06/OPP-34145 (36PP)

7-15-98

REREGISTRATION ELIGIBILITY DECISION

Fenthion

EFED CHAPTER
CASE 0290

ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF PESTICIDE PROGRAMS
SPECIAL REVIEW AND REREGISTRATION DIVISION

RED TEAM REVIEW AND
CONCURRENCE COPY
July 15, 1998

1

a. **Environmental Assessment**

1. **Ecological Toxicity Data**

a. **Toxicity to Terrestrial Animals**

(1) **Birds, Acute and Subacute**

An acute oral toxicity study using the technical grade of the active ingredient (TGAI) is required to establish the toxicity of fenthion to birds. The preferred test species is either the mallard duck or bobwhite quail. Avian testing with degradates also may be required if the parent material is short-lived and any degradate is formed in large percentage. Because evidence exists that fenthion meets these criteria, degradate testing is required. Results of testing with the TGAI and the two major degradates (fenthion phenol sulfoxide and fenthion phenol sulfone) are presented in Tables 1 and 2, respectively.

Table 1: Avian Acute Oral Toxicity (TGAI)

Species	% ai	LD_{50} (mg/kg)	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	96.9	7.1	very highly toxic	401867-01 (Stubblefield, 1987)	Core

Table 2: Avian Acute Oral Toxicity (Degradates)

Species	% ai	LD_{50} (mg/kg)	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	≥87.6% fenthion phenol sulfoxide	>2000	practically nontoxic	411717-01 (Waggoner, 1989)	supplemental*
Northern bobwhite quail *(Colinus virginianus)*	>99% fenthion phenol sulfone	>2000	practically nontoxic	411717-01 (Waggoner, 1989)	supplemental*

*some test procedures varied from guideline requirements

These results indicate that the TGAI is very highly toxic to avian species on an acute oral basis. Methodological problems occurred in the degradate tests; however, no mortality occurred at acute oral doses up to 2000 mg/kg, and additional testing is not required. The guideline requirement (71-1) is fulfilled (MRID Nos

401867-01, 411717-01).

Two subacute dietary studies using the TGAI are required to establish the toxicity of fenthion to birds. The preferred test species are mallard duck (a waterfowl) and bobwhite quail (an upland gamebird). Results of testing with the TGAI are tabulated below.

Table 3: Avian Subacute Dietary Toxicity (TGAI)

Species	% ai	LC_{50} (ppm)	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	96.9	60	highly toxic	401867-02 (Stubblefield, 1987)	Core
Mallard duck *(Anas platyrhynchus)*	96.9	1259	slightly toxic	401867-03 (Stubblefield, 1987)	Core

The results indicate that the TGAI is slightly to highly toxic to avian species on a subacute dietary basis. The guideline requirement (71-2) is fulfilled (MRID Nos 401867-02, 401867-03).

(2) Birds, Chronic

Avian reproduction studies using the TGAI are required for fenthion, because (1) multiple applications for mosquito control may repeatedly expose birds to fenthion; (2) the laboratory rat chronic toxicity NOEC of 14 ppm (based on reduced fertility at 100 ppm, Table 4) indicates that reproduction in terrestrial vertebrates may be adversely affected by repeated use of the mosquito adulticide; and (3) avian acute oral toxicity (LD_{50} = 7.1 mg/kg, Table 1) indicates that birds are more acutely sensitive than the laboratory rat (LD_{50} = 405 mg/kg for males, Table 4). Data have not been submitted. The guideline requirement (71-4) is not fulfilled.

(3) Mammals

Wild mammal testing is required on a case-by-case basis, depending on the results of lower tier laboratory mammalian studies, intended use patterns, and pertinent environmental fate characteristics of the pesticide. In most cases, rat or mouse toxicity values obtained from the Agency's Health Effects Division (HED) substitute for wild mammal testing. These toxicity values are tabulated below.

Table 4: Mammalian Toxicity (TGAI)

Species	% ai	Test Type	Toxicity Values	MRID No.
Laboratory rat *(Rattus norvegicus)*	96.9	acute oral	LD_{50} = 405 mg/kg (males) = 566 mg/kg (females)	072022
Laboratory rat *(Rattus norvegicus)*	96.9	reproduction (multi-generation)	NOEC = 14 ppm LOEC = 100 ppm	413498-01 and 429014-01

The results indicate that the TGAI is moderately toxic to small mammals on an acute oral basis. A multi-generation reproduction test with the laboratory rat demonstrated chronic effects, including decreased fertility, at a dietary concentration of 100 ppm.

(4) Insects

The current use patterns of fenthion are not expected to result in any significant exposure to the honey bee, and an acute contact honey bee study is not required. However, a study was submitted to support previous uses of fenthion. Results of that study are tabulated below.

Table 5: Nontarget Insect Acute Contact Toxicity

Species	% ai	LD_{50} (μg/bee)	Toxicity Category	MRID No. Author/Year	Study Classification
Honey bee *(Apis mellifera)*	not reported	0.308	highly toxic	Accession No. 00036935	Core

The results indicate that fenthion is highly toxic to bees on an acute contact basis.

b. Toxicity to Aquatic Animals

(1) Freshwater Fish

Freshwater Fish, Acute (TGAI, Degradates, and TEP)

Two freshwater fish toxicity studies using the TGAI are required to establish the toxicity of fenthion to fish. The preferred test species are rainbow trout (a cold-water fish) and bluegill sunfish (a warmwater fish). Degradate testing also may be required if the parent material is short-lived and any degradate is formed in large percentage. Because evidence exists that fenthion meets these criteria, degradate testing is required. Testing with the TEP also is required, because some of the mosquito-adulticide product (3125-148) will be directly deposited in water from ULV or thermal-fog aerial application. Acceptable data have not been submitted for the degradates or TEP, but further testing is reserved pending the requirement for degradate and TEP acute toxicity testing with a freshwater invertebrate. Results of testing with the TGAI are tabulated below.

Table 6: Freshwater Fish Acute Toxicity (TGAI)

Species	% ai	LC_{50} (ppm)	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout *(Oncorhynchus mykiss)*	96.9	0.83	highly toxic	402142-01 (Swigert, 1986)	Core
Bluegill sunfish *(Lepomis macrochirus)*	96.9	1.7	moderately toxic	402741-01 (Swigert, 1987)	Core

The results indicate that the TGAI is moderately to highly toxic to freshwater fish on an acute basis. The guideline requirement (72-1) is fulfilled for the TGAI (MRID Nos 402142-01, 402741-01) and reserved for the degradates and TEP.

Freshwater Fish, Chronic (TGAI and Degradates)

A freshwater fish early life-stage test using the TGAI is required for fenthion, because the mosquito adulticide product (3125-148) is expected to be transported to water from the intended use site and the following conditions exist: (1) the mosquito adulticide is intended for use such that fenthion's presence in water is likely to be continuous or recurrent regardless of toxicity; (2) the rainbow trout acute LC_{50} (0.83 ppm) is less than 1 mg/L; and (3) the aquatic EEC (0.09-14.68 ppb, Table 25) is equal to or greater than 0.01 of the acute LC_{50} value. The preferred test species is the rainbow trout. Degradate testing also may be required if the parent material is short-lived and any degradate is formed in large percentage. Degradate testing is reserved, pending results of chronic degradate testing with an estuarine/marine mysid. Results of testing with the TGAI are tabulated below.

Table 7: Freshwater Fish Early Life-Stage Toxicity (TGAI)

Species	% ai	NOEC and LOEC (ppb)	MATC (ppb)	Endpoint Affected	MRID No. Author/Year	Study Classification
Rainbow trout *(Oncorhynchus mykiss)*	96.9	NOEC = 7.5 LOEC = 15	10.6	time to hatch	405641-02 (Surprenant, 1988)	core

The guideline requirement (72-4a) is fulfilled for the TGAI (MRID No. 405641-02) and reserved for the degradates.

(2) Freshwater Invertebrates

Freshwater Invertebrates, Acute (TGAI, Degradates, and TEP)

A freshwater aquatic invertebrate toxicity test using the TGAI is required to assess the toxicity of fenthion to invertebrates. The preferred test species is the waterflea. Degradate testing also may be required if the parent material is short-lived and any degradate is formed in large percentage. Testing with the TEP also is required, because some of the mosquito-adulticide product (3125-148) will be directly deposited in water due to aerial ULV or thermal-fog application. Degradate and TEP testing are reserved, pending results of tests with an estuarine/marine mysid. Results of testing with the TGAI are presented below.

Table 8: Freshwater Invertebrate Toxicity (TGAI)

Species	% ai	EC_{50} (ppb)	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	96.9	5.2	very highly toxic	402464-01 (Forbis, 1987)	core
Waterflea *(Daphnia magna)*	93	5.7	very highly toxic	Accession No. 266036 (Heimbach, 1986)	supplemental*

* failed to report test water characteristics and frequency in which physical parameters were measured

The results indicate that the TGAI is very highly toxic to aquatic invertebrates on an acute basis. The guideline requirement (72-2) is fulfilled for the TGAI (MRID No. 402464-01) and reserved for the degradates and TEP.

Freshwater Invertebrate, Chronic (TGAI and Degradates)

A freshwater aquatic invertebrate life-cycle test is required for fenthion, because the mosquito adulticide product (3125-148) is expected to be transported to water from the intended use site and the following conditions exist: (1) the mosquito adulticide is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity; (2) the daphnid acute EC_{50} (5.7 ppb) is less than 1 mg/L; and (3) the aquatic EEC (0.09-14.68 ppb, Table 25) is equal to or greater than 0.01 of the acute EC_{50} value. The preferred test species is the waterflea. Chronic degradate testing is reserved, pending results of degradate tests with an estuarine/marine mysid. Results of testing with the TGAI are tabulated below.

Table 9: Freshwater Aquatic Invertebrate Life-Cycle Toxicity (TGAI)

Species	% ai	NOEC and LOEC (ppb)	MATC (ppb)	Endpoint Affected	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	97.9	NOEC = 0.013 LOEC = 0.021	0.016	length	408714-01 (Forbis, 1988)	core

The guideline requirement (72-4b) is fulfilled for the TGAI (MRID No. 408714-01) and reserved for the degradates.

(3) Estuarine and Marine Animals

Estuarine and Marine Fish, Acute (TGAI, Degradates, and TEP)

Acute toxicity testing with estuarine/marine fish using the TGAI is required for fenthion, because the mosquito adulticide (93125-148) is expected to reach the estuarine/marine environment due to its use in coastal counties in Florida. The preferred test species is the sheepshead minnow. Degradate and TEP testing may be required, pending results of acute toxicity testing with an estuarine/marine mysid. Results of tests with the TGAI are tabulated below.

Table 10: Estuarine/Marine Fish Acute Toxicity (TGAI)

Species	% ai	LC_{50} (ppb)	Toxicity Category	MRID No. Author/Year	Study Classification
Sheepshead minnow *(Cyprinodon variegatus)*	96.9	1200	moderately toxic	404955-01 (Surprenant, 1988)	core

The results indicate that fenthion is moderately toxic to estuarine/marine fish on an acute basis. The guideline requirement (72-3) is fulfilled for the TGAI (MRID Nos 404955-01) and reserved for the degradates and TEP.

Estuarine and Marine Fish, Chronic (TGAI and Degradates)

An estuarine/marine fish early life-stage toxicity test using the TGAI is not required for fenthion, based on the acute toxicity to the sheepshead minnow (LC_{50} = 1200 ppb) and instantaneous EECs in 6-foot deep water (0.09-1.22 ppb, Table 25). Additionally, the rainbow trout is more sensitive to fenthion than is the sheepshead minnow, and chronic data are available for the trout (Table 7). Degradate testing is reserved, however, pending results of estuarine/marine mysid acute toxicity testing.

Estuarine and Marine Invertebrates, Acute (TGAI, Degradates, and TEP)

Acute toxicity testing with estuarine/marine invertebrates using the TGAI is required for fenthion, because fenthion can be repeatedly applied for mosquito control in coastal counties of Florida. The preferred test species are the mysid shrimp and eastern oyster. Degradate and TEP (3125-148) testing are required to support the mosquito adulticide use, but data have not been submitted. Degradate and TEP testing with the oyster are reserved, pending results of degradate and TEP mysid testing. Results of tests with the TGAI are tabulated below.

Table 11: Estuarine/Marine Invertebrate Acute Toxicity (TGAI)

Species	% A.I.	LC_{50} or EC_{50} (ppb)	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern oyster (shell deposition) *(Crassostrea virginica)*	96.9	321	highly toxic	405641-01 (Surprenant, 1988)	core
Mysid Shrimp *(Americamysis bahia)*	96.9	0.22	very highly toxic	408794-01 (Surprenant, 1988)	core

The results indicate that fenthion is highly to very highly toxic to estuarine/marine invertebrates on an acute basis. The guideline requirement (72-3) is fulfilled for the TGAI (MRID Nos 405641-01, 408794-01). Degradate and TEP data are outstanding for the mysid and are reserved for the oyster.

Estuarine and Marine Invertebrates, Chronic (TGAI and Degradates)

An estuarine/marine invertebrate life-cycle toxicity test is required for fenthion, because fenthion when used as a mosquito adulticide (3125-148) is expected to reach the estuarine/marine environment and the following conditions exist: (1) it is intended for use such that fenthion's presence in water is likely to be continuous or recurrent regardless of toxicity; (2) the mysid acute LC_{50} (0.22 ppb) is less than 1 mg/L; and (3) the aquatic EEC (0.09-14.68 ppb, Table 25) is equal to or greater than 0.01 of the mysid acute LC_{50} value. The required test species is the mysid shrimp. Degradate testing is reserved, pending results of acute mysid degradate testing. Results of testing with the TGAI are tabulated below.

Table 12: Estuarine/marine Invertebrate Life-cycle Toxicity (TGAI)

Species	% ai	NOEC and LOEC (ppb)	MATC (ppb)	Endpoints Affected	MRID No. Author/Year	Study Classification
Mysid shrimp *(Mysidopsis bahia)*	not reported	NOEC = 0.037 LOEC = 0.079	0.054	no. young produced; growth	record no. 167096 (McKenney, 1985)	supplemental*

*the purity of the test material was not reported

The guideline requirement (72-4b) is not fulfilled for the TGAI (Record No. 167096) and is reserved for the degradates.

c. Toxicity to Plants

(1) Terrestrial

Terrestrial plant testing is not currently required for pesticides other than herbicides except on a case-by-case basis (e.g. labeling bears phytotoxicity warnings; incident data or literature which demonstrate phytotoxicity). Terrestrial plant testing was previously required for fenthion, because aerial spray operations were presumed to potentially adversely affect nontarget plants. Germination and vegetative vigor tests using fenthion mixed with diesel oil and using diesel oil alone were submitted and reviewed. These results are tabulated below.

Table 13: Nontarget Terrestrial Germination Test Results (Tier I)[1]

Species	No. seeds planted	Fenthion (0.6 ppm) with Diesel Oil (5.0 ppm)		Diesel Oil (5.0 ppm)	
		No. seeds germinated	% of control	No. seeds germinated	% of control
Monocots:					
corn	50	49	116	43	105
wheat	50	48	102	44	94
timothy	100	65	102	71	111
onion	100	34	148	30	130
Dicots:					
soybean	50	41	95	43	100
cotton	50	43	123	41	117
pea	50	33	110	36	120
sugar beet	75	66	93	67	94
cucumber	50	45	92	46	94
tomato	75	36	88	43	105

[1] citation: MRID No. 401104-02 (Ciarletta, 1986); supplemental study

Table 14: Nontarget Terrestrial Vegetative Vigor Test Results (Tier I)[1]

Species	Fenthion (0.6 ppm) with Diesel Oil (5.0 ppm)			Diesel Oil (5.0 ppm)		
	phytotoxicity[2]	height inhibition[3]	weight inhibition[4]	phytotoxicity[2]	height inhibition[3]	weight inhibition[4]
Monocots:						
corn	3	0	2	2	0	8
wheat	1	12	0	3	3	+17[3]
timothy	0	9	2	0	15	1
onion	0	+20	+17	0	+13	+2
Dicots:						
soybean	15	+1	+7	13	17	+3
cotton	10	3	0	13	5	1
pea	4	+13	19	2	+16	6
sugar beet	8	+20	+49	12	+14	+19
cucumber	4	9	+3	7	7	+23
tomato	3	+8	+8	7	+14	+1

[1] citation: MRID No. 401104-02 (Ciarletta, 1986); supplemental study

[2] phytotoxicity was rated on a 0-100% scale, where 0% is no effect and 100% is plant death

[3] height and wet-weight inhibition results are based on comparison to the control; actual measurement values were not provided

[4] values preceded by a "+" indicate stimulation.

These results indicate that fenthion and diesel oil likely have no major adverse effects on terrestrial plants at the application rate tested (2X the maximum label rate for fenthion). The study is not a guideline requirement for the currently registered uses of fenthion.

(2) Aquatic

Aquatic plant testing is not currently required for insecticides, except on a case-by-case basis. Testing was previously required for fenthion, because mosquito larvicide products could be repeatedly applied to the aquatic environment. Results of Tier I and Tier II toxicity testing on the technical material are tabulated below.

Table 15: Nontarget Aquatic Plant Toxicity (Tier I/II)

Species	% ai	EC_{50} (ppm)	NOEC (ppm)	MRID No. Author/Year	Study Classification
Vascular Plants:					
Duckweed *Lemna gibba* (Tier I)	96.9	n/a	2.8	401867-14 (Hughes, 1987)	core
Nonvascular Plants:					
Green algae *Kirchneria subcapitata* (Tier II)	96.9	1.1	0.7	401867-11 (Hughes, 1987)	core
Marine diatom *Skeletonema costatum* (Tier II)	96.9	0.4	0.2	401867-13 (Hughes, 1987)	core
Freshwater diatom *Navicula pelliculosa* (Tier II)	96.9	1.0	0.2	401867-15 (Hughes, 1987)	core
Blue-green algae *Anabaena flos-aquae* (Tier I)	96.9	n/a	3.8	401867-12 (Hughes, 1987)	core

These studies are not guideline requirements for the currently registered uses of fenthion.

2. Environmental Fate

a. Environmental Fate Assessment

The environmental fate data base is incomplete. However, it is clear that fenthion degrades by aerobic microbial metabolism with calculated half-lives of <1 day in an aerobic soil metabolism study and 11 days under anaerobic aquatic conditions. Major degradates were fenthion sulfoxide, 3-methyl-4-methylsulfonyl) phenol, fenthion phenol sulfoxide, fenthion phenol, and 3-methyl phenol. In both studies, carbon dioxide was a major degradate at the end of the studies.

Although no clear degradation rates are available, fenthion also probably degrades by photolysis in water. Several studies that are unacceptable for various reasons (impure parent material, undescribed light sources, unidentified degradates, etc) have been submitted; all these flawed studies indicate rapid degradation (half-lives of 1-4 hours) when irradiated with undescribed artificial light sources.

No mobility studies with unaged fenthion have been submitted; however, since fenthion degrades rapidly and thermal fogs and ULV are the only terrestrial uses of fenthion, there probably would be no serious groundwater contamination from the parent compound. The aged column leaching studies showed that fenthion residues (aged 30 days and leached 45 days) were mobile through the column. Fenthion sulfoxide, fenthion sulfone, fenthion phenol, 3-methyl-4-methylsulfonyl) phenol, and 3-methyl-4-methylsulfinyl) phenol were all recovered from the leachate. From information on other organophosphate insecticides, we know that the sulfoxide and sulfone compounds are often very toxic. It is not clear if the fenthion degradates are biologically active, but if they are found to be of toxicological concern, further groundwater/drinking water concerns may be evident.

Fenthion has an octanol water partition coefficient of 69,000, which indicates that it may bioaccumulate in fish and non-target organisms

b. Environmental Fate and Transport

(1) Degradation

Photodegradation in Water: 161-2

In this upgradeable study, fenthion degraded with a calculated half-life of 29 minutes when irradiated with an unspecified light source. There were three major degradates: fenthion phenol, fenthion sulfoxide, and fenthion phenol sulfoxide. Because no spectral distribution or intensity information was included with the study, we are unable to determine the photodegradation potential of fenthion under natural sunlight conditions. This study could potentially be upgraded (MRID 40110401).

Aerobic soil metabolism: 162-1

Fenthion degraded with a half-life of <1 day in a non-sterilized silt loam soil. Major non-volatile degradates were fenthion sulfoxide and 3-methyl-4-methylsulfonyl) phenol; both declined during the course of the 60-day study. Carbon dioxide comprised approximately 50% of the recovered radioactivity at the end of the 60 day study (MRID 00114318).

Anaerobic soil metabolism: 162-2

Fenthion degraded slowly under anaerobic conditions. After a 30-day aerobic aging of fenthion in soil, 1.9% of the applied radioactivity remained as parent fenthion. After a 60 day anaerobic (flooded) incubation, fenthion had decreased to 1% of the applied radioactivity (MRID 00114318).

Anaerobic aquatic metabolism: 162-3

[^{14}C]Fenthion degraded under anaerobic aquatic conditions with a calculated half-life of 11 days. The major degradates were fenthion phenol sulfoxide, fenthion phenol, and 3-methyl phenol (M1). $^{14}CO_2$ accounted for 51.6-52.3% of the total applied radioactivity at days 120 and 190. The submitted study provides marginally acceptable data to fulfill this data requirement (MRID 40825801).

Aerobic aquatic metabolism: 162-4

In this scientifically invalid study, [^{14}C]fenthion degraded under aerobic aquatic conditions. Half-life calculations were not possible, because the fenthion content was inexplicably low in the time 0 sample for the loamy sand sediment, and because too few samples were taken for the silt loam sediment. However, in both sediment:water systems, fenthion comprised ≤2.1% of the initial radioactivity by 31 days posttreatment. Degradates were fenthion sulfoxide, des-methyl oxygen analog sulfone, fenthion phenol sulfoxide, and fenthion oxygen analog sulfone. $^{14}CO_2$ comprised 9.5-10.0% of the radioactivity at day 66. The submitted study does not provide acceptable data to fulfill this data requirement; however, these data are not required for the current use patterns (MRID 40825802).

(2) Mobility

Aged column leaching: 163-1

Fenthion residues which were aged 30 days, applied to the top of a column, and leached with 22.5 inches of water over a 45 day period, were mobile. After leaching approximately 50% of the applied radioactivity was retained at the top of the column, 14% was recovered in the leachate (including fenthion sulfoxide, fenthion sulfone, fenthion phenol, 3-methyl-4-methylsulfonyl) phenol, and 3-methyl-4-methylsulfinyl) phenol. This study partially fulfills the mobility data requirements by fulfilling the aged mobility portion of the requirement (MRID 00115918).

(3) Accumulation

Laboratory accumulation - fish: 165-4

In this scientifically valid but unacceptable study, carp exposed to fenthion at 0.01 and 0.1 ppm had bioconcentration factors of approximately 2000x and 2300x, respectively. Depuration occurred with approximately 95% of the residues depurating during 15 days. The study was unacceptable because the results did not distinguish whether the parent or the degradates bioaccumulated and whether the accumulations were in edible or visceral tissues (MRID 00154965).

(4) Field Dissipation

(5) Spray Drift

[Start Entering text here]

c. **Water Resources**

(1) Ground Water

Because of the rapid degradation of fenthion and the limited terrestrial use patterns, there are no major groundwater concerns about the parent compound.

In the past, field dissipation studies monitoring for fenthion and degradates were required. Soil leaching data were also requested. The mobility data requirements have not been fulfilled, and terrestrial field dissipation studies were waived due to the low volume/minor use status of fenthion.

The degradates of fenthion were mobile in a column leaching study. If any of these degradates are biologically active, the potential for fenthion degradates to contaminate groundwater may be reassessed.

(2) Surface Water

Fenthion can contaminate surface water at application via spray drift for terrestrial uses involving aerial, blast, or ground spray. Significant fractions of applied fenthion should be available for runoff for only one to several days post-application (based upon an aerobic soil metabolism half-life of less than one day). The rapid dissipation of fenthion in soil makes accurate determinations of soil to water partitioning difficult. However, the Agriculture Research Service database lists a somewhat intermediate K_{oc} value of 1500 for fenthion, which corresponds to K_d values of 15-75 for soils with organic carbon contents of 1 to 5%. Although that indicates that fenthion concentrations adsorbed to soil may generally be more than 10X greater than concentrations dissolved in runoff water, it also indicates that substantial fractions of total fenthion runoff will generally occur via both dissolution in runoff water and adsorption to eroding soil. This is because the volume of runoff water will be much greater than the mass of soil.

Fenthion degrades by aerobic soil metabolism. There is some evidence from an invalid study that it substantially degrades in aerobic aquatic metabolism studies more rapidly than in the hydrolysis study (half-lives of 4-8 weeks). Therefore, in aerobic natural waters with sufficient microbiological activity, the persistence of fenthion should be somewhat limited by its susceptibility to biodegradation. However, its limited susceptibility to hydrolysis, coupled with its limited potential for volatilization from water (Henry's Law constant = 2.0×10^{-7} atm*m^3/mol), should make fenthion more persistent in natural waters with low microbiological activity. That is particularly true for those natural waters with long hydrological residence times where advective transport would not be a major dissipation pathway. A slower dissipation rate in the anaerobic aquatic metabolism study (half-life of 11 days) than in the aerobic aquatic metabolism study indicates that fenthion may be somewhat more persistent under the anaerobic conditions often found in sediment.

The somewhat intermediate K_{oc} value of 1500 and corresponding K_d values of 15-75 for sediments with organic carbon contents of 1-5% suggests that the concentration of fenthion adsorbed to suspended and bottom sediment should generally be greater than the concentration in the water column. However, the mass of water in the water column is generally substantially greater than the mass of suspended or bottom sediment available for binding. Consequently, in many water bodies, substantial portions of the total mass of fenthion present will probably be dissolved in the water column as well as adsorbed to suspended and bottom sediment. An octanol/water partition coefficient of 69,000 suggests that fenthion may have some significant potential for bioaccumulation.

Major degradates reported for the various laboratory studies include fenthion sulfoxide (aerobic soil metabolism), fenthion phenol (anaerobic aquatic metabolism), and fenthion phenol sulfoxide (anaerobic aquatic metabolism). The available data are inadequate to accurately assess the mobility and persistence of major degradates. The available data from metabolism and aged soil column leaching studies somewhat suggest that at least some of the degradates may be more persistent than fenthion and may possess comparable or greater mobility. If so, such degradates could be available for runoff for longer periods post-application than fenthion and might partition into runoff water or receiving water columns to a comparable or greater extent than fenthion.

A search of STORET for 1/1/80-2/6/96 for the water column of freshwaters resulted in very little data, but included two total fenthion detects reportedly over 100 ug/L. (Note, however, that misreporting of data by three orders of magnitude occurs occasionally in STORET. Detects of any pesticide in natural surface waters above 100 ug/L are rare; consequently, the reported values above 100 ug/L may not be correct.) All three samples analyzed for total fenthion had detects: 125 ug/L in a sample collected on 2/23/89 from the Nueces River near Mathis, Texas; 360 ug/L in a sample collected 3/24/88 from Canadaway Creek at Dunkirk, New York; and 2.8 ug/L in a sample collected 4/6/90 from Silver Creek near Freeburg Illinois. Dissolved fenthion was not detected above detection limits of 0.08 ug/L in seven samples collected from the Mad River CA, of 0.50 ug/L in two samples collected from the Russian River, and of 0.10 ug/L in 74 samples collected from Rock Creek ID.

It is unclear how representative (if at all) the sampled areas are of surface waters receiving direct fenthion application or drainage from high fenthion use areas. However, other than those data obtained from STORET, the Agency has no data on the concentrations of fenthion or its major degradates in surface water.

Fenthion is not currently regulated under the Safe Drinking Water Act (SDWA). Therefore, no MCL has been established for it and water supply systems are not required to sample and analyze for it. The Office of Drinking Water has not established any HALs for fenthion or its degradates. However, fenthion is of possible concern with respect to dietary risks to humans due to its inclusion on the HED list of "Apparent Exceeders (Chronic Effects and Cancer)." Also, the somewhat intermediate K_{oc} value of fenthion and the mobility of some degradates in aged soil column leaching studies indicate that the primary treatment methods employed by most surface water source supply systems will not be very effective in removing fenthion and its degradates. The susceptibility of fenthion (and possibly to a lesser extent major degradates) to biodegradation greatly lowers the possibility that fenthion and possibly its major degradates will exert chronic effects in drinking water. However, the microbiological activities of drinking water reservoirs are typically low. The susceptibility of fenthion and its major degradates to abiotic processes (with the possible but unproven exception of direct photolysis) and to biodegradation in the presence of low microbiological activities may not be sufficient to completely rule out the possibility of fenthion and/or some of its major degradates exerting chronic effects from the consumption of drinking water

3. **Exposure and Risk Characterization**

a. **Ecological Exposure and Risk Characterization**

Risk characterization integrates the results of the exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects. The quotient method is used to integrate exposure estimates and ecotoxicity data. For this method, risk quotients (RQs) are calculated by dividing exposure estimates by ecotoxicity values, both acute and chronic.

RQ = Exposure value/ecotoxicity value

Rqs are then compared to OPP's levels of concern (LOCs), which are criteria used to indicate potential risk to nontarget organisms and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories:

acute high risk - potential for acute risk is high; regulatory action may be warranted in addition to restricted use classification

acute restricted use - the potential for acute risk is high, but this may be mitigated through restricted use classification

acute endangered species - the potential for acute risk to endangered species is high; regulatory action may be warranted

chronic risk - the potential for chronic risk is high; regulatory action may be warranted

Currently, the Agency has no procedures for assessing chronic risk to plants, acute or chronic risks to nontarget insects, or chronic risk from granular/bait formulations to mammalian or avian species.

The ecotoxicity test values (i.e., measurement endpoints) used in the acute and chronic risk quotients are derived from the results of required studies. Examples of ecotoxicity values derived from the results of short-term laboratory studies which assess acute effects are:

LC_{50} - fish and birds
LD_{50} - birds and mammals
EC_{50} - aquatic plants and aquatic invertebrates

EC_{25} - terrestrial plants
EC_{05} or NOEC - endangered plants

Examples of toxicity test effect levels derived from the results of long-term laboratory studies which assess chronic effects are:

LOEC - birds, fish, and aquatic invertebrates
NOEC - birds, fish and aquatic invertebrates
MATC - fish and aquatic invertebrates

For birds and mammals, the NOEC value is generally used as the ecotoxicity test value in assessing chronic effects. Other values may be used when justified. The MATC (defined as the geometric mean of the NOEC and LOEC) is generally used as the ecotoxicity test value in assessing chronic effects to fish and aquatic invertebrates. However, the NOEC is used if the measurement end point is production of offspring or survival.

Risk presumptions, along with the corresponding RQs and LOCs, are tabulated below.

Table 16: Risk Presumptions For Terrestrial Animals

Risk Presumption	RQ	LOC
Birds:		
Acute High Risk	EEC^1/LC_{50} or LD_{50}/ft^2 or LD_{50}/day^3	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or $LD_{50} < 50$ mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/ft^2 LD_{50}/day	0.1
Chronic Risk	EEC/NOEC	1
Wild Mammals:		
Acute High Risk	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or $LD_{50} < 50$ mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day	0.1
Chronic Risk	EEC/NOEC	1

[1] EEC = Estimated Environmental Concentration (ppm) on avian/mammalian food items

[2] $\frac{mg/ft^2}{LD_{50} * \text{bird weight}}$ [3] $\frac{\text{mg of toxicant consumed/day}}{LD_{50} * \text{bird weight}}$

Table 17: Risk Presumptions For Aquatic Animals

Risk Presumption	RQ	LOC
Aquatic Animals:		
Acute High Risk	EEC^1/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Endangered Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/MATC or NOEC	1

[1] EEC = Estimated Environmental Concentration (ppm or ppb) in water

Table 18: Risk Presumptions For Plants

Risk Presumption	RQ	LOC
Terrestrial and Semi-Aquatic Plants:		
Acute High Risk	EEC^1/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1
Aquatic Plants:		
Acute High Risk	EEC^2/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1

[1] EEC = Estimated Environmental Concentration (lb ai/A)
[2] EEC = Estimated Environmental Concentration (ppm or ppb) in water

(1) Exposure and Risk to Nontarget Terrestrial Animals

For mosquito adulticide applications, estimated environmental concentrations (EECs) of active ingredient on avian and mammalian food items following product application are compared to LC_{50} values to assess risk. The predicted 0-day maximum and mean EECs expected immediately following a direct single application of a pesticide at 1 lb ai/A are tabulated below.

Table 19: Predicted Maximum and Mean EECs on Avian and Mammalian Food Items From a 1-lb Pesticide Application*

Food Item	EEC (ppm) Predicted Maximum Residue	EEC (ppm) Predicted Mean Residue
Short grass	240	85
Tall grass	110	36
Broadleaf plants and small insects	135	45
Fruits, pods, seeds, and large insects	15	7

* Predicted maximum and mean residues are based on Hoerger and Kenaga (1972) as modified by Fletcher et al (1994)

Spray applications of fenthion for mosquito control in Florida can be made at maximum application rates of 0.1 lb ai/acre (ULV) or 0.03 lb ai/acre (thermal fog) as needed. Because the maximum number of applications and the minimum interval between applications are not specified on product labels, the Agency cannot calculate EECs for multiple applications. However, fenthion degrades rapidly in the environment (aerobic soil metabolism half-life = ≈1 day); therefore, EECs for multiple applications are likely to be approximately the same or only slightly exceed those from a single application. For determining avian and mammalian RQs and conducting risk assessments, the Agency assumes the RQ values tabulated below apply to both single and multiple applications.

Table 20: Maximum EECs On Food Items From Maximum Mosquito Adulticide Applications (FL)

	EEC (ppm)			
Application Rate (lb ai/A)	Short Grass	Tall Grass	Broadleaf Plants & Small Insects	Seeds & Large Insects
0.1	24	11	14	2
0.03	7	3	4	<1

(2) Birds

Mosquito Adulticide Application:

Acute RQs for maximum mosquito adulticide applications are tabulated below.

Table 21: Avian Acute RQs From Mosquito Adulticide Applications (FL)

Application Rate (lb ai/A)	Food Item	Maximum EEC (ppm)	LC_{50}[1] (ppm)	Acute RQ (EEC/LC_{50})
0.1	Short grass	24	60	0.40
0.1	Tall grass	11	60	0.18
0.1	Broadleaf plants/Insects	14	60	0.23
0.1	Seeds	2	60	0.03
0.03	Short grass	7	60	0.12
0.03	Tall grass	3	60	0.05
0.03	Broadleaf plants/Insects	4	60	0.07
0.03	Seeds	<1	60	<0.02

[1] based on the bobwhite quail, the most sensitive test species (Table 3)

The acute high risk LOC for birds is not exceeded at either maximum registered application rate for mosquito adulticide applications. The restricted use LOC is exceeded at 0.1 lb ai/acre, and the endangered species LOC is exceeded at both 0.03 and 0.1 lb ai/acre. A chronic risk assessment for birds from use of fenthion for mosquito control cannot be completed until chronic toxicity data are submitted.

Although avian high risk LOCs have not been exceeded, published literature and incident reports indicate that spray applications of fenthion present a more serious threat to birds than indicated by these risk presumptions. The Agency's risk presumptions assume that exposure from spray applications is primarily via ingestion of contaminated food sources (e.g., grass, seeds, insects). However, dermal contact with aerial droplets and contaminated vegetation and inhalation of ULV or thermal-fog mists also are possible routes of exposure for birds. Fenthion is very highly toxic to birds dermally. Schaffer et al. (1973) reported dermal LD_{50} values of 1.8 and 2.4 mg/kg for red-billed quelea (*Quelea quelea*) and house sparrows (*Passer domesticus*), respectively, when fenthion was applied on the underside of the wing and 9.5 mg/kg for starlings (*Sturnus vulgaris*) when fenthion was applied to their breast. Fenthion applied aerially by ULV spray is used for lethal control of red-billed quelea (*Quelea*) in Africa. The massive mortality that results from quelea flying through the ULV spray mist is presumed to be due to both dermal contact and inhalation.

DeWeese et al. (1981, 1983) reported considerable bird mortality from fenthion mosquito-spray operations in Wyoming in 1978 and 1979. A large expanse of flood-irrigated pastures and meadows were sprayed with a single application of 0.04-0.05 lb ai/acre in both years. Dying birds were observed in spray areas within a few hours of treatment. More than 200 sick and dead animals, mostly birds, were found on study plots that represented only a small portion of the area treated. The authors postulated that many more birds died than were found in the study plots. Birds were presumed to have been exposed both from eating poisoned insects and from contact with contaminated water and vegetation. A sample of invertebrates contained 3.1 ppm fenthion, and pooled stomach contents from several dead birds also contained 3.1 ppm fenthion. Monitoring in treated pastures indicated sharp declines in bird numbers in those areas where mortality was heaviest. The authors believe that their findings indicate that fenthion is a high-risk chemical for birds.

A fenthion spray of 0.08 lb ai/acre for mosquito control across 1440 acres of residential parklands and adjacent river in North Dakota also resulted in heavy bird mortality (Seabloom et al. 1973). Within two days of treatment, 453 dead birds comprising 37 species were found dead. Overall mortality was estimated to be several thousand birds.

Darsie et al. (1962) examined wildlife mortality in saltwater marshes treated with fenthion at rates of 0.05 and 0.1 lb ai/acre. Caged mallards survived direct spray exposure to both treatment levels and feeding on fenthion-treated (173-346 ppb) food, but dead shorebirds were found in plots sprayed at the higher application rate.

Acute brain ChE depression was recorded in sandpipers and blackbirds after aerial applications of 0.1 lb ai/acre for mosquito control (Elder and Henderson 1969). The authors speculated that exposure of birds resulted from ingestion of contaminated aquatic invertebrates. Brain ChE depression was significant in red-winged blackbirds, but red-wings placed out in cages survived the treatment. ChE depression was not significant in upland and bottomland bird species.

Other incidents involving bird mortality from use of fenthion for mosquito control have been reported. In California, American goldfinch, gulls, ducks, shorebirds, green-backed heron, egrets, and other passerine species have been found after fenthion sprays for mosquito and/or midge control. In an incident in Louisiana in 1970, more than 1000 birds were reported dead following fenthion application. In Massachusetts and Idaho, robins, sparrows, catbirds, and sandpipers have been killed.

Livestock:

The Agency currently has no method for quantifying exposure to birds from applying a pesticide on livestock. It is possible that such application poses some risk to birds that perch on recently treated livestock or consume contaminated hairs or invertebrates. Dermal contact with fenthion can contaminate a bird's feet and feathers. Contamination of birds' feet is the basis for fenthion uptake from the toxic Rid-A-Bird perch registered for use against pigeons, sparrows, and starlings.

Although the potential for exposure exists from treatment of livestock, this use of fenthion probably poses the least risk to birds of the three currently registered uses. Of the incidents reported to the Agency (see Attachment), only two are presumed to be related to livestock use. In one reported incident, also discussed by Henny et al. (1987), five bald eagles (*Haliaeetus leucocephalus*) died from fenthion poisoning in Iowa after consuming dead, contaminated piglets. Remains of piglets and fenthion (0.1-6.8 ppm) were detected in the eagles' stomachs. Brain ChE activity of the dead eagles was depressed 80-92%, indicating organophosphate poisoning. The piglets apparently had not been treated with fenthion, but fenthion had been topically applied to sows. The piglets may have been contaminated from dermal contact with treated sows or from suckling contaminated sows' milk. Residue levels on the piglets were too low to indicate an illegal topical treatment. In this situation, proper disposal of piglet carcasses could have prevented exposure.

Hanson and Howell (1981) reported an incident in Canada where black-billed magpies (*Pica pica*) were found dead in the vicinities of feedlots. Cattle in the feedlots had been dermally treated with fenthion up to 4-5 months prior to the incident. Fenthion (7.29-483 mg/kg) was detected in the magpie gizzards, which also contained grain, hair, and epidermal debris. Because fenthion degrades rapidly, it is unclear why magpies died so long after the presumed exposure.

Toxic Perch:

Because the Rid-A-Bird perch is registered as an avicide, intended to kill pigeons, starlings, and house sparrows that perch on a wick saturated with fenthion, the Agency presumes acute high risk to any nontarget birds exposed to this product.

Birds - Secondary Risk

The Agency has received numerous incident reports where deaths of nontarget avian predators and scavengers have been attributed to their consumption of target species exposed to fenthion (see Attachment). Birds confirmed to have died from probable secondary exposure include bald eagles, peregrine falcon (*Falco peregrinus*), red-tailed hawks (*Buteo jamaicensis*), sharp-shinned hawks (*Accipiter striatus*), Cooper's hawks (*A. cooperii*), kestrels (*Falco sparverius*), unidentified hawk species, snowy owl (*Nyctea scandiaca*), great horned owl (*Bubo virginianus*), barred owl (*Strix varia*), short-earred owl (*Asio flammeus*), unidentified owl species, and crows (*Corvus* sp.). Collectively, these incidents indicate that raptors and scavengers may be at high risk from feeding upon birds exposed to fenthion.

Published literature supports the Agency's contention that fenthion poses a high risk to birds that prey on contaminated birds. Schaffer et al. (1964) fed fenthion-killed (10 mg/kg) house sparrows (*Passer domesticus*) to two kestrels and both died after eating 3-4 sparrows in as many days. Other tests demonstrated that captive kestrels will selectively prey on fenthion-exposed sparrows, and that consumption of contaminated sparrows can be lethal to kestrels. Hunt et al. (1992) presented four sparrows, one of which had been exposed for five minutes to fenthion via a Rid-A-Bird perch, to 30 kestrels in individual predation trials. In 12 (80%) of the 15 trials in which a capture was made, the kestrel captured the sparrow that had been exposed to fenthion. Erratic behavior was observed in some contaminated sparrows but not in others that were captured. In another test, 11 of 14 kestrels capturing contaminated sparrows died within 24 hours after consuming all or most of one exposed sparrow (Hunt et al. 1991). Two other kestrels died after consuming a second sparrow on day 2, and another died after partially consuming a third sparrow on day 3. The sparrows were contaminated mostly on their feet, with some fenthion also on their plumage and within the carcass. Fenthion residues were confirmed in the GI tracts of the kestrels, and brain ChE activity was depressed to levels indicative of organophosphate poisoning.

In Africa, where fenthion is applied as a contact poison to control red-billed quelea, extensive mortality of queleas and insects results from spray applications to quelea roosts and nesting colonies. Mortality of raptors, avian scavengers, and insectivorous birds has been reported from consumption of dead and debilitated queleas and insects (Bruggers et al. 1989).

b. Mammals

An assessment of the potential for adverse primary effects to wild mammals is based upon the Agency's draft 1995 SOP of mammalian risk assessments and methods used by Hoerger and Kenaga (1972) as modified by Fletcher et al (1994). The dietary concentration of fenthion that is expected to be acutely lethal to 50% of the test population (LC_{50}) is determined by dividing the LD_{50} value (usually rat LD_{50}) by the % (decimal of) body weight consumed. The RQ is then determined by dividing the EEC by the derived LC_{50} value. RQs are calculated for three separate weight classes of mammals (15, 35, and 1000 g), each presumed to consume four different kinds of food (grass, broadleaf plants, insects, and seeds).

The acute RQs for mosquito adulticide applications are tabulated below for herbivores and insectivores (Table 22) and granivores (Table 23). Chronic RQs are presented in Table 24.

Table 22: Mammalian (Herbivore and Insectivore) Acute RQs From Mosquito Adulticide Applications (FL)

Application Rate (lb ai/A)	Body Weight (g)	% Body Weight Consumed	Lab. Rat LD_{50} (mg/kg)	Max. EEC Short Grass (ppm)	Max. EEC Forage & Small Insects (ppm)	Max. EEC Large Insects (ppm)	Acute RQ* Short Grass	Acute RQ* Forage & Small Insects	Acute RQ* Large Insects
0.1	15	95	405	24	14	2	0.06	0.03	<0.01
0.1	35	66	405	24	14	2	0.04	0.02	<0.01
0.1	1000	15	405	24	14	2	<0.01	<0.01	<0.01
0.03	15	95	405	7	4	<1	0.02	<0.01	<0.01
0.03	35	66	405	7	4	<1	0.01	<0.01	<0.01
0.03	1000	15	405	7	4	<1	<0.01	<0.01	<0.01

* where RQ = $\frac{\text{EEC (mg/kg)}}{LD_{50}\text{ (mg/kg)/ \% Body Weight Consumed}}$

Table 23: Mammalian (Granivore) Acute RQs From Mosquito Adulticide Applications (FL)

Application Rate (lb ai/A)	Body Weight (g)	% Body Weight Consumed	Lab. Rat LD_{50} (mg/kg)	EEC Seeds (ppm)	Acute RQ* Seeds
0.1	15	21	405	2	<0.01
0.1	35	15	405	2	<0.01
0.1	1000	3	405	2	<0.01
0.03	15	21	405	2	<0.01
0.03	35	15	405	2	<0.01
0.03	1000	3	405	2	<0.01

* where RQ = $\frac{\text{EEC (mg/kg)}}{LD_{50}\text{ (mg/kg)/ \% Body Weight Consumed}}$

Table 24: Mammalian Chronic RQs from Mosquito Adulticide Applications (FL)

Application Rate (lb ai/A)	Food Item	Maximum EEC (ppm)	Lab. Rat Chronic NOEC (ppm)	Chronic RQ (EEC/NOEC)
0.1	Short grass	24	14	1.7
0.1	Tall grass	12	14	0.8
0.1	Broadleaf plants/Insects	14	14	1
0.1	Seeds	2	14	0.1
0.03	Short grass	7	14	0.5
0.03	Tall grass	3	14	0.2

Application Rate (lb ai/A)	Food Item	Maximum EEC (ppm)	Lab. Rat Chronic NOEC (ppm)	Chronic RQ (EEC/NOEC)
0.1	Short grass	24	14	1.7
0.03	Broadleaf plants/Insects	4	14	0.3
0.03	Seeds	<1	14	<0.1

The results indicate that acute risk LOCs are not exceeded for small mammals at either registered maximum application rate. The chronic LOC for small mammals is slightly exceeded at 0.1 lb ai/A; however, because fenthion degrades rapidly in the environment, chronic exposure is unlikely.

The Agency is aware of only one incident involving mammals. DeWeese et al (1983) found 15 dead mammals of six species following fenthion spraying for mosquito control in Wyoming in 1978 (see Attachment). Based on the dead mammals found, most or all of which were unlikely to be predators or scavengers, poisoning was likely due to ingestion of contaminated food and water and/or dermal exposure from contaminated vegetation.

c. Insects

The Agency currently has no procedure for assessing risk to nontarget insects. Results of acceptable studies are used for recommending appropriate label precautions.

4. Exposure and Risk to Nontarget Aquatic Animals

ULV and thermal-fog sprays produce a mist intended to remain airborne longer than do the larger droplets produced by standard spray applications. Therefore, The Agency's standard assumption of 5% drift from aerial spray applications may be too conservative when estimating how much spray may be directly deposited in a water body. Although one field study reported that 5-6% of fenthion aerially applied as a thermal fog for mosquito control in Florida was deposited on water surfaces (Wang et al. 1987), The Agency assumes as much as 20% of a ULV or thermal-fog spray might be directly deposited in a body of water. For risk assessment purposes, aquatic EECs are estimated from spray scenarios that consider 5%, 10%, and 20% drift into 0.5- and 6-ft deep water bodies. The Agency's "FATE" program is used to determine aquatic residues over time, based on an aquatic metabolism half-life of about 1 day for fenthion. Acute risk assessments are performed using the instantaneous (day 0) EEC value. Chronic risk assessments are performed using the 21-day average EEC for invertebrates and the 56-day average EEC for fish.

Table 25: EECs For Aquatic Exposure From Mosquito Adulticide Applications (FL)

Application Rate (lb ai/A)	% Drift Assumed	Water Depth (ft)	Instantaneous EEC (ppb)	21-day avg. EEC (ppb)	56-day avg. EEC (ppb)
0.1	5	0.5	3.67	0.33	0.13
0.1	5	6	0.31	0.03	0.01
0.1	10	0.5	7.34	0.66	0.26
0.1	10	6	0.61	0.06	0.02
0.1	20	0.5	14.68	1.34	0.52
0.1	20	6	1.22	0.11	0.04
0.03	5	0.5	1.10	0.10	0.04
0.03	5	6	0.09	<0.01	<0.01
0.03	10	0.5	2.20	0.20	0.08
0.03	10	6	0.18	0.02	<0.01
0.03	20	0.5	4.40	0.40	0.16
0.03	20	6	0.37	0.03	0.01

(1) Freshwater Fish

Mosquito Adulticide Application:

Acute and chronic RQs for mosquito adulticide applications of fenthion are tabulated below.

Table 26: RQs For Freshwater Fish From Mosquito Adulticide Applications (FL)

Application Rate (lb ai/A)	% Drift Assumed	Water Depth (ft)	LC_{50}[1] (ppb)	NOEC[2] (ppb)	EEC Initial (ppb)	EEC 56-Day (ppb)	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/ NOEC)
0.1	5	0.5	830	7.5	3.67	0.13	<0.01	0.02
0.1	5	6	830	7.5	0.31	0.01	<0.01	<0.01
0.1	10	0.5	830	7.5	7.34	0.26	<0.01	0.03
0.1	10	6	830	7.5	0.61	0.02	<0.01	<0.01
0.1	20	0.5	830	7.5	14.68	0.52	0.02	0.07
0.1	20	6	830	7.5	1.22	0.04	<0.01	<0.01
0.03	5	0.5	830	7.5	1.10	0.04	<0.01	<0.01
0.03	5	6	830	7.5	0.09	<0.01	<0.01	<0.01
0.03	10	0.5	830	7.5	2.20	0.08	<0.01	0.01
0.03	10	6	830	7.5	0.18	<0.01	<0.01	<0.01
0.03	20	0.5	830	7.5	4.40	0.16	<0.01	0.02
0.03	20	6	830	7.5	0.37	0.01	<0.01	<0.01

[1] based on the rainbow trout, the most sensitive fish species (Table 6)

[2] based on the rainbow trout (Table 7)

The results indicate that acute and chronic LOCs for freshwater fish are not exceeded at either maximum mosquito adulticide application rate, assuming that no more than 5-20% of the spray would be deposited directly in 0.5-6 feet of water.

The Agency is aware of two incidents where freshwater fish died as a result of exposure to fenthion. In one incident in Hawaii, an estimated 6000 fish were found dead along a ½-mile section of stream during a two-day period in 1971. Fenthion was detected in samples of dead fish, but it is not known how the stream was contaminated. Approximately 65 bluegill sunfish and largemouth bass were found dead in a farm pond in Nebraska in 1986 after fenthion was sprayed onto nearby fields prior to heavy rainfall. Fenthion residues of 6.0 ppm were detected in the pond. Both incidents likely occurred from uses of fenthion that are not currently registered.

Livestock Application:

Because the fenthion either is contained within an ear tag or is spot treated to livestock, primarily in winter, The Agency presumes little risk to aquatic organisms from this use.

Toxic Perch:

Because the fenthion is contained within a metal perch, contamination of water bodies is unlikely. Therefore, The Agency presumes minimal risk to aquatic organisms from this use.

(2) Freshwater Invertebrates

Mosquito Adulticide Application:

Acute and chronic RQs are tabulated below for mosquito adulticide applications.

Table 27: RQs For Freshwater Invertebrates From Mosquito Adulticide Applications (FL)

Application Rate (lb ai/A)	% Drift Assumed	Water Depth (ft)	LC_{50}[1] (ppb)	NOEC[1] (ppb)	EEC Initial (ppb)	EEC 21-Day (ppb)	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/NOEC)
0.1	5	0.5	5.2	0.016	3.67	0.33	0.70	20.6
0.1	5	6	5.2	0.016	0.31	0.03	0.06	1.8
0.1	10	0.5	5.2	0.016	7.34	0.66	1.41	41.3
0.1	10	6	5.2	0.016	0.61	0.06	0.12	3.8
0.1	20	0.5	5.2	0.016	14.68	1.34	2.82	83.8
0.1	20	6	5.2	0.016	1.22	0.11	0.23	6.9
0.03	5	0.5	5.2	0.016	1.10	0.10	0.21	6.3
0.03	5	6	5.2	0.016	0.09	<0.01	0.02	<1
0.03	10	0.5	5.2	0.016	2.20	0.20	0.44	12.5
0.03	10	6	5.2	0.016	0.18	0.02	0.03	1.3
0.03	20	0.5	5.2	0.016	4.40	0.40	0.85	25.0
0.03	20	6	5.2	0.016	0.37	0.03	0.07	1.9

[1] based on the waterflea (Tables 8 and 9)

The results indicate that acute high risk, restricted use, and endangered species LOCs are exceeded for freshwater invertebrates at maximum application rates of 0.1 and 0.03 lb ai/acre. The chronic risk LOC is greatly exceeded for maximum application rates.

(3) Estuarine and Marine Animals

Estuarine/Marine Fish (Mosquito Adulticide

Application)

Acute RQs are tabulated below for mosquito adulticide applications.

Table 28: RQs For Estuarine/Marine Fish From Mosquito Adulticide Applications (FL)

Application Rate (lb ai/A)	% Drift Assumed	Water Depth (ft)	LC_{50}[1] (ppb)	EEC Initial (ppb)	Acute RQ (EEC/LC_{50})
0.1	5	0.5	1200	3.67	<0.01
0.1	5	6	1200	0.31	<0.01
0.1	10	0.5	1200	7.34	<0.01
0.1	10	6	1200	0.61	<0.01
0.1	20	0.5	1200	14.68	0.01
0.1	20	6	1200	1.22	<0.01
0.03	5	0.5	1200	1.10	<0.01
0.03	5	6	1200	0.09	<0.01
0.03	10	0.5	1200	2.20	<0.01
0.03	10	6	1200	0.18	<0.01
0.03	20	0.5	1200	4.40	<0.01
0.03	20	6	1200	0.37	<0.01

[1] based on the sheepshead minnow (Table 10)

The results indicate that acute risk LOCs are not exceeded for maximum application rates of 0.1 and 0.03 lb ai/A.

Estuarine/Marine Invertebrates (Mosquito Adulticide Application)

Acute and chronic RQs are tabulated below for mosquito adulticide applications.

Table 29: RQs For Estuarine/Marine Invertebrates From Mosquito Adulticide Applications (FL)

Application Rate (lb ai/A)	% Drift Assumed	Water Depth (ft)	LC_{50}[1] (ppb)	NOEC[1] (ppb)	EEC Initial (ppb)	EEC 21-Day (ppb)	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/NOEC)
0.1	5	0.5	0.22	0.037	3.67	0.33	16.7	8.9
0.1	5	6	0.22	0.037	0.31	0.03	1.4	0.8
0.1	10	0.5	0.22	0.037	7.34	0.66	33.7	17.8
0.1	10	6	0.22	0.037	0.61	0.06	2.8	1.6
0.1	20	0.5	0.22	0.037	14.68	1.34	66.7	36.2
0.1	20	6	0.22	0.037	1.22	0.11	5.5	3.0
0.03	5	0.5	0.22	0.037	1.10	0.10	5.0	2.7
0.03	5	6	0.22	0.037	0.09	<0.01	0.4	<0.3
0.03	10	0.5	0.22	0.037	2.20	0.20	10.0	5.4
0.03	10	6	0.22	0.037	0.18	0.02	0.8	0.5
0.03	20	0.5	0.22	0.037	4.40	0.40	20.0	10.8
0.03	20	6	0.22	0.037	0.37	0.03	1.7	0.8

[1] based on mysid shrimp (Tables 11 and 12)

The results indicate that acute high risk, restricted use, and endangered species LOCs are greatly exceeded for estuarine/marine invertebrates for maximum application rates of 0.1 and 0.03 lb ai/acre. The chronic risk LOC also is greatly exceeded for estuarine/marine invertebrates at these application rates.

Field tests in Florida indicate that some estuarine invertebrates in some situations will likely be adversely affected by mosquito adulticide control operations with fenthion. Clark et al. (1987) found that fenthion residues diminish rapidly in estuarine waters that undergo tidal flushing but may persist at levels lethal to aquatic invertebrates in waters not flushed (e.g., inland canals). Their field tests included aerial thermal-fog applications at 0.03 lb ai/acre, ULV ground applications at 0.01 lb ai/acre, and direct application to water at 0.1 lb ai/acre (Clark et al. 1987). Mortality of caged mysids (*Mysidopsis bahia*), grass shrimp (*Palaemonetes pugio*), pink shrimp (*Penaeus duorarum*), and sheepshead minnow (*Cyprinodon variegatus*) was examined for four days after each treatment. Three thermal-fog applications were made along an estuarine bay and two along a residential canal system. ULV ground applications were made along a shallow marsh embayment. Whereas larvicidal treatments resulted in high mortality of mysids and shrimps, the extent of mortality from adulticide sprays largely depended on whether the receiving waters were flushed (estuarine bay) or not (inland canal). Mortality did not exceed 10% for the three thermal-fog applications along the bay. Maximum fenthion concentrations in the bay reached 0.43, 1.5, and 0.05 ppb but decreased to 0.02 ppb or less within 24 hours after treatment. At the canal, mortality of mysids and shrimps occurred within 24 hours post-spray. Initial peak fenthion concentrations in the canal were 2.6 and 0.5 ppb; after 24 hours, 0.16-0.39 ppb was detected in the water. Mortality of mysids was significant in one of the four ULV treatments, but shrimps and minnows were not affected.

Other field testing in Florida found that low-level exposure to fenthion can result in increased mortality and sublethal growth retardation of *Mysidopsis bahia* (McKenney et al. ?date). Caged mysids were exposed to fenthion residues resulting from three ground ULV applications in Florida. Only 35% of the mysids survived the first spray, versus 68% survival at a reference site. Measured fenthion concentrations in water close to the caged mysids were about 0.5 ppb 1 hour after the spray, 0.1 ppb after 6 hours, 0.01 ppb after 12 hours, and nondetectable after 18 hours. No mortality occurred after the second and third sprays, but lower levels of fenthion were detected in the water. Mysids examined 8 days after the second spray exhibited significantly higher rates of oxygen consumption and reduced weights, suggesting bioenergetic disruptions in mysids exposed sublethally to fenthion in the field.

Together, these field tests indicate that some estuarine invertebrates are at risk from exposure to low levels of fenthion. Aerial ULV sprays of 0.1 lb ai/acre would likely increase exposure and risk more than that reported for ground applications of 0.01 lb ai/acre.

(4) Exposure and Risk to Nontarget Plants

Terrestrial and aquatic plant testing results are presented in Tables 12, 13, and 14. Because no significant adverse affects were found in Tier I testing at twice the label application rate for the mosquito adulticide, risk to terrestrial plants is not anticipated from spray applications. Because the NOEC of the most sensitive aquatic plant species (0.2 ppm, Table 15) is less than the expected aquatic EEC values (0.09-14.68 ppb, Table 25), the Agency presumes no risk to aquatic plant species from maximum labeled rates of fenthion for adult mosquito control.

(a) **Terrestrial and Semi-aquatic**

[Start Entering text here]

(b) **Aquatic**

[Start Entering text here]

(5) **Endangered Species**

Endangered species LOCs are exceeded for birds, freshwater invertebrates, and some estuarine/marine invertebrates. The Endangered Species Protection Program is expected to become final in the future. Limitations in the use of fenthion may be required to protect endangered and threatened species, but these limitations have not been defined and may be formulation specific. EPA is in consultation with the Fish and Wildlife Service in accordance with the species-based priority approach described in the Program. After completion of consultation, registrants will be informed if any required label modifications are necessary. Such modifications would most likely consist of the generic label statement referring pesticide users to use limitations contained in county Bulletins.

a. Water Resources Risk Implication for Human Health

[Start entering here only if this section is applicable if completed by EFGWB and HED].

(1) **Ground Water**

[Start entering text here]

(2) **Surface Water**

[Start entering text here]

b. Environmental Risk Characterization

[Start entering text here]