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Date Out of EFB: MAY 13 1982
MAY 13 1982

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

From: Willa Garner, Ph.D., Head
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

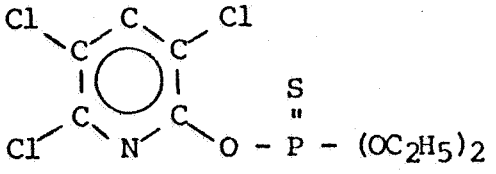
Date Out: 5/13/82

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 concentations 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 cornstalk 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

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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 (SWRRB[3]) 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 preceed 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 YR DAY	Worst Runoff YR DAY	Quantity of Pesticide runoff (lb/A/day)	Rainfall (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 EXAMS[4] 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 months[5]. 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

R	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

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 CHLORPYRFOS
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

d

SWRRB - WATKINS2 VS CHLORPYRFOS

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

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

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 CHLORPYRFOS
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* Y	PSEUDO-FIRST-ORDER RATE CONSTANTS (/HR) 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* Y P	PH	POH	TEMP DEG. C.	REAERATION COEFF. M/HR	COMPOSITE LIGHT AVE %	BACTERIAL POP. SIZE CELLS/**	OXIDANT CONC. (MOLAR)	DISSOLVED PERCENT %
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 G/M^2	KILOS	%	**** TOXICANT CONCENTRATIONS **** 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	AVERAGE POLLUTANT CONCENTRATIONS				MASS OF POLLUTANT	
	WATER COLUMN		BOTTOM SEDIMENTS		WATER COL	SEDIMENTS
DAYS	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	9.181E-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.