Risks of Methomyl Use to the Federally Listed California Red-Legged Frog (*Rana aurora draytonii*)

Pesticide Effects Determination

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Washington, D.C. 20460

July 20, 2007

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1. Executive Summary

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).

Methomyl is used throughout the United States on a variety of agricultural (including orchards) and commercial non-agricultural use sites (there are no registered residential uses for methomyl). Although the action area is likely to encompass a large area of the United States, the scope of this assessment limits consideration of the overall action area to those portions that are applicable to the protection of the CRLF and its designated critical habitat. As such, the action area in this assessment is focused on the State of California. The initial area of concern for methomyl is limited to potential methomyl use sites in the state of CA. The initial area of concern represents the "footprint" where methomyl could potentially be used based on land cover information. The initial area of concern is then expanded as necessary based on the potential for environmental effects based on toxicity data from the most sensitive terrestrial and aquatic taxa and the fate and transport characteristics of the pesticide. The portion of the action area relevant to this assessment encompasses all known core areas and designated critical habitat of the CRLF.

In accordance with the methodology specified in the Agency's Overview Document (U.S. EPA, 2004), screening-level EECs, based on the PRZM/EXAMS static water body scenario and the Kenaga nomogram (T-REX), were used to derive risk quotients (RQs) for all relevant agricultural and orchard methomyl uses in CA. The assessment endpoints for the CRLF included direct toxic effects on survival, reproduction, and growth of individual frogs, as well as indirect effects and/or modification of habitat related to a reduction of potential prey items. Risk quotients (RQs) for direct effects to aquatic-phase CRLF were calculated using acute toxicity data for freshwater fish, which serve as a surrogate for aquatic-phase amphibians when adequate amphibian data are not available. RQs for direct effects to terrestrial-phase CRLF were calculated using toxicity data for birds, which serve as a surrogate for terrestrial-phase amphibians when adequate amphibian data are not available. To assess potential indirect effects to the CRLF via adverse effects to potential prey (and consequently a reduction of available food items), toxicity data for freshwater fish and invertebrates as well as birds and mammals were considered. Based on uses, incident data, and the results of efficacy studies, methomyl is not expected to adversely affect plants, and because there are no degradates of toxicological concern for methomyl, only the parent compound was assessed.

Adverse modifications to the primary constituent elements (PCE) of designated critical habitat, as defined in 50 CFR 414.12(b), were also evaluated. PCEs evaluated as part of this assessment focused on a reduction or change in community structure of potential prey items for the CRLF.

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 methomyl use has the potential to adversely affect the CRLF or adversely modify its designated critical habitat. When RQs for a particular type of effect are below LOCs, there is "no effect" to the CRLF. Where RQs exceed LOCs, a potential to cause adverse effects or habitat modification is identified, leading to a conclusion of "may affect". If methomyl use "may affect" the CRLF, and/or cause adverse modification to designated critical habitat, the best available information and data are considered to refine the potential for exposure and effects, and distinguish actions that are 'not likely to adversely affect' from those that are 'likely to adversely affect'.

For methomyl use in CA, we make a 'may affect' determination based on the potential for adverse effects to aquatic- and terrestrial-phase CRLF, freshwater fish, freshwater invertebrates, terrestrial invertebrates, birds, and mammals. Therefore, we refined our assessment by considering usage data; the chance of individual effects to relevant taxa (*i.e.*, probit dose-response analyses); species sensitivity distributions for relevant taxa (when possible); and refined exposure estimates. Effects determinations for direct/indirect effects to the CRLF and the critical habitat impact analysis are summarized in **Table 1**.

Table 1. Effects Determination Summary for Methomyl Use and the CRLF.

Assessment Endpoint	Effects Determination	Basis for Determination
Survival, growth, and reproduction of CRLF via direct effects	May affect and likely to adversely affect (LAA)	RQs for both aquatic-phase and terrestrial-phase CRLF exceed acute and chronic endangered species LOCs for several uses. ***Aquatic-phase***: - The uses that exceed the chronic and/or acute LOCs for freshwater fish (used as a surrogate for aquatic-phase CRLF) account for 97% of the lbs of methomyl applied on average per year in CA. - Methomyl applications are made during times of year when aquatic-phase CRLF are likely to be present (based on methomyl usage data and CRLF life history information). - RQs exceed the acute LOC after a single application of methomyl at a rate likely to be used on orchards and agricultural crops (based on usage data). - Chances of individual effects range from ~ 1 in 6.6 (cole crops) to ~ 1 in 7.48E+16 (mint). - Based on a species sensitivity distribution for freshwater fish (which serve as surrogates for amphibians), amphibians with sensitivities even at the 95th percentile exceed the endangered species acute LOC. - Many of the CRLF core areas are adjacent to and/or overlap with potential methomyl use sites. ***Terrestrial-phase***: - RQs exceed the acute LOC after a single application of methomyl at a rate likely to be used on orchards and agricultural crops (based on usage data). - Chances of individual effects range from ~ 1 in 1 (dose-based RQ, 238 g frog eating a herbivorous mammal) to ~ 1 in 8.86E+18 (dietary-based RQ, frog eating a frog). - Many of the CRLF core areas are adjacent to or overlap with potential methomyl use sites.
Indirect effects to the CRLF via reduction of prey (*i.e.*, freshwater invertebrates, fish, terrestrial invertebrates, mammals, and frogs)	May affect and likely to adversely affect (LAA)	RQs for all prey taxa for the aquatic-phase and terrestrial-phase CRLF exceed acute and chronic LOCs for several uses. ***Aquatic prey items***: - Based on the exposure and effects analyses and the chance of individual effects, CRLF adjacent to agricultural and orchard use sites have the potential to be indirectly affected by methomyl due to a loss of potential aquatic prey items, especially aquatic invertebrates. ***Terrestrial prey items***: - Based on the exposure and effects analyses and the chance of individual effects, CRLF adjacent to agricultural and orchard use sites have the potential to be indirectly affected by methomyl due to a loss of potential terrestrial prey items, especially terrestrial invertebrates. The potential loss of prey in affected areas could result in mortality through direct starvation or reduced survival and reproductive rates caused by food stress and/or reduced body size during vulnerable stages in their life-cycle. The likelihood of these effects lessens with distance from the site of application. However, since the potential adverse effects to many of the potential prey taxa extend well beyond the use site (even after one application of 0.9 lb a.i./acre to an agricultural or orchard use site), and all of the CRLF core areas and incident occurrences are adjacent to or overlap with potential methomyl use sites, the Agency makes a Likely to Adversely Affect determination for indirect effects to the CRLF based on the potential loss of food resources associated with methomyl use in CA.

Adverse modification of the CRLFs designated critical habitat based on the potential loss of food resources	Habitat modification	For methomyl use, the assessment endpoints for designated critical habitat PCEs involve a potential reduction and/or modification of food sources necessary for normal growth and viability of aquatic-phase CRLFs, and a potential reduction and/or modification of food sources for terrestrial phase juveniles and adults. Since, all of the designated critical habitat for the CRLF is directly adjacent to or overlap with potential methomyl uses sites in CA, the Agency's effects determination as it relates to the potential for adversely modifying the designated critical habitat of the CRLF is the same as for the effects determination for indirect effect to the CRLF (see above).

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 adverse 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 methomyl on variety of sites including field, vegetable, and orchard crops; turf (sod farms only); livestock quarters; commercial premises; and refuse containers. In addition, this assessment evaluates whether these actions can be expected to result in the destruction or adverse modification of the species' critical habitat. Key biological information for the CRLF is included in Section 2.5, and designated critical habitat information for the species is provided in Section 2.6 of this assessment. This ecological risk assessment has been prepared as part of the *Center for Biological Diversity (CBD) vs. EPA et al*. (Case No. 02-1580-JSW(JL)) settlement entered in the Federal District Court for the Northern District of California on October 20, 2006.

In this endangered species assessment, direct and indirect effects to the CRLF and potential adverse modification to its critical habitat are evaluated in accordance with the methods (both screening level and species-specific refinements, when appropriate) described in the Agency's Overview Document (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 methomyl are based on an action area. The action area is considered to be the area directly or indirectly affected by the federal action, as indicated by the exceedance of Agency Levels of Concern (LOCs) used to evaluate direct or indirect effects. It is acknowledged that the action area for a national-level FIFRA regulatory decision associated with a use of methomyl 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 for registration of methomyl at the use sites described in this document to affect CRLF individuals and/or result in the destruction or adverse modification of designated CRLF critical habitat:

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

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 (Section 2.6).

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 the FIFRA regulatory action regarding methomyl as it relates to this species and its designated critical habitat. If, however, direct or indirect effects to individual CRLFs are anticipated and/or effects may impact the PCEs of the CRLFs designated critical habitat, a preliminary "may affect" determination is made for the FIFRA regulatory action regarding methomyl.

If a determination is made that use of methomyl within the action area(s) associated with the CRLF "may affect" this species and/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 methomyl use sites) and further evaluation of the potential impact of methomyl on the PCEs is also used to determine whether destruction or adverse modification to 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 and/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 methomyl is expected to directly impact living organisms within the action area (defined in Section 2.7), critical habitat analysis for methomyl 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 destroy or adversely modify critical habitat are those that alter the PCEs and appreciably diminish the value of the habitat. Evaluation of actions related to use of methomyl 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

Methomyl is an insecticide currently registered for use on a wide variety of sites including field, vegetable, and orchard crops; turf (sod farms only); livestock quarters; commercial premises; and refuse containers. Estimates of methomyl usage indicate that it is used extensively on sweet corn, lettuce, cotton, and alfalfa (these uses represent 50% of methomyl-use in the United States). All uses are agricultural, industrial, or commercial; there are no residential uses for methomyl. It is recognized that methomyl is used in many parts of the U.S., however, the scope of this assessment limits consideration of the areas of use that may be applicable to the protection of the CRLF and its designated critical habitat within the state of California.

Methomyl is formulated mainly as soluble concentrates, but also includes granular, pelleted/tableted, and bait/solid formulations. Application methods for the agricultural uses of methomyl include aircraft (fixed-wing and helicopter), high and low volume ground sprayer, ultra low volume sprayer, and granule application. Although all potential uses are assessed, risks from ground boom and aerial applications are focused on in this assessment because they are expected to result in the highest off-target concentrations of methomyl. Runoff associated with large rainfall events is expected to be responsible for the greatest off-target movement of methomyl.

The end result of the EPA pesticide registration process (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 methomyl in accordance with the approved product labels for California is "the action" being assessed.

Although current registrations of methomyl allow for use nationwide, this ecological risk assessment and effects determination addresses currently registered uses of methomyl 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 only non-volatile degradate in the laboratory studies was methomyl oxime (S-methyl-N-hydroxythioacetimidate). It was present at high concentrations in the alkaline hydrolysis study, but was only a minor degradate in the aerobic soil metabolism, anaerobic soil metabolism, photolysis and aerobic aquatic metabolism studies. Since exposure is estimated in a neutral environment (the standard ecological scenario is pH 7) and the oxime degradate is only a minor transformation product from other routes of degradation, it is not included in exposure estimates.

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).

Methomyl has registered products that contain multiple active ingredients. Analysis of the available acute oral mammalian LD_{50} data for multiple active ingredient products relative to the single active ingredient is provided in **APPENDIX A**. The results of this analysis show that an assessment based on the toxicity of the single active ingredient of methomyl is appropriate.

2.3 Previous Assessments

Several ecological risk assessments for methomyl have been completed since it was first registered in 1968. The most encompassing assessment was for the Reregistration Eligibility Decision (RED) process and was completed in 1998 (U.S.EPA 1998b; available via the internet at http://www.epa.gov/oppsrrd1/REDs/0028red.pdf). The current risk assessment builds upon the 1998 risk assessment, which determined that risk quotients (RQ) exceeded risk levels of concern (LOC) for endangered/threatened birds (and, thus, reptiles and terrestrial-phase amphibians), mammals, and aquatic vertebrates (and, thus, aquatic-phase amphibians) and invertebrates.

Subsequent to the RED, the registrant submitted several studies including, but not limited to, two predatory mite studies (MRID 451255-01, 451255-02); two aphid studies (MRID 451333-01, 451333-02); two earthworm studies (MRID 454592-01, 449693-01); and an acute oral and contact honey bee study (MRID 450930-01). These studies have been reviewed and are incorporated into the current risk assessment because of their potential relevance for assessing risks to amphibians. The current assessment also builds on the previous RED by incorporating open literature (from the ECOTOX search engine) and assessing indirect effects, including those effects caused by the potential loss of food items (*e.g.*, terrestrial and aquatic invertebrates).

On April 1, 2003, EPA initiated formal consultation with the National Marine Fisheries Service relative to an effects determination regarding methomyl's potential effects to 26 Environmentally Significant Units (ESUs) of Pacific salmon and steelhead. That assessment concluded that use of methomyl would have no effect on two ESU's based on lack of use in proximity to waters supporting these two ESUs and that methomyl was Likely to Adversely Affect 24 ESUs both directly and indirectly based on effects to aquatic invertebrate prey base. That assessment noted that current labels of methomyl products required the product not be applied within 25 feet of water bodies for ground application and within 100 to 450 feet of water bodies for aerial applications, but that methodology at the time did not permit a quantitative assessment of the potential reduction in exposure resulting from these buffers.

2.4 Stressor Source and Distribution

2.4.1 Environmental Fate and Transport Assessment

As noted in the 1998 RED, methomyl is moderately persistent and mobile in soil. Methomyl is less persistent in aqueous environments. It is stable to hydrolysis at lower pHs (neutral to acidic), but it degrades slowly in alkaline conditions ($t_{1/2}$ = 30 days). Methomyl degradation

appears to be dependent on microbially-mediated (aerobic soil metabolism - $t_{1/2}$ = 10.5 - 45 d; anaerobic soil metabolism - $t_{1/2}$ = 14 days; aerobic aquatic metabolism - $t_{1/2}$ = 3.5-4.5 d) and abiotic processes (photodegradation in water - $t_{1/2}$ = 1 d). Under anaerobic conditions methomyl degradation is likely to be faster than under aerobic conditions (Smelt *et al.*, 1983), particularly in the presence of reduced iron (Bromilow *et al.*, 1986). In laboratory studies, methomyl does not readily adsorb to soil and has the potential to be mobile (mean K_{oc} = 24 mL/g_{oc}). **Table 2** summarizes the fate and physical-chemical properties of methomyl based on information from the registrants.

Field dissipation studies (MRIDs 00008844, 00009324, 416239-01, 422880-01) show varying dissipation rates of the chemical is soils (DT_{50} from 4 to 54 days). Dissipation rates were related primarily to differences in soil moisture content, which may affect the microbial activity, and rainfall/irrigation, which could influence leaching. Methomyl was detected as deep as 8 – 15 cm at two sites and as deep as 30 cm in two additional sites.

Major degradates include methomyl oxime (S-methyl-N-hydroxythioacetimidate) detected at a maximum of 44% in the alkaline hydrolysis study; acetonitrile detected at a maximum of 66%, 40% and 27% in the aqueous photolysis, soil photolysis and aerobic aquatic metabolism studies, respectively; acetamide detected at 14% in the aerobic aquatic metabolism study; and CO_2 detected at 22.5-75% in the aerobic soil, anaerobic soil, and aquatic metabolism studies. The only non-volatile degradate in the laboratory studies was methomyl oxime (S-methyl-N-hydroxythioacetimidate). It was present at high concentrations in the alkaline hydrolysis study, but was only a minor degradate in the aerobic soil metabolism, anaerobic soil metabolism, photolysis and aerobic aquatic metabolism studies.

Table 2. Summary of Environmental Chemistry, Fate and Transport Properties of Methomyl.

PARAMETER	VALUE				REFERENCE/ COMMENTS
Selected Physical/Chemical Parameters					
PC code	090301				
CAS No.	16752-77-5				
Chemical name	(S-methyl N-((methylcarbamoyl)oxy) thioacetimidate				
Chemical formula	$C_5H_{10}N_2O_2S$				
Molecular weight	162.2 g/mol				
Water solubility (20 °C)	58000 mg/L				Product chemistry
Vapor pressure	5×10^{-5} torr				Product chemistry
Henry's law constant (atm-m^3/mol)	1.8×10^{-10}				Calculated
K_{OW}	1.29 – 1.33				U.S. EPA 1998b
Persistence					
Hydrolysis	pH 5: stable pH 7: stable pH 9: 30 d				MRID 00131249
Photolysis in water	$t_{1/2}$ = 1 d				MRID 0161885 Clear water, near surface
Photolysis in soil	$t_{1/2}$ = 34 d				MRID 00163745
Aerobic soil metabolism	**Soil texture**	**DT_{50} observed**	**$t_{1/2}$ calculated**		MRID 00008568, 43217901
	Loam	8-14 d	10.5 d		
	Silt loam	30-45 d	45 d		
Anaerobic soil metabolism	Loam soil: 14 d (static), 7 d (flowing)				MRID 432179-02
Aerobic aquatic metabolism	$t_{1/2}$ = 3.5, 4.5 d				MRID 433254-01
Anaerobic aquatic metabolism	No data				
Mobility					
Batch equilibrium	**Soil Texture**	**K_f[1]**	**1/N**	**K_{oc}[2]**	MRID 00161884
	Sandy loam	0.72	0.86	34	
	Silt loam	1.0	0.86	23	
	Silt	1.4	0.86	19	
	Sandy loam	0.23	0.90	21	
Field Dissipation					
Terrestrial field dissipation	Dissipation $t_{1/2}$ from soil surface: 4-54 d				MRIDs 00008844, 00009324, 00009326, 416239-01, 416239-02

PARAMETER	VALUE	REFERENCE/ COMMENTS
Bioaccumulation		
Accumulation in fish, BCF	No data	Bioaccumulation is not expected based on low K_{ow}
1. Units of $(mg/kg)/(mg/L)^{1/N}$, where 1/N is the Freundlich exponent. 2. Approximation calculated from the Freundlich coefficient, per standard EFED guidance.		

Potential transport mechanisms for methomyl include surface water runoff, spray drift, and leaching. Secondary drift (atmospheric transport) of volatilized or soil-bound residues leading to deposition onto nearby or more distant ecosystems is not expected given methomyl's relatively high solubility in water (58 g/L), low vapor pressure (5×10^{-5} torr) and Henry's law constant (1.8×10^{-10} atm-m^3/mol). Air monitoring data reported by the California Department of Pesticide Regulation (CDPR) show that methomyl was not detected in 84 samples in taken 1987 and 20 samples taken in 1989 in Fresno County. The Association of American Pesticide Control Officials (AAPCO) report in the 1999 Pesticide Enforcement Survey (http://aapco.ceris.purdue.edu/doc/surveys/drift99.html) that methomyl is one of the least commonly confirmed active ingredient by state agencies as regards to drift complaints (2,4-D, atrazine, dicamba, paraquat and glyphosate were the most common). However the survey does not provide information on the magnitude of exposure arising from these reports, does not differentiate between drift and volatility, and indicates that the most common confirmation technique is visual examination of drift and residue confirmation.

Air monitoring data collected from the 1960s through the 1980s, and summarized by Majewski and Capel (1995), do not indicate the presence of methomyl in the atmosphere, due in large part to the lack of testing for methomyl. The authors' review a single study which tested for methomyl in ambient air at three residential sites near an agricultural area in Salinas, California which were sampled during a high pesticide use month. Methomyl was not detected at any of the air monitoring sites (the level of detection was 35 nanograms per cubic meter).

In general, deposition of drifting pesticides is expected to be greatest close to the site of application. Computer models of spray drift (AgDRIFT or AGDISP) are used to determine if the exposures to aquatic and terrestrial organisms are below the Agency's Levels of Concern (LOCs). AgDRIFT (version 2.01) utilizes empirical data to estimate off-site deposition of aerial and ground applied pesticides. Details concerning the specifics and uncertainties of AgDRIFT are available online at www.agdrift.com. AGDISP (version 8.15) predicts the motion of spray material released from aircraft, including the mean position of the material and the position variance about the mean as a result of turbulent fluctuations.

If the limit of exposure that is below the LOC can be determined using AgDRIFT or AGDISP, longer-range transport is not considered in defining the action area. For example, if a buffer zone <1,000 feet (the optimal range for AgDRIFT) results in terrestrial and aquatic exposures that are below LOCs, no further drift analysis is required. If exposures exceeding LOCs are expected beyond the standard modeling range of AgDRIFT or AGDISP, the Gaussian extension feature of AGDISP may be used.

2.4.2 Mechanism of Action

Based on its chemical structure, methomyl belongs to the oxime carbamate class of insecticides. A number of other insecticides included in this chemical class, such as aldicarb, butocarboxin, and oxamyl are very similar in structure to methomyl.

Carbamate insecticides act by inhibiting acetylcholinesterase and reducing the degradation of the neurotransmitter acetylcholine. As a result, intersynaptic concentrations of acetylcholine increase as the neurotransmitter accumulates leading to increased firing of the postsynaptic neurons. This may ultimately lead to convulsions, paralysis, and death of the organism exposed to the chemical.

2.4.3 Use Characterization

Analysis of labeled use information is the critical first step in evaluating the federal action. The current labels for methomyl represent the FIFRA regulatory action; therefore, labeled uses and application rates specified on the labels 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.

Seven end-use products containing methomyl are currently registered for use in the U.S. (see **Table 3**). Two of the end-use products are labelled as 'restricted use' chemicals (Lannate® LV and Lannate® SP), indicating that only licensed pesticide applicators are legally allowed to apply the product. None of the scatter bait/bait station end-use products are labelled as 'restricted use' chemicals. Methomyl is registered for use on a wide variety of sites including field, vegetable, and orchard crops; turf (sod farms only); livestock quarters; commercial premises; and refuse containers. Low volume aerial applications (a minimum of 1 gallon of tank mixture/acre) are allowed in CA for a variety of non-orchard agricultural uses (see **APPENDIX B**). For the purposes of this assessment 'agricultural uses' refer to all field and vegetable crops and sod farms. Orchard uses are analyzed separately from other agricultural uses because of their different use patterns.

For agricultural and orchard uses, the maximum *single* application rate allowed on the labels is 0.9 lb active ingredient (a.i.)/acre, which is the most common single maximum application rate for all agricultural uses (see **APPENDIX B** for a complete list of registered uses and application rates).

Maximum *seasonal* labeled application rates (indicated on the label as maximum application rates per *crop*) for agricultural uses range from 0.9 lb a.i./acre/crop [*i.e.*, Bermuda grass (pasture), avocado, lentils, beans (interplanted with trees), sorghum, and soybeans (interplanted with trees)] to 7.2 lbs a.i./acre/crop [*i.e.*, cabbage, lettuce (head), cauliflower, broccoli raab, celery, and Chinese cabbage].

Several methomyl crops can be grown more than one time per year in CA (*i.e.,* they have multiple crop cycles). Therefore, for those methomyl uses that have more than one crop cycle per year, the maximum allowable *yearly* application rate will be higher than the maximum

seasonal application rate. For perennial crops (*e.g.*, alfalfa), the number of cuttings per year was used to determine the number of crop cycles per year. Based on the labeled application rates and information from EPA's Office of Pesticide Programs' Benefits and Economic Analysis Division (BEAD) on the number of times each crop for which methomyl is registered for use can be grown in CA (see **APPENDIX B**), the maximum yearly application rates for methomyl are 32.4 lb a.i./acre/year (alfalfa) and 21.6 lb a.i./acre/year (broccoli raab, cabbage, and Chinese cabbage) for agricultural crops; 5.4 lb a.i./acre/year (peaches) for orchards; and 0.22 lb a.i./acre/application for non-agricultural uses (no maximum application/acre/year is provided on the non-agricultural use labels).

All orchard and most agricultural uses involve foliar application. The only granular agricultural/orchard use is for corn (which also has a foliar use). Since the maximum seasonal application rate for methomyl use on corn is the same for the foliar and granular formulations, no spray drift is expected for granular use, and information regarding the formulation for methomyl use in CA is not available, we will only evaluate foliar applications for corn in this assessment.

All non-agricultural and non-orchard outside uses for methomyl in CA are limited to scatter baits and bait stations around agricultural (*e.g.*, animal premises) and commercial structures and commercial dumpsters, where children or animals are not likely to contact the pesticide. The scatter bait can also be mixed with water to form a paste which can be brushed onto walls, window sills, and support beams. Since the bait station use involves placing the pesticide within the bait station and hanging the bait station at least four feet off the ground (as stipulated on the labels), no spray drift or runoff is expected from this use. No off-site exposure via spray drift is expected from the scatter bait uses since it is granular (or a paste), however, there is potential for off-site exposure via runoff from scatter bait uses. The maximum application rate for the scatter bait use is 0.22 lb a.i./acre (0.0025 lb a.i./500 ft^2). It is unlikely that applications would involve a full acre, however, since the outside use of the scatter bait is limited to areas around structures and dumpsters. No minimum application interval or maximum application rate per year is provided on the scatter bait labels.

Table 3. Currently Registered Methomyl End-Use Products.

FORMULATION	EPA REG. NO.	% ACTIVE	METHODS OF APPLICATION	USE RESTRICTIONS
LANNATE SP (There are 15 SLNs. 7 are for CA) CA770308 CA770431 CA770495 CA780136 CA860059 CA900034 CA910011	352-342	90% by weight	Ground Aerial	- Do not apply through any type of irrigation system - Do not apply by ground equipment within 25 ft, or by air within 100 feet of lakes, reservoirs, rivers, estuaries, commercial fish ponds, and natural, permanent streams, marshes, or ponds (increase buffer to 450 ft with ultra low volume application). - Use only in commercial and farm plantings (not for home plantings or for U-Pick operations). - Use of hand held application equipment is prohibited.
LANNATE LV (There are 3 SLNs. None are for CA)	352-384	29% by weight (2.4 lb ai/gallon)	Ground Aerial Chemigation	- Overhead sprinkler chemigation is allowed for alfalfa, barley, succulent and dried beans, oats, onion, succulent peas, potatoes, rye, sweet corn (not in CA), sugar beets, and wheat. Drip chemigation is allowed for onions. Refer to supplemental, or Special Local Need (SLN) label or crop specific sections of this label for direction for chemigation. Do not apply this product through any other type of irrigation systems, except those allowed by instructions provided in supplemental, SLN or this product label. - Do not apply by ground equipment within 25 ft, or by air within 100 feet of lakes, reservoirs, rivers, estuaries, commercial fish ponds, and natural, permanent streams, marshes, or ponds (increase buffer to 450 ft with ultra low volume application). - Use only in commercial and farm plantings (not for home plantings or for U-Pick operations). - Use of hand held application equipment is prohibited.
FARNAM® DIE FLY	270-255	1%	Scatter bait Bait station	- Not to be used inside or around homes, or any other place where children or pets are likely to be present. - Place scatterbait in areas inaccessible to livestock. Keep children and pets out of treated
STIMUKIL® FLY BAIT	53871-3	1%	Scatter bait Bait station Brush on paste	
LURECTRON® SCATTERBAIT	7319-6	1%	Scatter bait Bait station	

FORMULATION	EPA REG. NO.	% ACTIVE	METHODS OF APPLICATION	USE RESTRICTIONS
			Paste	areas. Do not place scatterbait around commercial dumpsters that are not enclosed. - Bait stations should be at least 4' above ground and in areas not accessible to children, pets, and livestock. - Brush paste on outside of structures so that it is inaccessible to children, pets, and livestock.
GOLDEN MALRIN® RF-128 FLY KILLER	2724-274	1.1%	Scatter bait Bait station	
METHOMYL® 5G GRANULES (granular)	57242-2	5%	Ground, banded application	- Do not apply within 25 ft of lakes, reservoirs, rivers, estuaries, commercial fishponds, and natural, permanent streams, marshes or natural, permanent ponds. - Not for use in home plantings or U-Pick operations.

Of all of the registered uses of methomyl (excluding non-CA Special Local Needs [SLN] registrations), the following uses are excluded from our assessment because they are not registered for use in or applicable to CA:

- peanuts (not grown in CA)
- pears (methomyl is registered for use on pears in the Northeastern U.S. only)
- pecans (methomyl is registered for use on pecans in the Southeastern U.S. only)
- tobacco (not grown in CA).

Methomyl use on strawberries has been voluntarily cancelled by the registrant (DuPont). The strawberry use, however, has not yet been removed from methomyl labels at this time. Therefore, the strawberry use will be included in this assessment. We mapped the potential agricultural and non-agricultural use sites in CA for the remaining registered uses (see **Fig. 1**).

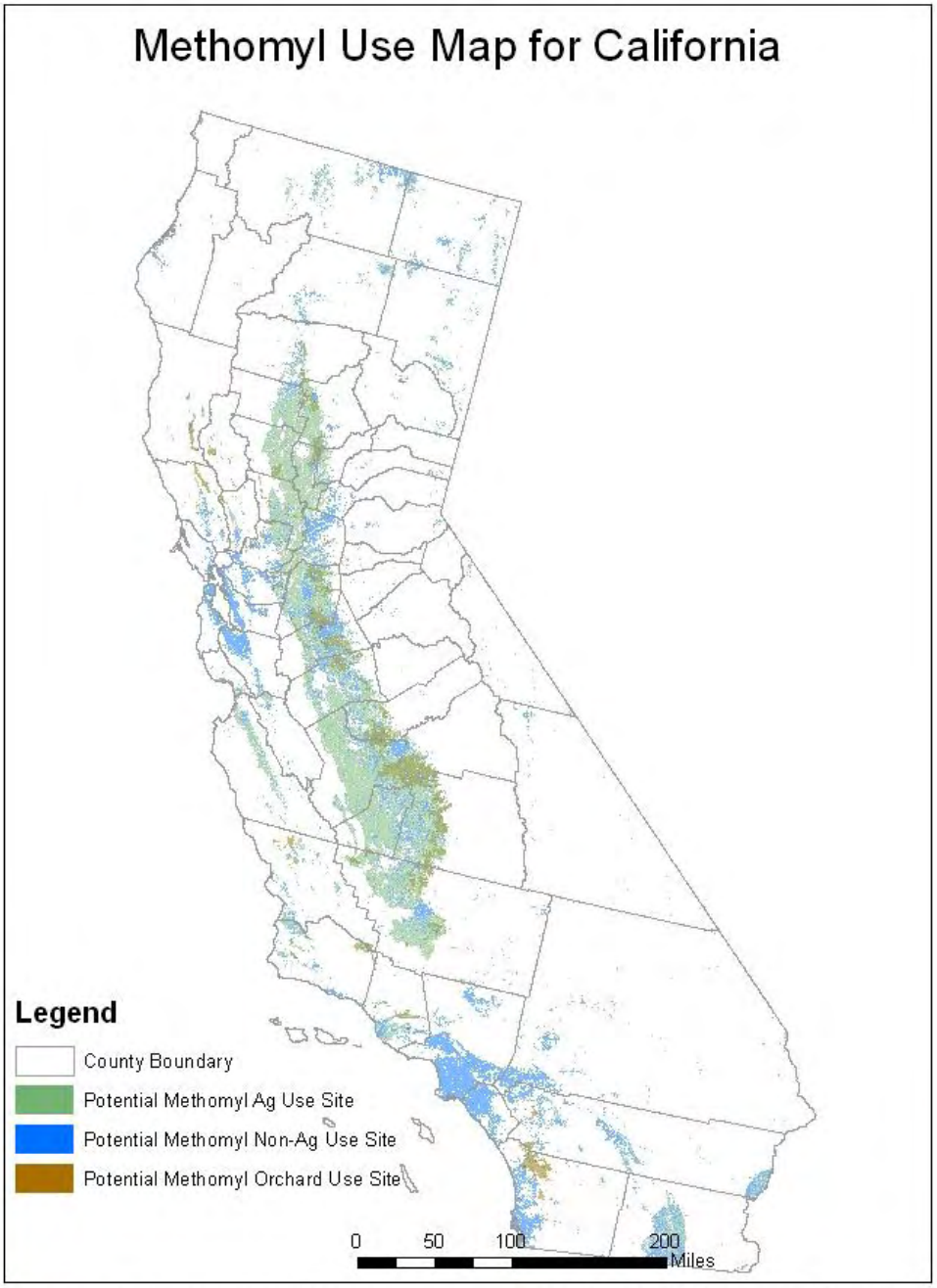


Figure 1. Map of Potential Methomyl Use Sites in CA.

The Agency's Biological and Economic Analysis Division (BEAD) provides an analysis of both national- and county-level usage information using state-level usage data obtained from US Department of Agriculture-National Agricultural Statistics Survey[1] (USDA-NASS), Doane (www.doane.com; the full dataset is not provided due to its proprietary nature), and the California Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database[2]. CDPR PUR is considered a more comprehensive source of usage data than USDA-NASS or EPA proprietary databases, and thus the usage data reported for methomyl 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 and crop for methomyl, 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. The summary of methomyl usage for all use sites, including both agricultural, orchard, and non-agricultural, is provided in **APPENDIX C**.

The uses considered in this risk assessment represent all currently registered uses according to a review of all current labels. No other uses are relevant to this assessment. Any reported use, such as may be seen in the CDPR PUR database, represent either historic uses that have been canceled, mis-reported uses, or mis-use. Historical uses, mis-reported uses, and misuse are not considered part of the federal action and, therefore, are not considered in this assessment.

In California, based on usage data provided by BEAD, an average of 320,255 lbs [range = 264,201 lbs (2004) – 371,855 lbs (2003)] of methomyl was applied to an average of 543,710 acres [range = 437,600 acres (2004) – 615,773 acres (2003)] per year from 2002-2005. During the last 4 years in CA, methomyl was used in a total of 47 counties involving 107 different uses, as listed in the CDPR PUR data (see **APPENDIX C**). Five counties account for 70% of the total lbs of methomyl applied on average per year [Fresno (26.7%), Monterey (16.7%), Imperial (13.5%), Merced (8%), and Kern (5%)] (see **Fig. 2**), and seven crops account for approximately 75% of the total lbs applied per year in CA on average [lettuce (head and leaf) (19.7%), alfalfa (14.5%), corn (12.4%), tomatoes (including tomatillos) (10.2%), grapes (6.3%), beets (including sugar beets) (6%), and strawberries (5.7%)]. Approximately 91% of the average lbs of methomyl applied per year in California is used on row crops, field crops, and nurseries; approximately 9% is used on orchards and vineyards; and only 0.009% (*i.e.*, 29 lb a.i./year) of the yearly average of lbs of methomyl applied in CA per year involves non-agricultural and non-orchard uses (*i.e.*, those uses that might involve the scatter bait and bait station formulations).

[1] 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.

[2] 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.

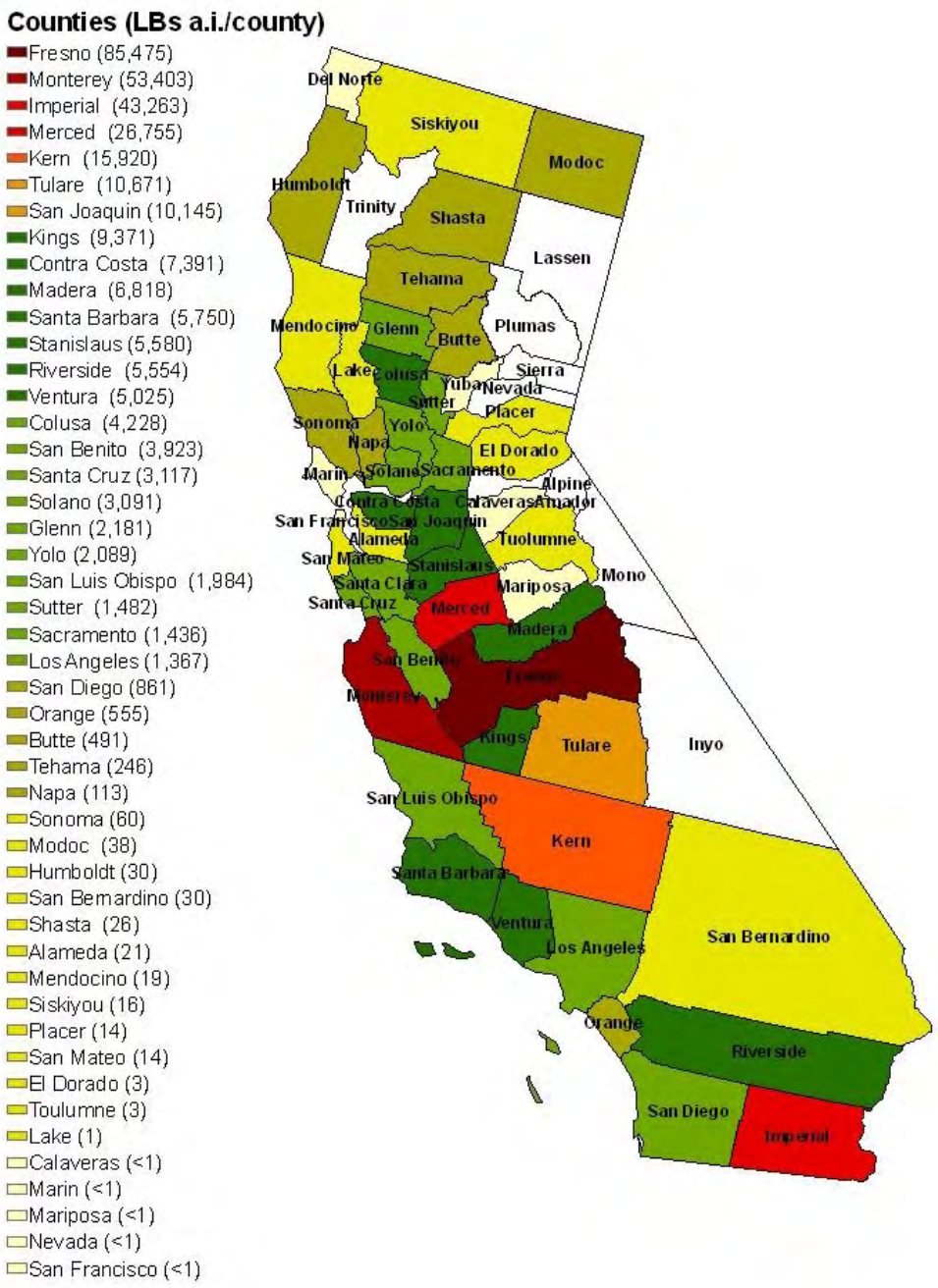


Figure 2. Average Pounds of Methomyl Applied Per Year Per CA County from 2002-2005.

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 Mountains (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).

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 **Fig. 3**). 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.

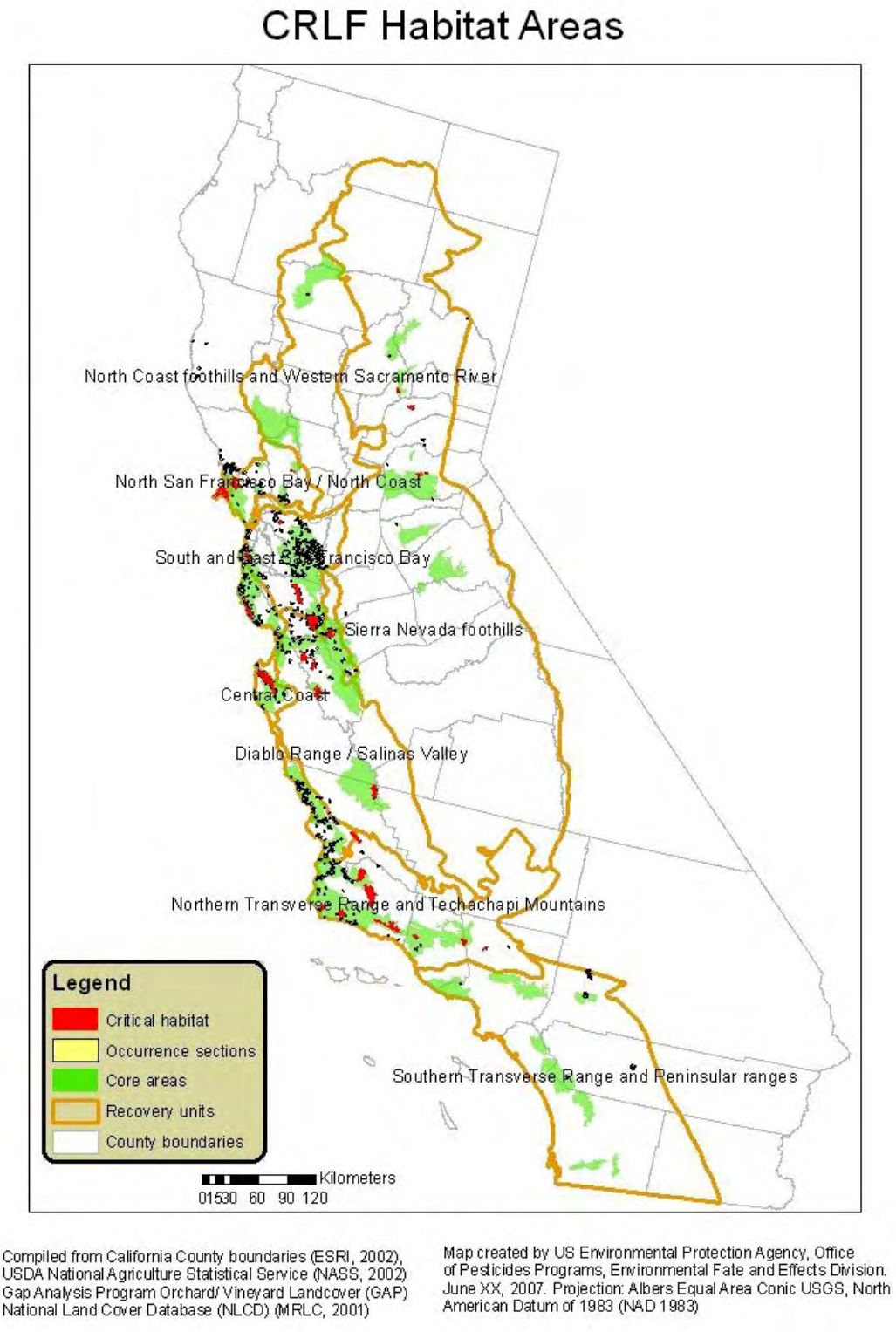


Figure 3. Distribution of the CRLF Range and Designated Critical Habitat.

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 **APPENDIX D** and shown in **Figure 3.**

Core Areas

USFWS has designated 35 core areas across the eight recovery units to focus their recovery efforts for the CRLF (see **Fig. 3**). 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. Each type of locational information is evaluated within the broader context of recovery units. For example, if no labeled uses of methomyl occur (or if labeled uses occur at predicted exposures less than the Agency's LOCs) within an entire recovery unit, a "no effect" determination would be made for all designated critical habitat, currently occupied core areas, and other known CNDDB occurrences within that recovery unit. 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 **APPENDIX D**. 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.

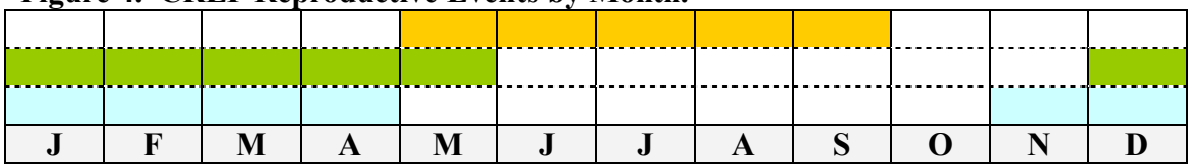
Other Known Occurrences from the CNDBB

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 4** depicts CRLF annual reproductive timing.

Figure 4. 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 **APPENDIX D**.

'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.

Please note that a more complete 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 methomyl 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 methomyl is expected to directly impact living organisms within the action area, critical habitat analysis for methomyl 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 methomyl is likely to encompass considerable portions of the United States based on the large

array of agricultural and non-agricultural uses. However, the scope of this assessment limits consideration of the overall action area to those portions that may be applicable to the protection of the CRLF and its designated critical habitat within the State of California. Deriving the geographical extent of this portion of the action area is the product of consideration of the types of effects that methomyl may be expected to have on the environment, the exposure levels to methomyl that are associated with those effects, and the best available information concerning the use of methomyl and its fate and transport within the 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 methomyl. An analysis of labeled uses and review of available product labels was completed. This analysis indicates that, for methomyl, the following uses are considered as part of the federal action evaluated in this assessment (**Table 4**):

Table 4. Summary of the Uses Considered as Part of the Federal Action Evaluated in This Assesment.

USE CATEGORY	USES
Agricultural	Alfalfa, anise, asparagus, barley, beans (succulent and dry), beets, Bermuda grass (pasture), blueberries, broccoli, broccoli raab, Brussels sprouts, cabbage, carrot, cauliflower, celery, chicory, Chinese broccoli, Chinese cabbage, collards (fresh market), corn, corn (sweet), corn (field and popcorn), corn (seed), cotton, cucumber, eggplant, endive, garlic, horseradish, leafy green vegetables, lentils, lettuce (head and leaf), lupine, melons, mint, nonbearing nursery stock (field grown), oats, onions (dry and green), peas, peppers, potato, pumpkin, radishes, rye, sorghum, soybeans, spinach, strawberry, sugar beet, summer squash, sweet potato, tomatillo, tomato, turf (sod farms only), wheat
Orchard	Apple, avocado, grapes, grapefruit, lemon, nectarines, oranges, peaches, pomegranates, tangelo, tangerine
Non-Agricultural*	Bakeries, beverage plants, broiler houses, canneries, commercial dumpsters which are enclosed, commercial use sites (unspecified), commissaries, dairies, dumpsters, fast food establishments, feedlots, food processing establishments, hog houses, kennel, livestock barns, meat processing establishments, poultry houses, poultry processing establishments, restaurants, supermarkets, stables, warehouses

* These refer to non-crop uses; all uses are outside uses and involve scatter bait/bait station formulations.

After a determination of which uses will be assessed, an evaluation of the locations of potential use sites that will be assessed should be determined. The potential use sites represent the initial area of concern and is typically based on available land cover data. Local land cover data available for the state of California were analyzed to refine the understanding of potential methomyl use. The initial area of concern is defined as all land cover types that represent the labeled uses described above. Therefore, a map representing all the land cover types that make up the initial area of concern is the same as the map which shows all potential methomyl use sites in CA (see **Fig. 1,** in Section 2.4.3).

Once the initial area of concern is defined, the next step is to compare the extent of that area with the results of the baseline risk assessment. The baseline risk assessment will define which taxa, if any, are predicted to be exposed at concentrations above the Agency's Levels of Concern (LOC). The baseline assessment includes an evaluation of the environmental fate properties of methomyl to determine which routes of transport are likely to have an impact on the CRLF. The exposure routes for methomyl most likely to affect non-target organisms are spray drift and runoff. To determine the action area for this assessment, the terrestrial and aquatic portions of the action area in CA are determined separately and then are combined to produce a final action area.

2.7.1 Terrestrial Portion of the action Area

For the terrestrial portion of the action area, the acute endangered species LOC and the LC_{50} of 0.00022 lb a.i./acre (see Section 4, below) for terrestrial invertebrates (the most sensitive terrestrial organism, of those tested, to methomyl) are used to establish a boundary around a treatment site beyond which potential effects to terrestrial invertebrates from methomyl use in CA are not expected.

Since spray drift is the most likely means through which non-target terrestrial organisms will be potentially exposed to methomyl, the AGDISP model (version 8.13) is used to estimate the terrestrial distance from the site of application where RQs are predicted to fall below the endangered species LOC. Separate 'boundaries' are calculated for the different methomyl use categories (*i.e.*, agricultural uses, non-agricultural uses, and orchard uses). The highest maximum application rates allowed on the label for any agricultural use and any orchard use were selected to model the maximum potential off-site estimated environmental concentrations (EECs) based on upper bound Kenaga values for the agricultural and orchard use sites, respectively.

The maximum single application rate for both agricultural and orchard uses is 0.9 lb a.i./acre. The highest seasonal application rate for an orchard use is 5.4 lbs a.i./acre/crop for peaches (6 applications at 0.9 lb a.i./acre/application with a 5-day reapplication interval). The highest seasonal application rate for an agricultural use is 7.2 lbs a.i./acre/crop for a variety of uses (*e.g.*, head lettuce; 8 applications at 0.9 lb a.i./acre/application with a 2-day application interval). Some agricultural uses have more than one crop cycle in CA per year (*e.g.*, alfalfa), and have a higher allowable maximum *yearly* application rate than the uses with the highest seasonal application rates. To determine the agricultural use pattern(s) that resulted in the highest terrestrial EECs, several application scenarios were modeled using T-REX (see **APPENDIX E**). Because of the relatively short foliar half life for methomyl of 3 days based on total residues (Willis and McDowell, 1987), the maximum *seasonal* rates produced the highest acute EECs in T-REX, and, therefore, are used to determine the action area (for more information on T-REX, see Section 3.1.2.1 below). Since the non-agricultural uses are limited to scatter baits and bait stations, spray drift is not expected for non-agricultural uses.

Based on the LC_{50} for the most sensitive terrestrial organism – the parasitic wasp (*Aphidius rhopalosiphi*) (0.00022 lb a.i./acre) and the maximum single application rate for methomyl (0.9 lb a.i./acre), the RQ for terrestrial invertebrates, for both agricultural and orchard uses, is 4,090 (*i.e.*, 0.9/0.00022) for a single application. However, because the toxicity endpoint of 0.00022 lb a.i./acre for the wasp does not account for multiple applications, we estimated the peak concentration on the field (in lbs a.i./acre) for multiple applications assuming a first order decay rate from the first order rate equation used in T-REX (see **APPENDIX F**). The peak concentrations for the maximum seasonal application rates (with multiple applications) associated with peaches and head lettuce (and other agricultural uses with similar application rates) are 1.31 and 2.37 lbs a.i./acre, respectively. Therefore, the terrestrial invertebrate RQ for the maximum seasonal application rate for peach orchards equals 5,955 (1.31/0.00022). The RQ for terrestrial invertebrates for the maximum seasonal application rate for lettuce equals 10,773 (2.37/0.00022).

Using these RQs and the endangered species LOC of 0.05, AGDISP is used to model how far out from the site of application environmental effects from methomyl use are possible from potential spray drift for orchards and agricultural use sites. Aerial applications are modeled since spray drift is expected to travel further with aerial applications than with ground applications because of the higher release heights, and AGDISP cannot currently model spray drift from orchard/airblast applications. Since low volume aerial spraying is allowed for several

agricultural uses, low volume spray is modeled for the agricultural uses but not for the orchard uses (see **APPENDIX F**, for the AGDISP input parameters used). Based on this modeling, potential effects from spray drift from a single application of 0.9 lb a.i./acre could occur 30,009 ft (5.7 miles) for orchard uses and >65,616 ft (>12.4 miles, outside the range for AGDISP) for agricultural uses from the site of methomyl application. Based on multiple applications, this distance extends to 40,774 ft (7.7 miles) for orchard uses and >65,616 ft (>12.4 miles) for agricultural uses.

It is unlikely that the same terrestrial invertebrate would be exposed to the maximum amount of spray drift from every application made. For a terrestrial invertebrate to receive the maximum concentration of methomyl from multiple applications would require that each application is made under identical atmospheric conditions (*e.g.*, same wind speed and same wind direction) and the terrestrial invertebrate being exposed is located in the same location (which receives the maximum amount of spray drift) after each application. Additionally, certain factors, including variations in topography, cover, and meteorological conditions over the transport distance are not accounted for by the AGDISP model (*i.e.*, it models spray drift from aerial and 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 AGDISP will 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.*). Furthermore, conservative assumptions are made regarding the droplet size distributions being modeled ('ASAE Very Fine to Fine' for orchard uses and 'ASAE Very Fine' for agricultural uses), the application method (*i.e.*, aerial), release heights and wind speeds. Alterations in any of these inputs would decrease the area of potential effect. As noted in Section 3, no methomyl was detected in an air monitoring study conducted in CA during a month of high pesticide use. Therefore, it is unlikely that any terrestrial invertebrate more than a few miles from the site of methomyl application would actually receive a level of exposure high enough to cause an adverse effect.

To maintain a level of conservatism in light of these uncertainties, the buffer calculated for the maximum single application rate for orchards (~6 miles) will be used to delineate the terrestrial portion of the action area. Therefore, the terrestrial portion of the methomyl action area for this assessment includes all potential non-agricultural use sites and all areas that are within 6 miles of potential methomyl orchard and agricultural use sites in CA (see **Fig. 5**). Based on this analysis, a total of 22,387 km^2 (79%) of the CRLF range overlaps with the terrestrial portion of the methomyl action area (for more information see **APPENDIX G**).

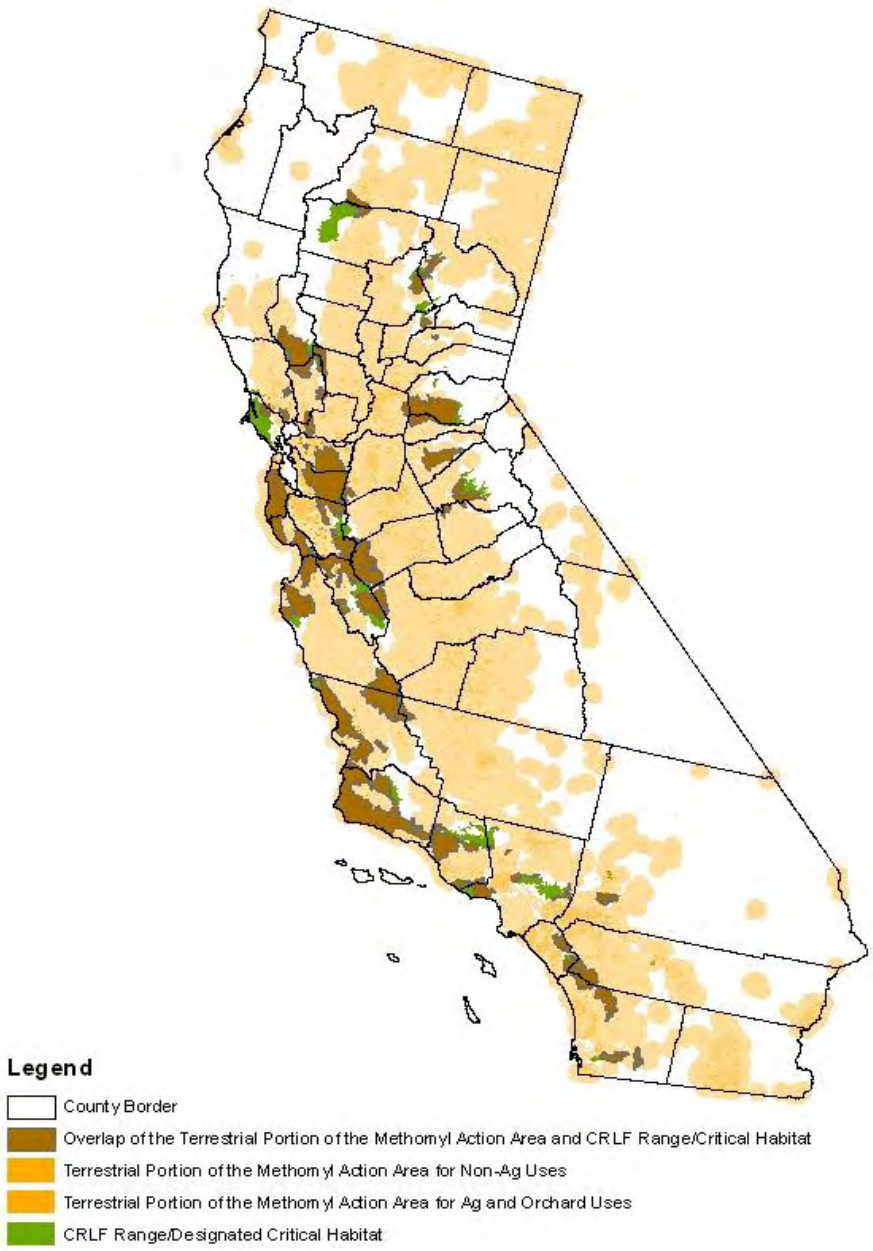


Figure 5. The Terrestrial Portion of the Action Area for Methomyl Use in CA.

2.7.2 Aquatic Portion of the Action Area

For the aquatic portion of the action area being assessed here, all aquatic risk quotients (RQs) will be calculated, and the greatest 'RQ to level of concern (LOC) ratio' of all aquatic organisms (plants and animals) will be selected. For example, if both fish and aquatic plants have the same RQ of 1, the fish RQ to LOC ratio (1/0.05) would be greater than for plants (1/1). This ratio will be used to identify all stream reaches downstream from the initial area of concern where the percent cropped area (PCA) for the land uses identified for the chemical are greater than 1/20 or 5%. All streams identified as draining upstream catchments greater than 5% of the land class of concern, would be considered part of the action area.

For methomyl, the largest RQ to LOC ratio for an aquatic organism was 732 [highest peak aquatic EEC = 183 µg/L (cole crop scenario) (see Section 3.1.1); acute endangered species LOC for aquatic organisms = 0.05; most sensitive EC_{50} = 5 µg a.i./L (*Daphnia magna*) (see Section 4); RQ = 183/5 = 36.6; RQ/LOC = 36.6/0.05 = 732]. Based on this analysis, a total of 93,631 stream km are within the aquatic portion of the action area for methomyl use in CA. Many of these stream miles overlap with the CRLF range and designated critical habitat (see **Fig. 6** and **APPENDIX G**).

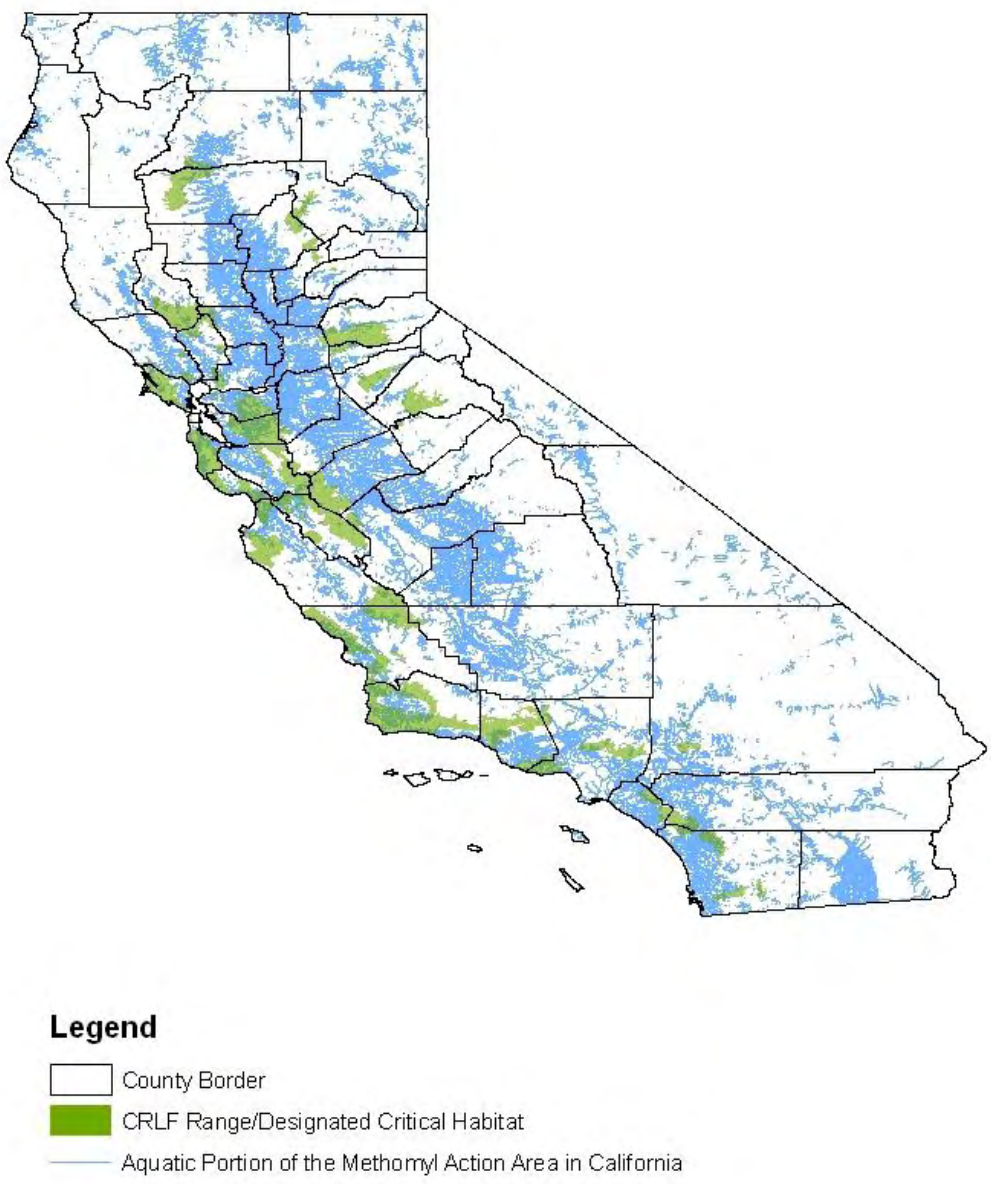


Figure 6. Map of the Aquatic Portion of the Action Area for Methomyl Use in CA.

Therefore, the action area for methomyl use in CA does overlap with the range of the CRLF and its designated critical habitat.

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."[3] 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 methomyl (*e.g.*, runoff, spray drift, *etc.*), and the routes by which ecological receptors are exposed to methomyl-related contamination (*e.g.*, direct contact, *etc.*).

Methomyl has registered products containing multiple active ingredients. The only methomyl products that contain multiple active ingrediants involve the scatter bait/bait station uses (*i.e.*, FARNAM® DIE FLY, STIMUKIL® FLY BAIT, LURECTRON® SCATTERBAIT, GOLDEN MALRIN®, and RF-128 FLY KILLER). These products, their product registration numbers, the active ingredient(s) in the products, and the percentage of each active ingredient in the product are listed in **Table 3** above. As noted in **APPENDIX A**, only one product (EPA Reg. No. 2724-274) has a LD_{50} value and associated confidence interval. When this product's LD_{50} and its associated confidence interval, are adjusted for the percent methomyl (1.1%) the adjusted LD_{50} value of 34.1 mg/kg-bw (CI range of 25.6 to 42 mg/kg) is not statistically distinct from the LD_{50} of methomyl (30 mg/kg-bw; CI range of 23 - 40 mg/kg). Consequently, the acute mammal endpoint from the Technical Grade Active Ingredient (TGAI) will be used in this assessment.

The remaining methomyl formulations only contain a single active ingredient (*i.e.*, methomyl). Available toxicity data for aquatic freshwater animals did not show any significant differences between formulated commercial products and the technical active ingredient. For species in which comparative data are available, the confidence intervals of the toxicity endpoints for freshwater fish and invertebrates exposed to the TGAI and formulated methomyl overlap, indicating that the toxicity of methomyl TGAI and formulated methomyl are very similar, if not the same, for freshwater animals (see **APPENDICES J** and **K**). Toxicity data for birds are only available for the TGAI. For terrestrial invertebrates there were not enough comparative data to determine the relative toxicity between the TGAI and formulated methomyl. Since methomyl is the only active ingredient in the formulated products tested, and the primary route of exposure for terrestrial invertebrates is expected to be deposition via spray drift (see Section 3 below), toxicity data from both the TGAI and formulated methomyl products (from products similar to those currently registered) are appropriate for assessing potential acute risks to terrestrial invertebrates. As a result, the risk analyses were conducted using the most sensitive endpoint determined from toxicity studies using either formulated commercial products, corrected for active ingredient, or technical active ingredient.

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

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 the prey base and/or modification of its habitat. An additional potential indirect endpoint is the integrity of the habitat required to support CRLF based on effects to aquatic and terrestrial plants. Risks to plants, however, will not be quantitatively assessed in this assessment. Aquatic and terrestrial plant toxicity studies and associated risk analysis of aquatic plants are not required for registration of a pesticide unless it meets specific use and pesticide classification criteria (CFR Part 158) which would trigger potential concerns, and no plant studies have been submitted by the registrants. Plant toxicity data are required when there is some indication that there may be significant toxicity to plants. These indicators may be an herbicidal mode of action or statements on the label indicating toxicity to plants. None of these indicators are present for methomyl. Furthermore, methomyl is registered for use on a variety of plants, it has been registered since 1968, and there are no plant incidents reported for methomyl.

Additionally, several efficacy studies that were conducted to test the effects of methomyl on a variety of invertebrate target and non-target pests also supplied information on effects to plants after methomyl applications. Due to a lack of information on study design and data analyses, these efficacy studies are classified as 'supplemental' and are not adequate for plant (or terrestrial invertebrate) RQ calculation, however, they are considered scientifically valid. None of the studies showed any adverse effects to plants at the highest treatment levels tested (most of which were above the maximum allowable single application rate for methomyl) (see **Table 5**). Therefore, the available data based on use patterns, a lack of plant incidents, and a lack of effects to plants in efficacy studies indicate that methomyl will not adversely affect plants to a level that would impact habitat quality for the CRLF. Therefore, the potential risk to plants from methomyl use will not be considered further in this assessment.

Table 5. Measures of Effects to Plants from Methomyl Efficacy Studies that Included Information on Effects to Plants.

PLANT SPECIES	NOAEL	HIGHEST LEVEL TESTED?[1]	EFFECT[2]	ECOTOX NO./REFERENCE
Alfalfa (*Medicago sativa*)	≥0.9 lb a.i./acre	Yes	Growth	88088/Laub *et al*. (1999)
Auberine (*Solanum melongena*)	≥3.6 lb a.i./acre	Yes	Growth Injury	74745/Morale and Kurundkar (1989)
	≥1,000 ppm	Yes	Growth	89394/Sharma *et al*. (1997)
Bean (*Phaseolus vulgaris*)	≥0.9 lb a.i./acre	Yes	Injury	88838/Ghidiu (1988)
Bell pepper (*Capsicum annuum*)	≥946 ml/acre	Yes	Growth	82231/Stansly and Cawley (1993)
	≥0.9 lb a.i./acre	Yes	Growth	82730/Schuster (1994)
	≥0.9 lb a.i./acre	Yes	Biomass	82246/Zehnder and Speese (1992)
Cabbage (*Brassica oleracea*)	≥0.9 lb a.i./acre	Yes	Injury	88084/Edelson *et al*. (1999)
Hybrid strawberry (*Fragaria x ananassa*)	≥0.9 lb a.i./acre	Yes	Photosynthesis	88792/Carson *et al*. (1986)
Lettuce (*Lactuca sativa*)	≥1 lb a.i./acre	Yes	Abundance	82237/Palumbo *et al*. (1991)
Paeony (*Paeonia lactiflora*)	≥20.0 lb a.i./acre	Yes	Abundance	89251/Schmitt *et al*. (1974)
Peach (*Prunus persica*)	≥0.23 lb a.i./100 gallon	Yes	Injury	88091/Hull (1999)
Pigeonpea (*Cajanus cajan*)	≥0.53 lb a.i./acre	Yes	Abundance	82560/Giraddi *et al*. (2002)
Potato (*Solanum tuberosum*)	≥1.0 lb a.i./acre	Yes	Injury	77263/Raman and Palacios (1986)
Tomato (*Lycopersicon* sp.)	≥0.45 lb a.i./acre	Yes	Injury	74169/Walgenbach *et al*. (1991)
	≥0.9 lb a.i./acre	Yes	Injury	88062/Carson *et al*. (1999)
	≥0.9 lb a.i./acre	Yes	Injury	88089/Kund *et al*. (1999)
	≥0.9 lb a.i./acre	Yes	Injury	88089/Kund *et al*. (1999)
	≥0.45 lb a.i./acre	Yes	Injury	88269/Stansly *et al*. (1999)
	≥4.0 lb a.i./acre	Yes	Biomass	89472/McLeod (1972)
Wild celery (*Apium graveolens*)	≥0.9 lb a.i./acre	Yes	Injury	82728/Carson *et al*. (1994)

[1] 'Highest Level Tested' refers to whether the NOAEL represents the highest level tested.
[2] 'Effect' refers to the effect that was measured in the study. Because the NOAELs represent the highest level tested in each study, no adverse effects to plants were observed in any of the studies.

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.

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 methomyl is provided in **Table 6**.

Table 6. Summary of Assessment Endpoints and Measurements of Ecological Effects for Direct and Indirect Effects of Methomyl on the CRLF.

Assessment Endpoint	Measures of Ecological Effects
Aquatic Phase (eggs, larvae, tadpoles, juveniles, and adults)[a]	
1. Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	1a. Most sensitive fish acute LC_{50} (guideline or ECOTOX) 1b. Most sensitive fish chronic NOAEC (guideline or ECOTOX) 1c. Most sensitive fish early-life stage NOAEC (guideline or ECOTOX)
2. Survival, growth, and reproduction of CRLF individuals via effects to food supply (*i.e.,* freshwater invertebrates)	2a. Most sensitive fish and aquatic invertebrate EC_{50} or LC_{50} (guideline or ECOTOX) 2b. Most sensitive aquatic invertebrate and fish chronic NOAEC (guideline or ECOTOX)
Terrestrial Phase (Juveniles and adults)	
3. Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	3a. Most sensitive bird[b] acute LC_{50} or LD_{50} (guideline or ECOTOX) 3b. Most sensitive bird[b] chronic NOAEC (guideline or ECOTOX)
4. Survival, growth, and reproduction of CRLF individuals via effects on prey (*i.e.,*terrestrial invertebrates, small terrestrial vertebrates, including mammals and terrestrial phase amphibians)	4a. Most sensitive terrestrial invertebrate and vertebrate acute EC_{50} or LC_{50} (guideline or ECOTOX)[c] 4b. Most sensitive terrestrial invertebrate and vertebrate chronic NOAEC (guideline or ECOTOX)

[a] 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.
[b] Birds are used as surrogates for terrestrial phase amphibians.
[c] Although the most sensitive toxicity value is initially used to evaluate potential indirect effects, sensitivity distribution is used (if sufficient data are available) to evaluate the potential impact to food items of the CRLF.

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 methomyl 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 destroy or adversely modify critical habitat are those that alter the PCEs. 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 methomyl effects data are available.

Assessment endpoints and measures of ecological effect selected to characterize potential modification to designated critical habitat associated with exposure to methomyl are provided in **Table 7**. Adverse modification to the critical habitat of the CRLF includes the following, as specified by USFWS (2006) and previously discussed in Section 2.6.

Measures of such possible effects by labeled use of methomyl on critical habitat of the CRLF are described in **Table 7**. 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 7. Summary of Assessment Endpoints and Measures of Ecological Effects for Primary Constituent Elements of Designated Critical Habitat.

Assessment Endpoint	Measures of Ecological Effect[4]
Aquatic Phase PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)	
Reduction and/or modification of food sources necessary for normal growth and viability of CRLFs.	a. Most sensitive EC_{50} or LC_{50} values for fish and aquatic invertebrates (guideline or ECOTOX) b. Most sensitive NOAEC values for fish and aquatic invertebrates (guideline or ECOTOX)
Terrestrial Phase PCEs (Upland Habitat and Dispersal Habitat)	
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	a. Most sensitive food source acute EC_{50}/LC_{50} and NOAEC values for terrestrial vertebrates (mammals) and invertebrates, birds, and freshwater fish.

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, 1998a). For this assessment, the risk is stressor-linked, where the stressor is the release of methomyl to the environment. The following risk hypotheses are presumed for this endangered species assessment:

- Labeled uses of methomyl in CA may directly affect the CRLF by causing mortality or by adversely affecting growth or fecundity;
- Labeled uses of methomyl CA may indirectly affect the CRLF by reducing or changing the composition of food supply;
- Labeled uses of methomyl in CA may adversely modify the designated critical habitat of the CRLF by reducing the food supply required 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 stressor (methomyl), release mechanisms, biological receptor types, and effects

[4] All toxicity data reviewed for this assessment are included in Section 4 and APPENDICES I, J, and K.

endpoints of potential concern. The conceptual models for aquatic and terrestrial phases of the CRLF are shown in **Figures 7** and **8**, and the conceptual models for the aquatic and terrestrial PCE components of critical habitat are shown in **Figures 9** and **10**. Exposure routes shown in dashed lines are not quantitatively considered because the resulting exposures are expected to be so low as not to cause adverse effects to the CRLF. The exposure route from groundwater is implicitly accounted for in exposure modeling which relies on the curve number method which is based on stream response (whether overland or subsurface) to a rain event. Our conceptual model assumes the "response" comprises the groundwater and surface water components.

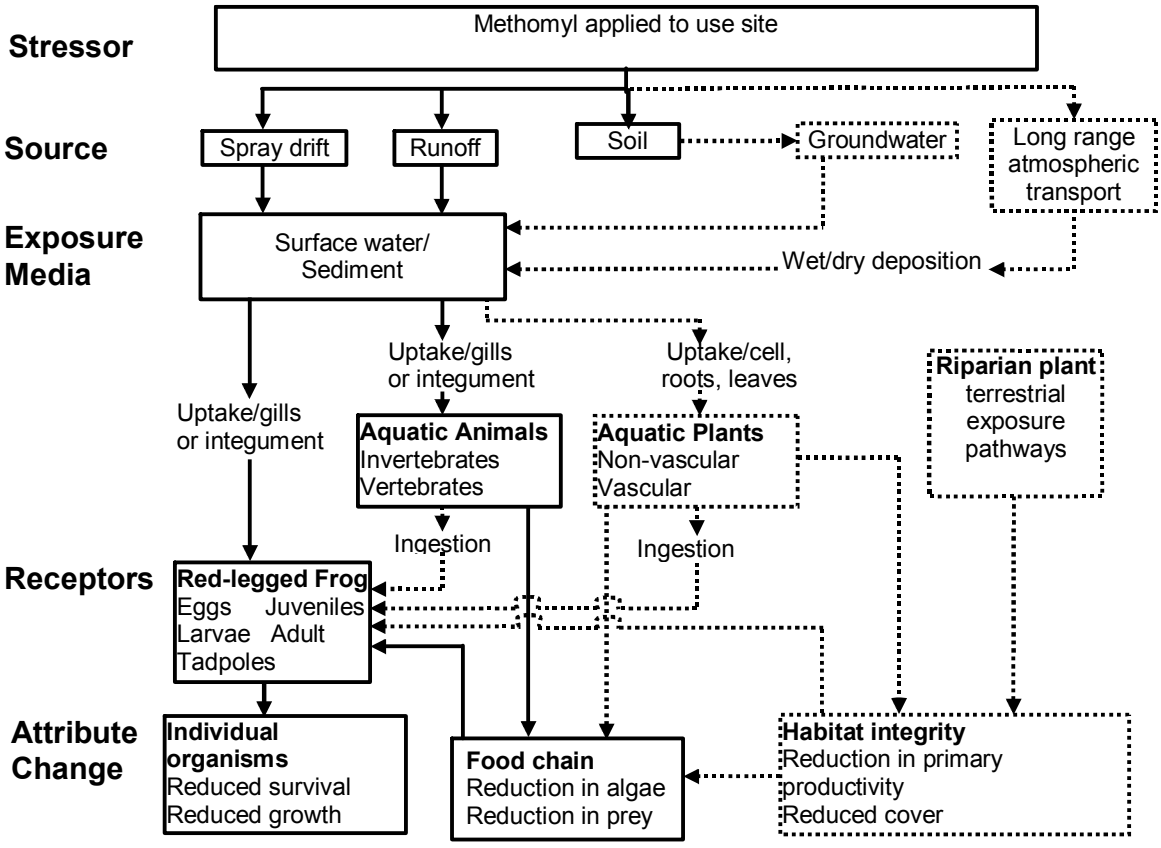


Figure 7. Conceptual Model for Potential Methomyl Effects on Aquatic-Phase CRLF.

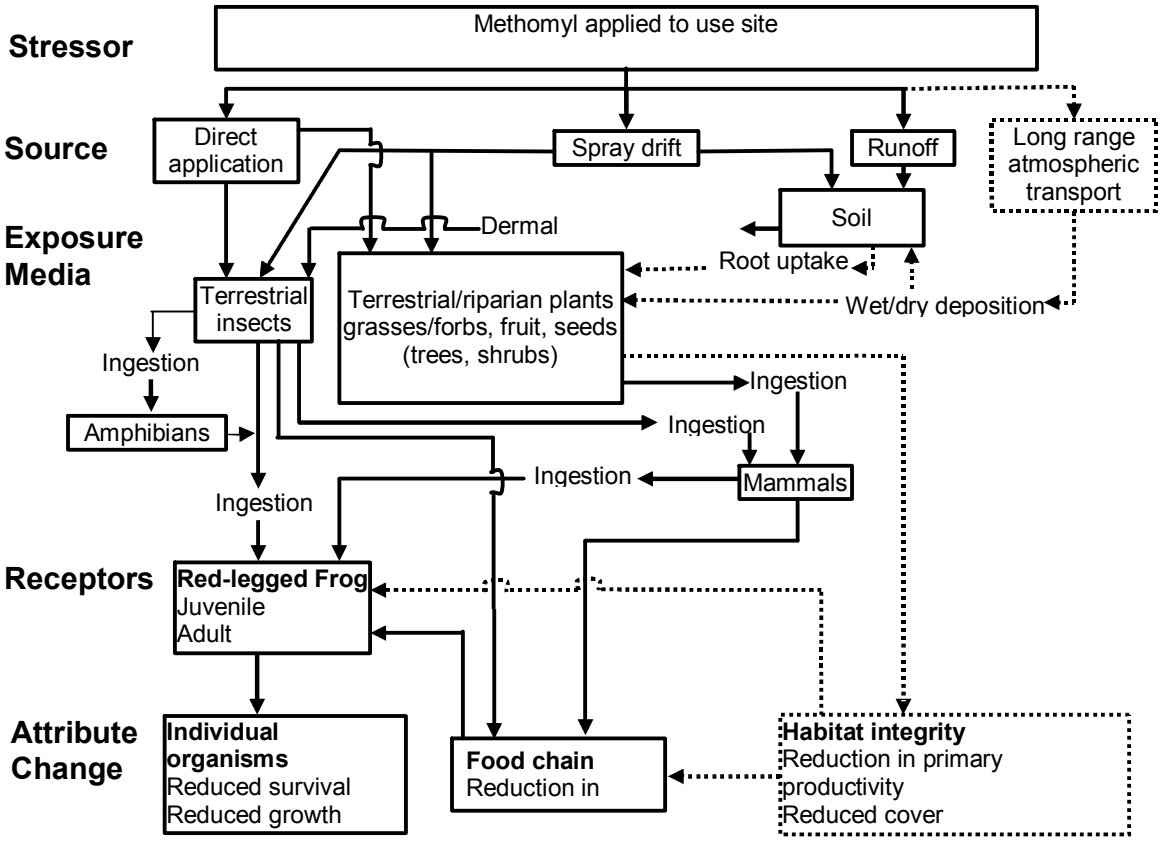


Figure 8. Conceptual Model for Potential Methomyl Effects on Terrestrial-Phase CRLF.

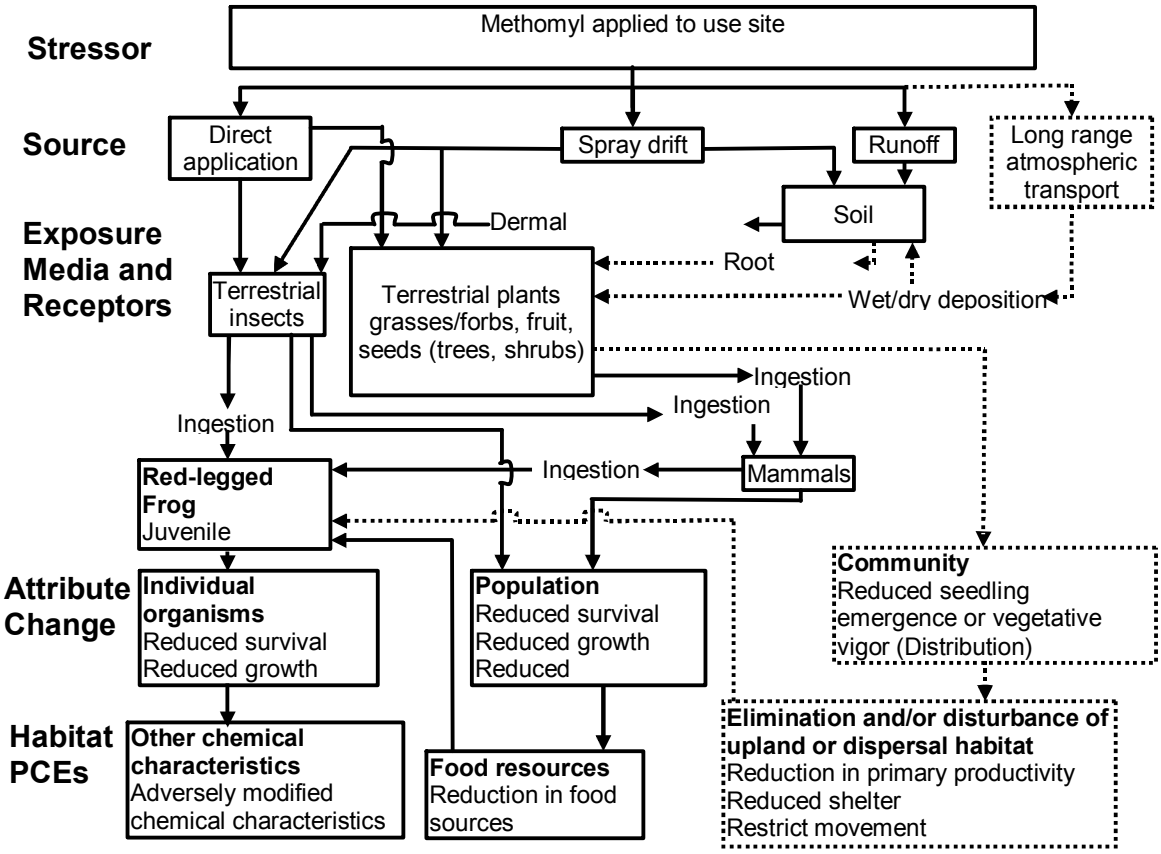


Figure 9. Conceptual Model for Potential Methomyl Effects on Aquatic Components of CRLF Critical Habitat.

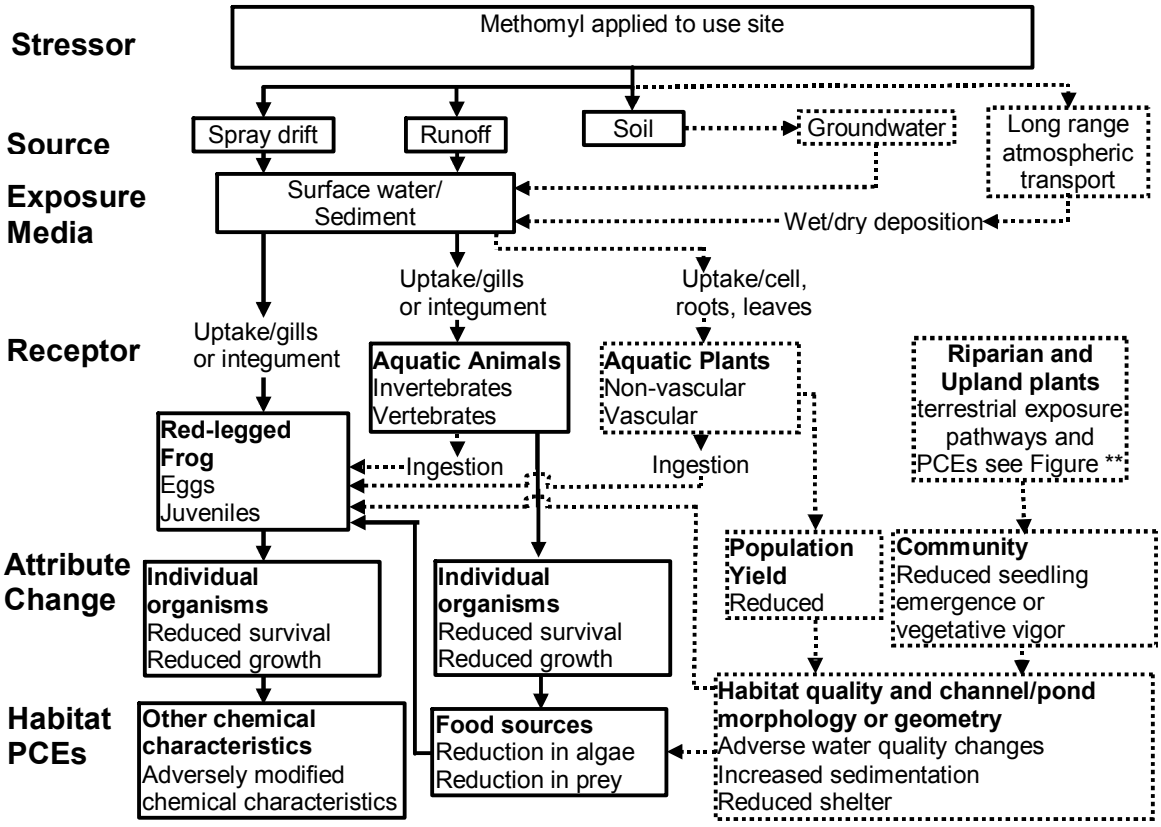


Figure 10. Conceptual Model for Potential Methomyl Effects on Terrestrial Components of CRLF Critical Habitat.

2.10 Analysis Plan

As with any pesticide, there is concern regarding the potential effects methomyl use may pose to non-target animals and plants. This document characterizes the environmental fate and transport of methomyl to assess whether labeled uses of methomyl in CA provide a means of exposure to non-target species that may directly or indirectly affect the CRLF or its designated critical habitat. Additionally, the toxicity of methomyl is characterized, and then both potential exposure and effects are integrated to estimate the likelihood of adverse effects (risk) to non-target animals that could potentially impact the CRLF.

The maximum label application rates for use of methomyl on agricultural, non-agricultural, and orchard use sites in CA were selected for modeling environmental concentrations for the screening-level deterministic (risk-quotient based) portion of this assessment. The most sensitive toxicity endpoints from surrogate test species are used to estimate treatment-related effects on growth, and survival and reproduction. Estimated environmental concentrations (EECs) used for this assessment are based solely on methomyl parent compound.

The following sections characterize the use, environmental fate, and ecological effects of methomyl and, using a risk quotient (ratio of exposure concentration to effects concentration)

approach, estimate the potential for adverse effects on non-target terrestrial and aquatic animals. The assessment is then refined by exploring the potential for direct and/or indirect effects to the CRLF and/or the modification of its designated critical habitat from methomyl use in CA to make our effects determinations.

2.10.1 Measures to Evaluate Risk Hypotheses and Conceptual Model

2.10.1.1 Measures of Exposure

Measures of exposure are based on terrestrial and aquatic models that estimate environmental concentrations of the chemical being assessed using labeled application rates and methods. The measure of exposure for aquatic species is the estimated environmental concentration (EEC) expected once every ten years based on 30 years of simulations. The 1-in-10 year peak concentration is used for estimating acute effects to aquatic vertebrate and invertebrate species; the 1-in-10 year 21-day mean concentration is used for assessing aquatic invertebrate chronic exposure; and the1-in-10 year 60-day mean concentration is used for assessing chronic exposure for fish (and aquatic-phase amphibians). The terrestrial measure of exposure for vertebrate and invertebrate animals is the upper 90th percentile concentration normalized for application rates on various dietary items.

2.10.1.2 Measures of Effect

Measures of effect are obtained from a suite of registrant-submitted guideline studies conducted with a limited number of surrogate species and/or from acceptable open literature studies (EPA 2004, USFWS/NMFS 2004). The acute measures of effect routinely used for listed and non-listed animals in screening level assessments are the LD_{50}, LC_{50} or EC_{50}, depending on taxa (see **Table 8**). 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 a group of test organisms. LC stands for "Lethal Concentration" and LC_{50} is the concentration of a chemical that is estimated to kill 50% of a sample population. EC stands for "Effective Concentration" and the EC_{50} is the concentration of a chemical that is estimated to produce some measured effect in 50% of the test population. Endpoints for chronic measures of exposure for listed and non-listed animals are the NOAEL or NOAEC. 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 a test population. The NOAEC (*i.e.*, "No-Observed-Adverse-Effect-Concentration") is the highest test concentration at which none of the observed results were statistically different from the control.

Table 8. Acute and Chronic Measures of Effect.

TAXA	ASSESSMENT	MEASURE OF EFFECT
Aquatic Animals (*Freshwater fish and inverts. and estuarine/marine fish and inverts.*)	Acute	Lowest tested EC_{50} or LC_{50} (acute toxicity tests)
	Chronic	Lowest NOAEC (early life-stage or full life-cycle tests)
Terrestrial Animals *Birds*	Acute/Subacute	Lowest LD_{50} (single oral dose) and LC_{50} (subacute dietary)
	Chronic	Lowest NOAEC (21-week reproduction test)
Terrestrial Animals *Mammals*	Acute	Lowest LD_{50} (single oral dose test)
	Chronic	Lowest NOAEC (two-generation reproduction test)

3. Exposure Assessment

3.1 Measures of Aquatic Exposure

3.1.1 Aquatic Exposure Modeling

Tier II modeling for scenarios representing all agricultural, orchard, and non-agricultural uses was used to generate EECs. For Tier II, two models are used in tandem: the Pesticide Root Zone Model, (PRZM, Carsel *et al*., 1997) and the Exposure Analysis Modeling System (EXAMS, Burns, 1997). PRZM (3.12 beta dated May 24, 2001) simulates fate and transport on the agricultural field, and EXAMS (2.98.04, dated July 18, 2002) simulates the fate and resulting daily concentrations in a standard model water body. Simulations are carried out with the linkage program shell, PE4V01.pl (dated August 13, 2003), which incorporates the standard crop and orchard scenarios developed by EFED. Simulations are run for multiple (usually 30) years, and the EECs represent peak values that are expected once every ten years based on the thirty years of daily values generated during the simulation. Additional information on these models can be found at: http://www.epa.gov/oppefed1/models/water/index.htm. The AgDRIFT (v 2.01) model was used to estimate spray drift from aerial and ground spray applications. The AgDRIFT spray drift model has undergone thorough peer review and can be used to provide estimates of off-target spray drift deposition from aerial and ground boom application methods (U.S. EPA 1996, 1999). Tier 1 AgDRIFT conditions were used to estimate spray drift deposition from methomyl applications as allowed by product labels. The inputs used for modeling are generally consistent with high-end wind speed and release height conditions specified on methomyl labels (*i.e*. 10 mph wind speed and, for aerial application, 10 ft release height).

For aquatic endpoints, the exposure is estimated for the maximum application pattern to a 10-ha field bordering a 1-ha pond, 2-m deep (20,000 m^3) with no outlet. Exposure estimates generated using this 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 pesticide-treated drainage area to water body volume would be expected to have higher peak EECs than the standard pond. These water bodies will be either smaller in size or have large drainage areas. Smaller water bodies have limited storage capacity and thus may overflow and carry pesticide in the discharge, whereas the standard pond has no discharge. As watershed size increases beyond 10-ha, it becomes increasingly unlikely that the entire watershed is planted with a non-major single crop that is all treated simultaneously with the pesticide. Headwater streams can also have peak concentrations higher than the standard pond, but they likely persist for only short periods of time and are then carried and dissipated downstream.

Standard and CRLF-specific PRZM crop scenarios, which consist of location-specific soils, weather, and cropping practices, were used in the simulations to represent labeled agricultural uses of methomyl. These scenarios were developed to represent high-end exposure sites in terms of vulnerability to runoff and erosion and subsequent off-site transport of pesticide. Methomyl is registered on a wide variety of field, vegetable and orchard crops (see **APPENDIX B**). Registered uses were grouped into categories according to similarity of growth, morphology, product use and cropping area and representative PRZM scenarios for each category were used for modeling. Particular attention was given to grouping crops according to the areas in which they are grown because rainfall is understood to be a driving variable in the PRZM model. A summary of the crop scenarios (location, meteorological file, *etc*.) used to estimate methomyl concentrations in the aquatic systems for ecological risk assessment can be found in **APPENDIX H**. Even though many agricultural practices in California rely on irrigation, non-irrigated scenarios were used for this assessment. The current version of PRZM applies excessive irrigation and it is therefore EFED's policy at this time to run only non-irrigated scenarios with this version of PRZM. EECs from irrigated scenarios could be higher or lower than those predicted here depending on irrigation practices.

For the scatter bait use pattern, a conceptual model was developed and the impervious and residential scenarios were post-processed to obtain the EECs. The conceptual model includes the assumption that 50% of the modeled area is impervious, and 3% of the impervious area is treated. Details of the conceptual model are in **APPENDIX I**.

PRZM/EXAMS modeling was done using the maximum seasonal use pattern for each category. Methomyl product labels, however, specify application rates on a per crop basis and not on a per annual basis. Information from the BEAD indicates that many crops can be grown more than one time/year in California (**APPENDIX B**). Since standard PRZM scenarios only consist of one crop per year, applications to only one crop per year were modeled (this is discussed further in Section 7). Even though methomyl is short-lived in water, it is moderately persistent in soils. Any carry-over in the soil from a previous crop may be available for runoff and may result in runoff loadings that are larger than what was modeled in this assessment.

Application-specific and chemical-specific input parameters are listed in **Tables 9** and **10,** respectively. Modeling inputs were selected according to EFED's Input Parameter Guidance (USEPA 2002). Pesticide applications were simulated as aerial spray applications or ground spray as prescribed by product labels. Foliar applications (PRZM chemical application method, CAM = 2) were simulated and spray drift estimates were calculated with AgDRIFT

corresponding to the label-required buffers of 100 ft and 25 ft for aerial and ground spray applications, respectively. Tier I aerial and ground models were run assuming ASAE Very Fine to Fine droplet size distribution and a high boom assumption for ground spray to determine the spray drift values. The disposition of the pesticide remaining on foliage after harvest (PRZM variable IPSCND) was selected according to post-harvest cropping practices. The first day of application was chosen according to the cropping period in the scenario. When a range of application dates was possible, the first application was chosen to correspond to the wetter portion of the year, winter/early spring.

Table 9. Application-Specific PRZM/EXAMS Input Parameters Used in Aquatic Exposure Modeling.

CATEGORY	USES	PRZM SCENARIO	MAX APP RATE (lbs ai/A)	# APPS/ CROP	MIN INTER-VAL	% DRIFT/ EFFICINECY[1]	IPSCND[2]	DATE OF 1st APP	CROP-PING PERIOD
Alfalfa	Alfalfa, lupine	CA alfalfa	0.9	5	5	14.6/95	2	Nov 1	All year
Avocado	Avocado	CA avocado	0.9	1	5	14.6/95	3	Feb 1	All year
Citrus	Grapefruit, lemon, oranges, tangerines, tangelo	CA citrus	0.9	3	5	14.6/95	3	Feb 1	All year
Cole crop	Broccoli, Chinese broccoli, broccoli raab, cabbage, Chinese cabbage, cauliflower, horseradish, leafy green vegetables	CA cole crop	0.9	8	2	14.6/95	2	Jan 15	Jan – Mar
Corn	Corn (field and popcorn), corn (seed), corn (sweet), corn	CA corn	0.45	14	1	14.6/95	1	Apr 15	Apr – Sept
Cotton	Cotton	CA cotton	0.675	2	3	14.6/95	1	May 15	May – Nov
Fruit tree	Apples, nectarines, peaches, pomegranates	CA fruit tree	0.9	6	5	14.6/95	1	Feb 1	All year
Garlic	Garlic	CA garlic	0.45	6	5	14.6/95	3	Feb 1	Oct – Jul
Grapes	Grapes	CA grapes	0.9	5	5	14.6/95	1	Mar 1	Feb – Aug
Lettuce	Brussels sprouts, chicory, endive, escarole, lettuce (head), lettuce (leaf), spinach	CA lettuce	0.9	8	2	14.6/95	3	Feb 15	Feb – May

CATEGORY	USES	PRZM SCENARIO	MAX APP RATE (lbs ai/A)	# APPS/ CROP	MIN INTER-VAL	% DRIFT/ EFFICINECY[1]	IPSCND[2]	DATE OF 1st APP	CROP-PING PERIOD
Melons	Cucumber, eggplant, melons, pumpkin, summer squash	CA melons	0.9	6	5	14.6/95	1	May 20	May – Aug
Nursery	Nonbearing fruit, grape, and nut nursery stock	CA nursery	0.9	5	5	14.6/95	1	Mar 15	Mar – Nov
Onion	Onions (green), onions (bulb), radishes	CA onion	0.9	6	5	14.6/95	2	Feb 1	Jan – Jun
Potato	Potato, sweet potato	CA potato	0.9	5	5	14.6/95	1	Mar 1	Feb – Jun
Rangeland	Bermuda grass (pasture)	CA rangeland hay	0.9	1	5	14.6/95	3	Feb 1	Nov – May
Vegetables/truck crops	Anise, asparagus, beans (succulent), beans (interplanted with nonbearing almonds, plums, prunes, peaches and walnuts), beets (table), carrots, celery, lentils, peas (succulent), peppers, soybeans, soybeans (interplanted with nonbearing almonds, plums, prunes, peaches and walnuts)	CA row crop	0.9	8	5	14.6/95	1	Feb 1	Jan – Apr
Strawberry	Strawberry	CA strawberry	0.9	5	5	14.6/95	1	Feb 1	Jan – Jul

CATEGORY	USES	PRZM SCENARIO	MAX APP RATE (lbs ai/A)	# APPS/ CROP	MIN INTER-VAL	% DRIFT/ EFFICINECY[1]	IPSCND[2]	DATE OF 1st APP	CROP-PING PERIOD
Sugar beet	Sugar beet	CA sugar beet	0.9	5	5	14.6/95	1	Mar 1	Feb – Aug
Tomato	Tomato, tomatillo	CA tomato	0.9	7	5	14.6/95	1	Mar 15	Mar – Sep
Turf	sod farms	CA turf	0.9	4	5	14.6/95	3	Feb 1	All year
Cereal grains	Barley, oats, rye, sorghum, wheat	CA wheat	0.45	4	5	14.6/95	1	Mar 15	Jan – Jun
Blueberries	Blueberries	CA wine grapes	0.9	4	5	2.7/99	1	Apr 15	Mar – Aug
Mint	Mint	OR mint	0.9	2	5	2.7/99	1	Jan 15	Apr - Aug
Scatter bait	Scatter bait	CA impervious; CA residential	0.22	26[3]	5	0	1	Jan 15	NA

[1] Drift values calculated with AgDRIFT according to 100 ft and 25 ft buffers for aerial and ground spray applications as directed by product labels
[2] Flag indicating the disposition of pesticide remaining on foliage after harvest; 1 - pesticide remaining on foliage is converted to surface application, 2 - remaining pesticide on foliage is completely removed, 3- remaining pesticide on foliage is retained as surface residue and continues to undergo decay.
[3] Not specified on the label. 26 applications per year is the most PRZM can process.

Table 10. Chemical-Specific PRZM/EXAMS Input Parameters.

INPUT PARAMETER	VALUE	SOURCE	COMMENT
Molecular mass (g/mol)	162.2	Product chemistry	
Vapor pressure (Torr)	5×10^{-5}	Product chemistry	
Henry's law constant (atm-m^3/mol)	1.8×10^{-10}	Calculated	
Water solubility (mg/L)	5.8×10^{4}	Product chemistry	Not multiplied by 10
Organic carbon-water partition coefficient (K_{OC}, ml/g_{oc})	24 [2]	MRID 46801703	Mean of four values.[1]
Aerobic soil metabolism $t_{1/2}$ (d)	81	MRIDs 00008568, 43217901	90th percentile upper confidence bound on the mean [1]
Aerobic aquatic metabolism $t_{1/2}$ (d)	5.5	MRID 43325401	90th percentile upper confidence bound on the mean [1]
Anaerobic aquatic metabolism $t_{1/2}$ (d)	28	MRID 43217902	2x anaerobic soil metabolism $t_{1/2}$ [1]
Hydrolysis $t_{1/2}$ (d)	0	MRID 46801705	Assume stable at pH 7
Photolysis $t_{1/2}$ (d)	1	MRID 0161885	Clear water, near surface
Foliar extraction	0.5		Default
Decay rate on foliage (d)	0		Assume stable (default)

1. EFED input parameter guidance is located at: http://www.epa.gov/oppefed1/models/water/input_guidance2_28_02.htm.
2. A recent review of the soil adsorption data (DP339908) revealved that the value of 24 ml/g is incorrect, and that the correct value should be 46 ml/g. The impact of the difference was tested on the CA cole crop and less than a 2% difference was observed. Therefore the error is well within the inherent uncertainty of the PRZM/EXAMS models, and revisions are unnecessary.

Aquatic EECs for the various use categories are listed in **Table 11**. Aquatic EECs range from 2.76 – 183 µg/L for peak concentrations for mint and cole crops, respectively. The cole crop category resulted in the highest EECs with 1-in-10 year peak, 21-day and 60-day concentrations of 183, 114, and 60.1 µg/L, respectively. The variability in EECs is driven by seasonal application rate, application type, application timing relative to rainfall events and variability in the vulnerability of the PRZM scenario (rainfall and soils).

Table 11. 1-in-10 Year Aquatic Estimated Environmental Concentrations (in µg/L) from PRZM/EXAMS Modeling for Maximum Use Patterns of Methomyl.

USE CATEGORY	SEASONAL APP RATE (lbs ai/A/crop)	PEAK (µg/L)	21-DAY (µg/L)	60-DAY (µg/L)
Alfalfa[1]	4.5	46.0	32.4	21.5
Avocado	0.9	9.24	6.16	3.12
Citrus[2]	2.7	21.1	13.7	7.54
Cole crops[3]	7.2	183	114	60.1
Corn[4]	6.3	38.1	27.1	13.1
Cotton	1.35	9.64	4.99	1.95
Fruit trees[5]	5.4	28.6	23.4	15.1
Garlic	2.7	25.3	15.1	9.30
Grapes	4.5	24.0	17.9	10.8
Lettuce [6]	7.2	122	78.6	43.4
Melons [7]	5.4	17.3	12.3	6.73
Nursery	4.5	27.6	17.4	11.9
Onion[8]	5.4	28.0	22.6	13.9
Potato[9]	4.5	22.4	16.7	9.84
Rangeland	0.9	13.5	9.09	4.86
Row crops [10]	7.2	40.1	30.7	22.2
Strawberry	4.5	53.9	39.9	25.5
Sugarbeets	4.5	28.6	21.7	13.6
Tomato[11]	6.3	43.3	29.4	18.3
Turf	3.6	38.2	24.7	14.4
Cereal grains[12]	1.8	23.4	16.6	9.24
Blueberries	3.6	13.8	8.8	4.80
Mint	1.8	2.76	1.81	0.987
Scatter bait	5.7	4.54	3.54	2.49

[1] alfalfa, lupine

[2] grapefruit, lemons, oranges, tangelo, tangerines

[3] broccoli, broccoli (Chinese), broccoli raab, cabbage, cabbage (Chinese), cauliflower, collards, horseradish, leafy green vegetables

[4] corn (field and popcorn), corn (seed), corn (sweet), corn

[5] apples, nectarines, peaches, pomegranates

[6] Brussels sprouts, chicory, endive (escarole), lettuce (head), lettuce (leaf), spinach

[7] cucumber, eggplant, melons, pumpkin, summer squash

[8] onion (green), onion (bulb dry), radishes

[9] potato, sweet potatoes

[10] anise, asparagus, beans (succulent), beans (dry), beets, carrots, celery, lentils, peas (succulent) peppers, soybeans

[11] tomato, tomatillo

[12] barley, oats, rye, sorghum, wheat

3.1.1.1 Monitoring Data

Methomyl has a limited set of surface water monitoring data relevant to the CRLF assessment. No surface water monitoring studies which specifically targeted methomyl use (application period and/or sites) were available for analysis as part of this assessment. Generally, targeted monitoring data are collected with a sampling program designed to capture, both spatially and temporally, the maximum use of a particular pesticide. Because none of the available regional monitoring studies were designed specifically for methomyl, they are considered 'non-targeted'. Typically, sampling frequencies employed in monitoring studies are insufficient to document peak exposure values. This coupled with the fact that these data are not temporally or spatially correlated with pesticide application times and/or areas limit the utility of these data in estimating exposure concentrations for risk assessment. Monitoring data can be used to set lower bounds on the occurrence in the environment, since concentrations were at least as high as those found in the monitoring studies. For these reasons, baseline risk assessments rely on model-generated values for estimating acute and chronic exposure values, and the non-targeted monitoring data are typically used for qualitative characterizations. Included in this assessment are methomyl data from the USGS NAWQA program (http://water.usgs.gov.nawqa), and California Department of Pesticide Regulation (CDPR) monitoring efforts.

3.1.1.2 USGS NAWQA Data

Surface water monitoring data from the United States Geological Survey (USGS) NAWQA program was accessed on May 10, 2007 and all data for the State of California were downloaded. A total of 346 water samples were analyzed for methomyl. Of these samples, 18 (5.2%) had positive detections of methomy at four sites. The maximum concentration detected was 0.67 µg/L in the Salt Slough at Highway 165 near Stevinson, CA. Methomyl was detected in the Salt Slough in 4 samples with concentrations ranging 0.13 -0.67 µg/L. Methomyl was also detected in the San Joaquin River near Vernalis, CA (3 samples ranging in concentration 0.0052 – 0.0723 µg/L), the Orestimba Creek at River Road near Crows Landing, CA (10 samples ranging in concentration 0.0043 – 0.33 µg/L) and at Merced River at River Road bridge new Newman, CA (1 sample 0.01 µg/L). Reported levels of detection (LODs) ranged from 0.0044 – 1.22 µg/L.

3.1.1.3 California Department of Pesticide Regulation (CDPR) Data

Surface water monitoring data were accessed from the California Department of Pesticide regulation (CDPR) on February 8, 2007 and all data with analysis for methomyl were extracted. A total of 1,118 water samples were analyzed for methomyl. Of these, 191 samples (17%) had positive detections of methomyl. The maximum concentration was 5.4 µg/L in the Ingram/Hospital Creek (tributary to the San Joaquin River). Methomyl was detected at 21 sites (out of a total of 84) in Imperial, Merced, Stanilaus, and Yolo Counties at concentrations ranging between 0.05 – 5.4 µg/L.

3.1.2 Measures of Terrestrial Exposure

3.1.2.1 Terrestrial Exposure Modeling

The EEC values used for terrestrial animal exposure are derived from the Kenaga nomograph, as modified by Fletcher *et al.* (1994), based on a large set of actual field residue data. The upper limit values from the nomograph represent the 95th percentile of residue values from actual field measurements (Hoerger and Kenaga, 1972). The Fletcher *et al.* (1994) modifications to the Kenaga nomograph are based on measured field residues from 249 published research papers, including information on 118 species of plants, 121 pesticides, and 17 chemical classes. These modifications represent the 95th percentile of the expanded data set. Risk quotients are based on the most sensitive LC_{50} and NOAEC for birds (bobwhite quail and mallard duck) and LD_{50} for mammals (based on lab rat studies).

We derive terrestrial estimated environmental concentrations (**Table 12**) for methomyl using the maximum proposed application rates (8 applications at 0.9 lb a.i./acre/application with a 2-day application interval). Terrestrial exposure estimates for avian and mammalian risk assessments were derived using the T-REX model (version 1.3.1, December 22, 2006). A pesticide residue half-life of 3 days was used based on the 90th percentile of the mean for all total residue half-life value for methomyl in Willis and McDowell (1987) (*i.e.*, 2.7 days) [per the OPP interim policy for calculating foliar half-life values for modeling purposes (USEPA 1999)]. A complete description of the input parameters and output is contained in **Table A** in **APPENDIX M**.

Table 12. Estimated Environmental Concentrations (in mg/kg; parts per million (ppm)) on Potential Food Items Following Label-Specified Applications (8 Applications at 0.9 lb a.i./Acre/Application with a 2-Day Application Interval) of Methomyl Using T-REX

DIETARY-BASED EECs	Estimated Environmental Concentrations (ppm)	
	Upper Bound	Mean
Short Grass	569	202
Tall Grass	261	85
Broadleaf Plants/Small Insects	320	107
Fruits/Pods/Seeds/Large Insects	36	17

4. Effects Assessment

Based on the available data, methomyl is characterized as 'very highly toxic' to freshwater fish and freshwater invertebrates on an acute exposure basis. Chronic exposure resulted in reduced growth in fish and reduced survival in freshwater aquatic invertebrates. Methomyl is characterized as 'highly toxic' to birds and mammals on an acute oral exposure basis, and 'highly toxic' to terrestrial invertebrates on an acute exposure basis (contact and oral exposures). Chronic exposure to birds resulted in fewer eggs laid and eggs set, while chronic exposure in mammals resulted in decreased body weight and food consumption and altered hematology parameters in the parental

generation and decreases in both the mean number of live pups and mean body weights of offspring. Toxicity data for terrestrial invertebrates chronically exposed to methomyl are not currently available. See **Table 13** for the assessment endpoints used in this assessment (*i.e.*, the most sensitive acute and chronic endpoints for each taxon assessed here).

Table 13. Summary of Specific Assessment Endpoints Considered in This Assessment.

TAXA	MEASURE OF EFFECT		
Survival, growth and/ or reproduction of:	**Species**	**Toxicity**	**Endpoint**
Freshwater Fish	***Acute***		
	Ictalurus punctatus Channel catfish	LC_{50} = 320 µg a.i./L	Mortality
	Chronic		
	Ictalurus punctatus Channel catfish*	NOAEC = 12µg a.i./L	Reduction in survival
Freshwater Invertebrates	***Acute***		
	Daphnia magna	EC_{50} = 5.0 µg a.i./L	Mortality
	Chronic		
	Daphnia magna	NOAEC = 0.7 µg a.i./L	Mortality
Birds	***Acute***		
	Colinus virginianus Northern bobwhite quail *Colinus virginianus* Northern bobwhite quail	LC_{50} = 1,100 mg/kg-diet LD_{50} = 24.2 mg/kg-bw	Mortality
	Chronic		
	Colinus virginianus Northern bobwhite quail	NOAEC = 150 mg a.i./kg-diet	Fewer eggs laid and eggs set
Mammals	***Acute***		
	Rattus rattus Rat	LD_{50} = 30 mg a.i./kg-bw	Mortality
	Chronic		
	Rattus rattus Rat	NOAEL = 3.75 mg a.i./kg-bw	Decreases in the mean number of live pups and mean body weights of offspring
Terrestrial Invertebrates	***Acute***		
	Aphidius rhopalosiphi Wasp	LC_{50} = 0.00022 lb a.i./A	Mortality

* Based on an acute to chronic ratio using acute (LC_{50} = 1,500 ppb) and chronic (NOAEC = 57 ppb) values from fathead minnow and an acute value (LC_{50} = 320 ppb) from channel catfish.

4.1 Toxicity to Freshwater Organisms

4.1.1 Freshwater Fish

Summaries of the most sensitive toxicity value for each species of freshwater fish tested are presented in **Tables 14** (acute exposure) and **15** (chronic exposure). Additionally, all acute toxicity values for fish tested are presented in **APPENDIX J**.

Table 14. Summary of Most Sensitive Submitted Acute Toxicity Studies for Freshwater Fish Exposed to Methomyl.

Species	Compound (% a.i.)	Exposure Type	96-h LC_{50} (ug/L)	Slope	95% C.I. (ug/L)	MRID	Toxicity	Classification
Salmo salar Atlantic salmon	99	Static	560	N/A	460-690	400980-01	Highly toxic	Supplemental
	29	Static	1200	N/A	1050-1380	400980-01	Moderately toxic	Supplemental
Lepomis macrochirus Bluegill sunfish	95	Static	480	N/A	320-710	400980-01	Highly toxic	Supplemental
	24	Static	370	N/A	262-522	400980-01	Highly toxic	Supplemental
Salvelinus fontinalis Brook trout	99	Static	1500	N/A	1230-1830	400980-01	Moderately toxic	Supplemental
	24	Static	1220	N/A	860-1730	400980-01	Moderately toxic	Supplemental
Ictalurus punctatus Channel catfish	95	Static	530	N/A	375-748	400980-01	Highly toxic	Supplemental
	24	Static	**320***	N/A	200-430	400980-01	Highly toxic	Supplemental
Pimephales promelas Fathead minnow	99	Static	2800	N/A	1800-4300	400980-01	Moderately toxic	Supplemental
	29	Static	1500	N/A	900-2500	400980-01	Moderately toxic	Supplemental
Micropterus salmoides Largemouth bass	95	Static	1250	N/A	971-1610	400980-01	Moderately toxic	Supplemental
	24	Static	760	N/A	589-979	400980-01	Highly toxic	Supplemental
Oncorhynchus mykiss Rainbow trout	95	Static	860	N/A	590-1260	400980-01	Highly toxic	Supplemental
	24	Static	1200	N/A	1100-1400	400980-01	Moderately toxic	Supplemental

*Bolded endpoints are used to calculate RQ values.

Table 15. Summary of Submitted Chronic Toxicity Studies for Freshwater Fish Exposed to Methomyl.

Species	Test Duration	Endpoint	Compound (% a.i.)	Exposure	LOAEC ppb	NOAEC ppb	MRID	Classification
Pimephales promelas Fathead minnow	Early life-stage 28 days	Survival	>99	Flow-through	117	57	131255	Acceptable
Pimephales promelas Fathead minnow	Full life-cycle 193 days	Growth	98.4	Flow-through	142	76	430721-01	Acceptable

All acute toxicity values for freshwater fish were derived from Mayer and Ellersieck (1986) (MRID: 400980-01). Per EFED policy (USEPA 2006), all data from Mayer and Ellersieck (1986) are considered 'supplemental' unless, after evaluation of the raw data, it is deemed the classification can be changed to 'acceptable' or 'invalid'. Additionally, all

data from Mayer and Ellersieck (1986) used for RQ calculations must be reviewed and evaluated. Of the fish species tested, the channel catfish is the most sensitive (96-hr LC_{50} = 320 µg/L). After review of the raw data, the data for the channel catfish were considered 'supplemental', scientifically valid, and adequate for RQ calculation. The study deviated from current guidelines in the following: the acclimation period of 4-days was less than the recommended >14-day acclimation period; the following water parameters were not reported: dissolved oxygen, total organic carbon, particulate matter, metals, pesticide, and chlorine; there was only one container used per concentration instead of the recommended 3 containers per treatment level; and the following information was not provided: lighting during the test and stability of the chemical in the test system. Methomyl is characterized as 'very highly toxic' to freshwater fish on an acute exposure basis. There are no submitted methomyl toxicity studies on amphibians available.

The life stage of the fish during exposure can influence its sensitivity to methomyl. From the available data, the egg and yolk-sac stage of fish are less sensitive to methomyl than more advanced stages of development. As a result, eggs and yolk-sac fry are at less risk than swim-up fry and juveniles. For the rainbow trout (*Oncorhynchus mykiss*), the eyed-egg stage has a 96-h LC_{50} of 32,000 µg/L, the yolk-sac stage has a 96-h LC_{50} of 3,200 µg/L, and the swim-up stage has a 96-h LC_{50} of 1,300 µg/L. The same trend is also seen for channel catfish exposed to methomyl. The 96-h LC_{50} for channel catfish yolk-sac fry, swim-up fry, and fingerlings are 1,800 µg/L, <560 µg/L, and 760 µg/L, respectively.

Two chronic toxicity studies are available with fathead minnows (*Pimephales promelas*), an early life-stage test (MRID 131255) and a full life-cycle test (MRID 430721-01). The NOAEC and LOAEC are 57 and 117 µg/L, respectively, based on reduced survival. Mean larval survival was reduced by roughly 10% at the LOAEC of 117 µg/L. In the full life-cycle study, methomyl was tested at mean-measured concentrations ranging from 18 to 280 µg/L. The NOAEC and LOAEC are 76 and 142 µg/L, respectively, based on reduced growth of the parental and F_1 generation fish. Since no toxicity data from chronic exposure to methomyl were available for the most acutely sensitive species, the channel catfish, an acute to chronic ratio (ACR) was used to calculate a chronic freshwater fish endpoint using acute and chronic data from the fathead minnow. This resulted in a NOAEC of 12 µg/L for the channel catfish [(1,500 µg/L)/(57 µg/L) = (320 µg/L)/(x µg/L)].

4.1.1.1 Open Literature

All acceptable values for freshwater fish from the open literature were less sensitive than the most sensitive values discussed already (see **APPENDIX J**). No acceptable acute toxicity studies were available from the open literature for amphibians. No acceptable chronic toxicity studies were available from the open literature for freshwater fish or aquatic-phase amphibians. For a complete list of open literature toxicity studies identified by ECOTOX for methomyl, see **APPENDIX L.**

4.1.2 Freshwater Invertebrates

Submitted data were collected using freshwater invertebrate species primarily found in the water column and benthic invertebrates (sediment-dwelling invertebrates). Summaries of the most sensitive endpoints and concentrations identified from submitted studies on each species of aquatic invertebrate tested are presented in **Tables 16** (acute exposure) and **17** (chronic exposure). Additionally, all acute toxicity values for freshwater invertebrates tested are presented in **APPENDIX K**.

Table 16. Summary of Submitted Acute Toxicity Studies for Freshwater Invertebrates Exposed to Methomyl.

Species	% a.i.	Exposure	LC_{50} (ppb)		Slope	95% C.I. (ppb)	MRID	Toxicity	Classification
			48-h	96-h					
Chironomus plumosus Midge	95	Static	88	--	N/A	60-129	400980-01	Very highly toxic	Supplemental
	24	Static	32	--	N/A	13-80	400980-01	Very highly toxic	Supplemental
Daphnia magna Daphnid	95	Static	8.8	–	N/A	4.1-19	400980-01	Very highly toxic	Supplemental
	24	Static	**5.0***	–	N/A	4.8-12.1	400980-01	Very highly toxic	Supplemental
Gammarus pseudolimnaeus Scud	99	Static	--	920	N/A	680-1240	400980-01	Highly toxic	Supplemental
	24	Static	--	720	N/A	572-907	400980-01	Highly toxic	Supplemental
Isogenus sp. Stonefly	95	Static	–	343	N/A	268-440	400980-01	Highly toxic	Supplemental
	24	Static	–	29	N/A	21-41	400980-01	Very highly toxic	Supplemental
Pteronarcella badia Stonefly	95	Static	--	69	N/A	44-108	400980-01	Very highly toxic	Supplemental
	24	Static	--	60	N/A	45-80	400980-01	Very highly toxic	Supplemental
Skwala sp. Stonefly	95-98	Static	–	34	N/A	N/A	400946-02	Very highly toxic	Acceptable
	24	Static	–	29	N/A	N/A	400946-02	Very highly toxic	Acceptable

*Bolded endpoint is used to calculate RQ values

Table 17. Summary of Submitted Chronic Toxicity Studies for Freshwater Invertebrates Exposed to Methomyl.

Species	Test Duration	Most Sensitive Endpoint	Compound (% a.i.)	Exposure Type	LOAEC (ppb)	NOAEC (ppb)	MRID	Classification
Daphnia magna Daphnid	Life-cycle 21 days	Reproduction	>99	Static-renewal	1.0	**0.7***	131254	Acceptable

*Bolded endpoint is used to calculate RQ values

All acute toxicity values for freshwater invertebrates were derived from Mayer and Ellersieck (1986) (MRID: 400980-01), except for stonefly (*Skwala* sp.), which were derived from Johnson and Finley (1980) (MRID: 400946-02). Of the invertebrate species tested, the water flea (*Daphnia magna*) is the most sensitive (48-hr EC_{50} = 5.0 µg/L). Per

EFED policy (USEPA 2006), the raw data for the daphnid endpoint was evaluated and the data were deemed 'supplemental', scientifically valid, and adequate for RQ calculations. The study deviated from current guidelines in the following: information on the acclimation period, feeding of the test organisms, and health of the test organisms was not provided; the test vessels (150 ml) were smaller than recommended (250 ml); information on dissolved oxygen, total organic carbon, particulate matter, metals, pesticide, and chlorine were not reported; there was only one container used per concentration instead of the recommended 2 containers per treatment level. Methomyl is characterized as 'very highly toxic' to freshwater invertebrates on an acute exposure basis.

In a 21-day life-cycle toxicity study of *Daphnia magna*, methomyl was tested at mean-measured concentrations ranging from 0.7 to 13.8 µg/L (MRID 131254). Exposure of daphnia to technical-grade methomyl resulted in a NOAEC of 0.7 µg./L and a LOAEC of 1.0 µg/L based on delayed reproduction. The NOAEC and LOAEC are 1.6 and 3.5 µg/L, respectively, based on the number of young produced. No other sublethal effects were noted at any other time or concentration.

4.1.2.1 Open Literature

No acceptable open literature acute or chronic toxicity studies (not already discussed) were identified for methomyl on freshwater invertebrates.

4.1.3 Microcosm Study

An outdoor microcosm study (MRID 437444-02) was conducted with the formulated methomyl product Lannate® L (24% a.i.) to evaluate the fate in tank water and hydrosoil and assess the effects on populations of phytoplankton, zooplankton, macroinvertebrates, and bluegill sunfish. Applications were performed over a period of 22 days (22 daily applications) to 28 days (4 applications with a 7-day reapplication interval); the total length of the study was 35 days. Treatment groups were defined by the amount of test substance added at each application (0.48 or 0.048 g a.i.; test vessel volume = 5,900 L; nominal treatment concentrations were not provided) and by the interval between test substance applications [1 day (total of 22 applications), 3 days (total of 8 applications), or 7 days (total of 4 applications)]. Each of the 56 tanks used in the study was stocked with bluegill sunfish and inoculated with aquatic plants and animals (invertebrates) from an untreated, pre-existing pond on site, colonized by native invertebrates.

Water and hydrosoil samples were collected throughout the study and analyzed for methomyl. Degradation of methomyl occurred so rapidly in the sediment and hydrosoil samples that concentrations of methomyl in sediment could not be determined within acceptable quality control limits (methomyl in hydrosoil stored at ambient temperature had a half-life of 5.7 hours). Overall, in water, methomyl increased with each application until day 10, and then decreased, even though applications continued. A summary of the methomyl concentrations for the lowest and highest treatment levels is presented in **Table 18**.

Table 18. Summary of Methomyl Water Concentrations from the Microcosm Study at the Lowest and Highest Treatment Levels.

Treatment Level	Measured Concentration on Day 1 (µg/L)	Max. Concentration (µg/L)/Day	Concentration on Day 22 (µg/L) - Last Treatment Day	Concentration on Day 35 (µg/L)
0.048 g a.i./ applied every 7 days	9.7	12.8/7	3.3	<LOQ
0.48 g a.i./ applied daily	90.6	706/10	114	9.6

The populations of phytoplankton, zooplankton, macroinvertebrates, and bluegill sunfish were sampled and characterized from each microcosm tank before, during, and after methomyl applications. Phytoplankton showed no apparent methomyl-related effects.

Zooplankton showed mixed results; the abundance of adult copepodes and rotifers generally increased following methomyl applications, however, cladoceran abundance was reduced (to less than 1% of the abundance of the control group) in the methomyl-treated groups and their numbers did not recover during the study period. The decrease in the number of cladocerns in the microcosm study parallels the results from the submitted laboratory toxicity studies for methomyl showing that cladocerans, *i.e.*, *Daphnia magna*, an order of magnitude more sensitive than midge larvae.

During the microcosm study, temporary declines in abundance were observed in mayflies and three genera of chironomids, however, the results are difficult to assess because they are confounded by a low number of organisms and high degree of variability within measurement endpoints in each treatment group, including the controls.

Although macroinvertebrate sensitivity in the microcosm study paralleled results from laboratory toxicity tests, the sensitivity of fish in the microcosm study was not consistent with what was observed in the laboratory acute toxicity tests. Maximum methomyl concentrations at the highest treatment levels in the microcosm study (706 µg/L) were almost twice as high as the most sensitive bluegill LC_{50} value from the submitted laboratory studies (370 µg/L), bluegill survival was not affected in any of the microcosm treatment levels. Body length and body weight at harvest, however, were significantly reduced (up to 18.5%) at all methomyl treatment levels when compared with controls. The decrease in body length and weight was not strongly associated with the methomyl treatment levels, *i.e.*, none of the measurements displayed a graded dose-response across the treatment groups. The size reductions were, thus, attributed to a decrease in food resources, particularly cladocerans.

4.2 Toxicity to Terrestrial Organisms

4.2.1 Birds

Summaries of the most sensitive toxicity values for birds are presented in **Table 19** (acute oral, subacute dietary, and chronic exposure).

Table 19. Summary of Submitted Acute, Subacute, and Chronic Studies of Birds Exposed to Methomyl.

Species	Type of test	Duration	Endpoint	MRID	Classification
Mallard Duck (*Anas platrhynchos*)	Subacute dietary	8-days	LC_{50}: 3602 mg a.i./kg diet	45299802	Acceptable
Northern Bobwhite (*Colinus virginianus*)	Subacute dietary	8-days	LC_{50}: >5080 mg a.i./kg diet	45299801	Acceptable
Northern Bobwhite (*Colinus virginianus*)	Subacute dietary	8-days	**LC_{50} = 1100 mg a.i./kg diet***	22923	Acceptable
Mallard Duck (*Anas platrhynchos*)	Subacute dietary	8-days	LC_{50} = 2883 mg a.i./kg diet	22923	Acceptable
Ring-necked Pheasant (*Phasianus colchicus)*	Subacute dietary	8-days	LC_{50} = 1975 mg a.i./kg diet	22923	Acceptable
Northern Bobwhite (*Colinus virginianus*)	Acute oral	14-days	**LD_{50} = 24.2 mg/kg-bw**	00161886	Acceptable
Northern Bobwhite (*Colinus virginianus*)	Reproduction	21-weeks	**NOAEC = 150 ppm*** LOAEC = 500 ppm	41898602	Acceptable Fewer eggs laid and eggs set

Bolded endpoints are used to calculate RQs in this assessment

Based on the acute oral LD_{50} values for the northern Bobwhite quail (*Colinus virginianus*) of 24.2 mg/kg-bw (MRID 00161886), methomyl is characterized as "highly toxic" to avian species on an acute oral-exposure basis. The RED for methomyl (USEPA 1998) identified an additional acute oral avian toxicity study (classified in the RED as acceptable) that resulted in the following LD_{50} values: Ring-necked pheasant (*Phasianus colchicus)* LD_{50} = 15.4 mg/kg-bw and mallard duck (*Anas platrhynchos*) LD_{50} = 15.9 mg/kg-bw (MRID: 115198). Upon further review of the study and the accompanying data evaluation records (DERs), however, it was discovered that the study was classified as supplemental and is not adequate for RQ calculations due to a variety of factors (including, some of the study individuals were less than 4-months old, only males were tested, and information on the number of individuals tested, controls, dose-response data,

and testing conditions was not provided). Therefore, the bobwhite quail LD_{50} value (24.2 mg/kg-bw) is used here. Methomyl is "slightly toxic" to avian species on a subacute dietary-exposure basis, with the lowest LC_{50} of 1,100 mg/kg-diet reported for northern bobwhite quail (Hill *et al.,* 1975).

An avian reproduction study was performed on methomyl with the northern bobwhite quail. In this study, the LOAEC was 500 mg/kg-diet) based on fewer eggs laid and eggs set and the NOAEC was 150 mg a.i./kg-diet (MRID: 41898602).

4.2.1.1 Open Literature

All acceptable values for birds from the open literature were less sensitive than the most sensitive values discussed already. No acceptable acute or chronic toxicity studies were available from the open literature for terrestrial-phase amphibians.

4.2.2 Mammals

Summaries of the most sensitive toxicity values for mammals are presented in **Table 20** (acute and chronic exposure).

Table 20. Summary of Submitted Toxicity Studies for Mammals Exposed to Methomyl.

Species	Test Duration	Endpoint	Endpoint Based on:	MRID	Classification
Rattus rattus Rat	14-day	**LD_{50} = 30 mg/kg-bw***	Mortality	42140101	Acceptable
Rattus rattus Rat	2-Generation	LOAEL = 30 mg/kg-bw	Reproduction	43250701, 43769401	Acceptable
		NOAEL = 3.75 mg/kg-bw*			

* Bolded endpoints are used to calculate RQs in this assessment

Based on the results from a rat (*Rattus rattus*) acute oral toxicity study (LD_{50}=30 mg/kg-bw) involving a single dose/animal and a 14-day observation period, methomyl is characterized as “highly toxic" to mammalian species on an acute oral-exposure basis (MRID: 42140101).

In a 2-generation reproduction study with rats, the NOAEL for parental systemic toxicity is 3.75 mg/kg-bw and the LOAEL is 30 mg/kg-bw based on decreased body weight and food consumption and altered hematology parameters. The NOAEL for offspring toxicity is also 3.75 mg/kg-bw and the LOAEL is 30 mg/kg-bw based on decreases in both the mean number of live pups and mean body weights of offspring (MRIDs: 43250701, 43769401).

4.2.2.1 Open Literature

No acceptable open literature acute or chronic toxicity studies, with more sensitive endpoints than those already discussed, were identified for methomyl on mammals.

4.2.3 Terrestrial Invertebrates

A summary of the endpoints and concentrations identified from registrant-submitted studies on terrestrial invertebrates is presented in **Table 21**.

Table 21. Summary of Submitted Toxicity Data for Terrestrial Invertebrates Exposed to Methomyl.

Species	Type of test	Duration	Endpoint(s)	MRID	Classification
Wasp (*Aphidius rhopalosiphi*)	Formulated product (Methomyl® 25WP) applied to glass plates at various rates (non-treated food provided)	48-hr	Mortality: LC_{50} = 0.00027 lb/A NOAEC = 0.00015 lb a.i./A Reproduction: EC_{50} = 0.000017 lb a.i./A NOAEC = <0.000005 lb ai/A	45133302	Supplemental (non-guideline, but scientifically sound)
Wasp (*Aphidius rhopalosiphi*)	Formulated product (Methomyl® 20L) applied to glass plates at various rates (non-treated food provided)	48-hr	Mortality: LC_{50} = **0.00022 lb a.i./A*** NOAEC = 0.000017 lb a.i./A	45133301	Supplemental (non-guideline, but scientifically sound)
Mite (*Typhlodromus pyri*)	Formulated product (Methomyl® 20L) applied to glass plates at various rates (non-treated food provided)	7-day	Mortality: LC_{50} = 0.0114 lb a.i./A NOAEC = 0.0027 lb a.i./A	45125501	Supplemental (non-guideline, but scientifically sound)
Mite (*Typhlodromus pyri*)	Formulated product (Methomyl® 25WP) applied to glass plates at various rates (non-treated food provided)	7-day	Mortality: LC_{50} = 0.01115 lb a.i./A NOAEC = 0.0027 lb a.i./A	45125502	Supplemental (non-guideline, but scientifically sound)
Honeybee (*Apis mellifera*)	TGAI (oral and contact tests)	48-hr	Oral: LD_{50} = 0.28 µg a.i./bee NOAEL = 0.09 µg a.i./bee Contact: LD_{50} = 0.16 µg a.i./bee (1.25 ppm) NOAEL = 0.08 µg a.i./bee (0.624 ppm)	45093001	Acceptable
Earthworms (*Eisenia fetida*)	(Methomyl 20L)	28-day (exposure)	LC_{50} = N/A (no mortalities) (highest concentration = 12 mg a.i./kg dry soil) NOAEL = 1.5 mg a.i./kg dry soil (based on reproduction)	45459201	Supplemental (non-guideline, but scientifically sound)
Earthworms (*Eisenia fetida*)	TGAI	14-day	LC_{50} = 23 mg/kg dry soil	44969301	Supplemental (non-guideline, but scientifically sound)

* Bolded endpoints are used to calculate RQs in this assessment

The only guideline terrestrial invertebrate tests are for honey bees. A registrant-submitted study includes both acute contact and acute oral LD_{50} values for methomyl (MRID 45093001). The acute contact LD_{50} is 0.16 µg/bee and the acute oral LD_{50} is 0.28 µg/bee, which classifies methomyl as 'highly toxic' to honey bees on an acute exposure basis. The acute NOAELs are 0.08 and 0.16 µg/bee in the contact and oral toxicity tests, respectively, based on survival. No sublethal effects were observed between bees exposed to methomyl versus controls.

Additional registrant-submitted studies of formulated endproduct were submitted on aphids (*Aphidius rhopalosiphi*), predatory mites (*Typhlodromus pyri*), wasps (*Aphidius rhopalosiphi*), and earthworms (*Eisenia fetida*). Of the invertebrate species tested, the wasp is the most sensitive with a reported LC_{50} value equivalent to an application rate of 0.00022 lb a.i./A for a formulated methomyl product containing 20% active ingredient (MRID: 45133301).

Regarding sediment-dwelling invertebrates, in a 14-day acute toxicity study, earthworms (*Eisenia fetida*) were exposed to technical grade methomyl at concentrations ranging from 6.25 to 200 mg/kg dry soil (MRID 449693-01). The LC_{50} is 23 mg/kg dry soil and the NOAEC is 6.25 mg/kg dry soil. In another toxicity study, earthworms (*Eisenia fetida*) were exposed for 28 days to Methomyl® 20L at 1.4 to 60 mg formulated product/kg dry weight of artificial soil (MRID 454592-01). The LC_{50} exceeded the highest concentration tested. The NOAEC, based on body weight (growth) and reproduction (number of worms produced) was 7.5 mg product/kg dry weight of soil.

4.2.3.1 Open Literature

No acceptable open literature acute or chronic toxicity studies, with more sensitive endpoints than those already discussed, were identified for methomyl on terrestrial invertebrates.

4.3 Incidents

EPA maintains an incident database system (Ecological Incident Information System or EIIS) to track and evaluate accidental kills associated with pesticide use. The likelihood that a particular pesticide caused the incident is classified as "highly probable", "probable", "possible", or "unlikely", based on the information contained in the incident report. In the years since EPA has maintained the database, a total of 9 incidents associated with methomyl use have been reported (5 involving terrestrial organisms – all birds -and 4 involving aquatic organisms – all fish). Of these incidents, 3 were reported in California. The certainty in which these incidents were a result of methomyl use was described as highly probable in two incidents, probable in four incidents, possible in one incident, and unlikely in two incidents. Three of the incidents were the result of registered use, three were the result of misuse (intentional baiting), but it is unknown if the incident resulted from misuse or registered use in the other three incidents. Specific details of the incidents are described below.

4.3.1 Terrestrial Incidents

Three of the terrestrial incidents (one from New York, one from Florida, and one from Greece) were the result of intentional baiting and involved mortality in the following birds: rock dove (*Columbia livia*), an American kestrel (*Falco sparverius*), Eleanora's falcon (*Falco eleonorae*), and grackle (*Quiscalus spp*.) (Incident #'s: I009064-001, I011181-001, and I017139-001). Two of the incidents occurred in France and involved the registered use (in France) of methomyl on cabbage. Incident # I006382-001 occurred in 1989 from a foliar spray of methomyl at a rate of 0.225 lb a.i./acre. This incident, which was classified as 'probable', resulted in the mortality of at least 52 finches. The other French incident (I006382-002; 1992) was also classified as 'probable' and involved the registered use of methomyl (foliar spray) on cabbage. This incident involved the incapacitation of 31 birds and mortality in 35 birds (finches and linnets) after the birds were observed drinking dew from the cabbage field the day after methomyl application.

4.3.2 Aquatic Incidents

A fish kill occurred in a canal near Blythe, California on January 7, 1978 (Incident # B0000-501-36). The treatment site is unknown, and it is unknown if the kill was the result of misuse or registered use. Approximately 540 catfish (*Ictalurus spp*.) and largemouth bass (*Micropterus salmoides*) were killed in an area of standing water. Lannate® (methomyl), Thiodan® (endosulfan), and parathion were suspected as being the cause of the kill, but analyses of water and fish showed only endosulfan to be present. Water samples contained between 0.27 and 0.64 ppb endosulfan. Also, gills and liver contained 2500 and 1100 ppb endosulfan, respectively, and gills of largemouth bass contained 930 ppb endosulfan. This report was listed as 'unlikely' relative to methomyl being the cause of the incident, and the fact that only endosulfan was detected in water and fish samples makes it likely that endosulfan, and not methomyl, was responsible for this fish kill.

In a report from the California Fish and Game Department (Incident # I000108-001), there was a large fish kill, *i.e*., several thousand threadfin shad (*Dorosoma petenense*) and catfish (*Ictalurus spp*.), in the San Joaquin River near the town of Lathrop, California on October 16, 2001. The treatment site is unknown, and it is unknown if the kill was the result of misuse or registered use. The certainty that the kill resulted from methomyl was listed as 'possible'. However, upon further review of the incident, it was acknowledged by California Fish and Game that un-ionized ammonia was the cause of the fish kill. Analyses of composited gill samples found the presence of several pesticides (dioxathion = 121.1 ppm; carbaryl = 1.75 ppm; carbofuran = 4.51 ppm; fenurin = 0.78 ppm; methomyl = 5.08 ppm; monuron = 5.83 ppm). However, these pesticides were not detected in the water samples and no mention was made in the California Fish and Game report that these pesticides may have been important factors in the fish kill.

A fishkill incident occurred in Seminole county, Georgia, on June 16, 1992 (Incident # I00108-001). The treatment site was corn, and it is unknown if the kill was the result of misuse or registered use. Also, the certainty that the kill resulted from methomyl was

listed as 'probable'. Upon further review of the incident report, it was assumed that runoff from a 200-acre plot of sweet corn treated with fertilizer and insecticides killed 125 bluegill, bowfin (*Amia calva*), and carp (*Cyprinus spp*). During a rainy two week period prior to the fishkill, the corn plot had been treated with 5 applications of methomyl (aerial, 1.5 pints/acre), 4 applications of chlorpyrifos, 4 applications of fertilizer, and 2 applications of borax. The suspected cause of the fish kill was methomyl, as Lannate® LV, toxicosis. Measured concentrations of methomyl were found in water samples taken from the pond and pond-overflow area.

A fish kill involving an unknown number and species of fish occurred in Riverside County, California, on November 18, 1976 (B0000-216-19). The incident occurred after registered uses of endulsulfan, mevinphos, and methomyl on lettuce; however, the report states it was 'unlikely' that methomyl caused the fish kill.

Reports contained in the database must be interpreted in the context that 1) not all incidents are expected to be reported and 2) in many instances it is difficult to establish a direct cause-effect relationship. Generally, if there are a significant number of incidents associated with the use of a certain pesticide, it is an indication that the pesticide may pose a higher environmental risk. However, the lack of reported incidents does not necessarily indicate a lack of incidents.

5. Risk Characterization

5.1 Risk Estimation - Integration of Exposure and Effects Data

Risk characterization is the integration of exposure and ecological effects characterization to determine the potential ecological risk from registered uses of methomyl, and the likelihood of direct and indirect effects to CRLF in aquatic and terrestrial habitats. For the screening-level portion of this assessment, the deterministic risk quotient method is used to provide a metric of potential risks. The RQ is a comparison of exposure estimates to toxicity endpoints; estimated exposure concentrations are divided by acute and chronic toxicity values. The resulting unitless RQs are compared to the Agency's levels of concern (LOCs) (see **Table 22**). LOCs are used to indicate when the use of a pesticide, as directed on the label, has the potential to cause adverse effects on non-target organisms.

Table 22. Agency Levels of Concern (LOC).

Risk	Description	RQ	Taxa
Acute	Potential for acute risk to non-target organisms which may warrant regulatory action in addition to restricted use classification	acute RQ > 0.5	aquatic animals, mammals, birds
Acute Restricted Use	Potential for acute risk to non-target organisms, but may be mitigated through restricted use classification	acute RQ > 0.1	aquatic animals
		acute RQ > 0.2	mammals and birds
Acute Listed Species	Listed species may be potentially affected by use	acute RQ > 0.05	aquatic animals and terrestrial invertebrates
		acute RQ > 0.1	mammals and birds
Chronic	Potential for chronic risk may warrant regulatory action, listed species may potentially be affected through chronic exposure	chronic RQ > 1	all animals
Non-Listed and Listed Plant	Potential for effects in non-listed and listed plants	RQ > 1	all plants

5.2 Potential for Direct Effects

5.2.1 Aquatic-Phase

Based on surrogate freshwater fish toxicity data and modeled aquatic EECs for various use scenarios used to represent all of the agricultural, non-agricultural, and orchard uses of methomyl in CA, there is a potential for direct adverse effects to aquatic-phase CRLF individuals from methomyl use in CA. The acute freshwater fish RQs range from 0.014 to 0.57 for all of the agricultural and orchard uses modeled. Eighteen of the use scenarios modeled [representing 54 uses: alfalfa (alfalfa and lupine), citrus (grapefruit, lemons, oranges, tangelos, and tangerines), cole crops (broccoli, Chinese broccoli, broccoli raab, cabbage, Chinese cabbage, cauliflower, and collards), corn (field and sweet), fruit trees (apples, nectarines, peaches, and pomegranates), garlic, grapes, lettuce (Brussels sprouts, chicory, endive, head lettuce, leaf lettuce, and spinach), melons (cucumber, eggplant, melons, pumpkins, and summer squash), nurseries, onions (green onions, dry bulb onions, and radishes), potatoes (potatoes and sweet potatoes), row crops (anise, asparagus, beans – succulent and dry, beets, carrots, celery, lentils, peas), strawberry, sugar beets, tomato (tomato and tomatillo), turf, and cereal grains (barley, oats, rye, sorghum, and wheat)] resulted in an exceedance of the Agency's acute endangered species LOC (RQ≥0.05)(see **Table 23**). Six of the use scenarios modeled [representing six uses: avocado, cotton, rangeland (Bermuda grass), scatter baits, blueberries, and mint] resulted in no acute LOC exceedances.

Freshwater fish RQs from chronic exposure to methomyl ranged from 0.08 to 5.01. Thirteen of the agricultural and orchard scenarios [representing 37 uses: alfalfa (alfalfa and lupine), cole crops (broccoli, Chinese broccoli, broccoli raab, cabbage, Chinese cabbage, cauliflower, and collards), corn (field and sweet), fruit trees (apples, nectarines, peaches, and pomegranates), lettuce (Brussels sprouts, chicory, endive, head lettuce, leaf lettuce, and spinach), nursery, onion (green onions, dry bulb onions, and radishes), row crops (anise, asparagus, beans – succulent and dry, beets, carrots, celery, lentils, peas), strawberry, sugar beets, tomato (tomato and tomatillo), and turf] resulted in an exceedance of the Agency's chronic risk LOC (RQ≥1.0) (see **Table 23**). Eleven of the use scenarios modeled [representing 24 uses: avocado, cereal grains (barley, oats, rye, sorghum, and wheat), citrus (grapefruit, lemons, oranges, tangelos, and tangerines), cotton, garlic, melons (cucumber, eggplant, melons, pumpkins, and summer squash), potatoes (potatoes and sweet potatoes), rangeland (Bermuda grass), scatter baits, blueberries, and mint] resulted in no chronic LOC exceedances.

Table 23. Acute and Chronic RQs for Freshwater Fish Based on EECs from Use Scenarios Used to Represent All Methomyl Uses in CA.

USE SCENARIO	Peak EEC (µg/L)	ACUTE RQ (LC_{50} = 320 µg/L)	60 day EEC (µg/L)	CHRONIC RQ (NOAEC = 12 µg/L)
Alfalfa	46.0	**0.14**	21.5	**1.79**
Avocado	9.24	0.03	3.12	0.26
Citrus	21.1	**0.07**	7.54	0.63
Cole crops	183	**0.57**	60.1	**5.01**
Corn	38.1	**0.12**	13.1	**1.09**
Cotton	9.64	0.03	1.95	0.16
Fruit trees	28.6	**0.09**	15.1	**1.26**
Garlic	25.3	**0.08**	9.30	0.78
Grapes	24.0	**0.08**	10.8	**0.9**
Lettuce	122	**0.38**	43.4	**3.62**
Melons	17.3	**0.05**	6.73	0.56
Nursery	27.6	**0.09**	11.90	**1**
Onion	28.0	**0.09**	13.9	**1.16**
Potato	22.4	**0.07**	9.84	0.82
Rangeland	13.5	0.04	4.86	0.41
Row crops	40.1	**0.13**	22.2	**1.85**
Strawberry	53.9	**0.17**	25.5	**2.13**
Sugar beets	28.6	**0.09**	13.6	**1.13**
Tomato	43.3	**0.14**	18.3	**1.53**
Turf	38.2	**0.12**	14.4	**1.2**
Cereal grains	23.4	**0.07**	9.24	0.77
Blueberries	13.8	0.04	4.80	0.4
Mint	2.76	0.01	0.987	0.08
Scatter Baits	4.54	0.01	2.49	0.21

Bolded RQs exceed the Agency's endangered species LOCs .

5.2.2 Terrestrial-Phase

Based on surrogate avian toxicity data, the maximum allowable application rate (8 applications, 0.9 lbs a.i./acre/application, 2-day application interval), the body-weight scaling factor for methomyl from Mineau *et al.* (1996) of 1.0778, and upper bound Kenaga values from T-REX, there is a potential for direct adverse effects on terrestrial-phase CRLF individuals from methomyl use in CA (see **APPENDIX M**). Using calculations based on bird ingestion rates and dietary and weight categories for the CRLF, all of the acute dose-based RQs (RQ range = 1 – 17.9) exceed the Agency's endangered species LOC. Additionally, the acute dietary-based (RQ = 0.3) and chronic (RQ = 2.1) RQs for the small insect dietary category exceed the endangered species LOCs (see **Table 24**).

Table 24. Acute and Chronic RQs for Terrestrial-Phase CRLF (Based on Upper Bound Kenaga Values from T-REX).

DIETARY CATEGORY	ACUTE RQ: DOSE-BASED		ACUTE RQ: DIETARY-BASED	CHRONIC RQ: DIETARY-BASED
	20 g	100 g		
Broadleaf plants/small insects	**17.9**	**9.0**	**0.3**	**2.1**
Fruits/pods/seeds/large insects	**2.0**	**1.0**	0.03	0.2

Bolded RQs exceed the Agency's endangered species LOC

5.3 Potential for Indirect Effects (Decreased Availability of Food Items)

5.3.1 Aquatic-Phase

Aquatic-phase CRLF are known to eat diatoms, algae, and detritus (larvae CRLF) and aquatic and terrestrial invertebrates (juvenile CRLF). Since no effects to aquatic plants are expected from the use of methomyl (see Section 2.8.1), only the invertebrate food sources will be assessed for potential indirect effects to aquatic-phase CRLF. The acute (RQ≥0.05) and chronic (RQ≥1.0) endangered species LOCs for freshwater invertebrates are exceeded for all agricultural and orchard uses of methomyl in CA (see **Table 25**). The acute RQs ranged from 0.55 (mint) to 36.6 (cole crops) and the chronic RQs ranged from 2.59 (mint) to 163 (cole crops).

The acute RQ for terrestrial invertebrates (RQ = 4,090) also exceeds the endangered species LOC (RQ≥0.05) for a single methomyl application at the maximum allowable agricultural and orchard use rate [(0.9 lb a.i./acre)/(0.00022 lb a.i./acre)]. Considering the maximum seasonal application rates, the acute RQ for orchard uses and agricultural uses equal 5,955 and 10,773, respectively (see Section 2.7.1 for an explanation of how these RQs are derived). No chronic toxicity data for terrestrial invertebrates are available, and, therefore, chronic RQs could not be calculated.

Table 25. Acute and Chronic RQs for Freshwater Invertebrates Based on EECs from Use Scenarios Used to Represent All Methomyl Uses in CA.

USE SCENARIO	Peak EEC (µg/L)	ACUTE RQ (EC_{50} = 5 µg/L)	21 day EEC (µg/L)	CHRONIC RQ (NOAEC = 0.7 µg/L)
Alfalfa	46.0	**9.2**	32.4	**46.29**
Avocado	9.24	**1.85**	6.16	**8.8**
Citrus	21.1	**4.22**	13.7	**19.57**
Cole crops	183	**36.6**	114	**162.86**
Corn	38.1	**7.62**	27.1	**38.71**
Cotton	9.64	**1.93**	4.99	**7.13**
Fruit trees	28.6	**5.72**	23.4	**33.43**
Garlic	25.3	**5.06**	15.1	**21.57**
Grapes	24.0	**4.8**	17.9	**25.57**
Lettuce	122	**24.4**	78.6	**112.29**
Melons	17.3	**3.46**	12.3	**17.57**
Nurseries	27.6	**5.52**	17.4	**24.86**
Onion	28.0	**5.6**	22.6	**32.29**
Potato	22.4	**4.48**	16.7	**23.86**
Rangeland	13.5	**2.7**	9.09	**12.99**
Row crops	40.1	**8.02**	30.7	**43.86**
Strawberry	53.9	**10.78**	39.9	**57**
Sugar beets	28.6	**5.72**	21.7	**31**
Tomato	43.3	**8.66**	29.4	**42**
Turf	38.2	**7.64**	24.7	**35.29**
Cereal grains	23.4	**4.68**	16.6	**23.71**
Blueberries	13.8	**2.76**	8.8	**12.57**
Mint	2.76	**0.55**	1.81	**2.59**
Scatter bait	4.54	**0.91**	3.54	**5.06**

Bolded RQs exceed the Agency's endangered species LOCs.

5.3.2 Terrestrial-Phase

Adult and juvenile CRLFs forage in aquatic and terrestrial habitats. The main food sources for juvenile terrestrial-phase CRLFs are thought to be aquatic and terrestrial invertebrates. In addition to aquatic and terrestrial invertebrates, adults also feed on fish, frogs, and small mammals. The RQs for fish, frogs, and aquatic and terrestrial invertebrates are discussed above (in Sections 5.2.1, 5.2.2, 5.3.1, and 2.7.1).

Mammalian RQs are only calculated for the 15 g and 35 g body size categories in T-REX, since these body weights better represent potential prey sizes for the terrestrial-phase adult frog than the 1,000 g body size category. RQs are calculated for both

agricultural and orchard uses using maximum seasonal application rates for each use category.

Methomyl is classified as 'highly toxic' to mammals on an acute oral exposure basis. All of the RQs calculated for acute exposure (dose-based) for 15 g and 35 g mammals (all forage categories) for agricultural uses exceed (RQs range from 0.1 to 8) the Agency's acute endangered species LOC (RQ≥0.1) (see **Table 26**). All of the RQs calculated for acute exposure (dose-based) for 15 g and 35 g mammals (all forage categories expect granivores) for orchard uses exceed (RQs range from 0.05 to 5) the Agency's acute endangered species LOC (RQ≥0.1). All of the chronic dose-based RQs for 15 g and 35 g mammals, except for those in the granivore dietary category, for both orchard and agricultural uses exceed (RQs range from 0.43 to 66) the Agency's chronic endangered species LOC (RQ≥1.0) (see **Table 26**). Additionally, all of the chronic dietary-based RQs exceeded (RQ range from 1.9 – 7.6) the Agency's chronic LOC except for those in the 'fruits/pods/seeds/large insect' dietary category (see **Table 27**).

Table 26. Mammalian Dose-Based RQ Values for Acute and Chronic Exposure to Methomyl from Agricultural and Orchard Uses (Based on Maximum Seasonal Application Rates and Upper Bound Kenaga Values).

DIETARY CATEGORY	BODY SIZE	USE CATEGORY	ACUTE RQ	CHRONIC RQ
Short Grass	**15 g**	Agriculture	**8.23**	**65.85**
		Orchard	**4.56**	**36.44**
	35 g	Agriculture	**7.03**	**56.25**
		Orchard	**3.89**	**31.13**
Tall Grass	**15 g**	Agriculture	**3.77**	**30.18**
		Orchard	**2.09**	**16.7**
	35 g	Agriculture	**3.22**	**25.78**
		Orchard	**1.78**	**14.27**
Broadleaf Plants/Small Insects	**15 g**	Agriculture	**4.63**	**37.04**
		Orchard	**2.56**	**20.5**
	35 g	Agriculture	**3.96**	**31.64**
		Orchard	**2.19**	**17.51**
Fruits/Pods/Seeds/Large Insects	**15 g**	Agriculture	**0.51**	**4.12**
		Orchard	**0.28**	**2.28**
	35 g	Agriculture	**0.44**	**3.52**
		Orchard	**0.24**	**1.95**
Granivore	**15 g**	Agriculture	**0.11**	0.91
		Orchard	0.06	0.51
	35 g	Agriculture	**0.1**	0.78
		Orchard	0.05	0.43

Bolded numbers indicate RQs that exceed the Agency's endangered species LOCs for mammals

Table 27. Mammalian Dietary-Based RQ Values for Chronic Exposure to Methomyl from Agricultural and Orchard Uses (Based on Maximum Seasonal Application Rates and Upper Bound Kenaga Values).

DIETARY CATEGORY	USE CATEGORY	RQ
Short Grass	Agriculture	**7.59**
	Orchard	**4.2**
Tall Grass	Agriculture	**3.48**
	Orchard	**1.93**
Broadleaf Plants/Small Insects	Agriculture	**4.27**
	Orchard	**2.36**
Fruits/Pods/Seeds/Large Insects	Agriculture	0.47
	Orchard	0.26

Bolded numbers indicate RQs that exceed the Agency's chronic risk LOC for mammals

5.4 Potential for Adverse Effects on Designated Critical Habitat PCEs

For methomyl use, 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. Since 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 will be the same as the effects determinations regarding the potential for adverse effects on designated critical habitat PCEs.

6. Risk Description

As noted in Section 2.7, the action area for methomyl use in CA overlaps with the range of the CRLF and its designated critical habitat. Therefore, a refined assessment is warranted.

6.1 Direct Effects

6.1.1 Aquatic-Phase

Based on surrogate freshwater fish toxicity data, there is a potential for direct adverse effects of aquatic-phase CRLF individuals from the following methomyl uses in CA (non-bolded uses = potential acute risk; bolded uses = potential acute and chronic risk): **alfalfa**, **anise**, **apples**, **asparagus**, barley, **beans** (succulent and dry), beets, **broccoli**, **broccoli raab**, **Brussels sprouts**, **cabbage**, **carrots**, **cauliflower**, **celery**, **chicory**, **Chinese broccoli**, **Chinese cabbage**, **collards**, **corn**, cucumber, eggplant, **endive**, garlic, grapefruit, grapes, **lettuce** (head and leaf), lemons, **lentils**, **lupine**, melons, **nectarines**, **nursery**, oats, **onions** (green onions and dry bulb onions), oranges, **peas**, **peaches**, **pomegranates**, potatoes, pumpkins, **radishes**, rye, sorghum, **spinach**, **strawberry**, **sugar beets**, summer squash, sweet potatoes, tangelos, tangerines, **tomato**, **tomatillo**, **turf**, and wheat. Therefore, there is a potential for direct effects to aquatic-phase CRLF from some agricultural and orchard uses of methomyl in CA.

Based on methomyl usage data in CA from 2002-2005, the agricultural uses that pose a potential for direct effects to aquatic-phase CRLF account for 97% (310,306 lbs) of all the methomyl applied on average per year in CA and include all of the top seven methomyl uses (by lbs a.i. applied per year). These seven uses account for 75% of all of the methomyl used in CA on average per year [lettuce (head and leaf) (19.7%), alfalfa (14.5%), corn (12.4%), tomatoes (including tomatillos) (10.2%), grapes (6.3%), beets (including sugar beets) (6%), and strawberries (5.7%)]]. Additionally, data on actual application dates for methomyl in CA for the top seven uses in 2003, 2004, and 2005, indicate that methomyl is being applied to these seven use sites during times of the year when aquatic-phase CRLF are likely to be present based on their reproductive parameters (*e.g.*, non-overwintering tadpoles are present from Dec. through May, and young juveniles are present from May through Sept.) (see **Figs. 4 and 11**).

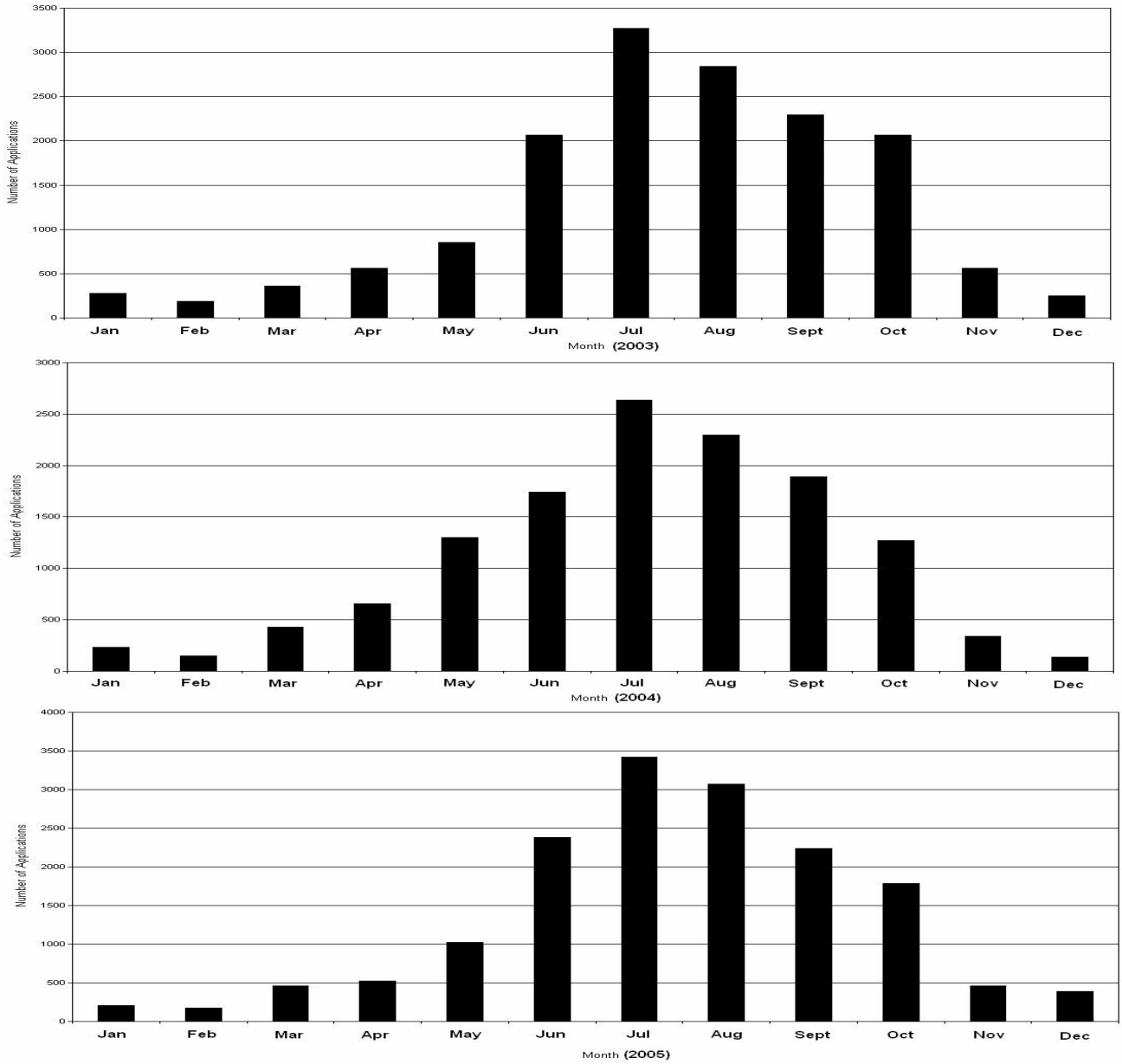


Figure 11. Application Dates for Methomyl in CA During 2003, 2004, and 2005 [Including the Following Uses: Lettuce (Head and Leaf), Alfalfa, Corn, Tomatoes (Including Tomatillos), Grapes, and Beets (Including Sugar Beets)].

Based on the CA cole crop PRZM scenario, the EECs from only one application of methomyl, at the maximum single application rate (0.9 lb a.i./acre), result in an exceedance (RQ = 0.09) of the Agency's acute risk to listed species LOC for aquatic

animals. The chronic risk LOC is not exceeded (RQ = 0.90) after only one 0.9 lb a.i./acre application of methomyl . This indicates that there is a risk of acute direct effects to aquatic-phase CRLF after one application of methomyl, at least to those found adjacent to application sites. Because some potential agricultural use sites in CA overlap with the CRLF's range (see **Fig. 12**) and usage data indicate that applicators do apply methomyl at the 0.9 lb a.i./acre application rate, the potential for direct adverse effects to aquatic-phase CRLF, even after one application, cannot be discounted at this time.

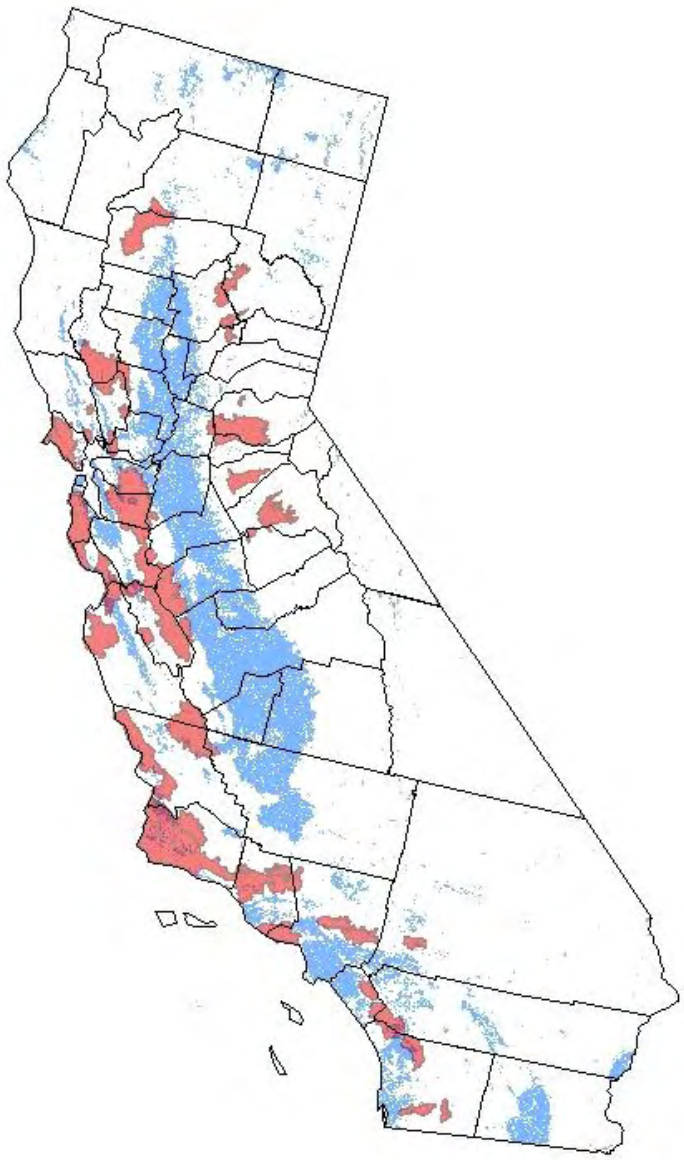


Figure 12. Overlap of Potential Methomyl Use Sites (Blue) in CA and CRLF Range and Designated Critical Habitat (Red).

6.1.1.1 Risks Based on the Probit Slope Analysis

The probit dose-response slope can be used to calculate the chance of an individual event corresponding to the listed species acute LOCs and/or RQs. The analysis uses the EFED spreadsheet IEC (version 1.1.xls). It is important to note that the IEC model output can go as low as 1×10^{-16} in estimating the event probability for animals. This cut-off is a limit in the Excel spreadsheet environment and is not to be interpreted as an agreed upon

lower bound threshold for concern for individual effects in any given listed species. If information is unavailable to estimate a slope from a study, a default slope assumption of 4.5 is used as per original Agency assumptions of typical acute toxicity dose-response slope cited in Urban and Cook (1986).

The slope for the LC_{50} of the most sensitive acute freshwater fish (channel catfish; LC_{50} = 320 µg a.i./L) is 4.23 (95 percent confidence limits = 2.32 and 6.15). Using the acute endangered species LOC of 0.05, the chance of an individual mortality for aquatic-phase CRLF is ~ 1 in 53,700,000 (with lower and upper bounds of ~ 1 in 787 to ~ 1 in 1.62E+15, respectively) (see **Table 28**). Based on an analysis of the likelihood of individual mortality and using the highest RQ value for freshwater fish (RQ=0.57, cole crop scenario) and a probit dose response of 4.23, the likelihood of individual mortality is ~ 1 in 6.6. At the lowest RQ value, *i.e*, RQ = 0.01 (mint scenario), the likelihood of individual mortality is ~ 1 in 7.48E+16.

Table 28. Chance of Individual Acute Effects to Aquatic-Phase CRLF Using Surrogate Freshwater Fish Toxicity Data and the Probit Slope Response Relationship.

LOC OR USE SITE SCENARIO (RQ)	LOC OR RQ	PROBIT SLOPE		CHANCE OF AN INDIVIDUAL EFFECT
Acute Endangered Species LOC	0.05	Slope	4.23	~ 1 in 53,700,000
		Upper Bound	2.32	~ 1 in 787
		Lower Bound	6.15	~ 1 in 1.62E+15
Alfalfa	**0.14**	Slope	4.23	~ 1 in 6,580
		Upper Bound	2.32	~ 1 in 42
		Lower Bound	6.15	~ 1 in 13,200,000
Avocado	0.03	Slope	4.23	~ 1 in 1.69E+10
		Upper Bound	2.32	~ 1 in 4,870
		Lower Bound	6.15	~ 1 in 2.65E+20
Citrus	**0.07**	Slope	4.23	~ 1 in 1,940,000
		Upper Bound	2.32	~ 1 in 271
		Lower Bound	6.15	~ 1 in 1.63E+12
Cole crops	**0.57**	Slope	4.23	~ 1 in 6.63
		Upper Bound	2.32	~ 1 in 3.5
		Lower Bound	6.15	~ 1 in 15
Corn	**0.12**	Slope	4.23	~ 1 in 20,400
		Upper Bound	2.32	~ 1 in 61.2
		Lower Bound	6.15	~ 1 in 134,000,000
Cotton	0.03	Slope	4.23	~ 1 in 1.69E+10
		Upper Bound	2.32	~ 1 in 4,870
		Lower Bound	6.15	~ 1 in 2.65E+20
Fruit trees	**0.09**	Slope	4.23	~ 1 in 206,000
		Upper Bound	2.32	~ 1 in 131
		Lower Bound	6.15	~ 1 in 1.58E+10
Garlic	**0.08**	Slope	4.23	~ 1 in 574,000
		Upper Bound	2.32	~ 1 in 183
		Lower Bound	6.15	~ 1 in 1.32E+11
Grapes	**0.08**	Slope	4.23	~ 1 in 574,000
		Upper Bound	2.32	~ 1 in 183
		Lower Bound	6.15	~ 1 in 1.32E+11
Lettuce	**0.38**	Slope	4.23	~ 1 in 26.5
		Upper Bound	2.32	~ 1 in 6.07
		Lower Bound	6.15	~ 1 in 205
Melons	**0.05**	Slope	4.23	~ 1 in 53,700,000
		Upper Bound	2.32	~ 1 in 787
		Lower Bound	6.15	~ 1 in 1.62E+15
Nursery	**0.09**	Slope	4.23	~ 1 in 206,000
		Upper Bound	2.32	~ 1 in 131
		Lower Bound	6.15	~ 1 in 1.58E+10
Onion	**0.09**	Slope	4.23	~ 1 in 206,000
		Upper Bound	2.32	~ 1 in 131
		Lower Bound	6.15	~ 1 in 1.58E+10
Potato	**0.07**	Slope	4.23	~ 1 in 1,940,000
		Upper Bound	2.32	~ 1 in 271
		Lower Bound	6.15	~ 1 in 1.63E+12

LOC OR USE SITE SCENARIO (RQ)	LOC OR RQ	PROBIT SLOPE		CHANCE OF AN INDIVIDUAL EFFECT
Rangeland	0.04	Slope	4.23	~ 1 in 596,000,000
		Upper Bound	2.32	~ 1 in 1,690
		Lower Bound	6.15	~ 1 in 2.45E+17
Row crops	**0.13**	Slope	4.23	~ 1 in 11,200
		Upper Bound	2.32	~ 1 in 50.2
		Lower Bound	6.15	~ 1 in 39,400,000
Strawberry	**0.17**	Slope	4.23	~ 1 in 1,760
		Upper Bound	2.32	~ 1 in 27
		Lower Bound	6.15	~ 1 in 902,000
Sugar beets	**0.09**	Slope	4.23	~ 1 in 206,000
		Upper Bound	2.32	~ 1 in 131
		Lower Bound	6.15	~ 1 in 1.58E+10
Tomato	**0.14**	Slope	4.23	~ 1 in 6,580
		Upper Bound	2.32	~ 1 in 42
		Lower Bound	6.15	~ 1 in 13,200,000
Turf	**0.12**	Slope	4.23	~ 1 in 20,400
		Upper Bound	2.32	~ 1 in 61.2
		Lower Bound	6.15	~ 1 in 134,000,000
Cereal grains	**0.07**	Slope	4.23	~ 1 in 1,940,000
		Upper Bound	2.32	~ 1 in 271
		Lower Bound	6.15	~ 1 in 1.63E+12
Blueberries	0.04	Slope	4.23	~ 1 in 596,000,000
		Upper Bound	2.32	~ 1 in 1,690
		Lower Bound	6.15	~ 1 in 2.45E+17
Mint	0.01	Slope	4.23	~ 1 in 7.48E+16
		Upper Bound	2.32	~ 1 in 574,000
		Lower Bound	6.15	~ 1 in 2.21E+34
Scatter Bait	0.01	Slope	4.23	~ 1 in 7.48E+16
		Upper Bound	2.32	~ 1 in 574,000
		Lower Bound	6.15	~ 1 in 2.21E+34

Bolded RQs are those that exceed the Agency's acute endangered species LOC

6.1.1.2 Species Sensitivity Distribution for Freshwater Fish

Because freshwater fish are being used as surrogates for aquatic-phase CRLF and the most sensitive acute toxicity value for methomyl is being used, we wanted to gauge how sensitive freshwater fish, in general, are to methomyl on an acute exposure basis. Therefore, a species sensitivity distribution (SSD) for the eight freshwater fish for which acute toxicity data are available was calculated. The eight genus mean 96-h LC_{50} values used to calculate the acute SSD for freshwater fish are listed in **Table 29**. For a specific species with multiple tests available, the geometric species mean LC_{50} value for the specific species was calculated first, and then the genus mean LC_{50} was calculated.

Table 29. Freshwater Fish Genus and Species Mean Acute 96-Hr LC_{50} Values.

GENUS MEAN ACUTE VALUE (µg/L)	SPECIES	NUMBER OF ACUTE VALUES USED TO CALCULATE THE SPECIES MEAN VALUE	SPECIES MEAN ACUTE VALUE (µg/L)
1,996	*Pimephales promelas* Fathead minnow	4	1,996
1,590	*Salvelinus fontinalis* Brook trout	3	1,590
1,504	*Oncorhynchus mykiss* Rainbow trout	18	1,504
1,070	*Tilapia nilotica* Tilapia	1	1,070
975	*Micropterus salmoides* Largemouth bass	2	975
964	*Salmo salar* Atlantic salmon	10	964
831	*Lepomis macrochirus* Bluegill sunfish	21	831
587	*Ictalurus punctatus*[1] Channel catfish	5	587

The genus log LC_{50} values are used to calculate a SSD using a Student's t-distribution (a t-distribution was used because toxicity values were only available for eight freshwater fish genera). Therefore, a t- distribution of genus mean log LC_{50} values and log SD values was assumed in extrapolating 5th, 50th, and 95th percentile LC_{50} values for freshwater fish. All caculations were done using Excel 2003. Using this approach, the 5th percentile LC_{50} is 526 µg/L, the 50th or median percentile LC_{50} value is 1,112 µg/L, and the 95th is 2,352 µg/L (**Fig. 13**). Assuming that the genera tested represent the full range of freshwater fish sensitivity to methomyl, these results indicate that 5% of freshwater fish will have an LC_{50} value less than or equal to 526 µg/L, 50% less than or equal to 1,112 µg/L, and 95% less than or equal to 2,352 µg/L. Relative to this sensitivity distribution, the channel catfish LC_{50} value (320 µg/L) is a conservative estimate with over 95% of the fish being less sensitive. Even relative to the genus mean for catfish (*Ictalurus spp*. LC_{50}=587 µg/L), the value used in this assessment is conservative.

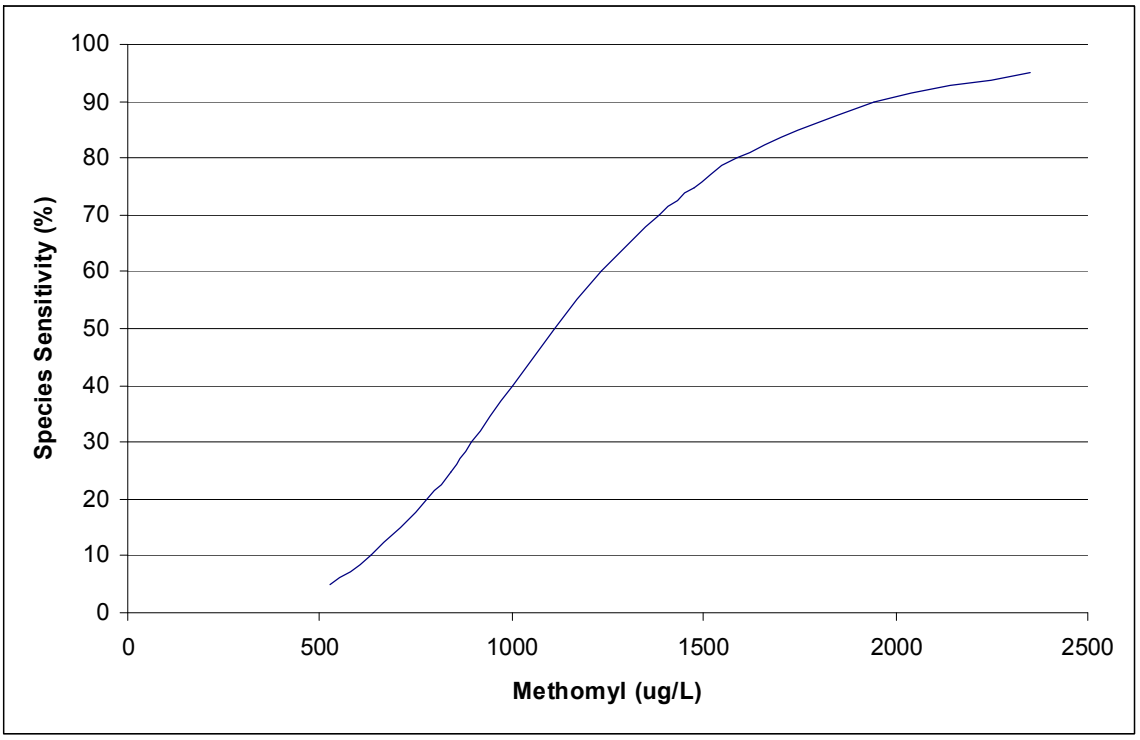


Figure 13. Freshwater Fish Species Sensitivity Distribution for Methomyl.

The highest 1 in ten year aquatic EEC for all of the agricultural, non-agricultural, and orchard scenarios for methomyl is 183 µg/L (for the cole crops scenario). At this EEC, and as discussed above, the Agency's acute risk to listed species LOC is exceeded using the most sensitive acute toxicity value for freshwater fish (*i.e.*, 320 µg/L). If RQs were calculated based on this EEC and the 5th percentile (*i.e.*, LC_{50} = 526 µg/L), the median percentile (*i.e.*, LC_{50} = 1,112 µg/L), and the 95th percentile (*i.e.*, LC_{50} = 2,352 µg/L) LC_{50} for freshwater fish, the RQs would equal 0.35, 0.16, and 0.08, respectively. Therefore, according to this analysis, unless aquatic-phase CRLF are less sensitive to methomyl than essentially all freshwater fish tested, the potential for direct adverse effects (mortality) on aquatic-phase CRLF from methomyl use (at maximum seasonal application rates) exists. Although aquatic-phase amphibians (including the CRLF) may be less sensitive to methomyl than freshwater fish, until comparative toxicity data on amphibians are available, conclusions regarding their relative sensitivity to methomyl cannot be made and we assume they are as sensitive to methomyl as freshwater fish.

Therefore, based on the above analyses, there is the potential for risk of direct effects to aquatic-phase CRLF from acute and/or chronic exposure to methomyl from most registered agricultural (including orchards) uses of methomyl. Additionally, there is the potential for acute risk to aquatic-phase CRLF after a single application of methomyl on some crops (*i.e.*, cole crops) at the maximum allowed application rate. Because some potential agricultural use sites in CA overlap with the CRLF's range (see **Fig. 12**) and usage data indicate that applicators do apply methomyl at the 0.9 lb a.i./acre application

rate, the potential for direct adverse effects to aquatic-phase CRLF, even after a single application, cannot be discounted at this time. Therefore, the Agency makes a 'likely to adversely affect' (LAA) determination for direct effects to aquatic-phase CRLF from methomyl use in CA.

6.1.2 Terrestrial-Phase

For birds, used as a surrogate for terrestrial-phase CRLF, all of the acute dose-based RQs, and the acute dietary-based and chronic RQs for the small insect forage category from T-REX exceed the endangered species LOCs at the maximum application rate for methomyl in CA. This indicates a potential for direct adverse effects to terrestrial-phase CRLF from methomyl use in CA. This is supported by the two bird kill incidents that occurred in France and involved the registered use of methomyl on cabbage (Incident # I006382-001 and I006382-002).

In order to refine our assessment of the potential for direct effects to the frog, T-HERPS was used to calculate RQs for the CRLF using toxicity data from birds and the ingestion rate of insectivorous iguanids (see **APPENDIX N** for more details). All of the LOCs (acute and chronic) were exceeded for the small insect (all frog size classes) and the small herbivore mammal forage categories (assuming a 238 g frog) (see **Table 30**). Additionally, the acute dose-based RQ exceeded the Agency's LOC for 238 g frogs eating small insectivorous mammals. This indicates that terrestrial-phase CRLF (all size classes) that eat small insects and larger CRLF that eat small herbivorous mammals are at potential risk from acute and chronic exposure to methomyl from labeled use in CA. Larger frogs that eat small insectivorous mammals are also at potential risk from acute exposure to methomyl.

Table 30. Upper Bound Kenaga Acute and Chronic Terrestrial Herpetofauna RQs (from T-HERPS) (8 Applications, 0.9 lb a.i./Acre/Application, 2-Day Application Interval).

Acute Dose-Based					
Size Class (grams)	**Broadleaf Plants/ Small Insects**	**Fruits/Pods/ Seeds/ Large Insects**	**Small Herbivore Mammals**	**Small Insectivore Mammal**	**Small Amphibians**
	RQ	**RQ**	**RQ**	**RQ**	**RQ**
1.4	**0.51**	0.06	N/A	N/A	N/A
37	**0.51**	0.06	N/A	N/A	0.03
238	**0.33**	0.04	**2.28**	**0.14**	0.01
Acute Dietary-Based					
	0.29	0.03	**0.34**	0.02	0.01
CHRONIC RQs					
	2.13	0.24	**2.50**	0.16	0.07

Bolded numbers exceed the Agency's endangered species LOCs.

Using the acute endangered species LOC of 0.1 and default slopes (4.5, upper and lower bounds of 2 and 9), the chance of an individual mortality for terrestrial-phase CRLF is ~

1 in 418,000,000 (with lower and upper bounds of ~ 1 in 216 to ~ 1 in 1.75E+31, respectively) (see **Table 31**). The chances of individual effects for the different body size and dietary categories range from 100% (dose-based, 238 g frog that eats a herbivorous mammal) to ~ 1 in 8.86E+18 (dietary-based, frog that eats an amphibian).

Table 31. Chance of Individual Effects for Terrestrial-Phase CRLF from Methomyl Use (8 Applications, 0.9 lb a.i./Acre/Application, 2-Day Application Interval).

Size Class (grams)	Slope	Small Insect (RQ)	Chance of Ind. Effects	Large Insect (RQ)	Chance of Ind. Effects	Herb. Mam. (RQ)	Chance of Ind. Effects	Insct. Mam. (RQ)	Chance of Ind. Effects	Amph (RQ)	Chance of Ind. Effects
Dose-Based											
N/A	4.5	LOC = 0.1	4.18E+08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2		216								
	9		1.75E+31								
1	4.5	0.51	11.4	0.06	52,200,000	N/A	N/A	N/A	N/A	N/A	N/A
	2		3.66		138						
	9		297		5.04E+27						
37	4.5	0.51	11.4	0.06	52,200,000	N/A	N/A	N/A	N/A	0.03	2.76E+11
	2		3.66		138						862
	9		297		5.04E+27						2.14E+42
238	4.5	0.33	66.1	0.04	6.33E+09	2.28	1.06	0.14	648	0.01	8.86E+18
	2		5.96		386		1.31		942		31,600
	9		136,000		7.49E+35		1		6.14E+8		1.03E+72
Dietary-Based											
N/A	4.5	0.29	129	0.03	2.76E+11	0.34	175	0.02	9.60E+13	0.01	8.86E+18
	2		7.09		862		5.73		2,950		31,600
	9		1,530,000		2.14E+42		80,700		2.27E+52		1.03E+72

After a single application of methomyl (0.9 lb a.i./acre), all of the RQ values exceed the acute risk to listed species LOC for the small insect and the small herbivore mammalian forage categories (all size classes) (see **Table 32**). This indicates a potential risk to terrestrial-phase CRLF after a single application of methomyl at the maximum application rate.

Table 32. Upper Bound Kenaga Acute and Chronic Terrestrial Herpetofauna RQs (from T-HERPS) (1 Application, 0.9 lb a.i./Acre/Application).

Size Class (grams)	Broadleaf Plants/ Small Insects RQ	Fruits/Pods/ Seeds/ Large Insects RQ	Small Herbivore Mammals RQ	Small Insectivore Mammal RQ	Small Amphibians RQ
Acute Dose-Based					
1.4	**0.2**	0.02	N/A	N/A	N/A
37	**0.19**	0.02	N/A	N/A	0.01
238	**0.13**	0.01	**0.86**	0.05	<0.01
Acute Dietary-Based					
	0.11	0.01	**0.13**	0.01	0.00
CHRONIC RQs					
	0.81	0.09	**0.95**	0.06	0.03

Bolded numbers exceed the Agency's endangered species LOCs.

To explore what application rate would be needed to reduce RQs so that they no longer exceeded Agency LOCs, we modeled various single application rates in T-HERPS. Single application rates ≤0.6 lbs a.i./acre result in RQs below the Agency's chronic risk LOC and single application rates ≤0.1 lbs a.i./acre result in RQs below the Agency's acute risk to listed species LOC. The methomyl usage data provided by BEAD indicate that the *maximum* single application rate and the *average* single application rate for all orchard and agricultural uses in CA between 2002 and 2005 were ≥0.1 lbs a.i./acre. All orchard and most agricultural uses [except chicory, dandelion green, forage (hay/silage), garlic, rye, tangelo, and uncultivated ag] have a *maximum* and *average* reported single application rate ≥ 0.6 lb a.i./acre. This indicates that there is a potential risk of direct acute effects and chronic effects on terrestrial-phase CRLF from all orchard and agricultural uses of methomyl in CA after a single application of the pesticide based on maximum and average use rates.

These potential risks for direct effects to terrestrial-phase CRLF are associated with food items contaminated with methomyl on the site of application during application. For the agricultural and orchard uses, off-site exposure to methomyl may occur via spray drift. AgDRIFT (Tier III, aerial, ASAE Very Fine to Fine droplet size distribution) and the smallest ratio of LOC/RQ from T-HERPS [238 g frog that eats small herbivorous mammals (LOC = 0.1)/(RQ = 2.28) = 0.044] are used to determine the fraction of application applied for the RQ to be below the LOC for the maximum seasonal application rate (8 applications at 0.9 lb a.i./acre). Based on this analysis, small mammals that feed on grasses within 906 ft of the site of methomyl application and are eaten by small CRLF could result in direct effects on the frogs. Following a single application of methomyl at 0.9 lbs a.i./A, the mimimum distance from the treated field would have to be 256 ft for a terrestrial-phase 238-g CRLF not to be affected. For low volume aerial applications, the distance (for a single application at 0.9 lbs a.i./acre) would extend to 2,031 ft.

Based on this analysis, a terrestrial-phase CRLF frog within 906 ft of the site of application (for agricultural uses) may be directly adversely affected, through ingestion of contaminated forage items, from methomyl use at the maximum labeled use rate for CA. The distance where no direct effects occur to terrestrial-phase CRLF is 256 ft and 2,031 ft from the site of methomyl application at a single application of 0.9 lb a.i./acre [for orchard and agricultural uses (low volume), respectively]. Because potential agricultural and orchard use sites for methomyl overlap with the CRLF's range and designated critical habitat (see **Fig. 12**), and the usage data show that the maximum single application rate for many agricultural and orchard uses (0.9 lb a.i./acre) is being used, the Agency makes a 'likely to adversely affect' determination for direct effects to terrestrial-phase CRLF from methomyl use in CA.

6.2 Indirect Effects

Because methomyl is not expected to adversely affect plants (see Section 2.8.1), the potential for indirect effects to CRLF is limited to possible decreases in their food supply (*i.e.*, loss of aquatic and terrestrial invertebrate and vertebrate prey items). The potential loss of prey could result in mortality of CRLF through direct starvation or reduced survival and reproductive rates caused by food stress and/or reduced body size during vulnerable stages in their life-cycle.

6.2.1 Aquatic Prey

This section will focus on potential aquatic prey items (*i.e.*, freshwater fish, aquatic-phase amphibians, and freshwater invertebrates).

6.2.1.1 Fish and Aquatic-Phase Amphibians

The results of the species sensitivity distribution for freshwater fish (see Section 6.1.1.2) indicate that 5% of freshwater fish may have an LC_{50} value less than or equal to 526 µg/L, 50% less than or equal to 1,112 µg/L, and 95% less than or equal to 2,352 µg/L. The peak aquatic EEC of all the agricultural and orchard scenarios for methomyl is 183 µg/L (cole crops). As discussed above, if RQs were calculated based on this EEC and the 5th percentile, the median percentile, and the 95th percentile LC_{50} for freshwater fish, the RQs would equal 0.34, 0.16, and 0.08, respectively. Although these RQs do exceed the acute risk to listed species LOC, indicating a potential for direct effects to aquatic-phase CRLF, they do not exceed the acute risk LOC for non-listed species of 0.5. For cole crops, based on the probit slope analysis, there is the potential for 1 in 6.6 individuals to be affected by methomyl use at maximum seasonal application rates (at least of those fish more sensitive than the 5th percentile, since the most sensitive LC_{50} value of 320 µg/L is used in the probit dose analysis).

The use scenario with the next highest peak EEC is the lettuce scenario with 122 µg/L. If RQs were calculated based on this EEC and the 5th, the median, and the 95th percentile LC_{50} for freshwater fish, the RQs would equal 0.23, 0.11, and 0.05, respectively. Therefore, the risk picture for freshwater fish is similar using the lettuce and cole crop

scenarios [*i.e.,* the RQs exceed the acute risk to listed species LOC; however, they do not exceed the acute risk to non-listed species LOC. The chance of an individual effect for the lettuce scenario is 1 in 26.5 for fish more sensitive than the 5th percentile. The next highest peak EEC is from the strawberry scenario (53.9 µg/L). This EEC results in of 0.10, 0.05, and 0.02 for the 5th, the median, and the 95th percentile LC_{50} values for freshwater fish, respectively.

Therefore, there is a likelihood that the use of methomyl on several agricultural crops could result in mortality of individual fish. The results would be the same for aquatic-phase amphibians assuming equal toxicity among fish and aquatic-phase amphibians to methomyl.

6.2.1.2 Freshwater Invertebrates

The acute and chronic risk to listed species LOCs for freshwater invertebrates are exceeded for all agricultural and orchard uses of methomyl in CA. The acute RQs range from 0.55 (mint) to 36.6 (cole crops) and the chronic RQs ranged from 2.59 (mint) to 163 (cole crops). A single application of 0.9 lb a.i./acre (using the cole crop scenario; peak EEC = 30 µg/L and 21-day EEC = 21 µg/L) results in EECs that exceed the most sensitive EC_{50} value for a freshwater invertebrate (daphnid EC_{50} = 5 µg/L). Additionally, all of the use scenarios modeled result in peak EECs above 5 µg/L except for the mint and scatter bait scenarios. This suggests that most of the California agricultural and orchard uses of methomyl, if used at maximum seasonal application rates (and in some cases at maximum single application rates), could result in at least 50% mortality in aquatic invertebrates that are at least as acutely sensitive to methomyl as daphnids and are found adjacent to application sites.

The chance of individual effects for freshwater invertebrates for each use scenario using the IECv1.1.xls spreadsheet and daphnid toxicity data [slope = 3.45 (95% confidence limits = 1.12 and 5.79)] range from ~1 in 5.4 (mint) to 100% for all other uses (see **Table 33**).

Table 33. Chance of Individual Acute Effects to Freshwater Invertebrates Using the Probit Slope Response Relationship.

LOC OR USE SITE SCENARIO (RQ)	LOC OR RQ	PROBIT SLOPE		CHANCE OF AN INDIVIDUAL EFFECT
Acute Endangered Species LOC	**0.05**	Slope	3.45	~ 1 in 279,000
		Upper Bound	1.12	~ 1 in 13.8
		Lower Bound	5.79	~ 1 in 4.03E+13
Alfalfa	**9.2**	Slope	3.45	~ 1 in 1
		Upper Bound	1.12	~ 1 in 1
		Lower Bound	5.79	~ 1 in 1
Avocado	**1.85**	Slope	3.45	~ 1 in 1.22
		Upper Bound	1.12	~ 1 in 1.62
		Lower Bound	5.79	~ 1 in 1.06
Citrus	**4.22**	Slope	3.45	~ 1 in 1.02
		Upper Bound	1.12	~ 1 in 1.32
		Lower Bound	5.79	~ 1 in 1
Cole crops	**36.6**	Slope	3.45	~ 1 in 1
		Upper Bound	1.12	~ 1 in 1
		Lower Bound	5.79	~ 1 in 1
Corn	**7.62**	Slope	3.45	~ 1 in 1
		Upper Bound	1.12	~ 1 in 1.19
		Lower Bound	5.79	~ 1 in 1
Cotton	**1.93**	Slope	3.45	~ 1 in 1.19
		Upper Bound	1.12	~ 1 in 1.60
		Lower Bound	5.79	~ 1 in 1.05
Fruit trees	**5.72**	Slope	3.45	~ 1 in 1
		Upper Bound	1.12	~ 1 in 1.25
		Lower Bound	5.79	~ 1 in 1
Garlic	**5.06**	Slope	3.45	~ 1 in 1.01
		Upper Bound	1.12	~ 1 in 1.27
		Lower Bound	5.79	~ 1 in 1
Grapes	**4.8**	Slope	3.45	~ 1 in 1.01
		Upper Bound	1.12	~ 1 in 1.29
		Lower Bound	5.79	~ 1 in 1
Lettuce	**24.4**	Slope	3.45	~ 1 in 1
		Upper Bound	1.12	~ 1 in 1.06
		Lower Bound	5.79	~ 1 in 1
Melons	**3.46**	Slope	3.45	~ 1 in 1.03
		Upper Bound	1.12	~ 1 in 1.38
		Lower Bound	5.79	~ 1 in 1
Nursery	**5.52**	Slope	3.45	~ 1 in 1.01
		Upper Bound	1.12	~ 1 in 1.25
		Lower Bound	5.79	~ 1 in 1
Onion	**5.6**	Slope	3.45	~ 1 in 1
		Upper Bound	1.12	~ 1 in 1.25
		Lower Bound	5.79	~ 1 in 1
Potato	**4.48**	Slope	3.45	~ 1 in 1.01
		Upper Bound	1.12	~ 1 in 1.3
		Lower Bound	5.79	~ 1 in 1
Rangeland	**2.7**	Slope	3.45	~ 1 in 1.07

LOC OR USE SITE SCENARIO (RQ)	LOC OR RQ	PROBIT SLOPE		CHANCE OF AN INDIVIDUAL EFFECT
		Upper Bound	1.12	~ 1 in 1.46
		Lower Bound	5.79	~ 1 in 1.01
Row crops	**8.02**	Slope	3.45	~ 1 in 1
		Upper Bound	1.12	~ 1 in 1.18
		Lower Bound	5.79	~ 1 in 1
Strawberry	**10.78**	Slope	3.45	~ 1 in 1
		Upper Bound	1.12	~ 1 in 1.14
		Lower Bound	5.79	~ 1 in 1
Sugarbeets	**5.72**	Slope	3.45	~ 1 in 1
		Upper Bound	1.12	~ 1 in 1.25
		Lower Bound	5.79	~ 1 in 1
Tomato	**8.66**	Slope	3.45	~ 1 in 1
		Upper Bound	1.12	~ 1 in 1.17
		Lower Bound	5.79	~ 1 in 1
Turf	**7.64**	Slope	3.45	~ 1 in 1
		Upper Bound	1.12	~ 1 in 1.19
		Lower Bound	5.79	~ 1 in 1
Cereal grains	**4.68**	Slope	3.45	~ 1 in 1.01
		Upper Bound	1.12	~ 1 in 1.29
		Lower Bound	5.79	~ 1 in 1
Blueberries	**2.76**	Slope	3.45	~ 1 in 1.07
		Upper Bound	1.12	~ 1 in 1.45
		Lower Bound	5.79	~ 1 in 1.01
Mint	**0.55**	Slope	3.45	~ 1 in 5.4
		Upper Bound	1.12	~ 1 in 2.59
		Lower Bound	5.79	~ 1 in 15.1
Scatter bait	**0.91**	Slope	3.45	~ 1 in 2.25
		Upper Bound	1.12	~ 1 in 2.08
		Lower Bound	5.79	~ 1 in 2.46

Bolded RQs are those that exceed the Agency's acute endangered species LOC

6.2.1.2.1 Species Sensitivity Distribution for Acute Exposure in Freshwater Invertebrates

The six genus mean EC_{50} values used to calculate the acute SSD for freshwater invertebrates are listed in **Table 34**. For a specific species with multiple tests available, the geometric species mean EC_{50} value for the specific species was calculated first, and then the mean EC_{50} for the genus was calculated. The log EC_{50} values for available genera are assumed to be from a normal distribution and are used to calculate the parameters of this distribution, *i.e.*, mean and standard deviation (SD).

Table 34. Ranked Freshwater Invertebrate Genus Mean Acute Values.

RANK	GENUS MEAN ACUTE VALUE (Total µg/L)	SPECIES	NUMBER OF ACUTE VALUES USED TO CALCULATE THE SPECIES MEAN VALUE
6	886	*Gammarus pseudolimnaeus*[1] Scud	3
5	99.7	*Isogenus* sp.[2] Stonefly	2
4	64.3	*Pteronarcella* sp.[2] Stonefly	2
3	53.1	*Chironomus plumosus*[1] Midge	2
2	31.4	*Skwala* sp.[2] Stonefly	2
1	15.7	*Daphnia magna*[1] Daphnid	4

[1] Endpoints are from a 48-hr study.
[2] Endpoints are from a 96-hr study.

The genus log LC_{50} values are used to calculate a SSD using a Student's t-distribution (a t-distribution was used because toxicity values were only available for six freshwater invertebrate genera). Therefore, a t-distribution of genus mean log LC_{50} values and log SD values was assumed in extrapolating 5th, 50th, and 95th percentile LC_{50} values for freshwater invertebrates. All calculations were done using Excel 2003. Since there was a relatively small sample size, data from 48-hr and 96-hr studies were combined. This may alter the shape of the distribution curve and may result in underestimating the effects, however, the information provided by the SSD was still considered useful. Using this approach, the 5th percentile LC_{50} is 4.5 µg/L, the 50th or median percentile LC_{50} value is 73 µg/L, and the 95th is 1,174 µg/L. The cumulative EC_{50} SSD with concentration-response curves for the 5th, 50th, and 95th percentile generic species are presented in **Figure 14**.

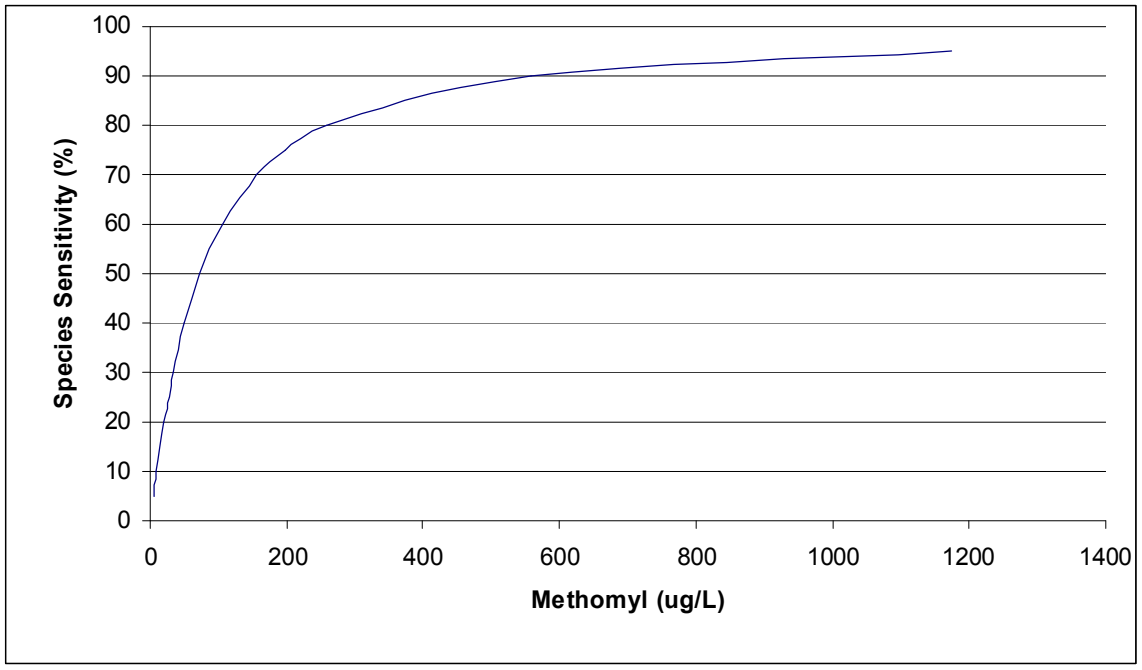


Figure 14. Species Sensitivity Distribution for Freshwater Invertebrates and Methomyl.

The acute sensitivity distribution for freshwater aquatic invertebrates indicates that 5% of the freshwater invertebrate genera have an EC_{50} value of 4.5 µg/L or less, 50% have an EC_{50} value of 73 µg/L or less, and 95% have an EC_{50} value of 1,174 µg/L or less (assuming the invertebrates tested exhibit a full range of sensitivity to methomyl). The modeled scenarios for methomyl predict peak EECs ranging from 2.76 µg/L to 183 µg/L. The predicted peak EECs for only one of the scenarios modeled (mint) is below 4.5 µg/L; 21 of the modeled uses have EEC values that range from >4.5 µg/L to 73 µg/L; and two uses (lettuce and cole crops) have EECs >73. Therefore, based on available data and this analysis, estimated environmental concentrations of methomyl may result in 50% mortality of sensitive freshwater invertebrates for most of the modeled uses at their maximum methomyl application rates in the assessment area.

6.2.1.2.2 Microcosm Study

The microcosm study discussed in Section 4.1.3 showed significant adverse effects to aquatic organisms at methomyl concentrations within the range of aquatic EECs predicted for most agricultural and orchard uses of methomyl. At the lower treatment level (0.048 lb a.i./applied every 7 days), the initial concentration at day one was 9.7 µg/L, the peak concentration was 12.8 µg/L (day 7), and the concentration dropped to 3.3 µg/L and <LOQ on day 22 and day 35, respectively. At these concentrations, no effects were seen in phytoplankton. Zooplankton, however, showed mixed results; the abundance of adult copepods and rotifers generally increased following methomyl applications, however, cladoceran abundance was reduced (to less than 1% of the

abundance of the control group) and their numbers did not recover during the study period. Bluegill survival was not affected in any of the microcosm treatment levels. Bluegill length and body weight at harvest, however, were significantly reduced (up to 18.5%) at all methomyl treatment levels when compared with controls. The size reductions were attributed to a decrease in food resources, particularly cladocerans. Therefore, the microcosm study shows that EECs below those predicted from a single application of methomyl could affect aquatic invertebrates at a level that could adversely impact fish, and, thus, presumably aquatic-phase CRLF.

6.2.1.3 Effects Determination for Indirect Effects to the CRLF Due to a Potential Decrease in Aquatic Prey

The most commonly observed aquatic prey species for the CRLF are larval alderflies, pillbugs, water striders and sowbugs (Hayes and Tennant, 1985). Unfortunately, none of the acceptable methomyl data we have for aquatic invertebrate toxicity overlap taxonomically (even to the Order level) with these preferred prey species. Therefore, there is no information available to indicate whether the preferred prey species are actually more or less sensitive to methomyl than the species used in the above analyses. However, based on the exposure analyses, the chance of individual effects (*i.e.*, the probit dose analysis), the species sensitivity distributions for freshwater fish and invertebrates, and the results from the microcosm study, CRLF adjacent to agricultural and orchard use sites have the potential to be indirectly affected by methomyl due to a loss of potential aquatic prey items, especially aquatic invertebrates. Therefore, the Agency makes a likely to adversely affect determination for the CRLF based on the potential loss of aquatic prey from the labeled use of methomyl in California.

6.2.2 Terrestrial Prey

This section will focus on potential terrestrial prey items (*i.e.*, small mammals, frogs, and terrestrial invertebrates).

6.2.2.1 Small Terrestrial Vertebrates

RQs calculated for the 15 g and 35 g mammals, for both agricultural and orchard uses at maximum seasonal application rates, range from 0.05 to 8 for acute dose-based exposure and 0.43 to 65.85 for chronic dose-based exposure. Additionally, chronic dietary-based RQs range from 0.26 to 7.59. Therefore, for most of the mammalian size-class, forage and use category combinations, the Agency's acute and chronic risk to listed species, acute restricted use, and acute and chronic risk to non-listed species LOCs are exceeded. The same LOCs are exceeded after a single application of methomyl at the maximum application rate for agricultural and orchard uses (see **Tables 35** and **36**).

Table 35. Mammalian Dose-Based RQ Values for Acute and Chronic Exposure to Methomyl from the Maximum Single Application Rate (0.9 lb a.i./Acre).

DIETARY CATEGORY	BODY SIZE	ACUTE RQ	CHRONIC RQ
Short Grass	**15 g**	**3.12**	**24.99**
	35 g	**2.67**	**21.34**
Tall Grass	**15 g**	**1.43**	**11.45**
	35 g	**1.22**	**9.78**
Broadleaf Plants/Small Insects	**15 g**	**1.76**	**14.06**
	35 g	**1.50**	**12.01**
Fruits/Pods/Seeds/Large Insects	**15 g**	**0.20**	**1.56**
	35 g	**0.17**	**1.33**
Granivore	**15 g**	0.04	0.35
	35 g	0.04	0.3

Bolded numbers indicate RQs that exceed the Agency's endangered species LOCs for mammals

Table 36. Mammalian Dietary-Based RQ Values for Chronic Exposure to Methomyl from the Maximum Single Application Rate (0.9 lb a.i./Acre).

DIETARY CATEGORY	RQ
Short Grass	**2.88**
Tall Grass	**1.32**
Broadleaf Plants/Small Insects	**1.62**
Fruits/Pods/Seeds/Large Insects	0.18

Bolded numbers indicate RQs that exceed the Agency's endangered species LOC for mammals

The single application rate would need to drop to 0.03 lb a.i./acre before all of the acute and chronic dose-based RQs (for 15 and 35 g mammals) would no longer exceed the Agency's acute risk to non-listed species LOCs. The usage data indicate that the maximum amounts of methomyl (single application) actually applied to use sites in CA, for all agricultural and orchard uses, are above 0.03 lb a.i./acre. Additionally, for both maximum seasonal and maximum single application rates (for agricultural and orchard uses), the acute RQs are greater than one (except for the fruits and granivore dietary categories), indicating that mammals on the site of application may experience at least 50% mortality (since RQs of one indicate EECs equal to the LD_{50} value from laboratory studies).

Using AGDISP (low volume, aerial application) and AgDRIFT (Tier I, aerial, ASAE Very Fine to Fine droplet size distribution), the maximum seasonal application rate could result in exposure levels on food items equal to the LD_{50} value up to 600 ft and 105 ft from the site of application for agricultural and orchard uses, respectively (for 15 g mammals that eat short grass). The distance drops to 174 ft and 46 ft for one application at the 0.9 lb a.i./acre (again, for a 15 g mammal eating short grass), for agricultural and orchard uses, respectively.

The chance of individual effects for mammals using the IECv1.1.xls spreadsheet and rat acute toxicity data [default slope = 4.5 (upper and lower bound = 2 and 9)] ranges from 100% to ~1 in 418,000,000 for small mammals (all forage categories) and maximum seasonal application rates (agricultural and orchard) (see **Table 37**). For most of the

small mammal dietary categories there is 100% likelihood of mortality at the maximum seasonal application rate for agricultural and orchard uses.

Table 37. Chance of Individual Effects for Small Mammals from Maximum Seasonal Application Rates for Methomyl Use in CA.

DIETARY CATEGORY	BODY SIZE	USE CATEGORY	ACUTE RQ	SLOPE	CHANCE OF INDIVUAL EFFECTS
Acute Endangered Species LOC (0.1)	N/A	N/A	N/A	4.5	~ 1 in 294,000
				2	~ 1 in 44
				9	~ 1 in 8.86E+18
Short Grass	**15 g**	Agriculture	**8.23**	4.5	~ 1 in 1
				2	~ 1 in 1.03
				9	~ 1 in 1
		Orchard	**4.56**	4.5	~ 1 in 1
				2	~ 1 in 1.10
				9	~ 1 in 1
	35 g	Agriculture	**7.03**	4.5	~ 1 in 1
				2	~ 1 in 1.05
				9	~ 1 in 1
		Orchard	**3.89**	4.5	~ 1 in 1
				2	~ 1 in 1.14
				9	~ 1 in 1
Tall Grass	**15 g**	Agriculture	**3.77**	4.5	~ 1 in 1
				2	~ 1 in 1.14
				9	~ 1 in 1
		Orchard	**2.09**	4.5	~ 1 in 1.08
				2	~ 1 in 1.35
				9	~ 1 in 1
	35 g	Agriculture	**3.22**	4.5	~ 1 in 1.01
				2	~ 1 in 1.18
				9	~ 1 in 1
		Orchard	**1.78**	4.5	~ 1 in 1.15
				2	~ 1 in 1.45
				9	~ 1 in 1.01
Broadleaf Plants/Small Insects	**15 g**	Agriculture	**4.63**	4.5	~ 1 in 1
				2	~ 1 in 1.10
				9	~ 1 in 1
		Orchard	**2.56**	4.5	~ 1 in 1.03
				2	~ 1 in 1.26
				9	~ 1 in 1
	35 g	Agriculture	**3.96**	4.5	~ 1 in 1
				2	~ 1 in 1.13
				9	~ 1 in 1
		Orchard	**2.19**	4.5	~ 1 in 1.07
				2	~ 1 in 1.33
				9	~ 1 in 1
Fruits/Pods/Seeds/Large Insects	**15 g**	Agriculture	**0.51**	4.5	~ 1 in 10.6
				2	~ 1 in 3.58
				9	~ 1 in 236
		Orchard	**0.28**	4.5	~ 1 in 156
				2	~ 1 in 7.44
				9	~ 1 in 3,070,000
	35 g	Agriculture	**0.44**	4.5	~ 1 in 18.4
				2	~ 1 in 4.20

DIETARY CATEGORY	BODY SIZE	USE CATEGORY	ACUTE RQ	SLOPE	CHANCE OF INDIVUAL EFFECTS
				9	~ 1 in 1,500
		Orchard	**0.24**	4.5	~ 1 in 378
				2	~ 1 in 9.3
				9	~ 1 in 82,200,000
Granivore	**15 g**	Agriculture	**0.11**	4.5	~ 1 in 125,000
				2	~ 1 in 36.2
				9	~ 1 in 3.19E+17
		Orchard	0.06	4.5	~ 1 in 52,200,000
				2	~ 1 in 138
				9	~ 1 in 5.04E+27
	35 g	Agriculture	**0.1**	4.5	~ 1 in 294,000
				2	~ 1 in 44
				9	~ 1 in 8.86E+18
		Orchard	0.05	4.5	~ 1 in 418,000,000
				2	~ 1 in 216
				9	~ 1 in 1.75E+31

For frogs, as described in Section 6.1.2, the Agency determined that terrestrial-phase frogs (all size classes) that eat small insects and/or small herbivorous mammals are at potential risk from acute and chronic exposure to methomyl from maximum seasonal application rates. There is also a potential risk to terrestrial-phase CRLF after one application of methomyl at the maximum single application rate. Single application rates ≤0.6 lbs a.i./acre result in RQs below the Agency's chronic risk LOC and single application rates ≤0.1 lbs a.i./acre result in RQs below the Agency's acute risk to listed species LOC. The methomyl usage data provided by BEAD indicate that the *maximum* single application rate and the *average* single application rate for all orchard and agricultural uses in CA between 2002 and 2005 were ≥0.1 lbs a.i./acre. All orchard and most agricultural uses [except chicory, dandelion green, forage (hay/silage), garlic, rye, tangelo, and uncultivated ag] have a *maximum* and *average* reported single application rate ≥ 0.6 lb a.i./acre. This indicates that there is a potential risk of adverse effects to frogs from all orchard and agricultural uses of methomyl in CA after a single application of the pesticide based on usage data. Again, as described in Section 6.1.2, frogs within 906 ft of the site of application (for agricultural uses) may be directly adversely affected, through ingestion of contaminated prey items following methomyl use at the maximum seasonal labeled use rate. This distance drops to 256 ft from the site of methomyl application with a single application of 0.9 lb a.i./acre (for agricultural and orchard uses). For low volume aerial applications, the distance extends to 2,031 ft for a single application at 0.9 lbs a.i./acre..

The chance of individual effects for frogs using the IECv1.1.xls spreadsheet and bird acute toxicity data [default slope = 4.5 (upper and lower bound = 2 and 9)] ranges from 100% for frogs that eat small, herbivorous mammals to ~1 in 8.86E+18 for frogs that eat frogs (at maximum seasonal application rates) (see **Table 38**).

Table 38. Chance of Individual Effects Based on Acute Terrestrial Herpetofauna RQs (from T-HERPS) (8 Applications, 0.9 lb a.i./Acre/Application, 2-Day Application Interval).

Size Class (grams)	Slope	Small Insect (RQ)	Chance of Ind. Effects	Large Insect (RQ)	Chance of Ind. Effects	Herb. Mam. (RQ)	Chance of Ind. Effects	Insct. Mam. (RQ)	Chance of Ind. Effects	Amph (RQ)	Chance of Ind. Effects
Dose-Based											
N/A	4.5	LOC = 0.1	4.18E+08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2		216								
	9		1.75E+31								
1	4.5	0.51	11.4	0.06	52,200,000	N/A	N/A	N/A	N/A	N/A	N/A
	2		3.66		138						
	9		297		5.04E+27						
37	4.5	0.51	11.4	0.06	52,200,000	N/A	N/A	N/A	N/A	0.03	2.76E+11
	2		3.66		138						862
	9		297		5.04E+27						2.14E+42
238	4.5	0.33	66.1	0.04	6.33E+09	2.28	1.06	0.14	648	0.01	8.86E+18
	2		5.96		386		1.31		942		31,600
	9		136,000		7.49E+35		1		6.14E+8		1.03E+72
Dietary-Based											
N/A	4.5	0.29	129	0.03	2.76E+11	0.34	175	0.02	9.60E+13	0.01	8.86E+18
	2		7.09		862		5.73		2,950		31,600
	9		1,530,000		2.14E+42		80,700		2.27E+52		1.03E+72

6.2.2.2 Terrestrial Invertebrates

Terrestrial invertebrates (excluding earthworms) are very sensitive to the insecticide methomyl. Considering the maximum seasonal application rates and the most sensitive terrestrial invertebrate endpoint (LC_{50} for the parasitic wasp), the acute RQs for orchard uses and agricultural uses equal 5,955 and 10,773, respectively, for insects. The acute RQ for terrestrial invertebrates for a single methomyl application at the maximum allowable agricultural and orchard use rate is 4,090. Due to differences in study design and routes of exposure, a meaningful species sensitivity distribution could not be calculated for terrestrial invertebrates. However, all of the non-soil-dwelling terrestrial invertebrates, for which submitted data are available, are sensitive to methomyl on an acute-exposure basis and result in RQs that exceed Agency LOCs, even after one application of methomyl (see **Table 39**). Additionally, all of the RQs (for the wasp, mite, and honeybee) are above one, even for a single application rate of 0.9 lb a.i./acre. This suggests that most of the methomyl agricultural and orchard uses in CA, if used at maximum single application rates (which seems likely based on the usage data), could result in at least 50% mortality in a variety of terrestrial invertebrates that are found on or adjacent to application sites. No chronic toxicity data for terrestrial invertebrates are available, and, therefore, chronic RQs could not be calculated.

Table 39. RQs for Non-Sediment-Dwelling Terrestrial Invertebrates Exposed to Methomyl at Maximum Seasonal and Maximum Single Application Rates.

SPECIES	LC_{50} or LD_{50} (Most Sensitive for the Species)	RQ			
		BASED ON THE KENAGA VALUE FROM T-REX (Upper Bound) FOR:	MAX. SEASONAL RATE (Agricultural Uses)[1]	MAX. SEASONAL RATE (Orchard Uses)[2]	MAX. SINGLE RATE (0.9 lb a.i./acre)
Wasp (*Aphidius rhopalosiphi*)	0.00022 lb/A	N/A	10,773	5,955	4,090
Mite (*Typhlodromus pyri*)	0.01115 lb a.i./A	N/A	213	117	81
Honeybee (*Apis mellifera*)	0.16 µg a.i./bee (1.25 ppm)[3]	Large Insect	28	16	11
		Small Insect	256	142	97

[1] 8 applications, 0.9 lb a.i./application, 2-day application interval
[2] 6 applications, 0.9 lb a.i./application, 5-day application interval
[3] Since a honey bee on average weighs 0.128 g (Mayer and Johansen, 1990), 0.16 µg/bee is equivalent to 1.25 ppm (0.16/0.128).
N/A – Non applicable.

The chance of individual effects for terrestrial invertebrates using the IECv1.1.xls spreadsheet, the endangered species LOC of 0.05, and default slopes [4.5 (upper and lower bound = 2 and 9)] is ~1 in 4.18E+08, ~1 in 216, and ~1 in 1.75E+31 for the slopes, 4.5. 2, and 9, respectively. The chances are 100% for all insects for maximum seasonal and maximum single application rates when the RQs from **Table 39** are entered into the IECv1.1.xls spreadsheet using default slopes.

6.2.3 Effects Determination for Indirect Effects to the CRLF Due to the Potential Decrease in Terrestrial Prey

Unfortunately, none of the acceptable methomyl toxicity data we have for terrestrial taxa overlap taxonomically with the presumed preferred CRLF prey species. Therefore, there is no information available to indicate whether the preferred prey species are actually more or less sensitive to methomyl than the species used in the above analyses. However, based on the exposure and effects analyses and the chance of individual effects (*i.e.*, the probit dose analysis), CRLF adjacent to agricultural and orchard use sites have the potential to be indirectly affected by methomyl due to a loss of potential terrestrial prey items, especially terrestrial invertebrates. Therefore, the Agency makes a Likely to Adversely Affect determination for the CRLF and methomyl use in CA based on the potential loss of terrestrial prey.

6.2.4 Effects Determination for Indirect Effects to the CRLF Due to the Potential Decrease in Food Items

The data, taken together indicate, as would be expected with an insecticide, that aquatic and terrestrial invertebrates are very sensitive to methomyl and are vulnerable to mortality in areas adjacent to methomyl use sites. Adverse effects to small mammals, frogs, and fish, from methomyl use (even after a single application) are also possible. The potential effects to CRLF (both in scale and type) from the loss of aquatic and terrestrial prey items would depend on a variety of factors, including (but not limited to): the ability of the CRLF to substitute less-favored foods in their diet when choice foods are not available; the ability of the prey community to recover either through reproduction or re-colonization of an affected area; and the sensitivity of specific prey species to methomyl. Exploring the specific effects these factors might have on the CRLF is beyond the scope of this assessment. However, since methomyl has the potential to affect a wide range of CRLF food items (*i.e.*, aquatic and terrestrial invertebrates, fish, small mammals, and frogs), it is reasonable to assume that the ability of a CRLF to substitute less-favored foods in its diet when choice foods are not available is diminished in affected areas, and that there would be variable rates of community recovery depending on the sensitivity of the prey species affected. Additionally, although toxicity data are not available for known CRLF prey species, it is likely that at least some potential CRLF prey items are sensitive to methomyl.

The potential loss of prey in affected areas could result in mortality through starvation or reduced survival and reproductive rates caused by decreased food availability and/or reduced body size during vulnerable stages in their life-cycle. The likelihood of these effects lessens with distance from the site of application. However, since the potential adverse effects to many of the potential prey taxa extends well beyond the use site (even after a single application of 0.9 lb a.i./acre to an agricultural or orchard use site), and all of the CRLF core areas and incident occurrences are adjacent to or overlap with potential methomyl use sites (see **Fig. 12**), the Agency makes a likely to adversely affect determination for indirect effects to the CRLF based on the potential loss of food resources associated with methomyl use in CA.

6.2.5 Designated Critical Habitat

For methomyl use, 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 a reduction and/or modification of food sources for terrestrial-phase juveniles and adults. Since, most of the designated critical habitat for the CRLF are directly adjacent to or overlap with potential methomyl uses sites in CA (see **Fig. 15**), the Agency's effects determination as it relates to the potential for adversely modifying the designated critical habitat of the CRLF is the same as for the effects determination for indirect effect to the CRLF. Therefore, the Agency makes a finding that methomyl may modify the CRLF's designated critical habitat based on the potential loss of food resources associated with methomyl use in California.

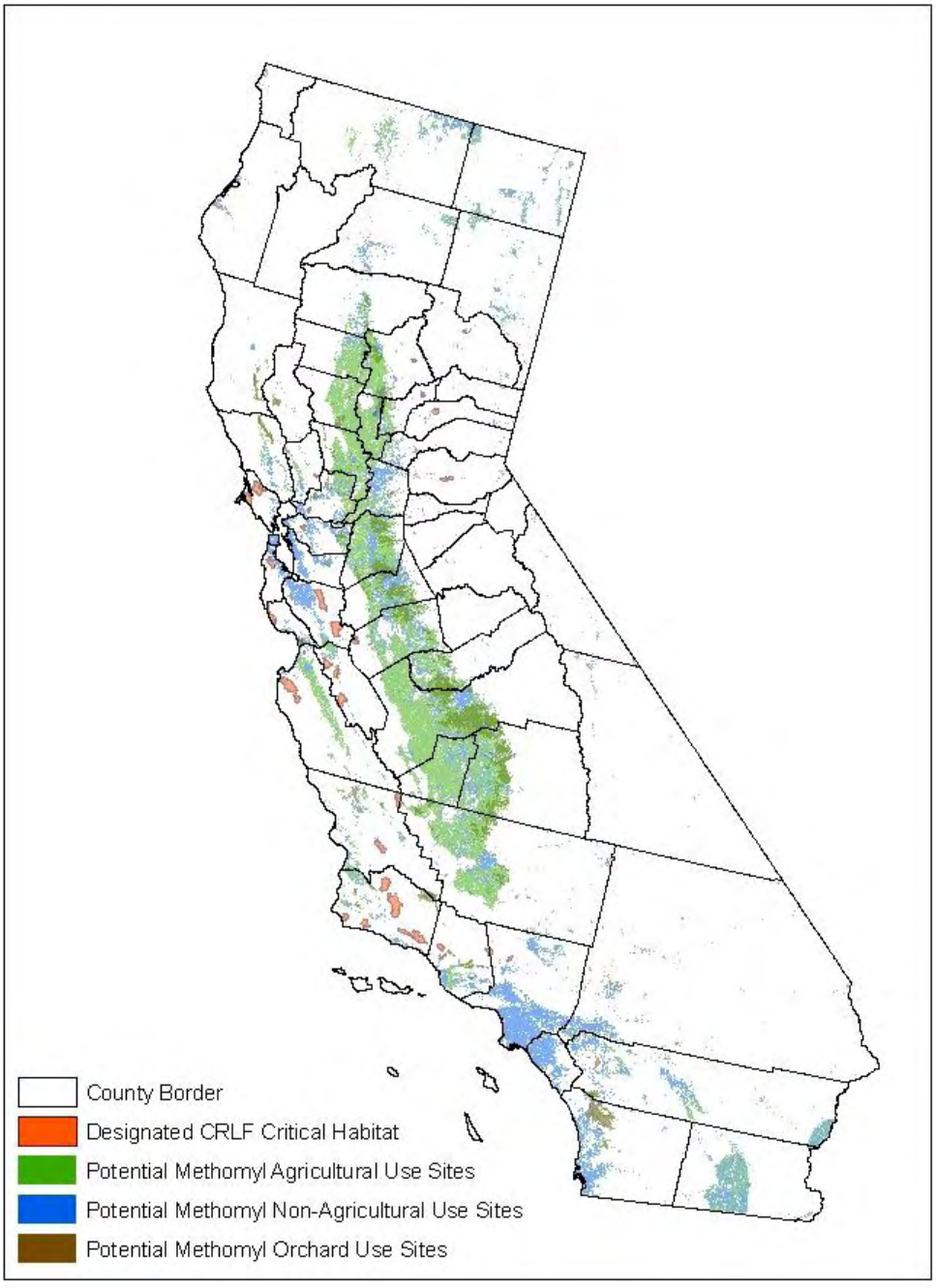


Figure 15. Potential Methomyl Use Sites in CA and Designated Critical Habitat for the CRLF.

7. Uncertainties

7.1 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 insecticide resistance, timing of applications, cultural practices, and market forces.

7.2 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 use 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.

7.3 Aquatic EECs

7.3.1 Water Body

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. As previously discussed in Section 2.5 and **ATTACHMENT 1**, 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 have agreed that the existing EXAMS pond represents the best currently available approach for estimating aquatic exposure to pesticides (USFWS/NMFS 2004).

7.3.2 Buffers

Methomyl product labels specify spatial buffers between application sites and most water bodies (25 ft for ground spray and 100 ft for aerial spray). However, land use, soil, and vegetation characteristics of these buffers are not specified. Due to the lack of buffer characteristics defined by the labels, the lack of data on buffer effectiveness on attenuating methomyl loadings in runoff, and the tendency of runoff to follow channelized flow, the impact of buffers on methomyl concentrations in local water bodies resulting from runoff cannot be quantitatively assessed. Therefore, methomyl RQs are calculated for water bodies adjacent to application sites and cannot quantitatively account for potential for buffers to reduce runoff.

For spray drift, the AgDRIFT model was used to estimate drift values according to the buffer distances and resulted in estimates of 14.6 and 2.6% for aerial and ground spray applications. The aquatic exposure modeling assumes the same drift value for multiple applications. For methomyl, up to 8 applications were modeled for some crops. This essentially results in the use of Tier I drift values for each application assuming constant wind direction and speed (reasonably worse case) for all 8 applications. This will result in an unquantifiable overestimation of exposure resulting from spray drift for scenarios with multiple applications.

7.3.3 Applications

There is uncertainty in the PRZM/EXAMS application timing relative to rainfall/runoff events. An attempt was made to model applications during the wet season (winter/early

spring), but changing application dates even within a season can result in variable EECs. Usage data suggests that methomyl is used throughout the year on most crops, but the highest usage appears to be during the summer months. To the extent that applications made in the summer are subject to less runoff than those made during the rainy season, EECs presented in this assessment may over-predict exposures.

Methomyl product labels specify application rates on a per crop basis (not on a per annual basis). Information from BEAD indicates that many crops can be grown more than one time/year in California (**APPENDIX B**). Since standard PRZM scenarios only consist of one crop per year, applications to only one crop per year were modeled. Even though methomyl is short-lived in water, it is moderately persistent in soils. Any carry-over in the soil from a previous crop may be available for runoff and may result in runoff loadings that are larger than what was modeled in this assessment. To characterize the difference that could be possible, the CA alfalfa scenario was modeled with a mximum number of 26 appliccations, which is the maximum the PRZM model is capable of processing. According to the label and the information provide by BEAD, a maximum of 36 applications is actually possible (*i.e.*, 4 applications per crop and 9 cuttings per year). With 26 applications a year, PRZM/EXAMS predictes acute, 21-day and 60-day EECs of 76, 54 and 44 µg/L compared to 46, 32 and 21 µg/L modeling the maximum for one crop cycle (5 applications).

Based on a memo on the current labels and uses for methomyl from the Special Review and Reregistration Division (SRRD) and the Registration Division (RD) in OPP (U.S. EPA, 2007), the maximum labeled application rate for alfalfa is considered 3.6 lb a.i./acre. However, because the methomyl labels are not clear on the maximum *yearly* application rates for a variety of crops (including alfalfa) (*i.e.*, the rates are provided as maximum application rates per *crop*), we used the conservative interpretation that a 'cutting' of alfalfa could be considered a 'crop'. This is because alfalfa is a perennial that can grow for 5 to 6 years and be cut several times per year, and, therefore, it is not clear, based on current label language what 'crop' refers to in this case [*e.g.*, a cutting, a yearly cyle, or the life-span of the alfalfa (5-6 years)].

Typical seasonal application rates were not available for this assessment. For characterization, we considered the results from a single application at the maximum rate.

7.3.4 Irrigation Scenarios

Even though many agricultural practices in California rely on irrigation, non-irrigated scenarios were used for this assessment since there is a known bug in the irrigation routines in the current version of PRZM. EECs from irrigated scenario could be higher or lower than those predicted in this assessment depending on irrigation practices.

7.3.5 Action Area

An example of an important simplifying assumption that may require future refinement is the assumption of uniform runoff characteristics throughout a landscape. It is well

documented that runoff characteristics are highly non-uniform and anisotropic, and become increasingly so as the area under consideration becomes larger. The assumption made for estimating the aquatic Action Area (based on predicted in-stream dilution) was that the entire landscape exhibited runoff properties identical to those commonly found in agricultural lands in this region. However, considering the vastly different runoff characteristics of: a) undeveloped (especially forested) areas, which exhibit the least amount of surface runoff but the greatest amount of groundwater recharge; b) suburban/residential areas, which are dominated by the relationship between impermeable surfaces (roads, lots) and grassed/other areas (lawns) plus local drainage management; c) urban areas, that are dominated by managed storm drainage and impermeable surfaces; and d) agricultural areas dominated by Hortonian and focused runoff (especially with row crops), a refined assessment should incorporate these differences for modeled stream flow generation. As the zone around the immediate (application) target area expands, there will be greater variability in the landscape; in the context of a risk assessment, the runoff potential that is assumed for the expanding area will be a crucial variable (since dilution at the outflow point is determined by the size of the expanding area). Thus, it important to know at least some approximate estimate of types of land use within that region. Runoff from forested areas ranges from 45 – 2,700% less than from agricultural areas; in most studies, runoff was 2.5 to 7 times higher in agricultural areas (*e.g.*, Okisaka *et al.*, 1997; Karvonen *et al.*, 1999; McDonald *et al.*, 2002; Phuong and van Dam 2002). Differences in runoff potential between urban/suburban areas and agricultural areas are generally less than between agricultural and forested areas. In terms of likely runoff potential (other variables – such as topography and rainfall – being equal), the relationship is generally as follows (going from lowest to highest runoff potential):

Three-tiered forest < agroforestry < suburban < row-crop agriculture < urban.

There are, however, other uncertainties that should serve to counteract the effects of the aforementioned issue. For example, the dilution model considers that 100% of the agricultural area has the chemical applied, which is almost certainly a gross over-estimation. Thus, there will be assumed chemical contributions from agricultural areas that will actually be contributing only runoff water (dilutant); so some contributions to total contaminant load will really serve to lessen rather than increase aquatic concentrations. In light of these (and other) confounding factors, Agency believes that this model gives us the best available estimates under current circumstances.

7.4 Sub-lethal Effects

For an acute risk assessment, 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 assessment 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.

To determine effects of carbamates on channel catfish, Carter (1971; ref #: 14034) observed brain cholinesterase inhibition and other signs of poisoning. In a static 48-h exposure to methomyl at concentrations ranging from 100 to 1,000 µg/L, inhibition of brain cholinesterase was proportional to the concentration of methomyl and maximum inhibition occurred within 2 hours with little or no recovery in 48 hours. Sequential signs of poisoning included hyperactivity, lethargy, paralysis, scoliosis, loss of equilibrium, and opercular and mouth paralysis. Another study by Coppage (1977; ref #: 7669) in which estuarine/marine fishes (pinfish, sheepshead minnow, and sailfin molly) were exposed to methomyl, acetylcholinesterase inhibition was similar (77-89%) regardless of the species or period of exposure (4 to 48 h), when a near-median kill occurred. In the wild, effects such as those noted in the previous tests could be manifested as reduced foraging efficiency, and/or lowered predator avoidance. Alternatively, fish may sense and avoid the contaminated area. Extrapolation of these measurement endpoints to the assessment endpoints of reduced survival, growth and reproduction of individual fish in the wild is highly uncertain and because currently accepted methods are unavailable to quantitatively estimate risk (EPA 2004, USFWS/NMFS 2004), they are summarized qualitatively.

7.5 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 normally 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 California Red Legged Frog.

7.6 Terrestrial Exposure

7.6.1 Residue Levels Selection

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.

7.6.2 Dietary Intake

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. EPA, 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.

7.6.3 Location of Wildlife Species

For this baseline terrestrial 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.

8. Summary of Direct and Indirect Effects to the CRLF

All of the risk hypotheses outlined in Section 2.9.1 and repeated below, are supported under some circumstances of methomyl use:

- Labeled uses of methomyl in CA may directly affect the CRLF by causing mortality or by adversely affecting growth or fecundity;
- Labeled uses of methomyl in CA may indirectly affect the CRLF by reducing or changing the composition of food supply;
- Labeled uses of methomyl in CA may adversely modify the designated critical habitat of the CRLF by reducing the food supply required for normal growth and viability of juvenile and adult CRLFs.

Therefore, the Agency makes a "may affect and likely to adversely affect' determination for the CRLF from the currently labeled uses of methomyl. This is based on the potential for direct effects (to both aquatic and terrestrial-phase CRLF), indirect effects due to potential decreases in aquatic and terrestrial prey items, and the potential for adversely modifying designated critical habitat due to a potential loss of aquatic and terrestrial prey items (see **Table 40** for a summary). Baseline status and cumulative effects for the CRLF can be found in **ATTACHMENT 2**.

Table 40. Effects Determination Summary for Methomyl Use and the CRLF.

Assessment Endpoint	Effects Determination	Basis for Determination
Survival, growth, and reproduction of CRLF via direct effects	May affect and likely to adversely affect (LAA)	RQs for both aquatic-phase and terrestrial-phase CRLF exceed acute and chronic endangered species LOCs for several uses. ***Aquatic-phase***: - The uses that exceed the chronic and/or acute LOCs for freshwater fish (used as a surrogate for aquatic-phase CRLF) account for 97% of the lbs of methomyl applied on average per year in CA. - Methomyl applications are made during times of year when aquatic-phase CRLF are likely to be present (based on methomyl usage data and CRLF life history information). - RQs exceed the acute LOC after a single application of methomyl at a rate likely to be used on orchards and agricultural crops (based on usage data). - Chances of individual effects range from ~ 1 in 6.6 (cole crops) to ~ 1 in 7.48E+16 (mint). - Based on a species sensitivity distribution for freshwater fish (which serve as surrogates for amphibians), amphibians with sensitivities even at the 95th percentile exceed the endangered species acute LOC. - Many of the CRLF core areas are adjacent to and/or overlap with potential methomyl use sites. ***Terrestrial-phase***: - RQs exceed the acute LOC after a single application of methomyl at a rate likely to be used on orchards and agricultural crops (based on usage data). - Chances of individual effects range from ~ 1 in 1 (dose-based RQ, 238 g frog eating a herbivorous mammal) to ~ 1 in 8.86E+18 (dietary-based RQ, frog eating a frog). - Many of the CRLF core areas are adjacent to or overlap with potential methomyl use sites.
Indirect effects to the CRLF via reduction of prey (*i.e.*, freshwater invertebrates, fish, terrestrial invertebrates, mammals, and frogs)	May affect and likely to adversely affect (LAA)	RQs for all prey taxa for the aquatic-phase and terrestrial-phase CRLF exceed acute and chronic LOCs for several uses. ***Aquatic prey items***: - Based on the exposure and effects analyses and the chance of individual effects, CRLF adjacent to agricultural and orchard use sites have the potential to be indirectly affected by methomyl due to a loss of potential aquatic prey items, especially aquatic invertebrates. ***Terrestrial prey items***: - Based on the exposure and effects analyses and the chance of individual effects, CRLF adjacent to agricultural and orchard use sites have the potential to be indirectly affected by methomyl due to a loss of potential terrestrial prey items, especially terrestrial invertebrates. The potential loss of prey in affected areas could result in mortality through direct starvation or reduced survival and reproductive rates caused by food stress and/or reduced body size during vulnerable stages in their life-cycle. The likelihood of these effects lessens with distance from the site of application. However, since the potential adverse effects to many of the potential prey taxa extend well beyond the use site (even after one application of 0.9 lb a.i./acre to an agricultural or orchard use site), and all of the CRLF core areas and incident occurrences are adjacent to or overlap with potential methomyl use sites, the Agency makes a Likely to Adversely Affect determination for indirect effects to the CRLF based on the potential loss of food resources associated with methomyl use in CA.

Adverse modification of the CRLFs designated critical habitat based on the potential loss of food resources	Habitat modification	For methomyl use, the assessment endpoints for designated critical habitat PCEs involve a potential reduction and/or modification of food sources necessary for normal growth and viability of aquatic-phase CRLFs, and a potential reduction and/or modification of food sources for terrestrial phase juveniles and adults. Since, all of the designated critical habitat for the CRLF is directly adjacent to or overlap with potential methomyl uses sites in CA, the Agency's effects determination as it relates to the potential for adversely modifying the designated critical habitat of the CRLF is the same as for the effects determination for indirect effect to the CRLF (see above).

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 adverse modification to critical habitat.

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8568 Harvey, J., Jr. (1977) Degradation of 14C-Methomyl in Flanagan Silt Loam in Biometer Flasks. (Unpublished study received Feb 28, 1977 under 352-342; prepared in cooperation with Univ. of Delaware, Soil Testing Laboratory, submitted by E.I. du Pont de Nemours & Co., Wilmington, Del.; CDL:096026-B)

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APPENDIX A: Product Formulations Containing Multiple Active Ingredients.

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[5] [6].

Acute oral toxicity data (*i.e.*, LD_{50} values) from mammalian studies for formulated products that contain methomyl and one or more additional active ingredients are summarized below.

Currently, the Agency's guidance for assessing the potential risk of chemical mixtures is limited to human health applications (USEPA, 2000). However, the guidance includes principles for evaluating mixtures to assess potential interactive effects that are generally applicable. Consistent with EPA's Overview Document (USEPA, 2004), the Agency's mixture guidance (USEPA, 2000) discusses limitations in quantifying the risk of specified mixture when there is differential degradation, transport and fate of chemical components following environmental release or application. The LD_{50} values are potentially useful only to the extent that a wild mammal would consume plants or animals immediately after these dietary items were directly sprayed by the product. Increasing time post application, the differential rates of degradation, transport, *etc*. for the active ingredients in the formulation only permit a qualitative discussion of potential acute risk (USEPA 2004).

As discussed in USEPA (2000) a quantitative component-based evaluation of mixture toxicity requires data of appropriate quality for each component of a mixture. In this mixture evaluation LD_{50}s, with associated 95% confidence intervals, are needed for the formulated products. The same quality of data is also required for each component of the mixture. Given that many of the formulated products do not have LD_{50} values of the required quality and since LD_{50} values are not available for all the components of these formulations a quantitative analysis of potential interactive effects is not possible.

While a quantitative evaluation of the data is not possible with currently accepted scientific methods, as a screening tool, a qualitative analysis can be used to indicate if formulated products exhibit interactive effects (*e.g.*, synergism or antagonism). In the case of methomyl, of the formulated products, only one product (EPA Reg. No. 2724-274) has a LD_{50} value and associated confidence interval. When this product LD_{50} and

[5] Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs, Environmental Protection Agency (January 2004) (Overview Document).

[6] Memorandum to Office of Prevention, Pesticides and Toxic Substance, US EPA conveying an evaluation by the U.S. Fish and Wildlife Service and National Marine Fisheries Service of an approach to assessing the ecological risks of pesticide products (January 2004).

its associated confidence interval, are adjusted for the percent methomyl (1.1%) the adjusted LD_{50} value of 34.1 mg/kg-bw (CI range of 25.6 to 42 mg/kg) is not statistically distinct from the LD_{50} of methomyl (30 mg/kg-bw; CI range of 23 - 40 mg/kg). Based on this qualitative evaluation of the best available data and the Agency's existing guidance it is reasonable to conclude that these formulations are reflecting an independent additive toxicity response. Given that the active and inert ingredients would not be expected to have similar mechanisms of action, metabolites or toxicokinetic behavior it is also reasonable to conclude that an assumption of dose-addition would be inappropriate. Consequently, an assessment of methomyl's potential effect on the CRLF when it is co-formulated with other active ingredients can based on the toxicity of methomyl.

Methomyl Products with More than One Active Ingredient [7], [8]

PRODUCT/ TRADE NAME	EPA Reg.No.	% Methomyl	PRODUCT		ADJUSTED FOR ACTIVE INGREDIENT	
			LD_{50} (mg/kg)	CI (mg/kg)	LD_{50} (mg/kg)	CI (mg/kg)
Farnam die fly	270-255	1	2712	No Data	No Data	No Data
Golden malrin rf-128 fly killer	2724-274	1.1	3106	2324-3822	34.1	25.56-42.0
Lurectron scatterbait	7319-6	1	No Data	No Data	No Data	No Data
Stimukil fly bait	53871-3	1	No Data	No Data	No Data	No Data

[7] From registrant submitted data to support registration. Compiled by Office of Pesticide Programs Health Effects Division.
[8] Methomyl: LD50 = 30 mg/kg ; CI= 23-40 mg/kg.

APPENDIX B: Registered Uses and Application Rates for Methomyl in CA.

USE	PRODUCT	MAX APPL. RATE	MIN APP. INTER -VAL[1]	MAX APPL. RATE/ CROP	MAX NO. OF APPL./ CROP	MAX NO. OF CROPS/ YEAR IN CA*	MAX APPL. RATE/ YEAR
Alfalfa[LV]	Lannate LV Lannate SP	0.9 lb ai/A	5	3.6 lb ai/A	10	9**	32.4 lb a.i./A
Anise (Fennel)[LV]	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb a/A	10	2	9 lb a.i./A
Apple (**ground** only)	Lannate LV Lannate SP	0.9 lb ai/A	7	4.5 lb ai/A	5	1	4.5 lb a.i./A
Asparagus[LV]	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	8	1	4.5 lb a.i./A
Avocado	Lannate LV Lannate SP	0.9 lb ai/A	5	0.9 lb ai/A	2	1	0.9 lb a.i./A
Barley[LV]	Lannate LV Lannate SP	0.45 lb ai/A	5	1.8 lb ai/A	4	1	1.8 lb a.i/.A
Beans, Succulent[LV] (kidney, lima, mung, Navy, pinto, snap, wax, broad, fava, asparagus beans, blackeyed peas, cowpeas)	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	10	1	4.5 lb a.i/.A
Sweet Lupine, White Sweet Lupine, White Lupine, Grain Lupine	Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	10	1	4.5 lb a.i./A
Beans, Dry[LV] (same as succulent beans)	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	10	1	4.5 lb a.i/.A
Beans[SLN] (interplanted with nonbearing almonds, plums, prunes, peaches, and walnuts) (CA-770431)	Lannate SP	0.45 lb ai/A	5	0.9 lb ai/A	2	1	0.9 lb a.i/.A
Beets (table)	Lannate LV Lannate SP	0.9 lb ai/A	5	3.6 lb ai/A	8	2	7.2 lb a.i/.A
Bermudagrass (pasture)	Lannate LV Lannate SP	0.9 lb ai/A	5	0.9 lb ai/A	4	1	0.9 lb a.i/.A
Blueberries (**ground** only)	Lannate LV Lannate SP	0.9 lb ai/A	5	3.6 lb ai/A	4	1	3.6 lb a.i./A
Broccoli[LV]	Lannate LV Lannate SP	0.9 lb ai/A	2	6.3 lb ai/A	10	Imperial Valley: 1 Coastal Valleys: 3 San Joaquin Valley: 2	6.3 lb a.i./A 18.9 lb a.i./A 12.6 lb a.i./A
Broccoli,	Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	5	2	9 lb a.i./A

USE	PRODUCT	MAX APPL. RATE	MIN APP. INTER -VAL[1]	MAX APPL. RATE/ CROP	MAX NO. OF APPL./ CROP	MAX NO. OF CROPS/ YEAR IN CA*	MAX APPL. RATE/ YEAR
Chinese[SLN] (CA-860059)							
Broccoli Raab[SLN] (CA-900034)	Lannate SP	0.9 lb ai/A	5	7.2 lb ai/A	10	Imperial Valley: 1 Coastal Valleys: 3 San Joaquin Valley: 2	7.2 lb a.i./A 21.6 lb a.i./A 14.4 lb a.i./A
Brussels Sprouts [LV]	Lannate LV Lannate SP	0.9 lb ai/A	2	5.4 lb ai/A	10	1	5.4 lb ai/A
Cabbage [LV]	Lannate LV Lannate SP	0.9 lb ai/A	2	7.2 lb ai/A	15	3	21.6 lb a.i./A
Carrot [LV]	Lannate LV Lannate SP	0.9 lb ai/A	5	6.3 lb ai/A	10	1	6.3 lb a.i./A
Cauliflower [LV]	Lannate LV Lannate SP	0.9 lb ai/A	2	7.2 lb ai/A	10	Coastal Region: 2 San Joaquin Valley: 1	14.4 lb a.i./A 7.2 lb a.i./A
Celery [LV]	Lannate LV Lannate SP	0.9 lb ai/A	5	7.2 lb ai/A	10	2.5	18 lb a.i./A
Chicory	Lannate LV Lannate SP	0.9 lb ai/A	5	1.8 lb ai/A	2	San Joaquin Valley: 2 Desert: 1	3.6 lb a.i./A 1.8 lb a.i./A
Chinese Cabbage	Lannate LV Lannate SP	0.9 lb ai/A	5	7.2 lb ai/A	10	3	21.6 lb a.i./A
Collards [LV] (fresh market only)	Lannate LV Lannate SP	0.9 lb ai/A	5	5.4 lb ai/A	8	3	16.2 lb a.i./A
Corn (field and popcorn)	Lannate LV Lannate SP	0.45 lb ai/A	5	2.25 lb ai/A	10	1	2.25 lb a.i./A
Corn (seed) [LV]	Lannate SP	0.45 lb ai/A	5	2.25 lb ai/A	10	1	2.25 lb a.i./A
Corn (sweet) [LV]	Lannate LV Lannate SP	0.45 lb ai/A	1	6.3 lb ai/A	28	3	18.9 lb a.i./A
Corn [LV]	Methomyl 5G Granules	0.15 lb ai/A	NR	6.3 lb ai/A	10	3	18.9 lb a.i./A
Cotton[2, LV]	Lannate LV Lannate SP	0.675 lb ai/A	3	1.8 lb ai/A	8	1	1.8 lb a.i./A
Cucumber [LV]	Lannate LV Lannate SP	0.9 lb ai/A	5	5.4 lb ai/A	12	1	5.4 lb a.i./A
Eggplant	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	10	1	4.5 lb a.i./A
Endive, Escarole	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	8	2 (less in desert)	9 lb a.i./A
Garlic	Lannate LV Lannate SP	0.45 lb ai/A	5	2.7 lb ai/A	6	1	2.7 lb a.i./A
Grapefruit[3]	Lannate LV Lannate SP	0.9 lb ai/A	5	2.7 lb ai/A	4	1	2.7 lb a.i./A

USE	PRODUCT	MAX APPL. RATE	MIN APP. INTER -VAL[1]	MAX APPL. RATE/ CROP	MAX NO. OF APPL./ CROP	MAX NO. OF CROPS/ YEAR IN CA*	MAX APPL. RATE/ YEAR
Grapes[2]	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	5	1	4.5 lb a.i./A
Horseradish (**ground** Only)	Lannate LV Lannate SP	0.45 lb ai/A	5	1.8 lb ai/A	4	1	1.8 lb a.i./A
Leafy Green Vegetables (beet tops, dandelions, kale, mustard greens, parsley, Swiss chard, turnip greens)	Lannate LV Lannate SP	0.9 lb ai/A	5	3.6 lb ai/A	8	4	14.4 lb a.i./A
Lemon[3]	Lannate LV Lannate SP	0.9 lb ai/A	5	2.7 lb ai/A	4	1	2.7 lb a.i./A
Lentils	Lannate LV Lannate SP	0.9 lb ai/A	5	0.9 lb ai/A	2	1	0.9 lb a.i./A
Lettuce[LV] (head varieties)	Lannate LV Lannate SP	0.9 lb ai/A	2	7.2 lb ai/A	15	Central Coast: 2 Central Valley: 2 Other Regions: 1	14.4 lb a.i./A 14.4 lb a.i./A 7.2 lb a.i./A
Lettuce[LV] (leaf varieties)	Lannate LV Lannate SP	0.9 lb ai/A	2	3.6 lb ai/A	8	Desert: 1 Other Regions: 2	3.6 lb a.i./A 7.2 lb a.i./A
Melons[LV] (cantaloupe, casaba, Santa Claus, Crenshaw, honeydew, honey balls, Persian, golden pershaw, mango melon, pinapple melon, snake, watermelon)	Lannate LV Lannate SP	0.9 lb ai/A	5	5.4 lb ai/A	12	1	5.4 lb a.i./A
Mint[LV] (peppermint, spearmint)	Lannate LV Lannate SP	0.9 lb ai/A	5	1.8 lb ai/A	4	Peppermint: 1** Spearmint: 2**	1.8 lb a.i./A 3.6 lb a.i./A
Nectarine[3]	Lannate LV Lannate SP	0.9 lb ai/A	5	2.7 lb ai/A	3	1	2.7 lb a.i./A
Nonbearing Fruit, Grape, and Nut Nursery Stock (field grown)[SLN] (CA-770308)	Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	5	1	4.5 lb a.i./A
Oats[LV]	Lannate LV	0.45 lb	5	1.8 lb ai/A	4	1	1.8 lb a.i./A

USE	PRODUCT	MAX APPL. RATE	MIN APP. INTER -VAL[1]	MAX APPL. RATE/ CROP	MAX NO. OF APPL./ CROP	MAX NO. OF CROPS/ YEAR IN CA*	MAX APPL. RATE/ YEAR
	Lannate SP	ai/A					
Onions (green)	Lannate LV Lannate SP	0.9 lb ai/A	5	5.4 lb ai/A	8	3	16.2 lb a.i./A
Onions (dry bulb)	Lannate LV Lannate SP	0.9 lb ai/A	5	3.6 lb ai/A	8	1	3.6 lb a.i./A
Oranges[3]	Lannate LV Lannate SP	0.9 lb ai/A	5	2.7 lb ai/A	4	1	2.7 lb a.i./A
Peaches	Lannate LV Lannate SP	0.9 lb ai/A	5	5.4 lb ai/A	6	1	5.4 lb a.i./A
Peanuts (not grown in CA)	Lannate LV Lannate SP	0.9 lb ai/A	5	3.6 lb ai/A	8	N/A	N/A
Pears (Northeast only)	Lannate LV Lannate SP	0.9 lb ai/A	5	1.8 lb ai/A	2	1	1.8 lb a.i./A
Peas, succulent [LV] (pigeon peas, chick, garbanzo, dwarf peas, garden peas, green peas, English peas, Field peas, edible pod peas)	Lannate LV Lannate SP	0.9 lb ai/A	3	2.7 lb ai/A	6	1	2.7 lb a.i./A
Pecans (Southeast only)	Lannate LV Lannate SP	0.9 lb ai/A	5	6.3 lb ai/A	7	1	6.3 lb a.i./A
Peppers [LV] (bell, hot, pimentos, sweet)	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	10	1	4.5 lb a.i./A
Pomegranates	Lannate LV Lannate SP	0.9 lb ai/A	5	1.8 lb ai/A	2	1	1.8 lb a.i./A
Potato [LV]	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	10	1	4.5 lb a.i./A
Pumpkins[SLN] (CA-910011) (San Joaquin, Stanislaus, Merced, Sacramento, and Riverside Counties)	Lannate SP	0.9 lb ai/A	5	2.7 lb ai/A	3	1	2.7 lb a.i./A
Radishes[SLN] (CA-770495)	Lannate SP	0.9 lb ai/A	5	1.8 lb ai/A	2	5	9 lb a.i./A
Rye [LV]	Lannate LV Lannate SP	0.45 lb ai/A	5	1.8 lb ai/A	4	1	1.8 lb a.i./A
Sorghum (except sweet sorghum)	Lannate LV Lannate SP	0.45 lb ai/A	5	0.9 lb ai/A	2	1	0.9 lb a.i./A
Soybeans [LV]	Lannate LV Lannate SP	0.45 lb ai/A	5	1.35 lb ai/A	3	1	1.35 lb a.i./A
Soybeans [SLN] (interplanted	Lannate SP	0.45 lb ai/A	5	0.9 lb ai/A	2	1	0.9 lb a.i./A

USE	PRODUCT	MAX APPL. RATE	MIN APP. INTER -VAL[1]	MAX APPL. RATE/ CROP	MAX NO. OF APPL./ CROP	MAX NO. OF CROPS/ YEAR IN CA*	MAX APPL. RATE/ YEAR
with nonbearing almonds, plums, prunes, peaches, and walnuts) (CA-770431)							
Spinach [LV]	Lannate LV Lannate SP	0.9 lb ai/A	5	3.6 lb ai/A	8	3	10.8 lb a.i./A
Strawberry	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	10	1	4.5 lb a.i./A
Sugar Beet [LV]	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	10	1	4.5 lb a.i./A
Summer Squash [LV] (crookneck, straightneck, scallop, vegetable marrow, spaghetti, hyotan, cucuzza, hechima, Chinese okra, bitter melon, balsam pear, balsam apple, Chinese cucumber)	Lannate LV Lannate SP	0.9 lb ai/A	5	5.4 lb ai/A	12	1	5.4 lb a.i./A
Sweet Potatoes[SNL] (**Aerial** only) (CA-780136)	Lannate SP	0.9 lb ai/A	5	2.7 lb ai/A	3	1	2.7 lb a.i./A
Tangelo, Tangerine[3]	Lannate LV Lannate SP	0.9 lb ai/A	5	2.7 lb ai/A	4	1	2.7 lb a.i./A
Tobacco (except shade) (not grown in CA)	Lannate LV Lannate SP	0.45 lb ai/A	5	2.25 lb ai/A	5	1	2.25 lb a.i./A
Tomato	Lannate LV Lannate SP	0.9 lb ai/A	5	6.3 lb ai/A	16	1	6.3 lb a.i./A
Tomatillo	Lannate LV Lannate SP	0.9 lb ai/A	5	4.5 lb ai/A	5	1	4.5 lb a.i./A
Turf (sod farms only)	Lannate LV Lannate SP	0.9 lb ai/A	5	3.6 lb ai/A	4	2	7.2 lb a.i./A
Wheat [LV]	Lannate LV Lannate SP	0.45 lb ai/A	5	1.8 lb ai/A	4	1	1.8 lb a.i./A
Feedlots (outside)	Farnam Die Fly (scatter bait) Stimukil Fly Bait (scatter bait)	0.22 lb ai/acre (4 ounces of product/5 00 ft^2) or	1 NR	NR	NR	N/A	

USE	PRODUCT	MAX APPL. RATE	MIN APP. INTER-VAL[1]	MAX APPL. RATE/ CROP	MAX NO. OF APPL./ CROP	MAX NO. OF CROPS/ YEAR IN CA*	MAX APPL. RATE/ YEAR
	Lurectron Scatterbait (scatter bait; bait stations)	2 bait stations/500 ft^2	3				
	Golden Malrin Fly Killer (scatter bait)		1				
Dairies (outside)	Farnam Die Fly (scatter bait)	0.22 lb ai/acre (4 ounces of product/500 ft^2)	1				
Stables (outside)	Farnam Die Fly (scatter bait)	0.22 lb ai/acre (4 ounces of product/500 ft^2)	1	NR	NR	N/A	
Broiler Houses (outside)	Farnam Die Fly (scatter bait)	0.22 lb ai/acre (4 ounces of product/500 ft^2) or 2 bait stations/500 ft^2	1	NR	NR	N/A	
	Stimukil Fly Bait (bait station)		NR				
	Golden Malrin Fly Killer (scatter bait)		1				
Hog Houses (outside)	Farnam Die Fly (scatter bait)	0.22 lb ai/acre (4 ounces of product/500 ft^2)	1	NR	NR	N/A	
Livestock Barns (outside)	Farnam Die Fly (scatter bait)	0.22 lb ai/acre (4 ounces of product/500 ft^2) or 2 bait stations/500 ft^2	1	NR	NR	N/A	
	Stimukil Fly Bait (scatter bait)		NR				
	Lurectron Scatterbait (scatter bait; bait stations; paste)		3				

USE	PRODUCT	MAX APPL. RATE	MIN APP. INTER-VAL[1]	MAX APPL. RATE/ CROP	MAX NO. OF APPL./ CROP	MAX NO. OF CROPS/ YEAR IN CA*	MAX APPL. RATE/ YEAR
	Golden Malrin Fly Killer (scatter bait)		1				
Meat Processing Establishments (outside)	Farnam Die Fly (scatter bait)	0.22 lb ai/acre (4 ounces of product/500 ft^2) or 2 bait stations/500 ft^2	1	NR	NR	N/A	
	Stimukil Fly Bait (bait station; scatter bait)		NR				
	Lurectron Scatterbait (scatter bait; bait stations)		3				
	Golden Malrin Fly Killer (scatter bait)		1				
Poultry Processing Establishments (outside)	Farnam Die Fly (scatter bait)	0.22 lb ai/acre (4 ounces of product/500 ft^2) or 2 bait stations/500 ft^2	1	NR	NR	N/A	
	Stimukil Fly Bait (bait station; scatter bait)		NR				
	Lurectron Scatterbait (scatter bait; bait stations)		3				
	Golden Malrin Fly Killer (scatter bait)		1				
Beverage Plants (outside)	Farnam Die Fly (scatter bait)	0.22 lb ai/acre (4 ounces	1	NR	NR	N/A	

USE	PRODUCT	MAX APPL. RATE	MIN APP. INTER-VAL[1]	MAX APPL. RATE/ CROP	MAX NO. OF APPL./ CROP	MAX NO. OF CROPS/ YEAR IN CA*	MAX APPL. RATE/ YEAR
	Stimukil Fly Bait (bait station; scatter bait)	of product/500 ft^2) or 2 bait stations/500 ft^2	NR				
	Lurectron Scatterbait (scatter bait; bait stations)		3				
	Golden Malrin Fly Killer (scatter bait)		1				
Canneries (outside)	Farnam Die Fly (scatter bait)	0.22 lb ai/acre (4 ounces of product/500 ft^2) or 2 bait stations/500 ft^2	1	NR	NR	N/A	
	Stimukil Fly Bait (scatter bait; bait station)		NR				
	Lurectron Scatterbait (scatter bait; bait stations)		3				
	Golden Malrin Fly Killer (scatter bait)		1				
Food Processing Establishments (outside)	Farnam Die Fly (scatter bait)	0.22 lb ai/acre (4 ounces of product/500 ft^2) or 2 bait stations/500 ft^2	1	NR	NR	N/A	
	Stimukil Fly Bait (bait station)		NR				
	Lurectron Scatterbait (scatter bait; bait stations)		3				
	Golden Malrin Fly Killer (scatter bait)		1				

USE	PRODUCT	MAX APPL. RATE	MIN APP. INTER -VAL[1]	MAX APPL. RATE/ CROP	MAX NO. OF APPL./ CROP	MAX NO. OF CROPS/ YEAR IN CA*	MAX APPL. RATE/ YEAR
Commercial use Sites (unspecified)	Farnam Die Fly (bait station)	0.22 lb ai/acre (2 bait stations/5 00 ft^2)	NR	NR	NR	N/A	
	Stimukil Fly Bait (bait station)	2 bait stations/5 00 ft^2					
	Stimukil Fly Bait (scatter bait)	0.22 lb ai/acre (4 ounces of product/5 00 ft^2)					
	Stimukil Fly Bait (brush on)	NR					
	Lurectron Scatterbait (scatter bait)	0.22 lb ai/acre (4 ounces of product/5 00 ft^2)	3				
Kennels (outside)	Stimukil Fly Bait (bait station)	2 bait stations/5 00 ft^2	NR	NR	NR	N/A	
	Lurectron Scatterbait (bait station)		3				
	Golden Malrin Fly Killer (bait station)	4 bait stations/5 00 ft^2	1				
Dumpsters (associated with above uses)	Stimukil Fly Bait (bait station)	2 bait stations/5 00 ft^2	NR	NR	NR	N/A	
	Lurectron Scatterbait (bait station)		3				
	Golden Malrin Fly Killer (bait station)	4 bait stations/5 00 ft^2	1				
Restaurants (outside)	Stimukil Fly Bait (bait station)	2 bait stations/5 00 ft^2	NR	NR	NR	N/A	
	Lurectron Scatterbait (bait station)		3				

USE	PRODUCT	MAX APPL. RATE	MIN APP. INTER -VAL[1]	MAX APPL. RATE/ CROP	MAX NO. OF APPL./ CROP	MAX NO. OF CROPS/ YEAR IN CA*	MAX APPL. RATE/ YEAR
	Golden Malrin Fly Killer (bait station)	4 bait stations/5 00 ft^2	1				
Supermarkets (outside)	Stimukil Fly Bait (bait station)	2 bait stations/5 00 ft^2	NR	NR	NR	N/A	
	Lurectron Scatterbait (bait station)		3				
	Golden Malrin Fly Killer (bait station)	4 bait stations/5 00 ft^2	1				
Commissaries (outside)	Stimukil Fly Bait (bait station)	2 bait stations/5 00 ft^2	NR	NR	NR	N/A	
	Golden Malrin Fly Killer (bait station)	4 bait stations/5 00 ft^2	1				
Bakeries (outside)	Stimukil Fly Bait (bait station)	2 bait stations/5 00 ft^2	NR	NR	NR	N/A	
	Lurectron Scatterbait (bait station)		3				
	Golden Malrin Fly Killer (bait station)	4 bait stations/5 00 ft^2	1				
Poultry houses	Stimukil Fly Bait (scatter bait)	0.22 lb ai/acre (4 ounces of product/5 00 ft^2) or 2 bait stations/5 00 ft^2	NR	NR	NR	N/A	
	Lurectron Scatterbait (scatter bait; bait stations; paste)		3				
Commercial Dumpsters which are enclosed	Stimukil Fly Bait (scatter bait)	0.22 lb ai/acre (4 ounces of product/5 00 ft^2)	NR	NR	NR	N/A	
	Lurectron Scatterbait (scatter bait)		3				
	Golden Malrin Fly Killer (scatter bait)		1				

USE	PRODUCT	MAX APPL. RATE	MIN APP. INTER -VAL[1]	MAX APPL. RATE/ CROP	MAX NO. OF APPL./ CROP	MAX NO. OF CROPS/ YEAR IN CA*	MAX APPL. RATE/ YEAR
Stables	Golden Malrin Fly Killer (bait station)	4 bait stations/5 00 ft^2	1	NR	NR	N/A	
Fast Food Establishments	Golden Malrin Fly Killer (bait station)	4 bait stations/5 00 ft^2	1	NR	NR	N/A	
Warehouses	Golden Malrin Fly Killer (bait station)	4 bait stations/5 00 ft^2	1	NR	NR	N/A	

[LV] Low volume aerial applications (a minimum of 1 gallon of tank mixture/acre) is allowed
[1] 5 days was used unless otherwise stated on the label.
[2] Different rates depending on geographic region; the listed rates are for CA
[3] Limited to use in CA, AZ, and HI
[SLN] = CA Special Local Needs 24(c)
* Based on a memo from BEAD (see below)
** For perennial crops, we used the number of cuttings per year.

APPENDIX C. Methomyl Usage in CA - Data from BEAD and Supporting Material.

Purpose

Calculate pesticide usage data for California as follows:

(1) Average annual pounds applied **across four years** (2002-2005),

(2) Average annual area treated **across four years** (2002-2005),

(3) Average, Maximum, 95th Percentile, and 99th Percentile for the application rate **across all observations** for four years (2002-2005).

Notes on Calculating Average Annual Values

When calculating Average annual pounds applied and Average annual area treated (not Application rates) across four years, zeros are added when no usage or area is reported for a certain year.

Records with missing values for a certain year (i.e., unknown non-zero values) remain as missing.

Application Rate Estimation

Application rate is calculated as "pounds of active ingredient applied" divided by "acres treated"

Data Source

Pesticide Use Report Data, California Department of Pesticide Regulation

http://calpip.cdpr.ca.gov/cfdocs/calpip/prod/main.cfm

Data Description

Years: 2002 through 2005

58 counties for each year

Pesticides analyzed (total of 11)

Acephate, aldicarb, azinphos-methyl, chloropicrin, diazinon, imazapyr, metam-sodium, methamidophos, methomyl, (s)-metolachlor, and metolachlor.

Date Created:

12-Jun-07

Estimation Steps

1. Combine pesticide usage data for 58 counties for all four years.

2. Keep information only on eleven chemicals of interest.

3. Application Rate: Calculate across all observations for four years for each chemical-county-site-unit treated combination:

Average, Maximum, 95th Percentile, 99th Percentile for application rates, and the Number of records.

The number of records represents the number of non-missing records used to calculate average/max/percentile values.

4. Pounds Applied and Area Treated: Calculate for each year and chemical-county-site-unit treated combination: Total pounds applied, Total area treated, and the Number of records.

The number of records represents the number of non-missing records used to calculate total values.

4a. Combine estimated values for all four years. Add zeros for years with no data.

4b. Calculate **four-year** Average annual pounds applied and Average annual area treated.

5. Populate chemical, county, and site names.

Output variables

Averages and Rates

Active Ingredient, County, Site Name, Average Annual Pounds Applied, Number Records Pounds, Average Annual Area Treated, Unit Area Treated, Number Records Area,
Average Application Rate, 95th Percentile Application Rate, 99th Percentile Application Rate, Maximum Application Rate, Number Records Rate.

Total Annual Usage

Active Ingredient, County, Site Name, Total Pounds 2002, Total Pounds 2003, Total Pounds 2004, Total Pounds 2005, Average Annual Pounds Applied, Number Records Pounds,
Total Area 2002, Total Area 2003, Total Area 2004, Total Area 2005, Average Annual Area Treated, Unit Area Treated, Number Records Area,

Application Rate, 95th percentile Application Rate, 99th percentile Application Rate, Maximum Application Rate, Records Rate.

Notes on the Output

Missing values are presented as blanks.

Error Note

Errors identified in the process of estimating outliers by California Department of Pesticide Regulation are treated as follows:

Errors are reported for 2002 through 2005.

Application rate values are replaced with missing values when the "error" file indicated a potential error: "Pounds of AI per area treated is greater than 200 for non-fumigants or 1000 for fumigants, or pounds of product per area treated is greater than 50 times the median rate for this product on this commodity."

BEAD further tried to identify other records of questionable validity in the final data set using the following arbitrary criteria:

Average application rate > 95th percentile;

Number of records for pounds and area do not match;

Area units are missing or are questionable;

Less than one pound applied per year;

Less than one acre or 100 sq ft treated per year;

Calculated application rate is less than 0.1 lb per acre (or pound per sq foot);

Less than four occurrences of use over four years of data.

Using these criteria, over half of the records (2090 records of 3939) are identified as meeting one or more of these criteria.

While these records were kept in the dataset as requested by EFED, BEAD recommends that these records (highlighted in the spreadsheet) be used with extreme caution (if at all) in any further assessments.

See accompanying memorandum titled red_legged_frog_group1_revised051407.doc for additional information.

TABLE A. Methomyl Usage Information for CA (2002-2005).

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
ALAMEDA	ALFALFA	21	117	Acres	0.2	0.3
ALAMEDA	LANDSCAPE MAINTENANCE	0	0			
ALAMEDA	STRUCTURAL PEST CONTROL	0				
BUTTE	ALFALFA	4	12	Acres	0.3	0.3
BUTTE	BEAN, DRIED	82	166	Acres	0.5	0.7
BUTTE	BEAN, UNSPECIFIED	331	664	Acres	0.5	0.7
BUTTE	BLACKBERRY	0	0	Acres	0.9	0.9
BUTTE	CORN, HUMAN CONSUMPTION	1	0	Acres	1.8	1.8
BUTTE	COTTON	2	5	Acres	0.5	0.5
BUTTE	CUCUMBER	12	21	Acres	0.5	0.6
BUTTE	MELON	7	13	Acres	0.5	0.6
BUTTE	PEACH	1	1	Acres	0.9	0.9
BUTTE	SQUASH	11	22	Acres	0.5	0.7
BUTTE	STRAWBERRY	1	1	Acres	0.9	0.9
BUTTE	UNCULTIVATED AG	8	19	Acres	0.5	0.5
BUTTE	WALNUT	31	54	Acres	0.6	0.6
BUTTE	WATERMELON	0	1	Acres	0.7	0.7
CALAVERAS	STRUCTURAL PEST CONTROL	0	0			

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
COLUSA	ALFALFA	757	1,753	Acres	0.4	0.9
COLUSA	BEAN, DRIED	464	909	Acres	0.5	4.5
COLUSA	CABBAGE	1	4	Acres	0.2	0.2
COLUSA	CANTALOUPE	5	12	Acres	0.5	0.5
COLUSA	CARROT	174	289	Acres	0.6	0.9
COLUSA	CUCUMBER	219	468	Acres	0.5	0.7
COLUSA	LETTUCE, HEAD	7	16	Acres	0.5	0.5
COLUSA	MELON	5	14	Acres	0.4	0.5
COLUSA	ONION, DRY	380	497	Acres	0.8	1.8
COLUSA	SOIL FUMIGATION/PREPLANT	8	18	Acres	0.5	0.5
COLUSA	SORGHUM/MILO	1	6	Acres	0.2	0.2
COLUSA	SQUASH	82	145	Acres	0.6	3.6
COLUSA	SUGARBEET	13	14	Acres	0.9	0.9
COLUSA	TOMATO, PROCESSING	1,938	3,661	Acres	0.5	6.9
COLUSA	WATERMELON	173	365	Acres	0.5	0.9
CONTRA COSTA	ALFALFA	134	322	Acres	0.4	0.5
CONTRA COSTA	BEAN, SUCCULENT	1	3	Acres	0.5	0.5
CONTRA COSTA	CORN, HUMAN CONSUMPTION	7,199	15,871	Acres	0.5	4.9
CONTRA COSTA	GRAPE, WINE	21	47	Acres	0.5	0.5
CONTRA COSTA	LETTUCE, LEAF	8	18	Acres	0.5	0.5
CONTRA COSTA	STRAWBERRY	5	6	Acres	0.9	0.9
CONTRA COSTA	STRUCTURAL PEST CONTROL	0	0			
CONTRA COSTA	TOMATO	7	11	Acres	0.7	0.9
CONTRA COSTA	TOMATO, PROCESSING	15	34	Acres	0.5	0.5
EL DORADO	GRAPE, WINE	3	3	Acres	0.9	0.9
EL DORADO	STRUCTURAL PEST CONTROL	0	0			
FRESNO	ALFALFA	8,952	14,953	Acres	0.6	0.9
FRESNO	ALMOND	25	40	Acres	0.6	0.7
FRESNO	APPLE	1	1	Acres	0.9	0.9
FRESNO	ASPARAGUS	387	721	Acres	0.6	0.9
FRESNO	BARLEY	21	107	Acres	0.3	0.5
FRESNO	BEAN, DRIED	474	672	Acres	0.7	0.9
FRESNO	BEAN, SUCCULENT	285	410	Acres	0.7	1.4
FRESNO	BEET	2	3	Acres	0.7	0.7
FRESNO	BLUEBERRY	2	3	Acres	0.9	0.9
FRESNO	BOK CHOY	7	8	Acres	1.0	1.8
FRESNO	BROCCOLI	863	1,486	Acres	0.6	0.9
FRESNO	CABBAGE	23	43	Acres	0.7	1.4
FRESNO	CANTALOUPE	6,099	9,145	Acres	0.7	1.8
FRESNO	CARROT	22	29	Acres	0.7	0.9
FRESNO	CHINESE CABBAGE (NAPPA)	54	59	Acres	1.0	1.8
FRESNO	CITRUS	151	17	Acres	8.4	47.7
FRESNO	CORN (FORAGE -	651	1,517	Acres	0.4	0.5

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
	FODDER)					
FRESNO	CORN, HUMAN CONSUMPTION	18,696	41,702	Acres	0.5	12.6
FRESNO	COTTON	484	757	Acres	0.6	1.4
FRESNO	CUCUMBER	22	31	Acres	1.1	1.8
FRESNO	EGGPLANT	63	131	Acres	0.5	3.1
FRESNO	ENDIVE (ESCAROLE)	3	7	Acres	0.5	0.5
FRESNO	GAI LON	53	69	Acres	0.8	2.3
FRESNO	GARLIC	354	1,192	Acres	0.3	0.5
FRESNO	GRAPE	1,723	2,173	Acres	0.8	9.2
FRESNO	GRAPE, WINE	157	188	Acres	0.8	0.9
FRESNO	LANDSCAPE MAINTENANCE	0	0			
FRESNO	LETTUCE, HEAD	11,554	17,555	Acres	0.7	4.8
FRESNO	LETTUCE, LEAF	1,574	2,880	Acres	0.6	4.5
FRESNO	MELON	1,377	1,948	Acres	0.7	0.9
FRESNO	NECTARINE	1,806	2,248	Acres	0.8	4.5
FRESNO	OAT (FORAGE - FODDER)	24	54	Acres	0.5	0.5
FRESNO	ONION, DRY	3,397	5,716	Acres	0.6	1.4
FRESNO	ONION, GREEN	46	100	Acres	0.6	0.9
FRESNO	ORANGE	60	104	Acres	0.6	0.9
FRESNO	PEACH	331	391	Acres	0.8	1.0
FRESNO	PEAS	3	4	Acres	1.0	2.0
FRESNO	PEPPER, FRUITING	2,588	4,245	Acres	0.6	0.9
FRESNO	PLUM	9	8	Acres	1.5	3.6
FRESNO	POMEGRANATE	327	420	Acres	0.8	0.9
FRESNO	RESEARCH COMMODITY	1	1	Acres	0.5	0.5
FRESNO	SORGHUM (FORAGE - FODDER)	12	26	Acres	0.5	0.5
FRESNO	SPINACH	0	1	Acres	0.7	0.7
FRESNO	SQUASH	4	6	Acres	0.7	0.7
FRESNO	SQUASH, SUMMER	11	17	Acres	0.6	0.9
FRESNO	SQUASH, WINTER	2	2	Acres	1.1	1.1
FRESNO	SQUASH, ZUCCHINI	1	1	Acres	0.5	0.5
FRESNO	STRAWBERRY	3	8	Acres	0.5	0.9
FRESNO	STRUCTURAL PEST CONTROL	1				
FRESNO	SUDANGRASS	152	368	Acres	0.4	0.5
FRESNO	SUGARBEET	4,836	7,256	Acres	0.7	0.9
FRESNO	SWISS CHARD	0	0	Acres	1.4	1.4
FRESNO	TANGERINE	3	4	Acres	0.6	0.9
FRESNO	TOMATILLO	2	3	Acres	0.9	0.9
FRESNO	TOMATO	1,748	2,578	Acres	0.7	1.0
FRESNO	TOMATO, PROCESSING	13,796	16,746	Acres	0.8	10.8
FRESNO	WATERMELON	2,194	2,727	Acres	0.8	0.9
FRESNO	WHEAT	23	25	Acres	0.9	0.9
FRESNO	WHEAT (FORAGE - FODDER)	12	26	Acres	0.5	0.5

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
GLENN	ALFALFA	1,274	3,142	Acres	0.4	4.5
GLENN	BARLEY	24	35	Acres	0.7	0.7
GLENN	BEAN, DRIED	184	382	Acres	0.5	0.7
GLENN	BEAN, SUCCULENT	122	203	Acres	0.6	0.7
GLENN	BEAN, UNSPECIFIED	395	780	Acres	0.5	0.9
GLENN	BROCCOLI	2	3	Acres	0.6	0.9
GLENN	CANTALOUPE	3	6	Acres	0.5	0.7
GLENN	CARROT	10	15	Acres	0.7	0.9
GLENN	CORN (FORAGE - FODDER)	18	39	Acres	0.5	0.5
GLENN	CUCUMBER	7	16	Acres	0.5	0.5
GLENN	MELON	13	28	Acres	0.5	0.5
GLENN	ONION, DRY	17	29	Acres	0.7	0.9
GLENN	PEAS	7	10	Acres	0.7	0.7
GLENN	SQUASH	30	64	Acres	0.5	0.7
GLENN	TOMATO	0	1	Acres	0.5	0.5
GLENN	WATERMELON	75	147	Acres	0.5	0.7
HUMBOLDT	CORN (FORAGE - FODDER)	30	65	Acres	0.5	0.5
HUMBOLDT	STRUCTURAL PEST CONTROL	0	0			
IMPERIAL	ALFALFA	3,436	5,465	Acres	0.6	0.9
IMPERIAL	ASPARAGUS	574	778	Acres	0.8	0.9
IMPERIAL	BEAN, SUCCULENT	40	46	Acres	0.9	0.9
IMPERIAL	BEAN, UNSPECIFIED	0	1	Acres	0.6	0.6
IMPERIAL	BERMUDAGRASS	1,230	1,908	Acres	0.6	0.9
IMPERIAL	BOK CHOY	13	19	Acres	0.6	0.9
IMPERIAL	BROCCOLI	1,146	2,176	Acres	0.5	1.0
IMPERIAL	CABBAGE	635	907	Acres	0.7	0.9
IMPERIAL	CANTALOUPE	86	146	Acres	0.6	0.7
IMPERIAL	CARROT	840	1,367	Acres	0.6	0.9
IMPERIAL	CAULIFLOWER	149	275	Acres	0.6	0.9
IMPERIAL	CELERY	38	49	Acres	0.8	0.9
IMPERIAL	CHINESE CABBAGE (NAPPA)	37	55	Acres	0.6	0.9
IMPERIAL	CORN (FORAGE - FODDER)	9	20	Acres	0.4	0.4
IMPERIAL	CORN, HUMAN CONSUMPTION	3,692	10,077	Acres	0.4	0.7
IMPERIAL	COTTON	64	96	Acres	0.7	0.7
IMPERIAL	EGGPLANT	1	2	Acres	0.4	0.8
IMPERIAL	ENDIVE (ESCAROLE)	130	201	Acres	0.7	3.4
IMPERIAL	FENNEL	15	17	Acres	0.9	0.9
IMPERIAL	KALE	16	29	Acres	0.7	1.0
IMPERIAL	LETTUCE, HEAD	11,113	18,377	Acres	0.6	8.8
IMPERIAL	LETTUCE, LEAF	6,819	10,874	Acres	0.6	1.9
IMPERIAL	MELON	6	9	Acres	0.7	0.7
IMPERIAL	MUSTARD	2	3	Acres	0.5	0.6
IMPERIAL	ONION, DRY	1,811	3,080	Acres	0.6	0.9
IMPERIAL	PEPPER, FRUITING	63	115	Acres	0.6	0.9

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
IMPERIAL	RAPPINI	298	456	Acres	0.7	0.7
IMPERIAL	SPINACH	421	583	Acres	0.7	2.2
IMPERIAL	SQUASH	2	4	Acres	0.5	0.5
IMPERIAL	STRUCTURAL PEST CONTROL	0				
IMPERIAL	SUDANGRASS	62	138	Acres	0.4	0.5
IMPERIAL	SUGARBEET	10,495	18,127	Acres	0.6	0.9
IMPERIAL	SWISS CHARD	10	16	Acres	0.8	0.9
IMPERIAL	TOMATO	11	15	Acres	0.8	0.9
KERN	ALFALFA	395	741	Acres	0.5	0.9
KERN	BEAN, DRIED	182	247	Acres	0.7	0.9
KERN	BEET	14	20	Acres	0.7	0.9
KERN	CABBAGE	49	63	Acres	0.8	0.9
KERN	CARROT	158	192	Acres	0.8	0.9
KERN	CHINESE CABBAGE (NAPPA)	12	13	Acres	0.9	0.9
KERN	CORN (FORAGE - FODDER)	31	69	Acres	0.5	0.5
KERN	CORN, HUMAN CONSUMPTION	80	177	Acres	0.5	0.5
KERN	COTTON	1	3	Acres	0.5	0.5
KERN	EGGPLANT	1	3	Acres	0.5	0.5
KERN	GRAPE	9,349	13,070	Acres	0.8	21.6
KERN	GRAPE, WINE	252	320	Acres	0.7	1.9
KERN	LEMON	25	34	Acres	0.7	0.9
KERN	LETTUCE, HEAD	371	498	Acres	0.7	0.9
KERN	LETTUCE, LEAF	20	29	Acres	0.6	0.9
KERN	MELON	38	45	Acres	0.7	0.9
KERN	NECTARINE	1,120	1,461	Acres	0.8	1.2
KERN	N-GRNHS FLOWER	11	15	Acres	0.8	0.9
KERN	N-OUTDR PLANTS IN CONTAINERS	13	16	Acres	0.7	0.9
KERN	ONION, DRY	172	266	Acres	0.7	1.1
KERN	ORANGE	954	1,256	Acres	0.8	0.9
KERN	PEACH	260	325	Acres	0.8	0.9
KERN	PEPPER, FRUITING	184	235	Acres	0.8	0.9
KERN	PEPPER, SPICE	7	11	Acres	0.7	0.7
KERN	POMEGRANATE	45	50	Acres	0.9	0.9
KERN	POTATO	1,129	1,271	Acres	1.3	28.3
KERN	SQUASH	0	0	Acres	0.5	0.5
KERN	STRUCTURAL PEST CONTROL	0	0			
KERN	SUDANGRASS	22	39	Acres	0.6	0.7
KERN	SUGARBEET	109	123	Acres	0.9	0.9
KERN	TANGERINE	88	181	Acres	0.6	0.9
KERN	TOMATO	591	667	Acres	0.9	0.9
KERN	TOMATO, PROCESSING	220	314	Acres	0.7	0.9
KERN	WATERMELON	2	5	Acres	0.5	0.5
KERN	WHEAT	14	15	Acres	0.9	0.9
KINGS	ALFALFA	4,996	6,120	Acres	0.6	8.5

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
KINGS	ASPARAGUS	57	64	Acres	0.9	0.9
KINGS	BEAN, SUCCULENT	1	2	Acres	0.5	0.5
KINGS	BROCCOLI	5	6	Acres	0.9	0.9
KINGS	CARROT	46	61	Acres	0.8	0.9
KINGS	CORN (FORAGE - FODDER)	168	305	Acres	0.6	4.5
KINGS	CORN, HUMAN CONSUMPTION	11	25	Acres	0.5	0.5
KINGS	COTTON	286	653	Acres	0.5	0.9
KINGS	FORAGE HAY/SILAGE	16	38	Acres	0.4	0.4
KINGS	GARLIC	55	112	Acres	0.5	0.5
KINGS	GRAPE	7	8	Acres	0.9	0.9
KINGS	GRAPE, WINE	87	118	Acres	0.7	0.9
KINGS	LANDSCAPE MAINTENANCE	0	0			
KINGS	LETTUCE, HEAD	59	65	Acres	0.9	0.9
KINGS	LETTUCE, LEAF	9	21	Acres	0.5	0.5
KINGS	NECTARINE	400	498	Acres	0.7	0.9
KINGS	ONION, DRY	789	1,213	Acres	0.7	0.9
KINGS	PEACH	13	15	Acres	0.9	0.9
KINGS	PEPPER, FRUITING	8	9	Acres	0.9	0.9
KINGS	POMEGRANATE	378	420	Acres	0.9	0.9
KINGS	SORGHUM (FORAGE - FODDER)	6	13	Acres	0.5	0.5
KINGS	SORGHUM/MILO	12	29	Acres	0.4	0.4
KINGS	SQUASH	1	2	Acres	0.5	0.5
KINGS	STRUCTURAL PEST CONTROL	0	0			
KINGS	SUDANGRASS	29	64	Acres	0.5	0.5
KINGS	SUGARBEET	466	887	Acres	0.6	0.9
KINGS	SUGARBEET (FORAGE - FODDER)	331	713	Acres	0.5	0.6
KINGS	TOMATO	392	496	Acres	0.8	0.9
KINGS	TOMATO, PROCESSING	721	956	Acres	0.8	0.9
KINGS	WATERMELON	7	8	Acres	0.9	0.9
KINGS	WHEAT	16	35	Acres	0.5	0.5
LAKE	STRAWBERRY	1	2	Acres	0.5	0.9
LAKE	STRUCTURAL PEST CONTROL	0	0			
LOS ANGELES	CORN (FORAGE - FODDER)	63	142	Acres	0.4	0.5
LOS ANGELES	NECTARINE	82	92	Acres	0.9	1.4
LOS ANGELES	ONION, DRY	1,108	1,371	Acres	0.8	3.9
LOS ANGELES	POTATO	40	44	Acres	0.9	0.9
LOS ANGELES	SOIL FUMIGATION/PREPLANT	6	6	Acres	0.9	0.9
LOS ANGELES	STRAWBERRY	42	47	Acres	0.8	0.9
LOS ANGELES	STRUCTURAL PEST CONTROL	2				
LOS ANGELES	TOMATO	25	27	Acres	0.9	1.4
MADERA	ALFALFA	5,403	15,093	Acres	0.4	15.9

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
MADERA	BEAN, DRIED	53	98	Acres	0.5	0.7
MADERA	BEAN, UNSPECIFIED	118	175	Acres	0.6	0.9
MADERA	CARROT	34	37	Acres	0.9	0.9
MADERA	CORN (FORAGE - FODDER)	401	1,044	Acres	0.4	3.0
MADERA	COTTON	5	12	Acres	0.4	0.5
MADERA	GRAPE	200	287	Acres	0.8	0.9
MADERA	GRAPE, WINE	75	107	Acres	0.7	1.9
MADERA	NECTARINE	15	20	Acres	0.7	0.9
MADERA	N-OUTDR PLANTS IN CONTAINERS	1	1	Acres	0.9	0.9
MADERA	N-OUTDR TRANSPLANTS	5	6	Acres	0.8	0.9
MADERA	PEACH	21	23	Acres	0.9	0.9
MADERA	POMEGRANATE	23	26	Acres	0.9	0.9
MADERA	SQUASH	66	73	Acres	0.9	0.9
MADERA	STRUCTURAL PEST CONTROL	0	0			
MADERA	SUDANGRASS	6	13	Acres	0.5	0.5
MADERA	SUGARBEET	371	555	Acres	0.7	0.9
MADERA	TOMATO	19	39	Acres	0.5	0.7
MADERA	UNCULTIVATED AG	4	8	Acres	0.5	0.5
MARIN	LANDSCAPE MAINTENANCE	0	0			
MARIN	STRUCTURAL PEST CONTROL	0	0			
MARIPOSA	STRUCTURAL PEST CONTROL	0	0			
MENDOCINO	BEAN, UNSPECIFIED	3	7	Acres	0.5	0.5
MENDOCINO	CORN, HUMAN CONSUMPTION	3	7	Acres	0.4	0.5
MENDOCINO	PEAS	10	22	Acres	0.5	0.5
MENDOCINO	STRAWBERRY	3	4	Acres	1.6	4.5
MENDOCINO	STRUCTURAL PEST CONTROL	0	0			
MERCED	ALFALFA	15,021	39,933	Acres	0.4	0.9
MERCED	ALMOND	9	7	Acres	1.2	1.5
MERCED	ANIMAL PREMISE	1	15	Misc. unit	0.0	0.1
MERCED	ASPARAGUS	264	370	Acres	0.7	0.9
MERCED	BEAN, DRIED	106	194	Acres	0.5	0.7
MERCED	BEAN, SUCCULENT	274	493	Acres	0.6	0.9
MERCED	CANTALOUPE	630	1,109	Acres	0.6	0.9
MERCED	CARROT	2	2	Acres	0.8	1.1
MERCED	CAULIFLOWER	31	23	Acres	1.3	1.3
MERCED	CHINESE CABBAGE (NAPPA)	16	17	Acres	0.9	0.9
MERCED	CORN (FORAGE - FODDER)	457	1,096	Acres	0.4	0.5
MERCED	CORN, HUMAN CONSUMPTION	252	556	Acres	0.5	0.7
MERCED	COTTON	71	135	Acres	0.5	0.9
MERCED	GRAPE, WINE	120	135	Acres	0.8	0.9
MERCED	MELON	34	57	Acres	0.5	0.9

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
MERCED	N-GRNHS PLANTS IN CONTAINERS	7	8	Acres	0.9	0.9
MERCED	N-OUTDR PLANTS IN CONTAINERS	52	76	Acres	0.8	1.1
MERCED	OAT (FORAGE - FODDER)	19	53	Acres	0.4	0.5
MERCED	ONION, DRY	56	86	Acres	0.7	0.9
MERCED	PEACH	2	1	Acres	1.8	1.8
MERCED	PEAS	8	11	Acres	0.7	0.7
MERCED	PEPPER, FRUITING	39	61	Acres	0.7	0.9
MERCED	PUMPKIN	1	1	Acres	0.7	0.7
MERCED	SORGHUM (FORAGE - FODDER)	2	9	Acres	0.2	0.2
MERCED	STRAWBERRY	15	26	Acres	0.5	0.9
MERCED	STRUCTURAL PEST CONTROL	0	0			
MERCED	SUDANGRASS	132	293	Acres	0.4	0.5
MERCED	SUGARBEET	2,351	5,364	Acres	0.4	0.9
MERCED	SWEET POTATO	2,127	2,520	Acres	0.8	0.9
MERCED	TOMATILLO	6	20	Acres	0.3	0.5
MERCED	TOMATO	2,626	3,976	Acres	0.7	0.9
MERCED	TOMATO, PROCESSING	1,985	3,174	Acres	0.6	0.9
MERCED	WATERMELON	41	101	Acres	0.4	0.9
MERCED	WHEAT (FORAGE - FODDER)	1	8	Acres	0.2	0.2
MODOC	ALFALFA	8	18	Acres	0.4	0.4
MODOC	FORAGE HAY/SILAGE	13	29	Acres	0.4	0.5
MODOC	MINT	17	28	Acres	0.6	0.6
MONTEREY	ASPARAGUS	6	7	Acres	0.9	0.9
MONTEREY	BEAN, DRIED	246	467	Acres	0.6	0.9
MONTEREY	BEAN, SUCCULENT	178	294	Acres	0.6	0.9
MONTEREY	BEAN, UNSPECIFIED	4	5	Acres	0.9	0.9
MONTEREY	BOK CHOY	13	17	Acres	0.8	0.9
MONTEREY	BROCCOLI	1,962	2,268	Acres	0.9	44.3
MONTEREY	CABBAGE	392	478	Acres	0.8	1.5
MONTEREY	CARROT	20	31	Acres	0.7	0.9
MONTEREY	CAULIFLOWER	330	426	Acres	0.8	0.9
MONTEREY	CELERY	4,702	6,028	Acres	0.8	45.0
MONTEREY	CHICORY	3	7	Acres	0.5	0.5
MONTEREY	CHINESE CABBAGE (NAPPA)	18	25	Acres	0.8	0.9
MONTEREY	CORN, HUMAN CONSUMPTION	2	5	Acres	0.5	0.5
MONTEREY	ENDIVE (ESCAROLE)	204	310	Acres	0.6	0.9
MONTEREY	FENNEL	332	378	Acres	0.9	0.9
MONTEREY	GRAPE, WINE	2,553	3,301	Acres	0.8	8.9
MONTEREY	KALE	76	111	Acres	0.7	0.9
MONTEREY	LETTUCE, HEAD	11,164	16,162	Acres	0.7	11.5
MONTEREY	LETTUCE, LEAF	13,743	20,635	Acres	0.7	9.0
MONTEREY	MUSHROOM	0	0	Acres	0.0	0.0
MONTEREY	MUSTARD	6	13	Acres	0.4	0.5

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MONTEREY	N-GRNHS FLOWER	4	5	Acres	0.9	0.9
MONTEREY	N-GRNHS PLANTS IN CONTAINERS	1	2	Acres	0.0	0.0
MONTEREY	N-GRNHS TRANSPLANTS	35	75	Acres	0.0	0.0
MONTEREY	N-OUTDR FLOWER	1	4	Acres	0.4	0.5
MONTEREY	N-OUTDR TRANSPLANTS	0	4	Acres	0.0	0.0
MONTEREY	N-OUTDR TRANSPLANTS	16	35	Acres	0.0	0.0
MONTEREY	OAT	2	6	Acres	0.5	0.5
MONTEREY	ONION, DRY	1,598	2,218	Acres	0.7	0.9
MONTEREY	ONION, GREEN	234	378	Acres	0.6	0.9
MONTEREY	PARSLEY	12	17	Acres	0.8	0.9
MONTEREY	PEAS	1,026	1,392	Acres	0.7	1.0
MONTEREY	PEPPER, FRUITING	312	498	Acres	0.6	0.9
MONTEREY	PEPPER, SPICE	225	341	Acres	0.6	0.9
MONTEREY	PIMENTO	50	74	Acres	0.6	0.9
MONTEREY	RAPPINI	223	258	Acres	0.9	0.9
MONTEREY	RASPBERRY	5	6	Acres	0.9	0.9
MONTEREY	RESEARCH COMMODITY	0	0			
MONTEREY	RESEARCH COMMODITY	2	12	Acres	0.7	0.9
MONTEREY	SPINACH	2,365	3,404	Acres	0.7	7.7
MONTEREY	SQUASH	2	5	Acres	0.5	0.5
MONTEREY	SQUASH, SUMMER	47	55	Acres	0.9	0.9
MONTEREY	STRAWBERRY	11,193	13,578	Acres	0.8	28.8
MONTEREY	STRUCTURAL PEST CONTROL	0	0			
MONTEREY	SWISS CHARD	3	4	Acres	0.6	0.9
MONTEREY	TOMATILLO	0	1	Acres	0.5	0.5
MONTEREY	TOMATO	89	156	Acres	0.6	0.9
NAPA	GRAPE, WINE	113	128	Acres	0.8	0.9
NAPA	LANDSCAPE MAINTENANCE	0	0			
NAPA	STRUCTURAL PEST CONTROL	0				
NEVADA	STRUCTURAL PEST CONTROL	0	0			
ORANGE	BEAN, SUCCULENT	9	10	Acres	0.9	0.9
ORANGE	BEAN, UNSPECIFIED	0	0	Acres	0.6	0.6
ORANGE	PEAS	22	26	Acres	0.9	0.9
ORANGE	PEPPER, FRUITING	161	186	Acres	0.9	0.9
ORANGE	SORGHUM/MILO	0	0	Acres	0.5	0.5
ORANGE	STRAWBERRY	362	408	Acres	0.9	0.9
ORANGE	STRUCTURAL PEST CONTROL	0				
PLACER	STRAWBERRY	1	2	Acres	0.3	0.6
PLACER	STRUCTURAL PEST CONTROL	0	0			
PLACER	SUDANGRASS	13	30	Acres	0.5	0.5
RIVERSIDE	ALFALFA	288	890	Acres	0.3	0.9

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
RIVERSIDE	ANIMAL PREMISE	1	56	Misc. unit	0.1	0.7
RIVERSIDE	ANIMAL PREMISE	0	16	Acres	0.0	0.0
RIVERSIDE	BEAN, SUCCULENT	35	47	Acres	0.7	0.9
RIVERSIDE	BERMUDAGRASS	9	18	Acres	0.5	0.5
RIVERSIDE	BOK CHOY	7	15	Acres	0.5	0.7
RIVERSIDE	BROCCOLI	418	713	Acres	0.6	0.9
RIVERSIDE	CABBAGE	58	126	Acres	0.5	0.9
RIVERSIDE	CANTALOUPE	28	33	Acres	0.9	0.9
RIVERSIDE	CARROT	95	130	Acres	0.7	0.9
RIVERSIDE	CAULIFLOWER	133	204	Acres	0.6	0.9
RIVERSIDE	CELERY	92	136	Acres	0.7	0.7
RIVERSIDE	CHINESE CABBAGE (NAPPA)	26	56	Acres	0.5	0.7
RIVERSIDE	CORN (FORAGE - FODDER)	28	63	Acres	0.5	0.5
RIVERSIDE	CORN, HUMAN CONSUMPTION	1,193	2,859	Acres	0.4	0.9
RIVERSIDE	COTTON	7	12	Acres	0.5	0.6
RIVERSIDE	COTTON (FORAGE - FODDER)	4	9	Acres	0.5	0.5
RIVERSIDE	EGGPLANT	41	52	Acres	0.8	0.9
RIVERSIDE	FENNEL	1	2	Acres	0.7	0.7
RIVERSIDE	GRAPE	195	233	Acres	0.8	1.0
RIVERSIDE	KALE	1	1	Acres	0.7	0.7
RIVERSIDE	LANDSCAPE MAINTENANCE	0	0			
RIVERSIDE	LEMON	9	10	Acres	0.9	0.9
RIVERSIDE	LETTUCE, HEAD	309	664	Acres	0.5	0.7
RIVERSIDE	LETTUCE, LEAF	563	812	Acres	0.7	0.9
RIVERSIDE	ONION, DRY	181	324	Acres	0.6	0.7
RIVERSIDE	ORANGE	19	21	Acres	0.9	0.9
RIVERSIDE	PEPPER, FRUITING	258	398	Acres	0.7	0.9
RIVERSIDE	POTATO	596	1,086	Acres	0.6	4.5
RIVERSIDE	POULTRY	0	3	Acres	0.0	0.0
RIVERSIDE	POULTRY	0	2	Misc. unit	0.0	0.0
RIVERSIDE	PUBLIC HEALTH	0	0			
RIVERSIDE	RAPPINI	6	8	Acres	0.7	0.7
RIVERSIDE	SPINACH	14	30	Acres	0.5	0.8
RIVERSIDE	SQUASH, SUMMER	4	7	Acres	0.6	0.7
RIVERSIDE	STRAWBERRY	124	163	Acres	0.8	0.9
RIVERSIDE	STRUCTURAL PEST CONTROL	1				
RIVERSIDE	TANGERINE	32	38	Acres	0.9	0.9
RIVERSIDE	TOMATO	701	806	Acres	0.9	1.8
RIVERSIDE	UNKNOWN	1	2	Acres	0.5	0.5
RIVERSIDE	WATERMELON	47	86	Acres	0.5	0.9
RIVERSIDE	WHEAT	29	67	Acres	0.4	0.5
SACRAMENTO	ALFALFA	23	52	Acres	0.5	0.5
SACRAMENTO	BROCCOLI	0	0	Acres	0.0	0.0
SACRAMENTO	BROCCOLI	0	0	Acres	0.5	0.5

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
SACRAMENTO	CABBAGE	0	0	Acres	0.0	0.0
SACRAMENTO	CABBAGE	0	0	Acres	0.5	0.5
SACRAMENTO	CHINESE CABBAGE (NAPPA)	0	0	Acres	0.5	0.5
SACRAMENTO	CORN (FORAGE - FODDER)	116	159	Acres	0.6	6.9
SACRAMENTO	CORN, HUMAN CONSUMPTION	253	573	Acres	0.4	0.5
SACRAMENTO	CUCUMBER	1	2	Acres	0.5	0.5
SACRAMENTO	MUSTARD	0	14	Square feet	0.0	0.0
SACRAMENTO	ONION, GREEN	11	12	Acres	0.9	0.9
SACRAMENTO	PEPPER, FRUITING	12	28	Acres	0.5	0.5
SACRAMENTO	PUMPKIN	73	173	Acres	0.4	0.5
SACRAMENTO	RIGHTS OF WAY	0	0			
SACRAMENTO	SQUASH	0	1	Acres	0.7	0.9
SACRAMENTO	STRAWBERRY	2	4	Acres	0.5	0.6
SACRAMENTO	STRUCTURAL PEST CONTROL	0	0			
SACRAMENTO	SUDANGRASS	534	1,184	Acres	0.5	6.3
SACRAMENTO	TOMATO	90	200	Acres	0.5	0.5
SACRAMENTO	TOMATO, PROCESSING	316	543	Acres	0.7	5.4
SACRAMENTO	WATERMELON	3	6	Acres	0.5	0.5
SAN BENITO	ASPARAGUS	171	140	Acres	1.1	9.1
SAN BENITO	BEAN, SUCCULENT	3	4	Acres	0.8	0.9
SAN BENITO	BEAN, UNSPECIFIED	8	9	Acres	0.9	0.9
SAN BENITO	BOK CHOY	1	2	Acres	0.6	0.7
SAN BENITO	BROCCOLI	30	41	Acres	0.7	0.9
SAN BENITO	CABBAGE	8	10	Acres	1.4	10.4
SAN BENITO	CELERY	379	446	Acres	0.8	0.9
SAN BENITO	CORN, HUMAN CONSUMPTION	37	83	Acres	0.4	0.5
SAN BENITO	ENDIVE (ESCAROLE)	11	18	Acres	0.6	0.9
SAN BENITO	GRAPE, WINE	577	681	Acres	0.8	1.8
SAN BENITO	KALE	2	3	Acres	0.6	0.9
SAN BENITO	LETTUCE, HEAD	508	665	Acres	0.8	4.5
SAN BENITO	LETTUCE, LEAF	1,338	1,877	Acres	0.7	4.5
SAN BENITO	OAT	15	33	Acres	0.5	0.5
SAN BENITO	ONION, DRY	66	82	Acres	0.8	0.9
SAN BENITO	PEPPER, FRUITING	457	513	Acres	0.9	0.9
SAN BENITO	PEPPER, SPICE	23	25	Acres	0.9	0.9
SAN BENITO	SPINACH	81	153	Acres	0.5	1.1
SAN BENITO	STRAWBERRY	37	41	Acres	0.9	0.9
SAN BENITO	TOMATO	168	200	Acres	0.9	0.9
SAN BENITO	TOMATO, PROCESSING	5	6	Acres	0.9	0.9
SAN BERNARDINO	ANIMAL PREMISE	2	18	Acres	0.0	0.0
SAN BERNARDINO	ANIMAL PREMISE	1	34	Misc. unit	0.1	0.1
SAN BERNARDINO	ANIMAL PREMISE	0	26	Acres	0.0	0.0

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SAN BERNARDINO	CABBAGE	4	4	Acres	0.9	0.9
SAN BERNARDINO	STRAWBERRY	23	29	Acres	0.7	1.8
SAN BERNARDINO	STRUCTURAL PEST CONTROL	0				
SAN DIEGO	BEAN, SUCCULENT	59	67	Acres	0.9	0.9
SAN DIEGO	BEAN, UNSPECIFIED	13	15	Acres	0.9	0.9
SAN DIEGO	CAULIFLOWER	26	30	Acres	0.9	0.9
SAN DIEGO	CORN, HUMAN CONSUMPTION	130	304	Acres	0.4	0.5
SAN DIEGO	CUCUMBER	6	14	Acres	0.9	5.6
SAN DIEGO	LANDSCAPE MAINTENANCE	0	0			
SAN DIEGO	LETTUCE, LEAF	5	7	Acres	0.7	0.9
SAN DIEGO	N-OUTDR FLOWER	2	2	Acres	0.8	0.9
SAN DIEGO	ONION, GREEN	0	0	Acres	0.9	1.4
SAN DIEGO	PEPPER, FRUITING	51	72	Acres	0.5	1.1
SAN DIEGO	POTATO	111	182	Acres	0.7	1.5
SAN DIEGO	POULTRY	0	0	Acres		
SAN DIEGO	SQUASH	1	1	Square feet	0.5	0.5
SAN DIEGO	SQUASH	44	55	Acres	0.8	0.9
SAN DIEGO	STRAWBERRY	54	60	Acres	0.9	0.9
SAN DIEGO	STRUCTURAL PEST CONTROL	1				
SAN DIEGO	TOMATO	358	408	Acres	0.9	0.9
SAN FRANCISCO	STRUCTURAL PEST CONTROL	0	0			
SAN JOAQUIN	ALFALFA	1,439	3,877	Acres	0.4	0.8
SAN JOAQUIN	ANIMAL PREMISE	0	0	Acres	0.0	0.0
SAN JOAQUIN	APPLE	51	114	Acres	0.5	0.5
SAN JOAQUIN	ASPARAGUS	10	22	Acres	0.5	0.5
SAN JOAQUIN	BEAN, DRIED	711	1,547	Acres	0.5	0.7
SAN JOAQUIN	BEAN, SUCCULENT	995	1,921	Acres	0.5	0.9
SAN JOAQUIN	BEAN, UNSPECIFIED	49	77	Acres	0.7	0.9
SAN JOAQUIN	BROCCOLI	150	27	Acres	5.0	9.0
SAN JOAQUIN	CABBAGE	55	115	Acres	0.5	0.7
SAN JOAQUIN	CANTALOUPE	113	227	Acres	0.5	0.9
SAN JOAQUIN	CORN (FORAGE - FODDER)	434	959	Acres	0.5	1.4
SAN JOAQUIN	CORN, HUMAN CONSUMPTION	1,963	4,182	Acres	0.5	5.0
SAN JOAQUIN	COTTON	9	19	Acres	0.5	0.5
SAN JOAQUIN	GRAPE	177	196	Acres	0.9	0.9
SAN JOAQUIN	GRAPE, WINE	8	18	Acres	0.5	0.5
SAN JOAQUIN	MELON	5	10	Acres	0.5	0.5
SAN JOAQUIN	N-GRNHS PLANTS IN CONTAINERS	0	0	Acres	0.5	0.5
SAN JOAQUIN	OAT (FORAGE - FODDER)	0	1	Acres	0.5	0.5
SAN JOAQUIN	PEPPER, FRUITING	7	11	Acres	0.6	0.7
SAN JOAQUIN	POTATO	13	45	Acres	0.3	0.3
SAN JOAQUIN	PUMPKIN	350	815	Acres	0.4	0.6

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
SAN JOAQUIN	RYE	7	19	Acres	0.4	0.5
SAN JOAQUIN	SQUASH	6	12	Acres	0.6	0.8
SAN JOAQUIN	STRAWBERRY	5	8	Acres	0.7	1.5
SAN JOAQUIN	STRUCTURAL PEST CONTROL	0	0			
SAN JOAQUIN	SUDANGRASS	38	91	Acres	0.4	0.5
SAN JOAQUIN	SUGARBEET	12	42	Acres	0.3	0.3
SAN JOAQUIN	TOMATO	743	1,205	Acres	0.6	5.9
SAN JOAQUIN	TOMATO, PROCESSING	2,693	6,112	Acres	0.5	22.5
SAN JOAQUIN	WALNUT	7	11	Acres	0.7	0.7
SAN JOAQUIN	WATERMELON	94	187	Acres	0.5	0.7
SAN LUIS OBISPO	APPLE	40	42	Acres	0.9	0.9
SAN LUIS OBISPO	BOK CHOY	7	10	Acres	0.7	0.9
SAN LUIS OBISPO	BROCCOLI	43	71	Acres	0.6	0.9
SAN LUIS OBISPO	CABBAGE	11	14	Acres	0.7	0.9
SAN LUIS OBISPO	CELERY	196	298	Acres	0.7	4.5
SAN LUIS OBISPO	CHINESE CABBAGE (NAPPA)	101	123	Acres	0.8	0.9
SAN LUIS OBISPO	CUCUMBER	0	1	Acres	0.9	0.9
SAN LUIS OBISPO	ENDIVE (ESCAROLE)	4	8	Acres	0.5	0.5
SAN LUIS OBISPO	FENNEL	2	2	Acres	0.8	0.9
SAN LUIS OBISPO	GRAPE	41	69	Acres	0.6	0.6
SAN LUIS OBISPO	GRAPE, WINE	116	299	Acres	0.9	1.6
SAN LUIS OBISPO	LETTUCE, HEAD	593	1,025	Acres	0.6	9.0
SAN LUIS OBISPO	LETTUCE, LEAF	137	241	Acres	0.6	0.9
SAN LUIS OBISPO	MUSTARD	1	3	Acres	0.2	0.5
SAN LUIS OBISPO	NECTARINE	501	645	Acres	0.8	0.9
SAN LUIS OBISPO	PEACH	31	35	Acres	0.9	0.9
SAN LUIS OBISPO	PEAS	29	65	Acres	0.5	0.8
SAN LUIS OBISPO	PEPPER, FRUITING	73	66	Acres	1.2	7.5
SAN LUIS OBISPO	PEPPER, SPICE	5	6	Acres	0.9	0.9
SAN LUIS OBISPO	SPINACH	11	21	Acres	0.5	0.9
SAN LUIS OBISPO	SQUASH	3	6	Acres	0.6	0.9
SAN LUIS OBISPO	SQUASH, SUMMER	6	7	Acres	0.9	0.9
SAN LUIS OBISPO	STRAWBERRY	31	37	Acres	0.8	0.9
SAN LUIS OBISPO	TOMATO	4	12	Acres	0.4	0.5
SAN MATEO	BRUSSELS SPROUT	14	16	Acres	0.9	0.9
SAN MATEO	STRUCTURAL PEST CONTROL	0				
SANTA BARBARA	BOK CHOY	2	2	Acres	0.8	0.9
SANTA BARBARA	BROCCOLI	170	240	Acres	0.7	0.9
SANTA BARBARA	CAULIFLOWER	47	52	Acres	0.9	0.9
SANTA BARBARA	CELERY	736	920	Acres	0.8	0.9
SANTA BARBARA	CHINESE CABBAGE (NAPPA)	8	10	Acres	0.7	0.9
SANTA BARBARA	CORN, HUMAN CONSUMPTION	278	587	Acres	0.5	5.0
SANTA BARBARA	ENDIVE (ESCAROLE)	2	3	Acres	0.9	0.9
SANTA BARBARA	FENNEL	7	12	Acres	0.6	0.9

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
SANTA BARBARA	GRAPE, WINE	132	145	Acres	0.9	1.1
SANTA BARBARA	LETTUCE, HEAD	1,461	2,244	Acres	0.6	9.0
SANTA BARBARA	LETTUCE, LEAF	211	418	Acres	0.5	1.8
SANTA BARBARA	ONION, GREEN	0	0	Acres	0.9	0.9
SANTA BARBARA	PEAS	36	35	Acres	0.9	4.5
SANTA BARBARA	PEPPER, FRUITING	34	37	Acres	0.9	0.9
SANTA BARBARA	POTATO	478	531	Acres	0.9	1.0
SANTA BARBARA	SPINACH	3	5	Acres	0.6	0.7
SANTA BARBARA	SQUASH	3	6	Acres	0.7	0.9
SANTA BARBARA	SQUASH, SUMMER	14	17	Acres	0.8	0.9
SANTA BARBARA	STRAWBERRY	2,115	2,417	Acres	0.9	9.0
SANTA BARBARA	STRUCTURAL PEST CONTROL	0	0			
SANTA BARBARA	TOMATO	10	23	Acres	0.5	0.5
SANTA BARBARA	VERTEBRATE CONTROL	3	4	Acres	0.9	0.9
SANTA CLARA	BOK CHOY	0	1	Acres	0.6	0.9
SANTA CLARA	BROCCOLI	50	56	Acres	0.9	0.9
SANTA CLARA	CABBAGE	2	4	Acres	0.5	0.6
SANTA CLARA	CELERY	324	397	Acres	0.8	9.0
SANTA CLARA	CORN, HUMAN CONSUMPTION	39	70	Acres	0.6	4.5
SANTA CLARA	ENDIVE (ESCAROLE)	0	1	Acres	0.5	0.5
SANTA CLARA	GAI LON	0	1	Acres	0.5	0.5
SANTA CLARA	GRAPE, WINE	75	165	Acres	0.6	0.9
SANTA CLARA	LETTUCE, HEAD	1	2	Square feet	0.5	0.5
SANTA CLARA	LETTUCE, HEAD	361	421	Acres	0.9	9.0
SANTA CLARA	LETTUCE, LEAF	341	479	Acres	0.7	1.5
SANTA CLARA	NECTARINE	0	0	Acres	0.6	0.6
SANTA CLARA	N-GRNHS FLOWER	0	0	Acres	0.9	0.9
SANTA CLARA	N-OUTDR FLOWER	36	45	Acres	1.1	9.4
SANTA CLARA	ONION, DRY	19	21	Acres	0.9	0.9
SANTA CLARA	PEPPER, FRUITING	176	230	Acres	0.8	1.0
SANTA CLARA	PEPPER, SPICE	42	47	Acres	0.9	0.9
SANTA CLARA	RESEARCH COMMODITY	21	21	Acres	2.9	40.7
SANTA CLARA	SPINACH	147	185	Acres	0.8	1.0
SANTA CLARA	STRUCTURAL PEST CONTROL	0				
SANTA CLARA	SWISS CHARD	1	1	Acres	0.9	0.9
SANTA CLARA	TOMATO	44	80	Acres	0.6	0.7
SANTA CLARA	UNKNOWN	0	0	Acres	0.9	0.9
SANTA CRUZ	BEET	6	7	Acres	0.9	0.9
SANTA CRUZ	BRUSSELS SPROUT	99	110	Acres	0.9	1.0
SANTA CRUZ	CABBAGE	6	12	Acres	0.5	0.7
SANTA CRUZ	CELERY	52	64	Acres	0.8	0.9
SANTA CRUZ	LETTUCE, HEAD	223	294	Acres	0.7	1.1
SANTA CRUZ	LETTUCE, LEAF	311	452	Acres	0.7	1.3
SANTA CRUZ	MUSTARD	1	1	Acres	0.9	0.9

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SANTA CRUZ	SPINACH	44	50	Acres	0.9	0.9
SANTA CRUZ	STRAWBERRY	2,370	2,671	Acres	0.8	9.0
SANTA CRUZ	SWISS CHARD	5	8	Acres	0.9	0.9
SHASTA	SORGHUM (FORAGE - FODDER)	11	28	Acres	0.4	0.4
SHASTA	SQUASH	1	1	Acres	0.9	0.9
SHASTA	STRAWBERRY	2	3	Acres	0.7	0.9
SHASTA	SUDANGRASS	13	34	Acres	0.4	0.4
SISKIYOU	OAT	9	24	Acres	0.4	0.4
SISKIYOU	ONION, DRY	7	7	Acres	0.9	0.9
SOLANO	ALFALFA	182	419	Acres	0.4	0.7
SOLANO	BEAN, DRIED	50	74	Acres	0.7	0.9
SOLANO	BEAN, SUCCULENT	5	8	Acres	0.7	0.7
SOLANO	CABBAGE	0	1	Acres	0.5	0.5
SOLANO	CANTALOUPE	0	1	Acres	0.2	0.2
SOLANO	CORN (FORAGE - FODDER)	18	40	Acres	0.5	0.5
SOLANO	CORN, HUMAN CONSUMPTION	2,127	4,674	Acres	0.5	4.5
SOLANO	CUCUMBER	0	0	Acres	0.0	0.0
SOLANO	PEPPER, FRUITING	114	167	Acres	0.7	0.9
SOLANO	RYEGRASS	16	36	Acres	0.5	0.5
SOLANO	SORGHUM (FORAGE - FODDER)	332	749	Acres	0.4	0.5
SOLANO	SORGHUM/MILO	58	128	Acres	0.5	0.5
SOLANO	STRAWBERRY	3	7	Acres	0.5	0.7
SOLANO	STRUCTURAL PEST CONTROL	0	0			
SOLANO	SUDANGRASS	57	158	Acres	0.3	0.5
SOLANO	TOMATILLO	2	4	Acres	0.5	0.5
SOLANO	TOMATO	1	2	Acres	0.5	0.5
SOLANO	TOMATO, PROCESSING	100	244	Acres	0.4	0.9
SOLANO	UNCULTIVATED AG	20	47	Acres	0.5	0.7
SOLANO	WATERMELON	1	2	Acres	0.4	0.5
SOLANO	WHEAT	6	12	Acres	0.5	0.5
SONOMA	GRAPE, WINE	45	63	Acres	0.6	0.9
SONOMA	LANDSCAPE MAINTENANCE	0	0			
SONOMA	PEPPER, SPICE	2	3	Acres	0.9	0.9
SONOMA	SQUASH	7	10	Acres	0.7	0.9
SONOMA	STRUCTURAL PEST CONTROL	0	0			
SONOMA	TOMATILLO	5	7	Acres	0.6	0.9
SONOMA	TOMATO	1	3	Acres	0.5	0.5
STANISLAUS	ALFALFA	401	956	Acres	0.4	0.9
STANISLAUS	ANIMAL PREMISE	0	2	Acres	0.0	0.0
STANISLAUS	ANIMAL PREMISE	0	0	Acres	0.0	0.0
STANISLAUS	ANIMAL PREMISE	13	36	Misc. unit	0.3	1.6
STANISLAUS	ANIMAL PREMISE	0	1	Acres	0.0	0.1
STANISLAUS	BEAN, DRIED	1,466	3,080	Acres	0.5	0.9

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
STANISLAUS	BEAN, SUCCULENT	458	846	Acres	0.6	0.9
STANISLAUS	BEET	72	120	Acres	0.6	0.9
STANISLAUS	BOK CHOY	20	33	Acres	0.6	3.0
STANISLAUS	BROCCOLI	5	11	Acres	0.5	0.5
STANISLAUS	CABBAGE	22	43	Acres	0.5	0.9
STANISLAUS	CANTALOUPE	204	444	Acres	0.5	0.9
STANISLAUS	CAULIFLOWER	63	86	Acres	0.7	0.9
STANISLAUS	COLLARD	22	37	Acres	0.6	0.9
STANISLAUS	CORN (FORAGE - FODDER)	228	550	Acres	0.4	0.5
STANISLAUS	CORN, HUMAN CONSUMPTION	1	2	Acres	0.7	0.9
STANISLAUS	CUCUMBER	9	21	Acres	0.5	0.5
STANISLAUS	DANDELION GREEN	3	5	Acres	0.5	0.9
STANISLAUS	FENNEL	4	8	Acres	0.5	0.7
STANISLAUS	GRAPE, WINE	55	85	Acres	0.7	0.9
STANISLAUS	KALE	10	17	Acres	0.6	0.9
STANISLAUS	LETTUCE, LEAF	80	142	Acres	0.6	0.9
STANISLAUS	MINT	1	2	Acres	0.6	0.9
STANISLAUS	MUSTARD	30	51	Acres	0.6	1.3
STANISLAUS	N-OUTDR PLANTS IN CONTAINERS	216	266	Acres	0.8	4.8
STANISLAUS	N-OUTDR TRANSPLANTS	437	489	Acres	0.9	0.9
STANISLAUS	OAT (FORAGE - FODDER)	19	43	Acres	0.4	0.5
STANISLAUS	ONION, DRY	3	4	Acres	0.9	0.9
STANISLAUS	PARSLEY	8	17	Acres	0.5	0.7
STANISLAUS	PEPPER, FRUITING	5	12	Acres	0.5	0.5
STANISLAUS	POULTRY	2	9	Acres	0.2	0.2
STANISLAUS	PUMPKIN	7	8	Acres	0.8	0.9
STANISLAUS	RADISH	0	1	Acres	0.4	0.5
STANISLAUS	RIGHTS OF WAY	0	0			
STANISLAUS	SPINACH	9	13	Acres	0.6	0.9
STANISLAUS	STRAWBERRY	8	13	Acres	0.7	1.1
STANISLAUS	STRUCTURAL PEST CONTROL	1	0			
STANISLAUS	SUDANGRASS	60	134	Acres	0.4	0.5
STANISLAUS	SUGARBEET	32	69	Acres	0.4	0.7
STANISLAUS	SWEET POTATO	15	17	Acres	0.9	0.9
STANISLAUS	SWISS CHARD	45	88	Acres	0.5	0.9
STANISLAUS	TOMATO	391	506	Acres	0.8	0.9
STANISLAUS	TOMATO, PROCESSING	1,132	2,429	Acres	0.5	2.3
STANISLAUS	TURNIP	12	20	Acres	0.6	0.9
STANISLAUS	WATERMELON	1	4	Acres	0.3	0.3
STANISLAUS	WHEAT	2	5	Acres	0.5	0.5
STANISLAUS	WHEAT (FORAGE - FODDER)	7	15	Acres	0.5	0.5
SUTTER	ALFALFA	61	135	Acres	0.5	0.5
SUTTER	BEAN, DRIED	409	948	Acres	0.4	0.9

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SUTTER	BEAN, SUCCULENT	14	33	Acres	0.4	0.5
SUTTER	CARROT	86	182	Acres	0.5	0.7
SUTTER	CUCUMBER	19	48	Acres	0.4	0.5
SUTTER	MELON	53	119	Acres	0.5	0.5
SUTTER	N-OUTDR TRANSPLANTS	2	1	Acres	1.4	1.4
SUTTER	ONION, DRY	7	15	Acres	0.5	0.5
SUTTER	PEACH	5	5	Acres	1.1	1.2
SUTTER	SORGHUM/MILO	9	14	Acres	0.7	0.7
SUTTER	SQUASH	10	25	Acres	0.4	0.5
SUTTER	SQUASH, ZUCCHINI	2	4	Acres	0.5	0.5
SUTTER	TOMATO, PROCESSING	778	1,756	Acres	0.4	0.7
SUTTER	WATERMELON	28	65	Acres	0.5	0.9
TEHAMA	ALFALFA	11	25	Acres	0.5	0.5
TEHAMA	BEAN, DRIED	23	45	Acres	0.6	0.7
TEHAMA	BEAN, UNSPECIFIED	170	361	Acres	0.5	0.7
TEHAMA	CORN (FORAGE - FODDER)	10	22	Acres	0.5	0.5
TEHAMA	MELON	2	5	Acres	0.5	0.5
TEHAMA	SQUASH	2	4	Acres	0.5	0.5
TEHAMA	STRUCTURAL PEST CONTROL	0	0			
TEHAMA	WALNUT	39	87	Acres	0.5	0.5
TOTALS		302,428	514,895			
TULARE	ALFALFA	2,865	6,244	Acres	0.5	0.9
TULARE	AVOCADO	9	10	Acres	0.9	0.9
TULARE	BEAN, DRIED	409	761	Acres	0.5	0.9
TULARE	BEAN, SUCCULENT	7	9	Acres	0.7	0.9
TULARE	BEAN, UNSPECIFIED	5	10	Acres	0.5	0.5
TULARE	BLUEBERRY	361	617	Acres	0.6	0.9
TULARE	BROCCOLI	73	126	Acres	0.7	3.6
TULARE	CANTALOUPE	2	3	Acres	0.9	0.9
TULARE	CAULIFLOWER	28	36	Acres	0.8	0.9
TULARE	CORN (FORAGE - FODDER)	173	348	Acres	0.5	4.5
TULARE	CORN, HUMAN CONSUMPTION	217	332	Acres	0.7	3.6
TULARE	CUCUMBER	1	1	Acres	0.5	0.5
TULARE	EGGPLANT	1	2	Acres	0.5	0.9
TULARE	GRAPE	3,836	5,877	Acres	0.7	2.5
TULARE	GRAPE, WINE	128	176	Acres	0.7	0.9
TULARE	LEMON	13	14	Acres	0.9	0.9
TULARE	NECTARINE	822	1,231	Acres	0.7	3.0
TULARE	N-OUTDR PLANTS IN CONTAINERS	41	50	Acres	0.7	0.9
TULARE	OAT (FORAGE - FODDER)	12	25	Acres	0.6	0.9
TULARE	ORANGE	903	1,429	Acres	0.7	0.9
TULARE	PEACH	128	149	Acres	0.8	1.8
TULARE	PEPPER, FRUITING	4	6	Acres	0.7	0.7

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
TULARE	PLUM	5	6	Acres	0.8	0.8
TULARE	POMEGRANATE	250	333	Acres	0.8	1.7
TULARE	POTATO	88	130	Acres	0.7	0.7
TULARE	SORGHUM (FORAGE - FODDER)	18	40	Acres	0.5	0.5
TULARE	STRUCTURAL PEST CONTROL	0	0			
TULARE	SUDANGRASS	9	20	Acres	0.5	0.5
TULARE	SUGARBEET	248	419	Acres	0.6	0.9
TULARE	TANGELO	2	6	Acres	0.4	0.7
TULARE	TANGERINE	12	19	Acres	0.6	0.9
TULARE	WATERMELON	3	4	Acres	0.8	0.9
TULARE	WHEAT	1	2	Acres	0.5	0.5
TULARE	WHEAT (FORAGE - FODDER)	1	3	Acres	0.5	0.5
TUOLUMNE	APPLE	3	8	Acres	0.3	0.4
TUOLUMNE	STRUCTURAL PEST CONTROL	0	0			
VENTURA	BEAN, UNSPECIFIED	16	25	Acres	0.8	0.9
VENTURA	BEET	4	7	Acres	0.5	0.9
VENTURA	BOK CHOY	3	3	Acres	0.9	1.0
VENTURA	BROCCOLI	2	3	Acres	0.9	0.9
VENTURA	CABBAGE	112	137	Acres	0.8	0.9
VENTURA	CARROT	1	2	Acres	0.9	0.9
VENTURA	CELERY	253	306	Acres	0.9	5.0
VENTURA	COLLARD	33	37	Acres	0.9	0.9
VENTURA	CORN, HUMAN CONSUMPTION	230	499	Acres	0.5	0.9
VENTURA	KALE	40	45	Acres	0.9	0.9
VENTURA	LETTUCE, HEAD	129	195	Acres	0.6	0.9
VENTURA	LETTUCE, LEAF	17	22	Acres	0.8	0.9
VENTURA	MUSTARD	36	47	Acres	0.8	0.9
VENTURA	N-GRNHS FLOWER	3	8	Acres	0.4	0.9
VENTURA	ONION, DRY	16	18	Acres	0.9	0.9
VENTURA	ONION, GREEN	64	117	Acres	0.6	0.9
VENTURA	PEAS	2	2	Acres	0.9	0.9
VENTURA	PEPPER, FRUITING	1,204	1,329	Acres	1.0	5.6
VENTURA	PEPPER, SPICE	361	401	Acres	0.9	0.9
VENTURA	RADISH	5	6	Acres	0.9	0.9
VENTURA	RIGHTS OF WAY	0	1	Acres	0.7	0.7
VENTURA	SPINACH	10	19	Acres	0.5	0.9
VENTURA	STRAWBERRY	1,884	2,171	Acres	0.9	3.6
VENTURA	STRUCTURAL PEST CONTROL	0	0			
VENTURA	SWISS CHARD	1	1	Acres	0.7	0.9
VENTURA	TOMATO	587	559	Acres	1.3	8.8
VENTURA	TURNIP	10	11	Acres	0.9	1.8
YOLO	ALFALFA	701	1,506	Acres	0.5	13.5
YOLO	BEAN, DRIED	18	38	Acres	0.6	0.9
YOLO	CARROT	41	68	Acres	0.6	0.9

County	Site Name	AVG Annual Pounds Applied	AVG Annual Area Treated	Unit Area Treated	AVG Application Rate	MAX Application Rate
YOLO	CORN (FORAGE - FODDER)	0	0	Acres	0.5	0.5
YOLO	CORN, HUMAN CONSUMPTION	424	949	Acres	0.4	0.5
YOLO	CORN, HUMAN CONSUMPTION	10	0	Acres	0.3	0.5
YOLO	CUCUMBER	38	76	Acres	0.5	0.9
YOLO	GRAPE, WINE	2	4	Acres	0.5	0.5
YOLO	MELON	294	599	Acres	0.5	0.9
YOLO	N-GRNHS TRANSPLANTS	0	0	Acres	0.0	0.0
YOLO	ONION, DRY	39	64	Acres	0.6	0.9
YOLO	PEPPER, FRUITING	16	35	Acres	0.5	0.5
YOLO	PUMPKIN	2	4	Acres	0.5	0.5
YOLO	RESEARCH COMMODITY	0	0	Acres	0.0	0.0
YOLO	RESEARCH COMMODITY	6				
YOLO	RESEARCH COMMODITY	6	6	Acres	0.9	0.9
YOLO	SORGHUM (FORAGE - FODDER)	53	117	Acres	0.5	0.5
YOLO	SORGHUM/MILO	6	13	Acres	0.5	0.5
YOLO	SQUASH	29	64	Acres	0.5	0.7
YOLO	SQUASH, SUMMER	0	1	Acres	0.5	0.5
YOLO	STRUCTURAL PEST CONTROL	0	0			
YOLO	TOMATO	7	8	Acres	0.7	0.9
YOLO	TOMATO, PROCESSING	39	86	Square feet	0.5	0.5
YOLO	TOMATO, PROCESSING	290	533	Acres	0.5	0.9
YOLO	UNCULTIVATED AG	12	30	Square feet	0.4	0.5
YOLO	WATERMELON	38	85	Acres	0.5	0.5
YOLO	WHEAT	18	30	Acres	0.6	0.7

APPENDIX D. CRLF Recovery Units with Overlapping Core Areas and Designated Critical Habitat.

Recovery Unit [1] (Figure 3)	Core Areas [2,7] (Figure 3)	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)	**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)	--		✓
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], MNT-1 [5]	✓	
	Carmel River-Santa Lucia (20)	MNT-2	✓	
	Estero Bay (22)	--	✓	
	Arroyo Grande Creek (23)	SLO-8	✓	
	Santa Maria River-Santa Ynez River (24)	--	✓	
Diablo Range and Salinas Valley (6)	**East San Francisco Bay (partial) (16)**	MER-1A-B	✓	
	--	SNB-1, SBB-2	✓[6]	
	Santa Clara Valley (17)	--	✓	

	Watsonville Slough- Elkhorn Slough (partial)(19)	--	✓	
	Carmel River-Santa Lucia (partial)(20)	--	✓	
	Gablan Range (21)	SNB-3	✓	
	Estrella River (28)	SLO-1	✓	
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)	--		✓

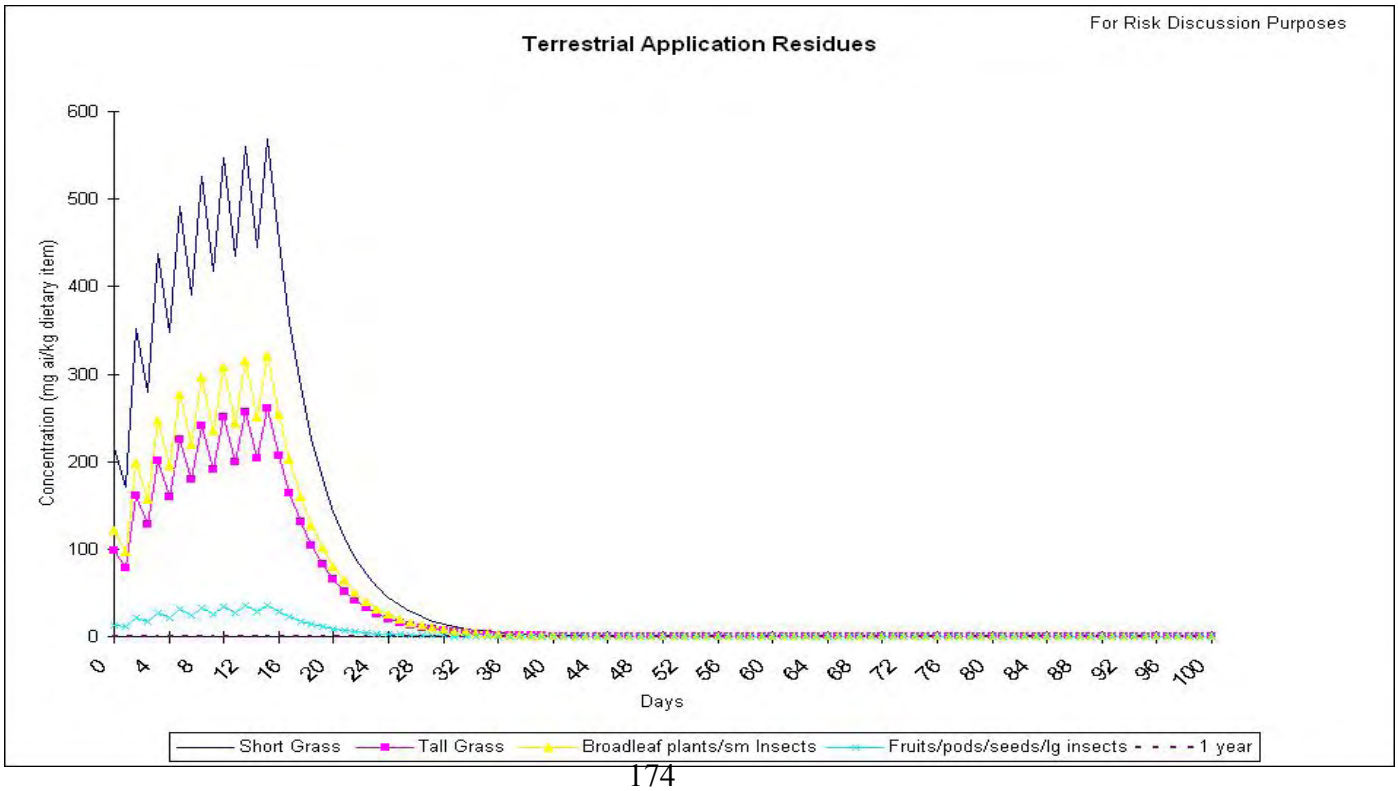
1 Recovery units designated by the USFWS (USFWS 2000, pg 49)
2 Core areas designated by the USFWS (USFWS 2000, pg 51)
3 Critical habitat units designated by the USFWS on April 13, 2006 (USFWS 2006, 71 FR 19244-19346)
4 Currently occupied (post-1985) and historically occupied core areas as designated by the USFWS (USFWS 2002, pg 54)
[5] Critical habitat unit where identified threats specifically included pesticides or agricultural runoff (USFWS
[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.

APPENDIX E. Maximum EECs from T-REX for Several Agricultural Use Scenarios for Methomyl.

A. Maximum *Single* and *Seasonal* Application Rate (7.2 lb a.i./acre) with Shortest Application Interval (2-Days): Cabbage.

Upper Bound Kenaga Residues For RQ Calculation	
Chemical Name:	Methomyl
Use	Cabbage
Application Rate	0.9 lbs a.i./acre
Half-life	3 days
Application Interval	2 days
Maximum # Apps./Year	8
Length of Simulation	1 year
Dietary-based EECs (ppm)	**Kenaga Values**
Short Grass	569.24
Tall Grass	260.90
Broadleaf plants/sm Insects	320.20
Fruits/pods/seeds/lg insects	35.58

There are up to three crop cycles per year for cabbage in CA. However, because the EECs drop to negligible levels by day 35 after application (see below) and cabbage is not likely to be planted back-to-back in the same field due to pest pressure (*i.e.*, the crop cycles would not likely be within 30-days of each other), the maximum EECs for three crop cycles would not likely be higher than the resulting EECs from one crop cycle.



B. Maximum *Yearly* Application Rate (32.4 lb a.i./acre): Alfalfa.

Upper Bound Kenaga Residues For RQ Calculation	
Chemical Name:	Methomyl
Use	Alfalfa
Formulation	0
Application Rate	0.9 lbs a.i./acre
Half-life	3 days
Application Interval	5 days
Maximum # Apps./Year	36
Length of Simulation	1 year
Dietary-based EECs (ppm)	**Kenaga Values**
Short Grass	315.32
Tall Grass	144.52
Broadleaf plants/sm Insects	177.37
Fruits/pods/seeds/lg insects	19.71

APPENDIX F. Determining the Terrestrial Portion of the Methomyl Action Area in CA.

A. Calculating Maximum Concentrations on the Site of Application (in lbs a.i./acre) After Multiple Applications of Methomyl.

First order decay rate from the first order rate equation used in T-REX (modified to calculate EECs in lbs a.i./acre instead of ppm):

$$C_t = C_0 e^{-kt}$$

C_t = concentration, lbs a.i./acre, at time T.
C_0 = concentration (lbs a.i./acre), present initially (on day zero) on the field (i.e., the application rate).
k = Exponential rate constant = ln 2 ÷ foliar dissipation half-life.
t = time, in days, since the start of the simulation. The initial application is on day 0.

Agricultural Uses: 8 applications, 0.9 lbs a.i./acre (each application), foliar half-life of 3 days, and an application interval of 2 days results in the following:

Day	# of Applications	Application Period	Lbs/acre (from applications)
0	1	0	0.90
1	1	1	0.71
2	2	0	1.47
3	2	1	1.16
4	3	0	1.82
5	3	1	1.45
6	4	0	2.05
7	4	1	1.63
8	5	0	2.19
9	5	1	1.74
10	6	0	2.28
11	6	1	1.81
12	7	0	2.34
13	7	1	1.85
14	8	0	**2.37**
15	8	1	1.88
16	8	0	1.49
17	8	1	1.19
18	8	0	0.94
19	8	1	0.75
20	8	0	0.59
21	8	1	0.47
22	8	0	0.37
23	8	1	0.30
24	8	0	0.24
25	8	1	0.19
26	8	0	0.15
27	8	1	0.12
28	8	0	0.09
29	8	1	0.07

Day	# of Applications	Application Period	Lbs/acre (from applications)
30	8	0	0.06
31	8	1	0.05
39	8	1	0.01
40	8	0	0.01
41	8	1	0.00

The peak concentration is bolded. We did not model past day 41 when the concentrations reached zero.

Orchard Uses: 6 applications, 0.9 lbs a.i./acre (each application), foliar half-life of 3 days, and an application interval of 5 days results in the following:

Day	# of Applications	Application Period	Lbs/acre (from applications)
0	1	0	0.90
1	1	1	0.71
2	1	2	0.57
3	1	3	0.45
4	1	4	0.36
5	2	0	1.18
6	2	1	0.94
7	2	2	0.75
8	2	3	0.59
9	2	4	0.47
10	3	0	1.27
11	3	1	1.01
12	3	2	0.80
13	3	3	0.64
14	3	4	0.51
15	4	0	1.30
16	4	1	1.03
17	4	2	0.82
18	4	3	0.65
19	4	4	0.52
20	5	0	1.31
21	5	1	1.04
22	5	2	0.83
23	5	3	0.65
24	5	4	0.52
25	6	0	**1.31**
26	6	1	1.04
27	6	2	0.83
28	6	3	0.66
29	6	4	0.52
30	6	0	0.41
31	6	1	0.33
39	6	4	0.05
40	6	0	0.04
41	6	1	0.03
42	6	2	0.03
43	6	3	0.02
44	6	4	0.02
45	6	0	0.01
46	6	1	0.01
47	6	2	0.01

Day	# of Applications	Application Period	Lbs/acre (from applications)
48	6	3	0.01
49	6	4	0.01
50	6	0	0.00

The peak concentration is bolded. We did not model past day 50 when the concentrations reached zero.

B. AGDISP Input Parameters Used in This assessment.

ORCHARD, AERIAL APPLICATIONS:

AGDISP Input Data Summary

--Aircraft--	----------	
Name		Air Tractor AT-401
Type		Library
Boom Height (ft)		10
Spray Lines		20
Optimize Spray Lines		No
Spray Line Reps	#	Reps
	1	1
	2	1
	3	1
	4	1
	5	1
	6	1
	7	1
	8	1
	9	1
	10	1
	11	1
	12	1
	13	1
	14	1
	15	1
	16	1
	17	1
	18	1
	19	1
	20	1
Wing Type		Fixed-Wing
Semispan (ft)		24.5
Typical Speed (mph)		119.99
Biplane Separation (ft)		0
Weight (lbs)		6000
Planform Area (ft²)		294
Propeller RPM		2000
Propeller Radius (ft)		4.5
Engine Vert Distance (ft)		1.2
Engine Fwd Distance (ft)		11.9
--Aerial Application Type--	----------	
Aerial Application Type		Liquid
--Drop Size Distribution--	----------	
Name		ASAE Very Fine to Fine

Type Reference

Drop Categories #	Diam (um)	Frac
1	10.77	0.0017
2	16.73	0.0013
3	19.39	0.0017
4	22.49	0.0027
5	26.05	0.0043
6	30.21	0.0060
7	35.01	0.0070
8	40.57	0.0077
9	47.03	0.0130
10	54.50	0.0227
11	63.16	0.0353
12	73.23	0.0487
13	84.85	0.0590
14	98.12	0.0717
15	113.71	0.0863
16	131.73	0.1020
17	152.79	0.1247
18	177.84	0.1420
19	205.84	0.1077
20	238.45	0.0573
21	276.48	0.0450
22	320.60	0.0273
23	372.18	0.0120
24	430.74	0.0053
25	498.91	0.0037
26	578.54	0.0020
27	670.72	0.0020

--Nozzle Distribution-- ----------

Boom Length (%) 65.06

Nozzle Locations #	Hor(ft)	Ver(ft)	Fwd(ft)
1	-15.94	0	0
2	-15.16	0	0
3	-14.38	0	0
4	-13.61	0	0
5	-12.83	0	0
6	-12.05	0	0
7	-11.27	0	0
8	-10.5	0	0
9	-9.72	0	0
10	-8.94	0	0
11	-8.16	0	0
12	-7.39	0	0
13	-6.61	0	0
14	-5.83	0	0
15	-5.05	0	0
16	-4.28	0	0
17	-3.5	0	0
18	-2.72	0	0
19	-1.94	0	0
20	-1.17	0	0
21	-0.3888	0	0
22	0.3888	0	0
23	1.17	0	0

24	1.94	0	0
25	2.72	0	0
26	3.5	0	0
27	4.28	0	0
28	5.05	0	0
29	5.83	0	0
30	6.61	0	0
31	7.39	0	0
32	8.16	0	0
33	8.94	0	0
34	9.72	0	0
35	10.5	0	0
36	11.27	0	0
37	12.05	0	0
38	12.83	0	0
39	13.61	0	0
40	14.38	0	0
41	15.16	0	0
42	15.94	0	0

--Swath--	----------
Swath Width	60 ft
Swath Displacement	0 ft
--Spray Material--	----------
Name	Water
Type	Reference
Nonvolatile Fraction	0.1875
Active Fraction	0.054
Spray Volume Rate (gal/ac)	2
--Meteorology--	----------
Wind Speed (mph)	15
Wind Direction (deg)	-90
Temperature (deg F)	65
Relative Humidity (%)	50
--Atmospheric Stability--	----------
Atmospheric Stability	Overcast
--Transport--	----------
Flux Plane Distance (ft)	0
--Canopy--	----------
Type	None
--Terrain--	----------
Surface Roughness (ft)	0.0246
Upslope Angle (deg)	0
Sideslope Angle (deg)	0
--Advanced--	----------
Wind Speed Height (ft)	6.56
Max Compute Time (sec)	600
Max Downwind Dist (ft)	2608.24
Vortex Decay Rate (IGE) (mph)	1.25

Vortex Decay Rate (OGE) (mph)	0.3355
Aircraft Drag Coeff	0.1
Propeller Efficiency	0.8
Ambient Pressure (in hg)	29.91
Save Trajectory Files	No
Half Boom	No
Default Swath Offset	1/2 Swath
Specific Gravity (Carrier)	0.99
Specific Gravity (Nonvolatile)	1
Evaporation Rate (μm²/deg C/sec)	84.76

AGRICULTURAL, AERIAL (LOW VOLUME) APPLICATIONS:

AGDISP Input Data Summary

--Aircraft--	----------	
Name		Air Tractor AT-401
Type		Library
Boom Height (ft)		10
Spray Lines		20
Optimize Spray Lines		No
Spray Line Reps	#	Reps
	1	1
	2	1
	3	1
	4	1
	5	1
	6	1
	7	1
	8	1
	9	1
	10	1
	11	1
	12	1
	13	1
	14	1
	15	1
	16	1
	17	1
	18	1
	19	1
	20	1
Wing Type		Fixed-Wing
Semispan (ft)		24.5
Typical Speed (mph)		119.99
Biplane Separation (ft)		0
Weight (lbs)		6000
Planform Area (ft²)		294
Propeller RPM		2000
Propeller Radius (ft)		4.5
Engine Vert Distance (ft)		-1.2
Engine Fwd Distance (ft)		11.9
--Aerial Application Type--	----------	
Aerial Application Type		Liquid
--Drop Size Distribution--	----------	

Name		ASAE Very Fine	
Type		Reference	
Drop Categories	#	Diam (um)	Frac
	1	10.77	0.0148
	2	16.73	0.0182
	3	19.39	0.0158
	4	22.49	0.0113
	5	26.05	0.0127
	6	30.21	0.0260
	7	35.01	0.0425
	8	40.57	0.0568
	9	47.03	0.0690
	10	54.50	0.0733
	11	63.16	0.0607
	12	73.23	0.0548
	13	84.85	0.0645
	14	98.12	0.0713
	15	113.71	0.0702
	16	131.73	0.0645
	17	152.79	0.0653
	18	177.84	0.0720
	19	205.84	0.0588
	20	238.45	0.0287
	21	276.48	0.0225
	22	320.60	0.0137
	23	372.18	0.0060
	24	430.74	0.0027
	25	498.91	0.0018
	26	578.54	0.0010
	27	670.72	0.0010

--Nozzle Distribution--		----------		
Boom Length (%)		65.06		
Nozzle Locations	#	Hor(ft)	Ver(ft)	Fwd(ft)
	1	-15.94	0	0
	2	-15.16	0	0
	3	-14.38	0	0
	4	-13.61	0	0
	5	-12.83	0	0
	6	-12.05	0	0
	7	-11.27	0	0
	8	-10.5	0	0
	9	-9.72	0	0
	10	-8.94	0	0
	11	-8.16	0	0
	12	-7.39	0	0
	13	-6.61	0	0
	14	-5.83	0	0
	15	-5.05	0	0
	16	-4.28	0	0
	17	-3.5	0	0
	18	-2.72	0	0
	19	-1.94	0	0
	20	-1.17	0	0
	21	-0.3888	0	0
	22	0.3888	0	0

23	1.17	0	0
24	1.94	0	0
25	2.72	0	0
26	3.5	0	0
27	4.28	0	0
28	5.05	0	0
29	5.83	0	0
30	6.61	0	0
31	7.39	0	0
32	8.16	0	0
33	8.94	0	0
34	9.72	0	0
35	10.5	0	0
36	11.27	0	0
37	12.05	0	0
38	12.83	0	0
39	13.61	0	0
40	14.38	0	0
41	15.16	0	0
42	15.94	0	0

--Swath--	----------
Swath Width	60 ft
Swath Displacement	0 ft

--Spray Material--	----------
Name	Water
Type	Reference
Nonvolatile Fraction	0.375
Active Fraction	0.109
Spray Volume Rate (gal/ac)	1

--Meteorology--	----------
Wind Speed (mph)	15
Wind Direction (deg)	-90
Temperature (deg F)	65
Relative Humidity (%)	50

--Atmospheric Stability--	----------
Atmospheric Stability	Overcast

--Transport--	----------
Flux Plane Distance (ft)	0

--Canopy--	----------
Type	None

--Terrain--	----------
Surface Roughness (ft)	0.0246
Upslope Angle (deg)	0
Sideslope Angle (deg)	0

--Advanced--	----------
Wind Speed Height (ft)	6.56
Max Compute Time (sec)	600
Max Downwind Dist (ft)	2608.24

Vortex Decay Rate (IGE) (mph)	1.25
Vortex Decay Rate (OGE) (mph)	0.3355
Aircraft Drag Coeff	0.1
Propeller Efficiency	0.8
Ambient Pressure (in hg)	29.91
Save Trajectory Files	No
Half Boom	No
Default Swath Offset	1/2 Swath
Specific Gravity (Carrier)	0.99
Specific Gravity (Nonvolatile)	1
Evaporation Rate (μm²/deg C/sec)	84.76

APPENDIX G: Spatial Summary for terrestrial and Aquatic Uses.

Methomyl Use List
The following use list is derived from label use information. It is used as a basis for terrestrial and aquatic pesticide use area determination.

Table 41 Use list from labels

Category	Use
Agriculture	Alfalfa, Anise (Fennel), Apple , Asparagus, Avocado, Barley, Beans, Dry (same as succulent beans), Beans, Succulent (kidney, lima, mung, Navy, pinto, snap, wax, broad, fava, asparagus beans, blackeyed peas, cowpeas), BeansSLN (interplanted with nonbearing almonds, plums, prunes, peaches, and walnuts) (CA-770431), Beets (table), Bermudagrass (pasture), Beverage Plants (outside), Blueberries (ground only), Broccoli, Broccoli RaabSLN, Broccoli, ChineseSLN, Brussels Sprouts, Cabbage, Canneries (outside), Carrot, Cauliflower, Celery, Chicory, Chinese Cabbage, Collards (fresh market only), Corn, Corn (field and popcorn), Corn (seed), Corn (sweet), Cotton, Cucumber, Eggplant, Endive, Escarole, Garlic, Grapefruit, Grapes, Horseradish (ground Only), Leafy Green Vegetables (beet tops, dandelions, kale, mustard greens, parsley, Swiss chard, turnip greens), Lemon, Lentils, Lettuce (head varieties), Lettuce (leaf varieties), Melons (cantaloupe, casaba, Santa Claus, Crenshaw, honeydew, honey balls, Persian, golden pershaw, mango melon, pinapple melon, snake, watermelon), Mint (peppermint, spearmint), Nectarine, Nonbearing Fruit, Grape, and Nut Nursery Stock (field grown)SLN, Oats, Onions (dry bulb), Onions (green), Oranges, Peaches, Peanuts, Peas, succulent (pigeon peas, chick, garbanzo, dwarf peas, garden peas, green peas, English peas, Field peas, edible pod peas), Peppers (bell, hot, pimentos, sweet), Pomegranates, Potato, PumpkinsSLN (CA-910011) (San Joaquin, Stanislaus, Merced, Sacramento, and Riverside Counties), RadishesSLN (CA-770495), Rye, Sorghum (except sweet sorghum), Soybeans, Soybeans SLN (interplanted with nonbearing almonds, plums, prunes, peaches, and walnuts) (CA-770431), Spinach, Strawberry, Sugar Beet, Sweet Lupine, White Sweet Lupine, White Lupine, Grain Lupine, Sweet PotatoesSNL (Aerial only) (CA-780136), Tangelo, Tangerine, Tobacco (except shade), Tomatillo, Tomato , Turf (sod farms only), Wheat
Non-agriculture	Warehouses, Restaurants (outside), Stables, Supermarkets (outside), Food Processing Establishments (outside), Bakeries (outside), Poultry houses, Poultry Processing Establishments (outside), Hog Houses (outside), Commercial Dumpsters which are enclosed, Commercial use Sites (unspecified), Commissaries (outside), Fast Food Establishments, Feedlots (outside), Livestock Barns (outside), Meat Processing

	Establishments (outside), Kennels (outside), Dairies (outside), Dumpsters, Broiler Houses (outside),

Terrestrial Use Determination
Sources and Methods
Base mapping layers for the terrestrial analysis component were obtained from the National Land-cover Dataset (NLCD 2001) for the majority of land use types and the California GAP data (6/98) for the orchards and vineyard uses. The NLCD is a recently released national land use dataset and the GAP is from the Biogeography Lab from UCLA-Santa Barbara. These raster files were converted to vector and used in the analysis. Table 2 shows the land-cover sources used.

Table 42 Landcover data sources.

Land Cover Data Sources			
Layer name	**Base source**	**Description**	**non-NASS**
Cultivated Crops	NLCD	Grid code 82: Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.	No
Developed, High Intensity	NLCD	Grid code 24: Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to100 percent of the total cover.	Yes
Developed, Low Intensity	NLCD	Grid code 22: Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.	Yes
Developed, Medium Intensity	NLCD	Grid code 23: Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.	Yes
Developed, Open Space	NLCD	Grid code 21: Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.	Yes
Forest	NLCD	Grid codes 41,42,43: Deciduous, evergreen and mixed. Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover.	Yes
Open Water	NLCD	Grid code 11: All areas of open water, generally with less than 25% cover of vegetation or soil.	Yes
Orchards and vineyards	CA GAP	Grid codes 11210, 11211 and 11212. This is the only CA GAP reference.	No
Pasture/Hay	NLCD	Grid code 81: Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.	No
Wetlands	NLCD	Grid codes 90, 95: Woody wetlands and emergent herbaceous.	Yes

U.S. Department of Agriculture's National Agriculture Statistics Service (NASS) census dataset, 2002 was used to determine whether a crop was grown in a particular county. This census dataset provides survey information over five years on agricultural practices and is used mainly for cultivated or agriculture crops. Chemical labeled uses were matched to NASS uses; an agriculture use match would result in a mapped area for one or more counties. For uses that are not agricultural, the use is assumed to occur in every county where that particular land-cover occurs within California (*i.e.* a 'forestry' labeled use is assumed to potentially occur in all California counties where NLCD indicates there is forest land-cover).

The 'Initial Area of Concern' represents the use type and its occurrence in the NASS or NLCD datasets. These are the areas where the pesticide has potential to be applied. The 'Action Area' represents the 'Initial Area of Concern' plus a buffer distance. There may not always be a buffer distance in which case the 'Action Area' is the same as the 'Initial Area of Concern'. The overlap of the 'Action Area' with CRLF habitat areas is named 'Overlapping Area' and is the target of spatial analysis. The ratio of Overlapping Area to CRLF habitat area is reported for each of eight Recovery Units (RU1 to RU8).

There are three types of CRLF habitat areas considered in this assessment: Critical Habitat (CH); Core Areas; and California Natural Diversity Database (CNDDB) occurrence sections (EPA Region 9). Critical habitat areas were obtained from the U.S. Fish and Wildlife Service's (USFWS) final designation of critical habitat for the CRLF (USFWS 2006). Core areas were obtained from USFWS's Recovery Plan for the CRLF (USFWS 2002). The occurrence sections represent an EPA-derived subset of occurrences noted in the CNDDB. They are generalized by the Meridian Range and Township Section (MTRS) one square mile units so that individual habitat areas are obfuscated. As such, only occurrence section counts are provided and not the area potentially affected.

Spatially Determined Analysis for Terrestrial Uses

Table 43 Terrestrial spatial summary results for agriculture and orchard uses with a 6 mile buffer applied.

Measure	RU1	RU2	RU3	RU4	RU5	RU6	RU7	RU8	Total
Initial Area of Concern (no buffer)									33,730 sq km agriculture 7,716 sq km orchard 41,446 sq km total
Action Area – Initial area of concern + buffer									236,363 sq km total
Established species range area (sq km)	3654	2742	1323	3279	3650	5306	4917	3326	28,197
Overlapping area (sq km)	2761	1599	578	2955	3399	4683	3993	2419	22,387
Percent area affected	*76%*	*58%*	*44%*	*90%*	*93%*	*88%*	*81%*	*73%*	*79%*

# CNDDB Occurrence Sections (959 total)	9	0	45	310	275	110	88	33	870

Aquatic Action Area Delineation

The aquatic analysis uses a downstream dilution model to determine the downstream extent of exposure in streams and rivers. The downstream component, combined with the initial area of concern, define the aquatic action area. The downstream extent includes the area where the EEC could potentially be above levels that would exceed the most sensitive LOC. The model calculates two values, the dilution factor (DF) and the threshold Percent Cropped Area (PCA). The dilution factor (DF) is the maximum RQ/LOC, and the threshold PCA is the inverse value represented as a percent.

The dilution model uses the NHDPlus data set (http://www.horizon-systems.com/nhdplus/) as the framework for the downstream analysis. The NHDPlus includes several pieces of information that can be used to analyze downstream effects. For each stream reach in the hydrography network, the data provide a tally of the total area in each NLCD land cover class for the upstream cumulative area contributing to the given stream reach. Using the cumulative land cover data provided by the NHDPlus, an aggregated use class is created based on the classes listed in Table 4. A cumulative PCA is calculated for each stream reach based on the aggregate use class (divided by the total upstream contribution area).

The dilution model traverses downstream from each stream segment within the initial area of concern. At each downstream node, the threshold PCA is compared to the aggregate cumulative PCA. If the cumulative PCA exceeds the threshold then the stream segment is included in the downstream extent. The model continues traversing downstream until the cumulative PCA no longer exceeds the threshold. The additional stream length by the downstream analysis is presented in Table 5.

Spatially Determined Analysis for Aquatic Uses

Table 44 Aquatic spatial quantitative results for Methomyl.

Measure	Total
Total California stream kilometers	332,962 km
Total stream kilometers in initial area of concern	93,469 km
Total stream kilometers added downstream	162 km
Total stream kilometers in final action area	93,631 km

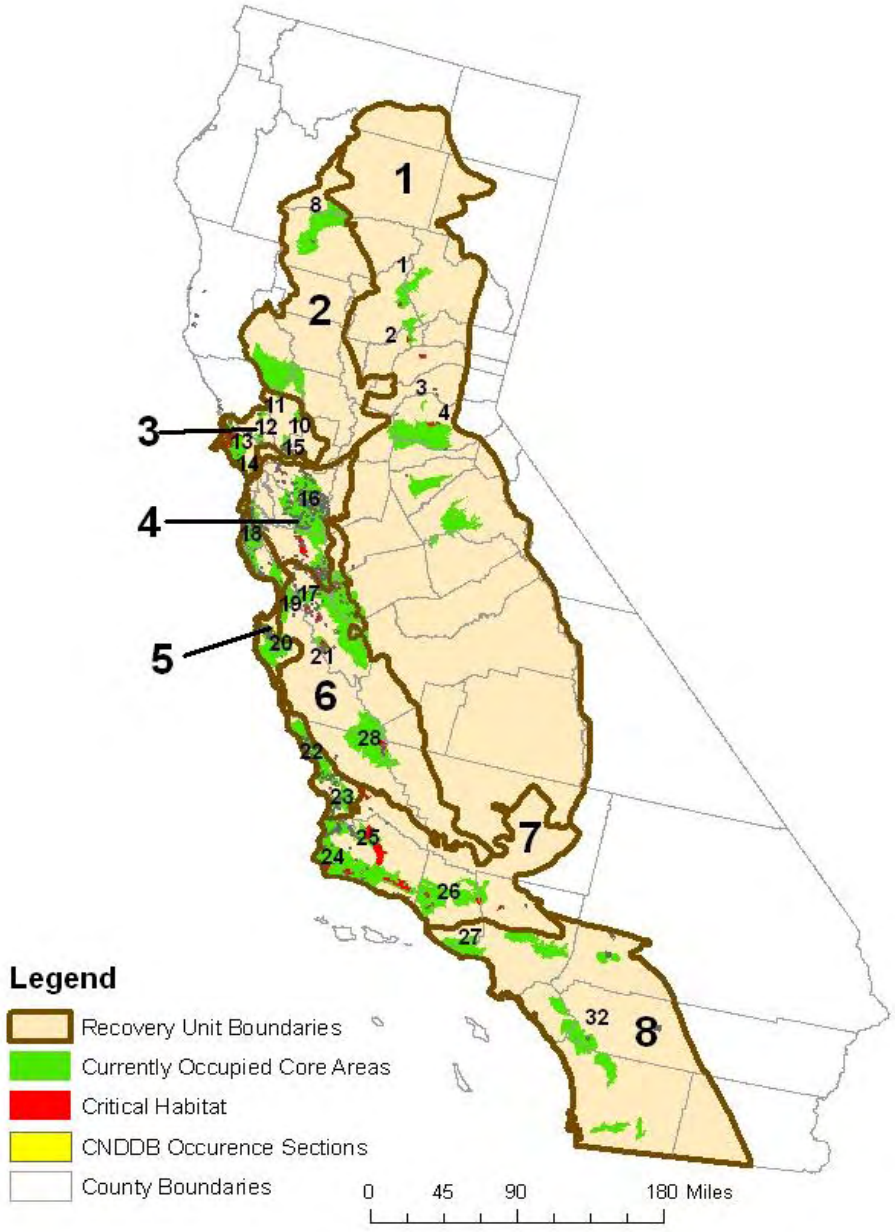
A Note on Limitations and Constraints of Tabular and Geospatial Sources
The geographic data sets used in this analysis are limited with respect to their accuracy and timeliness. The NASS Census of Agriculture (NASS 2002) contains adjusted survey data collected prior to 2002. Small use sites, and minor uses (e.g., specialty crops) tend

to be underrepresented in this dataset. The National Land Cover Dataset (NLCD 2001) represents the best comprehensive collection of national land use and land cover information for the United States representing a range of years from 1994 – 1998. Because the NLCD does not explicitly include a class to represent orchard and vineyard landcover, California Gap Analysis Project data (CaGAP 1998) were overlaid with the NCLD and used to identify these areas.

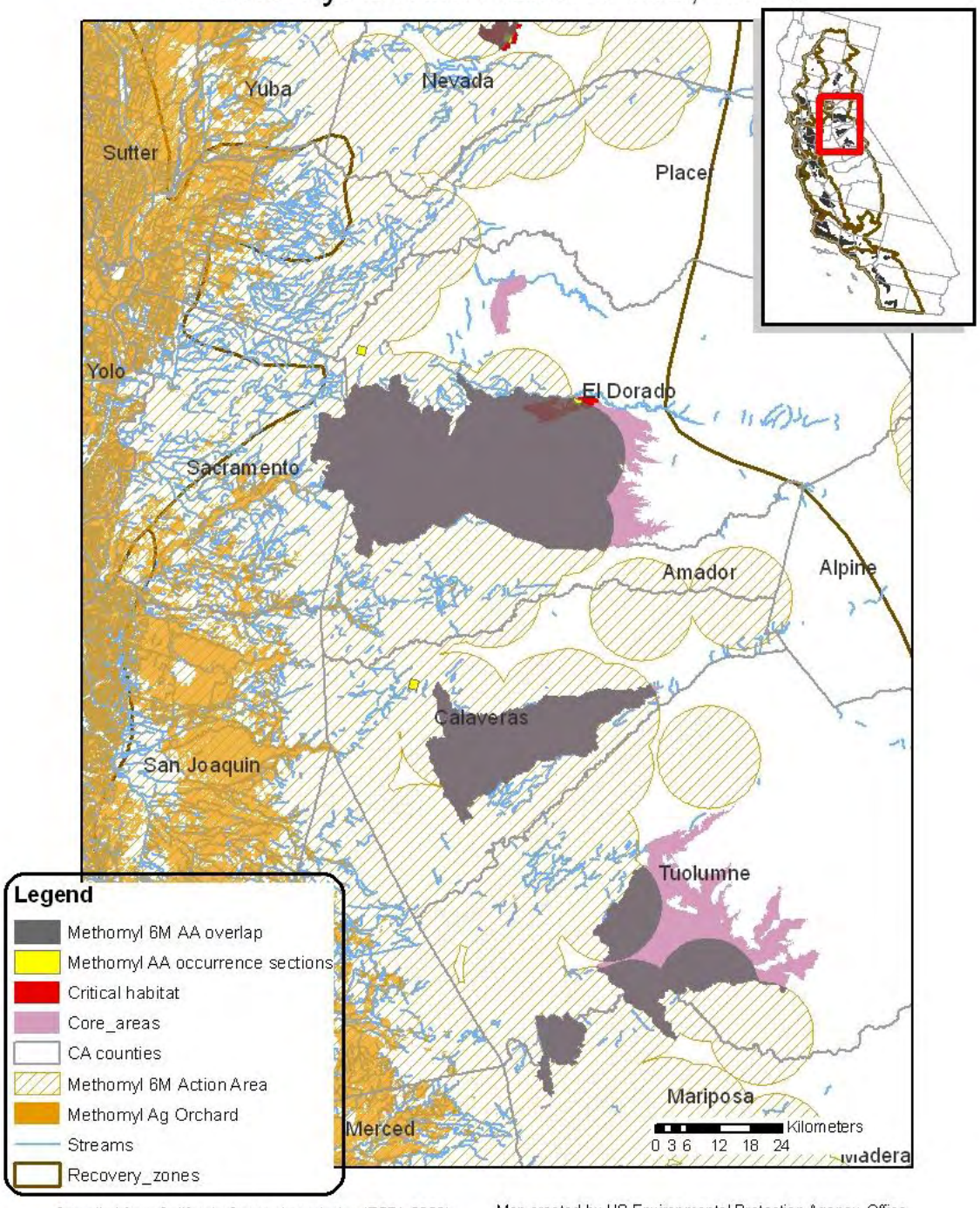
Hydrographic data are from the NHDPlus dataset (http://www.horizon-systems.com/nhdplus/). NHDPlus contains the most current and accurate nationwide representation of hydrologic data. In some isolated instances, there are, however, errors in the data including missing or disconnected stream segments and incorrect assignment of flow direction. Spatial data describing the recovery zones and core areas are from the US Fish and Wildlife Service. The data depicting survey sections in which the species has been found in past surveys is from the California Natural Diversity Database (http://www.dfg.ca.gov/bdb/html/cnddb.html).

The relatively coarse spatial scale of these datasets precludes use of the data for highly localized studies, therefore, tabular information presented here is limited to the scale of individual Recovery Units. Additionally, some labeled uses are not possible to map precisely due to the lack of appropriate spatial data in NLCD on the location of these areas. To account for these uncertainties, the spatial analysis presented here is conservative, and may overestimate the areal extent of actual pesticide use in California.

Reference Maps
California Red-Legged Frog Habitat Areas



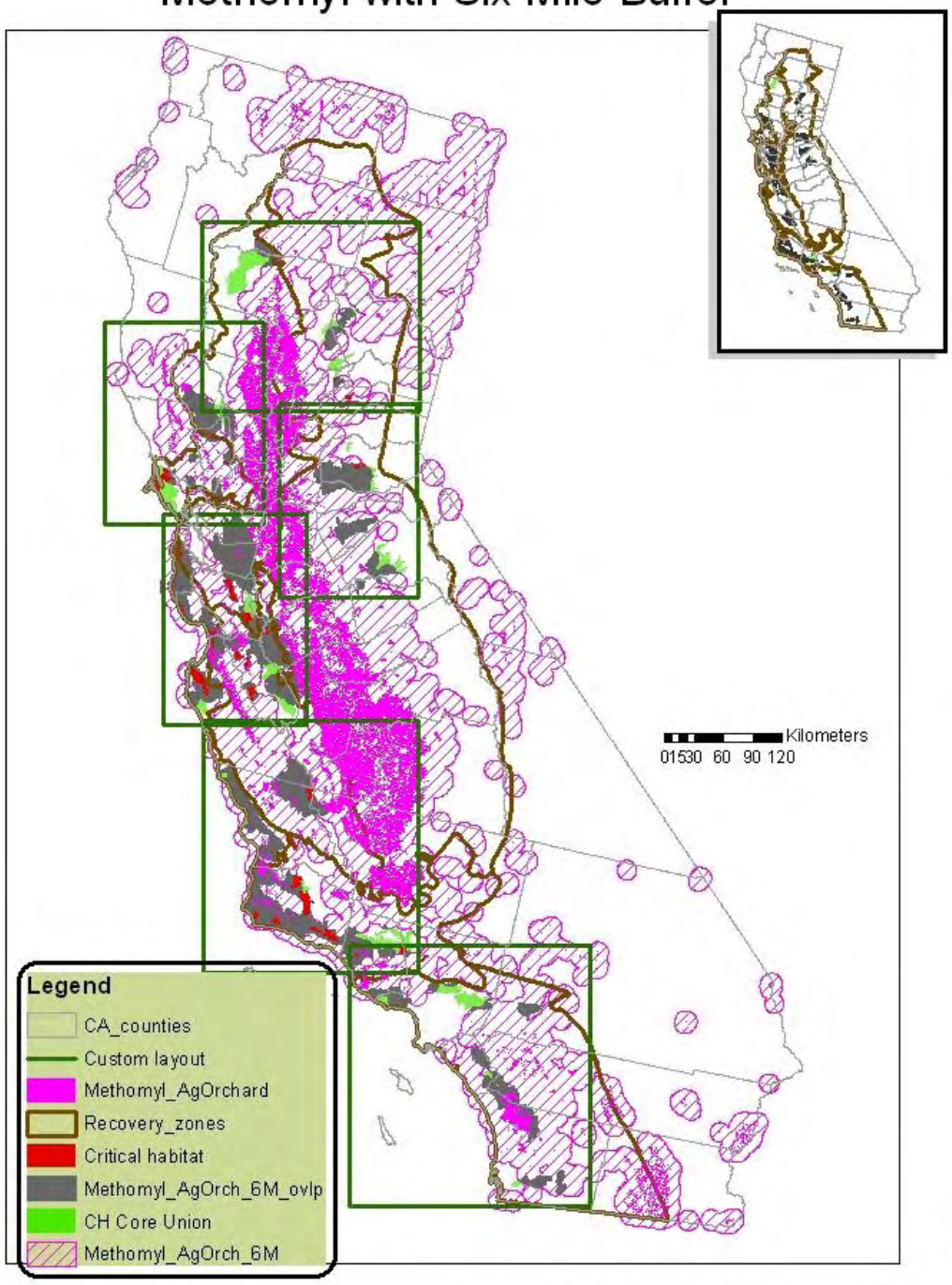
Methomyl 6 mile Action Area, RU 1



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. June, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

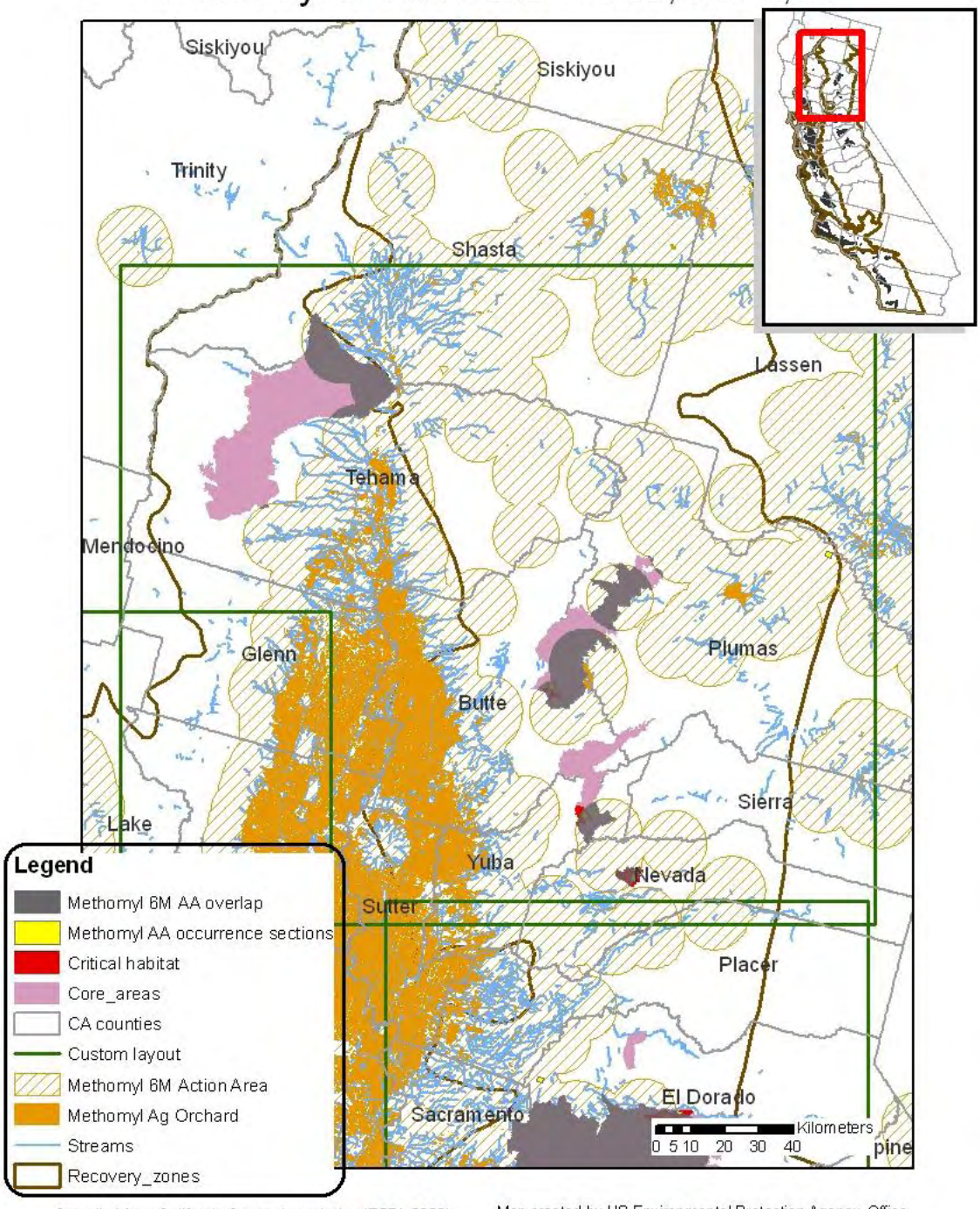
Methomyl with Six Mile Buffer



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. June, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

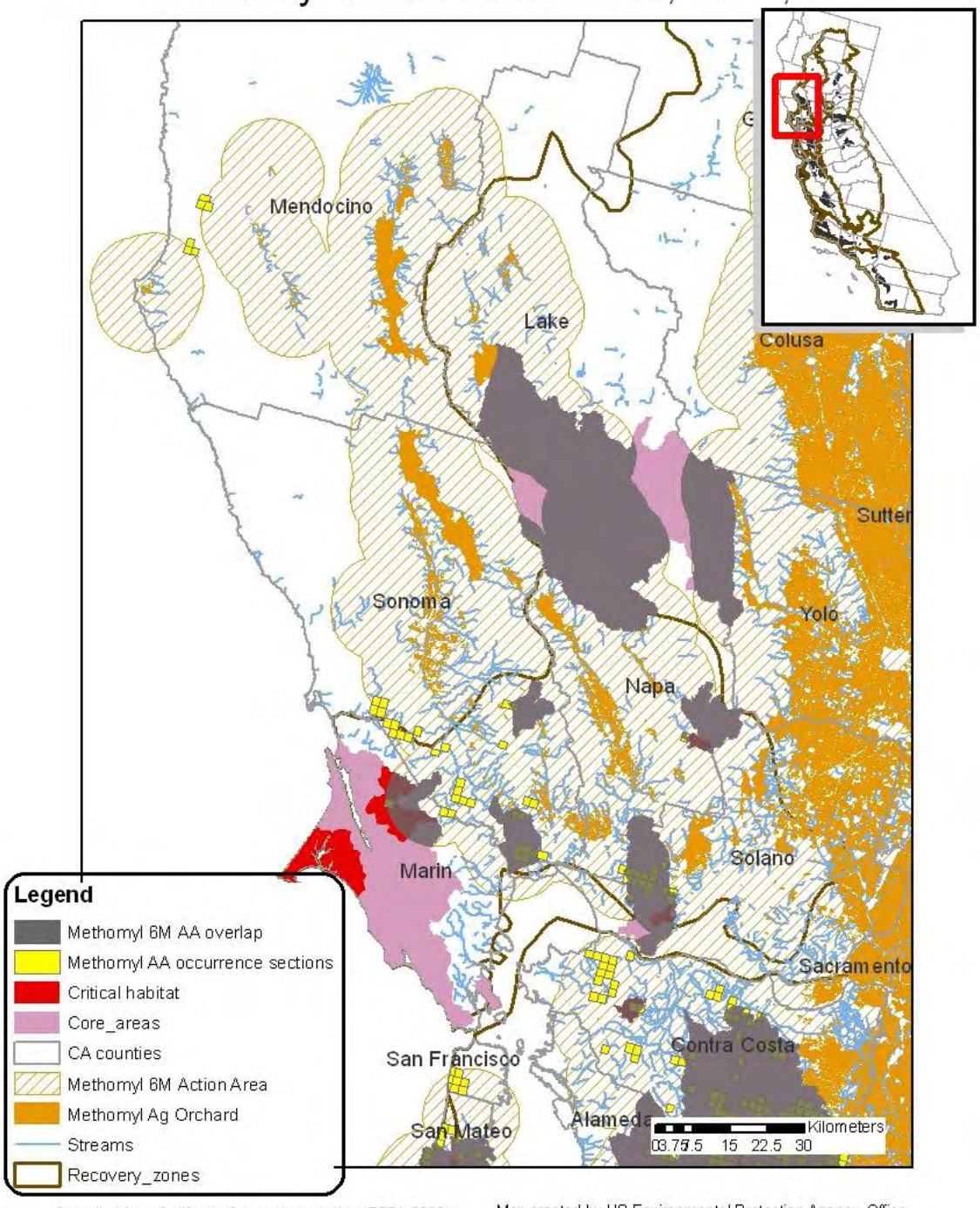
Methomyl 6 mile Action Area, RU 1, 2



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. June, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

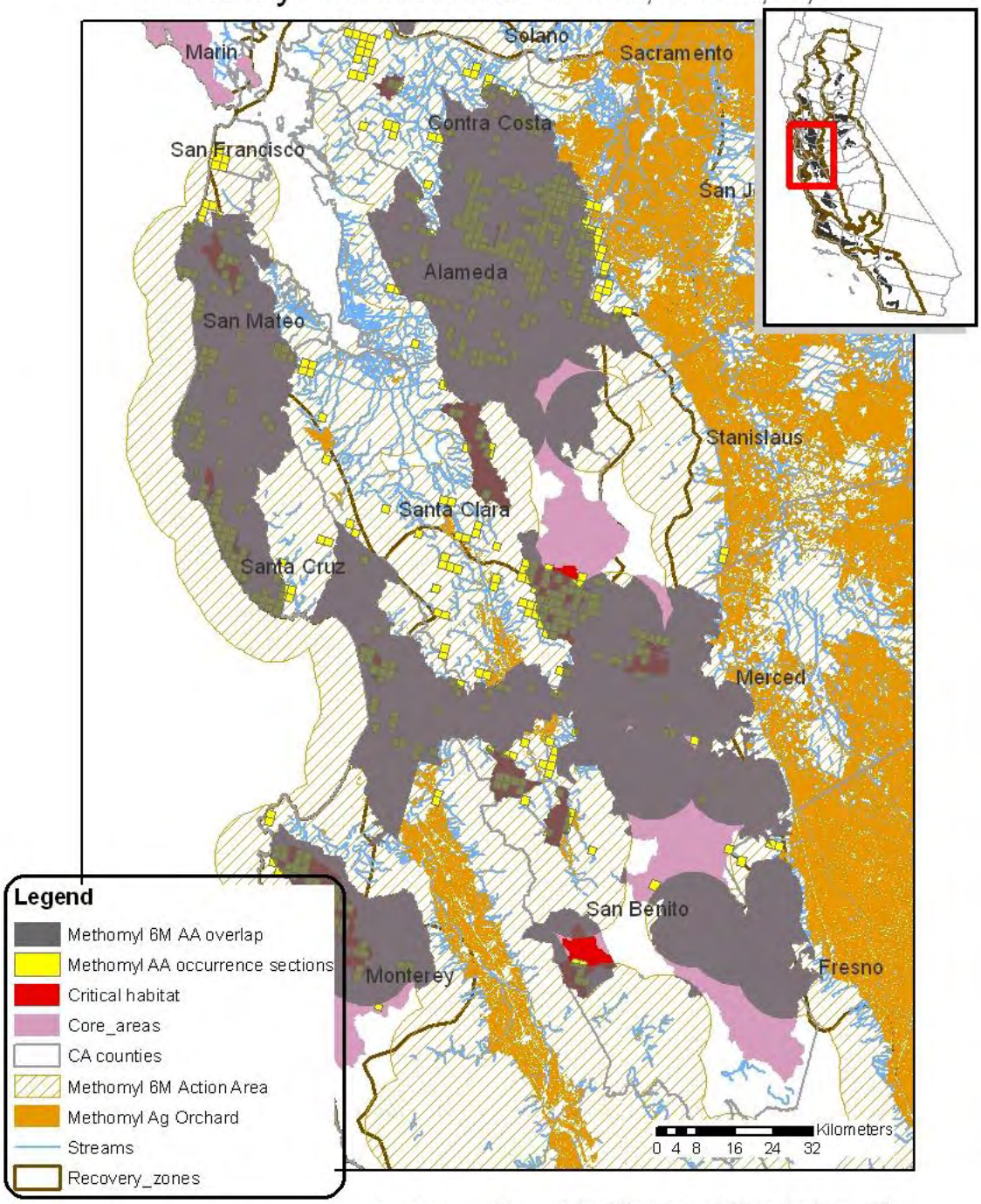
Methomyl 6 mile Action Area, RU 2, 3



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. June, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

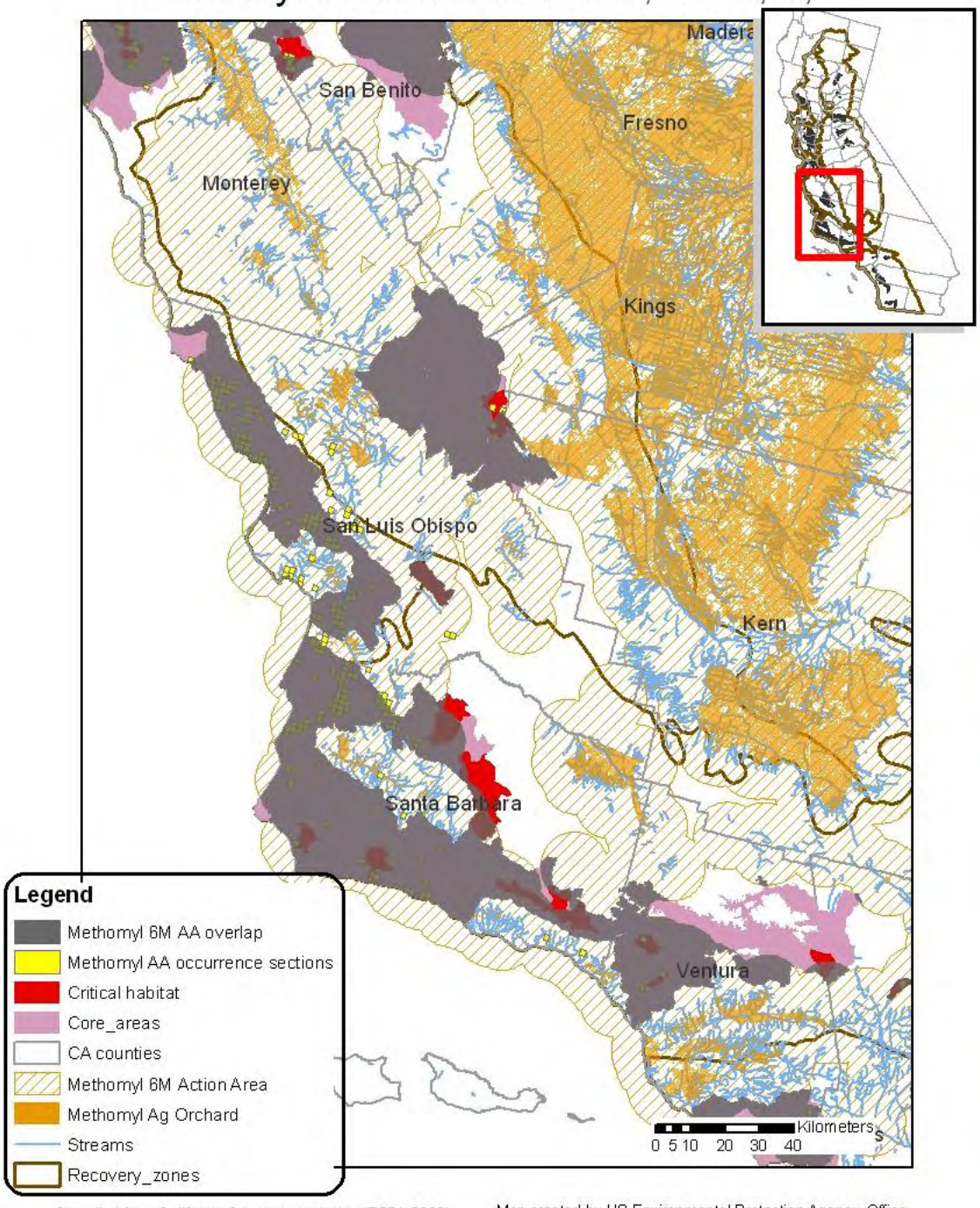
Methomyl 6 mile Action Area, RU 4, 5, 6



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. June, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

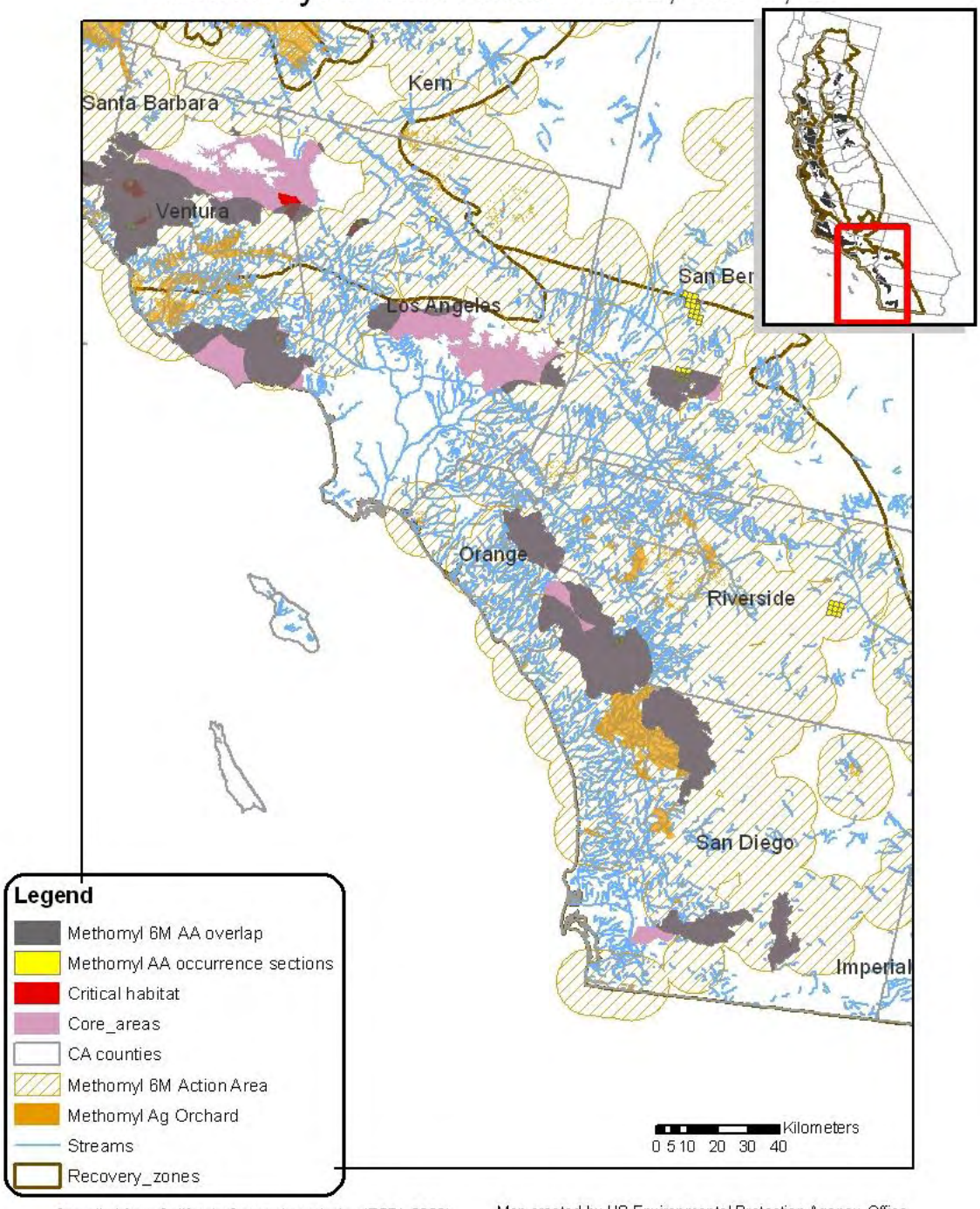
Methomyl 6 mile Action Area, RU 5, 6, 7



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. June, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

Methomyl 6 mile Action Area, RU 7, 8



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. June, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

APPENDIX H. PRZM Scenarios and Surrogate Justifications.

PRZM Scenario*	Scenario Location - County	Scenario Location - Region	Scenario Met Station	Methomyl Use	Surrogate Justification
CA alfalfa OP	San Joaquin	Central Valley	Fresno, CA (W93193)	alfalfa	Intended use
				sweet Lupine	Lupine is in the bean family (Fabaceae). Lupines are grown as ornamental plants, as well as forage and grain. Since Alfalfa is also perennial legume, it is assumed that the two plants would have similar cultivation requirements. No data have been identified to indicate where in CA Lupine is grown.
CA avocado RLF	San Diego, Stana Barbara Ventura	Southern Costal	San Diego County (W 23188)	avocado	Intended use
CA citrus STD	Fresno	Central Valley	Bakersfield, CA (W23155)	oranges	Intended use
				grapefruit	Intended use
				Lemon	Intended use
				tangelo	Intended use
				tangerine	Intended use
CA cole crop RLF	Monterey	Central California Coast/ costal Valleys Range	Santa Maria (W23234)	broccoli	Classified as cole crop. Scenario was developed based on broccoli
				cauliflower	Classified as cole crop.
				cabbage	Classified as cole crop.
				collards	Classified as cole crop.
				kale	Classified as cole crop.
				mustard greens	Classified as cole crop.
				Chinese broccoli	Classified as cole crop.
				Broccoli raab	Classified as cole crop.
				Chinese cabbage	Classified as cole crop.
				Leafy green vegetables	Classified as cole crop.

PRZM Scenario*	Scenario Location - County	Scenario Location - Region	Scenario Met Station	Methomyl Use	Surrogate Justification
				Horseradish	In the Brassicaceae family (which includes cabbage and mustard). This plant has a leafy appearance like cole crops. Based on this information, it is assumed that the plant would have simliar cultivation requirements as cole crops. No data have been identified to indicate where horseradish is grown in CA.
CA corn OP	Stanislaus, Jan Joaquin	Central Valley	Sacramento, CA (W23232)	Corn (field, popcorn, seed, sweet)	Intended use
CA cotton STD	Fresno	Central Valley	Bakersfield, CA (W23155)	cotton	Intended use
CA fruit STD	Fresno	Central Valley	Fresno, CA (W93193)	apples	This scenario is intended to represent non-citrus fruit, including peaches, plums, prunes, pears, apples. Additional characterization may be needed for apple grown in coastal areas of California.
				nectarines	This scenario is intended to represent non-citrus fruit, including peaches, plums, prunes, pears, apples.
				peaches	This scenario is intended to represent non-citrus fruit, including peaches, plums, prunes, pears, apples.
				pomegranate	According to a publication from Purdue University Horticulture & Landscape Architecture department: (http://www.hort.purdue.edu/newcrop/morton/pomegranate.html) "California, commercial pomegranate cultivation is concentrated in Tulare, Fresno and Kern county
CA garlic RLF	Fresno, Kern, Kings	San Joaquin Valley	Fresno, CA (W93193)	garlic	Intended use
CA grapes STD	NA	Southern San Joaquin Valley	Fresno, CA (W93193)	grapes	Intended use
CA impervious RLF	San Francisco	San Francisco Area	San Francisco, CA (W23234)	impervious surfaces	Intended use
				dumpsters	It is assumed that areas where dumsters are located are covered by impervious surfaces.
				areas outside of buildings	It is assumed that areas where buildings are located are covered by impervious surfaces.

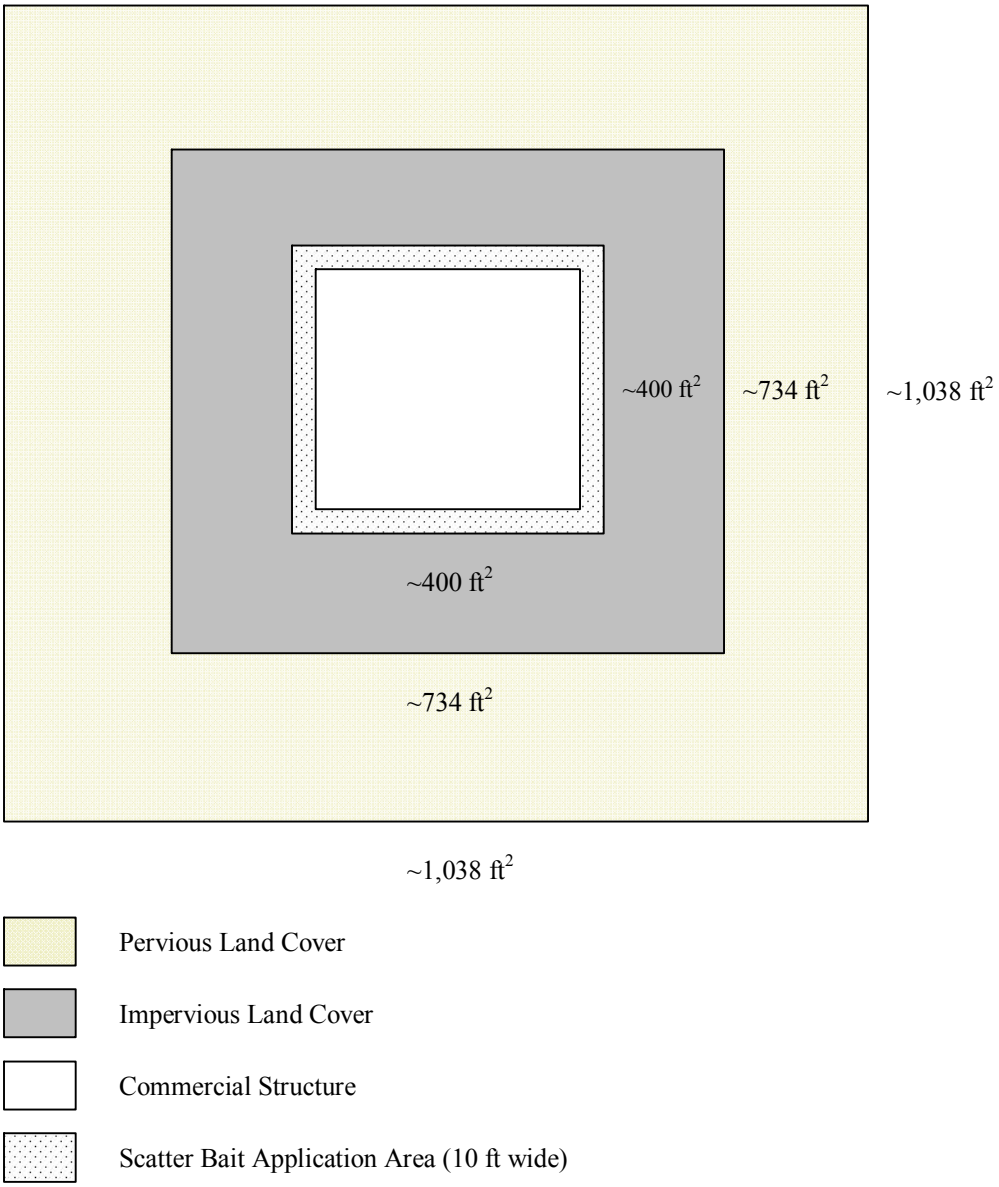
PRZM Scenario*	Scenario Location - County	Scenario Location - Region	Scenario Met Station	Methomyl Use	Surrogate Justification
CA lettuce STD	Monterey	NA	Santa Maria, CA (W23273)	lettuce	Intended use
				endive	This crop is a leafy vegetable with similar cultural practices.
				brussel sprouts	This crop is a leafy vegetable with similar cultural practices.
				spinach	This crop is a leafy vegetable with similar cultural practices.
				chicory	Type of endive.
				Melons	Intended use
				Cucumber	In the same family as melons. Presumed to have similar growing requirements and cultivation practices. According to NASS data, San Joaquin county contained the majority of CA harvested acres of cucumbers and pickles in 1997 and 2002.
				Pumpkins	In the same family as melons. Presumed to have similar growing requirements and cultivation practices. Nass data indicate that the majority of harvested acres of pumpkins (in 1997 and 2002) were in San Joaquin Co.
				Summer squash	In the same family as melons. Presumed to have similar growing requirements and cultivation practices. NASS data indicate that the majority of harvested acres of squash (in 1997 and in 2002) were located in Fresno, San Joaquin, San Luis Obispo and Santa Barbara Counties. This range overlaps with the identified meteorological and soil data for the scenario.
				Eggplant	According to NASS, the majority of CA acres harvested for eggplant were in Fresno Co (1997 and 2002).
CA onion STD	Kern	San Joaquin valley	Bakersfield, CA (W23155)	onion	Intended use
				radish	Radishes and onions are both root crops and potentially grown in similar areas.
CA potato RLF	Kern	NA	Bakersfield, CA (W23155)	potatoes	Intended use
				sweet potatoes	
				Bermudagrass (pasture)	This scenario is conceptualized as an open rangeland dominated by grasses and legumes. Crop specific parameters were determined by grass.

PRZM Scenario*	Scenario Location - County	Scenario Location - Region	Scenario Met Station	Methomyl Use	Surrogate Justification
				carrots	Intended use
				beans	Intended use
				asparagus	Intended use
				Beets	Most of these were grown in coastal counties with Ventura County having the greatest acreage with 273 acres. The CA Rowcrop scenario ('CARowcrop RLF') was specifically designed to represent these and other truck crops which are typically grown in rows in California
				celery	Intended use
				peppers	Intended use
				Anise	This is a type of herb. It is related to parsley and carrot. Given its similarity to the carrot, this crop is represented by the same scenario as the carrot.
				Lentils	This is a type of bean, which is an intended use of the scenario.
				Peas	Grown as a row crop
				Soybeans	Grown as a row crop.
CA strawberry (non plastic) RLF	Monterey, Santa Cruz, Santa Clara, San Luis Obispo, and northern Santa Barbara Counties	Santa Maria Valley	Santa Maria, CA (W 23273).	strawberries	Intended use
CA sugarbeet OP	NA	Central Valley	Fresno, California (W93193).	sugarbeets	Intended use
CA tomato STD	San Joaquin	Central Valley	Fresno, California (W93193).	tomato	Intended use
				Tomatillo	This crop is in the same family as the tomato. It has similar form and fruit and would be expected to have similar cultivation practices.
CA turf RLF	NA	Central / northern CA	San Francisco, CA (W23234)	sod farms	Intended use

PRZM Scenario*	Scenario Location - County	Scenario Location - Region	Scenario Met Station	Methomyl Use	Surrogate Justification
CA wheat RLF	Fresno, Kern, Kings, Madera, Merced, and Tulare	San Joaquin Valley	Fresno, CA (W93193)	wheat	Intended use
				barley	Intended use
				oats	Intended use
				Rye	This is a grain crop and would be expected to have similar cultivation requirements to wheat.
				Sorghum	This is a grain crop and would be expected to have similar cultivation requirements to wheat.
				blue berries	According to NASS, blueberries are grown in the costal valley. This scenario is intended to represent a field in Northern Costal CA (Sonoma, Napa, Lake and Mendocino Counties). The meteorological station for this scenario is located in San Francisco. The meteorological station and the soil overlap in range with the region of blueberry cultivation.
OR mint STD	Marion	NA	Salem, OR (W24232)	Mint	According to NASS data, Mint (grown for oil) has been grown in Lassen, Shasta and Siskiyou Counties. These are located in The Northern Counties of CA, boardering OR. Although this scenario represents a field located North of the area where mint is grown in CA, it was developed based on a mint field in the Pacific Northwest. Since the locations were mint is grown in CA are in the North part of the state, this scenario is appropriate for modeling mint grown in CA.
*STD = standard scenario, RLF = Red Legged Frog scenario, OP = organo phosphate scenario					

APPENDIX I. Schematic for Methomyl Scatter Bait Uses.

In a 10 ha plot, 50% impervious and 50% pervious land cover, with a 160,000 ft^2 commercial structure, if a 10-ft wide area around the structure is treated with scatter bait this results in 16,400 ft^2 being treated [0.08 lb a.i. at the maximum single application rate (0.0025 lb a.i./500 ft^2)]. The treatment area (16,400 ft^2) represents 1.5% of the entire 10 ha plot and 3% of the 5-ha impervious plot (including the commercial structure). This is likely an overestimation for a typical scatter bait application because we assumed that: 1) the structure involved in the treatment was a large, warehouse-type retailer; 2) the treatment area uncluded an area surrounding the entire structure; 3) and the treatment area was 10 ft wide.



APPENDIX J. Summary of Acute Toxicity Values for Freshwater Fish.

Species	Compound (% a.i.)	LC50 (96-h)	95% C.I. ppb	MRID	Classification	Notes:
Salmo salar Atlantic salmon	99	560	460-690	400980-01	Supplemental	Temp = 17°C pH = 7.5 Hardness = 40 mg/L
		640	500-830	400980-01	Supplemental	Temp = 12°C pH = 6.0 Hardness = 40 mg/L
		700	570-870	400980-01	Supplemental	Temp = 12°C pH = 6.5 Hardness = 40 mg/L
		1000	830-1200	400980-01	Supplemental	Temp = 12°C pH = 7.5 Hardness = 12 mg/L
		1050	950-1160	400980-01	Supplemental	Temp = 12°C pH = 8.5 Hardness = 40 mg/L
		1120	930-1350	400980-01	Supplemental	Temp = 12°C pH = 7.5 Hardness = 40 mg/L
		1150	980-1360	400980-01	Supplemental	Temp = 12°C pH = 7.5 Hardness = 40 mg/L
		1220	1080-1380	400980-01	Supplemental	Temp = 12°C pH = 7.5 Hardness = 40 mg/L
	29	1200	1050-1380	400980-01	Supplemental	Temp = 12°C pH = 7.5 Hardness = 40 mg/L
	24	1400	1250-1570	400980-01	Supplemental	Temp = 12°C pH = 7.5 Hardness = 40 mg/L
Lepomis macrochirus Bluegill sunfish	95	480	320-710	400980-01	Supplemental	Temp = 17°C pH = 6.5 Hardness = 40 mg/L
		600	420-860	400980-01	Supplemental	Temp = 17°C pH = 7.5 Hardness = 40 mg/L
		620	370-1040	400980-01	Supplemental	Temp = 17°C pH = 8.5 Hardness = 40 mg/L
		840	530-1340	400980-01	Supplemental	Temp = 17°C pH = 7.4 Hardness = 320 mg/L
		860	644-1150	400980-01	Supplemental	Temp = 22°C pH = 7.4 Hardness = 40 mg/L

Species	Compound (% a.i.)	LC50 (96-h)	95% C.I. ppb	MRID	Classification	Notes:
		940	650-1360	400980-01	Supplemental	Temp = 17°C pH = 6.0 Hardness = 40 mg/L
		1050	859-1280	400980-01	Supplemental	Temp = 20°C pH = 7.2 Hardness = 40 mg/L
		1150	928-1420	400980-01	Supplemental	Temp = 17°C pH = 7.4 Hardness = 40 mg/L
		1200	820-1760	400980-01	Supplemental	Temp = 17°C pH = 7.4 Hardness = 40 mg/L
		2000	1430-2800	400980-01	Supplemental	Temp = 12°C pH = 7.4 Hardness = 40 mg/L
	29	670	428-1048	400980-01	Supplemental	Temp = 17°C pH = 7.4 Hardness = 44mg/L
		670	428-1048	400980-01	Supplemental	Temp = 22°C pH = 7.4 Hardness = 40 mg/L
	24	370	262-522	400980-01	Supplemental	Temp = 20°C pH = 7.4 Hardness = 40 mg/L
		430	310-590	400980-01	Supplemental	Temp = 27°C pH = 7.4 Hardness = 40 mg/L
		560	420-750	400980-01	Supplemental	Temp = 17°C pH = 7.4 Hardness = 40 mg/L
		560	380-830	400980-01	Supplemental	Temp = 22°C pH = 7.4 Hardness = 40 mg/L
		600	496-725	400980-01	Supplemental	Temp = 22°C pH = 7.4 Hardness = 40 mg/L
		710	561-898	400980-01	Supplemental	Temp = 20°C pH = 7.2 Hardness = 40 mg/L
		1200	924-1560	400980-01	Supplemental	Temp = 17°C pH = 7.4 Hardness = 40 mg/L
		1800	1300-2400	400980-01	Supplemental	Temp = 12°C pH = 7.4 Hardness = 40 mg/L
		2800	2500-3200	400980-01	Supplemental	Temp = 22°C pH = 7.4 Hardness = 272 mg/L

Species	Compound (% a.i.)	LC50 (96-h)	95% C.I. ppb	MRID	Classification	Notes:
	degradate	462,000	430,000 - 486,000	00009061	Supplemental	Test compound is a degradate of methomyl
Salvelinus fontinalis Brook trout	99	1500	1230-1830	400980-01	Supplemental	Temp = 12°C pH = 7.5 Hardness = 40 mg/L
		2200	1600-3010	400980-01	Supplemental	Temp = 12°C pH = 7.5 Hardness = 40 mg/L
	24	1220	860-1730	400980-01	Supplemental	Temp = 12°C pH = 7.5 Hardness = 40 mg/L
Ictalurus punctatus Channel catfish	95	530	375-748	400980-01	Supplemental	Temp = 22°C pH = 7.4 Hardness = 40 mg/L
	24	320	200-430	400980-01	Supplemental	Temp = 22°C pH = 7.4 Hardness = 40 mg/L
		<560	N/A	400980-01	Supplemental	Temp = 25°C pH = 7.4 Hardness = 40 mg/L swim-up fry tested
		760	635-909	400980-01	Supplemental	Temp = 22°C pH = 7.4 Hardness = 40 mg/L fingerlings tested
		1800	1300-2400	400980-01	Supplemental	Temp = 25°C pH = 7.4 Hardness = 40 mg/L yolk-sac fry tested
Pimephales promelas Fathead minnow	99	2800	1800-4300	400980-01	Supplemental	Temp = 17°C pH = 7.4 Hardness = 45 mg/L
	29	1500	900-2500	400980-01	Supplemental	Temp = 17°C pH = 7.2 Hardness = 46 mg/L
	24	1800	1200-2700	400980-01	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L
Micropterus salmoides Largemouth bass	95	1250	971-1610	400980-01	Supplemental	Temp = 22°C pH = 7.2 Hardness = 40 mg/L
	24	760	589-979	400980-01	Supplemental	Temp = 22°C pH = 7.2 Hardness = 40 mg/L
Oncorhyncus mykiss Rainbow trout	95	860	590-1260	400980-01	Supplemental	Temp = 17°C pH = 7.4 Hardness = 40 mg/L
		1050	670-1630	400980-01	Supplemental	Temp = 12°C pH = 7.4 Hardness = 40 mg/L

Species	Compound (% a.i.)	LC50 (96-h)	95% C.I. ppb	MRID	Classification	Notes:
		1100	760-1600	400980-01	Supplemental	Temp = 12°C pH = 7.5 Hardness = 40 mg/L
		1200	780-1860	400980-01	Supplemental	Temp = 12°C pH = 8.5 Hardness = 40 mg/L
		1400	950-2000	400980-01	Supplemental	Temp = 12°C pH = 7.4 Hardness = 320 mg/L
		1500	1100-2000	400980-01	Supplemental	Temp = 12°C pH = 6.5 Hardness = 40 mg/L
		1600	1190-2150	400980-01	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L
		1700	1180-2440	400980-01	Supplemental	Temp = 12°C pH = 7.4 Hardness = 40 mg/L
		2000	1430-2790	400980-01	Supplemental	Temp = 7°C pH = 7.4 Hardness = 40 mg/L
	29	1200	764-1880	400980-01	Supplemental	Temp = 12°C pH = 7.4 Hardness = 40 mg/L
	24	1200	1100-1400	400980-01	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L
		1300	960-1600	400980-01	Supplemental	Temp = 12°C pH = 7.4 Hardness = 40 mg/L Swim-up fry tested
		1400	1100-1600	400980-01	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L
		1400	1100-1600	400980-01	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L 1-day degradation
		1400	1100-1600	400980-01	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L 3-day degradation
		1400	1100-1790	400980-01	Supplemental	Temp = 17°C pH = 7.2 Hardness = 40mg/L
		1500	800-2800	400980-01	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L 7-day degradation

Species	Compound (% a.i.)	LC50 (96-h)	95% C.I. ppb	MRID	Classification	Notes:
		2000	1510-2640	400980-01	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L
		2100	1610-2730	400980-01	Supplemental	Temp = 10°C pH = 7.2 Hardness = 40 mg/L
		2300	1770-2980	400980-01	Supplemental	Temp = 10°C pH = 7.2 Hardness = 40 mg/L
		>2500	N/A	400980-01	Supplemental	Temp = 12°C pH = 7.4 Hardness = 272 mg/L Flow-through test
		3200	2300-4500	400980-01	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L Yolk-sac fry
		32,000	18,000-50,000	400980-01	Supplemental	Temp = 10°C pH = 7.2 Hardness = 40 mg/L Eyed egg tested

APPENDIX K. Summary of Acute Toxicity Values for Freshwater Invertebrates.

Species	Compound (% a.i.)	LC50		95% C.I. ppb	MRID	Toxicity	Classification	Notes:
		48-h	96-h					
Chironomus plumosus Midge	95	88	--	60-129	400980-01	Very highly toxic	Supplemental	Temp = 22°C pH = 7.4 Hardness = 40 mg/L
	24	32	--	13-80	400980-01	Very highly toxic	Supplemental	Temp = 20°C pH = 7.4 Hardness = 272 mg/L
Daphnia magna Water flea	95	8.8	–	4.1-19	400980-01	Very highly toxic	Supplemental	Temp = 21°C pH = 7.4 Hardness = 272 mg/L
	>99	31.7	–	29.5-34.1	19977	Very highly toxic	Acceptable	Temp = 20°C pH = 6.8-8.6 Hardness = 92.8 mg/L
	24	5.0	–	4.8-12.1	400980-01	Very highly toxic	Supplemental	Temp = 20°C pH = 7.2 Hardness = 40 mg/L
Gammarus pseudolimnaeus scud	99	--	920	680-1240	400980-01	Highly toxic	Supplemental	Temp = 17°C pH = 7.1 Hardness = 40 mg/L
	24	--	720	572-907	400980-01	Highly toxic	Supplemental	Temp = 17°C pH = 7.4 Hardness = 40 mg/L
		--	1050	839-1315	400980-01	Moderately toxic	Supplemental	Temp = 12°C pH = 7.4 Hardness = 274 mg/L Flow-through test
		1050	--	424-2600	400980-01	Moderately toxic	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L
		1050	--	328-3360	400980-01	Moderately toxic	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L 1-day degradation
		750	--	342-1646	400980-01	Highly toxic	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L 3-day degradation

Species	Compound (% a.i.)	LC50		95% C.I. ppb	MRID	Toxicity	Classification	Notes:
		48-h	96-h					
		340	--	194-594	400980-01	Highly toxic	Supplemental	Temp = 12°C pH = 7.2 Hardness = 40 mg/L 7-day degradation
Isogenus sp. Stonefly	95	–	343	268-440	400980-01	Highly toxic	Supplemental	Temp = 7.0°C pH = 7.5 Hardness = 42 mg/L
	24	–	29	21-41	400980-01	Very highly toxic	Supplemental	Temp = 7.0°C pH = 7.5 Hardness = 42 mg/L
Pteronarcella badia Stonefly	95	--	69	44-108	400980-01	Very highly toxic	Supplemental	Temp = 7.0°C pH = 7.5 Hardness = 40 mg/L
	24	--	60	45-80	400980-01	Very highly toxic	Supplemental	Temp = 7.0°C pH = 7.5 Hardness = 40 mg/L
Skwala sp. Stonefly	95-98	–	34	N/A	400946-02	Very highly toxic	Acceptable	Temp = 7.0°C pH = N/A Hardness = N/A
	24	–	29	N/A	400946-02	Very highly toxic	Acceptable	Temp = 7.0°C pH = N/A Hardness = N/A

APPENDIX L. All Papers Identified by ECOTOX for Methomyl (from an ECOTOX Run Conducted on 3/17/2007).

A. Papers Accepted by ECOTOX and OPP (All of the papers with endpoints more sensitive than the registrant-submitted data were fully reviewed; not all of the papers with endpoints less sensitive than registrant-submitted data were fully reviewed).

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B. Papers Accepted by ECOTOX But Rejected By OPP and Reasons Why They Were Rejected.

Explanation of OPP Acceptability Criteria and Rejection Codes for ECOTOX Data

Studies located and coded into ECOTOX must meet acceptability criteria, as established in the *Interim Guidance of the Evaluation Criteria for Ecological Toxicity Data in the Open Literature, Phase I and II*, Office of Pesticide Programs, U.S. Environmental Protection Agency, July 16, 2004. Studies that do not meet these criteria are designated in the bibliography as "Accepted for ECOTOX but not OPP." The intent of the acceptability criteria is to ensure data quality and verifiability. The criteria parallel criteria used in evaluating registrant-submitted studies. Specific criteria are listed below, along with the corresponding rejection code.

Abstract—the paper is not presented as a full article (*i.e.*, the publication includes only an abstract).

No Control—the treatments were not compared to an appropriate control.

Review--all toxicity tests reported elsewhere. If the publication is applicable to one of the ECOTOX databases, the bibliography is skimmed and any applicable articles are ordered.

Methods--no usable toxicity tests. Reports of methods of conducting tests (see "Applicable publications"), determination or purification of chemicals, etc. Methods publications are selected to be ordered for the ECOTOX toxicology methods information file (Methfile).

Modeling only, no new organism exposure data. Modeling studies may report original toxicity tests performed as comparisons or as a basis for extrapolation; order the paper if it is not clear from the abstract.

Biological Toxicant--includes venoms, fungal toxins, *Bacillus thuringiensis*, other plant, animal, or microbial extracts or toxins.

Effluent, sewage, or polluted runoff.

Survey studies--measuring amounts of chemical present, but no usable quantification of exposure. Lacks either usable concentration or duration or both.

Mixture--no single chemical tests reported.

No Quantifiable Toxicity Results – the results are presented in a way that be quantified.

No Species--no organism present or tested or unable to verify a species or exposure of dead organism.

No Endpoint—no endpoint was provided.

Risk Assessment – the paper is not the primary source of the data.

Not Public – the article is not publically available.

In Vitro studies, including exposure of cell cultures and excised tissues.

Bacteria as test organism, including **Microtox** tests, or other microbial organisms.

Yeast as a test organism is historically not coded in ECOTOX.

No Toxicity Data--publications which are not toxicology studies.

Human Health effects; studies with human subjects or with animal subjects as surrogates for human health risk assessment (see "Applicable publications").

No Concentration--no usable dose or concentration reported; identified after examination of full paper. Includes lead-shot studies which lack dose information or give only number of pellets. Concentrations reported only in log units are not coded.

No Duration reported, identified after examination of full paper (see "Applicable publications"). **Survey** studies--measuring amounts of chemical present, but no usable quantification of exposure. Lacks either usable concentration or duration or both.

Fate: Studies reporting only what happens to the chemical in abiotic matrices

PUBL AS, author has results were published in a different format. For example, may be used for a Ph.D. dissertation when the same results were also published in a peer-reviewed journal.

NON-ENGLISH or **FORE**, paper was published in a foreign language.

Additionally, efficacy studies on target species are excluded and coded as **NO TARGET**.

Data that originated from the OPP Pesticide Ecotoxicity Database is coded as **NO EFED**. These data are already available to the chemical team.

NO EFED

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FOREIGN, NO CONTROL

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MIXTURE

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MIXTURE, NO DURATION, NO ENDPOINT

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NO ENDPOINT,MIXTURE

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NO ENDPOINT, NO CONTROL

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NOT PUBLIC, NO CONTROL

EPA/OTS (1999). Initial Submission: Letter from U.S.EPA Reporting Results of Acute Studies with a Methomyl R&D Proprietary Mixture, Dated 8/3/1999 (Sanitized). *EPA/OTS Doc #88990000241S*

ONLY ONE CONCENTRATION TESTED

Liburd, O. E., Funderburk, J. E., and Olson, S. M. (2000). Effect of Biological and Chemical Insecticides on Spodoptera species (Lep., Noctuidae) and Marketable Yields of Tomatoes. *J.Appl.Entomol.* 124: 19-25.

SUBCUTANEOUS EXPOSURE

Al-Baggou, B. K. and Mohammad, F. K. (1999). Antagonism of Methomyl-Induced Toxicosis by Diphenhydramine in Rats. *Environ.Toxicol.Pharmacol.* 7: 119-125.

C. Papers Excluded from ECOTOX and Reasons Why They Were Rejected.

ABSTRACT

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APPENDIX M. T-REX and T-HERPS Input Parameters and Output.

A. T-REX (version 1.3.1) Runs.

Endpoints		
Avian (Bobwhite Quail)	LD50 (mg/kg-bw)	24.20
	LC50 (mg/kg-diet)	1100.00
	NOAEC (mg/kg-diet)	150.00
Mammals (Rat)	LD50 (mg/kg-bw)	30.00
	LC50 (mg/kg-diet)	0.00
	NOAEL (mg/kg-bw)	3.75
	NOAEC (mg/kg-diet)	75.00

A scaling factor of 1.0778 was used for birds (Mineau *et al.*, 1996).

1. Maximum Seasonal Application Rate for Agricultural Uses

Chemical Name:	Methomyl
Use	Agricultural
Formulation	0
Application Rate	0.9 lbs a.i./acre
Half-life	3 days
Application Interval	2 days
Maximum # Apps./Year	8
Length of Simulation	1 year

Upper 90th Percentile Kenaga, Acute Avian Dose-Based Risk Quotients									
Size Class (grams)	Adjusted LD50	EECs and RQs							
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
20	20.42	648.31	31.76	297.14	14.55	364.68	17.86	40.52	1.98
100	23.14	369.69	15.98	169.44	7.32	207.95	8.99	23.11	1.00
1000	27.68	165.52	5.98	75.86	2.74	93.10	3.36	10.34	0.37

Upper 90th Percentile Kenega, Subacute Avian Dietary Based Risk Quotients								
	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
LC50	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
1100	569.24	0.52	260.90	0.24	320.20	0.29	35.58	0.03

Size class not used for dietary risk quotients

Upper 90th Percentile Kenega, Chronic Avian Dietary Based Risk Quotients								
	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
NOAEC (ppm)	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
150	569.24	3.79	260.90	1.74	320.20	2.13	35.58	0.24

Size class not used for dietary risk quotients

Upper 90th Percentile Kenaga, Acute Mammalian Dose-Based Risk Quotients											
Size Class (grams)	Adjusted LD50	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	37.36	542.73	8.23	248.75	3.77	305.29	4.63	33.92	0.51	7.54	0.11
35	30.23	375.10	7.03	171.92	3.22	210.99	3.96	23.44	0.44	5.21	0.10
1000	13.08	86.97	3.77	39.86	1.73	48.92	2.12	5.44	0.24	1.21	0.05

Upper 90th Percentile Kenega, Chronic Mammalian Dietary Based Risk Quotients								
NOAEC (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
75	569.24	7.59	260.90	3.48	320.20	4.27	35.58	0.47

Size class not used for dietary risk quotients

Upper 90th Percentile Kenega, Chronic Mammalian Dose-Based Risk Quotients											
Size Class (grams)	Adjusted NOAEL	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	8.24	542.73	65.85	248.75	30.18	305.29	37.04	33.92	4.12	7.54	0.91
35	6.67	375.10	56.25	171.92	25.78	210.99	31.64	23.44	3.52	5.21	0.78
1000	2.88	86.97	30.15	39.86	13.82	48.92	16.96	5.44	1.88	1.21	0.42

2. Maximum Seasonal Application Rates for Orchard Uses.

Chemical Name:	Methomyl
Use	Orchard
Formulation	0
Application Rate	0.9 lbs a.i./acre
Half-life	3 days
Application Interval	5 days
Maximum # Apps./Year	6
Length of Simulation	1 year

Upper 90th Percentile Kenaga, Acute Avian Dose-Based Risk Quotients									
Size Class (grams)	Adjusted LD50	EECs and RQs							
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
20	20.42	358.77	17.57	164.43	8.05	201.81	9.89	22.42	1.10
100	23.14	204.58	8.84	93.77	4.05	115.08	4.97	12.79	0.55
1000	27.68	91.59	3.31	41.98	1.52	51.52	1.86	5.72	0.21

Upper 90th Percentile Kenega, Subacute Avian Dietary Based Risk Quotients								
	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
LC50	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
1100	315.01	0.29	144.38	0.13	177.19	0.16	19.69	0.02

Size class not used for dietary risk quotients

Upper 90th Percentile Kenega, Chronic Avian Dietary Based Risk Quotients								
NOAEC (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
150	315.01	2.10	144.38	0.96	177.19	1.18	19.69	0.13

Size class not used for dietary risk quotients

Upper 90th Percentile Kenaga, Acute Mammalian Dose-Based Risk Quotients											
Size Class (grams)	Adjusted LD50	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	37.36	300.34	4.56	137.66	2.09	168.94	2.56	18.77	0.28	4.17	0.06
35	30.23	207.57	3.89	95.14	1.78	116.76	2.19	12.97	0.24	2.88	0.05
1000	13.08	48.13	2.09	22.06	0.96	27.07	1.17	3.01	0.13	0.67	0.03

Upper 90th Percentile Kenega, Chronic Mammalian Dietary Based Risk Quotients								
NOAEC (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
75	315.01	4.20	144.38	1.93	177.19	2.36	19.69	0.26

Size class not used for dietary risk quotients

Upper 90th Percentile Kenega, Chronic Mammalian Dose-Based Risk Quotients											
Size Class (grams)	Adjusted NOAEL	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	8.24	300.34	36.44	137.66	16.70	168.94	20.50	18.77	2.28	4.17	0.51
35	6.67	207.57	31.13	95.14	14.27	116.76	17.51	12.97	1.95	2.88	0.43
1000	2.88	48.13	16.69	22.06	7.65	27.07	9.39	3.01	1.04	0.67	0.23

3. Single Maximum Application Rates (for Orchard and Agricultural Uses).

Chemical Name:	Methomyl
Use	Orchard/Agricultural
Formulation	0
Application Rate	0.9 lbs a.i./acre
Half-life	3 days
Application Interval	0 days
Maximum # Apps./Year	1
Length of Simulation	1 year

Upper 90th Percentile Kenaga, Acute Avian Dose-Based Risk Quotients									
Size Class (grams)	Adjusted LD50	EECs and RQs							
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
20	20.42	246.00	12.05	112.75	5.52	138.38	6.78	15.38	0.75
100	23.14	140.28	6.06	64.30	2.78	78.91	3.41	8.77	0.38
1000	27.68	62.81	2.27	28.79	1.04	35.33	1.28	3.93	0.14

Upper 90th Percentile Kenega, Subacute Avian Dietary Based Risk Quotients								
	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
LC50	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
1100	216.00	0.20	99.00	0.09	121.50	0.11	13.50	0.01

Size class not used for dietary risk quotients

Upper 90th Percentile Kenega, Chronic Avian Dietary Based Risk Quotients								
	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
NOAEC (ppm)	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
150	216.00	1.44	99.00	0.66	121.50	0.81	13.50	0.09

Size class not used for dietary risk quotients

Upper 90th Percentile Kenaga, Acute Mammalian Dose-Based Risk Quotients											
		EECs and RQs									
Size Class (grams)	Adjusted LD50	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	37.36	205.94	3.12	94.39	1.43	115.84	1.76	12.87	0.20	2.86	0.04
35	30.23	142.33	2.67	65.24	1.22	80.06	1.50	8.90	0.17	1.98	0.04
1000	13.08	33.00	1.43	15.13	0.66	18.56	0.80	2.06	0.09	0.46	0.02

Upper 90th Percentile Kenega, Chronic Mammalian Dietary Based Risk Quotients								
	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
NOAEC (ppm)	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
75	216.00	2.88	99.00	1.32	121.50	1.62	13.50	0.18

Size class not used for dietary risk quotients

Upper 90th Percentile Kenega, Chronic Mammalian Dose-Based Risk Quotients											
		EECs and RQs									
Size Class (grams)	Adjusted NOAEL	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	8.24	205.94	24.99	94.39	11.45	115.84	14.06	12.87	1.56	2.86	0.35
35	6.67	142.33	21.34	65.24	9.78	80.06	12.01	8.90	1.33	1.98	0.30
1000	2.88	33.00	11.44	15.13	5.24	18.56	6.44	2.06	0.72	0.46	0.16

B. T-HERPS (version 1.0) Runs.

T-REX version 1.3.1 has been modified to allow for an estimation of exposure to terrestrial reptiles and amphibians (herptiles). The following key changes were made to T-REX version 1.3.1. in the development of T-HERPS v. 1.0:

- Food Intake allometric equation for insectivorous herptiles was incorporated
- Small mammals and insectivorous herpatofauna were added as potential dietary items
- The user may enter water content of food items for various stages of assessed species

1. Maximum Seasonal Application Rate for Agricultural Uses (the same inputs that were used for T-REX, see above, were used, except that a scaling factor of '1' was used).

Upper Bound Kenaga, Acute Terrestrial Herpetofauna Dose-Based Risk Quotients											
Size Class (grams)	Adjusted LD50	EECs and RQs									
		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Small Herbivore Mammals		Small Insectivore Mammal		Small Amphibians	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
1.4	24.20	12.44	0.51	1.38	0.06	N/A	N/A	N/A	N/A	N/A	N/A
37	24.20	12.23	0.51	1.36	0.06	354.82	14.66	22.18	0.92	0.42	0.02
238	24.20	8.01	0.33	0.89	0.04	55.16	2.28	3.45	0.14	0.28	0.01

Upper Bound Kenaga, Subacute Terrestrial Herpetofauna Dietary Based Risk Quotients										
LC50 (ppm)	EECs and RQs									
	Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Small Herbivore Mammals		Small Insectivore Mammals		Small Amphibians	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
1100	320.20	0.29	35.58	0.03	375.10	0.34	23.44	0.02	11.11	0.01

Size class not used for dietary risk quotients

Upper Bound Kenaga, Chronic Terrestrial Herpetofauna Dietary Based Risk Quotients										
NOAEC (ppm)	EECs and RQs									
	Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Small Herbivore Mammals		Small Insectivore Mammals		Small Amphibians	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
150	320.20	2.13	35.58	0.24	375.10	2.50	23.44	0.16	11.11	0.07

Size class not used for dietary risk quotients

2. Maximum Seasonal Application Rates for Orchard Uses (the same inputs that were used for T-REX, see above, were used, except that a scaling factor of '1' was used).

Upper Bound Kenaga, Acute Terrestrial Herpetofauna Dose-Based Risk Quotients											
Size Class (grams)	Adjusted LD50	EECs and RQs									
		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Small Herbivore Mammals		Small Insectivore Mammal		Small Amphibians	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
1.4	24.20	6.88	0.28	0.76	0.03	N/A	N/A	N/A	N/A	N/A	N/A
37	24.20	6.77	0.28	0.75	0.03	196.35	8.11	12.27	0.51	0.23	0.01
238	24.20	4.43	0.18	0.49	0.02	30.53	1.26	1.91	0.08	0.15	0.01

Upper Bound Kenaga, Subacute Terrestrial Herpetofauna Dietary Based Risk Quotients										
LC50 (ppm)	EECs and RQs									
	Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Small Herbivore Mammals		Small Insectivore Mammals		Small Amphibians	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
1100	177.19	0.16	19.69	0.02	207.57	0.19	12.97	0.01	6.15	0.01

Size class not used for dietary risk quotients

Upper Bound Kenaga, Chronic Terrestrial Herpetofauna Dietary Based Risk Quotients										
NOAEC (ppm)	EECs and RQs									
	Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Small Herbivore Mammals		Small Insectivore Mammals		Small Amphibians	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
150	177.19	1.18	19.69	0.13	207.57	1.38	12.97	0.09	6.15	0.04

Size class not used for dietary risk quotients

3. Single Maximum Application Rates (for Orchard and Agricultural Uses) (the same inputs that were used for T-REX, see above, were used, except that a scaling factor of '1' was used).

Upper Bound Kenaga, Acute Terrestrial Herpetofauna Dose-Based Risk Quotients											
Size Class (grams)	Adjusted LD50	EECs and RQs									
		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Small Herbivore Mammals		Small Insectivore Mammal		Small Amphibians	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
1.4	24.20	4.72	0.20	0.52	0.02	N/A	N/A	N/A	N/A	N/A	N/A
37	24.20	4.64	0.19	0.52	0.02	134.64	5.56	8.41	0.35	0.16	0.01
238	24.20	3.04	0.13	0.34	0.01	20.93	0.86	1.31	0.05	0.11	0.00

Upper Bound Kenaga, Subacute Terrestrial Herpetofauna Dietary Based Risk Quotients										
LC50 (ppm)	EECs and RQs									
	Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Small Herbivore Mammals		Small Insectivore Mammals		Small Amphibians	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
1100	121.50	0.11	13.50	0.01	142.33	0.13	8.90	0.01	4.22	0.00

Size class not used for dietary risk quotients

Upper Bound Kenaga, Chronic Terrestrial Herpetofauna Dietary Based Risk Quotients										
NOAEC (ppm)	EECs and RQs									
	Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Small Herbivore Mammals		Small Insectivore Mammals		Small Amphibians	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
150	121.50	0.81	13.50	0.09	142.33	0.95	8.90	0.06	4.22	0.03

Size class not used for dietary risk quotients

APPENDIX N. Summary of Changes Made in T-REX to Allow for Food Intake Estimations for Herpetofauna (T-HERPS, Version 1.0).

Equation 3 is an iguanid food ingestion rate that was implemented in T-HERPS to allow for estimation of daily food ingestion for herptiles (Nagy, 1987 as cited in U.S. EPA, 1993, equation 3-13, page 3-7).

(EQ 3)

Equation 3 replaces the following equivalent allometric equation that is used in T-REX (v. 1.3.1.) to estimate food ingestion rates of birds, reported by Nagy (1987) and cited in U.S. EPA (1993):

(EQ4)

The iguanid allometric equation presented in U.S. EPA (1993) (EQ 3) is used to estimate the food ingestion rate of herpatofauna. It is assumed that since both reptiles and amphibians are poikilothermic, they have similar caloric requirements.

The current version of T-REX (v. 1.3.1) evaluates exposure from consumption of grasses, plants, insects, seeds, and fruits. However, some herpatofauna consume small mammals and other amphibians. Larger CRLFs may consume up to approximately half of their diet from consumption of larger prey (vertebrates). Therefore, there is a need to evaluate potential exposure from these food sources. There is uncertainty in EECs resulting from consumption of contaminated prey species; therefore, simplifying assumptions were made in T-HERPS that likely result in a conservative estimate of exposure in most cases.

In order to assess potential exposures to CRLF via consumption of a pesticide contained in herpatofauna, concentrations of the pesticide in the prey item must first be estimated. The basis for the herpatofaunal prey item EEC is the oral daily dose for the prey item. Daily dose is calculated using methodology in T-REX (v. 1.3.1) with incorporation of Equation 3. The prey herptile is assumed to eat small insects. Then, assuming the entire prey species is consumed, the daily dose calculated for the prey herptile species (mg/kg-bw) is equal to the dietary exposure concentration (mg/kg-food item = ppm). Therefore, the resulting estimated dietary concentration in small prey amphibians (ppm) can be used in the same manner as other standard food items represented in T-REX (plants, insects, fruits, etc., with estimates of residue levels from the Kenaga nomogram) to estimate potential dose-based exposures (i.e., exposure is a function of residue level in the prey item and food intake of the assessed species).

For the CRLF assessment, the weight of the prey item was based on data for the Pacific treefrog (*Pseudacris regilla*), which has been reported to be a dietary item of the CRLF (CA OEHHA, 1999). The user can alter the weight of the prey amphibian as needed for species specific assessments,

For mammals that serve as prey to the CRLF, an alternative method for derivation of EECs is used. This is because the weight of a small mammal that may be consumed is larger than the estimated daily food intake, resulting in an underestimation of acute exposures (see section 4.3). Two mammalian EECs are calculated by T-HERPS by assuming the prey mammal consumes either (1) short grass or (2) large insects.

Potential exposures from consumption of contaminated mammals is calculated in T-HERPS using the following steps: (1) estimated daily dose for a mammal (mg/kg-bw) of user defined size is calculated using methodology identical to that incorporated into T-REX (version 1.3.1.); (2) the mass of pesticide consumed (mg) by the assessed species is calculated by multiplying the weight of the prey item (kg-bw) by the dose in the prey item (mg/kg-bw); (3) the resulting EEC (mg/kg-bw) for the assessed herpatofaunal species is then calculated as the pesticide mass consumed (mg) / bw of assessed species (kg-bw). Uncertainties associated with this calculation are discussed in Section 4.

For the CRLF, prey mammals were assumed to be 35 grams, which is the high-end weight of a deer mouse (U.S. EPA, 1993).

Water content of potential food items is used to convert the dry weight food intake estimate calculated using Equation 3 to wet weight. Water contents of various potential food items of wildlife are presented in Tables 4-1 and 4-2 of U.S. EPA (1993) and are included in Figures 1 and 2 below. A summary of mean water content values for various broad taxonomic groups is reported below:

Terrestrial Invertebrates:	84%, earthworms
Terrestrial Insects	69%, grasshoppers and crickets
Terrestrial Vertebrates:	67% to 68%, birds and mammals
Terrestrial Plants:	88%, young grasses
Terrestrial Reptiles and Amphibians:	85%, frogs and toads

Given that availability of particular food items will vary across locations and time, the use of the highest mean water content of the taxonomic group (e.g., terrestrial invertebrates) consumed by the assessed species is recommended at this time. For the CRLF, water content of terrestrial-phase insects (69%) is used in the dose-calculation for small terrestrial-phase CRLFs, and a water content of terrestrial herptiles (85%) is used for the dose-calculation for larger terrestrial-phase CRLFs.

Up to three body weights of herpatofauna can be entered. A small, medium, and large value considered representative of the range of body weights of the assessed species may be entered.

For the CRLF, data from Fellars (2007) were used to define the range of terrestrial-phase red-legged frog body weights (Table 2). Frogs were collected from Point Reyes National Seashore and may not be reflective of the range of weights for the species over its entire range. However, these data are considered the best available information for the species.

Table A. Summary Statistics for California Red Legged Frog Size Data (Fellars (2007).

Statistic	Length (cm)	Weight (g)
Number of Observations (N)	545	545
Mean	6.1	37
SD	3.7	43
Minimum	2.5	1.4
Median	4.7	9.9
Maximum	13	238

For the small sized terrestrial phase CRLF, RQs are not calculated for the terrestrial phase herpatofauna or the mammal food item given that a 1.4 gram frog would not likely eat animals that are larger than its body weight. Therefore, RQs in the summary tables of the "print results" worksheet are not calculated for all body weight/food item combinations. The user should consider the body weight of the assessed species and the body weight assumptions of the prey items when evaluating the RQs from T-HERPS.