GEORGIA DEPARTMENT OF NATURAL RESOURCES

ENVIRONMENTAL PROTECTION DIVISION

Updated Human Health Criteria

Supporting Documentation for Human Health Ambient Water Quality Criteria Derived Using Probabilistic Risk Assessment for the 2022 Triennial Review of Water Quality Standards

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Table of Contents

1.0 Introduction 5
2.0 Deterministic Method Used to Derive Human Health Criteria 8
3.0 Probabilistic Method Used to Derive Human Health Criteria 13
3.1 Monte Carlo Analysis 13
3.2 Probabilistic Distributions 17
3.2.1 Body Weight 17
3.2.2 Drinking Water Ingestion Rate 20
3.2.3 Fish Consumption Rate Distribution 21
3.3 @RISK 33
3.3.1 Risk Levels 33
3.3.2 Criteria Selection 34
3.3.3 Proposed Criteria 42
References 56
Appendices 57

Table of Tables

Table 1. Difference Between the 2015 EPA Proposed Human Health Criteria and Georgia's Current Human Health Criteria 8

Table 2. Cancer Slope Factor and Reference Dose Values by Pollutant 14

Table 3. Body Weight Percentiles for Adults 21 and Over 17

Table 4. Fitted Parameters for Lognormal Body Weight Distribution 19

Table 5. Water Ingestion Percentiles for Adults 21+ 20

Table 6. Fitted Parameters for BetaGeneral Drinking Water Ingestion Distribution 21

Table 7. Fish Consumption Estimated by Geographic Regions 23

Table 8. Fitted Parameters for Lognormal Inland South Fish Consumption Rate Distribution 24

Table 9. Fitted Parameters for Lognormal Atlantic Coast Fish Consumption Rate Distribution .. 25

Table 10. 2020 Georgia County Population 27

Table 11. Georgia Population Located in Inland and Coastal Counties 31

Table 12. Fish Consumption Rates by Trophic Level 31

Table 13. Comparison of the Criteria for the Various Risk Scenarios 36

Table 14. Scenario Results Table 40

Table 15. Proposed Human Health Criteria Values 43

Table 16. Comparison of Proposed Water + Organism Criteria to Georgia's Current Human Health Criteria 46

Table 17. Comparison of Proposed Organism Only Criteria to Georgia's Current Human Health Criteria 48

Table 18. Comparison of Georgia's Proposed Human Health Criteria to EPA's Recommended Human Health Criteria by Pollutant 52

Table of Figures

Figure 1. Comparison of EPA's Organism Only Criteria to EPD's Current Human Health Criteria for 82 Pollutants 11

Figure 2. Comparison of EPA's Water + Organism Criteria to EPD's Current Human Health Criteria for 82 Pollutants 12

Figure 3. Fit Comparison of Body Weight Inputs to Resulting Inverse Gause and Lognormal Distributions 18

Figure 4. Fit comparison of body weight inputs to resulting Lognormal distribution. 19

Figure 5. Probability Distribution of Drinking Water Ingestion Rates for Adults 21+ 20

Figure 6. Fit Comparison of Drinking Water Ingestion Inputs to Resulting BetaGeneral Distribution 21

Figure 7. Probability Distributions of Fish Consumption Rates in the Inland South and Atlantic Coast Regions 23

Figure 8. Fit Comparison of Inland South Fish Consumption Rate Inputs to Resulting Lognormal Distribution. 24

Figure 9. Fit Comparison of Atlantic Coast Fish Consumption Rate Inputs to Resulting Lognormal Distribution. 25

Figure 10. Coastal Counties 26

Figure 11. Proposed Water + Organism Criteria Compared to Georgia's Current Human Health Criteria for 82 Pollutants 50

Figure 12. Proposed Organism Only Criteria Compared to Georgia's Current Human Health Criteria for 82 Pollutants 50

Figure 13. Comparison of Georgia's Proposed Water + Organism Human Health Criteria for 88 Pollutants to EPA's Criteria Recommendation 54

Figure 14. Comparison of Georgia's Proposed Organism Only Human Health Criteria for 88 Pollutants to EPA's Criteria Recommendation 55

1.0 Introduction

Human health criteria (HHC) are the highest concentration of pollutants in surface water that are not expected to pose a significant risk to human health over a lifetime. These criteria are set to protect against harmful concentrations of pollutants in ambient surface waters that could impact human health through treated drinking water or consumption of contaminated fish and shellfish.

The methodology for deriving human health criteria was published by the U.S. Environmental Protection Agency (EPA) in 2000. In 2002, EPA published an updated compilation of its national recommended water quality criteria for 158 pollutants (US EPA, 2002). Most of Georgia's current human health criteria were adopted in the early 2000s based on the 2002 EPA recommendation.

For non-carcinogenic compounds, criteria for consumption of water and organisms are derived by multiplying the body weight value by the parameter-specific reference dose value times the relative source contribution and dividing by the sum of the drinking water intake value plus the product of the parameter specific fish consumption rates and bioaccumulation factors for fish trophic levels 2 through 4. Criteria for consumption of organisms only are derived using the same equation, excluding the drinking water intake value.

For consumption of water and organisms (non-carcinogens):

$$\mathrm{AWQC}(\mu\mathrm{g/L}) = \frac{\left[RfD\ \left({}^{mg}/_{kg \cdot d}\right) \times RSC\right] \times BW\ (kg)\ \times 1{,}000\ (\mu\mathrm{g/mg})}{DI\ (L/d) +\ \sum_{i=2}^{4}[FCR_i(kg/d) \times\ BAF_i\ (L/kg)]}$$

For consumption of organisms only (non-carcinogens):

$$\mathrm{AWQC}(\mu\mathrm{g/L}) = \frac{\left[RfD\ \left({}^{mg}/_{kg \cdot d}\right) \times RSC\right] \times BW\ (kg)\ \times 1{,}000\ (\mu\mathrm{g/mg})}{\sum_{i=2}^{4}[FCR_i(kg/d) \times\ BAF_i\ (L/kg)]}$$

For carcinogenic compounds, criteria for consumption of water plus organisms are derived by multiplying the quotient of the target incremental lifetime increased cancer risk divided by the parameter specific cancer slope factor times the body weight value and dividing by the sum of the drinking water intake value plus the product of the parameter specific fish consumption rates and bioaccumulation factors for fish trophic levels 2 through 4. Criteria for consumption of organisms only are derived using the same equation, excluding the drinking water intake value.

For consumption of water and organisms (carcinogens):

$$\text{AWQC}(\mu\text{g/L}) = \frac{\left[Risk/CSF\left({}^{mg}/_{kg \cdot d}\right)\right] \times BW\ (kg)\ \times 1{,}000\ (\mu\text{g/mg})}{DI\ (L/d) + \sum_{i=2}^{4}[FCR_i(kg/d) \times\ BAF_i\ (L/kg)]}$$

For consumption of organisms only (carcinogens):

$$\text{AWQC}(\mu\text{g/L}) = \frac{\left[Risk/CSF\left({}^{mg}/_{kg \cdot d}\right)\right] \times BW\ (kg)\ \times 1{,}000\ (\mu\text{g/mg})}{\sum_{i=2}^{4}[FCR_i(kg/d) \times\ BAF_i\ (L/kg)]}$$

Where:

AWQC = ambient water quality criterion (µg/L)
RfD = parameter-specific reference dose (mg/kg-day)
RSC = relative source contribution (percentage); accounts for non-water sources of exposure
BW = body weight (kg)
DI = drinking water intake (L/day)
CSF = cancer slope factor (mg/kg-day)
Risk = incremental lifetime increased cancer risk (10^{-6} to 10^{-4})
FCR_i = fish consumption rate at trophic level *i* (*i* = 2, 3, and 4)
BAF_i = bioaccumulation factor for trophic level *i* (*i* = 2, 3, and 4)

As updated National Health and Nutrition Examination Survey (NHANES) data became available, EPA decided that the input values used to calculate the criteria in 2002 were no longer relevant. Therefore, the recommended criteria needed to be updated. In 2015, EPA updated its national recommended water quality criteria for human health for 94 chemical pollutants using the 2000 methodology. The updated criteria reflected the latest scientific information and EPA policies, including updated fish consumption rates, body weight, and drinking water intake (US EPA, 2015).

The updated body weight value of 80 kg is based on the mean body weight for adults ages 21 and older from 1999 to 2006. The updated drinking water value of 2.4 liters per day is based on the per capita estimate of community water ingestion at the 90th percentile for adults ages 21 and older from 2003 to 2006. The updated fish consumption rate of 22 grams per day represents the 90th percentile consumption rate of fish and shellfish from inland and nearshore waters for adults ages 21 and older from 2003 to 2010.

EPA also used updated values for parameter specific reference dose, relative source contribution, cancer slope factors, and bioaccumulation factors (replacing the bioconcentration factors used in the previous criteria derivation) whenever available. The reference dose (RfD), relative source contribution (RSC), and cancer slope factor (CSF) values result from studies conducted to determine how dangerous a substance is and are used to determine the toxicity endpoints. The Hazard Quotient (HQ) is the toxicity endpoint for non-carcinogens and is determined based on the parameter-specific RfD and RSC, which accounts for non-water sources of exposure. A hazard quotient less than one means the RfD has not been exceeded. A hazard quotient greater than one means the RfD has been exceeded. A reference dose is an estimate of daily exposure over a lifetime without adverse effects. Criteria are derived by setting the hazard quotient equal to one.

Incremental life-time increased cancer risk is the toxicity endpoint for carcinogens. It is determined based on the parameter-specific cancer slope factor (CSF) and represents one's risk of developing cancer (in addition to background cancer risk) if exposed to the criterion level over a lifetime. The cancer risks discussed here refer to the increased risk of cancer for each individual pollutant and are in addition to the background cancer risk people are exposed to in everyday life. The target incremental lifetime increased cancer risk is determined by the agency responsible for risk management decisions and is expressed as a fraction or ratio (ex: 10^{-6} = 1 in 1 million, 10^{-5} = 1 in 100,000, 10^{-4} = 1 in 10,000).

2.0 Deterministic Method Used to Derive Human Health Criteria

EPA's approach of assigning a single value (from a range of possible values) to each parameter is referred to as the deterministic method. The deterministic risk assessment method calculates the criteria based on the risk to individuals weighing 80 kg who consume 22 grams of fish per day and drink 2.4 liters of water per day. The resulting criteria protects individuals with these exact exposure variable values from an incremental life-time increased cancer risk at the target risk level of one in one million. Using this approach, it is impossible to determine what percentage of the population is protected by the criteria. The risk to individuals whose body weight, fish consumption rate, and water ingestion rate differ from those point estimates is unclear. It does not account for variability among the population and has raised concerns for compounded conservatism, which results from using upper bound percentiles for multiple inputs. This can result in criteria values that are unnecessarily overprotective leading to misallocation of limited resources.

EPA's human health criteria recommendations included "water + organism" criteria to protect human health from exposure via drinking water and fish consumption, as well as "organism only" criteria to protect human health from exposure via consumption of fish only. Georgia's current water quality standards list one criterion value for each pollutant based on EPA's 2002 organism only criteria recommendations. Table 1 compares Georgia's current criteria for 82 pollutants in 391-3-6-.03 (5)(e)(iv) with EPA's 2015 criteria recommendations.

Table 1. Difference Between the 2015 EPA Proposed Human Health Criteria and Georgia's Current Human Health Criteria

Chemical Name	Current Georgia WQS (µg/L)	EPA 2015 AWQC (µg/L)		% difference current vs EPA 2015	
		Water + Organism	Organism Only	Water + Organism	Organism Only
1,1,2,2-Tetrachloroethane	4	0.2	3	-95%	-25%
1,1,2-Trichloroethane	16	0.55	8.9	-97%	-44%
1,1-Dichloroethylene	7100	300	20000	-96%	182%
1,2,4-Trichlorobenzene	70	0.071	0.076	-100%	-100%
1,2-Dichlorobenzene	1300	1000	3000	-23%	131%
1,2-Dichloroethane	37	9.9	650	-73%	1657%
1,2-Dichloropropane	15	0.9	31	-94%	107%
1,2-Diphenylhydrazine	0.2	0.03	0.2	-85%	0%
1,3-Dichlorobenzene	960	7	10	-99%	-99%
1,3-Dichloropropene	21	0.27	12	-99%	-43%
1,4-Dichlorobenzene	190	300	900	58%	374%
2,4,6-Trichlorophenol	2.4	1.5	2.8	-38%	17%
2,4-Dichlorophenol	290	10	60	-97%	-79%
2,4-Dimethylphenol	850	100	3000	-88%	253%
2,4-Dinitrophenol	5300	10	300	-100%	-94%
2,4-Dinitrotoluene	3.4	0.049	1.7	-99%	-50%
2-Chloronaphthalene	1600	800	1000	-50%	-38%

Chemical Name	Current Georgia WQS (µg/L)	EPA 2015 AWQC (µg/L)		% difference current vs EPA 2015	
		Water + Organism	Organism Only	Water + Organism	Organism Only
2-Chlorophenol	150	30	800	-80%	433%
2-Methyl-4,6-Dinitrophenol	280	2	30	-99%	-89%
3,3'-Dichlorobenzidine	0.028	0.049	0.15	75%	436%
Acenaphthene	990	70	90	-93%	-91%
Acrolein	9.3	3	400	-68%	4201%
Acrylonitrile	0.25	0.061	7	-76%	2700%
Aldrin	0.00005	0.00000077	0.00000077	-98%	-98%
alpha-Endosulfan	89	20	30	-78%	-66%
alpha-Hexachlorocyclohexane (HCH)	0.0049	0.00036	0.00039	-93%	-92%
Anthracene	40000	300	400	-99%	-99%
Benzene	51	0.58	16	-99%	-69%
Benzidine	0.0002	0.00014	0.011	-30%	5400%
Benzo(a)anthracene	0.018	0.0012	0.0013	-93%	-93%
Benzo(a)pyrene	0.018	0.00012	0.00013	-99%	-99%
Benzo(b)fluoranthene	0.018	0.0012	0.0013	-93%	-93%
Benzo(k)fluoranthene	0.018	0.012	0.013	-33%	-28%
beta-Endosulfan	89	20	40	-78%	-55%
beta-Hexachlorocyclohexane (HCH)	0.17	0.008	0.014	-95%	-92%
Bis(2-Chloro-1-Methylethyl) Ether	65000	200	4000	-100%	-94%
Bis(2-Chloroethyl) Ether	0.53	0.03	2.2	-94%	315%
Bis(2-Ethylhexyl) Phthalate	2.2	0.32	0.37	-85%	-83%
Bromoform	140	7	120	-95%	-14%
Butylbenzyl Phthalate	1900	0.1	0.1	-100%	-100%
Carbon Tetrachloride	1.6	0.4	5	-75%	213%
Chlordane	0.00081	0.00031	0.00032	-62%	-60%
Chlorobenzene	1600	100	800	-94%	-50%
Chlorodibromomethane	13	0.8	21	-94%	62%
Chloroform	470	60	2000	-87%	326%
Chrysene	0.018	0.12	0.13	567%	622%
Dibenzo(a,h)anthracene	0.018	0.00012	0.00013	-99%	-99%
Dichlorobromomethane	17	0.95	27	-94%	59%
Dieldrin	0.000054	0.0000012	0.0000012	-98%	-98%
Diethyl Phthalate	44000	600	600	-99%	-99%
Dimethyl Phthalate	1100000	2000	2000	-100%	-100%
Di-n-Butyl Phthalate	4500	20	30	-100%	-99%
Endosulfan Sulfate	89	20	40	-78%	-55%
Endrin	0.06	0.03	0.03	-50%	-50%

Chemical Name	Current Georgia WQS (µg/L)	EPA 2015 AWQC (µg/L)		% difference current vs EPA 2015	
		Water + Organism	Organism Only	Water + Organism	Organism Only
Endrin Aldehyde	0.3	1	1	233%	233%
Ethylbenzene	2100	68	130	-97%	-94%
Fluoranthene	140	20	20	-86%	-86%
Fluorene	5300	50	70	-99%	-99%
gamma-Hexachlorocyclohexane (HCH)	1.8	4.2	4.4	133%	144%
Heptachlor	0.000079	0.0000059	0.0000059	-93%	-93%
Heptachlor Epoxide	0.000039	0.000032	0.000032	-18%	-18%
Hexachlorobenzene	0.00029	0.000079	0.000079	-73%	-73%
Hexachlorobutadiene	18	0.01	0.01	-100%	-100%
Hexachlorocyclopentadiene	1100	4	4	-100%	-100%
Hexachloroethane	3.3	0.1	0.1	-97%	-97%
Indeno(1,2,3-cd)pyrene	0.018	0.0012	0.0013	-93%	-93%
Isophorone	960	34	1800	-96%	88%
Methoxychlor	0.03	0.02	0.02	-33%	-33%
Methyl Bromide	1500	100	10000	-93%	567%
Methylene Chloride	590	20	1000	-97%	69%
Nitrobenzene	690	10	600	-99%	-13%
p,p'-Dichlorodiphenyldichloroethane (DDD)	0.00031	0.00012	0.00012	-61%	-61%
p,p'-Dichlorodiphenyldichloroethylene (DDE)	0.00022	0.000018	0.000018	-92%	-92%
p,p'-Dichlorodiphenyltrichloroethane (DDT)	0.00022	0.00003	0.00003	-86%	-86%
Pentachlorophenol	3	0.03	0.04	-99%	-99%
Phenol	857000	4000	300000	-100%	-65%
Pyrene	4000	20	30	-100%	-99%
Tetrachloroethylene (Perchloroethylene)	3.3	10	29	203%	779%
Toluene	5980	57	520	-99%	-91%
Toxaphene	0.00028	0.0007	0.00071	150%	154%
trans-1,2-Dichloroethylene (DCE)	10000	100	4000	-99%	-60%
Trichloroethylene (TCE)	30	0.6	7	-98%	-77%
Vinyl Chloride	2.4	0.022	1.6	-99%	-33%

An example is Georgia’s current criterion of 4 µg/L for 1,1,2,2 - Tetrachloroethane. This is the highest concentration of this pollutant in the water column that is assumed to be safe if fish from these waters are consumed over a person's lifetime. EPA's updated inputs yielded a criterion value of 0.2 µg/L for water plus organism, meaning this concentration is assumed safe for lifetime consumption of fish and ingestion of drinking water sourced from that water body. For waterbodies that are not used as drinking water sources, EPA's recommended criterion is 3 µg/L. EPA's water plus organism criterion is 95% more stringent than Georgia's current criteria and their organism only criterion is 25% more stringent.

The comparison from Table 1 is summarized in the following figures. Figure 1 displays EPA's 2015 organism only criteria compared to the 82 pollutants in Georgia's current water quality standards (WQS). Figure 2 displays EPA's 2015 water + organism criteria compared to the 82 pollutants in our current WQS. The shades of green represent the percentage of pollutants for which EPA's updated criteria are less stringent (higher criteria value) than Georgia's current WQS. The shades of red/orange represent the percentage of pollutants for which EPA's updated criteria are more stringent (lower criteria value) than Georgia's current WQS.

Georgia's current WQS are based on organism only exposure pathway, so EPA's updated water + organism criteria for most parameters are much more stringent because they account for an additional exposure route.

The goal of EPA's 2015 criteria update was not specifically to derive more stringent (or less stringent) criteria, but to use the best available data to ensure the criteria are adequately protective of the target population(s).

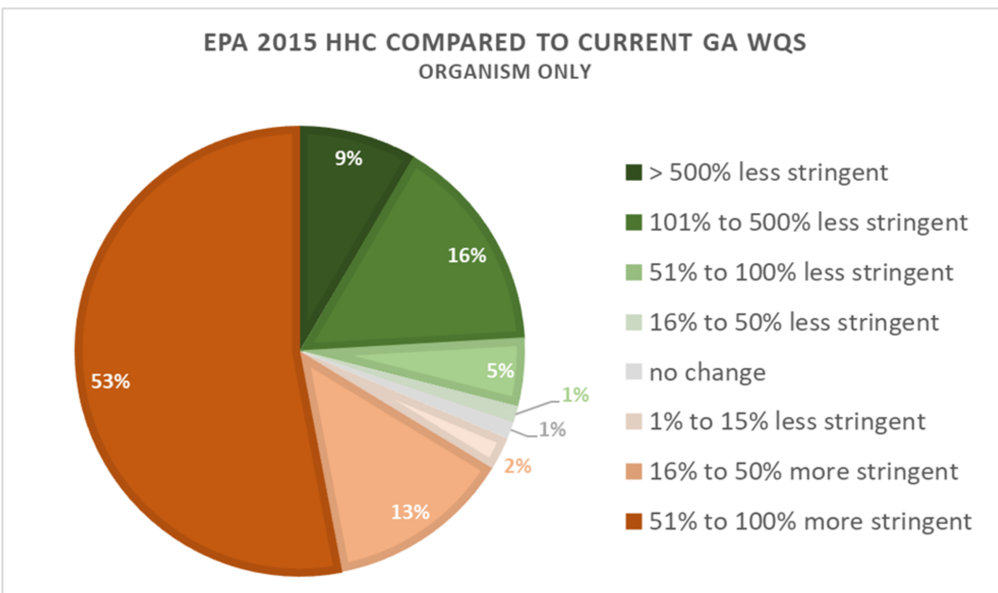

Figure 1. Comparison of EPA's Organism Only Criteria to EPD's Current Human Health Criteria for 82 Pollutants

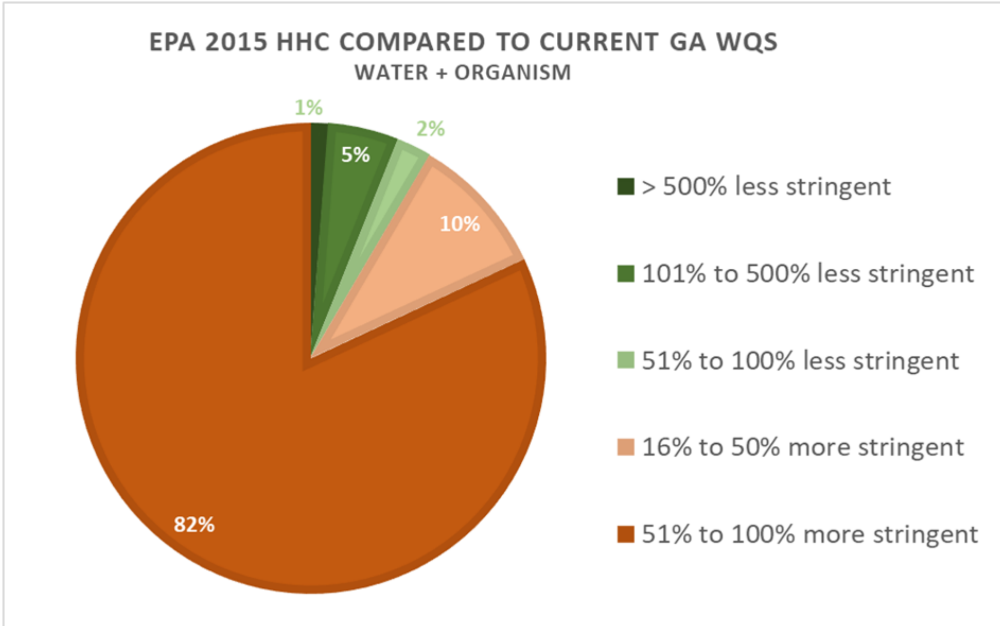

Figure 2*2*. Comparison of EPA's Water + Organism Criteria to EPD's Current Human Health Criteria for 82 Pollutants

3.0 Probabilistic Method Used to Derive Human Health Criteria

Concerns regarding compounded conservatism in EPA's recommended criteria led Georgia to evaluate alternate criteria derivation options. Compounded conservatism results from using upper bound percentiles for multiple inputs, as summarized in Section 2. This can result in criteria values that are unnecessarily overprotective. Additionally, using single point values for inputs does not adequately reflect the variability among the target population. It is also impossible to determine the percentage of the population to which the target risk applies.

Georgia EPD began researching the use of probabilistic risk assessment (PRA) for derivation of human health criteria during the 2019 Triennial Review. Probabilistic risk assessment evaluates risk based on a distribution of data, rather than a single point, for one or more inputs. This allows for transparent risk management decisions by identifying the target population and its level of protection.

3.1 Monte Carlo Analysis

Under the probabilistic approach, Monte Carlo analysis inserts one or more of the exposure variables into the equation as probability distributions. Exposure distributions are treated as random variables, allowing for an evaluation of risk to both the entire population and to higher risk sub-populations. Unlike the deterministic method, Monte Carlo analysis reflects the variability in the target population by calculating various possible outcomes using the whole range of possible input values from the distributions provided. Georgia ran 100,000 various combinations of possible inputs for each of three risk scenarios that will be discussed in Section 3.3.

EPD used a program called @RISK to perform the Monte Carlo analysis (Barnhart et al., 2022). The program allows input of percentile data for each variable. Distributions are then fit to the provided data. This process is explained in greater detail in the next section. The program randomly selects input values from each probability distribution and solves the equation to calculate risk. The outcome of PRA is a distribution rather than a single value and criteria values are selected from the distribution based on risk management decisions selected to protect the target population. For example: the 90th percentile of the population must have an excess lifetime cancer risk (ELCR) equal to or less than $1x10^{-5}$. Selecting the 90th percentile value from the distribution results in criteria protective of 90 % of the population at the selected ECLR.

The equations used to derive the human health criteria require input values specific to each chemical. The @RISK program used the chemical-specific values provided by EPA in the 2015 recommendation. Table 2 displays the cancer slope factor and the reference dose input values used for each pollutant.

Table 2. Cancer Slope Factor and Reference Dose Values by Pollutant

Chemical Name	Chemical-specific Inputs for Human Health Ambient Water Quality Criteria					
	Cancer Slope Factor, CSF (per mg/kg-d)	Reference Dose, RfD (mg/kg-d)	Relative Source Contribution, RSC (-)	Bioaccumulation Factor		
				Trophic Level 2 (L/kg tissue)	Trophic Level 3 (L/kg tissue)	Trophic Level 4 (L/kg tissue)
1,1,1-Trichloroethane	ND	2	0.2	6.9	9	10
1,1,2,2-Tetrachloroethane	0.2	0.02	0.2	5.7	7.4	8.4
1,1,2-Trichloroethane	0.057	0.004	0.2	6	7.8	8.9
1,1-Dichloroethylene	ND	0.05	0.2	2	2.4	2.6
1,2,4-Trichlorobenzene	0.029	0.01	0.2	2800	1500	430
1,2-Dichlorobenzene	ND	0.3	0.2	52	71	82
1,2-Dichloroethane	0.0033	0.078	0.2	1.6	1.8	1.9
1,2-Dichloropropane	0.036	0.0893	0.2	2.9	3.5	3.9
1,2-Diphenylhydrazine	0.8	ND	ND	18	24	27
1,3-Dichlorobenzene	ND	0.002	0.2	31	120	190
1,3-Dichloropropene	0.122	0.025	0.2	2.3	2.7	3
1,4-Dichlorobenzene	ND	0.07	0.2	28	66	84
2,4,6-Trichlorophenol	0.011	0.001	0.2	94	130	150
2,4-Dichlorophenol	ND	0.003	0.2	31	42	48
2,4-Dimethylphenol	ND	0.02	0.2	4.8	6.2	7
2,4-Dinitrophenol	ND	0.002	0.2	4.4	4.4	4.4
2,4-Dinitrotoluene	0.667	0.002	0.2	2.8	3.5	3.9
2-Chloronaphthalene	ND	0.08	0.8	150	210	240
2-Chlorophenol	ND	0.005	0.2	3.8	4.8	5.4
2-Methyl-4,6-Dinitrophenol	ND	0.0003	0.2	6.8	8.9	10
3,3'-Dichlorobenzidine	0.45	ND	ND	44	60	69
3-Methyl-4-Chlorophenol	ND	0.1	0.2	25	34	39
Acenaphthene	ND	0.06	0.2	510	510	510
Acrolein	ND	0.0005	0.2	1	1	1
Acrylonitrile	0.54	0.04	ND	1	1	1
Aldrin	17	0.00003	0.2	18000	310000	650000
alpha-Endosulfan	ND	0.006	0.2	130	180	200
alpha-Hexachlorocyclohexane (HCH)	6.3	0.008	0.2	1700	1400	1500
Anthracene	ND	0.3	0.2	610	610	610
Benzene High	0.015	0.0005	0.2	3.6	4.5	5
Benzene Low	0.055	0.0005	0.2	3.6	4.5	5
Benzidine	230	0.003	0.2	1.4	1.6	1.7
Benzo(a)anthracene	0.73	ND	ND	3900	3900	3900
Benzo(a)pyrene	7.3	ND	ND	3900	3900	3900
Benzo(b)fluoranthene	0.73	ND	ND	3900	3900	3900

Chemical Name	Chemical-specific Inputs for Human Health Ambient Water Quality Criteria					
	Cancer Slope Factor, CSF (per mg/kg-d)	Reference Dose, RfD (mg/kg-d)	Relative Source Contribution, RSC (-)	Bioaccumulation Factor		
				Trophic Level 2 (L/kg tissue)	Trophic Level 3 (L/kg tissue)	Trophic Level 4 (L/kg tissue)
Benzo(k)fluoranthene	0.073	ND	ND	3900	3900	3900
beta-Endosulfan	ND	0.006	0.2	80	110	130
beta-Hexachlorocyclohexane (HCH)	1.8	ND	ND	110	160	180
Bis(2-Chloro-1-Methylethyl) Ether	ND	0.04	0.2	6.7	8.8	10
Bis(2-Chloroethyl) Ether	1.1	ND	ND	1.4	1.6	1.7
Bis(2-Ethylhexyl) Phthalate	0.014	0.06	0.2	710	710	710
Bromoform	0.0045	0.03	0.2	5.8	7.5	8.5
Butylbenzyl Phthalate	0.0019	1.3	0.2	19000	19000	19000
Carbon Tetrachloride	0.07	0.004	0.2	9.3	12	14
Chlordane	0.35	0.0005	0.2	5300	44000	60000
Chlorobenzene	ND	0.02	0.2	14	19	22
Chlorodibromomethane	0.04	0.02	0.2	3.7	4.8	5.3
Chloroform	ND	0.01	0.2	2.8	3.4	3.8
Chlorophenoxy Herbicide (2,4,5-TP) [Silvex]	ND	0.008	0.8	58	58	58
Chlorophenoxy Herbicide (2,4-D)	ND	0.21	0.2	13	13	13
Chrysene	0.0073	ND	ND	3900	3900	3900
Cyanide	ND	0.0006	0.2	1	1	1
Dibenzo(a,h)anthracene	7.3	ND	ND	3900	3900	3900
Dichlorobromomethane	0.034	0.003	0.2	3.4	4.3	4.8
Dieldrin	16	0.00005	0.2	14000	210000	410000
Diethyl Phthalate	ND	0.8	0.2	920	920	920
Dimethyl Phthalate	ND	10	0.2	4000	4000	4000
Di-n-Butyl Phthalate	ND	0.1	0.2	2900	2900	2900
Endosulfan Sulfate	ND	0.006	0.2	88	120	140
Endrin	ND	0.0003	0.8	4600	36000	46000
Endrin Aldehyde	ND	0.0003	0.8	440	920	850
Ethylbenzene	ND	0.022	0.2	100	140	160
Fluoranthene	ND	0.04	0.2	1500	1500	1500
Fluorene	ND	0.04	0.2	230	450	710
gamma-Hexachlorocyclohexane (HCH)	ND	0.0047	0.5	1200	2400	2500
Heptachlor	4.1	0.0001	0.2	12000	180000	330000
Heptachlor Epoxide	5.5	0.000013	0.2	4000	28000	35000
Hexachlorobenzene	1.02	0.0008	0.2	18000	46000	90000
Hexachlorobutadiene	0.04	0.0003	0.2	23000	2800	1100
Hexachlorocyclopentadiene	ND	0.006	0.2	620	1500	1300

Chemical Name	Chemical-specific Inputs for Human Health Ambient Water Quality Criteria					
	Cancer Slope Factor, CSF (per mg/kg-d)	Reference Dose, RfD (mg/kg-d)	Relative Source Contribution, RSC (-)	Bioaccumulation Factor		
				Trophic Level 2 (L/kg tissue)	Trophic Level 3 (L/kg tissue)	Trophic Level 4 (L/kg tissue)
Hexachloroethane	0.04	0.0007	0.2	1200	280	600
Indeno(1,2,3-cd)pyrene	0.73	ND	ND	3900	3900	3900
Isophorone	0.00095	0.2	0.2	1.9	2.2	2.4
Methoxychlor	ND	0.00002	0.8	1400	4800	4400
Methyl Bromide	ND	0.02	0.2	1.2	1.3	1.4
Methylene Chloride	0.002	0.006	0.2	1.4	1.5	1.6
Nitrobenzene	ND	0.002	0.2	2.3	2.8	3.1
p,p'-Dichlorodiphenyldichloroethane (DDD)	0.24	0.0005	0.2	33000	140000	240000
p,p'-Dichlorodiphenyldichloroethylene (DDE)	0.167	0.0005	0.2	270000	1100000	3100000
p,p'-Dichlorodiphenyltrichloroethane (DDT)	0.34	0.0005	0.2	35000	240000	1100000
Pentachlorophenol	0.4	0.005	0.2	44	290	520
Phenol	ND	0.6	0.2	1.5	1.7	1.9
Pyrene	ND	0.03	0.2	860	860	860
Tetrachloroethylene (Perchloroethylene)	0.0021	0.006	0.2	49	66	76
Toluene	ND	0.0097	0.2	11	15	17
Toxaphene	1.1	0.00035	0.2	1700	6600	6300
trans-1,2-Dichloroethylene (DCE)	ND	0.02	0.2	3.3	4.2	4.7
Trichloroethylene (TCE)	0.05	0.0005	0.2	8.7	12	13
Vinyl Chloride	1.5	0.003	0.2	1.4	1.6	1.7

ND – No data
Source: https://www.epa.gov/sites/default/files/2016-03/documents/summary_of_inputs_final_revised_3.24.16.pdf

3.2 Probabilistic Distributions

3.2.1 Body Weight

For the body weight variable, Georgia used the same survey data from which EPA selected the mean body weight of 80 kg for adults 21 and over. In Table 8-3 of EPA's Exposure Factors Handbook, Chapter 8 – Body Weight Studies, mean and percentile body weights for males and females combined derived from NHANES (1999 – 2006) are provided for multiple age groups. A copy of this table is provided in Table A-1 in Appendix A (US EPA, 2011). While the table provides percentile body weight data for adults 21 to <30 years, 30 to <40 years, 40 to <50 years, 50 to <60 years, 60 to <70 years, 70 to <80 years, and over 80 years, EPA did not provide the mean and percentile body weight data for all adults 21 and over. EPD used the data provided to calculate weighted mean and percentile body weights for all adults 21 and over, weighted by the number of individuals in each age group. Table 3 lists the resulting percentile body weight data determined for adults 21 and over. The calculations for the weighted mean and percentile body weights can be found in Tables A-2 and A-3 of Appendix A.

Table 3. Body Weight Percentiles for Adults 21 and Over

Body Weight (kg) Adults 21+	Percentile
52.9	0.05
57.2	0.1
60.4	0.15
66.0	0.25
77.6	0.5
91.0	0.75
99.5	0.85
105.6	0.9
115.4	0.95

The percentile values were input into the @RISK tool and the distribution fitting feature was used to fit possible distributions to the provided data. @RISK provides multiple distribution options and ranks them in order of root mean square error (RMS error), which is a performance indicator used to measure the average magnitude of error of a model. For the body weight data, an Inverse Gauss distribution was the best fit with an RMS error of 0.0020, followed by a lognormal distribution with an RMS error of 0.0021. In most cases, the distribution with the lowest RMS error was selected for the analysis, but in this case, EPD chose to use the lognormal distribution. The definition of the log-normal distribution holds that its skewness is essentially zero, whereas the inverse Gaussian distribution is slightly right (positively) skewed. These differences are so small, and their RMS errors are so similar, that EPD concluded there is no appreciable benefit for using the more complex inverse Gaussian compared with the more common and widely used log-normal distribution. EPD's intention was to select a distribution that more people would be familiar with in hopes of not increasing confusion in an already complex topic. Figures 3 and 4 compare fit results of both distributions to the body weight data provided. The table appearing in the pane on the left of these figures displays distribution types ranked in order of RMS error. Figure 3 is comparing the input data (blue) with the resulting probability curve for both an Inverse Gauss distribution (red) and a Lognormal distribution (green). The red curve of the Inverse Gauss distribution is barely visible because it is nearly identical to the green curve of the Lognormal distribution. The statistics table on the right provides statistics for the input data and the fit distributions. Statistics for the lognormal distribution were not visible in the pane in figure 3 and are displayed in the statistics pane of Figure 4, which displays the input data (blue) with the probability curve of the Lognormal distribution (red) only. The fitted parameters for the lognormal distribution are displayed in Table 4. A table comparing fit results for 17 different distribution types can be found in Table B-1 of Appendix B.

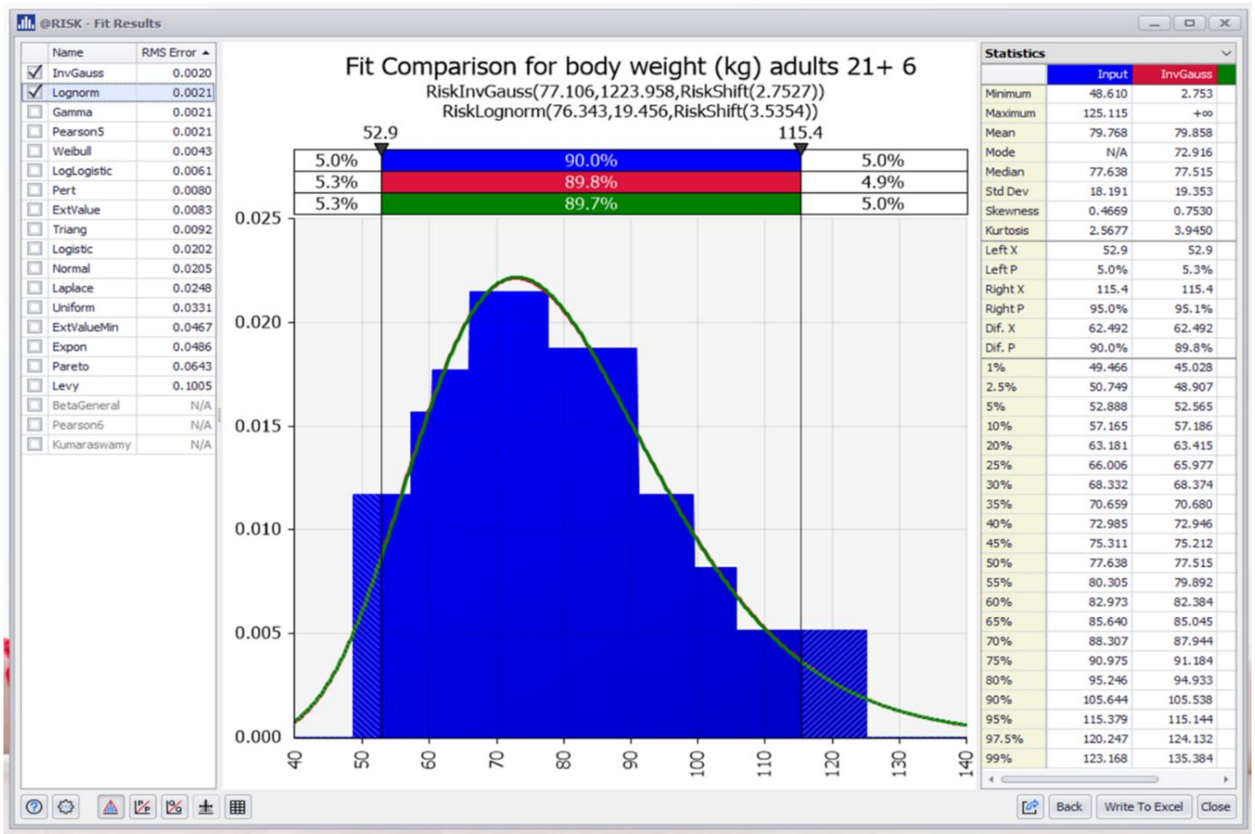

Figure 3. Fit Comparison of Body Weight Inputs to Resulting Inverse Gause and Lognormal Distributions

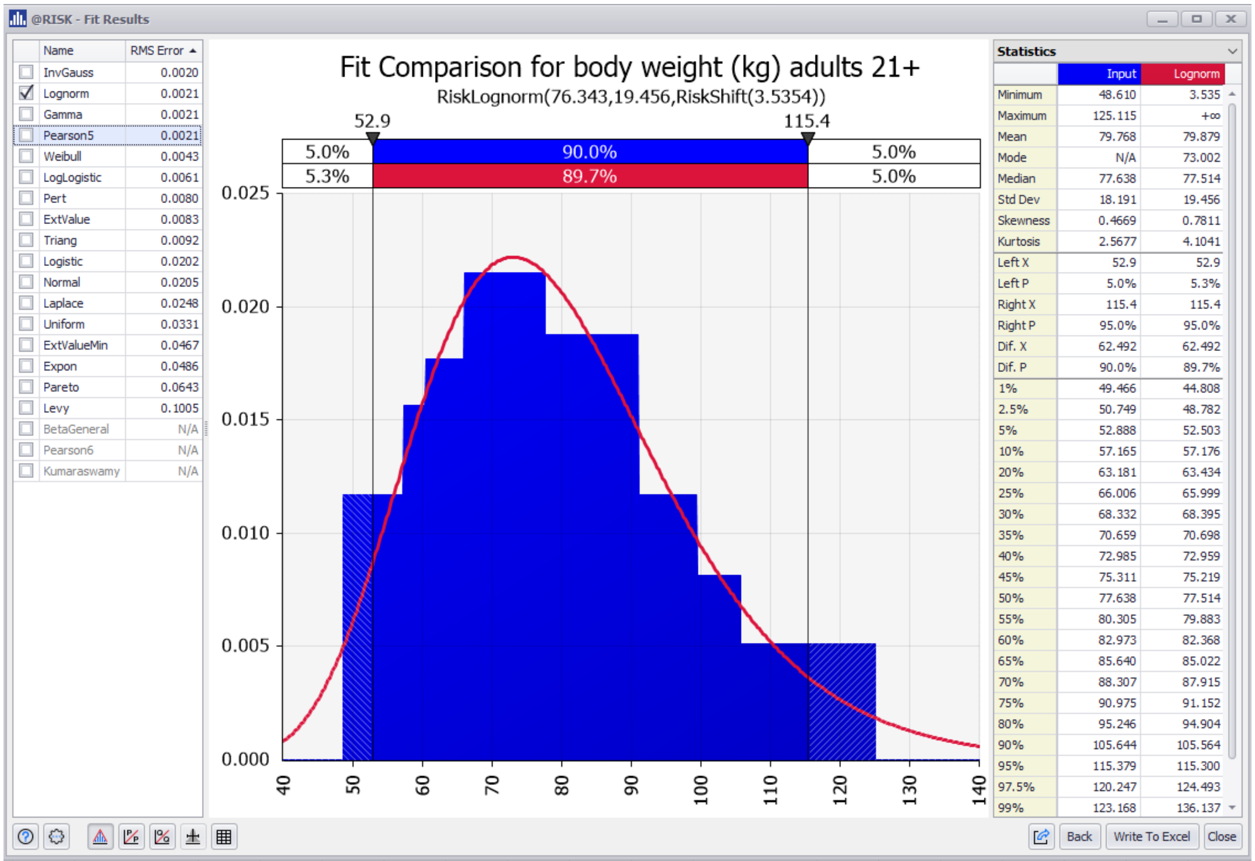

Figure 4. Fit comparison of body weight inputs to resulting Lognormal distribution.

Table 4. Fitted Parameters for Lognormal Body Weight Distribution

Distribution	
Function	Lognorm ...
Parameters	Standard ...
μ	76.343
σ	19.456
Shift	3.5354

3.2.2 Drinking Water Ingestion Rate

The drinking water consumption rate data distribution used in EPD's analysis is from Table 3-23 from Chapter 3 of EPA's Exposure Factors Handbook (US EPA, 2011), which lists per capita estimates of combined direct and indirect community water ingestion rates for the 25th, 50th, 75th, 90th, 95th, and 99th percentiles for adults 21 and older based on 2003 to 2006 NHANES data. A copy of this table is included as Appendix C. This is the same dataset from which EPA selected the 90th percentile value of 2.4 liters per day used in the 2015 criteria recommendation. The drinking water ingestion rate data was used in the calculation of the "water + organism" criteria only. Table 5 displays the inputs used to generate the drinking water distribution used in our analysis. Figure 5 displays the resulting probability distribution. Figure 6 displays a comparison of distribution fitting tool inputs to the resulting distribution. Figure 6 also includes a comparison of RMS error for various distribution types. The BetaGeneral distribution was selected for the drinking water ingestion rate because it had the lowest RMS error. The fitted parameters for the BetaGeneral distribution are given in Table 6. A table comparing fit results for 17 different distribution types can be found in Table B-2 of Appendix B.

Table 5. Water Ingestion Percentiles for Adults 21+

Water Ingestion for Adults 21+ (mL/day)	Percentile
227	0.25
787	0.50
1,577	0.75
2,414	0.90
2,958	0.95
4,405	0.99

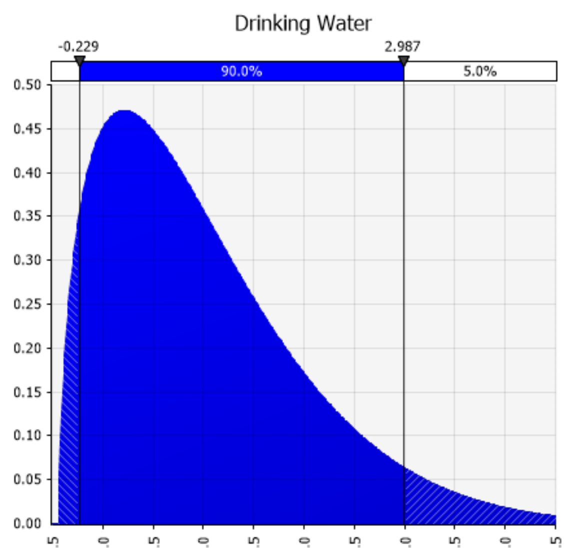

Figure 5. Probability Distribution of Drinking Water Ingestion Rates for Adults 21+

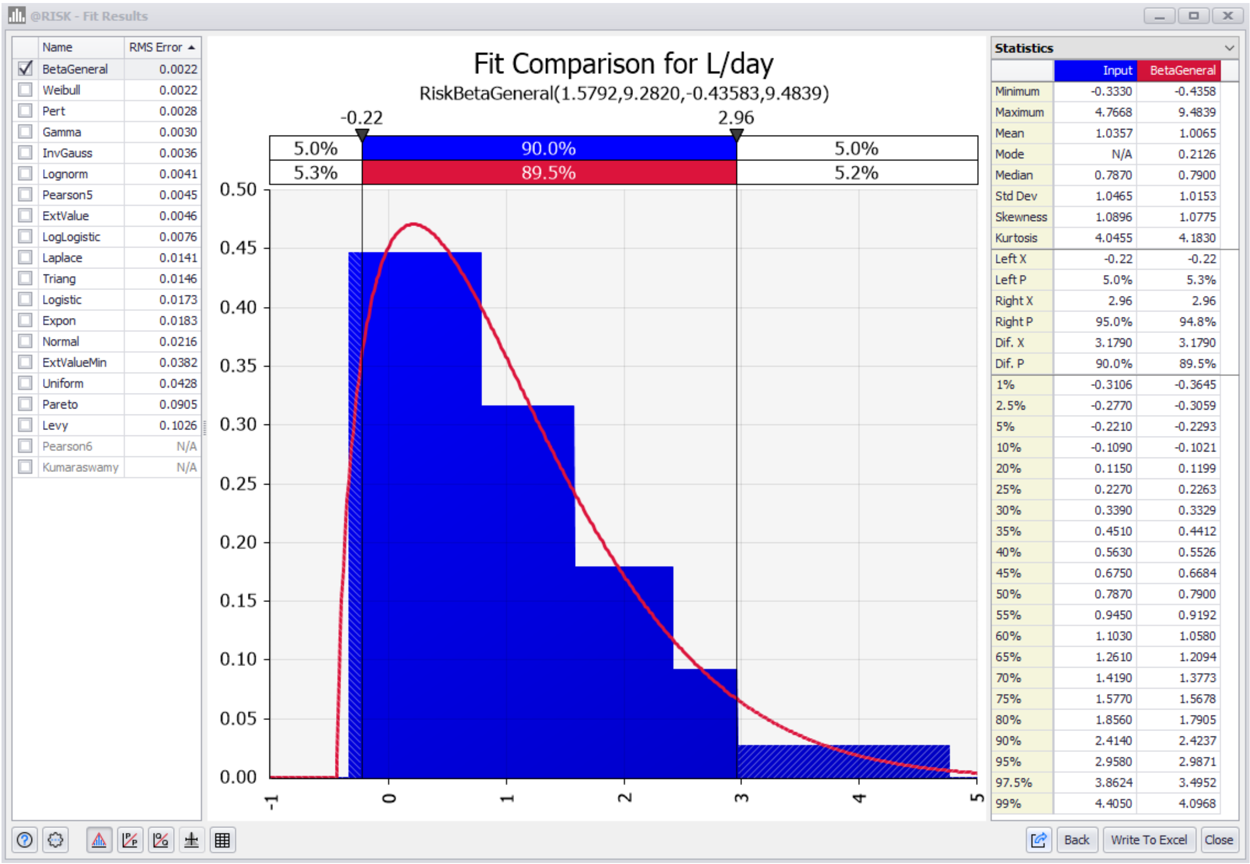

Figure 6. Fit Comparison of Drinking Water Ingestion Inputs to Resulting BetaGeneral Distribution

Table 6. Fitted Parameters for BetaGeneral Drinking Water Ingestion Distribution

Distribution	
Function	BetaGeneral
Parameters	Standard
a1	1.5792
a2	9.282
Min	-0.43583
Max	9.4839

3.2.3 Fish Consumption Rate Distribution

Fish consumption rate (FCR) data from EPA's *Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations* (US EPA, 2014) were used as input data in the @RISK tool to generate the fish consumption probability distributions. This report used NHANES data from 2003 to 2010 and is the same report used by EPA to select the 22 g/day 90th percentile national fish consumption rate. This report provided regional fish consumption rate data for specific subpopulations and two of the geographical subpopulations are applicable to Georgia.

EPD used a population based weighted combination of the Inland South and Atlantic Coast data sets, which listed fish consumption rates for the 50th, 75th, 90th, 95th, 97th, and 99th percentiles.

The Atlantic Coast region applies to Georgia's coastal counties and the Inland South region applies to the remaining non-coastal counties in Georgia. Coastal regions were defined as including counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Table 7 displays fish consumption rate estimates by geographic area given in EPA's Estimated Fish Consumption Rates report (US EPA, 2014). These percentiles were used in the distribution fitting tool in @RISK to generate data distributions for both the Inland South and Atlantic Coast regions, which are shown in Figure 7. Figures 8 and 9 display a comparison of distribution fitting tool inputs to the resulting distribution. Both figures include a comparison of RMS errors for various distribution types. The Lognormal distribution was selected for the Inland South fish consumption rate because it had the lowest RMS error. The Lognormal distribution was selected for the Atlantic South fish consumption rate as well, despite having a slightly greater RMS error than the Weibull distribution. Table 8 provides the Fitted Parameters for Lognormal Inland South Fish Consumption Rate Distribution. A table comparing fit results for 17 different distributions can be found in Table B-3 of Appendix B. The fit comparison in Figure 9 shows that the Lognormal distribution (green) is a more consistent fit than the Weibull distribution (red). Table 9 provides the Fitted Parameters for Lognormal Atlantic Coast Fish Consumption Rate Distribution. A table comparing fit results for 17 different distribution types can be found in Table B-4 of Appendix B.

Table 7. Fish Consumption Estimated by Geographic Regions

Freshwater + Estuarine Finfish and Shellfish	Percentiles (95% CI)					
	50th	75th	90th	95th	97th	99th
Adults (≥21 yrs)	5.0 (4.1,6.0)	11.4 (9.9,13.1)	22.0 (19.1,25.4)	31.8 (26.9,37.6)	40.2 (33.3,48.5)	61.1 (48.7,76.6)
Region[1]						
Northeast	5.8 (4.4,7.6)	12.6 (9.9,16.0)	23.1 (18.3,29.2)	32.3 (25.4,41.0)	39.9 (31.0,51.5)	58.5 (44.2,77.5)
Midwest	3.2 (2.5,4.2)	7.4 (6.0,9.0)	14.3 (11.8,17.4)	20.8 (16.9,25.7)	26.3 (21.0,33.0)	41.1 (31.3,54.0)
South	6.4 (4.7,8.5)	14.0 (11.3,17.4)	26.3 (21.6,32.0)	37.5 (30.5,46.1)	46.7 (37.6,58.1)	69.0 (54.3,87.7)
West	5.1 (3.9,6.6)	11.4 (8.8,14.8)	22.4 (16.8,29.8)	32.7 (23.9,44.9)	42.0 (30.0,58.8)	66.9 (45.4,98.5)
Coastal Status[2]						
Noncoastal	4.2 (3.4,5.2)	9.8 (8.2,11.6)	19.0 (15.8,22.9)	27.4 (22.3,33.8)	34.6 (27.7,43.3)	52.8 (40.7,68.4)
Coastal	6.6 (5.1,8.4)	14.4 (11.8,17.5)	27.1 (22.4,32.8)	38.6 (31.4,47.6)	48.4 (38.6,60.6)	72.7 (55.6,95.0)
Coastal/Inland Region[1,2]						
Pacific	6.3 (4.4,9.0)	14.0 (10.1,19.5)	27.3 (19.3,38.6)	39.7 (27.4,57.7)	51.2 (34.3,76.3)	81.2 (51.6,127.8)
Atlantic	8.3 (6.4,10.7)	17.0 (13.9,20.8)	30.8 (25.3,37.5)	42.8 (34.5,53.0)	52.3 (41.8,65.5)	75.8 (58.8,97.7)
Gulf of Mexico	7.3 (4.8,11.1)	15.7 (11.7,21.1)	28.6 (22.5,36.4)	40.1 (31.8,50.6)	50.3 (39.3,64.4)	73.8 (55.6,97.8)
Great Lakes	4.0 (3.1,5.1)	8.7 (7.1,10.7)	16.5 (13.5,20.2)	23.6 (19.1,29.1)	29.4 (23.5,36.8)	44.5 (34.1,57.9)
Inland Northeast	5.0 (3.5,7.3)	11.3 (8.0,16.0)	21.0 (14.8,29.7)	29.5 (20.6,42.2)	36.5 (25.3,52.8)	54.4 (36.7,80.6)
Inland Midwest	3.0 (2.3,4.0)	6.9 (5.5,8.7)	13.5 (10.8,17.0)	19.8 (15.5,25.2)	25.1 (19.4,32.6)	39.5 (29.1,53.5)
Inland South	5.3 (4.0,7.1)	12.0 (9.7,14.9)	22.8 (18.6,27.9)	32.7 (26.2,40.7)	40.9 (32.3,51.7)	61.0 (46.7,79.7)
Inland West	4.3 (3.3,5.4)	9.4 (7.4,12.1)	18.2 (13.7,24.3)	26.3 (19.1,36.1)	33.3 (23.8,46.7)	51.6 (35.5,74.9)

[1] U.S. regions are the U.S. Census Bureau regions. Midwest = OH, MI, IN, WI, IL, MO, IA, MN, SD, ND, NE, KS. Northeast = PA, NY, NJ, CT, RI, MA, NH, VT, ME. South = DE, MD, DC, VA, WV, KY, TN, NC, SC, GA, AL, MS, FL, LA, AR, OK, TX. West = NM, CO, WY, MT, ID, UT, AZ, NV, CA, OR, WA, AK, HI.

[2] Coastal regions include counties bordering the 3 coasts (Pacific, Atlantic, and Gulf of Mexico) and the Great Lakes and estuaries and bays. Additionally, any county that did not directly border a coast, but the central point was within 25 miles of a coast was defined as coastal. The inland regions are the remaining counties in each of the 4 Census Regions.

Usual fish consumption rate estimates in grams per day raw weight, edible portion. Freshwater + estuarine fish, adults, 21 years and older, by geographic area.

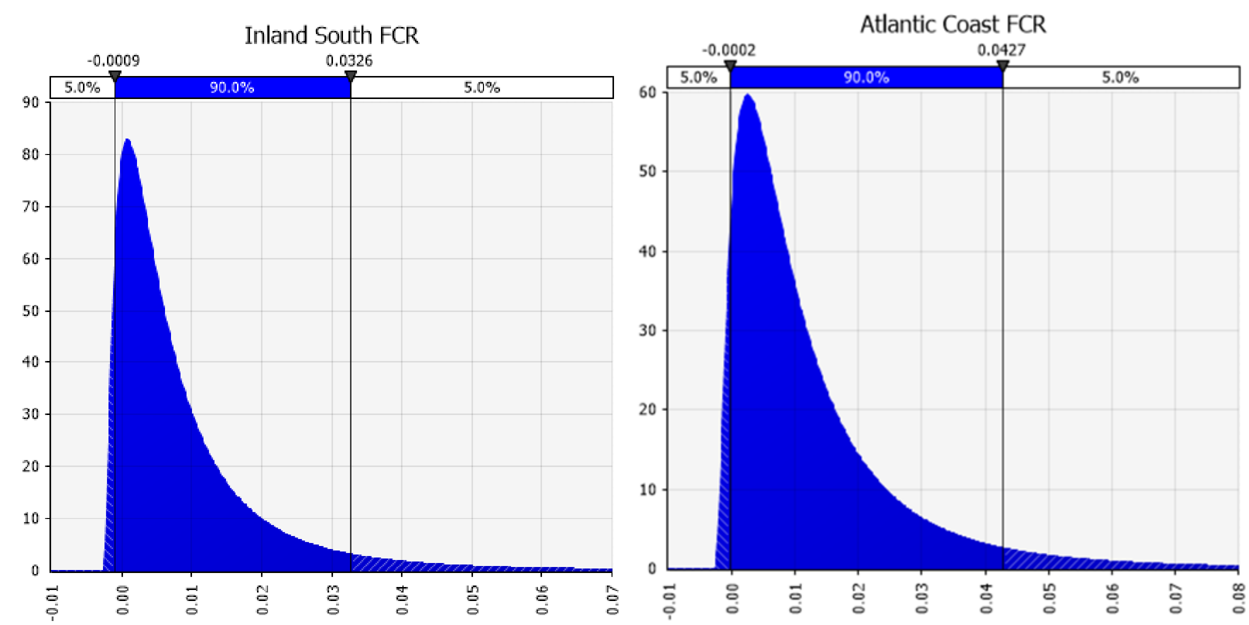

Figure 7. Probability Distributions of Fish Consumption Rates in the Inland South and Atlantic Coast Regions

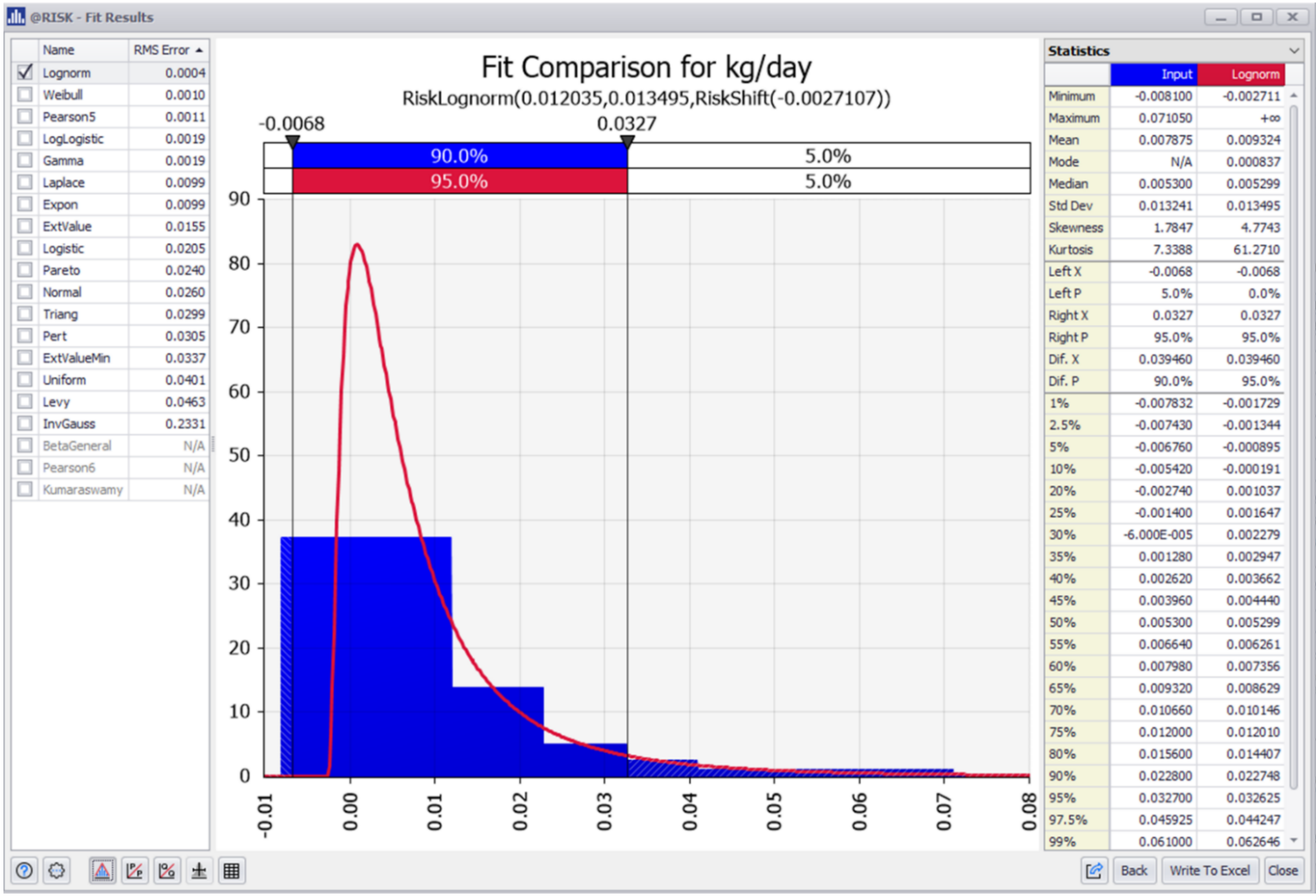

Figure 8. Fit Comparison of Inland South Fish Consumption Rate Inputs to Resulting Lognormal Distribution.

Table 8. Fitted Parameters for Lognormal Inland South Fish Consumption Rate Distribution

Distribution	
Function	Lognorm
Parameters	Standard
μ	0.012035
σ	0.013495
Shift	-0.0027107

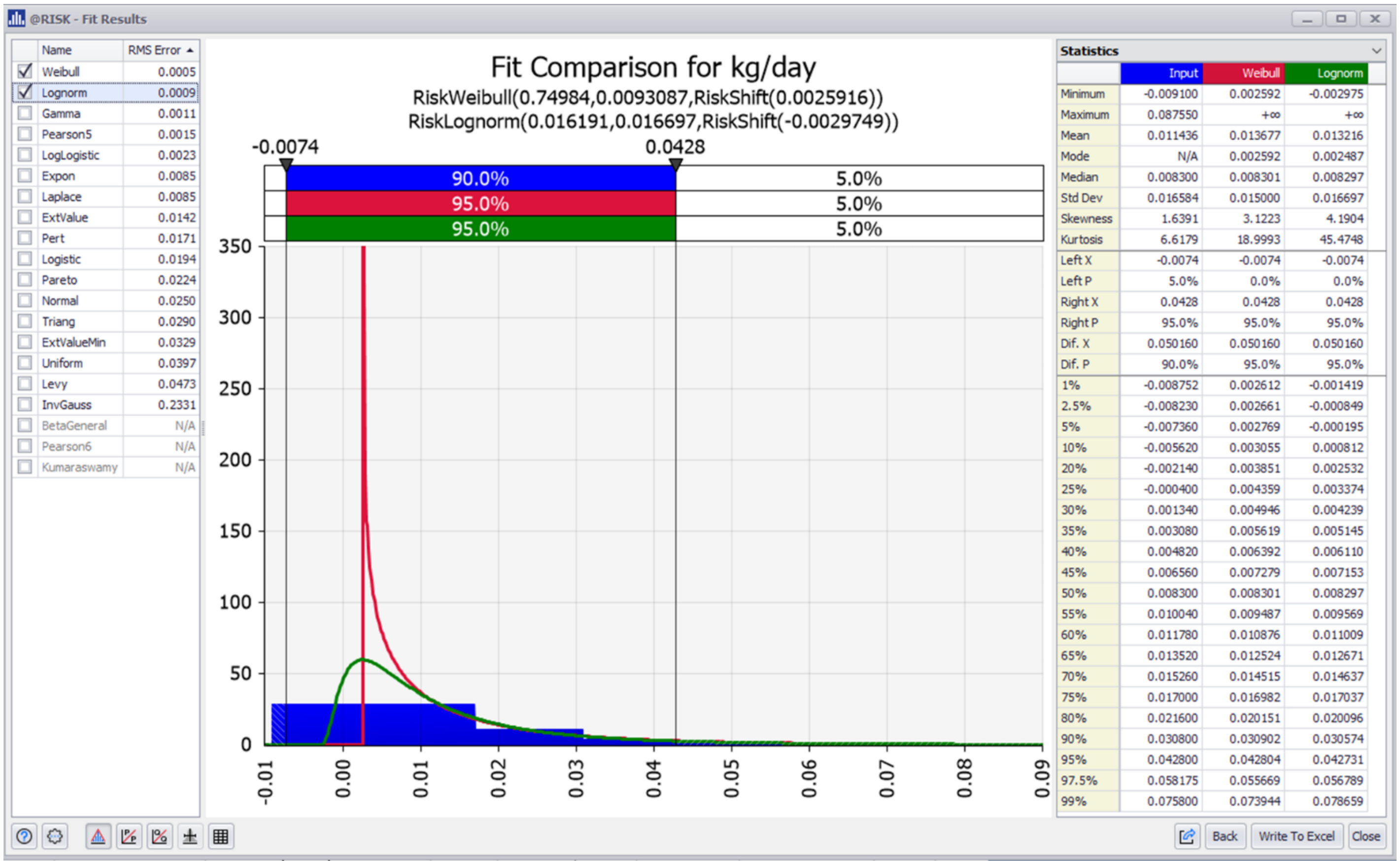

Figure 9. Fit Comparison of Atlantic Coast Fish Consumption Rate Inputs to Resulting Lognormal Distribution.

Table 9. Fitted Parameters for Lognormal Atlantic Coast Fish Consumption Rate Distribution

Function	Lognorm
Parameters	Standard
µ	0.016191
σ	0.016697
Shift	-0.0029749

The portion of Georgia's population residing in each of these two regions was calculated using 2020 census data. Camden, Glynn, McIntosh, Liberty, and Chatham counties are considered coastal counties because they border the coast. Bryan county does not directly border the coast but has a center point within 25 miles of the coast. Figure 10 shows the coastal counties highlighted in blue, as well as the second line counties and their center points (red diamonds).

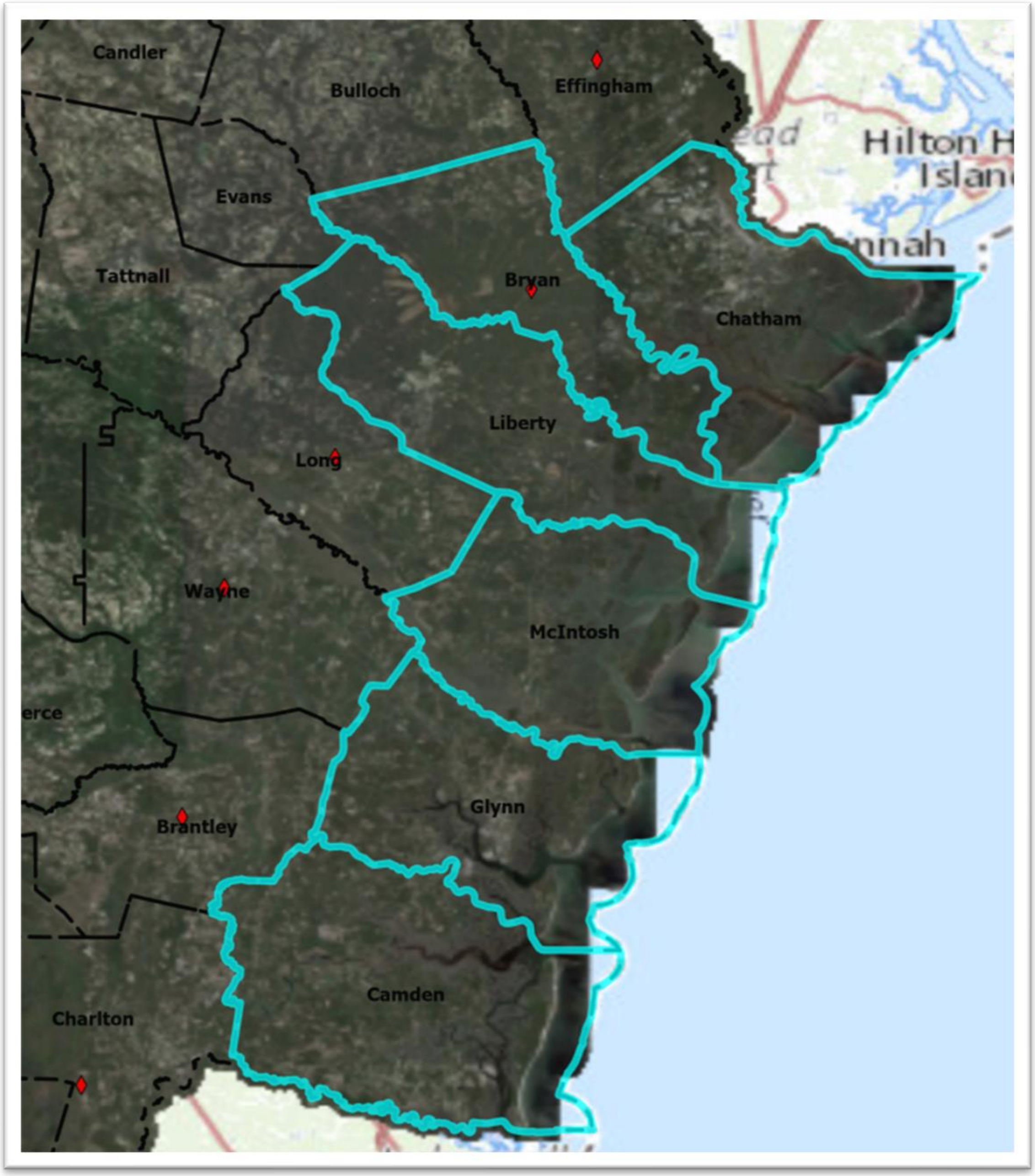

Figure 10. Coastal Counties

Table 10 provides the 2020 census data used to assign the population percentages to either the Atlantic Coast region or the Inland South Region.

Table 10. 2020 Georgia County Population

County	Total Population	Total population 18 years and over	Total population under 18 years	Inland vs Coastal
Georgia	10,711,908	8,220,274	2,491,634	
Appling County, Georgia	18,444	13,958	4,486	Inland
Atkinson County, Georgia	8,286	6,129	2,157	Inland
Bacon County, Georgia	11,140	8,310	2,830	Inland
Baker County, Georgia	2,876	2,275	601	Inland
Baldwin County, Georgia	43,799	35,732	8,067	Inland
Banks County, Georgia	18,035	13,900	4,135	Inland
Barrow County, Georgia	83,505	62,195	21,310	Inland
Bartow County, Georgia	108,901	83,570	25,331	Inland
Ben Hill County, Georgia	17,194	13,165	4,029	Inland
Berrien County, Georgia	18,160	13,690	4,470	Inland
Bibb County, Georgia	157,346	120,902	36,444	Inland
Bleckley County, Georgia	12,583	9,613	2,970	Inland
Brantley County, Georgia	18,021	13,692	4,329	Inland
Brooks County, Georgia	16,301	12,747	3,554	Inland
Bryan County, Georgia	44,738	31,828	12,910	Coastal
Bulloch County, Georgia	81,099	64,494	16,605	Inland
Burke County, Georgia	24,596	18,778	5,818	Inland
Butts County, Georgia	25,434	20,360	5,074	Inland
Calhoun County, Georgia	5,573	4,687	886	Inland
Camden County, Georgia	54,768	41,808	12,960	Coastal
Candler County, Georgia	10,981	8,241	2,740	Inland
Carroll County, Georgia	119,148	90,996	28,152	Inland
Catoosa County, Georgia	67,872	52,448	15,424	Inland
Charlton County, Georgia	12,518	10,135	2,383	Inland
Chatham County, Georgia	295,291	234,715	60,576	Coastal
Chattahoochee County, Georgia	9,565	7,199	2,366	Inland
Chattooga County, Georgia	24,965	19,416	5,549	Inland
Cherokee County, Georgia	266,620	202,928	63,692	Inland
Clarke County, Georgia	128,671	106,830	21,841	Inland
Clay County, Georgia	2,848	2,246	602	Inland
Clayton County, Georgia	297,595	220,578	77,017	Inland
Clinch County, Georgia	6,749	5,034	1,715	Inland
Cobb County, Georgia	766,149	591,848	174,301	Inland
Coffee County, Georgia	43,092	32,419	10,673	Inland
Colquitt County, Georgia	45,898	34,193	11,705	Inland
Columbia County, Georgia	156,010	114,823	41,187	Inland

County	Total Population	Total population 18 years and over	Total population under 18 years	Inland vs Coastal
Cook County, Georgia	17,229	12,938	4,291	Inland
Coweta County, Georgia	146,158	111,155	35,003	Inland
Crawford County, Georgia	12,130	9,606	2,524	Inland
Crisp County, Georgia	20,128	15,570	4,558	Inland
Dade County, Georgia	16,251	12,987	3,264	Inland
Dawson County, Georgia	26,798	21,441	5,357	Inland
Decatur County, Georgia	29,367	22,443	6,924	Inland
DeKalb County, Georgia	764,382	595,276	169,106	Inland
Dodge County, Georgia	19,925	15,709	4,216	Inland
Dooly County, Georgia	11,208	9,187	2,021	Inland
Dougherty County, Georgia	85,790	66,266	19,524	Inland
Douglas County, Georgia	144,237	108,428	35,809	Inland
Early County, Georgia	10,854	8,315	2,539	Inland
Echols County, Georgia	3,697	2,709	988	Inland
Effingham County, Georgia	64,769	47,295	17,474	Inland
Elbert County, Georgia	19,637	15,493	4,144	Inland
Emanuel County, Georgia	22,768	17,320	5,448	Inland
Evans County, Georgia	10,774	8,127	2,647	Inland
Fannin County, Georgia	25,319	21,188	4,131	Inland
Fayette County, Georgia	119,194	91,798	27,396	Inland
Floyd County, Georgia	98,584	76,295	22,289	Inland
Forsyth County, Georgia	251,283	181,193	70,090	Inland
Franklin County, Georgia	23,424	18,307	5,117	Inland
Fulton County, Georgia	1,066,710	847,182	219,528	Inland
Gilmer County, Georgia	31,353	25,417	5,936	Inland
Glascock County, Georgia	2,884	2,236	648	Inland
Glynn County, Georgia	84,499	66,468	18,031	Coastal
Gordon County, Georgia	57,544	43,500	14,044	Inland
Grady County, Georgia	26,236	19,962	6,274	Inland
Greene County, Georgia	18,915	15,358	3,557	Inland
Gwinnett County, Georgia	957,062	709,484	247,578	Inland
Habersham County, Georgia	46,031	35,878	10,153	Inland
Hall County, Georgia	203,136	153,844	49,292	Inland
Hancock County, Georgia	8,735	7,487	1,248	Inland
Haralson County, Georgia	29,919	22,854	7,065	Inland
Harris County, Georgia	34,668	26,799	7,869	Inland
Hart County, Georgia	25,828	20,436	5,392	Inland
Heard County, Georgia	11,412	8,698	2,714	Inland

County	Total Population	Total population 18 years and over	Total population under 18 years	Inland vs Coastal
Henry County, Georgia	240,712	179,973	60,739	Inland
Houston County, Georgia	163,633	122,118	41,515	Inland
Irwin County, Georgia	9,666	7,547	2,119	Inland
Jackson County, Georgia	75,907	56,451	19,456	Inland
Jasper County, Georgia	14,588	11,118	3,470	Inland
Jeff Davis County, Georgia	14,779	10,856	3,923	Inland
Jefferson County, Georgia	15,709	12,301	3,408	Inland
Jenkins County, Georgia	8,674	7,005	1,669	Inland
Johnson County, Georgia	9,189	7,474	1,715	Inland
Jones County, Georgia	28,347	21,575	6,772	Inland
Lamar County, Georgia	18,500	14,541	3,959	Inland
Lanier County, Georgia	9,877	7,326	2,551	Inland
Laurens County, Georgia	49,570	37,734	11,836	Inland
Lee County, Georgia	33,163	24,676	8,487	Inland
Liberty County, Georgia	65,256	48,014	17,242	Coastal
Lincoln County, Georgia	7,690	6,270	1,420	Inland
Long County, Georgia	16,168	11,234	4,934	Inland
Lowndes County, Georgia	118,251	89,031	29,220	Inland
Lumpkin County, Georgia	33,488	27,689	5,799	Inland
McDuffie County, Georgia	21,632	16,615	5,017	Inland
McIntosh County, Georgia	10,975	9,040	1,935	Coastal
Macon County, Georgia	12,082	9,938	2,144	Inland
Madison County, Georgia	30,120	23,112	7,008	Inland
Marion County, Georgia	7,498	5,854	1,644	Inland
Meriwether County, Georgia	20,613	16,526	4,087	Inland
Miller County, Georgia	6,000	4,749	1,251	Inland
Mitchell County, Georgia	21,755	17,065	4,690	Inland
Monroe County, Georgia	27,957	21,913	6,044	Inland
Montgomery County, Georgia	8,610	6,792	1,818	Inland
Morgan County, Georgia	20,097	15,574	4,523	Inland
Murray County, Georgia	39,973	30,210	9,763	Inland
Muscogee County, Georgia	206,922	157,052	49,870	Inland
Newton County, Georgia	112,483	84,748	27,735	Inland
Oconee County, Georgia	41,799	30,221	11,578	Inland
Oglethorpe County, Georgia	14,825	11,639	3,186	Inland
Paulding County, Georgia	168,661	123,998	44,663	Inland
Peach County, Georgia	27,981	22,111	5,870	Inland
Pickens County, Georgia	33,216	26,799	6,417	Inland

County	Total Population	Total population 18 years and over	Total population under 18 years	Inland vs Coastal
Pierce County, Georgia	19,716	14,899	4,817	Inland
Pike County, Georgia	18,889	14,337	4,552	Inland
Polk County, Georgia	42,853	32,238	10,615	Inland
Pulaski County, Georgia	9,855	8,012	1,843	Inland
Putnam County, Georgia	22,047	17,847	4,200	Inland
Quitman County, Georgia	2,235	1,870	365	Inland
Rabun County, Georgia	16,883	13,767	3,116	Inland
Randolph County, Georgia	6,425	4,977	1,448	Inland
Richmond County, Georgia	206,607	160,899	45,708	Inland
Rockdale County, Georgia	93,570	71,503	22,067	Inland
Schley County, Georgia	4,547	3,328	1,219	Inland
Screven County, Georgia	14,067	10,893	3,174	Inland
Seminole County, Georgia	9,147	7,277	1,870	Inland
Spalding County, Georgia	67,306	52,123	15,183	Inland
Stephens County, Georgia	26,784	21,163	5,621	Inland
Stewart County, Georgia	5,314	4,617	697	Inland
Sumter County, Georgia	29,616	23,036	6,580	Inland
Talbot County, Georgia	5,733	4,783	950	Inland
Taliaferro County, Georgia	1,559	1,289	270	Inland
Tattnall County, Georgia	22,842	17,654	5,188	Inland
Taylor County, Georgia	7,816	6,120	1,696	Inland
Telfair County, Georgia	12,477	10,190	2,287	Inland
Terrell County, Georgia	9,185	7,204	1,981	Inland
Thomas County, Georgia	45,798	35,037	10,761	Inland
Tift County, Georgia	41,344	31,224	10,120	Inland
Toombs County, Georgia	27,030	20,261	6,769	Inland
Towns County, Georgia	12,493	10,923	1,570	Inland
Treutlen County, Georgia	6,406	4,934	1,472	Inland
Troup County, Georgia	69,426	52,581	16,845	Inland
Turner County, Georgia	9,006	6,960	2,046	Inland
Twiggs County, Georgia	8,022	6,589	1,433	Inland
Union County, Georgia	24,632	20,808	3,824	Inland
Upson County, Georgia	27,700	21,711	5,989	Inland
Walker County, Georgia	67,654	52,794	14,860	Inland
Walton County, Georgia	96,673	73,098	23,575	Inland
Ware County, Georgia	36,251	27,788	8,463	Inland
Warren County, Georgia	5,215	4,159	1,056	Inland
Washington County, Georgia	19,988	15,709	4,279	Inland

County	Total Population	Total population 18 years and over	Total population under 18 years	Inland vs Coastal
Wayne County, Georgia	30,144	23,105	7,039	Inland
Webster County, Georgia	2,348	1,847	501	Inland
Wheeler County, Georgia	7,471	6,217	1,254	Inland
White County, Georgia	28,003	22,482	5,521	Inland
Whitfield County, Georgia	102,864	76,262	26,602	Inland
Wilcox County, Georgia	8,766	7,218	1,548	Inland
Wilkes County, Georgia	9,565	7,651	1,914	Inland
Wilkinson County, Georgia	8,877	7,026	1,851	Inland
Worth County, Georgia	20,784	16,444	4,340	Inland

Table 11 provides the percentages of Georgia's population living in each region.

Table 11. Georgia Population Located in Inland and Coastal Counties

Inland Total Population	Inland Total Population 18 & Over	Inland Total Population under 18	Coastal Total Population	Coastal Total Population 18 & Over	Coastal Total Population under 18
10,156,381	7,788,401	2,367,980	555,527	431,873	123,654
95%	95%	95%	5%	5%	5%

Table 12 lists the fish consumption rates by region for each trophic level given in EPA's *Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations* (US EPA, 2014). These data were used in the @RISK tool to input data distributions for trophic level-specific fish consumption rates.

Table 12. Fish Consumption Rates (FCRs) by Trophic Level

Total

Inland South		
g/day	kg/day	Percentile
5.3	0.0053	0.5
12.0	0.0120	0.75
22.8	0.0228	0.9
32.7	0.0327	0.95
40.9	0.0409	0.97
61.0	0.0610	0.99
FCR Dist	0.013847863	
Weight	0.95	

Atlantic Coast		
g/day	kg/day	Percentile
8.3	0.0083	0.5
17.0	0.0170	0.75
30.8	0.0308	0.9
42.8	0.0428	0.95
52.3	0.0523	0.97
75.8	0.0758	0.99
FCR Dist	0.0041087	
Weight	0.05	

Trophic Level 2

Inland South		
g/day	kg/day	Percentile
0.6	0.0006	0.25
1.6	0.0016	0.5
3.7	0.0037	0.75
7.6	0.0076	0.9
11.3	0.0113	0.95
14.6	0.0146	0.97
23.1	0.0231	0.99
FCR Dist	0.015257547	
Weight	0.95	

Atlantic Coast		
g/day	kg/day	Percentile
1.1	0.0011	0.25
2.8	0.0028	0.5
6.2	0.0062	0.75
11.6	0.0116	0.9
16.4	0.0164	0.95
20.4	0.0204	0.97
29.6	0.0296	0.99
FCR Dist	0.0038765	
Weight	0.05	

Trophic Level 3

Inland South		
g/day	kg/day	Percentile
0.9	0.0009	0.25
2.2	0.0022	0.5
4.7	0.0047	0.75
8.6	0.0086	0.9
11.9	0.0119	0.95
14.7	0.0147	0.97
21.4	0.0214	0.99
FCR Dist	0.000560786	
Weight	0.95	

Atlantic Coast		
g/day	kg/day	Percentile
1.6	0.0016	0.25
3.6	0.0036	0.5
7.1	0.0071	0.75
12.3	0.0123	0.9
16.6	0.0166	0.95
20.1	0.0201	0.97
28.5	0.0285	0.99
FCR Dist	0.003998	
Weight	0.05	

Trophic Level 4

Inland South		
g/day	kg/day	Percentile
0.2	0.0002	0.25
0.7	0.0007	0.5
2.3	0.0023	0.75
6.1	0.0061	0.9
10.9	0.0109	0.95
15.8	0.0158	0.97
32.5	0.0325	0.99
FCR Dist	0.089507192	
Weight	0.95	

Atlantic Coast		
g/day	kg/day	Percentile
0.2	0.0002	0.25
0.8	0.0008	0.5
2.2	0.0022	0.75
5.8	0.0058	0.9
10.2	0.0102	0.95
14.7	0.0147	0.97
28.8	0.0288	0.99
FCR Dist	0.0030589	
Weight	0.05	

A random number generator was used to select which probability distribution would be used for each iteration. A number between 0 and 1 was generated for each iteration. If the number generated was 0.95 or below, the simulation would select values from the Inland South probability distributions for the fish consumption rate variables for that iteration. If the number generated was greater than 0.95, fish consumption values from the Atlantic Coast distributions were used.

3.3 @RISK

Once the relevant data distributions were identified and input into @RISK, the tool was used to run a naïve Monte Carlo simulation in which the program randomly selected input values from each probability distribution. Each group of selections was an iteration. For Georgia's probabilistic risk assessment of the human health criteria, 100,000 Monte Carlo draws were used; that is, 100,000 different combinations of input values were used for each simulation. This resulted in a distribution of risk rather than a single value. The final criteria value from a simulation was selected based on pre-determined risk target inputs to protect the target population.

3.3.1 Risk Levels

The probabilistic method allows EPD to model the range of possible input variables that represent the population as a whole. This covers the range of risk that would be associated with varying fish consumption, varying water consumption, and varying body weight. It also allows EPD to ensure the appropriate level of protection for select subgroups of the population and to evaluate criteria based on a range of risk taking by the public. While Georgia does not have federally recognized tribes, EPA guidance states that subsistence fishers that consume more fish than the majority of the population must be protected at a risk level of 10^{-4} (1 in 10,000) (EPA 2000).

In addition, Georgia's fish consumption guidelines, which are protective of the portion of the population that regularly consumes fish caught in Georgia waters, are based on a risk level of 10^{-4}. EPD's goal in using probabilistic risk assessment is to evaluate the risk to various portions of the population and select the criteria that applies the appropriate level of protection to both the entire population and to higher risk sub-populations.

For this probabilistic risk assessment criteria derivation process, EPD evaluated three risk scenarios:

> Scenario 1 was set to protect the 50^{th} percentile of the population (median population) at a target risk of one in one million (10^{-6}). In other words, consuming fish from Georgia waters over the course of a lifetime (defined here as 70 years) could increase a person's incremental lifetime cancer risk by 0.000001 and this level of risk applies to 50% of the population.
>
> Scenario 2 was set to protect the 90^{th} percentile of the population at a target risk of one in one hundred thousand (10^{-5}). Consuming fish from Georgia waters over the course of a lifetime (defined here as 70 years) could increase a person's incremental lifetime cancer risk by 0.00001 and this level of risk applies to 10% of the population. The 90^{th} percentile references the portion of the population that are protected from this level of risk, so this increased risk level only applies to the most at-risk 10% of the population.
>
> Scenario 3 was set to protect the 99th percentile of the population at a target risk of one in ten thousand (10^{-4}). Consuming fish from Georgia waters over the course of a lifetime could increase a person's incremental lifetime cancer risk by 0.0001 and this level of risk

applies to 1% of the population. The 99th percentile references the portion of the population that are protected from this level of risk, so this increased risk level only applies to the most at-risk 1% of the population and is intended to specifically protect subsistence fishers that consume fish at a much higher rate than the general population.

It should be noted that these target risk levels are only applicable to pollutants with the cancer endpoint as the limiting effect. Target risk levels refer to the increased incremental lifetime cancer risk for each pollutant.

Pollutants with a noncancerous endpoint as the limiting effect were evaluated with two scenarios, in which hazard quotient (HQ) values were required to be less than or equal to 1. First, HQ=1 was applied to the 90th percentile (scenario 2) as the target population for criteria derivation. In addition, HQ=1 was also evaluated at the 50th percentile target population (scenario 1) for comparison purposes.

3.3.2 Criteria Selection

@RISK ran a Monte Carlo simulation for each risk scenario described above. Each simulation consisted of 100,000 draws of inputs. For each scenario, the results included values for both “water + organism” and “organism only” criteria. Depending on the toxicity endpoints of the pollutant, criteria results were displayed based on either cancer risk, non-cancer hazard quotient, or both. The most stringent water + organism result of the three scenarios was selected as the final value for the water + organism criteria for each pollutant, and the most stringent organism only result of the three scenarios was selected as the final value for the organism only criteria for each pollutant. For pollutants with both carcinogenic and noncarcinogenic properties, separate results were calculated, and the more stringent value was selected as the final criteria value. Table 13 displays the results from all scenarios, with the final criteria value for each pollutant highlighted in yellow. Table 14 lists the minimum scenario and limiting effect for each pollutant. Inputs and results for each simulation are archived in EPD’s electronic files and are available upon request.

The EPD’s risk management policy is to derive criteria that are protective of the 50th percentile of the population at a target risk of one in one million, the 90th percentile of the population at one in one hundred thousand, and the 99th percentile of the population (or the most at risk group) at a target risk of one in ten thousand. Selecting the lowest value from the results of all three scenarios ensures that the resulting criteria are protective of all three for cancerous effects.

Scenario 1 yielded the most stringent (lowest) criteria result for pollutants where cancer was the limiting effect. Scenario 1 protects the 50th percentile of the population at a target risk of one in one million. However, because this was the lowest criteria value of all three scenarios, this value is also protective of the 90th percentile at a target risk of one in one hundred thousand and of the 99th percentile at a target risk of one in ten thousand.

For pollutants where the non-cancerous endpoint was the limiting effect, all had scenario 2 for the most stringent (lowest) criteria result. Toxicity endpoints for noncarcinogenic pollutants were derived using a non-linear hazard quotient instead of a target risk, and therefore it is not possible to express the risk in the same way as it is for cancerous pollutants. Because criteria for noncarcinogenic compounds are derived by setting the hazard quotient equal to one, the only difference between scenarios 1 and 2 is the percentile of the population the criteria are set to protect. Naturally, the criteria set to protect the 90th percentile of the population in scenario 2 are more stringent than the criteria set to protect the 50th percentile of the population in scenario 1. The important thing to consider in comparing all effects of all scenarios is that for pollutants that display both cancerous and noncancerous effects, the resulting criteria is protective of all effects across all scenarios. Therefore, the risk management policy for the non-cancerous effect is to select the 90th percentile of the population.

Table 13. Comparison of the Criteria for the Various Risk Scenarios

Summary of Final Probabilistic AWQC	Scenario 1				Scenario 2				Scenario 3	
	Target Risk = 0.000001, Hzd = 1, %ile = 0.5				Target Risk = 0.00001, Hzd = 1, %ile = 0.9				Target Risk = 0.0001, %ile = 0.99	
Chemical Name	Probabilistic AWQC (mg/L)				Probabilistic AWQC (mg/L)				Probabilistic AWQC (mg/L)	
	Water + Organism		Organism Only		Water + Organism		Organism Only		Water + Organism	Organism Only
	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Cancer Risk
1,1,1-Trichloroethane	NA	3.61E+01	NA	5.35E+02	NA	1.18E+01	NA	1.76E+02	NA	NA
1,1,2,2-Tetrachloroethane	4.59E-04	3.67E-01	8.08E-03	6.46E+00	1.49E-03	1.19E-01	2.66E-02	2.13E+00	8.16E-03	9.48E-02
1,1,2-Trichloroethane	1.60E-03	7.31E-02	2.69E-02	1.22E+00	5.21E-03	2.38E-02	8.85E-02	4.04E-01	2.86E-02	3.15E-01
1,1-Dichloroethylene	NA	9.72E-01	NA	4.91E+01	NA	3.05E-01	NA	1.62E+01	NA	NA
1,2,4-Trichlorobenzene	2.18E-04	1.26E-02	2.39E-04	1.38E-02	7.53E-04	4.37E-03	7.78E-04	4.51E-03	2.99E-03	3.01E-03
1,2-Dichlorobenzene	NA	3.32E+00	NA	1.02E+01	NA	1.34E+00	NA	3.36E+00	NA	NA
1,2-Dichloroethane	2.96E-02	1.53E+00	1.95E+00	1.00E+02	9.26E-02	4.77E-01	6.49E+00	3.34E+01	5.03E-01	2.38E+01
1,2-Dichloropropane	2.66E-03	1.71E+00	9.30E-02	5.98E+01	8.42E-03	5.42E-01	3.07E-01	1.98E+01	4.59E-02	1.11E+00
1,2-Diphenylhydrazine	9.70E-05	NA	6.29E-04	NA	3.45E-04	NA	2.07E-03	NA	1.92E-03	7.39E-03
1,3-Dichlorobenzene	NA	1.84E-02	NA	4.66E-02	NA	7.42E-03	NA	1.38E-02	NA	NA
1,3-Dichloropropene	7.94E-04	4.84E-01	3.53E-02	2.15E+01	2.49E-03	1.52E-01	1.17E-01	7.12E+00	1.36E-02	4.22E-01
1,4-Dichlorobenzene	NA	8.28E-01	NA	2.89E+00	NA	3.25E-01	NA	9.08E-01	NA	NA
2,4,6-Trichlorophenol	3.80E-03	8.35E-03	8.48E-03	1.87E-02	1.60E-02	3.53E-03	2.79E-02	6.14E-03	7.88E-02	9.83E-02
2,4-Dichlorophenol	NA	4.02E-02	NA	1.73E-01	NA	1.52E-02	NA	5.68E-02	NA	NA
2,4-Dimethylphenol	NA	3.72E-01	NA	7.71E+00	NA	1.20E-01	NA	2.54E+00	NA	NA
2,4-Dinitrophenol	NA	3.79E-02	NA	1.31E+00	NA	1.21E-02	NA	2.95E-01	NA	NA
2,4-Dinitrotoluene	1.44E-04	3.84E-02	5.08E-03	1.36E+00	4.55E-04	1.21E-02	1.68E-02	4.47E-01	2.48E-03	6.04E-02
2-Chloronaphthalene	NA	2.05E+00	NA	3.72E+00	NA	8.69E-01	NA	1.22E+00	NA	NA
2-Chlorophenol	NA	9.44E-02	NA	2.47E+00	NA	3.01E-02	NA	8.17E-01	NA	NA
2-Methyl-4,6-Dinitrophenol	NA	5.42E-03	NA	8.10E-02	NA	1.78E-03	NA	2.67E-02	NA	NA
3,3'-Dichlorobenzidine	1.32E-04	NA	4.48E-04	NA	5.21E-04	NA	1.47E-03	NA	2.86E-03	5.20E-03
3-Methyl-4-Chlorophenol	NA	1.42E+00	NA	7.11E+00	NA	5.27E-01	NA	2.34E+00	NA	NA
Acenaphthene	NA	2.40E-01	NA	3.39E-01	NA	6.93E-02	NA	7.63E-02	NA	NA
Acrolein	NA	9.88E-03	NA	1.44E+00	NA	3.07E-03	NA	3.24E-01	NA	NA
Acrylonitrile	1.83E-04	NA	2.67E-02	NA	5.68E-04	NA	6.00E-02	NA	3.07E-03	2.12E-01
Aldrin	2.73E-09	2.78E-07	2.73E-09	2.78E-07	7.13E-09	7.28E-08	7.13E-09	7.28E-08	1.85E-08	1.85E-08
alpha-Endosulfan	NA	4.22E-02	NA	8.16E-02	NA	1.80E-02	NA	2.69E-02	NA	NA

Summary of Final Probabilistic AWQC	Scenario 1				Scenario 2				Scenario 3	
	Target Risk = 0.000001, Hzd = 1, %ile = 0.5				Target Risk = 0.00001, Hzd = 1, %ile = 0.9				Target Risk = 0.0001, %ile = 0.99	
Chemical Name	Probabilistic AWQC (mg/L)				Probabilistic AWQC (mg/L)				Probabilistic AWQC (mg/L)	
	Water + Organism		Organism Only		Water + Organism		Organism Only		Water + Organism	Organism Only
	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Cancer Risk
alpha-Hexachlorocyclohexane (HCH)	1.06E-06	1.07E-02	1.17E-06	1.18E-02	3.77E-06	3.80E-03	3.90E-06	3.93E-03	1.43E-05	1.45E-05
Anthracene	NA	1.06E+00	NA	1.42E+00	NA	2.94E-01	NA	3.19E-01	NA	NA
Benzene High	6.32E-03	9.48E-03	1.76E-01	2.64E-01	2.01E-02	3.02E-03	5.80E-01	8.71E-02	1.10E-01	2.09E+00
Benzene Low	1.72E-03	9.48E-03	4.80E-02	2.64E-01	5.49E-03	3.02E-03	1.58E-01	8.71E-02	3.00E-02	5.71E-01
Benzidine	4.26E-07	5.88E-02	3.16E-05	4.36E+00	1.33E-06	1.84E-02	1.05E-04	1.45E+00	7.22E-06	3.85E-04
Benzo(a)anthracene	4.82E-06	NA	5.06E-06	NA	1.12E-05	NA	1.14E-05	NA	4.00E-05	4.02E-05
Benzo(a)pyrene	4.82E-07	NA	5.06E-07	NA	1.12E-06	NA	1.14E-06	NA	4.00E-06	4.02E-06
Benzo(b)fluoranthene	4.82E-06	NA	5.06E-06	NA	1.12E-05	NA	1.14E-05	NA	4.00E-05	4.02E-05
Benzo(k)fluoranthene	4.82E-05	NA	5.06E-05	NA	1.12E-04	NA	1.14E-04	NA	4.00E-04	4.02E-04
beta-Endosulfan	NA	5.44E-02	NA	1.31E-01	NA	2.28E-02	NA	4.31E-02	NA	NA
beta-Hexachlorocyclohexane (HCH)	2.10E-05	NA	4.30E-05	NA	8.92E-05	NA	1.41E-04	NA	4.20E-04	5.01E-04
Bis(2-Chloro-1-Methylethyl) Ether	NA	7.23E-01	NA	1.09E+01	NA	2.37E-01	NA	3.59E+00	NA	NA
Bis(2-Chloroethyl) Ether	8.91E-05	NA	6.61E-03	NA	2.78E-04	NA	2.20E-02	NA	1.51E-03	8.04E-02
Bis(2-Ethylhexyl) Phthalate	1.12E-03	1.89E-01	1.45E-03	2.43E-01	3.05E-03	5.12E-02	3.26E-03	5.48E-02	1.12E-02	1.15E-02
Bromoform	2.04E-02	5.50E-01	3.54E-01	9.55E+00	6.61E-02	1.78E-01	1.17E+00	3.15E+00	3.63E-01	4.16E+00
Butylbenzyl Phthalate	3.95E-04	1.95E-01	3.99E-04	1.97E-01	8.96E-04	4.43E-02	8.98E-04	4.44E-02	3.17E-03	3.17E-03
Carbon Tetrachloride	1.24E-03	6.97E-02	1.41E-02	7.90E-01	4.16E-03	2.33E-02	4.64E-02	2.60E-01	2.29E-02	1.64E-01
Chlordane	1.04E-06	3.63E-05	1.04E-06	3.64E-05	2.98E-06	1.04E-05	2.98E-06	1.04E-05	8.85E-06	8.85E-06
Chlorobenzene	NA	3.25E-01	NA	2.54E+00	NA	1.13E-01	NA	8.35E-01	NA	NA
Chlorodibromomethane	2.36E-03	3.78E-01	6.26E-02	1.00E+01	7.54E-03	1.21E-01	2.07E-01	3.31E+00	4.12E-02	7.42E-01
Chloroform	NA	1.92E-01	NA	6.90E+00	NA	6.07E-02	NA	2.28E+00	NA	NA
Chlorophenoxy Herbicide (2,4,5-TP) [Silvex]	NA	3.84E-01	NA	1.59E+00	NA	1.46E-01	NA	3.58E-01	NA	NA
Chlorophenoxy Herbicide (2,4-D)	NA	3.60E+00	NA	4.65E+01	NA	1.22E+00	NA	1.05E+01	NA	NA
Chrysene	4.82E-04	NA	5.06E-04	NA	1.12E-03	NA	1.14E-03	NA	4.00E-03	4.02E-03

Summary of Final Probabilistic AWQC	Scenario 1				Scenario 2				Scenario 3	
	Target Risk = 0.000001, Hzd = 1, %ile = 0.5				Target Risk = 0.00001, Hzd = 1, %ile = 0.9				Target Risk = 0.0001, %ile = 0.99	
Chemical Name	**Probabilistic AWQC (mg/L)**				**Probabilistic AWQC (mg/L)**				**Probabilistic AWQC (mg/L)**	
	Water + Organism		Organism Only		Water + Organism		Organism Only		Water + Organism	Organism Only
	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Cancer Risk
Cyanide	NA	1.19E-02	NA	1.73E+00	NA	3.68E-03	NA	3.89E-01	NA	NA
Dibenzo(a,h)anthracene	4.82E-07	NA	5.06E-07	NA	1.12E-06	NA	1.14E-06	NA	4.00E-06	4.02E-06
Dichlorobromomethane	2.80E-03	5.70E-02	8.14E-02	1.66E+00	8.89E-03	1.81E-02	2.69E-01	5.48E-01	4.85E-02	9.65E-01
Dieldrin	4.36E-09	6.98E-07	4.37E-09	6.99E-07	1.16E-08	1.86E-07	1.16E-08	1.86E-07	3.07E-08	3.07E-08
Diethyl Phthalate	NA	2.06E+00	NA	2.50E+00	NA	5.35E-01	NA	5.64E-01	NA	NA
Dimethyl Phthalate	NA	6.88E+00	NA	7.20E+00	NA	1.60E+00	NA	1.62E+00	NA	NA
Di-n-Butyl Phthalate	NA	9.31E-02	NA	9.93E-02	NA	2.20E-02	NA	2.24E-02	NA	NA
Endosulfan Sulfate	NA	5.20E-02	NA	1.21E-01	NA	2.19E-02	NA	3.96E-02	NA	NA
Endrin	NA	1.08E-04	NA	1.09E-04	NA	3.13E-05	NA	3.14E-05	NA	NA
Endrin Aldehyde	NA	3.05E-03	NA	3.73E-03	NA	1.13E-03	NA	1.22E-03	NA	NA
Ethylbenzene	NA	1.77E-01	NA	3.83E-01	NA	7.51E-02	NA	1.26E-01	NA	NA
Fluoranthene	NA	6.80E-02	NA	7.68E-02	NA	1.68E-02	NA	1.73E-02	NA	NA
Fluorene	NA	1.56E-01	NA	2.18E-01	NA	5.91E-02	NA	6.79E-02	NA	NA
gamma-Hexachlorocyclohexane (HCH)	NA	1.25E-02	NA	1.35E-02	NA	4.25E-03	NA	4.37E-03	NA	NA
Heptachlor	2.03E-08	1.67E-06	2.03E-08	1.67E-06	5.46E-08	4.48E-07	5.46E-08	4.48E-07	1.48E-07	1.48E-07
Heptachlor Epoxide	1.04E-07	1.49E-06	1.05E-07	1.51E-06	3.06E-07	4.38E-07	3.07E-07	4.39E-07	9.45E-07	9.45E-07
Hexachlorobenzene	2.59E-07	4.22E-05	2.60E-07	4.24E-05	7.67E-07	1.25E-05	7.68E-07	1.25E-05	2.15E-06	2.15E-06
Hexachlorobutadiene	3.61E-05	8.67E-05	3.68E-05	8.84E-05	9.58E-05	2.30E-05	9.62E-05	2.31E-05	3.11E-04	3.11E-04
Hexachlorocyclopentadiene	NA	1.06E-02	NA	1.20E-02	NA	3.72E-03	NA	3.91E-03	NA	NA
Hexachloroethane	3.56E-04	1.99E-03	4.49E-04	2.51E-03	1.24E-03	6.93E-04	1.35E-03	7.53E-04	4.48E-03	4.59E-03
Indeno(1,2,3-cd)pyrene	4.82E-06	NA	5.06E-06	NA	1.12E-05	NA	1.14E-05	NA	4.00E-05	4.02E-05
Isophorone	1.02E-01	3.89E+00	5.56E+00	2.11E+02	3.21E-01	1.22E+00	1.84E+01	7.00E+01	1.74E+00	6.70E+01
Methoxychlor	NA	5.09E-05	NA	5.32E-05	NA	1.65E-05	NA	1.68E-05	NA	NA
Methyl Bromide	NA	3.94E-01	NA	3.50E+01	NA	1.22E-01	NA	1.17E+01	NA	NA
Methylene Chloride	4.91E-02	1.18E-01	3.79E+00	9.09E+00	1.53E-01	3.67E-02	1.26E+01	3.03E+00	8.30E-01	4.63E+01
Nitrobenzene	NA	3.87E-02	NA	1.68E+00	NA	1.22E-02	NA	5.56E-01	NA	NA

Summary of Final Probabilistic AWQC	Scenario 1				Scenario 2				Scenario 3	
	Target Risk = 0.000001, Hzd = 1, %ile = 0.5				Target Risk = 0.00001, Hzd = 1, %ile = 0.9				Target Risk = 0.0001, %ile = 0.99	
Chemical Name	Probabilistic AWQC (mg/L)				Probabilistic AWQC (mg/L)				Probabilistic AWQC (mg/L)	
	Water + Organism		Organism Only		Water + Organism		Organism Only		Water + Organism	Organism Only
	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Non-cancer HQ	Cancer Risk	Cancer Risk
p,p'-Dichlorodiphenyldichloroethane (DDD)	4.11E-07	9.86E-06	4.12E-07	9.88E-06	1.19E-06	2.86E-06	1.19E-06	2.86E-06	3.38E-06	3.39E-06
p,p'-Dichlorodiphenyldichloroethylene (DDE)	6.27E-08	1.05E-06	6.27E-08	1.05E-06	1.66E-07	2.77E-07	1.66E-07	2.77E-07	4.00E-07	4.00E-07
p,p'-Dichlorodiphenyltrichloroethane (DDT)	1.20E-07	4.08E-06	1.20E-07	4.08E-06	2.71E-07	9.23E-07	2.71E-07	9.23E-07	5.72E-07	5.72E-07
Pentachlorophenol	7.18E-05	2.87E-02	1.24E-04	4.94E-02	2.73E-04	1.09E-02	3.45E-04	1.38E-02	8.98E-04	9.54E-04
Phenol	NA	1.17E+01	NA	8.10E+02	NA	3.67E+00	NA	2.68E+02	NA	NA
Pyrene	NA	8.14E-02	NA	1.00E-01	NA	2.14E-02	NA	2.26E-02	NA	NA
Tetrachloroethylene (Perchloroethylene)	2.71E-02	6.83E-02	8.69E-02	2.19E-01	1.09E-01	2.74E-02	2.86E-01	7.21E-02	5.91E-01	1.01E+00
Toluene	NA	1.64E-01	NA	1.57E+00	NA	5.58E-02	NA	5.17E-01	NA	NA
Toxaphene	2.16E-06	1.66E-04	2.23E-06	1.71E-04	6.86E-06	5.28E-05	6.94E-06	5.34E-05	2.35E-05	2.36E-05
trans-1,2-Dichloroethylene (DCE)	NA	3.81E-01	NA	1.13E+01	NA	1.21E-01	NA	3.75E+00	NA	NA
Trichloroethylene (TCE)	1.75E-03	8.76E-03	2.05E-02	1.02E-01	5.84E-03	2.92E-03	6.77E-02	3.38E-02	3.22E-02	2.43E-01
Vinyl Chloride	6.54E-05	5.88E-02	4.85E-03	4.36E+00	2.04E-04	1.84E-02	1.61E-02	1.45E+00	1.11E-03	5.90E-02

final water + organism and organism only criterion value for each pollutant highlighted in yellow

Table 14. Scenario Results Table

Chemical Name	Water + Organism Outcomes		Organism Only Outcomes	
	Minimum Scenario	Limiting Effect	Minimum Scenario	Limiting Effect
1,1,1-Trichloroethane	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
1,1,2,2-Tetrachloroethane	Scenario 1	Cancer	Scenario 1	Cancer
1,1,2-Trichloroethane	Scenario 1	Cancer	Scenario 1	Cancer
1,1-Dichloroethylene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
1,2,4-Trichlorobenzene	Scenario 1	Cancer	Scenario 1	Cancer
1,2-Dichlorobenzene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
1,2-Dichloroethane	Scenario 1	Cancer	Scenario 1	Cancer
1,2-Dichloropropane	Scenario 1	Cancer	Scenario 1	Cancer
1,2-Diphenylhydrazine	Scenario 1	Cancer	Scenario 1	Cancer
1,3-Dichlorobenzene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
1,3-Dichloropropene	Scenario 1	Cancer	Scenario 1	Cancer
1,4-Dichlorobenzene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
2,4,6-Trichlorophenol	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
2,4-Dichlorophenol	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
2,4-Dimethylphenol	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
2,4-Dinitrophenol	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
2,4-Dinitrotoluene	Scenario 1	Cancer	Scenario 1	Cancer
2-Chloronaphthalene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
2-Chlorophenol	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
2-Methyl-4,6-Dinitrophenol	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
3,3'-Dichlorobenzidine	Scenario 1	Cancer	Scenario 1	Cancer
3-Methyl-4-Chlorophenol	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Acenaphthene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Acrolein	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Acrylonitrile	Scenario 1	Cancer	Scenario 1	Cancer
Aldrin	Scenario 1	Cancer	Scenario 1	Cancer
alpha-Endosulfan	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
alpha-Hexachlorocyclohexane (HCH)	Scenario 1	Cancer	Scenario 1	Cancer
Anthracene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Benzene High	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Benzene Low	Scenario 1	Cancer	Scenario 1	Cancer
Benzidine	Scenario 1	Cancer	Scenario 1	Cancer
Benzo(a)anthracene	Scenario 1	Cancer	Scenario 1	Cancer
Benzo(a)pyrene	Scenario 1	Cancer	Scenario 1	Cancer
Benzo(b)fluoranthene	Scenario 1	Cancer	Scenario 1	Cancer

Chemical Name	Water + Organism Outcomes		Organism Only Outcomes	
	Minimum Scenario	Limiting Effect	Minimum Scenario	Limiting Effect
Benzo(k)fluoranthene	Scenario 1	Cancer	Scenario 1	Cancer
beta-Endosulfan	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
beta-Hexachlorocyclohexane (HCH)	Scenario 1	Cancer	Scenario 1	Cancer
Bis(2-Chloro-1-Methylethyl) Ether	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Bis(2-Chloroethyl) Ether	Scenario 1	Cancer	Scenario 1	Cancer
Bis(2-Ethylhexyl) Phthalate	Scenario 1	Cancer	Scenario 1	Cancer
Bromoform	Scenario 1	Cancer	Scenario 1	Cancer
Butylbenzyl Phthalate	Scenario 1	Cancer	Scenario 1	Cancer
Carbon Tetrachloride	Scenario 1	Cancer	Scenario 1	Cancer
Chlordane	Scenario 1	Cancer	Scenario 1	Cancer
Chlorobenzene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Chlorodibromomethane	Scenario 1	Cancer	Scenario 1	Cancer
Chloroform	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Chlorophenoxy Herbicide (2,4,5-TP) [Silvex]	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Chlorophenoxy Herbicide (2,4-D)	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Chrysene	Scenario 1	Cancer	Scenario 1	Cancer
Cyanide	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Dibenzo(a,h)anthracene	Scenario 1	Cancer	Scenario 1	Cancer
Dichlorobromomethane	Scenario 1	Cancer	Scenario 1	Cancer
Dieldrin	Scenario 1	Cancer	Scenario 1	Cancer
Diethyl Phthalate	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Dimethyl Phthalate	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Di-n-Butyl Phthalate	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Endosulfan Sulfate	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Endrin	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Endrin Aldehyde	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Ethylbenzene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Fluoranthene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Fluorene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
gamma-Hexachlorocyclohexane (HCH)	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Heptachlor	Scenario 1	Cancer	Scenario 1	Cancer
Heptachlor Epoxide	Scenario 1	Cancer	Scenario 1	Cancer
Hexachlorobenzene	Scenario 1	Cancer	Scenario 1	Cancer
Hexachlorobutadiene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer

Chemical Name	Water + Organism Outcomes		Organism Only Outcomes	
	Minimum Scenario	Limiting Effect	Minimum Scenario	Limiting Effect
Hexachlorocyclopentadiene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Hexachloroethane	Scenario 1	Cancer	Scenario 1	Cancer
Indeno(1,2,3-cd)pyrene	Scenario 1	Cancer	Scenario 1	Cancer
Isophorone	Scenario 1	Cancer	Scenario 1	Cancer
Methoxychlor	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Methyl Bromide	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Methylene Chloride	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Nitrobenzene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
p,p'-Dichlorodiphenyldichloroethane (DDD)	Scenario 1	Cancer	Scenario 1	Cancer
p,p'-Dichlorodiphenyldichloroethylene (DDE)	Scenario 1	Cancer	Scenario 1	Cancer
p,p'-Dichlorodiphenyltrichloroethane (DDT)	Scenario 1	Cancer	Scenario 1	Cancer
Pentachlorophenol	Scenario 1	Cancer	Scenario 1	Cancer
Phenol	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Pyrene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Tetrachloroethylene (Perchloroethylene)	Scenario 1	Cancer	Scenario 2	Non-Cancer
Toluene	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Toxaphene	Scenario 1	Cancer	Scenario 1	Cancer
trans-1,2-Dichloroethylene (DCE)	Scenario 2	Non-Cancer	Scenario 2	Non-Cancer
Trichloroethylene (TCE)	Scenario 1	Cancer	Scenario 1	Cancer
Vinyl Chloride	Scenario 1	Cancer	Scenario 1	Cancer

3.3.3 Proposed Criteria

Georgia's Water Quality Standards currently have human health criteria for 82 of the pollutants listed in EPA's 2015 update. These 82 pollutants are listed in paragraph (5)(e)(iv) in Georgia's water quality standards, each with a single criterion value, most of which are based on the "organism only" criteria from EPA's 2002 recommendation. These criteria values will be updated based on EPD's PRA results, which derived two criteria values for each pollutant; one to protect human health from exposure through fish consumption ("organism only") and one to protect human health from exposure through fish consumption and water ingestion ("water + organism"). For assessment and implementation purposes, EPD is planning to utilizing the "organism only" criteria values for all waterbodies except those with a designated use of Drinking Water. For assessment and implementation purposes, the "water + organism" criteria values will be utilized for waterbodies with a designated use of Drinking Water.

There are 11 pollutants in EPA's 2015 update for which Georgia has no current human health criteria. EPD is only moving forward with adopting criteria for the five of these pollutants with approved methods listed in 40 CFR part 136. Table 15 displays the results of EPD's probabilistic risk assessment as final criteria values for 88 pollutants in micrograms per liter (µg/L). Tables 16 and 17 provide comparisons of the updated criteria to the human health criteria currently in Georgia's Water Quality Standards. Table 16 compares proposed criteria for waterbodies designated as a drinking water source (water + organism) to Georgia's current criteria. Table 17 compares proposed criteria for all waterbodies that are not designated as a drinking water source (organism only) to Georgia's current criteria. A negative percentage value in the comparison column indicates that the updated criteria value is lower (more stringent) than the current criteria. A positive percentage value indicates that the updated criteria value is higher (less stringent) than the current criteria. Figures 11 and 12 display the percent difference between the updated human health criteria values and Georgia's current criteria values for 82 pollutants. The shades of green represent an increase in criteria values (new criteria are less stringent than current criteria) and the shades of orange represent a decrease in criteria values (new criteria are more stringent than current criteria).

Table 15. Proposed Human Health Criteria Values

Chemical Name	Final Probabilistic AWQC (ug/L)	
	Water + Organism	Organism Only
1,1,1-Trichloroethane	**1.18E+04**	**1.76E+05**
1,1,2,2-Tetrachloroethane	**4.59E-01**	**8.08E+00**
1,1,2-Trichloroethane	**1.60E+00**	**2.69E+01**
1,1-Dichloroethylene	**3.05E+02**	**1.62E+04**
1,2,4-Trichlorobenzene	**2.18E-01**	**2.39E-01**
1,2-Dichlorobenzene	**1.34E+03**	**3.36E+03**
1,2-Dichloroethane	**2.96E+01**	**1.95E+03**
1,2-Dichloropropane	**2.66E+00**	**9.30E+01**
1,2-Diphenylhydrazine	**9.70E-02**	**6.29E-01**
1,3-Dichlorobenzene	**7.42E+00**	**1.38E+01**
1,3-Dichloropropene	**7.94E-01**	**3.53E+01**
1,4-Dichlorobenzene	**3.25E+02**	**9.08E+02**
2,4,6-Trichlorophenol	**3.53E+00**	**6.14E+00**
2,4-Dichlorophenol	**1.52E+01**	**5.68E+01**
2,4-Dimethylphenol	**1.20E+02**	**2.54E+03**
2,4-Dinitrophenol	**1.21E+01**	**2.95E+02**
2,4-Dinitrotoluene	**1.44E-01**	**5.08E+00**
2-Chloronaphthalene	**8.69E+02**	**1.22E+03**
2-Chlorophenol	**3.01E+01**	**8.17E+02**
2-Methyl-4,6-Dinitrophenol	**1.78E+00**	**2.67E+01**
3,3'-Dichlorobenzidine	**1.32E-01**	**4.48E-01**

Chemical Name	Final Probabilistic AWQC (ug/L)	
	Water + Organism	**Organism Only**
3-Methyl-4-Chlorophenol	**5.27E+02**	**2.34E+03**
Acenaphthene	**6.93E+01**	**7.63E+01**
Acrolein	**3.07E+00**	**3.24E+02**
Acrylonitrile	**1.83E-01**	**2.67E+01**
Aldrin	**2.73E-06**	**2.73E-06**
alpha-Endosulfan	**1.80E+01**	**2.69E+01**
alpha-Hexachlorocyclohexane (HCH)	**1.06E-03**	**1.17E-03**
Anthracene	**2.94E+02**	**3.19E+02**
Benzene	**1.72E+00**	**4.80E+01**
Benzidine	**4.26E-04**	**3.16E-02**
Benzo(a)anthracene	**4.82E-03**	**5.06E-03**
Benzo(a)pyrene	**4.82E-04**	**5.06E-04**
Benzo(b)fluoranthene	**4.82E-03**	**5.06E-03**
Benzo(k)fluoranthene	**4.82E-02**	**5.06E-02**
beta-Endosulfan	**2.28E+01**	**4.31E+01**
beta-Hexachlorocyclohexane (HCH)	**2.10E-02**	**4.30E-02**
Bis(2-Chloro-1-Methylethyl) Ether	**2.37E+02**	**3.59E+03**
Bis(2-Chloroethyl) Ether	**8.91E-02**	**6.61E+00**
Bis(2-Ethylhexyl) Phthalate	**1.12E+00**	**1.45E+00**
Bromoform	**2.04E+01**	**3.54E+02**
Butylbenzyl Phthalate	**3.95E-01**	**3.99E-01**
Carbon Tetrachloride	**1.24E+00**	**1.41E+01**
Chlordane	**1.04E-03**	**1.04E-03**
Chlorobenzene	**1.13E+02**	**8.35E+02**
Chlorodibromomethane	**2.36E+00**	**6.26E+01**
Chloroform	**6.07E+01**	**2.28E+03**
Chlorophenoxy Herbicide (2,4,5-TP) [Silvex]	**1.46E+02**	**3.58E+02**
Chlorophenoxy Herbicide (2,4-D)	**1.22E+03**	**1.05E+04**
Chrysene	**4.82E-01**	**5.06E-01**
Cyanide	**3.68E+00**	**3.89E+02**
Dibenzo(a,h)anthracene	**4.82E-04**	**5.06E-04**
Dichlorobromomethane	**2.80E+00**	**8.14E+01**
Dieldrin	**4.36E-06**	**4.37E-06**
Diethyl Phthalate	**5.35E+02**	**5.64E+02**
Dimethyl Phthalate	**1.60E+03**	**1.62E+03**
Di-n-Butyl Phthalate	**2.20E+01**	**2.24E+01**
Endosulfan Sulfate	**2.19E+01**	**3.96E+01**

Chemical Name	Final Probabilistic AWQC (ug/L)	
	Water + Organism	Organism Only
Endrin	**3.13E-02**	**3.14E-02**
Endrin Aldehyde	**1.13E+00**	**1.22E+00**
Ethylbenzene	**7.51E+01**	**1.26E+02**
Fluoranthene	**1.68E+01**	**1.73E+01**
Fluorene	**5.91E+01**	**6.79E+01**
gamma-Hexachlorocyclohexane (HCH)	**4.25E+00**	**4.37E+00**
Heptachlor	**2.03E-05**	**2.03E-05**
Heptachlor Epoxide	**1.04E-04**	**1.05E-04**
Hexachlorobenzene	**2.59E-04**	**2.60E-04**
Hexachlorobutadiene	**2.30E-02**	**2.31E-02**
Hexachlorocyclopentadiene	**3.72E+00**	**3.91E+00**
Hexachloroethane	**3.56E-01**	**4.49E-01**
Indeno(1,2,3-cd)pyrene	**4.82E-03**	**5.06E-03**
Isophorone	**1.02E+02**	**5.56E+03**
Methoxychlor	**1.65E-02**	**1.68E-02**
Methyl Bromide	**1.22E+02**	**1.17E+04**
Methylene Chloride	**3.67E+01**	**3.03E+03**
Nitrobenzene	**1.22E+01**	**5.56E+02**
p,p'-Dichlorodiphenyldichloroethane (DDD)	**4.11E-04**	**4.12E-04**
p,p'-Dichlorodiphenyldichloroethylene (DDE)	**6.27E-05**	**6.27E-05**
p,p'-Dichlorodiphenyltrichloroethane (DDT)	**1.20E-04**	**1.20E-04**
Pentachlorophenol	**7.18E-02**	**1.24E-01**
Phenol	**3.67E+03**	**2.68E+05**
Pyrene	**2.14E+01**	**2.26E+01**
Tetrachloroethylene (Perchloroethylene)	**2.71E+01**	**7.21E+01**
Toluene	**5.58E+01**	**5.17E+02**
Toxaphene	**2.16E-03**	**2.23E-03**
trans-1,2-Dichloroethylene (DCE)	**1.21E+02**	**3.75E+03**
Trichloroethylene (TCE)	**1.75E+00**	**2.05E+01**
Vinyl Chloride	**6.54E-02**	**4.85E+00**

Table 16. Comparison of Proposed Water + Organism Criteria to Georgia's Current Human Health Criteria

Chemical Name	Water + Organism Final Probabilistic AWQC (ug/L)	Current Georgia WQS (µg/L)	Water + Organism PRA Comparison to Current Criteria
1,1,2,2-Tetrachloroethane	0.0459	4	-89%
1,1,2-Trichloroethane	1.6	16	-90%
1,1-Dichloroethylene	305	7100	-96%
1,2,4-Trichlorobenzene	0.218	70	-100%
1,2-Dichlorobenzene	1340	1300	3%
1,2-Dichloroethane	29.6	37	-20%
1,2-Dichloropropane	2.66	15	-82%
1,2-Diphenylhydrazine	0.097	0.2	-52%
1,3-Dichlorobenzene	7.42	960	-99%
1,3-Dichloropropene	0.794	21	-96%
1,4-Dichlorobenzene	325	190	71%
2,4,6-Trichlorophenol	3.53	2.4	47%
2,4-Dichlorophenol	15.2	290	-95%
2,4-Dimethylphenol	120	850	-86%
2,4-Dinitrophenol	12.1	5300	-100%
2,4-Dinitrotoluene	0.144	3.4	-96%
2-Chloronaphthalene	869	1600	-46%
2-Chlorophenol	30.1	150	-80%
2-Methyl-4,6-Dinitrophenol	1.78	280	-99%
3,3'-Dichlorobenzidine	0.132	0.028	370%
Acenaphthene	69.3	990	-93%
Acrolein	3.07	9.3	-67%
Acrylonitrile	0.183	0.25	-27%
Aldrin	0.0000027	0.00005	-95%
alpha-Endosulfan	18	89	-80%
alpha-Hexachlorocyclohexane (HCH)	0.00106	0.0049	-78%
Anthracene	294	40000	-99%
Benzene	1.72	51	-97%
Benzidine	0.00043	0.0002	113%
Benzo(a)anthracene	0.00482	0.018	-73%
Benzo(a)pyrene	0.00048	0.018	-97%
Benzo(b)fluoranthene	0.00482	0.018	-73%
Benzo(k)fluoranthene	0.0482	0.018	168%
beta-Endosulfan	22.8	89	-74%
beta-Hexachlorocyclohexane (HCH)	0.021	0.17	-88%
Bis(2-Chloro-1-Methylethyl) Ether	237	65000	-100%
Bis(2-Chloroethyl) Ether	0.0891	0.53	-83%
Bis(2-Ethylhexyl) Phthalate	1.12	2.2	-49%
Bromoform	20.4	140	-85%
Butylbenzyl Phthalate	0.395	1900	-100%
Carbon Tetrachloride	1.24	1.6	-22%
Chlordane	0.00104	0.00081	28%
Chlorobenzene	113	1600	-93%

Chemical Name	Water + Organism Final Probabilistic AWQC (ug/L)	Current Georgia WQS (µg/L)	Water + Organism PRA Comparison to Current Criteria
Chlorodibromomethane	2.36	13	-82%
Chloroform	60.7	470	-87%
Chrysene	0.482	0.018	2580%
Dibenzo(a,h)anthracene	0.00048	0.018	-97%
Dichlorobromomethane	2.8	17	-84%
Dieldrin	0.0000044	0.000054	-92%
Diethyl Phthalate	535	44000	-99%
Dimethyl Phthalate	1600	1100000	-100%
Di-n-Butyl Phthalate	22	4500	-100%
Endosulfan Sulfate	21.9	89	-75%
Endrin	0.0313	0.06	-48%
Endrin Aldehyde	1.13	0.3	275%
Ethylbenzene	75.1	2100	-96%
Fluoranthene	16.8	140	-88%
Fluorene	59.1	5300	-99%
gamma-Hexachlorocyclohexane (HCH)	4.25	1.8	136%
Heptachlor	0.00002	0.000079	-74%
Heptachlor Epoxide	0.0001	0.000039	168%
Hexachlorobenzene	0.00026	0.00029	-11%
Hexachlorobutadiene	0.023	18	-100%
Hexachlorocyclopentadiene	3.72	1100	-100%
Hexachloroethane	0.356	3.3	-89%
Indeno(1,2,3-cd)pyrene	0.00482	0.018	-73%
Isophorone	102	960	-89%
Methyl Bromide	122	1500	-92%
Methylene Chloride	36.7	590	-94%
Nitrobenzene	12.2	690	-98%
p,p'-Dichlorodiphenyldichloroethane (DDD)	0.00041	0.00031	33%
p,p'-Dichlorodiphenyldichloroethylene (DDE)	0.0000063	0.00022	-72%
p,p'-Dichlorodiphenyltrichloroethane (DDT)	0.00012	0.00022	-45%
Pentachlorophenol	0.0718	3	-98%
Phenol	3670	857000	-100%
Pyrene	21.4	4000	-99%
Tetrachloroethylene (Perchloroethylene)	27.1	3.3	721%
Toluene	55.8	5980	-99%
Toxaphene	0.00216	0.00028	670%
trans-1,2-Dichloroethylene (DCE)	121	10000	-99%
Trichloroethylene (TCE)	1.75	30	-94%
Vinyl Chloride	0.0654	2.4	-97%

Table 17. Comparison of Proposed Organism Only Criteria to Georgia's Current Human Health Criteria

Chemical Name	Organism Only Final Probabilistic AWQC (µg/L)	Current Georgia WQS (µg/L)	Organism Only PRA Comparison to Current Criteria
1,1,2,2-Tetrachloroethane	8.08	4	102%
1,1,2-Trichloroethane	26.9	16	68%
1,1-Dichloroethylene	16200	7100	129%
1,2,4-Trichlorobenzene	0.239	70	-100%
1,2-Dichlorobenzene	3360	1300	158%
1,2-Dichloroethane	1950	37	5172%
1,2-Dichloropropane	93	15	520%
1,2-Diphenylhydrazine	0.629	0.2	214%
1,3-Dichlorobenzene	13.8	960	-99%
1,3-Dichloropropene	35.3	21	68%
1,4-Dichlorobenzene	908	190	378%
2,4,6-Trichlorophenol	6.14	2.4	156%
2,4-Dichlorophenol	56.8	290	-80%
2,4-Dimethylphenol	2540	850	199%
2,4-Dinitrophenol	295	5300	-94%
2,4-Dinitrotoluene	5.08	3.4	49%
2-Chloronaphthalene	1220	1600	-24%
2-Chlorophenol	817	150	445%
2-Methyl-4,6-Dinitrophenol	26.7	280	-90%
3,3'-Dichlorobenzidine	0.448	0.028	1499%
Acenaphthene	76.3	990	-92%
Acrolein	324	9.3	3385%
Acrylonitrile	26.7	0.25	10567%
Aldrin	0.00000273	0.00005	-95%
alpha-Endosulfan	26.9	89	-70%
alpha-Hexachlorocyclohexane (HCH)	0.00117	0.0049	-76%
Anthracene	319	40000	-99%
Benzene	48	51	-6%
Benzidine	0.0316	0.0002	15708%
Benzo(a)anthracene	0.00506	0.018	-72%
Benzo(a)pyrene	0.000506	0.018	-97%
Benzo(b)fluoranthene	0.00506	0.018	-72%
Benzo(k)fluoranthene	0.0506	0.018	181%
beta-Endosulfan	43.1	89	-52%
beta-Hexachlorocyclohexane (HCH)	0.043	0.17	-75%
Bis(2-Chloro-1-Methylethyl) Ether	3590	65000	-94%
Bis(2-Chloroethyl) Ether	6.61	0.53	1147%
Bis(2-Ethylhexyl) Phthalate	1.45	2.2	-34%
Bromoform	354	140	153%
Butylbenzyl Phthalate	0.399	1900	-100%
Carbon Tetrachloride	14.1	1.6	782%
Chlordane	0.00104	0.00081	29%
Chlorobenzene	835	1600	-48%
Chlorodibromomethane	62.6	13	382%
Chloroform	2280	470	386%

Chemical Name	Organism Only Final Probabilistic AWQC (µg/L)	Current Georgia WQS (µg/L)	Organism Only PRA Comparison to Current Criteria
Chrysene	0.506	0.018	2710%
Dibenzo(a,h)anthracene	0.000506	0.018	-97%
Dichlorobromomethane	81.4	17	379%
Dieldrin	0.0000044	0.000054	-92%
Diethyl Phthalate	564	44000	-99%
Dimethyl Phthalate	1620	1100000	-100%
Di-n-Butyl Phthalate	22.4	4500	-100%
Endosulfan Sulfate	39.6	89	-55%
Endrin	0.0314	0.06	-48%
Endrin Aldehyde	1.22	0.3	306%
Ethylbenzene	126	2100	-94%
Fluoranthene	17.3	140	-88%
Fluorene	67.9	5300	-99%
gamma-Hexachlorocyclohexane (HCH)	4.37	1.8	143%
Heptachlor	0.00002	0.000079	-74%
Heptachlor Epoxide	0.000105	0.000039	170%
Hexachlorobenzene	0.00026	0.00029	-10%
Hexachlorobutadiene	0.0231	18	-100%
Hexachlorocyclopentadiene	3.91	1100	-100%
Hexachloroethane	0.449	3.3	-86%
Indeno(1,2,3-cd)pyrene	0.00506	0.018	-72%
Isophorone	5560	960	479%
Methyl Bromide	11700	1500	677%
Methylene Chloride	3030	590	413%
Nitrobenzene	556	690	-19%
p,p'-Dichlorodiphenyldichloroethane (DDD)	0.000412	0.00031	33%
p,p'-Dichlorodiphenyldichloroethylene (DDE)	0.000063	0.00022	-71%
p,p'-Dichlorodiphenyltrichloroethane (DDT)	0.00012	0.00022	-45%
Pentachlorophenol	0.124	3	-96%
Phenol	268000	857000	-69%
Pyrene	22.6	4000	-99%
Tetrachloroethylene (Perchloroethylene)	72.1	3.3	2084%
Toluene	517	5980	-91%
Toxaphene	0.00223	0.00028	695%
trans-1,2-Dichloroethylene (DCE)	3750	10000	-63%
Trichloroethylene (TCE)	20.5	30	-32%
Vinyl Chloride	4.85	2.4	102%

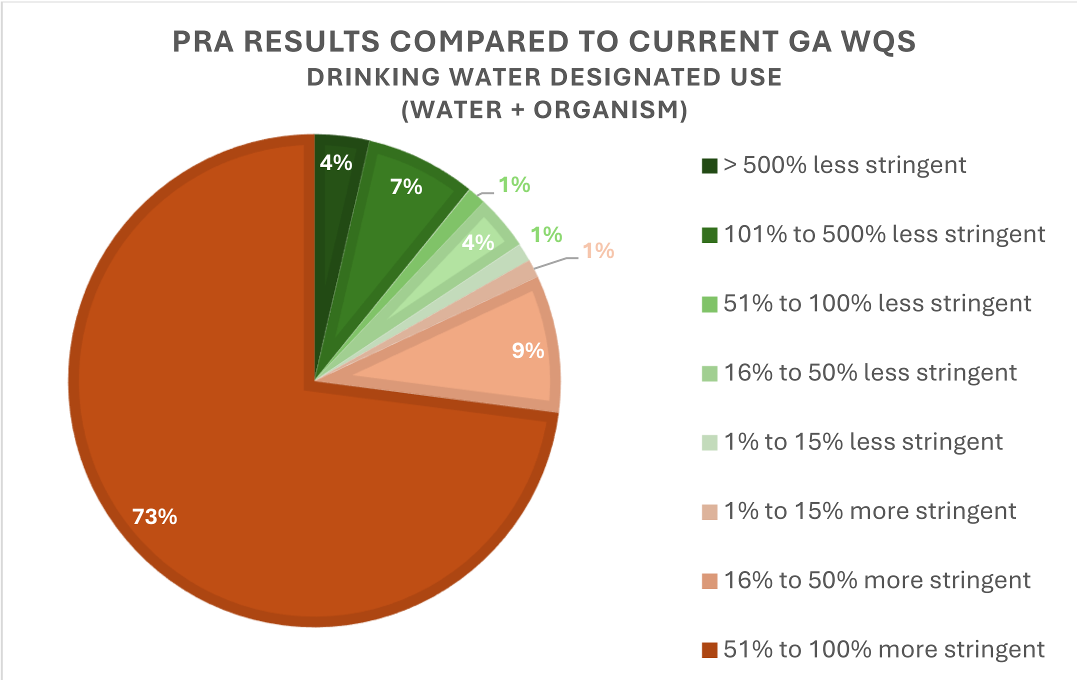

Figure 11. Proposed Water + Organism Criteria Compared to Georgia's Current Human Health Criteria for 82 Pollutants

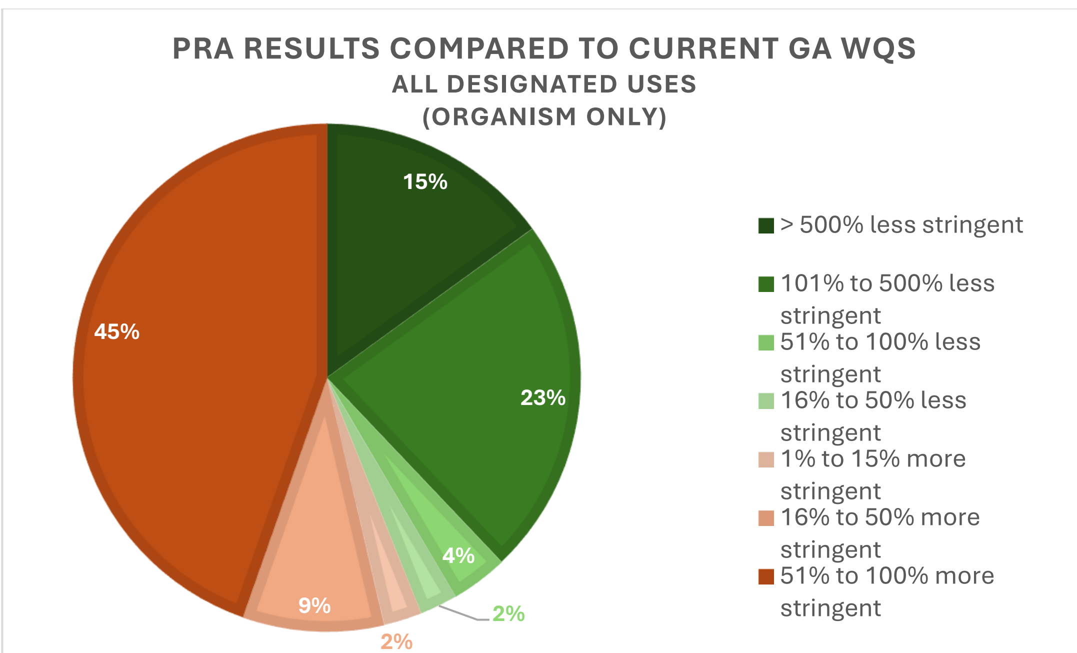

Figure 12. Proposed Organism Only Criteria Compared to Georgia's Current Human Health Criteria for 82 Pollutants

EPD used probabilistic risk assessment to derive criteria human health criteria because of concerns for compounded conservatism resulting from the deterministic method used by EPA. Comparison of EPD's PRA results to EPA's criteria recommendation reveals that PRA criteria values were less stringent for the majority of the pollutants. Table 18 compares EPD's proposed human health criteria to EPA's recommended human health criteria for 88 pollutants. A negative percentage value in the comparison column indicates that EPD's criteria value is lower (more stringent) than EPA's criteria. A positive percentage value indicates that EPD's critertia value is higher (less stringent) than EPA's. Figures 13 and 14 display the percent difference between EPD's proposed criteria and EPA's recommended criteria for 88 pollutants. The shades of green represent criteria for which EPD's values are greater (less stringent) than EPA's and the shades of orange represent criteria for which EPD's values are lower (more stringent) than EPA's.

Table 1817. Comparison of Georgia's Proposed Human Health Criteria to EPA's Recommended Human Health Criteria by Pollutant

Chemical Name	Final Probabilistic AWQC (ug/L)		EPA 2015 AWQC (ug/L)		% difference final HHC vs 2015	
	Water + Organism	Organism Only	Water + Organism	Organism Only	Water + Organism	Organism Only
1,1,1-Trichloroethane	1.18E+04	1.76E+05	1.00E+04	2.00E+05	18%	-12%
1,1,2,2-Tetrachloroethane	4.59E-01	8.08E+00	2.00E-01	3.00E+00	129%	169%
1,1,2-Trichloroethane	1.60E+00	2.69E+01	5.50E-01	8.90E+00	191%	202%
1,1-Dichloroethylene	3.05E+02	1.62E+04	3.00E+02	2.00E+04	2%	-19%
1,2,4-Trichlorobenzene	2.18E-01	2.39E-01	7.10E-02	7.60E-02	206%	214%
1,2-Dichlorobenzene	1.34E+03	3.36E+03	1.00E+03	3.00E+03	34%	12%
1,2-Dichloroethane	2.96E+01	1.95E+03	9.90E+00	6.50E+02	199%	200%
1,2-Dichloropropane	2.66E+00	9.30E+01	9.00E-01	3.10E+01	196%	200%
1,2-Diphenylhydrazine	9.70E-02	6.29E-01	3.00E-02	2.00E-01	223%	214%
1,3-Dichlorobenzene	7.42E+00	1.38E+01	7.00E+00	1.00E+01	6%	38%
1,3-Dichloropropene	7.94E-01	3.53E+01	2.70E-01	1.20E+01	194%	194%
1,4-Dichlorobenzene	3.25E+02	9.08E+02	3.00E+02	9.00E+02	8%	1%
2,4,6-Trichlorophenol	3.53E+00	6.14E+00	1.50E+00	2.80E+00	135%	119%
2,4-Dichlorophenol	1.52E+01	5.68E+01	1.00E+01	6.00E+01	52%	-5%
2,4-Dimethylphenol	1.20E+02	2.54E+03	1.00E+02	3.00E+03	20%	-15%
2,4-Dinitrophenol	1.21E+01	2.95E+02	1.00E+01	3.00E+02	21%	-2%
2,4-Dinitrotoluene	1.44E-01	5.08E+00	4.90E-02	1.70E+00	194%	199%
2-Chloronaphthalene	8.69E+02	1.22E+03	8.00E+02	1.00E+03	9%	22%
2-Chlorophenol	3.01E+01	8.17E+02	3.00E+01	8.00E+02	0%	2%
2-Methyl-4,6-Dinitrophenol	1.78E+00	2.67E+01	2.00E+00	3.00E+01	-11%	-11%
3,3'-Dichlorobenzidine	1.32E-01	4.48E-01	4.90E-02	1.50E-01	168%	198%
3-Methyl-4-Chlorophenol	5.27E+02	2.34E+03	5.00E+02	2.00E+03	5%	17%
Acenaphthene	6.93E+01	7.63E+01	7.00E+01	9.00E+01	-1%	-15%
Acrolein	3.07E+00	3.24E+02	3.00E+00	4.00E+02	2%	-19%
Acrylonitrile	1.83E-01	2.67E+01	6.10E-02	7.00E+00	200%	281%
Aldrin	2.73E-06	2.73E-06	7.70E-07	7.70E-07	254%	255%
alpha-Endosulfan	1.80E+01	2.69E+01	2.00E+01	3.00E+01	-10%	-10%
alpha-Hexachlorocyclohexane (HCH)	1.06E-03	1.17E-03	3.60E-04	3.90E-04	195%	200%
Anthracene	2.94E+02	3.19E+02	3.00E+02	4.00E+02	-2%	-20%
Benzene High	3.02E+00	8.71E+01	2.10E+00	5.80E+01	44%	50%
Benzene Low	1.72E+00	4.80E+01	5.80E-01	1.60E+01	197%	200%
Benzidine	4.26E-04	3.16E-02	1.40E-04	1.10E-02	205%	187%
Benzo(a)anthracene	4.82E-03	5.06E-03	1.20E-03	1.30E-03	302%	289%
Benzo(a)pyrene	4.82E-04	5.06E-04	1.20E-04	1.30E-04	302%	289%
Benzo(b)fluoranthene	4.82E-03	5.06E-03	1.20E-03	1.30E-03	302%	289%
Benzo(k)fluoranthene	4.82E-02	5.06E-02	1.20E-02	1.30E-02	302%	289%
beta-Endosulfan	2.28E+01	4.31E+01	2.00E+01	4.00E+01	14%	8%

Chemical Name	Final Probabilistic AWQC (ug/L)		EPA 2015 AWQC (ug/L)		% difference final HHC vs 2015	
	Water + Organism	Organism Only	Water + Organism	Organism Only	Water + Organism	Organism Only
beta-Hexachlorocyclohexane (HCH)	2.10E-02	4.30E-02	8.00E-03	1.40E-02	162%	207%
Bis(2-Chloro-1-Methylethyl) Ether	2.37E+02	3.59E+03	2.00E+02	4.00E+03	18%	-10%
Bis(2-Chloroethyl) Ether	8.91E-02	6.61E+00	3.00E-02	2.20E+00	197%	200%
Bis(2-Ethylhexyl) Phthalate	1.12E+00	1.45E+00	3.20E-01	3.70E-01	252%	292%
Bromoform	2.04E+01	3.54E+02	7.00E+00	1.20E+02	191%	195%
Butylbenzyl Phthalate	3.95E-01	3.99E-01	1.00E-01	1.00E-01	295%	299%
Carbon Tetrachloride	1.24E+00	1.41E+01	4.00E-01	5.00E+00	211%	182%
Chlordane	1.04E-03	1.04E-03	3.10E-04	3.20E-04	234%	225%
Chlorobenzene	1.13E+02	8.35E+02	1.00E+02	8.00E+02	13%	4%
Chlorodibromomethane	2.36E+00	6.26E+01	8.00E-01	2.10E+01	195%	198%
Chloroform	6.07E+01	2.28E+03	6.00E+01	2.00E+03	1%	14%
Chlorophenoxy Herbicide (2,4,5-TP) [Silvex]	1.46E+02	3.58E+02	1.00E+02	4.00E+02	46%	-11%
Chlorophenoxy Herbicide (2,4-D)	1.22E+03	1.05E+04	1.30E+03	1.20E+04	-6%	-13%
Chrysene	4.82E-01	5.06E-01	1.20E-01	1.30E-01	302%	289%
Cyanide	3.68E+00	3.89E+02	4.00E+00	4.00E+02	-8%	-3%
Dibenzo(a,h)anthracene	4.82E-04	5.06E-04	1.20E-04	1.30E-04	302%	289%
Dichlorobromomethane	2.80E+00	8.14E+01	9.50E-01	2.70E+01	194%	201%
Dieldrin	4.36E-06	4.37E-06	1.20E-06	1.20E-06	264%	264%
Diethyl Phthalate	5.35E+02	5.64E+02	6.00E+02	6.00E+02	-11%	-6%
Dimethyl Phthalate	1.60E+03	1.62E+03	2.00E+03	2.00E+03	-20%	-19%
Di-n-Butyl Phthalate	2.20E+01	2.24E+01	2.00E+01	3.00E+01	10%	-25%
Endosulfan Sulfate	2.19E+01	3.96E+01	2.00E+01	4.00E+01	10%	-1%
Endrin	3.13E-02	3.14E-02	3.00E-02	3.00E-02	4%	5%
Endrin Aldehyde	1.13E+00	1.22E+00	1.00E+00	1.00E+00	13%	22%
Ethylbenzene	7.51E+01	1.26E+02	6.80E+01	1.30E+02	10%	-3%
Fluoranthene	1.68E+01	1.73E+01	2.00E+01	2.00E+01	-16%	-14%
Fluorene	5.91E+01	6.79E+01	5.00E+01	7.00E+01	18%	-3%
gamma-Hexachlorocyclohexane (HCH)	4.25E+00	4.37E+00	4.20E+00	4.40E+00	1%	-1%
Heptachlor	2.03E-05	2.03E-05	5.90E-06	5.90E-06	245%	245%
Heptachlor Epoxide	1.04E-04	1.05E-04	3.20E-05	3.20E-05	227%	229%
Hexachlorobenzene	2.59E-04	2.60E-04	7.90E-05	7.90E-05	228%	229%
Hexachlorobutadiene	2.30E-02	2.31E-02	1.00E-02	1.00E-02	130%	131%
Hexachlorocyclopentadiene	3.72E+00	3.91E+00	4.00E+00	4.00E+00	-7%	-2%
Hexachloroethane	3.56E-01	4.49E-01	1.00E-01	1.00E-01	256%	349%
Indeno(1,2,3-cd)pyrene	4.82E-03	5.06E-03	1.20E-03	1.30E-03	302%	289%
Isophorone	1.02E+02	5.56E+03	3.40E+01	1.80E+03	201%	209%
Methoxychlor	1.65E-02	1.68E-02	2.00E-02	2.00E-02	-17%	-16%
Methyl Bromide	1.22E+02	1.17E+04	1.00E+02	1.00E+04	22%	17%
Methylene Chloride	3.67E+01	3.03E+03	2.00E+01	1.00E+03	84%	203%

Chemical Name	Final Probabilistic AWQC (ug/L)		EPA 2015 AWQC (ug/L)		% difference final HHC vs 2015	
	Water + Organism	Organism Only	Water + Organism	Organism Only	Water + Organism	Organism Only
Nitrobenzene	1.22E+01	5.56E+02	1.00E+01	6.00E+02	22%	-7%
p,p'-Dichlorodiphenyldichloroethane (DDD)	4.11E-04	4.12E-04	1.20E-04	1.20E-04	242%	243%
p,p'-Dichlorodiphenyldichloroethylene (DDE)	6.27E-05	6.27E-05	1.80E-05	1.80E-05	248%	248%
p,p'-Dichlorodiphenyltrichloroethane (DDT)	1.20E-04	1.20E-04	3.00E-05	3.00E-05	300%	300%
Pentachlorophenol	7.18E-02	1.24E-01	3.00E-02	4.00E-02	139%	209%
Phenol	3.67E+03	2.68E+05	4.00E+03	3.00E+05	-8%	-11%
Pyrene	2.14E+01	2.26E+01	2.00E+01	3.00E+01	7%	-25%
Tetrachloroethylene (Perchloroethylene)	2.71E+01	7.21E+01	1.00E+01	2.90E+01	171%	149%
Toluene	5.58E+01	5.17E+02	5.70E+01	5.20E+02	-2%	-1%
Toxaphene	2.16E-03	2.23E-03	7.00E-04	7.10E-04	208%	214%
trans-1,2-Dichloroethylene (DCE)	1.21E+02	3.75E+03	1.00E+02	4.00E+03	21%	-6%
Trichloroethylene (TCE)	1.75E+00	2.05E+01	6.00E-01	7.00E+00	192%	193%
Vinyl Chloride	6.54E-02	4.85E+00	2.20E-02	1.60E+00	197%	203%

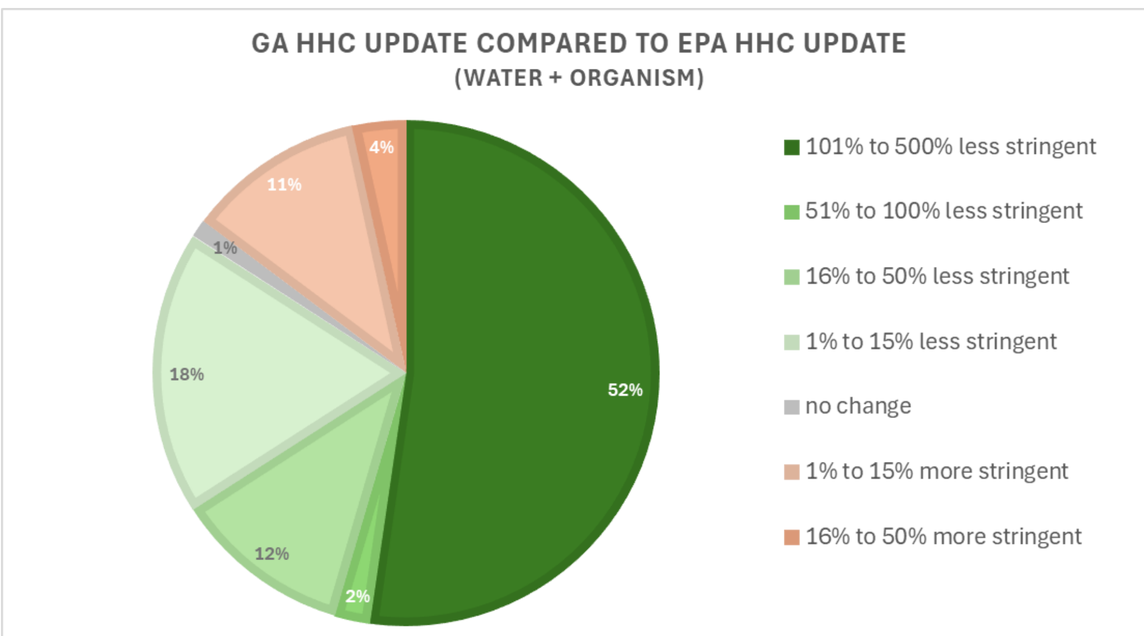

Figure 13. Comparison of Georgia's Proposed Water + Organism Human Health Criteria for 88 Pollutants to EPA's Criteria Recommendation

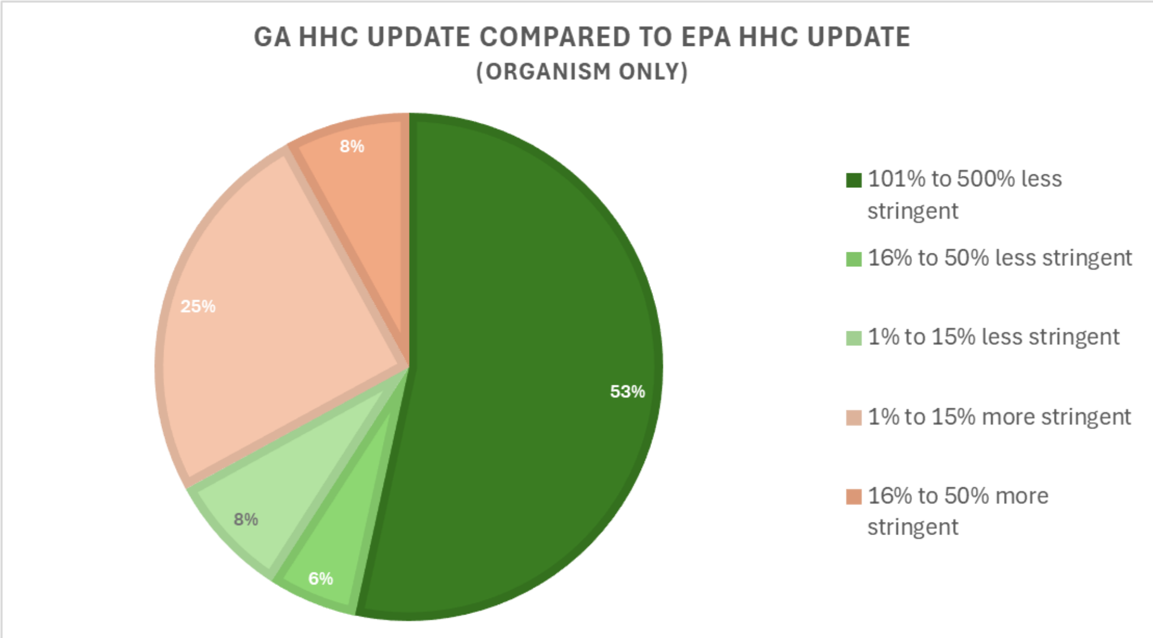

Figure 14. Comparison of Georgia's Proposed Organism Only Human Health Criteria for 88 Pollutants to EPA's Criteria Recommendation

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Human Health Criteria Derivation and Review

This document was prepared by the DNR EPD Watershed Protection Branch, Watershed Planning & Monitoring Program. Contributors included Elizabeth Booth, Ph.D., Gillian Batson, Tyler Parsons, and Anna Truszczynski.

Appendices

Appendix A: Calculation of Mean and Percentile Body Weights (kg) for Adults 21 and Over

Table A-1. Mean and Percentile Body Weights Listed in EPA's Exposure Factors Handbook

Exposure Factors Handbook

Chapter 8—Body Weight Studies

Table 8-3. Mean and Percentile Body Weights (kg) Derived From NHANES (1999–2006) Males and Females Combined

Age Group	*N*	Mean	Percentiles								
			5th	10th	15th	25th	50th	75th	85th	90th	95th
Birth to <1 month	158	4.8	3.6	3.9	4.1	4.2	4.8	5.1	5.5	5.8	6.2
1 to <3 months	284	5.9	4.5	4.7	4.9	5.2	5.9	6.6	6.9	7.1	7.3
3 to <6 months	489	7.4	5.7	6.1	6.3	6.7	7.3	8.0	8.4	8.7	9.1
6 to <12 months	927	9.2	7.1	7.5	7.9	8.3	9.1	10.1	10.5	10.8	11.3
1 to <2 years	1,176	11.4	8.9	9.3	9.7	10.3	11.3	12.4	13.0	13.4	14.0
2 to <3 years	1,144	13.8	10.9	11.5	11.9	12.4	13.6	14.9	15.8	16.3	17.1
3 to <6 years	2,318	18.6	13.5	14.4	14.9	15.8	17.8	20.3	22.0	23.6	26.2
6 to <11 years	3,593	31.8	19.7	21.3	22.3	24.4	29.3	36.8	42.1	45.6	52.5
11 to <16 years	5,297	56.8	34.0	37.2	40.6	45.0	54.2	65.0	73.0	79.3	88.8
16 to <21 years	4,851	71.6	48.2	52.0	54.5	58.4	67.6	80.6	90.8	97.7	108.0
21 to <30 years	3,232	78.4	50.8	54.7	57.9	63.3	75.2	88.2	98.5	106.0	118.0
30 to <40 years	3,176	80.8	53.5	57.4	60.1	66.1	77.9	92.4	101.0	107.0	118.0
40 to <50 years	3,121	83.6	54.3	58.8	62.1	68.3	81.4	95.0	104.0	111.0	122.0
50 to <60 years	2,387	83.4	54.7	59.0	62.8	69.1	80.8	95.5	104.0	110.0	120.0
60 to <70 years	2,782	82.6	55.2	59.8	63.3	69.0	80.5	94.2	103.0	109.0	116.0
70 to <80 years	2,033	76.4	52.0	56.5	59.7	64.4	74.9	86.8	93.8	98.0	106.0
Over 80 years	1,430	68.5	46.9	51.4	53.8	58.2	67.4	77.4	82.6	87.2	93.6

Source: U.S. EPA Analysis of NHANES 1999–2006 data.

Source: US EPA Exposure Factors Handbook: 2011 Edition, EPA/600/R-09/052F

Table 8-3 from EPA's Exposure Factors Handbook was used to calculate mean and percentile body weights for adults age 21 and over by assigning a weight to each age group (highlighted in blue). The weight was determined by dividing the number of individuals (N) by the total number of adults 21 and over (18,161) as shown in Table A-2.

Table A-2. Weight of Each Age Group Data Set for Adults 21 and Older

Age group	**N**	**Weight**
21 to <30 years	3,232	0.1780
30 to <40 years	3,176	0.1749
40 to <50 years	3,121	0.1719
50 to <60 years	2,387	0.1314
60 to <70 years	2,782	0.1532
70 to <80 years	2,033	0.1119
Over 80 years	1,430	0.0787
total	18,161	

The weight for each age group was multiplied by the mean or percentile value for that group. The final weighted percentile values for adults 21 and older are the sum of the products for each percentile column. The weighted percentile values are displayed in bold in Table A-3. Note that the weighted mean body weight is 80.01, which is consistent with the mean body weight of 80 kg used by EPA.

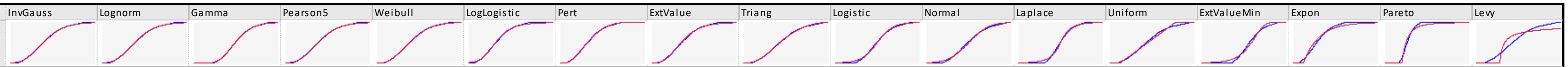
Table A-3. Calculation of Weighted Percentile Values for Body Weight Data Distribution

Age	Mean	Weighted Mean	5th%	Weighted 5th	10th%	Weighted 10th	15th%	Weighted 15th	25th%	Weighted 25th	50th%	Weighted 50th	75th%	Weighted 75th	85th%	Weighted 85th	90th%	Weighted 90th	95th%	Weighted 95th
21-30	78.4	13.95236	50.8	9.040559	54.7	9.734618	57.9	10.3041	63.3	11.26511	75.2	13.38288	88.2	15.6964	98.5	17.52943	106	18.86416	118	20.99972
30-40	80.8	14.13032	53.5	9.356093	57.4	10.03813	60.1	10.5103	66.1	11.55958	77.9	13.62317	92.4	16.15893	101	17.6629	107	18.71219	118	20.63587
40-50	83.6	14.36681	54.3	9.331551	58.8	10.10488	62.1	10.67199	68.3	11.73748	81.4	13.98873	95	16.32592	104	17.87258	111	19.07555	122	20.96592
50-60	83.4	10.96172	54.7	7.189522	59	7.754694	62.8	8.254149	69.1	9.082193	80.8	10.61999	95.5	12.55209	104	13.66929	110	14.4579	120	15.77226
60-70	82.6	12.65311	55.2	8.455834	59.8	9.160487	63.3	9.696636	69	10.56979	80.5	12.33142	94.2	14.43006	103	15.7781	109	16.69721	116	17.76951
70-80	76.4	8.552459	52	5.821045	56.5	6.324789	59.7	6.683008	64.4	7.20914	74.9	8.384544	86.8	9.716668	93.8	10.50027	98	10.97043	106	11.86598
80+	68.5	5.393701	46.9	3.692913	51.4	4.047244	53.8	4.23622	58.2	4.582677	67.4	5.307087	77.4	6.094488	82.6	6.503937	87.2	6.866142	93.6	7.370079
21+		**80.01048**		**52.88752**		**57.16484**		**60.35641**		**66.00597**		**77.63782**		**90.97457**		**99.51651**		**105.6436**		**115.3793**

Appendix B:

Table B-1. Fit Results For Body Weight Distributions

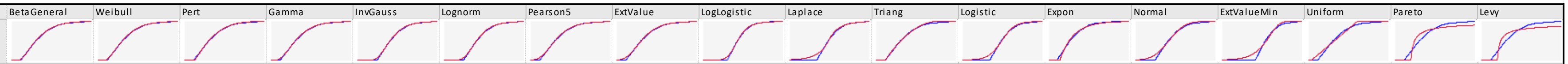
@RISK - Fit Results
Performed By: Batson, Gillian
Date: Thursday, March 7, 2024 11:34:00 AM

Name	InvGauss	Lognorm	Gamma	Pearson5	Weibull	LogLogistic	Pert	ExtValue
Graph								
Function	RiskInvGauss(77.1	RiskLognorm(76.34	RiskGamma(7.510!	RiskPearson5(28.5	RiskWeibull(1.998	RiskLogLogistic(4.4	RiskPert(45.980,71.	RiskExtValue(71.04
Method	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares
Parameters - [* Values unavailable without running a bootstrap.]								
Num. Est.	3	3	3	3	3	3	3	2
Fitted Parameter #1	mu	mu	alpha	alpha	alpha	gamma	Min	a
Fitted Value	77.10566	76.34339	7.510867	28.597	1.99861	4.43802	45.9804	71.04011
Fitted Parameter #2	lambda	sigma	beta	beta	beta	beta	M. likely	b
Fitted Value	1,223.95803	19.45612	7.012853	2,782.817	40.18575	73.06765	71.1142	16.02239
Fitted Parameter #3	Shift Factor	Shift Factor	Shift Factor	Shift Factor	Shift Factor	alpha	Max	
Fitted Value	2.75266	3.53537	27.171645	-20.943	44.17551	6.64660	147.3366	
Distribution Statistics								
Minimum	2.75266	3.53537	27.171645	-20.943	44.17551	4.43802	45.9804	−∞
Maximum	+∞	+∞	+∞	+∞	+∞	+∞	147.3366	+∞
Mean	79.85832	79.87876	79.844254	79.895	79.78966	80.29895	79.6290	80.28848
Mode	72.91567	73.00236	72.831401	73.081	72.57442	74.24732	71.1142	71.04011
Median	77.51493	77.51414	77.525984	77.514	77.62809	77.50567	77.6345	76.91252
Std. Deviation	19.35290	19.45612	19.219398	19.553	18.62798	21.69493	18.0407	20.54952
Skewness	0.7530	0.7811	0.7298	0.8059	0.6320	1.5659	0.4720	1.1395
Kurtosis	3.9450	4.1041	3.7988	4.2578	3.2468	11.4969	2.6303	5.4000
Percentiles								
1%	45.02822	44.80844	45.551890	44.559	48.19776	41.03760	49.2504	46.57104
2.5%	48.90680	48.78155	49.178131	48.644	50.56154	46.54411	51.2673	50.12572
5%	52.56508	52.50323	52.684638	52.436	53.26741	51.35532	53.6528	53.46052
10%	57.18637	57.17558	57.198258	57.164	57.20933	56.93770	57.2612	57.67691
20%	63.41481	63.43416	63.376451	63.453	63.14860	63.75015	62.9516	63.41529
25%	65.97651	65.99881	65.937030	66.021	65.72022	66.37370	65.4930	65.80665
30%	68.37396	68.39540	68.339769	68.417	68.16676	68.76038	67.9453	68.06592
35%	70.68017	70.69820	70.655004	70.716	70.54334	71.00772	70.3540	70.26109
40%	72.94603	72.95889	72.932071	72.972	72.89040	73.18153	72.7530	72.44081
45%	75.21209	75.21853	75.210466	75.225	75.24155	75.33262	75.1708	74.64532
50%	77.51493	77.51414	77.525984	77.514	77.62809	77.50567	77.6345	76.91252
55%	79.89172	79.88327	79.915052	79.876	80.08239	79.74533	80.1720	79.28262
60%	82.38439	82.36829	82.418834	82.354	82.64138	82.10181	82.8156	81.80278
65%	85.04496	85.02179	85.088373	85.001	85.35086	84.63789	85.6048	84.53338
70%	87.94371	87.91490	87.992559	87.889	88.27245	87.43997	88.5920	87.55808
75%	91.18394	91.15236	91.232499	91.124	91.49598	90.63844	91.8524	91.00239
80%	94.93260	94.90381	94.971222	94.878	95.16504	94.45134	95.5029	95.07273
90%	105.53797	105.56440	105.484352	105.587	105.17212	106.13163	105.0065	107.09637
95%	115.14419	115.29967	114.917034	115.437	113.75625	118.23147	112.4685	118.62974
97.5%	124.13182	124.49274	123.661540	124.812	121.39309	131.23396	118.4616	129.94238
99%	135.38386	136.13656	134.499755	136.803	130.45851	150.31077	124.7122	144.74550

Name	Triang	Logistic	Normal	Laplace	Uniform	ExtValueMin	Expon	Pareto	Levy
Graph									
Function	RiskTriang(42.177,	RiskLogistic(78.91	RiskNormal(79.040	RiskLaplace(78.52!	RiskUniform(50.53	RiskExtValueMin(	RiskExpon(25.865,	RiskPareto(3.1697,	RiskLevy(64.2333,2
Method	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares
Parameters - [* Values unavailable without running a bootstrap.]									
Num. Est.	3	2	2	2	2	2	2	2	2
Fitted Parameter #1	Min	alpha	mu	mu	Min	a	beta	theta	a
Fitted Value	42.17722	78.91254	79.03993	78.525710	50.53776	86.925615	25.86487	3.16973	64.233318
Fitted Parameter #2	M. likely	beta	sigma	sigma	Max	b	Shift Factor	a	c
Fitted Value	68.43047	10.99454	18.54605	22.287184	108.53278	16.055717	56.07396	58.63997	2.455531
Fitted Parameter #3	Max								
Fitted Value	127.61561								
Distribution Statistics									
Minimum	42.17722	−∞	−∞	−∞	50.53776	−∞	56.07396	58.63997	64.233318
Maximum	127.61561	+∞	+∞	+∞	108.53278	+∞	+∞	+∞	+∞
Mean	79.40777	78.91254	79.03993	78.525710	79.53527	77.658004	81.93883	85.66634	N/A
Mode	68.43047	78.91254	79.03993	78.525710	50.53776	86.925615	56.07396	58.63997	65.051828
Median	77.33299	78.91254	79.03993	78.525710	79.53527	81.040988	74.00212	72.97329	69.630843
Std. Deviation	17.86666	19.94189	18.54605	22.287184	16.74172	20.592257	25.86487	44.48932	N/A
Skewness	0.3454	0	0	0	0	-1.1395	2	29.8474	N/A
Kurtosis	2.4000	4.2000	3	6	1.8000	5.4000	9	N/A	N/A
Percentiles									
1%	46.91329	28.39131	35.89536	16.874501	51.11771	13.066923	56.33391	58.82620	64.603411
2.5%	49.66561	38.63337	42.69034	31.314710	51.98764	27.900831	56.72880	59.11023	64.722089
5%	52.76740	46.53979	48.53439	42.238307	53.43751	39.237002	57.40065	59.59662	64.872536
10%	57.15399	54.75507	55.27221	53.161904	56.33726	50.794355	58.79909	60.62190	65.140911
20%	63.35757	63.67087	63.43118	64.085501	62.13676	62.843004	61.84554	62.91690	65.728428
25%	65.85757	66.83380	66.53081	67.602113	65.03651	66.921809	63.51482	64.21108	66.088925
30%	68.11774	69.59689	69.31437	70.475395	67.93626	70.373288	65.29931	65.62403	66.519246
35%	70.28461	72.10649	71.89376	72.904720	70.83602	73.404278	67.21610	67.17639	67.044596
40%	72.53376	74.45464	74.34134	75.009097	73.73577	76.140557	69.28640	68.89434	67.699984
45%	74.87876	76.70626	76.70941	76.865290	76.63552	78.665958	71.53693	70.81173	68.536346
50%	77.33299	78.91254	79.03993	78.525710	79.53527	81.040988	74.00212	72.97329	69.630843
55%	79.91333	81.11882	81.37045	80.186131	82.43502	83.312908	76.72726	75.43966	71.105450
60%	82.64147	83.37044	83.73852	82.042323	85.33477	85.521999	79.77370	78.29563	73.162654
65%	85.54616	85.71859	86.18610	84.146700	88.23452	87.706256	83.22747	81.66445	76.159153
70%	88.66686	88.22819	88.76549	86.576025	91.13427	89.905986	87.21456	85.73412	80.772013
75%	92.06043	90.99128	91.54905	89.449307	94.03402	92.169962	91.93028	90.81009	88.418343
80%	95.81409	94.15421	94.64868	92.965920	96.93377	94.566290	97.70186	97.43336	102.490547
90%	105.12854	103.07001	102.80765	103.889516	102.73327	100.316604	115.63002	121.24891	219.737466
95%	111.71485	111.28529	109.54547	114.813113	105.63302	104.541766	133.55818	150.88568	688.710289
97.5%	116.37208	119.19171	115.38953	125.736710	107.08290	107.883507	151.48634	187.76654	2,564.597938
99%	120.50458	129.43377	122.18450	140.176919	107.95282	111.445579	175.18609	250.70440	15,695.809862

Table B-2. Fit Results for Drinking Water Distributions

@RISK - Fit Results
Performed By: Batson, Gillian
Date: Thursday, March 7, 2024 2:45:31 PM

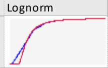
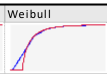
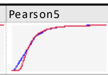
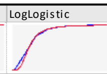
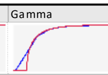
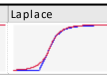
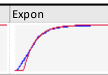
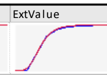


Name	BetaGeneral	Weibull	Pert	Gamma	InvGauss	Lognorm	Pearson5	ExtValue	LogLogistic
Graph									
Function	RiskBetaGeneral(:	RiskWeibull(1.424	RiskPert(-0.28811,(	RiskGamma(2.776:	RiskInvGauss(2.67	RiskLognorm(2.72(	RiskPearson5(13.1	RiskExtValue(0.49⁄	RiskLogLogistic(-2.
Method	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares
Parameters									
Num. Est.	4	3	3	3	3	3	3	2	3
Fitted Parameter #1	alpha1	alpha	Min	alpha	mu	mu	alpha	a	gamma
Fitted Value	1.579219	1.424627	-0.288110	2.7761048	2.675201	2.719967	13.16853	0.4943367	-2.651076
Fitted Parameter #2	alpha2	beta	M. likely	beta	lambda	sigma	beta	b	beta
Fitted Value	9.282017	1.592201	0.021821	0.6350984	16.527016	1.090214	44.83741	0.8491395	3.462343
Fitted Parameter #3	Min	Shift Factor	Max	Shift Factor	Shift Factor	Shift Factor	Shift Factor		alpha
Fitted Value	-0.435825	-0.438584	6.256139	-0.7609381	-1.678773	-1.724462	-2.69085		5.796883
Fitted Value	9.483867								
Distribution Statistics									
Minimum	-0.435825	-0.438584	-0.288110	-0.7609381	-1.678773	-1.724462	-2.69085	−∞	-2.651076
Maximum	9.483867	+∞	6.256139	+∞	+∞	+∞	+∞	+∞	+∞
Mean	1.006493	1.008739	1.009219	1.0021615	0.996428	0.995505	0.99385	0.9844733	0.986744
Mode	0.212580	0.242176	0.021821	0.3670631	0.424609	0.450784	0.47372	0.4943367	0.609251
Median	0.789989	0.792442	0.784939	0.7955807	0.798234	0.800250	0.80204	0.8055573	0.811267
Std. Deviation	1.015304	1.030669	0.986117	1.0581785	1.076310	1.090214	1.10257	1.0890638	1.211756
Skewness	1.0775	1.1655	1.0013	1.2004	1.2070	1.2669	1.3146	1.1395	1.9207
Kurtosis	4.1830	4.7172	3.6701	5.1613	5.4280	5.9832	6.5295	5.4000	16.3396
Percentiles									
1%	-0.364473	-0.375538	-0.257852	-0.5313193	-0.651978	-0.695871	-0.74511	-0.8024519	-1.083927
2.5%	-0.305925	-0.317996	-0.222111	-0.4278025	-0.507873	-0.539621	-0.57350	-0.6140645	-0.810723
5%	-0.229305	-0.240641	-0.168198	-0.3131449	-0.364301	-0.386381	-0.40903	-0.4373296	-0.567656
10%	-0.102123	-0.110505	-0.067503	-0.1470232	-0.172561	-0.184949	-0.19716	-0.2138732	-0.281028
20%	0.119894	0.116994	0.128228	0.1094033	0.103548	0.099978	0.09656	0.0902439	0.074830
25%	0.226300	0.225447	0.227717	0.2242433	0.222785	0.221553	0.22034	0.2169786	0.213522
30%	0.332888	0.333601	0.329880	0.3360824	0.337271	0.337619	0.33787	0.3367137	0.340443
35%	0.441203	0.443013	0.435670	0.4473307	0.449976	0.451343	0.45252	0.4530509	0.460587
40%	0.552588	0.555043	0.546044	0.5598672	0.563111	0.565050	0.56675	0.5685698	0.577368
45%	0.668368	0.671033	0.662056	0.6753798	0.678576	0.680715	0.68260	0.6854021	0.693462
50%	0.789989	0.792442	0.784939	0.7955807	0.798234	0.800250	0.80204	0.8055573	0.811267
55%	0.919158	0.920994	0.916217	0.9223909	0.924119	0.925726	0.92719	0.9311656	0.933222
60%	1.058015	1.058850	1.057851	1.0581530	1.058670	1.059613	1.06053	1.0647266	1.062113
65%	1.209404	1.208895	1.212479	1.2059366	1.205056	1.205107	1.20529	1.2094404	1.201469
70%	1.377326	1.375202	1.383816	1.3700443	1.367694	1.366673	1.36598	1.3697405	1.356193
75%	1.567774	1.563912	1.577404	1.5569555	1.553236	1.551038	1.54937	1.5522790	1.533743
80%	1.790478	1.785087	1.802145	1.7773052	1.772615	1.769307	1.76670	1.7679950	1.746662
90%	2.423676	2.420658	2.426288	2.4206117	2.418658	2.415920	2.41342	2.4052125	2.406974
95%	2.987101	3.000744	2.956689	3.0232534	3.032909	3.039204	3.04321	3.0164469	3.102838
97.5%	3.495218	3.541780	3.410237	3.5999262	3.629477	3.655308	3.67394	3.6159835	3.862794
99%	4.096803	4.212513	3.912715	4.3350657	4.402321	4.472534	4.52540	4.4005052	4.998372

Name	Laplace	Triang	Logistic	Expon	Normal	ExtValueMin	Uniform	Pareto	Levy
Graph									
Function	RiskLaplace(0.826(	RiskTriang(-0.4075	RiskLogistic(0.858:	RiskExpon(1.1672,I	RiskNormal(0.8673	RiskExtValueMin(1	RiskUniform(-0.78⁄	RiskPareto(0.6781!	RiskLevy(0.13913,0
Method	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares
Parameters									
Num. Est.	2	3	2	2	2	2	2	2	2
Fitted Parameter #1	mu	Min	alpha	beta	mu	a	Min	theta	a
Fitted Value	0.826630	-0.407498	0.8583219	1.167205	0.867353	1.305476	-0.784185	0.6781530	0.139131
Fitted Parameter #2	sigma	M. likely	beta	Shift Factor	sigma	b	Max	a	c
Fitted Value	1.374800	-0.251508	0.6542996	-0.086582	1.099044	1.066685	2.608358	0.1600721	0.122569
Fitted Parameter #3		Max							
Fitted Value		3.602866							
Fitted Value									
Distribution Statistics									
Minimum	−∞	-0.407498	−∞	-0.086582	−∞	−∞	-0.784185	0.1600721	0.139131
Maximum	+∞	3.602866	+∞	+∞	+∞	+∞	2.608358	+∞	+∞
Mean	0.826630	0.981286	0.8583219	1.080623	0.867353	0.689769	0.912086	N/A	N/A
Mode	0.826630	-0.251508	0.8583219	-0.086582	0.867353	1.305476	-0.784185	0.1600721	0.179987
Median	0.826630	0.822808	0.8583219	0.722463	0.867353	0.914522	0.912086	0.4448489	0.408552
Std. Deviation	1.374800	0.927415	1.1867683	1.167205	1.099044	1.368077	0.979343	N/A	N/A
Skewness	0	0.5627	0	2	0	-1.1395	0	N/A	N/A
Kurtosis	6	2.4000	4.2000	9	3	5.4000	1.8000	N/A	N/A
Percentiles									
1%	-2.976368	-0.328405	-2.1482634	-0.074851	-1.689407	-3.601435	-0.750259	0.1624621	0.157604
2.5%	-2.085614	-0.282441	-1.5387452	-0.057031	-1.286734	-2.615922	-0.699371	0.1661611	0.163528
5%	-1.411784	-0.229179	-1.0682235	-0.026712	-0.940414	-1.862787	-0.614558	0.1726491	0.171038
10%	-0.737954	-0.126973	-0.5793214	0.036396	-0.541129	-1.094957	-0.444931	0.1869775	0.184434
20%	-0.064125	0.086340	-0.0487300	0.173872	-0.057626	-0.294488	-0.105676	0.2224429	0.213760
25%	0.152800	0.198004	0.1395002	0.249202	0.126059	-0.023506	0.063951	0.2446524	0.231754
30%	0.330040	0.313457	0.3039352	0.329731	0.291014	0.205798	0.233578	0.2708527	0.253234
35%	0.479895	0.433112	0.4532847	0.416230	0.443869	0.407166	0.403205	0.3021290	0.279457
40%	0.609705	0.557465	0.5930262	0.509657	0.588913	0.588955	0.572832	0.3399792	0.312171
45%	0.724205	0.687117	0.7270231	0.611217	0.729246	0.756734	0.742459	0.3865228	0.353919
50%	0.826630	0.822808	0.8583219	0.722463	0.867353	0.914522	0.912086	0.4448489	0.408552
55%	0.929054	0.965471	0.9896206	0.845441	1.005460	1.065460	1.081714	0.5196205	0.482158
60%	1.043554	1.116306	1.1236175	0.982918	1.145793	1.212225	1.251341	0.6181807	0.584844
65%	1.173364	1.276902	1.2633590	1.138776	1.290837	1.357339	1.420968	0.7527139	0.734417
70%	1.323219	1.449442	1.4127085	1.318702	1.443692	1.503481	1.590595	0.9448204	0.964671
75%	1.500459	1.637068	1.5771435	1.531508	1.608647	1.653892	1.760222	1.2362588	1.346342
80%	1.717384	1.844603	1.7653738	1.791963	1.792332	1.813095	1.929849	1.7179569	2.048766
90%	2.391214	2.359586	2.2959651	2.601008	2.275835	2.195126	2.269103	4.7742935	7.901224
95%	3.065043	2.723734	2.7848672	3.410053	2.675120	2.475831	2.438730	13.2680154	31.310314
97.5%	3.738873	2.981226	3.2553889	4.219098	3.021440	2.697844	2.523544	36.8725200	124.946495
99%	4.629627	3.209706	3.8649071	5.288597	3.424113	2.934496	2.574432	142.3975573	780.399679

Table B-3. Fit Results for Inland South Fish Consumption Distributions

@RISK - Fit Results
Performed By: Batson, Gillian
Date: Thursday, March 7, 2024 2:56:57 PM

Name	Lognorm	Weibull	Pearson5	LogLogistic	Gamma	Laplace	Expon	ExtValue
Graph								
Function	RiskLognorm(0.012	RiskWeibull(0.717	RiskPearson5(3.20	RiskLogLogistic(-0.	RiskGamma(0.426	RiskLaplace(0.005	RiskExpon(0.01074	RiskExtValue(0.00
Method	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares
Parameters								
Num. Est.	3	3	3	3	3	2	2	2
Fitted Parameter #1	mu	alpha	alpha	gamma	alpha	mu	beta	a
Fitted Value	0.01203453	0.717723835	3.19995927	-0.00732893	0.42655542	0.005172	0.01074044	0.001689904
Fitted Parameter #2	sigma	beta	beta	beta	beta	sigma	Shift Factor	b
Fitted Value	0.01349531	0.006824745	0.03700347	0.01262228	0.01744850	0.015189	-0.00227258	0.009031133
Fitted Parameter #3	Shift Factor	Shift Factor	Shift Factor	alpha	Shift Factor			
Fitted Value	-0.00271066	0.001206730	-0.00758125	2.56036955	0.00240258			
Distribution Statistics								
Minimum	-0.00271066	0.001206730	-0.00758125	-0.00732893	0.00240258	−∞	-0.00227258	−∞
Maximum	+∞	+∞	+∞	+∞	+∞	+∞	+∞	+∞
Mean	0.00932387	0.009647278	0.00923883	0.00912131	0.00984533	0.005172	0.00846786	0.006902815
Mode	0.00083737	0.001206730	0.00122919	0.00181662	0.00240258	0.005172	-0.00227258	0.001689904
Median	0.00529902	0.005302255	0.00529620	0.00529336	0.00530227	0.005172	0.00517213	0.004999931
Std. Deviation	0.01349531	0.011996663	0.01535481	0.01858567	0.01139582	0.015189	0.01074044	0.011582878
Skewness	4.7743	3.3551	21.9130	N/A	3.0623	0	2	1.1395
Kurtosis	61.2710	21.7374	N/A	N/A	17.0662	6	9	5.4000
Percentiles								
1%	-0.00172905	0.001217964	-0.00334833	-0.00523141	0.00240285	-0.036844	-0.00216463	-0.012102258
2.5%	-0.00134443	0.001247429	-0.00267370	-0.00431093	0.00240488	-0.027003	-0.00200065	-0.010098639
5%	-0.00089509	0.001315578	-0.00196891	-0.00333227	0.00241429	-0.019558	-0.00172167	-0.008218953
10%	-0.00019074	0.001503479	-0.00097187	-0.00197785	0.00246219	-0.012114	-0.00114096	-0.005842354
20%	0.00103727	0.002050984	0.00058862	1.608E-005	0.00270833	-0.004669	0.00012408	-0.002607877
25%	0.00164736	0.002409529	0.00131251	0.00088951	0.00292290	-0.002273	0.00081725	-0.001259974
30%	0.00227942	0.002829551	0.00203818	0.00173712	0.00320953	-0.000314	0.00155827	1.348E-005
35%	0.00294667	0.003317792	0.00278342	0.00258248	0.00357779	0.001341	0.00235422	0.001250803
40%	0.00366215	0.003883584	0.00356381	0.00344471	0.00403915	0.002775	0.00321391	0.002479420
45%	0.00444039	0.004539464	0.00439531	0.00434185	0.00460787	0.004040	0.00414845	0.003722005
50%	0.00529902	0.005302255	0.00529620	0.00529336	0.00530227	0.005172	0.00517213	0.004999931
55%	0.00626075	0.006194800	0.00628922	0.00632244	0.00614652	0.006303	0.00630374	0.006335854
60%	0.00735633	0.007248827	0.00740465	0.00745922	0.00717363	0.007569	0.00756879	0.007756359
65%	0.00862949	0.008509823	0.00868517	0.00874568	0.00843020	0.009003	0.00900297	0.009295481
70%	0.01014585	0.010045852	0.01019474	0.01024457	0.00998514	0.010658	0.01065862	0.011000373
75%	0.01201049	0.011964759	0.01203615	0.01205700	0.01194623	0.012616	0.01261683	0.012941786
80%	0.01440679	0.014451496	0.01439015	0.01436228	0.01449579	0.015013	0.01501349	0.015236061
90%	0.02274848	0.023021931	0.02260161	0.02244493	0.02318100	0.022458	0.02245819	0.022013270
95%	0.03262543	0.032683850	0.03256045	0.03253490	0.03264329	0.029902	0.02990290	0.028514131
97.5%	0.04424711	0.043273275	0.04478239	0.04546183	0.04260287	0.037347	0.03734760	0.034890581
99%	0.06264602	0.058510392	0.06544119	0.06862853	0.05627988	0.047188	0.04718897	0.043234462

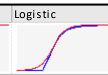
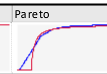
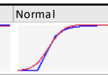
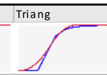
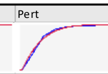
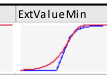
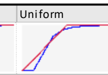
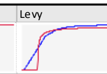
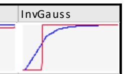
Name	Logistic	Pareto	Normal	Triang	Pert	ExtValueMin	Uniform	Levy	InvGauss
Graph									
Function	RiskLogistic(0.0047	RiskPareto(1.1033,	RiskNormal(0.0045	RiskTriang(-0.0281	RiskPert(-0.008246	RiskExtValueMin(	RiskUniform(-0.01	RiskLevy(0.004523	RiskInvGauss(0.01
Method	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares
Parameters									
Num. Est.	2	2	2	3	3	2	2	2	3
Fitted Parameter #1	alpha	theta	mu	Min	Min	a	Min	a	mu
Fitted Value	0.004761638	1.103276710	0.00453531	-0.02812253	-0.00824669	0.009253	-0.01920311	0.004524	0.01597525
Fitted Parameter #2	beta	a	sigma	M. likely	M. likely	b	Max	c	lambda
Fitted Value	0.007687561	0.002880466	0.01335192	0.00517628	-0.00824669	0.014445	0.02624299	0.000357	91.11567300
Fitted Parameter #3				Max	Max				Shift Factor
Fitted Value				0.03603905	0.08661438				-0.00810000
Distribution Statistics									
Minimum	−∞	0.002880466	−∞	-0.02812253	-0.00824669	−∞	-0.01920311	0.004524	-0.00810000
Maximum	+∞	+∞	+∞	0.03603905	0.08661438	+∞	0.02624299	+∞	+∞
Mean	0.004761638	0.030771222	0.00453531	0.00436427	0.00756349	0.000915	0.00351994	N/A	0.00787525
Mode	0.004761638	0.002880466	0.00453531	0.00517628	-0.00824669	0.009253	-0.01920311	0.004643	0.00787105
Median	0.004761638	0.005399003	0.00453531	0.00456160	0.00403303	0.003959	0.00351994	0.005309	0.00787525
Std. Deviation	0.013943694	N/A	0.01335192	0.01310008	0.01336204	0.018527	0.01311916	N/A	0.00021153
Skewness	0	N/A	0	-0.0372	1.1832	-1.1395	0	N/A	0.0397
Kurtosis	4.2000	N/A	3	2.4000	4.2000	5.4000	1.8000	N/A	3.0026
Percentiles									
1%	-0.030563628	0.002906825	-0.02652589	-0.02350030	-0.00805620	-0.057196	-0.01874865	0.004577	0.00739068
2.5%	-0.023402217	0.002947330	-0.02163396	-0.02081414	-0.00776757	-0.043851	-0.01806696	0.004595	0.00746600
5%	-0.017873918	0.003017545	-0.01742663	-0.01778690	-0.00727851	-0.033652	-0.01693080	0.004617	0.00753108
10%	-0.012129661	0.003169107	-0.01257586	-0.01350575	-0.00626868	-0.023254	-0.01465850	0.004656	0.00760645
20%	-0.005895585	0.003526152	-0.00670194	-0.00745128	-0.00410624	-0.012414	-0.01011389	0.004741	0.00769821
25%	-0.003684012	0.003738574	-0.00447042	-0.00501136	-0.00294277	-0.008744	-0.00784158	0.004794	0.00773321
30%	-0.001752017	0.003979829	-0.00246644	-0.00280552	-0.00171549	-0.005639	-0.00556928	0.004856	0.00776471
35%	2.736E-006	0.004256340	-0.00060945	-0.00077703	-0.00041596	-0.002912	-0.00329697	0.004933	0.00779395
40%	0.001644600	0.004576615	0.00115264	0.00111104	0.00096618	-0.000450	-0.00102467	0.005028	0.00782175
45%	0.003218969	0.004952170	0.00285749	0.00288435	0.00244376	0.001822	0.00124764	0.005150	0.00784869
50%	0.004761638	0.005399003	0.00453531	0.00456160	0.00403303	0.003959	0.00351994	0.005309	0.00787525
55%	0.006304306	0.005940017	0.00621313	0.00618789	0.00575498	0.006003	0.00579225	0.005524	0.00790185
60%	0.007878676	0.006609246	0.00791798	0.00789510	0.00763750	0.007990	0.00806455	0.005823	0.00792893
65%	0.009520540	0.007459595	0.00968008	0.00971280	0.00971876	0.009956	0.01033686	0.006259	0.00795697
70%	0.011275292	0.008578182	0.01153707	0.01166568	0.01205329	0.011935	0.01260916	0.006930	0.00798656
75%	0.013207287	0.010119624	0.01354105	0.01378931	0.01472314	0.013972	0.01488147	0.008043	0.00801856
80%	0.015418861	0.012388044	0.01577257	0.01613828	0.01786101	0.016128	0.01715377	0.010091	0.00805427
90%	0.021652937	0.023219540	0.02164648	0.02196708	0.02676109	0.021301	0.02169838	0.027152	0.00814865
95%	0.027397193	0.043521561	0.02649726	0.02608866	0.03450907	0.025102	0.02397069	0.095394	0.00822700
97.5%	0.032925493	0.081574670	0.03070459	0.02900307	0.04125407	0.028109	0.02510684	0.368364	0.00829526
99%	0.040086904	0.187173576	0.03559652	0.03158910	0.04884951	0.031314	0.02578853	2.279154	0.00837498

Table B-4. Fit Results for Atlantic Fish Consumption Distribution

@RISK Fit Results
Performed By: Bradley Barnhart
Date: Tuesday, October 29, 2024 4:58:51 PM

	Input	Weibull	Lognorm	Gamma	Pearson5	Loglogistic	Expon	Laplace	ExtValue	Logistic	Pareto	Normal	Triang	ExtValueMin	Uniform	Levy	Invgauss
Fit																	
Function	4,0.0093087,RiskShift(0.0025916))	skShift(-0.0029749))	iskShift(0.0040845))	skShift(-0.0096367))	97113,0.018,2.7589)	skShift(-0.0014041))	).0081547,0.019503)	).0036803,0.011617)	0076338,0.0099035)	o(1.2342,0.0048096)	).0073245,0.017265)	).0062344,0.048195)	(0.013425,0.018771)	-0.023115,0.035227)	073174,0.00045227)	5,RiskShift(-0.0091))
Method		Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares
RMS Error		0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.05	0.23
Parameters - [* Values unavailable without running a bootstrap]																	
Num. Est. Parameters		3.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	3.00
Fitted Parameter #1		alpha	mu	alpha	alpha	gamma	beta	mu	a	alpha	theta	mu	Min	a	Min	a	mu
Fitted Value		0.75	0.02	0.47	3.52	(0.01)	0.01	0.01	0.00	0.01	1.23	0.01	(0.03)	0.01	(0.02)	0.01	0.02
Fitted Parameter #2		beta	sigma	beta	beta	beta	Shift Factor	sigma	b	beta	a	sigma	M. likely	b	Max	c	lambda
Fitted Value		0.01	0.02	0.02	0.06	0.02	(0.00)	0.02	0.01	0.01	0.00	0.02	0.01	0.02	0.04	0.00	74.67
Fitted Parameter #3		Shift Factor	Shift Factor	Shift Factor	Shift Factor	alpha							Max				Shift Factor
Fitted Value		0.00	(0.00)	0.00	(0.01)	2.76							0.05				(0.01)
Distribution Statistics																	
Minimum	0.00910 [est]	0.00	(0.00)	0.00	(0.01)	(0.01)	(0.00)	-Infinity	-Infinity	-Infinity	0.00	-Infinity	(0.03)	-Infinity	(0.02)	0.01	(0.01)
Maximum	0.0876 [est]	+Infinity	+Infinity	+Infinity	+Infinity	+Infinity	+Infinity	+Infinity	+Infinity	+Infinity	+Infinity	+Infinity	0.05	+Infinity	0.04	+Infinity	+Infinity
Mean	0.0114 [est]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.01	0.01	0.00	0.01	+Infinity	0.01
Mode	N/A	0.00	0.00	0.00	0.00	0.00	(0.00)	0.01	0.00	0.01	0.00	0.01	0.01	0.01	(0.02)	0.01	0.01
Median	0.00830 [est]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Std. Deviation	0.0166 [est]	0.02	0.02	0.01	0.02	0.02	0.01	0.02	0.01	0.02	+Infinity	0.02	0.02	0.02	0.02	+Infinity	0.00
Skewness	1.6391 [est]	3.12	4.19	2.92	9.47	+Infinity	2.00	-	1.14	-	+Infinity	-	0.05	(1.14)	-	+Infinity	0.05
Kurtosis	6.6179 [est]	19.00	45.47	15.81	+Infinity	+Infinity	9.00	6.00	5.40	4.20	+Infinity	3.00	2.40	5.40	1.80	+Infinity	3.00
Percentiles																	
5%	(0.01)	0.00	(0.00)	0.00	(0.00)	(0.00)	(0.00)	(0.02)	(0.01)	(0.02)	0.01	(0.02)	(0.02)	(0.04)	(0.02)	0.01	0.01
10%	(0.01)	0.00	0.00	0.00	(0.00)	(0.00)	4.90E-05	(0.01)	(0.01)	(0.01)	0.01	(0.01)	(0.01)	(0.03)	(0.02)	0.01	0.01
15%	(0.00)	0.00	0.00	0.00	0.00	(0.00)	0.00	(0.01)	(0.00)	(0.01)	0.01	(0.01)	(0.01)	(0.02)	(0.01)	0.01	0.01
20%	(0.00)	0.00	0.00	0.00	0.00	0.00	0.00	(0.00)	(0.00)	(0.01)	0.01	(0.01)	(0.01)	(0.01)	(0.01)	0.01	0.01
25%	(0.00)	0.00	0.00	0.00	0.00	0.00	0.00	(0.00)	(0.00)	(0.00)	0.01	(0.00)	(0.00)	(0.01)	(0.01)	0.01	0.01
30%	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	(0.00)	0.01	(0.00)	(0.00)	(0.01)	(0.01)	0.01	0.01
35%	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	(0.00)	(0.00)	0.01	0.01
40%	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01
45%	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01
50%	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
55%	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
60%	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
65%	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
70%	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01
75%	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01
80%	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
85%	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.01
90%	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.01
95%	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.03	0.03	0.12	0.01

Appendix C: Drinking Water Ingestion Distribution Data from EPA's Exposure Factors Handbook

Table 3-23. Per Capita[a] Estimates of Combined Direct and Indirect[b] Water Ingestion Based on NHANES 2003–2006: Community Water (mL/day)

Age	Sample Size	Mean	Percentile						
			10	25	50	75	90	95	99
Birth to <1 month	88	239*	-	-	78*	473*	693*	851*	956*
1 to <3 months	143	282*	-	-	41*	524*	784*	962*	1,102*
3 to <6 months	244	373*	-	-	378*	630*	794*	925*	1,192*
6 to <12 months	466	303	-	46	199	520	757*	866*	1,150*
1 to <2 years	611	223	-	27	134	310	577*	760*	1,206*
2 to <3 years	571	265	-	39	160	387	657*	861*	1,354*
3 to <6 years	1,091	327	-	67	245	465	746	959	1,570*
6 to <11 years	1,601	414	-	64	297	598	1,000	1,316	2,056*
11 to <16 years	2,396	520	-	60	329	688	1,338	1,821	2,953
16 to <18 years	1,087	573	-	59	375	865	1,378	1,783	3,053
18 to <21 years	1,245	681	-	88	355	872	1,808	2,368	3,911
≥21 years	8,673	1,043	-	227	787	1,577	2,414	2,958	4,405
≥65 years	2,287	1,046	-	279	886	1,587	2,272	2,730	4,123
All ages	18,216	869	-	134	560	1,299	2,170	2,717	4,123

[a] Includes all participants whether or not they ingested any water from the source during survey period.

[b] Direct water is defined as water ingested directly as a beverage; indirect water is defined as water added in the preparation of food or beverages.

\- = Zero.

* Estimates are less statistically reliable based on guidance published in the *Joint Policy on Variance Estimation and Statistical Reporting Standards on NHANES III and CSFII Reports: NHIS/NCHS Analytical Working Group Recommendations* (NCHS, 1993).

Source: U.S. EPA analysis of NHANES 2003–2006 data.