Risks of Naled Use to Federally Threatened California Red Legged Frog

(*Rana aurora draytonii*)

Pesticide Effects Determination

Environmental Fate and Effects Division
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1.0 Executive Summary

The purpose of this assessment is to evaluate potential direct and indirect effects on the California red-legged frog (*Rana aurora draytonii*) (CRLF) arising from FIFRA regulatory actions regarding naled use on agricultural and non-agricultural sites. In addition, this assessment evaluates whether these actions can be expected to result in modification of the species' designated critical habitat. This assessment was completed in accordance with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Endangered Species Consultation Handbook (USFWS/NMFS, 1998) and procedures outlined in the Agency's Overview Document (U.S. EPA, 2004).

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

Naled is an organophosphate insecticide that acts as a potent cholinesterase (ChE) inhibitor. Numerous application methods are employed for a vast array of naled uses. These uses include crop and non-crop applications, such as: orchard uses, row crop uses, vineyard uses, bedding plants uses, forestry uses, farming uses, residential uses, and many others. Application methods include: aerial spray, ground spray, hand spray, airblast, mist/fogging, and bait stations. Aerial and ground spray methods may use ultra-low volume (ULV) nozzles which suspend the product in the air for a longer duration, in order to intercept flying insects. Naled can be applied indoors, around structures, on agricultural fields, in wetlands, urban areas, as an ambient atmospheric suspension – essentially in any form anywhere, at any time of the year. Thus, there are no areas within the state of California where naled may not be used, so potential exposure to insects and other invertebrates, fish, and other wildlife exists statewide. Certain application methods/usages (aerial spray or ground spray) are expected to result in greater and more extensive (high-end) exposure than others (indoor uses, hand spray around structural perimeters, bait stations) because of higher application rates and more widespread applications. All outdoor uses are considered in this assessment; indoor uses are deemed to have no effect on the CRLF.

Dichlorvos (DDVP) is a major toxic degredate of naled. This assessment estimates risk from exposure to naled, and its degredate DDVP by evaluating "total naled residues of concern" (naled plus DDVP). Because DDVP is also an active ingredient in other pesticide products, and is also a degredate of pesticides other than naled, the presence of DDVP in the environment in monitoring studies cannot be used as evidence of naled use.

The highest reported uses of naled in California from 2002-2005 were: Cotton (representing about 38% of the total applied), Broccoli (~ 12%), Public Health (~ 11%), Strawberry (~10%) and Sugarbeet (6%); all other uses individually comprised less than

5% of total naled applied. During this period (2002-2005), at least 40 counties in California reported naled use; however, since there are no specific labeled use restrictions that would preclude naled use in any county, and given the variety of labeled usese, there is no reason to assume that naled is not used in any of these counties.

Most widespread applications of naled are in (aerial or ground) spray form, typically with ultrafine droplets or as mist or ULV. Degradation/dissipation of naled is rapid following application. Initially much of the parent degrades to another toxic form, DDVP; however, DDVP degrades rapidly as well. Total naled residues of concern degrade rapidly under a wide variety of conditions (and mechanisms), so persistence is unlikely in nearly any naturally-occurring environment. Potential exposure is instead determined largely by spatial and temporal proximity to application sites, with long-range transport an unlikely occurrence.

Atmospheric background levels (samples taken prior to application) of naled have been detected; likely the result of other uses in the area, or drift from a neighboring airshed with recent aerial use. Air samples obtained immediately after local spraying predictably have much higher naled (and DDVP) concentrations. Deposition of naled residues in nearby non-target environments is possible, but rapid dissipation makes it unlikely that re-mobilization of residues would become a factor. However, spray drift re-deposition directly onto water (or other sensitive non-target areas) could present substantial short-term exposure. And while potential exposure to residues (naled and DDVP) resulting from naled use is likely to be relatively brief, it may become magnified and extended during high-use periods (especially if there are multiple uses and/or DDVP applications in the same area). The potential for year-round, multiple, frequent uses indicate the possibility of recurrent high-exposure episodes in certain areas. Thus, there is a 'window of vulnerability' for naled exposure that corresponds with spatial and (especially) temporal proximity to application sites; significant exposure events are probably of short duration (during and soon after application) because of the transitory nature of naled (and DDVP).

The very fine or finer droplet sizes typical of many naled applications (especially aerial) make naled (and DDVP) potentially very mobile in the atmosphere – degradation/dissipation/dilution are the primary limiting factors to off-site atmospheric naled movement. Although moving air masses containing suspended fine naled spray could conceivably transport naled residues far from application sites, because of the non-persistence of naled residues any such exposure is likely limited to 1-2 days following application. Thus, substantial long-range atmospheric transport is unlikely. However, the impact of different uses occurring simultaneously within the same region could potentially result in more extended (local) exposure durations.

Since CRLFs exist within aquatic and terrestrial habitats, exposure of the CRLF, its prey and habitat primary constituent elements to naled are assessed separately for the two habitats. Tier-II aquatic exposure models are used to estimate total naled residues in aquatic habitats resulting from runoff and spray drift for different high-end application rates and uses. Peak model-estimated aquatic environmental concentrations resulting from naled uses range from 0.02 to 32.8 micrograms per liter (µg/L). Most of the aquatic model scenarios (representations of a particular set of meteorological and hydrological conditions for a given geographical area) yielded estimated environmental concentration (EEC) values within similar ranges. EECs were consistently related to amounts applied in a single application rather than total seasonal application; reflecting the transitory nature of this chemical. Greater variations were seen as a result of differences in single application amounts (maximum versus minimum) for a given use than were observed between many of the modeled uses. Where both ground and aerial spray applications were run (*e.g.*, Walnut, Cabbage, Celery, Hops), aerial applications had consistently higher EECs; other application methods (*e.g.*, airblast) yielded somewhat lower EECs than either aerial or ground spray.

The exposure estimates for vulnerable sites are supplemented with analysis of available California surface water monitoring data from U. S. Geological Survey's National Water Quality Assessment (NAWQA) program and the California Department of Pesticide Regulation (CDPR). There were no measurable detections of naled in either the NAWQA or CDPR databases. A single detection of the degredate DDVP was found in the CDPR database; however, since DDVP is used as the primary active ingredient in other products, and can also be formed as a degredate of other registered pesticides, DDVP detection alone cannot be used as evidence of naled use.

To estimate naled residues in on-field dietary items and exposure to the terrestrial-phase CRLF, and its potential prey resulting from a range of naled application rates, the T-REX model was used. Because T-REX does not track total toxic residues, two separate T-REX runs were executed for each application scenario to capture the range in possible naled and DDVP residues: one run was conducted at 100% of the application rate (assuming 100% residue as naled), and one run at 20% of the application rate (representing the maximum possible DDVP residue level from naled). For each run, the resulting EECs were compared to their respective toxicity endpoints to generate estimates of risk (*i.e.*, 100% application run compared to naled toxicity, and the 20% application run compared to DDVP toxicity). The RQ values generated from each model run were not summed but rather used to bound the range of possible RQ values.

The T-HERPS model was used to refine dietary exposure estimates to terrestrial-phase CRLFs, relative to screening exposure estimates based on birds in TREX. The TerrPlant model was used to estimate naled exposures to plants in semi-aquatic and dry habitats, resulting from run-off and spray drift.

The assessment endpoints for the CRLF include direct toxic effects on their survival, reproduction, and growth, as well as indirect effects, such as reduction of the prey base or modification of its habitat. Direct effects to the CRLF in the aquatic habitat are based on toxicity information for freshwater fish, which are used as a surrogate here for aquatic-phase amphibians. In the terrestrial habitat, direct effects are based on toxicity information for birds, which are used here as a surrogate for terrestrial-phase amphibians. Given that the CRLF's prey items and primary constituent elements (PCEs) of designated critical habitat include or are dependant on the availability of freshwater aquatic invertebrates and aquatic plants, toxicity information for these taxonomic groups is also discussed. In the terrestrial habitat, indirect effects to the CRLF and effects to PCEs of designated critical habitat due to depletion of prey are assessed by considering effects to terrestrial insects, small terrestrial mammals, and frogs. Indirect effects and effects to PCEs of critical habitat due to modification of the terrestrial flora are characterized by available data for terrestrial monocots and dicots.

Based on the available data, naled is classified as highly toxic to freshwater fish and very highly toxic to freshwater invertebrates. As fish are used here as a surrogate for aquatic-phase amphibians the classification for freshwater fish is assumed to also apply to amphibians. Naled is classified as slightly toxic to birds on a sub-acute, dietary basis and as moderately to highly toxic on an acute oral basis. As birds are used as surrogates here for reptiles and terrestrial-phase amphibians the classification for birds is assumed to apply to these taxa also. Naled is classified as highly toxic to insects and moderately toxic to mammals, on an acute basis. The results of aquatic plant toxicity testing found naled toxicity to range from 25 ppb a.i. for non-vascular aquatic plants up to 1,800 ppb for vascular aquatic plants. There are no submitted terrestrial plant toxicity data for naled. Plant toxicity data for naled and DDVP in the open literature are limited and related to superficial plant damage.

Risk quotients (RQs), which are ratios of exposure estimates to appropriate toxicity measurement endpoints, are used as estimates of potential risk in this assessment. Acute and chronic RQs are compared to the Agency's levels of concern (LOCs) to identify instances where naled use within the action area has the potential to affect the CRLF via direct toxicity or indirectly based on effects to its food supply (*i.e.*, freshwater invertebrates, algae, fish, frogs, terrestrial invertebrates, and mammals) or habitat (*i.e.*, aquatic plants and terrestrial upland and riparian vegetation), and the potential to affect PCEs of its designated critical habitat. When a RQ is below its respective LOC, the pesticide is determined to have "no effect" and where a RQ exceeds its respective LOC, a potential to cause effects is identified. One or more exceedences is used to draw a conclusion of "may affect." If a determination is made that naled use within the action area "may affect" the CRLF and its designated critical habitat, additional information is considered to refine the potential for exposure and effects, and the best available information is used to distinguish those actions that "may affect, but are not likely to adversely affect" (NLAA) from those actions that are "likely to adversely affect" (LAA) the CRLF and its critical habitat.

Effects determinations for the assessment are summarized below:

- "No Effect" determination is made for the CRLF or its designated critical habitat for indoor uses of naled as they will not result in exposure to the CRLF or its designated critical habitat.
- "May effect but NLAA" for spot treatments (e.g., utility poles, refuse sites, structural perimeters), and bait stations, because while there may be exposure/effects at the sites of application, these sites are discrete and very

limited in extent. No significant impact on CRLFs, their prey, or habitat is expected.

- A "Likely to Adversely Affect" (LAA) determination is made for all other uses due primarily to indirect effects to the aquatic and terrestrial invertebrate prey base, and the mammalian and amphibian prey base. Depending on the use there may be additional direct effects to the aquatic- and terrestrial-phase CRLF. Modification to designated critical habitat from theses uses is also expected primarily due to changes in food resources for juvenile and adult CRLFs (aquatic and terrestrial invertebrates, small mammals, and amphibians). Insignificant effects to terrestrial and aquatic plants of designated critical habitat are expected.

A summary of the risk conclusions and effects determinations for the CRLF and its critical habitat is presented in Tables 1.1 and 1.2, respectively. Further details on the results of the effects determination are included as part of the Risk Description in Section 5.2.

Table 1.1 Effects Determination Summary for Naled - Direct and Indirect Effects to CRLF

Assessment Endpoint	**Effects Determination**	**Basis For Determination**
Aquatic Phase (eggs, larvae, tadpoles, juveniles, and adults)		
Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	**LAA**	Numerous uses are likely to adversely affect CRLF via direct effects. For details, see Table 35 in the main body of the document.
Survival, growth, and reproduction of CRLF individuals via effects to food supply (*i.e.*, freshwater invertebrates, non-vascular plants)	**LAA**	Numerous uses are likely to adversely affect CRLF via effects to food supply, especially freshwater invertebrates. Although naled and DDVP are not long lived in the environment, if there was a massive aquatic invertebrate kill the population would not likely recover in sufficient time for CRLF individuals dependent on these food sources to recover. For details, see Table 35 of indirect effect in the main body of the document.
Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, and/or primary productivity (*i.e.*, aquatic plant community)	**NLAA**	None of the uses are likely to adversely affect CRLF via effects to riparian vegetation. Neither upland nor aquatic vascular plants are expected to be significantly impacted by naled use.
Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	**NE**	Neither upland nor aquatic vascular plants are expected to be significantly impacted by naled use.
Terrestrial Phase		

Assessment Endpoint	Effects Determination	Basis For Determination
(Juveniles and adults)		
Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	**LAA**	Numerous uses are likely to adversely affect the terrestrial phase CRLF via direct effects. For details, see Table 35 in the main body of the doument
Survival, growth, and reproduction of CRLF individuals via effects on prey (*i.e.*, terrestrial invertebrates, small terrestrial mammals and terrestrial phase amphibians)	**LAA**	Numerous uses are likely to adversely affect CRLF via effects on many prey items of the frog's diet.
Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (*i.e.*, riparian vegetation)	**NLAA**	Few to none of the uses are likely to adversely affect CRLF via indirect effects on habitat. Neither aquatic nor terrestrial plants are expected to be significantly impacted by naled use.

Table 1.2. Effects Determination Summary for Naled– PCEs of Designated Critical Habitat for the CRLF

Assessment Endpoint	Effects Determination	Basis For Determination
Aquatic Phase PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)		
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	**NE**	No effects expected
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	**NE**	No effects expected
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	**NE**	No effects expected
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (e.g., algae)	**HM Not Likely**	There are few to no uses that may alter the availability of algal food sources. These uses are not likely to occur in simultaneity with the habitats of the pre-metamorphs and therefore the effect is discountable.

Assessment Endpoint	Effects Determination	Basis For Determination
Terrestrial Phase PCEs (Upland Habitat and Dispersal Habitat)		
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	**HM Not Likely*** (except for direct application to swamps under hot and humid conditions)	Due to lack of effects data for plants, effects cannot be dismissed as No Effect. Toxic effects to plants have been observed but the expected environmental concentrations, combined with the high uncertainty associated with the biological significance of observed phytotoxic results in discountable effects for nearly all uses. However, uses on swamps are an exception. Typical use for swamps is for mosquito control. The same environmental conditions that lead to mosquito outbreaks are also associated with plant damage. Based on information contained in incident reports and label warnings, effects to upland plants are not expected under most conditions, with the exception of hot and humid areas, such as uses in swamps for mosquito control.
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	**HM Not Likely**	Due to lack of effects data for plants, effects cannot be dismissed as No Effect. However, based on information contained in incident reports and label warnings, effects to upland plants are not expected under most conditions, with the exception of hot and humid areas, such as uses in swamps for mosquito control.
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	**HM**	Based on likely effects to small mammals, amphibians, and terrestrial invertebrates reduction in food sources is expected.
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	**NE**	No effects expected.

HM: Habitat Modification

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

When evaluating the significance of this risk assessment's CRLF direct/indirect and designated critical habitat 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. However, given the broad scope of labeled uses, and since there are no areas within the state of California where naled use is restricted, and it is not unlikely that multiple uses for (and applications of) naled will occur simultaneously within the same areas, there are no areas where potential effects from naled use can be categorically discounted. Thus, there is no need to consider such potentially mitigating effects as 'downstream dilution' or 'drift attenuation' (to areas where naled is not used), as no region lies outside the bounds of potential naled use.

Characterizing 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 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 influence the recovery of prey resources is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual frogs and potential modification to critical habitat.

2.0 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 naled on all registered uses. In addition, this assessment evaluates whether these actions can be expected to result in the modification of the species' designated 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 consistent with a settlement agreement in the case *Center for Biological Diversity (CBD) vs. EPA et al*. (Case No. 02-1580-JSW(JL)) settlement entered in the Federal District Court for the Northern District of California on October 20, 2006.

In this assessment, direct and indirect effects to the CRLF and potential modification to its designated critical habitat are evaluated in accordance with the methods described in the Agency's Overview Document (U.S. EPA 2004). Screening level methods include use of standard models such as PRZM-EXAMS, T-REX, TerrPlant, and AgDRIFT all of which are described at length in the Overview Document. Additional refinements include an analysis of California use reporting data, and the use of the T-HERPS model to predict daily dietary intake specifically by the CRLF of naled residues in terrestrial invertebrates and small mammal dietary items. Use of such information is consistent with the methodology described in the Overview Document, which specifies that "the assessment process may, on a case-by-case basis, incorporate additional methods, models, and lines of evidence that EPA finds technically appropriate for risk management objectives" (Section V, page 31 of U.S. EPA 2004).

In accordance with the Overview Document, provisions of the ESA, and the Services' *Endangered Species Consultation Handbook,* the assessment of effects associated with registrations of naled 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 exceedence 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 naled may potentially involve numerous areas throughout the United States and its Territories. However, for the purposes of this assessment, attention will be focused on relevant sections of the action area including those geographic areas associated with locations of the CRLF and its designated critical habitat within the state of California.

As part of the "effects determination," one of the following three conclusions will be reached regarding the potential use of naled in accordance with current labels:

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

Designated critical habitat identifies specific areas that have the physical and biological features, (known as primary constituent elements or PCEs) essential to the conservation of the listed species. The PCEs for CRLFs are aquatic and upland areas where suitable breeding and non-breeding aquatic habitat is located, interspersed with upland foraging and dispersal habitat (Section 2.6).

If the results of initial screening-level assessment methods show no direct or indirect effects (no LOC exceedences) 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 naled 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 CRLF's designated critical habitat, a preliminary "may affect" determination is made for the FIFRA regulatory action regarding naled.

If a determination is made that use of naled 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 naled use sites) and further evaluation of the potential impact of naled on the PCEs is also used to determine whether 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 total naled residues are expected to directly impact living organisms within the action area (defined in Section 2.7), critical habitat analysis for naled 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 naled 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

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

There are a total of nineteen registered products containing naled. This includes one technical product (5481-478). Because this product is used only to formulate naled end use products and is not registered for release to the environment, this action has no effect on the CRLF or its critical habitat and will not be reviewed further. Of the remaining eighteen registrations, thirteen are special local needs (SLNs) and five are Section 3 nationwide registrations; however, of the SLNs only three are registrations for use in California. The other ten SLNs are not biologically relevant to the CRLF or its critical habitat and are not reviewed further. Based on the three SLNs and five Section 3 registrations naled is currently registered for 87 different uses in California, which includes both agricultural and non-agricultural uses.

Table 1 provides a complete listing of the five Section 3 end-use products and the three SLNs registered for use in California. The table includes the formulation, the EPA registration number, methods of application, and any relevant use restrictions.

Table 1. Current Naled FIFRA Product Registrations Relevant for CRLF

FORMULATION	Uses	USE RESTRICTIONS
Naled Technical 5481-478	For formulation of naled insecticide products only.	
Dibrom 8 Emulsive 5481-479 SLNs:	Alfalfa, almond (SLN-CA), beans, peas, broccoli, cabbage, cauliflower, Brussels sprouts, kale, collards, cantaloupes, muskmelons, hops, melons, celery, cotton (SLN-CA), eggplant, peppers, grapes, oranges,	- Do not apply through any type of irrigation system - Do not apply by ground equipment within 25 ft, or by air within 150 feet, or by airblast within 50-100 feet of lakes, reservoirs, rivers, permanent streams,

FORMULATION	Uses	USE RESTRICTIONS
CA000006 CA050011 Prokil Naled Insecticide 10163-46	lemons, grapefruit, tangerines, peaches, safflower (CA), strawberries, sugar beets, summer squash, Swiss chard, walnuts, forest and shade trees, ornamental shrubs and flowering plants, greenhouse, vapor treatment of roses and other ornamental plants, in and around food processing plants, loading docks, cull piles, refuse areas, swamps and pastures, for reduction of livestock pests in confined animal feeding operations, containing dairy and beef cattle, hogs, sheep, or horses. For reduction of pests in rangelands. Residential areas, municipalities, tidal marshes, swamps, woodlands, and agricultural areas. Livestock pastures, including dairy cattle	marshes, or natural ponds; estuaries, and commercial fish ponds, where wind is blowing or gusting toward these areas. - Do not cultivate within 10 feet of the aquatic area so as to allow growth of a vegetative filter strip to alleviate drift and mitigate runoff.
Dibrom Concentrate 5481-480 SLN: CA860005	Telephone or light poles, residential areas, municipalities, tidal marshes, swamps, woodlands, and agricultural areas.	- Spray during periods when the wind speed is between 1 and 15 mph at ground level and when thermal activity is low. - Do not apply when ambient temperature is less than 50 degrees Fahrenheit. - Do not apply when it is raining in the treatment area.
Trumpet EC 5481-481	Residential areas, municipalities, tidal marshes, swamps, woodlands, and agricultural areas.	- Spray during periods when the wind speed is between 1 and 15 mph at ground level and when thermal activity is low. - Do not apply when ambient temperature is less than 50 degrees Fahrenheit. - Do not apply when it is raining in the treatment area.
Fly Killer D 5481-482	In and around dairy barns, livestock barns, pig pens, poultry houses, feed lots, cattle pens, garbage dumps, outside meat packing establishments, pens, docks, ramps, disposal areas and cider mills. In and around food processing plants, loading docks, cull piles and refuse areas and cider mills. Feed lots including dairy cattle, and pastures including woodlands, swamps	-Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark -Do not apply within 8 hours following rainfall or irrigation, or in areas where intense or sustained rainfall is forecasted to occur within 24 hours

Although current registrations of naled allow for use nationwide, this ecological risk assessment and effects determination addresses currently registered uses of naled 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.

Indoor uses of naled will not result in exposure to the CRLF or its designated critical habitat. Therefore, indoor uses[1] of naled are determined to have "*No Effect*" on the CRLF and are not evaluated further in this assessment.

Naled Degredates:
There are several degredates of naled that are found in various amounts under different conditions. The primary degredate of concern, DDVP, is considered to have attributes and effects similar to parent naled, and can account for as much as 20% of applied parent under certain conditions (MRIDs 41310702 and 42445103). Thus, DDVP degredate residue levels are considered along with naled residue levels as 'total naled residues of concern' in this assessment, and model results (exposure estimates) reflect the predicted fate of both naled and DDVP resulting from naled usage. Although DDVP is a major degredate of naled, this assessment does not evaluate the usage or impact of DDVP as a primary active ingredient or as a degredate of other compounds. DDVP that is applied separately as the active ingredient or degredate in other products is considered independent of naled usage, and while DDVP may potentially be used simultaneously (for different purposes) within the same areas as naled, this is not addressed in this risk assessment.

Two other major degredates that form from naled are bromodichloroacetaldehyde (BDCA) and dichloroacetic acid (DCAA). These may constitute as much as 77% and 26% of applied naled, respectively. However, the acute toxicity of these compounds relative to naled and DDVP appears to be much lower and would therefore not add significantly to estimates of acute risk from the use of naled. Additionally, these are not considered likely to add to chronic risk estimates as compared to exposure from naled and DDVP, as they degrade too rapidly to pose long-term exposure risk under likely field conditions. Therefore, neither BDCA nor DCAA are directly considered in this assessment. Other degredates either formed below 10% of applied naled and/or were not considered particularly toxic compared to naled and DDVP and as such are not likely to add significantly to risk estimates based on exposure to naled and DDVP.

Mixtures

The Agency does not routinely include, in its risk assessments, an evaluation of products with 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

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[1] Indoor uses include: greenhouses and vapor treatment, indoor food processing facilities, and structural interiors.

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). However, there are currently no registered mixture products with naled.

Spot Treatments

The effects determination to the CRLF and its designated critical habitat is evaluated here qualitatively for bait and other spot treatments. Spot treatments are not considered quantitatively in this effects determination. Additionally, for reasons described in following paragraphs, registered spot treatments are unlikely to contribute in a meaningful way to effects or risk from other more spatially widespread uses which may intersect in either space or time or both. Such spot treatments include outdoor baits (roach, flies, etc.), hand-spray of structural exterior (*e.g.*, perimeter treatments, loading docks, refuse areas) treatments, or applications to utility poles.

Outdoor baits are contained in small vessels (mixed with sugar solution) and are unlikely to result in direct or indirect exposure to the CRLF. Additionally, while the bait is likely to impact both target insects (flies, roaches, *etc*.) and nontarget insects at the point of treatment, effects to insect populations on a scale large enough to indirectly affect a CRLF or its designated critical habitat are unlikely, and cannot be adequately measured or detected. Thus, a determination of "May Effect" but NLAA is determined for these uses as the effects are discountable.

Applications to utility poles or tree trunks entails applying very small amounts ("6 square inches of material to each station" according to the label) at discrete spots (poles) within large areas; total amounts applied per unit area will be very low. Since both target and nontarget insects will be affected at treatment sites, there is a *May Affect* determination for this use. However, as these uses are unlikely to result in significant impact on overall local insect populations, a *NLAA* decision is appropriate for this use as the effects are discountable. Spot treatments by hand spray along structural perimeters is also very unlikely to result in significant impact to the CRLF, its prey, or its habitat, as this usage does not favor surface runoff, widespread spray drift or substantial volatilization (only a tiny fraction of land area is treated, and at ground level). A *May Affect* determination is assumed for this usage because there will be some adverse effects on insects; but ultimately a *NLAA* determination is made because any adverse effects will be limited to sprayed areas (and overall insect populations should be relatively unaffected). Thus these effects are discountable. Overall contributions from these additional uses should be minor compared to the uses evaluated in this assessment; Agency expects that additional loading within a catchment from these uses (indoor, bait stations, perimeter treatments, etc.) should be minimal, even if such uses are concurrent with more widespread and ubiquitous (modeled) uses. Similarly, the use of DDVP (toxic degredate of concern resulting from naled use) as a separate active ingredient in other (non-naled) products is not considered here, although any impact from DDVP directly resulting from naled use is considered.

Actual maximum allowable amounts applied as spot treatments by hand spray to structural perimeters are not specified on the label(s); although this could be construed as allowing unlimited usage for this purpose (and indeterminate total application rates), it is unlikely that real usage for this purpose will result in significant adverse impact to the CRLF. No quantitative estimation of exposure/effects resulting from this usage can be performed; nevertheless, Agency believes that this usage should result in a *NLAA* determination.

Exposure from nursery uses (bedding plants, foliage plants, outdoor nursery operations) with label instructions to apply 0.9 lbs a.i./A "as needed" cannot be definitively quantified or modeled. However, as most other (similar) uses that include multiple applications at the same rate result in exceedences, and since presumably there can be an almost indefinite number of seasonal applications for this use, a determination of LAA is assumed. Preliminary data suggest that there will be numerous exceedences with as few as 3 applications; unless there is firmer definition as to what constitutes "as needed" it should be assumed that multiple applications will be made.

2.3 Previous Assessments

The most recent major naled registration-related documents produced by the Agency are a 2002 Interim Reregisteration Eligibility Document (IRED) and a 1997 Reregisteration Eligibility Document (RED). The 1997 RED was incorporated into the 2002 IRED. The 2002 IRED cited ecological risks and recommended the registrant adopt measures to reduce ecological risk, beyond what had been implemented since 1999; these included setbacks, buffers, application rate reductions, and application method restrictions for some uses (see 2002 IRED for details). The conclusions are summarized below. For details see the original RED and IRED documents (http://epa.gov/oppsrrd1/REDs/naled_ired.pdf and http://www.epa.gov/pesticides/reregistration/REDs/naled_red.pdf).

Terrestrial Organisms

Birds and mammals will be exposed to naled through the consumption of insect and plant food material containing naled residues and from direct exposure during application. The level of concern (LOC) for acute risk to avian species is exceeded for use on almonds, grapes, cotton, cole crops and seed alfalfa. The chronic avian LOCs are exceeded for almonds, cole, citrus, and seed alfalfa. The LOC for acute and chronic risks to mammals is exceeded for naled use on safflower, grapes, seed alfalfa, citrus, cole crops, and almonds. The LOC for the mosquito use is only exceeded for acute risk to mammals. There is potential for chronic risk to mammals because naled may be applied repeatedly and because some of the use sites (citrus, grapes, and seed alfalfa) are high exposure sites for mammals.

Data from an acute study shows naled to be highly toxic to honey bees. Data from foliar residue studies showed a significant decrease in residual toxicity from 3 to 24 hours post treatment. Acute risk to bees is anticipated from the use of naled on blooming crops. The extent of the hazard will vary with the application rate, weather conditions and the formulation of the specific product.

Because no submitted data were available, terrestrial plants were not considered in previous assessments. In this assessment plants will be considered qualitatively in the absence of definitive quantitative toxicity data.

Aquatic Organisms
The acute and chronic LOC's for freshwater fish were not exceeded for any application rate. However, acute and chronic LOC's were exceeded for freshwater invertebrates. There are also potential risks to marine fish and invertebrates; however they are not of major concern.

Aquatic plants will be exposed to naled through drift and runoff from treated areas (from aerial and ground application) and through direct exposure of wetlands and aquatic habitats from mosquito/black fly control applications. However, the level of concern for risk to aquatic plants were exceeded only for cole crops and almonds.

Endangered Species
Endangered species LOCs for naled are exceeded for birds as follows: acute risks to herbivorous birds from all uses except for mosquito control; acute risks to insectivorous birds from the applications on almonds, cole crops and citrus; chronic risks to herbivorous birds from the uses on almonds, cole crops, citrus and seed alfalfa; and chronic risks to insectivorous birds from the use on almonds. Endangered species LOCs for mammals are exceeded as follows: acute risks to herbivorous and insectivorous mammals from all uses, including mosquito control. In addition, seed-eating mammals are at risk from the almond use. Chronic risks are also a concern for herbivorous and insectivorous mammals from all uses except for mosquito control. The chronic risk exceedence for birds and mammals are based on maximum residues following one application and do not include degradation or dissipation of naled in the environment. In addition, endangered terrestrial invertebrates are expected to be at risk from all uses of naled.

There are also risk concerns for endangered aquatic species. Endangered species acute and chronic LOCs are exceeded for freshwater invertebrates from all uses. Naled's use for mosquito control is only an acute risk to freshwater invertebrates. The acute LOC for endangered freshwater fish is only exceeded for the uses on cole crops, citrus, and almonds and to control horn flies. The acute LOC for endangered estuarine invertebrates is exceeded for the use on cotton.

2.4 Stressor Source and Distribution

The chemical structure of naled is shown in Figure 1. Figure 2 depicts the chemical structure of the degredate Dichlorvos (DDVP).

Figure 1. Naled Chemical Structure

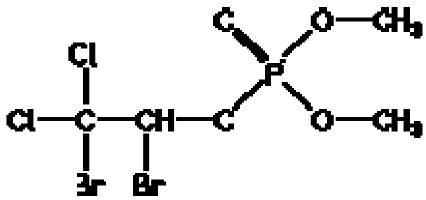
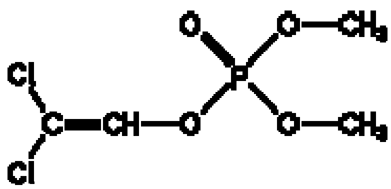


Figure 2. Dichlorvos (DDVP) Chemical Structure



2.4.1 Environmental Fate Assessment

Naled and its degredates are transformed largely by chemical hydrolysis and biodegradation. Volatilization from soils and/or water and spray drift are likely the major mode(s) of transport for naled and its bioactive degredate DDVP from application sites. It is unclear to what extent transport of naled residues in the atmosphere results directly from spray drift or from re-suspension in the atmosphere caused by volatilization of deposited naled. It is likely that a substantial portion of airborne naled results from spray drift, since it is typically applied as ultra-fine droplets or mist with the intent that it remain suspended in the air as long as possible. It is probable that both factors contribute to overall atmospheric transport, so it is best to consider in terms of 'total atmospheric transport' rather than attempting to distinguish between volatilization and spray drift as separate phenomena.

Under terrestrial, aquatic and forestry field conditions naled was observed to dissipate rapidly with half-lives of less than 2 days in all three cases. The dissipation of DDVP was also observed to be similarly rapid. While naled and DDVP are potentially mobile, their degradation is very rapid; thus residues of naled and its degredate DDVP are not likely to leach into ground water.

Substantial amounts of naled residues should be available for runoff to surface waters for only one or two days post-application; rapid hydrolysis and even faster biodegradation help quickly decrease the concentration of naled available for runoff. This should also be the case for naled in the atmosphere; however, there are targeted studies (e.g., Tulare County, CA, 1995) that indicate that measurable background levels of naled can be found even in the absence of local naled use. This is likely due to the widespread and extensive spray usage of naled, often applied aerially as very fine droplets or mist – which can enhance the probability of short-term atmospheric transport within catchments and to neighboring catchments. Thus, it is more likely for naled to remain suspended in the atmosphere, with frequent uses allowing detectable amounts to 'persist' over wide areas; once adhered to soil, vegetation, or water, however, it will likely dissipate and degrade fairly quickly. Generally, though, runoff may be the most likely mode of transport if rain occurs soon after application – otherwise, atmospheric transport is probably dominant. Naled and DDVP appear to have low bioaccumulation potential.

Major routes of possible transport of naled to surface waters are spray drift associated with aerial or ground spray – especially for direct applications to water (swamps, wetlands, saturated areas) for mosquito abatement. Although all labels clearly state "Do not apply directly to water" there are specific exceptions made for certain treatments; in particular, mosquito and fly control uses. For example, *Trumpet EC* insecticide label states "Do not apply directly to water except when used over water as labeled for adult mosquito, blackfly, or housefly control"; *FLY KILLER D* and *DIBROM* labels include "swamps" as treatment sites for "adult mosquito, gnat, and housefly control". Thus, there are uses where direct application to water must be considered.

The Agency has very little monitoring data on the concentrations of naled or its degredates in surface water; a single detection of DDVP (0.242 µg/L) in surface water was reported in the Del Puerto Creek (a tributary to San Joaquin River) in Stanislaus County, CA, 9/2003 (California Department of Pesticide Regulations (CDPR)). It is unknown whether this detection reflected naled use as the source of DDVP. No detections of parent naled were found in any local or national databases; however, it is not known whether any water monitoring studies targeted specifically to naled use have been conducted.

2.4.2 Environmental Transport Assessment

Potential transport mechanisms include pesticide surface water runoff, spray drift, and secondary drift of volatilized or soil-bound residues leading to deposition onto nearby or more distant ecosystems. The magnitude of pesticide transport via secondary drift depends on the pesticide's ability to be mobilized into air and its eventual removal through wet and dry deposition of gases/particles and photochemical reactions in the atmosphere. A number of studies have documented atmospheric transport and redeposition of pesticides from the Central Valley to the Sierra Nevada Mountains (Fellers et al., 2004, Sparling et al., 2001, LeNoir et al., 1999, and McConnell et al., 1998). Prevailing winds blow across the Central Valley eastward to the Sierra Nevada mountains, transporting airborne industrial and agricultural pollutants into Sierra Nevada ecosystems (Fellers et al., 2004, LeNoir et al., 1999, and McConnell et al., 1998). Several sections of critical habitat for the CLRF are located east of the Central Valley. Therefore, physicochemical properties of the pesticide that describe its potential to enter the air from water or soil (e.g., Henry's Law constant and vapor pressure), pesticide use, modeled estimated concentrations in water and air, and available air monitoring data from the Central Valley and the Sierra Nevadas are considered in evaluating the potential for atmospheric transport of naled to locations where it could impact the CRLF or its designated critical habitat.

In general, deposition of drifting or volatilized pesticides is expected to be greatest close to the site of application. Computer models of spray drift (AgDRIFT or AGDISP) are used to determine if the exposures to aquatic and terrestrial organisms are below the Agency's Levels of Concern (LOCs). 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 and AGDISP models) 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. In addition to the use of spray drift models to determine potential off-site transport of pesticides, other factors such as available air monitoring data and the physicochemical properties of the chemical are also considered.

The physical/chemical properties of parent naled are shown in Table 2. Detailed information on the fate and transport properties of naled can be found in Appendix E.

Table 2 Physical/Chemical Properties of Naled

PARAMETER	VALUE	SOURCE(S)
Molecular Weight	381	*EXTOXNET*
Henry's Law Constant	1E-4	Calculated
Vapor Pressure (torr)	2E-3	*EXTOXNET*
Solubility (mg/L)	1 mg/L	*EXTOXNET*
K_{OC}	180	*EXTOXNET*
Hydrolysis (days)	pH 5 = 4 pH 7 = 0.642 pH 9 = 0.067	MRID 40034902, 41354101
Aqueous Photolysis half-life (days)	4.4 - 4.7 days	MRID 41310702, 42445103
Aerobic Aquatic half-life (days)	--	No Valid Data Submitted
Anaerobic Aquatic half-life (days)	4.5	MRID 40618201, 41354102, 42445101
Aerobic Soil half-life (days)	1	MRID 00085408
Soil Photolysis (days)	0.4	MRID 41310701, 42445104

Table 3 gives the relevant physical/chemical properties of the degredate DDVP. Detailed information on the fate and transport properties of DDVP can be found in Appendix F.

Table 3 Physical/Chemical Properties of DDVP

PARAMETER	VALUE	SOURCE(S)
Molecular Weight	221	*EXTOXNET*
Henry's Law Constant	5E-8	
Vapor Pressure (torr)	1.2E-2	
Solubility (mg/L)	15600	
K_d	0.3	MRID 41354105

PARAMETER	VALUE	SOURCE(S)
K_{OC}	37	MRID 41354105
Hydrolysis (days)	pH 5 = 11.6 pH 7 = 5.2 pH 9 = 0.88	MRID 41723101
Aqueous Photolysis half-life (days)	10	MRID 43326601
Aerobic Aquatic half-life (days)	--	No Valid Data Submitted
Anaerobic Aquatic half-life (days)	4.5	MRID 40618201, 41354102, 42445101
Aerobic Soil half-life (days)	0.42	MRID 41723102 (X3 = 1.26 days)
Anaerobic Soil half-life (days)	6.3	MRID 43835701
Soil Photolysis (days)	0.65	MRID 43642501

2.4.3 Pesticidal Mechanism of Action

Naled is an organophosphate insecticide. It is a potent cholinesterase (ChE) inhibitor, causing reversible inhibition of erythrocyte acetylcholinesterase (RBC ChE) as well as plasma butyryl ChE by binding to the active site of the enzyme. Acetylcholinesterase is an enzyme necessary for the degradation of the neurotransmitter acetylcholine (ACh) and subsequent cessation of synaptic transmission. Inhibition of these enzymes results in the accumulation of ACh at cholinergic nerve endings and continual nerve stimulation, resulting in insect death. The naled degredate of concern, dichlorvos (DDVP), has an identical mode of action.

2.4.4 Use Characterization

Analysis of labeled use information is the critical first step in evaluating the federal action. The current label for naled represents the FIFRA regulatory action; therefore, labeled use and application rates specified on the label form the basis of this assessment. The assessment of use information is critical to the development of the action area and selection of appropriate modeling scenarios and inputs.

Certain naled uses are not specifically incorporated into this risk assessment because it is believed that they present minimal capacity to affect the overall risk conclusions (based upon uses with much higher risk likelihood), and individually they are discountable. Specifically, bait uses, indoor uses, hand spray applications, and utility pole applications are not quantified here because either preliminary results from modeling yielded very low environmental exposure concentrations (EECs), or it is understood that total exposure resulting from these uses is likely to be very low and limited in scope. For example, because of very low application “rates” and limited ‘spot’ treatments at designated areas (i.e.: 6 square inches of diluted bait applied only to utility poles linearly at 200-foot intervals; small containers of sugar water and naled bait placed around structural perimeters), bait station applications will almost certainly have minimal effect on total environmental exposure (especially when compared to widespread spray applications that may occur in the same area). Similarly, indoor uses should have little impact on the exterior environment. Hand spray applications require much lower application rates than aerial/ground spray, ULV, and airblast applications, and are used over much smaller areas (as 'spot' treatments); thus their impact and contribution to total pesticide load should be less as well. Any of these uses individually should result in negligible and discountable effect on the CRLF.

Table 4 provides detailed information for each use site on the remaining end-use labels as well as the pertinent SLNs.

Table 4. Maximum Naled Use Rates and Management Practices by Crop Based on Current Labels.
(Generalized Screening Level Portrayal Of Current Label Uses)
Current As Of - 05/31/2007

Use Site	Maximum Application rate	Minimum Retreatment Interval	Maximum No. of Applications	Maximum application rate/season
Alfalfa (SLN CA000006)	1.4 lbs a.i./A	7 days	3	4.2 lbs a.i./A
Almond (ground only)	1.9 lbs a.i./A	---	1 (dormant or dormant delayed, only)	1.9 lbs a.i./A
Beans, lima beans and Peas (dry and succulent form)	Ground: 1.4 lbs a.i./A Aerial (CA only): 0.9 lbs a.i./A	7 days	5	4.2 lbs a.i./A
Broccoli, cabbage (includes tight head varieties of Chinese cabbage), cauliflower, Brussels sprouts, kale, and collards	1.9 lbs a.i./A	7 days	5	9.4 lbs a.i./A
Cantaloupes, muskmelons	0.9 lbs a.i./A	7 days	---	1.9 lbs a.i./A
Hops	0.9 lbs a.i./A	14 days	5	4.7 lbs a.i./A
Melons (grown for seed only)	0.9 lbs a.i./A	7 days	2	1.9 lbs a.i./A
Celery	1.4 lbs a.i./A	7 days	5	7.0 lbs a.i./A
Cotton	0.9 lbs a.i./A	7 days	---	4.7 lbs a.i./A
(Section 3 and SLN CA050011)	1.4 lbs a.i./A	---		
Eggplant, peppers	1.9 lbs a.i./A	7 days	5	5.6 lbs a.i./A
Grapes (ground only)	Airblast (CA only): 0.9 lbs a.i./A	---	---	5.6 lbs a.i./A
Oranges, lemons, grapefruit, tangerines	1.9 lbs a.i./A	7 days	5 (may only apply to aerial application?)	5.6 lbs a.i./A
Peaches (ground only)	1.9 lbs a.i./A	N/A	1 (dormant or delayed	1.9 lbs a.i./A

Use Site	Maximum Application rate	Minimum Retreatment Interval	Maximum No. of Applications	Maximum application rate/season
			dormant)	
Safflower (CA and AZ only)	2.1 lbs a.i./A	7 days	2	4.2 lbs a.i./A
Strawberries	0.9 lbs a.i./A	7 days	5	4.7 lbs a.i./A
Sugar beets	0.9 lbs a.i./A	7 days	5	4.7 lbs a.i./A
Summer squash	1.9 lbs a.i./A	7 days	5	5.6 lbs a.i./A
Swiss chard (ground only with fine mist spray)	0.9 lbs a.i./A	7 days	7	7.0 lbs a.i./A
Walnuts	1.9 lbs a.i./A	7 days	4	3.8 lbs a.i./A
Forest and shade trees, ornamental shrubs and flowering plants (ground only)	0.9 lbs a.i./A	---	---	Repeat as necessary
Greenhouse, vapor treatment of roses and other ornamental plants (hot plate application)	0.06 lb ai/10,000 cu ft. (label incorrect, see letter from RD)	4-7 days	2-4	Repeat as necessary
In and around food processing plants, loading docks, cull piles, refuse areas. (ground only)	0.1 lb a.i.	5-7 days	---	As necessary
Swamps and pastures (Consult State Fish and Game Agency before applying; this application rate will kill shrimp, do not apply to tidal or marsh waters)	Aircraft: 0.23 lb a.i./A Mist or cold fog: 0.25 lb a.i./A	---	---	---
For reduction of livestock pests in confined animal feeding operations (e.g. corrals, holding pens, feedlots) containing dairy and beef cattle, hogs, sheep, or horses	Aerial: 0.2 lb a.i./A Ground: 0.25 lb a.i./A	7 days (may only apply to ground applications?)	---	---
For reduction of pests in rangelands	0.1 lb a.i./A	7 days	---	---
In and around dairy barns, livestock barns, pig pens, poultry houses, feed lots, cattle pens, garbage dumps, outside meat packing establishments, pens, docks, ramps, disposal areas and cider mills (space spray only)	0.9 lbs ai/40 gallons water 0.06 lbs ai/2.5 gallons water	---	---	---
In and around food processing plants, loading docks, cull piles and refuse areas and cider mills	2.25 lbs ai/100 gallons water 0.06 lbs ai/2.5 gallons water	---	---	---

Use Site	Maximum Application rate	Minimum Retreatment Interval	Maximum No. of Applications	Maximum application rate/season
Telephone or light poles (ground hand-spray only) (SLN CA860005)	1.14 lbs a.i./gallon of attractant; 6 inches of material per bait station	2-4 weeks	600 bait stations/ square mile	Repeat spot applications until infestation has been eradicated
Residential areas, municipalities, tidal marshes, swamps, woodlands, and agricultural areas	0.1 lb a.i./A (label rate is incorrect, see letters from RD)	24 hours	---	Dibrom 8 Emulsive: 0.22 lbs a.i./week 10.4 lbs a.i./year (180 oz. = 10.5 lbs a.i./year) Dibrom Concentrate: 0.21 lb a.i./week 10.73 lb a.i./year Trumpet EC Insecticide: 0.17 lb a.i./week 10.73 lb a.i./year More frequent treatments may be made, if determined necessary by a state, tribe, or local health or vector control agency.

Use Site	Maximum Application rate	Minimum Retreatment Interval	Maximum No. of Applications	Maximum application rate/season
Livestock pastures, including dairy cattle	0.1 lb a.i./A	7 days (label interval is incorrect; see letter from RD)	---	0.22 lbs a.i./week 10.4 lbs a.i./year (180 oz. = 10.5 lbs a.i./year) More frequent treatments may be made, if determined necessary by a state, tribe, or local health or vector control agency.
Feed lots including dairy cattle, and pastures including woodlands, swamps (direct application to water is prohibited)	Aircraft: 0.06 lbs a.i./A Mist blower: 0.1 lbs a.i./A	7 days (unless monitoring demonstrates that mosquitoes have re-infested the area)	---	---

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 USDA-NASS[2], Doane (www.doane.com); the full dataset is not provided due to its proprietary nature), and the California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database[3] . 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 naled by county in this California-specific assessment were generated using CDPR PUR data. Usage data are presented for the years 2002 to 2005 to calculate average annual usage statistics by county and crop for naled, including pounds of active ingredient applied and base acres treated. California State law requires that every commercial pesticide application be reported to the state and made available to the public. The summary of naled usage for all use sites, including both agricultural and non-agricultural, is provided below in Table 5 and Table 6.

[2] 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.
[3] 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.

According to 2002-2005 CA PUR data, a total of 743,280 lbs of naled was applied in California during that period. The dominant naled uses in California are represented by use on Cotton (approximately 38% of total naled applied in CA from 2002 to 2005), Broccoli (about 12% of total applied), for Public Health (including flying insect control) (roughly 11% of total), Strawberry (~10%), and Sugarbeet (6%). All other uses individually represented <5% of total. Fresno and King Counties had the highest naled usage for this period (255,250 lbs and 106,305 lbs, respectively), followed by Monterey County (88,629 lbs) and Sutter County (43,010). Lake, El Dorado, Tehama, and San Francisco Counties reported the lowest amounts used, with the latter two counties reporting zero lbs used from 2002-2005.

Table 5. Total Pounds Applied in Each County for the Years 2002-2005

Counties are sorted in descending order by the greatest pounds a.i. applied in 2005.

County	Sum of Total Pounds 2002	Sum of Total Pounds 2003	Sum of Total Pounds 2004	Sum of Total Pounds 2005
Fresno	61,737	75,847	36,749	80,916
Kings	22,173	15,957	20,274	47,901
Monterey	21,886	24,862	24,635	17,246
San Joaquin	7,674	8,177	6,776	13,397
Santa Barbara	2,989	7,636	9,223	12,219
Sutter	10,533	12,973	10,466	9,038
Butte	3,746	1,888	3,613	8,393
Imperial	725	2,217	4,480	5,518
Colusa	2,721	1,670	4,049	5,503
Stanislaus	4,818	5,101	10,730	3,847
Merced	8,911	5,272	3,491	3,445
San Bernardino	6,603	4,560	2,418	2,614
Ventura	930	1,852	1,637	1,992
Santa Cruz	1,268	1,862	2,399	1,896
Riverside	3,775	3,441	900	1,517
Tulare	4,956	1,825	1,793	1,465
San Luis Obispo	873	2,188	750	1,326
Santa Clara	1,323	530	427	1,017
Glenn	236	542	439	840
Shasta	0	0	0	814
Kern	2,215	2,104	1,476	787
Madera	66	1,135	683	595
Los Angeles	582	251	184	484
San Benito	450	407	288	138
Solano	0	0	0	134
Orange	41	23	615	127
Contra Costa	60	91	106	103
San Mateo	29	7	14	63
Sonoma	0	0	48	26
Amador	10	0	0	14
San Diego	462	270	69	1
Tehama	0	0	0	0

County	Sum of Total Pounds 2002	Sum of Total Pounds 2003	Sum of Total Pounds 2004	Sum of Total Pounds 2005
San Francisco	0	0	0	0
Yuba	948	2,386	2,149	0
Alameda	1	3	1,569	0
Yolo	381	90	18	0
Lake	0	0	8	0
El Dorado	0	0	2	0
Calaveras	11	95	0	0
Sacramento	14	19	0	0
Grand Total	173,145	185,279	152,479	223,377

Table 6. Reported Uses and Annual Pounds (a.i.) Applied for 2002-2005 in California

Site Name	Sum of Total Pounds 2002	Sum of Total Pounds 2003	Sum of Total Pounds 2004	Sum of Total Pounds 2005
Cotton	64,439	69,376	36,387	107,437
Public Health	15,409	18,814	18,499	26,600
Broccoli	9,223	26,350	24,315	25,850
Strawberry	13,604	19,213	19,653	19,528
Sugarbeet	10,291	11,605	9,409	13,217
Walnut	8,043	7,637	5,501	7,711
Animal Premise	11,105	10,194	1,984	3,558
Structural Pest Control	1,869	1,040	4,710	3,411
Bean, Dried	4,173	2,063	1,501	3,263
Alfalfa	8,357	2,687	7,623	3,151
Cauliflower	3,753	1,456	2,460	1,651
Cabbage	546	859	1,591	1,497
Landscape Maintenance	5,376	1,422	9,754	1,188
Bean, Succulent	1,183	553	327	1,090
Regulatory Pest Control	535	621	923	598
Collard	594	627	381	592
Almond	686	471	1,092	353
Squash	36	508	0	342
Kale	521	270	273	325
Grape, Wine	462	2,210	81	312
Peas	259	373	278	301
Grape	1,034	395	389	252
N-Grnhs Flower	720	1,725	896	223
Safflower	5,714	2,190	1,970	175
Pepper, Fruiting	619	451	207	148
Bean, Unspecified	167	125	41	130
Brussels Sprout	89	44	41	96

Site Name	Sum of Total Pounds 2002	Sum of Total Pounds 2003	Sum of Total Pounds 2004	Sum of Total Pounds 2005
N-Outdr Flower	0	51	153	69
Pepper, Spice	0	78	192	63
Orange	2,563	271	1,168	55
Rights Of Way	9	0	0	45
Research Commodity	61	71	33	33
Lettuce, Head	1	0	0	24
Cantaloupe	0	227	0	22
N-Outdr Plants In Containers	14	16	80	9
N-Grnhs Plants In Containers	22	7	2	9
N-Grnhs Transplants	2	13	13	8
Squash, Summer	56	77	35	8
Bok Choy	0	0	0	7
N-Outdr Transplants	2	4	5	6
Peach	37	0	22	5
Chinese Cabbage (Nappa)	0	2	0	5
Celery	4	25	29	3
Eggplant	0	1	0	2
Pastureland	2	146	7	2
Vertebrate Control	0	0	0	0
Chicory	0	0	0	0
Sugarbeet (Forage - Fodder)	0	0	334	0
Tangerine	82	10	57	0
Citrus	23	0	50	0
Blackberry	0	0	10	0
Lemon	3	0	2	0
Cattle	48	717	0	0
Squash, Zucchini	0	211	0	0
Swiss Chard	39	37	0	0
Commodity Fumigation	40	32	0	0
Pistachio	0	2	0	0
Lettuce, Leaf	14	0	0	0
Chicken	7	0	0	0
Corn, Human Consumption	34	0	0	0
Cucumber	2	0	0	0
Dairy Equipment	1,074	0	0	0
Poultry	Not reported	0	0	0
Soil Fumigation/Preplant	30	0	0	0
Tangelo	40	0	0	0
Tomato	26	0	0	0
Uncultivated Non-Ag	105	0	0	0
Grand Total	173,145	185,279	152,479	223,377

* a zero indicates a value less than one.

The available data for naled application spans only four years. This does not provide sufficient data for a quantitative evaluation of trends and averages. The data above are presented to give context to the wide variety of uses allowed on the naled label. The appearance of an increase or decrease in naled usage for a particular crop should not be used to make prediction for future use as pest pressures change not only year to year, but even season to season. These data may be used to characterize risk.

2.5 Assessed Species

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

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

2.5.1 Distribution

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

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

The distribution of CRLFs within California is addressed in this assessment using four categories of location including recovery units, core areas, designated critical habitat, and known occurrences of the CRLF reported in the California Natural Diversity Database (CNDDB) that are not included within core areas and/or designated critical habitat (see Figure 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.

Recovery Units

Eight recovery units have been established by USFWS for the CRLF. These areas are considered essential to the recovery of the species, and the status of the CRLF "may be considered within the smaller scale of the recovery units, as opposed to the statewide range" (USFWS 2002). Recovery units reflect areas with similar conservation needs and population statuses, and therefore, similar recovery goals. The eight units described for the CRLF are delineated by watershed boundaries defined by US Geological Survey hydrologic units and are limited to the elevational maximum for the species of 1,500 m above sea level. The eight recovery units for the CRLF are listed in Table 7 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 Figure 3). Table 7 summarizes the geographical relationship among recovery units, core areas, and designated critical habitat. The core areas, which are distributed throughout portions of the historic and current range of the species, represent areas that allow for long-term viability of existing populations and reestablishment of populations within historic range. These areas were selected because they: 1) contain existing viable populations; or 2) they contribute to the connectivity of other habitat areas (USFWS 2002). Core area protection and enhancement are vital for maintenance and expansion of the CRLF's distribution and population throughout its range.

For purposes of this assessment, designated critical habitat, currently occupied (post-1985) core areas, and additional known occurrences of the CRLF from the CNDDB are considered. Each type of locational information is evaluated within the broader context of recovery units. For example, if no labeled uses of naled 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 Table 7 (currently occupied core areas are bolded). While core areas are considered essential for recovery of the CRLF, core areas are not federally-designated critical habitat, although designated critical habitat is generally contained within these core recovery areas. It should be noted, however, that several critical habitat units are located outside of the core areas, but within the recovery units. The focus of this assessment is currently occupied core areas, designated critical habitat, and other known CNDDB CRLF occurrences within the recovery units. Federally-designated critical habitat for the CRLF is further explained in Section 2.6.

Table 7. California Red-legged Frog Recovery Units with Overlapping Core Areas and Designated Critical Habitat

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

Recovery Unit [1] (Figure 2.a)	Core Areas [2,7] (Figure 2.a)	Critical Habitat Units [3]	Currently Occupied (post-1985) [4]	Historically Occupied [4]
South and East San Francisco Bay (4)	--	CCS-1A[6]		
	East San Francisco Bay (partial) (16)	ALA-1A, ALA-1B, STC-1B	✓	
	--	STC-1A[6]		
	South San Francisco Bay (partial) (18)	SNM-1A	✓	
Central Coast (5)	**South San Francisco Bay (partial) (18)**	SNM-1A, SNM-2C, SCZ-1	✓	
	Watsonville Slough- Elkhorn Slough (partial) (19)	SCZ-2 [5]	✓	
	Carmel River-Santa Lucia (20)	MNT-2	✓	
	Estero Bay (22)	--	✓	
	--	SLO-8[6]		
	Arroyo Grande Creek (23)	--	✓	
	Santa Maria River-Santa Ynez River (24)	--	✓	
Diablo Range and Salinas Valley (6)	**East San Francisco Bay (partial) (16)**	MER-1A-B, STC-1B	✓	
	--	SNB-1[6], SNB-2[6]		
	Santa Clara Valley (17)	--	✓	
	Watsonville Slough- Elkhorn Slough (partial)(19)	MNT-1	✓	
	Carmel River-Santa Lucia (partial)(20)	--	✓	
	Gablan Range (21)	SNB-3	✓	
	Estrella River (28)	SLO-1A-B	✓	
Northern Transverse Ranges and Tehachapi Mountains (7)	--	SLO-8[6]		
	Santa Maria River-Santa Ynez River (24)	STB-4, STB-5, STB-7	✓	
	Sisquoc River (25)	STB-1, STB-3	✓	
	Ventura River-Santa Clara River (26)	VEN-1, VEN-2, VEN-3	✓	
	--	LOS-1[6]		
Southern Transverse and Peninsular Ranges (8)	**Santa Monica Bay-Ventura Coastal Streams (27)**	--	✓	
	San Gabriel Mountain (29)	--		✓
	Forks of the Mojave (30)	--		✓
	Santa Ana Mountain (31)	--		✓
	Santa Rosa Plateau (32)	--	✓	
	San Luis Rey (33)	--		✓
	Sweetwater (34)	--		✓
	Laguna Mountain (35)	--		✓

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

Recovery Unit [1] (Figure 2.a)	**Core Areas [2,7] (Figure 2.a)**	**Critical Habitat Units [3]**	**Currently Occupied (post-1985) [4]**	**Historically Occupied [4]**
(USFWS 2002). [6] Critical habitat units that are outside of core areas, but within recovery units. [7] Currently occupied core areas that are included in this effects determination are bolded.				

Recovery Units

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

Core Areas

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

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

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

Figure 3. Recovery Unit, Core Area, Critical Habitat, and Occurrence Designations for CRLF

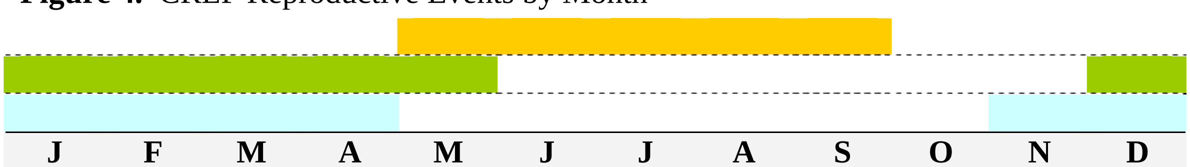
Other Known Occurrences from the CNDBB

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 Table 7.

"Critical habitat" is defined in the ESA as the geographic area occupied by the species at the time of the listing where the physical and biological features necessary for the conservation of the species exist, and there is a need for special management to protect the listed species. It may also include areas outside the occupied area at the time of listing if such areas are "essential to the conservation of the species". All designated critical habitat for the CRLF was occupied at the time of listing. Critical habitat receives protection under Section 7 of the ESA through prohibition against destruction or adverse modification with regard to actions carried out, funded, or authorized by a federal Agency. Section 7 requires consultation on federal actions that are likely to result in the destruction or adverse modification of critical habitat.

To be included in a critical habitat designation, the habitat must be 'essential to the conservation of the species.' Critical habitat designations identify, to the extent known using the best scientific and commercial data available, habitat areas that provide essential life cycle needs of the species or areas that contain certain primary constituent elements (PCEs) (as defined in 50 CFR 414.12(b)). PCEs include, but are not limited to, space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing (or development) of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. The designated critical habitat areas for the CRLF are considered to have the following PCEs that justify critical habitat designation:

- Breeding aquatic habitat;
- Non-breeding aquatic habitat;
- Upland habitat; and

- Dispersal habitat.

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

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

USFWS has established adverse modification standards for designated critical habitat (USFWS 2006). Activities that may destroy or adversely modify critical habitat are those that alter the PCEs and jeopardize the continued existence of the species. Evaluation of actions related to use of naled 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 naled is expected to directly impact living organisms within the action area, critical habitat analysis for naled 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 naled 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 naled may be expected to have on the environment, the exposure levels to naled that are associated with those effects, and the best available information concerning the use of naled 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 naled. An analysis of labeled uses and review of available product labels was completed. Several of the currently labeled uses are special local needs (SLN) uses or are restricted to specific states and are excluded from this assessment. In addition, a distinction has been made between food use crops and those that are non-food/non-agricultural uses. For those uses relevant to the CRLF, the analysis indicates that, for naled, the following agricultural uses are considered as part of the federal action evaluated in this assessment:

- Beans
- almonds
- peas
- cabbage
- broccoli
- cauliflower
- Brussels sprouts
- collards
- kale
- cantaloupes
- muskmelons
- hops
- melons

- celery
- cotton
- eggplant
- peppers
- grapes
- oranges
- lemon
- grapefruit
- tangerine
- peaches
- safflower
- strawberries
- sugar beets
- summer squash
- Swiss chard
- walnuts

In addition, the following non-food and non-agricultural uses are considered:

- forestry
- bedding plant
- foliage plants
- outdoor nursery operations
- areas outside of buildings
- forestry
- impervious surfaces
- parks
- rangeland
- recreational fields
- residential (including lawns)
- wetlands/stagnant water/saturated areas/vegetation in and around water bodies

The following indoor (and other) uses are not quantitatively assessed in this assessment given that these uses are not expected to result in exposure to the CRLF: commercial/institutional/industrial premises/equipment; household/domestic dwellings; indoor premises; and baiting refuse/solid waste sites.

Following a determination of the assessed uses, an evaluation of the potential "footprint" of naled use patterns is determined. This "footprint" represents the initial area of concern, based on an analysis of available land cover data for the state of California. The initial area of concern is defined as all land cover types and the stream reaches within the land cover areas that represent the labeled uses described above. A map representing all the land cover types that make up the initial area of concern for naled is presented in Figure 5.

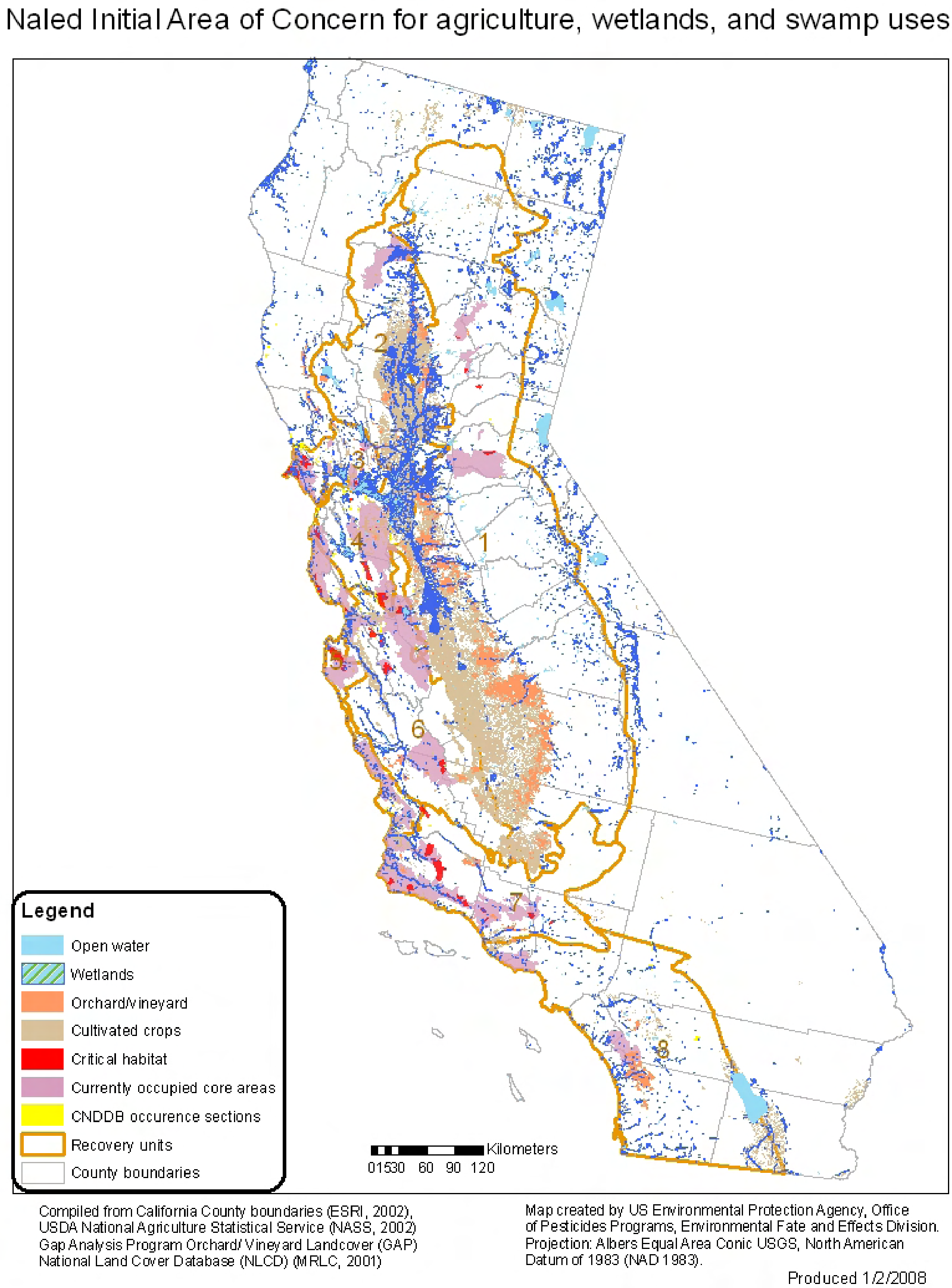


Figure 5. Initial area of concern, or "footprint" of potential use, for naled

Once the initial area of concern is defined, the next step is to compare the extent of that area with the results of the screening level risk assessment. The screening level risk assessment will define which taxa, if any, are predicted to be exposed at concentrations above the Agency's Levels of Concern (LOC). The screening level assessment includes an evaluation of the environmental fate properties of naled to determine which routes of transport are likely to have an impact on the CRLF.

Atmospheric transport is likely a major transportation pathway for naled and the toxic degredate of concern dichlorvos (DDVP), especially for airborne application methods (spray, mist, ULV, airblast) that constitute the majority of naled applications. Runoff in surface water is possible, specifically if rainfall occurs within 2 days of application. Leaching to groundwater is unlikely – although DDVP is potentially mobile in soil, it is insufficiently persistent to cause widespread or long-term groundwater contamination in most conditions. In all cases, rapid dissipation/degradation of both naled and DDVP make it likely that any potential exposures (air, soil, water) will be short-lived.

Subsequent to defining the action area, an evaluation of usage information was conducted to determine areas where use of naled may impact the CRLF. This analysis is used to characterize where predicted exposures are most likely to occur but does not preclude use in other portions of the action area. A more detailed review of the county-level use information was also completed, as described above.

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."[4] 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.,. water bodies, riparian vegetation, and upland and dispersal habitats), the migration pathways of naled (e.g., runoff, spray drift, etc.), and the routes by which ecological receptors are exposed to naled-related contamination (e.g., direct contact, etc).

2.8.1 Assessment Endpoints for the CRLF

Assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF, as well as indirect effects, such as reduction of the prey base or modification of its habitat. In addition, potential modification of critical habitat is assessed by evaluating potential effects to PCEs, which are components of the habitat areas that provide essential life cycle needs of the CRLF. Each assessment endpoint requires one or more "measures of ecological effect," defined as changes in the attributes of an assessment endpoint or changes in a surrogate entity or attribute in response to exposure to a pesticide. Specific measures of ecological effect are generally

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

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 naled is provided in Table 8.

It should be noted here that the common naled degredate, DDVP, is toxic. Therefore, it is necessary to capture the potential for risk from exposure to this compound. Because DDVP is also a registered pesticide (PC Code: 084001) toxicity studies are available for inclusion in the assessment. To adequately capture the risk from naled, a rapidly degrading compound, the more toxic of the two pesticides were selected for each specific measurement endpoint. For example, naled is more toxic to fish while DDVP is more toxic to birds. Because the organism will potentially be exposed to both of these chemicals, it is necessary to measure risk by comparing the modeled exposure values to the most sensitive endpoint. The more toxic chemical was identified by comparing the toxicity values with molar units.

Table 8. Summary of Assessment Endpoints and Measures of Ecological Effects for Direct and Indirect Effects of Naled on the California Red-legged Frog

Assessment Endpoint	Measures of Ecological Effects[5]	
Aquatic-Phase CRLF (Eggs, larvae, juveniles, and adults)[a]		
Direct Effects		
1. Survival, growth, and reproduction of CRLF	1a. Amphibian acute LC_{50} (ECOTOX) or most sensitive fish acute LC_{50} (guideline or ECOTOX) if no suitable amphibian data are available 1b. Amphibian chronic NOAEC (ECOTOX) or most sensitive fish chronic NOAEC (guideline or ECOTOX) 1c. Amphibian early-life stage data (ECOTOX) or most sensitive fish early-life stage NOAEC (guideline or ECOTOX)	1a. Naled, Lake trout 96-hr LC50 =92 ppb 1b. Naled, Fathead minnow 35 Day NOAEC=2.9 ppb
Indirect Effects and Critical Habitat Effects		
2. Survival, growth, and reproduction of CRLF individuals via indirect effects on aquatic prey food supply (*i.e.*, fish, freshwater invertebrates, non-	2a. Most sensitive fish, aquatic invertebrate, and aquatic plant EC_{50} or LC_{50} (guideline or ECOTOX) 2b. Most sensitive aquatic invertebrate and fish chronic NOAEC (guideline or ECOTOX)	2a. Naled, Lake trout 96-hr LC50 =92 ppb DDVP, Daphnia pulex 48-hr LC50=0.066ppb Naled, Freshwater Diatom

[5] All registrant-submitted and open literature toxicity data reviewed for this assessment are included in Appendix A.

Assessment Endpoint	Measures of Ecological Effects[5]	
vascular plants)		(Navicula pelliculosa) 5 D EC50=25 ppb 2b. Naled, Fathead minnow 35 D NOAEC=2.9ppb Naled, Daphnia magna 21 D NOAEC = 0.045ppb Naled Estimated NOAEC (using freshwater ACR) =0.00017 ppb
3. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, food supply, and/or primary productivity (*i.e.*, aquatic plant community)	3a. Vascular plant acute EC_{50} (duckweed guideline test or ECOTOX vascular plant) 3b. Non-vascular plant acute EC_{50} (freshwater algae or diatom, or ECOTOX non-vascular)	3a. Naled, Duckweed 14 D EC50 >1800 ppb 3b. Naled, Freshwater Diatom (Navicula pelliculosa) 5 D EC50=25 ppb
4. Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation	4a. Distribution of EC_{25} values for monocots (seedling emergence, vegetative vigor, or ECOTOX) 4b. Distribution of EC_{25} values for dicots (seedling emergence, vegetative vigor, or ECOTOX)	4a. No data available 4b. No data available
Terrestrial-Phase CRLF (Juveniles and adults)		
Direct Effects		
5. Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	5a. Most sensitive bird[b] or terrestrial-phase amphibian acute LC_{50} or LD_{50} (guideline or ECOTOX) 5b. Most sensitive bird[b] or terrestrial-phase amphibian chronic NOAEC (guideline or ECOTOX)	5a. Naled, Canada goose, 14 D acute oral LD50=36.9 mg/kg-bw DDVP, Mallard duck 14 D acute oral LD50= 7.8 mg/kg Naled, Japanese quail, 8 Day dietary LC50=1327ppm DDVP, Japanese quail 8D dietary LC50=298ppm 5b. Naled, Mallard duck NOAEC=266 ppm DDVP, Mallard duck 22 WK NOAEC=15 ppm
Indirect Effects and Critical Habitat Effects		
6. Survival, growth, and reproduction of CRLF individuals via effects on terrestrial prey (*i.e.*,terrestrial invertebrates, small	6a. Most sensitive terrestrial invertebrate and vertebrate acute EC_{50} or LC_{50} (guideline or ECOTOX)[c] 6b. Most sensitive terrestrial invertebrate and vertebrate chronic NOAEC (guideline or ECOTOX)	6a. Naled, Rat acute-oral LD50=92 mg/kg Naled, Honey bee 48-hr LD50=0.48 µg/bee or 3.75 ppm DDVP, Rat acute-oral

Assessment Endpoint	Measures of Ecological Effects[5]	
mammals , and frogs)		LD50=56mg/kg-bw 6b. Naled, Rat chronic NOAEL=6 mg/kg DDVP, Rat chronic NOAEL=20 mg/kg-bw
7. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (*i.e.,* riparian and upland vegetation)	7a. Distribution of EC_{25} for monocots (seedling emergence, vegetative vigor, or ECOTOX 7b. Distribution of EC_{25} for dicots (seedling emergence, vegetative vigor, or ECOTOX)	No data available

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.

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 naled that may alter the PCEs of the CRLF's critical habitat. PCEs for the CRLF were previously described in Section 2.6. Actions that may modify critical habitat are those that alter the PCEs. 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 naled effects data are available.

Assessment endpoints and measures of ecological effect selected to characterize potential modification to designated critical habitat associated with exposure to naled are provided in Table 9. Adverse modification to the critical habitat of the CRLF includes the following, as specified by USFWS (2006) and previously discussed in Section 2.6:

1. Alteration of water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs.
2. Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.
3. Significant increase in sediment deposition within the stream channel or pond or disturbance of upland foraging and dispersal habitat.
4. Significant alteration of channel/pond morphology or geometry.
5. Elimination of upland foraging and/or aestivating habitat, as well as dispersal habitat.

6. Introduction, spread, or augmentation of non-native aquatic species in stream segments or ponds used by the CRLF.
7. Alteration or elimination of the CRLF's food sources or prey base.

Measures of such possible effects by labeled use of naled on critical habitat of the CRLF are described in Table 9. 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 9. Summary of Assessment Endpoints and Measures of Ecological Effect for Primary Constituent Elements of Designated Critical Habitat

Assessment Endpoint	**Measures of Ecological Effect**[6]	
	Aquatic Phase PCEs *(Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)*	
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	a. Most sensitive aquatic plant EC_{50} (guideline or ECOTOX) b. Distribution of EC_{25} values for terrestrial monocots (seedling emergence, vegetative vigor, or ECOTOX) c. Distribution of EC_{25} values for terrestrial dicots (seedling emergence, vegetative vigor, or ECOTOX)	a. Naled, Freshwater Diatom (Navicula pelliculosa) 5 D EC50=25 ppb b. No data available c. No data available
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.[7]	a. Most sensitive EC_{50} values for aquatic plants (guideline or ECOTOX) b. Distribution of EC_{25} values for terrestrial monocots (seedling emergence or vegetative vigor, or ECOTOX) c. Distribution of EC_{25} values for terrestrial dicots (seedling emergence, vegetative vigor, or ECOTOX)	a. Naled, Freshwater Diatom (Navicula pelliculosa) 5 D EC50=25 ppb b. No data available c. No data available
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	a. Most sensitive EC_{50} or LC_{50} values for fish or aquatic-phase amphibians and aquatic invertebrates (guideline or ECOTOX) b. Most sensitive NOAEC values for fish or aquatic-phase amphibians and aquatic invertebrates (guideline or ECOTOX)	2a. Naled, Lake trout 96-hr LC50 =92 ppb DDVP, Daphnia pulex 48-hr LC50=0.066ppb Naled, Freshwater Diatom (Navicula pelliculosa) 5 D EC50=25 ppb 2b. Naled, Fathead minnow 35 D NOAEC=2.9ppb Naled, Daphnia magna 21 D NOAEC = 0.045ppb Naled Estimated NOAEC (using freshwater ACR) =0.00017 ppb

[8] All toxicity data reviewed for this assessment are included in Appendix A

[9] Physico-chemical water quality parameters such as salinity, pH, and hardness are not evaluated because these processes are not biologically mediated and, therefore, are not relevant to the endpoints included in this assessment.

Assessment Endpoint	Measures of Ecological Effect[6]	
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae)	a. Most sensitive aquatic plant EC_{50} (guideline or ECOTOX)	a. Naled, Freshwater Diatom (Navicula pelliculosa) 5 D EC50=25 ppb
Terrestrial Phase PCEs *(Upland Habitat and Dispersal Habitat)*		
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or drip line surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	a. Distribution of EC_{25} values for monocots (seedling emergence, vegetative vigor, or ECOTOX) b. Distribution of EC_{25} values for dicots (seedling emergence, vegetative vigor, or ECOTOX) c. Most sensitive food source acute EC_{50}/LC_{50} and NOAEC values for terrestrial vertebrates (mammals) and invertebrates, birds or terrestrial-phase amphibians, and freshwater fish.	a. No data available b. No data available
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal		
Reduction and/or modification of food sources for terrestrial phase juveniles and adults		
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.		

2.9 Conceptual Model

2.9.1 Risk Hypotheses

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

- Labeled uses of naled within the action area may directly affect the CRLF by causing mortality or by adversely affecting growth or fecundity;
- Labeled uses of naled within the action area may indirectly affect the CRLF by reducing or changing the composition of food supply;

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

2.9.2 Diagram

The conceptual model is a graphic representation of the structure of the risk assessment. It specifies the stressor (naled), release mechanisms, biological receptor types, and effects endpoints of potential concern. The conceptual models for aquatic and terrestrial phases of the CRLF are shown in Figure 6 and Figure 7, and the conceptual models for the aquatic and terrestrial PCE components of critical habitat are shown in Figure 8 and Figure 9. 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.

Figure 6 is a visual depiction of the Conceptual Model (CM) for the CRLF aquatic phase, and Figure 8 represents the aquatic component of the CRLF habitat. The most likely exposure routes are through spray drift/volatilization (limited-range atmospheric transport) and runoff/erosion (surface transport). Infiltration into the soil is also possible, but rapid degradation of naled (and the major toxic degredate of concern, DDVP) make it unlikely that significant amounts of the chemical(s) will enter groundwater. Similarly, long-range atmospheric transport would appear possible because of several of the application methods (aerial spraying of very fine droplets, ULV applications, airblast, mist), but the non-persistence of naled and DDVP greatly decrease the likelihood of real long-range transport. Indeed, all possible transport mechanisms are effectively limited by rapid degradation/dissipation; however, multitudinous spray uses (crop and non-crop) and the extent of land areas where spraying may occur, create conditions where naled/DDVP can be detected in ambient atmospheric conditions – but this is more likely the result of widespread spraying and movement of air masses than atmospheric persistence. The same may be said for transport through runoff, but in this case the potentially impacted areas are limited to those regions near where applications are made (assuming that any air-transported material from distant application sites will be greatly 'diluted' by mixing with intervening air masses, such that re-deposited chemical concentrations will be very low). Thus, local atmospheric transport (spray drift/volatilization) is probably the dominant exposure route, followed by runoff; other potential exposure routes should be fairly negligible. The one notable exception, though, relates to spray applications directly to water bodies. Although all labeled uses prohibit direct application to open water bodies, there are specific uses (particularly, mosquito and fly control) where naled may be applied to "swamps, stagnant water bodies, marshy areas, and vegetation alongside surface waters." In these cases some naled is more likely to end up in surface water – but even for these uses it is indicated that application should not be performed directly onto open water bodies (presumably vegetated saturated areas are acceptable though). Nevertheless, these areas may also serve as habitat for the CRLF aquatic phase.

Figure 7 depicts the CM for the CRLF terrestrial phase, and Figure 9 represents the CM for the terrestrial component of the CRLF habitat. Likely exposure routes are similar to those for the aquatic phase, for the same reasons as stated above. In this case, however, the dominant terrestrial exposure route is likely to be direct application on-site; it is expected that the highest terrestrial concentrations will be in those areas where naled is applied directly to or above the land surface. Additionally, exposure can occur during and immediately after application, so there is less attenuation than would result from the time-lag required for conveyance to an off-site water body (that is, no degradation prior to potential exposure – exposure can occur at 0 hours after application). This is highly significant when assessing chemicals with low persistence.

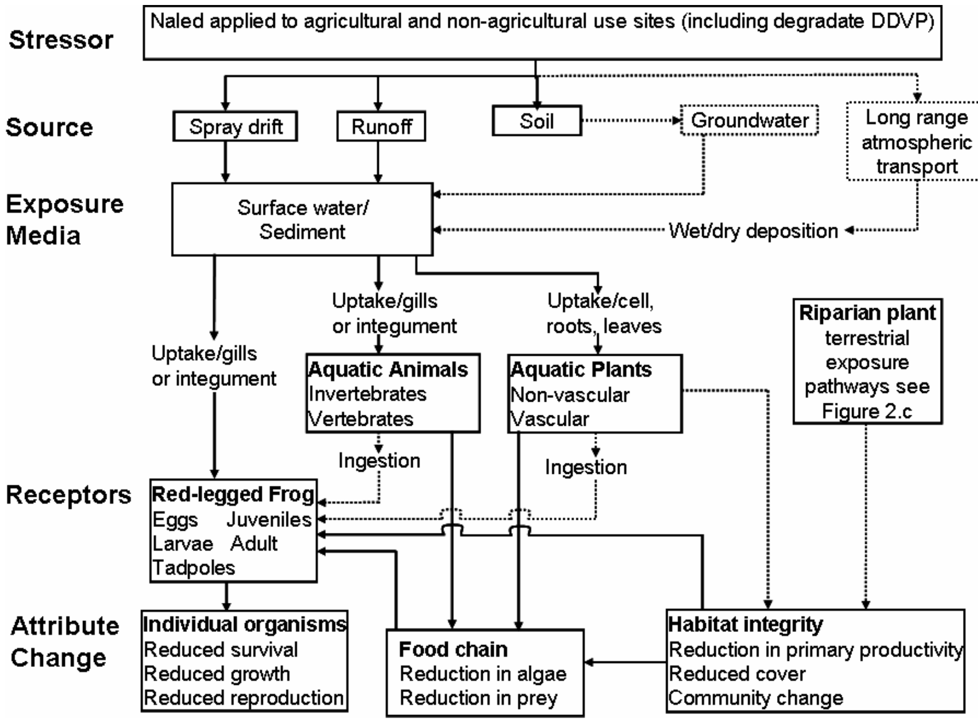

Figure 6. Conceptual Model for Pesticide Effects on Aquatic Phase of the Red-Legged Frog

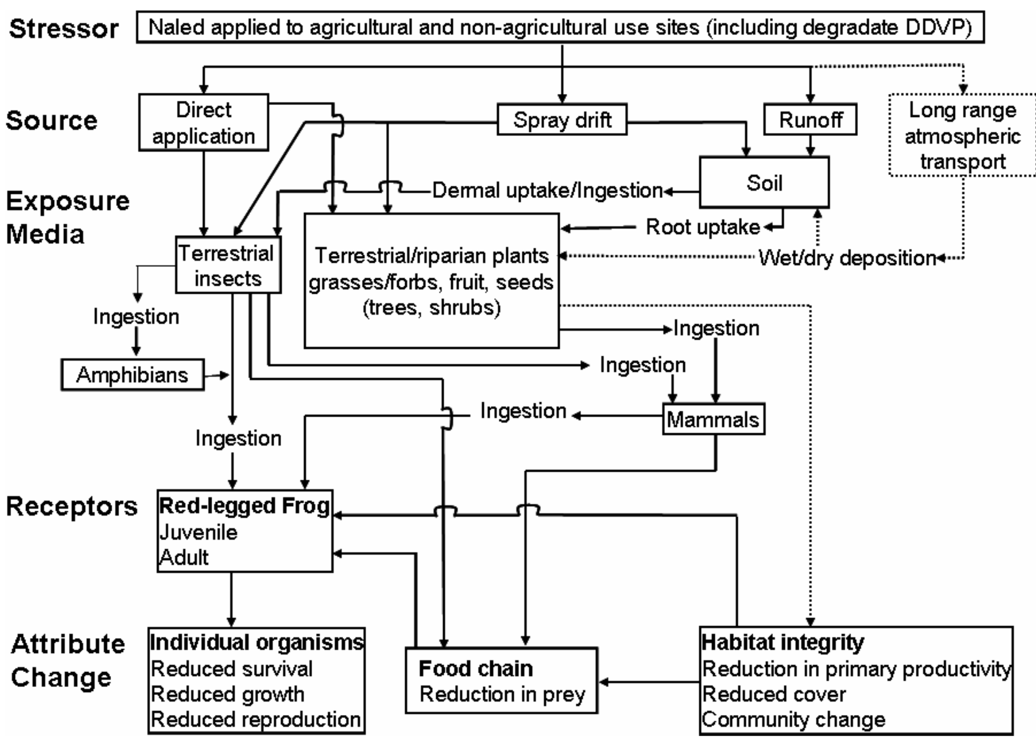

Figure 7. Conceptual Model for Pesticide Effects on Terrestrial Phase of Red-Legged Frog

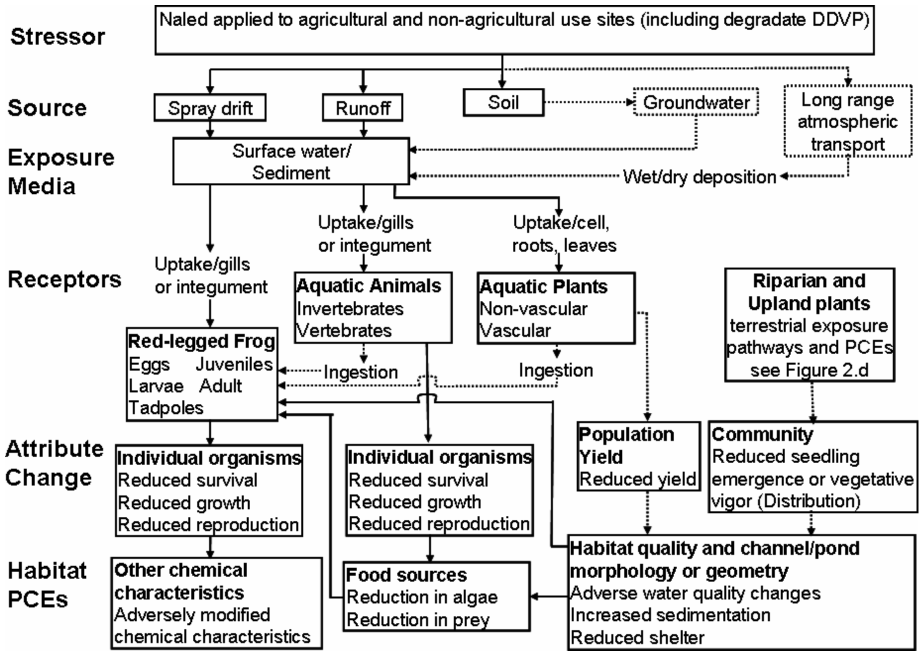

Figure 8. Conceptual Model for Pesticide Effects on Aquatic Components of Red-Legged Frog Critical Habitat

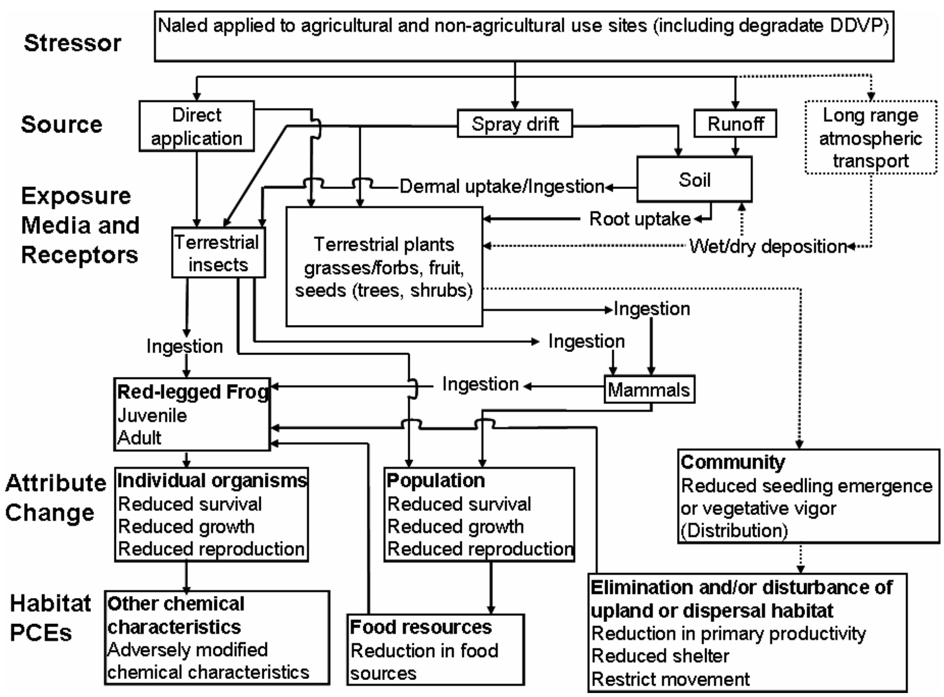

Figure 9. Conceptual Model for Pesticide Effects on Terrestrial Components of Red-Legged Frog Critical Habitat

2.10 Analysis Plan

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

There are a number of labeled uses for naled not explicitly considered in this assessment. There is no exposure pathway from indoor applications to the CRLF or its habitat and therefore, indoor applications are determined to have **No Effect** on the CRLF. Agency believes additional effects from other potential simultaneous uses occurring within the same watershed – such as outdoor baits (Roach, Flies, etc.), hand-spray structural exterior treatments, or applications to utility poles – that may be concurrent with widespread aerial/ground spray operations will add negligibly to overall CRLF exposure and risk. Outdoor baits are contained in small vessels (mixed with sugar solution) and are unlikely to result in significant exposure to the CRLF; a determination of *NLAA* is assumed for this use. Applications to utility poles or other inanimate objects entails applying very small amounts ("6 square inches of material to each station" according to the label) at discrete spots (poles) within large areas; total amounts applied per unit area will be very low, so a *NLAA* determination is appropriate for this use. Spot treatments by hand spray along structural perimeters is also very unlikely to result in significant impact to the CRLF, its prey, or its habitat, as this usage does not favor surface runoff, widespread spray drift or substantial volatilization (only a tiny fraction of land area is treated, and at ground level); a *NLAA* determination is made for this use. Overall contributions from these additional uses should be minor compared to the uses evaluated in this assessment; Agency expects that additional loading within a catchment from these uses (indoor, bait stations, perimeter treatments, etc.) should be minimal, even if such uses are concurrent with more widespread and ubiquitous (modeled) uses. Similarly, the use of DDVP (toxic degredate of concern resulting from naled use) as a separate active ingredient in other (non-naled) products is not considered here, although any impact from DDVP specifically associated with naled use is considered.

Exposure from nursery uses (bedding plants, foliage plants, outdoor nursery operations) with label instructions to apply 0.9 lbs a.i./A "as needed" cannot be definitively quantified or modeled due to vagueness of label language; a determination of LAA is made because multiple applications (>3 per season) will result in several exceedences.

2.10.1 Exposure Analysis

Direct effects to the aquatic phase CRLF will be assessed by comparing modeled surface water exposure concentrations of naled and DDVP to acute and chronic (early life stage hatching success and growth) effect concentrations for aquatic phase amphibians (surrogate freshwater fish) from laboratory studies (see the Effects Analysis section below). Effects to aquatic dietary food resources (fish, aquatic invertebrates, algae) of the aquatic phase CRLF or effects to aquatic habitat that support the CRLF will also be assessed by comparing modeled surface water exposure concentrations of total naled residues to laboratory established effect levels appropriate for the taxa.

Surface water concentrations will be estimated using appropriate EFED aquatic exposure models. Considering the wide variety of uses for naled, and the different application methods (aerial spray, ground spray, hand spray, airblast, ULV, baiting) and settings (application allowed in one form or another essentially throughout the entire state of California) in which naled is applied, several models will be used for estimating/predicting surface water naled concentrations. Ground spray applications are to be modeled using PRZM-EXAMS and/or AgDRIFT, aerial spray with PRZM-EXAMS, RICE Model, and/or AgDRIFT, and airblast modeled using AgDRIFT. Hand spray and bait uses will not be modeled because they are not expected to contribute significantly to total pesticide loading within a catchment or to independently adversely affect the CRLF.

The method used to evaluate potential terrestrial exposure also considers 'total toxic naled residues of concern' (naled + DDVP), but – because of differences between the models (PRZM vs. T-REX) and how they process data – is estimated in a manner different from that used in the aquatic exposure estimations. Specifically, the fate inputs used for the PRZM-EXAMS aquatic exposure estimations reflect the characteristics of both compounds (naled and DDVP), so the results should also represent aspects of both chemicals. In practice, though, the important fate parameters of naled and DDVP are so similar that changing the input values from one to the other does not appreciably alter the aquatic model results; nevertheless, results presented in this document reflect combined residues. To convert the PRZM-EXAMS EECs from µg/L to µmoles/L, the relative proportions of naled and DDVP (80% naled, 20% DDVP – based upon the highest percent formation of DDVP observed in laboratory studies) were applied to the output EEC values. In addition, correction was also made for differences in molecular weight. Thus, the aquatic exposure estimations (in µmoles/L) should represent the relative amounts of each compound that are likely to be found in the aquatic environment. The method used to estimate relative terrestrial exposure to naled and DDVP (resulting from naled use) is somewhat different. For these estimations, two separate T-REX model runs were conducted for each application type/amount: one run was conducted assuming 100% naled applied and 100% of exposure as naled only (naled toxicity endpoints used), and another run conducted assuming only 20% of chemical is applied (as DDVP), corrected for molecular weight difference (with DDVP toxicity endpoints used). The results of each set of 2 runs are compared (naled toxicity endpoints compared with DDVP toxicity endpoints), and the most sensitive of the two is selected. Where results indicate naled as the more sensitive endpoint, the assumption that 100% of terrestrial exposure is to naled only is very conservative. However, when the DDVP endpoint is selected as the more sensitive, it may represent an under-estimation of true exposure to naled residues – in this case, only 20% of total mass of applied chemical is considered. While this is likely an over-estimation of actual DDVP exposure (since 20% conversion to DDVP is the maximum observed, with most studies indicating a conversion of 12% or less), it fails to account for the additional 80% of naled that is expected to be concurrent with 20% DDVP. There is currently no acceptable method by which the Agency can evaluate possible synergistic (or antagonistic) effects of simultaneous naled/DDVP exposure, but it may be assumed that there is at least an additive effect – especially as both chemicals have the same action (ChE inhibition). However, as potential additive effects cannot be adequately quantified, it should simply be noted that for cases where DDVP terrestrial exposure endpoints are used, there is less confidence that the most conservative possible determination has been made.

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

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

2.10.2 Effects Analysis

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

The assessment of risk for direct effects to the terrestrial-phase CRLF makes the assumption that toxicity of naled to birds is similar to or less than the toxicity to the terrestrial-phase CRLF. The same assumption is made for fish and aquatic-phase CRLF.

Algae, aquatic invertebrates, fish, and amphibians represent potential prey of the CRLF in the aquatic habitat. Terrestrial invertebrates, small mammals, and terrestrial-phase amphibians represent potential prey of the CRLF in the terrestrial habitat. Aquatic, semi-aquatic, and terrestrial plants represent habitat of CRLF.

The acute measures of effect used for animals in this screening level assessment are the LD50, LC50 and EC50. LD stands for "Lethal Dose", and LD50 is the amount of a material, given all at once, that is estimated to cause the death of 50% of the test organisms. LC stands for “Lethal Concentration” and LC50 is the concentration of a chemical that is estimated to kill 50% of the test organisms. EC stands for “Effective Concentration” and the EC50 is the concentration of a chemical that is estimated to produce a specific effect in 50% of the test organisms. Endpoints for chronic measures of exposure for listed and non-listed animals are the NOAEL/NOAEC and NOEC. NOAEL stands for “No Observed-Adverse-Effect-Level” and refers to the highest tested dose of a substance that has been reported to have no harmful (adverse) effects on test organisms. The NOAEC (i.e., “No-Observed-Adverse-Effect-Concentration”) is the highest test concentration at which none of the observed effects were statistically different from the control. The NOEC is the No-Observed-Effects-Concentration. For non-listed plants, only acute exposures are assessed (i.e., EC25 for terrestrial plants and EC50 for aquatic plants).

As previously discussed in Section 2.8.1 and 2.8.2, assessment endpoints for the CRLF include direct toxic effects on survival, reproduction, and growth of the species itself, as well as indirect effects, such as reduction of the prey base and/or modification of CRLF habitat. Direct effects to the CRLF are based on toxicity information for freshwater fish and birds, which are generally used as a surrogate for aquatic and terrestrial phase amphibians, respectively. The open literature will be screened also for available amphibian toxicity data. Indirect effects to the CRLF are assessed by looking at available toxicity information relative to the CRLF’s prey items and habitat requirements (freshwater invertebrates, freshwater vertebrates, aquatic plants, terrestrial invertebrates, terrestrial vertebrates, and terrestrial plants). Both guideline and open literature toxicity data will be identified and evaluated for use in determining RQ values.

There are no submitted plant toxicity studies and no relevant plant toxicity studies were found in the open literature for naled.

DDVP was found to be more toxic than naled to freshwater aquatic invertebrates on an acute basis. There are minimal effects data for chronic DDVP exposure to freshwater invertebrates, and there are acute and chronic data for saltwater invertebrates. These data will be evaluated and compared to naled and DDVP freshwater aquatic invertebrate toxicity endpoints.

2.10.3 Integration of Exposure and Effects

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

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

3.0 Exposure Assessment

Naled is formulated as both a liquid (undiluted) and an emulsifiable concentrate. Application equipment includes: ground spray application, aerial application, Ultra-Low Volume (ULV), airblast, hand spray (spot treatments), and bait stations (mixed with sugar water in open containers, or applied to poles, trees, etc. as gel). Risks from ground boom and aerial applications are emphasized in this assessment because they are expected to result in the highest off-target levels of naled due to generally higher spray drift levels. Ground boom and aerial modes of application tend to use lower volumes of application applied in finer sprays than other applications and thus have a higher potential for off-target movement via spray drift.

3.1 Label Application Rates and Intervals

Label application rates and intervals are shown in Table 10. Crop types, scenarios, and labeled application instructions are also shown in Table 10. Modeled application rates , intervals, application methods, and number of applications are given as well. Information about runs performed using different aquatic exposure models (AgDrift, RICE Model) is given in Table 11. Information provided in Table 11 is for model comparison purposes only; results are not used in making risk determinations. Application rates and intervals are highly variable, as this chemical has multitudinous uses: single application rates range from 0.1 to 2.1 lb a.i./A, with intervals anywhere from 0-14 days.

All application rates/amounts cited here are “maximum rates” (except where noted) and pertain to seasonal (not annual) application totals. This can be a significant distinction for California, as there is often more than one crop cycle per year for some uses in this region. However, since naled residues are very short-lived, repeated applications through multiple crop cycles have negligible effects on resultant EEC values. Rather, the application timing and amount applied in a single event have a much greater effect on model results. Therefore, multiple crop cycles were not considered in this assessment; but timing of applications was considered – application dates were assigned to each scenario according to the part of the year when maximum application rates are likely and also environmental impact greatest. In many cases, the highest aquatic exposure estimates are obtained when both rainfall (initiating runoff) and spray drift are contributing factors. This is most common for California in the spring and autumn months; during summer there are typically fewer rain events, so essentially all conveyance to water results solely from spray drift. In cases where applications can be made throughout the year (or from spring through fall), an appropriate non-summer date was selected for modeling; in other cases, maximum application rates are much more likely only during summer, so a suitable summer application date was used. Application dates are also given in Table 10.

Table 10. Modeled Naled Uses.

PRZM Scenario	Uses Covered	App. Method(s)	App. Rate(s) (lbs a.i./A)	# of Apps.	App. Intervals (days)	Seasonal Total (lbs a.i./A)	Application Date
CA almond STD	almond, walnut	Aerial spray	1.9	2	8	3.8	Apr. 15
CA almond STD	almond, walnut	Ground spray	1.9	2	8	3.8	Apr. 15
CA citrus STD	orange, lemon, grapefruit, tangerine	Aerial spray	1.9	3	7	5.7	Apr. 15
CA citrus STD	orange, lemon, grapefruit, tangerine	Aerial spray only* (Ag Drift)	1.9	3	7	5.7	
CA cole crop RLF (“minimum” application rate)	cabbage, broccoli, cauliflower, collards, kale	Aerial spray	0.9	5	7	4.5	Mar. 15
CA cole crop RLF (“minimum” application rate)	cabbage, broccoli, cauliflower, collards, kale	Ground spray	0.9	5	7	4.5	Mar. 15
CA cole crop RLF	cabbage, broccoli, cauliflower, collards, kale	Ground spray	1.9	5	7	9.5	Mar. 15
CA cole crop RLF	cabbage, broccoli, cauliflower, collards, kale	Aerial spray	1.9	5	7	9.5	Mar. 15
CA cotton STD	cotton	Aerial spray	0.9	5	7	4.5	July 1
CA fruit STD	peaches	Ground spray	1.9	1		1.9	June 1
CA grapes STD	grapes	Airblast* (Ag Drift)	0.5	11	8	5.5	
CA grapes STD	grapes	Ground spray	0.5	11	8	5.5	May 1
CA lettuce STD	Brussels sprouts, Swiss chard	Aerial spray	1.9	5	7	9.5	June 15
CA melons RLF	cantaloupes, muskmelons, melons, eggplant, summer squash	Aerial spray	1.4	4	7	5.6	May 15

PRZM Scenario	Uses Covered	App. Method(s)	App. Rate(s) (lbs a.i./A)	# of Apps.	App. Intervals (days)	Seasonal Total (lbs a.i./A)	Application Date
CA Nursery	bedding plant, foliage plants, outdoor nursery ops.	Ground spray only	0.9	"As needed"	"As needed"	**Not Modeled (LAA assumed)**	
CA row crop RLF	celery, beans, peas	Ground spray	1.4	5	7	7	Mar. 15
CA row crop RLF	celery, beans, peas	Aerial spray	1.4	5	7	7	Mar. 15
CA row crop RLF	peppers	Aerial spray	1.9	3	7	5.7	Apr. 15
CA strawberry (non plastic) RLF	strawberries	Aerial spray	0.9	5	7	4.5	May 1
CA sugarbeet	sugar beets	Aerial spray	0.9	5	7	4.5	May 1
CA wheat RLF	safflower	Aerial spray	2.1	1		2.1	June 1
OR hops	hops	Aerial spray	0.9	5	14	4.5	
OR hops	hops	Ground spray	0.9	5	14	4.5	May 1
CA forestry RLF	forestry	Aerial spray	0.1	25	3	2.5	July 1
CA impervious RLF	areas outside bldgs., impervious surfaces	Aerial spray	0.1	25	3	2.5	Sep. 1
CA residential RLF	residential (including lawns)	Aerial spray	0.1	25	3	2.5	Sep. 1
CA turf RLF *	parks, recreational fields						
CA rangeland hay RLF	rangeland	Aerial spray	1.1	25	3	2.5	Apr. 15
CA alfalfa	alfalfa	Aerial spray	1.4	3	7	4.2	Mar. 15

* Not modeled – should be adequately represented (bounded) by residential/forestry/impervious uses and other models (see below).

Table 11. Modeling Information for Runs Conducted with AgDrift and RICE Model.

Model Used	App. Rate(s) (lbs a.i./A)	App. Method(s)	Buffer (feet)	Uses Covered
AgDRIFT	1.9	Aerial spray	150 – on label	orange

Model Used	App. Rate(s) (lbs a.i./A)	App. Method(s)	Buffer (feet)	Uses Covered
		(very fine)		lemon grapefruit tangerine
AgDRIFT	1.9	Ground spray	25 – on label	peaches
AgDRIFT	0.5	Airblast	50 – on label	grapes
AgDRIFT	0.9	Aerial spray (very fine)	150 – on label	sugar beets
AgDRIFT	0.42	Aerial spray (very fine)	10 – minimum required, from label	Horn flies (rangeland)
AgDRIFT	0.25	Aerial spray (very fine)	0 – applied directly to water (only allowable non-buffer use)	Mosquitoes, other flying insects (swamp)
RICE MODEL	0.25	Aerial spray	applied directly to water	Mosquitoes, other flying insects (swamp)

1 Uses assessed based on memorandum from SRRD

3.2 Aquatic Exposure Assessment

3.2.1 Conceptual Model of Exposure

The conceptual model of exposure envisions primarily aerial and ground spray applications of very fine droplet size, allowing much of the chemical to remain suspended aboveground for some time (as many applications are intended to control flying insects). Thus, spray drift becomes a crucial component of exposure. Naled is expected to degrade to the toxic degredate DDVP fairly quickly (< 1 day); however, the action and toxicity of DDVP are such that it effectively functions much the same as parent naled.
Total toxic residues (naled + DDVP) are used to establish most chemical fate half-lives; where degradation rates for DDVP were slower (hydrolysis, photolysis), the values for DDVP were used as model inputs. Short half-lives for fate parameters obviate the need to evaluate vadose zone storage and potential leaching to groundwater; terrestrial and surface water environments are the dominant venues for potential non-target exposure.

Substantial amounts of naled and DDPV are likely available for runoff to surface waters for only a few days post-application. Even though both these chemicals are mobile, they have low persistence. If a runoff event occurs very soon (1-2 days) after an application and if naled or DDVP is transported into surface water, naled will degrade rapidly (half-life ≈ 0.5 day) and DDVP will persist for slightly longer (half-life ≈ 0.9 day). Therefore, the impact of both of these chemicals on chronic surface water concentrations should be minimal.

3.2.2 Existing Monitoring Data

There are no known targeted aquatic monitoring studies for naled in the U.S. Very few have been identified internationally. Currently, only one known positive detection of DDVP (degredate of naled, as well as a primary-use chemical and degredate of other compounds) in surface water has been reported in CA (2003); approximately 1600 samples were analyzed over a 13-year period (1992-2005).

Naled and DDVP have been detected in air monitoring studies, verifying that atmospheric transport is a viable transmission mode for naled and DDVP. In a targeted ambient air monitoring study in Tulare County, CA (June 1995), naled and DDVP were both detected at elevated air concentrations following naled airblast application. Air samples were collected before, during, and for 72 hours after application of naled to an orange grove. Maximum air concentrations detected for naled and DDVP were 6.30 ug/m^3 and 0.994 ug/m^3, respectively. Moreover, naled was detected at measurable concentrations (0.016 ug/m^3) in samples taken prior to application, indicating that naled residues can be carried across land catchments through the airshed. An earlier (non-targeted) urban ambient air monitoring program in Tulare County in 1991 yielded lower concentrations: 0.077 ug/m^3 for naled and 0.059 ug/m^3 for DDVP. However, model results indicate that exposure risk is significantly greater for aerial (and ground) spray applications than for orchard airblast, so these studies probably under-represent atmospheric concentrations during and soon after spray applications. The relatively short half-lives of both naled and DDVP help limit real mobility, but widespread and frequent usage can allow background levels to persist in high-use areas during high-use periods (such as during summer, when agricultural spraying is likeliest to occur simultaneously and in proximity to other pest control operations).

3.2.3 Modeling Approach

Naled (and DDVP) aquatic exposure was assessed using the PRZM-EXAMS, AgDRIFT, and RICE models. Spray applications (aerial and ground) were modeled with PRZM-EXAMS and/or AgDRIFT, with the exception of mosquito/fly spraying directly onto swamps, standing water, and riparian areas; this was the only usage also modeled with the RICE model (all other uses require buffers around water bodies of 10-200 feet). Because of the large number of potential uses for naled, uses were organized according to application method, crop type, application rate, and usage pattern. A representative (or surrogate) PRZM scenario was selected for each major use category, as appropriate. All available appropriate scenarios were utilized, and paired with uses that included the highest application rates for that category. Table 10 shows the crop type modeled, the scenario appropriate for that crop, the label application rates, the label application method(s), maximum number of applications per season (on label), the minimum labeled interval allowed between applications, and the labeled maximum total amount that can be used in one season. Model results are given in Tables 14 & 15.

Although all labels clearly state "Do not apply directly to water" there are specific exceptions made for certain treatments; in particular, mosquito and fly control uses (e.g., *Trumpet EC* insecticide label states "Do not apply directly to water except when used over water as labeled for adult mosquito, blackfly, or housefly control"; *FLY KILLER D* and *DIBROM* labels includes "swamps" as treatment sites for "adult mosquito, gnat, and housefly control"). Thus, there are uses where direct application to water must be modeled. For these applications, both the RICE and PRZM-EXAMS models were used.

Since application is to be made directly onto or around water bodies, the PRZM-EXAMS model was run with essentially the entire application amount considered as spray drift deposited directly into the EPA 'standard pond' – 99% of applied naled was input as spray drift in the model. Results from this PRZM-EXAMS method were consistent with other uses (although, predictably, somewhat higher), while results from the RICE model were an order of magnitude higher than all others. The results from the PRZM-EXAMS model runs are used for making determinations in this assessment because it is believed they are more accurate, since the RICE model does not consider the very rapid degradation of naled/DDVP. The PRZM-EXAMS direct application to water modeling method for mosquito/fly control was conducted for a single application at the maximum rate (0.25 lb a.i./A) and for the maximum number of applications (25, at 3-day intervals) at the maximum rate, as per label instructions.

3.2.3.1 Model Inputs

The PRZM-EXAMS model runs are intended to represent 'total naled residues' (naled + DDVP), using the most conservative input values (naled or DDVP) where applicable: naled input values for aerobic and anaerobic metabolic half-lives, DDVP for abiotic half-lives and mobility inputs. Physical/chemical parameters for 'total naled residues' that were used as inputs for the PRZM model runs are given in Table 12. However, since both compounds appear to degrade/dissipate rapidly, it was often impractical to establish a specific half-life for some parameters with any degree of certitude. The selection of aerobic soil half-life of 3 days (3x single study showing half-life of about 1 day for combined residues – MRID 00085408) was conservative insofar as degradation was too rapid and data were inadequate to establish a time-series decay curve. In the absence of a verifiable, suitable aerobic aquatic study, the naled aerobic soil half-life is multiplied by two (as per Input Parameter Guidance Document). Specific inputs (application rates, number of applications, application intervals) for each model run are listed in Table 10. For all model input parameters, the most conservative reasonable estimate was used. Test runs (not shown) of the PRZM-EXAMS model using different input parameters (e.g., naled-only, DDVP-only) resulted in very little difference (<5%) in model output values – not surprising, since both naled and DDVP degrade rapidly and have similar physical/chemical properties (see Tables 2 & 3).

Table 12. PRZM-EXAMS Input Parameters for Naled (total toxic residues).

PARAMETER	VALUE	COMMENTS
Molecular Weight	381	
Henry's Law Constant	5E-8	
Vapor Pressure (torr)	1.2E-2	
Solubility (mg/L)	15600	
K_{OC}	37	MRID 41354105
CAM	2	Spray
Application Efficiency	0.99 (ground) 0.95 (aerial)	
Spray Drift	0.027 (ground) 0.12 (aerial) 0.227 (ULV)	CRLF guidelines

PARAMETER	VALUE	COMMENTS
Hydrolysis (days)	pH 5 = 11.6 pH 7 = 5.2 pH 9 = 0.88	MRID 41723101
Aqueous Photolysis half-life (days)	10	MRID 43326601
Aerobic Aquatic half-life (days)	6	2X aerobic soil half-life
Anaerobic Aquatic half-life (days)	4.5	MRIDs 40618201, 41354102, 42445101
Aerobic Soil half-life (days)	3	MRID 00085408 – 3X single value of ~1 day

Since most naled uses entail spray applications of some type, often requiring ultra-fine droplet sizes (with the intent that the chemical remain airborne), it is not sufficiently protective to assume a default spray drift value of 1% for ground spray and 5% for aerial spray. Naled labels contain instructions to include buffers of specific widths according to type and method of application. The model AgDrift is used to obtain estimations of the percentage of applied chemical that may be transported onto a nearby surface water body, according to prescribed buffer width. Table 13 gives buffer widths for each major type of naled use according to application method, and percentage of applied chemical that is expected to reach a water body just beyond the buffer. Representative maximum application rates, and AgDrift-estimated amounts 'applied' onto the water (as a result of drift) are also shown. The spray drift percentages are then used instead of the PRZM default values, and the PRZM-EXAMS model is run with the appropriate recalculated spray drift percent input (see Table 13). For 'swamp' uses, it was assumed that essentially all the applied chemical went directly into the water body, so a spray drift input value of 0.99 (99%) in PRZM was used.

Table 13 Buffer Widths for Naled Uses, and Spray Drift Calculated from AgDrift.

Application Type:	Application Method:	Application Rate (lb/ac):	Buffer Width (ft):	% Spray Drift:	Application Estimate (lb/ac):
Ag. (e.g., citrus)	Air spray	1.9	150	12	0.229
Orchard	Ground spray	1.9	25	2.7	0.051
Vineyard	Airblast	0.5	50	0.6	0.003
Ag (e.g., sugarbeets)	Air spray	0.9	150	12	0.108
Range (flies)	Air spray	0.42	10	22.7	0.095

3.2.3.2 Results

Results from PRZM model runs are shown in Table 14. Results for runs conducted using the default spray drift settings (1% for ground, 5% for aerial) are shown, along with results from the same scenarios using the AgDRIFT-derived spray drift estimates (in bold). The bold numbers in Table 14 are used for calculating exposure and effects, and for making determinations. Table 15 provides the results for runs conducted using AgDrift and RICE Model; however, these data are presented merely for characterization and comparison with PRZM model results and are neither used for making determinations nor discussed further in the text.

All aquatic EECs presented here were also converted into units of *micromoles per liter* (µmole/L). Since the initial EEC values were obtained using model inputs reflecting total naled residues (naled + DDVP), the unit conversion to micromoles also represents total residues. The initial assumption is that 20% of naled is converted to DDVP – the maximum amount converted in approved registrant studies. As this represents the upper bound of expected transformation to DDVP, and DDVP is often more toxic than parent naled, this assumption is conservative and should yield a high-end exposure value. The conversions were calculated using the following formula:

["EEC" (micromoles/liter)] *equals* [(EEC (micrograms/liter) divided by molecular weight of naled) x 80%] plus [(EEC (micrograms/liter) divided by molecular weight of DDVP) x 20%]

or

$$\mu mole/L = ((EEC\ (ug/L) / 381)*0.8) + ((EEC\ (ug/L) / 221)*0.2)$$

Table 14. Results from PRZM Model Runs

PRZM Scenario	Uses Covered	App. Method(s)	Peak EEC (ppb)	96 hour EEC ppb	21 Day EEC ppb	60 Day EEC ppb	Peak EEC (umoles/L)	96 hour EEC (umole/L)	21 Day EEC (umole/L)	60 Day EEC (umole/L)
CA almond STD	almond, walnut	Aerial spray	6.29	3.54	1.73	0.62	0.019	0.011	0.005	0.002
CA almond STD	**almond, walnut**	**Air spray (with 12% spray drift**)	**16.2**	**11.54**	**6.51**	**2.42**	0.049	0.035	0.020	0.007
CA almond STD	almond, walnut	ground spray only	3.23	1.7	0.54	0.24	0.010	0.005	0.002	0.001
CA almond STD	**almond, walnut**	**Ground spray (with 2.7% spray drift**)	**4.79**	**3.27**	**1.76**	**0.76**	0.014	0.010	0.005	0.002
CA citrus STD	orange, lemon, grapefruit, tangerine	Aerial spray	7.21	3.8	2.05	0.76	0.022	0.011	0.006	0.002
CA citrus STD	**orange, lemon, grapefruit, tangerine**	**Air spray (with 12% spray drift**)	**17.54**	**12.22**	**8.5**	**3.29**	0.053	0.037	0.026	0.010
CA cole crop RLF	cabbage, broccoli, cauliflower, collards, kale	Aerial spray	7.9	4.6	2.24	1.25	0.024	0.014	0.007	0.004
CA cole crop RLF	**cabbage, broccoli, cauliflower, collards, kale**	**Air** (**with 12% spray drift**)	**11.69**	**8.6**	**6.29**	**3.77**	0.035	0.026	0.019	0.011

PRZM Scenario	Uses Covered	App. Method(s)	Peak EEC (ppb)	96 hour EEC ppb	21 Day EEC ppb	60 Day EEC ppb	Peak EEC (umoles/L)	96 hour EEC (umole/L)	21 Day EEC (umole/L)	60 Day EEC (umole/L)
CA cole crop RLF	cabbage, broccoli, cauliflower, collards, kale	Ground spray only	6.11	3.55	1.38	0.73	0.018	0.011	0.004	0.002
CA cole crop RLF	**cabbage, broccoli, cauliflower, collards, kale**	**Ground spray (with 2.7% spray drift)**	**6.98**	**5.02**	**2.82**	**1.65**	0.021	0.015	0.008	0.005
CA cole crop RLF	cabbage, broccoli, cauliflower, collards, kale	ground spray only	12.88	7.49	2.91	1.55	0.039	0.023	0.009	0.005
CA cole crop RLF	**cabbage, broccoli, cauliflower, collards, kale**	**Ground spray (with 2.7% spray drift)**	**14.71**	**10.59**	**5.94**	**3.49**	0.044	0.032	0.018	0.010
CA cole crop RLF	cabbage, broccoli, cauliflower, collards, kale	Aerial spray	16.66	9.69	4.72	2.64	0.050	0.029	0.014	0.008
CA cole crop RLF	**cabbage, broccoli, cauliflower, collards, kale**	**Air (with 12% spray drift)**	**24.66**	**18.41**	**13.26**	**7.95**	0.074	0.055	0.040	0.024
CA cotton STD	cotton	Aerial spray	11.7	5.09	1.14	0.53	0.035	0.015	0.003	0.002
CA cotton STD	**cotton**	**Air spray (with 12% spray drift)**	**11.68**	**7.26**	**5.13**	**2.99**	0.035	0.022	0.015	0.009
CA fruit STD	peaches	Ground spray	1.07	0.4	0.08	0.03	0.003	0.001	0.000	0.000
CA fruit STD	**peaches**	**Ground spray (with 2.7% spray drift)**	**3.35**	**2.18**	**0.74**	**0.26**	0.010	0.007	0.002	0.001
CA grapes STD	grapes	Airblast	0.02	NA	NA	NA	0.000			
CA grapes STD	grapes	Ground spray	0.29	0.14	0.1	0.08	0.001	0.000	0.000	0.000
CA grapes STD	**grapes**	**Ground spray (with 2.7% spray**	**0.93**	**0.64**	**0.48**	**0.43**	0.003	0.002	0.001	0.001

PRZM Scenario	**Uses Covered**	**App. Method(s)**	**Peak EEC (ppb)**	**96 hour EEC ppb**	**21 Day EEC ppb**	**60 Day EEC ppb**	**Peak EEC (umoles/L)**	**96 hour EEC (umole/L)**	**21 Day EEC (umole/L)**	**60 Day EEC (umole/L)**
		drift)								
CA lettuce STD	Brussels sprouts, Swiss chard	Aerial spray	5.84	3.18	2.17	1.26	0.018	0.010	0.007	0.004
CA lettuce STD	**Brussels sprouts, Swiss chard**	**Aerial spray (with 12% spray drift**)	**17.24**	**12.05**	**9.44**	**5.56**	0.052	0.036	0.028	0.017
CA melons RLF	cantaloupes, muskmelons, melons, eggplant, summer squash	Aerial spray	4.15	2.13	1.32	0.57	0.012	0.006	0.004	0.002
CA melons RLF	**cantaloupes, muskmelons, melons, eggplant, summer squash**	**Aerial spray (with 12% spray drift**)	**12.61**	**8.58**	**6.06**	**2.83**	0.038	0.026	0.018	0.009
CA row crop RLF	beans, peas, celery	Ground spray	6.52	3.88	1.57	0.69	0.020	0.012	0.005	0.002
CA row crop RLF	**beans, peas, celery**	**Ground spray (with 2.7% spray drift**)	**7.87**	**6.12**	**3.62**	**1.8**	0.024	0.018	0.011	0.005
CA row crop RLF	beans, peas, celery	Aerial Spray	7.49	5.3	2.95	1.51	0.023	0.016	0.009	0.005
CA row crop RLF	**beans, peas, celery**	**Aerial Spray (with 12% spray drift**)	**16.86**	**12.02**	**9.2**	**5.12**	0.051	0.036	0.028	0.015
CA row crop RLF	peppers	Aerial spray,	7.48	4.67	2.72	0.98	0.022	0.014	0.008	0.003
CA row crop RLF	**peppers**	**Aerial spray (with 12% spray drift**)	**17.49**	**12.48**	**8.94**	**3.52**	0.053	0.037	0.027	0.011
CA strawberry	strawberries	Aerial spray	9.08	4.68	1.71	0.99	0.027	0.014	0.005	0.003

PRZM Scenario	Uses Covered	App. Method(s)	Peak EEC (ppb)	96 hour EEC ppb	21 Day EEC ppb	60 Day EEC ppb	Peak EEC (umoles/L)	96 hour EEC (umole/L)	21 Day EEC (umole/L)	60 Day EEC (umole/L)
(non plastic) RLF										
CA strawberry (non plastic) RLF	**strawberries**	**Aerial spray (with 12% spray drift)**	**8.52**	**6.02**	**4.72**	**2.88**	0.026	0.018	0.014	0.009
CA wheat RLF	safflower	Aerial spray	5.87	2.49	0.54	0.19	0.018	0.007	0.002	0.001
CA wheat RLF	**safflower**	**Aerial spray (with 12% spray drift)**	**22.46**	**9.28**	**2.39**	**0.84**	0.067	0.028	0.007	0.003
OR hops	hops	Aerial spray	3.55	1.99	0.88	0.67	0.011	0.006	0.003	0.002
OR hops	**hops**	**Aerial spray (with 12% spray drift)**	**7.1**	**5.04**	**3.08**	**2.57**	0.021	0.015	0.009	0.008
OR hops	hops	Ground spray	2.43	1.34	0.42	0.22	0.007	0.004	0.001	0.001
OR hops	**hops**	**Ground spray (with 2.7% spray drift)**	**2.86**	**2.23**	**1**	**0.74**	0.009	0.007	0.003	0.002
CA rangeland hay	**Mosquitoes, Flies, etc.**	*** Aerial spray (with 22.7% drift)**	**6.78**	**4.72**	**2.64**	**0.97**	0.020	0.014	0.008	0.003
CA forestry	**Mosquitoes, Flies, etc.**	*** Aerial spray (with 22.7% drift)**	**10.46**	**7.79**	**4.17**	**3.15**	0.031	0.023	0.013	0.009
CA impervious	**Mosquitoes, Flies, etc.**	*** Aerial spray (with 22.7% drift)**	**10.28**	**7.55**	**4.62**	**3.32**	0.031	0.023	0.014	0.010
CA residential	**Mosquitoes, Flies, etc.**	*** Aerial spray (with 22.7% drift)**	**3.5**	**2.7**	**2.42**	**2.33**	0.011	0.008	0.007	0.007
CA forestryRLF (single appl.)	**"swamp"**	*** Aerial spray (with 99% drift)**	**13.85**	**9.81**	**3.5**	**1.25**	0.042	0.029	0.011	0.004
CA forestryRLF (25 apps, 3-day intervals)	**"swamp"**	*** Aerial spray (with 99% drift)**	**32.78**	**26.46**	**25.17**	**24.84**	0.098	0.080	0.076	0.075

PRZM Scenario	**Uses Covered**	**App. Method(s)**	**Peak EEC (ppb)**	**96 hour EEC ppb**	**21 Day EEC ppb**	**60 Day EEC ppb**	**Peak EEC (umoles/L)**	**96 hour EEC (umole/L)**	**21 Day EEC (umole/L)**	**60 Day EEC (umole/L)**
CA sugarbeet	**sugar beets**	**Ground spray (with 2.7% spray drift)**	**1.99**	**1.36**	**1.00**	**0.56**	0.006	0.004	0.003	0.002
CA alfalfa	**alfalfa**	**Aerial spray (with 12% spray drift)**	**14.39**	**10.44**	**7.22**	**3.00**	0.043	0.031	0.022	0.009

Table 15. Results from Other (non-PRZM) Model Runs.

Model Used	**App. Rate(s) (lbs a.i./A)**	**App. Method(s)**	**Buffer (feet)**	**Uses Covered**	**Peak (ppb)**
AgDRIFT	1.9	Aerial spray (very fine)	150 – on label	orange, lemon, grapefruit, tangerine	4.17
AgDRIFT	1.9	Ground spray	25 – on label	peaches	2.84
AgDRIFT	0.5	Airblast	50 – on label	grapes	0.02
AgDRIFT	0.9	Aerial spray (very fine)	150 – on label	sugar beets	6.07
AgDRIFT	0.42	Aerial spray (very fine)	10 – minimum required, from label	Horn flies (rangeland)	5.31
AgDRIFT	0.25	Aerial spray (very fine)	0 – applied directly to water (only non-buffer use allowed on label)	Mosquitoes, other flying insects (swamp)	3.40
AgDRIFT	1.25	Aerial spray (very fine)	1 – applied directly to water (only non-buffer use allowed on label)	Mosquitoes, other flying insects (swamp)	5.10
RICE MODEL	0.25	Aerial spray	applied directly to water	Mosquitoes, other flying insects (swamp)	239

3.2.4 Additional Modeling Exercises Used to Characterize Potential Exposures

3.2.4.1 Residential Uses (Impact of overspray and Impervious Surfaces)

Aerial and ground spray applications to residential areas (including impervious surfaces) for flying insect (mosquitoes, flies, etc.) control were modeled in this assessment (see Tables 14 & 15). Generally, these uses produced higher EECs when modeled in residential and forested areas than when modeled for the same uses in crop-type scenarios. However, these uses did not produce the highest calculated EECs in this assessment – probably because application rates were lower than for some other (mostly 'agricultural') uses.

3.2.4.2 Comparison of Modeled EECs with Available Monitoring Data

There were insufficient monitoring data with which to compare modeling results.

3.2.5 Modeling with Typical Usage Information

A wide range of different uses, scenarios, and application rates was utilized in this assessment. In addition to all model runs using maximum application rates (and maximum number of applications, minimum application intervals), the cabbage, broccoli, etc. usage (CA cole crop scenario) label directions state a 'minimum' application rate of 0.9 lb a.i./A. This permutation was also modeled, to give an idea (in the absence of hard data) of what possible "typical" (or "minimum") usage might produce. The array of model results presented here should roughly encompass the range of exposure values that might be expected in a variety of settings for most naled uses. These results are shown in Table 11.

3.2.6 Summary of Modeling vs. Monitoring Data

There were insufficient monitoring data with which to compare modeling results. A comprehensive, targeted monitoring study of several years' duration would be required to adequately compare monitoring and modeling data.

3.3 Terrestrial Exposure

3.3.1 Terrestrial Animal Exposure Assessment

T-REX (Version 1.3.1) is used to calculate dietary and dose-based EECs of naled and DDVP for the CRLF and its potential prey (e.g. small mammals and terrestrial insects) inhabiting terrestrial areas. EECs used to represent the CRLF are also used to represent exposure values for frogs serving as potential prey of CRLF adults. T-REX simulates a 1-year time period. For this assessment spray applications of naled are considered, as discussed in below.

Terrestrial EECs for foliar formulations of naled were derived for the uses summarized in.Table 17, Table 18, Table 19, Table 20, and Table 21. A foliar dissipation half-life study was not available for naled or DDVP, however, naled studies indicate a field dissipation half-life of greater than one day. Therefore, a foliar dissipation half life of 2 days will be used as the input value for the TREX model. Since both chemicals exhibit similar behavior in the environment, the same value will be used for naled and DDVP. Use specific input values, including number of applications, application rate and application interval are provided in Table 16. An example output from T-REX is available in Appendix C.

In lieu of submitted data regarding foliar dissipation half-lives, a half-life of 2 days was extrapolated from field dissipation studies (MRID # 40494101, 40976401, 40976402 and 41354107, 40304301 and 41354108). Initial screening revealed that the EEC value calculated by the T-REX model is more sensitive to application rate and frequency than to the number of applications. To adequately address the risk from all uses, they were first grouped by the maximum allowable one time application rate then by the number of applications and the application interval. The similar scenarios were grouped and numbered 1 through 9, with Scenario 1 having the highest one-time application rate. The table below (Table 16) includes the uses, rates, frequency and scenario number.

Table 16. Input Parameters for Foliar Applications Used to Derive Terrestrial EECs for Naled with T-REX , Application Scenarios Used in TREX to get a Baseline Risk Value for Each Use

Scenario	Scenario Summary	Rate (lbs a.i./A)	# of Applications	Application Interval (Days)	Uses
1	Safflower (2.1 lbs ai/a, 1 application)	2.1	1	7	Safflower
2	Cole crops, tree nuts, citrus (1.9 lbs ai/A, 1 application)	1.9	1	7	almond, broccoli, cabbage, cauliflower, Brussels sprouts, kale, and collards, eggplant, peppers, oranges, lemons, grapefruit, tangerines, peaches, summer squash, walnuts
3	Alfalfa, row crops, cotton (1.4 lbs ai/A, 1 application)	1.4	1	7	alfalfa, beans, lima beans, and peas, celery, cotton,
4	Melons, misc food and non-food plants (0.9 lbs ai/A, 1 application)	0.9	1	7	Beans (aerial), cantaloupes, muskmelons, hops, melons grown for seed, grapes, strawberries, sugar beets, Swiss chard, forest and shade trees, ornamental shrubs and flowering plants
5	Non-food plants (0.9 lbs ai/A, 52 applications, 7 day interval)	0.9	52	7	forest and shade trees, ornamental shrubs and flowering plants
6	Non-food plants (0.9 lbs ai/A, 104 applications, 3 day interval)	0.9	104	3	forest and shade trees, ornamental shrubs and flowering plants

Scenario	Scenario Summary	Rate (lbs a.i./A)	# of Applications	Application Interval (Days)	Uses
7	Insect pests- animal and human health concerns (0.25 lbs ai/A, 2 applications, 7 day interval)	0.25	2	7	Swamps and pastures, for reduction of livestock pests in confined animal feeding operations (0.2 aerial, 0.25 by ground)
8	Insect pests- animal and human health concerns (0.1 lbs ai/A, 2 applications, 1 day interval)	0.1	2	1	in and around food processing plants, loading docks, cull piles, refuse areas, or reduction of rangeland pests, residential areas, municipalities, tidal marshes, swamps, woodlands, and agricultural areas, livestock areas including dairy cattle
9	Insect pests- animal and human health concerns (0.1 lbs ai/A, 2 applications, 7 day interval)	0.1	2	7	in and around food processing plants, loading docks, cull piles, refuse areas, reduction of rangeland pests, residential areas, municipalities, tidal marshes, swamps, woodlands, and agricultural areas, livestock areas including dairy cattle

The use scenarios were modeled using T-REX v.1.3.1. The modeling results include estimated environmental concentrations (EEC) based on dose or dietary concentrations.

T-REX is also used to calculate EECs for terrestrial insects exposed to naled. Dietary-based EECs calculated by T-REX for small and large insects (units of a.i./g) are used to bound an estimate of exposure to bees. Available acute contact toxicity data for bees exposed to naled (in units of µg a.i./bee), are converted to µg a.i./g (of bee) by multiplying by 1 bee/0.128 g. The EECs are later compared to the adjusted acute contact toxicity data for bees in order to derive RQs. Because naled is highly toxic to terrestrial invertebrates, it is unnecessary to consider the toxicity of DDVP, as it will not affect the risk conclusion.

For modeling purposes, exposures of the CRLF to naled through contaminated food are estimated using the EECs for the small bird (20 g) which consumes small insects. Dietary-based and dose-based exposures of potential prey are assessed using the small mammal (15 g) which consumes short grass. Upper-bound Kenaga nomogram values reported by T-REX for these two organism types are used for derivation of EECs for the CRLF (Table 17**)** and its potential prey (Table 18 and Table 19). .

The three tables below are the T-TEX results relevant to the terrestrial phase CRLF. The first table includes dose, dietary and chronic based EEC values which will be compared to avian toxicity data to calculate RQ values used to assess direct effects to the CRLF.

Table 17. Upper-bound Kenega Nomogram EECs (ppm) for Dietary- and Dose-based Exposures of the CRLF and its Prey to Naled

Scenario (20 g bird consuming small insects)	Scenario Summary	EEC Acute Dose based frog (avian)	EEC Acute Dietary and Chronic Dose based frog (avian)
1	Safflower (2.1 lbs ai/a, 1 application)	322.9	283.5
2	Cole crops, tree nuts, citrus (1.9 lbs ai/A, 1 application)	292.1	256.5
3	Alfalfa, row crops, cotton (1.4 lbs ai/A, 1 application)	215.3	189
4	Melons, misc food and non-food plants (0.9 lbs ai/A, 1 application)	138.4	121.5
5	Non-food plants (0.9 lbs ai/A, 52 applications, 7 day interval)	151.8	133.3
6	Non-food plants (0.9 lbs ai/A, 104 applications, 3 day interval)	214.1	188.0
7	Insect pests-animal and human health concerns (0.25 lbs ai/A, 2 applications, 7 day interval)	41.84	36.73
8	Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 1 day interval)	26.25	23.05
9	Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 7 day interval)	16.73	14.69

The next table presents EEC values for small and large insects as part of the CRLF diet. These values will be compared against terrestrial invertebrate toxicity data to assess if insects, a prey item for the CRLF, will be adversely affected by naled use, thus indirectly affecting the CRLF.

Table 18. Naled EECs (ppm) for Indirect Effects to the Terrestrial-Phase CRLF via Effects to Terrestrial Invertebrate Prey Items

Scenario (Naled)	Scenario Summary	Rate	Number of Applications	Small Insects	Large Insects
1	Safflower (2.1 lbs ai/a, 1 application)	2.1	1	283.50	31.50
2	Cole crops, tree nuts, citrus (1.9 lbs ai/A, 1 application)	1.9	1	256.50	28.50
3	Alfalfa, row crops, cotton (1.4 lbs ai/A, 1 application)	1.4	1	189.00	21.00
4	Melons, misc food and non-food plants (0.9 lbs ai/A, 1 application)	0.9	1	121.50	13.50
5	Non-food plants (0.9 lbs ai/A, 52 applications, 7 day interval)	0.9	52	133.28	14.81
6	Non-food plants (0.9 lbs ai/A, 104 applications, 3 day interval)	0.9	104	187.95	20.88
7	Insect pests-animal and human health concerns (0.25 lbs ai/A, 2 applications, 7 day interval)	0.25	2	36.73	4.08
8	Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 1 day interval)	0.1	2	23.05	2.56
9	Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 7 day interval)	0.1	2	14.69	1.63

Table 19. DDVP EECs (ppm) for Indirect Effects to the Terrestrial-Phase CRLF via Effects to Terrestrial Invertebrate Prey Items

Scenario (DDVP)	Scenario Summary	Rate	Number of Applications	Small Insects	Large Insects
1	Safflower (2.1 lbs ai/a, 1 application)	0.24	1	32.83	3.65
2	Cole crops, tree nuts, citrus (1.9 lbs ai/A, 1 application)	0.22	1	29.70	3.30
3	Alfalfa, row crops, cotton (1.4 lbs ai/A, 1 application)	0.16	1	21.88	2.43
4	Melons, misc food and non-food plants (0.9 lbs ai/A, 1 application)	0.10	1	14.07	1.56
5	Non-food plants (0.9 lbs ai/A, 52 applications, 7 day interval)	0.10	52	15.43	1.71

Scenario (DDVP)	Scenario Summary	Rate	Number of Applications	Small Insects	Large Insects
6	Non-food plants (0.9 lbs ai/A, 104 applications, 3 day interval)	0.10	104	21.76	2.42
7	Insect pests-animal and human health concerns (0.25 lbs ai/A, 2 applications, 7 day interval)	0.03	2	4.25	0.47
8	Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 1 day interval)	0.01	2	2.67	0.30
9	Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 7 day interval)	0.01	2	1.70	0.19

The third table includes acute and chronic EEC values for small mammals, a part of the CRLF diet. The EEC values will be compared to mammalian toxicity endpoints to assess risk to the CRLF via indirect effects mediated by adverse effects to prey items.

Table 20. Mammalian EECs (ppm), as Modeled by T-REX to Assess Potential for Indirect Effects to CRLF

Scenario (15 g mammal eating small insects)	Scenario Summary	Acute and Chronic Dose based small mammals EEC
1	Safflower (2.1 lbs ai/a, 1 application)	480.53
2	Cole crops, tree nuts, citrus (1.9 lbs ai/A, 1 application)	434.76
3	Alfalfa, row crops, cotton (1.4 lbs ai/A, 1 application)	320.35
4	Melons, misc food and non-food plants (0.9 lbs ai/A, 1 application)	205.94
5	Non-food plants (0.9 lbs ai/A, 52 applications, 7 day interval)	225.91
6	Non-food plants (0.9 lbs ai/A, 104 applications, 3 day interval)	318.57
7	Insect pests-animal and human health concerns (0.25 lbs ai/A, 2 applications, 7 day interval)	62.26
8	Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 1 day interval)	39.06
9	Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 7 day interval)	24.90

3.3 Terrestrial Plant Exposure Assessment

TerrPlant (Version 1.1.2) is used to calculate EECs for non-target plant species inhabiting dry and semi-aquatic areas. Parameter values for application rate, drift assumption and incorporation depth are based upon the use and related application method (Table 21). A runoff value of 5% is utilized based on naled's solubility, which is classified by TerrPlant as 15600 mg/L. For aerial and ground application methods, drift is assumed to be 5% and 1%, respectively. EECs relevant to terrestrial plants consider pesticide concentrations in drift and in runoff. These EECs are listed by use in Table 21. An example output from TerrPlant v.1.2.2 is available in Appendix F.

Table 21. TerrPlant Inputs and Resulting EECs (lbs a.i./A) for Plants Inhabiting Dry and Semi-aquatic Areas Exposed to naled via Runoff and Drift

Chemical Identity.			
Chemical Name	**Naled**		
PC code	**034401**		
Application Method	**Aerial Spray**		
Solubility in Water (ppm)	**15600**		
Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**See below**	**Lb ai/A**
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.05**	none

EECs for Naled.							
Description	**Equation**	**EEC (2.1 lb ai/A)**	**EEC 1.9 lb ai/A)**	**EEC 1.4 lb ai/A)**	**EEC 0.9 lb ai/A)**	**EEC 0.25 lb ai/A)**	**EEC 0.1 lb ai/A)**
Runoff to dry areas	(A/I)*R	0.105	0.095	0.07	0.045	0.0125	0.005
Runoff to semi-aquatic areas	(A/I)*R*10	1.05	0.95	0.7	0.45	0.125	0.05
Spray drift	**A*D**	**0.105**	**0.095**	**0.07**	**0.045**	**0.0125**	**0.005**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.21**	**0.19**	**0.14**	**0.09**	**0.025**	**0.01**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**1.155**	**1.045**	**0.77**	**0.495**	**0.1375**	**0.055**

3.4 Spray Drift Modeling

Many naled uses, especially aerially-applied spray and ULV applications, are prone to spray drift. This is consistent with many of the intended uses on flying insects, where it is desirable that naled remain suspended in the atmosphere for a length of time sufficient to kill insects in flight. The real limit to naled/DDVP mobility in these cases is the rapid degradation and dissipation of naled residues. However, considering the very fine droplet sizes recommended for these uses, it is expected that some drift to non-target areas will occur. For many of these types of uses, modeling was conducted using both the PRZM-EXAMS model (with the spray drift fraction set for 5%) and the AgDrift model (with appropriate buffer widths and application amounts – as per label instructions – included). Results from both these models were very similar when compared for the same uses. Ultimately, though, results from PRZM-EXAMS model runs where AgDRIFT-derived percent spray drift values were substituted for the default values were used for making effects determinations. Although there is an option to use the Gaussian extension to predict the full distance that might be affected by a spray drift event, this should not be necessary. Usage patterns allow that the same applications may be performed in neighboring catchments at the same time essentially anywhere in California; considered alongside the non-persistent characteristics of naled (which are not accounted for in the Gaussian extension to the spray drift model), exposure in nearby areas will more likely be higher as a result of local spraying than from long-range drift. Any potential contributions from long-range drift should add negligibly to exposure resulting from local spray applications

4.0 Effects Assessment

The effects assessment characterizes the types of effects naled and it's degredate of concern, DDVP, have on organisms when exposed at various levels. This characterization is based on registrant-submitted toxicity studies and a comprehensive review of the open literature on naled and DDVP toxicity and effects. Where data are sufficient, acute probit dose- or concentration-response relationships are evaluated to establish the probability of an individual effect (listed species) or the effect to a proportion of exposed individuals (non-listed organisms). To further refine the characterization of potential ecological effects associated naled use, reported incidents from the Ecological Incident Information System (EIIS) are reviewed.

A summary of the available ecotoxicity information and probit dose- or concentration-response relationships, and the incident information for naled technical grade active ingredient (TGAI) and formulated product are provided in **Sections 4.1 through 4.4,** respectively. A detailed summary of the available ecotoxicity information for naled and DDVP TGAI and formulated product is presented in **Appendix A.**

Toxicity endpoints used to estimate risk are based on data generated from guideline studies submitted by the registrant, and from open literature studies that meet the criteria for inclusion into the ECOTOX database, maintained by EPA/Office of Research and Development (ORD) (U.S. EPA, 2004). Open literature data presented in this assessment were obtained from ECOTOX.

In order to be included in the ECOTOX database, papers must meet the following minimum criteria:

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

Data that pass the ECOTOX screen for inclusion in that database are further screened (U.S. EPA 2004), and then evaluated for scientific soundness and applicability to estimating or characterizing risk along with the registrant-submitted data, and may be incorporated qualitatively or quantitatively into this endangered species assessment. Studies in ECOTOX were screened using a check list for ecological toxicity data outlined by EPA (USEPA, 2004) and developed in conjunction with the Services. Criteria include public literature studies with measurement endpoints commensurate with guideline studies, maintaining proper organism survival in a control treatment, testing only with healthy, unstressed organisms, and using appropriate testing procedures. Results from studies, where the test descriptions did not contain sufficient information to evaluate these fundamentals, were not used. The degree to which open literature data are quantitatively or qualitatively characterized is dependent on whether the information is relevant to the direct and indirect assessment endpoints identified for this assessment (*i.e.*, maintenance of CRLF survival, reproduction, and growth) as identified in Section 2.8. For example, endpoints such as behavior modifications are likely to be qualitatively evaluated, because quantitative relationships between modifications and reduction in species survival, reproduction, and/or growth are not generally available.

Citations of all open literature not considered as part of this assessment are listed in Appendix H for those rejected for inclusion in ECOTOX, for those that did not pass an initial screen of the ECOTOX data (U.S. EPA 2004b), and for those that passed the initial screen but were not used quantitatively (e.g., the endpoint is less sensitive and/or not appropriate for use in this assessment). Also included is the rationale for why a specific literature source was rejected for inclusion in ECOTOX, why it did not pass the ECOTOX screen, or why it was not used, at least quantitatively, as part of this endangered species risk assessment. respectively. The chemicals included in the CRLF assessments were placed in a queue in preparation for the staggered deadlines. Because DDVP is being assessed in the context that it is a degredate of naled, a formal OPP ECOTOX run was not conducted for DDVP. However, the publicly accessible ECOTOX database was surveyed for DDVP toxicity data and several studies were reviewed.

As described in the analysis plan, naled is rapidly converted to the toxic degredate DDVP, and to assess the risk from naled uses exposure was estimated using a total residues approach. For the aquatic phase CRLF assessment, the toxicity of naled and DDVP are compared and the chemical that is most toxic to each taxa is used in the risk equations. The comparison was performed by first determining, for each taxa, the most sensitive endpoint for each chemical. Next for comparison, these values were normalized to micromoles (i.e., 380.84 µg of naled = 1 µmole of naled and 221 µg of DDVP = 1 µmole of DDVP). For terrestrial RQ calculations the EEC values are compared to both the naled and DDVP toxicity endpoints as described in the Problem Formulation section.

Based on the available data, naled is classified as highly toxic to freshwater fish and very highly toxic to freshwater invertebrates. Naled is classified as slightly toxic to birds on a sub-acute, dietary basis. On an acute basis, naled is classified as moderately to highly toxic to birds, reptiles, and terrestrial-phase amphibians. Naled is classified as highly toxic to insects and moderately toxic to mammals, on an acute basis.

The results of aquatic plant toxicity testing found naled toxicity to range from 22 ppb a.i. for non-vascular aquatic plants up to 1,800 ppb for vascular aquatic plants. There are no submitted terrestrial plant toxicity data for naled.

4.1 Evaluation of Naled and DDVP Aquatic Ecotoxicity Studies

As described in the Agency's Overview Document (U.S. EPA, 2004), the most sensitive measurement endpoint for each taxa is used to calculate risk for an assessment endpoint. For this assessment, evaluated taxa relevant to the aquatic habitat of the CRLF include freshwater fish and freshwater aquatic invertebrates, and freshwater aquatic plants. Freshwater fish are used as a surrogate species for aquatic-phase amphibians as described in the Overview Document (U.S. EPA, 2004). Table 22 summarizes the most sensitive aquatic organism toxicity endpoints (naled or DDVP, as appropriate) for the aquatic-phase CRLF, its aquatic prey and its aquatic habitat, based on an evaluation of both the submitted studies and the open literature for freshwater fish, invertebrates and plants as discussed in Sections 4.1.1, 4.1.2 and 4.1.3, respectively.

Table 22. Selected endpoints (naled or DDVP) for direct (freshwater fish) and indirect (aquatic invertebrates) effects to aquatic phase CRLF

Assessment Endpoint	Measurement Endpoint Selected	Chemical	Selected Study Result			
			Species	**Study Duration and Selected Measurement Endpoint**	**Toxicity Value**	**Source and Study Classification**
Survival and reproduction of freshwater vertebrates (fish, etc)	Most sensitive acute freshwater fish LC50	Naled	Lake Trout *Salvelinus namaycush*	96-hr LC50	0.24 µmoles/L (92 ppb a.i.)	40098001 Supplemental
	Most sensitive freshwater fish early life stage NOAEC	Naled	Fathead minnow *Pimephales promelas*	35-D NOAEC	0.0076 µmoles a.i./L (2.9 ppb a.i.)	42602201 Acceptable
		Naled	Lake Trout *Salvelinus namaycush*	Estimate	0.00017 umoles/L	ACR
Survival and reproduction of freshwater invertebrates	Most sensitive acute freshwater aquatic invertebrate EC50	DDVP	Water flea *Daphnia pulex*	48-hr EC50	0.00030 µmoles/L (0.066 ppb)	40098001 Acceptable
	Most sensitive freshwater aquatic invertebrate life cycle NOAEC	Naled	Water flea *Daphnia magna*	21 D NOAEC	0.00012 µmoles/L (0.045 ppb)	42908801 Acceptable

D = day; hr = hour; ACR = acute-to-chronic ratio

4.1.1 Toxicity to Freshwater Fish

Because this assessment considers total naled residues of concern (naled and DDVP), toxicity values need to be expressed on an equivalent basis. Toxicity values expressed on a mass basis were converted into a molar basis to allow them to be compared. To clarify each of the toxicity values in text and tables, values are expressed both in terms of mass (ug/L) and molar (umol/L).

4.1.1.1 Freshwater Fish: Acute Exposure (Mortality) Studies

Technical Grade Active Ingredient

Eleven scientifically sound freshwater fish acute toxicity tests with technical grade naled were submitted (Appendix TBD). Eight species were tested and included: Bluegill sunfish (*Lepomis macrochirus*); Channel catfish, *Ictalurus punct*atus; Cutthroat trout, *Oncorhynchus clarki*; Fathead minnow, *Pimephales promelas*; Lake trout, *Salvelinus namaycush*; Largemouth bass, *Micropterus salmoides*; Rainbow trout, *Oncorhynchus mykiss*; and Striped bass, *Morone saxatilis.*

The 96-hr LC50 values ranged from 92 ppb (0.24 µmoles/L) for the coldwater Lake trout to 3,300 ppb (8.7 µmoles/L) for the warm water Fathead minnow. Naled is therefore descriptively classified as very highly toxic to moderately toxic acutely to freshwater fish.

The Lake trout study was classified as a supplemental study (i.e., scientifically sound but deviates substantially from guideline test protocols) because although a solvent was used in the stock solution to prepare treatments, two controls (one a solvent control and the other a dilution water only control) were not tested. Only one control was tested and it is not clear if it was a dilution water alone control or a solvent control. There was no mortality in the control tested, and the solvent used was a typical solvent used in fish toxicity tests, acetone, at levels below expected adverse effect levels. Considering the impact to test results under the possible alternative control scenarios (e.g., assume solvent control tested and that if a dilution control was tested it would have demonstrated mortality or no mortality and vice versa), the greatest uncertainty is that the test result may be an overestimate of toxicity. Given these conditions, and that a clear-cut concentration response was exhibited the uncertainty introduced to risk estimates based on using the supplemental study results were considered low.

Product Formulations

Seven product formulations containing naled were tested with freshwater fish; four were tested with Bluegill sunfish, four were tested with Rainbow trout, and one with Atlantic salmon. The 96-hr LC50 values range from 130 ppb (MRID#: 00263578) for Rainbow trout to 4,000 ppb (MRID#: 00160741)for Bluegill sunfish. Formulations did not appear to be more toxic than the TGAI. Therefore, TGAI study values will be used.

Degredate DDVP

Eleven scientifically sound studies with DDVP were submitted by registrants (Appendix TBD). Species tested included Bluegill sunfish (*L. macrochirus*); Cutthroat trout (*O.*

clarki); Fathead minnow (*P. promelas)*; Lake trout (*S. namaycush)*; Mosquito fish (*Gambusia affinis*); and Rainbow trout (*O. mykiss).* The 96-hr LC50 values range from 100 ppb DDVP (0.45 µmoles/L) for Rainbow trout to 11,600 ppb DDVP (52.5 µmoles/L) for Fathead minnow.

There are no core studies available for the rainbow trout. Mayer and Ellersieck (40098001) cite a 24-hour LC50 of 500 ppb for rainbow trout. The two 96-hour lake trout LC50s of 187 ppb and 183 ppb showed 24-hour LC50s of 486 ppb and 667 ppb, respectively. The studies are classified "supplemental" because they were not performed using standard test species. Mayer and Ellersieck state (p. 9) the correlation coefficient (r) between rainbow and lake trout for acute static LC50s is 0.99. Since the results are comparable within the limits of the toxic category (i.e., highly toxic), the lake trout studies will be substituted for the rainbow trout study. Since the LC50s are less than 1 ppm, dichlorvos is categorized as highly toxic to freshwater fish on an acute basis.

Two studies were performed with an emulsifiable concentrate formulation (42.3% ai). Since the TEP and TGAI demonstrated similar toxicities (on an active ingredient basis), it does not appear inerts in the EC formulation are toxic.

Naled versus DDVP Sensitivity

Five species of freshwater fish were tested with both naled and DDVP: Bluegill sunfish, Cutthroat trout, Fathead minnow, Lake trout, and Rainbow trout. On a molar basis, three of the five species tested (Cutthroat trout, Fathead minnow, and Lake trout) or 60% of the species were 2 to 6 times more sensitive to the parent naled than to its degredate DDVP (0.33, 8.7, and 0.24 µmoles/L versus 0.77, 52.5, and 0.83 µmoles/L, respectively). One of the five species tested, the Rainbow trout, or 20% of the species was about as sensitive to naled as to DDVP (0.42 versus 0.45 µmoles/L); and one of the five species, the Bluegill sunfish, or 20% of the species was about 1.5 times more sensitive to DDVP than to naled (3.9 versus 5.8 µmoles/L). Based on these results, 80% of the species tested were as sensitive as or more sensitive to the parent naled than to the degredate DDVP.

Measurement Endpoint Selected

Based on the available naled and DDVP data, the most sensitive endpoint on a molar basis is the Lake trout study with naled of 0.24 µmoles/L. Therefore, the measurement endpoint selected for use in estimating direct effects to the CRLF and effects to fish from total naled residues (naled + DDVP) in surface water was the Lake trout naled result of 0.24 µmoles/L (Table 22).

4.1.1.2 *Freshwater Fish: Chronic Exposure (Early Life Stage and Reproduction) Studies*

Technical Grade Active Ingredient

One fish early life stage toxicity study with the Fathead minnow was submitted (MRID: 42602201), with a resultant NOAEC and LOAEC for length of 2.9 and 6.3 ppb naled, respectively (0.0076 and 0.0165 µmoles/L, respectively). Fathead minnow embryos through hatching and early growth were exposed to nominal concentrations of naled at 2.2, 4.4, 8.7, 17, and 35 ppb a.i. for 35 days. Hatch was complete in 5 days in all chambers and was unaffected by exposure to the test material. Compared to pooled controls, larval survival at hatch and at the end of the test was unaffected by the concentration of naled technical. The test was a flow-through design and mean measured naled concentrations of the test solutions were about 70 to 80% of nominal concentrations. They were 1.6, 2.9, 6.3, 13 and 27 ppb a.i., respectively. The concentration of DDVP in solution was also measured and was observed to increase over the exposure duration.

The increase in DDVP was likely due to naled degradation in the stock solution. If the concentrations of naled and DDVP are combined, the mean measured concentration can be considered "total naled equivalents" and the concentrations were therefore 1.7, 3.4, 6.9, 15, and 33 ppb naled equivalents. For this assessment, the measured naled concentrations, rather than naled equivalents, are used.

The naled acute-to-chronic ratio (ACR) for freshwater fish based on the available acute 96-hr LC50 and early life stage NOAEC data for the Fathead minnow is 1448 (ACR = 4,200 ppb a.i./2.9 ppb a.i.). Such a large difference between the acute and chronic values typically indicates that the chronic mode-of-action in fish differs from the acute mode-of-action and may require some transformation or activation step. Given this ACR value, the estimated NOAEC for Lake trout, the most acutely sensitive freshwater fish to naled, is 0.06 ppb (0.00017 µmoles/L) Table 23.

Degredate DDVP

One scientifically sound freshwater fish early life stage with Rainbow trout was submitted (MRID: 43788001) for the degredate DDVP with a post-hatch larval survival NOAEC and LOAEC of 5.2 and 10.1 ppb DDVP, respectively (0.024 and 0.046 µmoles/L). This was also the most acutely sensitive test species to DDVP.

Naled versus DDVP Sensitivity

While naled and DDVP were both tested in fish early life tests, they were not tested with the same fish species, naled was tested with Fathead minnow and DDVP with Rainbow trout, preventing any direct comparison and conclusion regarding sensitivity of freshwater fish to naled versus DDVP. Therefore, the sensitivity of early life stages to naled as compared to DDVP was made indirectly using an estimated Rainbow trout NOAEC for naled of 0.11 ppb (0.00029 µmoles/L) and a Fathead minnow NOAEC for DDVP of 610 ppb (2.8 µmoles/L), calculated using naled and DDVP freshwater fish ACR values, respectively (Table 23). Based on these measured and estimated NOAEC values, the Rainbow trout and Fathead minnow freshwater fish early life stages are estimated to be more sensitive to naled than the DDVP degredate (0.00029 and 0.076 µmoles naled/L compared to 0.024 and 2.8 µmoles DDVP/L, respectively).

Table 23. Calculation methods for determination of chronic aquatic early life stage toxicity values.

Chemical	Species	Value To Be Estimated	NOAEC - ppb	umol/L	ACR
Naled	Lake trout	Naled Lake Trout early life stage NOAEC (est)=Lake trout 96-hr LC50/naled freshwater fish ACR=92 ppb/1448	0.06	0.00017	
Naled	Rainbow trout	Naled Rainbow trout early life stage NOAEC (est)=naled Rainbow trout 96-hr LC50/naled FW fish ACR=160ppb/1448	0.11	0.00029	
Naled	Fathead minnow	Naled fathead minnow NOAEC=2.9ppb	2.90	0.00762	
Naled	ACR Calculation	Naled FW fish ACR=Fathead minnow 96-hr LC50/Fathead minnow early life stage NOAEC=3300ppb/2.9ppb			1448
DDVP	Fathead minnow	DDVP Fathead minnow early life stage NOAEC (est)= DDVP Fathead minnow 96-hr LC50/DDVP FW fish ACR=11600/19	610.53	2.76	
DDVP	ACR Calculation	DDVP Freshwater fish ACR=Rainbow trout DDVP 96-hr LC50/Rainbow trout early life stage NOAEC=100ppb/5.2ppb			19
DDVP	Rainbow Trout	DDVP Rainbow trout 96-hr LC50	5.2	0.024	

Measurement Endpoint Selected

Of the naled and DDVP fish early life stage tests, on a molar basis the naled NOAEC value of 0.0076 µmoles/L (2.9 ppb) for Fathead minnow was approximately 3.2 times more sensitive than the DDVP NOAEC of 0.024 µmoles/L (5.2 ppb DDVP) for Rainbow trout. Of these two values the more sensitive naled NOAEC of 0.0076 µmoles/L was selected for determining risk estimates for total naled residues (Table 22).

The use of the Fathead minnow NOAEC may potentially underestimate risk to some degree because it is not the most acutely sensitive species to naled. However given that under environmental conditions the half-life for naled to DDVP is less than a day, long-term exposure is likely to be to DDVP rather than the parent naled. In this case, the use of the naled value may appropriately estimate risk given that it is more sensitive than the DDVP fish early life stage value for Rainbow trout which was also the most acutely sensitive fish species to DDVP.

4.1.2 Toxicity to Freshwater Invertebrates

4.1.2.1 Freshwater Invertebrates: Acute Exposure (Mortality) Studies

Technical Grade Active Ingredient

Scientifically sound studies with naled and seven species of freshwater invertebrates, six crustaceans and one aquatic insect, were submitted by registrants (Appendix A). Species tested include the aquatic sowbug (*Asellus brevicaudus*), three species of water flea (*Daphnia magna*, *Daphnia pulex*, and *Simocephalus serrulatus*), two species of scud or amphipods (*Gammarus fasciatus* and *Gammarus lacustris*), and a stonefly (*Pteronarcys californica*). Acute toxicity values for naled range from 0.14 ppb a.i. (0.00037 µmoles/L) for the 48-hr LC50 for the *G. lacustris* amphipod (MRID#:05009242)) to 41 ppb a.i. (0.11 µmoles/L) for the 96-hr LC50 for the aquatic sowbug *A. brevicaudus* . Naled is therefore descriptively classified as very highly toxic acutely to freshwater invertebrates.

Product Formulations

No available studies conducted with product formulations have been identified for naled freshwater invertebrates.

Degredate DDVP

Scientifically sound studies with DDVP and five species of freshwater invertebrates, four crustaceans and one aquatic insect, were submitted by registrants (Appendix TBD). Species tested include two species of water flea (*D. pulex* and *S. serrulatus*), two species of scud or amphipods (*G. fasciatus* and *G. lacustris*), and a stonefly (*P. californica*). Acute toxicity values for DDVP range from 0.066 ppb (0.00030 µmoles/L) for the 48-hr EC50 for the water flea *D. pulex* to 400,000 ppb (1,810 µmoles/L) for the 96-hr LC50 for the amphipod *G. fasciatus*. The effect measured for the *D. pulex* study was immobilization as a surrogate for mortality.

Naled versus DDVP Sensitivity

Five species of freshwater invertebrates were tested with both naled and DDVP: *D. pulex*, *G. fasciatus*, *G. lacustris*, *P. californica* and *S. serrulatus*. On a molar basis, two of the five species tested (*G. fasciatus* and *G. lacustris*, both amphipods) or 40% of the species tested were 6 and 49 times more sensitive, respectively, to the parent naled than to its degredate DDVP (0.037 and 0.00037 µmoles/L versus 1.81 and 0.0023 µmoles/L, respectively). Alternatively, three of the five species (*D. pulex*, *P. californica* and *S. serrulatus*) or 60% of the species tested were about 2.5 to 46 times more sensitive to DDVP than to naled (0.00030, 0.00050 and 0.0012 µmoles/L versus 0.0011, 0.021 and 0.0029 µmoles/L, respectively).

Measurement Endpoint Selected

Based on the available naled and DDVP data, the most sensitive endpoint on a molar basis is the 48-hr EC50 water flea *D. pulex* study with DDVP (0.00030 µmoles/L). Therefore, the measurement endpoint selected for use in estimating effects to the freshwater invertebrate fauna from total naled residues (naled + DDVP) in surface water was the *D. pulex* naled result of 0.00030 µmoles/L (Table 22).

4.1.2.2 Freshwater Invertebrates: Chronic Exposure (Reproduction) Studies

Technical Grade Active Ingredient

One scientifically sound freshwater invertebrate life cycle study was submitted (MRID: 42908801). The species tested was the water flea *D. magna* and the 21-day NOAEC = 0.098 ppb (0.00026 µmoles/L) and LOAEC = 0.180 ppb (0.00047 µmoles/L). The most sensitive effect was growth as measured by length.

Degredate DDVP

A freshwater aquatic invertebrate life-cycle study (MRID: 43890301- Ward and Davis, 1995) was submitted to support the mosquito larvicide use. The study resulted in a chronic toxicity endpoint for waterflea (*D. magna*) NOAEC=0.0058 pbb (0.0000262 umoles/L), LOAEC=0.0122, based on egg production and growth (length and weight).

Naled versus DDVP Sensitivity

Daphnia magna was found to be ten times more sensitive to the degredate DDVP than to the parent naled, on a molar mass adjusted basis.

Measurement Endpoint Selected

The DDVP *D. magna* NOAEC value of 0.0058 ppb (0.000026 µmoles/L), is the most sensitive and therefore selected to determine estimates of reproductive risk for total naled residues (Table 22).

4.1.3 Toxicity to Aquatic Plants

Technical Grade Active Ingredient

Four species of freshwater aquatic plants were tested for toxic effects of naled exposure: the duckweed, *Lemna gibba*; the green algae *Selenastrum capricornutum*; the freshwater diatom *Navicula pelliculosa*; and the cyanobacteria (formerly known as bluegreen algae) *Anabaena flos-aquae*. Biomass or growth-based EC50 values for these species ranged from 25 ppb a.i. (0.0656 µmoles/L) for the freshwater diatom *N. pelliculosa*, 46 ppb (0.121 umoles/L) for the green algae *S. capricornutum* and >1,800 ppb a.i. (>4.73 µmoles/L) for the duckweed L. gibba.

To assess risk to endangered plant species, the NOAEC values, or EC05 where a NOAEC could not be determined, are used as measurement endpoints, The NOAEC value for *Navicula pelliculosa*= 4.2 ppb and the extrapolated EC05 for *S. capricornutum*= 4.2 ppb. The NOAEC= 1,800 ppb for duckweed.

The most sensitive non-vascular freshwater plant is the freshwater diatom, *Navicula pelliculosa*. Toxicity tests resulted in a 5-day EC50=25 ppb, based on cell density. The initial measured concentrations of the test solutions were 4.2, 10.0, 16.0, 30.0, 53.0 and 110.0 ppb. These values indicate average recoveries between 72 and 92%. Because the hydrolytic half-life of naled is 15.4 and 1.6 hours at pH 7 and 9, respectively, the results are therefore based on these initially measured concentrations.

In a Tier I 14-day toxicity study with the aquatic vascular plant duckweed (*L. gibba*), the EC50 and NOAEC were determined to be >1800 ppb a.i. (>4.73 µmoles/L) and 1800 ppb a.i. (4.73 µmoles/L), respectively, based on dry weight and frond production. At test termination (14 days), naled was not detected in the test solutions but the degredate DDVP was present at a concentration of 0.31 ppb (0.0014 µmoles/L). Plants exposed to the test material were curled, and appeared smaller and chlorotic, and lacked root development in comparison to the control plants but no significant difference in terms of biomass or growth were detected.

Product Formulations
No scientifically sound freshwater aquatic plant testing was performed by registrants with product formulations of naled.

Degredate DDVP
When registered, plant testing was not required for dichlorvos. The DDVP RED identified available supplemental data (F.L. Mayer, 1986; 40228401) showing 48 hour EC50 values of >100,000 ppb for green algae, 14,000 ppb for algae (species not given) and 17,00-28,000 pbb for marine diatom.

Measurement Endpoint Selected
Aquatic plant toxicity data available for naled show it to be more toxic than DDVP, based on the limited DDVP data. Therefore, naled toxicity endpoints are used to assess risk from "total naled residues."

Table 24. Aquatic Plants

Assessment Endpoint	Measurement Endpoint	Selected Study Results			
		Species	Study Duration and Measurement Endpoint	Toxicity Value —	Source and Study Classification
Reduced biomass and growth rate of aquatic plants	Most sensitive aquatic vascular plant biomass and growth rate NOAEC(1) and EC50	Duckweed *Lemna gibba*	14-D EC50	>4.73 µmoles/L (>1800 ppb a.i.)	42529601 Supplemental
			14–D NOAEC	4.73 µmoles/L[8] 1800 ppb a.i.	
	Most sensitive aquatic nonvascular plant biomass and growth rate NOAEC and EC50	Freshwater diatom *Navicula pelliculosa*	5–D EC50	0.066 µmoles/L [9] 25.0 ppb	42529603 Acceptable
			5–D NOAEC	4.2 ppb	

D = day
(1) Where a NOAEC could not be determined, an EC05 may be used as a surrogate

[8] 1,800 ppb naled ÷ 380.8 g naled/mole= 4.73 µmoles/L
[9] 25 ppb naled ÷ 380.8 g naled/mole=0.066 µmoles/L

4.1.4 Probit Slope Information for Fish and Aquatic Invertebrates

The statistical analysis of the most sensitive acute fish and invertebrate studies did not generate a probit-slope value. Therefore, when characterizing the likelihood of risk associated with the RQ values generated from the toxicity endpoints described above, the default slope (4.5) for the Individual Effects Calculation model will be used. As presented in the appendix, there were numerous fish and invertebrate studies, both with technical grade naled and DDVP and product formulations. Most studies did not report the slope of the dose-response curve. However, a review of the reported slopes indicates a broad range and therefore, the default slope will be used as a best estimate.

Chemical	**Species Name**	**Type**	**a.i.**	**96 Hr LC50 (ppb)**	**96 Hr LC50 µmols**	**Corr A.I.**	**CL**	**Curve slope**	**MRID And Classification**
Naled (Dibrom 8 EC)	Bluegill sunfish *Lepomis macrochirus*	Flow-thru	58	240	0.63	139	0.127-.357	4.26	00263578 Supplemental
Naled (Orthp Dibrom 8 EC)	Rainbow trout Oncorhynchus mykiss	Flow-thru	58	130	0.34	75	0.12-0.14	12.64	00263578 Supplemental
Naled (Ortho Fly Killer D)	Rainbow trout Oncorhynchus mykiss	Flow-thru	36	340	0.89	122	0.215-1.64	3.0	00263580 Supplemental
Naled (Ortho Fly Killer D)	Bluegill sunfish Lepomis macrochirus	Flow-thru	36	1200	3.15	432	1.0-1.3	6.44	00263580 Supplemental

4.2 Evaluation of Terrestrial Ecotoxicity Studies

As described in the Agency's Overview Document (U.S. EPA, 2004), the most sensitive endpoint for each taxa is used to calculate risk for a taxa. For this assessment, evaluated taxa relevant to the terrestrial habitat of the CRLF include birds as a surrogate for effects to terrestrial-phase amphibians and reptiles, and small mammals, insects, and terrestrial and riparian plants representing the CRLF critical habitat. Currently, no guideline tests exist for direct effects to terrestrial-phase frogs. Therefore, birds are used as a surrogate species for terrestrial-phase amphibians as described in the Overview Document (U.S. EPA, 2004). Table 25 summarizes the most sensitive terrestrial organism toxicity endpoints (naled or DDVP, as appropriate) for the terrestrial-phase CRLF, its terrestrial prey and habitat, based on an evaluation of both the submitted studies and the open literature for birds, mammals, plants, and insects as discussed in Sections 4.2.1, 4.2.2, 4.2.3, and 4.2.4, respectively.

Several studies were submitted on the toxic effects of naled exposure to terrestrial organisms. Bird species tested include Mallard duck (*Anas platyrhynchos*), Canada goose (*Branta Canadensis*), Sharp-tailed grouse, Bobwhite quail (*Colinus virginianus*), Ring-necked pheasant, and Japanese quail (*Coturnix japonica*). Laboratory studies on mice and rats were evaluated to assess indirect effects to the CRLF via toxicity to prey items (i.e. small mammals). Finally, submitted toxicity studies of honey bee exposure to naled are also used to evaluate indirect effects via prey items (insects).

Table 25. Selected toxicity endpoints for terrestrial organisms, including avian, mammalian and invertebrates.

Assessment Endpoint	Measurement Endpoint	Selected Study Results				
		Chemical	**Species**	**Study Duration and Measurement Endpoint**	**Toxicity Value**	**Source and Study Classification**
Survival and Reproduction of Birds, Reptiles and Amphibians	Most sensitive avian acute oral toxicity, LD50 (single-dose)	Naled	Mallard duck *Anas platyrhynchos*	14-D LD50	36.90 mg/kg-bw	00160000 Acceptable
	Most sensitive acute avian dietary toxicity	Naled	Japanese quail *Coturnix japonica*	8-D LC50	1327 mg/kg-diet	00022923 Acceptable
	Most sensitive avian reproductive toxicity NOAEC	Naled	Mallard duck *Anas platyrhynchos*	22-WKS NOAEC	266 mg/kg-diet	44517902 Acceptable
Survival and Reproduction of Terrestrial Mammals	Most sensitive acute oral toxicity, LD50 (single-dose)	Naled	Rat (female)	LD50	0.24 mmoles/kg-bw (92 mg/kg-bw)	142660
	Most sensitive reproduction NOAEL[1]	Naled	Rat	LD50	0.016 mmoles/L (6 mg/kg-bw/day)	146498
Survival of Terrestrial Invertebrates and beneficial insects	Most sensitive acute contact LD50 (µg/bee)	Naled	Honey bee *Apis mellifera*	48-hr LD50	0.0013 umoles/bee (0.48 µg/bee or 3.75 ppm[10])	00036935

[1] The most sensitive endpoint, parental systemic effects NOAEL= 6 mg/kg-bw/day will be used to calculate a chronic RQ value.

[10] See Appendix G for calculation

Assessment Endpoint	Measurement Endpoint	Selected Study Results				
		Chemical	Species	Study Duration and Measurement Endpoint	Toxicity Value	Source and Study Classification
Survival and Reproduction of Birds, Reptiles and Amphibians	Most sensitive avian acute oral toxicity, LD50 (single-dose)	DDVP	Mallard duck *Anas platyrhynchos*	14-D LD50	0.035 mmoles/kg-bw[11] (7.8 mg/kg-bw)	00160000 Acceptable
	Most sensitive acute avian dietary toxicity	DDVP	Japanese quail *Coturnix japonica*	8-D LC50	1.35 mmoles/kg-diet (298 ppm)	0022923 Supplemental
	Most sensitive avian reproductive toxicity NOAEC	DDVP	Mallard duck *Anas platyrhynchos*	22-WKS NOAEC	0.023 mmoles/kg-diet (5 ppm)	44233401 Acceptable
Survival and Reproduction of Terrestrial Mammals	Most sensitive acute oral toxicity, LD50 (single-dose)	DDVP	Rat (female)	Acute Oral LD50	56 mg/kg-bw	MRID# 0005467 (from DDVP RED)
	Most sensitive reproduction NOAEL[1]	DDVP	Rat	Acute Oral LD50	2.30 mg/kg-bw	From DDVP RED
Survival of Terrestrial Invertebrates and beneficial insects	Most sensitive acute contact LD50 (µg/bee)	DDVP	Honey bee *Apis mellifera*	48-hr LD50	0.495 ug/bee	MRID # 00036935 (Atkins et al 1975) (From DDVP RED)

4.2.1 Toxicity to Birds

4.2.1.1 Birds: Acute Exposure (Mortality) Studies

Technical Grade Active Ingredient

The only available avian acute oral study is one published by the Fish and Wildlife Service, US Department of Interior, 1970. In the study, three species of birds were evaluated: mallard duck (*Anas platyrhynchos*), Canada goose (*Branta canadensis*), and sharp tailed grouse (*Tympanuchus phasianellus*). The resultant acute oral LD50 values were 52.2, 36.9, and 64.9 mg/kg-bw, respectively (0.137, 0.097, and 0.170 mmoles/kg-bw, respectively). (MRID: 00075226). For all species, signs of intoxication included ataxia, goose-stepping, ataxia, tachypnea, salivation, tremors, loss of righting reflex, violent wing-beat convulsions, and opisthotonos. Signs appeared as soon as 5 minutes and mortalities usually occurred between 15 minutes and 3.5 hours after treatment;

[11] 7.8 mg DDVP/kg-bw / 220.98 g DDVP/mole DDVP= 0.035mmmoles/kg-bw

however, one pheasant died between 2 and 3 days after treatment. Remission took up to 2 weeks. A treatment level as low as 22.2 mg/kg caused a mortality in Canada geese.

Degredate DDVP
Three species of birds were tested with DDVP and include the Bobwhite quail (*Colinus virginiaus*), Mallard duck (*A. platyrhynchos*), and Ring-necked pheasant *(Phasianus colchicus)* . The LD50 values ranged from 7.8 mg/kg-bw (0.035 mmoles/kg-bw) for the Mallard duck to 11.3 mg/kg-bw (0.051 mmoles/kg-bw) for Ring-necked pheasant (MRID for both results: 00075226 and Accession #: 224035).

Acute symptoms included goose stepping ataxia, use of wings to aid in balance, tremors, and convulsions. The data are considered scientifically sound as supplementary data , but do not fulfill core Guideline requirements for an avian acute oral study. This study does not satisfy core data requirements because of lack of reporting on dose levels tested, number of birds tested per level , mortality/dosage data, and study only tests one sex of both mallards and pheasants. The data indicate that technical DDVP is highly toxic to waterfowl and upland game species.

Naled versus DDVP Sensitivity
One species of bird was tested with both naled and DDVP, the Mallard duck. On a molar basis the Mallard duck was approximately 4 times more sensitive to the degredate DDVP than to the parent naled (0.035 mmoles/kg-bw versus 0.137 mmoles/kg-bw, respectively). Although the other species tested with DDVP (Bobwhite quail and Japanese quail) did not have naled counterparts, both of these species on a molar basis had LD50 values lower than the three species tested with naled. Based on this data birds appear to be more acutely sensitive to the degredate DDVP than to the parent naled.

Measurement Endpoint Selection

Based on the available naled and DDVP data, the most sensitive endpoint on a molar basis is the LD50 Mallard duck study with DDVP (0.035 mmoles/kg-bw). Therefore, this is the acute oral measurement endpoint selected for use in estimating effects to bird fauna and the taxa for which they are a surrogate (i.e., amphibians and reptiles) DDVP exposure. For naled exposure, the most sensitive acute oral value is for Canada goose. (Table 25).

4.2.1.2 Birds: Subacute Dietary Exposure (Mortality and Growth) Studies

Technical Grade Active Ingredient
In a subacute study testing numerous pesticides in the diet, the effects of naled were evaluated on four avian species: Bobwhite quail, Japanese quail, Ring-necked pheasant (*Phasianus colchicus*), and Mallard duck. The resulting 5-day dietary LC50 values ranged from 1,327 ppm (3.48 mmoles/kg-diet) for the Japanese quail to 2,724 ppm (7.15 mmoles/kg-diet) for the Mallard duck. The LC50 is defined as ppm naled (mmoles/kg-diet) in an ad libitum diet expected to produce 50 percent mortality among 2- to 3-week-old birds in 8 days comprising 5 days on treated diet followed by 3 days on untreated diet.

Product Formulations
Product formulation toxicity data is not available from either submitted studies or the open literature.

Degredate DDVP
Three species of birds were tested with DDVP and include the Mallard duck, the Japanese quail, and the Ring-necked pheasant (MRID: 00022923). The Mallard duck was tested both with 5 day old birds and 16 day old birds. The LC50 values ranged from 298 ppm (1.35 mmoles/kg-diet) for the Japanese quail to >5,000 ppm (>22.63 mmoles/kg-diet) for the 16 day old Mallard ducks. Based on the Mallard duck studies, even the slight age difference between the birds appears to affect sensitivity to DDVP with the younger 5 day old birds being more sensitive than the 16 day old birds (1,317 ppm versus >5000 ppm, respectively).

Naled versus DDVP Sensitivity
Three species of birds were tested with both naled and DDVP, the Japanese quail, the Ring-necked pheasant, and the Mallard duck On a molar basis the Ring-necked pheasant and Japanese quail were approximately 2.6 times more sensitive to the degredate DDVP than to the parent naled (2.57 and 1.35 mmoles/kg-diet versus 6.66 and 3.48 mmoles/kg-diet, respectively). While the Ring-necked pheasant naled and DDVP tests both used 10 day old birds at test initiation, younger birds were tested with DDVP than naled for Japanese quail (14 days old versus 17 days old, respectively) and may account for some of the difference in sensitivity as discussed earlier, even slight differences in age were noted to impact sensitivity. While the 5 day old Mallard duck DDVP test result was lower than the 10 day old Mallard duck naled test result (5.96 mmoles/kg-diet versus 7.15 mmoles/kg-diet), the 14 day old Mallard duck DDVP test result was higher (>22.63 mmoles/kg-diet versus 7.15 mmoles/kg-diet). Based on data for these species, there is some indication that birds of a similar age may be more sensitive to DDVP in the diet than to naled.

Measurement Endpoint Selected
Based on the available naled and DDVP data, the most sensitive endpoint on a molar basis is the LC50 Japanese quail study with DDVP (1.35 mmoles/kg-bw). Therefore, this is the dietary measurement endpoint selected for use in estimating effects to bird fauna and the taxa for which they are a surrogate (i.e., amphibians and reptiles) from DDVP exposure. For naled exposure, the LC50=1327 ppm for Japanese quail will be used (Table 25).

4.2.1.3 Birds: Chronic Exposure (Reproduction) Studies

Technical Grade Active Ingredient
Two studies on the toxic effects of naled to reproduction of birds were submitted. The test species were the Northern bobwhite quail (MRID: 44517901) and the Mallard duck

(MRID: 44517902). The more sensitive species was the Northern bobwhite quail, with a LOAEC of 130 ppm a.i. (0.34 mmoles/kg-diet) and a NOAEC of < 130 ppm a.i. (<0.34 mmoles/kg-diet), based on significant reductions in body weight of males. At this treatment level, the average weight of a male bird was 10 grams less than the control. The results of the Mallard study, based on reductions in egg production (eggs laid, egg set, etc.) and in percentage of eggs set and eggs laid were a LOAEC of 520 ppm a.i. (1.37 mmoles/kg-diet) and a NOAEC of 260 ppm a.i. (0.68 mmoles/kg-diet). The more sensitive endpoint will be used to assess risk to the CRLF. The following reproductive endpoints were measured in both studies: eggs laid, eggs cracked, eggs set, viable embryos, live 3-week embryos, normal hatchlings, weights for 14-day-old survivors, egg shell thickness, total food consumption, and initial and final body weights, by sex.

Degredate DDVP
Two species of birds were tested with DDVP and include the Mallard duck (MRID: 44233401) and the Northern bobwhite quail (MRID: 43981701). The Mallard duck was more sensitive to DDVP than the Northern bobwhite quail. The NOAEC for the Mallard duck, based on a reduction in eggshell thickness and a reduction in the # of eggs laid, eggs set, viable embryos and live three-week embryos was 5 ppm (0.023 mmoles/kg-diet) and the LOAEC was 15 ppm (0.068 mmoles/kg-diet). The NOAEC for the Northern bobwhite quail, based on eggs laid, viable embryos, live three-week embryos, normal hatchlings, 14-day old survivors, 14-day survivor weight, food consumption, terminal adult male and female body weight was 30 ppm (0.136 mmoles/kg-diet) and the LOAEC =100 ppm (0.453 mmoles/kg-diet).

Naled versus DDVP Sensitivity
Two species of birds were tested with both naled and DDVP, the Mallard duck and the Northern bobwhite quail. On a molar basis the Mallard duck was approximately 30 times more sensitive to the degredate DDVP than to the parent naled (0.023 versus 0.683 mmoles/kg-diet, respectively). While the Northern bobwhite quail test with naled did not result in a definitive NOAEC, given that at the lowest dietary concentration tested (0.341 mmoles/kg-diet) the difference from the control was approximately 5 percent for male body-weight, it appears that this species too is more sensitive to DDVP than to naled.

Measurement Endpoint Selected
Based on the available naled and DDVP data, the most sensitive endpoint on a molar basis is the NOAEC from the reproduction test with the Mallard duck and DDVP (0.023 mmoles/kg-diet). Therefore, this is the dietary measurement endpoint selected for use in estimating effects to bird fauna and the taxa for which they are a surrogate (i.e., amphibians and reptiles) from DDVP exposure. For naled exposure, the NOAEC for the Mallard duck will be used. (Table 25).

4.2.2 Toxicity to Mammals

Data are available for a number of mammalian endpoints, including mortality from acute oral, dermal or inhalation exposure, primary eye irritation, primary dermal irritation and dermal sensitization. EFED does not have quantitative methods to evaluate the risk from inhalation, dermal or ocular exposures, the data are included for risk characterization (Table 26).

Table 26. Acute Mammalian Toxicity for Technical Naled and DDVP

	Naled		**DDVP**	
Test	**Results**	**Source**	**Result**	**Source**
Acute Oral LD50	Rat Corn oil carrier: 325 mg/kg-b (0.853 mmoles/kg-bw) (M); 230 mg/kg-b (0.604 mmoles/kg-bw) (F) Carboxymethyl-cellulose[2] carrier: 191 mg/kg-bw (0.502 mmoles/kg-bw) (M); 92 mg/kg-bw (0.242 mmoles/kg-bw) (F)	00142660	Rat 80 mg/kg-bw (0.362 mmoles/kg-bw) (M) 56 mg/kg-bw (0.253 mmoles/kg-bw) (F)	00005467
Acute Dermal LD50	Rabbit 390 mg/kg-bw (1.024 mmoles/kg-bw) (M) 360 mg/kg-bw (0.945 mmoles/kg-bw) (F)	00146493	Rat 107 mg/kg-bw (0.484 mmoles/kg-bw) (M) 75 mg/kg-bw (0.339 mmoles/kg-bw) (F)	00005467
Acute Inhalation LC50	Rat 0.20 mg/L (0.00053 mmoles/L) (M) 0.19 mg/L (0.00050 mmoles/L) (F) for 4 hr. exposure	00146494	> 0.198 mg/L (>0.0090)	00137239
Primary eye irritation[1]	Rabbit Severe irritation	00074826	Mild irritant	00146921
Primary dermal irritation[1]	Rabbit Corrosive (escharotic)	00074825	Mild irritant	00146920
Dermal sensitization[1]	Guinea pig Weakly positive	00074657	No study available	None

[1] Data pertaining to eye irritation, dermal irritation and skin sensitization are not required to support the reregistration of the TGAI. These data are presented for information purposes.

[2]A preliminary study to a cytogenetics assay obtained somewhat lower oral LD_{50} values of 85.1 mg/kg/day for male rats and 81.2 mg/kg/day for females using CMC as the vehicle (MRID 00142665).

4.2.2.1 Mammals: Acute Exposure (Mortality) Studies

Technical Grade Active Ingredient

The most sensitive acute oral rat LD50 value is 92 mg/kg-bw (0.242 mmoles/kg-bw).

The acute oral studies indicated that naled was more toxic when administered as an aqueous suspension in 0.5% carboxymethylcellulose (CMC) than when administered as a corn oil preparation. Acute mammalian toxicity data for naled and DDVP are presented in Table 26 above.

Degredate DDVP
Acute oral studies with DDVP resulted in LD50=56 mg/kg-bw (0.253 mmoles/kg-bw) for females rats and 80 mg/kg-bw (0.362 mmoles/kg-bw) for males.

Naled versus DDVP Sensitivity
On a mass adjusted basis, the toxicity of DDVP and naled to rats is similar. Naled is slightly more toxic, with an LD50=0.242 mmoles/kg-bw vs a DDVP LD50=0.253 mmoles/kg-bw.

Measurement Endpoint Selected
Both naled and DDVP acute oral endpoints, as identified above, will be used to estimate indirect effects.

4.2.2.2 Mammals: Chronic Exposure (Reproduction) Studies

Technical Grade Active Ingredient
The most sensitive reproductive rat NOAEL = 6 mg/kg-bw. A two-generation reproduction study was conducted with Sprague-Dawley-derived Charles River CD rats. Naled was administered at doses of 0, 2, 6, or 18 mg/kg-bw/day by gavage. Systemic effects were observed in adult male rats of both generations. Body weight gain was depressed at the 18 mg/kg-bw/day dose for F0 males and at all dose levels for F1 males. Reproductive indices were unaffected in both generations. Survival of pups was reduced at 18 mg/kg-bw/day in the F1 and F2b generations. A consistent decrease in pup weight was also noted during lactation in both generations. The NOAEL for parental systemic effects was 6 mg/kg-bw/day. The LOAEL was 18 mg/kg-bw/day based on decreased body weight gain in both generations. The reproductive toxicity NOAEL was 18 mg/kg-bw/day, which was the highest dose tested (MRID 00146498).

The most sensitive endpoint, parental systemic effects NOAEL= 6 mg/kg-bw/day will be used to calculate a chronic RQ value.

Degredate DDVP
The most sensitive reproductive rat parental/systemic NOAEL = 2.3 mg/kg-bw/day and LOAEL=8.3 mg/kg-bw/day (MRID: 42483901- Revised Human Health Risk Assessment for Dichlorvos March 26, 2002). The endpoint is based on decreased percent of females with estrous cycle and increased percent of females with abnormal cycling. The offspring NOAEL=2.3 mg/kg-bw/day, LOAEL=8.3 mg/kg-bw/day based on reduced number of dams bearing litter, fertility index, pregnancy index and pup weight.

4.2.2.3 Mammals: Sublethal Effects and Open Literature Data

A 13-week inhalation study exposed male and female Fischer-344 rats to filtered air (control group) or aerosols containing 0.2, 1, or 6 μg/L of naled for 6 hours/day, 5 days/week. Additional control and high-dose groups recovered for six weeks. Exposure to the highest concentration of 6 μg/L resulted in clinical signs of toxicity manifested as tremors, salivation, nasal discharge, abnormal respiration and anogenital staining. The clinical signs were consistent with cholinergic effects and the observed inhibition of ChE activity. Brain ChE was inhibited at 6 μg/L, while plasma and RBC cholinesterases were inhibited at 1 and 6 μg/L. Only plasma ChE continued to be inhibited six weeks after exposure to the high concentration. No other treatment-related effects were observed. The NOAEL for ChE inhibition was 0.2 μg/L and the LOAEL was 1 μg/L based on depression of plasma (25-30% throughout the study) and RBC (50-60% early in study and 25-30% at 13-weeks) ChE activities. The NOAEL for systemic toxicity was 1 μg/L and the LOAEL was 6 μg/L based on clinical signs of toxicity (MRID 00164224).

A 28-day dermal study conducted with male and female CD/Sprague-Dawley rats applied naled to intact skin at dose levels of 0, 1, 20, or 80 mg/kg-bw/day for 6 hours/day, 5 days/week. Carboxymethylcellulose was the vehicle. The two highest doses were extremely irritating to the skin and produced severe erythema and edema, necrosis and exfoliation. After 28 days, histopathological findings in the skin included acute ulcerative inflammation, necrosis and epidermal hyperplasia. Exposure to 20 and 80 mg/kg-bw/day also produced systemic toxicity. Body weight gain by males was depressed despite increased food consumption. Plasma, RBC and brain cholinesterases were inhibited by 20 and 80 mg/kg-bw/day. Other treatment-related findings were confined to the 80 mg/kg-bw/day groups. Liver and adrenal weights of females were increased and clinical chemistry changes were suggestive of mild renal effects. Both sexes displayed increased blood urea nitrogen and decreased creatinine, total protein and albumin. No treatment-related histopathological changes were observed other than those of the skin. The NOAEL was 1 mg/kg-bw/day for dermal irritation, systemic toxicity and ChE inhibition. The LOAEL was 20 mg/kg-bw/day based on the findings of dermal irritation, reduced weight gain and ChE (60% brain, approximately 50% plasma and approximately 25% RBC) inhibition (MRID 00160750).

In a 28-day oral study rats (10/sex/dose level) received 0, 0.25, 1, 10 or 100 mg/kg/day of naled by gavage. The 100 mg/kg-bw/day dose level produced mortality and marked cholinergic signs. The 10 mg/kg/day dose produced mild cholinergic signs and 50% reduction in plasma and brain ChE. The 1 mg/kg-bw/day dosage produced 15% plasma ChE inhibition without clinical signs. Although this study was classified as supplemental, it was adequate to establish a NOAEL of 1 mg/kg-bw/day and a LOAEL of 10 mg/kg-bw/day based on cholinergic effects (MRID 00088871).

Sublethal endpoints will not be used to assess risk because the acute mortality endpoints are more sensitive.

4.2.3 Toxicity to Terrestrial Plants

There are no submitted plant toxicity studies for naled. In lieu of registrant submitted data, there are a number of alternatives to assessing plant toxicity. First, naled is foliarly applied to agricultural crops. The label cautions that application under certain conditions (humidity, etc) will result in crop damage and there are reported incidents that give validity to this warning. However, effects to plants include spots and burns and significance of such an effect is unknown.

Koike et al. (1997) found that naled was associated with celery petiole damage that could cause mature plants to be unmarketable. Affected plants exhibited sunken, brown to tan, dry areas or lesions on the lower portions of petioles. Even with trimming to remove damaged areas, when the lesions affect inner, young petioles the plants were not salable for fresh market purposes. These problems were only observed on plants to which naled was applied by ground spray, not by air.

In the absence of phytotoxicity data and given plant incidents, crop tolerance studies and label warnings risk to plants from naled application must be assumed.

4.2.4 Toxicity to Terrestrial Insects

4.2.4.1 Insects: Acute Exposure (Mortality) Studies

Technical Grade Active Ingredient

Naled was shown to be highly toxic to honey bees (MRID 00036935, 00037799, 00060628, 05011163) and alfalfa leafcutter bees (0500083, 00060628) when bees were exposed to direct treatment or to short-term (less than three hours) residues.

Treatments were made by hand to small plots of alfalfa (MRID: 00037799). Cages of bees were placed in the plots prior to treatment. At intervals after treatment, foliage samples from each plot were placed in cages and the cages were loaded with bees. Bees were checked for mortality after 24 hours. At 1 lb a.i./A, both dibrom formulations caused 100% mortality of bees treated during the application. All bees were dead within 30 minutes. Three hour residues of the WP formulation (1 lb a.i./A) caused 100% mortality, while residues of the E formulation (same time and rate) caused 59% mortality. 24-hour residues were not toxic to honey bees.

Short-term residues were moderately to highly toxic to alkali bees (0500083, 00060628). In all of the above studies which dealt with residues, data indicated a significant decrease in residual toxicity from 3 to 24 hours post-treatment.

In another study (MRID: 05000837), field-weathered residue samples were obtained by applying the recommended rates of various insecticides to 1/100-acre plots of alfalfa with a hand sprayer at 25 gal/acre and 20 psi pressure. Sample foliages were collected from each plot at desired post-application intervals, chopped and placed in various bee cages. The experiments were conducted with four replicates and mortality was checked at 24 hours. Experimental conditions for various bees were described as follows:

A) Honey bees: 50-100 bees/cage were fed sugar syrup and held at 78 degrees Fahrenheit
B) Alkali bees and alfalfa leafcutter bees: 10-15 alkali bee/cage or 20-30 leafcutter bees/cage were fed with honey syrup at 88 degrees Fahrenheit.

Susceptibility of three most important bee pollinators to 25 common insecticides were compared. The typical pattern of susceptibility is in descending order from alfalfa leafcutter bee > alkali bee > honey bee in 17 of the 25 insecticides tested. For naled, the order was the same.

Naled was determined to be highly toxic to honey bees in a laboratory acute contact toxicity test (MRID: 00036935). A bell-jar vacuum duster is used to apply the pesticide, mixed with a pyrolite dust diluent. Dosages of dust were weighed, bees were aspirated into dusting cages and treated, and bees were then transferred into holding cages. Observations are recorded at 12, 24, 48, 72, and 96 hours. When test bees were exposed to direct treatment, LD50 was determined to be 0.480 micrograms per bee, with a reported slope value of 18.18.

Degredate DDVP

Results of a honey bee (*Apis mellifera*) acute contact study using the TGAI for DDVP resulted in an acute LD50= 0.495 ug/bee. An analysis of the results indicate that DDVP is categorized as being highly toxic to bees on an acute contact basis. A study of the toxicity of residues on foliage to honey bees using the typical end-use product was required for DDVP in the 1987 Standard to support the terrestrial non-food and domestic outdoor sites. The study submitted showed residues of Dichlorvos 4E applied at 0.5 lb ai/A were practically nontoxic to honey bees at three hours post treatment.

Naled versus DDVP Sensitivity

Based on the limited toxicity data available for DDVP and naled, honey bee is more sensitive to naled than to DDVP and toxic residues of both quickly dissipate as demonstrated in the foliage study above.

Measurement Endpoint Selected

Naled toxicity endpoints will be used to estimated risk to terrestrial insects from exposure to total naled residues.

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

The statistical analysis of the most sensitive bird and mammal studies did not generate a probit-slope value. Therefore, when characterizing the likelihood of risk associated with the RQ values generated from the toxicity endpoints described above, the default slope (4.5) for the Individual Effects Calculation model will be used. As presented in the appendix, there were numerous studies, with naled and DDVP. Most studies did not report the slope of the dose-response curve. However, a brief review of reported slopes indicates a broad range, and therefore use of the default slope is the best estimate.

For terrestrial insects, a probit-slope value of 18.2 is reported. This value will be used to characterize the likelihood of risk to individuals with the Individual Effects Calculation model.

4.4 Incident Database Review

4.4.1 Insects

I005855-001
On August 26, 1997 the American Beekeeping Federation, Inc. submitted a report to the U.S. EPA to let EPA know about the ongoing problem of bees being killed by the pesticides in the United States, one of which was naled. Purpose was to be aware of the severity of the bee kill situation and which may not be overlooked while revising or significantly changing the pesticide labels. The incidents included took place between January 1 and June 16, 1997.

I005980-002
Beekeepers observe damage to their beehive caused by a pesticide, initially identified as naled formulations. Because of conflict between needing to move the bees out of harm's way and collection of bees by officials it is difficult to collect bees in order to file a report of loss in sufficient time, especially given that residues quickly dissipate.

I003870-001
A private citizen who lives on a narrow finger of land surrounded by Newport and Synepuxent Bay, complained about the aerial spraying of the area with Dibrom (Naled). No data of any kind were reported. The report provides subjective observations by the citizen of the eradication of dragonflies, butterflies, praying mantis, honey bees and other insects and birds associated with water. This is a revision of the incident reported earlier as #I003750-001.

4.4.2 Birds

I003062-001
To comply with 6(a)2 regulations, Valent Corp. reported a complaint (neither state nor county identified) that a bird died as the result of exposure to Naled. The symptom was marked as "respiratory arrest" and no other information was provided.

B0000-506-03
A citizen of Minoa, NY, reported the death of approximately 60 pheasants on his farm, to a State agency that was not identified in the file item. He made the following (approximate) statement: "Despite his request to the Onondaga Health Dept. that they not spray (Dibrom 14, 1.5 oz/acre) the road in front of his house, his property was sprayed on July 14 (12:15 AM, and a second pass was made at 12:35). Over the next couple of days birds died. Symptoms began within 6 hours and included limping , followed by leg paralysis and death. He felt birds dying after day 1 did so because they stopped eating. Dead by July 19 were 60 pheasants and 3 turkeys. Also dying were

several barn swallows nesting on his barn. The portion of his flock that was left indoors were not exposed to the spray and they were unaffected."

Health Department officials took birds for analysis but seemed interested in bacterial causes and discounted the possibility of pesticides as a factor.

4.4.3 Plants

I002969-055
The product caused defoliation of cotton plant. Injury was attributed to fertilizer burn or tank contamination.

I012366-025
To comply with 6(a)2 requirements, Dow reported a complaint from Fresno, CA, that LORSBAN 4E damaged a total of 751 acres of cotton. There were 4 growers who had 9 fields ranging from 34 acres to 155 acres. One applicator sprayed aerially the various fields with Lorsban @ 1 qt/acre, Dibrom @ 1 pt/acre, and Britz Buffer @ 3.2 oz/acre; the Britz Buffer is a petroleum distillate and contains no pesticide. Different varieties of cotton were used by the various growers. Some of the fields were sprayed in the morning, and some in the afternoon or evening. There is reason to think that spraying in the morning caused less damage than spraying in the afternoon; whether the effect of temperature alone was the operative factor is not known, but in all cases the temperatures were in the 60s in the morning and in the high 90s in the afternoon. Symptoms of damage were burned leaves and dropped bolls, and the yield losses ranged from 250- to 470-pounds/acre.

I007467-021
Celery was damaged by product Dibrom showing celery skin burn.

4.4.4 Fish

B0000-501-32
A fish kill took place in Snodgrass Slough, Sacramento County, on September 2, 1977. Approximately 6000-7000 fish were killed, of which approximately 75% were game fish. A field of tomatoes adjacent to the area of the fish loss had been sprayed with Dibrom and Toxaphene. Analyses of water samples showed no Dibrom but a low level of toxaphene (six days after the event took place).

I014341-015
This is a spreadsheet report from the Washington State Department of Agriculture. It is in table format with minimal data to make a judgement. The report only gives the year of the incident, not the month. Kill magnitude was unknown.

4.5 Uncertainties Related to the Use of Incident Information from the Ecological Incident Information System

Incident data are used in risk assessments to provide evidence that the risk predictions from the screening level assessment are supported by actual effects in the field. Incident reports submitted to EPA since approximately 1994 have been tracked by assignment of incident numbers in an Incident Data System (IDS), microfiched, and then entered to a second database, the Ecological Incident Information System (EIIS). Additionally, there is an on-going effort to enter information to EIIS on incident reports received prior to establishment of current databases. Incident reports are not received in a consistent format (*e.g.*, states and various labs usually have their own formats), may involve multiple incidents involving multiple chemicals in one report, and may report on only part of a given incident investigation (*e.g.*, residues).

Incidents entered into EIIS are categorized into one of several certainty levels regarding the likelihood that a particular pesticide is associated with the incident: highly probable, probable, possible, unlikely, or unrelated. In brief, "highly probable" incidents usually require carcass residues and/or clear circumstances regarding the exposure. "Probable" incidents include those where residues were not available and/or circumstances were less clear than for "highly probable." "Possible" incidents include those where multiple chemicals may have been involved and it is not clear what the contribution was of a given chemical. The "unlikely" category is used, for example, where a given chemical is practically nontoxic to the category of organism killed and/or the chemical was tested for but not detected in samples. "Unrelated" incidents are those that have been confirmed to be not pesticide-related.

Incidents entered into the EIIS are also categorized as to use/misuse. Unless specifically confirmed by a state or federal agency to be misuse, or there was very clear misuse such as intentional baiting to kill wildlife, incidents are not typically considered misuse.

The number of documented kills in EIIS is believed to be a small fraction of total mortality caused by pesticides. Mortality incidents must be seen, reported, investigated, and have investigation reports submitted to EPA to have the potential for entry into the database. Incidents often are not seen, due to scavenger removal of carcasses, decay in the field, or simply because carcasses may be hard to see on many sites and/or few people are systematically looking. Poisoned animals may also move off-site to less conspicuous areas before dying. Incidents may not get reported to appropriate authorities capable of investigating the incident for a variety of reasons including the finder may not know of the importance of reporting incidents, may not know who to call, may not feel they have the time or desire to call, or may hesitate to call because of their own involvement in the kill. Incidents reported may not get investigated if resources are limited or may not get investigated thoroughly, with residue analyses, for example. Also, if kills are not reported and investigated promptly, there will be little chance of documenting the cause, since tissues and residues may deteriorate quickly. Reports of investigated incidents often do not get submitted to EPA, since reporting by states is voluntary.

Furthermore, the database relies heavily on registrant-submitted incident reports, and registrants are currently only required to submit detailed information on ‘major’ ecological incidents, while ‘minor’ incidents are reported aggregately.

Based on the 40 CFR (§159.184 Toxic or adverse effect incident reports), an ecological incident is considered ‘major’ if any of the following criteria are met:

> *Fish or wildlife:*
>
> (A) Involves any incident caused by a pesticide currently in Formal Review for ecological concerns.
>
> (B) Fish: Affected 1,000 or more individuals of a schooling species or 50 or more individuals of a non-schooling species.
>
> (C) Birds: Affected 200 or more individuals of a flocking species, or 50 or more individuals of a songbird species, or 5 or more individuals of a predatory species.
>
> (D) Mammals, reptiles, amphibians: Affected 50 or more individuals of a relatively common or herding species or 5 or more individuals of a rare or solitary species.
>
> (E) Involves effects to, or illegal pesticide treatment (misuse) of a substantial tract of habitat (greater than or equal to 10 acres, terrestrial or aquatic).
>
> *Plants*:
>
> (A) The effect is alleged to have occurred on more than 45 percent of the acreage exposed to the pesticide.

All other ecological incidents are considered ‘minor’ and only need to be aggregately reported. ‘Minor’ incidents reported by the registrants are not included in the EIIS database. Therefore, for example, an incident could affect 900 fish, 150 birds, 45 mammals, and 40% of an exposed crop and not be included in the EIIS database [unless is it reported by a non-registrant (*e.g.*, an incident submitted by a state agency – which are not systematically collected)]. Therefore, because the number of documented kills in EIIS is believed to be a small fraction of total mortality caused by pesticides, absence of reports does not necessarily provide evidence of an absence of incidents.

5.0 Risk Characterization

Risk characterization is the integration of the exposure and effects characterizations to determine the potential ecological risk from naled uses and potential of direct and indirect effects on the CRLF and its designated critical habitat. The risk characterization provides an estimation and description of the likelihood of effects; it articulates risk assessment assumptions, limitations, and uncertainties; and synthesizes an overall conclusion regarding the effects determination (i.e., "no effect," "likely to adversely affect," or "may affect, but not likely to adversely affect") for the CRLF.

5.1 Risk Estimation

Risk is estimated by calculating the ratio of exposure to toxicity. This ratio is the risk quotient (RQ), which is then compared to established acute and chronic levels of concern (LOCs) for each category evaluated (APPENDIX I). For acute exposures to the CRLF and its animal prey in aquatic habitats, as well as terrestrial invertebrates, the LOC is 0.05. For acute exposures to the CRLF and mammals, the LOC is 0.1. The LOC is 1.0 for chronic exposures to CRLF and its prey, as well as acute exposures to plants.

Risk to the aquatic-phase CRLF is estimated by calculating the ratio of exposure to toxicity using 1-in-10 year EECs based on the label-recommended naled usage scenarios summarized in Table 10 and the appropriate aquatic toxicity endpoint from Table 22. Risks to the terrestrial-phase CRLF and its prey (e.g. terrestrial insects, small mammals and terrestrial-phase frogs) are estimated based on exposures resulting from applications of naled (Table 17 through Table 20) and the appropriate toxicity endpoint from Table 25 and Table 26. Exposures are also derived for terrestrial plants, as discussed in Section 3.3 and summarized in Table 21, based on the highest application rates of naled use within the action area.

5.1.1 Direct Effects to the CRLF

5.1.1.1 Aquatic-Phase CRLF

Direct acute effects to the aquatic-phase CRLF are based on modeled peak EECs in a small surface water body and the lowest acute toxicity value for freshwater fish. Direct chronic risks to the CRLF are calculated using modeled 60-day EECs and the lowest chronic toxicity value for freshwater fish. As discussed in detail in Section 3.1, surface water EECs were modeled for 27 specific use scenarios which model directly or indirectly all registered agricultural and non-agricultural uses except indoor and spot treatment uses. Table 10 provides a list of the 27 scenarios and the uses they cover, PRZM scenario used, the number of applications, application rate, application method, and modeled spray drift percentage.

Screening-level RQs are based on the most sensitive endpoints and modeled EECs in aquatic systems from the following scenarios for naled:

- CA almond STD
- CA row crop RLF
- CA cole crop RLF
- CA lettuce STD
- CA melons RLF
- OR hops
- CA cotton STD
- CA grapes STD
- CA citrus STD
- CA fruit STD
- CA wheat RLF
- CA strawberry (non plastic) RLF
- CA sugarbeet OP
- CA forestry RLF
- CA Nursery
- CA impervious RLF
- CA turf RLF
- CA rangeland hay RLF
- CA residential RLF
- CA alfalfa OP

Surface water EECs for the 27 scenarios (63 uses) and toxicity values used in RQ calculations, and RQ values for direct effects to the CRLF are provided in Table 27 for acute effects and

Table 28 for chronic effects. Resulting acute RQs range from <0.05 (stone fruit, hops, grapes, sugar beets, and alfalfa) up to 0.41 (control flying insects in swamps, at 25 applications) and therefore some uses exceed the acute LOC (0.05) for direct effects to the CRLF. Chronic RQ values range from 0.1 (peaches) up to 9.8 ("swamp"). RQs exceed the chronic risk LOC (1.0) for 14 of the 27 naled scenarios (41 out of 63 uses) (Table 28).

Table 27. Acute Aquatic RQ Values - Direct Effects to aquatic phase CRLF (PRZM)

Uses Covered	PRZM Scenario	App. Method(s)	Peak EEC		Acute RQ Values	Preliminary Risk Determination (MA or NE)	Probability of Individual Effect
			ppb	umoles/L			
Mosquitoes, Flies, *etc*. "swamp" (no buffer)	CA forestryRLF (25 apps, 3-day intervals)	Aerial (with 99% drift)	32.8	0.098	**0.41**	MA	1 in 24.6
	CA forestryRLF (single appl.)	Aerial (with 99% drift)	13.8	0.042	**0.17**	MA	1 in 3300

Uses Covered	PRZM Scenario	App. Method(s)	Peak EEC		Acute RQ Values	Preliminary Risk Determination (MA or NE)	Probability of Individual Effect
			ppb	umoles/L			
Mosquitoes, Flies, *etc*. (with buffers)	CA forestry	Aerial (with 22.7% drift)	10.46	0.031	**0.13**	MA	1 in 29,900
	CA impervious	Aerial (with 22.7% drift)	10.28	0.031	**0.13**	MA	1 in 29,900
	CA rangelandhay	Aerial (with 22.7% drift)	6.78	0.020	**0.08**	MA	1 in 2.51 E 6
	CA residential	Aerial (with 22.7% drift)	3.5	0.011	0.04	NE	1 in 1.94 E 9
cabbage, broccoli, cauliflower, collards, kale	CA cole crop RLF (1.9)	Aerial (with 12% spray drift)	24.7	0.074	**0.31**	MA	1 in 90.6
	CA cole crop RLF (0.9)	Aerial (with 12% spray drift)	11.69	0.035	**0.15**	MA	1 in 9,560
	CA cole crop RLF (1.9)	Ground spray (with 2.7% spray drift)	14.7	0.044	**0.18**	MA	1 in 2,490
	CA cole crop RLF (0.9)	Ground spray (with 2.7% spray drift)	6.98	0.021	**0.09**	MA	1 in 7.91 E 6
safflower	CA wheat RLF	Aerial (with 12% spray drift)	22.5	0.067	**0.28**	MA	1 in 156
orange, lemon, grapefruit, tangerine	CA citrus STD	Aerial (with 12% spray drift)	17.5	0.053	**0.22**	MA	1 in 648
beans, peas, celery, peppers	CA row crop RLF (1.9)	Aerial (with 12% spray drift)	17.5	0.053	**0.22**	MA	1 in 648
	CA row crop RLF (1.4)	Aerial (with 12% spray drift)	16.9	0.051	**0.21**	MA	1 in 874
	CA row crop RLF (1.4)	Ground spray (with 2.7% spray drift)	7.87	0.024	**0.10**	MA	1 in 2.94 E 5
Brussels sprouts, Swiss chard	CA lettuce STD	Aerial (with 12% spray drift)	17.2	0.052	**0.22**	MA	1 in 648

Uses Covered	PRZM Scenario	App. Method(s)	Peak EEC		Acute RQ Values	Preliminary Risk Determination (MA or NE)	Probability of Individual Effect
			ppb	umoles/L			
almond, walnut	CA almond STD	Aerial (with 12% spray drift)	16.2	0.049	**0.20**	MA	1 in 1,210
	CA almond STD	Ground spray (with 2.7% spray drift)	4.79	0.014	**0.06**	MA	1 in 5.22 E 7
cantaloupes, muskmelons, melons, eggplant, summer squash	CA melons RLF	Aerial (with 12% spray drift)	12.6	0.038	**0.16**	MA	1 in 5850
cotton	CA cotton STD	Aerial (with 12% spray drift)	11.68	0.035	**0.15**	MA	1 in 9560
strawberries	CA strawberry (non plastic) RLF	Aerial (with 12% spray drift)	8.52	0.026	**0.11**	MA	1 in 1.25 E 5
hops	OR hops	Aerial (with 12% spray drift)	7.1	0.021	**0.09**	MA	1 in 7.91 E 5
	OR hops	Ground spray (with 2.7% spray drift)	2.86	0.009	0.04	NE	1 in 6.33 E10
peaches	CA fruit STD	Ground spray (with 2.7% spray drift)	3.35	0.010	0.04	NE	1 in 6.33 E 9
grapes	CA grapes STD	Ground spray (with 2.7% spray drift)	0.93	0.003	0.01	NE	1 in 8.86 E18
sugar beets	CA sugarbeet	Ground spray (with 2.7% spray drift)	1.992	0.006	0.02	NE	1 in 9.6 E13
alfalfa	CA alfalfa	Aerial (with 12% spray drift)	14.393	0.043	0.18	MA	1 in 2,490

(Lake Trout, 96-hr LC50=0.24 umoles/L)
Values in Bold exceed the LOC
Probability of Individual Effect is based on default slope=4.5

Table 28. Chronic Aquatic RQ Values - Direct Effects to aquatic phase CRLF (PRZM)

Uses Covered	PRZM Scenario	App. Method(s)	60 Day EEC umoles/L	Chronic RQ Values	Preliminary Risk Determination (MA or NE)
Mosquitoes, flies, *etc*. "swamp" (no buffers)	CA forestryRLF (25 apps, 3-day intervals)	Aerial (with 99% drift)	0.075	**9.8**	MA
	CA forestryRLF (single appl.)	Aerial (with 99% drift)	0.004	0.5	NE
Mosquitoes, flies, *etc*. (with buffers)	CA forestry	Aerial (with 22.7% drift)	0.009	**1.2**	MA
	CA impervious	Aerial (with 22.7% drift)	0.010	**1.3**	MA
	CA rangelandhay	Aerial (with 22.7% drift)	0.003	0.4	NE
	CA residential	Aerial (with 22.7% drift)	0.007	0.9	NE
cabbage, broccoli, cauliflower, collards, kale	CA cole crop RLF (1.9)	Aerial (with 12% spray drift)	0.024	**3.1**	MA
	CA cole crop RLF (0.9)	Aerial (with 12% spray drift)	0.011	**1.5**	MA
	CA cole crop RLF (1.9)	Ground spray (with 2.7% spray drift)	0.010	**1.4**	MA
	CA cole crop RLF (0.9)	Ground spray (with 2.7% spray drift)	0.005	0.7	NE
safflower	CA wheat RLF	Aerial (with 12% spray drift)	0.003	0.3	NE
orange, lemon, grapefruit, tangerine	CA citrus STD	Aerial (with 12% spray drift)	0.010	**1.3**	MA
beans, peas, celery, peppers	CA row crop RLF (1.4)	Aerial (with 12% spray drift)	0.011	**1.4**	MA
	CA row crop RLF (1.9)	Aerial (with 12% spray drift)	0.015	**2.0**	MA
	CA row crop RLF (1.4)	Ground spray (with 2.7% spray drift)	0.005	0.7	NE
Brussels sprouts, Swiss chard	CA lettuce STD	Aerial (with 12% spray drift)	0.017	**2.2**	MA
almond, walnut	CA almond STD	Aerial (with 12% spray drift)	0.007	1.0	MA
	CA almond STD	Ground spray (with 2.7% spray drift)	0.002	0.3	NE

Uses Covered	PRZM Scenario	App. Method(s)	60 Day EEC umoles/L	Chronic RQ Values	Preliminary Risk Determination (MA or NE)
cantaloupes, muskmelons, melons, eggplant, summer squash	CA melons RLF	Aerial (with 12% spray drift)	0.009	**1.1**	MA
cotton	CA cotton STD	Aerial (with 12% spray drift)	0.009	**1.2**	MA
strawberries	CA strawberry (non plastic) RLF	Aerial (with 12% spray drift)	0.009	**1.1**	MA
hops	OR hops	Aerial (with 12% spray drift)	0.008	1.0	NE
	OR hops	Ground spray (with 2.7% spray drift)	0.002	0.3	NE
peaches	CA fruit STD	Ground spray (with 2.7% spray drift)	0.001	0.1	NE
grapes	CA grapes STD	Ground spray (with 2.7% spray drift)	0.001	0.2	NE
sugar beets	CA sugarbeet	Ground spray (with 2.7% spray drift)	0.002	0.2	NE
alfalfa	CA alfalfa	Aerial (with 12% spray drift)	0.009	**1.2**	MA

LOAEC 0.0165 µmoles/L (Fathead Minnow NOAEC= 0.0076 µmoles/L)
Values in bold exceed the LOC

5.1.1.2 Terrestrial-Phase CRLF

For RQs for the terrestrial-phase CRLF, exposures to total naled residues resulting from ground and aerial applications of naled are modeled. Uses were modeled according to the list in Table 16 which portrays use groupings according to similarity in application rate, number of applications and application intervals which are key model inputs for estimating residues on dietary items on the site of application in TREX.

To assess risks of naled to terrestrial-phase CRLF, dietary-based and dose-based exposures are used, as modeled in T-REX. The dose-based exposures of concern in TREX used as a surrogate for direct effects to terrestrial-phase CRLF are those for a small bird (20g) consuming small invertebrates. Dose-based risks to the CRLF are expected to decrease with increasing size of the animal. Acute and chronic dietary-based RQ values are calculated by dividing dietary-based EECs by the lowest available acute and chronic toxicity data, respectively, for birds. Acute dose-based RQ values are calculated by dividing dose-based. EECs by the most acutely sensitive toxicity value for a bird. Additionally, because T-REX does not track total toxic residues two separate T-REX runs were executed for each application scenario to capture the range in possible naled and DDVP residues, one run was made at 100% of the application rate—assumes 100% residue as naled, and one run at 20% of the application rate—which represents the maximum possible DDVP residue level from naled. For each run, the resulting EECs were compared to their respective toxicity endpoints to generate estimates of risk (*i.e.*, 100% application run compared to naled toxicity, and the 20% application run compared to DDVP toxicity).

For all modeled use scenarios, the acute dose-based RQs for both naled and DDVP exposure assumptions exceed the acute LOC (0.1). The dietary-based acute RQs, assuming 100% naled exposure, exceed the acute LOC (0.1) for all scenarios except insect pest control for animal and human health concerns. Under the assumption of exposure to DDVP residues (20% of applied rate), the acute LOC (0.1) is exceeded only for the safflower, cole crop, tree nuts, and citrus. While EFED does not have methodologies to sum the RQ values resulting from the two model runs for each scenario, the RQ values cannot be considered separately from one another. At any time in the environment, organisms will be exposed to naled alone or both naled and DDVP simultaneously. Both compounds have the same mode of action of on target pests. Therefore, the risk estimate is more likely equal to or slightly less than the sum of the RQs for the DDVP and naled T-REX runs and it is critical to not to evaluate the results separately but rather in combination.

The chronic RQ values exceed the chronic LOC (1.0) for all scenarios except insect pest control for animal and human health concern when assuming residues are present primarily as DDVP for long-term exposure. Assuming long-term exposure to 100% naled residues the RQs for safflower and the cole crop scenario are equal to the LOC. (Table 29).

Table 29. Avian Acute and Chronic RQ Values for Direct Effects to the Terrestrial-Phase CRLF

TREX Scenario (20g bird consuming small insects)	**Avian--RQ**					
	Acute Dose Based		**Acute Dietary**		**Chronic Dietary**	
	DDVP	**Naled**	**DDVP**	**Naled**	**DDVP**	**Naled**
Safflower (2.1 lbs ai/a, 1 application)	**9.2**	**17**	**0.11**	**0.21**	**6.6**	**1.0**
Cole crops, tree nuts, citrus (1.9 lbs ai/A, 1 application)	**8.4**	**15**	**0.10**	**0.19**	**5.9**	**1.0**
Alfalfa, row crops, cotton (1.4 lbs ai/A, 1 application)	**6.2**	**11**	0.07	**0.14**	**4.4**	0.7
Melons, misc food and non-food plants (0.9 lbs ai/A, 1 application)	**0.40**	**7.2**	0.05	0.09	**2.8**	0.5
Non-food plants (0.9 lbs ai/A, 52 applications, 7 day interval)	**4.3**	**7.9**	0.05	**0.10**	**3.1**	0.5
Non-food plants (0.9 lbs ai/A, 104 applications, 3 day interval)	**6.1**	**11**	0.07	**0.14**	**4.4**	0.7
Insect pests-animal and human health concerns (0.25 lbs ai/A, 2 applications, 7 day interval)	**1.2**	**2.2**	0.01	0.03	0.8	0.1
Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 1 day interval)	**0.75**	**1.4**	0.01	0.02	0.5	0.1

TREX Scenario (20g bird consuming small insects)	Avian--RQ					
	Acute Dose Based		Acute Dietary		Chronic Dietary	
	DDVP	Naled	DDVP	Naled	DDVP	Naled
Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 7 day interval)	**0.48**	**0.87**	0.01	0.01	0.3	<0.1

5.1.2 Indirect Effects

5.1.2.1 Evaluation of Potential Indirect Effects via Reduction in Food Items

Effects to Algal Food Resources for the Aquatic-Phase CRLF

For assessing risks of indirect effects of naled to the larval aquatic-phase CRLF (tadpoles) through effects to its diet, 1-in-10 year peak surface water EECs are divided by the lowest acute toxicity value for aquatic plants to derive plant RQs. Resulting unicellular plant RQs exceed the LOC (1) for aquatic plants for uses on swamps, assuming 25 applications a year and cole crops where the application is applied aerially at 1.9 lb a.i./A(Table 30).

Table 30. Aquatic Unicellular Plant RQ Values for Indirect Effects to the CRLF.

Uses Covered	PRZM Scenario	App. Method(s)	Peak EEC		Nonlisted Plant RQ
			ppb	umoles/L	(EC50=0.066 umoles/L) (Vascular Aq plants RQ values will be lower, as the EC50>1800 ppb)
Mosquitoes, flies, etc. "swamp" (no buffers)	CA forestryRLF (25 apps, 3-day intervals)	Aerial (with 99% drift)	32.8	0.098	**1.5**
	CA forestryRLF (single appl.)	Aerial (with 99% drift)	13.8	0.042	0.63
Mosquitoes, flies, *etc*. (with buffers)	CA forestry	Aerial (with 22.7% drift)	10.46	0.031	0.5
	CA impervious	Aerial (with 22.7% drift)	10.28	0.031	0.5
	CA rangelandhay	Aerial (with 22.7% drift)	6.78	0.020	0.3
	CA residential	Aerial (with 22.7% drift)	3.5	0.011	0.2

Uses Covered	PRZM Scenario	App. Method(s)	Peak EEC		Nonlisted Plant RQ
			ppb	umoles/L	(EC50=0.066 umoles/L) (Vascular Aq plants RQ values will be lower, as the EC50>1800 ppb)
cabbage, broccoli, cauliflower, collards, kale	CA cole crop RLF (1.9)	Aerial (with 12% spray drift)	24.7	0.074	**1.1**
	CA cole crop RLF (0.9)	Aerial (with 12% spray drift)	11.69	0.035	0.53
	CA cole crop RLF (1.9)	Ground spray (with 2.7% spray drift)	14.7	0.044	0.67
	CA cole crop RLF (0.9)	Ground spray (with 2.7% spray drift)	6.98	0.021	0.32
safflower	CA wheat RLF	Aerial (with 12% spray drift)	22.5	0.067	1.0
orange, lemon, grapefruit, tangerine	CA citrus STD	Aerial (with 12% spray drift)	17.5	0.053	0.8
beans, peas, celery, peppers	CA row crop RLF	Aerial (with 12% spray drift)	17.5	0.053	0.8
	CA row crop RLF	Aerial Spray (with 12% spray drift)	16.9	0.051	0.8
	CA row crop RLF	Ground spray (with 2.7% spray drift)	7.87	0.024	0.4
Brussels sprouts, Swiss chard	CA lettuce STD	Aerial (with 12% spray drift)	17.2	0.052	0.8
almond, walnut	CA almond STD	Aerial (with 12% spray drift)	16.2	0.049	0.7
	CA almond STD	Ground spray (with 2.7% spray drift)	4.79	0.014	0.2
cantaloupes, muskmelons, melons, eggplant, summer squash	CA melons RLF	Aerial (with 12% spray drift)	12.6	0.038	0.6
cotton	CA cotton STD	Aerial (with 12% spray drift)	11.68	0.035	0.5
strawberries	CA strawberry (non plastic) RLF	Aerial (with 12% spray drift)	8.52	0.026	0.4
hops	OR hops	Aerial (with 12% spray drift)	7.1	0.021	0.3
	OR hops	Ground spray (with 2.7% spray drift)	2.86	0.009	0.1
peaches	CA fruit STD	Ground spray (with 2.7% spray drift)	3.35	0.010	0.2
grapes	CA grapes STD	Ground spray (with 2.7% spray drift)	0.93	0.003	<0.1
sugar beets	CA sugarbeet	Ground spray (with 2.7% spray drift)	1.992	0.006	<0.1

Uses Covered	PRZM Scenario	App. Method(s)	Peak EEC		Nonlisted Plant RQ
			ppb	umoles/L	(EC50=0.066 umoles/L) (Vascular Aq plants RQ values will be lower, as the EC50>1800 ppb)
alfalfa	CA alfalfa	Aerial (with 12% spray drift)	14.393	0.043	0.7

Effects to Aquatic Invertebrate Food Resources for the CRLF

For assessing risks of indirect effects to the CRLF through acute effects to prey (invertebrates) in aquatic habitats, 1-in-10 year peak surface water EECs were compared to the lowest acute toxicity value for freshwater invertebrates. For chronic risks to aquatic invertebrates, 1-in-10 year peak 21-day surface water EECs were compared to the lowest chronic toxicity value for freshwater invertebrates. Acute and chronic RQs for aquatic invertebrates for all 27 modeled scenarios are presented in Table 31. Acute and chronic RQs exceed the acute and chronic LOCs (0.05 and 1.0, respectively) for all scenarios modeled. The acute RQs range from 9.3 (grapes) to 328 (mosquito use). The chronic RQ values for aquatic invertebrates range from 23.3 up to 630 (Table 31).

Table 31. Acute and Chronic Aquatic Invertebrate RQ Values for Indirect Effects

Uses Covered	PRZM Scenario	App. Method(s)	Peak EEC		Acute RQ Value Aq Inverts	21 d Peak EEC		Chronic RQInverts
			ppb	umoles/L		ppb	umole/L	
Mosquitoes, flies, *etc*. "swamp"(no buffers)	CA forestryRLF (25 apps, 3-day intervals)	Aerial (with 99% drift)	32.8	0.098	**328**	25.2	0.076	**2923**
	CA forestryRLF (single appl.)	Aerial (with 99% drift)	13.8	0.042	**139**	3.5	0.011	**423**
Mosquitoes, flies, *etc*. (with buffers) .	CA forestry	Aerial (with 22.7% drift)	10.46	0.031	**105**	4.17	0.013	**500**
	CA impervious	Aerial (with 22.7% drift)	10.28	0.031	**103**	4.62	0.014	**538**
	CA rangelandhay	Aerial (with 22.7% drift)	6.78	0.02	**68**	2.64	0.008	**308**
	CA residential	Aerial (with	3.5	0.011	**35**	2.42	0.011	**423**

		22.7% drift)						
cabbage, broccoli, cauliflower, collards, kale	CA cole crop RLF	Aerial (with 12% spray drift)	24.7	0.074	**247**	13.3	0.04	**1538**
	CA cole crop RLF	Aerial (with 12% spray drift)	11.69	0.035	**117**	6.29	0.019	**731**
	CA cole crop RLF	Ground spray (with 2.7% spray drift)	14.7	0.044	**147**	5.94	0.018	**692**
	CA cole crop RLF	Ground spray (with 2.7% spray drift)	6.98	0.021	**70**	2.82	0.008	**308**
safflower	CA wheat RLF	Aerial (with 12% spray drift)	22.5	0.067	**225**	2.39	0.007	**269**
orange, lemon, grapefruit, tangerine	CA citrus STD	Aerial (with 12% spray drift)	17.5	0.053	**176**	8.5	0.026	**1000**
beans, peas, celery, peppers	CA row crop RLF	Aerial (with 12% spray drift)	17.5	0.053	**175**	8.94	0.027	**1038**
	CA row crop RLF	Aerial (with 12% spray drift)	16.9	0.051	**169**	9.2	0.028	**1077**
	CA row crop RLF	Ground spray (with 2.7% spray drift)	7.87	0.024	**79**	3.62	0.011	**423**
Brussels sprouts, Swiss chard	CA lettuce STD	Aerial (with 12% spray drift)	17.2	0.052	**173**	9.44	0.028	**1077**
almond, walnut	CA almond STD	Aerial (with 12% spray drift)	16.2	0.049	**162**	6.51	0.02	**769**
	CA almond STD	Ground spray (with 2.7%	4.79	0.014	**48**	1.76	0.005	**192**

		spray drift)						
cantaloupes, muskmelons, melons, eggplant, summer squash	CA melons RLF	Aerial (with 12% spray drift)	12.6	0.038	**126**	6.06	0.018	**692**
cotton	CA cotton STD	Aerial (with 12% spray drift)	11.68	0.035	**117**	5.13	0.015	**577**
strawberries	CA strawberry (non plastic) RLF	Aerial (with 12% spray drift)	8.52	0.026	**85**	4.72	0.014	**538**
hops	OR hops	Aerial (with 12% spray drift)	7.1	0.021	**71**	3.08	0.009	**346**
	OR hops	Ground spray (with 2.7% spray drift)	2.86	0.009	**29**	1	0.003	**115**
peaches	CA fruit STD	Ground spray (with 2.7% spray drift)	3.35	0.01	**34**	0.74	0.002	**77**
grapes	CA grapes STD	Ground spray (with 2.7% spray drift)	0.93	0.003	**9.3**	0.48	0.001	**38**
sugar beets	CA sugarbeet	Ground spray	1.992	0.006	**20**	1	0.003	**115**
alfalfa	CA alfalfa	Aerial	14.393	0.043	**144**	7.22	0.022	**846**

Acute RQ Value Aq Inverts (*Daphnia pulex*) 0.0003 uumoles/L
Chronic RQInverts (*Daphnia magna*) NOAEC 0.00012 µmoles/L (0.045 ppb)

Effects to Freshwater Fish and Aquatic-Phase Amphibian Dietary Resources for CRLF

Freshwater fish and frogs also represent prey items of the CRLF. Acute and chronic RQs for these are the same acute and chronic RQs calculated for direct effects to the aquatic-phase CRLF (Table 27and

Table 28, respectively). The chronic LOC for effects to populations of aquatic fish and amphibians is 1.0 like that for the aquatic-phase CRLF. The level for acute effects for population level effects to these dietary resources are above the presumed acute restricted LOC of 0.1.

Terrestrial Invertebrate Dietary Resources for the CRLF

In order to assess the risks from direct application or contact of naled to terrestrial invertebrates, which are considered prey of terrestrial-phase CRLF, the honey bee is used as a surrogate for terrestrial invertebrates. Naled residuals on insects, EECs (µg a.i./g of insect or ppm), calculated by T-REX for small and large insects due to on-site applications are divided by the most sensitive adjusted (Appendix E) dermal contact toxicity value for the honey bee, (*i.e.*, acute LC50 = acute LD50 ÷ 0.0128 g/bee = 0.048 ug/bee ÷ 0.0128 g/bee = 3.75 ppm). The acute RQ values, which range from 0.44 up to 76, exceed the insect acute LOC (0.05) for all modeled scenarios. These exceedances refer to on-site residues exposures for terrestrial insects and would be expected to decline with distance from the site of application.

Table 32. Acute Terrestrial Insect RQ Values for Indirect Effects to the CRLF

Use Scenario	**Small Insect Residues (ppm)**	**Acute RQ Value** (honey bee LC50 = 3.75 ppm)	**Large Insect Residue (ppm)s**	**Acute RQ Value** (honey bee LC50 = 3.75 ppm)
1 Safflower (2.1 lbs ai/A, 1 application)1	284	**76**	31.5	**8.4**
2 Cole crops, tree nuts, citrus (1.9 lbs ai/A, 1 application	256	**68**	28.5	**7.6**
3 Alfalfa, row crops, cotton (1.4 lbs ai/A, 1 application)	189	**50**	21.0	**5.6**
4 Melons, misc. food and non-food plants (0.9 lbs ai/A, 1 application)	122	**32**	13.5	**3.6**
5 Non-food plants (0.9 lbs ai/A, 52 applications, 7 day interval)	133	**36**	14.8	**4.0**
6 Non-food plants (0.9 lbs ai/A 104 applications, 3 day interval)	188	**50**	20.9	**5.6**
7 I nsect pests-animal and human health concerns (0.25 lbs ai/A, 2 applications, 7 day interval)	36.7	**9.8**	4.1	**1.1**
8 Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 1 day interval)	23.0	**6.2**	2.6	**0.7**
9 Insect pests-animal and human health concerns (0.1 lb ai/A, 2 applications, 7 day interval)	14.7	**3.9**	1.6	**0.44**

Effects to Small Mammal Dietary Resources for the Terrestrial-Phase CRLF

To assess risks of naled to small mammalian prey of larger terrestrial-phase CRLF, dietary-based and dose-based exposures to small mammals are used, as modeled in TREX. The dose-based exposures of concern in TREX are those for a small mammal (20g). Acute and chronic dietary-based RQ values are calculated by dividing dietary-based EECs by the most sensitive mammalian acute and chronic toxicity data, respectively. Acute and chronic dose-based RQ values are calculated by dividing dose-based EECs by the most sensitive acute and chronic toxicity value, respectively, for a mammal. Additionally, because T-REX does not track total toxic residues, two separate T-REX runs were executed for each application scenario to capture the range in possible naled and DDVP residues, one run was made at 100% of the application rate—assumes 100% residue as naled, and one run at 20% of the application rate—which represents the maximum possible DDVP residue level from naled. For each run, the resulting EECs were compared to their respective toxicity endpoints to generate estimates of risk (*i.e.*, 100% application run compared to naled toxicity, and the 20% application run compared to DDVP toxicity). Acute and chronic dietary- and dose-based RQs for small mammals are listed in Table 33 for residues on short grass.

Acute dose based RQs for naled (100%) residues on short grass exceed the acute restricted LOC (0.2) for all modeled scenarios except for insect pest control for animal and human health concerns at the two lowest applications. Chronic RQs exceed the chronic LOC (1.0) for all modeled scenarios. Acute-dose based RQs for DDVP residues exceeds the acute restricted LOC (0.2) for all modeled scenarios except the insect pest control for animal and human health concerns, and the melon, misc. food and non-food plant scenarios. Chronic dose-based RQs for DDVP residues exceed the chronic LOC (1.0) for all modeled scenarios except the insect pest control for animal and human heal concerns.

Table 33. Acute and Chronic RQ Values for Indirect effects, effects to Small Mammals Ingesting Residues on Short Grass for Indirect Effects to the CRLF (prey) (Modeled with T-REX)

Use	**Dose-based**				**Dietary-based**	
Scenario	**Acute RQs[1, 2]**		**Chronic RQs[3,4]**		**Chronic RQs[3,5]**	
	Naled	**DDVP**	**Naled**	**DDVP**	**Naled**	**DDVP**
Safflower (2.1 lbs ai/A, 1 application)	**2.4**	**0.45**	**36**	**11**	**5.6**	**1.3**
Cole crops, tree nuts, citrus (1.9 lbs ai/A, 1 application)	**2.2**	**0.41**	**33**	**10**	**5.1**	**1.2**
Alfalfa, row crops, cotton (1.4 lbs ai/A, 1 application)	**1.6**	**0.30**	**29**	**7.3**	**3.7**	0.85
Melons, misc. Food and non-food plants 90.9 lbs ai/A, 1 application)	**1.0**	*0.19*	**16**	**4.7**	**2.4**	0.54
Non-food plants (0.9 lbs ai/A, 52 applications, 7 day interval)	**1.1**	**0.21**	**17**	**5.2**	**2.6**	0.60
Non-food plants (0.9 lbs ai/A, 104 applications, 3 day interval)	**1.6**	**0.30**	**24**	**7.3**	**3.7**	0.84
Insect pests-animal and human health concerns (0.25 lbs ai/A, 2 applications, 7 day interval)	**0.31**	0.06	**4.7**	**1.4**	0.73	0.16
Insect pests-animal and human health concerns (0.1 lb ai/A, 2 applications, 1 day interval)	*0.19*	0.04	**3.0**	0.90	0.46	0.10
Insect pests-animal and human health concerns (0.1 lb ai/A, 2 applications, 7 day	*0.12*	0.02	**1.9**	0.60	0.29	0.07

Use	Dose-based				Dietary-based	
Scenario	Acute RQs[1, 2]		Chronic RQs[3,4]		Chronic RQs[3,5]	
	Naled	DDVP	Naled	DDVP	Naled	DDVP
interval)						

[1]Values in bold exceed the non-listed species LOC (0.2), while the italicized values exceed the listed species LOC (0.1).
[2]Adusted acute oral LD50 for 15 g mammal = 202 mg/kg-bw/d
[3]Values in bold exceed the chronic LOC (1.0)
[4]Adjusted reproduction NOAEC for 15 g mammal = 13.2 mg/kg-bw/d
[5]Reproduction NOAEC = 90 ppm

Effects to the Terrestrial-Phase Amphibians Dietary Resources of the CRLF

An additional prey item of the adult CRLF is other species of frogs. In order to assess risks to these organisms, dietary-based and dose-based exposures modeled in T-REX for a small bird (20g) consuming small invertebrates are used. These are the same EECs, toxicity values and RQs used to assess direct effects to the CRLF (Table 29). Acute, dietary-based RQ values, dietary-based chronic RQ values and dose-based RQ values exceed LOC for listed species for all uses

5.1.2.2 Evaluation of Potential Indirect Effects via Reduction in Habitat and/or Primary Productivity (Freshwater Aquatic Plants)

No effects to aquatic plants are expected.

5.1.2.3 Evaluation of Potential Indirect Effects via Reduction in Terrestrial Plant Community (Riparian Habitat)

There is uncertainty regarding effects to terrestrial plants. There have been a few reported instances of plant damage, typically from direct application. The label also cautions about potential damage to crops if naled is applied under certain conditions. These conditions may co-incide with increases in pest pressure, such as mosquitos, and therefore the spraying swamps and wetlands may result in indirect effects to the CRLF via reduction in terrestrial plant communities.

5.1.3 Modification to Critical Habitat

Based on effects to prey items, modifications to critical habitat are expected. As described above, the possibility for risk exists for terrestrial and aquatic phase amphibians, small mammals, and terrestrial and aquatic invertebrates.

5.2 Risk Description

The risk description synthesizes an overall conclusion regarding the likelihood of impacts leading to an effects determination (i.e., “no effect,” “may affect, but not likely to adversely affect,” or “likely to adversely affect”) for the CRLF.

If the RQs presented in the Risk Estimation show no indirect effects and LOCs for the CRLF are not exceeded for direct effects, a “no effect” determination is made, based on use of naled within the action area. If, however, indirect effects are anticipated and/or exposure exceeds the LOCs for direct effects, the Agency concludes a preliminary "may affect" determination for the CRLF. Following a "may affect" determination, additional information is considered to refine the potential for exposure at the predicted levels based on the life history characteristics (i.e., habitat range, feeding preferences, etc.) of the CRLF and potential community-level effects to aquatic plants. Based on the best available information, the Agency uses the refined evaluation to distinguish those actions that "may affect, but are not likely to adversely affect" from those actions that are "likely to adversely affect" the CRLF.

The criteria used to make determinations that the effects of an action are "not likely to adversely affect" the CRLF include the following:

- Significance of Effect: Insignificant effects are those that cannot be meaningfully measured, detected, or evaluated in the context of a level of effect where "take" occurs for even a single individual. "Take" in this context means to harass or harm, defined as the following:

- Harm includes significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering.

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

- Likelihood of the Effect Occurring: Discountable effects are those that are extremely unlikely to occur. For example, use of dose-response information to estimate the likelihood of effects can inform the evaluation of some discountable effects.

- Adverse Nature of Effect: Effects that are wholly beneficial without any adverse effects are not considered adverse.

A description of the risk and effects determination for each of the established assessment endpoints for the CRLF is provided below.

5.2.1 Direct Effects to the CRLF

Refinement of Terrestrial-Phase CRLF Acute Risks from Ingestion of Residues

Before concluding which naled uses are LAA and which are NLAA, a refinement of the risks posed to the terrestrial-phase CRLF from ingestion of residues on small insects was performed. This refinement was performed because the avian acute dose-based RQ values in Table 29, used as screening surrogates for terrestrial-phase amphibians, likely overestimate risks to amphibians. Overestimation is due to the higher energy requirements of birds over amphibians of the same body weight, which results in a higher daily food intake rate value and a resultant higher dose-based exposure for birds than would occur for an amphibian of the same body weight. The THERPS model refines the dose-based RQ values based on using a dietary intake rate of an amphibian, rather than a dietary intake rate of an avian. Results of the analysis performed with THERPS are presented in Table 34. When an acute dose-based RQ exceeds the listed species acute LOC (0.1) when calculated with TREX, the likelihood of the risk should be considered in light of the results of the THERPS model.

TREX results for acute-dose-based RQ values based on avian dietary intake rates and ingestion of residues on small insects exceeded the acute LOC (0.1) for all modeled scenarios under both the assumption of 100% of the residues are in the form of naled and the assumption that 20% of the residues are in the form of its degredate DDVP (Table 29). However, taking into account the lower dietary intake rate of amphibians (for 1.4 and 37g amphibians) the acute-dose-based values for ingestion of small insects lower significantly. All of the insect pest control for animal and human health concern scenarios drop below acute LOCs (0.1) for both naled and DDVP residues. The safflower scenario, cole crops, tree nuts, and citrus scenario, alfalfa, row crops, and cotton scenario, and the non-food plant scenario at 104 applications exceed the listed species acute LOC (0.1) for both the 100% naled residue and 20% DDVP residue assumptions. The melons, misc. food and non-food plant scenario at 1 application and the non-food plant scenario at 52 applications exceed the listed acute species LOC (0.1) if it is assumed that 100% of the residue on small insects is naled but does not exceed if it is assumed that the organisms are exposed to only 20% of application rate as DDVP residues. As naled rapidly degrades, the assumption that residues are present as 100% naled will be conservative. The DDVP values should not be considered the lower bound but rather the two values summed together would represent a sort of upper bound (100% naled plus simultaneous exposure to 20% DDVP).

Table 34 Terrestrial-Phase Amphibian Acute Dose-Based RQ Values for Direct Effects to the CRLF from Ingestion of Residues on or in Prey Items

	Small Insects[1]			
Use Scenario	**DDVP**	**Chance of Individual Mortality (1 in__)**	**Naled**	**Chance of Individual Mortality (1 in__)**
Safflower (2.1 lbs ai/A, 1 application)	**0.16**	8,850	**0.30**	107
Cole crops, tree nuts, citrus (1.9 lbs ai/A, 1 application)	**0.15**	9,560	**0.27**	190
Alfalfa, row crops, cotton (1.4 lbs ai/A, 1 application)	**0.11**	125,000	**0.20**	1,210
Melons, misc. food and non-food plants (0.9 lbs ai/A, 1 application)	0.07	< 1 in a million	**0.13**	29,900
Non-food plants (0.9 lbs ai/A, 52 applications, 7 d interval)	0.08	< 1 in a million	**0.14**	16,400

	Small Insects[1]			
Use Scenario	**DDVP**	**Chance of Individual Mortality (1 in__)**	**Naled**	**Chance of Individual Mortality (1 in__)**
Non-food plants (0.9 lbs ai/A, 104 applications, 3 day interval)	**0.11**	125,000	**0.20**	1,210
Insect pests-animal and human health concerns (0.25 lbs ai/A, 2 applications, 7 day interval)	0.02	< 1 in a million	0.04	< 1 in a million
Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 1 day interval)	0.01	< 1 in a million	0.02	< 1 in a million
Insect pests-animal and human health concerns (0.1 lbs ai/A, 2 applications, 7 day interval)	<0.01	< 1 in a million	0.02	< 1 in a million

[1]Based on the daily food ingestion rate for an amphibian which is 1.4g or 37 g. Values for large frogs (238g) were slightly lower.

TREX is not a bioaccumulation model. Because CRLF ingest small mammals another refinement included in the THERPS model was a conservative[12] bioaccumulation model for residues in small herbivorous and insectivorous mammals[13]. The bioaccumulation model assumes that the animal ingests 100% of its daily intake instantaneously and that there is no metabolism or elimination of the pesticide residues before being consumed. Additionally, the diet of the herbivorous small mammal is modeled as short grass, which has the highest chemical residues after a pesticide exposure of any of the plant residues modeled. This scenario is highly improbable but also not relevant for naled and its degredate DDVP as they are such a short-lived chemicals, are rapidly metabolized, and have low bioaccumulation potential and are therefore not likely to be bioavailable for a secondary poisoning type exposure once consumed by the small mammal. Therefore this refinement was not included for naled.

Consideration of Dose-Based Versus Dietary-Based Results

There are distinct differences in results between acute dose-based RQ values and dietary-based RQs for the same exposure pathways evaluated in this assessment. This is due in part to differences in exposure techniques between acute oral dosing tests and dietary tests. Additionally, there are limitations to both methods. The dose-based approach assumes that the uptake and absorption kinetics of a gavage toxicity study approximate the absorption associated with uptake from a dietary matrix. Toxic response is a function of duration and intensity of exposure. Absorption kinetics across the gut and enzymatic activation/deactivation of a toxicant may be important and are likely variable across chemicals and species. For many compounds a gavage dose represents a very short-term high intensity exposure, where as dietary exposure may be of a more prolonged nature. The dietary-based approach assumes that animals in the field are consuming food at a rate similar to that of confined laboratory animals. Energy content in food items differs between the field and the laboratory and so do the energy requirements of wild and

[12] For chemicals with low bioaccumulation potential.
[13] Prey mammals were assumed to be 35 grams (wet weight), which is the high-end body weight of a deer mouse.

captive animals. Given the fate characteristics of naled and its degredate DDVP and its mode of action, dietary-based results are considered to be more characteristic of exposure and risks in the wild.

Consideration of the Probability of Individual Acute Effects

While the acute RQ for mortality effects, for the aquatic-phase and/or terrestrial-phase CRLF, for any use may exceed the listed species LOC, the probability of individual effects was low enough in some cases that the likelihood of measuring such an effect was considered improbable. For each aquatic acute RQ below 0.5, the probability of individual acute mortality for the aquatic-phase CRLF is in Table 27.

For terrestrial effects, the acute endangered LOC is 0.1. Using the default slope of 4.5, at this LOC the probability of individual mortality from acute effects is 1 in 294,000. Because slope data are not available for terrestrial organisms, the default slope is used to estimate the probability. Therefore, any use with an RQ value of 0.1 or greater, will be assumed to have a probability of 1 in <294,000. In the absence of other evidence, exceedence of the terrestrial listed species LOC (0.1) will lead to an LAA determination for such a use.

Direct Effects Determination Conclusions

For each use modeled, a conclusion for or against direct effects to the aquatic-phase CRLF were based on consideration of whether the listed species acute LOC (0.05) was exceeded and whether the chronic LOC was exceeded. Additionally for each use modeled, a conclusion for or against direct effects to the terrestrial-phase CRLF was based on whether the listed species acute LOC (0.1) was exceeded and, if exceeded, the probability of individual mortality effects, and whether the chronic LOC was exceeded. Also considered is the chronic EEC as compared to the chronic LOAEC for avian species. The direct effects determination for both the aquatic-phase and terrestrial-phase of the CRLF for each modeled use is summarized in Table 35.

Table 35. Summary Table for Effects Determinations for Direct Effects to both Aquatic and Terrestrial Phase CRLF

Use	Aquatic-Phase		Terrestrial- Phase	
	Effects Determ.	**Reason**	**Effects Determ.**	**Reason***
Alfalfa	**LAA**	The listed species acute and chronic RQs exceed LOCs. The probability of an individual acute mortality is 1 in 2500. The chronic exposure concentration is below the LOEC for an effect on growth. Based on best judgment chronic effects are considered discountable and insignificant, respectively, but acute effects are not.	**LAA**	Naled: dose and dietary acute RQs exceed LOC ; DDVP: dose-based acute, chronic RQs exceed LOC
Almond and walnut (ground only)	**NLAA**	The chronic LOC is not exceeded (RQ=0.3) and while acute RQs exceed the listed species acute LOC, the probability of an individual acute mortality is low (<1 in a million) such that based on best judgment acute direct effects are considered discountable.	**LAA**	All RQs exceed except chronic naled (0.96)
Almond and walnut (aerial)	**LAA**	The chronic RQ (1) is equal to the LOC. Additionally, the listed species acute LOC is exceeded and the probability of an individual acute mortality is 1 in 1,210		
Beans, lima beans and peas (dry and succulent form), celery, and peppers	Ground spray applications: **NLAA**	The chronic LOC is not exceeded; however, the listed species acute LOC is exceeded and the probability of an individual acute mortality is 1 in 290,000. Based on best judgment acute effects are considered discountable.	**LAA**	Naled: dose and dietary acute RQs exceed LOC ; DDVP: dose acute, chronic RQs exceed LOC
	Aerial spray applications: **LAA**	Acute and chronic RQs exceed LOCs are exceeded and the probability of an individual acute mortality is >1 in 900		

Use	Aquatic-Phase		Terrestrial- Phase	
	Effects Determ.	**Reason**	**Effects Determ.**	**Reason***
Brassica (broccoli, cabbage, cauliflower, Brussels sprouts)	Ground spray seasonal max 4.5 lbs ai/A: **NLAA**	The chronic LOC is not exceeded. While the listed species acute LOC is exceeded the probability of an individual acute mortality is low (<1 in a million) such that based on best judgment acute direct effects are considered discountable.	**LAA**	All exceed except chronic naled (0.96)
	Ground spray seasonal max of 9.5 lbs a.i./A applications: **LAA**	The listed species acute and chronic LOCs are exceeded, the probability of an individual acute mortality is 1 in 2500.		
	Aerial spray: **LAA**	Acute and chronic RQs exceed LOCs. Labels restricting application to a seasonal max of 4.5 lbs ai/A have a probability of an individual acute mortality o 1 in 9,600 and chronic levels are at or above concentrations reducing growth.		
Cantaloupes, muskmelons, melons, summer squash, and eggplant	**LAA**	Listed species acute and chronic RQs exceed LOC and the probability of an individual acute mortality is 1 in 5800. The chronic exposure concentration is below the LOEC for an effect on growth, such that based on best judgment chronic effects are considered insignificant.	**LAA**	Naled: acute dose and dietary RQs exceed LOC ; DDVP: chronic RQs exceed LOC
Grapes	**NE**	Neither acute or chronic RQs exceed LOCs are exceeded	**NLAA**	Naled: acute dose and dietary RQs exceed LOC; DDVP: chronic RQs exceed LOC. Although several RQs exceed the LOC, it is unlikely to find suitable frog habitat in ecological areas that support this type of crop. Hops and grapes require high mineral, well draining soil, whereas the CRLF is more likely to be found near soils of the opposite hydrologic profile. Therefore, terrestrial acute effects from use on grapes is discountable.
Hops (aerial)	**NLAA**	Acute RQs exceed LOC and	**NLAA**	Naled: acute dose and dietary

Use	Aquatic-Phase		Terrestrial- Phase	
	Effects Determ.	**Reason**	**Effects Determ.**	**Reason***
		the chronic RQ (1.0) is equal to the LOC. The probability of an individual acute mortality is <1 in 791,000. Based on best judgement, acute and chronic effects are considered discountable and insignificant, respectively.		RQs exceed LOC; DDVP: chronic RQs exceed LOC. Although several RQs exceed the LOC, it is unlikely to find suitable frog habitat in ecological areas that support this type of crop. Hops and grapes require high mineral, well draining soil, whereas the CRLF is more likely to be found near soils of the opposite hydrologic profile. Therefore, terrestrial acute effects from use on hops is discountable.
Hops (ground)	**NE**	Neither acute nor chronic RQs exceed LOCs are exceeded.	**NLAA**	Naled: acute dose and dietary RQs exceed LOC ; DDVP: chronic RQs exceed LOC
Oranges, lemons, grapefruit, tangerines	**LAA**	Acute and chronic RQs exceed LOCs are exceeded and the probability of an individual acute mortality is 1 in 650	**LAA**	All RQs exceed except chronic naled (0.96)
Peaches	**NE**	Neither acute or chronic RQs exceed LOCs are exceeded	**LAA**	All RQs exceed except chronic naled (0.96)
Safflower	**LAA**	The chronic LOC is not exceeded but the listed species acute LOC is exceeded and the probability of an individual acute mortality is 1 in 156	**LAA**	All RQs exceed LOCs
Strawberries	**NLAA**	The listed species acute and chronic RQs exceed LOCs. The probability of an individual acute mortality is 1 in 125,000. The chronic exposure concentration is below the LOEC for an effect on growth, such that based on best judgment chronic effects are considered insignificant.	**LAA**	Naled: acute dose and dietary RQs exceed LOC ; DDVP: chronic RQs exceed LOC. Strawberries can tolerate high moisture soil profiles and therefore may be located near low-lying areas that are also ideal for the CRLF. Strawberries are also grown close to the ground, where residues are more readily accessible to the CRLF.
Sugar beets	**NE**	Neither acute or chronic RQs exceed LOCs	**LAA**	Naled: acute dose and dietary RQs exceed LOC ; DDVP: chronic RQs exceed LOC
Swiss chard	**LAA**	Acute and chronic LOCs are exceeded and the probability of individual acute mortality is 1 in 650	**LAA**	Naled: acute dose and dietary RQs exceed LOC ; DDVP: chronic RQs exceed LOC
Cotton	**LAA**	The listed species acute and chronic RQs exceed LOCs. The probability of an individual acute mortality is 1	**LAA**	Naled: dose and dietary acute RQs exceed LOC; DDVP: dose acute, chronic RQs exceed LOC

Use	Aquatic-Phase		Terrestrial- Phase	
	Effects Determ.	**Reason**	**Effects Determ.**	**Reason***
		in 9,600. The chronic exposure concentration is below the LOEC for an effect on growth, such that based on best judgment chronic effects are considered insignificant.		
Feed lots including dairy cattle, and pastures including woodlands, swamps	Buffers and no direct application over water: **NLAA**	Listed species acute and chronic LOCs are exceeded and the probability of an individual acute mortality is 1 in 29,900. The chronic exposure concentration is below the LOEC for an effect on growth, such that based on best judgment chronic effects are considered insignificant.	**NLAA**	The only LOC exceedences are TREX generated acute dose-based. Effects are considered insignificant.
	Direct application over water single application **LAA**	The chronic LOC is not exceeded but the acute LOC is exceeded the probability of individual mortality of 1 in 3,300.		
	Direct application over water 25 applications: **LAA**	Acute and chronic RQs exceed LOCs are exceeded with a probability of individual acute mortality on order of 1 in 25.		
For reduction of pests in rangelands	**NLAA**	The chronic RQs do not exceed LOC. The listed species acute LOC is exceeded but the probability of an individual acute mortality is low (<1 in a million) such that based on best judgment acute direct effects are considered discountable.	**NLAA**	The only LOC exceedences are TREX generated acute dose-based. Effects are considered insignificant.
Forest and shade trees, ornamental shrubs and flowering plants	**NLAA**	Acute and chronic RQs exceed LOCs. The probability of an individual acute mortality 1 in 29,900. The chronic exposure concentration is below the LOEC for an effect on growth, such that based on best judgment chronic effects are considered insignificant.	**NLAA**	Naled: acute dose and dietary RQs exceed LOC; DDVP: chronic RQs exceed LOC. Exceedences are based on 52 applications, at 7 day intervals. This is a worst case scenario and therefore may not be likely. Effects to CRLF from this use are discountable.
Greenhouse, vapor treatment of roses and other ornamental plants	**NE**	Neither acute nor chronic RQs exceed LOCs.	**NLAA**	The only LOC exceedences are TREX generated acute dose-based. Effects are considered insignificant. Effects are also discountable

Use	Aquatic-Phase		Terrestrial- Phase	
	Effects Determ.	**Reason**	**Effects Determ.**	**Reason***
				as use within greenhouse and vapor treatment are unlikely to co-occur with the CRLF or its habitat.

*"Naled" and "DDVP" refer to the way the terrestrial modeling was approached. The parent and degredate were modeled separately, hence generating separate RQ values but the values are considered together. In the table, 'naled' and 'DDVP' refers to RQ values when the model input assumed 100% naled application rate and naled toxicity and 20% application rate, as DDVP compared to DDVP toxicity endpoints, respectively. As stated above, LOC exceedences are associated with probabilities too high to be discountable (based on default slope).

5.2.2 Indirect Effects via Reduction in Food Items

Based on LOC exceedences for multiple food items (aquatic invertebrates, terrestrial invertebrates, and mammals) all uses are likely to adversely affect the CRLF indirectly, via prey mediated effects.

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

Freshwater plants are not likely to be adversely affected by naled use. Two uses (safflower and swamps) exceed the LOC.

5.2.4 Indirect Effects via Alteration in Terrestrial Plant Community (Riparian Habitat)

Effects to terrestrial plants could not be quantified. While effects to terrestrial plants may affect the CRLF via habitat modification, they are not likely to adversely affect the CRLF based on the type and extent of damage as observed in crop studies and incident reports.

5.2.4.1 Sensitivity of Forested Riparian Zones to Naled

The impact of naled on forested riparian zones should be negligible and discountable, since nearly all naled uses result in little or no effect to vegetation – the one exception is a single borderline exceedence (1.02) only for non-vascular aquatic plants for a single use (safflower) at the maximum application rate. Therefore, Agency assumes **NLAA** for riparian vegetation.

5.2.4.2 Sediment Loading in the Watershed and the Potential for Naled to Affect the CRLF via Effects on Riparian Vegetation

Similarly, naled use should not result in significant increase in stream sediment loading, since it is not expected to affect riparian vegetation (see *section 5.2.4.2*, above). Increased sediment loading is the direct result of loss of vegetation and increased erosion; in the absence of vegetation diminution, there should not be significant increase in sediment loading.

5.2.5 Modification to Critical Habitat

All uses of naled are likely to adversely affect the CRLF via habitat modification, especially via effects to terrestrial invertebrates, aquatic invertebrates, small amphibians, mammals, and unicellular aquatic plants.

Table 36. Effects Determination Summary for Naled - Direct and Indirect Effects to CRLF

Assessment Endpoint	Effects Determination	Basis For Determination
Aquatic Phase (eggs, larvae, tadpoles, juveniles, and adults)		
Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	**LAA**	Numerous uses are likely to adversely affect CRLF via direct effects. For details, see Table 35 above
Survival, growth, and reproduction of CRLF individuals via effects to food supply (*i.e.*, freshwater invertebrates, non-vascular plants)	**LAA**	Numerous uses are likely to adversely affect CRLF via effects to food supply, especially freshwater invertebrates. Although naled and DDVP are not long lived in the environment, a massive aquatic invertebrate kill will not recovery in sufficient time for CRLF individuals dependent on these food sources to recover.
Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, and/or primary productivity (*i.e.*, aquatic plant community)	**NLAA**	Few to none of the uses are likely to adversely affect CRLF via effects to riparian vegetation. Neither upland nor aquatic vascular plants are expected to be significantly impacted by naled use. For details, see table X above.
Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	**NE**	Neither upland nor aquatic vascular plants are expected to be significantly impacted by naled use.
Terrestrial Phase (Juveniles and adults)		
Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	**LAA**	Numerous uses are likely to adversely affect the terrestrial phase CRLF via direct effects. For details, see Table 35 above.
Survival, growth, and reproduction of CRLF individuals via effects on prey (*i.e.*, terrestrial invertebrates, small terrestrial mammals and terrestrial phase amphibians)	**LAA**	Numerous uses are likely to adversely affect CRLF via effects on many prey items of the frog's diet.
Survival, growth, and reproduction of CRLF individuals via indirect effects	**NLAA**	None of the uses are likely to adversely affect CRLF via indirect effects on habitat. Neither aquatic nor terrestrial plants are expected to be significantly

on habitat (*i.e.*, riparian vegetation)		impacted by naled use.

Table 37. Effects Determination Summary for Naled– PCEs of Designated Critical Habitat for the CRLF

Assessment Endpoint	Effects Determination	Basis For Determination
Aquatic Phase PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)		
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	**NE**	No effects expected
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	**NE**	No effects expected
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	**NE**	No effects expected
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (e.g., algae)	**HM Not Likely**	There are few to no uses that may alter the availability of algal food sources. These uses are not likely to occur in simultaneity with the habitats of the pre-metamorphs and therefore the effect is discountable.
Terrestrial Phase PCEs (Upland Habitat and Dispersal Habitat)		
Elimination and/or disturbance of upland habitat; ability of habitat to support food source	**HM Not Likely*** (except for	Due to lack of effects data for plants, effects cannot be dismissed as No Effect. Toxic effects to plants have

Assessment Endpoint	Effects Determination	Basis For Determination
of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	direct application to swamps under hot and humid conditions)	been observed but the expected environmental concentrations, combined with the high uncertainty associated with the biological significance of observed phytotoxic effects results in discountable effects for nearly all uses. However, uses on swamps are an exception. Typical use for swamps is for mosquito control. The same environmental conditions that lead to mosquito outbreaks are also associated with plant damage. Based on information contained in incident reports and label warnings, effects to upland plants are not expected under most conditions, with the exception of hot and humid areas, such as uses in swamps for mosquito control.
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	**HM Not Likely**	Due to lack of effects data for plants, effects cannot be dismissed as No Effect. However, based on information contained in incident reports and label warnings, effects to upland plants are not expected under most conditions, with the exception of hot and humid areas, such as uses in swamps for mosquito control.
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	**HM**	Based on likely effects to small mammals, amphibians, and terrestrial invertebrates reduction in foods sources is expected.
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	**NE**	No effects expected.

When evaluating the significance of this risk assessment's direct/indirect and 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. Characterizing 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 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 influence the recovery of prey resources is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual frogs and potential modification to critical habitat.

6.0 Uncertainties

6.1 Exposure Assessment Uncertainties

DDVP is a major toxic degredate of concern that is produced from naled. Although it is assessed as part of 'total toxic residues' as a component of naled use, other uses of DDVP (as a primary active ingredient in other products, and as a degredate of other compounds) are not considered, even though their use may also occur simultaneous with naled use within the same catchment(s). Similarly, relatively minor uses of naled, and those thought to pose less exposure risk, are not considered even if they occur within the same area at the same time. Thus, there may be some underestimation of actual exposure to naled total toxic residues within a catchment; however, Agency believes that other conservative assumptions included in this assessment should more than compensate for any potential underestimations arising from these situations.

6.1.1 Modeling Assumptions

There are intrinsic limitations to all models used by EFED for evaluating potential exposure. For example, use of the PRZM-EXAMS aquatic exposure model does not readily allow for assessment of several aspects of application methods that might affect transport from application sites to nearby water bodies. Default spray drift approximations (5% for aerial applications; 1% for ground spray applications) in PRZM may not be suitable for this chemical, as much of it is meant to be applied aerially with very small droplet sizes (Dv < 60 um). In addition, many aerial applications are intended to intercept airborne targets (e.g., mosquitoes, flies) rather than as applications to foliage or soil; the intent is to allow the chemical to remain in the atmosphere long enough to eradicate flying insects in and around the target area. This may allow greater proportions (> 5%) of the applied chemical to drift away from the target area and be deposited into nearby water bodies, which is why AgDRIFT-derived spray drift values were used instead. The AgDRIFT model does allow selection of droplet size for aerial applications; however, the smallest droplet size available (Dv ≈ 140 um) is still greater than the recommended droplet size (Dv < 60 um) indicated on the label. Thus, there may still be underestimation of aquatic exposure risk. Agency nevertheless assumes that theses models are sufficiently protective overall.

Some of the modeling assumptions that were made for this assessment were deliberately simplified, due to time constraints, limited site-specific information, ease of use, and the need to have a method that can be applied to many different chemicals (e.g., as for other CRLF assessments). However, if further refinements are to be made, some of these assumptions may need to be revisited and addressed.

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, the vastly different runoff characteristics of undeveloped (especially forested) areas, which exhibit the least amount of surface runoff but the greatest amount of groundwater recharge, suburban/residential areas, which are dominated by the relationship between impermeable surfaces (roads, lots) and grassed/other areas (lawns) plus local drainage management, urban areas, that are dominated by managed storm drainage and impermeable surfaces, and agricultural areas dominated by Hortonian and focused runoff (especially with row crops), should be considered in a refined assessment incorporating 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 < agro forestry < 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 – such as rapid degradation of naled residues – Agency believes that this model gives us the best available estimates under current circumstances.

6.1.2 Impact of Vegetative Setbacks on Runoff

“Buffer” or “setback” restrictions apply for most naled spray uses (25 feet for ground spray applications, 150 feet for aerial spray, 50-100 feet for airblast, 10 feet minimum for other applications), which should serve to lessen the amount of drift that is deposited onto surface waters. However, PRZM assumes that the ‘edge-of-field’ runoff/erosion concentrations are delivered directly into the EXAMS “pond” without an intervening buffer. Theoretically, a buffer should provide additional protection to an adjacent surface water body by attenuating runoff through interception, flow retardation, and by providing conditions presumably conducive to increased degradation/dissipation of the applied chemical. Thus, it would be expected that water concentrations be lower in the presence of a vegetated (interceptive) buffer – and that the PRZM-EXAMS results would therefore be over-estimating water concentrations. Given the current uncertainty regarding the effectiveness of such buffers on runoff water quality, and the variability of such (putative) effectiveness according to physical/chemical properties of different chemicals, it may be most conservative and protective to assume there is an absence of buffer between application site and nearby water body.

Other exposure models (e.g., AgDRIFT) do allow for inclusion of setbacks of varying widths (distance from field to water body). In this case, the predicted exposure concentrations should account for the presence of such setbacks; and predicted surface water concentrations do indeed decrease with increasing setback distances. However, when the required setbacks (on label) are used in the AgDRIFT model, the results are consistent with those obtained from the PRZM-EXAMS model, using the same application rates, settings, and techniques. This indicates that either the PRZM-EXAMS model incorporates some measure of attenuation that is (incidentally?) consistent with a setback, or that both the PRZM and AgDRIFT models are similarly estimating exposure.

Inclusion of buffer setbacks are specifically incorporated into the PRZM-EXAMs model by first using the AgDRIFT model to estimate the amount of spray drift expected to reach a water body beyond the designated buffer width. Then, the percent spray drift obtained from AgDRIFT is used instead of the default PRZM spray drift input values. However, the application efficiency associated with any given application remains the same. Thus, a model run may include 12% spray drift onto a nearby water body and an on-site application efficiency of 95% – for a total application amount equivalent to 107% of what had actually been applied. Although in this case (naled applications in California) this inconsistency has little or no impact on the resulting PRZM-EXAMS EECs because most or all of the exposure in these scenarios is caused by spray drift (with almost no contribution from surface runoff), in cases where runoff processes are significant there may be an over-estimation of aquatic exposure.

6.1.3 PRZM Modeling Inputs and predicted Aquatic Concentrations

A specific limitation of the PRZM model for this assessment is evident in the relative effects of runoff and spray drift, as they are processed in the model. For example, in many of the CRLF scenarios, the associated meteorological files exhibit very little rainfall during those months (June-August) when certain pest pressures are assumed to be greatest. During this period, the predicted surface water concentrations are solely determined by the spray drift function; changing the initial application date within this period (summer) results in absolutely no change in the predicted concentrations. In contrast, if the same parameters are run with only the application date changed, there can be as much as an order of magnitude higher aquatic concentrations in surface water – the result of rainfall initiating runoff into the water body, combined with the spray drift inputs. Since spraying may occur during non-summer months (as California can have more than one ‘crop cycle’ – or ‘season’ – in a year), it is conservative and protective to model some of these uses in other months; provided, of course, that they still fall within the period that is appropriate for the given application.

6.2 Effects Assessment Uncertainties

6.2.1 Age Class and Sensitivity of Effects Thresholds

It is generally recognized that test organism age may have a significant impact on the observed sensitivity to a toxicant. For guideline tests, young (and theoretically more sensitive) organisms are used. Testing of juveniles may overestimate toxicity at older age classes for active ingredients of pesticides which act directly (without metabolic transformation) on the organism, because younger age classes often have not developed enzymatic systems associated with the detoxification of xenobiotics. When the available toxicity data provides a range of sensitivity information with respect to age class, the risk assessors use the most sensitive life-stage information as measures of effect.

6.2.2 Extrapolation of Long-term Environmental Effects from Short-term Laboratory Tests

Length of exposure and concurrent environmental stressors (e.g., urban expansion, habitat modification, and predators) will likely affect the response of the CRLF to naled. Because of the complexity of an organism's response to multiple stressors, the overall "direction" of the response is unknown. Additional environmental stressors may decrease or increase the sensitivity to the herbicide. Timing, peak concentration, and duration of exposure are critical in terms of evaluating effects, and these factors will vary both temporally and spatially within the action area. Overall, the effect of this variability may result in either an overestimation or underestimation of risk.

6.2.3 Use of Threshold Concentrations for Community-Level Endpoints

6.3 Assumptions Associated with the Acute LOCs

The risk characterization section of this assessment includes an evaluation of the potential for individual effects. The individual effects probability associated with the acute RQ is based on the assumption that the dose-response curve fits a probit model. It uses the mean estimate of the slope and the LC50 to estimate the probability of individual effects.

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