Risks of EPTC Use to Federally Threatened

Delta Smelt (*Hypomesus transpacificus*)

Pesticide Effects Determinations
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List of Commonly Used Abbreviations and Nomenclature

µg/kg	Symbol for "micrograms per kilogram"
µg/L	Symbol for "micrograms per liter"
ºC	Symbol for "degrees Celsius"
AAPCO	Association of American Pesticide Control Officials
a.i.	Active Ingredient
AIMS	Avian Monitoring Information System
Acc#	Accession Number
Amu	Atomic Mass Unit
BCB	Bay Checkerspot Butterfly
BCF	Bioconcentration Factor
BEAD	Biological and Economic Analysis Division
Bw	Body Weight
CAM	Chemical Application Method
CARB	California Air Resources Board
CAW	California Alameda Whipsnake
CBD	Center for Biological Diversity
CCR	California Clapper Rail
CDPR	California Department of Pesticide Regulation
CDPR-PUR	California Department of Pesticide Regulation Pesticide Use Reporting Database
CFWS	California Freshwater Shrimp
CI	Confidence Interval
CL	Confidence Limit
CTS	California Tiger Salamander
DS	Delta Smelt
EC	Emulsifiable Concentrate
EC_{05}	5% Effect Concentration
EC_{25}	25% Effect Concentration
EC_{50}	50% (or Median) Effect Concentration
ECOTOX	EPA managed database of Ecotoxicology data
EEC	Estimated Environmental Concentration
EFED	Environmental Fate and Effects Division
e.g.	Latin *exempli gratia* ("for example")
EIM	Environmental Information Management System

EPI	Estimation Programs Interface
ESU	Evolutionarily significant unit
et al.	Latin *et alii* ("and others")
etc.	Latin *et cetera* ("and the rest" or "and so forth")
EXAMS	Exposure Analysis Modeling System
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
FQPA	Food Quality Protection Act
Ft	Feet
GENEEC	Generic Estimated Exposure Concentration model
HPLC	High Pressure Liquid Chromatography
IC_{05}	5% Inhibition Concentration
IC_{50}	50% (or median) Inhibition Concentration
i.e.	Latin for *id est* ("that is")
IECV1.1	Individual Effect Chance Model Version 1.1
KABAM	K_{OW} (based) Aquatic BioAccumulation Model
Kg	Kilogram(s)
kJ/mole	Kilojoules per mole
Km	Kilometer(s)
K_{AW}	Air-water Partition Coefficient
Kd	Solid-water Distribution Coefficient
KF	Freundlich Solid-Water Distribution Coefficient
K_{OC}	Organic-carbon Partition Coefficient
K_{OW}	Octanol–water Partition Coefficient
LAA	Likely to Adversely Affect
lb a.i./A	Pound(s) of active ingredient per acre
LC_{50}	50% (or Median) Lethal Concentration
LD_{50}	50% (or Median) Lethal Dose
LOAEC	Lowest Observable Adverse Effect Concentration
LOAEL	Lowest Observable Adverse Effect Level
LOC	Level of Concern
LOD	Level of Detection
LOEC	Lowest Observable Effect Concentration
LOQ	Level of Quantitation
M	Meter(s)
MA	May Affect
MATC	Maximum Acceptable Toxicant Concentration

m^2/day	Square Meters per Days
ME	Microencapsulated
Mg	Milligram(s)
mg/kg	Milligrams per kilogram (equivalent to ppm)
mg/L	Milligrams per liter (equivalent to ppm)
Mi	Mile(s)
mmHg	Millimeter of mercury
MRID	Master Record Identification Number
MW	Molecular Weight
n/a	Not applicable
NASS	National Agricultural Statistics Service
NAWQA	National Water Quality Assessment
NCOD	National Contaminant Occurrence Database
NE	No Effect
NLAA	Not Likely to Adversely Affect
NLCD	National Land Cover Dataset
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAEC	No Observable Adverse Effect Concentration
NOAEL	No Observable Adverse Effect Level
NOEC	No Observable Effect Concentration
NRCS	Natural Resources Conservation Service
OPP	Office of Pesticide Programs
OPPTS	Office of Prevention, Pesticides and Toxic Substances
ORD	Office of Research and Development
PCE	Primary Constituent Element
pH	Symbol for the negative logarithm of the hydrogen ion activity in an aqueous solution, dimensionless
pKa	Symbol for the negative logarithm of the acid dissociation constant, dimensionless
Ppb	Parts per Billion (equivalent to µg/L or µg/kg)
Ppm	Parts per Million (equivalent to mg/L or mg/kg)
PRD	Pesticide Re-Evaluation Division
PRZM	Pesticide Root Zone Model
ROW	Right of Way
RQ	Risk Quotient

SFGS	San Francisco Garter Snake
SJKF	San Joaquin Kit Fox
SLN	Special Local Need
SMHM	Salt Marsh Harvest Mouse
TG	Tidewater Goby
T-HERPS	Terrestrial Herpetofaunal Exposure Residue Program Simulation
T-REX	Terrestrial Residue Exposure Model
UCL	Upper Confidence Limit
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VELB`	Valley Elderberry Longhorn Beetle
WP	Wettable Powder
Wt	Weight

1. Executive Summary

1.1. Purpose of Assessment

The purpose of this assessment is to evaluate potential direct and indirect effects on the Delta smelt (*Hypomesus transpacificus*, DS) arising from FIFRA regulatory actions regarding use of EPTC on agricultural and non-agricultural sites. In addition, this assessment evaluates whether these actions can be expected to result in modification of designated critical habitat for the Delta smelt. This assessment was completed in accordance with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) *Endangered Species Consultation Handbook* (USFWS/NMFS, 1998), procedures outlined in the Agency's Overview Document (USEPA, 2004), and consistent with a suit in which EPTC was alleged to be of concern to the DS (*Center for Biological Diversity (CBD) vs. EPA et al*. (Case No. 07-2794-JCS).

The Delta smelt (DS) was listed as threatened on March 5, 1993 (58 FR 12854) by the USFWS (USFWS, 2007a). DS are mainly found in the Suisun Bay and the Sacramento-San Joaquin estuary near San Francisco Bay. During spawning DS move into freshwater.

1.2. Scope of Assessment

1.2.1. Uses Assessed

EPTC is a pre-emergence (pre-plant) and early post-emergence thiocarbamate herbicide used to control the growth of germinating annual weeds, including broadleaves, grasses, and sedges. Due to its volatility, EPTC must be mechanically incorporated, injected in the subsurface of the soil, applied in irrigation water, or be watered-in after application. Thiocarbamates inhibit both cell division and elongation, fatty acid and lipid biosynthesis, proteins, and may alter plant hormonal distribution within a plant. EPTC exerts its herbicidal action through inhibition of cuticle formation at the early stages of seedling growth which inhibits germination and seedling development.

EPTC is used throughout the United States in agricultural production for a wide variety of food and non-food crops. California represents one of the states with highest EPTC use. The registered uses in California are alfalfa, almond, beans (dried, castor, snap or succulent), broccoli, cabbage, carrot, citrus, clover, conifers (seed orchard), corn (field, pop, silage, sweet, unspecified), cotton, grapefruit (bearing, nonbearing), lemon (bearing, nonbearing), lespedeza, lettuce, orange (bearing, nonbearing), ornamentals (ground cover, herbaceous plants, seed orchard, woody shrubs), potato (white/Irish), safflower, sugar beets, sunflower, sweet potato, tangerine, tomato, trefoil and walnut. These uses are considered as part of the federal action evaluated in this assessment. The label application rates range from 1.5 to 14.9 lbs a.i. per acre. The uses with the highest pounds of active ingredient (a.i.) used in California include alfalfa, potato, sugar beet, safflower, beans (all types), corn, carrots, and almonds. Counties with the highest use include Imperial, Kern, Kings, Tulare, San Joaquin, Fresno, Merced, and Riverside. During the period between 1999 and 2007, approximately 106,000 to 449,000 (average 229,663) pounds of EPTC (a.i.) were used annually in California.

EPTC is formulated either as an emulsifiable concentrate or a granular. Application equipment and methods for EPTC include ground application, soil band treatment, soil broadcast, direct spray, chemigation, flood treatment, and aerial application (granular formulation on alfalfa).

1.2.2. Environmental Fate Properties of EPTC

EPTC has relatively high volatility and is soluble in water. Therefore, potential transport mechanisms considered in this assessment include spray drift, runoff, and the deposition of vaporized EPTC through atmospheric transport. EPTC is stable to hydrolysis and photolysis, mobile in soils, and has been detected in surface water, ground water, and rain water monitoring studies. The major routes of degradation appear to be aerobic metabolism in soil and water and degradation/dissipation by volatilization. The soil degradation/dissipation rate [included both metabolism and volatilization] had half-lives which ranged from 36 to 75 days and DT_{50}s that ranged between 10 and 37 days. EPTC is more persistent in anaerobic conditions. Although mobile in soil, monitoring data suggest that leaching to ground water is not a major dissipation process. The importance of volatilization will decrease if EPTC is incorporated or watered into the soil, and where water and wind flow velocities are low. The potential transport mechanism of a discharge of ground water to the surface (aquatic and terrestrial exposure) is not considered in this assessment.

1.2.3. Evaluation of Degradates and Stressors of Concern

Consistent with the ecological risk assessment in support of the EPTC Registration Eligibility Decision (RED) (USEPA, 1999), this assessment considers the potential risk associated with the parent EPTC only. Two transformation products, dipropylamine and EPTC sulfoxide (ESO) have been identified; however, available fate information suggests that they occur as relatively low percentages of applied radio-labeled EPTC, do not accumulate, and degrade at rates similar to the parent EPTC. ESO has a half-life that is similar to EPTC and has only been found in soils at levels of 6% to 11% of the parent (MRIDs 42120805, 42120806). Furthermore, the estimated environmental concentrations (EECs) in the aquatic environment for the combined residues (EPTC plus the transformation product ESO) have been shown to be essentially the same as those for EPTC alone (EPTC Drinking Water Assessment, D339490). Limited toxicity data on daphnids suggest similar (or, perhaps, slightly lower) toxicity of the sulfoxide degradate to the parent (MRID 45442201).

1.3. Assessment Procedures

A description of routine procedures for evaluating risk to the San Francisco Bay Species are provided in **Attachment 1**.

1.3.1. Exposure Assessment

1.3.1.a. Aquatic Exposures

The DS spends part of its life in both freshwater and saltwater and so aquatic exposure to EPTC was assessed for the DS, its prey and its habitat. Aquatic and terrestrial EPTC exposures are assessed separately. Tier-II aquatic exposure models are used to estimate high-end exposures of EPTC in aquatic habitats resulting from runoff and spray drift from different uses. Peak model-estimated aquatic exposure concentrations resulting from different EPTC uses range from < 1 to 171 µg/L. These estimates are supplemented with analysis of available California surface water monitoring data from U. S. Geological Survey's National Water Quality Assessment (NAWQA) program and the California Department of Pesticide Regulation. The maximum concentration of EPTC reported by NAWQA from 1999-2007 for California surface waters with agricultural watersheds is 4.73 µg/L. The NAWQA and CDPR highest reported concentrations for the period are the same sample. The highest EPTC concentrations reported were 23 µg/L and 40 µg/L in 1993 and 1994, respectively. Thus, the surface water monitoring data tend to be less than the modeled estimates, but in general, they are in agreement with the range of modeling results.

Another potentially significant route of aquatic exposure of EPTC is via tailwater runoff as a result of flood irrigation (chemigation) application methods. Monitoring data suggest that EPTC concentrations in tailwater runoff from a flood-irrigated field (edge-of-field concentration rather than small pond or flowing water) can be considerably higher than the model-predicted EECs for surface water (stream or small pond). One field study (Cliath et al., 1980) reported a maximum EPTC concentration in tailwater of 1440 to1970 µg/L, which is more than 11 times the highest 1-in-10 year EEC (171 µg/L) as predicted by the PRZM/EXAMS model. Tailwater study data are used quantitatively in this assessment to assess the potential risk to the DS. The EPTC concentrations in tailwater reflect conditions at the end of the field and do not reflect the influence of volatilization and leaching into soil on adjacent fields or volatilization and dilution as the tailwater is mixed with other water as it moves downstream.

1.3.1.b. Terrestrial Exposures

The risk to terrestrial plants from EPTC exposure was also assessed since terrestrial plants are important to DS habitat. Riparian vegetation is an important component of the DS habitat providing shade, bank stability and filtration, and upland vegetation affects runoff. To estimate EPTC exposures to terrestrial plants from uses involving EPTC applications, The AgDRIFT model is used to estimate deposition of EPTC on terrestrial habitats from spray drift. The TERRPLANT model is used to estimate EPTC exposures to terrestrial plants inhabiting semi-aquatic and dry areas, resulting from uses involving foliar EPTC applications.

1.3.2. Toxicity Assessment

The effects determination assessment endpoints for the DS include direct toxic effects on survival, reproduction, and growth, as well as indirect effects such as reduction of the prey base or modification of its habitat. Federally-designated critical habitat has been established for the DS. Primary constituent elements (PCEs) were used to evaluate whether EPTC has the potential to modify designated critical habitat. The Agency evaluated registrant-submitted studies and data from the open literature to characterize EPTC toxicity. The most sensitive toxicity value available from acceptable or supplemental studies for each taxon relevant for estimating potential risks to the assessed species and/or their designated critical habitat was used.

Section 2.8.1 summarizes the ecotoxicity data used in this assessment. Direct effects to the DS are based on toxicity information for freshwater and saltwater fish. Given that the DS's prey items and designated critical habitat requirements in the aquatic habitat are dependant on the availability of freshwater and saltwater invertebrates and aquatic plants, toxicity information for these taxonomic groups is also discussed. Indirect effects due to modification of the terrestrial habitat are characterized by available data for terrestrial monocots and dicots.

Available aquatic toxicity data indicate that EPTC and several of its formulations are slightly toxic on an acute basis to freshwater fish and invertebrates (14 and 6.5 mg a.i./L, respectively). No freshwater fish chronic studies are available for EPTC. A freshwater invertebrate life-cycle study reported an NOAEC for reproduction of 0.81 mg/L. The most sensitive chronic endpoint was a saltwater invertebrate NOAEC of 0.08 mg a.i./L, estimated by using the acute to chronic ratio from the freshwater invertebrate data. Non-vascular and vascular aquatic plants have reported EC_{50}s ranging from about 1 to 6 mg a.i./L.

The sublethal endpoint used to define the action area was a dose-related decrease in absolute brain weight in male rat pups at post-natal day 63 from a developmental neurotoxicity study. These effects were observed at the lowest dose level tested (100 ppm, 7.6 mg/Kg bw/d), so there was no NOAEL (MRID 46319101). Terrestrial plant seedling emergence and vegetative vigor studies indicate that EPTC, an herbicide, elicits phytotoxic effects at rates less than 1 lb a.i./A for sensitive species.

1.3.3. Measures of Risk

Acute and chronic risk quotients (RQs) are compared to the Agency's Levels of Concern (LOCs) to identify instances where EPTC use has the potential to adversely affect the assessed species or modify their designated critical habitat. When RQs for a particular type of effect are below LOCs, the pesticide is considered to have "no effect" on the species and its designated critical habitat. Where RQs exceed LOCs, a potential to cause adverse effects or habitat modification is identified, leading to a conclusion of "may affect". If EPTC use may affect the assessed species, and/or may cause effects to designated critical habitat, the best available additional information is considered to refine the potential for exposure and effects, and distinguish actions that are Not Likely to Adversely Affect (NLAA) from those that are Likely to Adversely Affect (LAA).

1.4. Summary of Conclusions

Based on the best available information, the Agency makes a Likely to Adversely Affect determination for the DS from the use of EPTC. Additionally, the Agency has determined that there is the potential for modification of DS designated critical habitat from the use of the chemical. Based on the predicted environmental exposures and the available toxicity information, EPTC is likely to adversely affect the DS via direct effects and indirect effects through reduction in prey (aquatic invertebrates and non-vascular plants) and habitat (terrestrial plants). EPTC is predicted to result in modification of all of the relevant (biologically mediated) DS critical habitat Primary Constituent Elements (PCEs). Geospatial analysis indicates that there is an overlap between the EPTC action area and the species range. A summary of the risk conclusions and effects determinations for the DS and its critical habitat is presented in **Table 1.1** through **1.4**. Further information on the results of the effects determination is included as part of the Risk Description in **Section 5.2**.

Table 1.1 Effects Determination Summary for Effects of EPTC on the Delta smelt

Species	Effects Determination	Basis for Determination
Delta smelt (*Hypomesus transpacificus*)	**LAA**[1]	**Potential for Direct Effects**
		Freshwater Life Stages (Eggs, Larvae, and Breeding Adults): Using freshwater fish toxicity data and modeled EECs, acute RQs do not exceed LOC; however, available monitoring study data suggest that exposures via tailwater runoff could be considerably higher, and risk cannot be precluded for uses that allow flood irrigation/chemigation (alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black)). Chronic RQs cannot be calculated due to lack of chronic toxicity data; risk cannot be precluded.
		Saltwater Life Stage (Juveniles and Adults): Using estuarine/marine fish toxicity data and modeled EECs, acute RQs do not exceed LOC; however, available monitoring study data suggest that exposures via tailwater runoff could be considerably higher, and risk cannot be precluded for uses that allow flood irrigation/chemigation (alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black)). Chronic RQs cannot be calculated due to lack of chronic toxicity data; risk cannot be precluded.
		Potential for Indirect Effects
		Aquatic prey items, aquatic habitat, cover and/or primary productivity
	Freshwater invertebrates:	RQs do not exceed the acute or chronic LOC using modeled aquatic exposure estimates. Acute RQ calculated using tailwater study data exceeds LOC. Chronic RQ based on the tailwater data (estimated 21-day concentration based on 1.65 day half-life) are below the LOC (1.0).
	Saltwater invertebrates:	RQs do not exceed the acute LOC using modeled aquatic exposure estimates. RQs do exceed the chronic LOC for lettuce and ornamental uses. Acute RQ calculated using tailwater data exceeds LOC. Chronic RQ based on tailwater data (estimated 21-day concentration based on 1.65 day half-life) show that concentrations would be above would be above the LOC (1.0) for approximately one week, and so chronic risk cannot be precluded..
	Non-vascular aquatic plants:	RQs do not exceed the aquatic plant LOC using modeled aquatic exposure estimates. However, available monitoring study data suggest that exposures via tailwater runoff could be considerably higher, and risk cannot be precluded for uses that allow flood irrigation/chemigation (alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black)).
	Vascular aquatic plants:	RQs do not exceed the aquatic plant LOC using modeled aquatic exposure estimates or available tailwater data.
		Terrestrial prey items, riparian habitat
	Terrestrial Plants:	Terrestrial plant RQs exceed the LOC for all EPTC uses. Multiple lines of evidence, including several incidents of plant damage, support the conclusion of risk to plants. Existing vegetation, however, should not be affected but only germinating seedlings in riparian and upland habitats.

[1]LAA=likely to adversely affect.

Table 1.2. Effects Determination Summary for the Critical Habitat Impact Analysis

Assessment Endpoint	Effects Determination	Basis for Determination
Modification of aquatic PCEs	**HM**[1]	As summarized in **Table 1.1**, for both freshwater and saltwater fish, the acute RQs do not exceed LOC; however, available monitoring study data suggest that exposures via tailwater runoff could be considerably higher, and risk cannot be precluded. Chronic RQs cannot be calculated due to lack of chronic toxicity data; risk cannot be precluded. The LOC for terrestrial plants is exceeds for all EPTC uses. There are multiple lines of evidence, including several incidents of plant damage. Existing vegetation, however, should not be affected but only germinating seedlings in riparian and upland habitats. The aquatic plant LOC is not exceeded any EPTC uses for either vascular or non-vascular plants; however, for non-vascular plants, as with fish, risk cannot be precluded for uses that allow flood irrigation/chemigation. Freshwater and saltwater inverts: The acute LOC is not exceeded for any EPTC uses. As with fish, the acute LOC is exceeded using tailwater data and risk cannot be precluded. Chronic LOC exceeded for saltwater inverts for lettuce and ornamental uses. In addition, estimated 21-day concentration from tailwater data (1.65 day half-life) indicates that RQs would be above chronic LOC for approximately one week, so chronic risk cannot be precluded. For freshwater inverts, the RQs from the estimated 21-day concentration would be below chronic LOC.

[1]Habitat Modification

Table 1.3 EPTC Use Specific Summary of The Potential for Adverse Effects to Aquatic Taxa

Uses	Potential for Effects to Identified Taxa Found in the Aquatic Environment									
	Freshwater Vertebrates[1]		Estuarine/Marine Vertebrates[3]		Freshwater Invertebrates[4]		Estuarine/Marine Invertebrates[5]		Vascular Plants[6]	Non-vascular Plants[6]
	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic		
Alfalfa	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Almond	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Beans	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Broccoli	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Cabbage	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Carrot	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Castor Bean	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Cauliflower	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Citrus	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Clover	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Conifers	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Corn	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Cotton	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Fallow/Idle	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Grapefruit	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Lemon	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Lespedeza	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Lettuce	No	Yes[2]	No	Yes[2]	No	No	Yes	Yes	No	No
Orange	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Ornamentals	No	Yes[2]	No	Yes[2]	No	No	Yes	Yes	No	No
Pine	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Potato	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Safflower	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Sugar Beets	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No

Uses	Potential for Effects to Identified Taxa Found in the Aquatic Environment									
	Freshwater Vertebrates[1]		Estuarine/Marine Vertebrates[3]		Freshwater Invertebrates[4]		Estuarine/Marine Invertebrates[5]		Vascular Plants[6]	Non-vascular Plants[6]
	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic		
Sunflower	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Tangerine	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Tomato	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Trefoil Birdsfoot	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Walnut	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Monitoring Study Data										
Tailwater data	Yes	Yes[2]	Yes	Yes[2]	Yes	Yes	Yes	Yes	No	Yes

1A yes in this column indicates a potential for direct and indirect effects to DS.
[2]There is a lack of chronic data. Lack of chronic data does not preclude lack of risk.
[3]A yes in this column indicates a potential for direct and indirect effects to DS.
[4]A yes in this column indicates a potential for indirect effects to the DS.
[5]A yes in this column indicates a potential for indirect effects to the DS.
[6]A yes in this column indicates a potential for indirect effects to the DS.

Table 1.4 EPTC Use Specific Summary of The Potential for Adverse Effects to Terrestrial Taxa

Uses	Potential for Effects to Identified Taxa Found in the Terrestrial Environment:	
	Dicots[1]	Monocots[1]
All uses	Yes	Yes

[1]A yes in this column indicates a potential for indirect effects to DS. The LOC exceedances are evaluated based on the LOC for non-listed species.

Based on the conclusions of this assessment, a formal consultation with the U. S. Fish and Wildlife Service under Section 7 of the Endangered Species Act should be initiated.

When evaluating the significance of this risk assessment's direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the species and its resources (*i.e.*, food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (*i.e.*, attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available. Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of Delta smelt life stages within the action area and/or applicable designated critical habitat. This information would allow for quantitative extrapolation of the present risk assessment's predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the assessed species.
- Quantitative information on prey base requirements for the assessed species. While existing information provides a preliminary picture of the types of food sources utilized by the assessed species, it does not establish minimal requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.
- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual species and potential modification to critical habitat.

2. Problem Formulation

Problem formulation provides a strategic framework for the risk assessment. By identifying the important components of the problem, it focuses the assessment on the most relevant life history stages, habitat components, chemical properties, exposure routes, and endpoints. The structure of this risk assessment is based on guidance contained in U.S. EPA's *Guidance for Ecological Risk Assessment* (USEPA, 1998), the Services' *Endangered Species Consultation Handbook* (USFWS/NMFS, 1998) and is consistent with procedures and methodology outlined in the Overview Document (USEPA, 2004) and reviewed by the U.S. Fish and Wildlife Service and National Marine Fisheries Service (USFWS/NMFS/NOAA, 2004).

2.1. Purpose

The purpose of this endangered species assessment is to evaluate potential direct and indirect effects on individuals of the federally threatened Delta smelt (*Hypomesus transpacificus*, DS) arising from FIFRA regulatory actions regarding use of EPTC on agricultural and non-agricultural sites. In addition, this assessment evaluates whether use on these sites is expected to result in modification of the species' designated critical habitat. This ecological risk assessment has been prepared consistent with a suit brought against the Agency (*Center for Biological Diversity (CBD) vs. EPA et al*. (Case No. 07-2794-JCS) in which EPTC was alleged to be of concern to the DS.

In this assessment, direct and indirect effects to the DS and potential modification to DS designated critical habitat for the Delta smelt are evaluated in accordance with the methods described in the Agency's Overview Document (USEPA, 2004). The DS was listed as threatened on March 5, 1993 (58 FR 12854) by the USFWS (USFWS, 2007a). DS are mainly found in the Suisun Bay and the Sacramento-San Joaquin estuary near San Francisco Bay. During spawning DS move into freshwater.

In accordance with the Overview Document, provisions of the ESA, and the Services' *Endangered Species Consultation Handbook*, the assessment of effects associated with registrations of EPTC is based on an action area. The action area is the area directly or indirectly affected by the federal action, as indicated by the exceedance of the Agency's Levels of Concern (LOCs). It is acknowledged that the action area for a national-level FIFRA regulatory decision associated with a use of EPTC may potentially involve numerous areas throughout the United States and its Territories. However, for the purposes of this assessment, attention will be focused on relevant sections of the action area including those geographic areas associated with locations of the DS and its designated critical habitat within the state of California. As part of the "effects determination," one of the following three conclusions will be reached separately for each of the assessed species in the lawsuits regarding the potential use of EPTC in accordance with current labels:

- "No effect";
- "May affect, but not likely to adversely affect"; or
- "May affect and likely to adversely affect".

Additionally, for habitat and PCEs, a "No Effect" or a "Habitat Modification" determination is made. Description of the routine procedures for evaluating risk to the San Francisco Bay Species are provided in **Attachment 1**.

2.2. Scope

The end result of the EPA pesticide registration process (*i.e.*, the FIFRA regulatory action) is an approved product label. The label is a legal document that stipulates how and where a given pesticide may be used. Product labels (also known as end-use labels) describe the formulation type (*e.g.*, liquid or granular), acceptable methods of application, approved use sites, and any restrictions on how applications may be conducted. Thus, the use or potential use of EPTC in accordance with the approved product labels for California is "the action" relevant to this ecological risk assessment.

EPTC is a selective herbicide use for broadleaf and grass weed control. EPTC must be incorporated or wetted into the soil to be effective. It does not control established or germinated weeds present at application. EPTC is formulated either as an emulsifiable concentrate or a granular. It can be applied preplant, at-plant, postemergence, lay-by, fallow, established plantings, foliar, and seedling stage. Application equipment and methods for EPTC include ground application, soil band treatment, soil broadcast, direct spray, chemigation, flood treatment, and aerial application (for granular formulation). The granular formulation also needs to be watered in after application. EPTC is registered for a number of food and non-food uses.

Although current registrations of EPTC allow for use nationwide, this ecological risk assessment and effects determination addresses currently registered uses of EPTC in portions of the action area that are reasonably assumed to be biologically relevant to the DS and their designated critical habitat. Further discussion of the action area for the DS and their critical habitat is provided in **Section 2.7**.

2.2.1. Evaluation of Degradates

The primary environmental (soil and water) transformation/degradation products of EPTC are EPTC sulfoxide (ESO) and dipropylamine (a synonym is Di-n-propylamine). Previously, only the parent EPTC was considered in the ecological risk assessment in support of the Reregistration Eligibility Decision (RED) (USEPA, 1999). The data for the EPTC transformation/degradation products are limited, and the rates of formation and decline of ESO and dipropylamine were not determined. The data are sufficient, however, to show that the ESO (as percent applied radioactivity) remains low (maximum 6 to 11%). In the aerobic soil metabolism studies, neither transformation product accumulated, suggesting that dipropylamine and sulfoxide degrade at rates similar to EPTC. The half-lives estimated for EPTC alone and combined residues (plus ESO) yield similar half-lives. Aquatic estimated environmental concentrations (EECs) for EPTC and EPTC combined residues were of similar magnitude (D339490). In the RED, the PRZM (runoff) portion of the modeling considered volatilization separately from the aerobic soil metabolism, which resulted in an overestimate of the decline of EPTC through degradation because the aerobic soil metabolism degradation rate also includes losses due to volatilization. For this assessment, the losses of EPTC by volatilization in the terrestrial environment were assumed to be included with the aerobic soil metabolism rate. In the aquatic environment (pond) only volatilization was considered (as a rate of dissipation). Therefore, the aquatic exposure estimates presented here are more conservative than those presented in the 1999 RED. Limited toxicity data indicate that the sulfoxide degradation product is equal to or less toxic than parent EPTC to daphnids.

2.2.2. Evaluation of Mixtures

The Agency does not routinely include in its risk assessments, an evaluation of mixtures of active ingredients, either those mixtures of multiple active ingredients in product formulations or those in the applicator's tank. In the case of the product formulations of active ingredients (that is, a registered product containing more than one active ingredient), each active ingredient is subject to an individual risk assessment for regulatory decision regarding the active ingredient on a particular use site. If effects data are available for a formulated product containing more than one active ingredient, they may be used qualitatively or quantitatively in accordance with the Agency's Overview Document and the Services' Evaluation Memorandum (U.S., EPA 2004; USFWS/NMFS 2004).

EPTC has three registered products (EPA Reg. Nos. 000100-01083, 010163-00285, and 019713-00568) that contain multiple active ingredients. Analysis of the available acute oral mammalian LD_{50} data (*and available open literature for EPTC*) for multiple active ingredient products relative to the single active ingredient is provided in **Appendix A**. A qualitative examination of acute toxicity data (*e.g*., LD_{50}) trends, with the associated confidence intervals, across the range of percent active ingredient, show no discernable trends in potency that would suggest synergistic (*i.e.*, more than additive) or antagonistic (*i.e.,* less than additive) interactions. The results of this analysis show that an assessment based on the toxicity of the single active ingredient of EPTC is appropriate.

2.3. Previous Assessments

In May 1999, an ecological risk assessment was completed for EPTC in support of the Reregistration Eligibility Decision. Based on the estimated environmental exposures for EPTC and the available ecotoxicity data, acute and chronic risk quotients (RQs) for mammals and acute RQs for terrestrial plants exceeded the level of concern (LOC). The acute LOC was not exceeded for birds, bees, freshwater fish or invertebrates, or aquatic plants. At that time, acceptable toxicity data were unavailable to assess acute risks to estuarine/marine animals and chronic risks to birds, and freshwater and estuarine/marine fish and invertebrates. The status of product reregistration for EPTC was completed on October 15, 2004; therefore, all mitigation measures should be reflected on current labels.

In June, 2008, an ecological risk assessment[1] was completed on the potential direct and indirect effects to the California red-legged frog (CRLF) and potential modification to designated critical habitat from uses of EPTC. Based on the predicted environmental exposures and the available toxicity information, EPTC was found likely to adversely affect the aquatic-phase CRLF via direct effects and via indirect effects via reduction in prey (non-vascular plants, fish, and

[1] http://www.epa.gov/espp/litstatus/effects/redleg-frog/index.html#eptc

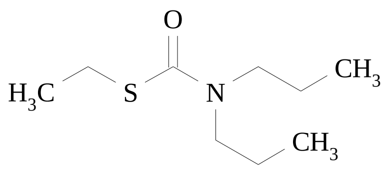
amphibians) and habitat (terrestrial plants). EPTC was also found likely to adversely affect the terrestrial-phase CRLF via direct effects and indirect effects on prey (mammals, amphibians, terrestrial invertebrates) and habitat (terrestrial plants). EPTC was predicted to result in modification to one or more CRLF critical habitat Primary Constituent Elements.

2.4. Environmental Fate Properties

EPTC is moderately mobile to mobile and with half-lives (or DT_{50}) ranging from 10 to 75 days. The major dissipation processes for EPTC are volatilization, runoff, and leaching. Volatilization of EPTC from soil and water and the metabolism of EPTC in soil appear to be the two most important dissipation/degradation pathways. Since the major degradation pathways of EPTC appear to be volatilization and metabolism, it may be more persistent in soil substrata with lower microbial activity and no volatilization, or in ground water and deep surface water. Volatilized EPTC can be transported by wind and deposited through wet or dry deposition processes. The primary environmental transformation/degradation products in soil and water are dipropylamine and EPTC sulfoxide (ESO).

With the exception of the sorption/desorption data for EPTC sulfoxide (MRID 45306701), no new environmental fate data have been submitted since the completion of the RED (USEPA, 1999). Data to assess aquatic metabolism has not been submitted.

Table 2.1. Physical-chemical Properties of EPTC

Study	Value and units	Major Degradates *Minor Degradates*	MRID #	Study Status
Structure			USEPA, 1999	
Hydrolysis	Stable at pH 5, 7, 9		00141373	Supplemental
Solubility	344 mg/L @ 25ºC		42120801	Acceptable
Direct Aqueous Photolysis	Stable to photolysis		42120803	Acceptable
Soil Photolysis	Stable to photolysis		42120804	Acceptable
Volatility Vapor Pressure	2.4 x 10e-02 mm Hg @25ºC 1.60 x 10-0e2 mm Hg @20ºC		42120800 42120801	Supplemental
Henry's Law Const.	1.5 x 10^{-5} atm-m^3/mol @ 20ºC)		42120801	Acceptable
Aerobic Soil Metabolism	$T_{1/2}$ range 36-75 days DT50 range 10-37 days (rate includes metabolism and volatilization (vaporized EPTC)	EPTC sulfoxide (ESO) Dipropylamine (≤6.0 to 11 % of applied)	42120805 42120806 40420402	Supplemental
Anaerobic Soil Metabolism	$T_{1/2}$ - 106 days; estimated 127 days	EPTC sulfoxide (ESO) Dipropylamine	40430402 42120807	Supplemental Supplemental
Aerobic Aquatic Metabolism	No Data			
Anaerobic Aquatic Metabolism	No Data			
Soil Water Partition Coefficient	EPTC: K_{fads} - 0.77 to 2.99 mL/g K_{OC} -136, 143, 146, 266 mL/g (the Koc model appears valid)		42120808	Acceptable
	EPTC sulfoxide (ESO): K_{fads} 0.13 to 1.15 mL/g K_{OC} 13, 24, 67 mL/g		45306701	Supplemental
Terrestrial Field Dissipation	Half-lives 2 to 56.8 days	Dipropylamine EPTC sulfoxide (ESO)	98250 146934 146935 404204-05, -06, -07 421208-10, -11 41724305	Supplemental
Octanol-Water Partition Coefficient (log K_{ow})	3.2 to 3.3 @ 25ºC		USEPA, 2006[1]	

[1] USEPA, 2006. Health Effects Support Document for S-Ethyl dipropylthiocarbamate (EPTC) USEPA/OW EPA-822-R-06-008 (August, 2006)

Microbial Degradation
In **aerobic soil metabolism** studies neither dipropylamine nor EPTC sulfoxide appear to accumulate. The aerobic soil metabolism half-lives ($T_{1/2}$) ranged from 36 to 75 days and the DT_{50} ranged from 10 to 37 days (USEPA, 1999). These half-lives include losses from volatilization (vaporization of EPTC). EPTC-sulfoxide (ESO) (maximum = 6% of total residues, 0.36 ppm) was identified in an aerobic soil metabolism study. The overall results of these mechanisms of dissipation suggest that EPTC has low to moderate persistence in the environment.

The rates of formation and decline of ESO and dipropylamine were not be determined because the data for all the EPTC transformation/degradation products are lacking. . These data are sufficient to show that the ESO (as percent applied radioactivity) remains low (maximum 6 to 11%) data for dipropylamine was incomplete. In one aerobic soil metabolism study (MRID 0420402), neither of the transformation product accumulated suggesting that dipropylamine and ESO degraded with rates similar to EPTC.

Soil metabolism and volatilization from soil and water are the most important dissipation pathways, for EPTC in the environment. Because the metabolism and volatilization of EPTC can occur simultaneously, it is difficult to evaluate them independently. The half-life values described above reflect degradation and dissipation rather than strictly degradation.

Anaerobic soil metabolism appeared to be quite slow with an estimated half-life of 127 days. Studies suggested that volatilization contributed more to the initial decline than did anaerobic metabolism as measured as CO_2.

Solubility
EPTC's solubility at 25ºC in water is 344 mg/L (42120801). Earlier documents indicated a solubility of 370 mg/L with the temperature reported as 20 or 25ºC.

Volatilization
Laboratory Volatility. EPTC is highly volatile (vapor pressure 1.60×10^{-2} mm Hg @ 20^{o}C and Henry's Law Constant of 1.5×10^{-5} atm-m^3/mol @ 20^{o}C). The Henry's Law constant is greater than 2×10^{-5} atm-m^3/mol, suggesting that volatilization can be important in all waters (Thomas, 1981). EPTC must be incorporated into the soil to reduce losses from the soil through volatilization.

Field Volatility. A USDA study (MRID 40420404) provides some information about the fate of EPTC when applied via flood irrigation. Of the 2.71 lb/ac applied (average concentration 2170 ppb), 73.6 percent volatilized (2.0 lb/ac) during the observation period of 52 hours. Of the 73.6 percent measured to be lost through volatilization, 28.4 percent volatilized from water and 45.2 percent volatilized from wet soil. They determined that for this experiment, 80.6 percent of the EPTC applied to the alfalfa was lost through runoff and volatilization.

Hydrolysis
EPTC is stable to photolysis and hydrolysis at the three pH values tested.

Mobility
EPTC can be classified with a medium mobility (K_{oc} 136 to 264 mL/g OC) and EPTC sulfoxide (ESO) has a high mobility[2] (K_{oc} 13 to 67 mL/g OC). In unaged leaching columns, 9 percent of applied EPTC was found in leachate of loam and clay loam soils, and 55 and 78 percent were found in leachate for loamy sand and sandy loam soils, respectively. In aged soil columns, an average of 22% of the parent was detected in the leachate. Less than 0.01 percent of applied radio labeled ^{14}C found in the leachate was attributed to degradates.

Field Dissipation
Terrestrial field dissipation studies indicate that EPTC is generally not very persistent with dissipation half-lives ranging from 2 to 57 days (mean 12.6 days). In the terrestrial field dissipation studies, only two degradates were detected in soil samples: EPTC-sulfoxide (ESO), and dipropylamine. However, since volatilization was not measured during these field studies, the contribution of volatilization to the dissipation of EPTC could not be determined. Other studies (field and laboratory) that measured the volatilization of EPTC, with traps, suggested that large quantities of EPTC were lost through volatilization. The requirement for the incorporation or watering-in of EPTC when applied supports this observation.

Photolysis
EPTC was determined to be photolytically stable in water. EPTC was also shown to be stable to photodegradation on soil. Therefore, photodegradation does not appear to contribute to the dissipation of EPTC.

Bioconcentration
The n-octanol-water partition coefficient, log K_{ow} of 3.2 indicates potential for bioaccumulation. Biconcentration factors are 37x, 60x, and 110x, respectively, in edible fish, whole fish, and non-edible fish (MRID 40575101, 40575102).

2.4.1. Environmental Transport Mechanisms

Potential pesticide transport mechanisms include surface water runoff, spray drift, leaching, ground water discharge, and the transport of airborne (volatilized) EPTC that can be carried by wind and deposited on non-target sites by dry and wet depositional process. Surface water runoff (including tailwater runoff for flood irrigation/chemigation applications), spray drift, and atmospheric transport are expected to be the major routes of exposure for EPTC. Runoff and spray drift are quantitatively characterized and atmospheric transport-rainfall deposition is qualitatively considered in this risk assessment. Tailwater runoff data from a field study are available for quantitative risk characterization for this exposure pathway.

Atmospheric transport and deposition data are used to qualitatively characterize risk to the DS in this assessment. A number of studies have documented atmospheric transport and re-deposition of pesticides from the Central Valley to the Sierra Nevada Mountains (Fellers *et al.*, 2004; LeNoir *et al.*, 1999; McConnell *et al.*, 1998; Sparling *et al.*, 2001). Prevailing winds blow across

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[2] U.S. EPA. 2005. Standardized Soil Mobility Classification Guidance. Fate and Transport Technology Team, Environmental Fate and Effects Division, Office of Pesticide Programs.

the Central Valley eastward to the Sierra Nevada Mountains, transporting airborne industrial and agricultural pollutants into the Sierra Nevada ecosystems (Fellers *et al.,* 2004, LeNoir *et al.,* 1999, and McConnell *et al.*, 1998). Several sections of critical habitat for the DS are located east of the Central Valley. The magnitude of transport via secondary drift depends on the EPTC's ability to be mobilized into air and its eventual removal through wet and dry deposition of gases/particles and photochemical reactions in the atmosphere. Therefore, physicochemical properties of EPTC that describe its potential to enter the air from water or soil (*e.g.,* Henry's Law constant and vapor pressure), pesticide use data, modeled estimated concentrations in water and air, and available air monitoring data from the Central Valley and the Sierra Nevadas are considered in evaluating the potential for atmospheric transport of EPTC to locations where it could impact the DS.

Review of the environmental fate data as well as physico-chemical properties of EPTC suggest that runoff, spray drift, and atmospheric drift of volatilized EPTC and the deposition in rain water are likely to be the dominant routes of exposure. EPTC concentrations in rainfall ranged between 100 and 2,800 ng/L (Majewski,et al. 1995[3]). Air monitoring data from Lompoc, California[4] reports an acute concentration of 6.5 ng/m^3, and a 10 week concentration of 0.43 ng/m^3, both far below the studies screening level value of overall maximum monitored. State and local pesticide monitoring programs from October 1987 to September 1990 found three locations with EPTC detections (≥0.1 µg/L) in snow and rain[5]. Given the physico-chemical profile for EPTC and observed detections of EPTC in air, rainfall and snow samples, the potential for long range transport outside of the defined action area cannot be precluded.

In general, deposition of drifting or volatilized pesticides is expected to be greatest close to the site of application. Computer models of spray drift (AgDRIFT and AGDISP) are used to determine potential exposures to terrestrial organisms via spray drift. The distance required to dissipate spray drift to below the LOC was determined using AgDrift based on the EC_{25} levels for terrestrial plants (see **Section 3.2.5**).

2.4.2. Mechanism of Action

EPTC is a pre-emergence and early post-emergence thiocarbamate herbicide used to control the growth of germinating annual weeds, including broadleaves, grasses, and sedges. As with other thiocarbamate herbicides, EPTC exerts its herbicidal action through inhibition of cuticle formation at the early stages of seedling growth.

2.4.3. Use Characterization

Analysis of labeled use information is the critical first step in evaluating the federal action. The current labels for EPTC represent the FIFRA regulatory action; therefore, labeled use and

[3] *Pesticides in the Atmosphere; Distribution, Trends and Governing Factors,* Majewski, Michael S; Capel, Paul D, Volume One in the Series, Pesticides in the Hydrologic System, Ann Arbor Press, Inc.; Chelsea, Michigan.
[4] Ambient Air Monitoring for Pesticides in Lompoc, California Volume 1: Executive Summary, Environmental Protection Agency California Department of Pesticide Regulation, State of California, March 2003 ://www.cdpr.ca.gov/docs/specproj/lompoc/exec_sum_march2003.pdf
[5] Nations, B.K., Hallberg, G.R., 1992, Pesticided in Pesticides in Iowa precipitation: J. *Environ. Qual.,* v.21, P. 486-492, cited in *Pesticides in the Atmosphere; Distribution, Trends and Governing Factors.*

application rates specified on the label form the basis of this assessment. The assessment of use information is critical to the development of the action area and selection of appropriate modeling scenarios and inputs. **Tables 2.2** through **2.4** summarize the uses considered in this assessment. Various timings of applications for each of the scenarios were considered in the aquatic exposure assessment.

The individual maximum label application rates range from 1.53 to 14.88 lb a.i./A. The highest labeled application rate, 14.88 lbs. a.i./acre, is for ornamental uses. Most of the uses have individual maximum application rates, but few uses specifically identify a per-crop or yearly maximum, a maximum number of applications, or an application interval (**Table 2.2**). In the exposure assessment, several application rate combinations (rates, number of applications) were considered. This assessment is based upon one crop per growing season or year. Crops that may have more than one cropping per season or year are listed in **Table 2.2**. Maximum single application rate, maximum number of applications, reapplication intervals, and maximum annual applications rate are listed in **Table 2.2**, if specified on the label.

Table 2.2 Maximum application rates, number of applications, reapplication intervals, crop cycles per year or season, and maximum total per year or crop (Cyran and Tompkins, 2010)

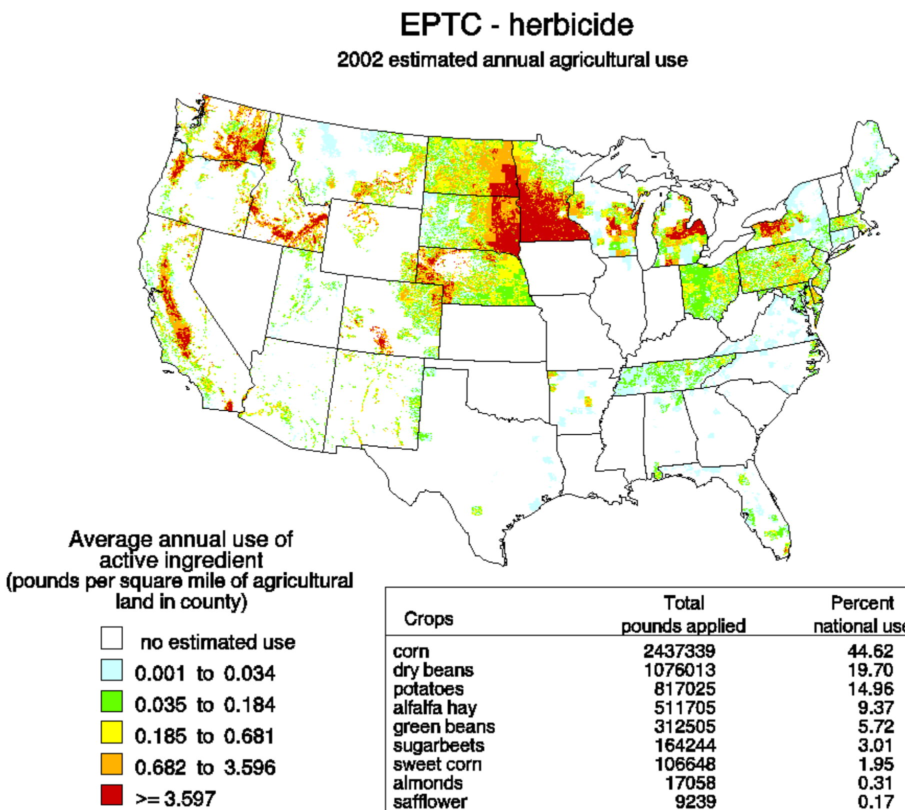
Use	Max. Single Rate (lb a.i./A)	Maximum No. Apps.	Interval (days)	Crop cycle (cc) or cutting[2]	Max. Annual Rate (lb a.i./A)
Granular Formulation					
Alfalfa	4	ns[1]; 1/cutting	30	2 to 9/yr	12.0/yr
Beans (dried)	4.5	1	na[3]	1/yr	
Beans (snap)	4	1	na	1/cc	4
Citrus	6	ns	ns	ns	
Clover	4	ns	ns	Unknown[4]	4
Conifers (seed orchard	6	ns	ns	1/yr	Ns
Corn (silage)	3	ns	ns	1/yr	Ns
Corn (field)	3	ns	ns	1/yr	Ns
Corn (sweet)	3	ns	ns	2 to 3/yr	Ns
Grapefruit (nonbearing)	6	ns	ns	1/yr	Ns
Lespedeza	4	ns	ns	Unknown	4
Orange (nonbearing)	6	ns	ns	ns	Ns
Potato (white/Irish)	6	ns	ns	1	Ns
Safflower	3	ns	ns	na	Ns
Sugar Beets	4.5	ns	na	1	Ns
Trefoil Birdsfoot	4	ns	na	ns	4
Emulsifiable Concentrate					
Alfalfa	3.94[5] 6.13	Ns; 1/cutting ns	30 ns	2 to 9/yr “	12.25/yr Ns
Almond	3.063	2	ns	1/yr	6.13/season[5]
Beans (dried)	4.60	1	na	1/yr	7.0/crop
Beans (snap)	4.60	ns	na	1/cc	7.0/crop
Broccoli	6.13	ns	ns	1 to 2/yr	Ns
Cabbage	6.13	ns	ns	Up to 3/yr	Ns
Carrot	6.13	ns	ns	1/yr	Ns
Castor Bean	4.60	ns	ns	1/yr	Ns
Cauliflower	6.13	ns	ns	1 to 2/yr	Ns
Citrus	6.13	ns	ns	1/yr	Ns
Clover	3.94	1	ns	Unknown	Ns
Conifers (seed orchard	6.13	ns	ns	1/yr	Ns
Corn (silage)	6.14	ns	ns	1/yr	Ns
Corn (unspecified)	6.14	ns	ns	1/yr	Ns
Corn (field)	6.14	ns	ns	1/yr	Ns

Use	Max. Single Rate (lb a.i./A)	Maximum No. Apps.	Interval (days)	Crop cycle (cc) or cutting[2]	Max. Annual Rate (lb a.i./A)
Corn (pop)	6.14	ns	ns	1/yr	Ns
Corn (sweet)	6.14	ns	ns	2 to 3/yr	Ns
Cotton	6.13	ns	ns	1/yr	Ns
Grapefruit (bearing)	3.06	Unknown	Unknown	1/yr	Unknown
Grapefruit (nonbearing)	6.13	1	ns	1/yr	ns
Lemon (bearing)	3.06	Unknown	Unknown	1/yr	Unknown
Lemon (nonbearing)	6.13	1	ns	1/yr	Ns
Lespedeza	3.94	1	ns	Unknown	4
Lettuce	6.13	ns	ns	1 to 2/yr	Ns
Orange (bearing)	3.06	Unknown	Unknown	1/yr	Unknown
Orange (nonbearing	6.13	1	ns	ns	Ns
Ornamentals (ground cover)	14.88	ns	ns	unknown	Ns
Ornamentals (herb. plants)	14.88	ns	ns	unknown	Ns
Ornamentals (woody shrubs)	14.88	ns	ns	unknown	Ns
Ornamentals and or shade trees	14.88	ns	ns	unknown	Ns
Pine (seed orchard)	6.13	ns	ns	unknown	Ns
Potato (white/Irish)	6.13	ns	ns	1	12.25/crop
Safflower	3.06	ns	na	unknown	Ns
Sugar Beets	3.06 6.13	ns ns	ns ns	1/yr ns	ns 6.13/crop
Sweet Potato	7.44	ns	ns	ns	Ns
Sunflower[6]	Spring: 3.06 Fall: 4.6 Postemerg.: 3.06	ns	ns	1/yr	6.13/ crop
Tangerine	3.06	Unknown	Unknown	1/yr	Unknown
Tomato	3.06	ns	ns	1/yr	Ns
Trefoil Birdsfoot	3.94	ns	ns	Unknown	Ns
Walnut	3.06	ns	ns	1/yr	Ns
Fallow/Idle	6.13	ns	ns	ns	Ns

[1] ns – not specified on label.
[2] Kaul, M. 2007. Maximum Number of Crop Cycles per Year in California for Methomyl Use Sites. USEPA\OPPTS\OPP\BEAD
[3] na -- not applicable
[4] Minimum rate is 1.97 lb a.i./A; yearly total cannot exceed 12.25 lb a.i./yr.
[5] Season not specified.
[6] Modification and additions to EPA Reg. No. 10163-283 D339490

According to the United States Geological Survey's (USGS) national pesticide usage data (based on information from 1999 to 2004), an average of 5,458,351 lbs of EPTC were applied nationally to agricultural use sites in the U.S. (non-agricultural uses are not included) **(Figure**

2.1). Nationally, the crops with the highest uses of EPTC are corn (2,400,000 lbs), dry beans (1,076,000 lbs), potatoes (817,000 lbs), alfalfa (511,000 lbs), green beans (313,000 lbs), sugar beets (106650 lbs), and sweet corn (107,000 lbs).[6]



Crops	Total pounds applied	Percent national use
corn	2437339	44.62
dry beans	1076013	19.70
potatoes	817025	14.96
alfalfa hay	511705	9.37
green beans	312505	5.72
sugarbeets	164244	3.01
sweet corn	106648	1.95
almonds	17058	0.31
safflower	9239	0.17
sunflower seed	7575	0.14

Figure 2.1. EPTC Use in Total Pounds per County[7]

The Agency's Biological and Economic Analysis Division (BEAD) provides an analysis of both national- and county-level usage information (Cyran and Tompkins, 2010) using state-level usage data obtained from USDA-NASS[8], Doane (www.doane.com; the full dataset is not provided due to its proprietary nature) and the California's Department of Pesticide

[6] http://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=02&map=m1414
[7] The pesticide use maps available from this site show the average annual pesticide use intensity expressed as average weight (in pounds) of a pesticide applied to each square mile of agricultural land in a county. The area of each map is based on state-level estimates of pesticide use rates for individual crops that were compiled by the CropLife Foundation, Crop Protection Research Institute based on information collected during 1999 through 2004 and on 2002 Census of Agriculture county crop acreage. The maps do not represent a specific year, but rather show typical use patterns over the five year period 1999 through 2004.
[8] United States Depart of Agriculture (USDA), National Agricultural Statistics Service (NASS) Chemical Use Reports provide summary pesticide usage statistics for select agricultural use sites by chemical, crop and state. See http://www.pestmanagement.info/nass/app_usage.cfm.

Regulation Pesticide Use Reporting (CDPR PUR) database[9]. CDPR PUR is considered a more comprehensive source of usage data than USDA-NASS or EPA proprietary databases, and thus the usage data reported for EPTC by county in this California-specific assessment were generated using CDPR PUR data. Nine years (1999-2007) of usage data were included in this analysis. Data from CDPR PUR were obtained for every agricultural pesticide application made on every use site at the section level (approximately one square mile) of the public land survey system.[10] BEAD summarized these data to the county level by site, pesticide, and unit treated. Calculating county-level usage involved summarizing across all applications made within a section and then across all sections within a county for each use site and for each pesticide. The county level usage data that were calculated include: average annual pounds applied, average annual area treated, and average and maximum application rate across all nine years. The units of area treated are also provided where available.

The average annual total pounds of EPTC used, and the average and maximum application rates (lb a.i./A), from the CDPR PUR database for each use site are summarized in **Table 2.3**.

[9] The California Department of Pesticide Regulation's Pesticide Use Reporting database provides a census of pesticide applications in the state. See http://www.cdpr.ca.gov/docs/pur/purmain.htm.

[10] Most pesticide applications to parks, golf courses, cemeteries, rangeland, pastures, and along roadside and railroad rights of way, and postharvest treatments of agricultural commodities are reported in the database. The primary exceptions to the reporting requirement are home-and-garden use and most industrial and institutional uses (http://www.cdpr.ca.gov/docs/pur/purmain.htm).

Table 2.3 Summary of California Department of Pesticide Registration (CDPR) Pesticide Use Reporting (PUR) Data from 1999 to 2007 for Currently Registered EPTC Uses[1]

Site Name	Average Annual Pounds Applied	Average Application Rate (lb a.i./A)	Maximum Application Rate
Alfalfa	101,236	2.24	12.00
Almond	4,214	2.57	57.88
Artichoke, Globe	24	6.10	6.10
Bean, Dried	2,876	2.51	7.41
Bean, Succulent	4,891	2.58	5.23
Bean, Unspecified	3,214	2.97	13.95
Beet	13	3.05	3.05
Blackberry	1	2.62	2.62
Broccoli	620	5.98	6.10
Cabbage	15	3.53	6.10
Cantaloupe	6	1.41	1.41
Carrot	2,179	4.97	6.29
Cauliflower	51	6.10	6.10
Chinese Cabbage (Nappa)	4	3.27	3.49
Clover	508	3.19	4.10
Commodity Fumigation	2	nc[2]	Nc
Corn (Forage – Fodder)	29,626	3.69	26.00
Corn, Human Consumption	4,147	4.57	33.42
Cotton	363	2.61	5.85
Cucumber	1	3.34	3.34
Forage Hay/Silage	29	3.29	3.49
Grape	1	0.78	0.78
Landscape Maintenance	42	nc	Nc
Lettuce, Head	85	4.53	6.10
Lettuce, Leaf	129	5.66	6.10
N-Outdr Transplants	0	0.44	0.44
Oat	46	2.91	4.01
Oat (Forage – Fodder)	76	3.85	5.01
Onion, Dry	5	6.11	6.11
Pepper, Fruiting	35	4.99	6.10
Pepper, Spice	2	1.74	1.74
Potato	25,381	2.91	54.73
Pumpkin	1	3.34	3.34
Rappini	24	6.10	6.10
Regulatory Pest Control	111	nc	Nc
Research Commodity	20	2.20	3.53
Rights Of Way	349	nc	Nc
Safflower	6,842	2.77	7.34
Soil Fumigation/Preplant	108	3.38	6.10
Squash	0	0.87	0.87
Structural Pest Control	0	nc	Nc
Sudangrass	34	3.00	4.00
Sugarbeet	23,430	2.65	9.07
Sugarbeet (Forage – Fodder)	107	2.08	2.22
Sunflower	40	2.58	2.58
Tomato	176	1.98	7.85
Tomato, Processing	7,529	2.37	5.62
Uncultivated Ag	10,431	4.51	6.97
Uncultivated Non-Ag	42	6.10	6.10

Site Name	Average Annual Pounds Applied	Average Application Rate (lb a.i./A)	Maximum Application Rate
Walnut	453	2.51	5.18
Watermelon	41	6.10	6.10
Wheat	17	6.13	6.13
Wheat (Forage – Fodder)	87	4.55	5.85
Total Pounds	229,663		

[1] Cyran and Tompkins, 2010
[2] Not calculated

The total amount of EPTC used in California over the period 1999 to 2007 ranged between 106,000 to 449,000 pounds active ingredient (CDPR PUR), with an average of 229,663 pounds. The counties with the highest and lowest average total pounds used were Imperial (64,450 lb a.i./year) and San Diego (3.1 lb a.i./year), respectively (Cyran and Tompkins, 2010). The uses with the highest total amount used per year were alfalfa (101,235 lb a.i./yr), potato (25,380 lb a.i./yr), and sugar beets (22,300 lb a.i./yr). The average EPTC useage (in lbs a.i.) for the seven counties within or immediately surrounding the action area are Alameda (0), Contra Costa (1,929 lbs), Sacramento (5,977 lbs), San Joaquin (13,620 lbs), Solano (1,952 lbs), Stanislaus (6,373 lbs), and Yolo (3,584 lbs) for a total of 33,434 lbs. This represents about 15% of the 229,663 lbs of EPTC used annually in California. The timing of EPTC applications in California on various crops is summarized below in **Table 2.4;** this information is summarized from CDPR PUR data from 2000 to 2005. While EPTC appears to be used throughout the year, the available data suggest that EPTC is most commonly applied during the months of March through June and August through November. Specific application dates for modeling purposes are listed in **Table 3.1**.

Table 2.4 Crop and Month of EPTC Application from CA PUR database 2000 to 2005[11]

Crop	J	F	M	A	M	J	J	A	S	O	N	D
Alfalfa	x	x	X	x	x	x	x	x	x	x	X	x
Almond			X		x	x	x	x	x			
Beans	x	x	X	x	x	x	x	x	x	x		
Broccoli						x	x					
Carrots			X	x	x	x		x	x	x		
Clover			X	x	x		x	x	x	x		
Corn			X	x	x	x	x	x		x		
Cotton				x		x	x		x	x		
Landscape			X	x	x			x				
Lettuce						x	x	x				
Miscellaneous			X	x		x	x	x	x	x		
Oats				x	x				x	x		
Pre-Plant			X	x	x				x			
Potato	x	x	X	x	x	x	x	x	x		X	x
Research			X	x	x		x			x	X	
Rights-of-way			X	x				x	x	x		
Regulatory										x	X	
Safflower		x	X	x	x	x		x	x			
Sugar Beets	x	x	X	x	x	x	x	x		x	X	x
Tomato			X	x	x	x	x		x			
Uncultivated			X	x	x	x	x	x	x	x		
Walnuts					x	x	x	x	x	x		
Wheat					x	x	x					

EPTC is formulated either as an emulsifiable concentrate or a granular. It can be applied preplant, at-plant, postemergence, lay-by, fallow, established plantings, foliar, and seedling stage. Application equipment and methods for EPTC include ground application, soil band treatment, soil broadcast, direct spray, and aerial application (for the granular formulation). In addition, EPTC may be applied via flood or sprinkler irrigation (chemigation) methods for several uses including alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black).[12] Tailwater from irrigation runoff from the treated field may be a significant exposure route for riparian and other terrestrial plants important to the DS's habitat.

[11] The California Department of Pesticide Regulation's Pesticide Use Reporting database provides a census of pesticide applications in the state. See http://www.cdpr.ca.gov/docs/pur/purmain.htm.
[12] According to the use characterization provided by the Agency's Biological and Economic Analysis Division (BEAD).

2.5. Assessed Species

Table 2.5 provides a summary of the current distribution, habitat requirements, and life history parameters for the Delta smelt (DS). More detailed life-history and distribution information can be found in **Attachment 2**. See **Figure 2.2** for a map of the current range and designated critical habitat of the DS. The DS was listed as threatened on March 5, 1993 (58 FR 12854) by the USFWS (USFWS, 2007a). DS are mainly found in the Suisun Bay and the Sacramento-San Joaquin estuary near San Francisco Bay. During spawning DS move into freshwater.

Table 2.5 Summary of Current Distribution, Habitat Requirements, and Life History Information for the Delta smelt

Assessed Species	Size	Current Range	Habitat Type	Designated Critical Habitat?	Reproductive Cycle	Diet
Delta Smelt [1] *Hypomesus transpacificus*	Up to 120 mm in length	Suisun Bay and the Sacramento-San Joaquin estuary (known as the Delta) near San Francisco Bay, CA	The species is adapted to living in fresh and brackish water. They typically occupy estuarine areas with salinities below 2 parts per thousand (although they have been found in areas up to 18ppt). They live along the freshwater edge of the mixing zone (saltwater-freshwater interface).	Yes	They spawn in fresh or slightly brackish water upstream of the mixing zone. Spawning season usually takes place from late March through mid-May, although it may occur from late winter (Dec.) to early summer (July-August). Eggs hatch in 9 – 14 days.	They primarily planktonic copepods, cladocerans, amphipods, and insect larvae. Larvae feed on phytoplankton; juveniles feed on zooplankton.

[1] For more detailed information on the distribution, habitat requirements, and life history information of the assessed listed species, see Attachment 2.

Delta Smelt Habitat

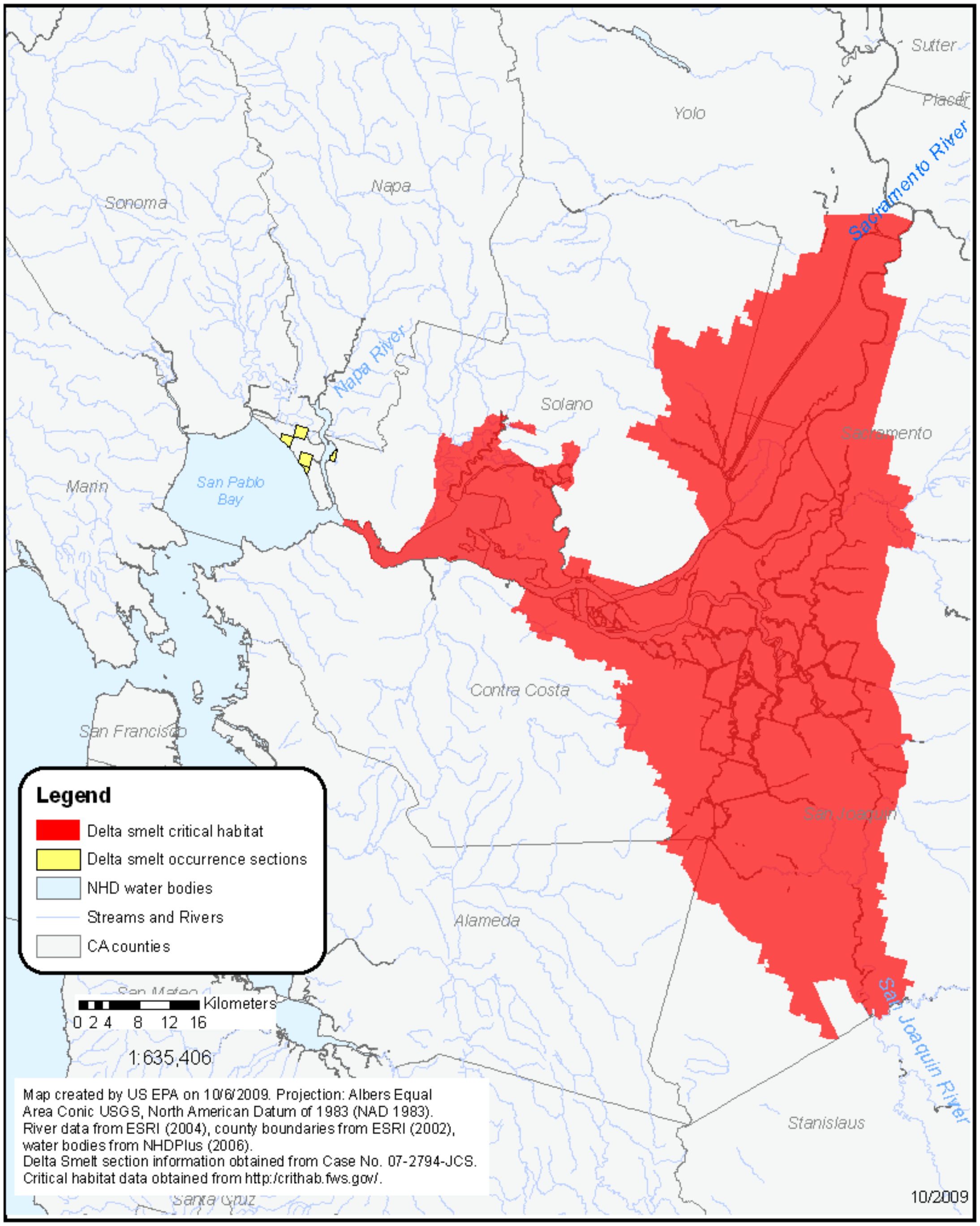


Figure 2.2 Delta Smelt Critical Habitat and Occurrence Sections identified in Case No. 07-2794-JCS.[13]

[13] Critical habitat maps (Delta Smelt, Calif. Tiger Salamander, Valley Elderberry Longhorn Beetle, Bay Checkerspot Butterfly, Alameda Whipsnake, Tidewater Goby) from crithab.fws.gov, Delta Smelt Recovery Plan, 1996. ecos.fws.gov

2.6. Designated Critical Habitat

Critical habitat has been designated for the Delta smelt. Risk to critical habitat is evaluated separately from risk to effects on the species. 'Critical habitat' is defined in the ESA as the geographic area occupied by the species at the time of the listing where the physical and biological features necessary for the conservation of the species exist, and there is a need for special management to protect the listed species. It may also include areas outside the occupied area at the time of listing if such areas are 'essential to the conservation of the species. Critical habitat designations identify, to the extent known using the best scientific and commercial data available, habitat areas that provide essential life cycle needs of the species or areas that contain certain primary constituent elements (PCEs) (as defined in 50 CFR 414.12(b)). **Table 2.6** describes the PCEs for the critical habitats designated for the Delta smelt.

Table 2.6. Designated Critical Habitat PCEs for the Delta smelt

PCEs[1,2,3]
(PCE 1) Spawning Habitat—shallow, fresh or slightly brackish backwater sloughs and edgewaters to ensure egg hatching and larval viability. Spawning areas also must provide suitable water quality (i.e., low "concentrations of pollutants) and substrates for egg attachment (e.g., submerged tree roots and branches and emergent vegetation).
(PCE 2) Larval and Juvenile Transport—Sacramento and San Joaquin Rivers and their tributary channels must be protected from physical disturbance and flow disruption. Adequate river flow is necessary to transport larvae from upstream spawning areas to rearing habitat in Suisun Bay. Suitable water quality must be provided so that maturation is not impaired by pollutant concentrations.
(PCE 3) Rearing Habitat—Maintenance of the 2 ppt isohaline and suitable water quality (low concentrations of pollutants) within the Estuary is necessary to provide delta smelt larvae and juveniles a shallow protective, food-rich environment in which to mature to adulthood.
(PCE 4) Adult Migration— Unrestricted access to suitable spawning habitat in a period that may extend from December to July. Adequate flow and suitable water quality may need to be maintained to attract migrating adults in the Sacramento and San Joaquin River channels and their associated tributaries. These areas also should be protected from physical disturbance and flow disruption during migratory periods.

[1] These PCEs are in addition to more general requirements for habitat areas that provide essential life cycle needs of the species such as, space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing (or development) of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.
[2] PCEs that are abiotic, including, physical-chemical water quality parameters such as salinity, pH, and hardness are not evaluated because these processes are not biologically mediated and, therefore, are not relevant to the endpoints included in this assessment.
[3]59 FR 65256 65279, 1994.

More detail on the designated critical habitat applicable to this assessment can be found in **Attachment 2**. Activities that may destroy or modify critical habitat are those that alter the PCEs and jeopardize the continued existence of the species. Evaluation of actions related to use of EPTC that may alter the PCEs of the designated critical habitat for the Delta smelt form the basis of the critical habitat impact analysis.

As previously noted in **Section 2.1**, the Agency believes that the analysis of direct and indirect effects to listed species provides the basis for an analysis of potential effects on the designated critical habitat. Because EPTC is expected to directly impact living organisms within the action area, critical habitat analysis for EPTC is limited in a practical sense to those PCEs of critical habitat that are biological or that can be reasonably linked to biologically mediated processes.

2.7. Action Area and LAA Effects Determination Area

2.7.1. Action Area

The action area is used to identify areas that could be affected by the Federal action. The Federal action is the authorization or registration of pesticide use or uses as described on the label(s) of pesticide products containing a particular active ingredient. The action area is defined by the Endangered Species Act as, "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.2). Based on an analysis of the Federal action, the action area is defined by the actual and potential use of the pesticide and areas where that use could result in effects. Specific measures of ecological effect for the assessed species that define the action area include any direct and indirect toxic effect to the assessed species and any potential modification of its critical habitat, including reduction in survival, growth, and fecundity as well as the full suite of sublethal effects available in the effects literature. It is recognized that the overall action area for the national registration of EPTC is likely to encompass considerable portions of the United States based on the large array of agricultural and non-agricultural uses. However, the scope of this assessment limits consideration of the overall action area to those portions that may be applicable to the protection of the DS and its designated critical habitat within the state of California.

For this assessment, the entire state of California is considered the action area. This is consistent with the risk assessment done on the California red-legged frog (USEPA, 2008). The sublethal endpoint used to define the action area in that risk assessment was a dose-related decrease in absolute brain weight in male rat pups at post-natal day 63 from a developmental neurotoxicity study. These effects were observed at the lowest dose level tested (100 ppm, 7.6 mg/Kg bw/d), so there was no NOAEL (MRID 46319101). Even though EPA did not assess the toxicity of EPTC to rats in this risk assessment, because mammals are not included as part of the conceptual models for the DS, the most conservative approach is to use this data to also define the action area for the DS. The purpose of defining the action area as the entire state of California is to ensure that the initial area of consideration encompasses all areas where the pesticide may be used now and in the future, including the potential for off-site transport via spray drift and downstream dilution that could influence the San Francisco Bay Species. Additionally, the concept of a state-wide action area takes into account the potential for direct and indirect effects and any potential modification to critical habitat based on ecological effect measures associated with reduction in survival, growth, and reproduction, as well as the full suite of sublethal effects available in the effects literature.

It is important to note that the state-wide action area does not imply that direct and/or indirect effects and/or critical habitat modification are expected to or are likely to occur over the full extent of the action area, but rather to identify all areas that may potentially be affected by the action. The Agency uses more rigorous analysis including consideration of available land cover data, toxicity data, and exposure information to determine areas where the DS and its designated critical habitat may be affected or modified via endpoints associated with reduced survival, growth, or reproduction.

2.7.2. LAA Effects Determination Area

A stepwise approach is used to define the Likely to Adversely Affect (LAA) Effects Determination Area. An LAA effects determination applies to those areas where it is expected that the pesticide's use will directly or indirectly affect the species and/or modify its designated critical habitat using EFED's standard assessment procedures (see **Attachment 1**) and effects endpoints related to survival, growth, and reproduction. This is the area where the "Potential Area of LAA Effects" (initial area of concern + drift distance or downstream dilution distance) overlaps with the range and/or designated critical habitat for the species being assessed. If there is no overlap between the potential area of LAA effects and the habitat or occurrence areas, a no effect determination is made. The first step in defining the LAA Effects Determination Area is to understand the federal action. The federal action is defined by the currently labeled uses for EPTC. An analysis of labeled uses and review of available product labels was completed. Several of the currently labeled uses are special local needs (SLN) uses not specified for use in California or are restricted to specific states and are excluded from this assessment. In addition, a distinction has been made between food use crops and those that are non-food/non-agricultural uses. For those uses relevant to the assessed species, the analysis indicates that, for EPTC, the following agricultural uses are considered as part of the federal action evaluated in this assessment: alfalfa, beans (dry, snap, castor), broccoli, cabbage, carrots, cauliflower, clover, corn (field, pop, silage, sweet, unspecified), cotton, grapefruit, lemon, lespedeza, lettuce, orange, potato (white/Irish, sweet), safflower, sugar beet, sunflower, sweet potato, tangerine, tomato, trefoil, and walnut.

In addition, the following non-food and non-agricultural uses are considered: agricultural fallow/idle land, citrus, conifers (seed orchard), grapefruit, lemon, orange, ornamental and shade trees, ornamental ground cover, ornamental herbaceous plants, ornamental woody shrubs and vines, and pine (seed orchard).

Following a determination of the assessed uses, an evaluation of the potential "footprint" of EPTC use patterns (*i.e.*, the area where pesticide application may occur) is determined. This "footprint" represents the initial area of concern, based on an analysis of available land cover data for the state of California. The initial area of concern is defined as all land cover types and the stream reaches within the land cover areas that represent the labeled uses described above. For EPTC, these land cover types include ornamental, row crops and right of way, representing all the land cover types that make up the initial area of concern for EPTC is presented in **Figure 2.3**.

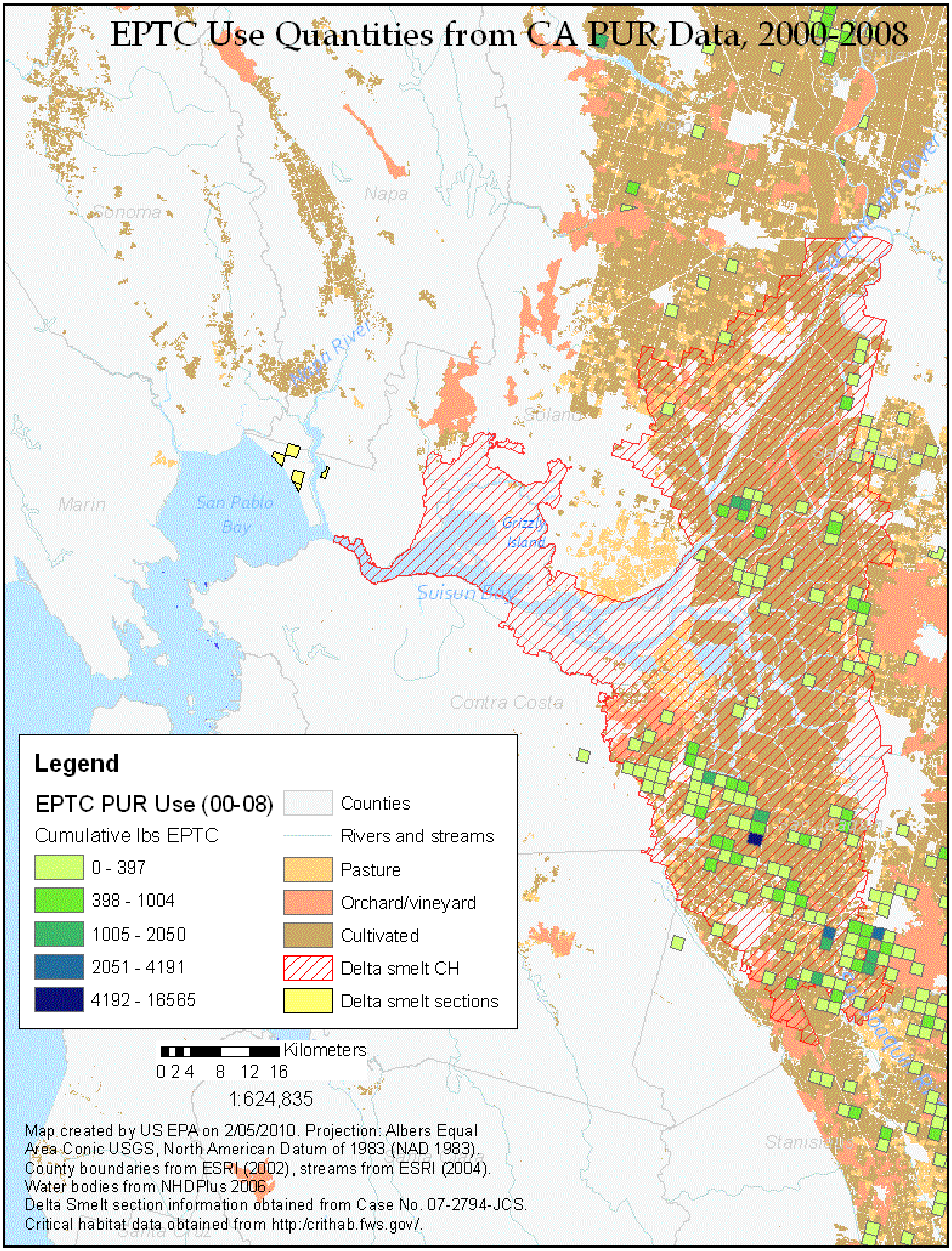


Figure 2.3. Initial area of concern, or "footprint" of potential use, for EPTC.

Figure 2.3 was constructed from data for 2000 to 2008 and includes both daily production and monthly production records. This data does not include the non-production summary, for which there is no MTRS (Meridian Township Range System) section data. This figure shows high correlation between the use site and the given landcover class, especially cultivated. The records for EPTC for which there were no MTRS sections, has 106K lbs, which compares to the 1,457,449 lbs for which there are MTRS section records.

As previously discussed, the action area is defined by the most sensitive measure of direct and indirect ecological toxic effects including reduction in survival, growth, reproduction, and the entire suite of sublethal effects from valid, peer-reviewed studies. Once the initial area of concern is defined, the next step is to define the potential boundaries of the Potential Area of LAA Effects by determining the extent of offsite transport via spray drift and runoff where exposure of one or more taxonomic groups to the pesticide will result in exceedances of the listed species LOCs. The AgDRIFT model (Version 2.01)/AGDISP model (Version 8.15) are used to define how far from the initial area of concern an effect to a given species may be expected via spray drift (*e.g.*, the drift distance). The spray drift analysis for EPTC uses the most sensitive endpoint of vegetative vigor for monocots and dicots. Further detail on the spray drift analysis is provided in **Section 5.2.5.a**.

In addition to the buffered area from the spray drift analysis, the Potential Area of LAA Effects also considers the downstream extent of EPTC that exceeds the LOC based on downstream dilution analysis (discussed in Section **5.2.5.b**).

Due to a positive result in a mutagenicity test (MRID 00161602) and to the lack of a NOAEC in the developmental neurotoxicity study in rats (MRID 46319101), the spatial extent of the action area (i.e., the boundary where exposures and potential effects are less than the Agency's LOC) for EPTC cannot be determined. Therefore, it is assumed that the action area encompasses the entire state of California, regardless of the spatial extent (i.e., initial area of concern or footprint) of the pesticide use(s).

Review of the environmental fate data of as well as physico-chemical properties of EPTC suggest that runoff, spray drift, and atmospheric drift of volatilized EPTC and the deposition in rain water are likely to be the dominant routes of exposure. EPTC concentrations in rainfall ranged between 100 and 2,800 ng/L (Majewski et al. 1995[14]). Air monitoring data from Lompoc, California[15] reports an acute concentration of 6.5 ng/m^3, and a 10 week concentration of 0.43 ng/m^3, both far below the studies screening level overall maximum monitored. State and local pesticide monitoring programs from October 1987 to September 1990 found three locations with EPTC detections (≥0.1 µg/L) in snow and rain[16]. Given the physico-chemical profile for EPTC and observed detections of EPTC in air, rainfall and snow samples, the potential for long range transport outside of the defined action area cannot be precluded.

[14] *Pesticides in the Atmosphere; Distribution, Trends and Governing Factors*, Majewski, Michael S; Capel, Paul D, Volume One in the Series, Pesticides in the Hydrologic System, Ann Arbor Press, Inc.; Chelsea, Michigan.
[15] Ambient Air Monitoring for Pesticides in Lompoc, California Volume 1: Executive Summary, Environmental Protection Agency California Department of Pesticide Regulation, State of California, March 2003 http://www.cdpr.ca.gov/docs/specproj/lompoc/exec_sum_march2003.pdf
[16] Nations, B.K., Hallberg, G.R., 1992, Pesticided in Iowa precipitation: J. *Environ. Qual.*, v.21, P. 486-492, cited in *Pesticides in the Atmosphere; Distribution, Trends and Governing Factors.*

An evaluation of usage information was conducted to determine the area where use of EPTC may impact the assessed species. This analysis is used to characterize where predicted exposures are most likely to occur, but does not preclude use in other portions of the action area. A more detailed review of the county-level use information was also completed. These data suggest that EPTC has historically been used on a wide variety of agricultural and non-agricultural sites.

2.8. Assessment Endpoints and Measures of Ecological Effect

2.8.1. Assessment Endpoints

A complete discussion of all the toxicity data available for this risk assessment, including resulting measures of ecological effect selected for each taxonomic group of concern, is included in **Section 4** of this document. **Table 2.7** identifies the taxa used to assess the potential for direct and indirect effects from the uses of EPTC for each listed species assessed here. The specific assessment endpoints used to assess the potential for direct and indirect effects to each listed species are provided in **Table 2.8**. For more information on the assessment endpoints, see **Attachment 1**.

Table 2.7 Taxa Used in the Analyses of Direct and Indirect Effects for the Assessed Listed Species

Listed Species	Terr. Plants	FW Fish	FW Inverts.	Estuarine/Marine Fish	Estuarine/Marine Inverts.	Aquatic Plants
Delta smelt	Indirect (habitat)	Direct*	Indirect (prey)	Direct*	Indirect (prey)	Indirect (food/ habitat)

Abbreviations: n/a = Not applicable; Terr. = Terrestrial; Invert. = Invertebrate; FW = Freshwater
*The most sensitive fish species across freshwater and estuarine/marine environments is generally used to assess effects for these species because they may be found in freshwater or estuarine/marine environments. In this case both freshwater and saltwater acute test results were very similar.

Table 2.8 Taxa and Assessment Endpoints Used to Evaluate the Potential for Use of EPTC to Result in Direct and Indirect Effects to the Assessed Listed Species or Modification of Critical Habitat

Taxa Used to Assess Direct and Indirect Effects to the Delta smelt and/or Modification to Critical Habitat or Habitat	Direct or Indirect Effect to the Delta smelt	Assessment Endpoints	Measures of Ecological Effects
1. Freshwater Fish	**Direct Effect** [1]	Survival, growth, and reproduction of individuals via direct effects	**1a.** Most sensitive fish acute LC_{50} (MRID 00144208): **Bluegill LC50 = 14**[2] **mg a.i./L** **1b.** Most sensitive fish chronic NOAEC (guideline or ECOTOX): **No data** **1c.** Most sensitive fish early-life stage NOAEC (guideline or ECOTOX): **No data**
2. Freshwater Invertebrates	**Indirect Effect (prey)**	Survival, growth, and reproduction of individuals or modification of critical habitat via indirect effects on aquatic prey food supply (*i.e.*, freshwater invertebrates)	**2a.** Most sensitive freshwater invertebrate EC_{50} (MRID 42945601): **Daphnid EC_{50} = 6.5 mg a.i./L** **2b**. Most sensitive freshwater invertebrate chronic NOAEC (MRID 45075006): **Daphnid repro NOAEC = 0.8 mg a.i./L**
3. Estuarine/Marine Fish	**Direct Effect***	Survival, growth, and reproduction of individuals via direct effects	**3a.** Most sensitive estuarine/marine fish EC_{50} (MRID 46145903): **Sheepshead LC_{50} = 17 mg a.i./L** **3b.** Most sensitive estuarine/marine fish chronic NOAEC (guideline or ECOTOX): **No data**
4. Estuarine/Marine Invertebrates	**Indirect Effect (prey)**	Survival, growth, and reproduction of individuals or modification of critical habitat via indirect effects on aquatic prey food supply (*i.e.*, estuarine/marine invertebrates)	**4a.** Most sensitive estuarine/marine invertebrate EC_{50} (MRID 40228401): **White shrimp LC_{50} = 0.6 mg a.i./L** **4b.** Most sensitive estuarine/marine invertebrate chronic NOAEC (estimated from daphnid ACR): **White shrimp NOAEC = 0.08 mg a.i./L**
5. Aquatic Plants (freshwater/marine)	**Indirect Effect (food/habitat)**	Survival, growth, and reproduction of individuals or modification of critical habitat via indirect effects on habitat, cover, food supply, and/or primary productivity (*i.e.*, aquatic plant community)	**5a.** Vascular plant acute EC_{50} (MRID 43096001): **Duckweed EC50 = 5.6 mg a.i./L** **5b.** Non-vascular plant acute EC_{50} (MRIDs 42921202 and 42899801): **Green algae EC50 = 1.4 mg a.i./L**
6. Terrestrial Plants	**Indirect Effect (habitat)**	Survival, growth, and reproduction of individuals or modification of critical habitat via indirect effects on food and habitat (*i.e.*, riparian and upland vegetation)	**9a.** Distribution of EC_{25} for monocots (seedling emergence and vegetative vigor, MRIDs 42120802 and 43217101): **EC_{25} = 0.27** - >7.4 **lbs a.i./A** **9b.** Distribution of EC_{25} for dicots (seedling emergence and vegetative vigor, MRIDs 42120802 and 43217101) **EC_{25} = 2.0** ->7.4 **lbs a.i./A**

Abbreviations: SF=San Francisco

[1]The most sensitive fish species across freshwater and estuarine/marine environments is generally used to assess effects for these species because they may be found in freshwater or estuarine/marine environments. In this case both freshwater and saltwater acute test results were very similar.

[2] The most sensitive endpoint was used in calculations and is displayed in bold font.

2.8.2. Assessment Endpoints for Designated Critical Habitat

As previously discussed, designated critical habitat is assessed to evaluate actions related to the use of EPTC that may alter the PCEs of the assessed species' designated critical habitat. PCEs for the assessed species were previously described in **Section 2.6**. Actions that may modify critical habitat are those that alter the PCEs and jeopardize the continued existence of the assessed species. Therefore, these actions are identified as assessment endpoints. It should be noted that evaluation of PCEs as assessment endpoints is limited to those of a biological nature (*i.e*., the biological resource requirements for the listed species associated with the critical habitat) and those for which EPTC effects data are available.

Assessment endpoints used to evaluate potential for direct and indirect effects are equivalent to the assessment endpoints used to evaluate potential effects to designated critical habitat. If a potential for direct or indirect effects is found, then there is also a potential for effects to critical habitat. Some components of these PCEs are associated with physical abiotic features (*e.g*., presence and/or depth of a water body, or distance between two sites), which are not expected to be measurably altered by use of pesticides.

2.9. Conceptual Model

2.9.1. Risk Hypotheses

Risk hypotheses are specific assumptions about potential adverse effects (*i.e.*, changes in assessment endpoints) and may be based on theory and logic, empirical data, mathematical models, or probability models (USEPA, 1998). For this assessment, the risk is stressor-linked, where the stressor is the release of EPTC to the environment. The following risk hypotheses are presumed in this assessment:

The labeled use of EPTC within the action area may:

- directly affect DS by causing mortality or by adversely affecting growth or fecundity;
- indirectly affect DS and/or modify their designated critical habitat by reducing or changing the composition of food supply;
- indirectly affect DS and/or modify their designated critical habitat by reducing or changing the composition of the aquatic plant community in the species' current range, thus affecting primary productivity, larval food supply and cover/egg attachment substrate;
- indirectly affect DS and/or modify their designated critical habitat by reducing or changing aquatic habitat in their current range (via modification of water quality parameters, habitat morphology, and/or sedimentation); and
- indirectly affect DS and/or modify their habitat by reducing or changing the composition of the terrestrial plant community in riparian and upland zones and, thus, affecting temperature, shade and runoff.

2.9.2. Diagram

The conceptual model is a graphic representation of the structure of the risk assessment. It specifies the EPTC release mechanisms, biological receptor types, and effects endpoints of potential concern. The conceptual model for the Delta smelt and the conceptual models for the aquatic and terrestrial PCE components of critical habitat are shown in **Figure 2.4** and **Figure 2.5**. Although the conceptual models for direct/indirect effects and modification of designated critical habitat PCEs are shown on the same diagrams, the potential for direct/indirect effects and modification of PCEs will be evaluated separately in this assessment. Exposure routes shown in dashed lines are not quantitatively considered because the contribution of those potential exposure routes to potential risks to the Delta smelt and modification to designated critical habitat is expected to be negligible.

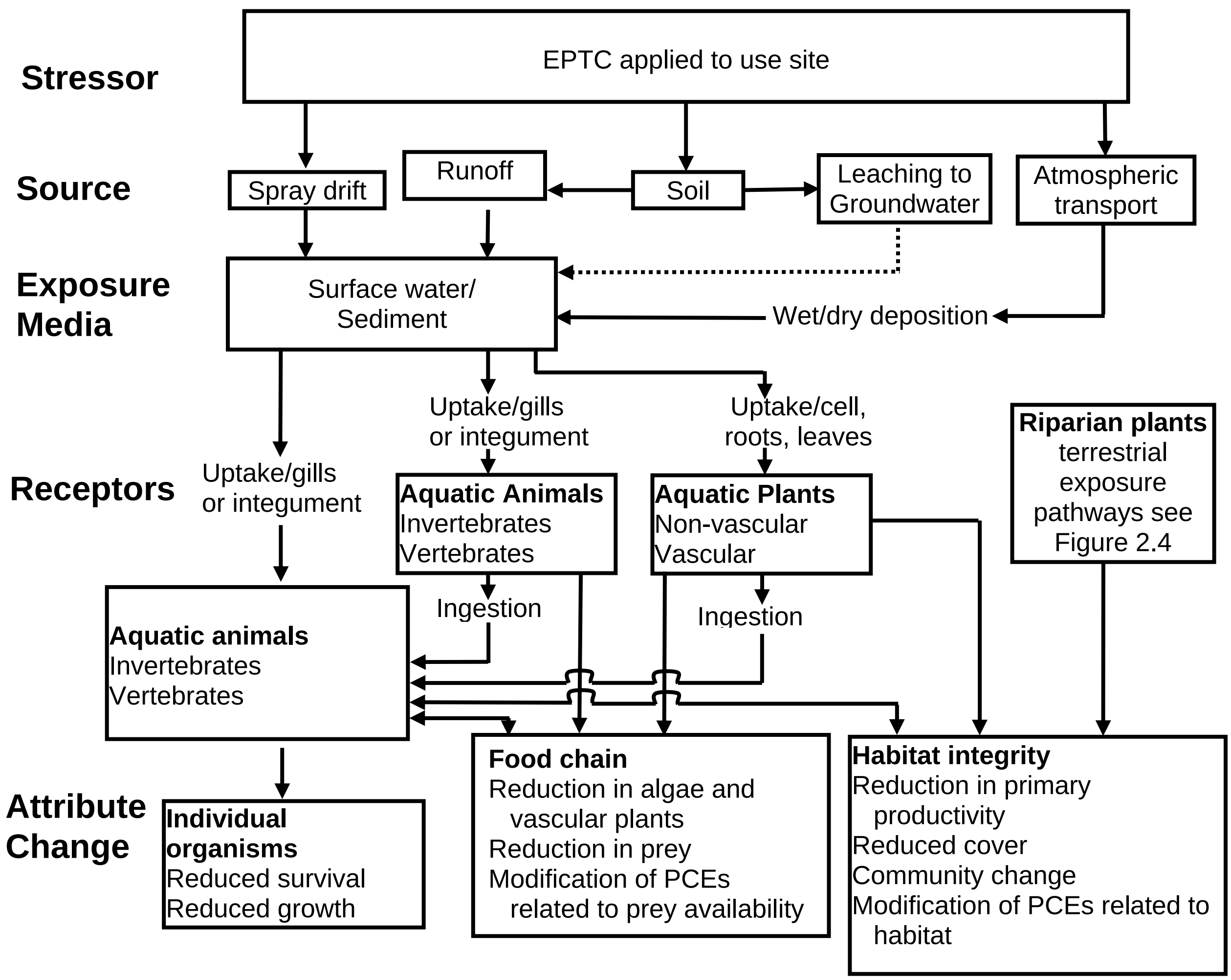


Figure 2.4. Conceptual Model Depicting Stressors, Exposure Pathways, and Potential Effects to Aquatic Organisms from the Use of EPTC.
Dotted lines indicate exposure pathways that have a low likelihood of contributing to ecological risk.

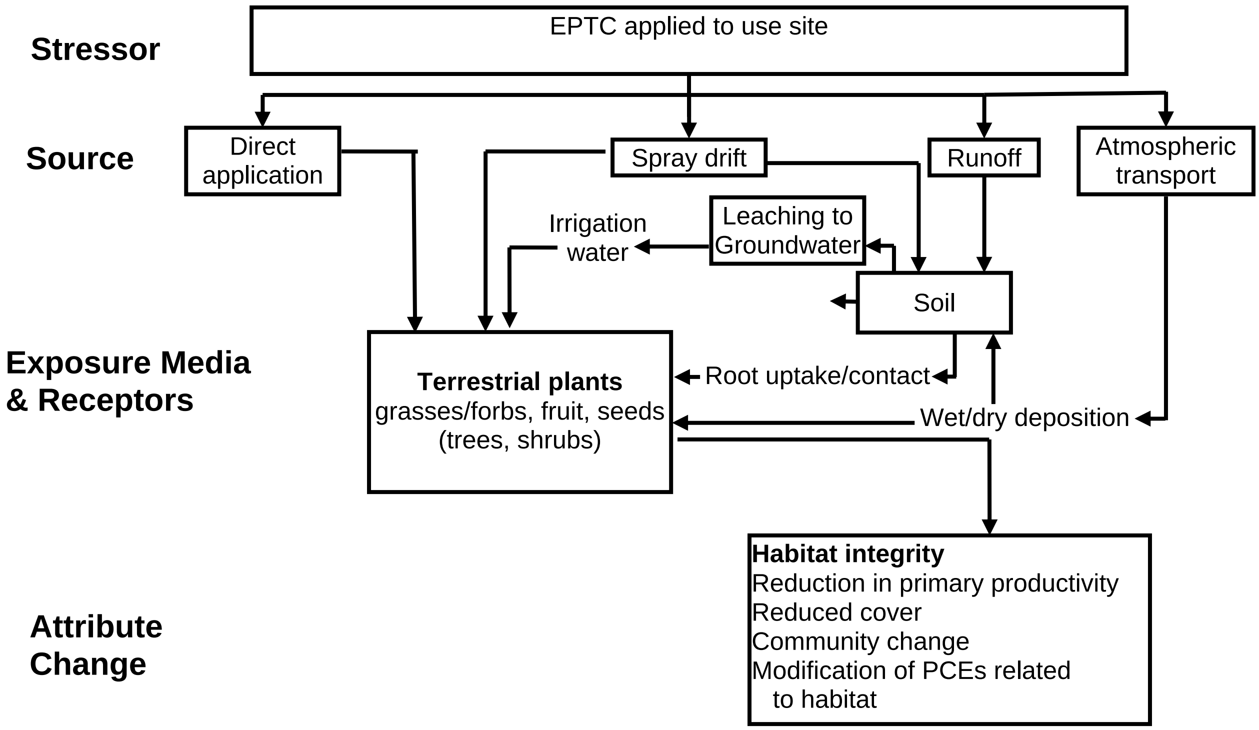


Figure 2.5. Conceptual model depicting stressors, exposure pathways, and potential effects to terrestrial organisms from the use of EPTC.
Dotted lines indicate exposure pathways that have a low likelihood of contributing to ecological risk.

2.10. Analysis Plan

In order to address the risk hypothesis, the potential for direct and indirect effects to the assessed species, prey items, and habitat is estimated based on a taxon-level approach. In the following sections, the use, environmental fate, and ecological effects of EPTC are characterized and integrated to assess the risks. This is accomplished using a risk quotient (ratio of exposure concentration to effects concentration) approach. Although risk is often defined as the likelihood and magnitude of adverse ecological effects, the risk quotient-based approach does not provide a quantitative estimate of likelihood and/or magnitude of an adverse effect. However, as outlined in the Overview Document (USEPA, 2004), the likelihood of effects to individual organisms from particular uses of EPTC is estimated using the probit dose-response slope and either the level of concern (discussed below) or actual calculated risk quotient value.

Descriptions of routine procedures for evaluating risk to the San Francisco Bay Species are provided in **Attachment 1**.

2.10.1. Measures of Exposure

The environmental fate properties of EPTC along with available monitoring data indicate that runoff and spray drift are the principle potential transport mechanisms of EPTC to the aquatic habitat of the DS. Transport of EPTC through runoff and spray drift are also considered in deriving quantitative estimates of EPTC exposure to its prey and its habitat components. In addition, EPTC can be applied via flood or sprinkler irrigation (i.e., chemigation) to various crops, and there is potential for aquatic exposure and terrestrial exposure via tailwater runoff from a treated field. EPTC field study data in tailwater runoff are used quantitatively in this assessment.

Due to its high vapor pressure, EPTC is also prone to losses by volatilization. Vaporized EPTC can then be transported in the atmosphere and be deposited off site in rain water or snow. Aquatic and terrestrial exposures via atmospheric deposition of EPTC are considered qualitatively in this risk assessment.

2.10.1.a. Estimating Exposure in the Aquatic Environment

Measures of exposure are based on aquatic and terrestrial models that predict estimated environmental concentrations (EECs) of EPTC using maximum labeled application rates and methods of application. The models used to predict aquatic EECs are the Pesticide Root Zone Model coupled with the Exposure Analysis Model System (PRZM/EXAMS). The model used to derive EECs relevant to terrestrial and wetland plants is TerrPlant. These models are parameterized using relevant reviewed registrant-submitted environmental fate data.

PRZM (v3.12.2, May 2005) and EXAMS (v2.98.4.6, April 2005) are screening simulation models coupled with the input shell pe5.pl (Aug 2007) to generate daily exposures and 1-in-10 year EECs of EPTC that may occur in surface water bodies adjacent to application sites receiving EPTC through runoff and spray drift. PRZM simulates pesticide application, movement and transformation on an agricultural field and the resultant pesticide loadings to a receiving water body via runoff, erosion and spray drift. EXAMS simulates the fate of the pesticide and resulting concentrations in the water body. The standard scenario used for ecological pesticide assessments assumes application to a 10-hectare agricultural field that drains into an adjacent 1-hectare water body, 2-meters deep (20,000 m^3 volume) with no outlet. PRZM/EXAMS was used to estimate screening-level exposure of aquatic organisms to EPTC. The measure of exposure for aquatic species is the 1-in-10 year return peak or rolling mean concentration. The 1-in-10 year peak is used for estimating acute exposures of direct effects to the DS, as well as indirect effects to the DS through effects to potential prey items and the food chain, including: algae and aquatic invertebrates. The 1-in-10-year 60-day mean is used for assessing chronic exposure to the DS; the 1-in-10-year 21-day mean is used for assessing chronic exposure for aquatic invertebrates, which are the chief prey items of the DS.

The standard scenario used in this assessment assumes standardized “geometry” (field size, pond depth and size, etc), and the soil, hydrogeologic, meteorological conditions, and agronomic practices utilized data specific to the crop and location being modeled. Therefore the scenarios for use in the DS assessment may not represent the highest exposure sites for EPTC use outside of California.

In addition to model-predicted surface water EECs, tailwater (flood irrigation end of field runoff) field study data will also be used quantitatively to assess risk to the DS. As mentioned above, EPTC can be applied via flood or sprinkler irrigation (chemigation) to various crops (i.e., alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black)), and there is potential for aquatic exposure via tailwater runoff from a treated field. Acute RQs will be calculated using the tailwater peak detection from the available field study data; chronic RQs for freshwater invertebrates will be calculated using an estimated 21-day tailwater concentration. Chronic fish RQs will not be calculated due to a lack of chronic fish toxicity data, and risk will be discussed qualitatively.

2.10.1.b. Estimating Exposure in the Terrestrial Environment

EECs for terrestrial plants inhabiting dry and wetland areas are derived using TerrPlant (version 1.2.2, 12/26/2006). This model uses estimates of pesticides in runoff and in spray drift to calculate EECs. EECs are based upon solubility, application rate and minimum incorporation depth.

In order to determine the extent of terrestrial habitats of concern beyond application sites, it is necessary to estimate the distance spray applications can drift from the treated field and still be greater than the level of concern. Spray drift modeling was done to determine the farthest distance required to not exceed the LOC for exposures to EPTC drifted to non-target areas. This assessment requires the use of the spray drift model, AgDrift (version 2.01). The Tier I version of AgDrift was used for simulating applications of EPTC to agricultural crops by ground methods.

2.10.2. Measures of Effect

Data identified in **Section 2.8** are used as measures of effect for direct and indirect effects. Data were obtained from registrant submitted studies or from literature studies identified by ECOTOX. More information on the ecotoxicology (ECOTOX) database and how toxicological data are used in assessments is available in **Attachment 1**.

2.10.2.a. Integration of Exposure and Effects

Risk characterization is the integration of exposure and ecological effects characterization to determine the potential ecological risk from agricultural and non-agricultural uses of EPTC, and the likelihood of direct and indirect effects to the assessed species in aquatic and terrestrial habitats. The exposure and toxicity effects data are integrated in order to evaluate the risks of adverse ecological effects on non-target species. The risk quotient (RQ) method is used to compare exposure and measured toxicity values. EECs are divided by acute and chronic toxicity values. The resulting RQs are then compared to the Agency's levels of concern (LOCs) (USEPA, 2004; see **Appendix C**). More information on standard assessment procedures is available in **Attachment 1**.

2.10.3. Data Gaps

No aerobic or anaerobic aquatic metabolism data are available for consideration in this assessment. Contrary to standard EFED guidance, the aquatic metabolism rate was not estimated from the aerobic soil metabolism study data, because the degradation by metabolism could not be separated from the losses due to volatilization. The aquatic EECs should be considered to be conservative for spray applications of EPTC because in the PRZM modeling only aerobic soil metabolism (ASM) was considered because the ASM half-life estimate included both metabolism and volatilization. The aquatic modeling with EXAMS only considered losses due to volatilization (function of Henry's constant) because the aquatic metabolism rates were not known.

No chronic effects data for freshwater or saltwater fish are available.

3. Exposure Assessment

EPTC is formulated as an emulsifiable concentrate and as a granule. Application equipment and methods include ground application, band treatment, soil broadcast, direct spray, chemigation, and flood treatment. EPTC must be soil incorporated or wetted in. Aerial application of granular EPTC is specified for alfalfa on the label (EPA 10163-281). Risks from ground boom (only aerial application of granular formulation is allowable under current labels) applications are considered in this assessment because they are expected to result in the highest off-target levels of EPTC due to generally higher spray drift levels. Ground boom modes of application tend to use lower volumes of application applied in finer sprays than applications coincident with sprayers and spreaders and thus have a higher potential for off-target movement via spray drift. Drift is not typically considered in granular application of pesticides.

3.1. Label Application Rates and Intervals

EPTC labels may be categorized into two types: labels for manufacturing uses (including technical grade EPTC and its formulated products) and end-use products. While technical products, which contain EPTC of high purity, are not used directly in the environment, they are used to make formulated products, which can be applied in specific areas to control weeds. The formulated product labels legally limit the potential use of EPTC to only those sites that are specified on the labels.

Currently registered agricultural and non-agricultural uses of EPTC within California include alfalfa, almonds, beans (dried, succulent and castor), broccoli, cabbage, citrus clover, corn (field, pop, sweet, silage), grapefruit (food and nonfood), lemon (food and nonfood), lespedeza, oranges (food and nonfood), ornamentals (shade trees, ground cover, woody shrubs, herbaceous plants, pine seed orchards), potatoes (Irish, sweet), safflower, sugar beets, sunflowers, sweet potatoes, tangerines, tomatoes, trefoil and fallow/idle lands. Application information is summarized in **Table 3.1.**

Most EPTC uses are limited to only one application per crop cycle or year. The labels are not clear about how many crop cycles may occur for each use per year; consequently, there is some uncertainty regarding the maximum number of EPTC applications that can be made annually. The highest application rate and minimum reapplication interval were generally used as this combination resulted in the most conservative estimates of aquatic EECs.

Table 3.1 Maximum application rates, number of applications, reapplication intervals, crop cycles per year or season, and maximum total per year or crop

Use	Max. Single Rate (lb a.i./A)	Maximum No. Apps.	Interval (days)	Crop cycle (cc) or cutting[2]	Max. Annual Rate (lb a.i./A)
Granular Formulation					
Alfalfa	4	ns[1]; 1/cutting	30	2 to 9/yr	12.0/yr
Beans (dried)	4.5	1	na[3]	1/yr	ns
Beans (snap)	4	1	na	1/cc	4
Citrus	6	ns	ns	ns	ns
Clover	4	ns	ns	Unknown[4]	4
Conifers (seed orchard	6	ns	ns	1/yr	ns
Corn (silage)	3	ns	ns	1/yr	ns
Corn (field)	3	ns	ns	1/yr	ns
Corn (sweet)	3	ns	ns	2 to 3/yr	ns
Grapefruit (nonbearing)	6	ns	ns	1/yr	ns
Lespedeza	4	ns	ns	Unknown	4
Orange (nonbearing)	6	ns	ns	ns	ns
Potato (white/Irish)	6	ns	ns	1	ns
Safflower	3	ns	ns	na	ns
Sugar Beets	4.5	ns	na	1	ns
Trefoil Birdsfoot	4	ns	na	ns	4
Emulsifiable Concentrate					
Alfalfa	3.94[5] 6.13	ns; 1/cutting ns	30 ns	2 to 9/yr "	12.25/yr ns
Almond	3.063	ns	ns	1/yr	6.13/season[5]
Beans (dried)	4.60	1	na	1/yr	7.0/crop
Beans (snap)	4.60	ns	na	1/cc	7.0/crop
Broccoli	6.13	ns	ns	1 to 2/yr	ns
Cabbage	6.13	ns	ns	Up to 3/yr	ns
Carrot	6.13	ns	ns	1/yr	ns
Castor Bean	4.60	ns	ns	1/yr	ns
Cauliflower	6.13	ns	ns	1 to 2/yr	ns
Citrus	6.13	ns	ns	1/yr	ns
Clover	3.94	ns	ns	Unknown	ns
Conifers (seed orchard	6.13	ns	ns	1/yr	ns
Corn (silage)	6.14	ns	ns	1/yr	ns
Corn (unspecified)	6.14	ns	ns	1/yr	ns
Corn (field)	6.14	ns	ns	1/yr	ns
Corn (pop)	6.14	ns	ns	1/yr	ns

Use	Max. Single Rate (lb a.i./A)	Maximum No. Apps.	Interval (days)	Crop cycle (cc) or cutting[2]	Max. Annual Rate (lb a.i./A)
Corn (sweet)	6.14	ns	ns	2 to 3/yr	ns
Cotton	6.13	ns	ns	1/yr	ns
Grapefruit (bearing)	3.06	Unknown	Unknown	1/yr	Unknown
Grapefruit (nonbearing)	6.13	ns	ns	1/yr	ns
Lemon (bearing)	3.06	Unknown	Unknown	1/yr	Unknown
Lemon (nonbearing)	6.13	ns	ns	1/yr	ns
Lespedeza	3.94	ns	ns	Unknown	4
Lettuce	6.13	ns	ns	1 to 2/yr	ns
Orange (bearing)	3.06	Unknown	Unknown	1/yr	Unknown
Orange (nonbearing	6.13	ns	ns	ns	ns
Ornamentals (ground cover)	14.88	ns	ns	unknown	ns
Ornamentals (herb. plants)	14.88	ns	ns	unknown	ns
Ornamentals (woody shrubs)	14.88	ns	ns	unknown	ns
Ornamentals and or shade trees	14.88	ns	ns	unknown	ns
Pine (seed orchard)	6.13	ns	ns	unknown	ns
Potato (white/Irish)	6.13	ns	ns	1	12.25/crop
Safflower	3.06	ns	na	unknown	ns
Sugar Beets	3.06 6.13	ns ns	ns ns	1/yr ns	ns 6.13/crop
Sweet Potato	7.44	ns	ns	ns	ns
Sunflower[6]	Spring: 3.06 Fall: 4.6 Postemerg.: 3.06	ns	ns	1/yr	6.13/ crop
Tangerine	3.06	Unknown	Unknown	1/yr	Unknown
Tomato	3.06	ns	ns	1/yr	ns
Trefoil Birdsfoot	3.94	ns	ns	Unknown	ns
Walnut	3.06	ns	ns	1/yr	ns
Fallow/Idle	6.13	ns	ns	ns	ns

[1] ns – not specified on label.
[2] Kaul, M. 2007. Maximum Number of Crop Cycles per Year in California for Methomyl Use Sites. USEPA\OPPTS\OPP\BEAD
[3] na -- not applicable
[4] Minimum rate is 1.97 lb a.i./A; yearly total cannot exceed 12.25 lb a.i./yr.
[5] Season not specified.
[6] Modification and additions to EPA Reg. No. 10163-283 D339490

3.2. Aquatic Exposure Assessment

3.2.1. Modeling Approach

The EECs (Estimated Environmental Concentrations) are calculated using the USEPA Tier II PRZM (Pesticide Root Zone Model) and EXAMS (Exposure Analysis Modeling System) with the EFED Standard Pond environment. The PRZM/EXAMS linkage program (PE5, PE Version 5, dated Nov. 15, 2006) was used for all surface water simulations. PRZM is used to simulate pesticide transport as a result of runoff and erosion from an agricultural field, and EXAMS estimates environmental fate and transport of pesticides in surface water. Aquatic exposure is modeled for the parent alone.

Aquatic exposures were quantitatively estimated for all of assessed uses using scenarios that represented high exposure sites for EPTC use. Each of these sites represents a 10 hectare field that drains into a 1-hectare pond that is 2 meters deep and has no outlet. Exposure estimates generated using the standard pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and first-order streams. As a group, there are factors that make these water bodies more or less vulnerable than the standard surrogate pond. Static water bodies that have larger ratios of drainage area to water body volume would be expected to have higher peak EECs than the standard pond. These water bodies will be either shallower or have large drainage areas (or both). Shallow water bodies tend to have limited additional storage capacity, and thus, tend to overflow and carry pesticide in the discharge whereas the standard pond has no discharge. As watershed size increases beyond 10 hectares, at some point, it becomes unlikely that the entire watershed is planted to a single crop, which is all treated with the pesticide. Headwater streams can also have peak concentrations higher than the standard pond, but they tend to persist for only short periods of time and are then carried downstream.

Crop-specific management practices for all of the assessed uses of EPTC were used for modeling, including application rates, number of applications per year, application intervals, and the first application date for each crop[17]. The date of first application was developed based on several sources of information including data provided by BEAD, a summary of individual applications from the CDPR PUR data, and Crop Profiles maintained by the USDA. The crop and month(s) in which EPTC was applied from the CDPR PUR database for 2001 to 2005 are summarized in Table 2.4**.** The first application was generally selected to represent when EPTC was typically applied. However, when a wide range of application dates were possible, several different initial application dates were considered.

Multiple applications were considered for alfalfa, almonds, and beans. For alfalfa, four applications at 3.0625 lb a.i./A with a 60-day reapplication interval was assumed. Aquatic exposures were estimated for almonds and beans based on one or two EPTC applications. See **Appendix D** for further details regarding the aquatic exposure assessment.

3.2.2. Model Inputs

The appropriate PRZM and EXAMS input parameters for EPTC and related compounds were selected from the environmental fate data submitted by the registrant. These data were generally

[17] More detail on the crop profiles and the previous assessments may be found at http://pestdata.ncsu.edu/cropprofiles/cropprofiles.cfm.

prepared in accordance with US EPA-OPP EFED water model parameter selection guidelines, *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides; Version 2.1 (* October 22, 2009) and *PE5 User's Manual ((P)RZM (E)XAMS Model Shell, Version (5)*, November 15, 2006). . Several deviations used are noted below. Input parameters can be grouped by physical-chemical properties and other environmental fate data, application information, and use scenarios. Physical and chemical properties relevant to assess the behavior of EPTC and related compounds in the environment are presented in **Table 2.1** and application information from the label in **Table 2.2** and **Table 2.4**. The input parameters for PRZM and EXAMS are in **Table 3.2**. **Appendix D** contains example model output files and tables showing the data used to calculate input values.

Table 3.2 Summary of PRZM/EXAMS Environmental Fate Data Used for Aquatic Exposure Inputs for EPTC Endangered Species Assessment for the Delta Smelt[1]

Fate Property	Value (unit)	MRID (or source)
Molecular Weight	189.2	42120801
Henry's constant	$1.5e^{-05}$ atm-m^3/mol	42120801
Vapor Pressure	$1.6e^{-02}$ mmHg at 20ºC	42120801
Solubility in Water	344 mg/L @ 25ºC	42120801
Photolysis in Water	Stable	42120803
Aerobic Soil Metabolism Half-lives (ASM)	37.08[2] days [This rate includes metabolism and volatilization (vaporization of EPTC][3,4].	42120805, 42120806, 40420402
Hydrolysis	Stable	00141373
Aerobic Aquatic Metabolism (water column)	Assumed stable [ASM include both volatilization and metabolism; metabolism was assumed to be 0 and volatilization was estimated via the aquatic volatilization.[4]	No data
Anaerobic Aquatic Metabolism (benthic)	Assumed stable	No data
Koc	172 mL/g- organic carbon	42120808
Application rate and frequency	3.0625 to 14.875 lb a.i./A	Label and BEAD data
Application intervals	None; 30 days; 90 days	Most uses single application; others estimated because not stated on label.
Chemical Application Method (CAM)	1 foliar 2 granular	EFED Guidance (2009)
Application Efficiency (Fraction)	0.99 ground spray 1.00 granular	EFED Guidance (2009)
Spray Drift Fraction (Fraction)	0.01 ground spray 0.0 granular	EFED Guidance (2009)

[1] Inputs determined in accordance with EFED "Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides" dated October 22, 2009.
[2] Upper 90th confidence bounds of the mean DT_{50}.
[3] D339490. Half-life reflects the combined residue approach (EPTC + ESO)
[4] Deviates from standard guidance.

The PRZM scenarios selected to represent the uses in California where EPTC may be used are summarized in **Table 3.3.**

Many of these California scenarios were developed specifically for the California Red Legged Frog ESA assessments (USEPA, 2008) or for the Organophosphate (OP) cumulative risk assessment, and therefore may not represent the most vulnerable conditions for a national assessment. Scenarios have not been developed for all the specific uses considered for EPTC. However, a number of the scenarios have been developed so that they can represent more than a single crop (i.e., cole crop scenario represents broccoli, cabbage and cauliflower). The scenario developers considered that the environmental and agronomic conditions of the California corn scenario were such that it could be used as a surrogate scenario for sunflower production.

Several assumptions were made in order to estimate aquatic exposures for EPTC use on fallow sites since there is currently no ‘fallow’ scenario available in PRZM/EXAMS. Tillage practice in California includes a fallow period of 3 to 6 months between crops for certain crop rotations.[18] Since onions and tomatoes are two of the crops often included in these rotations, these uses were selected as the crop scenarios in the model run. In addition, it was assumed that EPTC is applied before plant emergence and/or after harvest such that the scenario assumes a fallow surface condition, and there is no irrigation during the fallow period.

Table 3.3 PRZM scenarios assignments according to uses of EPTC

PRZM Scenario	Uses
CA alfalfa OP	Alfalfa, clover, lespedeza, birdsfoot trefoil
CA almond STD	Almonds, walnut
CA citrus STD	Citrus, grapefruit, lemon, orange, tangerine
CA cole crop RLF	Broccoli, cabbage, cauliflower
CA corn OP	Field corn, silage, popcorn, sweet corn, sunflower
CA cotton STD	Cotton
CA forestry RLF	Conifers (seed orchards), pine seed orchards
CA lettuce STD	Lettuce
CA nursery	Herbaceous ornamentals, woody shrubs and vines
CA potato RLF	White/Irish potato, sweet potato
CA row crop RLF	Beans, carrot, castor bean, snap beans
CA sugar beet OP	Sugar beet
CA tomato STD	Tomato
CA wheat RLF	Safflower
CA tomato STD CA onion STD	Agricultural fallow/Idle Land – EPTC was applied 90 days prior to emergence or after harvest

[18] Mitchell et al. 2008. http://vric.ucdavis.edu/news_and_events/bulletinboard/soilconf/sjtill.pdf.

3.2.3. Results

For spray applications of EPTC, the highest EECs occurred with the lettuce scenario, as shown in **Table 3.4.** The highest 1-in-10 year peak concentration was 171 µg/L. The 1-in-10 year 21 day and 60 day average values are 122 and 73 µg/L, respectively. The aquatic EECs for all scenarios and application options considered and PRZM/EXAMS output can be found in **Appendix D**. Because the application rates for the granular applications are similar and no spray drift is considered, only a granular application for potatoes was assessed. The EECs for granular versus liquid spray are essentially the same when applied on the same date in the model. The date of application had a substantial influence on the EECs for EPTC (in addition to application rate and number of applications). Based on the CDPR PUR data, EPTC is applied in every month of the year (**Table 2.4**). Due to precipitation patterns in California, EECs tend to be highest when application occurs in January or February, decrease in June and July, and increase again from August through December. The highest aquatic EECs are predicted for use of EPTC on lettuce with an application date of February 1. The peak 1-in-10 year concentrations for all simulations ranged from 1.90 to 171 µg/L (**Appendix D**).

To provide an indication of the contribution of drift during the application of EPTC by chemigation with sprinkler irrigation on, aquatic EECs were also generated assuming 95 percent application efficiency and spray drift fraction of 0.05 (default assumptions for aerial spray applicationsapplications). For the lettuce scenario (highest EECs – mostly due to runoff), the peak, 21-day and 60-day means were slightly higher (1.03, 1.01, and 1.05 times for the peak, 21-day and 60-day EECs, respectively) when applied by air compared to ground. For the potato scenario (lowest EECs – primarily due to drift), the peak, 21-day and 60-day EECs were 4.5, 4.4, and 4.4 times greater when applied by air spray compared to ground spray.

Table 3.4 One-in-10-year EEC concentrations for aquatic environments from the application of EPTC to uses in California Estimated by linked PRZM and EXAMS models

Use (1st app day/month)	Rate (lb a.i./A)/ Number/ Interval	Peak (µg/L)	21-day (µg/L)	60-day (µg/L)
Alfalfa (01/01)	3.0625/3/40	33.44	27.89	18.57
Alfalfa (05/01)	6.13/1/-	44.19	33.64	22.22
Alfalfa (20/01)	6.13/1/-	32.36	25.05	16.30
Alfalfa (20/01)	3.0625/4/60	21.08	15.55	9.57
Alfalfa (01/06)	3.0625/4/60	18.22	14.35	9.20
Almond (15/07)	3.0625/1/-	9.36	7.76	4.47
Almond (15/07)	3.0625/2/30	13.68	11.06	8.15
Almond (30/08)	3.0625/2/45	13.40	10.27	7.00
Beans, Dried (01/01)	4.594/1/-	31.12	22.74	13.80
Beans, Dried (01/04)	4.594/1/-	20.84	13.13	7.52
Beans, Dried (01/06)	4.594/1/-	4.034	2.96	1.73
Beans, Dried (01/01)	3.94/2/30	41.33	30.08	17.94

Use (1st app day/month)	Rate (lb a.i./A)/ Number/ Interval	Peak (µg/L)	21-day (µg/L)	60-day (µg/L)
Beans, Dried (01/04)	3.94/2/30	17.87	11.26	6.89
Beans, Dried (01/06)	3.94/2/30	6.71	3.70	2.14
Beans, Dried (01/01)	4.594 + 3.67/30	47.90	34.96	20.70
Beans, Dried (01/04)	4.594 + 3.67/30	20.84	13.13	7.96
Beans, Dried (01/06)	4.594 + 3.67/30	7.77	4.29	2.41
Beans, Snap (01/01)	3.94/1/-	26.67	19.49	11.83
Beans, Snap (01/04)	3.94/1/-	17.87	11.25	6.45
Beans, Snap (01/06)	3.94/1/-	3.46	2.54	1.48
Beans, Snap (01/01)	3.0625/1/-	37.29	25.62	14.68
Beans, Snap (01/04)	3.0625/1/-	9.74	5.91	2.98
Beans, Snap (01/06)	3.0625/1/-	2.69	1.97	1.15
Beans, Snap (01/08)	3.0625/1/-	4.65	2.85	1.62
Beans, Snap (01/01)	4.77/2/90	39.28	24.67	13.23
Beans, Snap (01/01)	3.94 + 4.58/2/90	41.09	26.16	13.34
Broccoli (05/01) [Cabbage][3]	6.13/1/-	68.64	50.41	30.47
Broccoli (05/06) [Cabbage]	6.13/1/-	14.74	8.638	4.07
Broccoli (05/09 [Cabbage]	6.13/1/-	33.87	21.48	14.16
Carrot (01/01)	6.13/1/-	41.49	30.32	18.40
Carrot (01/04)	6.13/1/-	27.79	17.51	10.03
Carrot (01/06)	6.13/1/-	5.38	3.94	2.31
Carrot (01/08)	6.13/1/-	9.30	5.71	3.24
Carrot (01/09)	6.13/1/-	16.80	10.31	5.85
Caster Beans (01/01)	1.76/1/-	13.33	9.75	5.91
Cauliflower (05/01)	6.13/1/-	68.64	50.41	30.47
Cauliflower (05/06)	6.13/1/-	14.74	8.64	4.07
Cauliflower (05/09)	6.13/1/-	33.87	21.48	14.16
Clover (06/09)	3.94/1/-	12.11	10.65	7.58
Corn (15/03)	6.13/1/-	43.55	29.91	19.53
Cotton (15/05)	6.13/1/-	3.43	2.72	1.65
Grapefruit (15/01)	6.13/1/-	7.47	5.48	3.59
Grapefruit (15/01)	3.0625/1/-	3.74	2.74	1.79
Lemon (15/01)	6.13/1/-	7.47	5.48	3.59
Lemon (15/01)	3.0625/1/-	3.74	2.74	1.79
Lespedeza (15/01)	3.94/1/-	28.21	20.86	13.56

Use (1st app day/month)	Rate (lb a.i./A)/ Number/ Interval	Peak (µg/L)	21-day (µg/L)	60-day (µg/L)
Lespedeza (g) (15/01)	4.00/1/-	27.56	20.92	13.80
Lettuce (01/02)	**6.13/1/-**	**170.8**	**122.2**	**72.94**
Lettuce (01/05)	6.13/1/-	13.98	9.84	6.12
Lettuce (01/06)	6.13/1/-	8.33	5.99	3.60
Lettuce (01/07)	6.13/1/-	14.63	10.54	6.33
Lettuce (01/08)	6.13/1/-	26.23	18.88	11.35
Lettuce (17/08)	6.13/1/-	35.46	25.52	15.34
Orchards /Nursery	14.88/1/-	115.13	81.75	47.81
Orange (15/01)	6.13/1/-	7.47	5.48	3.59
Orange (15/01)	3.0625/1/-	3.74	2.74	1.79
Potato (16/02)	3.0625/1/-	1.90	1.52	0.98
Potato (16/02)	6.13/1/-	3.81	3.04	1.97
Potato (16/02)	6.13/1/-	3.81	3.04	1.97
Potato (10/02)	6.00/1/- g[1]	73.99	52.95	31.33
Potato (10/02)	6.13/1/-	76.56	54.58	32.43
Potato (16/02)	6.00/1/- g	3.73	2.98	1.92
Potato (10/02)	6.13/1/-	78.16	55.72	33.10
Potato (16/02)	6.13/1/-	3.81	3.04	1.97
Potato (01/03)	6.13/1/-	4.10	3.11	2.03
Potato (10/02)	6.13/2/30	78.17	55.72	34.15
Potato (09/02)	6.13/2/30	54.45	36.77	20.86
Potato (16/02)	6.13/2/30	7.12	5.13	3.24
Safflower (01/01)	3.0625/1/-	27.79	21.85	14.48
Safflower (01/01)	3.0625/2/30	51.58	38.70	27.71
Safflower (01/03)	3.0625/1/-	32.30	23.98	15.33
Sugar Beet (25/01)	6.13/1/-	31.69	26.15	17.52
Sugar Beet (20/05)	6.13/1/-	3.50	2.61	1.65
Sugar Beet (05/06)	6.13/1/-	3.50	2.58	1.55
Sugar Beet (20/07)	6.13/1/-	3.51	2.70	1.70
Sugar Beet (07/11)	6.13/1/-	19.05	14.76	10.26
Sunflower (15/03)	3.06/2/30	23.77	16.88	10.68
Sunflower (01/04)	3.06/2/30	10.91	7.74	4.48
Sweet Potato (10/02)	7.44/1/-	94.93	67.68	40.21
Tomato (20/05)	3.0625/1/-	1.93	1.49	0.90

Use (1st app day/month)	Rate (lb a.i./A)/ Number/ Interval	Peak (µg/L)	21-day (µg/L)	60-day (µg/L)
Tangerine (15/01)	3.0625/1/-	3.74	2.74	1.79
Walnut (15/08)	3.0625/1/-	10.24	8.21	5.30
Walnut (15/01)	3.0625/1/-	23.85	17.87	11.15
Walnut (15/05)	3.0625/1/-	18.93	14.48	8.96
Walnut (15/06)	3.0625/1/-	11.53	9.02	5.83
Walnut (15/08)	3.0625/1/-	12.69	9.74	6.25
[Carrot] Fallow/Idle (20/09)	6.13/1/-	58.23	44.05	27.45
[Lettuce] Fallow/Idle (30/08)	6.13/1/-	45.34	32.63	19.61
[Lettuce] Fallow/Idle (01/08)	6.13/1/-	26.23	18.88	11.35
[Tomato] Fallow/Idle (02/01)	6.13/1/-	85.53	66.48	43.51
[Tomato] Fallow/Idle (30/09)	6.13/1/-	38.10	28.30	21.10
[Cotton] Fallow/Idle (15/03)	6.13/1/-	34.23	24.92	14.57
Forestry/Ornamental (15/01)	14.88/1/-	146.5	108.0	67.10

[1] granular formulation
[2] Unequal application rates.
[3] [] denotes surrogate scenario

3.2.4. Existing Monitoring Data

A critical step in the process of characterizing EECs is comparing the modeled estimates with available surface water monitoring data. EPTC has a limited set of surface and ground water monitoring data relevant to the CRLF assessment. Most of this data is non-targeted (i.e., study was not specifically designed to capture EPTC concentrations in high use areas).

Reviews of both surface water and ground water monitoring data for EPTC were conducted for the ecological risk assessment in support of the 1999 Reregistration Eligibility Decision (RED) for EPTC (USEPA, 1999). The surface and ground-water monitoring data sources considered at that time included the Agency's STORET database[19], the Pesticide in Ground Water (PGW) database (USEPA, 1992), and the USGS National Water Quality Assessment (NAWQA) program. Data have been reevaluated specifically for California, and additional monitoring data collected since the 1999 RED are considered in this assessment. Monitoring data specifically from California were obtained from the California Department of Pesticide Regulation (CDPR) Surface Water Database which contains monitoring data of pesticides in California from 1990 to 2005 (CDPR, 2006).

The number and percentage of samples with detections of EPTC depends upon the analytical method used (e.g., method detection limit (MDL), limit of quantification (LOQ), where and when the samples are collected, and where and when ETPC is used. The EPTC data from these monitoring studies are characterized in terms of general statistics including number of samples,

[19] http://www.epa.gov/STORET/

frequency of detections, maximum concentration, and means from all detections, where that level of detail is available.

3.2.4.a. USGS NAWQA Surface Water Data

Based on surface water monitoring data from the USGS NAWQA (National Water-Quality Assessment) program, EPTC is one of five most commonly detected herbicides in agricultural streams (USGS, 1999). The USGS NAWQA national database[20] currently contains monitoring data of pesticides from 1992 through 2006. The MDL for ETPC is defined as 0.02 µg/L by USGS (USGS, 1996). Prior to 2000, minimum reporting levels (MRL) were used by USGS rather than the MDL. The MRL ranged from 0.002 to 0.4 µg/L with a median MRL concentration of 0.002 µg/L. When a concentration is less than the MDL (or MRL), it was classified as a no detection. Using the lower the MDL rather than the higher MRL results in an increased number of samples no detections.

The USGS has collected 2136 surface water samples from 75 sites in California (**Table 3.5**). Of the 2136 surface water samples that have been collected and analyzed for EPTC residues in California, 41.8 % (893 samples out of 2136) had measurable EPTC concentrations. EPTC concentrations ranged between 0.007 µg/L and 40 µg/L. The mean and median peak concentrations (all data) were 0.0978 and 0.0096 µg/L, respectively. The highest reported EPTC concentration (40.0 µg/L) occurred during a June 1994 sampling event (prior to the available CA PUR data) in a mixed use watershed in Merced, CA. (The maximum arithmetic average concentration, 10.0 µg/L, is from the same sampling site). Average concentrations are expected to be conservative because concentrations with less than (<) remarks were considered to be equivalent to the minimum reporting limit (MRL). Three more recent samples were less than the MRL.

Table 3.5 Distribution of EPTC concentrations (µg/L) from 75 surface water sampling sites in the USGS NAWQA[21] data warehouse for California

Data	N	Percentile							
		Max	99.9	99.5	97.5	95.0	90.0	80.0	70.0
All site maximums	2136	40	4.73	0.716	0.156	0.786	0.037	0.011	0.005
All site averages	2136	10	0.249	0.250	0.238	0.18	0.086	0.024	0.014

3.2.4.b. USGS NAWQA Groundwater Data

EPTC was detected, but not quantified, in 1 of 272 agricultural wells in the San Joaquin Valley. EPTC was not detected in 176 urban wells (Paul *et al*., 2007, **Table 3.6**). The method detection limit (MDL) for the study was 0.001µg/L. EPTC has been detected in ground water in the USGS NAWQA study. The maximum detection was 0.091µg/L which was detected in an area with agricultural land use. The MDL for EPTC in the NAWQA program is 0.002 µg/L.

[20] http://water.usgs.gov/nawqa/. Accessed March 09, 2010.
[21] http://infotrek.er.usgs.gov/apex/f?p=NAWQA:HOME:3748645897450568

Table 3.6 Sample numbers, Minimum, Maximum, and Mean EPTC concentration in 766 samples collected from 479 sites from USGS NAWQA[1] data warehouse for California

Land Use Group	N	Minimum	Maximum	Average
Ag	336	0.002	0.091	0.0029
Mixed	263	0.002	0.0069	0.0023
Urban	89	0.002	0.004	0.0028
Other	78	0.00126	0.00388	0.0020
Total	766			

[1]http://water.usgs.gov.nawqa/. Accessed March 09, 2010

3.2.4.c. California Department of Pesticide Regulation (CDPR) Data

The California Department of Pesticide Regulation (CDPR) Surface Water Database contains monitoring data of pesticides in California from 1990 to 2006 (current to June 2008; CDPR, 2010a). The detection frequencies of EPTC ranged from about 1.4 to 43 %, and the highest EPTC concentrations ranged from 0.221 to 23 µg/L with average concentrations ranging from 0.10 to 4.68 µg/L (**Table 3.7**). These samples were collected between 1993 and October, 2006 in the Sacramento Valley (sacval1jun08, sacval2jun8), San Joaquin Valley (sjval1jun08, sjval2jun08, sjval3jun08), and other locations (OTHERJUN08) in California (CDPR, 2010b).

Table 3.7 Summary Statistics for EPTC from California Surface Water Ambient Monitoring Program[1] for 1993 through October 2006

Data File	N Samples	N Sites	Detection Frequency (%)	Range of Detections (µg/L)	Range for LOQ (µg/L)
SACVAL1JUN08	574	9	1.4	0[2] - 0.221	-1[*] to 0.1
SACVAL2JUN08	250	19	7.6	0 - 0.716	-1 to 0.1
SJVAL1JUN08	766	327	42.7	0 - 1.09	-1 to 0.015
SJVAL2JUN08	497	3	22.93	0 - 0.674	-1 to 0.129
SJVAL3JUN08	548	20	32.3	0 – 5.20	-1 to 0.002
OTHERJUN08	307	45	18.8	0 - 23.0	-1 to 0.1

[1] http://www.cdpr.ca.gov/docs/emon/surfwtr/surfdata.htm
[2-]Zero represents concentration ≤ the LOQ.
[*]Negative concentrations (-1 µg/L) were reported in several datasets. There is no explanation for the negative LOQs in the data.

The maximum EPTC concentration (23 µg/L) and the highest average EPTC concentration (4.68 µg/L) occurred at the Alamo River at Outlet (**Table 3.8**). Average concentrations are expected to be conservative because concentrations with less than (<) remarks were considered to be equivalent to the minimum reporting limit (MRL).

Table 3.8 Monitoring Site Summary Statistics for EPTC from California Surface Water Ambient Monitoring Program

Data File	Statistic	Concentration (µg/L)	Site Description
SACVAL1JUN08	Maximum	0.10[1]	Sacramento River at Freeport
	Average	0.10[1]	Arcade Creek at Norwood
SACVAL2JUN08	Maximum	0.716	Colusa Basin Drain above Knights Landing
	Average	0.101	Sacramento River near Hamilton City
SJVAL1JUN08	Maximum	1.09	Orestimba Creek at River Road (trib. to SJR)
	Average	0.25	Hospital C at River Rd Nr Patterson, California_USGS NAWQA site
SJVAL2JUN08	Maximum	0.674	San Joaquin River near Vernalis
	Average	0.129	San Joaquin River near Vernalis
SJVAL3JUN08	Maximum	4.73	Mud Slough (trib. to SJR)
	Average	0.282	Mud Slough (trib. to SJR)
Otherjun08	Maximum	23	Alamo River at Outlet
	Average	4.68	Alamo River at Outlet

[1] Max detection = 0.0221 µg/L; average diction = 0.00041 µg/L; except whereLOQ = 0.1 µg/L.
[2] Average concentration estimated with LOQ of 0.1 µg/L when concentration was reported as 0 µg/L

3.2.4.d. Additional Monitoring Data

As described in **Section 2.4.1**, tailwater runoff of EPTC following flood irrigation/chemigation is another possible exposure route for the DS. Monitoring study data suggest that EPTC concentrations in tailwater runoff from a flood-irrigated field can be considerably higher than the model-predicted EECs for surface water. A study was conducted by the USDA (Cliath et al., 1980; MRID 40420404) to evaluate the potential losses of EPTC from water through volatilization when applied by furrow irrigation. However, in addition to estimating losses of EPTC by volatilization, the concentration of EPTC in the runoff (irrigation tailwater) was also measured. EPTC was applied (2.7 lb per acre EPTC) at an average concentration of 2170 µg/L, and the field was irrigated for 9 hours (i.e., 0730 - 1630 hrs). Runoff was collected in a tailwater pit for 12 hours (i.e., 1300 - 0100 hrs the following day). Runoff volume was measured and sampled for analysis on an hourly basis. The measured EPTC concentrations in the tailwater ranged from 1440 to 1970 µg/L (and decreased with time). EPTC concentrations in the irrigation water at the head ditch ranged between 2100 and 2300 µg/L.

3.2.4.e. Atmospheric Monitoring Data

Detail concerning atmospheric monitoring data for EPTC are discussed in **Section 3.4**. Western Contaminants Assessment Project publication can be found at: http://www.nature.nps.gov/air/studies/air_toxics/wacap.cfm

Western Canada Reports (the files are located in the folder below):
G:\Teams and Panels\Special Teams\CRLF-SFBAY\Monitoring Data

3.3. Terrestrial Plant Exposure Assessment

TerrPlant (Version 1.1.2) is used to calculate EECs for non-target plant species inhabiting dry and semi-aquatic areas. Parameter values for application rate, drift assumption and incorporation depth are based upon the use and related application method (**Table 3.8**). The TerrPlant model estimated plant exposures assumes that only one (1) application of EPTC is made at the single maximum application rate on the label. A runoff value of 0.05 is utilized based on EPTC's solubility, which is classified by TerrPlant as 370 mg/L. More recent data (MRID 42120801) indicates that the solubility of EPTC is 344 mg/L (@ 25ºC) rather than 370 mg/L. Since TerrPlant assumes only three solubility class, EPTC will fall into the >100 mg/L class regardless of which solubility is used. EPTC is applied via ground application methods, and drift is assumed to be 1%. For aerial (only granular formulation) and ground application methods, drift is assumed to be 5% and 1%, respectively. EECs relevant to terrestrial plants consider pesticide concentrations in drift and in runoff. These EECs are listed by use in **Table 3.4**. An example output from TerrPlant v.1.2.2 is available in **Appendix F.**

Table 3.8 TerrPlant Inputs and Resulting EECs for Plants Inhabiting Dry and Semi-aquatic Areas Exposed to EPTC via Runoff and Drift

Use	Rate (lbs a.i./A)	Drift Value (%)	Spray drift EEC (lbs a.i./A)	Dry area EEC (lbs a.i./A)	Semi-aquatic area EEC (lbs a.i./A)
Ornamental[1]	14.88	1	0.149	0.893	7.589
		5	0.744	1.488	8.184
Sweet potato	7.44	1	0.074	0.446	3.794
		5	0.372	0.744	4.092
Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet, Alfalfa	6.13	1	0.061	0.368	3.126
		5	0.307	0.613	3.372
Dried beans	4.59	1	0.046	0.275	2.341
		5	0.230	0.459	2.525
Snap beans	3.94	1	0.039	0.236	2.009
		5	0.197	0.394	2.167
Almonds, Safflower, Tomato, Walnut	3.06	1	0.031	0.184	1.561
		5	0.153	0.306	1.683
Castor beans	1.76	1	0.018	0.106	0.898
		5	0.089	0.176	0.968

[1]Category includes shade trees, ornamental ground cover, ornamental herbaceous plants, ornamental woody shrubs and vines, and pine seed orchard.

3.4. Atmospheric Transport and Deposition

EPTC concentrations in rainfall ranged between 100 and 2,800 ng/L (Majewski,et al. 1995[22]). There were no detections of EPTC in air, smog or snow monitoring data. In a USDA study,

[22] *Pesticides in the Atmosphere; Distribution, Trends and Governing Factors.* 1996. Majewski, Michael S; Capel, Paul D, Volume One in the Series, Pesticides in the Hydrologic System, Ann Arbor Press, Inc.; Chelsea, Michigan.

Cliath, *et al.* reported[23] that 74% of the amount of EPTC added to irrigation water volatilized within the first 52 hours. Monitoring of rainfall in Indiana, Ohio, West Virginia and New York had a single EPTC detection (0.05 µg/L) in West Lafayette, Indiana[24]. State and local pesticide monitoring programs from October 1987 to September 1990 found three locations with EPTC detections (≥0.1 µg/L) in snow and rain[25].

Air monitoring data from Lompoc, California[26] reports an acute concentration of 6.5 ng/m^3, and a 10-week concentration of 0.43 ng/m^3, both far below the screening level value of 230,000 ng/m^3. The six weeks of ambient monitoring described in the "Report for the Air Monitoring of EPTC in Merced County (Application) and Imperial County (Ambient)" produced a maximum concentration of 12 $\mu g/m^3$ at the 9-hour sampling interval. None of the 24 ambient air samples taken by the California Department of Food and Agriculture's (CDFA) Worker Health and Safety Laboratory were above the limit of quantization. The highest ambient EPTC concentration was 0.24 $\mu g/m^3$ on October 1996.

In an attempt to estimate the amount of EPTC deposited into aquatic and terrestrial habitats, EPTC monitoring data were considered in combination with California specific precipitation data and runoff estimates from the PRZM model. The EPTC concentration in air was assumed to be 230,000 ng/m^3, which is the highest EPTC concentration in the available atmospheric monitoring data. PRZM runoff modeling was conducted using the following scenarios: CA lettuce, CA citrus (w/o irrigation), and CA citrus (with irrigation). The model provides an estimate of EPTC concentration in a standard pond scenario where the only contribution of EPTC is through rainfall. The model assumes rainwater EPTC concentrations are equal to the maximum concentration of EPTC (230,000 ng/m^3) in air monitoring data. EPTC concentrations are dependent on both direct deposition into the waterbody as well as runoff from the field. The maximum concentration of pesticide reported in rainfall is then factored into the volume of rainfall and runoff to determine deposition to terrestrial habitats in terms of pounds per acre, and to determine the concentration of pesticide in the standard ecological pond due to redeposition from runoff and from direct deposition by rainfall, in terms of micrograms per liter. This model does not consider sorption to soil, degradation or accumulation in the field or pond.

Peak EECs from atmospheric deposition are shown in **Table 3.9**. These exposure estimates are used to qualitatively describe the potential risk to the DS via the exposure route of atmospheric deposition.

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[23] Cliath, M.M., Spencer, W.F., Farmer, W.J., Shoup, T.D., and Grover, R,. 1980 Volatilization of S-ethyl N,N-dipropyl-thiocarbamate from water and wet soil during and after flood irrigation of alfalfa field; *J. Agri. Food Chem.*, v.28. no. 3, p-610-613 cited in *Pesticides in the Atmosphere; Distribution, Trends and Governing Factors.*

[24] Richards, R.P., Kramer, J.W., Baker, D.B., and Krieger, K.A., 1987, Pesticides in rainwater in the northeastern United States: *Nature*, v.327, no. 14 May, p.129-131, cited in *Pesticides in the Atmosphere; Distribution, Trends and Governing Factors.*

[25] Nations, B.K., Hallberg, G.R., 1992, Pesticides in Iowa precipitation: *J. Environ. Qual.*, v.21, P. 486-492, cited in *Pesticides in the Atmosphere; Distribution, Trends and Governing Factors.*

[26] Ambient Air Monitoring for Pesticides in Lompoc, California Volume 1: Executive Summary, Environmental Protection Agency California Department of Pesticide Regulation, State of California, March 2003 http://www.cdpr.ca.gov/docs/specproj/lompoc/exec_sum_march2003.pdf

Table 3.9 Estimated EPTC Concentration from Atmospheric Deposition

Scenario	Pond EEC	Terrestrial EEC
	µg/L	lbs ai/A
CA Lettuce	562	1.38
CA Citrus Irrigated	94.5	0.75
CA Citrus Non-Irrigated	73.2	0.67

4. Effects Assessment

This assessment evaluates the potential for EPTC to directly or indirectly affect the DS or modify their designated critical habitat. Assessment endpoints for the effects determination for each assessed species include direct toxic effects on the survival, reproduction, and growth, as well as indirect effects, such as reduction of the prey base or modification of its habitat. In addition, potential modification of critical habitat is assessed by evaluating effects to the PCEs, which are components of the critical habitat areas that provide essential life cycle needs of each assessed species.

As described in the Agency's Overview Document (USEPA, 2004), the most sensitive endpoint for each taxon is used for risk estimation. For this assessment, evaluated taxa include freshwater fish, freshwater invertebrates, estuarine/marine fish, estuarine/marine invertebrates, and aquatic plants. Acute (short-term) and chronic (long-term) toxicity information is characterized based on registrant-submitted studies and a comprehensive review of the open literature on EPTC.

One study with rats was also used to define the action area for this assessment to be consistent with the California red-legged frog risk assessment done in 2008; however this study is not presented here beyond this mention since mammals are not part of the conceptual models for the DS (**Figure 2.4** and **Figure 2.5**). In that study (MRID 46319101), the sublethal endpoint used to define the action area was a dose-related decrease in absolute brain weight in male rat pups at post-natal day 63 from developmental neurotoxicity data. These effects were observed at the lowest dose level tested, so there was no NOAEL.

4.1. Ecotoxicity Study Data Sources

Toxicity endpoints are established based on data generated from guideline studies submitted by the registrant and from open literature studies that meet the criteria for inclusion into the ECOTOX database maintained by EPA/Office of Research and Development (ORD) (USEPA, 2004). Open literature data presented in this assessment were obtained from the Re-registration Eligibility Decision (RED) document (USEPA, 1999) and the California red-legged frog risk assessment document (USEPA, 2008), as well as ECOTOX information obtained on January 28, 2010. In order to be included in the ECOTOX database, papers must meet the following minimum criteria:

1. toxic effects are related to single chemical exposure;
2. toxic effects are on an aquatic or terrestrial plant or animal species;
3. a biological effect is identified on live, whole organisms;
4. a concurrent environmental chemical concentration/dose or application rate is reported; and

5. duration of exposure is explicit.

Open literature toxicity data for 'target' terrestrial plant species, which include efficacy studies, are not currently considered in deriving the most sensitive endpoint for terrestrial plants. Efficacy studies do not typically provide endpoint values that are useful for risk assessment (*e.g.*, NOAEC, EC_{50}, etc.), but rather are intended to identify a dose that maximizes a particular effect (*e.g.*, EC_{100}). Therefore, efficacy data and non-efficacy toxicological target data are not included in the ECOTOX open literature summary table provided in **Appendix I**. The list of citations including toxicological and/or efficacy data on target plant species not considered in this assessment is provided in **Appendix H**.

Data that pass the ECOTOX screen are evaluated along with the registrant-submitted data, and may be incorporated qualitatively or quantitatively into this endangered species assessment. In general, effects data in the open literature that are more conservative than the registrant-submitted data are considered. The degree to which open literature data are quantitatively or qualitatively characterized for the effects determination is dependent on whether the information is relevant to the assessment endpoints (*i.e.*, survival, reproduction, and growth) identified in **Section 2.8**. For example, endpoints such as behavior modifications are likely to be qualitatively evaluated, because quantitative relationships between modifications and reduction in species survival, reproduction, and/or growth are not available. Although the effects determination relies on endpoints that are relevant to the assessment endpoints of survival, growth, or reproduction, it is important to note that the full suite of sublethal endpoints potentially available in the effects literature (regardless of their significance to the assessment endpoints) are considered, as they are relevant to the understanding of the area with potential effects, as defined for the action area.

Citations of all open literature not considered as part of this assessment because they were either rejected by the ECOTOX screen or accepted by ECOTOX but not used (*e.g.*, the endpoint is less sensitive) are included in **Appendix H. Appendix H** also includes a rationale for rejection of those studies that did not pass the ECOTOX screen and those that were not evaluated as part of this endangered species risk assessment.

A detailed spreadsheet of the available ECOTOX open literature data, including the full suite of lethal and sublethal endpoints is presented in **Appendix I**. **Appendix J** includes a summary of the human health effects data for EPTC.

In addition to registrant-submitted and open literature toxicity information, other sources of information, including use of the acute probit dose response relationship to establish the probability of an individual effect and reviews of ecological incident data, are considered to further refine the characterization of potential ecological effects associated with exposure to EPTC. A summary of the available aquatic and terrestrial ecotoxicity information and the incident information for EPTC are provided in **Sections 4.1** through **4.4**.

Consistent with the ecological risk assessment in support of the EPTC Registration Eligibility Decision (RED) (USEPA, 1999), this assessment considers the potential risk associated with the parent EPTC only. Two transformation products, dipropylamine and EPTC sulfoxide have been identified; however, available fate information suggests that they occur as relatively low percentages of applied radio-labeled EPTC, do not accumulate, and degrade at rates similar to the parent EPTC. Furthermore, the estimated aquatic exposure concentrations (EECs) for the combined residues (EPTC plus the transformation products) have been shown to be essentially the same as those for EPTC alone (EPTC Drinking Water Assessment, D339490). In addition, limited toxicity information suggests similar to lower toxicity between the parent, EPTC, and the tested degradates. One major degradate, R78202, was slightly less toxic to daphnids than the parent compound (MRID 45442201; **Appendix G**) with a 48-h LC50 of 22 mg R78202/L, while the range found for the parent compound was 6.5 to 14 mg a.i./L.

4.2. Toxicity of EPTC to Aquatic Organisms

A brief summary of submitted and open literature data considered relevant to this ecological risk assessment for the Delta smelt is presented in **Appendix G**. All endpoints are expressed in terms of the active ingredient (a.i.) unless otherwise specified.
Table 4.1

Table 4.1 summarizes the most sensitive aquatic toxicity endpoints, based on an evaluation of both the submitted studies and the open literature, as previously discussed. These endpoints were used to calculate RQs that relied on aquatic data. The most sensitive species among the freshwater and estuarine/marine fish species tested was used to calculate risk quotients and characterize the direct risk to the Delta smelt, regardless of the salinity environment, because the Delta smelt enters both freshwater and saltwater environments. Freshwater and estuarine/marine invertebrate and plant data were used to calculate RQs for indirect effects to the Delta smelt through the food chain.

Table 4.1. Aquatic Toxicity Profile for EPTC

Assessment Endpoint	Acute/ Chronic	Species Tested	Toxicity Value Used in Risk Assessment	Citation or MRID	Comment
Freshwater fish Direct Toxicity to the DS	Acute	Bluegill sunfish *Lepomis macrochirus*	96-h LC_{50} = 14 mg/L .	00144208	**Acceptable/Slightly toxic** NOAEC = 4.2 mg/L; LOAEC = 10 mg/L based on sublethal effects. 100% mortality observed at ≥ 24 mg/L
	Chronic	--	No data.	**Unfulfilled DCI**[2]	--
Freshwater invertebrates Indirect Toxicity to the DS (prey)	Acute	Water flea *Daphnia magna*	48-h EC_{50} = 6.5 mg/L	42945601	**Acceptable/Moderately toxic** NOAEC = 1.7 mg/L (mean measured). LOAEC = 3.2 mg/L (nominal) based on immobility.
	Chronic	Water flea *D. magna*	Reproduction: NOAEC = 0.8 mg/L LOAEC = 1.3 mg/L	45075006	**Acceptable** Survival: NOAEC = 1.3 mg ai./L LOAEC = 2.7 mg ai/L. Growth: NOAEC = 1.3 mg ai./L LOAEC = 2.7 mg ai./L

Assessment Endpoint	Acute/ Chronic	Species Tested	Toxicity Value Used in Risk Assessment	Citation or MRID	Comment
Estuarine/ marine fish Direct Toxicity to the DS	Acute	Sheepshead minnow *Cyprinodon variegattis*	96-h LC_{50} = 17 mg a.i./L	46145903	**Acceptable/Slightly Toxic**
	Chronic	--	No Data	**Unfulfilled DCI**[2]	--
Estuarine/ marine invertebrates Indirect Toxicity to the DS (prey)	Acute	Eastern oyster *Crassostrea Virginica* White shrimp *Penaeus setiferus*	96-h EC_{50} = 1.8 mg a.i./L 48-h LC_{50} = 0.63 mg a.i./L	46145901 40228401	**Acceptable/Moderately Toxic** **Supplemental, but scientifically sound.**
	Chronic	White shrimp *Penaeus setiferus*	NOAEC = 0.08 mg a.i./L	NOAEC calculated using daphnid ACR (8)[1]	Useable calculation
Aquatic plants Indirect Toxicity to the DS (food chain)	Non-vascular	Green Algae *Pseudokirchneriella subcapitata*	4-d EC_{50} = 1.4 mg/L	42921202 42899801	**Acceptable/Moderately Toxic** NOAEC = 0.9 mg/L LOAEC = 1.6 mg/L (% inhibition and cell density)
	Vascular	Duckweed *Lemna gibba*	Biomass: EC_{50} = 5.6 mg a.i./L NOAEC = 0.89 mg a.i./L Frond Number EC_{50}: 6.7 mg a.i./L NOAEC: 0.29 mg a.i./L	43096001	**Acceptable/Moderately Toxic** LOAEC (biomass): 2.9 mg a.i./L LOAEC (frond number): 0.89 mg a.i./L

[1]Acute to Chronic Ratio (ACR) from daphnid data (acute endpoint divided by chronic endpoint, 6.5/0.8 = 8).

Toxicity to fish and aquatic invertebrates is categorized using the system shown in **Table 4.2** (USEPA, 2004). Toxicity categories for aquatic plants have not been defined.

[2]Data Call-In previously submitted, not yet fulfilled.

Table 4.2. Categories of Acute Toxicity for Fish and Aquatic Invertebrates

LC_{50} (mg/L)	Toxicity Category
< 0.1	Very highly toxic
> 0.1 – 1	Highly toxic
> 1 – 10	Moderately toxic
> 10 – 100	Slightly toxic
> 100	Practically nontoxic

4.2.1. Toxicity to Freshwater Fish

A summary of acute and chronic freshwater fish data, including data from the open literature, is provided below in **Sections 4.2.1.a** through **4.2.1.c**. Additional information is included in **Appendices E, F and G**. Freshwater fish were used to estimate direct acute and chronic risks to the DS. Freshwater fish toxicity data were also used to assess potential indirect effects of EPTC to the DS via reduction in available prey items. As discussed in **Section 2.5.3**, the DS feeds chiefly on zooplankton, both as a juvenile and as an adult. A complete discussion of all available acute and chronic freshwater fish data is included in **Appendix G**.

4.2.1.a. Freshwater Fish: Acute Exposure (Mortality) Studies

Acceptable EPTC toxicity data were available for several fish species (**Appendix G**). The acute 96-hour median lethal toxicity thresholds (*i.e.*, LC_{50s}) for EPTC range from 14 to 27 mg a.i./L for bluegill sunfish, rainbow trout, cutthroat trout, and lake trout.

As shown in **Table 4.3**, the bluegill sunfish 96-hour LC_{50} of 14 mg/L will be used to calculate RQs. Fish toxicity studies with EPTC formulations (2.3 - 77.1% a.i.) are also available for consideration in this risk assessment. These studies suggest that the tested formulations and technical grade EPTC exhibit similar toxicity on an acute basis, with 96-hour LC_{50s} ranging from about 16 to 24 mg a.i./L.

Table 4.3 Freshwater Fish Acute Toxicity Data Used For RQ Calculation

Common Name	%AI	Study parameters	Test Results	MRID	Classification/ Category
Bluegill sunfish *Lepomis macrochirus*	98.6	96 hour study 10 fish/treatment 0, 0(solvent), 1.8, 4.2, 10, 24, 56 mg/L. Nominal concentrations used. Static study.	96-h LC_{50} = **14** (10-24) **mg a.i./L** Slope: undefined NOAEC = 4.2 mg/L LOAEC = 10 mg/L based on sublethal effects (darkened, quiescent and at the surface) and mortality (1 fish). At 24 mg/L and above, 100% mortality.	00144208	Acceptable/ Slightly toxic

Endpoints used in RQ calculations are presented in bold text.

A concern over volatilization of EPTC during aquatic toxicity tests was addressed in the RED (USEPA, 1999) by comparing nominal and measured concentrations from submitted studies; these measured concentrations at 48-h (MRID 42945601), 72-h (MRID 43096001), and 96-h (MRIDs 42899801, 42921202, 42921201, 42940901, and 42883501) indicated that EPTC volatilizes (degradation could also have been a factor) from water at losses ranging from 2 to approximately 50%. Therefore, at the end of a 96-h acute fish test, 20-25% losses would be expected, and by averaging initial and predicted final test concentrations, actual concentrations would be expected to be 10 to 13 percent less than nominal test concentrations.

4.2.1.b. Freshwater Fish: Chronic Exposure (Growth/Reproduction) Studies

No freshwater fish chronic studies are available for EPTC. Thus, the potential direct effects to the DS in terms of chronic effects (*e.g.*, reproduction, growth) cannot be quantitatively assessed at this time. Direct effects to DS are discussed in the Risk Description section (**5.2**).

4.2.1.c. Freshwater Fish: Sublethal Effects and Additional Open Literature Information

Sublethal effects reported in available acute fish toxicity studies for EPTC are summarized above in **Table 4.3** and in Appendix G. Based on this information, the observed sublethal effects (e.g., signs of intoxication, discoloration) generally occurred at levels close to (i.e., within an order of magnitude) of the calculated 96-hour LC_{50}.

Additional studies on the acute toxicity of EPTC on fish were identified in the open literature (**Appendix G**). However, none of the open literature studies resulted in a more sensitive acute toxicity threshold than the bluegill sunfish study (MRID 00144208), which reported a 96-hour LC_{50} of 14 mg a.i./L for EPTC. No chronic toxicity tests for fish were identified in the open literature; this remains a data gap.

4.2.1.d. Freshwater Fish: Information on Effects from Other Sources

A review of data from submitted ecotoxicity studies from other thiocarbamate herbicides was made in an attempt to find a useable acute to chronic ratio (ACR) for estimating a chronic fish endpoint (**Appendix G**). Only one ACR was found for fish, and this ACR was very low, the bluegill sunfish had an ACR of 4 from molinate exposures (MRIDs 41613601 and 00258924). When this ACR is applied to EPTC data, the estimated chronic NOAEC for bluegill sunfish would be 3.4 mg/L EPTC.

The EPI Suite™ v4.0 program[27] was also used to estimate chronic toxicity to fish based on EPTC's chemical structure (**Appendix E**). Estimated chronic endpoints ranged from 0.4 to 1.9 mg/L. The most conservative of these endpoints is 0.4 mg/L EPTC.

4.2.2. Toxicity to Freshwater Invertebrates

A summary of acute and chronic freshwater invertebrate data, including data published in the open literature, is provided below in **Sections 4.2.2.a** through **4.2.2.c**. Freshwater aquatic invertebrate toxicity data were used to assess potential indirect effects of EPTC to the DS via reduction in available food items. As discussed in Section 2.5.3, the main food source for juvenile and adult DS is aquatic invertebrates. A more detailed discussion of all available acute and chronic freshwater invertebrate data is included in Appendix G.

4.2.2.a. Freshwater Invertebrates: Acute Exposure Studies

Available toxicity data indicate that EPTC is slightly to moderately toxic on an acute basis to surrogate freshwater invertebrate species (**Appendix G**). The acute 48-hour EC_{50s} for EPTC range from 6.5 to 14 mg a.i./L for daphnids; the 48-hour LC_{50} of 6.5 mg/L will be used to calculate RQs (**Table 4.4**). The acute 96-hour EC_{50}s on the technical material for the isopod and scud (MRIDs 40094602 and 05001497) are 23, 66 and 23 mg/L, respectively. The 48-hour acute toxicities of the sulfoxide degradate and a mixture of two products, banvel plus eradicane 6.7 EC are 22 and 267 mg/L, respectively.

[27]http://www.epa.gov/oppt/exposure/pubs/episuitedl.htm

Table 4.4 Freshwater Invertebrate Acute Toxicity Data Used For RQ Calculation

Common Name	%AI	Study parameters	Test Results	MRID	Classification/ Category
Water flea *Daphnia magna*	98.4	48-hr static study Treatments: 1.8, 3.2, 5.6, 10, 18, 32, 56, and 100 mg/L. Mean measured concentrations from 1.7 to 93 mg/L.	48-h LC_{50}**: 6.5** (4.8-8.4) **mg a.i./L.** Probit slope: 2.08 (0.10 – 4.06) NOAEC: 1.7 mg a.i./L (mean measured) LOAEC: 3.2 mg a.i./L (nominal) based on immobility.	42945601	Acceptable/ Moderately toxic

Endpoints used in RQ calculations are presented in bold text.

4.2.2.b. Freshwater Invertebrates: Chronic Exposure Studies

A life-cycle study with the water flea (*Daphnia magna*) is available to assess the potential chronic risks of EPTC to freshwater invertebrates; study results are summarized in **Table 4.5**. An NOAEC of 0.81 mg/L based on a reduction in the number of offspring was established in the study and will be used to calculate RQs. The 21-day LC_{50} was 3.5 mg/L. This endpoint is not far from the NOAEC from observed sublethal effects in the acute study (1.7 mg a.i./L; **Table 4.4)**, approximately half.

Table 4.5 Freshwater Invertebrate Chronic Toxicity Data Used For RQ Calculation

Common Name	%AI	Study parameters	Test Results	MRID	Classification /Category
Water flea *Daphnia magna*	95.6	Static renewal life-cycle test. 10 daphnids/treatment. Treatments (mean measured) were 0 (neg. control), 0 (solvent control), 0.30, 0.47, 0.81, 1.3, 2.7 and 4.2 mg a.i./L.	21-d LC_{50} = 3.5 (2.9-4.3) mg ai./L Slope: 11.065 (3.87 - 18.26) NOAEC (survival): 1.3 mg a.i./L. LOAEC (survival): 2.7 mg a.i/L. NOAEC (growth): 1.3 mg a.i./L. LOAEC (growth): 2.7 mg a.i./L. NOAEC (reproduction): **0.81 mg a.i./L** LOAEC(reproduction): 1.3 mg a.i./L	45075006	Acceptable

Endpoints used in RQ calculations are presented in bold text.

4.2.2.c. Freshwater Invertebrates: Open Literature Data

Additional studies on the acute toxicity of EPTC on freshwater invertebrates were identified in the open literature (**Appendix G**). However, none of the open literature studies resulted in a more sensitive acute toxicity threshold than the *Daphnia magna* study (MRID 42945601), which reported a 48-hour EC_{50} of 6.5 (4.8-8.4) mg a.i./L for EPTC. There were no chronic EPTC toxicity studies for freshwater invertebrates identified in the open literature.

4.2.3. Toxicity to Estuarine/Marine Fish

A summary of acute and chronic estuarine/marine fish data, including data published in the open literature is provided below in **Sections 4.2.3.a** and **4.2.3.b**. Additional information is included in **Appendices E, F and G**. Estuarine/marine fish were used to estimate direct acute and chronic risks to the DS, and to assess potential indirect effects of EPTC to the DS via reduction in available prey items. As discussed in **Section 2.5.3**, the DS feeds chiefly on zooplankton, both as a juvenile and as an adult. A complete discussion of all available acute and chronic freshwater fish data is included in **Appendix G**.

4.2.3.a. Estuarine/Marine Fish: Acute Exposure Studies

Acceptable EPTC toxicity data were available for two saltwater fish species (**Appendix G**). The acute 96-hour median lethal toxicity thresholds (*i.e.*, LC_{50s}) for EPTC range from >5.0 to 17 mg a.i./L for longnose killifish and sheepshead minnows, respectively.

As shown in **Table 4.6**, the sheepshead minnow 96-hour LC_{50} of 17 mg/L was to calculate RQs. Freshwater fish toxicity studies with EPTC formulations (2.3 - 77.1% a.i.) suggest that the tested formulations and technical grade EPTC exhibit similar toxicity on an acute basis, with 96-hour LC_{50s} ranging from about 16 to 24 mg a.i./L. Similar data was unavailable from estuarine/marine fish studies for comparison.

Table 4.6 Saltwater Fish Acute Toxicity Data Used For RQ Calculation

Common Name	%AI	Study parameters	Test Results	MRID	Classification/ Category
Sheepshead minnow *Cyprinodon variegattis*	98.6	96 hour study 10 fish/treatment	96-h LC_{50} = **17 mg a.i./L**	46145903	Acceptable/ Slightly toxic

Endpoints used in RQ calculations are presented in bold text.

4.2.3.b. Estuarine/Marine Fish: Sublethal Effects and Chronic Exposure Studies

No saltwater fish chronic studies are available for EPTC. Thus, the potential direct sublethal effects (*e.g.*, reproduction, growth) to the DS from chronic exposure cannot be quantitatively assessed at this time. Direct effects to the DS are discussed in the Risk Description section (**5.2**).

Sublethal effects reported in available acute fish and invertebrate toxicity studies for EPTC are summarized above in **Table 4.3**, **Table 4.4**, and in **Appendix G**. Based on this information, the observed sublethal effects (e.g., signs of intoxication, discoloration) generally occurred at levels close to (i.e., within an order of magnitude) of the calculated 96-hour LC_{50} and of the NOAEC, in the case of the daphnid **(Table 4.5).**

4.2.3.c. Saltwater Fish: Information on Effects from Other Sources

A review of data from submitted ecotoxicity studies from other thiocarbamate herbicides was made in an attempt to find a useable acute to chronic ratio (ACR) for estimating a chronic fish endpoint (**Appendix G**), as discussed in **Section 4.2.1.d**. Only one ACR was found for fish, the bluegill sunfish ACR of 4 from molinate exposures (MRIDs 41613601 and 00258924). When this ACR is applied to EPTC data, the estimated chronic NOAEC for the sheepshead minnow would be 4.3 mg/L EPTC.

The EPI Suite™ v4.0 program[28] was also used to estimate chronic toxicity to fish based on EPTC's chemical structure (**Appendix E**). Estimated chronic endpoints ranged from 0.4 to 1.9 mg/L. The most conservative of these endpoints is 0.4 mg/L EPTC.

4.2.4. Toxicity to Estuarine/Marine Invertebrates

A summary of acute and chronic estuarine/marine invertebrate data, including data published in the open literature, is provided below in **Sections 4.2.4.a** and **4.2.4.b**. Saltwater aquatic invertebrate toxicity data were used to assess potential indirect effects of EPTC to the DS via reduction in available food items. As discussed in **Section 2.5.3**, the main food source for juvenile and adult DS is aquatic invertebrates. A more detailed discussion of all available acute and chronic freshwater invertebrate data is included in **Appendix G**.

4.2.4.a. Estuarine/Marine Invertebrates: Acute Exposure Studies

Available toxicity data indicate that EPTC is moderately to highly toxic on an acute basis to saltwater invertebrate species (**Appendix G**). The acute 96-hour EC_{50}s ranged from 1.8 to 3.7 mg a.i./L for oysters and shrimp, respectively. The acute 48-hour EC_{50}s for EPTC ranged from 0.6 to >20 mg a.i./L for shrimp and oysters, respectively; the 48-hour LC_{50} of 0.63 mg/L will be used to calculate RQs (**Table 4.7**). The reported endpoint 0.63 mg/L, when adjusted for 98% purity, is 0.64 mg a.i./L. The Mayer study (1986) was declared by EPA memo D274065 to be supplemental based on two deviations from the current EPA protocol (850.1035). First, concentrations were nominal, rather than measured, yet EPTC is a volatile chemical. Test concentrations in a daphnid chronic test (MRID 45075006) indicated losses of EPTC from uncovered beakers at the rate of 8 to 18 percent per day. Since the concentration reported is the lowest available endpoint and measuring the concentrations would only be expected to lower the endpoint, this deviation does not make the endpoint un-useable. Second, shrimp were only exposed for 48-, rather than 96-h. Again, a longer-term exposure could only make the endpoint lower, not higher, and so this also does not make this endpoint un-useable. Therefore, the Mayer (1986) study is considered supplemental but useable for risk assessment.

Table 4.7 Saltwater Invertebrate Acute Toxicity Data Used For RQ Calculation

Common Name	%AI	Study parameters	Test Results	MRID/ Reference	Classification/ Category
White shrimp *Penaeus (Litopenaeus) setiferus*	98	48-hr study	48-h LC_{50} = **0.64 mg a.i./L.**	40228401	Supplemental/ Highly toxic

Endpoints used in RQ calculations are presented in bold text.

[28] http://www.epa.gov/oppt/exposure/pubs/episuitedl.htm

The most important food organism for all sizes of the Delta smelt has been reported to be the copepod, *Eurytemora affinis* (USFWS, 1995 and 2004), which is a marine copepod. Supplemental toxicity data were not available to specifically address this species, so the white shrimp is used as a surrogate.

4.2.4.b. Estuarine/Marine Invertebrates: Chronic Exposure Studies

No saltwater invertebrate chronic studies are available for EPTC. A chronic toxicity endpoint estimate can be made for saltwater invertebrates from the acute shrimp data by using the *Daphnia magna* acute to chronic ratio (ACR) of 8 (acute endpoint, 6.5 mg a.i./L, divided by chronic endpoint, 0.8 mg a.i./L, 6.5/0.8 = 8). The estimated chronic toxicity endpoint is NOAEC = 0.08 mg a.i./L, which is over an order of magnitude lower than the NOAEC seen for sublethal effects in the acute test (1.7 mg a.i./L).

4.2.5. Toxicity to Aquatic Plants

Aquatic plant toxicity studies are used as one of the measures of effect to evaluate whether EPTC may affect primary production. Aquatic plants may also serve as dietary items for the Delta smelt and zooplankton upon which it preys. In addition, freshwater vascular and non-vascular plant data are used to evaluate PCEs associated with the critical habitat impact analysis.

Test results for three non-vascular and one vascular plant toxicity studies for EPTC are discussed in **Appendix G**. Based on the available data, green algae (*P. subcapitata*) is the most sensitive non-vascular plant species (**Table 4.8**), with an EC_{50} of 1.4 (1.3-1.5) mg a.i./L. The only vascular plant study available had an EC_{50} for duckweed of 5.6 (2.9 - 9.3) mg a.i./L.

Table 4.8 Non-target Aquatic Plant Toxicity Used For RQ Calculation

Species	%A.I.	Study Parameters	Test Results	MRID No.	Study Classification
Green Algae *P. subcapitata*	98.4	96-hour study. Treatments (mean-measured): 0 (neg. control), 0 (solvent control), 0.11, 0.22, 0.41, 0.86, 1.6, 3.3, 7.0, and 13 mg a.i./L	4-d EC_{50}: **1.4** (1.3-1.5) **mg a.i./L** Probit slope: 10 NOAEC: 0.9 mg a.i./L LOAEC: 1.6 mg a.i./L (based on % inhibition and cell density)	42921202 42899801	Acceptable
Duckweed *Lemna gibba*	98.4	14-day static renewal study. Treatments (mean-measured): Control, 0.012, 0.031, 0.092, 0.29, 0.89, 2.9, 9.3, 38.7 mg a.i./L	EC_{50} (biomass): **5.6** (2.9 - 9.3) **mg a.i./L** NOAEC (biomass): 0.89 mg a.i./L LOAEC (biomass): 2.9 mg a.i./L EC_{50} (frond no.): 6.7 (2.9 - 9.3) mg a.i./L NOAEC (frond no.): 0.29 mg a.i./L LOAEC (frond no.): 0.89 mg a.i./L	43096001	Acceptable

Endpoints used in RQ calculations are presented in bold text.

4.2.6. Aquatic Field/Mesocosm Studies

No freshwater field/mesocosm studies are available for EPTC.

4.3. Toxicity of EPTC to Terrestrial Plants

Plant taxa were the only terrestrial taxa considered in this risk assessment because terrestrial animals are not significant sources of food or habitat for the DS. **Table 4.9** summarizes the most sensitive terrestrial plant toxicity endpoints, based on an evaluation of both the submitted studies and the open literature, as previously discussed. A brief summary of submitted and open literature data considered relevant to this ecological risk assessment for the DS is presented in **Appendix G**. All endpoints are expressed in terms of the active ingredient (a.i.) unless otherwise specified.

Terrestrial plant data were used to calculate RQs for indirect effects to the DS through habitat modification since riparian vegetation provides shade and cover for smelt. Impacts to riparian and upland (i.e., grassland, woodland) vegetation may result in indirect effects to the DS, as well as modification to designated critical habitat PCEs via increased sedimentation, alteration in water quality, and reduction in of riparian habitat that provides shade and predator avoidance.

Table 4.9 Terrestrial Plant Toxicity of EPTC

Non-target Terrestrial Plant Seedling Emergence and Vegetative Vigor Toxicity (Tier II) Data Used For RQ Calculation						
Crop	**Type of Study Species**	**NOAEC [EC_{05}] (lb ai/A)**	**EC_{25} (lb ai/A)**	**Most sensitive parameter**	**Slope**	**MRID/ Category**
Seedling Emergence						
Monocot	Purple nutsedge *Cyperus rotundus)*	0.17 0.0144	0.27 **0.015**	Seedling emergence Dry weight	1.13±0.425	42120802/ Acceptable
Dicot	Morning glory *Ipomea hederacea*	7.4 [0.035] 0.23	>7.4 **0.26** 1.1	Seedling emergence Dry weight Phytotoxicity	1.10±0.206	42120802/ Acceptable
Vegetative Vigor						
Monocot	Winter wheat *Triticum aestivum*	0.925 [0.087]	2.9 **0.22**	Dry weight Phytotoxicity	2.33±0.740	43217101/ Acceptable
Dicot	Velvet leaf *Abutilon theophrastii*	[0.085] [0.023]	**2.0** 7.4	Dry weight Phytotoxicity	0.704±0.370	43217101/ Acceptable

Endpoints used in RQ calculations are presented in bold text.

Plant toxicity data from both registrant-submitted studies and studies in the scientific literature were reviewed for this assessment. Registrant-submitted studies are conducted under conditions and with species defined in EPA toxicity test guidelines. Sublethal endpoints such as plant growth, dry weight, and biomass are evaluated for both monocots and dicots, and effects are evaluated at both seedling emergence and vegetative life stages. Guideline studies generally evaluate toxicity to ten crop species. A drawback to these tests is that they are conducted on herbaceous crop species only, and extrapolation of effects to other species, such as the woody shrubs and trees and wild herbaceous species, contributes uncertainty to risk conclusions.

Commercial crop species have been selectively bred, and may be more or less resistant to particular stressors than wild herbs and forbs. The direction of this uncertainty for specific plants and stressors, including EPTC, is largely unknown. Homogenous test plant seed lots also lack the genetic variation that occurs in natural populations, so the range of effects seen from tests is likely to be smaller than would be expected from wild populations.

The results of the Tier II seedling emergence and vegetative vigor toxicity tests on non-target plants are presented in **Appendix G.**

4.4. Toxicity of Chemical Mixtures

As previously discussed, the results of available toxicity data for mixtures of EPTC with other pesticides are presented in **Appendix A**.

4.5. Incident Database Review

A review of the Ecological Incident Information System (EIIS, version 2.1), the 'Aggregate Incident Reports' (v. 1.0) database, and the Avian Monitoring Information System (AIMS) for ecological incidents involving EPTC was completed on January 21, 2010. The results of this review for terrestrial, plant, and aquatic incidents are discussed below in **Sections 4.5.1** through **4.5.3**. A complete list of the incidents involving EPTC including associated uncertainties is included as **Appendix L**.

4.5.1. Terrestrial Incidents

No terrestrial animal incidents involving EPTC have been found as of January 21, 2010.

4.5.2. Plant Incidents

Prior to the RED, EPTC had been identified in one incident which include stunted and/or dying plants (presented in Appendix VII of the RED). In a list of 6(a)2 incidents occurring between April 1 and June 30, 1997 submitted by Zeneca, one incident (I005805-002) occurred in Pennsylvania with symptoms reported as reduced stand and stunted plants in alfalfa and stunted and dying tomatoes. Eptam (a.i. is EPTC) was identified as the "possible" cause. No other information was available.

Since the 1999 RED was published, five new incidents were recorded in EPA's EIIS database. Incident I013636-043 occurred in 2001 and involved a registered use on dry beans in Oregon, with EPTC applied by ground broadcast; 59 acres of grass grown for seed was damaged and EPTC was deemed the possible cause. Then, in 2002, ground broadcast to alfalfa from a labeled use (Incident I013636-049) resulted in damage to 50 out of 53 acres of the alfalfa; EPTC was listed as the probable cause. In 2003, two incidents occurred (I014702-032 and I014702-033) in which 55 and 68 acres, respectively, of corn were damaged after ground broadcast/soil incorporation and broadcast applications of EPTC; however, EPTC was listed but deemed unlikely as the cause. In 2005, 2000 acres of potatoes were damaged (Incident I016595-028) following granular aerial application of EPTC; EPTC was determined to be a possible cause. A review of the AIMS database on January 21, 2010 revealed no bird incidents attributed to EPTC. EPTC was not among the listed pesticides in the AIMS data base at that time.

4.5.3. Aquatic Incidents

Two aquatic incidents were attributed to EPTC prior to the RED (these are presented in Appendix VII of the RED). Other pesticides more toxic than EPTC to aquatic species were also identified in the two fish kill incidents. In one case (Illinois 1993, incident number B000150-001), runoff after heavy rains killed approximately 40 fish in a one-acre pond adjacent to about 30 acres of corn treated with phorate plus propachlor, atrazine, EPTC and an ester of 2,4-D (phorate was believed to be responsible for the fish kill). The second fish kill incident (Illinois 1995, incident number 1001081-001), resulted in more than 600 catfish killed from runoff into a 2.5-acre pond following 03.-1.79 inches of rain on a 30-acre cornfield treated with tefluthrin. Other fields around the pond had been treated with Eradicane 6.7E (4 pints EPTCIA), Extrazine

I1 DF (2.5 lbs/A), Aatrex 9-0 (1.25 lbs/A) and dry anhydrous ammonia (180 lbs/A actual nitrogen). Although EPTC had been applied to fields adjacent to these ponds, it was not suspected as the cause of either fish kill. No aquatic animal or plant incidents involving EPTC have been found since the 1999 RED, as of January 21, 2010.

4.6. Use of Probit Slope Response Relationship to Provide Information on the Endangered Species Levels of Concern

The Agency uses the probit dose response relationship as a tool for providing additional information on the potential for acute direct effects to individual listed species and aquatic animals that may indirectly affect the listed species of concern (USEPA, 2004). As part of the risk characterization, an interpretation of acute RQs for listed species is discussed. This interpretation is presented in terms of the chance of an individual event (*i.e.*, mortality or immobilization) should exposure at the EEC actually occur for a species with sensitivity to EPTC on par with the acute toxicity endpoint selected for RQ calculation. To accomplish this interpretation, the Agency uses the slope of the dose response relationship available from the toxicity study used to establish the acute toxicity measures of effect for each taxonomic group that is relevant to this assessment. The individual effects probability associated with the acute RQ is based on the mean estimate of the slope and an assumption of a probit dose response relationship. In addition to a single effects probability estimate based on the mean, upper and lower estimates of the effects probability are also provided to account for variance in the slope, if available.

Individual effect probabilities are calculated based on an Excel spreadsheet tool IECV1.1 (Individual Effect Chance Model Version 1.1) developed by the U.S. EPA, OPP, Environmental Fate and Effects Division (June 22, 2004). The model allows for such calculations by entering the mean slope estimate (and the 95% confidence bounds of that estimate) as the slope parameter for the spreadsheet. In addition, the acute RQ is entered as the desired threshold.

5. Risk Characterization

Risk characterization is the integration of the exposure and effects characterizations. Risk characterization is used to determine the potential for direct and/or indirect effects to the Delta smelt or for modification to their designated critical habitat from the use of EPTC in CA. The risk characterization provides an estimation (**Section 5.1**) and a description (**Section 5.2**) of the likelihood of adverse effects; articulates risk assessment assumptions, limitations, and uncertainties; and synthesizes an overall conclusion regarding the likelihood of adverse effects to the assessed species or their designated critical habitat (*i.e.*, "no effect," "likely to adversely affect," or "may affect, but not likely to adversely affect"). In the risk estimation section, risk quotients are calculated using standard EFED procedures and models. In the risk description section, additional analyses may be conducted to help characterize the potential for risk.

5.1. Risk Estimation

Risk is estimated by calculating the ratio of exposure to toxicity. This ratio is the risk quotient (RQ), which is then compared to pre-established acute and chronic levels of concern (LOCs) for each category evaluated (**Appendix C**). For acute exposures to the aquatic animals the LOC is 0.05. The LOC for chronic exposures to animals, as well as acute exposures to plants is 1.0.

Acute and chronic risks to aquatic organisms are estimated by calculating the ratio of exposure to toxicity using 1-in-10 year EECs in **Table 3.1** based on the label-recommended EPTC usage scenarios summarized in **Table 3.2** and the appropriate aquatic toxicity endpoint from **Table 4.1**. Acute and chronic risks to terrestrial plants are estimated based on exposures resulting from applications of EPTC (**Table 3.2** through **Table 3.4**) and the appropriate toxicity endpoint from **Table 4.1.** Exposures are derived as discussed in **Section 3.3** and summarized in **Table 3.4**. To provide an indication of the contribution of drift during the application of EPTC by chemigation with sprinkler irrigation on, aquatic EECs were also generated assuming 95 percent application efficiency and spray drift fraction of 0.05 [default assumptions for aerial spray application]. For the lettuce scenario (highest EECs – mostly due to runoff), the peak, 21-day and 60-day means were slightly higher (1.03, 1.01, and 1.05 times for the peak, 21-day and 60-day EECs, respectively) when applied by air compared to ground. For the potato scenario (lowest EECs – primarily due to drift), the peak, 21-day and 60-day EECs were 4.5, 4.4, and 4.4 times greater when applied by air spray compared to ground spray, respectively based on the highest application rates of EPTC use within the action area.

5.1.1. Exposures in the Aquatic Habitat

5.1.1.a. Freshwater Fish

Acute risk to fish is generally based on 1 in 10 year peak EECs in the standard pond and the lowest acute toxicity value for freshwater fish. Chronic risk is usually based on the 1 in 10 year 60-day EECs and the lowest chronic toxicity value for freshwater fish. Risk quotients (RQs) for freshwater fish are shown in **Table 5.1**. Based on the peak EEC and most sensitive (lowest) 96-hour LC_{50} for freshwater fish (bluegill LC50 of 14, 000 µg a.i./L) from the available toxicity data, there is no exceedence of the acute risk level of concern (LOC) for endangered species (0.05). However, field monitoring studies show that EPTC concentrations in tailwater runoff from flood-irrigated fields can be considerably higher than the modeled pond EECs. Cliath *et al.* (1980) reported EPTC levels in tailwater up to 1970 µg/L. When RQs are calculated using this exposure estimate with the bluegill data, the RQ is 0.14, which exceeds the LOC (0.05), but the probability is low, approximately 1 in 16,400.

Table 5.1. Acute and Chronic RQs for Freshwater Fish

Uses/Application Rate	Species	Peak EEC (µg/L)	60-day EEC (µg/L)	Acute Effects			Chronic RQ[1]
				RQ[1]	Probability of Individual Effect at ES LOC[2,3]	Probability of Individual Effect at RQ[2]	
Highest Modeled Concentrations:							
Lettuce/6.13 lb a.i./A	Bluegill sunfish *Lepomis macrochirus*	171	73	0.01	~1 in 4.18 E+08 (~1 in 2.16 E+02 to 1 in 1.75E+31)	~1 in 8.86 E+18 (~1 in 3.16 E+04 to 1 in 1.03 E+72)	--
Lowest Modeled Concentrations:							

Tomato 3.06 lb a.i./A	Bluegill sunfish *L. macrochirus*		0.90				--
Potato 3.06 lb a.i./A	Bluegill sunfish *L. macrochirus*	1.90		<0.01	~1 in 4.18 E+08 (~1 in 2.16 E+02 to 1 in 1.00 E+16)	~1 in 8.86 E+18 (~1 in 3.16 E+04 to 1 in 1.03 E+72)	
Highest Concentration From Tailwater data:							
Tailwater data	Bluegill sunfish *L. macrochirus*	1970	<1-1440[4]	**0.14**	~1 in 4.18E+08 (~1 in 2.16 E+02 to 1 in 1.00 E+16)	~1 in 1.64 E+04 (~1 in 2.28 E+01 to 1 in 1.31 E+14)	--

[1]LOC exceedances (acute RQ $\geq$ 0.05; chronic RQ $\geq$ 1.0) are bolded and shaded. Acute RQ = use-specific peak EEC / [Bluegill LC50 = 14,000 µg a.i./L]. Chronic RQ could not be calculated due to lack of toxicity data and so a conclusion of "may effect" is assumed. However, an estimation can be made from calculated data below: Chronic RQ = use-specific 60-d EEC/ NOAEC, where the NOAEC is estimated using modeled data (see Section 4.2.1.d).
[2]The probit dose-response slope value for the bluegill sunfish acute toxicity study is not available; therefore, the effect probability was calculated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 to 9 (Urban and Cook, 1986).
[3]Endangered species LOC of 0.05.
[4]Monitoring concentration fell to 1440 µg/L after one day and to <1 by 21-d.

Direct chronic risks to the DS cannot be quantitatively assessed at this time because no chronic toxicity data for fish are available; thus, risk cannot be precluded at this time (see Risk Description for further discussion). Therefore, based on tailwater data and on a lack of chronic toxicity data for fish, the preliminary effect determination for direct effects to the DS is **may affect** for all of the assessed EPTC uses. EPTC **does** have the potential to directly affect Delta smelt in their freshwater habitat.

Risks can be estimated using the ACR from molinate and modeled data from EPI Suite, 3,400 and 400 µg/L EPTC, respectively (see **Section 4.2.1.d**). If RQs are calculated using these data with modeled exposure data, the LOC is not exceeded. However, when the most conservative of these endpoints, the modeled endpoint from EPI Suite - 400 µg/L EPTC, is used with the tailwater data, the chronic LOC is exceeded both at its max and average (1220 µg/L), which supports EPA's conclusion that chronic effects to freshwater fish cannot be precluded.

5.1.1.b. Freshwater Invertebrates

Acute risk to freshwater invertebrates is usually based on 1 in 10 year peak EECs in the standard pond and the lowest acute toxicity value for freshwater invertebrates. Chronic risk is based on 1 in 10 year 21-day EECs and the lowest chronic toxicity value for freshwater invertebrates. Risk quotients for freshwater invertebrates are shown in **Table 5.2**.

Table 5.2. Summary of Acute and Chronic RQs for Freshwater Invertebrates

Uses/Application Rate	Species	Peak EEC (µg/L)	21-day EEC (µg/L)	Acute Effects		Chronic RQ[1]
				RQ[1]	% Expected Effect on Prey Population at RQ[2]	
Highest Modeled Concentrations:						

Lettuce/6.13 lb a.i./A	Water Flea *Daphnia magna*	171	122	0.03	<0.1 (<0.1 - 44)	0.15
Lowest Modeled Concentrations:						
Tomato 3.06 lb a.i./A	Water Flea *D. magna*		1.49			<0.01
Potato 3.06 lb a.i./A	Water Flea *D. magna*	1.90		<0.01	<0.1 (<0.1 - 42)	
Highest Concentration From Tailwater data:						
Tailwater data	Water Flea *D. magna*	1970	<1-1440[4]	**0.30**[5]	14 (1.7- 48)	<0.01 - **1.7** Ave = 0.9

[1]LOC exceedances (acute RQ for non-ES ≥ 0.5; chronic RQ ≥ 1.0) are bolded and shaded. Acute RQ = use-specific peak EEC / [Daphnid EC50=6490 µg a.i./L]. Chronic RQ = use-specific 21-day EEC / [Daphnid NOAEC = 810 µg a.i./L]. Non-endangered LOCs are used for food items of the DS since none are obligate, but the endangered LOC (0.05) is noted for comparison.
[2]The % expected effect on prey population was calculated based on a probit dose-response slope value for the water flea acute toxicity study 2.08 with 95% confidence intervals of 0.10 – 4.06.
[3]Acute ES LOC = 0.05; non-ES LOC = 0.5.
[4]Monitoring concentration fell to 1440 µg/L after one day and to <1 by 21-d.
[5]Exceeds LOC for endangered species, but not LOC for non-endangered species.

Based on these EECs and acute toxicity data for the most sensitive freshwater invertebrate tested *(Daphnia magna)*, the acute RQs do not exceed the acute LOC of 0.5 for any EPTC uses. Likewise, the chronic RQs do not exceed the LOC of 1.0, based on the projected 21-day mean aquatic EECs and the reproductive NOAEC for the *Daphnia magna.* However, when freshwater invertebrate RQs are calculated using this exposure estimate of 1970 µg/L from tailwater runoff, the acute LOC for endangered species (0.05) is exceeded (RQ of 0.30), but not the LOC for non-endangered species (0.5) of freshwater invertebrates. As for the chronic exposures, the tailwater data reported a peak EPTC concentration of 1970 µg/L; 12 hours later the concentration had dropped to 1440 µg/L. Based on these monitoring data, the half-life of EPTC in tailwater is estimated to be 1.65 days, and the concentration at 21 days would be less than 1 µg/L. Therefore, indirect effects are projected based on tailwater data and acute effects. The determination for indirect effects (prey) to the DS in freshwater habitats is **may affect** for all of the assessed EPTC uses. EPTC **does** have the potential to affect the Delta smelt indirectly by reducing freshwater invertebrates they feed upon.

5.1.1.c. Estuarine/Marine Fish

Acute risk to estuarine/marine fish is generally based on 1 in 10 year peak EECs in the standard pond and the lowest acute toxicity value for estuarine/marine fish. Chronic risk is based on 1 in 10 year 60-day EECs and the lowest chronic toxicity value for estuarine/marine fish is used. Risk quotients are shown in **Table 5.3**. Based on the peak EEC and most sensitive (lowest) 96-hour LC_{50} for saltwater fish from the available toxicity data (sheepshead LC50 of 17,000 µg a.i./L), there is no exceedence of the acute risk LOC for endangered species (0.05). However, field monitoring concentrations mentioned in the freshwater section is substantially higher, 1970 µg/L. When RQs are calculated using this exposure estimate with the sheepshead data, the RQ is 0.12, which exceeds the LOC (0.05), but the probability is low, approximately 1 in 58,500.

Table 5.3. Summary of RQs for Estuarine/Marine Fish

Uses/Application Rate	Species	Peak EEC (µg/L)	60-day EEC (µg/L)	Acute			Chronic RQ*
				RQ[1]	Probability of Individual Effect at ES LOC[2,3]	Probability of Individual Effect at RQ[2]	
Highest Modeled Concentrations:							
Lettuce/6.13 lb a.i./A	Sheepshead minnow *Cyprinodon variegattis*	171	73	0.01	~1 in 4.18 E+ 08 (~1 in 2.16 E+02 to 1 in 1.75 E+31)	~1 in 8.86 E+18 (~1 in 3.16 E+04 to 1 in 1.03 E+72)	--
Lowest Modeled Concentrations:							
Tomato 3.06 lb a.i./A	Sheepshead minnow *C. variegattis*		0.90	<0.01			--
Potato 3.06 lb a.i./A	Sheepshead minnow *C. variegattis*	1.90					
Highest Concentration From Tailwater data:							
Tailwater data	Sheepshead minnow *C. variegattis*	1970	<1-1440[4]	**0.12**[5]	~1 in 4.18 E+ 08 (~1 in 2.16 E+02 to 1 in 1.75 E+31)	~1 in 5.85 E+04 (~1 in 30.5 to 1 in 1.73 E+16)	--

[1]LOC exceedances (acute RQ $\geq$ 0.05; chronic RQ $\geq$ 1.0) are bolded and shaded. Acute RQ = use-specific peak EEC / [Sheepshead LC_{50} of 17,000 µg a.i./L]. Chronic RQ could not be calculated due to lack of toxicity data and so a conclusion of "may effect" is assumed.
[2]The probit dose-response slope value for the sheepshead acute toxicity study is not available; therefore, the effect probability was calculated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986).
[3]Acute endangered species LOC of 0.05.
[4]Monitoring concentration fell to 1440 µg/L after one day and to <1 by 21-d.
[5]Exceeds LOC for endangered species, but not LOC for non-endangered species.

Direct chronic risks to the DS from saltwater exposure cannot be quantitatively assessed at this time because no chronic toxicity data are available; thus, risk cannot be precluded at this time (see Risk Description for further discussion). Therefore, the preliminary effect determination for direct acute and chronic effects to the DS from saltwater exposure is **may affect** for all of the assessed EPTC uses. Based on tailwater data and on a lack of chronic toxicity data for fish, EPTC **does** have the potential to directly affect Delta smelt in its saltwater habitat.

Risks can be estimated using the ACR from molinate and modeled data from EPI Suite, 4,300 and 400 µg/L EPTC, respectively (see **Section 4.2.3.c**). If RQs are calculated using these data, the LOC would not be exceeded when modeled data are used to calculate RQs. However, when the most conservative of these endpoints, the modeled endpoint from EPI Suite - 400 µg/L EPTC, is used with the tailwater data, the chronic LOC is exceeded both at its max and average (1220 µg/L), which supports EPA's conclusion that chronic effects to freshwater fish cannot be precluded.

5.1.1.d. Estuarine/Marine Invertebrates

Acute risk to estuarine/marine invertebrates is usually based on peak EECs in the standard pond and the lowest acute toxicity value for estuarine/marine invertebrates. Chronic risk is usually based on 21-day EECs and the lowest chronic toxicity value for estuarine/marine invertebrates. Risk quotients are shown in **Table 5.4.**

Table 5.4. Summary of Acute and Chronic RQs for Estuarine/Marine Invertebrates

Uses/1st app day/month	Application Rate (lb a.i./A)/ Number/ Interval	Species	Peak EEC (µg/L)	21-day EEC (µg/L)	Acute		Chronic RQ[1]
					RQ[1]	% Expected Effect on Prey Population at RQ[2]	
Highest Modeled Concentrations:							
Lettuce 01/02	6.13/1/-	White shrimp *Penaeus (Litopenaeus) setiferus*	171	122	0.29[4]	0.78 (<0.001 - 14)	**1.5**
Ornamental[5] 15/01	14.88/1/-	White shrimp	147	108	0.24[4]	0.26 (<0.001 - 11)	**1.4**
Sweet Potato 10/02	7.44/1/-	White shrimp	94.9	67.7	0.16[4]	0.017 (<0.001 - 5.6)	0.8[5]
[Tomato] Fallow/Idle02/01	6.13/1/-	White shrimp	85.5		0.14[4]	0.0061 (<0.001 - 44)	
Potato 10/02	6.13/2/30	White shrimp	78.2		0.13[4]	0.0033 (<0.001 - 3.8)	
Potato 10/02	6.13/1/-	White shrimp	78.2		0.13[4]	0.0033 (<0.001 – 3.8)	
Potato 10/02	6.13/1/-	White shrimp	76.6		0.13[4]	0.0033 (<0.001 - 3.8)	
Potato 10/02	6.00/1/-	White shrimp	74		0.12[4]	0.0017 (<0.001 – 3.3)	
Broccoli 05/01 [Cabbage]	6.13/1/-	White shrimp	68.6		0.11[4]	<0.001 (<0.001 - 2.8)	
Cauliflower 05/01	6.13/1/-	White shrimp	68.6		0.11[4]	<0.001 (<0.001 – 2.8)	
[Carrot] Fallow/Idle 20/09	6.13/1/-	White shrimp	58.2		0.097[4]	<0.001 (<0.001 - 2.1)	
Potato 09/02	6.13/2/30	White shrimp	54.5		0.091[4]	<0.001 (<0.001 - 1.9)	
Safflower 01/01	3.0625/2/30	White shrimp	51.6		0.086[4]	<0.001 (<0.001 - 1.7)	
Beans, Dried 01/01	4.594 + 3.67/30	White shrimp	47.9		0.080[4]	<0.001 (<0.001 - 1.4)	
[Lettuce] Fallow/Idle 30/08	6.13/1/-	White shrimp	45.3		0.076[4]	<0.001 (<0.001 - 1.3)	
Alfalfa 5/01	6.13/1/-	White shrimp	44.2		0.074[4]	<0.001 (<0.001 - 1.2)	
Corn 15/03	6.13/1/-	White shrimp	43.6		0.073[4]	<0.001 (<0.001 - 1.2)	
Carrot 01/01	6.13/1/-	White shrimp	41.5		0.069[4]	<0.001 (<0.001 - 1.0)	
Beans, Dried 01/01	3.94/2/30	White shrimp	41.3		0.069[4]	<0.001 (<0.001 - 1.0)	
Beans, Snap 01/01	3.94 + 4.58/2/90	White shrimp	41.1		0.068[4]	<0.001 (<0.001 - 0.98)	
Beans, Snap 01/01	4.77/2/90	White shrimp	39.3		0.065[4]	<0.001 (<0.001 - 0.88)	

Uses/1st app day/month	Application Rate (lb a.i./A)/ Number/ Interval	Species	Peak EEC (µg/L)	21-day EEC (µg/L)	Acute		Chronic RQ[1]
					RQ[1]	% Expected Effect on Prey Population at RQ[2]	
Highest Modeled Concentrations:							
[Tomato] Fallow/Idle 30/09	6.13/1/-	White shrimp	38.1		0.064[4]	<0.001 (<0.001 - 0.85)	
Beans, Snap 01/01	3.0625/1/-	White shrimp	37.3		0.062[4]	<0.001 (<0.001 - 0.79)	
Lettuce 17/08	6.13/1/-	White shrimp	35.5		0.059[4]	<0.001 (<0.001 - 0.70)	
[Cotton] Fallow/Idle 15/03	6.13/1/-	White shrimp	34.2		0.057[4]	<0.001 (<0.001 - 0.64)	
Broccoli 05/09 [Cabbage]	6.13/1/-	White shrimp	33.9		0.056[4]	<0.001 (<0.001 - 0.62)	
Cauliflower 05/09	6.13/1/-	White shrimp	33.9		0.056[4]	<0.001 (<0.001 - 0.62)	
Alfalfa 1/01	3.0625/3/40	White shrimp	33.4		0.056[4]	<0.001 (<0.001 - 0.62)	
Alfalfa 20/01	6.13/1/-	White shrimp	32.4		0.054[4]	<0.001 (<0.001 - 0.56)	
Safflower 01/03	3.0625/1/-	White shrimp	32.3		0.054[4]	<0.001 (<0.001 - 0.56)	
Sugar Beet 25/01	6.13/1/-	White shrimp	31.7		0.053[4]	<0.001 (<0.001 - 0.54)	
Beans, Dried 01/01	4.594/1/-	White shrimp	31.1		0.052[4]	<0.001 (<0.001 - 0.51)	
Lespedeza 15/01	3.94/1/-	White shrimp	28.2		0.047[6]	<0.001 (<0.001 - 0.40)	
Uses with peak modeled concentrations lower than that of lespedeza are omitted here – no exceedences.							
Lowest Modeled Concentrations:							
Tomato 20/05	3.0625/1/-	White shrimp		1.49			0.02
Potato 16/02	3.0625/1/-	White shrimp	1.90		<0.01	<0.001 (<0.001 - 0.032)	
Highest Concentration From Tailwater data:							
Tailwater data		White shrimp	1970	<1-1440[7]	**3.3**[8]	99 (85 - 100)	<1-**18** **Ave = 9**

[1]LOC exceedances (acute RQ ≥ 0.5; chronic RQ ≥ 1.0) are bolded and shaded. Acute RQ = use-specific peak EEC / [White shrimp LC_{50} of 600 µg a.i./L]. Chronic RQ = use-specific peak EEC / [White shrimp estimated NOAEC of 80 µg a.i./L - estimated from daphnid acute to chronic ratio].
[2]Category includes shade trees, ornamental ground cover, ornamental herbaceous plants, ornamental woody shrubs and vines, and pine seed orchard.
[3]The probit dose-response slope value for the white shrimp acute toxicity study is not available; therefore, the effect probability was calculated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986).
[4]Exceeds the acute endangered species LOC of 0.05, but not the non-endangered species LOC of 0.5. Food items of endangered species are assessed against the non-endangered species LOC for categorization of risk unless an obligate relationship exists with the endangered species. However, exceedances of the endangered species LOC are also examined as part of the weight of evidence.

Uses/1st app day/month	Application Rate (lb a.i./A)/ Number/ Interval	Species	Peak EEC (μg/L)	21-day EEC (μg/L)	Acute		Chronic RQ[1]
					RQ[1]	% Expected Effect on Prey Population at RQ[2]	
Highest Modeled Concentrations:							
[5]All uses with 21-d concentrations less than that of sweet potato do not have RQs that exceed the LOC. [6]All uses with peak concentrations less than that of lespedeza do not have RQs that exceed the LOC for endangered species.. [7]Monitoring concentration fell to 1440 μg/L after one day and to <1 by 21-d. [8]RQ based on tailwater data exceeds acute LOCs for both endangered spp. and non-endangered spp.(0.5).							

Based on these EECs and acute toxicity data for the most sensitive saltwater invertebrate tested, the white shrimp (LC50 of 600 μg a.i./L), the acute RQ exceeds the acute endangered species LOC of 0.05 (but not the non-endangered acute LOC of 0.5) for EPTC uses for lettuce, ornamental, sweet potatoes, tomatoes-fallow/idle, potatoes, broccoli-cabbage, cauliflower, safflower, lettuce-fallow/idle, corn, carrot, dried beans, snap beans, cotton-fallow/idle, alfalfa, safflower, and sugar beets. The percent expected effect on prey populations is very low, however, less than one for most uses. When tailwater data (1970 μg/L) is used for the exposure estimate, along with the shrimp acute toxicity data, the RQ (3.3) exceeds the LOC (based both on endangered species, 0.05, and other species, 0.5) by two orders of magnitude using the LOC for endangered species, which applies to all uses of EPTC. Therefore, on an acute basis, EPTC **has** the potential to affect the Delta smelt indirectly by reducing estuarine/marine invertebrates they feed upon.

A chronic toxicity endpoint estimate can be made for saltwater invertebrates from the acute shrimp data by using the *Daphnia magna* acute to chronic ratio (ACR) of 8. The estimated chronic toxicity endpoint is 80 ug/L. Using this endpoint, with the modeled data, the LOC is exceeded for lettuce and ornamental uses. Using the estimated endpoint with tailwater data, the chronic RQ for saltwater invertebrates would range from <1 to 18, with an average of 9, which exceeds the LOC (1). Calculations based on a half-life of 1.8 days show that concentrations above the chronic endpoint would persist for more than a week. Based on these figures, saltwater invertebrates cannot be precluded from risk due to chronic exposure to EPTC for all uses. Therefore, the DS **is** at risk from loss of saltwater invertebrate food based on chronic data.

5.1.1.e. Non-vascular Aquatic Plants

Acute risk to aquatic non-vascular plants is usually based on 1 in 10 year peak EECs in the standard pond and the lowest acute toxicity value. Risk quotients are shown in **Table 5.5**.

Table 5.5. Summary of Acute RQs for Non-Vascular Aquatic Plants

Uses/Application Rate	Species	Toxicity Value (μg/L)	Application rate (lb a.i./A) and type	Peak EEC (μg/L)	RQ[1]	% Expected Effect at RQ (using algal slope/and default slope)[2]
Highest Modeled Concentrations:						
Lettuce	Green Algae *Pseudokirchneriella subcapitata*	EC_{50} = 1400	6.13/emulsifiable concentrate	171	0.12	<0.001/ 0.0017 (<0.001-3.3)

Lowest Modeled Concentrations:						
Potato	Green Algae *P. subcapitata*	EC_{50} = 1400	3.06/emulsifiable concentrate	1.90	<0.01	<0.001/ <0.001 (<0.001-0.0032)
Highest Concentration From Tailwater data:						
Tailwater data	Green Algae *P. subcapitata*	EC_{50} = 1400	NA	1970	**1.4**	93/ 75 (62- 91)

[1]LOC exceedances (RQ $\geq$ 1) are bolded. RQ = use-specific peak EEC/ toxicity value.
[2]The probit dose-response slope value for the non-vascular aquatic plant toxicity study was 10 but no confidence intervals were available; therefore, the effect probability was calculated based on the slope of 10/ and a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986).

None of the RQs for aquatic non-vascular plants for any EPTC scenario exceeds the aquatic plant LOC. However, if aquatic plant RQs were calculated using this exposure estimate of 1970 µg/L from tailwater runoff, the RQ would be 1.4, which would exceed the LOC (1.0). Therefore, the preliminary effect determination for indirect effects (diet in larval stage) to the DS is **may affect**. Based on tailwater data, there **is** a potential for indirect effects to the Delta smelt from loss of non-vascular aquatic plants which provide the major part of primary production needed for their food source and the major food source for larvae.

5.1.1.f. Aquatic Vascular Plants

Acute risk to aquatic vascular plants is based on 1 in 10 year peak EECs in the standard pond and the lowest acute toxicity value. Risk quotients are shown in **Table 5.6**.

Table 5.6. Summary of Acute RQs for Vascular Aquatic Plants

Uses/Application Rate	Species	Toxicity Value (µg/L)	Application rate (lb a.i./A) and type	Peak EEC (µg/L)	RQ[1]	% Expected Effect at RQ[2]
Highest Modeled Concentrations:						
Lettuce	Duckweed *Lemna gibba*	EC_{50} = 5,600	6.13/emulsifiable concentrate	171	0.03	<0.001 (<0.001-0.12)
Lowest Modeled Concentrations:						
Potato	Duckweed *L. gibba*	EC_{50} = 5,600	3.06/emulsifiable concentrate	1.90	<0.01	<0.001 (<0.001- 0.0032)
Highest Concentration From Tailwater data:						
Tailwater data	Duckweed *L. gibba*	EC_{50} = 5,600	NA	1970	0.35	2.0 (0.0020 - 18)

[1]LOC exceedances (RQ $\geq$ 1) are bolded. RQ = use-specific peak EEC/ toxicity value.
[2]The probit dose-response slope value for the vascular aquatic plant toxicity study is not available; therefore, the effect probability was calculated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986).

None of the RQs for aquatic vascular plants for any EPTC scenario exceeds the aquatic plant LOC. Moreover, if aquatic plant RQs were calculated using this exposure estimate of 1970 µg/L from tailwater runoff, the RQ would be 0.35, which still would not exceed the LOC (1.0). The preliminary effect determination for indirect effects (food web and habitat) to the DS is **no**

effect. Therefore, based on both toxicity and tailwater data, there is not a potential for indirect effects to the DS from loss of vascular aquatic plants which provide primary production needed for their food source, as well as habitat.

5.1.2. Exposure to Terrestrial Plant Communities (Riparian and Upland)

Generally, for indirect effects, potential effects on terrestrial vegetation are assessed using RQs from terrestrial plant seedling emergence and vegetative vigor EC_{25} data as a screen. Risk quotients are shown in **Table 5.7** and **Table 5.8**. Toxicity endpoints used to calculate RQs were: monocot and dicot seedling emergence EC_{25}s of 0.015 and 0.26 lb ai/A, respectively (both dry weight), and vegetative vigor EC_{25}s of 0.22 (phytotoxicity) and 2.0 lb ai/A (dry weight).

Table 5.7. RQs for Monocots Inhabiting Dry and Semi-Aquatic Areas Exposed to EPTC via Runoff and Drift

Use	Application rate (lbs a.i./A)	Drift Value (%)	Spray drift RQ	Dry area RQ	Semi-aquatic area RQ
Ornamental[1]	14.88	1	**9.92**[2]	**59.5**	**505.9**
		5	**49.6**	**99.2**	**545.6**
Sweet potato	7.44	1	**4.96**	**29.8**	**253.0**
Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet, Alfalfa	6.13	1	**4.09**	**24.5**	**208.4**
Dried beans	4.59	1	**3.06**	**18.4**	**156.1**
Snap beans	3.94	1	**2.63**	**15.8**	**134.0**
Almonds, Safflower, Tomato, Walnut	3.06	1	**2.04**	**12.2**	**104.0**
Castor beans	1.76	1	**1.17**	**7.04**	**59.8**
		5	**5.87**	**11.7**	**64.5**

[1]Category includes shade trees, ornamental ground cover, ornamental herbaceous plants, ornamental woody shrubs and vines, and pine seed orchard.
[2]LOC exceedances (RQ $\geq$ 1) are bolded and shaded. The most sensitive monocot EC_{25}s of 0.015 (purple nutsedge) and 0.22 (winter wheat) lb a.i./A for seedling emergence and vegetative vigor, respectively were used in the TerrPlant calculations.

Table 5.8. RQs for Dicots Inhabiting Dry and Semi-Aquatic Areas Exposed to EPTC via Runoff and Drift

Use	Application rate (lbs a.i./A)	Drift Value (%)	Spray drift RQ	Dry area RQ	Semi-aquatic area RQ
Ornamental[1]	14.88	1	0.57	**3.43**[2]	**29.19**
		5	**2.86**	**5.72**	**31.48**
Sweet potato	7.44	1	0.29	**1.72**	**14.59**
		5	**1.43**	**2.86**	**15.74**
Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet, Alfalfa	6.13	1	0.24	**1.41**	**12.02**
		5	**1.18**	**2.36**	**12.97**
Dried beans	4.59	1	0.18	**1.06**	**9.00**
		5	0.88	**1.77**	**9.71**

Use	Application rate (lbs a.i./A)	Drift Value (%)	Spray drift RQ	Dry area RQ	Semi-aquatic area RQ
Snap beans	3.94	1	0.15	0.91	**7.73**
		5	0.76	1.52	**8.33**
Almonds, Safflower, Tomato, Walnut	3.06	1	0.12	0.71	**6.00**
		5	0.59	1.18	**6.47**
Castor beans	1.76	1	<0.1	0.041	**3.45**
		5	0.34	0.68	**3.72**

[1]Category includes shade trees, ornamental ground cover, ornamental herbaceous plants, ornamental woody shrubs and vines, and pine seed orchard
[2]LOC exceedances (RQ $\geq$ 1) are bolded and shaded. The most sensitive dicot EC_{25}s of 0.26 (morning glory) and 2 (velvet leaf) lb a.i./A for seedling emergence and vegetative vigor, respectively were used in the TerrPlant calculations.

Terrestrial plant RQs for monocots inhabiting dry and semi-aquatic areas exposed to EPTC via runoff and drift (both 1% and 5%) exceed the LOC for all of the assessed uses; RQs for dicots inhabiting semi-aquatic areas exposed to EPTC via runoff and drift (both 1% and 5%) exceed the LOC for all of the assessed uses; and RQs for dicots inhabiting dry areas under these conditions exceed the LOC for all uses except snap and castor beans, almonds, safflower, tomato and walnut. Example output from TerrPlant v.1.2.2 is provided in **Appendix F.** The LOC is exceeded for all uses, and the preliminary effect determination is **may affect** for the all of the assessed uses of EPTC (alfalfa, dry beans snap beans, castor beans, broccoli, cabbage, carrots, cauliflower, clover, corn, cotton, grapefruit, lemon, lespedeza, lettuce, orange, white/Irish potatoes, sweet potatoes, safflower, sugar beet, sunflower, tangerine, tomato, trefoil, walnut and ornamental).

Based on these results, since the non-listed plant RQs are exceeded, there **is** a potential for indirect effects to the Delta smelt based on effects to habitat, mainly via shade loss and potential runoff increase.

5.1.3. Primary Constituent Elements of Designated Critical Habitat

For EPTC use, the assessment endpoints for designated critical habitat PCEs involve the same endpoints as those being assessed for potential direct and indirect effects to the DS. Therefore, the effects determinations for direct and indirect effects are used as the basis of the effects determination for potential modification to designated critical habitat.

All four assessment endpoints for the primary constituent elements (PCEs) of designated critical habitat for the DS (spawning habitat, juvenile hatching and transport, rearing habitat and adult migration) involve potential effects to aquatic and/or terrestrial plants:

- Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond; aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult DSs; and flow rate alterations based on effects to upland vegetation.

- Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult DSs and their food source.
- Reduction and/or modification of primary production and food for DS larvae

The preliminary effects determination for all four DS PCEs of designated habitat is “habitat modification” based on the risk estimation provided in **Sections 5.1.2** and **5.1.3.** Terrestrial plant RQs for monocots and dicots inhabiting dry and semi-aquatic areas exposed to EPTC via runoff and drift exceed the LOC for all of the assessed uses.

PCEs also include alteration of water quality characteristics necessary for normal growth and viability of DSs and their food source, especially in the rearing habitat. To assess the impact of EPTC on this PCE, acute and chronic freshwater fish and invertebrate toxicity endpoints, as well endpoints for aquatic non-vascular plants, are used as measures of effects. If RQs were calculated using the exposure level from the tailwater study, the LOCs would be exceeded for fish, aquatic invertebrates, and non-vascular plants (i.e., algae) (see **Section 5.1.1**). Direct chronic risks to the DS cannot be quantitatively assessed at this time because no chronic toxicity data are available; thus, risk cannot be precluded (see Risk Description for further discussion). Fish and invertebrate toxicity data help corroborate the preliminary “habitat modification” determination.

5.2. Risk Description

The risk description synthesizes overall conclusions regarding the likelihood of adverse impacts leading to a preliminary effects determination (*i.e.*, “no effect,” “may affect, but not likely to adversely affect,” or “likely to adversely affect”) for the assessed species and the potential for modification of their designated critical habitat based on analysis of risk quotients and a comparison to the Level of Concern (LOC). The final No Effect/May Affect determination is made after the spatial analysis is completed at the end of the risk description, **Section 5.2**. In Section **5.2.4.c**, a discussion of any potential overlap between areas where potential usage may result in LAA effects and areas where species are expected to occur (including any designated critical habitat) is presented. If there is no overlap of the species habitat and occurrence sections with the Potential Area of LAA Effects a No Effect determination is made.

If the RQs presented in the Risk Estimation (**Section 5.1**) show no direct or indirect effects for the assessed species, and no modification to PCEs of the designated critical habitat, a “no effect” determination is made, based on EPTC’s use within the action area. However, if LOCs for direct or indirect effect are exceeded or effects may modify the PCEs of the critical habitat, the Agency concludes a preliminary “may affect” determination for the FIFRA regulatory action regarding EPTC. A summary of the risk estimation results are provided in **Table 5.9** for direct and indirect effects to the listed species assessed here and in

Table **5.10** for the PCEs of their designated critical habitat.

Table 5.9. Risk Estimation Summary for EPTC - Direct and Indirect Effects to the Delta Smelt

Taxa	LOC Exceedances (Yes/No)	Description of Results of Risk Estimation	Direct or Indirect Effects to the Delta smelt
Freshwater Fish	Listed Species **Yes**	Acute LOC not exceeded for any modeled concentration. Acute LOC exceeded with tailwater data. No chronic toxicity data available.	Direct Effects
Freshwater Invertebrates	Non-listed Species **Yes**	Acute LOC not exceeded for any modeled concentration. Acute LOC exceeded with tailwater data. Chronic LOC not exceeded for any modeled concentration. Chronic LOC exceeded with tailwater data.	Indirect Effects
Estuarine/Marine Fish	Listed Species **Yes**	Acute LOC not exceeded for any modeled concentration. Acute LOC exceeded for tailwater data. No chronic toxicity data available.	Direct Effects
Estuarine/Marine Invertebrates	Non-listed Species **Yes**	Acute LOC exceeded for restricted use for several uses. Acute LOC exceeded for tailwater data. Chronic LOC exceeded for lettuce and ornamentals and for tailwater data.	Indirect Effects
Vascular Aquatic Plants	Non-listed Species **Yes**	Aquatic plant LOC not exceeded for any modeled concentration. Aquatic plant LOC exceeded for tailwater data.	Indirect Effects
Non-Vascular Aquatic Plants	Non-listed Species **Yes**	Aquatic plant LOC not exceeded for any modeled concentration. Aquatic plant LOC exceeded for tailwater data.	Indirect Effects
Terrestrial Plants – Monocots	Non-listed Species **Yes**	Terrestrial plant LOC exceeded for ALL uses	Indirect Effects
Terrestrial Plants – Dicots	Non-listed Species **Yes**	Terrestrial plant LOC exceeded for ALL uses	Indirect Effects

Table 5.10. Risk Estimation Summary for EPTC – Effects to Designated Critical Habitat (PCEs) of the Delta Smelt

Taxa	LOC Exceedances (Yes/No) for the Delta smelt	Description of Results of Risk Estimation
Freshwater Fish	Listed Species **Yes**	Acute LOC not exceeded for any modeled concentration. Acute LOC exceeded for tailwater data. No chronic toxicity data available.
Freshwater Invertebrates	Non-listed Species[1] **Yes**	Acute LOC not exceeded for any modeled concentration. Acute LOC exceeded for restricted use for tailwater data. Chronic LOC not exceeded for any modeled concentration. Chronic LOC exceeded for tailwater data.
Estuarine/Marine Fish	Listed Species **Yes**	Acute LOC not exceeded for any modeled concentration. Acute LOC exceeded for tailwater data. No chronic toxicity data available.
Estuarine/Marine Invertebrates	Non-listed Species[1] **Yes**	Acute LOC exceeded for restricted use for several uses. Acute LOC exceeded for tailwater data. Chronic LOC exceeded for lettuce and ornamentals and for tailwater data.
Vascular Aquatic Plants	Non-listed Species[1] **No**	Aquatic vascular plant LOC not exceeded for any modeled concentration. Aquatic vascular plant LOC not exceeded for tailwater data.
Non-Vascular Aquatic Plants	Non-listed Species[1] **Yes**	Aquatic non-vascular plant LOC not exceeded for any modeled concentration. Aquatic non-vascular plant LOC exceeded for tailwater data.
Terrestrial Plants - Monocots	Non-listed Species[1] **Yes**	Terrestrial plant LOC exceeded for ALL uses
Terrestrial Plants - Dicots	Non-listed Species[1] **Yes**	Terrestrial plant LOC exceeded for ALL uses

[1] Only non-listed LOCs were evaluated because the Delta smelt does not have an obligate relationship with this taxonomic group

Following a preliminary "may affect" determination, additional information is considered to refine the potential for exposure at the predicted levels based on the life history characteristics (*i.e.*, habitat range, feeding preferences, *etc*.) of the assessed species. Based on the best available information, the Agency uses the refined evaluation to distinguish those actions that "may affect, but are not likely to adversely affect" from those actions that are "likely to adversely affect" the assessed species and its designated critical habitat.

The criteria used to make determinations that the effects of an action are "not likely to adversely affect" the assessed species or modify its designated critical habitat include the following:

- Significance of Effect: Insignificant effects are those that cannot be meaningfully measured, detected, or evaluated in the context of a level of effect where "take" occurs for even a single individual. "Take" in this context means to harass or harm, defined as the following:
    - Harm includes significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering.

- Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.

- Likelihood of the Effect Occurring: Discountable effects are those that are extremely unlikely to occur.
- Adverse Nature of Effect: Effects that are wholly beneficial without any adverse effects are not considered adverse.

A description of the risk and effects determination for each of the established assessment endpoints for the Delta smelt and its designated critical habitat is provided in **Sections 5.2.1** through **5.2.3**. The effects determination section will start with a discussion of the potential for direct effects, followed by a discussion of the potential for indirect effects. These discussions do not consider the spatial analysis. For those listed species that have designated critical habitat, the section will end with a discussion on the potential for modification to the critical habitat from the use of EPTC. Finally, in **Section 5.2.4**, a discussion of any potential overlap between areas of concern and the Delta smelt (including any designated critical habitat) is presented. If there is no overlap of the species habitat and occurrence sections with the Potential Area of LAA Effects a No Effect determination is made.

5.2.1. Direct Effects to the Delta Smelt

Actual measured concentrations in the field (detection limit, 0.02 to 2300 µg/L) showed that much higher concentrations (up to 1970 µg/L) of EPTC can occur than those expected from modeled data (1.9-171 µg/L peak concentrations for current uses). Such real world data must necessarily be treated with a high degree of importance since corroboration of modeled data depends on such data. EPA's policy is to use the most conservative data available as long as it is scientifically sound.

As discussed in **Section 3.2.4**, available field study data indicate that EPTC concentrations in tailwater (*i.e.*, runoff water at a treated field edge) can exceed 1000 µg/L (Cliath et al., 1980, MRID 40420404). This study reported that EPTC was detected in tailwater runoff from a treated alfalfa field at levels up to 1970 µg/L, which was equivalent to 7% of the applied rate of 2.71 lbs a.i./A. This reported EPTC concentration in tailwater is more than 11 times the highest 1-in-10 year EEC (171 µg/L) for the 'standard pond' as predicted by the PRZM/EXAMS model. It should be noted that the current label rate for alfalfa is 3.94 lbs a.i./A for flood irrigation/chemigation application, which is considerably higher than the application rate used in the Cliath et al. study.

Based on the tailwater data (1970 µg/L) as the peak exposure estimate and acute toxicity data from the bluegill sunfish (LC_{50} = 14,000 µg a.i./L), the RQ is 0.14, which exceeds the LOC for endangered species (0.05). Similarly, using the tailwater data and acute toxicity data from the sheepshead minnow (LC_{50} = 17,000 µg a.i./L), the RQ is 0.12, which also exceeds the LOC for endangered species (0.05). If RQs are calculated using exposure estimates LOCs are not exceeded.

No acceptable data were found to determine the chronic toxicity of EPTC to either freshwater or saltwater fish. Since toxic effects cannot be discounted, a **may affect** determination was made.

Using a weight-of-evidence approach, the following calculations support a finding of **may affect** for direct effects to the DS:

- Field study tailwater data (1970 μg/L acute and <1-1440 μg/L chronic) applied to fish acute toxicity data causes RQs to exceed the LOC for endangered species;
- Chronic data modeled by EPI Suite applied to the tailwater data causes RQs to exceed the LOC for endangered species;
- Chronic toxicity data for fish is lacking;
- Effects to terrestrial plants are very likely, with monocot RQs generally one to two orders of magnitude above the LOCs; and
- The overlap map (**Figure 5.1**) very clearly shows that the critical habitat of the DS is within the usage area of EPTC and threats to terrestrial plants affect all principal biologically mediated PCEs of the DS critical habitat.

Calculations that do not support the finding of **may effect**:

- Modeled exposure estimates (max of 171 μg/L acute; 73-122 μg/L chronic) applied to toxicity data only cause RQs to exceed the LOC for endangered species in two uses, lettuce and ornamental; and
- Probabilities and percent of populations affected estimates for direct effects and effects to DS food are generally low.

In summary, acute effects to both freshwater and saltwater fish are significant and not discountable, using actual measured data. Chronic effects may not be discounted due to lack of data. Effects to the terrestrial plant components of the DS critical habitat are likely. Therefore, based on the weight-of-evidence, a potential exists for direct effects to the Delta smelt in both freshwater and saltwater habitat.

5.2.2. Indirect Effects to the Delta Smelt

5.2.2.a. Potential Loss of Prey

Pesticides have the potential to indirectly affect listed species by causing changes in structural or functional characteristics of affected communities. Structural changes usually mean those changes that involve the loss of a plant or animal from the community that the listed species relies upon for food or shelter. Functional changes involve rates, for example primary productivity, which can be impaired by pesticides. Reduction in such a rate can affect the food source of the listed species. These are considered indirect effects of the pesticide, and can be part of the critical habitat modification evaluation. To assess indirect effects, direct effects LOCs were used from taxonomic groups (*e.g.,* freshwater fish, invertebrates and aquatic plants) essential to the life history of the listed species, to infer the potential for indirect effects upon listed species (USEPA, 2004).

The Delta smelt's diet consists primarily of planktonic copepods, cladocerans, amphipods, and insect larvae. Larvae feed on phytoplankton; juveniles feed on zooplankton. They live along the freshwater edge of the mixing zone (saltwater-freshwater interface), typically occupying estuarine areas with salinities below 2 parts per thousand (ppt); however, they have been found in areas up to 18 ppt. Therefore, their food source consists of both freshwater and saltwater invertebrates during most of their life, and brackish water plants as larvae.

Freshwater and saltwater invertebrate toxicity studies were reviewed for this assessment (**Appendix H**), because the Delta smelt needs both freshwater and saltwater invertebrates for food. For freshwater, based on tailwater data (1970 µg/L) as the peak exposure estimate and acute toxicity data from *Daphnia magna* (EC_{50} = 6490 µg a.i./L), the acute RQ would be 0.30, which exceeds the LOC for endangered species (0.05) but not the LOC for other species (0.5). Similarly, using the same tailwater data (1970 µg/L) as the 21-day estimate and the NOAEC from the *Daphnia magna* reproduction study (810 µg a.i./L) the chronic RQ is 2.4, which exceeds the LOC (1.0).

Species sensitivities seen in EPTC toxicity data (**Appendix G)** showed that daphnids were the most sensitive freshwater crustacean taxa studied (48-h LC_{50}s ranged from 6.5 to 22 mg a.i./L); one study with the isopod had similar toxicity with a 96-h LC_{50} of 23 mg a.i./L; and the scud was not quite as sensitive, though certainly within the same order of magnitude (96-h LC_{50} of 23 – 66 mg a.i./L). For aquatic invertebrates, the smelt's chief food, toxicity seems to lie solidly between the levels of concern for endangered species and for other species.

For saltwater estimates, again, using tailwater data (1970 µg/L) as the exposure estimate, and the most sensitive saltwater invertebrate tested, the white shrimp (LC_{50} of 600 µg a.i./L), the acute RQ (3.3) exceeds the LOC for endangered species (0.05) by two orders of magnitude and the LOC for other species (0.5) by one order of magnitude. The acute RQ (0.29), in this case, also exceeds the LOC for endangered species (0.05) using modeled exposure data (171 ug/L), still by one order of magnitude.

A chronic toxicity endpoint estimate can be made for saltwater invertebrates from the acute shrimp data by using the *Daphnia magna* acute to chronic ratio (ACR) of 8. Acknowledging a degree of uncertainty in applying a freshwater ACR to saltwater data, the estimated chronic toxicity endpoint is 80 ug/L. Using this chronic endpoint with tailwater data, the chronic RQ for saltwater invertebrates is 0.41, and with the modeled data, the RQ is 0.03; neither exceeds the LOC of 1.0. However, using the tailwater data as the exposure estimate, the RQ 3.3 exceeds the LOC (1.0) and would place the smelt at risk for loss of food in its estuarine environment, where it spends most of its time. Therefore, the DS would be at risk from loss of saltwater invertebrate food based on acute, but not chronic, data.

As previously mentioned, the food source of larval Delta smelt is mostly phytoplankton from their brackish water habitat. Brackish water has salinity closer to freshwater than saltwater (around 2 ppt), and since no saltwater plant toxicity data are available freshwater plant toxicity data were used to assess risk.

Limited toxicity information on EPTC acute effects to saltwater invertebrates (Appendix G) shows that saltwater invertebrates, like freshwater crustaceans studied, have a fairly tight sensitivity range among taxa, with 48- to 96-h LC_{50}s ranging from 0.6 to >20 mg a.i./L EPTC for the white shrimp, the mysid shrimp and the Eastern oyster. This range is very close to the range for freshwater invertebrates (6.5 to 66 mg a.i./L EPTC). The DS' chief food sources, freshwater and saltwater invertebrates, are roughly at equal risk.

Adult Delta smelt must also migrate between freshwater and brackish water. Since effects levels are similar for freshwater (bluegill LC_{50} = 14,000 µg a.i./L) and saltwater fish (sheepshead LC_{50} = 17,000 µg a.i./L), migration of the Delta smelt should not be affected in favor of either salinity.

5.2.2.b. Potential Modification of Habitat

5.2.3. Indirect Effects (via Habitat Effects)

5.2.3.a. Aquatic Plants (Vascular and Non-vascular)

Aquatic plants serve several important functions in aquatic ecosystems. Non-vascular aquatic plants are primary producers and provide the autochthonous energy base for aquatic ecosystems. Vascular plants provide structure, rather than energy, to the system, as attachment sites for many aquatic invertebrates, and refugia for juvenile organisms, such as fish and frogs. Emergent plants help reduce sediment loading and provide stability to nearshore areas and lower streambanks. In addition, vascular aquatic plants are important as attachment sites for egg masses of DSs.

Potential indirect effects to the DS based on impacts to habitat and/or primary production were assessed using RQs from freshwater aquatic vascular and non-vascular plant data. Based on PRZM/EXAMS model-predicted surface water exposure estimates, none of the RQs for aquatic non-vascular plants for any EPTC scenario exceeds the aquatic plant LOC. However, based on the available tailwater data, aquatic exposures have the potential be considerably higher for uses that allow flood irrigation/chemigation. If aquatic plant RQs were calculated using this exposure estimate of 1970 µg/L from tailwater runoff, the RQ would be 1.4, which would exceed the LOC (1.0). RQs for vascular aquatic plants do not exceed the LOC based on model-predicted or tailwater data.

Calculations based on the potential tailwater aquatic exposures associated with the EPTC uses described earlier, that allow flood irrigation/chemigation (alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black)), result in exceedances of the LOCs for aquatic vegetation. Based on this weight-of-evidence, the final effect determination for indirect effects (via habitat effects) to the DS is **likely to adversely affect**.

5.2.3.b. Terrestrial Plants

Riparian vegetation helps to maintain the integrity of aquatic systems for the DS by providing bank and thermal stability, and serving as a buffer to filter out sediment, nutrients, and contaminants before they reach the watershed. Upland vegetation helps to control runoff and thus helps protect DS habitat from sedimentation and contamination.

Herbicides can adversely impact habitat in a number of ways. In the most extreme case, herbicides in spray drift and runoff from the site of application have the potential to kill (or reduce growth and/or biomass) all or a substantial amount of the vegetation, thus removing or impacting structures in riparian and upland zones which function to control runoff.

EPTC is a selective soil herbicide for preemergence control of many annual and perennial grasses by interfering with normal germination and development. It does not control established weeds. EPTC is absorbed mostly through the plant roots with little or no foliar penetration. It is readily absorbed by roots and translocated upward to the leaves and stems. EPTC disrupts the growth of meristematic regions of the leaves and disrupts protein synthesis. Riparian vegetation typically consists of three tiers of vegetation: groundcover of grasses and forbs, an understory of shrubs and young trees, and an overstory of mature trees. Upland zones include grassland and woodlands, as well as scrub/shrub areas. No guideline data are available on the toxicity of EPTC to woody plants. However, EPTC is labeled for use around woody species including citrus, tree nuts and ornamental uses; therefore, toxicity to established woody plants is not expected.

As shown in **Table 5.7 and Table 5.8,** RQs exceed LOCs for monocots and dicots inhabiting dry and semi-aquatic areas exposed to EPTC via runoff and drift for all uses. In general, it appears that monocots are more sensitive than dicots to EPTC in dry and semi-aquatic areas. The seedling emergence EC_{25} values range from 0.015 lbs a.i./A to > 7.4 lbs a.i./A (monocots) and from 0.26 lbs a.i./A to > 7.4 a.i./A (dicots) based on dry weight. The vegetative vigor EC_{25} values range from 0.22 lbs a.i./A to > 7.4 lbs a.i./A (monocots, phytotoxicity) and from 2.0 lbs a.i./A to > 7.4 pounds a.i./A (dicots, dry weight). To further characterize the risk of EPTC to terrestrial plants, if RQs were calculated assuming an EC_{25} of 7.4 lbs a.i./A and an application rate of 14.88 lbs a.i./A (ornamental use), the plant LOC would be narrowly exceeded for terrestrial plants in semi-aquatic areas.

Based on exceedance of the terrestrial plant LOCs for all EPTC use patterns following runoff and spray drift to semi-aquatic and dry areas, the following general conclusions can be made with respect to potential harm to riparian zones:

- EPTC may enter riparian areas via runoff and/or spray drift where it may be taken up by the roots of sensitive emerging seedlings.

- Based on EPTC's mode of action and a comparison of seedling emergence EC_{25} values to EECs estimated using TerrPlant, emerging or developing seedlings may be affected. Inhibition of new growth could result in degradation of high quality riparian areas over time because as older growth dies from natural or anthropogenic causes, plant biomass may be prevented from being replenished in the riparian area.

- Because all of the plant species tested in either the seedling emergence or vegetative vigor studies could be affected, especially at the highest application rate, it is likely that many species of herbaceous plants may be affected by exposure to EPTC via runoff and spray drift.

A review of the EPTC incidents for terrestrial plants revealed 5 reports of plant damage. One report was classified as 'probably' related to EPTC and two others were reported as possibly' related. The remaining two incidents were classified as 'unlikely' related to EPTC. These incidents mainly involved monocots, which is consistent with their sensitivity to EPTC effects as seen in the toxicity data. Although the reported number of EPTC incidents for terrestrial plants is low, an absence of reports does not necessarily provide evidence of an absence of incidents. The only plant incidents that are reported are those that are alleged to occur on more than 45 percent of the acreage exposed to the pesticide. Therefore, an incident could impact 40% of an exposed crop and not be included in the EIIS database (unless it is reported by a non-registrant, such as a state agency, where data are not systemically collected).

In summary, terrestrial plant RQs are above LOCs; therefore, upland and riparian vegetation may be affected. Established woody plants may not be sensitive to environmentally relevant EPTC concentrations; thus, effects on shading, bank stabilization, structural diversity (height classes) of vegetation, and woodlands are not expected. Given that both upland and riparian areas are comprised of mixtures of both non-sensitive woody (trees and shrubs) and sensitive grassy herbaceous vegetation, the DS may be indirectly affected by adverse effects to herbaceous vegetation and so effects cannot be discounted. Therefore, the effects determination for this assessment endpoint is **likely to adversely affect** for all assessed EPTC use patterns.

5.2.4. Modification of Designated Critical Habitat

Based on the weight-of-evidence, there is a potential for the modification of designated critical habitat. Using tailwater data as the estimated exposure scenario, monocots are chiefly at risk and this should affect runoff and flow, which are critical components of DS' habitat. Direct effects are also likely and indirect effects from loss of food and habitat parameters.

5.2.5. Spatial Extent of Potential Effects

Since LOCs are exceeded, analysis of the spatial extent of potential LAA effects is needed to determine where effects may occur in relation to the treated site. If the potential area of usage and subsequent Potential Area of LAA Effects overlaps with habitat or areas of occurrence and/or critical habitat, a likely to adversely affect determination is made. If the Potential Area of LAA Effects and DS habitat, areas of occurrence and/or critical habitat do not overlap, a no effect determination is made.

To determine this area, the footprint of EPTC's use pattern is identified, using corresponding land cover data, see **Section 2.7**; these land cover types include ornamental, row crops and right of way. Actual usage is expected to occur in a smaller area as the chemical is only expected to be used on a portion of the identified area. The spatial extent of the effects determination also includes areas beyond the initial area of concern that may be impacted by runoff and/or spray drift (Use Footprint + distance down stream or down wind from use sites where organisms relevant to the assessed species may be affected). The determination of the buffer distance and downstream dilution for spatial extent of the effects determination is described below.

5.2.5.a. Spray Drift

In order to determine terrestrial and aquatic habitats of concern due to EPTC exposures through spray drift, it is necessary to estimate the distance that spray applications can drift from the treated area and still be present at concentrations that exceed levels of concern. Ground applications of EPTC granular formulations are not expected to result in any spray drift.

The distance required to dissipate spray drift to below the LOC was determined using AgDrift based on the EC_{25} levels for terrestrial plants. Input parameters for AgDrift included a low boom and fine to medium droplet size scenarios. Low boom was selected in view of typical ground applications of EPTC prior to crop emergence. Theoretically, dissipation to the no effect level should be modeled in order to provide potential buffer distances that are protective of endangered terrestrial plant species. However, because no obligate relationship exists between the DS and terrestrial plants, the portion of the action area that is relevant to the DS is defined by the dissipation distance to the EC_{25} level (*i.e.*, the potential buffer distance required to protect non-endangered terrestrial plant species).

Since the seedling emergence endpoints for monocots and dicots (purple nutsedge (monocot) EC_{25}: 0.015 lb a.i./acre and morning glory (dicot) EC_{25}: 0.26 lb a.i./A) are more sensitive than the vegetative vigor endpoints (winter wheat (monocot) EC_{25}: 0.22 lb a.i./A and velvet leaf (dicot) EC_{25}: 2.0 lbs a.i./A) and as EPTC is a preemergence herbicide that inhibits roots of emerging/developing plants with no activity against existing vegetation, spray drift distances are derived using the seedling emergence endpoint for both monocots and dicots. For comparison purposes, spray drift dissipation distances were also calculated using the vegetative vigor endpoint for monocots and dicots.

In order to determine the extent of terrestrial habitats of concern beyond application sites, it is necessary to estimate the distance spray applications can drift from the treated field and still be greater than the level of concern. Spray drift modeling was done to determine the farthest distance required to not exceed the LOC for exposures to EPTC drifted to non-target areas. This assessment requires the use of the spray drift model, AgDrift (version 2.01).

The Tier I version of AgDrift was used for simulating applications of EPTC to agricultural crops by ground methods. The labels state the following: "choose spray nozzles capable of producing spray droplets able to maintain good foliage coverage and weed control. Avoid using nozzles and excessive spray boom pressure that may increase the formation of fine droplets most likely to drift." Based on these recommendations, the spray droplet size distribution of fine to medium/coarse ($D_{V0.5}$= 341 µm) was used to determine the range of possible deposition of EPTC.

Spray drift dissipation distances for typical EPTC use rates are presented in **Table 5.11**. Based on the endpoints derived for seedling emergence, adverse effects to terrestrial plants might reasonably be expected to occur up to 610 feet for monocots and up to 20 feet for dicots from the use site for ground applications of EPTC. Vegetative vigor-based dissipation distances were 4 - 8 % and 0 – 100 % of those calculated based seedling emergence endpoints for monocots and dicots, respectively. The dissipation distance is expected to decrease based on an increase in droplet size as very coarse drops will result in less drift.

Table 5.11 Spray Drift Dissipation Distances for EPTC

EPTC Application Rate (lb ai/A)	Dissipation Distance (ft)			
	Seedling Emergence		Vegetative Vigor	
	Monocot EC_{25}: 0.015 lb a.i./acre	**Dicot** EC_{25}: 0.26 lb a.i./A	**Monocot** EC_{25}: 0.22 lb a.i./A	**Dicot** EC_{25}: 2.0 lbs a.i./A
Ornamental[1] 14.88	610	20	23	3
Potato, Alfalfa, Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet 6.13	220	7	10	3
Sweet potato 7.44	282	10	10	3
Dried and snap beans, clover 3.94	125	7	7	3
Dried beans 3.67	115	7	7	3
Alfalfa, Safflower, Almonds, Snap beans, Citrus, Potato, Tomato, Walnut 3.06	89	3	7	3
Snap beans 4.26	138	7	7	3
Dried and snap beans 4.59	154	7	7	3
Castor beans 1.76	43	3	3	0

[1]Category includes shade trees, ornamental ground cover, ornamental herbaceous plants, ornamental woody shrubs and vines, and pine seed orchard.

5.2.5.b. Downstream Dilution Analysis

The downstream extent of exposure in streams and rivers (lotic, or flowing, habitat) where the EEC could potentially be above levels that would exceed the most sensitive LOC is calculated using the downstream dilution model. To complete this assessment, the greatest ratio of aquatic RQ to LOC was estimated. Using an assumption of uniform runoff across the landscape, it is assumed that streams flowing through treated areas (*i.e.*, the Initial Area of Concern) are represented by the modeled EECs; as those waters move downstream, it is assumed that the influx of non-impacted water will dilute the concentrations of EPTC present. For this assessment, this applies to the RQ for direct acute effects to the DS based on tailwater data. The ratio is 2.8 (RQ/LOC = 0.14/0.05). The total stream kilometers within the action area that are estimated to be at levels of concern is 197 km (see **Appendix K** for further discussion).

5.2.5.c. Overlap of Potential Areas of LAA Effect and Habitat and Occurrence of the Delta Smelt

The spray drift and downstream dilution analyses help to identify areas of potential effect to the DS from registered uses of EPTC. The Potential Area of LAA Effects on survival, growth, and reproduction for the DS from EPTC spray drift extent are determined. **Appendix K** provides an overview of where the action area overlaps with species range as described in **Section 2.5.1**. The analysis indicates that overlap between the EPTC action area and species range (defined by critical habitat, core areas, and CNDDB occurrence data) occurs in the major part of DS habitat

Pesticide exposures and predicted risks to the species and its resources (i.e., food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (i.e., attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. That is, areas where overlap occurs between the initial area of concern and the species range are where the risk is presumed to be greatest. Moving from the initial area of concern to the edge of the action area, whether it be defined by spray drift distances or by transport of EPTC downstream from the site of application, the magnitude of exposure decreases as does the potential risk.

Delta Smelt Overlap Map

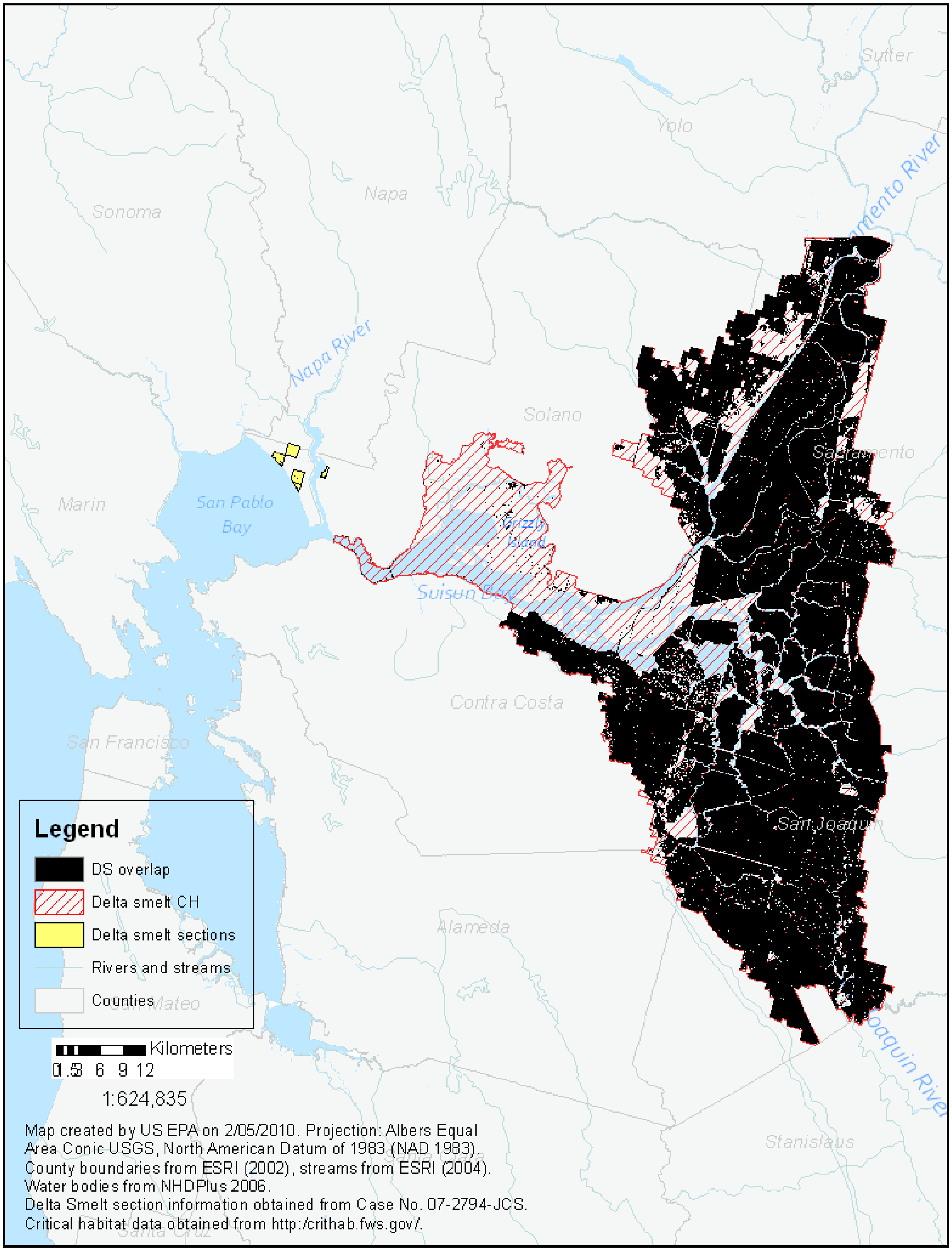

Figure 5.1. Map Showing the Overlap of the Delta smelt habitat with cultivated, pasture, orchards and developed (all) land cover classes representing potential use sites.

5.3. Effects Determinations for the Delta smelt

The Agency makes a **may affect, and likely to adversely affect** determination for the Delta smelt and a **habitat modification** determination for their designated critical habitat based on the potential for direct and indirect effects and effects to the PCEs of critical habitat.

5.3.1. Addressing the Risk Hypotheses

In order to conclude this risk assessment, it is necessary to address the risk hypotheses defined in Section 2.9.1. Based on the conclusions of this assessment, none of the hypotheses can be rejected, meaning that the stated hypotheses represent concerns in terms of direct and indirect effects of EPTC on the Delta smelt and its designated critical habitat.

The labeled use of EPTC within the action area may:

- directly affect DS by causing mortality or by adversely affecting growth or fecundity;
- indirectly affect DS and/or modify their designated critical habitat by reducing or changing the composition of food supply;
- indirectly affect DS and/or modify their designated critical habitat by reducing or changing the composition of the aquatic non-vascular plant community in the species' current range, thus affecting primary productivity and larval food supply;
- indirectly affect DS and/or modify their designated critical habitat by reducing or changing aquatic habitat in their current range (via modification of water quality parameters, habitat morphology, and/or sedimentation); and
- indirectly affect DS and/or modify their habitat by reducing or changing the composition of the terrestrial plant community in riparian and upland zones and, thus, affecting temperature, shade and runoff.

6. Uncertainties

Uncertainties that apply to most assessments completed for the San Francisco Bay Species Litigation are discussed in **Attachment 1**. This section describes additional uncertainties specific to this assessment.

6.1. Exposure Assessment Uncertainties

Uncertainties in this analysis include:

- usage uncertainties; and
- exposure uncertainties, especially modeled vs. monitoring discrepancies.

6.1.1. Maximum Use Scenario

The screening-level risk assessment focuses on characterizing potential ecological risks resulting from a maximum use scenario, which is determined from labeled statements of maximum application rate and number of applications with the shortest time interval between applications. The frequency at which actual uses approach this maximum use scenario may be dependant on pest resistance, timing of applications, cultural practices, and market forces.

6.1.2. Aquatic Exposure Modeling of EPTC

The standard ecological water body scenario (EXAMS pond) used to calculate potential aquatic exposure to pesticides is intended to represent conservative estimates, and to avoid underestimations of the actual exposure. The standard scenario consists of application to a 10-hectare field bordering a 1-hectare, 2-meter deep (20,000 m^3) pond with no outlet. Exposure estimates generated using the EXAMS pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and lower order streams. As a group, there are factors that make these water bodies more or less vulnerable than the EXAMS pond. Static water bodies that have larger ratios of pesticide-treated drainage area to water body volume would be expected to have higher peak EECs than the EXAMS pond. These water bodies will be either smaller in size or have larger drainage areas. Smaller water bodies have limited storage capacity and thus may overflow and carry pesticide in the discharge, whereas the EXAMS pond has no discharge. As watershed size increases beyond 10-hectares, it becomes increasingly unlikely that the entire watershed is planted with a single crop that is all treated simultaneously with the pesticide. Headwater streams can also have peak concentrations higher than the EXAMS pond, but they likely persist for only short periods of time and are then carried and dissipated downstream.

The Agency acknowledges that there are some unique aquatic habitats that are not accurately captured by this modeling scenario and modeling results may, therefore, under- or over-estimate exposure, depending on a number of variables. For example, smelts travel from estuarine to lotic habitats and the exposure may not be accurately reflected by the EXAMS pond. The Agency does not currently have sufficient information regarding the hydrology of these aquatic habitats to develop a specific alternate scenario for the DS. The EXAMS pond is assumed to be representative of exposure to the DS. In addition, the Services agree that the existing EXAMS pond represents the best currently available approach for estimating aquatic exposure to pesticides (USFWS/NMFS 2004).

In general, the linked PRZM/EXAMS model produces estimated aquatic concentrations that are expected to be exceeded once within a ten-year period. The Pesticide Root Zone Model is a process or “simulation” model that calculates what happens to a pesticide in an agricultural field on a day-to-day basis. It considers factors such as rainfall and plant transpiration of water, as well as how and when the pesticide is applied. It has two major components: hydrology and chemical transport. Water movement is simulated by the use of generalized soil parameters, including field capacity, wilting point, and saturation water content. The chemical transport component can simulate pesticide application on the soil or on the plant foliage. Dissolved, adsorbed, and vapor-phase concentrations in the soil are estimated by simultaneously considering the processes of pesticide uptake by plants, surface runoff, erosion, decay, volatilization, foliar wash-off, advection, dispersion, and retardation.

Uncertainties associated with each of these individual components add to the overall uncertainty of the modeled concentrations. Additionally, model inputs from the environmental fate degradation studies are chosen to represent the upper confidence bound on the mean values that are not expected to be exceeded in the environment approximately 90 percent of the time. Mobility input values are chosen to be representative of conditions in the environment. The natural variation in soils adds to the uncertainty of modeled values. Factors such as application date, crop emergence date, and canopy cover can also affect estimated concentrations, adding to the uncertainty of modeled values. Factors within the ambient environment such as soil temperatures, sunlight intensity, antecedent soil moisture, and surface water temperatures can cause actual aquatic concentrations to differ for the modeled values.

Unlike spray drift, tools are currently not available to evaluate the effectiveness of a vegetative setback on runoff and loadings. The effectiveness of vegetative setbacks is highly dependent on the condition of the vegetative strip. For example, a well-established, healthy vegetative setback can be a very effective means of reducing runoff and erosion from agricultural fields. Alternatively, a setback of poor vegetative quality or a setback that is channelized can be ineffective at reducing loadings. Until such time as a quantitative method to estimate the effect of vegetative setbacks on various conditions on pesticide loadings becomes available, the aquatic exposure predictions are likely to overestimate exposure where healthy vegetative setbacks exist and underestimate exposure where poorly developed, channelized, or bare setbacks exist.

In order to account for uncertainties associated with modeling, available tailwater data were compared to PRZM/EXAMS estimates of peak EECs for the different uses. As discussed above, several data values were available from NAWQA for EPTC concentrations measured in surface waters receiving runoff from agricultural areas. The specific use patterns (e.g. application rates and timing, crops) associated with the agricultural areas are unknown, however, they are assumed to be representative of potential EPTC use areas.

Modeled aquatic EECs for EPTC are higher than the reported concentrations in surface and groundwater. Peak model-estimated aquatic exposure concentrations resulting from different EPTC uses range from < 1 to 171 µg/L. The USGS has collected 1941 surface water samples from 74 sites in California. Of the 1914 surface water samples that have been collected and analyzed for EPTC residues in California, 44.6 % (853 samples out of 1914) had measurable EPTC concentrations. EPTC concentrations ranged between 0.007 µg/L and 40 µg/L. The mean and median peak concentrations (all data) were 0.047 and 0.0021 µg/L, respectively.

However, as discussed in **Section 3.2.4**, available tailwater data indicate that EPTC concentrations in tailwater (*i.e.*, runoff water at a treated field edge) can exceed 1000 µg/L (Cliath et al., 1980). This study reported that EPTC was detected in tailwater runoff from a treated alfalfa field at levels up to 1970 µg/L, which was equivalent to 7% of the applied rate of 2.71 lbs a.i./A. This reported EPTC concentration in tailwater is more than 11 times the highest 1-in-10 year EEC (171 µg/L) for the 'standard pond' as predicted by the PRZM/EXAMS model.

It should be noted that the current label rate for alfalfa is 3.94 lbs a.i./A for flood irrigation/chemigation application, which is considerably higher than the application rate used in the Cliath *et al*. study.

6.1.3. Exposure in Estuarine/marine Environments

PRZM-EXAMS modeled EECs are intended to represent exposure of aquatic organisms in relatively small ponds and low-order streams. Therefore it is likely that EECs generated from the PRZM-EXAMS model will over-estimate potential concentrations in larger receiving water bodies such as estuaries, embayments, and coastal marine areas because chemicals in runoff water (or spray drift, etc.) should be diluted by a much larger volume of water than would be found in the 'typical' EXAMS pond. However, as chemical constituents in water draining from freshwater streams encounter brackish or other near-marine-associated conditions, there is potential for important chemical transformations to occur. Many chemical compounds can undergo changes in mobility, toxicity, or persistence when changes in pH, Eh (redox potential), salinity, dissolved oxygen (DO) content, or temperature are encountered. For example, desorption and re-mobilization of some chemicals from sediments can occur with changes in salinity (Jordan *et al.*, 2008; Means, 1995; Swarzenski *et al.*, 2003), changes in pH (*e.g.*, Wood and Baptista 1993; Parikh et al. 2004; Fernandez et al. 2005), Eh changes (Velde and Church, 1999; Wood and Baptista, 1993), and other factors. Thus, although chemicals in discharging rivers may be diluted by large volumes of water within receiving estuaries and embayments, the hydrochemistry of the marine-influenced water may negate some of the attenuating impact of the greater water volume; for example, the effect of dilution may be confounded by changes in chemical mobility (and/or bioavailability) in brackish water. In addition, freshwater contributions from discharging streams and rivers do not instantaneously mix with more saline water bodies. In these settings, water will commonly remain highly stratified, with fresh water lying atop denser, heavier saline water – meaning that exposure to concentrations found in discharging stream water may propagate some distance beyond the outflow point of the stream (especially near the water surface). Therefore, it is not assumed that discharging water will be rapidly diluted by the entire water volume within an estuary, embayment, or other coastal aquatic environment. PRZM-EXAMS model results should be considered consistent with concentrations that might be found near the head of an estuary unless there is specific information – such as monitoring data – to indicate otherwise. Conditions nearer to the mouth of a bay or estuary, however, may be closer to a marine-type system, and thus more subject to the notable buffering, mixing, and diluting capacities of an open marine environment. Conversely, tidal effects (pressure waves) can propagate much further upstream than the actual estuarine water, so discharging river water may become temporarily partially impounded near the mouth (discharge point) of a channel, and resistant to mixing until tidal forces are reversed.

The Agency does not currently have sufficient information regarding the hydrology and hydrochemistry of estuarine aquatic habitats to develop alternate scenarios for assessed listed species that inhabit these types of ecosystems. The Agency acknowledges that there are unique brackish and estuarine habitats that may not be accurately captured by PRZM-EXAMS modeling results, and may, therefore, under- or over-estimate exposure, depending on the aforementioned variables.

6.1.4. Water Monitoring Data Limitations

The surface water monitoring data were derived from non-targeted monitoring programs. Therefore, the monitoring data may not represent the highest concentrations in drinking water source water. Further, the sampling frequency for the monitoring data was not designed to capture peak concentrations. Therefore, the maximum concentrations in the monitoring data may underestimate the actual peak concentration.

National distributional analyses were conducted to define the population of exposure concentrations among monitoring sites in the United States. These distributions do not represent distributions of EPTC concentrations for individual community water systems (CWS).

6.1.5. Usage Uncertainties

County-level usage data were obtained from California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database. Four years of data (2002 – 2005) were included in this analysis because statistical methodology for identifying outliers, in terms of area treated and pounds applied, was provided by CDPR for these years only. No methodology for removing outliers was provided by CDPR for 2001 and earlier pesticide data; therefore, this information was not included in the analysis because it may misrepresent actual usage patterns. CDPR PUR documentation indicates that errors in the data may include the following: a misplaced decimal; incorrect measures, area treated, or units; and reports of diluted pesticide concentrations. In addition, it is possible that the data may contain reports for pesticide uses that have been cancelled. The CPDR PUR data does not include home owner applied pesticides; therefore, residential uses are not likely to be reported. As with all pesticide usage data, there may be instances of misuse and misreporting. The Agency made use of the most current, verifiable information; in cases where there were discrepancies, the most conservative information was used.

6.1.6. Spray Drift Modeling

It is unlikely that the same organism would be exposed to the maximum amount of spray drift from every application made. In order for an organism to receive the maximum concentration of EPTC from multiple applications, each application of EPTC would have to occur under identical atmospheric conditions (e.g., same wind speed and same wind direction) and (if it is an animal) the animal being exposed would have to be located in the same location (which receives the maximum amount of spray drift) after each application. Additionally, other factors, including variations in topography, cover, and meteorological conditions over the transport distance are not accounted for by the AgDRIFT model (*i.e.*, it models spray drift from ground applications in a flat area with little to no ground cover and a steady, constant wind speed and direction). Therefore, in most cases, the drift estimates from AgDRIFT may overestimate exposure, especially as the distance increases from the site of application, since the model does not account for potential obstructions (*e.g.*, large hills, berms, buildings, trees, *etc*.).

6.1.7. Atmospheric Transport and Deposit

As discussed above, EPTC and has been detected in air and precipitation samples in California. Estimates of exposure of the DS, its prey and its habitat to EPTC included in this assessment are based on transport of EPTC through runoff and spray drift from application sites and exposure to the granular formulation (in terms of LD_{50}/ft^2). This assessment does not quantitatively consider additional sources of EPTC exposure due to atmospheric transport. Current estimates of aquatic exposures of EPTC to the DS through runoff and spray drift do not result in RQs that exceed the LOCs. If RQs were calculated using the maximum EEC for atmospheric deposition of EPTC (562 µg/L for the CA lettuce scenario), the acute RQs for aquatic invertebrates would exceed the LOC. No other aquatic RQs based on atmospheric deposition modeling would exceed the LOC. For terrestrial exposures, the modeled EECs for runoff and spray drift are sufficient to exceed the LOC for terrestrial plants; therefore, atmospheric deposition of EPTC would further increase risk to DS habitat.

6.1.8. Modeled Versus Monitoring Study Concentrations

In order to account for uncertainties associated with modeling, available tailwater study data were compared to PRZM/EXAMS estimates of peak EECs for the different uses. As discussed above, several data values were available from NAWQA for EPTC concentrations measured in surface waters receiving runoff from agricultural areas. The specific use patterns (*e.g.*, application rates and timing, crops) associated with the agricultural areas are unknown, however, they are assumed to be representative of potential EPTC use areas. In this case, PRZM/EXAMS models were an order of magnitude less conservative than actual measured concentrations from the monitoring study.

6.2. Effects Assessment Uncertainties

6.2.1. Data Gaps and Uncertainties

Data gaps include:

- chronic fish toxicity data for EPTC using freshwater and estuarine/marine species.

Uncertainties in this analysis include:

- uncertain toxicity mechanisms of EPTC and its degradates;
- uncertainty in extrapolating a freshwater acute to chronic ratio (ACR) to saltwater invertebrates;
- effects extrapolations from surrogate species to the Delta smelt; and
- age class sensitivity uncertainties for the Delta smelt.

6.2.2. Age Class and Sensitivity of Effects Thresholds

It is generally recognized that test organism age may have a significant impact on the observed sensitivity to a toxicant. The acute toxicity data for fish are collected on juvenile fish between 0.1 and 5 grams. Aquatic invertebrate acute testing is performed on recommended immature age classes (e.g., first instar for daphnids, second instar for amphipods, stoneflies, mayflies, and third instar for midges).

Testing of juveniles may overestimate toxicity at older age classes for pesticide active ingredients that act directly without metabolic transformation because younger age classes may not have the enzymatic systems associated with detoxifying xenobiotics. In so far as the available toxicity data may provide ranges of sensitivity information with respect to age class, this assessment uses the most sensitive life-stage information available as measures of effect for fish and aquatic invertebrates.

6.2.3. Use of Surrogate Species Effects Data

Guideline toxicity tests and open literature data on EPTC are not available for copepods, the chief food of the DS; therefore, other invertebrates are used as surrogate species for copepods. Endpoints based on daphnid and shrimp ecotoxicity data are assumed to be protective of potential indirect effects to the DS. Efforts are made to select the organisms most likely to be affected by the type of compound and usage pattern; however, there is an inherent uncertainty in extrapolating across phyla. In addition, the Agency's LOCs are intentionally set very low, and conservative estimates are made in the screening level risk assessment to account for these uncertainties.

6.2.4. Sublethal Effects

When assessing acute risk, the screening risk assessment relies on the acute mortality endpoint as well as a suite of sublethal responses to the pesticide, as determined by the testing of species response to chronic exposure conditions and subsequent chronic risk assessment. Consideration of additional sublethal data in the effects determination is exercised on a case-by-case basis and only after careful consideration of the nature of the sublethal effect measured and the extent and quality of available data to support establishing a plausible relationship between the measure of effect (sublethal endpoint) and the assessment endpoints. However, the full suite of sublethal effects from valid open literature studies is considered for characterization purposes, including defining the action area.

In this risk assessment, the uncertainty involved in estimating the probability of sublethal and chronic effects was further compounded by the necessity to extrapolate the acute to chronic ratio from freshwater to saltwater invertebrate species. The differences in both organismal physiology and environmental characteristics between freshwater and saltwater habitats make such extrapolations less certain than when used among species occupying the same habitat.

7. Risk Conclusions

In fulfilling its obligations under Section 7(a)(2) of the Endangered Species Act, the information presented in this endangered species risk assessment represents the best data currently available to assess the potential risks of EPTC to the DS and its designated critical habitat.

Based on the best available information, the Agency makes a **Likely to Adversely Affect** determination for the DS from the use of EPTC. Additionally, the Agency has determined that there is the potential for modification of DS designated critical habitat from the use of the chemical. Due to the LAA determination for the DS and potential modification of designated its critical habitat, a description of the baseline status and cumulative effects is provided in **Attachment 3**.

A summary of the risk conclusions and effects determinations for the DS and its critical habitat, given the uncertainties discussed in **Section 6** and **Attachment 1**, is presented in **Table 7.1** and **Table 7.2**. Use specific effects determinations are provided in **Table 7.3** and **Table 7.4**

Table 7.1 Effects Determination Summary for Effects of EPTC on the Delta smelt

Species	Effects Determination	Basis for Determination
		Potential for Direct Effects
Delta smelt (*Hypomesus transpacificus*)	**LAA**[1]	***Freshwater Life Stages (Eggs, Larvae, and Breeding Adults):*** Using freshwater fish toxicity data and modeled EECs, acute RQs do not exceed LOC; however, available monitoring study data suggest that exposures via tailwater runoff could be considerably higher, and risk cannot be precluded for uses that allow flood irrigation/chemigation (alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black)). Chronic RQs cannot be calculated due to lack of chronic toxicity data; risk cannot be precluded.
		Saltwater Life Stage (Juveniles and Adults): Using estuarine/marine fish toxicity data and modeled EECs, acute RQs do not exceed LOC; however, available monitoring study data suggest that exposures via tailwater runoff could be considerably higher, and risk cannot be precluded for uses that allow flood irrigation/chemigation (alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black)). Chronic RQs cannot be calculated due to lack of chronic toxicity data; risk cannot be precluded.
		Potential for Indirect Effects
	Freshwater invertebrates:	***Aquatic prey items, aquatic habitat, cover and/or primary productivity*** RQs do not exceed the acute or chronic LOC using modeled aquatic exposure estimates. Acute RQ calculated using tailwater study data exceeds LOC. Chronic RQ based on the tailwater data (estimated 21-day concentration based on 1.65 day half-life) are below the LOC (1.0).
	Saltwater invertebrates:	RQs do not exceed the acute LOC using modeled aquatic exposure estimates. RQs do exceed the chronic LOC for lettuce and ornamental uses. Acute RQ calculated using tailwater data exceeds LOC. Chronic RQ based on tailwater data (estimated 21-day concentration based on 1.65 day half-life) show that concentrations would be above would be above the LOC (1.0) for approximately one week, and so chronic risk cannot be precluded..
	Non-vascular aquatic plants:	RQs do not exceed the aquatic plant LOC using modeled aquatic exposure estimates. However, available monitoring study data suggest that exposures via tailwater runoff could be considerably higher, and risk cannot be precluded for uses that allow flood irrigation/chemigation (alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black)).
	Vascular aquatic plants:	RQs do not exceed the aquatic plant LOC using modeled aquatic exposure estimates or available tailwater data.
	Terrestrial Plants:	***Terrestrial prey items, riparian habitat*** Terrestrial plant RQs exceed the LOC for all EPTC uses. Multiple lines of evidence, including several incidents of plant damage, support the conclusion of risk to plants. Existing vegetation, however, should not be affected but only germinating seedlings in riparian and upland habitats.

[1]LAA=likely to adversely affect.

Table 7.2. Effects Determination Summary for the Critical Habitat Impact Analysis

Assessment Endpoint	Effects Determination	Basis for Determination
Modification of aquatic PCEs	**HM**[1]	As summarized in **Table 1.1**, for both freshwater and saltwater fish, the acute RQs do not exceed LOC; however, available monitoring study data suggest that exposures via tailwater runoff could be considerably higher, and risk cannot be precluded. Chronic RQs cannot be calculated due to lack of chronic toxicity data; risk cannot be precluded. The LOC for terrestrial plants is exceeds for all EPTC uses. There are multiple lines of evidence, including several incidents of plant damage. Existing vegetation, however, should not be affected but only germinating seedlings in riparian and upland habitats. The aquatic plant LOC is not exceeded any EPTC uses for either vascular or non-vascular plants; however, for non-vascular plants, as with fish, risk cannot be precluded for uses that allow flood irrigation/chemigation. Freshwater and saltwater inverts: The acute LOC is not exceeded for any EPTC uses. As with fish, the acute LOC is exceeded using tailwater data and risk cannot be precluded. Chronic LOC exceeded for saltwater inverts for lettuce and ornamental uses. In addition, estimated 21-day concentration from tailwater data (1.65 day half-life) indicates that RQs would be above chronic LOC for approximately one week, so chronic risk cannot be precluded. For freshwater inverts, the RQs from the estimated 21-day concentration would be below chronic LOC.

[1]Habitat Modification

Table 7.3 EPTC Use Specific Summary of The Potential for Adverse Effects to Aquatic Taxa

Uses	Potential for Effects to Identified Taxa Found in the Aquatic Environment									
	Freshwater Vertebrates[1]		Estuarine/Marine Vertebrates[3]		Freshwater Invertebrates[4]		Estuarine/Marine Invertebrates[5]		Vascular Plants[6]	Non-vascular Plants[6]
	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic		
Alfalfa	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Almond	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Beans	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Broccoli	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Cabbage	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Carrot	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Castor Bean	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Cauliflower	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Citrus	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Clover	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Conifers	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Corn	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Cotton	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Fallow/Idle	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Grapefruit	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Lemon	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Lespedeza	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Lettuce	No	Yes[2]	No	Yes[2]	No	No	Yes	Yes	No	No
Orange	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Ornamentals	No	Yes[2]	No	Yes[2]	No	No	Yes	Yes	No	No
Pine	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Potato	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Safflower	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Sugar Beets	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No

Uses	Potential for Effects to Identified Taxa Found in the Aquatic Environment									
	Freshwater Vertebrates[1]		Estuarine/Marine Vertebrates[3]		Freshwater Invertebrates[4]		Estuarine/Marine Invertebrates[5]		Vascular Plants[6]	Non-vascular Plants[6]
	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic		
Sunflower	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Tangerine	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Tomato	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Trefoil Birdsfoot	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Walnut	No	Yes[2]	No	Yes[2]	No	No	Yes	No	No	No
Monitoring Study Data										
Tailwater data	Yes	Yes[2]	Yes	Yes[2]	Yes	Yes	Yes	Yes	No	Yes

1A yes in this column indicates a potential for direct and indirect effects to DS.
[2]There is a lack of chronic data. Lack of chronic data does not preclude lack of risk.
[3]A yes in this column indicates a potential for direct and indirect effects to DS.
[4]A yes in this column indicates a potential for indirect effects to the DS.
[5]A yes in this column indicates a potential for indirect effects to the DS.
[6]A yes in this column indicates a potential for indirect effects to the DS.

Table 7.4 EPTC Use Specific Summary of The Potential for Adverse Effects to Terrestrial Taxa

Uses	Potential for Effects to Identified Taxa Found in the Terrestrial Environment:	
	Dicots[1]	Monocots[1]
All uses	Yes	Yes

[1]A yes in this column indicates a potential for indirect effects to DS. The LOC exceedances are evaluated based on the LOC for non-listed species.

Based on the conclusions of this assessment, a formal consultation with the U. S. Fish and Wildlife Service under Section 7 of the Endangered Species Act should be initiated.

When evaluating the significance of this risk assessment's direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the listed species and its resources (*i.e*., food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (*i.e*., attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available.

When evaluating the significance of this risk assessment's direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the species and its resources (*i.e*., food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (*i.e*., attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available. Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of DS life stages within the action area and/or applicable designated critical habitat. This information would allow for quantitative extrapolation of the present risk assessment's predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the assessed species.
- Quantitative information on prey base requirements for the DS. While existing information provides a preliminary picture of the types of food sources utilized by the assessed species, it does not establish minimal requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.
- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together

with the information described above, a more complete prediction of effects to individual species and potential modification to critical habitat.

8. References

A bibliography of ECOTOX references, identified by the letter E followed by a number, is located in **Appendix H**.

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00141373	00421211	40575102
00144208	40228401	41613601
00146934	40420402	41724305
00146935	40420404	42120800
00161602	40420405	42120801
00258924	40420406	42120802
00420402	40420407	42120803
00421208	40430402	42120804

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