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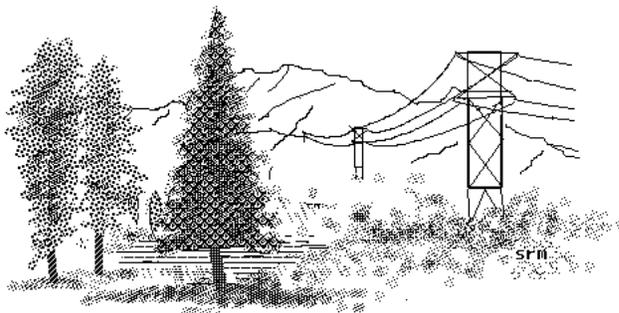
# Chlorpyrifos

## Pesticide Fact Sheet

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Prepared for the U.S. Department of  
Agriculture, Forest Service by Information  
Ventures, Inc.

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This fact sheet is one of a series issued by the Forest Service, the Bureau of Land Management, and the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions for the insecticide chlorpyrifos and its formulations. Unless otherwise stated, the toxicity data presented in this fact sheet refer to the active ingredient, chlorpyrifos. When included, data on formulated products will be specifically identified. A list of definitions is included in Section VIII of the fact sheet.

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### I. Basic Information

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**Common name:** Chlorpyrifos

**Chemical name:** 0,0-diethyl-0-(3,5,6-trichlor-2-pyridyl)phosphorothioate

**Common Product names:** Dursban®, Lorsban®

**Pesticide classification:** insecticide

**Registered Use Status:** "Restricted Use" due to hazards to avian and aquatic organisms

**Formulations:** Commercial chlorpyrifos products generally contain one or more inert ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the U.S. Environmental Protection Agency (EPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52 FR 13305). The intent of this policy is the regulation of inert ingredients. EPA's strategy for the implementation of this policy included the development of four lists of inerts based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3 and inerts of minimal concern were placed on List 4.

For pesticides containing List 1 inerts, the EPA has given the pesticide registrant the opportunity to reformulate the product to remove the List 1 inerts. If the registrant chooses not to reformulate the product, then the List 1 inerts must be identified on the product label. For List 2 inerts, the EPA is monitoring ongoing testing and gathering existing information on the potential adverse effects of these chemicals to determine if further regulatory action is required. The EPA has no particular regulatory

plans for List 3 and List 4 inerts. The Forest Service will incorporate new data on inerts into updated fact sheets as it becomes available.

The contents of 6 chlorpyrifos formulations are listed below. Other formulations are available.

Dursban® 2E: chlorpyrifos (24.1%) and inerts including xylene, 1,2,4-trimethylbenzene, cumene, 1,1,1-trichloroethane (methyl chloroform), and an emulsifier (75.9%)

Dursban® 4E: chlorpyrifos (44.9%) and inerts including xylene, 1,2,4-trimethylbenzene, cumene, and an emulsifier (55.1%)

Dursban® 50W: chlorpyrifos (50%) and inerts including clays and wetting agents (50%)

Dursban® 50WSP in water soluble packets: chlorpyrifos (50%) and clays, wetting agents, and packet material (50%)

Dursban® Turf: chlorpyrifos (44.9%) and inerts including xylene, 1,2,4-trimethylbenzene, cumene, and emulsifiers (55.1%)

Pagent® DF: chlorpyrifos (50%) and inerts including amorphous silica, wetting agents, and clays (50%)

**Residue assay methods:** Gas-liquid chromatography methods employing electron capture or flame photometric detection are available for assay of chlorpyrifos residues.

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## II. Insecticide Uses

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**Registered forestry, rangeland, right-of-way uses:** Chlorpyrifos is registered for use in non-agricultural and non-crop areas, as well as for food and feed crops.

### **Operational details:**

**Target Insects:** In forestry and rangeland applications, chlorpyrifos is used to control tent caterpillars, bagworms, leafrollers, leafcutters, borers, bark beetles, spider mites, ticks, chiggers, fire ants, and other soil insects.

**Mode of action:** Chlorpyrifos is active by contact, ingestion, and vapor action. It inhibits an enzyme of the nervous system (acetylcholine esterase); this causes convulsions and paralysis.

**Method of application:** aerial spraying; spraying from a truck, backpack or hand-held sprayer

**Use rates:** Use at 0.5 to 3 pounds of active ingredient per acre

### **Special Precautions:**

**Always read all of the information on the product label before using any pesticide. Read the label for application restrictions.**

**Timing Of Application:** For wood boring insects infesting shrubs and trees, apply to the trunks and lower limbs when adults begin to emerge. For beetles apply to the main trunk of trees in early spring as a preventive treatment; apply to main trunk of infected trees or logs for remedial treatment when damage occurs but before adult beetles begin to emerge. To prevent native elm bark beetle from overwintering in uninfected trees and to reduce beetle populations in disease-free areas, apply from spring through early fall. For bagworms, treat when insects are in the crawler stage. For leafrollers, treat when leaves are tightly rolled. For maple leafcutters, spray larvae when cases are being formed. For spider mites, apply when large numbers of eggs are present and then apply a second spray after initial treatment to control newly-hatched nymphs. Other infestations should be treated according to schedules specified on the insecticide label.

Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.

**Drift Control:** Do not allow careless application or spray drift.

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### III. Environmental Effects/Fate

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The EPA concludes that the environmental fate of chlorpyrifos can not be fully assessed due to insufficient data.

#### Soil:

- **Residual Soil Activity:** Chlorpyrifos is generally active in the soil.
  - **Adsorption:** Chlorpyrifos is strongly adsorbed by most soils and is relatively immobile in the soil. The EPA requires more information on the mobility of chlorpyrifos in soil.
  - **Persistence and Agents of Degradation:** The half-life of chlorpyrifos ranged from 11 to 141 days in a variety of different soil types; it is thus considered to be moderately persistent. Chlorpyrifos was less persistent in soils with higher pH values. Soil microorganisms break down chlorpyrifos. Chlorpyrifos is hydrolysed at a moderate rate. The EPA requires more information on the breakdown of chlorpyrifos by photodegradation.
  - **Metabolites/Degradation Products and Potential Environmental Effects:** The main breakdown product of chlorpyrifos in the soil (as well as in plants and animals) is 3,5,6-trichloropyridinol (TCP) which is weakly to moderately adsorbed, mobile and very persistent in the soil. TCP is considered to be relatively non-toxic. In laboratory studies, TCP was found to increase rat liver and kidney weights at the 100 mg/kg per day dose level; to decrease body-weight gain in dogs at lower dosages; to have no developmental effects in rats; and to cause an increase in the number of hydrocephalic fetuses in rabbits at the 100 mg/kg per day dose level. In mutagenicity studies, TCP was not shown to cause genetic changes. The EPA is requiring additional studies to be performed on TCP; these required studies include effects on fish and invertebrates. Chlorpyrifos is also hydrolysed to O-ethyl-O-(3,5,6-trichloro-2-pyridinol) phosphorothioate; the environmental effects of this degradate are not known.
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#### Water:

- **Solubility:** Chlorpyrifos does not dissolve easily in water.
- **Potential For Leaching Into Ground-Water:** Based on data from available studies, the EPA concludes that chlorpyrifos is unlikely to leach into ground-water in measurable quantities under most typical use scenarios.
- **Surface Waters:** Direct application of low concentrations of chlorpyrifos to bodies of water may lead to fish kills.

**Air:**

- **Volatilization:** Chlorpyrifos does not evaporate easily.
- **Potential For By-Products From Burning of Treated Vegetation:** No information is available on the by-products of chlorpyrifos produced from burning of treated vegetation. However, when chlorpyrifos burns, it decomposes into hydrogen chloride, ethyl sulfide, diethyl sulfide, and nitrogen oxides. The concentrations of these compounds in a treated-vegetation fire would be very low.

**IV. Ecological Effects**

**Non-Target Toxicity:**

- **Soil Microorganisms:** Chlorpyrifos may be toxic to algae in the soil (based on its aquatic algae toxicity). No information is available on its effects on other soil microorganisms.
- **Plants:** Chlorpyrifos is toxic to aquatic algae at concentrations as low as 1.2 ppb in the water. Other aquatic plants may be adversely affected by exposure levels expected from mosquito larvicide use of chlorpyrifos; however, recovery occurs in 9-17 days. Chlorpyrifos is toxic to some ornamental plants growing on land. Plants vary in their sensitivity to chlorpyrifos exposure.
- **Aquatic Animals:** Chlorpyrifos is very highly toxic to freshwater fish and to aquatic invertebrate animals. The EPA is requiring studies on the effects of chlorpyrifos on fish embryos and larvae. Direct application to water at rates as low as 0.01 pounds active ingredient per acre may cause death to fish and at a rate of 0.05 pounds active ingredient per acre may cause extensive fish kills. Formulations with petroleum distillates are very highly toxic to warm-water fish and highly toxic to cold-water fish. Chlorpyrifos builds up (bioaccumulates) in fish tissues. Chlorpyrifos and its formulations have not been tested for chronic effects in aquatic animals. Acute toxic level:

species	LC50	Source Table
fish - cold-water	3.0 ppb	(Table II, Aquatic)
fish - warm-water	3.3 ppb	(Table II, Aquatic)
fish - estuarine	0.42 ppb	(Table II, Aquatic)
water flea	1.7 ppb	(Table II, Aquatic)

oyster	34 ppb	(Table II, Aquatic)
shrimp	0.035-0.11 ppb	(Table II, Aquatic)

Formulations with Petroleum Distillates:

species	LC50	Source Table
fish - cold-water	1.3 ppb	(Table II, Aquatic)
fish - warm-water	140 ppb	(Table II, Aquatic)

- **Terrestrial Animals:** Chlorpyrifos is moderately to very highly toxic to birds. In reproductive toxicity tests in birds, chlorpyrifos had no effect at 125 ppm in the diet of quails; but at the same dosage in mallard ducks, the birds laid significantly fewer eggs. Chlorpyrifos is highly toxic to bees when exposed to direct treatment. It is moderately toxic to mammals (based on a study in rats). Acute toxic level:

species	LD50	Source Table
birds	8.4 to 112 mg/kg	(Table II, Avian)
bee	0.114 microgram/bee	---
rats	137 mg/kg	(Table II, Mammalian)
species	LC50	Source Table
birds	136 to 423 ppm	(Table II, Avian)

- **Threatened and Endangered Species:** Chlorpyrifos may be a hazard to endangered species if it is applied to areas where they live. The U.S. Fish and Wildlife Service (USFWS) has identified chlorpyrifos as likely to jeopardize endangered animal species, including endangered insects, when used on crops and as a mosquito larvacide. The USFWS specified reasonable and prudent alternatives to avoid jeopardizing the continued existence of the identified species by these uses. Terrestrial nonfood application of chlorpyrifos to sites such as turf and sod represents an acute hazard to birds. Runoff from such applications would be hazardous to fish and aquatic invertebrates. Granular application of chlorpyrifos may pose a risk to small birds and small mammals.

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## V. Toxicology Data

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## Acute toxicity:

- **Acute oral toxicity:** In tests in male and female rats, the acute oral median lethal dose (LD50) of technical chlorpyrifos was 163 and 137 mg/kg, respectively. (Toxicity Category II, Table I, Oral)
  - **Acute dermal toxicity:** In tests in rats, the acute dermal (skin) median lethal dose (LD50) of technical chlorpyrifos was 202 mg/kg. (Toxicity Category II, Table I, Dermal)
  - **Primary irritation score:** In laboratory tests in rabbits, chlorpyrifos was a moderate irritant. (Toxicity Category III, Table I, Skin irritation). Chlorpyrifos is not a sensitizer.
  - **Primary eye irritation:** In laboratory tests in rabbits, chlorpyrifos was a moderate eye irritant. Conjunctival irritation cleared within 48 hours. (Toxicity Category III, Table I, Eye irritation)
  - **Acute inhalation:** Because chlorpyrifos is a waxy solid and evaporates into the air only slightly, the EPA does not require that an acute inhalation study to be submitted.
  - **Neurotoxicity:** Chlorpyrifos was not a delayed neurotoxic agent at doses of 50 or 100 mg/kg (the highest dose tested) in acute tests in hens. The EPA requires more information on the acute neurotoxicity of chlorpyrifos.
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## Chronic toxicity:

- **Carcinogenicity:** In laboratory tests in mice and rats, chlorpyrifos has not shown any cancer causing activity.
- **Developmental:** In laboratory tests in rats and mice, chlorpyrifos did not cause toxicity to the fetuses or birth defects. These results were obtained at doses up to the highest tested in rats (15 mg/kg per day) and at a dose of up to 10 mg/kg per day in mice. The highest dose tested in mice (25 mg/kg per day) was associated with maternal and fetal toxic effects.
- **Reproduction:** A three generation test in rats showed no reproductive effects of chlorpyrifos at doses up to the highest tested (1 mg/kg per day).
- **Mutagenicity:** In three tests, chlorpyrifos did not cause genetic damage.
- **Neurotoxicity:** Chlorpyrifos was not a cholinesterase inhibitor at air concentrations up to 20.6 ppb (the highest dose tested) in a 90-day subchronic test in rats. The EPA requires more information on the chronic neurotoxicity of chlorpyrifos. The EPA also requires data on the potential toxicity of chlorpyrifos to the eyes after ingesting it orally.

The data reported above are results of animal studies which the Environmental Protection Agency has evaluated in support of the registration of chlorpyrifos. These data are used to make inferences relative to human health.

**HAZARD:** Based on the results of animal studies, chlorpyrifos does not cause genetic damage, cancer, or birth defects and has no effect on fertility or reproduction.

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## VI. Human Health Effects

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### **Acute toxicity (poisoning):**

**Reported effects:** Exposure to chlorpyrifos exposure has reportedly caused death or disability in humans. Lesser exposures may cause headache, dizziness, extreme weakness, unsteady movements, tiny pupils, twitching, tremor, nausea, slow heartbeat, fluid in the lungs, and sweating.

### **Chronic toxicity:**

**Reported effects:** Long term health effects in humans due to chlorpyrifos or its formulations may include weakness, loss of appetite, and malaise.

**Potential for adverse health effects from contacting or consuming treated vegetation, water or animals:** Contact with treated vegetation is safe if 24 hours passes between application and entry into treated areas. Consumption of treated vegetation, water, or animals should be avoided for some time after treatment so as to avoid undue exposure to chlorpyrifos residues. There is no acceptable level of chlorpyrifos in drinking water. Direct treatment of certain livestock is permitted with restrictions on time before slaughter.

**Potential for adverse health effects from inert ingredients contained in the formulated product:** Inert ingredients found in chlorpyrifos formulations include xylene, 1,2,4-trimethylbenzene, cumene, methyl chloroform, a petroleum solvent, an emulsifier, clays, wetting agents, and amorphous silica. The health effects of exposure to the first five ingredients include possible reproductive effects, eye and skin irritation, possible mutagenic effects, central nervous system effects, anemia, bronchitis, and possible developmental effects. Exposure to the last four ingredients listed above will not cause any adverse health effects.

**Health effects of exposure to formulated products:** All chlorpyrifos formulations may be fatal if swallowed. Formulated products are less acutely toxic than the technical chlorpyrifos. Formulations containing xylene and other solvents are less acutely toxic by ingestion than granular formulations. The granular formulation is a minimal hazard for skin exposure. Excessive exposure to the solvent-based product may cause eye and upper respiratory irritation, central nervous system depression, increased sensitivity to epinephrine and irregular heartbeats.

**Health effects associated with contaminants:** No information is available indicating the presence of contaminants. However, the EPA is requiring that chlorpyrifos be analyzed for the presence of potentially toxic dibenzodioxins which may form during manufacture.

**Health effects associated with other formulations:** Some formulations of chlorpyrifos also contain other insecticides, such as DDVP, benefin, tetramethrin, diphenamid, monuron, neburon, pyrethrins, piperonyl butoxide, d-trans allethrin, N-octylbicycloheptenedicarboximide, and pendimethalin. **The information in this fact sheet only applies to chlorpyrifos.** Consult other sources for information on any other insecticides.

**Health risk management procedures:** The Forest Service has evaluated health effects data in the

development of both pesticide background statement documents and environmental impact statements for pesticide use on forest lands. These health effects evaluations have taken into consideration the potential for both worker and public exposure from Forest Service operations. This information has been used in assessing health risks and consequently in formulating protective measures to reduce risk to forest workers and to the public. Section VII of this fact sheet, Safety Precautions, provides guidance for the safe handling and use of chlorpyrifos.

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## **VII. Safety precautions:**

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### **Signal word and definition:**

Dursban® 2E: **WARNING** - MAY BE FATAL IF SWALLOWED. EXCESSIVE ABSORPTION THROUGH SKIN MAY BE FATAL. CAUSES SUBSTANTIAL BUT TEMPORARY EYE INJURY. CAUSES SKIN IRRITATION.

Dursban® 4E and Dursban® Turf: **WARNING** - MAY BE FATAL IF SWALLOWED. ABSORPTION THROUGH SKIN MAY BE FATAL. CAUSES SUBSTANTIAL BUT TEMPORARY EYE INJURY. CAUSES SKIN IRRITATION.

Dursban® 50W and Dursban® 50WSP: **WARNING** - MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CAUSES EYE IRRITATION.

Pagent® DF: **WARNING** - MAY BE FATAL IF SWALLOWED. HARMFUL IF ABSORBED THROUGH THE SKIN. MAY BE FATAL IF INHALED.

**Protective Precautions for Workers:** Do not reenter treated areas for 24 hours after treatment. Avoid contact with eyes, skin or clothing. Avoid breathing vapors or spray mist; wear a mask or pesticide respirator. Handle concentrate in a well ventilated area. Wear eye protection, protective clothing and chemically resistant gloves when handling. Wear a face shield which allows use of chemical goggles, or wear a full-face respirator to protect face and eyes when there is any likelihood of splashes. Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse; destroy contaminated shoes and other contaminated leather articles such as watch bands and belts. Keep away from food, feedstuffs and water supplies.

**Medical Treatment Procedures (Antidotes):** For exposure to the eyes, irrigate with flowing water immediately and continuously for 15 minutes. Get medical attention. For exposure to the skin, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. In case of ingestion, do not induce vomiting; call a physician immediately. In case of inhalation, bring individual to fresh air. If breathing is difficult, give oxygen. If not breathing, administer mouth-to-mouth resuscitation; call a physician. Because chlorpyrifos is a cholinesterase inhibitor (capable of causing nervous system damage), treatment with atropine by a physician's injection may be necessary.

**In case of emergency, call your local poison control center for advice.**

**Handling, Storage, And Disposal:** Do not use or store near heat or open flame. Do not cut or weld

container. Do not contaminate water, food, animal feeds or seed by storage. Prevent cross-contamination with other pesticides and fertilizers. Wastes should be disposed of in a landfill approved for pesticide disposal or according to federal, state and local regulations. Triple rinse metal drum, then offer for recycling, or puncture and dispose of in a sanitary landfill or as permitted. Triple rinse plastic containers and then puncture and dispose of in a sanitary landfill; incinerate if permitted and stay out of smoke.

**Emergency (Spill) Hazards And Procedures:** Absorb spills with material such as sand, dirt, or an absorbant material. Contain spills by diking to keep out of sewers. Sweep up spills of powders and granules and place into containers for disposal. Packets should be swept into plastic bags. Do not contaminate water, food, animal feeds or seed by disposal. **For large spills, barricade area, eliminate ignition sources, and call CHEMTREC at 1-800-424-9300 for advice.**

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## VIII. Definitions

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**adsorption** - the process of attaching to a surface

**avian** - of, or related to, birds

**carcinogenicity** - ability to cause cancer

**dermal** - of, or related to, the skin

**ecotoxicology** - the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

**ecotoxicological** - related to the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

**formulation** - the form in which the pesticide is supplied by the manufacturer for use

**half-life** - the time required for half the amount of substance to be reduced by natural processes

**insecticide** - a substance used to kill or control insect pests

**LC50** - the concentration in air, water, or food which will kill approximately 50% of the subjects

**LD50** - the dose which will kill approximately 50% of the subjects

**leach** - to dissolve out by the action of water

**mg/kg** - milligrams of the substance per kilogram of body weight

**microorganisms** - living things too small to be seen without a micro-scope

**mutagenicity** - ability to cause genetic changes

**non-target** - animals or plants other than the ones which the pesticide is intended to kill

**persistence** - tendency of a pesticide to remain active after it is applied

**ppb** - parts per billion

**ppm** - parts per million

**residual activity** - the remaining amount of activity as a pesticide

**volatility** - the tendency to become a vapor at relatively low temperature

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## IX. Additional Reading

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1. Pesticide Fact Sheet: Chlorpyrifos. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC. EPA Publication No. 540/FS-88-124, 1984.
2. Registration Standard (Second Round Review) for the Reregistration of Pesticide Products

## X. Toxicity Categories

### Tables of Categories of Toxicity

Table I: Human Hazards

Category	Signal word	Route of Administration			Hazard	
		Oral (mg/kg)	Dermal (mg/kg)	Inhalation (mg/L)	Eye Irritation	Skin Irritation
I	DANGER Poison	0-50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II	WARNING	>50-500	>200-2000	>0.2-20	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III	CAUTION	>500-5000	>2000-20,000	>2.0-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV	none	>5000	>20,000	>20	no irritation	mild or slight irritation at 72 hours

40 CFR 162.10 (h) (1), July 3, 1975

Table II: Ecotoxicological Categories

Toxicity Category	Mammalian (Acute Oral)* mg/kg	Avian (Acute Oral)* mg/kg	Avian (Dietary)- ppm	Aquatic Organisms‡ ppm
very highly toxic	<10	<10	<50	<0.1
highly toxic	10-50	10-50	50-500	0.1-1
moderately toxic	51-500	51-500	501-1000	>1-10
slightly toxic	501-2000	501-2000	1000-5000	>10-100
practically non-toxic	>2000	>2000	>5000	>100

\* Reflects dose given to test animals and is based on body weight of the test animal.

\_ Concentration in the diet. Unrelated to body weight of the test animal. Measure of environmental exposure.

‡ Concentration in water. Unrelated to body weight of test animal. Measure of environmental exposure.

Adapted from Insecticides, Brooks, H.L. et al. (1973) Cooperative Extension, Kansas State University,

Manhattan, Kansas

For more information on Chlorpyrifos contact your local Forest Service, Bureau of Land Management, or Bonneville Power Administration office.

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