Risks of EPTC Use to Federally Threatened California Red-legged Frog

(*Rana aurora draytonii*)

Pesticide Effects Determination

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1. Executive Summary

The purpose of this assessment is to evaluate potential direct and indirect effects on the California red-legged frog (*Rana aurora draytonii*) (CRLF) arising from FIFRA regulatory actions regarding use of S-Ethyl dipropylthiocarbamate (EPTC) as an herbicide on agricultural and non-agricultural sites. In addition, this assessment evaluates whether these actions can be expected to result in modification of the species' designated critical habitat. 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) and procedures outlined in the Agency's Overview Document (U.S. EPA, 2004).

The CRLF was listed as a threatened species by USFWS in 1996. The species is endemic to California and Baja California (Mexico) and inhabits both coastal and interior mountain ranges. A total of 243 streams or drainages are believed to be currently occupied by the species, with the greatest numbers in Monterey, San Luis Obispo, and Santa Barbara counties (USFWS, 1996) in California.

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. 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 in every region of 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, tangerine, tomato, trefoil, walnut. The 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, Riverside, San Joaquin, and Tulare. During the period between 2002 and 2005, approximately 142,000 to 254,000 (average 189,800) pounds of EPTC (a.i.) were used annually in California.

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. 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.

Since CRLFs exist within aquatic and terrestrial habitats, exposure of the CRLF, its prey and its habitats to EPTC are assessed separately for the two habitats. 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 2000-2005 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 for 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 can be considerably higher than the model-predicted EECs for surface water. One study reported that a maximum EPTC concentration in tailwater of 1970 to 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 monitoring data are used quantitatively in this assessment to assess the potential risk to the CRLF.

To estimate EPTC exposures to the terrestrial-phase CRLF, and its potential prey resulting from uses involving EPTC applications, the T-REX model is used for bare ground spray. The AgDRIFT model is also used to estimate deposition of EPTC on terrestrial and aquatic habitats from spray drift. The TerrPlant model is used to estimate EPTC exposures to terrestrial-phase CRLF habitat, including plants inhabiting semi-aquatic and dry areas, resulting from uses involving foliar EPTC applications. The T-HERPS model is used to allow for further characterization of dietary exposures of the terrestrial-phase CRLF. EPTC is highly volatile, and inhalation is a likely route of terrestrial exposure; however, models are not available to estimate inhalation exposure following application and incorporation into the soil. Risk to the CRLF via inhalation of EPTC is discussed qualitatively in this assessment.

The effects determination assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF itself, as well as indirect effects, such as reduction of the prey base or modification of its habitat. Direct effects to the

CRLF in the aquatic habitat are based on toxicity information for freshwater fish, which are generally used as a surrogate for aquatic-phase amphibians. In the terrestrial habitat, direct effects are based on toxicity information for birds, which are used as a surrogate for terrestrial-phase amphibians. Given that the CRLF's prey items and designated critical habitat requirements in the aquatic habitat are dependant on the availability of freshwater aquatic invertebrates and aquatic plants, toxicity information for these taxonomic groups is also discussed. In the terrestrial habitat, indirect effects due to depletion of prey are assessed by considering effects to terrestrial insects, small terrestrial mammals, and frogs. Indirect effects due to modification of the terrestrial habitat are characterized by available data for terrestrial monocots and dicots.

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 toxicity between the parent EPTC and the tested degradates.

Available aquatic toxicity data indicate that EPTC and several of its formulations are slightly toxic on an acute basis to freshwater fish and invertebrates. 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. Non-vascular and vascular aquatic plants have reported EC_{50s} ranging from about 1 to 6 mg a.i./L.

Terrestrial toxicity tests indicated that EPTC is practically non-toxic to slightly toxic to birds on acute oral and dietary bases. The available acute oral toxicity tests for the mallard duck and bobwhite quail failed to establish a definitive LD_{50} (*e.g.*, mallard duck LD_{50} >1000 mg/kg). A definitive subacute dietary LC_{50} of 20000 ppm was established for the bobwhite quail. Based on available information, it appears that the tested EPTC formulations and mixtures exhibit toxic effects to birds in the same range as EPTC (a.i.). EPTC elicited reproductive effects in birds at 593 ppm. For mammals, EPTC technical and tested formulations are categorized as no more than slightly toxic on an acute basis. Chronic mammalian toxicity tests reported no frank reproductive effects; however, growth effects on pups were observed. The sublethal endpoint used to define the action area was a dose-related decrease in absolute brain weight in male pups at post-natal day 63 from a developmental neurotoxicity study. Honey bee toxicity information suggests that EPTC is practically non-toxic to terrestrial invertebrates. 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.

Risk quotients (RQs) are derived as quantitative estimates of potential high-end risk. Acute and chronic RQs are compared to the Agency's levels of concern (LOCs) to identify instances where EPTC use within the action area has the potential to adversely affect the CRLF and its designated critical habitat via direct toxicity or indirectly based on direct effects to its food supply (i.e., freshwater invertebrates, algae, fish, frogs, terrestrial invertebrates, and mammals) or habitat (i.e., aquatic plants and terrestrial upland and riparian vegetation). When RQs for a particular type of effect are below LOCs, the pesticide is determined to have "no effect" on the subject species. Where RQs exceed LOCs, a potential to cause adverse effects is identified, leading to a conclusion of "may affect." If a determination is made that use of EPTC use within the action area "may affect" the CRLF and its designated critical habitat, additional information is considered to refine the potential for exposure and effects, and the best available information is used to distinguish those actions that "may affect, but are not likely to adversely affect" (NLAA) from those actions that are "likely to adversely affect" (LAA) the CRLF and its critical habitat.

Based on the best available information, the Agency makes a Likely to Adversely Affect determination for the CRLF from the use of EPTC. Additionally, the Agency has determined that there is the potential for modification of CRLF 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 aquatic-phase CRLF via direct effects and via indirect effects via reduction in prey (non-vascular plants, fish, amphibians) and habitat (terrestrial plants). EPTC is also 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 is predicted to result in modification to one or more CRLF critical habitat Primary Constituent Elements (PCEs). Geospatial analysis indicates that overlap between the EPTC action area and species range occurs in all eight of the CRLF Recovery Units. A summary of the risk conclusions and effects determinations for the CRLF and its critical habitat is presented in Tables 1.1 and 1.2. 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 Direct and Indirect Effects of EPTC on the CRLF		
Assessment Endpoint	**Effects Determination[1]**	**Basis for Determination**
Aquatic-Phase CRLF (Eggs, Larvae, and Adults)		
Direct Effects: Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	LAA	Using fish toxicity data as a surrogate for the aquatic-phase CRLF and modeled EECs, acute RQs do not exceed LOC; however, available monitoring 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.
Indirect Effects: Survival, growth, and reproduction of CRLF individuals via effects to food supply (*i.e.*, freshwater invertebrates, non-vascular plants, fish, and frogs)	Freshwater invertebrates: NLAA	RQs do not exceed the acute or chronic LOC using modeled aquatic exposure estimates. Acute RQ calculated using tailwater monitoring data exceeds LOC; however, there is a very low probability of individual acute effects. Chronic RQ based on the tailwater monitoring data (estimated 21-day concentration based on 1.65 day half-life) would be well below the LOC (1.0).
	Non-vascular aquatic plants: LAA	RQs do not exceed the aquatic plant LOC using modeled aquatic exposure estimates. However, available monitoring 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)).
	Fish and frogs: LAA	Using fish toxicity data as a surrogate for the aquatic-phase CRLF, acute RQs do not exceed LOC using modeled aquatic exposure estimates. However, available monitoring 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 toxicity data; risk cannot be precluded.
Indirect Effects: Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, and/or primary productivity (*i.e.*, aquatic plant community)	Non-vascular aquatic plants: LAA	RQs do not exceed the aquatic plant LOC using modeled aquatic exposure estimates. However, available monitoring 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: NE	RQs do not exceed the aquatic plant LOC using modeled aquatic exposure estimates or available tailwater monitoring data.

Table 1.1 Effects Determination Summary for Direct and Indirect Effects of EPTC on the CRLF		
Assessment Endpoint	**Effects Determination[1]**	**Basis for Determination**
Indirect Effects: Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	LAA	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.
Terrestrial-Phase CRLF (Juveniles and adults)		
Direct Effects: Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	LAA	Avian toxicity data were used as a surrogate. Dose-based acute LD_{50} not definitive (i.e., LD_{50} > highest dose tested); due to 20% mortality at highest dose, RQs could exceed the acute avian LOC for all uses. Probability of effect is high. T-HERPS indicates potential LOC exceedance for highest application rate (forestry/ornamental uses). Subacute dietary acute RQs do not exceed LOC. Chronic RQs exceed the LOC for all EPTC uses except castor beans.
Indirect Effects: Survival, growth, and reproduction of CRLF individuals via effects on prey (*i.e.*, terrestrial invertebrates, small terrestrial vertebrates, including mammals and terrestrial phase amphibians)	Terrestrial invertebrates: LAA	Most sensitive honey bee LD_{50} data not definitive (mortality rate at highest dose tested 6%). RQs estimated using these data all exceed the terrestrial invertebrate LOC of 0.05 with values as high as 430 times LOC. Probability on individual effects at LOC is low; however, probability at highest RQ is 1 in 1.
	Mammals: LAA	Acute and chronic RQs exceed the LOC.
	Frogs: LAA	See terrestrial phase direct effects.
Indirect Effects: Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (*i.e.*, riparian vegetation)	LAA	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.
[1] NE = no effect; NLAA = may affect, but not likely to adversely affect; LAA = likely to adversely affect		

Table 1.2 Effects Determination Summary for the Critical Habitat Impact Analysis		
Assessment Endpoint	**Effects Determination[1]**	**Basis for Determination**
Aquatic-Phase CRLF PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)		
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 CRLFs.	HM	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.
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.[1]	HM	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.
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	HM	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.
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.,* algae)	HM	Aquatic plant RQs do not exceed the LOC using modeled aquatic exposure estimates. However, available monitoring 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)).
Terrestrial-Phase CRLF PCEs (Upland Habitat and Dispersal Habitat)		
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	HM	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.
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	HM	
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	HM	Weight of the evidence of acute risk to birds and chronic RQs for birds and acute and chronic RQs for mammals exceed the LOCs.
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	HM	Weight of the evidence of acute risk to birds and chronic RQs for birds and acute and chronic RQs for mammals exceed the LOCs.
[1] NE = No effect; HM = Habitat Modification		

[1] Physico-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.

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 CRLF life stages within specific recovery units and/or designated critical habitat within the action area. 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 species.
- Quantitative information on prey base requirements for individual aquatic- and terrestrial-phase frogs. While existing information provides a preliminary picture of the types of food sources utilized by the frog, 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 frogs 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* (U.S. EPA 1998), the Services' *Endangered Species Consultation Handbook* (USFWS/NMFS 1998) and is consistent with procedures and methodology outlined in the Overview Document (U.S. EPA 2004) and reviewed by the U.S. Fish and Wildlife Service and National Marine Fisheries Service (USFWS/NMFS 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 California red-legged frog *(Rana aurora draytonii*) (CRLF) arising from FIFRA regulatory actions regarding use of EPTC on agricultural and non-agricultural uses. In addition, this assessment evaluates whether use on these crops is expected to result in modification of the species' designated critical habitat. This ecological risk assessment has been prepared consistent with a settlement agreement in the case *Center for Biological Diversity (CBD) vs. EPA et al*. (Case No. 02-1580-JSW(JL)) settlement entered in Federal District Court for the Northern District of California on October 20, 2006.

In this assessment, direct and indirect effects to the CRLF and potential modification to its designated critical habitat are evaluated in accordance with the methods described in the Agency's Overview Document (U.S. EPA 2004). Screening level methods include use of standard models such as PRZM-EXAMS, T-REX, TerrPlant, and AgDRIFT, all of which are described at length in the Overview Document. Additional refinements include consideration of aquatic and terrestrial modeling based on EPTC atmospheric deposition data and for risk characterization purposes and the use of the T-HERPS model to refine terrestrial risks. Use of such information is consistent with the methodology described in the Overview Document (U.S. EPA 2004), which specifies that "the assessment process may, on a case-by-case basis, incorporate additional methods, models, and lines of evidence that EPA finds technically appropriate for risk management objectives" (Section V, page 31 of U.S. EPA 2004).

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 exceedence 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 CRLF 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 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".

Designated critical habitat identifies specific areas that have the physical and biological features, (known as primary constituent elements or PCEs) essential to the conservation of the listed species. The PCEs for CRLFs are aquatic and upland areas where suitable breeding and non-breeding aquatic habitat is located, interspersed with upland foraging and dispersal habitat.

If the results of initial screening-level assessment methods show no direct or indirect effects (no LOC exceedances) upon individual CRLFs or upon the PCEs of the species' designated critical habitat, a "no effect" determination is made for use of EPTC as it relates to this species and its designated critical habitat. If, however, potential direct or indirect effects to individual CRLFs are anticipated or effects may impact the PCEs of the CRLF's designated critical habitat, a preliminary "may affect" determination is made for the FIFRA regulatory action regarding EPTC.

If a determination is made that use of EPTC within the action area(s) associated with the CRLF "may affect" this species or its designated critical habitat, additional information is considered to refine the potential for exposure and for effects to the CRLF and other taxonomic groups upon which these species depend (e.g., aquatic and terrestrial vertebrates and invertebrates, aquatic plants, riparian vegetation, etc.). Additional information, including spatial analysis (to determine the geographical proximity of CRLF habitat and EPTC use sites) and further evaluation of the potential impact of EPTC on the PCEs is also used to determine whether modification of designated critical habitat may occur. Based on the refined information, the Agency uses the best available information to distinguish those actions that "may affect, but are not likely to adversely affect" from those actions that "may affect and are likely to adversely affect" the CRLF or the PCEs of its designated critical habitat. This information is presented as part of the Risk Characterization in Section 5 of this document.

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 (defined in Section 2.7), 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 (i.e., the biological resource requirements for the listed species associated with the critical habitat or important physical aspects of the habitat that may be reasonably influenced through biological processes). Activities that may modify critical habitat are those that alter the PCEs and appreciably diminish the value of the habitat. Evaluation of actions related to use of EPTC that may alter the PCEs of the

CRLF's critical habitat form the basis of the critical habitat impact analysis. Actions that may affect the CRLF's designated critical habitat have been identified by the Services and are discussed further in Section 2.6.

2.2 Scope

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). EPTC is registered for a number of food and non-food uses.

EPTC is used nationally; however, this assessment is limited in scope to the state of California. EPTC is currently registered on a number of agricultural and non-agricultural crops in California. Agricultural uses in California (in decreasing order of total pounds EPTC applied in 2005) include: alfalfa, potatoes, sugar beets, corn, safflower, beans, almonds, carrots, tomatoes, cotton and walnuts. Non-agricultural uses in California (in decreasing order of total pounds EPTC applied in 2005) include: uncultivated agricultural lands, commodity research, rights-of-way, and outdoor propagation nurseries.

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.

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 CRLF and its designated critical habitat. Further discussion of the action area for the CRLF and its critical habitat is provided in Section 2.7.

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 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.

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. The available open literature and acute oral mammalian LD_{50} data for multiple active ingredient products relative to the single active ingredient are considered in this assessment. In the case of EPTC, 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. Thus, the scope of this risk assessment is appropriately limited to the potential effects of the single active ingredient of EPTC.

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, 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.

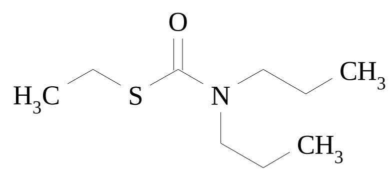
2.4 Stressor Source and Distribution

2.4.1 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, 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 and dipropylamine, 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 lists the environmental fate and chemical properties of EPTC, chemical structure and also identifies several environmental degradates.

Table 2.1 Summary of EPTC Environmental Fate Properties				
Study	**Value and units**	**Major Degradates** ***Minor Degradates***	**MRID #**	**Study Status**
Structure			USEPA, 1999	
Hydrolysis	Stable at pH 5, 7, 9		00141373	Supplemental
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 @25^{o}C 1.60 x 10-0e2 mm Hg @20^{o}C		42120800 42120801	Supplemental
Henry's Law Const.	1.5 x 10^{-5} m^3atm/g mol @ 20^{o}C)		42120801	Acceptable
Aerobic Soil Metabolism	$T_{1/2}$ range 36-75 days DT50 range 10-37 days (rate includes metabolism and volatilization (CO2 and vaporized EPTC)	EPTC sulfoxide (ESO) Dipropylamine	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: 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

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 (CO_2 from metabolism of EPTC and the 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 could not be determined because the data for 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%). In one aerobic soil metabolism study (MRID 0420402) neither transformation product accumulated suggesting that dipropylamine and sulfoxide 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 reflects 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.

Volatilization

Laboratory Volatility. EPTC is highly volatile (vapor pressure 1.60 x 10^{-2} mm Hg @ 20^{o}C and Henry's Law Constant of 1.5 x 10^{-5} m^3atm/g mol @ 20^{o}C). The Henry's Law constant is greater than 2 x 10^{-5} m^3-atm/g-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 (Appendix A). 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 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

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

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, 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.

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 monitoring data are available for quantitative risk characterization for this exposure pathway.

Atmospheric transport and deposition data are used to qualitatively characterize risk to the CRLF 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, Sparling et al., 2001, LeNoir et al., 1999, and McConnell et al., 1998). Prevailing winds blow across 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 CLRF 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 CRLF.

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/or AGDISP) are used to determine potential exposures to aquatic and 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 label for EPTC represents the FIFRA regulatory action; therefore, labeled use and 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 and 2.3 summarizes the uses considered in this assessment. Various timings of applications for each of the scenarios were considered in the aquatic exposure assessment.

The Agency's Biological and Economic Analysis Division (BEAD) provides an analysis of both national- and county-level usage information (Kaul and Jones, 2006) using state-level usage data obtained from USDA-NASS[3], Doane (www.doane.com; the full dataset is not provided due to its proprietary nature) and the California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database[4]. CDPR PUR is considered a more comprehensive source of usage data than USDA-NASS or proprietary databases, and thus the usage data reported for EPTC by county in this California-specific assessment were generated using CDPR PUR data. Usage data are averaged together over the years 2002 to 2005 to calculate average annual usage statistics by county (Table 2.2) and crop for EPTC (Appendix I, Table 1), including pounds of active ingredient applied and base acres treated. California State law requires that every pesticide application be reported to the state and made available to the public.

[3] 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.usda.gov/nass/pubs/estindx1.htm#agchem.
[4] 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.

A summary of EPTC usage for all California use sites for 2002 to 2005 is provided below in Table 2.2. The total amount of EPTC used in California over the 2002 to 2005 ranged between 142,000 to 254,000 pounds active ingredient (CDPR PUR). The counties with the highest and lowest average total pounds used were Imperial (49,000 lb a.i./year) and Santa Cruz (7.63 lb a.i./year), respectively (Table 2.2). The uses with the highest total amount used per year were alfalfa (88,725 lb a.i./yr), potato (27,161 lb a.i./yr), and sugar beets (19,150 lb a.i./yr) (Appendix I, Table 1).

The individual 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 forestry/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 3.1 and Appendix I, Table 2). In the exposure assessment, several application rate combinations (rates, number of applications) were considered.

The timing of EPTC applications in California on various crops is summarized below in Table 2.3; this information is summarized from CDPR PUR data from 2000 to 2005. While EPTC appears to be used throughout year, the available data suggest that EPTC is most commonly applied during months of March through June and August through November.

Table 2.2 Summary of the California Department of Pesticide Registration (CDPR) Pesticide Use Reporting (PUR) Data from 2002 to 2005 for currently registered uses of EPTC.		
County	**Average Total Applied/Year [lb a.i./yr]**	**Use(s)**
Butte	1374	almond, beans (dried, unspecified) walnut
Colusa	1031	alfalfa, beans (dried), cotton, safflower,
Contra Costa	34	tomato, processing; uncultivated ag
Fresno	6834	alfalfa., almond, beans (succulent, snap), beet, corn, cotton, research commodity, human consumption, sugar beet, tomato, uncultivated ag
Glenn	1198	alfalfa, beans (dried, unspecified), uncultivated ag
Imperial	49163	alfalfa, carrot, lettuce, head, lettuce, leaf, potato, rights of way, sugar beet, uncultivated ag
Kern	31246	alfalfa, beans (dried, succulent, snap), carrot, corn (forage - fodder), potato, regulatory pest control, rights of way, uncultivated ag
Kings	30281	alfalfa, corn (forage - fodder), sugar beet (forage - fodder), walnut
Los Angeles	3513	potato, uncultivated ag
Madera	932	alfalfa, almond, corn (forage - fodder), sugar beet
Merced	8303	alfalfa, almond, clover, corn (forage - fodder), sugar beet, tomato, tomato, processing
Mono	35	alfalfa
Monterey	3565	alfalfa, beans (dried, succulent, snap, unspecified), rights of way, soil fumigation/preplant, uncultivated ag, uncultivated non-ag
Riverside	10483	alfalfa, beans (succulent), broccoli, cabbage, carrot, cauliflower, lettuce, leaf pepper, fruiting, potato, rappini, sudan grass, uncultivated ag, uncultivated non-ag
Sacramento	5987	alfalfa, clover, corn (forage - fodder), corn, human consumption, safflower, tomato, tomato, processing
San Diego	0	landscape maintenance
San Joaquin	10242	alfalfa, almond, corn (forage - fodder), landscape maintenance, potato, safflower, tomato, processing
San Luis Obispo	1472	alfalfa, beans (succulent, unspecified, snap), carrot, potato, uncultivated ag
Santa Barbara	3752	alfalfa, beans (succulent, unspecified, snap), potato, uncultivated ag
Santa Clara	628	beans (dried, succulent, snap, unspecified), corn, human consumption, landscape maintenance
Santa Cruz	8	beans (unspecified)
Siskiyou	87	potato
Solano	1118	alfalfa, safflower, tomato, processing, uncultivated ag
Stanislaus	4783	alfalfa, almond, corn (forage - fodder), rights of way, tomato, processing,

Table 2.2 Summary of the California Department of Pesticide Registration (CDPR) Pesticide Use Reporting (PUR) Data from 2002 to 2005 for currently registered uses of EPTC.		
County	**Average Total Applied/Year [lb a.i./yr]**	**Use(s)**
		walnut
Sutter	1523	alfalfa, beans (dried), safflower
Tehama	248	beans, dried, beans, unspecified, oat, uncultivated ag
Tulare	10055	alfalfa, beans (succulent) corn (forage - fodder), cotton, sugar beet, walnut
Ventura	559	beans (succulent, unspecified), potato, uncultivated ag
Yolo	1350	alfalfa, beans (dried), research commodity, safflower, tomato, processing
Grand Total	**189804**	

Table 2.3 Crop and Month of EPTC Application from CA PUR database 2000 to 2005

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 granular formulation). In addition, EPTC may be applied via flood 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).[5] Tailwater irrigation runoff from the treated field may be a significant exposure route for the CRLF.

2.5 Assessed Species

The CRLF was federally listed as a threatened species by USFWS effective June 24, 1996 (USFWS 1996). It is one of two subspecies of the red-legged frog and is the largest native frog in the western United States (USFWS 2002). A brief summary of information regarding CRLF distribution, reproduction, diet, and habitat requirements is provided in Sections 2.5.1 through 2.5.4, respectively. Further information on the status, distribution, and life history of and specific threats to the CRLF is provided in Attachment 1.

Final critical habitat for the CRLF was designated by USFWS on April 13, 2006 (USFWS 2006; 71 FR 19244-19346). Further information on designated critical habitat for the CRLF is provided in Section 2.6.

2.5.1 Distribution

The CRLF is endemic to California and Baja California (Mexico) and historically inhabited 46 counties in California including the Central Valley and both coastal and interior mountain ranges (USFWS 1996). Its range has been reduced by about 70%, and the species currently resides in 22 counties in California (USFWS 1996). The species has an elevational range of near sea level to 1,500 meters (5,200 feet) (Jennings and Hayes 1994); however, nearly all of the known CRLF populations have been documented below 1,050 meters (3,500 feet) (USFWS 2002).

Populations currently exist along the northern California coast, northern Transverse Ranges (USFWS 2002), foothills of the Sierra Nevada (5-6 populations), and in southern California south of Santa Barbara (two populations) (Fellers 2005a). Relatively larger numbers of CRLFs are located between Marin and Santa Barbara Counties (Jennings and Hayes 1994). A total of 243 streams or drainages are believed to be currently occupied by the species, with the greatest numbers in Monterey, San Luis Obispo, and Santa Barbara counties (USFWS 1996). Occupied drainages or watersheds include all bodies of water that support CRLFs (i.e., streams, creeks, tributaries, associated natural and artificial ponds, and adjacent drainages), and habitats through which CRLFs can move (i.e., riparian vegetation, uplands) (USFWS 2002).

[5] According to the use characterization provided by the Agency's Biological and Economic Analysis Division (BEAD).

The distribution of CRLFs within California is addressed in this assessment using four categories of location including recovery units, core areas, designated critical habitat, and known occurrences of the CRLF reported in the California Natural Diversity Database (CNDDB) that are not included within core areas and/or designated critical habitat (see **Figure 1**). Recovery units, core areas, and other known occurrences of the CRLF from the CNDDB are described in further detail in this section, and designated critical habitat is addressed in Section 2.6. Recovery units are large areas defined at the watershed level that have similar conservation needs and management strategies. The recovery unit is primarily an administrative designation, and land area within the recovery unit boundary is not exclusively CRLF habitat. Core areas are smaller areas within the recovery units that comprise portions of the species' historic and current range and have been determined by USFWS to be important in the preservation of the species. Designated critical habitat is generally contained within the core areas, although a number of critical habitat units are outside the boundaries of core areas, but within the boundaries of the recovery units. Additional information on CRLF occurrences from the CNDDB is used to cover the current range of the species not included in core areas and/or designated critical habitat, but within the recovery units.

Recovery Units

Eight recovery units have been established by USFWS for the CRLF. These areas are considered essential to the recovery of the species, and the status of the CRLF "may be considered within the smaller scale of the recovery units, as opposed to the statewide range" (USFWS 2002). Recovery units reflect areas with similar conservation needs and population statuses, and therefore, similar recovery goals. The eight units described for the CRLF are delineated by watershed boundaries defined by US Geological Survey hydrologic units and are limited to the elevational maximum for the species of 1,500 m above sea level. The eight recovery units for the CRLF are listed in **Table 2.4** and shown in **Figure 1**.

Core Areas

USFWS has designated 35 core areas across the eight recovery units to focus their recovery efforts for the CRLF (see **Figure 1**). **Table 2.4** summarizes the geographical relationship among recovery units, core areas, and designated critical habitat. The core areas, which are distributed throughout portions of the historic and current range of the species, represent areas that allow for long-term viability of existing populations and reestablishment of populations within historic range. These areas were selected because they: 1) contain existing viable populations; or 2) they contribute to the connectivity of other habitat areas (USFWS 2002). Core area protection and enhancement are vital for maintenance and expansion of the CRLF's distribution and population throughout its range.

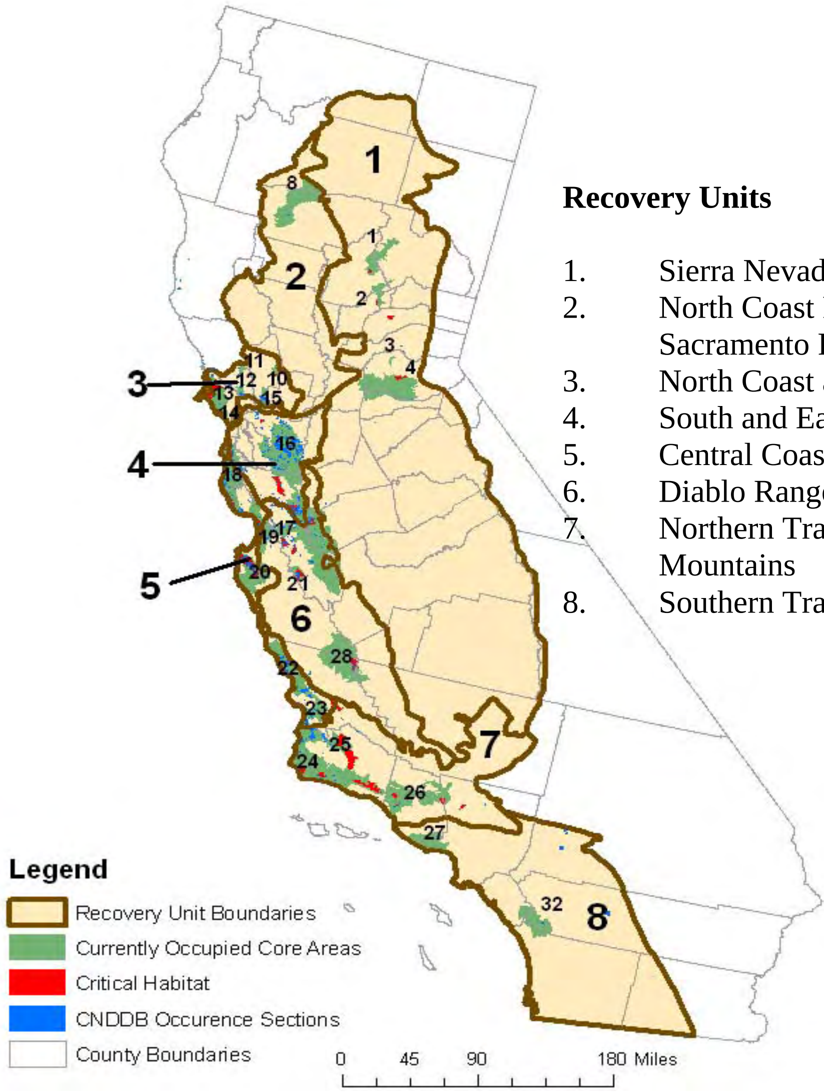
For purposes of this assessment, designated critical habitat, currently occupied (post-1985) core areas, and additional known occurrences of the CRLF from the CNDDB are considered. Historically occupied sections of the core areas are not evaluated as part of this assessment because the USFWS Recovery Plan (USFWS 2002) indicates that CRLFs are extirpated from these areas. A summary of currently and historically occupied core areas is provided in **Table 2.4** (currently occupied core areas are bolded). While core areas are considered essential for recovery of the CRLF, core areas are not federally-designated critical habitat, although designated critical habitat is generally contained within these core recovery areas. It should be noted, however, that several critical habitat units are located outside of the core areas, but within the recovery units. The focus of this assessment is currently occupied core areas, designated critical habitat, and other known CNDDB CRLF occurrences within the recovery units. Federally-designated critical habitat for the CRLF is further explained in Section 2.6.

Table 2.4 California Red-legged Frog Recovery Units with Overlapping Core Areas and Designated Critical Habitat

Recovery Unit [1] (Figure 1)	Core Areas [2,7] (Figure 1)	Critical Habitat Units [3]	Currently Occupied (post-1985) [4]	Historically Occupied [4]
Sierra Nevada Foothills and Central Valley (1) (eastern boundary is the 1,500m elevation line)	**Cottonwood Creek (partial) (8)**	--	✓	
	Feather River (1)	BUT-1A-B	✓	
	Yuba River-S. Fork Feather River (2)	YUB-1	✓	
	--	NEV-1[6]		
	Traverse Creek/Middle Fork American River/Rubicon (3)	--	✓	
	Consumnes River (4)	ELD-1	✓	
	S. Fork Calaveras River (5)	--		✓
	Tuolumne River (6)	--		✓
	Piney Creek (7)	--		✓
	East San Francisco Bay (partial)(16)	--	✓	
North Coast Range Foothills and Western Sacramento River Valley (2)	**Cottonwood Creek (8)**	--	✓	
	Putah Creek-Cache Creek (9)	--		✓
	Jameson Canyon – Lower Napa Valley (partial) (15)	--	✓	
	Belvedere Lagoon (partial) (14)	--	✓	
	Pt. Reyes Peninsula (partial) (13)	--	✓	
North Coast and North San Francisco Bay (3)	Putah Creek-Cache Creek (partial) (9)	--		✓
	Lake Berryessa Tributaries (10)	NAP-1	✓	
	Upper Sonoma Creek (11)	--	✓	
	Petaluma Creek-Sonoma Creek (12)	--	✓	
	Pt. Reyes Peninsula (13)	MRN-1, MRN-2	✓	
	Belvedere Lagoon (14)	--	✓	
	Jameson Canyon-Lower Napa River (15)	SOL-1	✓	
South and East San Francisco Bay (4)	--	CCS-1A[6]		
	East San Francisco Bay (partial) (16)	ALA-1A, ALA-1B, STC-1B	✓	
	--	STC-1A[6]		
	South San Francisco Bay (partial) (18)	SNM-1A	✓	
Central Coast (5)	**South San Francisco Bay (partial) (18)**	SNM-1A, SNM-2C, SCZ-1	✓	
	Watsonville Slough- Elkhorn Slough (partial) (19)	SCZ-2 [5]	✓	
	Carmel River-Santa Lucia (20)	MNT-2	✓	

Table 2.4 California Red-legged Frog Recovery Units with Overlapping Core Areas and Designated Critical Habitat				
Recovery Unit [1] (Figure 1)	**Core Areas [2,7] (Figure 1)**	**Critical Habitat Units [3]**	**Currently Occupied (post-1985) [4]**	**Historically Occupied [4]**
	Estero Bay (22)	--	✓	
	--	SLO-8[6]		
	Arroyo Grande Creek (23)	--	✓	
	Santa Maria River-Santa Ynez River (24)	--	✓	
Diablo Range and Salinas Valley (6)	**East San Francisco Bay (partial) (16)**	MER-1A-B, STC-1B	✓	
	--	SNB-1[6], SNB-2[6]		
	Santa Clara Valley (17)	--	✓	
	Watsonville Slough- Elkhorn Slough (partial)(19)	MNT-1	✓	
	Carmel River-Santa Lucia (partial)(20)	--	✓	
	Gablan Range (21)	SNB-3	✓	
	Estrella River (28)	SLO-1A-B	✓	
Northern Transverse Ranges and Tehachapi Mountains (7)	--	SLO-8[6]		
	Santa Maria River-Santa Ynez River (24)	STB-4, STB-5, STB-7	✓	
	Sisquoc River (25)	STB-1, STB-3	✓	
	Ventura River-Santa Clara River (26)	VEN-1, VEN-2, VEN-3	✓	
	--	LOS-1[6]		
Southern Transverse and Peninsular Ranges (8)	**Santa Monica Bay-Ventura Coastal Streams (27)**	--	✓	
	San Gabriel Mountain (29)	--		✓
	Forks of the Mojave (30)	--		✓
	Santa Ana Mountain (31)	--		✓
	Santa Rosa Plateau (32)	--	✓	
	San Luis Rey (33)	--		✓
	Sweetwater (34)	--		✓
	Laguna Mountain (35)	--		✓

[1] Recovery units designated by the USFWS (USFWS 2000, pg 49).
[2] Core areas designated by the USFWS (USFWS 2000, pg 51).
[3] Critical habitat units designated by the USFWS on April 13, 2006 (USFWS 2006, 71 FR 19244-19346).
[4] Currently occupied (post-1985) and historically occupied core areas as designated by the USFWS (USFWS 2002, pg 54).
[5] Critical habitat unit where identified threats specifically included pesticides or agricultural runoff (USFWS 2002).
[6] Critical habitat units that are outside of core areas, but within recovery units.
[7] Currently occupied core areas that are included in this effects determination are bolded.



Recovery Units

1. Sierra Nevada Foothills and Central Valley
2. North Coast Range Foothills and Western Sacramento River Valley
3. North Coast and North San Francisco Bay
4. South and East San Francisco Bay
5. Central Coast
6. Diablo Range and Salinas Valley
7. Northern Transverse Ranges and Tehachapi Mountains
8. Southern Transverse and Peninsular Ranges

Figure 1. Recovery Unit, Core Area, Critical Habitat, and Occurrence Designations for CRLF

Core Areas

1. Feather River
2. Yuba River- S. Fork Feather River
3. Traverse Creek/ Middle Fork/ American R. Rubicon
4. Cosumnes River
5. South Fork Calaveras River*
6. Tuolumne River*
7. Piney Creek*
8. Cottonwood Creek
9. Putah Creek – Cache Creek*
10. Lake Berryessa Tributaries
11. Upper Sonoma Creek
12. Petaluma Creek – Sonoma Creek
13. Pt. Reyes Peninsula
14. Belvedere Lagoon
15. Jameson Canyon – Lower Napa River
16. East San Francisco Bay
17. Santa Clara Valley
18. South San Francisco Bay
19. Watsonville Slough-Elkhorn Slough
20. Carmel River – Santa Lucia
21. Gablan Range
22. Estero Bay
23. Arroyo Grange River
24. Santa Maria River – Santa Ynez River
25. Sisquoc River
26. Ventura River – Santa Clara River
27. Santa Monica Bay – Venura Coastal Streams
28. Estrella River
29. San Gabriel Mountain*
30. Forks of the Mojave*
31. Santa Ana Mountain*
32. Santa Rosa Plateau
33. San Luis Ray*
34. Sweetwater*
35. Laguna Mountain*

* Core areas that were historically occupied by the California red-legged frog are not included in the map

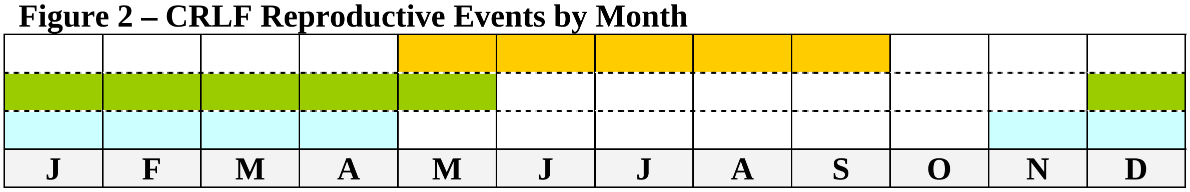
Other Known Occurrences from the CNDBB

The CNDDB provides location and natural history information on species found in California. The CNDDB serves as a repository for historical and current species location sightings. Information regarding known occurrences of CRLFs outside of the currently occupied core areas and designated critical habitat is considered in defining the current range of the CRLF. See: http://www.dfg.ca.gov/bdb/html/cnddb_info.html for additional information on the CNDDB.

2.5.2 Reproduction

CRLFs breed primarily in ponds; however, they may also breed in quiescent streams, marshes, and lagoons (Fellers 2005a). According to the Recovery Plan (USFWS 2002), CRLFs breed from November through late April. Peaks in spawning activity vary geographically; Fellers (2005b) reports peak spawning as early as January in parts of coastal central California. Eggs are fertilized as they are being laid. Egg masses are typically attached to emergent vegetation, such as bulrushes (*Scirpus* spp.) and cattails (*Typha* spp.) or roots and twigs, and float on or near the surface of the water (Hayes and Miyamoto 1984). Egg masses contain approximately 2000 to 6000 eggs ranging in size between 2 and 2.8 mm (Jennings and Hayes 1994). Embryos hatch 10 to 14 days after fertilization (Fellers 2005a) depending on water temperature. Egg predation is reported to be infrequent and most mortality is associated with the larval stage (particularly through predation by fish); however, predation on eggs by newts has also been reported (Rathburn 1998). Tadpoles require 11 to 28 weeks to metamorphose into juveniles (terrestrial-phase), typically between May and September (Jennings and Hayes 1994, USFWS 2002); tadpoles have been observed to over-winter (delay metamorphosis until the following year) (Fellers 2005b, USFWS 2002). Males reach sexual maturity at 2 years, and females reach sexual maturity at 3 years of age; adults have been reported to live 8 to 10 years (USFWS 2002). Figure 2 depicts CRLF annual reproductive timing.

Figure 2 – CRLF Reproductive Events by Month



Light Blue = **Breeding/Egg Masses**
Green = **Tadpoles (except those that over-winter)**
Orange = **Young Juveniles**
Adults and juveniles can be present all year

2.5.3 Diet

Although the diet of CRLF aquatic-phase larvae (tadpoles) has not been studied specifically, it is assumed that their diet is similar to that of other frog species, with the aquatic phase feeding exclusively in water and consuming diatoms, algae, and detritus

(USFWS 2002). Tadpoles filter and entrap suspended algae (Seale and Beckvar, 1980) via mouthparts designed for effective grazing of periphyton (Wassersug, 1984, Kupferberg *et al.*; 1994; Kupferberg, 1997; Altig and McDiarmid, 1999).

Juvenile and adult CRLFs forage in aquatic and terrestrial habitats, and their diet differs greatly from that of larvae. The main food source for juvenile aquatic- and terrestrial-phase CRLFs is thought to be aquatic and terrestrial invertebrates found along the shoreline and on the water surface. Hayes and Tennant (1985) report, based on a study examining the gut content of 35 juvenile and adult CRLFs, that the species feeds on as many as 42 different invertebrate taxa, including Arachnida, Amphipoda, Isopoda, Insecta, and Mollusca. The most commonly observed prey species were larval alderflies (*Sialis* cf. *californica*), pillbugs (*Armadilliadrium vulgare*), and water striders (*Gerris* sp). The preferred prey species, however, was the sowbug (Hayes and Tennant, 1985). This study suggests that CRLFs forage primarily above water, although the authors note other data reporting that adults also feed under water, are cannibalistic, and consume fish. For larger CRLFs, over 50% of the prey mass may consists of vertebrates such as mice, frogs, and fish, although aquatic and terrestrial invertebrates were the most numerous food items (Hayes and Tennant 1985). For adults, feeding activity takes place primarily at night; for juveniles feeding occurs during the day and at night (Hayes and Tennant 1985).

2.5.4 Habitat

CRLFs require aquatic habitat for breeding, but also use other habitat types including riparian and upland areas throughout their life cycle. CRLF use of their environment varies; they may complete their entire life cycle in a particular habitat or they may utilize multiple habitat types. Overall, populations are most likely to exist where multiple breeding areas are embedded within varying habitats used for dispersal (USFWS 2002). Generally, CRLFs utilize habitat with perennial or near-perennial water (Jennings et al. 1997). Dense vegetation close to water, shading, and water of moderate depth are habitat features that appear especially important for CRLF (Hayes and Jennings 1988). Breeding sites include streams, deep pools, backwaters within streams and creeks, ponds, marshes, sag ponds (land depressions between fault zones that have filled with water), dune ponds, and lagoons. Breeding adults have been found near deep (0.7 m) still or slow moving water surrounded by dense vegetation (USFWS 2002); however, the largest number of tadpoles have been found in shallower pools (0.26 – 0.5 m) (Reis, 1999). Data indicate that CRLFs do not frequently inhabit vernal pools, as conditions in these habitats generally are not suitable (Hayes and Jennings 1988).

CRLFs also frequently breed in artificial impoundments such as stock ponds, although additional research is needed to identify habitat requirements within artificial ponds (USFWS 2002). Adult CRLFs use dense, shrubby, or emergent vegetation closely associated with deep-water pools bordered with cattails and dense stands of overhanging vegetation (http://www.fws.gov/endangered/features/rl_frog/rlfrog.html#where).

In general, dispersal and habitat use depends on climatic conditions, habitat suitability, and life stage. Adults rely on riparian vegetation for resting, feeding, and dispersal. The foraging quality of the riparian habitat depends on moisture, composition of the plant community, and presence of pools and backwater aquatic areas for breeding. CRLFs can be found living within streams at distances up to 3 km (2 miles) from their breeding site and have been found up to 30 m (100 feet) from water in dense riparian vegetation for up to 77 days (USFWS 2002).

During dry periods, the CRLF is rarely found far from water, although it will sometimes disperse from its breeding habitat to forage and seek other suitable habitat under downed trees or logs, industrial debris, and agricultural features (UWFWS 2002). According to Jennings and Hayes (1994), CRLFs also use small mammal burrows and moist leaf litter as habitat. In addition, CRLFs may also use large cracks in the bottom of dried ponds as refugia; these cracks may provide moisture for individuals avoiding predation and solar exposure (Alvarez 2000).

2.6 Designated Critical Habitat

In a final rule published on April 13, 2006, 34 separate units of critical habitat were designated for the CRLF by USFWS (USFWS 2006; FR 51 19244-19346). A summary of the 34 critical habitat units relative to USFWS-designated recovery units and core areas (previously discussed in Section 2.5.1) is provided in Table 2.4.

'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.' All designated critical habitat for the CRLF was occupied at the time of listing. Critical habitat receives protection under Section 7 of the ESA through prohibition against destruction or adverse modification with regard to actions carried out, funded, or authorized by a federal Agency. Section 7 requires consultation on federal actions that are likely to result in the destruction or adverse modification of critical habitat.

To be included in a critical habitat designation, the habitat must be '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)). PCEs include, but are not limited to, 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. The designated critical habitat areas for the CRLF are considered to have the following PCEs that justify critical habitat designation:

- Breeding aquatic habitat;
- Non-breeding aquatic habitat;

- Upland habitat; and
- Dispersal habitat.

Further description of these habitat types is provided in Attachment 1.

Occupied habitat may be included in the critical habitat only if essential features within the habitat may require special management or protection. Therefore, USFWS does not include areas where existing management is sufficient to conserve the species. Critical habitat is designated outside the geographic area presently occupied by the species only when a designation limited to its present range would be inadequate to ensure the conservation of the species. For the CRLF, all designated critical habitat units contain all four of the PCEs, and were occupied by the CRLF at the time of FR listing notice in April 2006. The FR notice designating critical habitat for the CRLF includes a special rule exempting routine ranching activities associated with livestock ranching from incidental take prohibitions. The purpose of this exemption is to promote the conservation of rangelands, which could be beneficial to the CRLF, and to reduce the rate of conversion to other land uses that are incompatible with CRLF conservation. Please see Attachment 1 for a full explanation on this special rule.

USFWS has established adverse modification standards for designated critical habitat (USFWS 2006). Activities that may destroy or adversely 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 CRLF's critical habitat form the basis of the critical habitat impact analysis. According to USFWS (2006), activities that may affect critical habitat and therefore result in adverse effects to the CRLF include, but are not limited to the following:

(1) Significant alteration of water chemistry or temperature to levels beyond the tolerances of the CRLF that result in direct or cumulative adverse effects to individuals and their life-cycles.
(2) Significant increase in sediment deposition within the stream channel or pond or disturbance of upland foraging and dispersal habitat that could result in elimination or reduction of habitat necessary for the growth and reproduction of the CRLF by increasing the sediment deposition to levels that would adversely affect their ability to complete their life cycles.
(3) Significant alteration of channel/pond morphology or geometry that may lead to changes to the hydrologic functioning of the stream or pond and alter the timing, duration, water flows, and levels that would degrade or eliminate the CRLF and/or its habitat. Such an effect could also lead to increased sedimentation and degradation in water quality to levels that are beyond the CRLF's tolerances.
(4) Elimination of upland foraging and/or aestivating habitat or dispersal habitat.
(5) Introduction, spread, or augmentation of non-native aquatic species in stream segments or ponds used by the CRLF.
(6) Alteration or elimination of the CRLF's food sources or prey base (also evaluated as indirect effects to the CRLF).

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

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). 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 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 CRLF and its designated critical habitat within the state of California. The Agency's approach to defining the action area under the provisions of the Overview Document (USEPA 2004) considers the results of the risk assessment process to establish boundaries for that action area with the understanding that exposures below the Agency's defined Levels of Concern (LOCs) constitute a no-effect threshold. For the purposes of this assessment, attention will be focused on the footprint of the action (i.e., the area where pesticide application occurs), plus all areas where offsite transport (i.e., spray drift, downstream dilution, etc.) may result in potential exposure within the state of California that exceeds the Agency's LOCs.

Deriving the geographical extent of this portion of the action area is based on consideration of the types of effects that EPTC may be expected to have on the environment, the exposure levels to EPTC that are associated with those effects, and the best available information concerning the use of EPTC and its fate and transport within the state of California. Specific measures of ecological effect for the CRLF that define the action area include any direct and indirect toxic effect to the CRLF 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. Therefore, the action area extends to a point where environmental exposures are below any measured lethal or sublethal effect threshold for any biological entity at the whole organism, organ, tissue, and cellular level of organization. In situations where it is not possible to determine the threshold for an observed effect, the action area is not spatially limited and is assumed to be the entire state of California.

The definition of action area requires a stepwise approach that begins with an understanding of 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 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 CRLF, 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, 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 occurs) 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. A map representing all the land cover types that make up the initial area of concern for EPTC is presented in **Figure 3**.

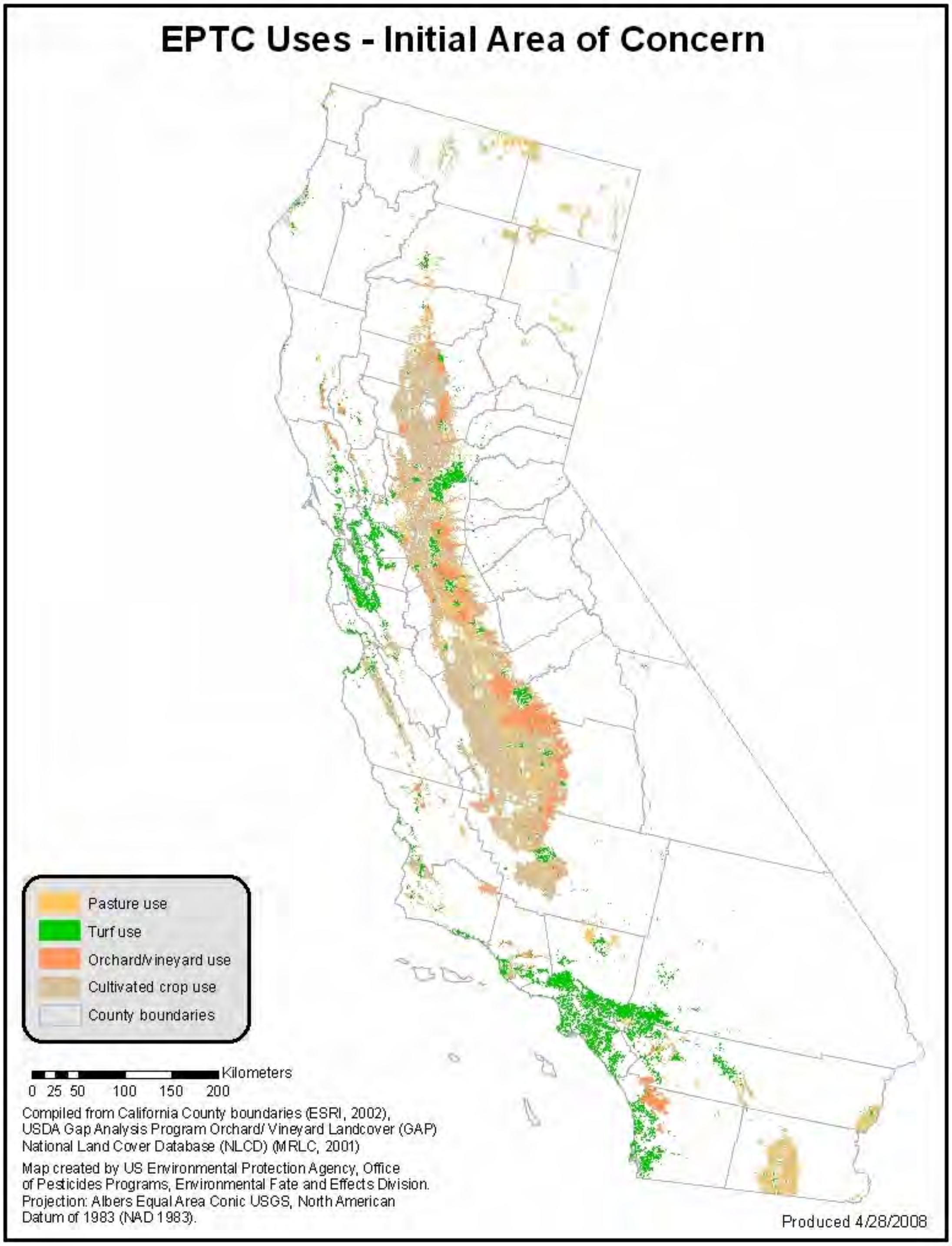


Figure 3. Initial area of concern, or "footprint" of potential use, for EPTC

Once the initial area of concern is defined, the next step is to define the potential boundaries of the action area by determining the extent of offsite transport via spray drift and runoff where exposure of one or more taxonomic groups to the pesticide exceeds the listed species LOCs.

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.

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 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[6]). Air monitoring data from Lompoc, California[7] 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. State and local pesticide monitoring programs from October 1987 to September 1990 found three locations with EPTC detections ($\geq$0.1 µg/L) in snow and rain[8]. 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.

2.8 Assessment Endpoints and Measures of Ecological Effect

Assessment endpoints are defined as "explicit expressions of the actual environmental value that is to be protected."[9] Selection of the assessment endpoints is based on valued entities (*e.g.,* CRLF, organisms important in the life cycle of the CRLF, and the PCEs of its designated critical habitat), the ecosystems potentially at risk (*e.g.,* waterbodies, riparian vegetation, and upland and dispersal habitats), the migration pathways of EPTC (*e.g.,* runoff, spray drift, etc.), and the routes by which ecological receptors are exposed to EPTC *(e.g.,* direct contact, *etc.).*

2.8.1. Assessment Endpoints for the CRLF

Assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF, as well as indirect effects, such as reduction of

[6] *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.
[7] 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
[8] 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.*
[9] From U.S. EPA (1992). *Framework for Ecological Risk Assessment.* EPA/630/R-92/001.

the prey base or modification of its habitat. In addition, potential modification of critical habitat is assessed by evaluating potential effects to PCEs, which are components of the habitat areas that provide essential life cycle needs of the CRLF. Each assessment endpoint requires one or more "measures of ecological effect," defined as changes in the attributes of an assessment endpoint or changes in a surrogate entity or attribute in response to exposure to a pesticide. Specific measures of ecological effect are generally evaluated based on acute and chronic toxicity information from registrant-submitted guideline tests that are performed on a limited number of organisms. Additional ecological effects data from the open literature are also considered. It should be noted that assessment endpoints are limited to direct and indirect effects associated with survival, growth, and fecundity, and do not include the full suite of sublethal effects used to define the action area. According the Overview Document (USEPA 2004), the Agency relies on acute and chronic effects endpoints that are either direct measures of impairment of survival, growth, or fecundity or endpoints for which there is a scientifically robust, peer reviewed relationship that can quantify the impact of the measured effect endpoint on the assessment endpoints of survival, growth, and fecundity.

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. A summary of the assessment endpoints and measures of ecological effect selected to characterize potential assessed direct and indirect CRLF risks associated with exposure to EPTC is provided in **Table 2.5**.

Table 2.5 Assessment Endpoints and Measures of Ecological Effects	
Assessment Endpoint	**Measures of Ecological Effects** [a]
Aquatic-Phase CRLF (Eggs, larvae, juveniles, and adults) [b]	
Direct Effects	
1. Survival, growth, and reproduction of CRLF	1a. Amphibian acute LC_{50} (ECOTOX) or most sensitive fish acute LC_{50} (guideline or ECOTOX) if no suitable amphibian data are available: bluegill sunfish 96-hr LC_{50}: 14 mg/L 1b. Amphibian chronic NOAEC (ECOTOX) or most sensitive fish chronic NOAEC (guideline or ECOTOX): study not available. 1c. Amphibian early-life stage data (ECOTOX) or most sensitive fish early-life stage NOAEC (guideline or ECOTOX): study not available
Indirect Effects and Critical Habitat Effects	
2. Survival, growth, and reproduction of CRLF individuals via indirect effects on aquatic prey food supply (*i.e.*, fish, freshwater invertebrates, non-vascular plants)	2a. Most sensitive fish, aquatic invertebrate, and aquatic plant EC_{50} or LC_{50} (guideline or ECOTOX): bluegill sunfish 96-hr LC_{50}: 14 mg/L; water flea 48-hr EC_{50}: 6.49 mg/L; green algae 96-hr EC_{50}: 1.4 mg/L 2b. Most sensitive aquatic invertebrate and fish chronic NOAEC (guideline or ECOTOX): fish study not available; water flea chronic NOAEC: 0.81 mg/L
3. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, food supply, and/or primary productivity (*i.e.*, aquatic plant community)	3a. Vascular plant acute EC_{50} (duckweed guideline test or ECOTOX vascular plant): duckweed biomass EC_{50}: 5.6 mg a.i./L 3b. Non-vascular plant acute EC_{50} (freshwater algae or diatom, or ECOTOX non-vascular): green algae 96-hr EC_{50}: 1.4 mg/L
4. Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation	4a. Distribution of EC_{25} values for monocots (seedling emergence, vegetative vigor, or ECOTOX): EC_{25} seedling emergence: 0.015 lbs a.i./A; EC_{25} vegetative vigor: 0.22 lbs a.i./A 4b. Distribution of EC_{25} values for dicots (seedling emergence, vegetative vigor, or ECOTOX): EC_{25} seedling emergence: 0.26 lbs a.i./A; EC_{25} vegetative vigor: 2.0 lbs a.i./A
Terrestrial-Phase CRLF (Juveniles and adults)	
Direct Effects	
5. Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	5a. Most sensitive bird[c] or terrestrial-phase amphibian acute LC_{50} or LD_{50} (guideline or ECOTOX): bobwhite acute LD_{50}: > 2510 mg a.i./kg bw; bobwhite subacute dietary LC_{50}: 20000 ppm 5b. Most sensitive bird[c] or terrestrial-phase amphibian chronic NOAEC (guideline or ECOTOX): mallard reproduction NOAEC 242 ppm
Indirect Effects and Critical Habitat Effects	
6. Survival, growth, and reproduction of CRLF individuals via effects on terrestrial prey (*i.e.,*terrestrial invertebrates, small mammals , and frogs)	6a. Most sensitive terrestrial invertebrate and vertebrate acute EC_{50} or LC_{50} (guideline or ECOTOX): honey bee acute contact LD_{50} > 12.09 µg a.i./bee; rat LD_{50}: 1465 mg a.i./kg 6b. Most sensitive terrestrial invertebrate and vertebrate chronic NOAEC (guideline or ECOTOX): Rat reproduction study NOAEC: 200 ppm. NOAEL: 10 mg/kg-bw/day
7. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (*i.e.*, riparian and upland vegetation)	7a. Distribution of EC_{25} for monocots (seedling emergence, vegetative vigor, or ECOTOX: EC_{25} seedling emergence: 0.015 lbs a.i./A; EC_{25} vegetative vigor: 0.22 lbs a.i./A 7b. Distribution of EC_{25} for dicots (seedling emergence, vegetative vigor, or ECOTOX): EC_{25} seedling emergence: 0.26 lbs a.i./A; EC_{25} vegetative vigor: 2.0 lbs a.i./A

[a] All registrant-submitted and open literature toxicity data reviewed for this assessment are included in Appendix B.
[b] Adult frogs are no longer in the "aquatic phase" of the amphibian life cycle; however, submerged adult frogs are considered "aquatic" for the purposes of this assessment because exposure pathways in the water are considerably different that exposure pathways on land.
[c] Birds are used as surrogates for terrestrial phase amphibians.

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 CRLF's critical habitat. PCEs for the CRLF 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 CRLF. 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.

Adverse modification to the critical habitat of the CRLF includes, but is not limited to, the following, as specified by USFWS (2006):

1. Alteration of water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs.
2. Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.
3. Significant increase in sediment deposition within the stream channel or pond or disturbance of upland foraging and dispersal habitat.
4. Significant alteration of channel/pond morphology or geometry.
5. Elimination of upland foraging and/or aestivating habitat, as well as dispersal habitat.
6. Introduction, spread, or augmentation of non-native aquatic species in stream segments or ponds used by the CRLF.
7. Alteration or elimination of the CRLF's food sources or prey base.

Measures of such possible effects by labeled use of EPTC on critical habitat of the CRLF are described in **Table 2.6**. 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. Assessment endpoints used for the analysis of designated critical habitat are based on the adverse modification standard established by USFWS (2006).

Table 2.6 Summary of Assessment Endpoints and Measures of Ecological Effect for Primary Constituent Elements of Designated Critical Habitat[a]	
Assessment Endpoint	**Measures of Ecological Effect**
Aquatic-Phase CRLF PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)	
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 CRLFs.	a. Most sensitive aquatic plant EC_{50} (guideline or ECOTOX): green algae 96-hr EC_{50}: 1.4 mg/L b. Distribution of EC_{25} values for terrestrial monocots (seedling emergence, vegetative vigor, or ECOTOX): EC_{25} seedling emergence: 0.015 lbs a.i./A; EC_{25} vegetative vigor: 0.22 lbs a.i./A c. Distribution of EC_{25} values for terrestrial dicots (seedling emergence, vegetative vigor, or ECOTOX): EC_{25} seedling emergence: 0.26 lbs a.i./A; EC_{25} vegetative vigor: 2.0 lbs a.i./A
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	a. Most sensitive EC_{50} values for aquatic plants (guideline or ECOTOX): green algae 96-hr EC_{50}: 1.4 mg/L b. Distribution of EC_{25} values for terrestrial monocots (seedling emergence or vegetative vigor, or ECOTOX): EC_{25} seedling emergence: 0.015 lbs a.i./A; EC_{25} vegetative vigor: 0.22 lbs a.i./A c. Distribution of EC_{25} values for terrestrial dicots (seedling emergence, vegetative vigor, or ECOTOX): EC_{25} seedling emergence: 0.26 lbs a.i./A; EC_{25} vegetative vigor: 2.0 lbs a.i./A
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	a. Most sensitive EC_{50} or LC_{50} values for fish or aquatic-phase amphibians and aquatic invertebrates (guideline or ECOTOX): bluegill sunfish 96-hr LC_{50}: 14 mg/L; water flea 48-hr EC_{50}: 6.49 mg/L b. Most sensitive NOAEC values for fish or aquatic-phase amphibians and aquatic invertebrates (guideline or ECOTOX): fish study not available; water flea chronic NOAEC: 0.81 mg/L
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae)	a. Most sensitive aquatic plant EC_{50} (guideline or ECOTOX): green algae 96-hr EC_{50}: 1.4 mg/L
Terrestrial-Phase CRLF PCEs (Upland Habitat and Dispersal Habitat)	
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	a. Distribution of EC_{25} values for monocots (seedling emergence, vegetative vigor, or ECOTOX): EC_{25} seedling emergence: 0.015 lbs a.i./A; EC_{25} vegetative vigor: 0.22 lbs a.i./A b. Distribution of EC_{25} values for dicots (seedling emergence, vegetative vigor, or ECOTOX): EC_{25} seedling emergence: 0.26 lbs a.i./A; EC_{25} vegetative vigor: 2.0 lbs a.i./A c. Most sensitive food source acute EC_{50}/LC_{50} and NOAEC values for terrestrial vertebrates (mammals) and invertebrates, birds or terrestrial-phase amphibians, and freshwater fish.: Laboratory rat acute oral LD_{50}: 1465 mg a.i./kg; Honey bee acute contact LD_{50}: >12.09 µg a.i./bee; Bobwhite acute oral LD_{50}: >2510 mg a.i./kg bw; Bobwhite subacute dietary LC_{50}: 20000 ppm Bluegill sunfish 96-hr LC_{50}: 14 mg/L; Laboratory rat reproduction study NOAEC (NOAEL): 200 ppm (10 mg/kg bw/day); Terrestrial invertebrate: no study available; Mallard reproduction NOAEC: 242 ppm; Freshwater fish (no study available)
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	

[a] Physico-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.

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 (U.S. EPA, 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 for this endangered species assessment:

The labeled use of EPTC within the action area may:

- directly affect the CRLF by causing mortality or by adversely affecting growth or fecundity;
- indirectly affect the CRLF by reducing or changing the composition of food supply;
- indirectly affect the CRLF or modify designated critical habitat by reducing or changing the composition of the aquatic plant community in the ponds and streams comprising the species' current range and designated critical habitat, thus affecting primary productivity and/or cover;
- indirectly affect the CRLF or modify designated critical habitat by reducing or changing the composition of the terrestrial plant community (i.e., riparian habitat) required to maintain acceptable water quality and habitat in the ponds and streams comprising the species' current range and designated critical habitat;
- modify the designated critical habitat of the CRLF by reducing or changing breeding and non-breeding aquatic habitat (via modification of water quality parameters, habitat morphology, and/or sedimentation);
- modify the designated critical habitat of the CRLF by reducing the food supply required for normal growth and viability of juvenile and adult CRLFs;
- modify the designated critical habitat of the CRLF by reducing or changing upland habitat within 200 ft of the edge of the riparian vegetation necessary for shelter, foraging, and predator avoidance.
- modify the designated critical habitat of the CRLF by reducing or changing dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal.
- modify the designated critical habitat of the CRLF by altering chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.

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 models for aquatic and terrestrial phases of the CRLF are shown in **Figures 4 and 5**, respectively, and the conceptual models for the aquatic and terrestrial PCE components of critical habitat are shown in **Figures 6 and** 7, respectively. Potential transport mechanisms for spray applications of EPTC considered in this assessment include spray drift, runoff (including tailwater), and the wet 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. EPTC is more persistent in anaerobic conditions. Leaching of EPTC to ground water is a potential route of dissipation, but data suggest that it is only a minor dissipation pathway. The importance of volatilization will decrease if EPTC is incorporated or watered into the soil, and where water and wind flow velocities are low. Exposure routes shown in dashed lines are considered to be negligible.

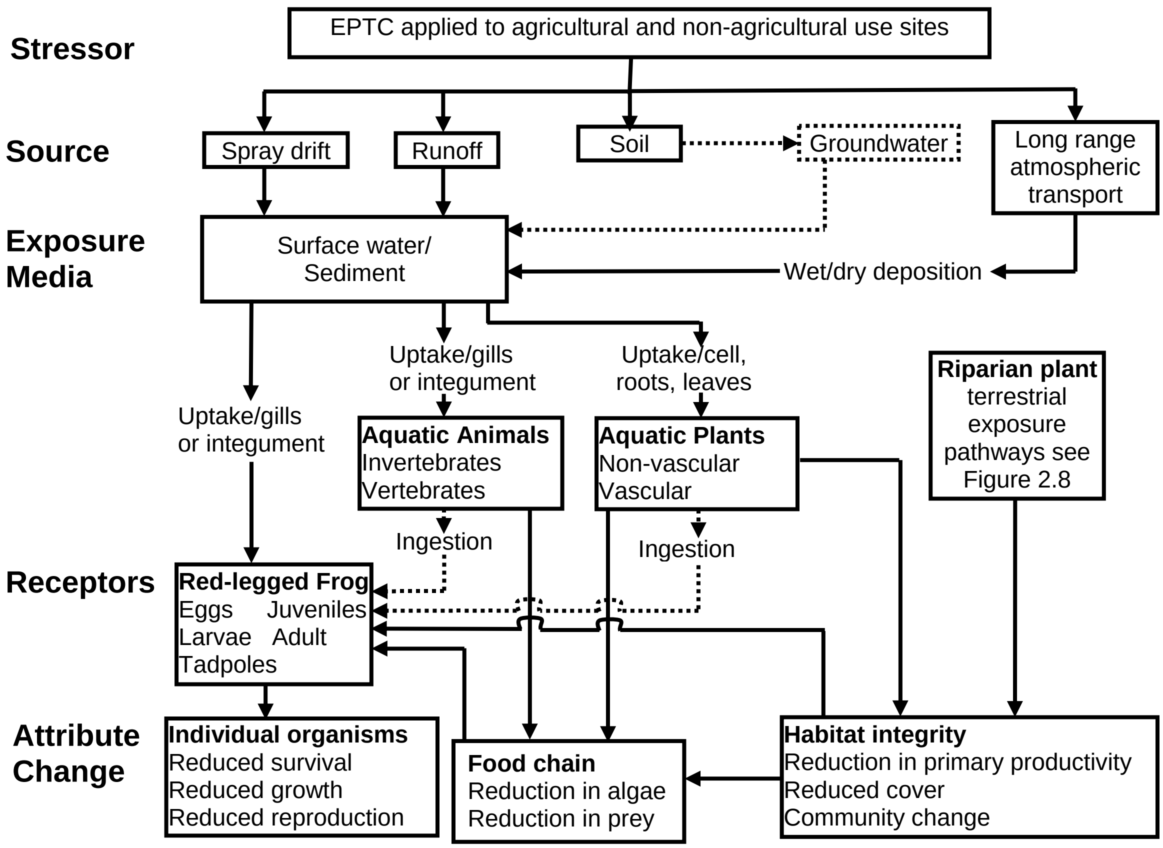


Figure 4. Conceptual Model for Aquatic-Phase of the CRLF

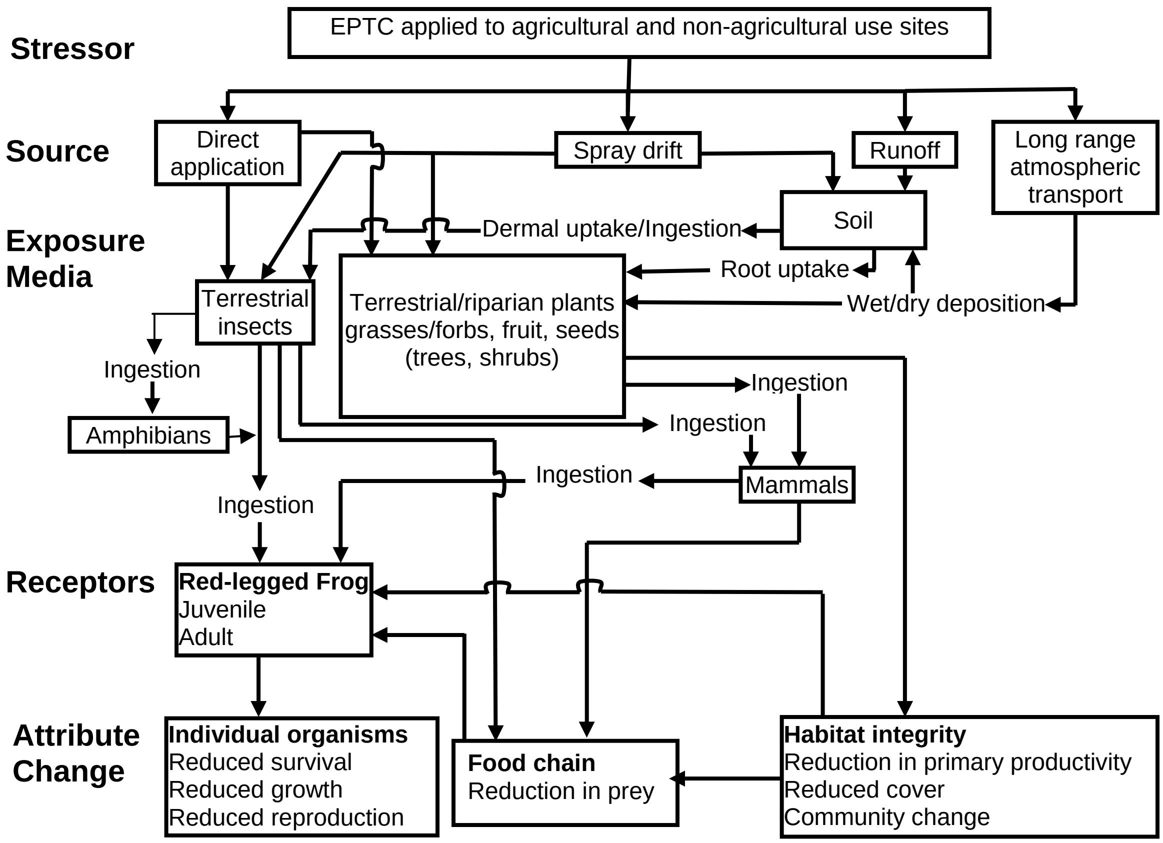


Figure 5. Conceptual Model for Terrestrial-Phase of the CRLF

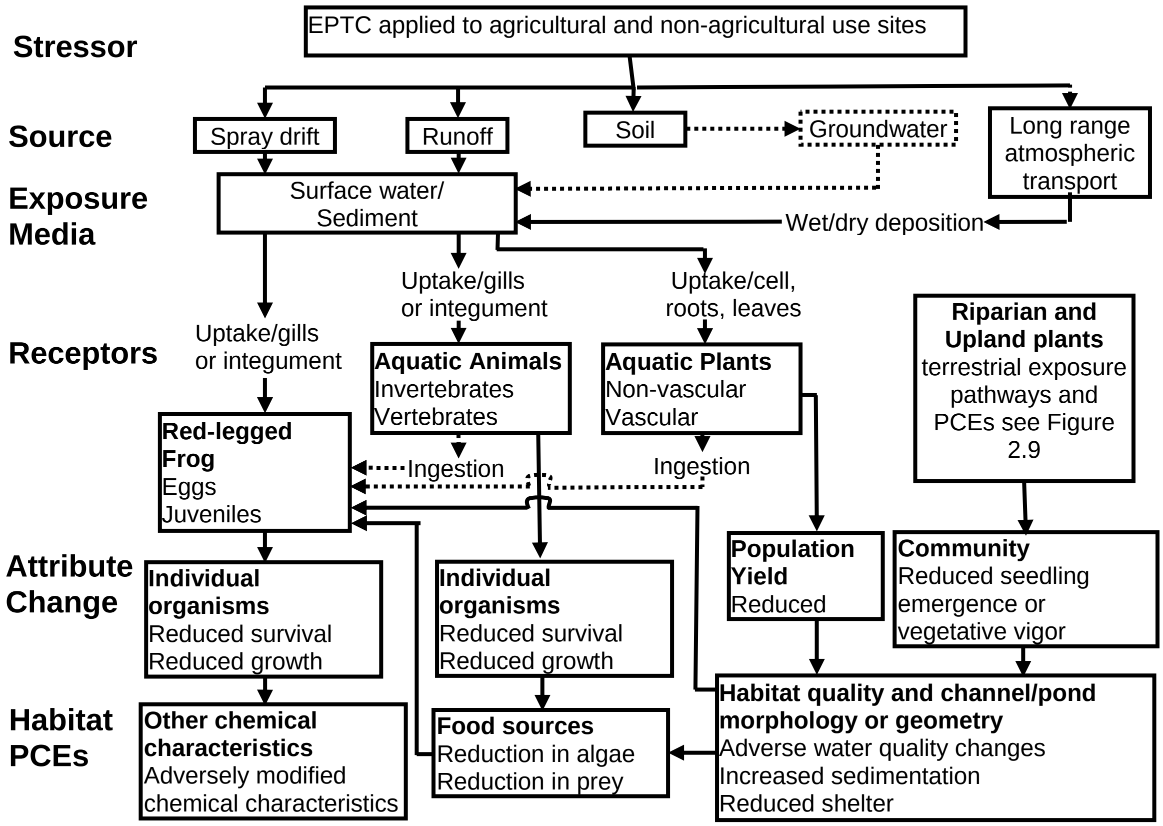


Figure 6. Conceptual Model for Pesticide Effects on Aquatic Component of CRLF Critical Habitat

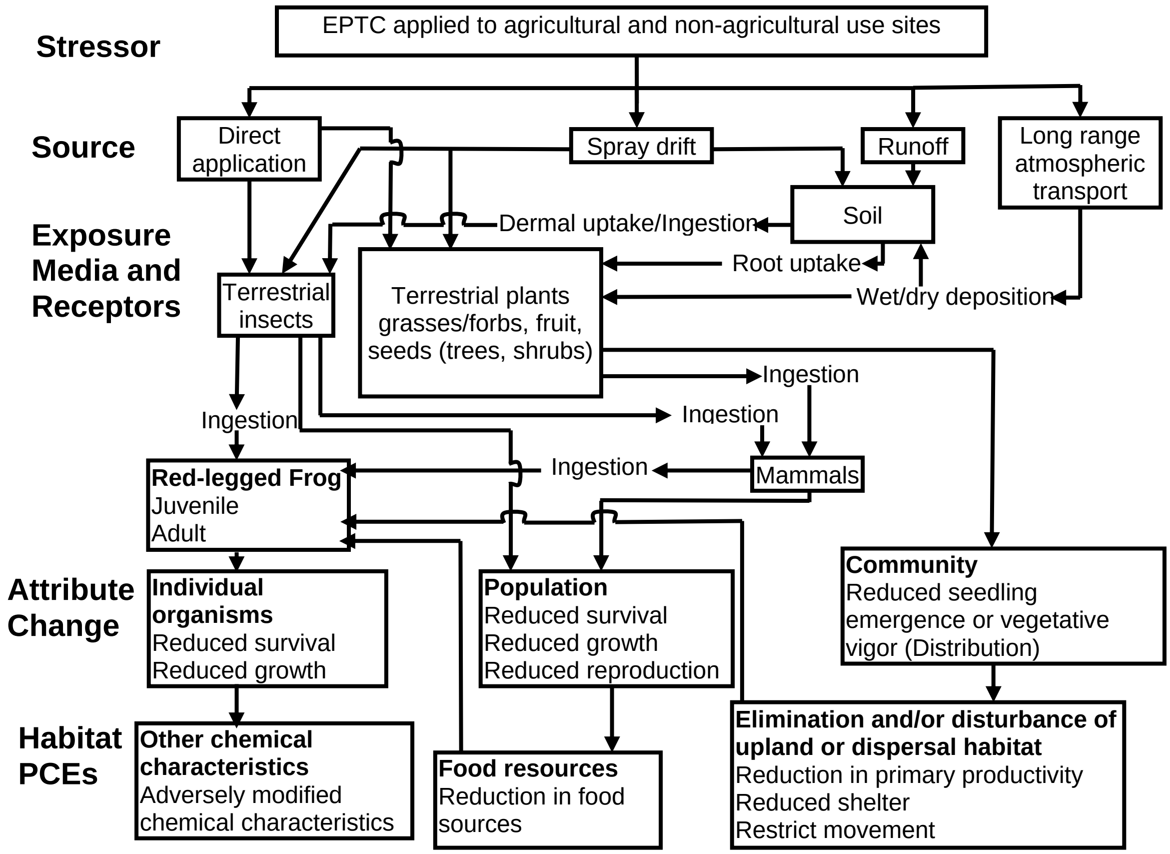


Figure 7. Conceptual Model for Pesticide Effects on Terrestrial Component of CRLF Critical Habitat

2.10 Analysis Plan

In order to address the risk hypothesis, the potential for direct and indirect effects to the CRLF, its prey, and its habitat is estimated. 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 (U.S. EPA, 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.

2.10.1 Measures to Evaluate the Risk Hypothesis and Conceptual Model

2.10.1.1 Measures of Exposure

Appendix A provides a summary of the available environmental fate information for EPTC. 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 aquatic and terrestrial habitats of the CRLF. Transport of EPTC through runoff and spray drift are also considered in deriving quantitative estimates of EPTC exposure to CRLF, its prey and its habitats. In addition, EPTC can be applied via flood irrigation/chemigation to various crops, and there is potential for aquatic exposure via tailwater runoff from a treated field. EPTC monitoring 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 or expose an organism through inhalation. Aquatic and terrestrial exposures via atmospheric deposition of EPTC are considered qualitatively in this risk assessment.

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 predict terrestrial EECs on food items is T-REX. 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 CRLF, as well as indirect effects to the CRLF through effects to potential prey items, including: algae, aquatic invertebrates, fish and frogs. The 1-in-10-year 60-day mean is used for assessing chronic exposure to the CRLF and fish and frogs serving as prey items; the 1-in-10-year 21-day mean is used for assessing chronic exposure for aquatic invertebrates, which are also potential prey items.

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 Red Legged Frog assessment may not represent the highest exposure sites for EPTC use outside of California.

In addition to model-predicted surface water EECs, tailwater (irrigation runoff) monitoring data will also be used quantitatively to assess risk to the CRLF. As mentioned above, EPTC can be applied via flood 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 monitoring data; chronic RQs for freshwater invertebrates will be calculated using an estimated 21-day tailwater concentration. (Chronic fish (i.e., surrogate for aquatic-phase CRLF) RQs will not be calculated due to a lack of chronic fish toxicity data, and risk will be discussed qualitatively).

Exposure estimates for the terrestrial-phase CRLF and terrestrial invertebrates and mammals (serving as potential prey) assumed to be in the target area or in an area exposed to spray drift are derived using the T-REX model (version 1.3.1, 12/07/2006). This model incorporates the Kenega nomograph, as modified by Fletcher *et al.* (1994), which is based on a large set of actual field residue data. The upper limit values from the nomograph represented the 95th percentile of residue values from actual field measurements (Hoerger and Kenega, 1972). For modeling purposes, direct exposures of the CRLF to EPTC through contaminated food are estimated using the EECs for the small bird (20 g) which consumes small insects. Dietary-based and dose-based exposures of potential prey (small mammals) are assessed using the small mammal (15 g) which consumes short grass. The small bird (20 g) consuming small insects and the small mammal (15 g) consuming short grass are used because these categories represent the largest RQs of the size and dietary categories in T-REX that are appropriate surrogates for the CRLF and one of its prey items. Estimated exposures of terrestrial insects to EPTC are bound by using the dietary based EECs for small insects and large insects.

Birds are currently used as surrogates for terrestrial-phase CRLF. However, amphibians are poikilotherms (body temperature varies with environmental temperature) while birds are homeotherms (temperature is regulated, constant, and largely independent of environmental temperatures). Therefore, amphibians tend to have much lower metabolic rates and lower caloric intake requirements than birds or mammals. As a consequence, birds are likely to consume more food than amphibians on a daily dietary intake basis, assuming similar caloric content of the food items. Therefore, the use of avian food intake allometric equation as a surrogate to amphibians is likely to result in an over-estimation of exposure and risk for reptiles and terrestrial-phase amphibians. Therefore, T-REX (version 1.3.1) has been refined to the T-HERPS model (v. 1.0), which allows for an estimation of food intake for poikilotherms using the same basic procedure as T-REX to estimate avian food intake.

Since EPTC is highly volatile, terrestrial animals may be exposed via inhalation. However, models are not currently available to estimate inhalation exposure following application and incorporation into the soil. Any potential risk associated with inhalation of EPTC will be discussed qualitatively.

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.

2.10.1.2 Measures of Effect

Data identified in Section 2.8 are used as measures of effect for direct and indirect effects to the CRLF. Data were obtained from registrant submitted studies or from literature studies identified by ECOTOX. The ECOTOXicology database (ECOTOX) was searched in order to provide more ecological effects data and in an attempt to bridge existing data gaps. ECOTOX is a source for locating single chemical toxicity data for aquatic life, terrestrial plants, and wildlife. ECOTOX was created and is maintained by the USEPA, Office of Research and Development, and the National Health and Environmental Effects Research Laboratory's Mid-Continent Ecology Division. Open literature studies that have been identified using the ECOTOX database are summarized in **Appendix L**.

The assessment of risk for direct effects to the terrestrial-phase CRLF makes the assumption that toxicity of EPTC to birds is similar to or less than the toxicity to the terrestrial-phase CRLF. The same assumption is made for fish and aquatic-phase CRLF. Algae, aquatic invertebrates, fish, and amphibians represent potential prey of the CRLF in the aquatic habitat. Terrestrial invertebrates, small mammals, and terrestrial-phase amphibians represent potential prey of the CRLF in the terrestrial habitat. Aquatic, semi-aquatic, and terrestrial plants represent habitat of CRLF.

The acute measures of effect used for animals in this screening level assessment are the LD_{50}, LC_{50} and EC_{50}. LD stands for "Lethal Dose", and LD_{50} is the amount of a material, given all at once, that is estimated to cause the death of 50% of the test organisms. LC stands for “Lethal Concentration” and LC_{50} is the concentration of a chemical that is estimated to kill 50% of the test organisms. EC stands for “Effective Concentration” and the EC_{50} is the concentration of a chemical that is estimated to produce a specific effect in 50% of the test organisms. Endpoints for chronic measures of exposure for listed and non-listed animals are the NOAEL/NOAEC and NOEC. NOAEL stands for “No Observed-Adverse-Effect-Level” and refers to the highest tested dose of a substance that has been reported to have no harmful (adverse) effects on test organisms. The NOAEC (*i.e.*, “No-Observed-Adverse-Effect-Concentration”) is the highest test concentration at which none of the observed effects were statistically different from the control. The

NOEC is the No-Observed-Effects-Concentration. For non-listed plants, only acute exposures are assessed (*i.e.*, EC_{25} for terrestrial plants and EC_{50} for aquatic plants).

It is important to note that the measures of effect for direct and indirect effects to the CRLF and its designated critical habitat are associated with impacts to survival, growth, and fecundity, and do not include the full suite of sublethal effects used to define the action area. According the Overview Document (USEPA 2004), the Agency relies on effects endpoints that are either direct measures of impairment of survival, growth, or fecundity or endpoints for which there is a scientifically robust, peer reviewed relationship that can quantify the impact of the measured effect endpoint on the assessment endpoints of survival, growth, and fecundity.

2.10.1.3 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 CRLF 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. For the assessment of EPTC risks, 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) (**Appendix C**).

For this endangered species assessment, listed species LOCs are used for comparing RQ values for acute and chronic exposures of EPTC directly to the CRLF. If estimated exposures directly to the CRLF of EPTC resulting from a particular use are sufficient to exceed the listed species LOC, then the effects determination for that use is "may affect". When considering indirect effects to the CRLF due to effects to animal prey (aquatic and terrestrial invertebrates, fish, frogs, and mice), the listed species LOCs are also used. If estimated exposures to CRLF prey of EPTC resulting from a particular use are sufficient to exceed the listed species LOC, then the effects determination for that use is a "may affect." If the RQ being considered also exceeds the non-listed species acute risk LOC, then the effects determination is a LAA. If the acute RQ is between the listed species LOC and the non-listed acute risk species LOC, then further lines of evidence (*i.e.* probability of individual effects, species sensitivity distributions) are considered in distinguishing between a determination of NLAA and a LAA. When considering indirect effects to the CRLF due to effects to algae as dietary items or plants as habitat, the non-listed species LOC for plants is used because the CRLF does not have an obligate relationship with any particular aquatic and/or terrestrial plant. If the RQ being considered for a particular use exceeds the non-listed species LOC for plants, the effects determination is "may affect". Further information on LOCs is provided in Appendix C.

2.10.2 Data Gaps

There are no amphibian toxicity data available for EPTC. In this assessment, freshwater fish are used as a surrogate for aquatic-phase CRLF, and birds are used as a surrogate for the terrestrial-phase CRLF. In addition, direct chronic risks to the aquatic-phase CRLF cannot be quantitatively assessed at this time because no chronic toxicity data for freshwater fish are available. Thus, the effects determination for direct chronic effects to the aquatic phase CRLF is discussed qualitatively.

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.

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 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, 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.

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	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	3	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)	3.94	1	na	1/yr	7.0/crop
Beans (snap)	3.94	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	1.93	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

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)**
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
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
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

Aquatic exposures are quantitatively estimated for all of assessed uses using scenarios that represent 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, buffer widths and resulting spray drift values modeled from AgDRIFT and AgDISP, and the first application date for each crop[10]. 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 2.3. The first application was generally selected to represent when EPTC was typically applied. However, when a wide range of application dates were possible (Table 2.3), 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.

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

3.2.2 Model Inputs

EPTC is an herbicide used on a wide variety of food and non-food crops. EPTC environmental fate data used for generating model parameters are listed in **Table 2.1.** The input parameters for PRZM and EXAMS are in **Table 3.2**.

Table 3.2 Summary of PRZM/EZAMS Environmental Fate Data Used for Aquatic Exposure Inputs[1] for EPTC Endangered Species Assessment for the CRLF		
Fate Property	**Value (unit)**	**MRID (or source)**
Molecular Weight	189.2	42120801
Henry's constant	$1.5e^{-05}$ atm-m^3/g-mol	42120801
Vapor Pressure	$1.6e^{-02}$ mmHg at 20ºC	42120801
Solubility in Water	370 mg/L (not multiplied by 10)	42120801
Photolysis in Water	Stable	42120803
Aerobic Soil Metabolism Half-lives (ASM)	37.08[2] days [This rate includes metabolism and volatilization ($C0_2$ and vaporization of EPTC][3].	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.	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	EFED Guidance (2002)
Application Efficiency (Fraction)	0.99 ground spray 1.00 granular	EFED Guidance (2002)
Spray Drift Fraction (Fraction)	0.01 ground spray 0.0 granular	EFED Guidance (2002)

[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 February 28, 2002.
[2] Upper 90[th] confidence bounds of the mean DT_{50}. (Appendix A. Table 2).
[3] D339490.

The PRZM scenarios selected to represent the uses in California where EPTC may be used are summarized in Table 3.3. Many of these scenarios were developed specifically for the California RLF ESA 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 between 3 and 6 months between crops for certain crop rotations.[11] 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

3.2.3 Aquatic Exposure Estimates

For spray applications of EPTC, the highest EECs occurred with the lettuce scenario, as shown in **Table 3.4.** The highest peak 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.

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

The aquatic EECs for all scenarios and application options considered are listed in Appendix D, Table 1. All 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 2.3). 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 0.78 to 171 µg/L (Appendix D, Table 1).

Table 3.4 The Highest Surface Water One-in-10-year EEC concentrations for aquatic environments from the application of EPTC to uses in California as Estimated by the 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)
Lettuce 01/02	6.13/1/-	170.8	122.2	72.94

3.2.4 Water Monitoring Data

A critical step in the process of characterizing EECs is comparing model estimates with available surface and ground 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[12], 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.

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

The EPTC data from these monitoring studies are characterized in terms of general statistics including number of samples, frequency of detections, maximum concentration, and means from all detections, where that level of detail is available.

3.2.4.1 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[13] 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). The MRL ranges from 0.002 to 0.4 µg/L with a median MRL concentration of 0.002 µg/L.

The USGS has collected 1941 surface water samples from 74 sites in California (Table 3.5). 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. 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. Addition information regarding the available surface water monitoring data (e.g., site specifics, etc.) can be found in Appendix J.

Table 3.5 Distribution of EPTC concentrations (µg/L) from 74 surface water sampling sites in the USGS NAWQA data warehouse for California

Data	N	Percentile							
		Max	98.6	95.8	90.4	80.8	71.2	61.6	49.3
All site maximums	1914	40	4.73	1.4	0.66	0.156	0.05	0.02	0.006
All site averages	1914	10	0.249	0.195	0.086	0.0231	0.015	0.004	0.0026

3.2.4.2 USGS NAWQA Ground Water 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). The method detection limit (MDL) for the study was 0.001 µg/L.

[13] http://water.usgs.gov/nawqa/. Accessed November 15, 2007.

3.2.4.3 California Department of Pesticide Regulation (CPR)

The California Department of Pesticide Regulation (CDPR) Surface Water Database contains monitoring data of pesticides in California from 1990 to 2005 (CDPR, 2006). As shown in Table 3.6, detection frequencies of EPTC ranged from about 5 to 50 %, and the highest EPTC concentrations ranged from 0.72 to 23 µg/L with average concentrations ranging from 0.10 to 4.68 µg/L. These samples were collected between 1993 and 2006 in the Sacramento Valley (SACVAL06), San Joaquin Valley (SJVAL06, SJVAL206), and other locations (OTHERFEB06) in California.

Table 3.6 Summary Statistics for EPTC from California Surface Water Ambient Monitoring Program

Data File	N Samples	N Sites	Detection Frequency (%)	Range of Detections (µg/L)	Range for LOQ (µg/L)
SACVAL06	784	27	5.22	0[1] - 0.716	-1* to 0.1
SJVAL06	634	23	49.68	0 - 1.09	-1 to -0.05
SJVAL206	862	13	32.02	0 - 4.73	-1* to 0.129
OTHERFEB06	289	47	19.72	0 - 23	-1* to 0.1

1-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 3.7). Average concentrations are expected to be conservative because concentrations with less than (<) remarks were considered to be equivalent to the minimum reporting limit (MRL). See Appendix J for more information regarding the CDPR surface water monitoring data (e.g., counties, number of samples, detection rate, sampling period, range of EPTC detections).

Table 3.7 Monitoring Site Summary Statistics for EPTC from California Surface Water Ambient Monitoring Program.

Data File	Statistic	Concentration (µg/L)	Site Description
SACVAL06	Maximum	0.7160	Colusa Basin Drain above Knights Landing
	Average	0.101	Sacramento River near Hamilton City
SJVALO6	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 Average
SJVAL206	Maximum	4.73	Mud Slough (trib. to SJR)
	Average	0.282	
OTHERFEB06	Maximum	23	Alamo River at Outlet
	Average	4.68	

3.2.4.4 Additional Monitoring Data

As described in Section 2.4.1, tailwater runoff of EPTC following flood irrigation/chemigation is another possible exposure route for CRLF. Monitoring 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 to µg/L (and decreased with time). EPTC concentrations in the irrigation water at the head ditch ranged between 2100 and 2300 µg/L.

3.3 Terrestrial Animal Exposure Assessment

T-REX (Version 1.3.1) is used to calculate dietary and dose-based EECs of EPTC for the CRLF and its potential prey (*e.g*. small mammals and terrestrial insects) inhabiting terrestrial areas. EECs used to represent the CRLF are also used to represent exposure values for frogs serving as potential prey of CRLF adults. T-REX simulates a 1-year time period. For this assessment, only spray applications of EPTC are considered, as discussed in below. Granular uses of EPTC on alfalfa, beans (dried, snap), citrus, clover, conifer, corn, grapefruit, lespedeza, orange, potatoes, safflower, sugar beets, sunflowers, and trefoil birdsfoot are evaluated using the LD_{50} per square foot method.

Terrestrial EECs for foliar spray formulations of EPTC were derived for the uses summarized in Table 3.1. Given that no data on interception and subsequent dissipation from foliar surfaces is available for EPTC, a default foliar dissipation half-life of 35 days is used based on the work of Willis and McDowell (1987). T-REX is also used to calculate EECs for terrestrial insects exposed to EPTC. Dietary-based EECs calculated by T-REX for small and large insects (units of a.i./g) are used to bound an estimate of exposure to bees. Available acute contact toxicity data for bees exposed to EPTC (in units of µg a.i./bee), are converted to µg a.i./g (of bee) by multiplying by 1 bee/0.128 g. The EECs are later compared to the adjusted acute contact toxicity data for bees in order to derive RQs.

For modeling purposes, exposures of the CRLF to EPTC through contaminated food are estimated using the EECs for the small bird (20 g) which consumes small insects. Dietary-based and dose-based exposures of potential prey are assessed using the small mammal (15 g) which consumes short grass. Upper-bound Kenega nomogram values reported by T-REX for these two organism types are used for derivation of EECs for the CRLF and its potential prey (**Table 3.8**). Dietary-based EECs for small and large insects reported by T-REX as well as the resulting adjusted EECs are available in **Table 3.9**.

Table 3.8 Upper-bound Kenega Nomogram EECs for Dietary- and Dose-based Exposures of the CRLF and its Prey for Spray Uses of EPTC					
Use	Rate (lbs ai/A) # Apps./ Minimum Interval (Days)	EECs for CRLF		EECs for Prey (small mammals)	
		Dietary-based EEC (ppm)[1]	Dose-based EEC (mg/kg-bw)	Dietary-based EEC (ppm)	Dose-based EEC (mg/kg-bw)
Forestry, ornamental	14.88 Single application	2009	2288	3571	3405
Potato	6.13 2 applications/30	1284	1463	2283	2177
Sweet potato	7.44 Single application	1004	1144	1786	1702
Dry beans	3.67 - 4.59[2] 2 applications/30	769 - 962	876 - 1095	1367 – 1710	1303 - 1630
Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet	6.13 Single application	828	943	1471	1403
Dry beans	3.94 2 applications/30	826	940	1468	1399
Alfalfa	6.12 Single application	826	941	1469	1400
Alfalfa	3.06 4 applications/40	685	780	1218	1161
Safflower	3.06 2 applications/30	641	703	1140	1087
Snap beans	3.94 – 4.58[2] 2 applications/90	621 - 722	708 - 833	1105 - 1284	1053 - 1462
Dry beans	4.59 Single application	620	706	1102	1050
Alfalfa	3.06 4 applications/60	589	671	1047	998
Almond	3.06 2 applications/45	583	663	1036	987
Snap beans, Clover	3.94 Single application	532	606	946	902
Almonds, Snap beans, Citrus, Potato, Safflower, Tomato, Walnut	3.06 Single application	413	470	734	700
Castor beans	1.76 Single application	238	271	422	403

[1] Based on predicted EPTC residues on small insects.
[2] The T-REX model does not estimate exposure for two different application rates. Therefore, in those instances, the upper and lower application rates were modeled separately and the EECs were provided as a range.

Table 3.9 EECs (ppm) for Indirect Effects to the Terrestrial-Phase CRLF via Effects to Terrestrial Invertebrate Prey Items for Spray Uses of EPTC			
Use	**Rate (lbs ai/A) # Apps./ Minimum Interval (Days)**	**Small Insect EEC (ppm)**	**Large Insect EEC (ppm)**
Forestry, ornamental	14.88 Single application	2009	223
Potato	6.13 2 applications/30	1284	143
Sweet potato	7.44 Single application	1004	112
Dried beans	3.67 - 4.59[1] 2 applications/30	769 - 962	85 - 107
Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet	6.13 Single application	828	92
Dried beans	3.94 2 applications/30	826	92
Alfalfa	6.12 Single application	826	92
Snap beans	3.94 - 4.58[1] 2 applications/90	621 - 722	69 - 80
Safflower	3.06 2 applications/30	641	71
Dried beans	4.59 Single application	620	69
Alfalfa	3.06 4 applications/40	685	76
Alfalfa	3.06 4 applications/60	589	65
Almond	3.06 2 applications/45	583	65
Snap beans	3.94 Single application	532	59
Almonds, Snap beans, Citrus, Potato, Safflower, Tomato, Walnut	3.06 Single application	413	46
Castor beans	1.76 Single application	238	26

[1] The T-REX model does not estimate exposure for two different application rates. Therefore, in those instances, the upper and lower application rates were modeled separately and the EECs were provided as a range.

The T-REX model (version 1.3.1) was also used to estimate the terrestrial exposures associated with granular applications of EPTC, as shown in Table 3.10. Soil incorporation of 3 to 6 inches is required for EPTC granular formulations; thus, it was assumed that the soil incorporation rate is 99%.[14]

[14] T-REX Model (Version 1.3.1) User's Guide. Environmental Fate and Effects Division, Office of Pesticide Programs, U.S. Environmental Protection Agency. December 07, 2006.

Table 3.10 EECs (mg a.i./ft^2) for Direct Effects to the Terrestrial-Phase CRLF for Granular Uses of EPTC Assuming 99% Soil Incorporation		
Use	**Rate (lbs ai/A)**	**EEC (mg a.i./ft^2)**
Corn, Safflower, Sugar beet	3	0.312
Alfalfa, Dried beans, Snap beans, Clover, Lespedeza, Trefoil Birdsfoot	4	0.412
Citrus, Conifers, Grapefruit, Orange, Potato	6	0.625

As described previously, terrestrial exposure via inhalation is possible; however, models are not currently available to predict inhalation exposure following application and incorporation into the soil. The potential risk to the terrestrial-phase CRLF associated with inhalation of EPTC will be discussed qualitatively.

3.4 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 3.11**). 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. EPTC is applied via ground application methods, and drift is assumed to be 1%. EECs relevant to terrestrial plants consider pesticide concentrations in drift and in runoff. An example output from TerrPlant v.1.2.2 is available in **Appendix F.**

Table 3.11 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)**
Forestry, ornamental	14.88	1	0.149	0.893	7.589
Sweet potato	7.44	1	0.074	0.446	3.794
Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet, Alfalfa	6.13	1	0.061	0.368	3.126
Dried beans	4.59	1	0.046	0.275	2.341
Snap beans	3.94	1	0.039	0.236	2.009
Almonds, Safflower, Tomato, Walnut	3.06	1	0.031	0.184	1.561
Castor beans	1.76	1	0.018	0.106	0.898

3.5 Atmospheric Transport and Deposition

EPTC concentrations in rainfall ranged between 100 and 2,800 ng/L (Majewski,et al. 1995[15]). There were no detections of EPTC in air, smog or snow monitoring data. Cliath, *et al.* reported[16] 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[17]. 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[18].

Air monitoring data from Lompoc, California[19] 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 modeling 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 pond 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

[15] *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.
[16] 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.*
[17] 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.*
[18] 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.*
[19] 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

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 estimated environmental EPTC concentrations from atmospheric deposition are shown in Table 3.12. These exposure estimates are used to qualitatively describe the potential risk to the CRLF via the exposure route of atmospheric deposition.

Table 3.12 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 CRLF or modify its designated critical habitat. As previously discussed in Section 2.7, assessment endpoints for the CRLF effects determination include direct toxic effects on the survival, reproduction, and growth of CRLF, 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 the CRLF. Direct effects to the aquatic-phase of the CRLF are based on toxicity information for freshwater fish as a surrogate for aquatic-phase amphibians when appropriate, while terrestrial-phase effects are based on avian toxicity data, given that birds are generally used as a surrogate for terrestrial-phase amphibians. Because the frog's prey items and habitat requirements are dependent on the availability of freshwater fish and invertebrates, small mammals, terrestrial invertebrates, and aquatic and terrestrial plants, toxicity information for these taxa are also discussed. 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.

As described in the Agency's Overview Document (U.S. EPA, 2004), the most sensitive endpoint for each taxon is used for risk estimation. For this assessment, evaluated taxa include aquatic-phase amphibians, freshwater fish, freshwater invertebrates, aquatic plants, birds (surrogate for terrestrial-phase amphibians), mammals, terrestrial invertebrates, and terrestrial plants.

All available ecotoxicity information for EPTC can be found in Appendices B and L. 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) (U.S. EPA, 2004). Open literature data presented in this assessment were obtained from a search of the ECOTOX database on 01/31/2008. In order to be included in the ECOTOX database, papers must meet the following minimum criteria:

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

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.*, maintenance of CRLF 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 to define the action area for EPTC.

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 L.** This appendix 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 as well as a summary of the human health effects data for EPTC are also included.

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 the Ecological Incident Information System (EIIS), are conducted to further refine the characterization of potential ecological effects associated with exposure to EPTC. A summary of the available aquatic and terrestrial ecotoxicity information, use of the probit dose response relationship, and the incident information for EPTC are provided in Sections 4.1 through 4.4, respectively.

There is very limited toxicity information for the sulfoxide degradate (R078202). An acute toxicity study with daphnids suggests similar toxicity to the parent EPTC. This risk assessment is based on the toxicity of the parent EPTC.

A detailed summary of the available ecotoxicity information for EPTC degradates and formulated products is presented in **Appendix B**.

EPTC has three registered products that contain multiple active ingredients. Analysis of the available open literature and acute oral mammalian LD_{50} data for multiple active ingredient products relative to the single active ingredient is provided in **Appendix G**. In the case of EPTC, 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 LD_{50} for the formulated products is 993 (768 – 1576) mg/kg, and the LD_{50} for EPTC is 1599 (1294 – 1976) mg/kg. Thus, the scope of this risk assessment is appropriately limited to the potential effects of the single active ingredient of EPTC.

4.1 Toxicity of EPTC to Aquatic Organisms

Table 4.1 summarizes the most sensitive aquatic toxicity endpoints for the CRLF, based on an evaluation of both the submitted studies and the open literature, as previously discussed. A complete discussion of all available acute and chronic aquatic toxicity data is included in Appendix B.

Table 4.1 Freshwater Aquatic Toxicity Profile for EPTC				
Assessment Endpoint	**Species**	**Toxicity Value Used in Risk Assessment**	**Citation MRID # (Author & Date)**	**Comments**
Acute Direct Toxicity to Aquatic-Phase CRLF	Bluegill sunfish *Lepomis macrochirus*	96 HR LC_{50} = 14 (10-24) mg/L	00144208 McAllister, W.; Cohle, P. (1984)	Acceptable/Slightly toxic NOAEC = 4.2 mg/L; LOAEC = 10 mg/L based on sublethal effects. 100% mortality observed at ≥ 24 mg/L.
Chronic Direct Toxicity to Aquatic-Phase CRLF	--	--	--	No chronic fish or amphibian studies are available.
Indirect Toxicity to Aquatic-Phase CRLF via Acute Toxicity to Freshwater Invertebrates (i.e. prey items)	Water flea *Daphnia magna*	48-HR EC_{50} = 6.49 (4.8-8.4) mg/L	42945601 Kent, S.; Sankey, S.; Johnson, P. (1993)	Acceptable/Moderately toxic NOAEC: 1.7 mg/L (mean measured). LOAEC: 3.2 mg/L (nominal) based on immobility.
Indirect Toxicity to Aquatic-Phase CRLF via Chronic Toxicity to Freshwater Invertebrates (i.e. prey items)	Water flea *Daphnia magna*	NOAEC (reproduction): 0.81mg/L NOAEC (survival): 1.3 mg ai./L NOAEC (growth): 1.3 mg ai./L	45075006 Stewart, K.; Tapp, J.; Williams, T. et al. (1990)	Acceptable LOAEC: (reproduction): 1.3 mg/L LOAEC (survival): 2.7 mg ai/L. LOAEC (growth): 2.7 mg ai./L
Indirect Toxicity to Aquatic-Phase CRLF via Acute Toxicity to Non-vascular Aquatic Plants	Green Algae *Pseudokirchneriella subcapitata*	4-day EC_{50}: 1.4 (1.3-1.5) mg/L	42921202 42899801 Smyth, D.; Sankey, S.; Kent, S.; et al. (1993)	Acceptable NOAEC: 0.9 mg/L LOAEC: 1.6 (effect on growth rate (% inhibition and cell density))
Indirect Toxicity to Aquatic-Phase CRLF via Acute Toxicity to Vascular Aquatic Plants	Duckweed *Lemna gibba*	Biomass EC_{50}: 5.6 (2.9 - 9.3) mg a.i./L NOAEC: 0.89 mg a.i./L Frond Number EC_{50}: 6.7 (2.9 - 9.3) mg a.i./L NOAEC: 0.29 mg a.i./L	43096001 Smyth, D.; Kent, S.; Sankey, S. et al. (1993)	Acceptable LOAEC (biomass): 2.9 mg a.i./L LOAEC (frond number): 0.89 mg a.i./L

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

Table 4.2 Categories of Acute Toxicity for Aquatic Organisms	
LC_{50} (ppm)	**Toxicity Category**
< 0.1	Very highly toxic
> 0.1 - 1	Highly toxic
> 1 - 10	Moderately toxic
> 10 - 100	Slightly toxic
> 100	Practically nontoxic

4.1.1 Toxicity to Freshwater Fish

Freshwater fish were used as a surrogate to estimate direct acute and chronic risks to the CRLF since no EPTC toxicity data are available for aquatic-phase amphibians. Freshwater fish toxicity data were also used to assess potential indirect effects of EPTC to the CRLF via reduction in available prey items. As discussed in Section 2.5.3, over 50% of the prey mass of the CRLF may consist of vertebrates such as mice, frogs, and fish (Hayes and Tennant, 1985).

A complete discussion of all available acute and chronic freshwater fish data is included in Appendix B.

4.1.1.1 Freshwater Fish: Acute Exposure (Mortality) Studies

Available data indicate that EPTC is slightly toxic on an acute basis to several surrogate freshwater fish species (Appendix B). 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 HR LC_{50} = 14 (10-24) mg/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

With regard to potential volatilization of EPTC during the aquatic toxicity tests, the measured test concentrations in a daphnid 48-hour study, 72-hour renewals in a duckweed study, and 96-hour algal studies indicate that EPTC volatilizes from water at levels ranging from 2 to about 50% losses. It is estimated that test concentrations at 96-hours at the end of the fish studies would be 20 to 25 percent less than initial nominal level. Averaging the initial and the predicted final test concentrations, it is estimated that the mean test concentrations are 10 to 13 percent less than nominal test concentrations.

4.1.1.2 Freshwater Fish: Chronic Exposure (Growth/Reproduction) Studies

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

4.1.1.3 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. 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 B**). 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.

4.1.1.4 Aquatic-phase Amphibian: Acute and Chronic Studies

No appropriate aquatic-phase amphibian studies are available for EPTC. In the absence of amphibian toxicity data, freshwater fish are used as a surrogate for risk assessment purposes.

4.1.2 Toxicity to Freshwater Invertebrates

Freshwater aquatic invertebrate toxicity data were used to assess potential indirect effects of EPTC to the CRLF via reduction in available food items. As discussed in Section 2.5.3, the main food source for juvenile aquatic- and terrestrial-phase CRLFs is thought to be aquatic invertebrates found along the shoreline and on the water surface, including aquatic sowbugs, larval alderflies and water striders.

A complete discussion of all available acute and chronic freshwater invertebrate data is included in Appendix B.

4.1.2.1 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 B). The acute 48-hour EC_{50s} for EPTC range from 6.49 to 14 mg a.i./L for daphnids; the 48-hour LC_{50} of 6.49 mg/L will be used to calculate RQs (Table 4.4). The acute 96-hour EC_{50}s on the technical material for the sowbug and scud (2 studies) 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 266.5 mg/L, respectively.

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-hr LC_{50}**:** 6.49 (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

4.1.2.2 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.

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-day LC_{50} = 3.5 (2.9-4.3) mg ai./L Slope: 11.065 (3.87 - 18.26) NOAEC (survival): 1.3 mg ai./L. LOAEC (survival): 2.7 mg ai/L. NOAEC (growth): 1.3 mg ai./L. LOAEC (growth): 2.7 mg ai./L. NOAEC (reproduction): 0.81 mg/L LOAEC(reproduction): 1.3 mg/L	45075006	Acceptable

4.1.2.3 Freshwater Invertebrates: Open Literature Data

Additional studies on the acute toxicity of EPTC on freshwater invertebrates were identified in the open literature (Appendix B). 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 6.49 (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.

4.1.3 Toxicity to Aquatic Plants

Aquatic plant toxicity data will be used to assess the potential for indirect effects of EPTC on the CRLF via effects on habitat, cover, and/or primary productivity or effects to the primary constituent elements (PCEs) relevant to the aquatic-phase CRLF. Laboratory studies were used to assess the potential effects of EPTC on aquatic plants.

4.1.3.1 Aquatic Plants: Laboratory Data

Table 4.6 summarizes test results for the most sensitive test aquatic plants (see Appendix B for a complete discussion). Based on the available data, green algae (*P. subcapitata*) is the most sensitive non-vascular plant species, with an EC_{50} of 1.4 (1.3-1.5) mg a.i./L. The only vascular plant study available identified an EC_{50} of 5.6 (2.9 - 9.3) mg a.i./L for duckweed.

Table 4.6. 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-day 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

4.1.4 Freshwater Field/Mesocosm Studies

No freshwater field/mesocosm studies are available for EPTC.

4.2 Toxicity of EPTC to Terrestrial Organisms

Table 4.7 summarizes the most sensitive terrestrial toxicity endpoints for the CRLF, based on an evaluation of both the submitted studies and the open literature. A complete discussion of all available acute and chronic terrestrial toxicity data is included in Appendix B.

Table 4.7 Terrestrial Toxicity Profile for EPTC				
Endpoint	**Species**	**Toxicity Value Used in Risk Assessment**	**Citation MRID**	**Comment**
Acute Direct Toxicity to Terrestrial-Phase CRLF (LD_{50})	Mallard Duck *Anas platyrhynchos*	LD_{50} > 1000 mg a.i/kg bw[a]	00131274	Supplemental. No more than slightly toxic. NOAEL: 1000 mg/kg LOAEL > 1000 mg/kg. LD_{50} based on the highest concentration which did not cause regurgitation. No effects observed other than regurgitation.
Acute Direct Toxicity to Terrestrial-Phase CRLF (LC_{50})	Bobwhite Quail *Colinus virginianus*	LC_{50} = 20000 ppm	00021834 Knott, W.; Beliles, R.P. (1967)	Supplemental study. Practically non-toxic. NOAEC: 1800 ppm LOAEC: 3200 ppm based on inhibition of body weight gain at ≥3200 ppm; mortality observed at ≥5600 ppm; slight depression observed at ≥10,000 ppm; ataxia observed ≥ 18,000 ppm; pale livers at 18,000 and 24,000 ppm; weight loss around breast area at 24,000 ppm. All birds died at 32,000 ppm; no necropsies were conducted. Birds were 8 weeks old rather than 5-10 days.
Chronic Direct Toxicity to Terrestrial-Phase CRLF	Mallard Duck *Anas platyrhynchos*	NOAEC =242 ppm	46554301 Temple, D.; Martin, K.; Beavers, J.; et. al. (2005)	Acceptable study. LOAEC: 593 ppm based on reduction in proportion of viable embryos of eggs set at the 593 and 1490 ppm levels (13 and 21%, respectively). At the highest treatment level (1490 ppm), the number of eggs laid, eggs set, viable embryos, and live embryos; number hatched; ratios of number hatched to eggs laid and to eggs set; and hatchling survival and the ratio of hatchling survivors to eggs set were adversely affected. Reductions in these endpoints ranged from 24 to 52% of control.
Indirect Toxicity to Terrestrial-Phase CRLF (via acute toxicity to mammalian prey items)	Laboratory rat *Rattus norvegicus*	Acute oral LD_{50} = 1465 (1290-1663) mg/kg (males)	00157868 Naas, D. (1985)	Acceptable study. Slightly toxic. Acute oral LD_{50}: 1712 (1324-2214) mg/kg (F), 1599 (1294-1976) mg/kg (combined). Dose-related lethargy, salivation, decreased limb tone, and ataxia, persisting to death (within 2 to 4 days) at the higher dosages. Weight loss, hemorrhages/congestion in brain, hemorrhages/erosion in GI tract and hyperemia and/or congestion of lungs and liver were reported.
Indirect Toxicity to Terrestrial-Phase CRLF (via chronic toxicity to mammalian prey items)	Laboratory rat *Rattus norvegicus*	Offspring/ Developmental Toxicity NOAEL: 200 ppm (10 mg/kg bw/day)	00161597 Mackenzie, K. (1986)	Acceptable study. Parental systemic Parental NOAEL: 50 ppm (2.5 mg/kg bw/day) Parental LOAEL: 200 ppm (10 mg/kg bw/day) based on decreased body weight and degenerative cardiomyopathy in females. Offspring/Developmental Toxicity

Table 4.7 Terrestrial Toxicity Profile for EPTC				
Endpoint	**Species**	**Toxicity Value Used in Risk Assessment**	**Citation MRID**	**Comment**
				NOAEL: 200 ppm (10 mg/kg bw/day) LOAEL: 800 ppm (40 mg/kg bw/day) based on reduced pup body weight during PND 4-21. Reproductive Toxicity NOAEL: 800 ppm (40 mg/kg bw/day) LOAEL: >800 ppm (40 mg/kg bw/day). There were no reproductive effects observed under the conditions of the study.
Indirect Toxicity to Terrestrial-Phase CRLF (via acute toxicity to terrestrial invertebrate prey items)	Honey bee acute contact	72-hour contact LD_{50}: >12.09 µg a.i./bee[a]	00142894 Atkins, E. (1985)	Acceptable/ Practically non-toxic. No stomach poison effect.
Indirect Toxicity to Terrestrial- and Aquatic-Phase CRLF (via toxicity to terrestrial plants)	Purple nutsedge *Cyperus rotundus)*	Monocot Seedling emergence EC_{25}: 0.015 lbs a.i./A	42120802 Farmer & Canning (1991)	Acceptable study. Dry weight
	Morning glory *Ipomea hederacea*	Dicot Seedling emergence EC_{25}: 0.26 lbs a.i./A	42120802 Farmer & Canning (1991)	Acceptable study. Dry weight
	Winter wheat *Triticum aestivum*	Monocot Vegetative Vigor EC_{25}: 0.22 lbs a.i./A	42120802 Farmer & Canning (1991)	Acceptable study. Phytotoxicity
	Velvet leaf *Abutilon theophrastii*	Dicot Vegetative Vigor EC_{25}: 2.0 lbs a.i./A	42120802 Farmer & Canning (1991)	Acceptable study. Phytotoxicity

[a] This is not a definitive endpoint and will not be used to quantitatively estimate risks (i.e., calculate RQs)

Acute toxicity to terrestrial animals is categorized using the classification system shown in **Table 4.8** (U.S. EPA, 2004). Toxicity categories for terrestrial plants have not been defined.

Table 4.8 Categories of Acute Toxicity for Avian and Mammalian Studies		
Toxicity Category	**Oral LD_{50}**	**Dietary LC_{50}**
Very highly toxic	< 10 mg/kg	< 50 ppm
Highly toxic	10 - 50 mg/kg	50 - 500 ppm
Moderately toxic	51 - 500 mg/kg	501 - 1000 ppm
Slightly toxic	501 - 2000 mg/kg	1001 - 5000 ppm
Practically non-toxic	> 2000 mg/kg	> 5000 ppm

4.2.1 Toxicity to Birds

As specified in the Overview Document, the Agency uses birds as a surrogate for terrestrial-phase amphibians when amphibian toxicity data are not available (U.S. EPA, 2004). No terrestrial-phase amphibian data are available for EPTC; therefore, acute and chronic avian toxicity data are used to assess the potential direct effects of EPTC to terrestrial-phase CRLFs. A complete discussion of all available acute and chronic avian toxicity data is included in Appendix B.

4.2.1.1 Birds: Acute Exposure (Mortality) Studies

EPTC is categorized as practically non-toxic to slightly toxic to birds on acute oral and dietary bases. The available acute oral toxicity tests for the mallard duck and bobwhite quail failed to establish a definitive LD_{50} (*e.g.*, mallard duck LD_{50} >1000 mg/kg). A definitive subacute dietary LC_{50} of 20000 ppm was established for the bobwhite quail (Table 4.9). Based on available information, it appears that the tested EPTC formulations and mixtures exhibit toxic effects to birds in the same range as EPTC (a.i.).

Table 4.9. Avian Acute Toxicity Data Used For RQ Calculation

Common Name	%AI	Study parameters	Test Results	MRID	Study Classification/ Toxicity Category
Mallard Duck *Anas platyrhynchos*	98.5	Acute oral study 5 birds/sex/dose level 14 day observation period 0 (vehicle), 398, 631, 1000, 1590, 2510 mg/kg bw (adjusted for purity).	LD_{50} > 1000 mg a.i/kg bw[1] NOAEL: 1000 mg/kg LOAEL > 1000 mg/kg. LD_{50} based on the highest concentration which did not cause regurgitation. No effects observed other than regurgitation (1590 and 2510 mg/kg).	00131274	Supplemental/ No more than slightly toxic
Bobwhite Quail *Colinus virginianus*	97.8	7-day dietary study (3 additional days on basal diet) 10 birds/concentration level (20 at 32,000 ppm) 0 (control), 1000, 1800, 3200, 5600, 10,000, 18,000, 24,000 32,000 ppm (nominal concentrations).	LC_{50}: 20000 ppm NOAEC: 1800 ppm LOAEC: 3200 ppm based on inhibition of body weight gain at ≥ 3200 ppm. Mortality observed at ≥ 5600 ppm; slight depression at ≥ 10,000 ppm; ataxia at ≥ 18,000 ppm; pale livers at 18,000 and 24,000 ppm; weight loss around breast area at 24,000 ppm. All birds died at 32,000 ppm; no necropsies were conducted. Birds were 8 weeks old rather than 5-10 days.	00021834	Supplemental/ Practically non-toxic

[1] RQs are not calculated using this endpoint since it is not definitive; used for qualitative risk description purposes.

Some uncertainty exists about the test concentrations to which the birds were exposed during the dietary tests. EPTC is volatile with a vapor pressure value of 1.6 x 10^{-2} Torr and the avian feed was not analyzed for concentrations of EPTC. In a laboratory, 40 percent of the EPTC volatilized during a 25-hour study and residue analyses indicate no degradation. In a field study, 73.6 % of EPTC applied by irrigation water volatilized within 52 hours after application. Results from 13 different locations (MN, CO, KY**,** OH, FL**,** 2MS, 5CA) indicate that EPTC dissipated with half-lives between 2 and 56.8 days. The uncertainty about the stability of the test concentrations extends the uncertainty about the toxicity values, since the LC_{50} values are based on test concentrations.

4.2.1.2 Birds: Chronic Exposure (Growth, Reproduction) Studies

Available chronic avian toxicity information for EPTC (Appendix B) reports reproductive effects in both bobwhite quail and mallard ducks. In the mallard duck study, effects including embryo viability; the number of eggs laid, set and hatched; the number of viable embryos; and hatchling survival were observed starting at 593 ppm (Table 4.10). Other effects, such as effects on eggs cracked and the proportion of eggs not cracked to eggs laid are not included because they do not relate to CRLF reproduction.

Table 4.10. Avian Chronic Toxicity Data Used For RQ Calculation

Common Name	%AI	Study Parameters	Test Results	MRID	Classification
Mallard Duck *Anas platyrhynchos*	98.1	Reproduction study. 16 pairs per treatment level. Mean-measured concentrations were <25.0 (<LOD, control), 242, 593, and 1490 mg ai/kg diet, respectively.	NOAEC: 242 ppm LOAEC: 593 ppm based on a significant reduction in the proportion of viable embryos of eggs set at the 593 and 1490 ppm levels (13 and 21%, respectively). At 1490 mg ai/kg diet, number of eggs laid, eggs set, viable embryos, and live embryos; number hatched; ratios of number hatched to eggs laid and to eggs set; and hatchling survival and the ratio of hatchling survivors to eggs set were adversely affected. Reductions ranged from 24 to 52% of control.	46554301	Acceptable

4.2.1.3 Terrestrial-phase Amphibian Acute and Chronic Studies

No terrestrial-phase amphibian acute or chronic studies are available for EPTC.

4.2.2 Toxicity to Mammals

Mammalian toxicity data are used to assess potential indirect effects of EPTC to the terrestrial-phase CRLF. Effects to small mammals resulting from exposure to EPTC may also indirectly affect the CRLF via reduction in available food. As discussed in Section 2.5.3, over 50% of the prey mass of the CRLF may consist of vertebrates such as mice, frogs, and fish (Hayes and Tennant, 1985). A complete discussion of all available acute and chronic mammalian toxicity data is included in Appendix B.

4.2.2.1 Mammals: Acute Exposure (Mortality) Studies

Based on the available data, EPTC technical and tested formulations are categorized as slightly toxic at most (Appendix B). Table 4.11 summarizes results from the test that yielded the most sensitive endpoint and will be used for RQ calculation.

Table 4.11. Mammalian Acute Toxicity Data Used For RQ Calculation

Common Name	%AI	Study parameters	Test Results	MRID	Classification /Category
Laboratory rat *Rattus norvegicus*	Tech	Acute oral study 991, 1427, 2055, 2959, and 5000 mg/kg bw tested 5/sex/dose level 14-day observation period	Acute oral LD_{50}: 1465 (1290-1663) mg/kg (M), 1712 (1324-2214) mg/kg (F), 1599 (1294-1976) mg/kg (combined). Dose-related lethargy, salivation, decreased limb tone, and ataxia, persisting to death (within 2 to 4 days) at the higher dosages. Weight loss, hemorrhages/congestion in brain, hemorrhages/erosion in GI tract and hyperemia and/or congestion of lungs and liver were some of the observations recorded.	00157868	Acceptable/ Slightly toxic

4.2.2.2 Mammals: Chronic Exposure (Growth, Reproduction) Studies

Appendix B summarizes the available chronic mammalian toxicity information for EPTC. Frank reproductive effects were not observed in either of the available 2-generation reproduction toxicity studies. Effects on the parents included decreased body weight, degenerative cardiomyopathy, and renal tubule degeneration. Effects on pups were decreased body weight during the lactation period. Although the NOAEC for pups is higher than the NOAEC for the parents, the effects on the pups were selected as the toxicological endpoint because effects on pup growth are more relevant for assessing ecological risk to the CRLF.

Table 4.12. Mammalian Chronic Toxicity Data Used For RQ Calculation					
Common Name	**%AI**	**Study Parameters**	**Test Results**	**MRID**	**Classification/ Category**
Laboratory rat *Rattus norvegicus*	98.4	2-generation reproduction study 30 male and 30 female rats/group at doses of 0, 50, 200, 800 ppm (0, 2.5, 10, 40 mg/kg/day).	Parental systemic NOAEL: 50 ppm (2.5 mg/kg bw/day) LOAEL: 200 ppm (10 mg/kg bw/day) based on decreased body weight and degenerative cardiomyopathy in females. Offspring/Developmental Toxicity NOAEL: 200 ppm (10 mg/kg bw/day) LOAEL: 800 ppm (40 mg/kg bw/day) based on reduced pup body weight during PND 4-21. Reproductive Toxicity NOAEL: 800 ppm (40 mg/kg bw/day) LOAEL: >800 ppm (40 mg/kg bw/day). There were no reproductive effects observed under the conditions of the study.	00161597	Acceptable

The sublethal endpoint used to define the action area was selected from a developmental neurotoxicity study (Appendix B). The sublethal effect of concern is a dose-related decrease in absolute brain weight in male pups at post-natal day 63. This study had no NOAEC. In addition to this, it is noted that EPTC tested positively in *in vitro* mouse lymphoma assays (MRIDs 00152454, 00161602), but not in the *in vivo* assays. Therefore, EPTC has intrinsic genotoxicity which was not expressed in either the *in vivo* micronucleus test or the *Drosophila* sex-linked recessive lethal mutation assay.

4.2.3 Toxicity to Terrestrial Invertebrates

Terrestrial invertebrate toxicity data are used to assess potential indirect effects of EPTC to the terrestrial-phase CRLF. Effects to terrestrial invertebrates resulting from exposure to EPTC may also indirectly affect the CRLF via reduction in available food.

4.2.3.1 Terrestrial Invertebrates: Acute Exposure (Mortality) Studies

The available acute toxicity studies on honey bees indicated that EPTC is practically non-toxic to terrestrial invertebrates (Appendix B). Table 4.13 summarizes the study that yielded the most sensitive endpoint for terrestrial invertebrate toxicity.

Table 4.13. Terrestrial Invertebrate Acute Toxicity Data					
Common Name	**%AI**	**Study parameters**	**Test Results**	**MRID**	**Classification /Category**
Honey bees *Apis mellifera*	Tech.	48-HR Acute contact toxicity test. Bell jar vacuum duster used to expose bees to pesticide. Large study with multiple pesticides tested.	LD_{50}>12.09 µg/bee. At 12.09 µg/bee, mortality was 5.91%. No other details were available. No other details provided	00036935	Supplemental

4.2.3.2 Terrestrial Invertebrates: Open Literature Studies

Additional terrestrial invertebrate toxicity studies were identified in the open literature (Appendix B). However, none of these studies identified a more sensitive endpoint than the submitted honey bee toxicity study that determined 5.91% mortality at 12.09 µg/bee.

4.2.4 Toxicity to Terrestrial Plants

Terrestrial plant toxicity data are used to evaluate the potential for EPTC to affect riparian zone and upland vegetation within the action area for the CRLF. Impacts to riparian and upland (i.e., grassland, woodland) vegetation may result in indirect effects to both aquatic- and terrestrial-phase CRLFs, as well as modification to designated critical habitat PCEs via increased sedimentation, alteration in water quality, and reduction in of upland and riparian habitat that provides shelter, foraging, predator avoidance and dispersal for juvenile and adult CRLFs.

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 B**.**

Table 4.14 Non-target Terrestrial Plant Seedling Emergence and Vegetative Vigor Toxicity (Tier II) Data (MRIDs 42120802, 43217101) Used For RQ Calculation					
Crop	**Type of Study Species**	**NOAEC [EC_{05}] (lb ai/A)**	**EC_{25} (lb ai/A)**	**Most sensitive parameter**	**Slope**
Seedling Emergence					
Monocot	Purple nutsedge *Cyperus rotundus)*	0.17 0.0144	0.27 0.015	Seedling emergence Dry weight	1.13±0.425
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
Vegetative Vigor					
Monocot	Winter wheat *Triticum aestivum*	0.925 [0.087]	2.9 0.22	Dry weight Phytotoxicity	2.33±0.740
Dicot	Velvet leaf *Abutilon theophrastii*	[0.085] [0.023]	2.0 7.4	Dry weight Phytotoxicity	0.704±0.370

4.3 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 (U.S. EPA, 2004). As part of the risk characterization, an interpretation of acute RQ 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.

4.4 Incident Database Review

A review of the EIIS database for ecological incidents involving EPTC was completed on 03/24/2008. The results of this review for terrestrial, plant, and aquatic incidents are discussed below in Sections 4.4.1 through 4.4.3, respectively. A complete list of the incidents involving EPTC including associated uncertainties is included as **Appendix H**.

4.4.1 Terrestrial Incidents

No incidents involving terrestrial animals have been reported.

4.4.2 Plant Incidents

Five incidents were reported from 1994 to 2005 concerning damage to terrestrial plants following application of EPTC. One of the incidents was classified as ‘probably’ related to EPTC, two incidents were ‘possibly’ related, and two incidents were ‘unlikely’ related to EPTC. The probable incident was a direct application to alfalfa. Fifty of 53 acres were damaged from a registered use for EPTC. Of the incidents classified as possible, 59 acres of grass grown for seed may have been damaged from a carryover of a registered use on dry beans and 2000 acres of potatoes may have been damaged from a registered use on potatoes.

4.4.3 Aquatic Incidents

Two incidents were reported which involved aquatic animals, both with uses on corn. The first incident was reported in 1970. Twenty bass and 30 bluegill sunfish were reported killed from runoff following use on corn. The certainty code classified the incident as possible from the use of EPTC, and the legality of the use was unknown. The second incident was reported in 1994. Six hundred catfish were reported killed from runoff following use on corn. The certainty code classified the incident as unlikely related to the use of EPTC, and the legality of the use was unknown.

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 CRLF or for modification to its 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 CRLF or its designated critical habitat (i.e., “no effect,” “likely to adversely affect,” or “may affect, but not likely to adversely affect”).

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 CRLF and its animal prey in aquatic habitats, as well as terrestrial invertebrates, the LOC is 0.05. For acute exposures to the terrestrial-phase CRLF and to mammals, the LOC is

0.1. The LOC for chronic exposures to CRLF and its prey, as well as acute exposures to plants is 1.0.

Risk to the aquatic-phase CRLF is estimated by calculating the ratio of exposure to toxicity using 1-in-10 year EECs based on the label-recommended EPTC usage scenarios summarized in **Table 3.3** and the appropriate aquatic toxicity endpoint from **Table 4.1**. In addition, as described in the aquatic exposure characterization (Section 3.2) field monitoring studies have reported that EPTC concentrations in tailwater runoff from a flood-irrigated field can be considerably higher than the standard pond EECs. Consequently, these measures of exposure are considered in the aquatic-phase CRLF assessment. Risks to the terrestrial-phase CRLF and its prey (*e.g*. terrestrial insects, small mammals and terrestrial-phase frogs) are estimated based on exposures resulting from applications of EPTC (**Tables 3.8-3.10**) and the appropriate toxicity endpoint from **Table 4.7**. Exposures are also derived for terrestrial plants, as discussed in Section 3.3 and summarized in **Table 3.11**, based on the highest application rates of EPTC use within the action area. Exposures and potential risk resulting from atmospheric deposition of EPTC are considered in a qualitative manner in the Risk Description (Section 5.2).

5.1.1 Exposures in the Aquatic Habitat

5.1.1.1 Direct Effects to Aquatic-Phase CRLF

Direct effect RQs for the aquatic-phase CRLF are presented in **Table 5.1**. Based on 1-in-10 year peak aquatic EECs from the PRZM/EXAMS model and the most sensitive (lowest) 96-hour LC_{50} for freshwater fish from the available toxicity data, there is no exceedence of the acute risk LOC for endangered species (0.05). However, field monitoring studies have reported that EPTC concentrations in tailwater runoff from a flood-irrigated field can be considerably higher than the standard pond EECs. Cliath *et al.* (1980) reported EPTC levels in tailwater up to 1970 µg/L. If RQs were calculated using this exposure estimate and the surrogate bluegill sunfish LC_{50} (14,000 µg/L), the RQ would be 0.14, which exceeds the LOC (0.05).

Direct chronic risks to the CRLF 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 effects to the aquatic phase CRLF is **may affect** for all of the assessed EPTC uses.

Table 5.1 Summary of Direct Effect RQs for the Aquatic-phase CRLF						
Direct Effects to CRLF[a]	**Surrogate Species**	**Toxicity Value (µg/L)**	**EEC (µg/L)**[b]	**RQ**	**Probability of Individual Effect**	**LOC Exceedance and Risk Interpretation**
Acute Toxicity	Bluegill Sunfish *Lepomis macrochirus*	LC_{50} = 14000	Peak: 170.8	0.01	1 in 8.86E+18 (1 in 3.16E+04 to 1 in 1.03E+72)[c]	No[d]
Chronic Toxicity	No data available	N/A	60-day: 72.94	N/A	N/A	May Affect

[a]RQs associated with acute and chronic direct toxicity to the CRLF are also used to assess potential indirect effects to the CRLF based on a reduction in freshwater fish and frogs as food items.
[b] The highest EEC based on EPTC use on lettuce with the start of application on 01/02 with one application at 6.13 lbs/A.
[c] A probit slope for the acute bluegill sunfish toxicity test is not available; therefore, the effect probability at the highest RQ of 0.01 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).
[d] RQ < acute endangered species LOC of 0.05.

5.1.1.2 Indirect Effects to Aquatic-Phase CRLF via Reduction in Prey (non-vascular aquatic plants, aquatic invertebrates, fish, and frogs)

Non-vascular Aquatic Plants

Indirect effects of EPTC to the aquatic-phase CRLF (tadpoles) via reduction in non-vascular aquatic plants in its diet are based on 1-in-10 year peak aquatic EECs from the PRZM/EXAMS model and the most sensitive (lowest) EC_{50} for aquatic non-vascular plants (**Table 5.2**). 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 tadpole stage and habitat) to the aquatic phase CRLF is **may affect**.

Table 5.2 Summary of Indirect Effect RQs For the CRLF: Non-Vascular Aquatic Plants					
Indirect Effect to CRLF	**Surrogate Species**	**Toxicity Value (µg/L)**	**Peak EEC**[a] **(µg/L)**	**RQ**	**LOC Exceedance and Risk Interpretation**
Acute Toxicity	Green Algae *Pseudokirchneriella subcapitata*	EC_{50} = 1400	170.8	0.13	No[b]

[a] Highest EEC based on EPTC use on lettuce with the start of application on 01/02 with one application at 6.13 lbs/A
[b] RQ < aquatic plant LOC of 1.0.

Aquatic Invertebrates

Table 5.3 presents the RQs for indirect effects to the aquatic-phase CRLF via effects to another potential food source, freshwater invertebrates. Based on the projected peak 1-in-10 year aquatic EECs (from PRZM/EXAMS) 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 estimated reproductive NOAEC for the *Daphnia magna*. However, if freshwater invertebrate RQs were calculated using this exposure estimate of 1970 µg/L from tailwater runoff, the acute and chronic LOCs would be exceeded. The acute RQ would be 0.30, and the chronic RQ would be 2.4. Therefore, the preliminary effect determination for indirect effects (prey) to the aquatic phase CRLF and adults in aquatic habitats is **may affect** for all of the assessed EPTC uses.

Table 5.3 Summary of Indirect Effect RQs For the CRLF: Aquatic Invertebrates

Indirect Effect to CRLF	Surrogate Species	Toxicity Value (µg/L)	EEC (µg/L)	RQ	Probability of Individual Effect	LOC Exceedance
Acute Toxicity	Water Flea *Daphnia magna*	EC_{50} = 6490	170.8[a]	0.03	1 in 1300 (1 in 3.2 E+09 to 1 in 2)	No[c]
Chronic Toxicity	Water Flea *Daphnia magna*	NOAEC = 810	122.2[d]	0.15	N/A	No[e]

[a] The highest EEC based on EPTC use on lettuce with the start of application on 01/02 with one application at 6.13 lbs/A.
[b] Based on a probit slope of 2.08 (0.10 – 4.06)
[c] RQ < acute risk LOC of 0.5.
[d] The highest 21-day mean EEC based on lettuce with a single application of EPTC at 6.125 lbs/A.
[e] RQ < chronic risk LOC of 1.0.

Fish and Frogs

Fish and frogs also represent potential prey items of adult aquatic-phase CRLFs. RQs associated with acute and chronic direct toxicity to the CRLF (**Table 5.1**) are used to assess potential indirect effects to the CRLF based on a reduction in freshwater fish and frogs as food items. None of the acute RQs for freshwater fish with any scenario exceeds the acute LOCs for freshwater fish; however, the LOC would be exceeded when considering the tailwater monitoring data. Direct chronic risks to the CRLF cannot be quantitatively assessed at this time because no chronic fish toxicity data are available; thus, risk cannot be precluded at this time (see Risk Description for further discussion). Therefore, the preliminary effect determination for indirect acute effects to the adult CRLF in aquatic habitat is **may affect** for all of the assessed EPTC uses.

5.1.1.3 Indirect Effects to CRLF via Reduction in Habitat and/or Primary Productivity (Freshwater Aquatic Plants)

Indirect effects to the CRLF via direct toxicity to aquatic plants are estimated using the most sensitive non-vascular and vascular plant toxicity endpoints. Because there are no obligate relationships between the CRLF and any aquatic plant species, the most sensitive EC_{50} values, rather than NOAEC values, were used to derive RQs. **Table 5.4** includes RQs for vascular plants (RQs for non-vascular plants are presented in Section 5.1.2.2 and Table 5.2). None of the RQs for aquatic vascular plants exceeds the aquatic plant LOC. Even if the RQ was calculated using an exposure estimate of 1970 µg/L from the tailwater monitoring study, the RQ would be 0.35, which is below the LOC. Therefore, the preliminary effect determination for indirect effects (reduction in habitat and/or primary productivity) to the CRLF is **no effect** for all of the assessed EPTC uses.

Table 5.4 Summary of Indirect Effect RQs For the CRLF: Vascular Aquatic Plants[a]

Indirect Effect to CRLF	Surrogate Species	Toxicity Value (μg/L)	Peak EEC[b] (μg/L)	RQ	LOC Exceedance and Risk Interpretation
Acute Toxicity	Duckweed *Lemna gibba*	EC_{50} = 5600	170.8	0.03	No[c]

[a] RQs used to estimate indirect effects to the CRLF via toxicity to non-vascular aquatic plants are summarized in Table 5.2.
[b] The highest EEC based on EPTC use on lettuce with the start of application on 01/02 with one application at 6.13 lbs/A.
[c] RQ < aquatic plant LOC of 1.0.

5.1.2 Exposures in the Terrestrial Habitat

5.1.2.1 Direct Effects to Terrestrial-phase CRLF

As previously discussed in Section 3.3, direct effect RQs for the terrestrial-phase CRLF were determined using the terrestrial exposure model T-REX to estimate exposures and risks in conservative scenarios to avian and mammalian species for spray and granular applications of EPTC. For spray applications, risk quotients were calculated using upper-bound EECs for a small (20 g) bird consuming small insects (*i.e.*, dietary residues on vegetation were not considered since the CRLF does not consume plants). Risk associated with granular applications of EPTC was assessed using the LD_{50}/ft^2 methodology. Avian acute and chronic toxicity data (*i.e*., acute oral LD_{50}, subacute dietary LC_{50}, and chronic dietary NOAEC) served as a surrogate for the terrestrial-phase CRLF. **Appendix E** provides an example of specific dose- and dietary-based acute and chronic RQs for direct and indirect effects to the terrestrial-phase CRLF.

An acute oral toxicity threshold could not be established in either of the submitted acute oral toxicity studies for birds (*i.e*., LD_{50} > highest level tested; mallard duck LD_{50} > 1000 mg a.i/kg bw and bobwhite quail LD_{50} > 2510 mg a.i/kg bw). Thus, no RQs or LD_{50}/ft^2 were calculated using these toxicity endpoints, and acute RQs for assessment of potential direct effects to the terrestrial-phase CRLF rely on the most sensitive (lowest) subacute dietary toxicity threshold (*i.e.*, LC_{50}) from the available data. See the Risk Description section (5.2) for further discussion regarding direct effects to the terrestrial-phase CRLF based on available avian acute toxicity data.

Table 5.5 presents the subacute and chronic dietary-based avian RQs used to estimate direct effects to the terrestrial-phase CRLF for spray uses of EPTC. The acute avian LOC is not exceeded for any modeled scenario. The chronic avian LOC is exceeded for all modeled scenarios for spray applications of EPTC except for castor beans. Therefore, the preliminary effect determination, based on exceedence of the chronic risk LOC, is **may affect** for alfalfa, beans (dry, snap), broccoli, cabbage, carrots, cauliflower, clover, corn, cotton, grapefruit, lemon, lespedeza, lettuce, orange, potato (white/Irish, sweet), safflower, sugar beet, sunflower, tangerine, tomato, trefoil, walnut and forestry/ornamental uses. The T-HERPS model can only be used to refine dose-based risk estimates; thus, further refinement of the chronic dietary-based RQs is not possible.

Table 5.5. Summary of Direct Effect RQs for the Terrestrial-phase CRLF for Spray Applications of EPTC[a]

Uses	Rate (lb ai/A) # Apps/App. Interval (days)	Broadleaf Plants/ Small Insects		
		EEC (ppm)	Acute RQ[b]	Chronic RQ[c]
Forestry, ornamental	14.88 Single application	2009	0.10	**8.30****
Potato	6.13 2 applications/30	1284	0.06	**5.31****
Sweet potato	7.44 Single application	1004	0.05	**4.15****
Dry beans	3.67 - 4.59 2 applications/30	769 - 962	0.04 – 0.05	**3.18 – 3.97**** [d]
Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet	6.13 Single application	828	0.04	**3.42****
Dried beans	3.94 2 applications/30	826	0.04	**3.41****
Alfalfa	6.12 Single application	826	0.04	**3.41****
Alfalfa	3.06 4 applications/40	685	0.03	**2.83****
Safflower	3.06 2 applications/30	641	0.03	**2.65****
Snap beans	3.94 – 4.58 2 applications/90	621 - 722	0.03 – 0.04 [d]	**2.57 – 2.98**** [d]
Dried beans	4.59 Single application	620	0.03	**2.56****
Alfalfa	3.06 4 applications/60	589	0.03	**2.43****
Almond	3.06 2 applications/45	583	0.03	**2.41****
Snap beans	3.94 Single application	532	0.03	**2.20****
Almonds, Snap beans, Citrus, Potato, Safflower, Tomato, Walnut	3.06 Single application	413	0.02	**1.71****
Castor beans	1.76 Single application	238	0.01	0.98

[a] Based on Upper Bound Kenaga Residues for Spray (Non-granular) Uses of EPTC Size class not used for dietary risk quotients
[b]Avian subacute dietary LC_{50}: 20000 ppm
[c]Avian chronic NOAEC: 242 ppm
[d] The T-REX model does not estimate exposure for two different application rates. Therefore, in those instances, the upper and lower application rates were modeled separately and the RQs were provided as a range.
* = LOC exceedances (acute RQ ≥ 0.1) are **bolded** and shaded
** = LOC exceedances (chronic RQ ≥ 1) are **bolded** and shaded.

5.1.2.2 Indirect Effects to Terrestrial-Phase CRLF via Reduction in Prey (terrestrial invertebrates, mammals, and frogs)

Terrestrial Invertebrates

Indirect effects to the CRLF as a result of effects to terrestrial invertebrates are typically assessed by comparing the expected residues on small and large insects (predicted by the T-REX model) to the acute contact toxicity data for terrestrial invertebrates. Available toxicity data suggest that EPTC is practically nontoxic to terrestrial invertebrates, with a honey bee acute contact LD_{50} > 12.09 µg a.i./bee, which is equivalent to > 94.2 ppm[20]. At this level, the mortality rate was 5.91%. Results from another honey bee toxicity test indicated the LD_{50} > 72.5µg a.i./bee (or > 565 ppm); the mortality rate at that level was 2.5%. Since a definitive LD_{50} was not established, RQs are not calculated. However, despite the fact that EPTC is categorized as practically non-toxic to the honey bee, the T-REX model predicted residues on insects are high enough to introduce some uncertainty regarding the potential risk of EPTC to terrestrial invertebrates (see Risk Description section (5.2.2.4). The preliminary effects determination is **may affect.**

Mammals

For spray applications of EPTC, risks associated with ingestion of small mammals by large terrestrial-phase CRLFs are derived for dietary-based and dose-based exposures modeled in T-REX for a small mammal (15 g) consuming short grass. Acute and chronic effects are estimated using the most sensitive mammalian toxicity data. EECs are divided by the toxicity value to estimate acute and chronic dose-based RQs as well as chronic dietary-based RQs. Table 5.6 summarizes the acute and chronic mammalian RQs for non-granular uses. These RQs are used to estimate indirect effects to the terrestrial-phase CRLF. Both the acute dose-based and chronic dose- and dietary-based RQs exceed the acute and/or chronic LOC for all scenarios modeled. Thus, the preliminary effects determination for indirect effects on the terrestrial-phase CRLF via effects to mammalian prey is **may affect** for the all of the assessed uses of EPTC (alfalfa, beans (dry, snap, castor), broccoli, cabbage, carrots, cauliflower, clover, corn, cotton, grapefruit, lemon, lespedeza, lettuce, orange, potato (white/Irish, sweet), safflower, sugar beet, sunflower, tangerine, tomato, trefoil, walnut and forestry/ornamental).

[20] According to Mayer, D. & C. Johansen. 1990. *Pollinator Protection: A Bee & Pesticide Handbook*. Wicwas Press. Cheshire, Conn. p. 161.

Table 5.6 Summary of Acute and Chronic RQs* For Small Mammals for Spray Applications of EPTC			
Use Rate (lb ai/A)/No. Apps./Interval (days)	Chronic RQ		Acute RQ
	Dose-based RQ[1]	Dietary-based RQ[2]	Dose-based RQ[3]
Forestry/ornamental 14.88 / 1	**154.92**	**17.86**	**1.06**
Potato 6.13 / 2 / 30	**99.05**	**11.42**	**0.68**
Sweet potato 7.44 / 1	**77.46**	**8.93**	**0.53**
Alfalfa, Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet 6.13 / 1	**63.82**	**7.36**	**0.44**
Dried beans 3.94 / 2 /30	**63.67**	**7.34**	**0.43**
Dried beans 4.59 + 3.67 / 1 application each / 30	**59.30 – 74.17[4]**	**6.84 – 8.55**	**0.40 – 0.51**
Alfalfa 3.06/ 3 / 40	**52.82**	**6.09**	**0.36**
Snap beans 4.26 / 2 / 90	**51.81**	**5.97**	**0.35**
Safflower 3.06 / 2 / 30	**49.45**	**5.70**	**0.34**
Snap beans 3.94 + 4.58 / 1 application each / 90	**47.92 – 55.71[4]**	**5.52 – 6.41**	**0.33 – 0.38**
Dried beans 4.59 / 1	**47.79**	**5.51**	**0.33**
Alfalfa 3.06 / 4 / 60	**45.43**	**5.24**	**0.31**
Almonds 3.06 / 2 / 45	**44.93**	**5.18**	**0.31**
Snap beans and clover 3.94 / 1	**41.02**	**4.73**	**0.28**
Almonds, Snap beans, Citrus, Potato, Safflower, Tomato, Walnut 3.06 / 1	**31.86**	**3.67**	**0.22**
Castor beans 1.76 / 1	**18.32**	**2.11**	**0.13**

* = LOC exceedances (acute RQ ≥ 0.1 and chronic RQ ≥ 1) are bolded and shaded.
[1] Based on dose-based EEC and EPTC rat NOAEL = 10 mg/kg-bw.
[2] Based on dietary-based EEC and EPTC rat NOAEC = 200 mg/kg-diet.
[3] Based on dose-based EEC and EPTC rat acute oral LD_{50} = 1465 mg/kg-bw.
[4] The T-REX model does not estimate exposure for two different application rates. Therefore, in those instances, the upper and lower application rates were modeled separately and the RQs were provided as a range.

For granular applications of EPTC, the LD_{50}/ft^2 method is used to estimate risks. As shown in Table 5.7, none of the LD_{50}/ft^2 calculations exceed the listed species LOC (0.1). Risk to mammals as a result of granular formulations of EPTC is presumed to be negligible.

Table 5.7 Summary of LD_{50}/ft^2 Calculations for Small (15 g) Mammals for Granular Uses of EPTC Assuming 99% Soil Incorporation		
Use	**Rate (lbs ai/A)**	**LD_{50}/ft^2**
Corn, Safflower, Sugar beet	3	0.0065
Alfalfa, Dried beans, Snap beans, Clover, Lespedeza, Trefoil Birdsfoot	4	0.0086
Citrus, Conifers, Grapefruit, Orange, Potato	6	0.013

Frogs

An additional prey item of the adult terrestrial-phase CRLF is other species of frogs. In order to assess risks to these organisms, dietary-based and dose-based exposures modeled in T-REX for a small bird (20 g) consuming small invertebrates are used. As discussed in Section 5.1.2.1, the chronic avian LOC is exceeded for all modeled scenarios for spray applications of EPTC except for castor beans. The preliminary effect determination is **may affect**.

5.1.2.3 Indirect Effects to CRLF via Reduction in Terrestrial Plant Community (Riparian and Upland Habitat)

Potential indirect effects to the CRLF resulting from direct effects on riparian and upland vegetation are assessed using RQs from terrestrial plant seedling emergence and vegetative vigor EC_{25} data as a screen. 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 (Tables 5.7 and 5.8). 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, beans (dry, snap, castor), broccoli, cabbage, carrots, cauliflower, clover, corn, cotton, grapefruit, lemon, lespedeza, lettuce, orange, potato (white/Irish, sweet), safflower, sugar beet, sunflower, tangerine, tomato, trefoil, walnut and forestry/ornamental).

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**
Forestry, ornamental	14.88	1	**9.92**	**59.52**	**505.92**
Sweet potato	7.44	1	**4.96**	**29.76**	**252.96**
Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet, Alfalfa	6.13	1	**4.09**	**24.52**	**208.42**
Dried beans	4.59	1	**3.06**	**18.36**	**156.06**
Snap beans	3.94	1	**2.63**	**15.76**	**133.96**
Almonds, Safflower, Tomato, Walnut	3.06	1	**2.04**	**12.24**	**104.04**
Castor beans	1.76	1	**1.17**	**7.04**	**59.84**
* = LOC exceedances (RQ $\geq$ 1) are bolded and shaded.					

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**
Forestry, ornamental	14.88	1	0.57	**3.43**	**29.19**
Sweet potato	7.44	1	0.29	**1.72**	**14.59**
Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet, Alfalfa	6.13	1	0.24	**1.41**	**12.02**
Dried beans	4.59	1	0.18	**1.06**	**9.00**
Snap beans	3.94	1	0.15	0.91	**7.73**
Almonds, Safflower, Tomato, Walnut	3.06	1	0.12	0.71	**6.00**
Castor beans	1.76	1	<0.1	0.041	**3.45**
* = LOC exceedances (RQ $\geq$ 1) are bolded and shaded.					

5.1.3 Primary Constituent Elements of Designated Critical Habitat

For EPTC, the assessment endpoints for designated critical habitat PCEs involve a reduction and/or modification of food sources necessary for normal growth and viability of aquatic-phase CRLFs, and/or a reduction and/or modification of food sources for terrestrial-phase juveniles and adults. Because these endpoints are also being assessed relative to the potential for indirect effects to aquatic- and terrestrial-phase CRLF, the effects determinations for indirect effects from the potential loss of food items are used as the basis of the effects determination for potential modification to designated critical habitat.

5.1.3.1 Aquatic-Phase (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)

Three of the four assessment endpoints for the aquatic-phase primary constituent elements (PCEs) of designated critical habitat for the CRLF are related to 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 CRLFs.
- Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.
- Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae).

The preliminary effects determination for aquatic-phase PCEs of designated habitat related to potential effects on terrestrial plants is “habitat modification”, based on the risk estimation provided in Sections 5.1.2.3. 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.

The remaining aquatic-phase PCE is "alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source." 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 monitoring 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 CRLF 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).

5.1.3.2 Terrestrial-Phase (Upland Habitat and Dispersal Habitat)

Two of the four assessment endpoints for the terrestrial-phase PCEs of designated critical habitat for the CRLF are related to potential effects to terrestrial plants:

- Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance
- Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal

The preliminary effects determination for terrestrial-phase PCEs of designated habitat related to potential effects on terrestrial plants is "habitat modification", based on the risk estimation provided in Section 5.1.2.3.

The third terrestrial-phase PCE is "reduction and/or modification of food sources for terrestrial phase juveniles and adults." To assess the impact of EPTC on this PCE, acute and chronic toxicity endpoints for birds, mammals, and terrestrial invertebrates are used as measures of effects. RQs for these endpoints were calculated in Section 5.1.2.2. Chronic RQs for birds and acute and chronic RQs for mammals exceed the LOCs; thus, the preliminary effects determination for this PCE is "habitat modification."

The fourth terrestrial-phase PCE is based on alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source. Based on surrogate avian toxicity data, chronic RQs exceed the LOC for effects to the terrestrial-phase PCE. Thus, the preliminary effects determination for this PCE is "habitat modification."

5.2 Risk Description

The risk description synthesizes an overall conclusion regarding the likelihood of adverse impacts leading to an effects determination (*i.e.*, "no effect," "may affect, but not likely to adversely affect," or "likely to adversely affect") for the CRLF and its designated critical habitat.

If the RQs presented in the Risk Estimation (Section 5.1) show no direct or indirect effects for the CRLF, and no modification to PCEs of the CRLF's designated critical habitat, a "no effect" determination is made, based on EPTC's use within the action area. However, if direct or indirect effect LOCs are exceeded or effects may modify the PCEs of the CRLF's critical habitat, the Agency concludes a preliminary "may affect" determination for the FIFRA regulatory action regarding EPTC. A summary of the results of the risk estimation (*i.e.*, "no effect" or "may affect" finding) is provided in **Table 5.9** for direct and indirect effects to the CRLF and in **Table 5.10** for the PCEs of designated critical habitat for the CRLF.

Table 5.9 Preliminary Effects Determination Summary for EPTC - Direct and Indirect Effects to CRLF		
Assessment Endpoint	**Preliminary Effects Determination**	**Basis For Preliminary Determination**
Aquatic Phase (eggs, larvae, tadpoles, juveniles, and adults)		
Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	May affect	Acute LOC is not exceeded using 1-in-10 year peak EEC; however, LOC would be exceeded if RQ was calculated using exposure estimate from tailwater monitoring study. Chronic risk cannot be quantitatively assessed due to lack of chronic toxicity data for freshwater fish; risk cannot be precluded at this time.
Survival, growth, and reproduction of CRLF individuals via effects to food supply (i.e., freshwater fish, invertebrates, non-vascular plants)	May affect	Using 1-in-10 year modeling data, the LOC is not exceeded for any of the assessed EPTC uses; however, LOCs would be exceeded if RQs were calculated using exposure estimate from tailwater monitoring study.
Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, and/or primary productivity (i.e., aquatic plant community)	May affect	Using 1-in-10 year modeling data, the LOC is not exceeded for any of the assessed EPTC uses; however, LOCs would be exceeded if RQs were calculated using exposure estimate from tailwater monitoring study.
Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	May affect	LOC is exceeded for all uses based on available seedling emergence and vegetative vigor data.
Terrestrial Phase (Juveniles and adults)		
Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	May affect	Dose-based RQs cannot be calculated since LD50 is not definitive; dose-based risk will be addressed qualitatively. Subacute dietary RQs do not exceed the LOC for any EPTC use. Chronic avian LOC is exceeded for all modeled scenarios for spray applications of EPTC except for castor beans, suggesting the potential for reproductive effects. Risk associated with granular uses appears to be negligible.
Survival, growth, and reproduction of CRLF individuals via effects on prey (i.e., terrestrial invertebrates, small terrestrial mammals and terrestrial phase amphibians)	May affect	Chronic avian LOC is exceeded for all modeled scenarios for spray applications of EPTC except for castor beans. Acute and chronic LOCs are exceeded for mammals for all spray uses of EPTC. Risk associated with granular uses appears to be negligible.
Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (i.e., riparian vegetation)	May affect	Terrestrial plant LOC is exceeded for all assessed EPTC uses.

Table 5.10 Preliminary Effects Determination Summary for EPTC – PCEs of Designated Critical Habitat for the CRLF		
Assessment Endpoint	**Preliminary Effects Determination**	**Basis For Preliminary Determination**
Aquatic Phase PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)		
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 CRLFs.	Habitat modification	Terrestrial plant LOC is exceeded for all assessed EPTC uses.
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	Habitat modification	Terrestrial plant LOC is exceeded for all assessed EPTC uses.
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	Habitat modification	Terrestrial plant LOC is exceeded for all assessed EPTC uses.
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (e.g., algae)	Habitat modification	Using 1-in-10 year modeling data, the LOC is not exceeded for any of the assessed EPTC uses; however, LOCs would be exceeded if RQs were calculated using exposure estimate from tailwater monitoring study.
Terrestrial Phase PCEs (Upland Habitat and Dispersal Habitat)		
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	Habitat modification	Terrestrial plant LOC is exceeded for all assessed EPTC uses.
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	Habitat modification	Terrestrial plant LOC is exceeded for all assessed EPTC uses.
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	Habitat modification	Chronic avian LOC is exceeded for all modeled scenarios for spray applications of EPTC except for castor beans. Acute and chronic LOCs are exceeded for mammals for all spray uses of EPTC. Risk associated with granular uses appears to be negligible.
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	Habitat modification	Chronic RQs for birds exceed the LOC.

Following a preliminary “may affect” or “habitat modification” determination, additional inform12ation 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 CRLF. 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 CRLF and its designated critical habitat.

The criteria used to make determinations that the effects of an action are “not likely to adversely affect” the CRLF and 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 CRLF and its designated critical habitat is provided in **Sections 5.2.1 through 5.2.3**.

5.2.1 Direct Effects

5.2.1.1 Aquatic-Phase CRLF

The aquatic-phase considers life stages of the frog that are obligatory aquatic organisms, including eggs and larvae. It also considers submerged terrestrial-phase juveniles and adults, which spend a portion of their time in water bodies that may receive runoff and spray drift containing EPTC.

Model-predicted aquatic EECs as well as surface water and tailwater runoff monitoring data from the open literature are used to characterize the potential risk to the aquatic-phase CRLF in this assessment. Aquatic exposures for spray and granular applications of EPTC are estimated using the Tier 2 PRZM/EXAMS model for various agricultural and non-agricultural uses. Model predicted peak 1-in-10 year concentrations are used to calculate RQs for acute risk, and 60-day averages are used to calculate chronic RQs for direct effects to the aquatic-phase CRLF. The model-predicted EECs are assumed to be conservative exposure estimates for surface water, and available surface water monitoring data for EPTC support this assumption. As discussed in Section 3.2.3, the highest model-predicted peak EEC is 171 µg/L (for the lettuce scenario); available surface water monitoring data from USGS NAWQA (collected from 1992 through 2006) reported a maximum concentration of 40 µg/L, and the mean and median peak concentrations were 0.047 and 0.0021 µg/L, respectively.

However, as discussed in Section 3.2.4, available monitoring 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.

For risk characterization purposes, RQs have been calculated using the model predicted EECs as well as the tailwater monitoring peak detection of 1970 µg/L. As shown in **Table 5.1**, based on 1-in-10 year peak aquatic EECs from the PRZM/EXAMS model and the available toxicity data, there is no exceedence of the acute risk LOC for endangered species (0.05). A probit slope for the acute bluegill sunfish toxicity test is not available; therefore, the effect probability at the highest RQ of 0.01 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). The individual effect probability for direct effects to the aquatic phase CRLF based on acute toxicity data is 1 in 8.86E+18 (1 in 1.03E+72 to 1 in 3.16E+04).

However, based on the highest EPTC concentration (1970 µg/L) detected in tailwater as reported in Cliath *et al.* (1980) and the surrogate bluegill sunfish LC_{50} (14,000 µg/L), the acute RQ is 0.14, which exceeds the LOC (0.05). The individual effect probability at an RQ of 0.14 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). For uses of EPTC that allow flood irrigation/chemigation (i.e., alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black)), the individual effect probability for direct effects to the aquatic phase CRLF based on acute toxicity data is 1 in 16,400 (1 in 1.31E+14 to 1 in 2).

There are no chronic freshwater fish toxicity data with which to quantitatively estimate direct chronic risk of EPTC to the aquatic-phase CRLF. The highest predicted 60-day mean aquatic EEC is 72.94 µg/L (*i.e*., for the use of EPTC on safflower with the start of application on 01 January at 3.06 lbs/A, applied twice per year at 30 day intervals). Thus, in order for a chronic RQ (*i.e*., 60-day EEC/NOAEC) to exceed the LOC of 1.0, the chronic toxicity NOAEC for freshwater fish would need to be less than 72.94 µg/L, which is 192 times lower than the bluegill sunfish acute LC_{50} (14 mg/L or 14,000 µg/L) and 58 times lower than the NOAEC for sublethal effects (4.2 mg/L or 4200 µg/L). Compared to the known toxicity of EPTC to freshwater invertebrates, a fish chronic NOAEC of 72.94 µg/L would be 11 times lower than the daphnid chronic NOAEC of 0.81 mg/L (or 810 µg/L). The lack of chronic fish toxicity data leads to a high level of uncertainty regarding the potential for direct effects of EPTC to the aquatic-phase CRLF, and risk cannot be precluded at this time.

Based on the potential tailwater aquatic exposures associated with the EPTC 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)) and the uncertainty of chronic risk due to the lack of toxicity data, the final effects determination for direct effects of EPTC to the aquatic-phase CRLF is **likely to adversely affect.**

5.2.1.2 Terrestrial-Phase CRLF

Avian acute and chronic toxicity data (*i.e.*, acute oral LD_{50}, subacute dietary LC_{50}, and chronic dietary NOAEC) served as a surrogate for the terrestrial-phase CRLF. As stated previously, on a dietary basis, the acute avian LOC is not exceeded for any modeled scenario. The study that was selected to assess subacute dietary risk to birds was conducted with bobwhite quail and determined an LC_{50} of 20000 ppm; this study was classified as supplemental because the test animals were 8 weeks old rather than 5-10 days old at test initiation. A second bobwhite quail study and two mallard studies are available, all of which are acceptable; however, none of these studies identified a definitive LC_{50} (i.e., > 5620 ppm in all three studies). No mortalities were observed in the acceptable studies. The only sublethal effects included a decrease in body weight gain and food consumption, which were observed at treatments ≥ 1780 ppm. In the bobwhite quail study that was used for risk estimation, inhibition of body weight gain was observed at treatment concentrations ≥ 3200 ppm, and mortality was observed at treatment concentrations ≥ 5600 ppm. Other sublethal and gross pathological effects were observed at concentrations ≥ 10,000 ppm. All birds died at 32,000 ppm. Because mortality was seen at concentrations comparable to those in the acceptable studies (i.e., EPTC exhibits similar toxicity to 1-week-old and 8-week-old chicks), the bobwhite quail LC_{50} of 20000 ppm was used for risk estimation.

Acute avian dose-based RQs for spray applications of EPTC were not calculated because definitive acute oral toxicity endpoints (*i.e.*, LD_{50}) were not determined in the mallard duck or the bobwhite quail acute oral toxicity study. For the mallard duck study, the NOAEL was 1000 mg/kg, and the LOAEL was greater than 1000 mg/kg. No effects were observed other than regurgitation at 1590 and 2510 mg/kg. Due to regurgitation, a precise LD_{50} could not be estimated (i.e., LD_{50} > 1000 mg/kg, the highest concentration at which no regurgitation was observed). In the bobwhite quail acute oral toxicity study, the mortality rate was 20% at 2510 mg a.i/kg bw, the highest dose tested (*i.e.*, LD_{50} > 2510 mg/kg); the NOAEL was less than 398 mg a.i./kg bw, and the LOAEL was 398 mg a.i./kg bw based on reduced food consumption, body weight loss, lethargy and reduced reactions to external stimuli. Using the T-REX model, the adjusted LD_{50} for a 20-gram bird is >1808 mg a.i./kg bw. This level is within the range of the predicted terrestrial EECs for small insects, a prey item for the terrestrial-phase CRLF, which range from about 300 to 2300 mg/kg bw (Table 5.11). RQs calculated using these small insect dose-based EECs and an LD_{50} of >1808 mg a.i./kg bw would range from <0.15 to <1.27, which could potentially exceed the acute endangered species LOC of 0.1. For granular applications of EPTC, assuming an avian LD_{50} > 2510 mg a.i/kg bw, all of the LD_{50}/ft^2 calculations would be less than the LOC (0.1).

Table 5.11. T-REX Model Dose-Based EECs for Characterization of Direct Effects to Terrestrial-phase CRLF

Uses	Rate (lb ai/A) # Apps/Interval (days)	Small Insect EEC[a] (mg/kg bw)
Forestry, ornamental	14.88 Single application	2287.82
Potato	6.13 2 applications/30	780.03
Sweet potato	7.44 Single application	1143.91
Dry beans	3.67 - 4.59 2 applications/30	875.77 – 1095.31
Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet	6.13 Single application	942.50
Dried beans	3.94 2 applications/30	940.20
Alfalfa	6.12 Single application	940.96
Alfalfa	3.06 4 applications/40	823.73
Safflower	3.06 2 applications/30	730.21
Snap beans	3.94 – 4.58 2 applications/90	707.70 – 822.65
Dried beans	4.59 Single application	705.72
Alfalfa	3.06 4 applications/60	670.87
Almond	3.06 2 applications/45	663.46
Snap beans, clover	3.94 Single application	605.78
Almonds, Snap beans, Citrus, Potato, Safflower, Tomato, Walnut	3.06 Single application	470.48
Castor beans	1.76 Single application	270.60

[a] Based on Upper Bound Kenaga Residues for Spray (Non-granular)
[b] Avian acute oral LD_{50}: bobwhite quail LD_{50} > 2510 mg a.i/kg bw); adusted LD_{50} for a 20 g bird is > 1808.28 mg a.i./kg bw.
[c] The T-REX model does not estimate exposure for two different application rates. Therefore, in those instances, the upper and lower application rates were modeled separately and the RQs were provided as a range.

The T-HERPS model v. 1.0 was used to further characterize the acute dose-based risk to the terrestrial-phase CRLF. This model is based on the premise that reptiles and amphibians are poikilotherms (body temperature varies with environmental temperature) while birds are homeotherms (temperature is regulated, constant, and largely independent of environmental temperatures). Therefore, reptiles and amphibians (collectively referred to as herptiles in this guidance) tend to have much lower metabolic rates and lower caloric intake requirements than birds or mammals. As a consequence, birds are likely to consume more food than amphibians or reptiles on a daily dietary intake basis, assuming similar caloric content of the food items. This can be seen when comparing the estimated caloric requirements for free living iguanid lizards (Iguanidae) (**EQ 1**) to passerines (song birds) (**EQ 2**) (U.S. EPA, 1993):

$$\textbf{iguanid FMR (kcal/day)= 0.0535 *(bw in g)}^{0.799} \qquad \textbf{(EQ 1)}$$

$$\textbf{passerine FMR (kcal/day) = 2.123 *(bw in g)}^{0.749} \qquad \textbf{(EQ 2)}$$

With relatively comparable exponents (slopes) to the allometric functions, one can see that, given a comparable body weight, the free living metabolic rate of birds can be 40 times higher than reptiles, though the requirement differences narrow with high body weights. Consequently, use of avian food intake allometric equation as a surrogate to herptiles is likely to result in an over-estimation of exposure for reptiles and terrestrial-phase amphibians.

In order to evaluate dietary exposure to the terrestrial-phase CRLF, T-REX (version 1.3.1.) has been altered to allow for an estimation of food intake for herptiles (T-HERPS) using the same basic procedure that T-REX uses to estimate avian food intake. RQ estimates using the T-HERPS model do not exceed the acute LOC (0.10) for any food category except for medium- and large-sized CRLFs (37 and 238 grams) that consume small herbivorous mammals for only the forestry/ornamental use. Because it is unlikely for a 37-gram CRLF to eat a 35-gram mammal, only the large-sized CLRF (238 grams) are shown below (Table 5.12). Since all other EPTC uses result in lower EECs, acute RQs in the T-HERPS model were only estimated for consumption of small herbivorous mammals. The acute RQ for the forestry/ornamental uses exceeds the acute endangered species LOC. The acute LOC is not exceeded for sweet potato, the use with the next lower application rate; thus, the acute LOC for endangered species would not be exceeded for any of the other uses.

Table 5.12. Summary of Direct Effect Dose-Based RQs for the Terrestrial-phase CRLF Consuming Small Herbivorous Mammals Using T-HERPS[a]

Uses	Rate (lb ai/A) # Apps/App. Interval (days)	EEC (mg/kg bw)	Acute RQ[a]
Forestry, ornamental	14.88 Single application	346.06	**< 0.14**
Sweet potato	7.44 Single application	173.03	< 0.07

[a] Based on LD50 > 2510 mg/kg

Chronic RQs for all EPTC uses except castor beans exceed the LOC (1.0); RQs range from about 2 to 8 and were based on a NOAEC of 242 ppm from a mallard duck chronic toxicity study (MRID 46554301). The LOAEC in this study was 593 ppm based on a significant reduction in the proportion of viable embryos of eggs set at the 593 and 1490 ppm levels (13 and 21%, respectively). At 1490 mg ai/kg diet, number of eggs laid, eggs set, viable embryos, and live embryos; number hatched; ratios of number hatched to eggs laid and to eggs set; and hatchling survival and the ratio of hatchling survivors to eggs set were adversely affected. Reductions ranged from 24 to 52% of control. As shown in Table 5.5, the terrestrial EECs may be up to 2009 ppm, which exceeds the level known to elicit significant reproductive effects in a laboratory toxicity test (Table 5.5).

Based on the weight of the evidence for risk to birds following both acute and chronic exposure, the final effects determination for direct effects to the terrestrial-phase CRLF is **likely to adversely affect**.

5.2.2 Indirect Effects (via Reductions in Prey Base)

5.2.2.1 Algae (non-vascular plants)

As discussed in Section 2.5.3, the diet of CRLF tadpoles is composed primarily of unicellular aquatic plants (i.e., algae and diatoms) and detritus. 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 monitoring 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).

Based on the potential tailwater aquatic exposures associated with the EPTC 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)), the final effect determination for indirect effects (diet in tadpole stage and habitat) to the aquatic phase CRLF is **likely to adversely affect**.

5.2.2.2 Aquatic Invertebrates

The potential for EPTC to elicit indirect effects to the CRLF via effects on freshwater invertebrate food items is dependent on several factors including: (1) the potential magnitude of effect on freshwater invertebrate individuals and populations; and (2) the number of prey species potentially affected relative to the expected number of species needed to maintain the dietary needs of the CRLF. Together, these data provide a basis to evaluate whether the number of individuals within a prey species is likely to be reduced such that it may indirectly affect the CRLF.

Based on the projected peak 1-in-10 year aquatic EECs (from PRZM/EXAMS) and toxicity data for the freshwater invertebrate, *Daphnia magna*, the acute RQ does not exceed the LOC for any EPTC use. However, based on the highest EPTC concentration (1970 µg/L) detected in tailwater as reported in Cliath *et al.* (1980) and the daphnid acute 48-hour EC_{50} (6490 µg/L), the acute RQ is 0.30, which exceeds the LOC (0.05). The individual effect probability at an LOC of 0.05 and at an RQ of 0.30 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). For uses of EPTC that allow flood irrigation/chemigation (i.e., alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black)), the individual effect probability for direct effects to freshwater invertebrates based on daphnid acute toxicity data and an LOC of 0.05 is 1 in 4.18E+08 (1 in 1.75E+31 to 1 in 216); based on an RQ of 0.30 the individual effect probability 1 in 107 (1 in 7.91E+05 to 1 in 7). EPTC may affect sensitive freshwater invertebrates; however, the low probability (<1%) of individual effects to daphnids is not likely to adversely affect the CRLF, given that it preys on a wide range of aquatic invertebrate species.

For chronic risk to freshwater invertebrates, the RQ does not exceed the LOC based on the 21-day PRZM/EXAMS predicted aquatic EEC and the chronic daphnid NOAEC (810 µg/L). As for the tailwater concerns, monitoring 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. Since the chronic daphnid NOAEC is 810 µg/L, a chronic RQ based on the tailwater monitoring data would be well below the LOC (1.0). In fact, assuming a half-life of 1.65 days, the EPTC concentration in tailwater would be below the chronic LOC after one day.

The final effects determination for indirect effects to the aquatic phase CRLF and adults in aquatic habitats via effects on freshwater invertebrates as prey items is **not likely to adversely affect**.

5.2.2.3 Fish and Aquatic-phase Frogs

RQs associated with acute and chronic direct toxicity to the CRLF are used to assess potential indirect effects to the CRLF based on a reduction in freshwater fish and frogs as food items. As described in Section 5.2.1.1, none of the RQs for freshwater fish with any modeled EPTC use scenario exceeds the acute LOCs for freshwater fish; however, if RQs were calculated using the tailwater runoff monitoring data, the LOC would be exceeded. There are no chronic freshwater fish toxicity data with which to quantitatively assess the potential indirect effects to the aquatic phase CRLF via chronic effects on fish or frogs. The lack of chronic fish toxicity data leads to a high level of uncertainty regarding the potential for indirect effects of EPTC to the CRLF, and risk cannot be precluded at this time.

Based on the potential tailwater aquatic exposures associated with the EPTC 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)) and the uncertainty of chronic risk due to the lack of toxicity data, the final effects determination for indirect effects of EPTC to the CRLF via effects on fish and amphibians as prey items is **likely to adversely affect.**

5.2.2.4 Terrestrial Invertebrates

When the terrestrial-phase CRLF reaches juvenile and adult stages, its diet is mainly composed of terrestrial invertebrates. The most sensitive honey bee acute contact LD_{50} > 12.09 µg a.i./bee, which is equivalent to >94 ppm. At this level, the mortality rate was about 6%. For risk characterization purposes, it is worthwhile to compare the T-REX model estimated residues on small and large insects to this toxicity endpoint. As shown in Table 3.9, predicted residues of EPTC on small insects are estimated to be 238 to 2009 ppm, which all exceed 94 ppm, the level at which there was about 6% mortality in the honey bee toxicity test. For large insects, the predicted residues range from 26 to 223 ppm.

There is a relatively high level of uncertainty regarding the potential risk to terrestrial invertebrates due to the lack of a definitive acute toxicity threshold (LD_{50} > 12.09 µg a.i./bee) combined with the comparatively high EPTC residues on insects as predicted by the T-REX model. As a result, risk cannot be precluded at this time, and the final effects determination regarding indirect effects of EPTC to the terrestrial-phase CRLF via reduction in terrestrial invertebrate prey is **likely to adversely affect**.

5.2.2.5 Mammals

Life history data for terrestrial-phase CRLFs indicate that large adult frogs consume terrestrial vertebrates, including mice. As stated previously, both the acute dose-based and chronic dose- and dietary-based RQs exceed the acute and/or chronic LOC for all modeled scenarios for spray uses of EPTC (see Table 5.6). The acute RQs for forestry, ornamental, potato, sweet potato and some of the dried bean uses exceed the non-listed acute LOC of 0.5. The acute RQs for all of the remaining uses are greater than 0.1 but less than 0.5. For granular applications of EPTC, none of the LD_{50}/ft^2 calculations exceeded LOC (0.1); risk to mammals as a result of granular applications of EPTC is presumed to be negligible.

For spray formulations of EPTC, the potential for indirect effects to the terrestrial-phase CRLF that consume small mammals can be evaluated by estimating the potential magnitude of effects to the food item. Table 5.13 summarizes the probability of mortality to the mammalian prey base using available data on the most sensitive mammalian species. A default slope of 4.5 (2 - 9) was assumed. Acute mammalian RQs for small mammals eating short grass range from 0.13 (castor beans) to 1.06 (forestry and ornamental use). Based on the default slope of 4.5, the estimated probability of an individual effect to small mammals would be range from less than 1% (castor beans) to 55% (forestry/ornamental). Assuming a slope of 2, the probability could be as high as 59% for forestry/ornamental uses. Based on an LOC of 0.5 and assuming a slope of 4.5 (2 - 9), the individual effect probability is 1 in 11 (1 in 297 to 1 in 4).

Table 5.13 Summary of Probability of Indirect Effects to the Terrestrial-phase CRLF via Direct Effects on Small Mammals as Prey (spray application)		
Use Application rate (lb ai/A) # Applications/interval (days)	**Acute RQ**	**Probability of an Effect (Slope Confidence Interval)**
Forestry/ornamental 14.88 Single application	**1.06**	1 in 1.83 (1 in 1.92 - 1 in 1.69)
Potato 6.13 2 applications (30)	**0.68**	1 in 4.43 (1 in 15.2– 1 in 2.71)
Sweet potato 7.44 Single application	**0.53**	1 in 9.32 (1 in 153 – 1 in 3.44)
Alfalfa, Broccoli, Cabbage, Carrot, Cauliflower, Corn, Cotton, Citrus, Lettuce, Potato, Sugar beet 6.13 Single application	**0.44**	1 in 18.4 (1 in 1500– 1 in 4.2)
Alfalfa 3.06 3 applications/40	**0.36**	1 in 43.6 (1 in 3.07E+04 – 1 in 5.34)
Almonds, Snap beans, Citrus, Potato, Safflower, Tomato, Walnut 3.06 Single application	**0.22**	1 in 648 (1 in 6.14E+08 – 1 in 10.6)
Castor beans 1.76 Single application	**0.13**	1 in 2.99E+04 (1 in 1.31E+15 - 1 in 26.2)

* = LOC exceedances (acute RQ $\geq$ 0.1 and chronic RQ $\geq$ 1) are bolded and shaded.
[1] Based on dose-based EEC and EPTC rat NOAEL = 10 mg/kg-bw.
[2] Based on dietary-based EEC and EPTC rat NOAEC = 200 mg/kg-diet.
[3] Based on dose-based EEC and EPTC rat acute oral LD_{50} = 1465 mg/kg-bw.
[4] The T-REX model does not estimate exposure for two different application rates. Therefore, in those instances, the upper and lower application rates were modeled separately and the RQ's were provided as a range.

The chronic RQs for mammals range from 2 to 155. In order for the chronic RQ not to exceed the chronic mammalian LOC, the application rate would have to decrease to a single application of 0.8 lb a.i./A/ year. For 2 applications with a 30-day application interval and 3 applications with a 40-day interval, the application rate would have to be decreased to 0.06 lb a.i./A/year.

EPTC has been shown to be absorbed and excreted very quickly in small mammals, thereby decreasing the body burden within 24 hours. In a rat metabolism study (MRID 00142896), 6 rats per sex were intubated with a single dose of 121-150 mg/kg [propyl-1-^{14}C] EPTC. The excretion pattern was determined for 1, 3, or 7 days. EPTC was rapidly absorbed and excreted: the urine of males and females contained 81 and 88% of the administered radiolabel, respectively, within 24 hours. The feces and expired air were minor excretion routes, each containing ≤ 3.2% of the radioactivity over 96 hours. Absorption was estimated to be 86.7-97.5% of the administered dose for the two sexes. The mass balance accounting for the 1, 3, and 7-day experiments was acceptable: radioactivity from the expired air, urine, feces, and cage wash accounted for 90.1, 99.6, and 88.8% of the given dose, respectively (for males and females combined; there were no notable gender-related differences).

Despite the fact that EPTC appears to be excreted rapidly by mammals, acute and chronic risks cannot be precluded at this time. Thus, the effects determination is **likely to adversely affect** based on indirect effects to the terrestrial phase CRLF via reduction in small mammal prey items that are exposed to EPTC via spray application.

5.2.2.6 Terrestrial-phase Amphibians

Terrestrial-phase adult CRLFs also consume frogs. RQ values representing direct exposures of EPTC to terrestrial-phase CRLFs are used to represent exposures of EPTC to frogs in terrestrial habitats. As discussed in Section 5.2.1.2, EPTC is likely to adversely affect the terrestrial-phase CRLF indirectly via effects on terrestrial-phase amphibian prey.

5.2.3 Indirect Effects (via Habitat Effects)

5.2.3.1 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 CRLFs.

Potential indirect effects to the CRLF 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 monitoring 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 monitoring data.

Based on the potential tailwater aquatic exposures associated with the EPTC 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)), the final effect determination for indirect effects (via habitat effects) to the aquatic phase CRLF is **likely to adversely affect**.

5.2.3.2 Terrestrial Plants

Terrestrial plants serve several important habitat-related functions for the CRLF. In addition to providing habitat and cover for invertebrate and vertebrate prey items of the CRLF, terrestrial vegetation also provides shelter for the CRLF and cover from predators while foraging. Upland vegetation including grassland and woodlands provides cover during dispersal. Riparian vegetation helps to maintain the integrity of aquatic systems by providing bank and thermal stability, serving as a buffer to filter out sediment, nutrients, and contaminants before they reach the watershed, and serving as an energy source.

Loss, destruction, and alteration of habitat were identified as a threat to the CRLF in the USFWS Recovery Plan (USFWS, 2002). 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 in) all or a substantial amount of the vegetation, thus removing or impacting structures which define the habitat, and reducing the functions (*e.g.*, cover, food supply for prey base) provided by the vegetation.

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 protein synthesis. Riparian vegetation typically consists of three tiers of vegetation, which include a groundcover of grasses and forbs, an understory of shrubs and young trees, and an overstory of mature trees. Frogs spend a considerable amount of time resting and feeding in riparian vegetation; the moisture and cover of the riparian plant community provides good foraging habitat, and may facilitate dispersal in addition to providing pools and backwater aquatic areas for breeding (USFWS, 2002). According to Hayes and Jennings (1988), the CRLF tends to occupy water bodies with dense riparian vegetation including willows (*Salix* sp.). Upland habitat includes grassland and woodlands, as well as scrub/shrub habitat. No guideline data are available on the toxicity of EPTC to woody plants. However, as EPTC is labeled for use around woody species including citrus, tree nuts, forestry and ornamental uses. Therefore, toxicity to established woody plants is not expected.

As shown in **Tables 5.7 and 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 (forestry use), the plant LOC would be narrowly exceeded for terrestrial plants in semi-aquatic areas.

In summary, 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 habitat:

- 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 habitat 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 potentially 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. 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. However, established woody plants may not be sensitive to environmentally relevant EPTC concentrations; therefore, 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 a mixture of both non-sensitive woody (trees and shrubs) and sensitive grassy herbaceous vegetation, CRLFs may be indirectly affected by adverse effects to herbaceous vegetation which provides habitat and cover for the CRLF and its prey. Therefore, the effects determination for this assessment endpoint is **likely to adversely affect** for all assessed EPTC use patterns.

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 CRLF and terrestrial plants, the portion of the action area that is relevant to the CRLF 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 5.14**. 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 5.14 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
Forestry/ornamental 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

5.2.4 Modification to Designated Critical Habitat

5.2.4.1 Aquatic-Phase PCEs

Three of the four assessment endpoints for the aquatic-phase primary constituent elements (PCEs) of designated critical habitat for the CRLF are related to 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 CRLFs.
- Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.
- Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae).

The effects determinations for indirect effects to the CRLF via direct effects to aquatic and terrestrial plants are used to determine whether modification to critical habitat may occur. Since terrestrial plant RQs exceed the LOC for all EPTC use scenarios EPTC, the final effects determination for these PCEs is **habitat modification**. For the third aquatic-phase PCE, the effects determination is **habitat modification** for uses on alfalfa, almonds, beans (dried, snap), grapefruit, lemon, orange, potato (white/Irish), safflower, sugar beet, tangerine, and walnut (English/black) since based on the available tailwater monitoring data, the non-vascular plant would exceed the LOC.

The remaining aquatic-phase PCE is "alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source." Based on the potential tailwater aquatic exposures associated with the EPTC 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)), the final effects determination for this PCE is **habitat modification**.

5.2.4.2 Terrestrial-Phase PCEs

Two of the four assessment endpoints for the terrestrial-phase PCEs of designated critical habitat for the CRLF are related to potential effects to terrestrial plants:

- Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or drip line surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance.

- Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal.

As stated in Section 5.2.3.2, the terrestrial plant RQs exceed the LOC for monocots and dicots inhabiting dry and semi-aquatic areas exposed to EPTC via runoff and drift for all uses. Thus, the final effect determination for these two PCEs is **habitat modification**.

The third terrestrial-phase PCE is "reduction and/or modification of food sources for terrestrial phase juveniles and adults." To assess the impact of EPTC on this PCE, acute and chronic toxicity endpoints for terrestrial invertebrates, mammals, and terrestrial-phase frogs are used as measures of effects. As suggested in Sections 5.2.2.4 – 5.2.2.6, the final effect determination for this PCE is **habitat modification**.

The fourth terrestrial-phase PCE is based on alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source. As suggested in Sections 5.2.2.4 – 5.2.2.6, the final effect determination for this PCE is **habitat modification**.

5.2.5 Action Area

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 all eight of the CRLF Recovery Units.

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. For example, the action area is defined as the entire state of California since EPTC is a known mutagen (Section 2.7). On the other hand, based on potential indirect effects to the CRLF via impacts to terrestrial plants, the action area is defined as extending up to 610 feet from the site of application (Section 5.2.3.2).

In order to determine the extent of the action area in lotic (flowing) aquatic habitats, the greatest ratio of the RQ to the LOC for any endpoint for aquatic organisms for each use category is used to determine the distance downstream for concentrations to be diluted below levels that would be of concern (*i.e*. result in RQs less than the LOC). For this assessment, this applies to the RQ for direct acute effects to the CRLF based on tailwater exposure monitoring data. The ratio is 2.8 (RQ/LOC = 0.14/0.05). (The ratio for freshwater invertebrates is higher (RQ/LOC = 0.30/0.05); however, it was not used in the downstream dilution analysis because the final effects determination is <u>not likely to adversely affect</u>). The total stream kilometers within the action area that are estimated to be at levels of concern is 46 km (see Appendix K for further discussion).

6. Uncertainties

6.1 Exposure Assessment Uncertainties

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, aquatic-phase CRLFs may inhabit water bodies of different size and depth and/or are located adjacent to larger or smaller drainage areas than 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 CRLF. CRLFs prefer habitat with perennial (present year-round) or near-perennial water and do not frequently inhabit vernal (temporary) pools because conditions in these habitats are generally not suitable (Hayes and Jennings 1988). Therefore, the EXAMS pond is assumed to be representative of exposure to aquatic-phase CRLFs. 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 monitoring 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 monitoring 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 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).

6.1.4 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.

6.1.5 Terrestrial Exposure Modeling of EPTC

The Agency relies on the work of Fletcher et al. (1994) for setting the assumed pesticide residues in wildlife dietary items. These residue assumptions are believed to reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify. It is important to note that the field measurement efforts used to develop the Fletcher estimates of exposure involve highly varied sampling techniques. It is entirely possible that much of these data reflect residues averaged over entire above ground plants in the case of grass and forage sampling.

It was assumed that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food intake estimates, it does not allow for gross energy differences. Direct comparison of a laboratory dietary concentration- based effects threshold to a fresh-weight pesticide residue estimate would result in an underestimation of field exposure by food consumption by a factor of 1.25 – 2.5 for most food items.

Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods do not account for a potentially important aspect of food requirements. Depending upon species and dietary matrix, bird assimilation of wild diet energy ranges from 23 – 80%, and mammal's assimilation ranges from 41 – 85% (U.S. Environmental Protection Agency, 1993). If it is assumed that laboratory chow is formulated to maximize assimilative efficiency (e.g., a value of 85%), a potential for underestimation of exposure may exist by assuming that consumption of food in the wild is comparable with consumption during laboratory testing. In the screening process, exposure may be underestimated because metabolic rates are not related to food consumption.

For the terrestrial exposure analysis of this risk assessment, a generic bird or mammal was assumed to occupy either the treated field or adjacent areas receiving a treatment rate on the field. Actual habitat requirements of any particular terrestrial species were not considered, and it was assumed that species occupy, exclusively and permanently, the modeled treatment area. Spray drift model predictions suggest that this assumption leads to an overestimation of exposure to species that do not occupy the treated field exclusively and permanently.

EPTC is highly volatile. Exposure via inhalation is likely; however, models are not available to predict inhalation exposure following application and incorporation into the soil. However, the (oral and dietary) LOCs for terrestrial species are already exceeded for spray applications of EPTC. Additional inhalation exposure would further increase the presumed risk to the CRLF.

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 Deposition

As discussed above, EPTC and has been detected in air and precipitation samples in California. Estimates of exposure of the CRLF, 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 CRLF and its prey 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) only the acute RQ for freshwater invertebrates would narrowly exceed the acute endangered species 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 birds, mammals, terrestrial invertebrates, and terrestrial plants; atmospheric deposition of EPTC would further increase terrestrial exposures and risk.

6.2 Effects Assessment Uncertainties

6.2.1 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 as measures of effect for surrogate aquatic animals, and is therefore, considered as protective of the CRLF.

6.2.2 Use of Surrogate Species Effects Data

Guideline toxicity tests and open literature data on EPTC are not available for frogs or any other aquatic-phase amphibian; therefore, freshwater fish are used as surrogate species for aquatic-phase amphibians. Endpoints based on freshwater fish ecotoxicity data are assumed to be protective of potential direct effects to aquatic-phase amphibians including the CRLF, and extrapolation of the risk conclusions from the most sensitive tested species to the aquatic-phase CRLF is likely to overestimate the potential risks to those species. 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.

6.2.3 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 the purposes of defining the action area.

6.2.4 Location of Wildlife Species

For the terrestrial exposure analysis of this risk assessment, a generic bird or mammal was assumed to occupy either the treated field or adjacent areas receiving a treatment rate on the field. Actual habitat requirements of any particular terrestrial species were not considered, and it was assumed that species occupy, exclusively and permanently, the modeled treatment area. Spray drift model predictions suggest that this assumption leads to an overestimation of exposure to species that do not occupy the treated field exclusively and permanently.

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 CRLF and its designated critical habitat.

Based on the best available information, the Agency makes a Likely to Adversely Affect determination for the CRLF from the use of EPTC. Additionally, the Agency has determined that there is the potential for modification of CRLF designated critical habitat from the use of the chemical. A summary of the risk conclusions and effects determinations for the CRLF and its critical habitat, given the uncertainties discussed in Section 6, is presented in Tables 7.1 and 7.2.

Table 7.1 Effects Determination Summary for Direct and Indirect Effects of EPTC on the CRLF		
Assessment Endpoint	**Effects Determination[1]**	**Basis for Determination**
Aquatic-Phase CRLF (Eggs, Larvae, and Adults)		
Direct Effects: Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	LAA	Using fish toxicity data as a surrogate for the aquatic-phase CRLF and modeled EECs, acute RQs do not exceed LOC; however, available monitoring 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.
Indirect Effects: Survival, growth, and reproduction of CRLF individuals via effects to food supply (*i.e.*, freshwater invertebrates, non-vascular plants, fish, and frogs)	Freshwater invertebrates: NLAA	RQs do not exceed the acute or chronic LOC using modeled aquatic exposure estimates. Acute RQ calculated using tailwater monitoring data exceeds LOC; however, there is a very low probability of individual acute effects. Chronic RQ based on the tailwater monitoring data (estimated 21-day concentration based on 1.65 day half-life) would be well below the LOC (1.0).
	Non-vascular aquatic plants: LAA	RQs do not exceed the aquatic plant LOC using modeled aquatic exposure estimates. However, available monitoring 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)).
	Fish and frogs: LAA	Using fish toxicity data as a surrogate for the aquatic-phase CRLF, acute RQs do not exceed LOC using modeled aquatic exposure estimates. However, available monitoring 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 toxicity data; risk cannot be precluded.
Indirect Effects: Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, and/or primary productivity (i.e., aquatic plant community)	Non-vascular aquatic plants: LAA	RQs do not exceed the aquatic plant LOC using modeled aquatic exposure estimates. However, available monitoring 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: NE	RQs do not exceed the aquatic plant LOC using modeled aquatic exposure estimates or available tailwater monitoring data.
Indirect Effects: Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	LAA	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.

Table 7.1 Effects Determination Summary for Direct and Indirect Effects of EPTC on the CRLF

Assessment Endpoint	Effects Determination[1]	Basis for Determination
	Terrestrial-Phase CRLF (Juveniles and adults)	
Direct Effects: Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	LAA	Avian toxicity data were used as a surrogate. Dose-based acute LD_{50} not definitive (i.e., LD_{50} > highest dose tested); due to 20% mortality at highest dose, RQs could exceed the acute avian LOC for all uses. Probability of effect is high. T-HERPS indicates potential LOC exceedance for highest application rate (forestry/ornamental uses). Subacute dietary acute RQs do not exceed LOC. Chronic RQs exceed the LOC for all EPTC uses except castor beans.
Indirect Effects: Survival, growth, and reproduction of CRLF individuals via effects on prey (*i.e.*, terrestrial invertebrates, small terrestrial vertebrates, including mammals and terrestrial phase amphibians)	Terrestrial invertebrates: LAA	Most sensitive honey bee LD_{50} data not definitive (mortality rate at highest dose tested 6%). RQs estimated using these data all exceed the terrestrial invertebrate LOC of 0.05 with values as high as 430 times LOC. Probability on individual effects at LOC is low; however, probability at highest RQ is 1 in 1.
	Mammals: LAA	Acute and chronic RQs exceed the LOC.
	Frogs: LAA	See basis under terrestrial phase direct effects.
Indirect Effects: Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (*i.e.*, riparian vegetation)	LAA	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.

[1] NE = no effect; NLAA = may affect, but not likely to adversely affect; LAA = likely to adversely affect

Table 7.2 Effects Determination Summary for the Critical Habitat Impact Analysis		
Assessment Endpoint	**Effects Determination[1]**	**Basis for Determination**
Aquatic-Phase CRLF PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)		
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 CRLFs.	HM	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.
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.[21]	HM	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.
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	HM	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.
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.,* algae)	HM	Aquatic plant RQs do not exceed the LOC using modeled aquatic exposure estimates. However, available monitoring 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)).
Terrestrial-Phase CRLF PCEs (Upland Habitat and Dispersal Habitat)		
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	HM	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.
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	HM	
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	HM	Weight of the evidence of acute risk to birds and chronic RQs for birds and acute and chronic RQs for mammals exceed the LOCs.
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	HM	Weight of the evidence of acute risk to birds and chronic RQs for birds and acute and chronic RQs for mammals exceed the LOCs.
[1] NE = No effect; HM = Habitat Modification		

[21] Physico-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.

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 CRLF life stages within specific recovery units and/or designated critical habitat within the action area. 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 species.
- Quantitative information on prey base requirements for individual aquatic- and terrestrial-phase frogs. While existing information provides a preliminary picture of the types of food sources utilized by the frog, 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 frogs and potential modification to critical habitat.

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