**Appendix 2-8: Chlorpyrifos Species Sensitivity Distribution Analysis for Aquatic Invertebrates**

**Summary**

SSDs were fit to toxicity data for aquatic invertebrates exposed to Chlorpyrifos. Five distributions were tested and the gumbel distribution was found to provide the best fit. Tests also suggested that a single SSD should be fit to pooled saltwater and freshwater test results. Important summary statistics from the fitted SSDs are provided below in **Table B 2-8.1**. Detailed results follow.

**Table B 2-8.1. Summary statistics for log-gumbel SSDs fit to Chlorpyrifos test results**

|  |  |  |  |
| --- | --- | --- | --- |
| Statistic | Pooled Results | Freshwater Results | Saltwater Results |
| Goodness of fit P-value |  0.7443 | 0.6144 | 0.9041 |
| CV of the HC05 | 0.47 | 0.47 | 2.03 |
| UCp1 of the HC05 | 0.121 | 0.13 | 0.221 |
| HC05 | 0.041 | 0.044 | 0.034 |
| HC10 | 0.072 | 0.075 | 0.073 |
| HC50 | 0.98 | 0.79 | 2.43 |
| HC90 | 59.5 | 32.0 | 602 |
| HC95 | 285.0 | 131.9 | 4947.5 |
| Mortality Threshold (slope = 4.5) | **0.0036** | **0.0039** | **0.0030** |
| Indirect Effects Threshold (slope = 4.5) | **0.0211** | **0.0230** | **0.0174** |

1ML=maximum likelihood, MO= moment estimators, and GR=graphical methods

1 UCp=projections of the upper confidence limit of the HC05 onto the cumulative distribution function of the fitted distribution.

1. **Data**

Data used in this analysis are from an updated dataset (file date: 8-26-16), and are detailed in **Table B 2-8.15** (end of document). The LC50 values that are included in this analysis are from either 48 or 96-hour tests with technical grade active ingredient. This updated analysis also includes the EC50 values for “Immobility” as a proxy for mortality from organisms tested under the same exposure criteria as noted above. **Table B 2-8.2** provides the distribution of the test results and the number of species represented.

**Table B 2-8.2. Distribution of test results available for Chlorpyrifos**

|  |  |  |
| --- | --- | --- |
| Media | Test results | Species |
| All | 189 | 64 |
| Freshwater | 151 | 51 |
| Saltwater | 38 | 15 |

 One species (*Palaemonetes pugio*) was tested in both saltwater and freshwater.

**Figs. B 2-8.1, 2 and 3** show the distribution of test results among subsets of invertebrate test results. In general, most species have been tested once or twice, with a few species having been tested as many as 17 times.

 

**Figure B 2-8.1. Distribution of test results among taxa in all chlorpyrifos test results**



**Figure B 2-8.2. Distribution of test results among taxa in freshwater chlorpyrifos test results**



**Figure B 2-8.3. Distribution of test results among taxa in saltwater chlorpyrifos test results**

Five potential distributions for the Chlorpyrifos data were considered (log-normal, log-logistic, log-triangular, log-gumbel, and Burr). To fit each of the first four distributions, the toxicity values were first common log (log10) transformed. The importance of separating the saltwater versus freshwater taxa was examined using a regression approach with examination of common plots. Finally, direct and indirect effect thresholds and five quantiles from the fitted SSDs (HC05, HC10, HC50, HC90, HC95) were calculated and reported.

**II. Comparison of distributions using AICc**

Akaike’s Information Criterion corrected for sample size (AICc ) was used to compare the five distributions for all three datasets, the full dataset combining freshwater and saltwater tests, and then separately for freshwater and saltwater test results. For this comparison all SSDs were fit using maximum likelihood. Based on the AICc ranking (*i.e.,* lowest value), for all three datasets, AICc suggested that the gumbel distribution provided the best fit (**Tables B 2-8.3, 4** and **5**).

**Table B 2-8.3. Comparison of distributions for all aquatic invertebrate toxicity data for Chlorpyrifos**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Distribution | AICc | ∆AICc | Weight | HC05 | HC05 (SE) |
| **gumbel** | 379.3427 | 0 | 0.7609 | 0.0407 | 0.0129 |
| burr | 381.6609 | 2.3182 | 0.2387 | 0.0406 | 0.0177 |
| logistic | 394.8018 | 15.4591 | 3.35E-04 | 0.0087 | 0.0052 |
| normal | 397.8775 | 18.5348 | 7.19E-05 | 0.0109 | 0.0064 |
| triangular | 406.8823 | 27.5396 | 7.96E-07 | 0.0089 | 0.0083 |

 **Table B 2-8.4. Comparison of distributions for freshwater invertebrate toxicity data for Chlorpyrifos**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Distribution | AICc | ∆AICc | Weight | HC05 | HC05 (SE) |
| **gumbel** | **259.4553** | 0 | 0.7539 | 0.0444 | 0.0141 |
| burr | 261.7608 | 2.3055 | 0.2381 | 0.0444 | 0.0157 |
| logistic | 269.2362 | 9.7809 | 0.0057 | 0.0133 | 0.0079 |
| normal | 271.0178 | 11.5624 | 0.0023 | 0.0162 | 0.0093 |
| triangular | 284.6211 | 25.1658 | 2.59E-06 | 0.0113 | 0.0109 |

**Table B 2-8.5. Comparison of distributions for saltwater invertebrate toxicity data for Chlorpyrifos**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Distribution | AICc | ∆AICc | Weight | HC05 | HC05 (SE) |
| **gumbel** | 135.0104 | 0 | 0.5506 | 0.0336 | 0.0298 |
| triangular | 137.5345 | 2.5241 | 0.1559 | 0.0112 | 0.0221 |
| normal | 138.1906 | 3.1802 | 0.1123 | 0.0073 | 0.0115 |
| burr | 138.3135 | 3.3031 | 0.1056 | 0.0321 | 0.0302 |
| logistic | 138.9783 | 3.9679 | 0.0757 | 0.0034 | 0.0057 |

**III. Test for the need to model results separately by medium**

To test whether or not separate SSDs should be used, the individual freshwater and saltwater SSDs were plotted with their confidence limits, against the pooled all-invertebrate SSD (**Fig. B 2-8.4**). For both freshwater and saltwater, the 95% confidence limits around the SSDs, encompass the SSD for pooled results (the null model), thus, these plots provide support for considering a single pooled SSD.



**Figure B 2-8.4. Log-gumbel SSD for aquatic invertebrate test results (black line; SSD plot), freshwater invertebrates (red dashed lines; 95% confidence limits), and saltwater invertebrates (blue dashed lines; 95% confidence limits).**

**IV. Goodness of fit & Uncertainty**

To test goodness-of-fit, all five distributions were fit to each of the three datasets (pooled, saltwater and freshwater toxicity data) and bootstrap goodness-of-fit tests with 5,000 bootstrap replicates were used. Three different fitting methods (maximum likelihood, moment estimators, and graphical methods) were used, though, not all methods are available for all distributions. **Tables B 2-8.6, 7 and 8** give results of these fitting exercises. No distribution showed significant lack-of-fit, except the Burr distribution for all datasets. In general, the gumbel distribution (determined to be the best by AICc) also had the lowest coefficients of variation for the HC05 (excluding the Burr distribution due to lack-of-fit). The gumbel distribution also tended to produce the highest estimates of the HC05, and generally, the narrowest confidence intervals around the HC05 (**Tables B 2-8.6, 7 and 8, Figs. B 2-8.5, 6 and 7**).

**Table B 2-8.6. Range of HC05 values for Chlorpyrifos SSDs fit to all invertebrates.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Distribution | Method1 | HC05 | SE | CV | LCx | Ucx | LCp | Ucp | P |
| normal | ML | 0.0109 | 0.0089 | 0.8151 | 0.0026 | 0.037 | 0.0176 | 0.1062 | 0.98 |
| normal | MO | 0.0105 | 0.0083 | 0.7899 | 0.003 | 0.0322 | 0.0205 | 0.1001 | 0.992 |
| normal | GR | 0.0081 | 0.0056 | 0.6932 | 0.0019 | 0.0232 | 0.0181 | 0.0934 | 0.989 |
| logistic | ML | 0.0087 | 0.0072 | 0.8322 | 0.0024 | 0.0302 | 0.0234 | 0.1 | 0.9211 |
| logistic | MO | 0.0112 | 0.0107 | 0.959 | 0.003 | 0.0416 | 0.0237 | 0.102 | 0.997 |
| logistic | GR | 0.0074 | 0.0052 | 0.7029 | 0.0011 | 0.0202 | 0.0184 | 0.083 | 0.994 |
| triangular | ML | 0.0089 | 0.009 | 1.0015 | 0.0043 | 0.034 | 0.0271 | 0.1086 | 1 |
| triangular | MO | 0.0095 | 0.0065 | 0.687 | 0.0034 | 0.0288 | 0.016 | 0.1067 | 0.997 |
| triangular | GR | 0.0083 | 0.0058 | 0.6967 | 0.0023 | 0.024 | 0.0113 | 0.1023 | 0.996 |
| gumbel | ML | 0.0407 | 0.0191 | 0.4701 | 0.0194 | 0.087 | 0.0148 | 0.1209 | 0.7443 |
| gumbel | MO | 0.0299 | 0.0149 | 0.4976 | 0.0122 | 0.0703 | 0.0131 | 0.1221 | 0.7363 |
| gumbel | GR | 0.0231 | 0.0101 | 0.438 | 0.0064 | 0.0453 | 0.0075 | 0.0988 | 0.6114 |
| burr | ML | 0.0406 | 0.0136 | 0.3354 | 0.0232 | 0.0766 | 0.0208 | 0.1064 | 0.1389 |

**Table B 2-8.7. Range of HC05 values for Chlorpyrifos SSDs fit to freshwater invertebrates.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Distribution** | **Method1** | **HC05** | **SE** | **CV** | **LCx** | **Ucx** | **LCp** | **Ucp** | **P** |
| normal | ML | 0.0162 | 0.0125 | 0.7728 | 0.0034 | 0.0512 | 0.0127 | 0.1132 | 0.959 |
| normal | MO | 0.0155 | 0.0108 | 0.6987 | 0.005 | 0.0463 | 0.0193 | 0.1084 | 0.972 |
| normal | GR | 0.0119 | 0.008 | 0.6702 | 0.003 | 0.0331 | 0.0163 | 0.0997 | 0.9451 |
| logistic | ML | 0.0133 | 0.0101 | 0.7603 | 0.004 | 0.0444 | 0.0226 | 0.1075 | 0.8462 |
| logistic | MO | 0.0164 | 0.0138 | 0.8378 | 0.0046 | 0.0585 | 0.0217 | 0.1109 | 0.971 |
| logistic | GR | 0.0109 | 0.0077 | 0.7125 | 0.0016 | 0.0293 | 0.0159 | 0.0888 | 0.9211 |
| triangular | ML | 0.0113 | 0.0129 | 1.146 | 0.0048 | 0.0524 | 0.0228 | 0.1244 | 1 |
| triangular | MO | 0.0143 | 0.0098 | 0.681 | 0.0054 | 0.0401 | 0.0138 | 0.1122 | 0.966 |
| triangular | GR | 0.0124 | 0.0074 | 0.5982 | 0.004 | 0.0329 | 0.0109 | 0.1062 | 0.975 |
| gumbel | ML | 0.0444 | 0.0207 | 0.4673 | 0.0189 | 0.0945 | 0.0098 | 0.1301 | 0.6144 |
| gumbel | MO | 0.0384 | 0.018 | 0.4688 | 0.0158 | 0.0854 | 0.0101 | 0.13 | 0.5874 |
| gumbel | GR | 0.0297 | 0.0134 | 0.4521 | 0.0084 | 0.06 | 0.0055 | 0.1111 | 0.4595 |
| burr | ML | 0.0444 | 0.017 | 0.3824 | 0.0244 | 0.0923 | 0.0174 | 0.1268 | 0.3297 |

1ML=maximum likelihood, MO= moment estimators, and GR=graphical methods

LCp and UCp=projections of the confidence limits of the HC05 (LCx and UCx) onto the cumulative distribution function of the fitted distribution.

**Table B 2-8.8. Range of HC05 values for Chlorpyrifos SSDs fit to saltwater invertebrates.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Distribution** | **Method1** | **HC05** | **SE** | **CV** | **LCx** | **Ucx** | **LCp** | **Ucp** | **P** |
| normal | ML | 0.00730 | 0.08000 | 10.96200 | 0.00047 | 0.23200 | 0.00990 | 0.21850 | 0.96500 |
| normal | MO | 0.00580 | 0.06320 | 10.89880 | 0.00021 | 0.13760 | 0.00720 | 0.19010 | 0.97400 |
| normal | GR | 0.00210 | 0.01360 | 6.56190 | 0.00001 | 0.03470 | 0.00280 | 0.14630 | 0.95500 |
| logistic | ML | 0.00340 | 0.04590 | 13.69880 | 0.00011 | 0.10140 | 0.01200 | 0.18480 | 0.94810 |
| logistic | MO | 0.00630 | 0.06060 | 9.57740 | 0.00015 | 0.18040 | 0.01000 | 0.18660 | 0.96500 |
| logistic | GR | 0.00140 | 0.01120 | 7.80090 | 0.00000 | 0.03160 | 0.00300 | 0.13810 | 0.93610 |
| triangular | ML | 0.01120 | 0.20010 | 17.88040 | 0.00200 | 0.29950 | 0.00880 | 0.22330 | 0.97500 |
| triangular | MO | 0.00510 | 0.05880 | 11.48970 | 0.00032 | 0.13940 | 0.00093 | 0.20680 | 0.96400 |
| triangular | GR | 0.00260 | 0.02890 | 11.03280 | 0.00004 | 0.03870 | 0.00000 | 0.15620 | 0.97000 |
| gumbel | ML | 0.03360 | 0.06850 | 2.03910 | 0.00770 | 0.24840 | 0.00710 | 0.22050 | 0.90410 |
| gumbel | MO | 0.02350 | 0.08170 | 3.47510 | 0.00260 | 0.23830 | 0.00270 | 0.23260 | 0.89110 |
| gumbel | GR | 0.00950 | 0.02330 | 2.44240 | 0.00012 | 0.07260 | 0.00011 | 0.16830 | 0.85310 |
| burr | ML | 0.03210 | 0.06470 | 2.01640 | 0.00410 | 0.24120 | 0.00290 | 0.21770 | 0.16280 |

1ML=maximum likelihood, MO= moment estimators, and GR=graphical methods

LCp and UCp=projections of the confidence limits of the HC05 (LCx and UCx) onto the cumulative distribution function of the fitted distribution.



**Figure B 2-8.5. Mean (red point) and range (black bar) of estimated HC05s for all Chlorpyrifos invertebrate test results**

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**Figure B 2-8.6. Mean (red point) and range (black bar) of estimated HC05s for all Chlorpyrifos freshwater invertebrate test results**



**Figure B 2-8.7. Mean (red point) and range (black bar) of estimated HC05s for all Chlorpyrifos saltwater invertebrate test results**

Another step to assess goodness-of-fit was to visually inspect the fit for evidence of problems. **Figures B 2-8.8, 9, and 10** below plot the data points against the fitted SSDs for pooled, freshwater and saltwater test results. These plots do show some evidence for lack-of-fit, especially at the higher quantiles. However, they seem to fit fairly well in the neighborhood of the HC05.

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**Figure B 2-8.8. Log-gumbel SSD for Chlorpyrifos toxicity values for pooled invertebrates. Black points indicate single toxicity values. Red points indicate average of multiple toxicity values for a single species. Blue line indicates full range of toxicity values for a given species.**



**Figure B 2-8.9. Log-gumbel SSD for Chlorpyrifos toxicity values for freshwater invertebrates. Black points indicate single toxicity values. Red points indicate average of multiple toxicity values for a single species. Blue line indicates full range of toxicity values for a given species.**

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**Figure B 2-8.10. Log-gumbel SSD for Chlorpyrifos toxicity values for saltwater invertebrates. Black points indicate single toxicity values. Red points indicate average of multiple toxicity values for a single species. Blue line indicates full range of toxicity values for a given species.**

**V. Calculation of other quantiles**

**Tables B 2-8.9, 10, and 11** provide estimates of the HC05 as well as other quantiles of the fitted SSDs.

**Table B 2-8.9. Estimated quantiles of the fitted SSDs for all invertebrate toxicity tests for Chlorpyrifos**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Distribution** | **method** | **HC05** | **HC10** | **HC50** | **HC90** | **HC95** |
| normal | ML | 0.0109 | 0.0332 | 1.7058 | 87.5577 | 267.3999 |
| normal | MO | 0.0105 | 0.0322 | 1.7058 | 90.3265 | 278.3013 |
| normal | GR | 0.0081 | 0.0263 | 1.7058 | 110.4267 | 360.1725 |
| logistic | ML | 0.0087 | 0.0301 | 1.163 | 44.8733 | 155.4108 |
| logistic | MO | 0.0112 | 0.04 | 1.7058 | 72.6844 | 260.3725 |
| logistic | GR | 0.0074 | 0.0294 | 1.7058 | 98.8087 | 392.9151 |
| triangular | ML | 0.0089 | 0.0287 | 3.9518 | 543.576 | 1.75E+03 |
| triangular | MO | 0.0095 | 0.0257 | 1.7058 | 113.0655 | 305.438 |
| triangular | GR | 0.0083 | 0.0231 | 1.7058 | 126.1057 | 349.5911 |
| gumbel | ML | 0.0407 | 0.0722 | 0.9847 | 59.4803 | 285.0498 |
| gumbel | MO | 0.0299 | 0.0565 | 1.0255 | 96.9959 | 551.7237 |
| gumbel | GR | 0.0231 | 0.0459 | 1.0486 | 142.1069 | 927.4016 |
| burr | ML | 0.0406 | 0.0722 | 0.9842 | 58.4338 | 277.8289 |
|  |  |  |  |  |  |  |

**Table B 2-8.10. Estimated quantiles of the fitted SSDs for freshwater invertebrate toxicity tests for Chlorpyrifos**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **dist** | **method** | **HC05** | **HC10** | **HC50** | **HC90** | **HC95** |
| normal | ML | 0.0162 | 0.0423 | 1.2519 | 37.0123 | 96.669 |
| normal | MO | 0.0155 | 0.0409 | 1.2519 | 38.2808 | 100.9418 |
| normal | GR | 0.0119 | 0.0333 | 1.2519 | 47.0424 | 131.5085 |
| logistic | ML | 0.0133 | 0.0395 | 0.9679 | 23.7374 | 70.4697 |
| logistic | MO | 0.0164 | 0.0494 | 1.2519 | 31.7441 | 95.3129 |
| logistic | GR | 0.0109 | 0.0362 | 1.2519 | 43.2837 | 144.4133 |
| triangular | ML | 0.0113 | 0.034 | 3.5444 | 369.6706 | 1.11E+03 |
| triangular | MO | 0.0143 | 0.0337 | 1.2519 | 46.452 | 109.3676 |
| triangular | GR | 0.0124 | 0.03 | 1.2519 | 52.1617 | 126.2309 |
| gumbel | ML | 0.0444 | 0.0745 | 0.789 | 32.026 | 131.8531 |
| gumbel | MO | 0.0384 | 0.0664 | 0.8075 | 40.7041 | 182.0372 |
| gumbel | GR | 0.0297 | 0.0539 | 0.8269 | 59.9252 | 307.8839 |
| burr | ML | 0.0444 | 0.0745 | 0.7891 | 31.7335 | 130.0851 |

**Table B 2-8.11. Estimated quantiles of the fitted SSDs for saltwater invertebrate toxicity tests for Chlorpyrifos**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **dist** | **method** | **HC05** | **HC10** | **HC50** | **HC90** | **HC95** |
| normal | ML | 0.0073 | 0.0311 | 5.14 | 851.9 | 3626.3 |
| normal | MO | 0.0058 | 0.0260 | 5.14 | 1019.2 | 4564.9 |
| normal | GR | 0.0021 | 0.0117 | 5.14 | 2265.0 | 12722.0 |
| logistic | ML | 0.0034 | 0.0192 | 3.24 | 546.0 | 3123.2 |
| logistic | MO | 0.0063 | 0.0347 | 5.14 | 763.0 | 4177.3 |
| logistic | GR | 0.0014 | 0.0114 | 5.14 | 2314.4 | 18480.0 |
| triangular | ML | 0.0112 | 0.0380 | 6.62 | 1153.6 | 3918.0 |
| triangular | MO | 0.0051 | 0.0192 | 5.14 | 1374.7 | 5167.5 |
| triangular | GR | 0.0026 | 0.0112 | 5.14 | 2360.4 | 10086.0 |
| gumbel | ML | 0.0336 | 0.0725 | 2.43 | 602.2 | 4947.5 |
| gumbel | MO | 0.0235 | 0.0548 | 2.61 | 1120.7 | 11362.0 |
| gumbel | GR | 0.0095 | 0.0267 | 2.90 | 4563.5 | 75969.0 |
| burr | ML | 0.0321 | 0.0708 | 2.45 | 594.4 | 4812.3 |

**VI. Calculation of thresholds**

Thresholds were calculated assuming a probit dose-response with the HC05 as the mean and a default slope of 4.5. Lower and upper confidence limits are calculated from the lower and upper confidence limits of the HC05 estimates. Calculated thresholds are provided in **Tables B 2-8.9.12, 13, and 14.**

**Table B 2-8.9.12. Morality and Indirect Effects Thresholds for Chlorpyrifos (all invertebrates)**

|  |  |  |  |
| --- | --- | --- | --- |
| **distrib.** | **method** | **Mortality Threshold (10-6)** | **Indirect Effects Threshold (10-1)** |
| **Expected** | **LCL** | **UCL** | **Expected** | **LCL** | **UCL** |
| normal | ML | 0.00096 | 0.00023 | 0.00320 | 0.00560 | 0.00140 | 0.01920 |
| normal | MO | 0.00092 | 0.00027 | 0.00280 | 0.00540 | 0.00160 | 0.01670 |
| normal | GR | 0.00071 | 0.00016 | 0.00200 | 0.00420 | 0.00097 | 0.01210 |
| logistic | ML | 0.00076 | 0.00021 | 0.00260 | 0.00450 | 0.00120 | 0.01570 |
| logistic | MO | 0.00098 | 0.00026 | 0.00370 | 0.00580 | 0.00150 | 0.02160 |
| logistic | GR | 0.00065 | 0.00010 | 0.00180 | 0.00380 | 0.00057 | 0.01050 |
| triangular | ML | 0.00079 | 0.00037 | 0.00300 | 0.00460 | 0.00220 | 0.01760 |
| triangular | MO | 0.00084 | 0.00030 | 0.00250 | 0.00490 | 0.00170 | 0.01490 |
| triangular | GR | 0.00073 | 0.00020 | 0.00210 | 0.00430 | 0.00120 | 0.01250 |
| **gumbel** | **ML** | **0.00360** | **0.00170** | **0.00760** | **0.02110** | **0.01000** | **0.04520** |
| gumbel | MO | 0.00260 | 0.00110 | 0.00620 | 0.01550 | 0.00640 | 0.03650 |
| gumbel | GR | 0.00200 | 0.00056 | 0.00400 | 0.01200 | 0.00330 | 0.02350 |
| burr | ML | 0.00360 | 0.00200 | 0.00670 | 0.02110 | 0.01200 | 0.03980 |

**Table B 2-8.9.13. Mortality and Indirect Effects Thresholds for Chlorpyrifos (freshwater invertebrates)**

|  |  |  |  |
| --- | --- | --- | --- |
| **distrib.** | **method** | **Mortality Threshold (10-6)** | **Indirect Effects Threshold (10-1)** |
| **Expected** | **LCL** | **UCL** | **Expected** | **LCL** | **UCL** |
| normal | ML | 0.00140 | 0.00030 | 0.00450 | 0.00840 | 0.00180 | 0.02660 |
| normal | MO | 0.00140 | 0.00044 | 0.00410 | 0.00810 | 0.00260 | 0.02400 |
| normal | GR | 0.00100 | 0.00026 | 0.00290 | 0.00620 | 0.00150 | 0.01720 |
| logistic | ML | 0.00120 | 0.00035 | 0.00390 | 0.00690 | 0.00210 | 0.02300 |
| logistic | MO | 0.00140 | 0.00041 | 0.00510 | 0.00850 | 0.00240 | 0.03040 |
| logistic | GR | 0.00095 | 0.00014 | 0.00260 | 0.00560 | 0.00084 | 0.01520 |
| triangular | ML | 0.00099 | 0.00042 | 0.00460 | 0.00590 | 0.00250 | 0.02720 |
| triangular | MO | 0.00130 | 0.00047 | 0.00350 | 0.00740 | 0.00280 | 0.02080 |
| triangular | GR | 0.00110 | 0.00035 | 0.00290 | 0.00640 | 0.00210 | 0.01710 |
| **gumbel** | **ML** | **0.00390** | **0.00170** | **0.00830** | **0.02300** | **0.00980** | **0.04910** |
| gumbel | MO | 0.00340 | 0.00140 | 0.00750 | 0.01990 | 0.00820 | 0.04430 |
| gumbel | GR | 0.00260 | 0.00074 | 0.00530 | 0.01540 | 0.00440 | 0.03110 |
| burr | ML | 0.00390 | 0.00210 | 0.00810 | 0.02300 | 0.01270 | 0.04790 |

**Table B 2-8.9.14. Thresholds for determination of action area for Chlorpyrifos (saltwater invertebrates)**

|  |  |  |  |
| --- | --- | --- | --- |
| **distrib.** | **method** | **Mortality Threshold (10-6)** | **Indirect Effects Threshold (10-1)** |
| **Expected** | **LCL** | **UCL** | **Expected** | **LCL** | **UCL** |
| normal | ML | 0.0006 | 0.0000 | 0.0204 | 0.0038 | 0.0002 | 0.1204 |
| normal | MO | 0.0005 | 0.0000 | 0.0121 | 0.0030 | 0.0001 | 0.0714 |
| normal | GR | 0.0002 | 0.0000 | 0.0030 | 0.0011 | 0.0000 | 0.0180 |
| logistic | ML | 0.0003 | 0.0000 | 0.0089 | 0.0017 | 0.0001 | 0.0526 |
| logistic | MO | 0.0006 | 0.0000 | 0.0158 | 0.0033 | 0.0001 | 0.0937 |
| logistic | GR | 0.0001 | 0.0000 | 0.0028 | 0.0007 | 0.0000 | 0.0164 |
| triangular | ML | 0.0010 | 0.0002 | 0.0263 | 0.0058 | 0.0010 | 0.1554 |
| triangular | MO | 0.0004 | 0.0000 | 0.0122 | 0.0027 | 0.0002 | 0.0724 |
| triangular | GR | 0.0002 | 0.0000 | 0.0034 | 0.0014 | 0.0000 | 0.0201 |
| **gumbel** | **ML** | **0.0030** | **0.0007** | **0.0218** | **0.0174** | **0.0040** | **0.1290** |
| gumbel | MO | 0.0021 | 0.0002 | 0.0209 | 0.0122 | 0.0014 | 0.1237 |
| gumbel | GR | 0.0008 | 0.0000 | 0.0064 | 0.0050 | 0.0001 | 0.0377 |
| burr | ML | 0.0028 | 0.0004 | 0.0212 | 0.0167 | 0.0021 | 0.1252 |

**Table B 2-8. 15** provides all of the available LC50 values for aquatic invertebrates (within the 24 or 48 hour timeframe-unless otherwise noted). These data sets are the same as reported in the effects characterization and provide additional data for the formulated products. Values that were included in the SSD (*i.e.,* TGAI) are marked with an \*.

**Table B 2-8.15. Available median lethal concentration (LC50) data for aquatic invertebrates exposed (48 or 96 hr) to chlorpyrifos as TGAI or formulation.**

| **Genus** | **Species** | **Endpoint** | **SSD** | **Conc. in ug/L** | **Ref #** | **Classification** |
| --- | --- | --- | --- | --- | --- | --- |
| Hyalella | azteca | MORT | \* | 0.014 | MRID 44345601 | Acceptable |
| Daphnia | magna | IMBL |   | 0.032 | 160353 | NA1 |
| Americamysis | bahia | MORT | \* | 0.035 | 15639 | NA1 |
| Daphnia | ambigua | MORT | \* | 0.035 | 71674 | NA1 |
| Americamysis | bahia | MORT | \* | 0.035 | MRID 40228401 | Supplemental  |
| Hyalella | azteca | MORT | \* | 0.038 | 352 | NA1 |
| Americamysis | bahia | MORT | \* | 0.040 | 3947 | NA1 |
| Americamysis | bahia | MORT | \* | 0.040 | MRID 40228401 | Supplemental |
| Hyalella | azteca | MORT | \* | 0.043 | 64955 | Quantitative  |
| Americamysis | bahia | MORT | \* | 0.045 | MRID 42144906 | Acceptable |
| Ceriodaphnia | dubia | MORT | \* | 0.048 | 158195 | NA1 |
| Hyalella | azteca | MORT | \* | 0.050 | 16806 | NA1 |
| Simocephalus | vetulus | MORT | \* | 0.050 | 16806 | NA1 |
| Haliplus | sp. | MORT | \* | 0.050 | 16806 | NA1 |
| Cloeon | sp. | MORT | \* | 0.050 | 16806 | NA1 |
| Ceriodaphnia | dubia | MORT | \* | 0.050 | 73373 | NA1 |
| Deleatidium | sp. | MORT | \* | 0.050 | 153793 | NA1 |
| Hyalella | azteca | MORT | \* | 0.051 | 160294 | NA1 |
| Ceriodaphnia | dubia | MORT | \* | 0.053 | 18190 | Quant. SSD |
| Ceriodaphnia | dubia | MORT | \* | 0.055 | 18190 | Quant. SSD |
| Ceriodaphnia | dubia | MORT | \* | 0.056 | 71674 | NA1 |
| Ceriodaphnia | dubia | MORT | \* | 0.058 | 18190 | Quant. SSD |
| Hyalella | curvispina | MORT | \* | 0.060 | 159934 | NA1 |
| Ceriodaphnia | dubia | MORT | \* | 0.060 | 16844 | NA1 |
| Ceriodaphnia | dubia | MORT | \* | 0.060 | 16844 | NA1 |
| Paratya | australiensis | MORT | \* | 0.063 | 121117 | NA1 |
| Ceriodaphnia | dubia | MORT | \* | 0.064 | 18190 | NA1 |
| Hyalella | azteca | MORT | \* | 0.065 | 86411 | NA1 |
| Ceriodaphnia | dubia | MORT | \* | 0.066 | 18190 | NA1 |
| Gammarus | pulex | MORT |   | 0.070 | 8107 | NA1 |
| Rhepoxynius | abronius | MORT | \* | 0.070 | 56538 | NA1 |
| Hyalella | azteca | MORT | \* | 0.070 | 86411 | NA1 |
| Ceriodaphnia | dubia | MORT | \* | 0.070 | 108483 | Quant. SSD |
| Hyalella | azteca | MORT | \* | 0.071 | 86411 | NA1 |
| Hyalella | azteca | MORT | \* | 0.072 | 86411 | NA1 |
| Hyalella | azteca | MORT | \* | 0.072 | 86411 | NA1 |
| Hyalella | azteca | MORT | \* | 0.074 | 86411 | NA1 |
| Hyalella | azteca | MORT | \* | 0.076 | 86411 | NA1 |
| Ceriodaphnia | dubia | MORT | \* | 0.079 | 18190 | Quant. SSD |
| Gammarus | pulex | MORT |   | 0.080 | 8107 | NA1 |
| Paratya | australiensis | MORT | \* | 0.080 | 18468 | NA1 |
| Paratya | australiensis | MORT | \* | 0.080 | 18468 | NA1 |
| Ceriodaphnia | dubia | IMBL | \* | 0.080 | 67777 | NA1 |
| Ceriodaphnia | dubia | MORT | \* | 0.080 | 157799 | NA1 |
| Hyalella | azteca | MORT | \* | 0.081 | 86411 | NA1 |
| Procloeon | sp. | MORT | \* | 0.081 | 90039 | NA1 |
| Hyalella | azteca | MORT | \* | 0.085 | 86411 | NA1 |
| Hyalella | azteca | MORT | \* | 0.086 | 86411 | NA1 |
| Chironomus | riparius | MORT | \* | 0.089 | 13342 | NA1 |
| Hyalella | azteca | MORT | \* | 0.089 | 86411 | NA1 |
| Daphnia | carinata | MORT | \* | 0.090 | 108483 | Acceptable  |
| Simocephalus | vetulus | MORT | \* | 0.090 | 108483 | Acceptable  |
| Ceriodaphnia | dubia | MORT | \* | 0.094 | 18190 | Quant. SSD |
| Paratya | australiensis | MORT | \* | 0.10 | 18468 | NA1 |
| Hyalella | azteca | MORT |   | 0.10 | 18996 | NA1 |
| Rhepoxynius | abronius | MORT | \* | 0.10 | 56538 | NA1 |
| Moina | australiensis | MORT | \* | 0.10 | 108483 | NA1 |
| Daphnia | magna | IMBL | \* | 0.10 | MRID 40840902 | Acceptable |
| Daphnia | magna | IMBL | \* | 0.11 | 13342 | NA1 |
| Gammarus | lacustris | MORT | \* | 0.11 | 6797 | NA1 |
| Ceriodaphnia | dubia | IMBL |   | 0.11 | 67777 | NA1 |
| Gammarus | lacustris | MORT | \* | 0.11 | MRID 40098001 | Supplemental |
| Ceriodaphnia | dubia | MORT | \* | 0.12 | 18190 | Quant. SSD |
| Neomysis | integer | MORT | \* | 0.13 | 53635 | NA1 |
| Rhepoxynius | abronius | MORT | \* | 0.14 | 56538 | NA1 |
| Paratya | australiensis | MORT | \* | 0.15 | 18468 | NA1 |
| Paratya | australiensis | MORT | \* | 0.15 | 18468 | NA1 |
| Neomysis | integer | MORT | \* | 0.15 | 53635 | NA1 |
| Palaemonetes | pugio | MORT | \* | 0.15 | 92616 | NA1 |
| Palaemonetes | pugio | MORT | \* | 0.15 | 92616 | NA1 |
| Ampelisca | abdita | MORT | \* | 0.16 | 56539 | NA1 |
| Palaemonetes | pugio | MORT | \* | 0.16 | 72741 | NA1 |
| Hyalella | curvispina | MORT | \* | 0.17 | 159934 | NA1 |
| Gammarus | palustris | MORT | \* | 0.19 | 51439 | NA1 |
| Neomysis | integer | MORT | \* | 0.19 | 53635 | NA1 |
| Daphnia | magna | IMBL | \* | 0.19 | 96171 | NA1 |
| Culex | pipiens ssp. molestus | MORT |   | 0.20 | 5162 | NA1 |
| Cloeon | dipterum | IMBL |   | 0.20 | 8107 | NA1 |
| Farfantepenaeus | aztecus | MORT | \* | 0.20 | MRID 40228401 | Supplemental |
| Daphnia | magna | IMBL | \* | 0.21 | 13342 | NA1 |
| Daphnia | magna | IMBL | \* | 0.22 | 13342 | NA1 |
| Gammarus | pulex | MORT | \* | 0.23 | 159804 | NA1 |
| Daphnia | carinata | MORT | \* | 0.23 | 107384 | Quantitative  |
| Atalophlebia | australis | MORT | \* | 0.24 | 108483 | Acceptable  |
| Daphnia | carinata | MORT | \* | 0.24 | 108495 | NA1 |
| Paratya | australiensis | MORT | \* | 0.25 | 18468 | NA1 |
| Daphnia | pulex | MORT |   | 0.25 | 18477 | NA1 |
| Daphnia | pulex | IMBL |   | 0.25 | 18477 | NA1 |
| Ceriodaphnia | dubia | IMBL |   | 0.25 | 67777 | NA1 |
| Daphnia | magna | MORT | \* | 0.25 | 157799 | NA1 |
| Chironomus | dilutus | IMBL | \* | 0.25 | 160294 | NA1 |
| Daphnia | carinata | MORT | \* | 0.28 | 107384 | NA1 |
| Paratya | australiensis | MORT | \* | 0.28 | 18468 | NA1 |
| Paratya | australiensis | MORT | \* | 0.28 | 18468 | NA1 |
| Paratya | australiensis | MORT | \* | 0.28 | 18468 | NA1 |
| Simulium | vittatum | MORT | \* | 0.28 | 71060 | NA1 |
| Atalophlebia | australis | MORT | \* | 0.28 | 108483 | Acceptable  |
| Chironomus | dilutus | MORT | \* | 0.29 | 160294 | NA1 |
| Cloeon | dipterum | MORT |   | 0.30 | 8107 | NA1 |
| Daphnia | longispina | MORT |   | 0.30 | 8107 | NA1 |
| Daphnia | longispina | IMBL |   | 0.30 | 8107 | NA1 |
| Daphnia | longispina | IMBL |   | 0.30 | 8107 | NA1 |
| Gammarus | pulex | IMBL |   | 0.30 | 17254 | NA1 |
| Chironomus | tentans | MORT |   | 0.30 | 18996 | NA1 |
| Gammarus | palustris | MORT | \* | 0.30 | 51439 | NA1 |
| Ceriodaphnia | dubia | IMBL | \* | 0.30 | 67777 | NA1 |
| Culex | quinquefasciatus | MORT | \* | 0.30 | 101101 | NA1 |
| Daphnia | carinata | MORT | \* | 0.30 | 108495 | NA1 |
| Macrobrachium | rosenbergii | MORT |   | 0.30 | 116838 | NA1 |
| Chaoborus | obscuripes | MORT | \* | 0.30 | 159804 | NA1 |
| Gammarus | fasciatus | MORT | \* | 0.32 | 887 | NA1 |
| Daphnia | magna | MORT | \* | 0.33 | 19813 | NA1 |
| Paratya | australiensis | MORT | \* | 0.33 | 108483 | Quant. SSD |
| Chironomus | riparius | MORT | \* | 0.34 | 13342 | NA1 |
| Ampelisca | abdita | MORT | \* | 0.34 | 56539 | NA1 |
| Daphnia | magna | MORT | \* | 0.34 | 19813 | NA1 |
| Cloeon | dipterum | MORT | \* | 0.36 | 159804 | NA1 |
| Palaemonetes | pugio | MORT | \* | 0.37 | 14848 | NA1 |
| Ampelisca | abdita | MORT | \* | 0.39 | 4061 | NA1 |
| Ampelisca | abdita | MORT | \* | 0.39 | 56539 | NA1 |
| Cloeon | dipterum | IMBL |   | 0.40 | 8107 | NA1 |
| Simocephalus | vetulus | IMBL |   | 0.40 | 8107 | NA1 |
| Simocephalus | vetulus | IMBL |   | 0.40 | 8107 | NA1 |
| Cloeon | dipterum | IMBL |   | 0.40 | 17254 | NA1 |
| Daphnia | pulex | IMBL |   | 0.42 | 18477 | NA1 |
| Gammarus | pulex | MORT |   | 0.43 | 159804 | NA1 |
| Palaemonetes | pugio | MORT | \* | 0.44 | 14848 | NA1 |
| Chironomus | tentans | MORT | \* | 0.45 | 352 | NA1 |
| Chironomus | dilutus | MORT | \* | 0.46 | 117852 | NA1 |
| Chironomus | tentans | IMBL | \* | 0.49 | 62472 | NA1 |
| Palaemonetes | argentinus | MORT |   | 0.49 | 101421 | NA1 |
| Simocephalus | vetulus | MORT |   | 0.50 | 8107 | NA1 |
| Caenis | horaria | IMBL |   | 0.50 | 8107 | NA1 |
| Lestes | sp. | MORT | \* | 0.50 | 16806 | NA1 |
| Chaoborus | obscuripes | IMBL |   | 0.50 | 17254 | NA1 |
| Daphnia | carinata | MORT | \* | 0.51 | 107384 | Quantitative  |
| Macrobrachium | lar | MORT |   | 0.54 | 157374 | NA1 |
| Claassenia | sabulosa | MORT | \* | 0.56 | MRID 40098001 | Supplemental |
| Claassenia | sabulosa | MORT | \* | 0.57 | 6797 | NA1 |
| Daphnia | magna | IMBL | \* | 0.57 | 13342 | NA1 |
| Daphnia | magna | MORT |   | 0.60 | 18996 | NA1 |
| Amphiascus | tenuiremis | MORT | \* | 0.61 | 87778 | NA1 |
| Chironomus | dilutus | MORT |   | 0.63 | 160293 | NA1 |
| Palaemonetes | pugio | MORT | \* | 0.69 | 14848 | NA1 |
| Chaoborus | obscuripes | IMBL |   | 0.70 | 8107 | NA1 |
| Caenis | horaria | IMBL |   | 0.70 | 8107 | NA1 |
| Diaptomus | forbesi | MORT |   | 0.72 | 303 | NA1 |
| Chironomus | tentans | MORT | \* | 0.72 | 103283 | NA1 |
| Paratya | australiensis | MORT | \* | 0.72 | 108483 | Quant. SSD |
| Daphnia | magna | IMBL | \* | 0.73 | 108323 | NA1 |
| Peltodytes | sp. | MORT | \* | 0.75 | 7775 | NA1 |
| Simocephalus | vetulus | MORT |   | 0.80 | 8107 | NA1 |
| Daphnia | longispina | MORT |   | 0.80 | 8107 | NA1 |
| Daphnia | pulex | MORT |   | 0.80 | 18477 | NA1 |
| Cloeon | dipterum | MORT |   | 0.81 | 159804 | NA1 |
| Daphnia | magna | MORT | \* | 0.82 | 159804 | NA1 |
| Chironomus | dilutus | MORT | \* | 0.83 | 117852 | NA1 |
| Anisops | sardeus | MORT |   | 0.90 | 59962 | NA1 |
| Daphnia | magna | IMBL | \* | 0.90 | 159999 | NA1 |
| Cloeon | dipterum | MORT |   | 1.0 | 8107 | NA1 |
| Daphnia | magna | MORT | \* | 1.0 | 16353 | NA1 |
| Anopheles | quadrimaculatus | MORT |   | 1.0 | 56989 | NA1 |
| Gammarus | fossarum | MORT | \* | 1.0 | 116122 | NA1 |
| Daphnia | magna | IMBL | \* | 1.1 | 62284 | NA1 |
| Chaoborus | obscuripes | MORT |   | 1.1 | 159804 | NA1 |
| Chironomus | plumosus | MORT | \* | 1.3 | 118362 | NA1 |
| Chaoborus | obscuripes | IMBL |   | 1.4 | 8107 | NA1 |
| Culex | pipiens ssp. molestus | MORT |   | 1.5 | 5162 | NA1 |
| Palaemonetes | pugio | MORT | \* | 1.5 | MRID 40228401 | Supplemental |
| Procambarus | sp. | MORT | \* | 1.6 | 159804 | NA1 |
| Daphnia | pulex | MORT |   | 1.6 | 18477 | NA1 |
| Corixa | punctata | IMBL |   | 1.7 | 8107 | NA1 |
| Daphnia | magna | IMBL | \* | 1.7 | MRID 102520 | NA1 |
| Plea | minutissima | MORT | \* | 2.0 | 159804 | NA1 |
| Anax | imperator | MORT | \* | 2.0 | 159804 | NA1 |
| Corixa | punctata | MORT |   | 2.0 | 8107 | NA1 |
| Sigara | arguta | MORT | \* | 2.2 | 153793 | NA1 |
| Farfantepenaeus | duorarum | MORT | \* | 2.4 | MRID 40228401 | Supplemental |
| Caenis | sp. | MORT | \* | 2.5 | 16806 | NA1 |
| Macrobrachium | lanchesteri | MORT | \* | 2.5 | 159754 | NA1 |
| Asellus | aquaticus | IMBL |   | 2.7 | 8107 | NA1 |
| Procambarus | sp. | MORT |   | 2.8 | 159804 | NA1 |
| Macrobrachium | lanchesteri | MORT | \* | 2.8 | 159754 | NA1 |
| Daphnia | pulex | MORT |   | 2.9 | 18477 | NA1 |
| Corixa | punctata | IMBL |   | 3.2 | 8107 | NA1 |
| Anax | imperator | MORT |   | 3.3 | 159804 | NA1 |
| Gammarus | pulex | MORT | \* | 3.4 | 115493 | NA1 |
| Asellus | aquaticus | IMBL |   | 3.4 | 17254 | NA1 |
| Streptocephalus | sudanicus | MORT |   | 3.5 | 59962 | NA1 |
| Amphiascus | tenuiremis | MORT | \* | 3.6 | 87778 | NA1 |
| Limnephilus | indivisus | MORT | \* | 3.6 | 16806 | NA1 |
| Diaptomus | forbesi | MORT | \* | 3.6 | 54793 | NA1 |
| Amphiascus | tenuiremis | MORT | \* | 3.6 | 87778 | NA1 |
| Asellus | aquaticus | IMBL |   | 4.3 | 8107 | NA1 |
| Litopenaeus | vannamei | MORT |   | 4.8 | 16892 | NA1 |
| Chironomus | plumosus | MORT | \* | 5.0 | 118362 | NA1 |
| Callinectes | sapidus | MORT | \* | 5.2 | MRID 40228401 | Supplemental |
| Gammarus | palustris | MORT |   | 5.2 | 51439 | NA1 |
| Enallagma | sp. | MORT | \* | 5.3 | 16806 | NA1 |
| Plea | minutissima | MORT |   | 5.9 | 159804 | NA1 |
| Corixa | punctata | MORT |   | 6.0 | 8107 | NA1 |
| Neoplea | striola | MORT | \* | 6.2 | 16806 | NA1 |
| Gammarus | palustris | MORT |   | 6.5 | 51439 | NA1 |
| Chaoborus | obscuripes | MORT |   | 6.6 | 8107 | NA1 |
| NR | Heptageniidae | MORT | \* | 7.0 | 97793 | NA1 |
| Daphnia | magna | IMBL | \* | 7.1 | 159936 | NA1 |
| Penaeus | monodon | MORT |   | 7.6 | 159862 | NA1 |
| Aulacomya | ater | MORT |   | 7.7 | 159923 | NA1 |
| Notonecta | maculata | MORT | \* | 8.0 | 159804 | NA1 |
| Amphiascus | tenuiremis | MORT | \* | 8.4 | 87778 | NA1 |
| Xanthocnemis | zealandica | MORT | \* | 8.4 | 153793 | NA1 |
| Asellus | aquaticus | MORT | \* | 8.6 | 159804 | NA1 |
| Chironomus | plumosus | MORT | \* | 8.6 | 118362 | NA1 |
| Pteronarcys | californica | MORT | \* | 10.0 | 6797 | NA1 |
| Pteronarcys | californica | MORT | \* | 10.0 | MRID 40098001 | Supplemental |
| Ranatra | linearis | MORT |   | 12.0 | 159804 | NA1 |
| Procambarus | sp. | MORT | \* | 12.9 | 159804 | NA1 |
| Branchiura | sowerbyi | MORT |   | 13.2 | 303 | NA1 |
| Chironomus | plumosus | MORT | \* | 19.8 | 118362 | NA1 |
| Penaeus | monodon | MORT |   | 20.7 | 159862 | NA1 |
| Eriocheir | sinensis | MORT | \* | 22.2 | 97350 | NA1 |
| Eriocheir | sinensis | MORT | \* | 23.7 | 97350 | NA1 |
| Notonecta | maculata | MORT |   | 23.9 | 159804 | NA1 |
| Spiralothelphusa | hydrodroma | MORT |   | 24.0 | 108872 | NA1 |
| NR | Parathelphusidae | MORT |   | 24.0 | 108873 | NA1 |
| Parapoynx | stratiotata | MORT | \* | 27.2 | 159804 | NA1 |
| Eriocheir | sinensis | MORT | \* | 27.4 | 97350 | NA1 |
| Daphnia | magna | MORT |   | 27.4 | 159804 | NA1 |
| Penaeus | monodon | MORT |   | 28.2 | 159862 | NA1 |
| Parapoynx | stratiotata | MORT |   | 29.4 | 159804 | NA1 |
| Spiralothelphusa | hydrodroma | MORT |   | 30.8 | 108872 | NA1 |
| Crassostrea | virginica | MORT | \* | 32.0 | MRID 40228401 | Supplemental |
| Spiralothelphusa | hydrodroma | MORT |   | 33.8 | 108872 | NA1 |
| NR | Parathelphusidae | MORT |   | 33.8 | 108873 | NA1 |
| Chironomus | plumosus | MORT | \* | 34.5 | 118362 | NA1 |
| Procambarus | sp. | MORT |   | 34.8 | 159804 | NA1 |
| Chironomus | plumosus | MORT | \* | 49.2 | 118362 | NA1 |
| Eriocheir | sinensis | MORT | \* | 53.1 | 97350 | NA1 |
| Chironomus | plumosus | MORT | \* | 63.7 | 118362 | NA1 |
| Branchiura | sowerbyi | MORT | \* | 66.0 | 54793 | NA1 |
| Eriocheir | sinensis | MORT | \* | 73.6 | 97350 | NA1 |
| Eriocheir | sinensis | MORT | \* | 76.1 | 97350 | NA1 |
| Chironomus | plumosus | MORT | \* | 78.6 | 118362 | NA1 |
| Crassostrea | virginica | MORT | \* | 84.0 |   MRID 42144905 | Supplemental |
| Chironomus | plumosus | MORT | \* | 93.3 | 118362 | NA1 |
| Anisus | vortex | IMBL |   | 94.0 | 8107 | NA1 |
| Lymnaea | stagnalis | IMBL |   | 94.0 | 8107 | NA1 |
| Chironomus | plumosus | MORT | \* | 108 | 118362 | NA1 |
| Chironomus | plumosus | MORT | \* | 123 | 118362 | NA1 |
| Eriocheir | sinensis | MORT | \* | 138 | 97350 | NA1 |
| Eriocheir | sinensis | MORT | \* | 140 | 97350 | NA1 |
| Lampsilis | siliquoidea | MORT |   | 148 | 99469 | NA1 |
| Chironomus | plumosus | MORT | \* | 174 | 118362 | NA1 |
| Chironomus | plumosus | MORT | \* | 226 | 118362 | NA1 |
| Chironomus | plumosus | MORT | \* | 236 | 118362 | NA1 |
| Donax | faba | MORT |   | 248 | 159921 | NA1 |
| Lampsilis | siliquoidea | MORT | \* | 250 | 99469 | Quant. SSD |
| Chironomus | plumosus | MORT | \* | 253 | 118362 | NA1 |
| Lampsilis | siliquoidea | MORT |   | 269 | 99469 | NA1 |
| Crassostrea | virginica | MORT | \* | 270 | MRID 40228401 | Supplemental |
| Sialis | lutaria | MORT |   | 327 | 159804 | NA1 |
| Lampsilis | siliquoidea | MORT |   | 430 | 99469 | NA1 |
| Neocaridina | denticulata | MORT | \* | 457 | 159804 | NA1 |
| Oziotelphusa | senex ssp. senex | MORT |   | 550 | 18025 | NA1 |
| Daphnia | magna | MORT | \* | 580 | 159937 | NA1 |
| Neocaridina | denticulata | MORT |   | 660 | 159804 | NA1 |
| Ischadium | recurvum | MORT |   | 960 | 84369 | NA1 |
| Hydra | attenuata | MORT | \* | 1000 | 159864 | NA1 |
| Hydra | attenuata | MORT | \* | 1500 | 159864 | NA1 |
| Crassostrea | virginica | MORT | \* | 2000 | MRID 40228401 | Supplemental |
| Litopenaeus | stylirostris | MORT | \* | 2266 | 73317 | NA1 |
| Brachionus | calyciflorus | MORT | \* | 12000 | 3963 | NA1 |
| Brachionus | calyciflorus | MORT | \* | 12000 | 17689 | NA1 |
| Mytilus | galloprovincialis | MORT | \* | 20925 | 14927 | Quant. SSD |

NA = Studies are acceptable for ECOTOX but have not been formally reviewed by EFED scientists