

US EPA ARCHIVE DOCUMENT

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Date Out of EFB: **MAY 13 1982**
MAY 13 1982

Drift EEC
no
water

To: Clayton Bushong, Chief
Ecological Effects Branch
Hazard Evaluation Division (TS-769)

From: Willa Garner, Ph.D., Head *WJ*
Review Section No. 1
Environmental Fate Branch
Hazard Evaluation Division (TS-769)

Attached please find the EEC information requested for:

Chemical: Chlorpyrifos

Lorsban, O,O-diethyl-O-(3,5,6-trichloro-2-pyridyl)-phosphorothioate

Product Name: LORSBAN 4E

Use Pattern for EEC Calculations: Soybeans and Alfalfa

Date In: 4/28/82

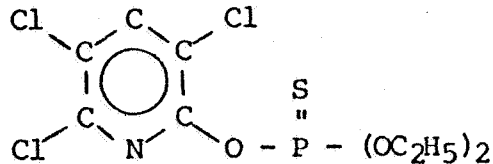
Date Out: 5/13/82

EEC/EFB#: 6

1.0 INTRODUCTION

On April 27, 1982, EEB and EFB met with representatives of The Office of Endangered Species to discuss the possible impact of the use of chlorpyrifos (Lorsban, O,O-diethyl-O-(3,5,6-trichloro-2-pyridyl)-phosphorothioate) on certain endangered aquatic species. On April 28, EEB requested EFB to estimate the environmental concentrations which might result (worst case) from the proposed aerial application use (on soybeans and alfalfa).

2.0 STRUCTURE



3.0 DIRECTIONS FOR USE

Soybeans: Use LORSBAN 4E to control larvae of the lesser corn-stalk borer by application at planting time or postemergence as a band (row) treatment at the rate of 4 pints per acre followed by light incorporation. Use 2 pints per acre at cracking in a 6 to 10 inch wide band followed by a second spray 5 days after initial treatment.

Restrictions: Do not apply more than 10 pints of LORSBAN 4E per acre or 5 pounds of chlorpyrifos (active ingredient) per acre per season. Do not apply within 28 days of harvest.

Alfalfa: Apply 1/4 - 1 lb ai/A as a broadcast foliar spray. Do not apply more than once per crop cutting nor make more than 4 application per year.

3.0 ESTIMATED ENVIRONMENTAL CONCENTRATION

Three mathematical models were utilized.

3.1 A model has been developed to estimate the quantity of downwind exposure (drift load). Inputs were as follows:

Application Rate:	1.0 lb/acre
Critical Threshold ¹ :	0.001 ppm
Height of Application:	10 and 15 feet
Wind Speed:	10 and 15 mph
Type of Application ² :	130 um VMD spinner and 270 um fan spray

¹/ normally 1/10 the LC50

²/ relates to the droplet size spectrum produced by a particular type of equipment.

In most cases this combination would not produce any recordable fallout beyond 200 meters. This is due to evaporation of the droplets and the dispersion of small droplets (<70-80 u) by the air currents or turbulence.

Based on the model, we would estimate 0.22 kg/ha as the most likely quantity of chlorpyrifos to reach water, resulting in an aqueous concentration of 0.16 ppm at 15 cm depth.

3.2 Chlorpyrifos reaching plants and ground during an aerial application may be washed-off into nearby streams and ponds after heavy rains. Therefore, a runoff model (SWRRB³) was utilized to estimate aquatic system input by this route. Inputs were as follows:

- Application Rate: 1 lb ai/acre
- Dates of Application: (see table below)
- % leaf wash off: 20%
- % efficiency of application: 50%

Dates of application were selected to precede the occurrence of a large rainstorm event by one day, in the selected basin. Only 20% is expected to wash off the leaves due to a good binding to vegetation, and the application efficiency for aerially applied insecticides is about 50%.

The river basins selected were YAZZ and WATKINS2. They are found in Yazoo MS and Watkinsville GA, respectively. These two rivers are the only ones available which provide a good rainfall during the growing season. The worst case situation was determined to occur in the YAZZ basin.

Yazoo MS

Date of Application		Worst Runoff		Quantity of Pesticide runoff	Rainfall
YR	DAY	YR	DAY	(lb/A/day)	(inches)
1974	May 23	1974	May 26	0.037	4.06
			1974 June 4-5	0.042	3.86
1975	May 28	1975	June 8-10	0.071	4.62

3.3. SWRRB and the Spray Drift Model outputs were used as inputs for the EXAMS⁴ model to estimate the partitioning within as well as the outflow from a given environment. In this case, the environment was assumed to be a one hectare pond, 2 meters deep with an outflow rate of about 20 cu meters/hr. The field adjacent to the pond was taken to be 5 ha.

3/ Simulated Water Runoff in Rural River Basins

4/ EXposure Analysis Model System

The combined inputs of Chlorpyrifos reaching the pond from runoff and drift was determined to be 3.14×10^{-5} kg/hr.

This input resulted from modifying the SWRRB and drift model outputs in order to achieve a steady-state concentration approximating the one time short duration inputs (from drift and runoff) due to the fact that EXAMS is a steady-state model. See Table 1 (attached) for a summary of chemical parameters used for this model.

The range of concentrations of chlorpyrifos in the environment immediately after runoff and aerial application were estimated to be:

Compartment	Median Concentration	Possible Concentration Range
Water Column and Pore Water:	4×10^{-5} ppm	4×10^{-4} to 4×10^{-6} ppm
Bottom + water column sediment:	3×10^{-2} mg/kg	3×10^{-1} to 3×10^{-3} mg/kg


4.0 CONCLUSIONS

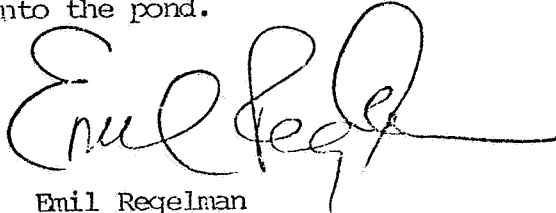
Chlorpyrifos concentrations in water would be expected to decline by an order of magnitude in about 40 days. Chlorpyrifos would most likely not accumulate in water, despite 3 subsequent weekly applications.

Chlorpyrifos concentrations in sediment would be expected to decline over a period of several months⁵. On the other hand, Chlorpyrifos levels in bottom sediments may increase with each application, possibly reaching 1.2 mg/kg (4 applications times 3×10^{-1} mg/kg sediment concentration).

5.0 RECOMMENDATION

The above estimates are probably between "normal" and "worst" case situation. The values are only rough approximations and should be used for reference purposes only. The ranges are provided as possible concentrations that may be encountered shortly after the input of the pesticide into the pond.


Robert W. Holst
Plant Physiologist


Emil Regelman
Chemist

Environmental Fate Branch
Hazard Evaluation Division
May 13, 1982

5/ See Tables 16 and 17, appended to this review.

HOLST DRIFT MODEL FOR ESTIMATIONS ONLY

INPUT - DROP NO., CRIT.LEVEL, APPL. RATE, HT, WIND SPD.

2. .001 1.0 10. 10.

DROPLETS EVAPORATED BEFORE REACHING THE GROUND. DUE TO DROPLET
EVAPORATION, A LIKELY MAXIMUM DRIFT DISTANCE OF

244. FEET OF 75. METERS IS POSSIBLE YIELDING A CONCENTRATION OF
0.160000 PPM IN 6 IN. OF WATER.

INPUT - DROP NO., CRIT.LEVEL, APPL. RATE, HT, WIND SPD.

3. .001 1. 10. 10.

DROPLETS EVAPORATED BEFORE REACHING THE GROUND. DUE TO DROPLET
EVAPORATION, A LIKELY MAXIMUM DRIFT DISTANCE OF

244. FEET OF 75. METERS IS POSSIBLE YIELDING A CONCENTRATION OF
0.060000 PPM IN 6 IN. OF WATER.

INPUT - DROP NO., CRIT.LEVEL, APPL. RATE, HT, WIND SPD.

2. .001 1.0 15. 15.

DROPLETS EVAPORATED BEFORE REACHING THE GROUND. DUE TO DROPLET
EVAPORATION, A LIKELY MAXIMUM DRIFT DISTANCE OF

550. FEET OF 168. METERS IS POSSIBLE YIELDING A CONCENTRATION OF
0.160000 PPM IN 6 IN. OF WATER.

INPUT - DROP NO., CRIT.LEVEL, APPL. RATE, HT, WIND SPD.

2. .001 1.0 10. 15.

DROPLETS EVAPORATED BEFORE REACHING THE GROUND. DUE TO DROPLET
EVAPORATION, A LIKELY MAXIMUM DRIFT DISTANCE OF

367. FEET OF 112. METERS IS POSSIBLE YIELDING A CONCENTRATION OF
0.160000 PPM IN 6 IN. OF WATER.

INPUT - DROP NO., CRIT.LEVEL, APPL. RATE, HT, WIND SPD.

2. .001 1. 15. 10.

DROPLETS EVAPORATED BEFORE REACHING THE GROUND. DUE TO DROPLET
EVAPORATION, A LIKELY MAXIMUM DRIFT DISTANCE OF

367. FEET OF 112. METERS IS POSSIBLE YIELDING A CONCENTRATION OF
0.160000 PPM IN 6 IN. OF WATER.

SWRRB Runoff Model Determination
Titles for column values

- A DAILY PRECIPITATION (IN)
- B DAILY RUNOFF (IN)
- C SOIL CONSERVATION CURVE
- D EVAPOTRANSPIRATION (IN)
- E PERCOLATION (IN)
- F PEAK RUNOFF RATE (CFS)
- G MEASURED RUNOFF (IN)
- H WATER YIELD (IN)
- I RETURN FLOW STORAGE (IN)
- J SOIL WATER (MM)
- K SEDIMENTATION YIELD (TONS/AC)
- L PESTICIDE LEACHED BELOW 1.0CM (LB/AC)
- M PESTICIDE RUNOFF (LB/AC)

INDEX TO MONTHLY SUMMARY ROW DEFINITIONS

- P PRECIPITATION (IN)
- Q MEASURED RUNOFF (IN)
- R PREDICTED RUNOFF (IN)
- S PREDICTED SURFACE Q (IN)
- T PREDICTED SED YLD (TONX/AC)
- U EVAPOTRANSPIRATION (IN)
- V DEEP PERCOLATION (IN)
- W PESTICIDE LEACHED BELOW 1.0CM (LB/AC)
- X PESTICIDE RUNOFF (LB/AC)

SWRRB Runoff Model Determination for Yazoo River Subbasin

YR DAY	A	B	L	M	YR DAY	A	B	L	M
4 140	0.000	0.000	0.000	0.000	74 192	0.000	0.000	0.000	0.000
4 141	0.660	0.108	0.000	0.000	74 193	0.000	0.000	0.000	0.000
4 142	3.290	2.664	0.000	0.000	74 194	2.280	0.775	0.005	0.006
4 143	0.000	0.000	0.000	0.000	74 195	0.000	0.000	0.003	0.000
4 144	0.000	0.000	0.000	0.000	74 196	1.130	0.374	0.003	0.003
4 145	0.360	0.059	0.000	0.001	74 197	0.000	0.000	0.002	0.000
4 146	3.700	3.190	0.002	0.036	74 198	0.000	0.000	0.000	0.000
4 147	0.000	0.000	0.000	0.000	74 199	0.000	0.000	0.000	0.000
4 148	0.000	0.000	0.000	0.000	74 200	0.000	0.000	0.000	0.000
4 149	0.000	0.000	0.000	0.000					
4 150	0.000	0.000	0.000	0.000	75 140	0.000	0.000	0.000	0.000
4 151	2.080	1.250	0.003	0.017	75 141	0.000	0.000	0.000	0.000
4 152	0.050	0.007	0.000	0.000	75 142	0.000	0.000	0.000	0.000
4 153	0.000	0.000	0.000	0.000	75 143	0.000	0.000	0.000	0.000
4 154	0.000	0.000	0.000	0.000	75 144	0.510	0.102	0.000	0.000
4 155	0.670	0.207	0.001	0.003	75 145	0.000	0.000	0.000	0.000
4 156	3.190	2.723	0.001	0.039	75 146	0.000	0.000	0.000	0.000
4 157	0.000	0.000	0.000	0.000	75 147	0.000	0.000	0.000	0.000
4 158	1.930	1.326	0.002	0.016	75 148	0.670	0.250	0.003	0.004
4 159	0.820	0.731	0.000	0.008	75 149	2.210	2.097	0.002	0.034
4 160	0.660	0.328	0.001	0.004	75 150	1.510	1.330	0.002	0.016
4 161	0.050	0.000	0.000	0.000	75 151	0.750	0.574	0.002	0.010
4 162	0.000	0.000	0.000	0.000	75 152	0.000	0.000	0.001	0.000
4 163	0.000	0.000	0.000	0.000	75 153	0.000	0.000	0.000	0.000
4 164	0.000	0.000	0.000	0.000	75 154	0.000	0.000	0.000	0.000
4 165	0.000	0.000	0.000	0.000	75 155	0.000	0.000	0.000	0.000
4 166	0.120	0.000	0.000	0.000	75 156	0.070	0.000	0.001	0.000
4 167	0.000	0.000	0.000	0.000	75 157	0.210	0.010	0.002	0.000
4 168	0.000	0.000	0.000	0.000	75 158	0.000	0.000	0.000	0.000
4 169	0.000	0.000	0.000	0.000	75 159	0.880	0.422	0.002	0.006
4 170	0.000	0.000	0.000	0.000	75 160	1.610	1.543	0.002	0.030
4 171	0.000	0.000	0.000	0.000	75 161	2.130	1.763	0.002	0.035
4 172	0.000	0.000	0.000	0.000	75 162	0.260	0.216	0.002	0.002
4 173	0.000	0.000	0.000	0.000	75 163	0.000	0.000	0.000	0.000
4 174	1.340	0.329	0.005	0.004	75 164	0.000	0.000	0.000	0.000
4 175	0.000	0.000	0.000	0.000	75 165	0.000	0.000	0.000	0.000
4 176	0.000	0.000	0.000	0.000	75 166	0.430	0.086	0.002	0.001
4 177	0.000	0.000	0.000	0.000	75 167	0.000	0.000	0.000	0.000
4 178	0.000	0.000	0.000	0.000	75 168	0.000	0.000	0.000	0.000
4 179	0.000	0.000	0.000	0.000	75 169	0.000	0.000	0.000	0.000
4 180	0.000	0.000	0.000	0.000	75 170	0.200	0.003	0.001	0.000
4 181	0.000	0.000	0.000	0.000	75 171	0.000	0.000	0.000	0.000
4 182	0.000	0.000	0.000	0.000	75 172	0.000	0.000	0.000	0.000
4 183	0.000	0.000	0.000	0.000	75 173	0.000	0.000	0.000	0.000
4 184	0.000	0.000	0.000	0.000	75 174	0.000	0.000	0.000	0.000
4 185	0.000	0.000	0.000	0.000	75 175	0.000	0.000	0.000	0.000
4 186	0.110	0.000	0.000	0.000	75 176	0.000	0.000	0.000	0.000
4 187	0.000	0.000	0.000	0.000	75 177	0.000	0.000	0.000	0.000
4 188	0.780	0.040	0.004	0.000	75 178	0.000	0.000	0.000	0.000
4 189	0.000	0.000	0.000	0.000	75 179	0.000	0.000	0.000	0.000
4 190	0.000	0.000	0.000	0.000	75 180	0.000	0.000	0.000	0.000
4 191	0.000	0.000	0.000	0.000	75 181	0.000	0.000	0.000	0.000

SWRRB Runoff Model Determination for Yazoo River Subbasin

5 182	0.000	0.000	0.000	0.000
5 183	0.000	0.000	0.000	0.000
5 184	0.000	0.000	0.000	0.000
5 185	0.000	0.000	0.000	0.000
5 186	0.000	0.000	0.000	0.000
5 187	0.000	0.000	0.000	0.000
5 188	0.940	0.079	0.005	0.001
5 189	0.140	0.000	0.001	0.000
5 190	0.000	0.000	0.000	0.000
5 191	0.000	0.000	0.000	0.000
5 192	0.000	0.000	0.000	0.000
5 193	0.000	0.000	0.000	0.000
5 194	0.000	0.000	0.000	0.000
5 195	0.000	0.000	0.000	0.000
5 196	0.000	0.000	0.000	0.000
5 197	0.000	0.000	0.000	0.000
5 198	0.000	0.000	0.000	0.000
5 199	0.000	0.000	0.000	0.000
5 200	0.000	0.000	0.000	0.000

SWRRB Runoff Model Determination for Yazoo River Subbasin

SWRRB - YAZOO VS CHLORPYRIFOS
SUMMARY OUTPUT

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
1974													
P	8.850	3.490	1.960	5.120	14.940	8.830	5.860	6.530	5.120	1.980	4.140	4.730	71.550
Q	0.885	0.349	0.196	0.512	1.494	0.883	0.586	0.653	0.512	0.198	0.414	0.473	7.
W	0.000	0.000	0.000	0.000	0.005	0.010	0.022	0.018	0.015	0.006	0.011	0.010	0.096
X	0.000	0.000	0.000	0.000	0.053	0.073	0.011	0.012	0.010	0.001	0.003	0.004	0.167
1975													
P	3.680	5.780	8.970	5.920	9.020	5.790	4.950	5.160	1.510	5.230	4.330	2.320	62.660
Q	0.368	0.578	0.897	0.592	0.902	0.579	0.495	0.516	0.151	0.523	0.433	0.232	6.266
W	0.003	0.003	0.003	0.002	0.010	0.014	0.019	0.020	0.006	0.017	0.012	0.008	0.117
X	0.005	0.007	0.020	0.005	0.068	0.075	0.013	0.009	0.000	0.006	0.003	0.001	0.213
AVE													
P	6.265	4.635	5.465	5.520	11.980	7.310	5.405	5.845	3.315	3.605	4.235	3.525	67.105
Q	0.627	0.464	0.547	0.552	1.198	0.731	0.541	0.585	0.332	0.361	0.424	0.353	6.711
W	0.001	0.002	0.002	0.001	0.007	0.012	0.021	0.019	0.011	0.011	0.012	0.009	0.107
X	0.003	0.004	0.010	0.003	0.060	0.074	0.012	0.010	0.005	0.004	0.003	0.003	0.190

SWRRB Runoff Model Determination for Watkinsville Subbasin P-2

SWRRB - WATKINS2 VS CHLORPYRIFOS

DAILY VALUES

YR DAY	A	B	L	M
74 140	0.000	0.000	0.000	0.000
74 141	0.000	0.000	0.000	0.000
74 142	0.000	0.000	0.000	0.000
74 143	0.260	0.000	0.000	0.000
74 144	2.500	0.332	0.009	0.006
74 145	0.000	0.000	0.004	0.000
74 146	0.280	0.239	0.003	0.004
74 147	0.000	0.000	0.001	0.000
74 148	0.000	0.000	0.000	0.000
74 149	0.000	0.000	0.000	0.000
74 150	0.000	0.000	0.000	0.000
74 151	0.500	0.000	0.002	0.000
74 152	0.000	0.000	0.000	0.000
74 153	0.000	0.000	0.000	0.000
74 154	0.000	0.000	0.000	0.000
74 155	0.000	0.000	0.000	0.000
74 156	0.000	0.000	0.000	0.000
74 157	0.000	0.000	0.000	0.000
74 158	0.000	0.000	0.000	0.000
74 159	0.300	0.000	0.000	0.000
74 160	0.000	0.000	0.000	0.000
74 161	0.250	0.000	0.000	0.000
74 162	0.000	0.000	0.000	0.000
74 163	0.000	0.000	0.000	0.000
74 164	0.000	0.000	0.000	0.000
74 165	0.000	0.000	0.000	0.000
74 166	0.000	0.000	0.000	0.000
74 167	0.000	0.000	0.000	0.000
74 168	0.000	0.000	0.000	0.000
74 169	0.000	0.000	0.000	0.000
74 170	0.000	0.000	0.000	0.000
74 171	0.480	0.000	0.003	0.000
74 172	0.000	0.000	0.000	0.000
74 173	0.000	0.000	0.000	0.000
74 174	0.000	0.000	0.000	0.000
74 175	0.000	0.000	0.000	0.000
74 176	0.000	0.000	0.000	0.000
74 177	0.000	0.000	0.000	0.000
74 178	1.000	0.927	0.010	0.010
74 179	0.000	0.000	0.005	0.000
74 180	0.000	0.000	0.004	0.000
74 181	0.000	0.000	0.004	0.000
74 182	0.000	0.000	0.004	0.000
74 183	0.000	0.000	0.000	0.000
74 184	0.000	0.000	0.000	0.000
74 185	0.000	0.000	0.000	0.000
74 186	0.000	0.000	0.000	0.000

11

SWRRB Runoff Model Determination for Watkinsville Subbasin P-2

YR DAY	A	B	L	M
74 187	0.000	0.000	0.000	0.000
74 188	0.000	0.000	0.000	0.000
74 189	0.000	0.000	0.000	0.000
74 190	0.000	0.000	0.000	0.000
74 191	0.000	0.000	0.000	0.000
74 192	0.000	0.000	0.000	0.000
74 193	0.000	0.000	0.000	0.000
74 194	0.000	0.000	0.000	0.000
74 195	0.000	0.000	0.000	0.000
74 196	0.000	0.000	0.000	0.000
74 197	0.000	0.000	0.000	0.000
74 198	0.110	0.000	0.001	0.000
74 199	0.000	0.000	0.000	0.000
74 200	0.000	0.000	0.000	0.000
75 140	0.000	0.000	0.000	0.000
75 141	0.000	0.000	0.000	0.000
75 142	0.000	0.000	0.000	0.000
75 143	0.000	0.000	0.000	0.000
75 144	0.000	0.000	0.000	0.000
75 145	0.000	0.000	0.000	0.000
75 146	0.000	0.000	0.000	0.000
75 147	0.000	0.000	0.000	0.000
75 148	0.000	0.000	0.000	0.000
75 149	0.100	0.000	0.001	0.000
75 150	0.000	0.000	0.000	0.000
75 151	1.000	0.008	0.008	0.000
75 152	0.420	0.007	0.006	0.000
75 153	0.000	0.000	0.003	0.000
75 154	0.000	0.000	0.000	0.000
75 155	0.000	0.000	0.000	0.000
75 156	0.000	0.000	0.000	0.000
75 157	0.000	0.000	0.000	0.000
75 158	0.000	0.000	0.000	0.000
75 159	0.000	0.000	0.000	0.000
75 160	0.000	0.000	0.000	0.000
75 161	0.450	0.000	0.005	0.000
75 162	2.800	0.869	0.005	0.015
75 163	0.000	0.000	0.004	0.000
75 164	0.000	0.000	0.004	0.000
75 165	0.000	0.000	0.004	0.000
75 166	0.000	0.000	0.003	0.000
75 167	0.000	0.000	0.001	0.000
75 168	0.000	0.000	0.000	0.000
75 169	0.050	0.000	0.001	0.000
75 170	0.250	0.000	0.003	0.000
75 171	0.000	0.000	0.000	0.000
75 172	0.000	0.000	0.000	0.000
75 173	0.000	0.000	0.000	0.000
75 174	0.000	0.000	0.000	0.000
75 175	0.000	0.000	0.000	0.000
75 176	0.000	0.000	0.000	0.000
75 177	0.000	0.000	0.000	0.000

SWRRB Runoff Model Determination for Watkinsville Subbasin. P-2

75 178	0.000	0.000	0.000	0.000
75 179	0.000	0.000	0.000	0.000
75 180	0.000	0.000	0.000	0.000
75 181	0.000	0.000	0.000	0.000
75 182	0.000	0.000	0.000	0.000
75 183	0.450	0.000	0.004	0.000
75 184	0.000	0.000	0.000	0.000
75 185	0.000	0.000	0.000	0.000
75 186	0.000	0.000	0.000	0.000
75 187	0.140	0.000	0.000	0.000
75 188	0.000	0.000	0.000	0.000
75 189	0.000	0.000	0.000	0.000
75 190	0.000	0.000	0.000	0.000
75 191	0.350	0.000	0.003	0.000
75 192	0.000	0.000	0.000	0.000
75 193	0.000	0.000	0.000	0.000
75 194	1.050	0.000	0.010	0.000
75 195	0.050	0.000	0.000	0.000
75 196	0.000	0.000	0.000	0.000
75 197	0.060	0.000	0.000	0.000
75 198	0.420	0.000	0.003	0.000
75 199	0.000	0.000	0.000	0.000
75 200	0.000	0.000	0.000	0.000

SWRRB Runoff Model Determination for Watkinsville Subbasin P-2

SWRRB - WATKINS2 VS CHLORPYRIFOS
SUMMARY OUTPUT

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
1974													
P	2.700	4.110	1.920	2.600	5.420	5.290	4.150	5.780	1.850	0.360	1.160	4.920	40.260
Q	0.036	0.077	0.008	0.270	0.327	1.684	1.869	0.517	0.025	0.000	0.000	0.005	4.818
W	0.000	0.000	0.000	0.000	0.018	0.026	0.031	0.033	0.009	0.000	0.003	0.016	0.136
X	0.000	0.000	0.000	0.000	0.010	0.010	0.004	0.003	0.000	0.000	0.000	0.000	0.028
1975													
P	5.020	7.170	9.780	3.930	5.650	3.970	4.670	2.340	5.370	0.350	0.000	0.000	48.250
Q	0.063	0.388	1.984	0.696	0.384	1.710	1.298	0.075	0.463	0.000	0.000	0.000	7.061
W	0.013	0.013	0.009	0.004	0.017	0.038	0.038	0.018	0.029	0.001	0.000	0.000	0.179
X	0.001	0.007	0.017	0.002	0.001	0.015	0.000	0.000	0.002	0.000	0.000	0.000	0.045
AVE													
P	3.860	5.640	5.850	3.265	5.535	4.630	4.410	4.060	3.610	0.355	0.580	2.460	44.255
Q	0.050	0.233	0.996	0.483	0.356	1.697	1.584	0.296	0.244	0.000	0.000	0.003	5.940
W	0.006	0.006	0.004	0.002	0.018	0.032	0.034	0.025	0.019	0.001	0.001	0.008	0.158
X	0.000	0.004	0.008	0.001	0.006	0.013	0.002	0.002	0.001	0.000	0.000	0.000	0.036

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AERL-ESB MODEL OF FATE OF ORGANIC TOXICANTS IN AQUATIC ECOSYSTEMS

Compound: CHLORPYRIFOS

Environment: POND, AERL DEVELOPMENT PHASE TEST DEFINITION

with a load of (kg/hr) > .3140006E-04

TABLE 1. SH2 (NEUTRAL MOLECULE, SPECIES #1) INPUT DATA.

MWT= 350.5 SOL = 1.000 VAPR= 1.870E-05 HENRY= 4.210E-06
 KPS= 75.43 KOW = 6.600E+04
 KAH2= 1203. KBH1= 545.0
 KDP= 1.440E-02 RFLAT= 34.00 QUANT1= 1.000

TABLE 10. KINETIC PROFILE OF ORGANIC TOXICANT. RATE CONSTANTS DERIVED FROM COUPLING OF TOXICANT CHARACTERISTICS TO ECOSYSTEM PROPERTIES.

CP T*	PSEUDO-FIRST-ORDER RATE CONSTANTS (/HR)					
Y	HYDROLYSIS	PHOTOLYSIS	OXIDATION	BIOLYSIS	VOLATILITY	TRANSPORT
1L	5.05E-04	1.98E-03	.0	.0	1.50E-04	4.83E-02
2B	1.20E-03	.0	.0	.0	.0	5.56E-04

* COMP. TYPE: "L"=LITTORAL; "E"=(EPI) AND "H"=(HYPO)LIMNION; "B"=BENTHIC

TABLE 11. CANONICAL PROFILE OF ECOSYSTEM.

CP T*	PH	POH	TEMP	REAERATION	COMPOSITE	BACTERIAL	OXIDANT	DISSOLVED
Y			DEG.	COEFF.	LIGHT AVE	POP. SIZE	CONC.	PERCENT
P			C.	M/HR	%	CELLS/**	(MOLAR)	%
1L	8.00	6.00	15.0	7.11E-02	20.8	1.00E+05	1.00E-09	92.5
2B	6.00	8.00	15.0	.0	.0	2.00E+07	.0	1.37E-02

* COMP. TYPE: "L"=LITTORAL; "E"=(EPI) AND "H"=(HYPO)LIMNION; "B"=BENTHIC

** ACTIVE BACTERIAL POPULATIONS AS CELLS/ML IN WATER COLUMN, CELLS/100 G (DRY WEIGHT) OF SEDIMENTS IN BOTTOM SEDIMENTS.

TABLE 12. TOXICANT LOADINGS (KG/HR) BY SYSTEM ELEMENT.

ELEMENT	STREAM FLOW	RAINFALL	INTERFLOW	NPS LOAD	DRIFT LOAD
1					3.140E-05
2					

TABLE 13. DISTRIBUTION OF CHEMICAL AT STEADY STATE: IN THE WATER COLUMN:

#	COMP STEADY-STATE RESIDENT MASS			**** TOXICANT CONCENTRATIONS ****			
	G/M	KILOS	%	TOTAL MG/*	DISSOLVED MG/L	SEDIMENTS MG/KG	BIOTA UG/G
1	8.71E-05	8.706E-04	100.00	4.35E-05	4.03E-05	.109	.0
SUBTOTAL:		8.706E-04	3.61				
AND IN THE BOTTOM SEDIMENTS:							
2	2.32E-03	2.323E-02	100.00	3.44E-02	1.27E-05	3.44E-02	.0
SUBTOTAL:		2.323E-02	96.39				
TOTAL MASS (KILOGRAMS) =			2.410E-02				

* TOTAL CONCENTRATION AS MG/L IN WATER COLUMN, AS MG/KG IN SEDIMENTS.

TABLE 15. ANALYSIS OF STEADY-STATE FATE OF ORGANIC TOXICANT.

PROCESS	MASS FLUX KG/DAY	% OF LOAD	HALF-LIFE* DAYS
HYDROLYSIS	6.812E-04	90.39	24.52
OXIDATION	.0	0.0	---
PHOTOLYSIS	4.147E-05	5.50	402.8
ALL CHEMICAL PROCESSES	7.226E-04	95.89	23.12
WATER COLUMN (BACTERIA)	.0	0.0	---
BOTTOM SEDIMENTS (BACTERIA)	.0	0.0	---
TOTAL BIOLYSIS	.0	0.0	---
VOLATILIZATION	3.125E-06	0.41	5346.
WATER-BORNE EXPORT	2.783E-05	3.69	600.4
TRANSFORMATION AND TRANSPORT	7.536E-04	100.00	
TOTAL SYSTEM LOAD	7.536E-04		
RESIDUAL ACCUMULATION RATE:	1.048E-09	0.00	

* HALF-LIVES ARE ESTIMATES BASED ON A FIRST-ORDER RATE APPROXIMATION.

TABLE 16. SIMULATION OF SYSTEM RESPONSE AFTER LOAD CEASES.

TIME DAYS	AVERAGE POLLUTANT CONCENTRATIONS				MASS OF POLLUTANT	
	WATER COLUMN		BOTTOM SEDIMENTS		WATER COL	SEDIMENTS
	FREE(MG/L)	SED(MG/KG)	PORE(MG/L)	SED(MG/KG)	TOTAL KG	TOTAL KG
0.	4.03E-05	.109	1.27E-05	3.44E-02	8.706E-04	2.32E-02
4.	1.11E-05	3.02E-02	1.16E-05	3.13E-02	2.411E-04	2.11E-02
8.	9.73E-06	2.63E-02	1.03E-05	2.78E-02	2.104E-04	1.88E-02
12.	8.64E-06	2.34E-02	9.13E-06	2.47E-02	1.868E-04	1.67E-02
16.	7.68E-06	2.08E-02	8.11E-06	2.19E-02	1.660E-04	1.48E-02
20.	6.82E-06	1.85E-02	7.21E-06	1.95E-02	1.474E-04	1.32E-02
24.	6.06E-06	1.64E-02	6.40E-06	1.73E-02	1.310E-04	1.17E-02
28.	5.38E-06	1.46E-02	5.69E-06	1.54E-02	1.163E-04	1.04E-02
32.	4.78E-06	1.29E-02	5.05E-06	1.37E-02	1.034E-04	9.23E-03
36.	4.25E-06	1.15E-02	4.49E-06	1.21E-02	9.191E-05	8.20E-03
40.	3.77E-06	1.02E-02	3.99E-06	1.08E-02	8.156E-05	7.28E-03
44.	3.35E-06	9.07E-03	3.54E-06	9.58E-03	7.245E-05	6.47E-03
48.	2.98E-06	8.05E-03	3.15E-06	8.51E-03	6.435E-05	5.75E-03

TABLE 17. EXPOSURE ANALYSIS SUMMARY.

EXPOSURE:

- A. MAXIMUM CONC. IN WATER COLUMN: 4.0E-05 MG/L DISSOLVED, 4.4E-05 TOT
MAX. CONC. IN BOTTOM SEDIMENT: 1.3E-05 MG/L DISSOLVED IN PORE WATER
- B. BIOSORPTION - MAX. CONCENTRATION - PLANKTON: .0 UG/G
BENTHOS: .0 UG/G
- C. MAXIMUM TOT. CONC. IN SEDIMENT DEPOSITS: 3.4E-02 MG/KG (DRY WEIGHT)

FATE:

- A. TOTAL STEADY-STATE ACCUMULATION: 2.4E-02 KG; 3.61% IN WATER COL.,
96.39% IN BOTTOM SEDIMENTS.
- B. TOTAL LOAD: 7.5E-04 KG/DAY - DISPOSITION: 95.89% VIA CHEMICAL
TRANSFORMATIONS, 0.0 % BIOTRANSFORMED, 0.41% VOLATILIZED,
3.69% EXPORTED VIA OTHER PATHWAYS.

PERSISTENCE:

- A. AT THE END OF A 48.0 DAY RECOVERY PERIOD, THE WATER COLUMN HAD
LOST 92.61% OF ITS INITIAL TOXICANT BURDEN; THE SEDIMENTS HAD
LOST 75.26% OF THEIR INITIAL BURDEN (75.89% REMOVAL OVERALL).
- B. SYSTEM SELF-PURIFICATION TIME IS ROUGHLY 4. MONTHS.