4.0 Tapwater Exposure Assessment

Approach Used to Derive LifeLine™ Inputs

In EPA's most recent assessment *Organophosphate Pesticides: Revised OP Cumulative Risk Assessment, June 11, 2002* (June 11 assessment), EPA has modeled the levels and co-occurrence of the residues of OP pesticides using the scenario of a surface water supply (reservoir) receiving water contaminated with pesticides from agricultural runoff. EPA modeled the residues using two linked fate and transport models (PRZM and EXAMS). This effort produces a "daily residue history" for hypothetical surface water supplies in seven agricultural regions of the United States for periods of time ranging from 18 to 35 years. This approach assumes that the random selection of the 18 to 35 residues available for a specific calendar date represents the variability in the residue levels on that specific date in a specific region.

LifeLine™ Version 2.0 estimates exposures for the general U.S. population and each of the four census regions. The estimates of tapwater exposures are based on data on residues entered by the user. Residue data can be entered into LifeLine™ as a single value or as a distribution. Separate distributions can be entered to account for variation in residues as a function of water source, census region, season of the year, and other factors. Thus, data on geographic and temporal variation can be entered into LifeLine™.

The goal in this assessment is to use the PRZM-EXAMS data in a manner that is consistent with EPA's use of the data in the June 11 assessment. It is not possible; however, to exactly match the June 11 assessment since LifeLine™ enters tapwater data using a different format and uses a different approach for assessing tapwater exposures and risks. First, LifeLine™ calculates the doses that occur on each of the 91-92 days of a season but it reports doses using three types of output, the average of the daily doses, the maximum of the daily doses, and the dose that occurs on a randomly selected day (see Chapter 6.0).

Both the maximum and the random days are independent of the specific calendar dates. The calendar date for the random day will vary from one individual to another and from one season to another. Thus, the 10th day of one season may be selected for winter and the 70th day for spring. In addition, the maximum day may occur on different days of a season depending on which is the day when doses are highest. For this reason the LifeLine™ approach will not focus on the specific calendar dates of the residue histories of the PRZM-EXAM modeling.

Second, LifeLine™ Version 2.0 assumes that residues will remain constant over a season. Thus, the model will select a single residue and hold it constant for a season. As a result, the software does not capture the day-to day variation in the history of residues in the PRZM-EXAMS data or

the linkage of a residue to a specific day in a season. However, this limitation is immaterial to the random day and maximum day metrics. Since these days are taken from different days each season and for each individual, it is not critical that the residues are linked to a specific date or to residues on prior or subsequent days. This approach is equivalent to saying that the residue on a randomly selected day of a season is best predicted by randomly sampling a residue from any day of a season in any year of the residue history.

In the case of a single day, the probability of selecting a specific residue in a season will be equal to the number of residues in the season and the number of years for which data are available. Therefore, in this analysis, the data on the residues in each season from multiple years will be entered into a common bin. This results in four bins for each of the seven agricultural regions for a total of 28 bins.

In LifeLine™, data on residues are entered using an empirical cumulative distribution. As a result, rather then entering in the thousand or more specific daily values, the percentiles of the cumulative distribution of the daily residues are entered.

Third, LifeLine™ is based on assigning individuals into each of the four United States census regions (South, West, Mid West, and Northeast). Therefore, the residues from the seven agricultural regions must be converted to equivalent residue distributions for each of the four census regions. This conversion was performed by sampling from each of the agricultural regions that overlap a given census region using a sample weight. The sample weight is defined as the fraction of the census region's population that falls into each of the agricultural regions.

Longer term doses (7-day average doses) were also calculated in this analysis. The determination of these longitudinal doses requires that the longitudinal patterns in the residue histories be captured and maintained throughout the exposure and risk assessment process. The binning and sorting of the individual days for each season and agricultural region lose this longitudinal pattern. Therefore, the tapwater distributions presented above may or may not be appropriate for these longer term exposure estimates.

In order to determine if the distribution of single day value is appropriate or if alternative distributions are required to characterize longer-term average doses, two separate set of residue distributions were created. These distributions are created in the same process as the one-day doses with one additional step. Prior to binning and sorting the daily residues, the residue exposure histories are used to create histories of running 7-day and 21-day average residue levels. These residue levels are created by calculating the average residues for the 7-day and 21-day periods ending on each day of the residue histories. For example, the first 7-day average residue in a specific agricultural region is calculated based on the first 7 daily residues in the residue history for that region (January 1 through January 7). The second average is created based on the residues on January 2 through January 8. This process is repeated for the entire residue history of

each of the agricultural regions. These 7-day averages are then binned by season, sorted, and used to prepare LifeLine™ input files that are relevant for that averaging period. The same process is used to generate the distribution of 21-day averages.

Creation of LifeLine™ Tapwater Input Files

The EPA data from the PRZM-EXAMS modeling of the seven agricultural regions were used to derive the distributions for the rural and urban public water supplies. The process for creating the input files for the OP cumulative assessment is as follows.

Creation of Inputs for One Day Tapwater Exposures

Using Excel, the data files for agricultural regions A - G are merged into a single table and placed onto a common time frame (1/1/49 to 12/31/83). Each day's value for each of the seven regions was assigned to one of the four seasons. Days in the months of January, February, and March were assigned to Winter. Days in the months of April, May, and June were assigned to Spring. Days in the months of July, August, and September were assigned to Summer. Days in the months of October, November, and December were assigned to Fall.

The days were then sorted by season. This resulted in 28 sets of data (seven sets of four seasons). Cumulative empirical distributions of the values of the 28 sets of data were constructed using the PERCENTILE function in Excel. These distributions are given in Tables 4.1-4.

Table 4.1. Cumulative Distribution of Daily Residues (ppm) During Winter Months (Jan.-March)							
Quantile	A	B	C	D	E	F	G
0	3.73E-06	8.36E-06	3.90E-05	1.96E-08	4.25E-07	1.67E-07	1.82E-06
0.01	4.30E-06	8.78E-06	4.62E-05	2.75E-08	5.72E-07	2.01E-07	2.18E-06
0.05	5.20E-06	1.05E-05	5.97E-05	8.20E-08	1.14E-06	3.41E-07	2.71E-06
0.25	7.09E-6	1.60E-05	7.85E-05	9.98E-07	7.33E-06	1.01E-06	3.76E-06
0.5	8.86E-06	2.18E-05	9.79E-05	1.90E-06	9.20E-06	1.43E-06	4.89E-06
0.75	1.28E-05	3.40E-05	1.25E-04	3.92E-06	1.13E-05	2.20E-06	6.71E-06
0.9	1.78E-05	5.20E-05	1.53E-04	6.32E-06	1.35E-05	3.10E-06	9.03E-06
0.95	2.10E-05	5.78E-05	1.81E-04	7.70E-06	1.48E-05	4.10E-06	1.06E-05
0.975	0.00003	6.38E-05	2.00E-04	1.04E-05	1.62E-05	5.07E-06	1.43E-05
0.99	0.00003	6.96E-05	2.24E-04	1.23E-05	1.70E-05	6.13E-06	1.89E-04
0.995	3.23E-05	7.28E-05	2.43E-04	1.29E-05	1.72E-05	6.74E-06	3.91E-04
0.9975	0.00003	7.41E-05	2.52E-04	1.31E-05	1.75E-05	7.53E-06	1.71E-03
0.999	0.00004	7.50E-05	2.69E-04	1.34E-05	1.77E-05	8.14E-06	2.44E-03
0.9995	3.64E-05	7.53E-05	2.75E-04	1.35E-05	1.77E-05	8.36E-06	2.51E-03
1	3.70E-05	7.58E-05	2.79E-04	1.36E-05	1.79E-05	8.58E-06	0.00258

Table 4.2. Cumulative Distribution of Daily Residues (ppm) During Spring Months (April-June)							
Quantile	A	B	C	D	E	F	G
0	1.20E-06	8.33E-06	1.78E-05	4.62E-08	3.94E-07	1.47E-07	1.35E-06
0.01	1.43E-06	9.10E-06	0.00002	1.44E-07	6.91E-07	3.39E-07	1.73E-06
0.05	1.91E-06	1.18E-05	2.61E-05	2.36E-07	4.25E-06	5.85E-07	3.18E-06
0.25	3.13E-06	1.87E-05	3.48E-05	5.73E-07	6.60E-06	3.24E-05	2.20E-04
0.5	4.35E-06	2.97E-05	0.00004	1.84E-06	7.25E-05	1.52E-04	5.48E-04
0.75	6.00E-06	4.69E-05	5.68E-05	2.38E-04	2.75E-04	3.89E-04	1.26E-03
0.9	8.79E-06	0.00008	0.00007	8.31E-04	6.03E-04	7.41E-04	2.62E-03
0.95	0.00001	0.000105	8.03E-05	1.36E-03	9.38E-04	1.14E-03	3.59E-03
0.975	0.00001	0.000126	0.00009	1.98E-03	1.50E-03	1.54E-03	4.69E-03
0.99	0.00001	1.33E-04	0.000104	0.00304	2.28E-03	2.03E-03	5.80E-03
0.995	0.00002	1.36E-04	0.000124	0.00358	0.00279	2.61E-03	6.58E-03
0.9975	0.00002	1.38E-04	1.34E-04	0.00419	0.00324	0.00317	0.00793
0.999	1.86E-05	1.41E-04	1.43E-04	4.51E-03	0.00353	0.00349	0.00837
0.9995	1.88E-05	1.42E-04	1.45E-04	4.71E-03	3.63E-03	3.57E-03	0.00844
1	0.00002	1.42E-04	1.48E-04	4.91E-03	3.75E-03	3.66E-03	0.00868

Table 4.3. Cumulative Distribution of Daily Residues (ppm) During Summer Months (July-Sept.)							
Quantile	A	B	C	D	E	F	G
0	4.09E-07	1.50E-05	1.72E-05	1.22E-07	2.06E-06	2.50E-07	2.71E-05
0.01	5.65E-07	0.00002	2.02E-05	7.60E-07	4.13E-06	7.80E-07	3.50E-05
0.05	7.66E-07	0.00002	2.38E-05	2.91E-06	1.86E-05	2.35E-06	4.45E-05
0.25	1.16E-06	0.00003	0.00003	1.69E-05	3.12E-05	6.57E-06	8.69E-05
0.5	1.83E-06	3.67E-05	0.00005	0.00004	4.49E-05	1.31E-05	1.85E-04
0.75	3.88E-05	5.43E-05	6.81E-05	0.000107	6.96E-05	3.01E-05	4.13E-04
0.9	2.48E-04	8.92E-05	8.93E-05	0.000254	1.16E-04	5.96E-05	8.46E-04
0.95	6.74E-04	1.07E-04	9.33E-05	3.95E-04	0.000159	8.27E-05	1.48E-03
0.975	1.41E-03	1.14E-04	9.63E-05	5.53E-04	1.95E-04	1.10E-04	2.41E-03
0.99	2.91E-03	1.18E-04	1.07E-04	7.67E-04	0.000247	1.52E-04	3.64E-03
0.995	4.04E-03	1.20E-04	1.33E-04	9.91E-04	2.73E-04	0.000191	5.45E-03
0.9975	5.60E-03	1.21E-04	1.59E-04	1.18E-03	3.03E-04	0.000222	6.96E-03
0.999	9.74E-03	1.22E-04	2.53E-04	1.27E-03	3.46E-04	0.000247	0.00807
0.9995	1.15E-02	1.22E-04	3.10E-04	1.30E-03	3.58E-04	2.52E-04	0.00846
1	1.37E-02	1.22E-04	3.95E-04	1.40E-03	3.71E-04	2.58E-04	0.00863

Table 4.4 Cumulative Distribution of Daily Residues (ppm) During Fall Months (Oct.-Dec.)							
Quantile	A	B	C	D	E	F	G
0	5.01E-06	1.14E-05	6.20E-05	7.59E-08	1.29E-06	2.49E-07	4.67E-06
0.01	5.88E-06	1.32E-05	7.00E-05	1.45E-07	1.72E-06	5.23E-07	5.54E-06
0.05	9.13E-06	1.54E-05	8.26E-05	1.00E-06	8.80E-06	1.19E-06	7.29E-06
0.25	1.27E-05	2.34E-05	1.04E-04	2.89E-06	1.31E-05	2.12E-06	1.09E-05
0.5	1.90E-05	3.18E-05	1.20E-04	5.59E-06	1.68E-05	3.32E-06	1.59E-05
0.75	2.83E-05	4.56E-05	1.40E-04	1.00E-05	2.10E-05	5.10E-06	2.58E-05
0.9	4.22E-05	7.60E-05	1.66E-04	1.70E-05	2.62E-05	6.91E-06	4.01E-05
0.95	5.35E-05	8.84E-05	1.84E-04	2.25E-05	2.93E-05	8.37E-06	5.04E-05
0.975	6.54E-05	9.63E-05	2.33E-04	2.75E-05	3.19E-05	1.10E-05	6.28E-05
0.99	8.39E-05	1.02E-04	3.46E-04	3.64E-05	3.57E-05	1.71E-05	8.35E-05
0.995	9.74E-05	1.04E-04	4.09E-04	4.29E-05	3.77E-05	2.08E-05	9.63E-05
0.9975	1.08E-04	1.05E-04	4.83E-04	4.66E-05	3.94E-05	2.29E-05	1.04E-04
0.999	1.19E-04	1.05E-04	6.13E-04	4.86E-05	4.06E-05	2.54E-05	1.09E-04
0.9995	1.25E-04	1.05E-04	6.54E-04	4.95E-05	4.10E-05	2.62E-05	1.10E-04
1	0.00013	1.06E-04	7.60E-04	5.04E-05	4.14E-05	2.67E-05	0.000112

The distributions for the four census regions and four seasons (total of 16 distributions) were created using @Risk, an Excel add-on program that facilitates Monte Carlo modeling. An @Risk function RISKCUMUL was constructed for each of the 16 combinations of census region and season that performed that actual sampling. Each of the 16 functions sampled the cumulative

functions for each of the agricultural regions that overlap a given census region based on the fraction of the census region that lives in each of the agricultural regions. (These fractions were calculated by EPA and provided to LLG. The fractions are given in Table 4.5.)

An example of this process is as follows. The Northeast census region is overlapped by two agricultural regions, D and E. In the Northeast census region, 94.6% of the population live in region D and 5.4% in region E. Thus, in developing the spring Northeast region distribution residues, the RISKCUMUL function sampled the spring cumulative distribution of agricultural region D 94.6 % of the time and the spring cumulative distribution of agricultural region E 5.4% of the time. A total of 20,000 samples is taken from the relevant agricultural region distributions and used to construct the final 16 distributions.

Table 4.5. Percent of Population in the Four Census Regions Living in Each of the Seven Agricultural Regions (A-G)

Census Region	Agricultural Regions[1]	Percent	Cumulative Percent
West	D(1_2_3)	2.63	2.633
West	F(4_11)	4.79	7.4
West	C(7_8)	77.12	84.5
West	B(10)	15.45	100
Midwest	D(1_2_3)	92.68	92.684
Midwest	F(4_11)	4.81	97.49
Midwest	E(5_6_EAST)	1.19	98.675
Midwest	G(5_6_WEST)	1.32	100
Northeast	D(1_2_3)	94.60	94.6
Northeast	E(5_6_EAST)	5.40	100
South	D(1_2_3)	3.27	3.275
South	F(4_11)	20.94	24.214
South	E(5_6_EAST)	48.98	73.195
South	G(5_6_WEST)	9.66	82.856
South	A(12)	17.14	100

[1]For additional information on the agricultural regions, see the June 11 assessment.

These 20,000 values were used to create the cumulative input distributions for each of the 16 season/census region combinations using the Excel PERCENTILE function. These functions are described by a minimum value, a maximum value, and the values that correspond to select

percentiles. Table 4.6 present the values for the cumulative functions for the 16 combinations of region and season.

Table 4.6. Final 1 Day Distributions for Seasons and Census Regions				
Quantile	Region			
	West	Midwest	Northeast	South
	Winter			
0	2.29e-08	1.96e-08	1.96e-08	2.15e-08
0.01	6.21e-07	2.92e-08	2.80e-08	2.77e-07
0.05	2.16e-06	1.02e-07	9.38e-08	7.11e-07
0.25	5.62e-05	1.02e-06	1.04e-06	2.70e-06
0.5	8.61e-05	1.93e-06	2.10e-06	7.50e-06
0.75	1.17e-04	3.98e-06	4.48e-06	1.04e-05
0.9	1.47e-04	6.48e-06	7.34e-06	1.33e-05
0.95	1.73e-04	8.35e-06	9.90e-06	1.56e-05
0.975	1.94e-04	1.08e-05	1.17e-05	1.73e-05
0.99	2.19e-04	1.25e-05	1.31e-05	2.22e-05
0.995	2.38e-04	1.31e-05	1.37e-05	2.84e-05
0.9975	2.50e-04	1.34e-05	1.51e-05	4.64e-05
0.999	2.64e-04	1.52e-05	1.67e-05	2.37e-04
0.9995	2.71e-04	1.71e-05	1.70e-05	1.17e-03
1	2.79e-04	1.58e-03	1.77e-05	2.58e-03
	Spring			
0	5.14e-08	4.64e-08	4.66e-08	6.23e-08
0.01	8.23e-07	1.46e-07	1.46e-07	4.29e-07
0.05	1.64e-05	2.42e-07	2.42e-07	1.93e-06
0.25	3.19e-05	6.61e-07	6.41e-07	5.80e-06
0.5	4.31e-05	2.43e-05	1.42e-05	6.44e-05
0.75	5.91e-05	2.87e-04	2.48e-04	3.21e-04
0.9	8.02e-05	8.55e-04	8.22e-04	7.77e-04
0.95	1.15e-04	1.38e-03	1.35e-03	1.32e-03
0.975	2.68e-04	2.04e-03	1.97e-03	2.11e-03
0.99	6.80e-04	3.14e-03	3.01e-03	3.08e-03
0.995	1.12e-03	3.68e-03	3.54e-03	3.71e-03
0.9975	1.57e-03	4.29e-03	4.16e-03	4.72e-03
0.999	1.89e-03	4.59e-03	4.50e-03	5.64e-03
0.9995	2.21e-03	4.80e-03	4.70e-03	6.57e-03
1	4.21e-03	7.80e-03	4.91e-03	8.54e-03

Table 4.6. Final 1 Day Distributions for Seasons and Census Regions (Continued)				
Quantile	Region			
	West	Midwest	Northeast	South
	Summer			
0	2.58e-07	1.23e-07	1.24e-07	1.55e-07
0.01	4.67e-06	7.79e-07	7.88e-07	7.29e-07
0.05	1.82e-05	2.90e-06	3.07e-06	1.20e-06
0.25	2.84e-05	1.63e-05	1.81e-05	1.66e-05
0.5	4.50e-05	4.10e-05	4.26e-05	3.84e-05
0.75	6.69e-05	1.05e-04	1.05e-04	7.65e-05
0.9	8.96e-05	2.53e-04	2.48e-04	1.81e-04
0.95	9.48e-05	3.97e-04	3.86e-04	3.38e-04
0.975	1.05e-04	5.64e-04	5.43e-04	6.54e-04
0.99	1.31e-04	8.18e-04	7.60e-04	1.38e-03
0.995	1.92e-04	1.06e-03	9.75e-04	2.44e-03
0.9975	2.51e-04	1.23e-03	1.16e-03	3.51e-03
0.999	3.87e-04	1.37e-03	1.27e-03	4.87e-03
0.9995	4.87e-04	2.20e-03	1.30e-03	7.45e-03
1	1.20e-03	6.22e-03	1.39e-03	1.33e-02
	Fall			
0	1.04e-07	7.66e-08	7.62e-08	8.77e-08
0.01	1.60e-06	1.60e-07	1.55e-07	1.03e-06
0.05	5.07e-06	1.02e-06	1.03e-06	1.81e-06
0.25	8.06e-05	2.89e-06	3.04e-06	7.73e-06
0.5	1.10e-04	5.55e-06	6.08e-06	1.45e-05
0.75	1.34e-04	1.03e-05	1.16e-05	2.07e-05
0.9	1.61e-04	1.75e-05	1.87e-05	2.79e-05
0.95	1.78e-04	2.29e-05	2.38e-05	3.51e-05
0.975	2.17e-04	2.86e-05	2.87e-05	4.20e-05
0.99	3.21e-04	3.76e-05	3.63e-05	5.61e-05
0.995	3.87e-04	4.38e-05	4.24e-05	7.09e-05
0.9975	4.63e-04	4.73e-05	4.63e-05	8.85e-05
0.999	5.87e-04	4.97e-05	4.85e-05	1.07e-04
0.9995	6.39e-04	5.76e-05	4.95e-05	1.10e-04
1	7.50e-04	1.09e-04	5.03e-05	1.30e-04

Creation of Inputs for 7-and 21- Day Tapwater Exposures

The daily residue data for agricultural regions A - G, are used to create 7- and 21- day averages using the process described in the prior section. Each of the 7-day average values for each of the seven regions was assigned to one of the four seasons. Averaging periods (7 and 21days) ending on days in the months of January, February, and March were assigned to Winter. Periods ending on days in the months of April, May, and June were assigned to Spring. Periods ending on days in the months of July, August, and September were assigned to Summer. Periods ending on days in the months of October, November, and December were assigned to Fall. The days were then sorted by season. This resulted in 28 sets of data (seven sets of four seasons).

Cumulative empirical distributions of the values of the 28 sets of data were constructed using the PERCENTILE function in Excel™. These distributions are given in Tables 4.7-11. These tables were combined to produce the cumulative seasonal distributions for the four census regions using the same process used to prepare the one day distributions. Table 4.12 presents the values for the 16 combinations of season and census region.

Table 4.7. Cumulative Distribution of Seven-Day Residues During Winter Months (Jan.-March)

Quantile	A	B	C	D	E	F	G
0	0.000004	8.42E-06	4.02E-05	2.00E-08	4.36E-07	1.76E-07	1.90E-06
0.01	4.39E-06	8.84E-06	4.66E-05	2.92E-08	5.91E-07	2.09E-07	2.25E-06
0.05	5.30E-06	0.0000106	6.09E-05	8.56E-08	1.17E-06	3.51E-07	2.80E-06
0.25	7.22E-06	1.62E-05	0.00008	1.03E-06	7.51E-06	1.04E-06	3.88E-06
0.5	9.03E-06	2.21E-05	0.0000995	1.96E-06	9.40E-06	1.48E-06	5.07E-06
0.75	1.30E-05	3.42E-05	0.000127	4.03E-06	1.15E-05	2.28E-06	7.01E-06
0.9	1.81E-05	5.26E-05	1.54E-04	6.52E-06	1.38E-05	3.23E-06	9.25E-06
0.95	2.15E-05	5.85E-05	1.81E-04	7.90E-06	1.50E-05	4.24E-06	1.13E-05
0.975	2.53E-05	6.47E-05	2.01E-04	0.00001	1.63E-05	5.24E-06	1.39E-05
0.99	2.96E-05	7.08E-05	2.21E-04	1.25E-05	1.71E-05	6.35E-06	5.80E-05
0.995	3.31E-05	7.38E-05	2.39E-04	1.31E-05	1.73E-05	7.12E-06	1.70E-04
0.998	0.0000354	7.52E-05	2.50E-04	1.34E-05	1.75E-05	7.74E-06	3.46E-04
0.999	3.68E-05	7.62E-05	2.62E-04	1.37E-05	1.76E-05	8.61E-06	1.05E-03
0.9995	3.73E-05	7.65E-05	2.67E-04	1.38E-05	1.76E-05	8.86E-06	1.35E-03
1	3.77E-05	7.70E-05	2.69E-04	1.41E-05	1.77E-05	9.12E-06	0.00165

Table 4.8. Cumulative Distribution of Seven-Day Residues During Spring Months (April-June)							
Quantile	A	B	C	D	E	F	G
0	1.28E-06	8.37E-06	1.83E-05	2.36E-08	4.01E-07	1.56E-07	1.44E-06
0.01	1.52E-06	9.14E-06	2.24E-05	1.47E-07	6.40E-07	3.68E-07	1.84E-06
0.05	2.05E-06	1.16E-05	2.69E-05	2.49E-07	4.36E-06	6.16E-07	3.15E-06
0.25	3.28E-06	0.0000185	3.59E-05	6.14E-07	6.77E-06	3.26E-05	2.10E-04
0.5	4.49E-06	0.0000285	4.55E-05	1.90E-06	6.86E-05	1.58E-04	5.63E-04
0.75	6.20E-06	0.0000462	0.0000585	2.27E-04	2.78E-04	3.95E-04	1.31E-03
0.9	9.04E-06	7.63E-05	0.0000731	8.13E-04	5.89E-04	7.30E-04	2.55E-03
0.95	1.13E-05	1.03E-04	0.0000829	1.31E-03	9.32E-04	1.11E-03	3.56E-03
0.975	1.31E-05	1.25E-04	0.0000927	1.93E-03	1.42E-03	1.47E-03	4.40E-03
0.99	1.53E-05	1.32E-04	1.08E-04	0.00291	2.21E-03	1.93E-03	5.50E-03
0.995	1.70E-05	1.35E-04	1.28E-04	0.00333	2.62E-03	2.54E-03	6.65E-03
0.998	1.83E-05	1.37E-04	1.39E-04	0.00395	0.00308	3.00E-03	7.44E-03
0.999	1.91E-05	1.39E-04	1.48E-04	4.40E-03	0.00336	3.30E-03	7.80E-03
0.9995	1.93E-05	1.40E-04	1.51E-04	4.56E-03	0.00346	3.41E-03	7.88E-03
1	1.96E-05	1.41E-04	1.53E-04	4.58E-03	0.00355	0.00349	8.08E-03

Table 4.9. Cumulative Distribution of Seven-Day Residues During Summer Months (July-Sept.)							
Quantile	A	B	C	D	E	F	G
0	4.27E-07	1.50E-05	1.77E-05	1.34E-07	2.21E-06	2.96E-07	2.96E-05
0.01	6.14E-07	1.57E-05	2.05E-05	7.80E-07	4.27E-06	8.29E-07	3.81E-05
0.05	7.99E-07	1.70E-05	2.41E-05	2.83E-06	1.92E-05	2.60E-06	4.93E-05
0.25	1.20E-06	2.80E-05	2.96E-05	1.84E-05	3.28E-05	7.08E-06	9.31E-05
0.5	0.000002	3.68E-05	4.74E-05	4.63E-05	4.69E-05	1.45E-05	2.02E-04
0.75	4.64E-05	5.44E-05	6.21E-05	1.20E-04	7.33E-05	3.37E-05	4.44E-04
0.9	3.60E-04	8.94E-05	7.95E-05	2.88E-04	1.26E-04	6.63E-05	9.04E-04
0.95	0.000781	1.08E-04	9.05E-05	4.43E-04	1.71E-04	9.36E-05	1.54E-03
0.975	1.37E-03	1.14E-04	9.33E-05	6.19E-04	2.13E-04	1.23E-04	2.38E-03
0.99	2.29E-03	1.19E-04	1.05E-04	8.31E-04	2.72E-04	1.71E-04	3.63E-03
0.995	0.00301	1.21E-04	1.19E-04	1.00E-03	3.05E-04	2.17E-04	5.20E-03
0.998	4.98E-03	1.22E-04	1.77E-04	1.17E-03	3.52E-04	2.51E-04	6.26E-03
0.999	6.60E-03	1.22E-04	2.31E-04	1.38E-03	3.95E-04	2.76E-04	6.85E-03
0.9995	0.00729	1.22E-04	2.45E-04	1.47E-03	4.07E-04	2.81E-04	7.19E-03
1	8.11E-03	1.22E-04	0.000271	1.56E-03	4.18E-04	2.87E-04	7.52E-03

Table 4.10. Cumulative Distribution of Seven-Day Residues During Fall Months (Oct.-Dec.)							
Quantile	A	B	C	D	E	F	G
0	0.00001	1.15E-05	6.37E-05	8.06E-08	1.32E-06	2.68E-07	0.000005
0.01	0.00001	0.000013	7.21E-05	1.54E-07	1.78E-06	5.29E-07	0.000006
0.05	0.00001	0.000016	8.48E-05	1.03E-06	9.05E-06	1.22E-06	0.000008
0.25	0.000013	0.000024	0.000103	3.02E-06	1.34E-05	2.17E-06	0.0000113
0.5	0.00002	0.000032	0.00012	5.85E-06	1.72E-05	3.44E-06	0.0000168
0.75	2.97E-05	0.000046	0.00014	0.00001	0.000022	5.20E-06	0.0000278
0.9	4.51E-05	7.66E-05	0.000164	1.79E-05	2.67E-05	6.90E-06	0.0000432
0.95	5.77E-05	0.00009	0.000182	2.37E-05	3.01E-05	8.55E-06	0.0000551
0.975	7.22E-05	9.74E-05	2.32E-04	0.00003	3.31E-05	0.00001	0.0000671
0.99	9.27E-05	0.000103	3.46E-04	0.00004	3.62E-05	0.00002	0.0000921
0.995	1.08E-04	0.000105	4.10E-04	0.00005	0.000038	1.97E-05	0.000108
0.998	1.19E-04	1.05E-04	4.74E-04	0.00005	0.00004	2.15E-05	0.000117
0.999	1.30E-04	1.06E-04	0.00056	0.00005	0.000041	2.35E-05	0.000124
0.9995	1.37E-04	1.06E-04	0.000593	0.00005	0.000042	0.00002	0.000126
1	0.000145	1.06E-04	0.000623	0.00006	0.000043	0.00003	0.000129

Table 4.11. Final Seven-Day Distributions for Seasons and Census Regions				
	Region			
Quantile	West	Midwest	Northeast	South
	Winter			
0	2.24E-08	2.00E-08	2.00E-08	2.23E-08
0.01	6.01E-07	3.06E-08	3.02E-08	3.12E-07
0.05	2.25E-06	1.03E-07	1.03E-07	7.57E-07
0.25	5.63E-05	0.000001	1.08E-06	2.81E-06
0.5	8.76E-05	1.99E-06	2.15E-06	7.63E-06
0.75	1.18E-04	4.09E-06	4.57E-06	1.06E-05
0.9	1.49E-04	6.70E-06	7.49E-06	1.35E-05
0.95	1.73E-04	8.54E-06	1.01E-05	1.56E-05
0.975	1.94E-04	1.10E-05	1.20E-05	1.73E-05
0.999	2.16E-04	1.27E-05	1.34E-05	2.25E-05
0.995	2.32E-04	1.33E-05	1.41E-05	2.77E-05
0.9975	2.45E-04	1.37E-05	1.57E-05	3.46E-05
0.999	2.57E-04	1.48E-05	1.68E-05	7.83E-05
0.9995	2.66E-04	1.65E-05	1.72E-05	1.56E-04
1	2.69E-04	1.29E-03	1.75E-05	1.59E-03
	Spring			
0	2.57E-08	2.41E-08	2.37E-08	3.68E-08
0.01	7.71E-07	1.49E-07	1.48E-07	4.36E-07
0.05	1.61E-05	2.55E-07	2.54E-07	2.05E-06
0.25	3.27E-05	6.97E-07	6.89E-07	5.92E-06
0.5	4.43E-05	2.42E-05	1.28E-05	6.20E-05
0.75	6.04E-05	2.79E-04	2.39E-04	3.20E-04
0.9	8.19E-05	8.48E-04	8.06E-04	7.48E-04
0.95	1.18E-04	1.35E-03	1.29E-03	1.27E-03
0.975	2.89E-04	1.98E-03	1.92E-03	2.02E-03
0.99	6.84E-04	2.96E-03	2.88E-03	2.95E-03
0.995	1.05E-03	0.00344	3.30E-03	3.59E-03
0.9975	1.48E-03	4.01E-03	3.92E-03	4.49E-03
0.999	2.11E-03	4.47E-03	4.36E-03	5.66E-03
0.9995	2.57E-03	4.57E-03	4.55E-03	6.69E-03
1	0.00345	6.37E-03	4.58E-03	8.03E-03

Table 4.11. Final Seven Day Distributions for Seasons and Census Regions (Continued)				
	Region			
Quantiles	West	Midwest	Northeast	South
	Summer			
0	2.31e-07	1.34e-07	1.34e-07	3.13e-07
0.1	5.13e-06	7.88e-07	7.90e-07	7.59e-07
0.5	1.90e-05	2.87e-06	3.03e-06	1.27e-06
0.25	2.87e-05	1.77e-05	1.98e-05	1.93e-05
0.5	4.45e-05	4.53e-05	4.65e-05	4.12e-05
0.75	6.16e-05	1.18e-04	1.18e-04	8.31e-05
0.9	8.29e-05	2.86e-04	2.82e-04	2.01e-04
0.95	9.28e-05	4.44e-04	4.33e-04	3.68e-04
0.975	1.07e-04	6.30e-04	6.06e-04	7.19e-04
0.99	1.48e-04	8.62e-04	8.21e-04	1.37e-03
0.995	2.33e-04	1.06e-03	9.98e-04	2.09e-03
0.9975	3.17e-04	1.28e-03	1.16e-03	2.63e-03
0.999	5.71e-04	1.49e-03	1.38e-03	4.33e-03
0.9995	7.42e-04	2.02e-03	1.46e-03	5.23e-03
1	1.39e-03	6.69e-03	1.55e-03	7.38e-03
	Fall			
0	8.96E-08	8.08E-08	8.08E-08	8.30E-08
0.1	1.74E-06	1.70E-07	1.68E-07	1.02E-06
0.5	5.63E-06	1.04E-06	1.05E-06	1.87E-06
0.25	8.20E-05	3.00E-06	3.17E-06	7.98E-06
0.5	1.10E-04	5.79E-06	6.32E-06	1.49E-05
0.75	1.34E-04	1.05E-05	1.20E-05	2.14E-05
0.9	1.60E-04	1.85E-05	1.96E-05	2.91E-05
0.95	1.77E-04	2.45E-05	2.50E-05	3.66E-05
0.975	2.19E-04	3.06E-05	3.00E-05	4.49E-05
0.99	3.25E-04	4.06E-05	3.86E-05	6.19E-05
0.995	3.89E-04	4.75E-05	4.51E-05	7.81E-05
0.9975	4.44E-04	5.16E-05	4.93E-05	9.50E-05
0.999	5.33E-04	5.46E-05	5.23E-05	1.14E-04
0.9995	5.70E-04	6.05E-05	5.37E-05	1.24E-04
1	6.21E-04	1.05E-04	5.50E-05	1.41E-04

Table 4.12 present the final 21-day distributions. These distributions were created in the same way as the 7-day distributions except that 21-day averages were used.

Table 4.12. Final 21 Day Distributions for Seasons and Census Regions				
Quantiles	Region			
	West	Midwest	Northeast	South
	Winter			
0	2.27E-08	2.25E-08	2.25E-08	2.83E-08
0.1	7.10E-07	3.56E-08	3.44E-08	3.46E-07
0.5	0.000003	1.22E-07	1.13E-07	8.48E-07
0.25	0.0000586	0.000001	1.18E-06	3.10E-06
0.5	9.03E-05	0.000002	2.32E-06	8.14E-06
0.75	0.000122	0.000004	4.91E-06	1.12E-05
0.9	0.000151	0.000007	8.08E-06	1.41E-05
0.95	0.000171	0.000009	1.08E-05	1.61E-05
0.975	0.000193	0.0000117	1.27E-05	1.78E-05
0.99	2.17E-04	0.0000134	1.41E-05	2.21E-05
0.995	2.30E-04	0.0000142	1.49E-05	2.75E-05
0.9975	2.38E-04	0.0000147	0.0000158	3.30E-05
0.999	2.45E-04	0.0000157	1.65E-05	3.89E-05
0.9995	2.48E-04	0.000017	1.71E-05	4.67E-05
1	2.51E-04	0.00054	1.86E-05	4.98E-04
	Spring			
0	1.31E-07	1.23E-07	1.23E-07	1.25E-07
0.1	6.88E-07	1.57E-07	1.57E-07	4.72E-07
0.5	1.58E-05	2.92E-07	2.90E-07	2.11E-06
0.25	3.42E-05	8.09E-07	7.75E-07	6.29E-06
0.5	0.0000468	1.99E-05	1.11E-05	5.78E-05
0.75	0.0000633	2.32E-04	1.88E-04	3.23E-04
0.9	8.75E-05	7.52E-04	7.17E-04	7.55E-04
0.95	1.16E-04	1.23E-03	1.18E-03	1.28E-03
0.975	2.66E-04	1.89E-03	1.84E-03	1.99E-03
0.99	6.26E-04	2.64E-03	2.58E-03	2.75E-03
0.995	9.67E-04	3.08E-03	2.95E-03	3.34E-03
0.9975	1.38E-03	3.50E-03	3.34E-03	3.97E-03
0.999	1.87E-03	3.77E-03	3.67E-03	4.64E-03
0.9995	2.60E-03	3.87E-03	3.76E-03	5.42E-03
1	3.28E-03	0.00649	3.88E-03	6.56E-03

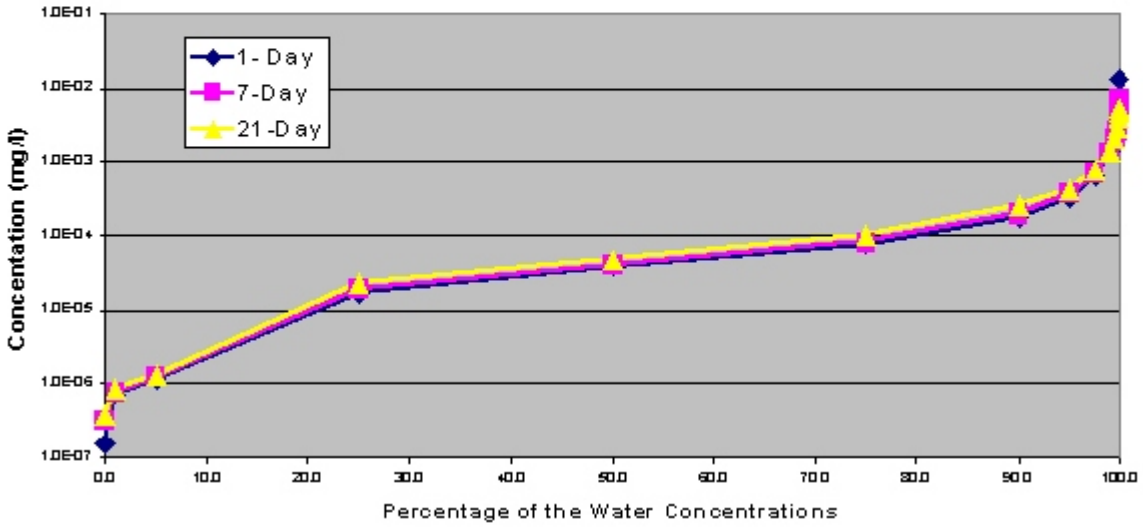
Table 4.12. Final 21 Day Distributions for Seasons and Census Regions (Continued)				
Quantiles	Region			
	West	Midwest	Northeast	South
	Summer			
0	3.55E-07	3.51E-07	3.51E-07	3.80E-07
0.1	6.28E-06	8.48E-07	8.49E-07	8.42E-07
0.5	0.0000194	3.08E-06	3.16E-06	0.000001
0.25	0.0000289	2.27E-05	2.50E-05	2.29E-05
0.5	4.04E-05	5.84E-05	5.94E-05	4.85E-05
0.75	5.61E-05	1.58E-04	1.57E-04	1.02E-04
0.9	7.54E-05	3.73E-04	3.70E-04	2.56E-04
0.95	8.47E-05	5.63E-04	5.59E-04	4.43E-04
0.975	1.09E-04	7.61E-04	7.46E-04	7.92E-04
0.99	1.57E-04	1.01E-03	9.79E-04	1.37E-03
0.995	3.13E-04	1.30E-03	1.16E-03	0.00217
0.9975	4.94E-04	1.63E-03	1.50E-03	2.92E-03
0.999	7.66E-04	1.88E-03	1.79E-03	3.87E-03
0.9995	8.99E-04	1.99E-03	1.90E-03	4.76E-03
1	1.43E-03	4.16E-03	2.03E-03	5.35E-03
	Fall			
0	9.26E-08	9.34E-08	9.35E-08	9.92E-08
0.1	1.74E-06	1.93E-07	1.87E-07	1.08E-06
0.5	5.85E-06	1.06E-06	1.07E-06	2.05E-06
0.25	8.20E-05	3.32E-06	3.55E-06	9.03E-06
0.5	1.08E-04	6.53E-06	7.16E-06	1.60E-05
0.75	1.31E-04	1.21E-05	1.37E-05	2.32E-05
0.9	1.56E-04	2.12E-05	2.23E-05	3.28E-05
0.95	1.70E-04	2.85E-05	2.84E-05	4.43E-05
0.975	2.00E-04	3.64E-05	3.51E-05	5.99E-05
0.99	3.20E-04	4.74E-05	4.47E-05	1.02E-04
0.995	3.87E-04	5.68E-05	5.42E-05	1.45E-04
0.9975	4.30E-04	6.32E-05	6.08E-05	2.08E-04
0.999	4.68E-04	6.74E-05	6.52E-05	3.21E-04
0.9995	4.82E-04	7.27E-05	6.68E-05	3.50E-04
1	4.95E-04	1.10E-04	6.85E-05	7.26E-04

Similarity of 1-day. 7-day and 21-day Distributions

Tables 4.6, 4.11, 4.12 present the cumulative distributions of the 1-day data and the 7- and 21-day averages for the four census regions. As a comparison of the tables shows, the distributions for the single day and the 7 and 21 day averages are essentially identical for all percentiles less than the 99th percentile and differ by less than 30% at the 99.9th percentile.

This finding is graphically presented in the Figure 4.1. Figure 4.1 presents the distributions of the single day and the 7 and 21 day average residues for water concentrations in the Summer in the South. This region and season had the highest residues of all the season/region combinations. Even here, where the difference would have been the greatest, there are only minor differences in the three distributions.

Figure 4.1 Cumulative Distrbution of 1 Day and 7-, and 21-Day Averages of the Cumulative Organophosphate Pesticides in the Hypothetical Water Supply (South During Summer)



The reason for this similarity is that while the models predict very sharp increases in concentration (spikes), the rate of decline is much slower and the elevated levels persist for several weeks. As a result, the average concentration in the first 7 or 21 days following a spike is only slightly lower then the highest daily value. The implication of this finding is that the use of the distribution of the 1 day concentrations can be used for the prediction of 1, 7-, and 21-day average doses. Therefore only a single tapwater distribution, OPwater.twc, that is based on the distribution of single days will be used in this assessment. A printout of Opwater.twc is given in Appendix G.