as well as systemic toxicants (consumption of organisms only and consumption of water and organisms). A principal change is the use of an updated fish consumption rate of 17.5 grams per day for both freshwater and marine stream quality objectives replacing a rate of 6.5 grams per day and 37.5 grams per day, respectively.

Criteria and standards reviewed by the Toxics Criteria Subcommittee for this update and revision are USEPA National Recommended Water Quality Criteria 2006; Delaware Water Quality Standards regulation, amended July 11, 2004; New Jersey Surface Water Quality Standards, adopted October 16, 2006; Title 25, Chapter 16 of Pennsylvania Code, Water Quality Toxics Management Strategy - revised 2009; and NYDEC Part 703: Surface Water and Groundwater Quality Standards and Groundwater Limitations. The ambient water quality criteria promulgated by the USEPA and standards adopted by the basin states are listed in Appendix Tables A3 and A4 for the protection of Human Health and Appendix Tables A8 through A11 for the protection of aquatic life.

The policies and procedures used to derive the water quality criteria presented in this report reflect the application of Section 3.10.3C. and D. with proposed amendments as recommended by the DRBC's Toxics Criteria Subcommittee members (Table 1), approved

by the Toxics Advisory Committee members (Table2) and reported to the Delaware River Basin Commissioners on December 9, 2009.

POLICIES AND PROCEDURES

The development of updated numerical criteria is based upon policies and procedures described in this report. Additional policies, procedures and implementation guidance for DRBC stream quality objectives are described in the “Administrative Manual – Part II Water Quality Regulations” 18 CFR Part 410, Delaware River Basin Commission.

Water quality criteria are specifications of the condition of ambient water which are designed to assure the protection of the designated use of a water body or portion thereof. Designated uses of Zones 2 - 6 of the Delaware Estuary are described in the “Administrative Manual – Part II Water Quality Regulations” 18 CFR Part 410, Delaware River Basin Commission

Aquatic Life Objectives for Toxic Pollutants

Section 3.10.3C. of the Commission’s regulations state that it is the policy of the Commission to designate numerical stream quality objectives for the protection of aquatic life for the Delaware River Estuary (Zones 2 through 5) which correspond to the designated uses of each zone. Aquatic life objectives for the protection from both acute and chronic effects are established on a pollutant-specific basis for pollutants listed as toxic under Section 307(a)(1) of the Clean Water Act for which the U.S. Environmental Protection Agency (EPA) has published final criteria, other chemicals for which EPA has published final criteria under Section 304(a) of the Act, and pollutants and other chemicals in combinations. Other toxic substances for which any of the three Estuary states have adopted criteria or standards may also be considered for the development of stream quality objectives. The revised stream quality objectives for toxic pollutants for the protection of aquatic life in all zones of the Delaware estuary are listed in Table 5.

For the purpose of determining compliance with stream quality objectives for the protection of aquatic life, the duration of exposure of aquatic organisms shall be 1 hour for acute objectives and 4 days for chronic objectives.

Form of Metals

Stream quality objectives for cadmium, chromium, copper, lead, mercury, nickel, silver and zinc shall be expressed as the dissolved form of the metal. Stream quality objectives for other metals shall be expressed as the concentration of the total recoverable form of the metal.

Hardness

For those stream quality objectives whose numerical value is related to hardness (cadmium, chromium III, copper, nickel silver and zinc), Section 4.20.5A.2. states that a median hardness value of 74 mg/Liter will be used to represent the hardness of the receiving water for the purposes of determining the numerical value of those objectives. A comparison of formulas used by the USEPA and basin states to calculate hardness dependent acute and chronic freshwater criteria is presented in Appendix Tables A5 and A6.

pH

For those stream quality objectives whose numerical value is related to pH (pentachlorophenol), a median pH value of 7.1 shall be used to represent the pH of the receiving water for the purposes of determining the numerical value of those objectives in the freshwater tidal river. A comparison of formulas used by the USEPA and basin states to calculate pH dependent freshwater criteria is presented in Appendix Table A7.

Adjustment Factors

The Commission established adjustment factors, based upon the best available scientific information, to convert total recoverable criteria to dissolved stream quality objectives (DRBC, 1995). In the absence of data to develop a factor for any of the metals, an adjustment factor of 1.0 shall be utilized.

Metal Toxicity

The criteria for metals were developed for general application in the absence of detailed site-specific information. Metal toxicity may be dependent on ambient pH, hardness, organic carbon, alkalinity, temperature, and other site-specific parameters.

Cyanide

Since representatives from the U.S. Fish and Wildlife Service on DRBC TAC noted that a national consultation was currently ongoing with the U.S. EPA under Section 7 of the Endangered Species Act on both the acute and chronic national criteria. They suggested that the 1.0 µg/L value be retained for both acute and chronic marine criteria for cyanide until the consultation is completed. TAC members agreed with this recommendation.

Human Health Objectives for Toxic Pollutants

Section 3.10.3D. of the Commission's regulations state that it is the policy of the Commission to designate numerical stream quality objectives for the protection of human health for the Delaware River Estuary (Zones 2 through 5) which correspond to the designated uses of each zone. Stream quality objectives for protection from both

carcinogenic and systemic effects are established on a pollutant-specific basis for pollutants listed as toxic in the Clean Water Act Section 307(a)(1) and other toxic pollutants, and other chemicals for which EPA has published final criteria under Section 304(a) of the Act. Other toxic substances for which any of the three Estuary states have adopted criteria or standards may also be considered for the development of stream quality objectives. Revised stream quality objectives for carcinogens and systemic toxicants in all Zones of the Delaware Estuary are listed in Tables 6 and 7.

Derivation of DRBC Human Health Stream Quality Objectives

The DRBC proposed human health criteria have been developed in accordance with the Methodology for Ambient Water Quality Criteria for the Protection of Human Health (2000) (EPA-822-B-00-004, October 2000). Listed below are the equations used for deriving human health criteria for carcinogens and non-carcinogens.

Noncancer effects

$$AWQC = Rfd * RSC * \left(\frac{BW}{DI + \sum_{i=2}^4 Fli * BAFi} \right)$$

Cancer effects: nonlinear low-dose extrapolation

$$AWQC = \frac{POD}{UF} * RSC * \left(\frac{BW}{DI + \sum_{i=2}^4 Fli * BAFi} \right)$$

Cancer effects: linear low-dose extrapolation

$$AWQC = RSD * \left(\frac{BW}{DI + \sum_{i=2}^4 FI_i * BAF_i} \right)$$

AWQC = ambient water quality criteria (mg/L)

Rfd = reference dose for noncancer effects (mg/Kg-day) from IRIS

POD = Point of departure for carcinogens based on a nonlinear low-dose extrapolation (mg/kg-day, usually the Lowest Observed Adverse Effect Level or LOAEL, No Observed Adverse Effect Level or NOAEL, or Lower 95th percent Confidence Limit on a Dose Associated with a 10 Percent Extra Risk or LED₁₀ from IRIS

UF = uncertainty factor for carcinogens based on a linear low-dose extrapolation (unitless)

RSD = risk-specific dose for carcinogens based on a linear low-dose extrapolation (mg/kg-day) (dose associated with a target risk, such as 10⁻⁶)

RSC = relative source contribution factor to account for non-water sources of exposure (not used for linear carcinogens). May be either a percentage (multiplied) or amount subtracted, depending on whether multiple criteria are relevant to the chemical.

BW = human body weight (default = 70 kg for adults)

DI = drinking water intake (default = 2L/day for adults)

FI_i = fish intake at trophic level (TL) i (i = 2, 3 and 4) (defaults for total intake = 0.0175 kg/day for general adult population and sport anglers, and 0.1424 kg/day for subsistence fishers).

BAF_i = bioaccumulation factor at trophic level i (i = 2, 3 and 4), lipid normalized (L/kg) (EPA 2003 updates used the BCF rather than the BAF)

Reference Dose (Rfd): An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used. RfDs are generally used in EPA's noncancer health assessments. Formerly called Acceptable Daily Intake (ADI).

Point of Departure: The dose-response point that marks the beginning of a low-dose extrapolation. This point can be the lower bound on dose for an estimated incidence or a change in response level from a dose-response model (benchmark dose or BMD), or a NOAEL or LOAEL for an observed incidence, or change in level of response.

The U.S. Environmental Protection Agency's Guidelines for Cancer Risk Assessment (USEPA, 2005) present the default approach for the cancer slope factor as the slope of the linear extrapolation to the origin, generally drawn from the 95% lower confidence limit on dose at the lowest prescribed risk level supported by the data. In the past, the cancer slope factor has been calculated as the upper 95% confidence limit on the coefficient (q*1 cancer potency factor) of the linear term of the multistage model for the extra cancer risk over background.

Fish Intake: Notable among the DRBC criteria revisions is the use of 17.5 g/day of fish intake for deriving criteria in Zones 2 through 6 of the Delaware River.

In the 2000 guidance, the U.S. EPA recommends that a hierarchy of preference be used in the selection of a fish consumption rate for used in the criteria equation (U.S. EPA, 2000). This hierarchy is: 1) the use of local data on fish consumption patterns, 2) use of data reflecting similar geography or population groups for the water body of concern, 3) use of data from national surveys, and 4) use of the U.S. EPA default consumption rates. The default rate recommended by the U.S. EPA for both recreational fisherman and the general population is 17.5 grams per day. This rate is based upon the 1994-96 Continuing Survey of Food Intake by Individuals (U.S.D.A., 1998)

Two sources of data were available on the fish consumption patterns of recreational fisherman in the Delaware River Estuary. A study commissioned by the State of Delaware examined catch and consumption patterns in Zones 5 and 6, the lower portion of the tidal Delaware River and Delaware Bay (KCA, 1994). The study involved dockside intercepts and follow-up phone interviews of over 800 participants. The northern part of Zone 5 adjoins the urban area of Wilmington, and the surrounding suburban area of New Castle County in Delaware. The second study by Faulds et al, 2004 examined catch and consumption patterns in Zones 2, 3 and 4 of the tidal Delaware River by intercepting and interviewing shore anglers at six sites in Pennsylvania. These zones include the urban areas in and around the City of Philadelphia.

The average consumption of all species in Zones 5 and 6 was 17.46 grams per day, and the maximum fish consumption by any particular demographic group was 53.9 grams per day (KCA, 1994). Channel catfish and white perch were consumed at approximately equal rates. Faulds et al (2004) reported that channel catfish, striped bass and white perch were the most frequently consumed species in Zones 2 through 4. Ethnic groups reporting the highest consumption were Cambodian, Vietnamese and Afro-American. Faulds et al (2004) reported the number of meals of the species consumed by shore anglers. This data was converted to grams per day, the unit used in the criteria equation, and resulted in consumption rates of 17.9 grams per day for channel catfish and 21.7 grams per day for white perch assuming a meal size of 8 ounces.

The consumption rate use in the updated criteria was 17.5 grams per day. This value is consistent with the national default value and the site-specific data for Zones 2 through 6. The consumption data reported by Faulds et al (2004) on urban fisherman in Zones 2 - 4 was not substantially higher than the rate observed in the lower estuary, and did not support the use of a different consumption rate for zones in the Philadelphia area, especially in light of the management benefits associated with a consistent, estuary-wide criterion.

Therefore, the proposed regulations do not contain separate freshwater and marine criteria Human health criteria for consumption of water and organism and human health criteria for consumption of organism only are proposed based on the USEPA national recommended water quality criteria and updated human health standards in basin states.

Specific Policies for Derivation of Human Health Criteria

Stream quality objectives for protection from both carcinogenic and systemic effects were established by the Commission in October 1996 and are proposed for updating. Two human health criteria are developed since the duration and design flows for applying each type of criteria are different. The more stringent effluent limitation developed from the two criteria will be applied in establishing wasteload allocations that can be used in NPDES permits issued for point source discharges to Zones 2 - 6.

Policies used in the derivation of stream quality objectives are the following:

1. An objective to protect against carcinogenic effects shall only be established if the pollutant has a cancer potency factor (CPF) and is classified as a carcinogen in IRIS. as A, B or C under the U.S. EPA classification system for carcinogens derived from the Risk Assessment Guidelines of 1986, and the proposed revised Carcinogen Risk Assessment Guidelines (U.S. EPA, 1996). or classified under the U.S. EPA 2005 Guidelines for Carcinogen Risk Assessment (USEPA/630/P/03/001B) five standard weight-of-evidence descriptors (Carcinogenic to Humans, Likely to Be Carcinogenic to Humans, Suggestive Evidence of Carcinogenic Potential, Inadequate Information to Assess Carcinogenic Potential, and Not Likely to Be Carcinogenic to Humans) are used as part of the narrative. (Appendix Table A1) – See Section 3.10.3D.1. of the Commission’s Regulations
2. An objective to protect against systemic effects shall only be established for a pollutant if a reference dose (RfD) exists in IRIS. An additional safety factor of 10 shall be utilized in establishing the stream quality objectives to protect against systemic effects for pollutants classified as carcinogens if a CPF is not available in IRIS. The safety factor was not used to derive any of the revised criteria because currently none of the systemic toxicants that are also classified as carcinogens do not have a CPF in IRIS (Appendix Table A2) – See Section 3.10.3D.2.
3. In the absence of toxicological data for an RfD or CPF in IRIS, data published in the 1980 U.S. EPA water quality criteria documents and New Jersey Drinking Water Quality Institute (NJDWQI) historical documents will be considered. – See Section 3.10.3D.3
4. In establishing stream quality objectives for carcinogens, the level of risk is established at 10^{-6} or one additional cancer in every 1,000,000 humans exposed for a lifetime (70 years). – See Section 3.10.3D.4.
5. For the purpose of determining compliance with human health stream quality objectives, the duration of exposure shall be 70 years for carcinogens and 30 days for systemic toxicants. – See Section 3.10.3D.5.

6. A rate of ingestion of water of 2.0 liters per day is assumed in calculating objectives for river zones where the designated uses include public water supplies after reasonable treatment. A rate of ingestion of fish of 17.5 grams per day (equivalent to consuming a ½ pound portion every 13 days) is assumed in calculating stream quality objectives for human health in Zones 2 through 6. – See proposed Section 3.10.3D.1

7. BCFs were used in updating the human health stream quality objectives rather than BAFs as recommended in the 2000 EPA methodology due to the lack of parameter-specific BAFs. A similar approach was used by the U.S. EPA in the 2003 update of the national criteria.

In addition, certain criteria were derived based on methods approved by the EPA and adopted by one or more of the basin states by:

- 1) using relative potency factors (i.e., benzo(a)pyrene (1.0), benz(a)anthracene (0.1), benzo(b)fluoranthene (0.1), benzo(k)fluoranthene (0,01), chrysene, (0.001), dibenz(a,h)anthracene (1.0), and indeno (1,2,3-c,d) pyrene(0.1)) (Appendix Tables A1 and A2);
- 2) following Group C carcinogens policy by using a carcinogenic slope factor at a 10^{-6} excess cancer risk level or if such a slope factor is not available, the risk assessment was based on non-carcinogenic effects using a reference dose with an additional uncertainty factor of ten to protect from possible carcinogenic effects (e.g., beryllium and butylbenzyl phthalate) (Appendix Table A1);
- 3) including relative source contribution (RSC) in the proposed criteria when RSC are included in finalized EPA criteria or standards adopted by Estuary states (e.g., endrin) (Appendix Table A2);
- 4) Using data for a compound to derive a criterion for a compound with similar toxicology (i.e., 1, 3 – dichlorobenzene and 1, 4- dichlorobenzene using data for 1,2-dichlorobenzene; bromoform using data from chloroform) (Appendix Tables A1 and A2)
- 5) Human health criteria for arsenic is the MCL of 10 ug/L which is the value adopted by DE and PA as an interim approach until issues of toxicology and bioconcentration of inorganic arsenic are resolved.

Proposed changes to Tables 3, 6 and 7 in the Commission’s Water Quality Regulations for human health are as follows:

Table 3 - “Maximum Contaminant Levels (MCLs) to be Applied as Human Health Stream Quality Objectives in Zones 2 and 3”.

- Antimony, Cadmium, 1,2 – Dichloropropane, Ethylbenzene ,and 1,2,4 – Trichlorobenzene were removed from Table 3 because revised human health water quality criteria for these toxics listed in Table 7 are more stringent than MCL.
- Nickel was removed from Table 3 because nickel MCL was withdrawn by the EPA.
- Total Chromium was replaced with Chromium III in Table 3 to be consistent with EPA guidance.

- Current MCL values for Beryllium, Copper, Lead, Asbestos, 2,3,7,8-TCDD (Dioxin), Benzene, Carbon Tetrachloride, 1,2-Dichloroethane, 1,1-Dichloroethylene, Dichloromethane(methylene chloride), Tetrachloroethylene (PCE), 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, Trichloroethylene, Toluene, Vinyl Chloride, Pentachlorophenol, Benzo(a)pyrene, Bis(2-Ethylhexyl) Phthalate, Alpha –BHC, beta-BHC, Toxaphene, 2,4-Dichloro- phenoxyacetic acid (2,4-D), Flouride, Methoxychlor, Nitrate, 2,4,5 Trichloro-phenoxypropionic acid (2,4,5-TP-Silvex) are proposed to be added to Table 3 because these MCL values were developed by EPA after 1996 in accordance with the Safe Drinking Water Act, 42 U.S.C.A. 1412g-1(b).

Table 6 - “Stream Quality Objectives for Carcinogens In All Zones of the Delaware Estuary”

- Beryllium and 1,1 – Dichloroethene were removed from Table 6 because they are not on current EPA list of carcinogens.
- 1,1,1,2 – Tetrachloroethane is proposed to be removed from Table 6 because it is no longer recommended by the EPA for water quality criteria development.
- Arsenic , beta- BHC, N-nitrosodi-n-butylamine , N-Nitrosodiethylamine , and N-Nitrosopyrrolidine were added to Table 6 because EPA and Estuary states have adopted criteria for them.
- Dinitrotoluene mixture (2,4 & 2,6) is proposed to be replaced by 2,4-Dinitrotoluene to be consistent with current EPA guidance.
- Hexachlorobutadiene is proposed to be moved to Table 6 (criteria for carcinogens) from Table 7 because its toxicity is based on carcinogenicity.

Table 7 - “Stream Quality Objectives for Systemic Toxicants in All Zones of the Delaware Estuary”

- 1,1,1,2 – Tetrachloroethane is proposed to be removed from Table 7 because it is no longer recommended by the EPA for water quality criteria development.
- Hexachlorobutadiene toxicity was based on carcinogenicity and deleted from Table 7 for systemic toxics and included in Table 6.
- DDT is proposed to be replaced with “DDT and Metabolites (DDD and DDE)” for clarity to conform to current EPA guidance relating to the systemic toxicity of DDT and its degradation products.
- Chromium (Total), Methylmercury, cyanide, alpha-Endosulfan, beta-Endosulfan, Endosulfan sulfate, endrin aldehyde, 2-methyl-4,6-dinitrophenol, Benzene, Vinyl chloride, 2- Chloronaphthalene and Pentachloro-benzene, 1,2,4,5-Tetrachloro-benzene and 2,4,5-Trichloro-phenol are proposed to be added to Table 7 based on EPA and Estuary states adopted criteria.

- Dinitrotoluene mixture(2,4& 2,6) is proposed to be changed to 2, 4-Dinitrotoluene to be consistent with EPA guidance.
- Mercury criterion is proposed to be changed and methylmercury criterion is proposed to be added to be consistent with EPA guidance.
- The column listing EPA Class is proposed to be removed from Table 7 because the information is not needed for criteria application.

Methylmercury

The methylmercury criterion in fish tissue recommended by USEPA is proposed for adoption. Comments are requested on the methylmercury criterion and the implementation procedures for this tissue-based criterion.

Use of Maximum Contaminants Levels

Maximum Contaminant Levels (MCLs) for selected pollutants have been promulgated under the Safe Drinking Water Act. In order to protect the quality of the water in Zones 2 and 3 where one of the designated uses is for public water supplies, MCLs will be applied as water quality criteria for those toxic pollutants where the MCL value is more stringent than the calculated human health criteria for carcinogens or systemic toxicants. MCL values for these pollutants are in Table 3. The MCLs for antimony, cadmium, nickel, 1,2 - dichloropropane, ethylbenzene, and 1,2,4 - trichlorobenzene were deleted from Table 3 because revised human health criteria for these chemicals as listed in Tables 6 and 7 are more protective and will apply.

Current MCL values for Beryllium, Copper, Lead, alpha-BHC, beta-BHC, 2,4-Dichlorophenoxyacetic acid (2,4-D), Methoxychlor, Toxaphene, Dioxin (2,3,7,8-TCDD), 2,4,5 - Trichloro-phenoxypropionic acid (2,4,5-TP-Silvex), Benzene, Carbon Tetrachloride, 1,2-Dichloroethane, 1,1-Dichloroethylene, Dichloromethane (methylene chloride), Tetrachloroethylene (PCE), Toluene, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, Trichloroethylene, Vinyl Chloride, Benzo(a)pyrene, Asbestos, Bis(2-Ethylhexyl) Phthalate, Flouride, Nitrate, and Pentachlorophenol are proposed to be added because these MCL values were developed by EPA after 1996 in accordance with the Safe Drinking Water Act, 42 U.S.C.A. § 1412g-1(b).

Taste and Odor Criteria

Section 3.30.3B.1. of the DRBC Water Quality Regulations state that “the waters of the Basin shall not contain substances attributable to municipal, industrial, or other discharges in concentrations or amounts sufficient to preclude the specified water uses to be protected. Within this requirement the waters shall be substantially free from unsightly or malodorous nuisances due to floating solids, sludge deposits, debris, oil, scum, substances in concentrations or combinations which are toxic or harmful to human, animal, plant, or

aquatic life, or that produce color, taste, odor of the water, or taint fish or shellfish flesh”. This narrative standard is further quantified by the numerical criteria for the pollutants listed in Table 4. These criteria apply if the values are more stringent than other human health criteria for these pollutants. No changes to the parameters or values contained in Table 4 are proposed as part on the 2010 criteria update and revisions.

Extension of Criteria to Delaware Bay (Zone 6)

A new section 3.10.6 C.11. is proposed to be added to make Tables 4 through 7 of Article 3 of the Water Quality Regulations and Water Code applicable to water quality management Zone 6, the Delaware Bay.

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Table 1: DRBC Toxics Criteria Subcommittee

Members	Affiliation
Dr. Steven S. Brown	DOW
Dr. Richard Greene	DNREC
Bart Ruiter	DuPont
Bonita Moore	PADEP
Thomas Barron	PADEP
Dr. Timothy Kubiak	FWS
Dr. Thomas Fikslin	DRBC
Dr. Ronald MacGillivray	DRBC
Jack Pflaumer	NJDEP
Roy Romano	PWD
Izabella Wojtenko	EPA-R2
Denise Hakowski	EPA-R3
Dr. Robert Hoke	DuPont
Debbie Hammond	NJDEP
Wayne Jackson	EPA-R2

Table 2: DRBC Toxics Advisory Committee

Members/Alternates	Affiliation	Representing
Dr. David Velinsky	Academy of Natural Sciences	Academic
Dr. Richard Greene	DNREC	DE
Bart Ruiter	DuPont	Industry
Maya K. van Rossum	Delaware Riverkeeper Network	Watershed
Dr. Timothy Kubiak	USFWS	FWS
Dr. Roland B. Hemmett	EPA -R2	EPA
Denise Hakowski	EPA-R3	EPA
Dr. Christopher S. Crockett	PWD	Municipal
Debra Hammond	NJDEP	NJ
James Newbold	PADEP-SERO	PA

TABLE 3. MAXIMUM CONTAMINANT LEVELS TO BE APPLIED AS HUMAN HEALTH STREAM QUALITY OBJECTIVES IN ZONES 2 AND 3 OF THE DELAWARE RIVER ESTUARY.

Parameter	Maximum Contaminant Level (µg/l)
Metals	
Arsenic	10
Barium	2000
Beryllium	4
Chromium (trivalent)	100
Copper	1300
Lead	15
Selenium	50
Pesticides/PCBs	
alpha-BHC	0.2
beta-BHC	0.2
gamma - BHC (Lindane)	2
2,4-Dichloro-phenoxyacetic acid (2,4-D)	70
Methoxychlor	40
Toxaphene	3
Dioxin (2,3,7,8-TCDD)	0.00003
2,4,5 Trichloro-phenoxypropionic acid (2,4,5-TP-Silvex)	50
Volatile Organic Compounds (VOCs)	
Benzene	5
Carbon Tetrachloride	5
1,2-Dichloroethane	5
1,1-Dichloroethylene	7
[1,2 - trans - Dichloroethene] 1,2 - trans - Dichloroethylene	100
Dichloromethane (methylene chloride)	5

Parameter	Maximum Contaminant Level (µg/l)
Tetrachloroethylene (PCE)	5
Toluene	1000
Total Trihalomethanes	80
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	5
Trichloroethylene	5
Vinyl Chloride	2
Polycyclic Aromatic Hydrocarbons (PAHs)	
Benzo(a)Pyrene	0.2
Other Compounds	
Asbestos	7 million fibers/L
Bis(2-Ethylhexyl) Phthalate	6
Fluoride	4,000
Nitrate	10,000
Pentachlorophenol	1
Dioxin (2,3,7,8-TCDD)	0.00003

TABLE 4. CRITERIA TO PROTECT THE TASTE AND ODOR OF INGESTED WATER AND FISH TO BE APPLIED AS HUMAN HEALTH STREAM QUALITY OBJECTIVES IN ALL ZONES OF THE DELAWARE ESTUARY.

PARAMETER	STREAM QUALITY OBJECTIVE (µg/l)
Phenol	300
2 - Chlorophenol	0.1
2,4 - Dichlorophenol	0.3
2,4 - Dimethylphenol	400
4 - Chloro - 3 - methylphenol	3.0 mg/l
Pentachlorophenol	30
Acenaphthene	20
Chlorobenzene	20
Hexachlorocyclopentadiene	1.0
Nitrobenzene	30

TABLE 5. STREAM QUALITY OBJECTIVES FOR TOXIC POLLUTANTS FOR THE PROTECTION OF AQUATIC LIFE IN ALL ZONES OF THE DELAWARE ESTUARY AND BAY.

Parameter	Freshwater Objectives (µg/l)		Marine Objectives (µg/l)	
	Acute	Chronic	Acute	Chronic
Metals				
Aluminum ^{a,b}	750	87	NA	NA
Arsenic (trivalent) ^c	340	150	69	36
Cadmium ^c	0.651*EXP(1.0166* LN(hardness)-3.924)	0.651*EXP(0.7409* LN(hardness)-4.719)	40	8.8
Chromium (trivalent) ^c	0.277*EXP(0.819* LN(hardness)+3.7256)	0.277*EXP(0.819* LN(hardness)+0.6848)	NA	NA
Chromium (hexavalent) ^c	16	11	1,100	50
Copper ^c	0.908*EXP(0.9422* LN(hardness)-1.7)	0.908*EXP(0.8545* LN(hardness)-1.702)	4.8	3.1
Lead ^c	38	5.4	210	8.1
Mercury ^c	1.4	0.77	1.8	0.94
Nickel ^c	0.846*EXP(0.846* LN(hardness)+2.255)	0.846*EXP(0.846* LN(hardness)+0.0584)	64	22
Selenium ^a	20	5.0	290	71
Silver ^c	0.85*EXP(1.72* LN(hardness)-6.59)	NA	1.9	NA
Zinc ^c	0.95*EXP(0.8473* LN(hardness)+0.884)	0.95*EXP(0.8473* LN(hardness)+0.884)	90	81
Pesticides/PCBs				
Aldrin	3	NA	1.3	NA
gamma - BHC (Lindane)	0.95	NA	0.16	NA
Chlordane	2.4	0.0043	0.09	0.004
Chlorpyrifos (Dursban)	0.083	0.041	0.011	0.0056
DDT and metabolites (DDE & DDD) ^d	1.1	0.001	0.13	0.001
Dieldrin	0.24	0.056	0.71	0.0019
Endosulfan ^c	0.22	0.056	0.034	0.0087
Endrin	0.086	0.036	0.037	0.0023
Heptachlor	0.52	0.0038	0.053	0.0036
Heptachlor Epoxide	0.52	0.0038	0.053	0.0036
Parathion	0.065	0.013	NA	NA
PCBs (Total)	1.0	0.014	5.0	0.03
Toxaphene	0.73	0.0002	0.21	0.0002

Parameter	Freshwater Objectives (µg/l)		Marine Objectives (µg/l)	
	Acute	Chronic	Acute	Chronic
Other Compounds				
Cyanide (free)	22	5.2	1	1
Pentachlorophenol	$e^{(1.005 \cdot \text{pH} - 4.83)}$	$e^{(1.005 \cdot \text{pH} - 5.29)}$	13	7.9
Indicator Parameters				
Whole Effluent Toxicity	0.3 Toxic Units _{acute}	1.0 Toxic Units _{chronic}	0.3 TU _a	1.0 TU _c

^a Total recoverable criterion

^b Aluminum criteria listed should be restricted to waters with pH between 6.5 and 9.0.

^c Dissolved Criterion

^d This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value.

^e This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

Criteria for cadmium, chromium(trivalent), copper, nickel, silver and zinc are hardness dependent and are expressed as the dissolved form (see Section 3.10.3.C.2. for form of metal).

NA = not available

**TABLE 6. STREAM QUALITY OBJECTIVES FOR
CARCINOGENS IN ALL ZONES OF THE DELAWARE
ESTUARY AND BAY.**

PARAMETER	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
	FISH & WATER INGESTION	FISH INGESTION ONLY	FISH INGESTION ONLY
Metals			
Arsenic	*	NA	NA
Pesticides/PCBs			
Aldrin	0.000049	0.000050	0.000050
alpha – BHC	0.0026	0.0049	0.0049
beta – BHC	0.0091	0.017	0.017
Chlordane	0.00080	0.00081	0.00081
DDD	0.00031	0.00031	0.00031
DDE	0.00022	0.00022	0.00022
DDT	0.00022	0.00022	0.00022
Dieldrin	0.000052	0.000054	0.000054
Heptachlor	0.000079	0.000079	0.000079
Heptachlor Epoxide	0.000039	0.000039	0.000039
PCBs (Total)	0.0000444	0.0000448	0.0000079
Toxaphene	0.00028	0.00028	0.00028
Volatile Organic Compounds (VOCs)			
Acrylonitrile	0.051	0.25	0.25
Benzene	0.61	14	14
Benzidine	0.000086	0.00020	0.00020
Bromoform	4.3	140	140
Bromodichloromethane	0.55	17	17
Carbon Tetrachloride	0.23	1.6	1.6
Chlorodibromomethane	0.40	13	13
Chloroform	5.7	470	470
3,3 - Dichlorobenzidine	0.021	0.028	0.028

PARAMETER	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
	FISH & WATER INGESTION	FISH INGESTION ONLY	FISH INGESTION ONLY
1,2 - Dichloroethane	0.38	37	37
1,2 - Dichloropropane	0.50	15	15
1,3 - Dichloropropene	0.34	21	21
Dichloromethane (Methylene chloride)	*	590	590
Tetrachloroethylene	0.69	3.3	3.3
1,1,2,2 - Tetrachloroethane	0.17	4.0	4.0
1,1,2 - Trichloroethane	0.59	16	16
Trichloroethylene	2.5	30	30
Vinyl Chloride	0.025	2.4	2.4
Polycyclic Aromatic Hydrocarbons (PAHs)			
Benz[a]anthracene	0.0038	0.18	0.18
Benzo[b]fluoranthene	0.038	0.18	0.18
Benzo[k]fluoranthene	0.38	1.8	1.8
Benzo[a]pyrene	0.0038	0.018	0.018
Chrysene	3.8	18	18
Dibenz[a,h]anthracene	0.0038	0.018	0.018
Indeno[1,2,3-cd]pyrene	0.038	0.18	0.18
Other Compounds			
Bis (2-chloroethyl) ether	0.03	0.53	0.53
Bis (2-ethylhexyl) phthalate	1.2	2.2	2.2
2,4 - Dinitrotoluene	0.11	3.4	3.4
1,2 - Diphenylhydrazine	0.036	0.2	0.2
Hexachlorobenzene	0.00028	0.00029	0.00029
Hexachlorobutadiene	0.44	18	18
Hexachloroethane	1.4	3.3	3.3
Isophorone	35	960	960
N-Nitrosodi-N-butylamine	0.0063	14	14
N-Nitrosodi-N-methylamine	0.00069	3.0	3.0
N-Nitrosodiethylamine	0.0008	1.24	1.24
N-Nitrosodi-N-phenylamine	3.3	6	6

PARAMETER	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
	FISH & WATER INGESTION	FISH INGESTION ONLY	FISH INGESTION ONLY
N-Nitrosodi-N-propylamine	0.0050	0.51	0.51
N-Nitrosopyrrolidine	0.016	34	34
Pentachlorophenol	0.27	3.0	3.0
Dioxin (2,3,7,8 – TCDD)	0.000000005	0.0000000051	0.0000000051
2,4,6 - Trichlorophenol	1.4	2.4	2.4

* The MCL for this compound applies in Zones 2 and 3 and is listed in Table 3.

NA = not available

**TABLE 7. STREAM QUALITY OBJECTIVES FOR
SYSTEMIC TOXICANTS IN ALL ZONES OF THE
DELAWARE ESTUARY AND BAY.**

PARAMETER	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
	FISH & WATER INGESTION	FISH INGESTION ONLY	FISH INGESTION ONLY
Metals			
Antimony	5.6	640	640
Arsenic	*	NA	NA
Beryllium	*	420	420
Cadmium	3.4	16	16
Chromium (trivalent)	*	380,000	380,000
Chromium (hexavalent)	92	NA	NA
Chromium (total)	NA	750	750
Mercury	0.050	0.051	0.051
Methylmercury	0.3 mg/kg fish tissue	0.3 mg/kg fish tissue	0.3 mg/kg fish tissue
Nickel	500	1,700	1,700
Selenium	170	4,200	4,200
Silver	170	40,000	40,000
Thallium	0.24	0.47	0.47
Zinc	7,400	26,000	26,000
Pesticides/PCBs			
Aldrin	0.025	0.025	0.025
gamma - BHC (Lindane)	0.98	1.8	1.8
Chlordane	0.14	0.14	0.14
DDT and Metabolites (DDD and DDE)	0.037	0.037	0.037
Dieldrin	0.041	0.043	0.043
alpha -Endosulfan	62	89	89
beta- Endosulfan	62	89	89
Endosulfan Sulfate	62	89	89
Endrin	0.059	0.060	0.060
Endrin Aldehyde	0.29	0.30	0.30

PARAMETER	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
	FISH & WATER INGESTION	FISH INGESTION ONLY	FISH INGESTION ONLY
Heptachlor	0.18	0.18	0.18
Heptachlor Epoxide	0.0046	0.0046	0.0046
Total PCBs	0.00839	0.00849	0.00149
Volatile Organic Compounds (VOCs)			
Acrolein	6.1	9.3	9.3
Benzene	*	3,100	3,100
Bromoform	650	9,600	9,600
Bromodichloromethane	680	NA	NA
Dibromochloromethane	680	21,000	21,000
Carbon Tetrachloride	*	150	150
Chloroform	68	2,100	2,100
Chlorobenzene	130	1,600	1,600
1,1 - Dichloroethylene	*	7,100	7,100
1,2 - trans - Dichloroethylene	140	10,000	10,000
1,3 - Dichloropropene	1,000	63,000	63,000
Ethylbenzene	530	2,100	2,100
Methyl Bromide	47	1,500	1,500
Methylene Chloride	*	260,000	260,000
1,1,2 - Trichloroethane	*	3,600	3,600
Tetrachloroethylene	*	1,300	1,300
Toluene	1,300	15,000	15,000
Polycyclic Aromatic Hydrocarbons (PAHs)			
Anthracene	8,300	40,000	40,000
Fluoranthene	130	140	140
Fluorene	1,100	5,300	5,300
Pyrene	830	4,000	4,000
Other Compounds			

PARAMETER	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
	FISH & WATER INGESTION	FISH INGESTION ONLY	FISH INGESTION ONLY
Acenaphthene	670	990	990
Benzidine	59	140	140
Bis (2-chloroisopropyl) ether	1,400	65,000	65,000
Bis (2-ethylhexyl) phthalate	*	620	620
Butylbenzyl phthalate	1,500	1,900	1,900
2 - Chloronaphthalene	1,000	1,600	1,600
2 - Chlorophenol	81	150	150
Cyanide	140	140	140
Dibutyl Phthalate	2,000	4,500	4,500
1,2 - Dichlorobenzene	420	1,300	1,300
1,3 - Dichlorobenzene	420	1,300	1,300
1,4 - Dichlorobenzene	63	190	190
2,4 - Dichlorophenol	77	290	290
Diethyl Phthalate	17,000	44,000	44,000
Dimethyl Phthalate	270,000	1,100,000	1,100,000
2,4 - Dimethylphenol	380	850	850
2,4 - Dinitrophenol	69	5,300	5,300
2,4 - Dinitrotoluene	68	2,100	2,100
Hexachlorobenzene	0.35	0.36	0.36
Hexachlorocyclopentadiene	40	1,100	1,100
Hexachloroethane	20	46	46
Isophorone	6,700	180,000	180,000
2-Methyl-4,6-dinitrophenol	13	280	280
Nitrobenzene	17	690	690
Pentachlorobenzene	1.4	1.5	1.5
Pentachlorophenol	*	11,000	11,000
Phenol	10,000	860,000	860,000
1,2,4,5-Tetrachlorobenzene	0.97	1.1	1.1
1,2,4 - Trichlorobenzene	35	70	70
2,4,5-Trichlorophenol	1,800	3,600	3,600
Vinyl Chloride	*	10,000	10,000

* The MCL for this compound applies in Zones 2 and 3 and is listed in Table 3. The methylmercury criterion in fish tissue recommended by USEPA is proposed for adoption. Comments are requested on the methylmercury criterion and the implementation procedures for this tissue-based criterion.

NA = not available

APPENDICES

APPENDIX TABLE A1: TOXICOLOGICAL DATA AND CALCULATIONS FOR DRBC HUMAN HEALTH WATER QUALITY CRITERIA FOR CARCINOGENS

PARAMETER	EPA CLASS. *	BCF	CANCER POTENCY FACTOR oral slope factor mg/kg/day	CRITERIA (UG/L)		Fish & Water Ingestion Regulatory Value	Fish Ingestion Only Existing	Fish Ingestion Only Revised*	Fish Ingestion Only Regulatory Value
				Fish & Water Ingestion Existing	Fish & Water Ingestion Revised**				
Arsenic	A	44.00	1.50E+00	MCL			0.017		
Aldrin	B2	4670.0	1.70E+01	0.00013	0.00005	0.000049	0.0001	0.000050	0.000050
alpha - BHC	B2	130.0	6.30E+00	0.00391	0.00260	0.0026	0.01315	0.004884	0.0049
Chlordane	B2	14100.0	3.50E-01	0.000575	0.00080	0.00080	0.000588	0.000811	0.00081
DDT	B2	53600.0	3.40E-01	0.000588	0.00022	0.00022	0.000591	0.000219	0.00022
DDE	B2	53600.0	3.40E-01	0.00059	0.00022	0.00022	0.00059	0.000219	0.00022
DDD	B2	53600.0	2.40E-01	0.00083	0.00031	0.00031	0.00084	0.000311	0.00031
Dieldrin	B2	4670.0	1.60E+01	0.000135	0.00005	0.000052	0.000144	0.000054	0.000054
Heptachlor	B2	11200.0	4.50E+00	0.000208	0.00008	0.000079	0.000214	0.000079	0.000079
Heptachlor epoxide	B2	11200.0	9.10E+00	0.000103	0.00004	0.000039	0.000106	0.000039	0.000039
Toxaphene	B2	13100.0	1.10E+00	0.000730	0.00028	0.00028	0.000747	0.000278	0.00028
Acrylonitrile	B1	30.00	5.40E-01	0.0591	0.05134	0.051	0.665	0.247	0.25
Benzene	A	5.21	5.50E-02	1.187	0.60862	0.61	71.277	13.959	14
Bromoform	B2	3.75	7.90E-03	4.314	4.28963	4.3	164.240	135.021	140
Bromodichloromethane	B2	3.75	6.20E-02	0.559	0.54658	0.55	55.672	17.204	17
Carbon tetrachloride	***	18.75	1.30E-01	0.254	0.23129	0.23	4.418	1.641	1.6
Chlorodibromomethane	C	3.75	8.40E-02	0.411	0.40343	0.40	27.750	12.698	13
Chloroform	B2	3.75	0.0061	5.669		5.7	470.786		470
1,2 - Dichloroethane	B2	1.2	9.10E-02	0.383	0.38062	0.38	98.619	36.630	37
1,3 - Dichloropropene	B2	1.9	1.00E-01	87.000	0.34428	0.34	14.000	21.053	21
Methylene chloride	B2	0.91	7.50E-03	4.653	4.62980	MCL	1577.909	586.081	590
1,1,2 - Trichloroethane	***	4.54	5.70E-02	0.605	0.59057	0.59	41.615	15.5	16
Tetrachloroethene	B2	30.6	3.98E-02	0.800	0.69367	0.69	8.850	3.284	3.3
1,1,2,2 - Tetrachloroethane	C	5.00	2.00E-01	0.172	0.16766	0.17	10.769	4.000	4
Trichloroethene	B2	10.6	1.26E-02	2.700	2.54201	2.5	80.700	29.949	30
Vinyl chloride	A	1.17	1.40E+00	2.000	0.02475	0.025	525.000	2.442	2.4

PARAMETER	EPA CLASS. *	BCF	CANCER POTENCY FACTOR oral slope factor mg/kg/day	CRITERIA (UG/L)		Fish & Water Ingestion Regulatory Value	Fish Ingestion Only Existing	Fish Ingestion Only Revised*	Fish Ingestion Only Regulatory Value
				Fish & Water Ingestion Existing	Fish & Water Ingestion Revised**				
Benzidine	A	87.50	2.30E+02	0.000118	0.00009	0.000086	0.000535	0.00020	0.00020
3,3 - Dichlorobenzidine	B2	312.00	4.50E-01	0.0386	0.02085	0.021	0.0767	0.028	0.028
Polynuclear aromatic hydrocarbons (PAHs)									
Benz[a]anthracene	B2	30.0	7.30E-01	0.00171	0.03798	0.038	0.00177	0.182648	0.18
Benzo[b]fluoranthene	B2	30.0	7.30E-01	0.000455	0.037976	0.038	0.000460	0.182648	0.18
Benzo[k]fluoranthene	B2	30.0	7.30E-02	0.000280	0.379764	0.38	0.000282	1.826484	1.8
Benzo[a]pyrene	B2	30.0	7.30E+00	0.0000644	0.003798	0.0038	0.0000653	0.018265	0.018
Chrysene	B2	30.0	7.30E-03	0.0214	3.797640	3.8	0.0224	18.264840	18
Dibenz[a,h]anthracene	B2	30.0	7.30E+00	0.0000552	0.003798	0.0038	0.0000559	0.018265	0.018
Indeno[1,2,3-cd]pyrene	B2	30.0	7.30E-01	0.0000576	0.037976	0.038	0.0000576	0.182648	0.18
Bis (2-chloroethyl) ether	B2	6.90	1.10E+00	0.0311	0.03001	0.03	1.419	0.527	0.53
Bis (2-ethylhexyl) phthalate	B2	130	1.40E-02	1.757	1.16959	1.2	5.917	2.198	2.20
Dinitrotoluene mixture	B2	3.8	3.11E-01	17.287	0.10892	0.11	1417.004	3.385	3.40
1,2 - Diphenylhydrazine	B2	24.9	8.00E-01	0.0405	0.03592	0.036	0.541	0.201	0.20
Hexachlorobenzene	B2	8690.00	1.60E+00	0.000748	0.00028	0.00028	0.000775	0.000288	0.00029
Hexachlorobutadiene	C	2.78	7.80E-02	0.445	0.43806	0.44	49.66	18.447	18
Hexachloroethane	C	86.90	1.40E-02	1.95	1.42015	1.4	8.85	3.288	3.3
Isophorone	C	4.38	9.50E-04	36.33	35.48225	35	2588.1	961.307	960
N-Nitrosodi-N-methylamine	B2	0.03	5.10E+01	0.000686	0.00069	0.00069	8.12	3.017	3
N-Nitrosodi-N-phenylamine	B2	136.00	4.90E-03	4.95	3.26158	3.3	16.16	6.002	6
N-Nitrosodi-N-propylamine	B2	1.13	7.00E+00	0.00498	0.00495	0.0050	1.508	0.506	0.51
2,4,6 - Trichlorophenol	B2	150.00	1.10E-02	2.14	1.37592	1.4	6.53	2.424	2.4
Pentachlorophenol	***	11.00	1.20E-01	0.282	0.26606	0.27	8.16	3.030	3.0
benzene	A	5.20	5.50E-02	0.282	0.60867	0.61	8.16	13.986	14
N-Nitrosodi-n-butylamine NP	B2	3.38	5.43E+00		0.00626	0.0063			1.24
N-Nitrosodiethylamine NP	B2	0.20	4.35E+01		0.00080	0.0008		0.460	1.24
N-Nitrosopyrrolidine NP	B2	0.06	2.13E+00		0.01642	0.016		34.144	34

* - USEPA Integrated Risk Information System <http://www.epa.gov/IRIS/> accessed November 10, 2010

** - Calculations use consumption rate of 17.5 grams per day.

*** - likely to be carcinogenic to humans. USEPA Integrated Risk Information System <http://www.epa.gov/IRIS/> accessed November 10, 2010

MCL = Maximum contaminant level

NP = non-priority pollutant

**APPENDIX TABLE A2: TOXICOLOGICAL DATA AND CALCULATIONS FOR DRBC HUMAN HEALTH WATER QUALITY CRITERIA
SYSTEMIC TOXICANTS**

PARAMETER	BCF	REFERENCE DOSE (MG/KG/DAY)	RSC	Fish & Water Ingestion Existing (UG/L)	Fish & Water Ingestion Revised* (UG/L)	Fish & Water Ingestion Regulatory Value (ug/L)	Fish Ingestion Only Existing (UG/L)	Fish Ingestion Only Revised* (UG/L)	Fish Ingestion Only Regulatory Value (ug/L)
Antimony	1.0	4.00E-04	0.4	13.95	5.55	5.60	4307.69	640.00	640
Arsenic	44.0	3.00E-04		9.19			73.43		
Beryllium	19.0	2.00E-03		164.82		MCL	2834.01	421.05	420
Cadmium	64.0	1.00E-03	0.25				84.13	15.63	16
Cadmium	64.0	5.00E-04	0.25	14.49	3.42	3.4			
Chromium (Trivalent)	16.0	1.50E+00		33269.96		MCL	673076.92	375000.00	380000
Hexavalent chromium	16.0	3.00E-03		166.35	92.11	92	3365.38	750.00	750
Cyanide	1.0	2.00E-02	0.2	697.73	138.79	140	215384.62		140
Lead	49.0	-							
Mercury		-							
Nickel	47.0	2.00E-02		607.24	496.01	500	4582.65	1702.13	1700
Selenium	4.8	5.00E-03		166.35	168	170	3365.38	4167	4200
Silver	0.5	5.00E-03		174.72	174	170	107692.31	40000	40000
Thallium	116.0	6.80E-05	0.2	1.70	0.24	0.24	6.22	0.47	0.47
Zinc	47.0	3.00E-01		9108.65	7440	7400	68739.77	25532	26000
Aldrin	4,670	3.00E-05		0.962	0.025	0.025	11.54	0.0257	0.025
gamma - BHC (Lindane)	130	3.00E-04	0.2	7.38	0.98	0.98	24.85	1.8	1.8
beta - BHC	130	-				MCL			
Chlordane	14,100	5.00E-04		0.0448	0.14	0.14	0.0458	0.14	0.14
DDT (and metabolites)	53,600	5.00E-04		0.100	0.037	0.037	0.100	0.037	0.037
DDE	5,410	-							
DDD	10,300	-							
Dieldrin	4,670	5.00E-05		0.108	0.042	0.042	0.115	0.043	0.043
Endosulfan	270	6.00E-03		111.851	62.45	62	239.316	88.89	89

PARAMETER	BCF	REFERENCE DOSE (MG/KG/DAY)	RSC	Fish & Water Ingestion Existing (UG/L)	Fish & Water Ingestion Revised* (UG/L)	Fish & Water Ingestion Regulatory Value (ug/L)	Fish Ingestion Only Existing (UG/L)	Fish Ingestion Only Revised* (UG/L)	Fish Ingestion Only Regulatory Value (ug/L)
Endosulfan sulfate	270	6.00E-03		111.851	62.45	62	239.316	88.89	89
Endrin	3,970	3.00E-04		0.755	0.059	0.059	0.814	0.060	0.060
Endrin aldehyde	3,970	3.00E-04				0.29			0.30
Heptachlor	11,200	5.00E-04		0.337	0.18	0.18	0.344	0.18	0.18
Heptachlor epoxide	11,200	1.30E-05		0.0234	0.0046	0.0046	0.0246	0.0046	0.0046
Acrolein	215.00	0.0005			6.1			9.3	9.3
Ethylbenzene	37.50	0.1	0.2	3119.78	527	530	28717.95	2133	2100
Bromoform	8.30	0.02		681.61	653	650	25949.95	9639	9600
Dichlorobromomethane (Bromodichloromethane)	3.75	0.02		692.97	678	680	69033.53	21333	
Chlorodibromomethane (Dibromochloromethane)	3.75	0.02		689.64	678	680	46620.05	21333	21000
Carbon tetrachloride	18.75	0.0007		23.09	21.0	MCL	402.05	149	150
Chloroform	3.75	0.01	0.2	345.79	68	68	28717.95	2133	2100
Chlorobenzene	10.30	0.02	0.2	677.33	128	130	20911.13	1553	1600
1,1 - Dichloroethylene	5.61	0.05	0.2	309.36	334	MCL	17276.84	7130	7100
1,2 - trans - Dichloroethylene	1.58	0.02	0.2	696.42	138	140	136319.38	1.0E+04	10000
1,3 - Dichloropropene	1.91	0.03		10.44	1032.74	1000	1691.50	62827.23	63000
Methyl bromide	3.75	0.0014		49.00	47.44	47	N/A	1.5E+03	1500
Methylene chloride	0.91	0.06		2093.81	2083	MCL	710059.17	2.6E+05	260000
1,1,1 - Trichloroethane	5.60	2			13346	MCL		2.9E+05	
1,1,2 - Trichloroethane	4.50	0.004		137.96	135	MCL	9488.31	3556	3600
Tetrachloroethylene	30.60	0.01		318.34	276	MCL	3519.36	1307	1300

PARAMETER	BCF	REFERENCE DOSE (MG/KG/DAY)	RSC	Fish & Water Ingestion Existing (UG/L)	Fish & Water Ingestion Revised* (UG/L)	Fish & Water Ingestion Regulatory Value (ug/L)	Fish Ingestion Only Existing (UG/L)	Fish Ingestion Only Revised* (UG/L)	Fish Ingestion Only Regulatory Value (ug/L)
Acenaphthene	242.00	0.06		1175.48	674	670	2670.06	992	990
Anthracene	30.00	0.3		4112.00	8317	8300	6758.93	40000	40000
Benzidine	87.50	0.003		81.75	59.5	59	369.23	137	140
Bis (2-chloroisopropyl) ether	2.47	0.04		1388.85	1370.4	1400	174400.50	64777	65000
Bis (2-ethylhexyl) phthalate	130.00	0.02		492.09	327	MCL	1656.80	615	620
Butylbenzyl phthalate	414.00	0.2		298.44	1514	1500	520.25	1932	1900
Diethyl phthalate	73.00	0.8		22630.83	17086	17000	118018.97	43836	44000
Dimethyl phthalate	36.00	10		313000.00	266160	270000	2990000.00	1111111	1100000
Dibutyl phthalate	89.00	0.1		2714.76	1968	2000	12100.26	4494	4500
1,2 - Dichlorobenzene	55.60	0.09		2667.91	424	420	17432.21	1295	1300
1,3 - Dichlorobenzene	55.60	0.09		414.00	424	420	3510.00	1295	1300
1,4 - Dichlorobenzene	55.60	0.0134		419.00	63	63	3870.00	193	190
2,4 - Dinitrotoluene	3.8	2.00E-03		69.15	68	68	5668.02	2105	2100
Fluoranthene	1150	0.04		295.51	127	130	374.58	139	140
Fluorene	30	0.04		730.50	1109	1100	1527.55	5333	5300
Hexachlorobenzene	8690	8.00E-04		0.958	0.363	0.36	0.991	0.368	0.37
Hexachlorobutadiene	2.78	0.002		69.37	68.3		7747.65	2878	
Hexachlorocyclopentadiene	4.34	0.006	0.2	241.59	40	40	17369.73	1106	1100
Hexachloroethane	86.9	0.001		27.29	19.9	20	123.93	46.0	46
Isophorone	4.38	0.2		6901.75	6741.6	6700	491745.70	182648	180000
Nitrobenzene	2.89	0.0005		17.34	17.1	17	1863.19	692	690
Pyrene	30	0.03		227.89	831.7	830	291.06	4000	4000
1,2,4 - Trichlorobenzene	114	0.01	0.2	255.38	35	35	944.67	70	70
2 - Chlorophenol	134.00	5.00E-03		121.91	80.6	81	401.84	149	150
2,4 - Dichlorophenol	40.70	3.00E-03		92.73	77.4	77	793.80	295	290
2,4 - Dimethylphenol	93.80	2.00E-02		536.46	384	380	2296.21	853	850

PARAMETER	BCF	REFERENCE DOSE (MG/KG/DAY)	RSC	Fish & Water Ingestion Existing (UG/L)	Fish & Water Ingestion Revised* (UG/L)	Fish & Water Ingestion Regulatory Value (ug/L)	Fish Ingestion Only Existing (UG/L)	Fish Ingestion Only Revised* (UG/L)	Fish Ingestion Only Regulatory Value (ug/L)
2-Methyl-4,6-Dinitrophenol	5.50	3.90E-04			13	13		284	280
2,4 - Dinitrophenol	1.51	2.00E-03		69.66	69.09	69	14263.88	5298	5300
Pentachlorophenol	11.00	3.00E-02		1013.76	958	MCL	29370.63	10909	11000
Phenol	1.40	3.00E-01		20904.88	10373	10000	4615384.62	857143	860000
benzene	5.20	4.00E-03		20904.88	134	MCL	4615384.62	3077	3100
vinyl chloride	1.17	3.00E-03		20904.88	104	MCL	4615384.62	10256	10000
Pentachloro-benzene NP (sys)									
	2125.00	8.00E-04			1.4	1.4		1.5	1.5
1,2,4,5-Tetrachloro-benzene NP (sys)									
	1125.00	3.00E-04			0.97	0.97		1.07	1.1
2,4,5-Trichloro-phenol NP (sys)									
	110.00	1.00E-01			1783	1800		3636	3600

* - Calculations use consumption rate of 17.5 grams per day.

MCL = Maximum contaminant level

NP = non-priority pollutant

Appendix Table A3: Ambient Water Quality Criteria Comparison for the Delaware River Human Health for Consumption of Water + Organism

Parameter	CAS #	µg/L						DRBC ⁸	DRBC revised
		US EPA ¹	DE ²	NJ ³	PA ⁴	NY ^{5,6}			
Antimony (sys)	7440360	5.6	6 (MCL)	5.6	5.6	3	14	5.6	
Arsenic (sys)			10 (MCL)			50	9.19	10 (MCL)	
Arsenic (c)	7440382	0.018		0.017	10			0.017	
Beryllium (sys)	7440417		4 (MCL)	6		3	165	4(MCL)	
Beryllium (c)	7440417		0.0034				0.00767	delete	
Cadmium (sys)	7440439		5 (MCL)	3.4		5 (FW); 2.7 (S-FC) ⁷	14.5	3.4	
Chromium III (sys)	16065831		100 (MCL)				33000	100 (MCL)	
Chromium VI (sys)	18540299		92				166	92	
Chromium (total) (sys)	67663		100 (MCL)	92		50		92	
Copper (sys)	7440508	1300	1300 (MCL)	1300		200		1300 (MCL)	
Lead (sys)	7439921		15 (MCL)			50		15 (MCL)	
Mercury (sys)	7439976			0.050	0.05	0.0007 (FC)	0.144	0.050	
Methylmercury (sys)	22967926		0.3 mg/kg fish tissue					0.3 mg/kg fish tissue	
Nickel (sys)	7440020	610	100 (MCL)	500	610	100	607	500	
Selenium (sys)	7782492	170	50 (MCL)	170		10	100	170	
Silver (sys)	7440224		170	170		50	175	170	
Thallium (sys)	7440280	0.24	2 (MCL)	0.24	0.24	0.5 ⁷	1.7	0.24	
Zinc (sys)	7440666	7400	7400	7400		2000 ⁷	9110	7400	
Cyanide (sys)	57125	140	200	140	140	200		140	
Asbestos (sys)	1332214	7 million fibers/L	7 million fibers/L	7 million fibers/L		7 million fibers/L		7 million fibers/L	
2,3,7,8-TCDD (Dioxin) (sys)	1746016		3.0E-05					3.0E-05	
2,3,7,8-TCDD (Dioxin) (c)	1746016	5.0E-09	5.0E-09	5.0E-09	5.0E-09	0.0000000006 (FC)	1.3E-08	5.0E-09	
Acrolein (sys)	107028	6.1	190	6.1	190	5	320	6.1	
Acrylonitrile (c)	107131	0.051	0.051	0.051	0.051	0.07	0.0591	0.051	
Benzene (sys)	71432		5 (MCL)					5 (MCL)	
Benzene (c)	71432	2.2	0.61	0.15	1.2	1	1.19	0.61	
Bromoform (sys)	75252		650			50	682	650	
Bromoform (c)	75252	4.3	4.1	4.3	4.3		4.31	4.3	
Carbon Tetrachloride (sys)	56235		5 (MCL)				23.1	5 (MCL)	
Carbon Tetrachloride (c)	56235	0.23	0.23	0.33	0.23	0.4 ⁷	0.254	0.23	
Chlorobenzene (sys)	108907	130	100 (MCL)	210	130	5		130	
Chlorodibromo-methane (sys)	124481		680			50	690	680	
Chlorodibromo-methane (c)	124481	0.40	0.4	0.40	0.40		0.559	0.40	
Chloroethane	75003					5			
Chloroform (sys)			340	68			346	68	
Chloroform (c)	67663	5.7		68	5.7	7	5.67	5.7	
Dichlorobromo-methane (sys)	75274		680			50		680	
Dichlorobromo-methane (c)	75274	0.55	0.55	0.55	0.55			0.55	
1,1-Dichloroethane	75343					5			
1,2-Dichloroethane (sys)	107062		5 (MCL)				696	5 (MCL)	
1,2-Dichloroethane (c)	107062	0.38	0.38	0.29	0.38	0.6	0.383	0.38	
1,1-Dichloroethylene (sys)	75354	330	7 (MCL)	4.7	33		309	7 (MCL)	
1,1-Dichloroethylene (1,1-DCE) (c)	75354		0.056			0.7 ⁷	0.0573	delete	
1,2-Dichloropropane (c)	78875	0.50	0.50	0.50		1		0.50	
1,3-Dichloropropene (sys)	542756		1000		10		10.4	1000	
1,3-Dichloropropene (cis and trans) (c)	542756	0.34	0.69	0.34		0.4	87	0.34	
Ethylbenzene (sys)	100414	530	700 (MCL)	530	530	5	3120	530	
Methyl Bromide (sys)	74839	47	47	47	47		49	47	

Parameter	CAS #	US EPA ¹	DE ²	NJ ³	PA ⁴	NY ^{5,6}	DRBC ⁸	DRBC revised
Dichloromethane(methylene chloride)(sys)	75092		5 (MCL)					5 (MCL)
Dichloromethane(methylene chloride)(c)	75092	4.6	4.6	2.5	4.6	5	4.65	4.6
1,1,1,2-Tetrachloroethane (sys)	630-20-6						1000	delete
1,1,1,2-Tetrachloroethane (c)	630-20-6						1.29	delete
1,1,2,2-Tetrachloroethane (sys)				4.7				
1,1,2,2-Tetrachloroethane (c)	79345	0.17	0.17		0.17	0.2	0.172	0.17
Tetrachloro-ethylene (PCE) (sys)	127184		5 (MCL)					5 (MCL)
Tetrachloro-ethylene (PCE) (c)	127184	0.69	0.69	0.34	0.69	0.7	0.80	0.69
Toluene (sys)	108883	1300	1000 (MCL)	1300	1300	5	6760	1300
1,2-Trans-Dichloroethylene (sys)	156605	140	100 (MCL)	590	140	5		140
1,1,1-Trichloroethane (sys)	71556		200 (MCL)	120		5		200 (MCL)
1,1,2-Trichloroethane (sys)	79005		5 (MCL)				138	5 (MCL)
1,1,2-Trichloroethane (c)	79005	0.59	0.59	13	0.59	1	0.605	0.59
Trichloroethylene (sys)	79016		5 (MCL)					5 (MCL)
Trichloroethylene (TCE) (c)	79016	2.5	2.5	1.0	2.5	5	2.7	2.5
Vinyl Chloride (sys)	75014		2 (MCL)					2 (MCL)
Vinyl Chloride (c)	75014	0.025	0.025	0.082	0.025	0.3 ⁷	2	0.025
2-Chlorophenol (sys)	95578	81	81	81	81		122	81
2,4-Dichlorophenol (DCP) (sys)	120832	77	77	77	77		92.7	77
2,4-Dimethylphenol (sys)	105679	380	380	380	380	50 ⁷	536	380
2-Methyl-4,6-Dinitrophenol (sys)	534521	13		13	13			13
2,4-Dinitrophenol (sys)	51285	69	69	69	69	10 ⁷	70	69
Pentachlorophenol (sys)	87865		1 (MCL)				1010	1 (MCL)
Pentachlorophenol (c)	87865	0.27	0.27	0.27	0.27		0.282	0.27
Phenol (sys)	108952	21000	10000	10000	21000		20900	10000
2,4,6-Trichlorophenol (c)	88062	1.4	1.4	0.58	1.4		2.14	1.4
Acenaphthene (sys)	83329	670	670	670	670		1180	670
Anthracene (sys)	120127	8300	8300	8300	8300		4110	8300
Benzidine (sys)	92875		59				81.8	59
Benzidine (c)	92875	0.000086	8.6E-05	0.000086	8.6E-05	0.02 ⁷	0.000118	8.60E-05
Benzo(a)-Anthracene (c)	56553	0.0038	0.038	0.038	0.0038	0.002 ⁷	0.00171	0.0038
Benzo(a)Pyrene (sys)	50328		0.2 (MCL)					0.2 (MCL)
Benzo(a)Pyrene (BaP) (c)	50328	0.0038	0.0038	0.0038	0.0038	0.0012 (FC)	0.0000644	0.0038
Benzo(b)-Fluoranthene (3,4-Benzofluor-anthene) (c)	205992	0.0038	0.038	0.038	0.0038	0.002 ⁷	0.000455	0.038
Benzo(k)-Fluoranthene (c)	207089	0.0038		0.38	0.0038	0.002 ⁷	0.00028	0.38
Bis(2-Chloroethoxyl) Methane	111911					5 ⁷		
Bis(2-Chloroethyl)Ether (Dichloroethyl ether) (c)	111444	0.030	0.030	0.030	0.030	0.03	0.0311	0.03
Bis(2-Chloroisopropyl) Ether (sys)	108601	1400	1400	1400	1400	5 ⁷	1390	1400
Bis(2-Ethylhexyl) Phthalate (sys)	117817		6 (MCL)				1660	6 (MCL)
Bis(2-Ethylhexyl) Phthalate (DEHP) (c)	117817	1.2	1.2	1.2	1.2	5	1.76	1.2
Butylbenzyl Phthalate (sys)	85687	1500	1500	150	150	50 ⁷	298	150
2-Chloronaphthalene (sys)	91587	1000	1000	1000	1000			1000
Chrysene (c)	218019	0.0038	0.038	3.8	0.0038	0.002 ⁷	0.0214	3.8
Dibenzo(a,h) Anthracene (c)	53703	0.0038	0.0038	0.0038	0.0038		0.0000552	0.0038
1,2-Dichlorobenzene (ortho) (sys)	95501	420	600 (MCL)	2000	420	3	2670	420
1,3-Dichlorobenzene (meta) (sys)	541731	320	350	2200	420	3	414	420
1,4-Dichlorobenzene (para) (sys)	106467	63	75 (MCL)	550	420	3	419	63

Parameter	CAS #	US EPA ¹	DE ²	NJ ³	PA ⁴	NY ^{5,6}	DRBC ⁸	DRBC revised
3,3'Dichlorobenzidine (c)	91941	0.021	0.021	0.021	0.021	5 ⁷	0.0386	0.021
Diethyl Phthalate (sys)	84662	17000	17000	17000	17000	50 ⁷	22600	17000
Dimethyl Phthalate (sys)	131113	270000	270000		270000	50 ⁷	313000	270000
Di-n-Butyl Phthalate (sys)	84742	2000	2000	2000	2000	50 ⁷	2710	2000
2,4-Dinitrotoluene (sys)	121142		68			5 ⁷	69.2	68
2,4-Dinitrotoluene (c)	121142	0.11	0.11	0.11	0.05			0.11
2,6-Dinitrotoluene	606202				0.05	0.07 ⁷		
Dinitrotoluene (c)							17.3	
Di-n-Octyl Phthalate	117840					50 ⁷		
1,2-Diphenyl-hydrazine (c)	122667	0.036	0.036	0.036	0.036	0.05 ⁷	0.0405	0.036
Fluoranthene (sys)	206440	130	130	130	130	50 ⁷	296	130
Fluorene (sys)	86737	1100	1108	1100	1100	50 ⁷	730	1100
Hexachloro-benzene (sys)	118741		0.35				0.958	0.35
Hexachloro-benzene (c)	118741	0.00028	0.00028	0.00028	0.00028	0.00003 (FC)	0.000748	0.00028
Hexachloro-butadiene (sys)	87683		68			0.01 (FC)	69.4	delete
Hexachloro-butadiene (c)	87683	0.44	0.44	0.44	0.44		1.95	0.44
Hexachlorocyclo-pentadiene (sys)	77474	40	50 (MCL)	40	40	5 ⁷	242	40
Hexachloroethane (sys)	67721		20				27.3	20
Hexachloroethane (c)	67721	1.4	1.4	1.4	1.4	0.6 (FC)	1.95	1.4
Ideno(1,2,3-cd)Pyrene (c)	193395	0.0038	0.038	0.038	0.0038	0.002 ⁷	0.0000576	0.038
Isophorone (sys)	78591		6700			50 ⁷	6900	6700
Isophorone (c)	78591	35	35	35	35		36.3	35
Nitrobenzene (sys)	98953	17	17	17	17	0.4	17.3	17
N-Nitrosodi-methylamine (c)	62759	0.00069	0.00069	0.00069	0.00069		0.000686	0.00069
N-Nitrosodi-N-Propylamine (Di-n-propylnitrosamine) ©	621647	0.0050	0.005	0.0050	0.005		0.00498	0.0050
N-Nitrosodi-N-phenylamine (c)	86306	3.3	3.3	3.3	3.3	50 ⁷	4.95	3.3
Phenanathrene	85018					50 ⁷		
Pyrene (sys)	129000	830	830	830	830	50 ⁷	228	830
1,2,4-Trichlorobenzene (sys)	120821	35	70 (MCL)	21	35	5 ⁷	255	35
Aldrin (sys)	309002		0.025				0.96	0.025
Aldrin (c)	309002	0.000049	4.90E-05	0.000049	4.9E-05	0.001 (FC)	0.00189	4.9E-05
alpha-BHC (sys)	319846		0.2 (MCL)					0.2 (MCL)
alpha-BHC (alpha-HCH) (c)	319846	0.0026	0.0026	0.0026	0.0026	0.002 (FC)	0.00391	0.0026
beta-BHC (sys)	319857		0.2 (MCL)					0.2 (MCL)
beta-BHC (beta-HCH) (c)	319857	0.0091	0.0091	0.0091	0.0091	0.007 (FC)		0.0091
gamma-BHC (gamma-HCH/Lindane)(sys)	58899	0.98	0.12	0.98	0.098	0.008 (FC)		0.98
gamma-BHC (Lindane) (c)	58899		0.2 (MCL)				7.38	delete
delta-BHC	319868					0.008 (FC)		
Chlordane (sys)	57749		0.14				0.0448	0.14
Chlordane (c)	57749	0.00080	0.0008	0.00010	0.00080	0.00002 (FC)	0.000575	0.00080
4,4'-DDT (c)	50293	0.00022		0.00022	0.00022	0.00001 (FC)	0.000588	0.00022
4,4'-DDE (c)	72559	0.00022		0.00022	0.00022	0.000007 (FC)	0.00554	0.00022
4,4'-DDD (p,p=-TDE)(c)	72548	0.00031		0.00031	0.00031	0.00008 (FC)	0.00423	0.00031
DDT and Metabolites (DDD and DDE) (sys)			0.037				0.100	0.037
DDT and Metabolites (DDD and DDE) (c)			0.00022					
Dieldrin (sys)	60571		0.041				0.108	0.041
Dieldrin (c)	60571	0.000052	5.20E-05	0.000052	0.000052	0.0000006(FC)	0.000135	5.2E-05
alpha-Endosulfan (sys)	959988	62			62			62
beta-Endosulfan (sys)	33213659	62			62			62

Parameter	CAS #	US EPA ¹	DE ²	NJ ³	PA ⁴	NY ^{5,6}	DRBC ⁸	DRBC revised
Endosulfan (alpha & beta)				62				
Endosulfan Sulfate (sys)	1031078	62		62				62
Endosulfan (sys)			62				111	delete
Endrin (sys)	72208	0.059	0.29	0.059	0.059	0.02 (FC)	0.755	0.059
Endrin Aldehyde (sys)	7421934	0.29	0.29	0.059	0.29	5 ⁷		0.29
Heptachlor (sys)	76448		0.18				0.337	0.18
Heptachlor (c)	76448	0.000079	7.90E-05	0.000079	7.9E-05	0.0002 (FC)	0.000208	7.9E-05
Heptachlor Epoxide (sys)	1024573		0.0046				0.0234	0.0046
Heptachlor Epoxide (c)	1024573	0.000039	3.90E-05	0.000039	3.9E-05	0.0003 (FC)	0.000198	3.9E-05
PCBs (sys)			0.5 (MCL)				0.00839	delete
PCBs (c)		0.000064	6.40E-05	0.000064	6.4E-05	0.000001 (FC)	0.0000444	0.000016 ⁹
Toxaphene (sys)	8001352		3 (MCL)					3 (MCL)
Toxaphene (c)	8001352	0.00028	0.00028	0.00028	0.00028	0.000006 (FC)	0.000730	0.00028
Barium (sys)			2000 (MCL)	2000	2400	1000		2000 (MCL)
2,4-Dichloro- phenoxyacetic acid (2,4-D)			70 (MCL)			50		70 (MCL)
Fluoride (sys)			4000 (MCL)			1500		4000 (MCL)
Hexachlorocyclo-hexane (c)			0.0091					
Methoxychlor (sys)			40 (MCL)	40		35		40 (MCL)
Nitrate (sys)	10000		10000 (MCL)	10000		10000		10000 (MCL)
Total Trihalomethanes (TTHM)			80 (MCL)					80 (MCL)
2,4,5 Trichloro-phenoxypropionic			50 (MCL)			10		50 (MCL)
Chloride NP	16887-00-6			250000		250000		
Methyl tertiary-butyl ether (MTBE)	1634-04-4			70		10		
N-Nitrosodi-n-butylamine NP (c)	924163	0.0063		0.0063				0.0063
N-Nitrosodiethyl-amine NP (c)	55185	0.0008		0.00023				0.0008
N-Nitrosopyrrolidine NP (c)	930552	0.016		0.016				0.016
Pentachloro-benzene NP (sys)	608935	1.4		1.4		5 ⁷		1.4
1,2,4,5-Tetrachloro-benzene NP (sys)	95943	0.97		0.97		5 ⁷		0.97
2,4,5-Trichloro-phenol (sys)	95954	1800		1800				1800
Boron	7440428				3100			
Acetone	67641				3500	50 ⁷		
Methylethyl ketone	78933				21000	50 ⁷		
1,2,3-Trichloropropane	96184				210	0.04		
Xylene	1330207				70000	5 (isomers)		
Formaldehyde	50000				700	8		

¹National Recommended Water Quality Criteria 2006

²Delaware Water Quality Standards regulation, amended July 11, 2004

³From New Jersey's amended Surface Water Quality Standards, June 16, 2008

⁴Title 25, Chapter 93 of Pennsylvania Code, Water Quality Standards, August 2009

⁵NYSDEC Part 703: Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations amended February 16, 2008
Standards for health- water source

⁶ NYSDEC criteria derived based on water source only unless noted as (FC) fish consumption only, (S-FC) salt water fish consumption only

⁷ NYS Division of Water TOGS 1.1.1 guidance value

⁸DRBC Water Quality Regulations, dated October 23, 1996

⁹ DRBC Proposed amendments to the the Water Quality Regulations, Water Code and Comprehensive Plan, 2009

NP = non-priority pollutant

(c) carcinogen

(sys) systemic toxicant

Appendix Table A4: Ambient Water Quality Criteria Comparison for the Delaware River
Human Health for Consumption of Organisms Only

µg/L

Parameter	CAS #	US EPA ¹	DE ²	NJ ³	PA ⁴	NY ^{5,6}	DRBC (Fresh) ⁷	DRBC (Marine) ⁷	DRBC revised
Antimony (sys)	7440360	640	1600	640			4310	757	640
Arsenic (sys)							73.4	12.9	delete
Arsenic (c)	7440382	0.14		0.061					0.061
Beryllium (sys)	7440417		420	42			2830	498	42
Beryllium (c)	7440417		0.024				0.132	0.0232	delete
Cadmium (sys)	7440439		31	16		2.7 ⁶	84.1	14.8	16
Chromium III (sys)	16065831		380000				673000	118000	380000
Chromium VI (sys)	18540299		750				3370	591	delete
Chromium (total) (sys)	7440473			750					750
Mercury (sys)	7439976			0.051		0.0007 ⁶	0.144	0.144	0.051
Methylmercury (sys)	22967926	0.3 mg/kg fish tissue	0.3 mg/kg fish tissue						0.3 mg/kg fish
Nickel (sys)	7440020	4600	1700	1700			4580	805	1700
Selenium (sys)	7782492	4200	4200	4200			2020	355	4200
Silver (sys)	7440224		40000	40000			108000	18900	40000
Thallium (sys)	7440280	0.47	18	0.47			6.2	1.1	0.47
Zinc (sys)	7440666	26000	26000	26000			68700	12100	26000
Cyanide (sys)	57125	140	80000	140		9000			140
2,3,7,8-TCDD (Dioxin) (c)	1746016	5.1E-09	5.1E-09	5.1E-09		6.0E-10	1.4E-08	2.4E-09	5.1E-09
Acrolein (sys)	107028	9.3	300	9.3			780	137	9.3
Acrylonitrile (c)	107131	0.25	0.25	0.25			0.665	0.117	0.25
Benzene (sys)	71432		3100						3100
Benzene (c)	71432	51	14	3.3		10	71.3	12.5	14
Bromoform (sys)	75252		9600				25900	4560	9600
Bromoform (c)	75252	140	61	140			164	28.9	140
Carbon Tetrachloride (sys)	56235		150				402	70.6	150
Carbon Tetrachloride (c)	56235	1.6	1.6	2.3			4.42	0.776	1.6
Chlorobenzene (Monochloro-benzene) (sys)	108907	1600	7800	2500		400	20900	3670	1600
Chlorodibromo-methane (sys)	124481		21000				46600	8190	21000
Chlorodibromo-methane (c)	124481	13	13	13			27.8	4.88	13
Chloroform (sys)	67663		11000	2100			28700	5050	2100
Chloroform (c)	67663	470					471	82.7	470
Dichlorobromo-methane (c)	75274	17	17	17			55.7	9.78	17
1,2-Dichloroethane (c)	107062	37	37	28			98.6	17.3	37
1,1-Dichloroethylene (sys)	75354	7100	36000	100					7100
1,1-Dichloroethylene (c)	75354		1.2				3.2	0.562	delete
1,2-Dichloropropane (c)	78875	15	15	15					15
1,3-Dichloropropene (1,3-Dichloropropylene) (sys)	542756		63000				1690	297	63000

Parameter	CAS #	US EPA ¹	DE ²	NJ ³	PA ⁴	NY ^{5,6}	DRBC (Fresh) ⁷	DRBC (Marine) ⁷	DRBC revised
1,3-Dichloropropene (cis and trans) (c)	542756	21	42	21			14.1	2.48	21
Ethylbenzene (sys)	100414	2100	11000	2100			28700	5050	2100
Methyl Bromide (sys) (Bromomethane)	74839	1500	1500	1500					1500
Dichloromethane(methylene chloride)(sys)	75092		260000				710000	125000	260000
Dichloromethane(methylene chloride)(c)	75092	590	590	310		200	1580	277	590
1,1,1,2-Tetrachloroethane (sys)	630-20-6						22400	3940	delete
1,1,1,2-Tetrachloroethane (c)	630-20-6						29.3	5.15	delete
1,1,2,2-Tetrachloroethane (sys)	79345			110					
1,1,2,2-Tetrachloroethane (c)	79345	4.0	4				10.8	1.89	4.0
Tetrachloroethylene (sys)	127184		1300						1300
Tetrachloroethylene (PCE) (c)	127184	3.3	3.3	1.6		1 ⁶	8.85	1.55	3.3
Toluene (sys)	108883	15000	75000	15000		6000	201000	35400	15000
1,2-Trans-Dichloroethylene (sys) (1,2-Dichloroethylene)	156605	10000	51000	43000					10000
1,1,1-Trichloroethane (sys)	71556			2600					
1,1,2-Trichloroethane (sys)	79005		3600	350			9490	1670	3600
1,1,2-Trichloroethane (c)	79005	16	16				41.6	7.31	16
Trichloroethylene (Trichloroethene) (TCE)(c)	79016	30	30	12		40	80.7	14.2	30
Vinyl Chloride (sys)	75014		10000						10000
Vinyl Chloride (c)	75014	2.4	2.4	8.1			525	92.9	2.4
2-Chlorophenol (sys)	95578	150	150	150			402	70.6	150
2,4-Dichlorophenol (DCP)	120832	290	290	290			794	139	290
2,4-Dimethylphenol (sys)	105679	850	850	850		1000	2300	403	850
2-Methyl-4,6-Dinitrophenol (sys) (4,6-Dinitro-o-cresol)	534521	280		280					280
2,4-Dinitrophenol (sys)	51285	5300	5300	5300		400	14300	2500	5300
Pentachlorophenol (sys)	87865		11000				29400	5160	11000
Pentachlorophenol (c)	87865	3.0	3	3.0			8.16	1.43	3.0
Phenol (sys)	108952	17000000	860000	860000			4620000	811000	860000
2,4,6-Trichlorophenol (c)	88062	2.4	2.4	1.0			6.53	1.15	2.4
Acenaphthene (sys)	83329	990	990	990			2670	469	990
Anthracene (sys)	120127	40000	40000	40000			6760	1190	40000
Benzidine (sys)	92875		140				369	64.9	140
Benzidine (c)	92875	0.00020	0.00019	0.00020			0.000535	0.000094	0.00020
Benzo(a)-Anthracene (c)	56553	0.018	0.18	0.18			0.00177	0.00031	0.18

Parameter	CAS #	US EPA ¹	DE ²	NJ ³	PA ⁴	NY ^{5,6}	DRBC (Fresh) ⁷	DRBC (Marine) ⁷	DRBC revised
Benzo(a)Pyrene (BaP)(c)	50328	0.018	0.018	0.018		0.0012 ⁶	0.0000653	0.0000115	0.018
Benzo(b)-Fluoranthene (c) (3,4-Benzofluoranthene)	205992	0.018	0.18	0.18			0.00046	0.000081	0.18
Benzo(k)-Fluoranthene (c)	207089	0.018		1.8			0.000282	0.000049	1.8
Bis(2-Chloroethyl)Ether (c) (Dichloroethyl ether)	111444	0.53	0.53	0.53			1.42	0.249	0.53
Bis(2-Chloroisopropyl) Ether (sys)	108601	65000	65000	65000			174000	30600	65000
Bis(2-Ethylhexyl) Phthalate (sys)	117817		620				1660	291	620
Bis(2-Ethylhexyl) Phthalate (c) (DEHP)	117817	2.2	2.2	2.2			5.92	1.04	2.2
Butylbenzyl Phthalate (sys)	85687	1900	1900	190			520	91.4	1900
2-Chloronaphthalene (sys)	91587	1600	1600	1600					1600
Chrysene (c)	218019	0.018	0.18	18			0.0224	0.00394	18
Dibenzo(a,h) Anthracene (c)	53703	0.018	0.018	0.018			0.0000559	0.0000098	0.018
1,2-Dichlorobenzene (ortho) (sys)	95501	1300	6500	6200			17400	3060	1300
1,3-Dichlorobenzene (meta) (sys)	541731	960	1300	8300			3510	617	1300
1,4-Dichlorobenzene (para) (sys)	106467	190	1400	2200			3870	677	190
3,3'-Dichloroben-zidine (c)	91941	0.028	0.028	0.028			0.0767	0.0135	0.028
Diethyl Phthalate (sys)	84662	44000	44000	44000			118000	20700	44000
Dimethyl Phthalate (sys)	131113	1100000	1100000				2990000	526000	1100000
Di-n-Butyl Phthalate (sys)	84742	4500	4500				12100	2130	4500
2,4-Dinitrotoluene (sys)	121142		2100				5670	996	2100
2,4-Dinitrotoluene (c)	121142	3.4	3.4	3.4					3.4
Dinitrotoluene (c)							1420	249	
1,2-Diphenylhydrazine (c)	122667	0.2	0.2	0.2			0.541	0.095	0.2
Fluoranthene (sys)	206440	140	140	140			375	65.8	140
Fluorene (sys)	86737	5300	5300	5300			1530	268	5300
Hexachloro-benzene (sys)	118741		0.36				0.991	0.174	0.36
Hexachloro-benzene (c)	118741	0.00029	0.00028	0.00029		0.00003	0.000775	0.000136	0.00029
Hexachloro-butadiene (sys)	87683		2900				7750	1360	delete
Hexachloro-butadiene (c)	87683	18	18	18		0.01	49.7	8.72	18
Hexachlorocyclo-pentadiene (sys)	77474	1100	5500	1100			17400	3050	1100
Hexachloroethane (sys)	67721		46				124	21.7	46
Hexachloroethane (c)	67721	3.3	3.3	3.3		0.6	8.85	1.56	3.3
Ideno(1,2,3-cd)Pyrene (c)	193395	0.018	0.18	0.18			0.0000576	0.0000101	0.18
Isophorone (sys)	78591		180000				492000	86400	180000
Isophorone (c)	78591	960	960	960			2590	455	960
Nitrobenzene (sys)	98953	690	690	690			1860	327	690
N-Nitrosodi-methylamine (c)	62759	3.0	3	3.0			8.12	1.43	3.0
N-Nitrosodi-n-Propylamine ©	621647	0.51	0.51	0.51			1.51	0.265	0.51

Parameter	CAS #	US EPA ¹	DE ²	NJ ³	PA ⁴	NY ^{5,6}	DRBC (Fresh) ⁷	DRBC (Marine) ⁷	DRBC revised
N-Nitrosodiphenyl-amine (c)	86306	6.0	6	6.0			16.2	2.84	6
Pyrene (sys)	129000	4000	4000	4000			291	51.1	4000
1,2,4-Trichlorobenzene (sys)	120821	70	350	42			945	166	70
Aldrin (sys)	309002		0.025				11.5	2.03	0.025
Aldrin (c)	309002	0.000050	0.00005	0.000050			0.0226	0.00397	0.000050
aldrin and dieldrin						0.001			
alpha-BHC (c) (alpha-HCH)	319846	0.0049	0.0048	0.0049		0.002	0.0132	0.00231	0.0049
beta-BHC (sys)	319857								
beta-BHC (c) (beta-HCH)	319857	0.017	0.017	0.017		0.007			0.017
gamma-BHC (Lindane) (sys)	58899	1.8	9.2	1.8			24.9	4.37	1.8
gamma-BHC (Lindane/gamma-HCH) (c)	58899		0.23			0.008			
delta-BHC	319868					0.008			
Chlordane (sys)	57749		0.14				0.0458	0.00805	0.14
Chlordane (c)	57749	0.00081	0.00081	0.00011		0.00002	0.000588	0.000104	0.00081
4,4'-DDT (c)	50293	0.00022		0.00022		0.00001	0.000591	0.000104	0.00022
4,4'-DDE (c)	72559	0.00022		0.00022		0.000007	0.00585	0.00103	0.00022
4,4'-DDD (p,p--TDE) (c)	72548	0.00031		0.00031		0.00008	0.00436	0.000765	0.00031
DDT and Metabolites (sys)			0.037				0.100	0.0176	0.037
DDT and Metabolites ©			0.00022						
Dieldrin (sys)	60571		0.043				0.115	0.020	0.043
Dieldrin (c)	60571	0.000054	0.000054	0.000054		0.0000006	0.000144	0.0000253	0.000054
alpha-Endosulfan (sys)	959988	89		89					89
beta-Endosulfan (sys)	33213659	89		89					89
Endosulfan Sulfate (sys)	1031078	89		89					89
Endosulfan (alpha and beta) (sys)	115297		89				239	42	
Endrin (sys)	72208	0.060	0.3	0.060		0.002	0.814	0.143	0.060
Endrin Aldehyde (sys)	7421934	0.30	0.3	0.060					0.30
Heptachlor (sys)	76448		0.18				0.344	0.060	0.18
Heptachlor (c)	76448	0.000079	0.000079	0.000079		0.0002	0.000214	0.0000375	0.000079
Heptachlor Epoxide (sys)	1024573		0.0046				0.0246	0.00433	0.0046
Heptachlor Epoxide (c)	1024573	0.000039	0.000039	0.000039		0.0003	0.000208	0.0000366	0.000039
Toxaphene (sys)	8001352								
Toxaphene (c)	8001352	0.00028	0.00028	0.00028		0.000006	0.000747	0.000131	0.00028
Hexachlorocyclo- hexane			0.017						
N-Nitrosodi-n-butylamine NP (c)	924163	0.22		0.22					0.22

Parameter	CAS #	US EPA ¹	DE ²	NJ ³	PA ⁴	NY ^{5,6}	DRBC (Fresh) ⁷	DRBC (Marine) ⁷	DRBC revised
N-Nitrosodiethyl-amine NP (c)	55185	1.24		0.13					0.13
N-Nitrosopyrrolidine NP (c)	930552	34		34					34
Pentachloro-benzene NP (sys)	608935	1.5		1.5					1.5
1,2,4,5-Tetrachloro-benzene NP (sys)	95943	1.1		1.1					1.1
2,4,5-Trichloro-phenol (sys)	95954	3600		3600					3600
Manganese NP	7439965	100		100					
Boron	7440428								
Acetone	67641								
Methylethyl ketone	78933								
1,2,3-Trichloropropane	96184								
Xylene	1330207								
Formaldehyde	50000								

¹National Recommended Water Quality Criteria 2006

²Delaware Water Quality Standards regulation, amended July 11, 2004

³From New Jersey's amended Surface Water Quality Standards, June 16, 2008 (saline water)

⁴Title 25, Chapter 93 of Pennsylvania Code, Water Quality Standards, August 2009

⁵NYSDEC Part 703: Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations amended February 16, 2008
Standards for health - fish consumption

⁶ NYS Division of Water TOGS 1.1.1 guidance value

⁷DRBC Water Quality Regulations, dated October 23, 1996

⁸ DRBC Proposed amendments to the the Water Quality Regulations, Water Code and Comprehensive Plan, 2009

NP = non-priority pollutant

(c) carcinogen

(sys) systemic toxicant

Appendix Table A5: Comparison of Hardness Dependent Water Quality Criteria for Zones 2 through 5						
Parameter	Freshwater Objectives (µg/l)					74
	Acute					
	DRBC, NJ		USEPA, DE, PA		NY	
Metals (hardness dependent) at 74 mg/l CaCO ₃	Dissolved	Total	Dissolved	Total	Dissolved	Total
Cadmium	$=0.651*EXP(1.0166*LN(74)-3.924)$	$=EXP(1.0166*LN(74)-3.924)$	$=(1.136672-LN(74)*0.041838)*EXP(1.0166*LN(74)-3.924)$	$=EXP(1.0166*LN(74)-3.924)$	$=(0.85)*EXP(1.128*LN(74)-3.6867)$	$=EXP(1.128*LN(74)-3.6867)$
	1.02	1.57	1.50	1.57	2.73	3.22
Chromium (trivalent)	$=0.277*EXP(0.819*LN(74)+3.7256)$	$=EXP(0.819*LN(74)+3.7256)$	$=0.316*EXP(0.819*LN(74)+3.7256)$	$=EXP(0.819*LN(74)+3.7256)$	$=0.316*EXP(0.819*LN(74)+3.7256)$	$=EXP(0.819*LN(74)+3.7256)$
	390	1409	445	1409	445	1409
Copper	$=0.908*EXP(0.9422*LN(74)-1.7)$	$=EXP(0.9422*LN(74)-1.7)$	$=0.96*EXP(0.9422*LN(74)-1.7)$	$=EXP(0.9422*LN(74)-1.7)$	$=0.96*EXP(0.9422*LN(74)-1.7)$	$=EXP(0.9422*LN(74)-1.7)$
	10	11	10	11	10	11
Lead	N/A	N/A	$=(1.46203-LN(74)*0.145712)*EXP(1.273*LN(74)-1.46)$	$=EXP(1.273*LN(74)-1.46)$	$=(1.46203-LN(74)*0.145712)*EXP(1.273*LN(74)-1.052)$	$=EXP(1.273*LN(74)-1.052)$
	38	53	46	56	70	84
Nickel	$=0.846*EXP(0.846*LN(74)+2.255)$	$=EXP(0.846*LN(74)+2.255)$	$=0.998*EXP(0.846*LN(74)+2.255)$	$=EXP(0.846*LN(74)+2.255)$	$=0.998*EXP(0.846*LN(74)+2.255)$	$=EXP(0.846*LN(74)+2.255)$
	308	364	363	364	363	364
Silver	$=0.85*EXP(1.72*LN(74)-6.59)$	$=EXP(1.72*LN(74)-6.59)$	$=0.85*EXP(1.72*LN(74)-6.59)^a$	$=EXP(1.72*LN(74)-6.59)$	$=0.85*EXP(1.72*LN(74)-6.59)$	$=EXP(1.72*LN(74)-6.59)$
	1.9	2.3	1.9	2.3	1.9	2.3
Zinc	$=0.95*EXP(0.8473*LN(74)+0.884)$	$=EXP(0.8473*LN(74)+0.884)$	$=0.978*EXP(0.8473*LN(74)+0.884)$	$=EXP(0.8473*LN(74)+0.884)$	$=0.978*EXP(0.8473*LN(74)+0.884)$	$=EXP(0.8473*LN(74)+0.884)$
	88	93	91	93	91	93

Appendix Table A6: Comparison of Hardness Dependent Water Quality Criteria for Zones 2 through 5						
Parameter	Freshwater Objectives (µg/l)					74
	Chronic					
	DRBC, NJ		USEPA, DE, PA		NY	
Metals (hardness dependent) at 74 mg/l CaCO3	Dissolved	Total	Dissolved	Total	Dissolved	Total
Cadmium	$=0.651*EXP(0.7409*LN(74)-4.719)$	$=EXP(0.7409*LN(74)-4.719)$	$=(1.101672-LN(74)*0.041838)*EXP(0.7409*LN(74)-4.719)$	$=EXP(0.7409*LN(74)-4.719)$	$=(0.85)*EXP(0.7852*LN(74)-2.715)$	$=EXP(0.7852*LN(74)-2.715)$
	0.14	0.22	0.20	0.22	1.67	1.94
Chromium (trivalent)	$=0.277*EXP(0.819*LN(74)+0.6848)$	$=EXP(0.819*LN(74)+0.6848)$	$=0.86*EXP(0.819*LN(74)+0.6848)$	$=EXP(0.819*LN(74)+0.6848)$	$=0.86*EXP(0.819*LN(74)+0.6848)$	$=EXP(0.819*LN(74)+0.6848)$
	19	67	58	67	58	67
Copper	$=0.908*EXP(0.8545*LN(74)-1.702)$	$=EXP(0.8545*LN(74)-1.702)$	$=0.96*EXP(0.8545*LN(74)-1.702)$	$=EXP(0.8545*LN(74)-1.702)$	$=0.96*EXP(0.8545*LN(74)-1.702)$	$=EXP(0.8545*LN(74)-1.702)$
	6.5	7.2	6.9	7.2	6.9	7.2
Lead	N/A	N/A	$=(1.46203-LN(74)*0.145712)*EXP(1.273*LN(74)-4.705)$	$=EXP(1.273*LN(74)-4.705)$	$=(1.46203-LN(74)*0.145712)*EXP(1.273*LN(74)-4.297)$	$=EXP(1.273*LN(74)-4.297)$
	5.4	7.5	1.8	2.2	2.7	3.3
Nickel	$=0.846*EXP(0.846*LN(74)+0.0584)$	$=EXP(0.846*LN(74)+0.0584)$	$=0.997*EXP(0.846*LN(74)+0.0584)$	$=EXP(0.846*LN(74)+0.0584)$	$=0.997*EXP(0.846*LN(74)+0.0584)$	$=EXP(0.846*LN(74)+0.0584)$
	34	40	40	40	40	40
Silver	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A
Zinc	$=0.95*EXP(0.8473*LN(74)+0.884)$	$=EXP(0.8473*LN(74)+0.884)$	$=0.986*EXP(0.8473*LN(74)+0.884)$	$=EXP(0.8473*LN(74)+0.884)$	$=*EXP(0.85*LN(74)+0.50)$ no translator???	$=EXP(0.85*LN(74)+0.50)$
	88	93	92	93	64	64

Appendix Table A7: Comparison of pH dependent Water Quality Criteria in Zones 2 through 5

Parameter	Freshwater Objectives (µg/l)		
	chronic		
	DRBC, NJ, PA, DE, USEPA pH 6.5	DRBC, NJ, PA, DE, USEPA pH 7.8	DRBC, NJ, PA, DE, USEPA pH 9.0
Pentachlorophenol	=EXP(1.005*6.5-5.134)	=EXP(1.005*7.8-5.134)	=EXP(1.005*9.0-5.134)
	4.0	15	50
Parameter	Freshwater Objectives (µg/l)		
	acute		
	DRBC, NJ, PA, DE, USEPA pH 6.5	DRBC, NJ, PA, DE, USEPA pH 7.8	DRBC, NJ, PA, DE, USEPA pH 9.0
Pentachlorophenol	=EXP(1.005*6.5-4.869)	=EXP(1.005*7.8-4.869)	=EXP(1.005*9.0-4.869)
	5.3	19	65

Appendix Table A8: Stream Quality Objectives For Toxic Pollutants For The Protection Of Aquatic Life In The Delaware Estuary

Freshwater Acute ($\mu\text{g/L}$) Zones 1 through 5

Parameter	CAS #	USEPA	DE ²	NJ ³	PA ⁴	NY ⁵	DRBC ⁶ revised
Metals							
Aluminum	7429905	750	750		750		750 ^a
Arsenic (trivalent)	7440382/22569-72-8	340	340	340	340	340	340
Cadmium	7440439	hardness dependent					
Chromium (trivalent)	16065831	hardness dependent					
Chromium (hexavalent)	18540299	16	16	15.0	16	16	16
Copper	7440508	hardness dependent					
Cyanide (free)	57125	22	22	22	22	22	22
Lead	7439921	hardness dependent		38	hardness dependent	hardness dependent	38
Mercury	7439976	1.4	1.4	1.4	1.4	1.4	1.4
Nickel	7440020	hardness dependent					
Selenium	7782492		20	20			20
Silver	7440224	hardness dependent					
Zinc	7440666	hardness dependent					
Pesticides/PCB							
Aldrin	309002	3	3	3	3		3
gamma - BHC (Lindane)	58899	0.95		0.95	0.95	0.95	0.95
Chlordane	57749	2.4		2.4	2.4		2.4
Chlorpyrifos (Dursban)	2921882	0.083	0.083	0.083			0.083
DDT and metabolites	50293	1.1		1.1	1.1		1.1 ^d
Dieldrin	60571	0.24	0.24	0.24	0.24	0.24	0.24
Endosulfan (sum of alpha and beta)			0.22			0.22	
alpha-Endosulfan	959988	0.22		0.22	0.22		0.22 ^b
beta-Endosulfan	33213659	0.22		0.22	0.22		0.22 ^b
Endrin	72208	0.086	0.086	0.086	0.086	0.086	0.086
Heptachlor	76448	0.52	0.52	0.52	0.52		0.52
Heptachlor Epoxide	1024573	0.52		0.52	0.5		0.52
Parathion	56382	0.065	0.065	0.065		0.065	0.065
Toxaphene	8001352	0.73	0.73	0.73	0.73	1.6	0.73
Acid Extractable Organics							
Pentachlorophenol	87865	19	19	19	19	19	19 ^c
Whole Effluent Toxicity		0.3			0.3		0.3

¹ USEPA National Recommended Water Quality Criteria 2006

² Delaware Water Quality Standards regulation, amended July 11, 2004

³ New Jersey Surface Water Quality Standards, adopted October 16, 2006

⁴ Title 25, Chapter 16 of Pennsylvania Code, Water Quality Toxics Management Strategy - amended 2009

⁵ NYDEC Part:703 Surface Water and Groundwater Quality Standards and Groundwater Limitations

⁶ Proposed DRBC Water Quality Stream Quality Objectives.

^a With recommendation that a statement about metal toxicity be added to the DRBC regulations.

Criteria for cadmium, chromium (trivalent), copper, lead, nickel, silver and zinc are hardness dependent and are expressed as the dissolved form.

See separate sheet for comparison of formulas used to calculate hardness dependent criteria.

^b This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

^c pH dependent (See separate sheet for comparison of formulas used to calculate pH dependent criteria.)

^d This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).

Criteria for pentachlorophenol are pH dependent. See separate sheet for comparison of formulas used to calculate the criteria.

Yellow highlight indicates a change from current DRBC criteria.

Basin states and/or USEPA have aquatic life criteria not included in this comparison.

Appendix Table A9: Stream Quality Objectives For The Protection Of Aquatic Life In The Delaware Estuary
 Freshwater Chronic $\mu\text{g/L}$ Zones 1 through 5

Parameter	CAS #	US EPA ¹	DE ²	NJ ³	PA ⁴	NY ⁵	DRBC ⁶ revised	
Metals								
Aluminum	7429905	87	87			100 (ionic)	87 ^a	
Arsenic (trivalent)	7440382/22569-72-9	150	150	150	150 (As3+)	150	150	
Cadmium	7440439	hardness dependent						
Chromium (trivalent)	16065831	hardness dependent						
Chromium (hexavalent)	18540299	11	11	10.0	10	11	11	
Copper	7440508	hardness dependent						
Cyanide (free)	57125	5.2	5.2	5.2	5.2	5.2	5.2	
Lead	7439921	hardness dependent		5.4	hardness dependent	hardness dependent	5.4	
Mercury	7439976	0.77	0.077	0.77	0.77	0.77	0.77	
Nickel	7440020	hardness dependent						
Selenium	7782492	5.0	5.0	5.0	4.6	4.6	5.0	
Silver	7440224	NA					0.1 (ionic)	NA
Zinc	7440666	hardness dependent						
Pesticides/PCB								
Chlordane	57749	0.0043	0.0043	0.0043	0.0043		0.0043	
Chlorpyrifos (Dursban)	2921882	0.041	0.041	0.041			0.041	
DDT and metabolites	50293	0.001		0.0010	0.001		0.001 ^d	
Dieldrin	60571	0.056	0.056	0.056	0.056	0.056	0.056	
Endosulfan (sum of alpha and beta)			0.056			0.009		
alpha-Endosulfan	959988	0.056		0.056	0.056		0.056 ^b	
beta-Endosulfan	33213659	0.056		0.056	0.056		0.056 ^b	
Endrin	72208	0.036	0.036	0.036	0.036	0.036	0.036	
Heptachlor	76448	0.0038	0.0038	0.0038	0.0038		0.0038	
Heptachlor Epoxide	1024573	0.0038		0.0038	0.0038		0.0038	
PCBs (Total)		0.014	0.014	0.014	0.014		0.014	
Parathion	56382	0.013	0.013	0.013			0.013	
Toxaphene	8001352	0.0002	0.0002	0.0002	0.0002	0.005	0.0002	
Acid Extractable Organics								
Pentachlorophenol	87865	15	15	15	15	15	15 ^c	
Whole Effluent Toxicity		1			1		1	

¹ USEPA National Recommended Water Quality Criteria 2006

² Delaware Water Quality Standards regulation, amended July 11, 2004

³ New Jersey Surface Water Quality Standards, adopted October 16, 2006

⁴ Title 25, Chapter 16 of Pennsylvania Code, Water Quality Toxics Management Strategy - amended 2009

⁵ NYDEC Part:703 Surface Water and Groundwater Quality Standards and Groundwater Limitations

⁶ Proposed DRBC Water Quality Stream Quality Objectives.

^a With recommendation that a statement about metal toxicity be added to the DRBC regulations.

Criteria for cadmium, chromium (trivalent), copper, lead, nickel, silver and zinc are hardness dependent and are expressed as the dissolved form.

See separate sheet for comparison of formulas used to calculate hardness dependent criteria.

^b This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

^c pH dependent (See separate sheet for comparison of formulas used to calculate pH dependent criteria.)

^d This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).

Criteria for pentachlorophenol are pH dependent. See separate sheet for comparison of formulas used to calculate the criteria.

Yellow highlight indicates a change from current DRBC criteria.

Basin states and/or USEPA have aquatic life criteria not included in this comparison.

Appendix Table A10: Stream Quality Objectives For The Protection Of Aquatic Life In The Delaware Estuary
Marine Acute µg/L Zones 5 through 6

Parameter	CAS #	US EPA ¹	DE ²	NJ ³	PA ⁴	DRBC ⁶ revised
Metals						
Arsenic (trivalent)	22569-72-8/7440382	69	69	69		69
Cadmium	7440439	40	40	40		40
Chromium (hexavalent)	18540299	1100	1100	1100		1100
Copper	7440508	4.8	4.8	4.8		4.8
Cyanide (free)	57125	1	1	2.7		2.7 ^a
Lead	7439921	210	210	210		210
Mercury	7439976	1.8	1.8	1.8		1.8
Nickel	7440020	74	74	64		64 ^b
Selenium	7782492	290	290	290		290
Silver	7440224	1.9	1.9	1.9		1.9
Zinc	7440666	90	90	90		90
Pesticides/PCB						
Aldrin	309002	1.3	1.3	1.3		1.3
gamma - BHC (Lindane)	58899	0.16		0.16		0.16
Chlordane	57749	0.09	0.09	0.09		0.09
Chlorpyrifos (Dursban)	2921882	0.011	0.011	0.011		0.011
DDT and metabolites (DDE & DDD)			0.13			
DDT and metabolites	50293	0.13		0.13		0.13 ^d
Dieldrin	60571	0.71	0.71	0.71		0.71
Endosulfan (sum of alpha and beta)			0.034	0.034		
alpha-Endosulfan	959988	0.034				0.034 ^c
beta-Endosulfan	33213659	0.034				0.034 ^c
Endrin	72208	0.037	0.037	0.037		0.037
Heptachlor	76448	0.053	0.053	0.053		0.053
Heptachlor Epoxide	1024573	0.053		0.053		0.053
Toxaphene	8001352	0.21	0.21	0.21		0.21
Acid Extractable Organics						
Pentachlorophenol	87865	13	13	13		13
Whole Effluent Toxicity						0.3

¹ USEPA National Recommended Water Quality Criteria 2006

² Delaware Water Quality Standards regulation, amended July 11, 2004

³ New Jersey Surface Water Quality Standards, adopted October 16, 2006

⁴ Title 25, Chapter 16 of Pennsylvania Code, Water Quality Toxics Management Strategy - amended 2009

⁵ NYDEC Part:703 Surface Water and Groundwater Quality Standards and Groundwater Limitations

⁶ Proposed DRBC Water Quality Stream Quality Objectives.

^a Proposed Revision of the New Jersey Water Quality Standards for Cyanide in Saltwater, May 16, 2007

www.state.nj.us/dep/wms/bwqsa

^b Technical Information Related to Developing a Saltwater Nickel Addendum to the Ambient Water Quality Criteria Document. GLEC 2003

^c This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

^d This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).

Yellow highlight indicates a change from current DRBC criteria.

Appendix Table A11: Stream Quality Objective For The Protection Of Aquatic Life In The Delaware Estuary
 Marine Chronic µg/L
 Zones 5 through 6

Parameter	CAS #	US EPA ¹	DE ²	NJ ³	PA ⁴	DRBC ⁶ revised
Metals						
Arsenic (trivalent)	7440382/22569-72-8	36	36 (III)	36		36
Cadmium	7440439	8.8	8.8	8.8		8.8
Chromium (hexavalent)	18540299	50	50	50.0		50
Copper	7440508	3.1	3.1	3.1		3.1
Cyanide (free)	57125	1		2.7		1 ^a
Lead	7439921	8.1	8.1	24		8.1
Mercury	7439976	0.94	0.94	0.94		0.94
Nickel	7440020	8.2	8.2	22		22 ^b
Selenium	7782492	71	71	71		71
Zinc	7440666	81	81	81		81
Pesticides/PCB						
Chlordane	57749	0.004	0.004	0.0040		0.004
Chlorpyrifos (Dursban)	2921882	0.0056	0.0056	0.0056		0.0056
DDT and metabolites (DDE & DDD)			0.001			
DDT and metabolites	50293	0.001		0.001		0.001 ^d
Dieldrin	60571	0.0019	0.0019	0.0019		0.0019
Endosulfan (sum of alpha and beta)			0.0087	0.0087		
alpha-Endosulfan	959988	0.0087				0.0087 ^c
beta-Endosulfan	33213659	0.0087				0.0087 ^c
Endrin	72208	0.0023	0.0023	0.0023		0.0023
Heptachlor	76448	0.0036	0.0036	0.0036		0.0036
Heptachlor Epoxide	1024573	0.0036		0.0036		0.0036
Toxaphene	8001352	0.0002	0.0002	0.0002		0.0002
Acid Extractable Organics						
Pentachlorophenol	87865	7.9	7.9	7.9		7.9

¹ USEPA National Recommended Water Quality Criteria 2006

² Delaware Water Quality Standards regulation, amended July 11, 2004

³ New Jersey Surface Water Quality Standards, adopted October 16, 2006

⁴ Title 25, Chapter 16 of Pennsylvania Code, Water Quality Toxics Management Strategy - amended 2009

⁵ NYDEC Part:703 Surface Water and Groundwater Quality Standards and Groundwater Limitations

⁶ Proposed DRBC Water Quality Stream Quality Objectives.

^a Proposed Revision of the New Jersey Water Quality Standards for Cyanide in Saltwater, May 16, 2007

www.state.nj.us/dep/wms/bwqsa

^b Technical Information Related to Developing a Saltwater Nickel Addendum to the Ambient Water Quality Criteria Document. GLEC 2003

^c This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

^d This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).

Yellow highlight indicates a change from current DRBC criteria.