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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

2/9/95

**MEMORANDUM**

**SUBJECT:** Transmittal of EFED List A Summary Report for Naled (Chemical #034401) Case #0092

**FROM:** Mary Frankenberry
Science Analysis and Coordination Staff
Environmental Fate and Effects Division (7507C)

**THRU:** for Evert K. Byington, Chief
Science Analysis & Coordination Staff,
Environmental Fate and Effects Division (7507C)

**TO:** Esther Saito, Chief
Reregistration Branch,
Special Review & Reregistration Division (7508W)

Attached please find the following documents for the completed EFED summary report of Naled.

1. EFGWB Science Chapter
2. EEB Science Chapter
3. SACS Reregistration Summary Report

Naled exceeds the levels of concern (LOC's) for chronic effects in mammals, acute and chronic effects in aquatic organisms, and acute hazard to honey bees. A memo addressing these concerns is also attached. If you have any questions, please contact Mary Frankenberry at 305-5694.

CC:\ (with SACS Reregistration Summary Report attached)

| | | |
|---|---|---|
| Anne Barton | Tony Maciorowski | Kathy Monk |
| Hank Jacoby | Doug Urban | Larry Schnaubelt |
| Elizabeth Leovey | Evert Byington | Brigid Lowery |
| List A File | List A Cover Memo File | Peter Caulkins |

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## Background

### Use Profile

Naled (Dibrom) is a non-systemic organophosphate insecticide and acaricide. End-use formulations include several emulsifiable concentrates, soluble concentrates, and ready to use products. Naled is registered for control of insects and mites on a variety of fruits and vegetables, as well as on seed alfalfa, almonds, cotton, and safflower. Naled is also registered for use in mosquito/fly abatement, and for use in flea collars. Minor use sites include greenhouse/ornamentals, outside dwellings/lawns, rangeland (grasshopper control), and indoor use (cockroach control). Estimates for usage from recent years show that roughly 50% of total use is in mosquito/fly abatement, 36% in agricultural use (major agricultural uses are grapes, citrus, cole crops, and alfalfa), and 14% in flea collars.

The highest application rate of naled is applied to almonds, at 7.2 lb ai/acre. This use is limited to a single dormant/delayed dormant application per season. Maximum application rates for other major uses are as follows: 1.8 lb ai/acre (cole crops, citrus); 1.35 lb ai/acre (seed alfalfa); 0.9 lb ai/acre (grapes); 0.675 lb ai/acre (safflower); 0.394 lb ai/acre (mosquito/fly abatement). For uses other than almonds, there are no restrictions on number of applications allowed.

## Levels of Concern Exceedances and Risk Reduction Measures

Naled has significant potential to cause chronic effects in mammals, acute and chronic effects in aquatic organisms, and acute hazard to honey bees. This potential is due in part to the inherent toxicity of the pesticide, and in part to the current lack of application restrictions (spray intervals, limits on number of applications, etc.) Since certain risk quotients so greatly exceed the standard LOC's (e.g. >1,800 for aquatic invertebrates from use on cole crops), it is unlikely that effective mitigation measures will be found for all uses. With other uses, however, there appears to be significant leeway for implementing measures which could greatly reduce the risk to nontarget organisms. The registrant is encouraged to investigate the effects of the following general measures in their impact on exposure levels and subsequent risk from naled:

- Reduce application rates;
- Establish restrictions on application (spray intervals, limits on number of applications, etc.)
- Establish spray drift restrictions;
- Establish vegetative buffers around nearby aquatic environments.

## Value of Additional Information

The only ecotoxicity data gaps for naled are in the areas of chronic testing with birds and estuarine organisms. The actual requirements which have not been fulfilled are avian reproduction tests (mallard and bobwhite), and estuarine fish early life stage and shrimp life cycle tests.

Due to the lack of avian reproduction data, EFED could not conduct an avian chronic assessment. Data from avian reproduction studies would supply the necessary information to perform this important assessment for birds.

Due to the lack of estuarine chronic data, EFED conducted the estuarine chronic assessment based on chronic toxicity values from studies with freshwater organisms. The use of these values has introduced uncertainty into the assessment. Data from estuarine chronic studies would reduce the uncertainty in the chronic assessment for estuarine fish and aquatic invertebrates.

One other area of uncertainty relates to the assessment of acute hazard to endangered mammals. This assessment was based on an $LC_{50}$ extrapolated from a rat $LD_{50}$ value, and represents a very conservative estimate. Data from a mammalian $LC_{50}$ dietary study could greatly reduce the uncertainty in EFED's hazard assessment for endangered mammals.

With regard to the data on environmental fate and transport, there are no data on the fate and transport of degradates containing only the organophosphate group, which form by cleavage of the P-O bond in naled and/or its DDVP degradate. The registrant is requested to address this issue by providing information on the fate and transport of the organophosphate group that can form from cleavage of the carbon-oxygen or phosphorus-oxygen bond of parent naled and/or its degradate 1,2- dichlorovinyl dimethyl phosphate (dichlorvos; DDVP). This information would be considered to be confirmatory data.

Otherwise, all of the environmental fate data requirements for naled have been satisfied, with the exception of Photodegradation in Air (Subdivision N, 161-4) and Spray Drift (Subdivision R, 201-1 and 202-1). The submitted photodegradation in air studies (41310703; 42445102) have been considered to provide supplemental information only. However, there is no merit in initiating a new study at this time, since the Agency and industry are presently seeking new experimental methods for conducting photodegradation in air studies. Thus, this requirement is reserved and the submitted studies will be used as confirmatory data.

It is EFED's understanding that the registrant intends to satisfy the Spray Drift requirements by using data generated by the Spray Drift Task Force (SDTF).

**Labeling Requirements for Manufacturing- Use Products**

The following label statement is required on all manufacturing-use products:

"This pesticide is toxic to birds, mammals, fish, and aquatic invertebrates. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public water unless this product is specifically identified and addressed in an NPDES permit. Do not discharge effluent containing this product to sewer systems without previously notifying the sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA."

**Labeling Requirements for End-Use Products (other than adult mosquito control)**

Environmental hazard requires the following labeling statement:

"This pesticide is toxic to birds, mammals, fish, and aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high-water mark. Drift and runoff may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwaters or rinsate."

**Labeling for End-Use Products for adult mosquito control**

An OPP work group is currently examining mosquito control labeling, with the intent of revising this labeling for all mosquito adulticides. Until this revised labeling is developed, the Agency will not recommend any changes from the current product labeling.

**Labeling for Endangered Species**

No use limitations to protect endangered species will be suggested until the OPP Endangered Species Protection Program is complete.

**Labeling for Surface Water Concerns**

If a decision is made to generate a labeling surface water advisory for naled, EFED recommends the following language:

"Naled can contaminate surface water through spray drift.
Under some conditions, naled may also have a high potential for runoff into surface water (via both dissolution in runoff water and adsorption to eroding soil), for one or two days post-application. These include poorly draining or wet soils with readily visible slopes toward adjacent surface waters, frequently flooded areas, areas over-laying extremely shallow ground water, areas with in-field canals or ditches that drain to surface water, areas not separated from adjacent surface waters with vegetated filter strips, and highly erodible soils cultivated using poor agricultural practices such as convential tillage and down the slope plowing, and areas where an intense or substained rainfall is forecasted to occur within 48 hours."

## C. ENVIRONMENTAL ASSESSMENT

### 1. Ecological Toxicity Data

#### a. Toxicity to Terrestrial Animals

##### i. Birds, Acute and Subacute

In order to establish the toxicity of naled to birds, the following tests are required using the technical grade material: one avian single dose oral ($LD_{50}$) study on one species (preferably mallard or bobwhite quail); two subacute dietary studies ($LC_{50}$) on one species of waterfowl (preferably mallard duck) and one species of upland game bird (preferably bobwhite quail).

Avian Acute Toxicity

| Species | % A.I. | $LD_{50}$ | ID# | Fulfills Gdln. |
|---|---|---|---|---|
| Mallard duck | 93 | 52.2 mg/kg | BA0NAL01 | Yes |
| Canada goose | 93 | 36.9 mg/kg | BA0NAL01 | Partial |
| Sharp-tailed grouse | 93 | 64.9 mg/kg | BA0NAL01 | Partial |

Based on acute toxicity data, naled is moderately to highly toxic to birds. Avian acute oral studies resulted in $LD_{50}$ values of 36.9 to 64.9 mg/kg. The guideline requirement (71-1) for an avian acute oral study has been satisfied. (MRID# BAONAL01)

Avian Subacute Toxicity

| Species | % A.I. | $LC_{50}$ | ID# | Fulfills Gdln. |
|---|---|---|---|---|
| Mallard duck | 95 | 2724 ppm | 00028757 | Yes |
| Bobwhite quail | 95 | 2117 ppm | 00028757 | Yes |
| Ring-necked pheasant | 95 | 2538 ppm | 00028757 | Yes |
| Japanese quail | 95 | 1327 ppm | 00028757 | Partial |



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On a subacute dietary basis, naled is slightly toxic to birds. Four studies produced $LC_{50}$ values ranging from 1327 to 2724 ppm. The guideline requirements (71-2a,b) for avian subacute dietary toxicity tests have been satisfied. (MRID# 00028757)

### ii. Birds, Chronic

Avian Reproduction

Avian reproduction studies are required for an end-use product (EP) when birds may be exposed to repeated or continuous exposure to the pesticide. Naled has uses which involve repeat applications during breeding season; thus, there is a potential for repeated exposure to birds.

Avian reproduction studies with naled are not available. The guideline requirements (71-4a,b) for avian reproduction tests have not been satisfied.

### iii. Mammals

The mammalian data available to the Agency indicate that naled is moderately toxic to mammals on an acute basis; rat $LD_{50}$ values ranged from 92 to 371 mg/kg. On a chronic basis, a two-generation reproduction study with rats produced parental and progeny NOEL's of 90 ppm (6 mg/kg/day). (MRID#s 00253453; 00257459-63)

### iv. Insects

The minimum data required to establish the acute toxicity to honey bees is an acute contact $LD_{50}$ study with the technical material. One acceptable study was submitted.

| Species | % A.I. | $LD_{50}$ | ID# | Fulfills Gdln. |
|---|---|---|---|---|
| *Apis mellifera* | Tech. | 0.48 $\mu$g/bee | 00036935 | Yes |

This study fulfills the data requirement (141-1) for honey bee acute testing, and shows that naled is highly toxic to honey bees. (MRID# 00036935)

When data from the acute study provide an $LD_{50}$ < 2 $\mu$g/bee, a foliar residue toxicity study is required. Two acceptable studies were reviewed.

| Species | % A.I. | Result | ID# | Fulfills Gdln. |
|---|---|---|---|---|
| Apis mellifera | 4 lb EC | At 1 lb ai/A, 1-hr-old residues highly toxic, 1-day-old residues prac. nontoxic | 00060628 | Yes |
| Apis mellifera | 8 lb EC | At 0.5 lb ai/A, 3-hr-old residues low to moderate in tox. to honey bee | 05000837 | Yes |

These studies fulfill the data requirement (141-2) for honey bee foliar residue testing, and show a significant decrease in residual toxicity from 3 to 24 hours posttreatment. (MRID#s 00060628; 05000837)

## b. Toxicity to Aquatic Animals

### i. Freshwater Fish

In order to establish the toxicity of a pesticide to freshwater fish, the minimum data required on the technical grade of the active ingredient are two freshwater fish toxicity studies. One study should use a coldwater species (preferably rainbow trout) and the other a warmwater species (preferably bluegill sunfish).

Acute Studies - Technical

| Species | % A.I. | $LC_{50}$ | ID# | Fulfills Gdln. |
|---|---|---|---|---|
| Rainbow trout | 90 | 195 ppb | 40098001 | Yes |
| Rainbow trout | 90 | 345 ppb | 40098001 | Yes |
| Rainbow trout | Tech. | 160 ppb | 05003107 | Yes |
| Rainbow trout | Tech. | 210 ppb | 00263579 | Yes |
| Bluegill sunfish | 90 | 2.2 ppm | 40098001 | Yes |
| Bluegill sunfish | Tech. | 600 ppb | 00263579 | Yes |
| Cutthroat trout | 90 | 127 ppb | 40098001 | Yes |

| | | | | |
|---|---|---|---|---|
| Lake trout | 90 | 87 ppb | 40098001 | Yes |
| Fathead minnow | 90 | 3.3 ppm | 40098001 | Yes |
| Channel catfish | 90 | 710 ppb | 40098001 | Yes |
| Largemouth bass | 90 | 1.9 ppm | 40098001 | Yes |

Eleven 96-hour acute toxicity tests showed that naled is very highly toxic to moderately toxic to freshwater fish, with $LC_{50}$ values ranging from 87 ppb to 3.3 ppm. The guideline requirements (72-1a,b) for acute toxicity tests with the technical pesticide have been satisfied. (MRID#s 40098001; 00263579; 05003107)

Acute Studies - Formulated Product

Formulated product testing on fish may be required when the $LC_{50}$ of the technical pesticide is less than the EEC in the aquatic environment. The acceptable fish toxicity data on the formulated products are listed in the following table.

| Species | % A.I. | $LC_{50}$ | ID# | Fulfills Gdln. |
|---|---|---|---|---|
| Rainbow trout | 15 | 0.9 ppm | 00263579 | Yes |
| Bluegill sunfish | 15 | 4.0 ppm | 00263579 | Yes |

These studies show that the formulated products of naled are moderately to highly toxic to freshwater fish. The guideline requirements (72-1b,d) for acute toxicity tests with formulated products have been fulfilled. (MRID# 00263579)

Fish Early Life Stage Test

A fish early life stage test is required when a product is applied directly to water or is expected to be transported to aquatic sites and 1) exposure of aquatic organisms will be continual or recurrent; or 2) the lowest $LC_{50}$ is 1 mg/L or less; or 3) the EEC in water is equal to or greater than 0.01 of any $LC_{50}$; or 4) if the EEC is less than any $LC_{50}$ and the product has reproductive effects on, or cumulative effects in, aquatic organisms, or has a half-life in water greater than 4 days.

Data on naled fulfill conditions 2) and 3), above. The acceptable fish early life stage data are listed in the following table.

| Species | % A.I. | Results | ID# | Fulfills Gdln. |
|---|---|---|---|---|
| Fathead minnow | 94.4 | MATC (length and weight) >6.9, <15.0 ppb | 42602201 | Yes |

An early life stage study performed with fathead minnow shows that growth is impaired at concentrations of greater than 6.9 ppb. The MATC (Maximum Allowable Toxicant Concentration) is >6.9 ppb, < 15.0 ppb. The requirement for a fish early life stage study (72-4a) has been fulfilled. (MRID# 42602201)

**ii. Freshwater Invertebrates**

In order to establish the toxicity of a pesticide to freshwater aquatic invertebrates, the minimum data required on the technical grade of the active ingredient is one acute toxicity study. The preferred test species is Daphnia magna.

Acute Studies - Technical

| Species | % A.I. | $EC_{50}$ | ID# | Fulfills Gdln. |
|---|---|---|---|---|
| Daphnia magna | 90 | 0.4 ppb | 40098001 | Yes |
| Daphnia magna | 91.6 | 0.3 ppb | BA0NAL02 | Yes |
| Simocephalus serrulatus | 90 | 1.1 ppb | 40098001 | Yes |
| Stonefly (Pteronarcys californica) | 90 | 8.0 ppb | 40098001 | Yes |
| Scud (Gammarus fasciatus) | 90 | 18 ppb | 40098001 | Yes |

These studies show that naled is very highly toxic to freshwater aquatic invertebrates. The guideline requirement for an aquatic invertebrate acute toxicity study (72-2a) has been fulfilled. (MRID#s 40098001; BAONAL02)

Acute Studies - Formulated Product

Formulated product testing on aquatic invertebrates may be required when the $EC_{50}$ of the technical pesticide is less than the EEC in the aquatic environment. The acceptable toxicity data on the formulated products are listed in the following table.

| Species | % A.I. | $EC_{50}$ | ID# | Fulfills Gdln. |
|---|---|---|---|---|
| Daphnia magna | 58 | 1.5 ppb | 00263578 | Yes |

This study shows that the formulated product of naled is very highly toxic to freshwater aquatic invertebrates. The guideline requirement (72-2b) for acute toxicity tests with formulated products have been fulfilled. (MRID# 00263578).

Aquatic Invertebrate Life Cycle Study

An aquatic invertebrate life cycle test is required when a product is applied directly to water or is expected to be transported to aquatic sites and 1) exposure of aquatic organisms will be continual or recurrent; or 2) the lowest $EC_{50}$ is 1 mg/L or less; or 3) the EEC in water is equal to or greater than 0.01 of any $EC_{50}$; or 4) if the EEC is less than any $EC_{50}$ and the product has reproductive effects on, or cumulative effects in, aquatic organisms, or has a half-life in water greater than 4 days.

Data on naled show that it meets the above conditions. Thus, data from a life cycle test are required.

The acceptable aquatic invertebrate life cycle data are listed in the following table.

| Species | % A.I. | Results | ID# | Fulfills Gdln. |
|---|---|---|---|---|
| Daphnia magna | 97.3 | MATC (length) >0.045, < 0.098 ppb | 42908801 | Yes |

A life-cycle study performed with Daphnia magna shows that length is affected at concentrations of greater than 0.045 ppb. The MATC is >0.045 ppb, <0.098 ppb. The requirement for a freshwater aquatic invertebrate life-cycle study (72-4b) has been fulfilled. (MRID# 42908801)

**iii. Estuarine and Marine Animals**

Acute Studies

Acute toxicity testing with estuarine/marine organisms is required when a product is intended for direct application to the estuarine/marine environment or is expected to reach this environment in significant concentrations. The use of naled on agricultural crops and in mosquito control may result in exposure of the estuarine environment.

Estuarine/marine testing requirements include an acute $LC_{50}$ for an estuarine fish, an acute $LC_{50}$ for an estuarine shrimp, and either an oyster embryolarvae study or an oyster shell deposition study.

Acceptable studies are listed in the following table.

| Species | % A.I. | $LC_{50}$ | ID# | Fulfills Gdln. |
|---|---|---|---|---|
| Sheepshead minnow | 90 | 1.2 ppm | 00263581 | Yes |
| Glass shrimp | 90 | 92 ppb | 40098001 | Yes |
| Grass shrimp | 90 | 9.3 ppb | 00263581 | Yes |
| Eastern oyster | 90 | 0.19 ppm | 00263581 | Yes |
| Eastern oyster | 59.6 | 91 ppb | 42751101 | Yes |
| Sheepshead minnow | 59.5 | 1.2 ppm | 42637201 | Yes |
| Mysid shrimp | 59.6 | 8.8 ppb | 42637202 | Yes |

There is sufficient information to characterize naled as very highly toxic to moderately toxic to estuarine fish and invertebrates. The guideline requirements for acute estuarine/marine testing (72-3a,b,c) have been satisfied. (MRID#s 00263581; 40098001; 42751101; 42637201; 42637202)

Chronic Studies

Estuarine/marine organism chronic tests are required when a product is applied directly to, or is expected to be transported to, estuarine sites and 1) exposure of aquatic organisms will be continual or recurrent; or 2) the lowest $EC_{50}$ is 1 mg/L or less; or 3) the EEC in water is equal to or greater than 0.01 of any $EC_{50}$; or 4) if the EEC is less than any $EC_{50}$ and the product has reproductive effects on, or cumulative effects in, aquatic organisms, or has a half-life in water greater than 4 days.

Data on naled show that it fulfills the above conditions. Thus, data from chronic tests with estuarine/marine organisms are required. These data are not available for naled. The guideline requirements have not been fulfilled for an estuarine/marine fish early life stage study and an estuarine/marine invertebrate life cycle study .

### c. Toxicity to Plants

#### i. Terrestrial

The current use patterns for naled do not require this testing.

#### ii. Aquatic

Aquatic plant testing is required for naled as it is registered for aquatic use patterns requiring direct application to wetlands.
Data are required on the following species: *Selenastrum capricornutum*, *Lemna gibba*, *Skeletonema costatum*, *Anabaena flos-aquae*, and a freshwater diatom.

The acceptable aquatic phytotoxicity data on the technical material are listed below:

| Species | % AI | $EC_{50}$ | Author | Date | MRID No. | Classification |
|---|---|---|---|---|---|---|
| *Anabaena flos-aquae* | 94.4 | 5-Day $EC_{50}$ = 0.64 mg ai/L | Hoberg | 1992 | 42529604 | Core |
| *Skeletonema costatum* | 94.4 | 5-Day $EC_{50}$ = 0.015 mg ai/L | Hoberg | 1992 | 42529602 | Core |
| *Navicula pelliculosa* | 94.4 | 5-Day $EC_{50}$ = 0.012 mg ai/L | Hoberg | 1992 | 42529603 | Core |
| *Lemna gibba* | 94.4 | NOEC > 1.8 mg ai/L | Hoberg | 1992 | 42529601 | Supp[1] |
| *Selenastrum capricornutum* | 94.4 | 5-Day $EC_{50}$ = 0.02 mg ai/L | Hoberg | 1992 | 42529605 | Supp[1] |

[1] Although this study was determined to be supplemental, it provides sufficient information to fulfill guideline requirements.

Guideline requirements for aquatic plant testing with naled have been fulfilled. (MRID#s 425296-01, 02, 03, 04, 05)



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## 2. Environmental Fate

### a. Environmental Fate Assessment

Chemical hydrolysis and biodegradation are the major processes involved in the transformation of naled and its degradates. Volatilization from soils and/or from water is the major mode of transport for degraded naled and its bioactive degradate DDVP, as opposed to leaching to ground water. Under field conditions (terrestrial, aquatic and forestry), naled dissipated rapidly with half-lives of less than 2-days. The dissipation of DDVP was also rapid. While naled, DDVP and the degradate dichloroacetic acid (DCAA) are potentially mobile, their degradation is rapid and thus residues of naled, DDVP or DCAA are not likely to contaminate ground water by leaching.

Substantial amounts of naled should be available for runoff to surface waters for only one or two days post-application. However, rapid hydrolysis and even faster biodegradation contribute to decrease the concentration of naled available for runoff. Runoff could occur by both dissolution in runoff water and as an adsorbate in eroding soil. The degradation products of naled, the bioactive DDVP and DCA also appear to biodegrade readily and to dissipate by volatilization. Thus, DDVP or DCA would be available for runoff for a short period of time only.

In surface waters, naled and/or its major degradates will not persist long. Naled, DDVP and DCA appear to have a low bioaccumulation potential.

A major route of contamination of surface waters by naled is spray drift and direct application for mosquito abatement. EFED does not have any monitoring data on the concentrations of naled or its degradates in surface water. It is the Agency's understanding that the registrant intends to satisfy the Spray Drift requirements by using data generated by the Spray Drift Task Force (SDTF).

There are no data on the fate and transport of degradates containing only the organophosphate group, which form by cleavage of the P-O bond in naled and/or DDVP. The registrant is requested to address this issue by providing information on the fate and transport of the organophosphate group that can form from cleavage of the carbon-oxygen or phosphorus-oxygen bond of parent naled and/or its degradate 1,2- dichlorovinyl dimethyl phosphate (dichlorvos; DDVP). This information would be considered confirmatory data.

Otherwise, all of the environmental fate data requirements for naled have been satisfied, with the exception of Photodegradation in Air (Subdivision N, 161-4) and Spray Drift (Subdivision R, 201-1 and 202-1). The submitted photodegradation in air studies (41310703; 42445102) have been considered to provide supplemental information only. However, there is no merit in initiating a new study at this time, since the Agency and industry are presently seeking new experimental methods for conducting photodegradation in air studies. Thus, this requirement is reserved and the submitted studies will be used as confirmatory data.

## b. Environmental Fate and Transport

### i. Degradation

Abiotic Hydrolysis

Abiotic hydrolysis studies conducted with $^{14}C$-naled showed that naled degraded rapidly in aqueous media. The rate and mechanism of degradation of naled is pH-dependent. The rates of degradation increased with increasing pHs. In sterilized buffered solutions maintained at 25 C, the estimated half-lives of hydrolysis were 96 hours (4 days) at pH 5, 15.4 hours (0.64 days) at pH 7, and 1.6 hour (0.07 days) at pH 9. At pH 9, the major degradate was desmethyl naled, but at pH 5 the major degradate was bromodichloro acetaldehyde (BDCA). Formation of this latter degradate implies cleavage of the P-O bond and elimination of the bromine at the C-2 position. At pH 7 both mechanisms, demethylation and P-O cleavage/C-2 bromine elimination, take place. Under the conditions of the abiotic hydrolysis study, there was no evidence of DDVP formation at any of the three pHs studied. (40034902; 41354101)

Photodegradation

Direct photolysis in water does not appear to be a major degradative pathway for naled, but indirect photolysis in water may be significant. On soils (viable soils) the contribution of biodegradation is greater than any contribution from photodegradation. The photodegradation of naled in air is not well defined at this time.

Photolysis in Water

Direct photolysis is not a major degradative pathway for naled. However, the study conducted in the presence of a chemical photosensitizer (acetone) indicated that indirect photolysis may play an important role in the photodegradation of naled in aqueous media. Moreover, data from the indirect photolysis study indicate that DDVP may be produced faster and in higher quantities in the presence of photosensitizers. The rate of degradation for irradiated solutions in the presence of a sensitizer was 0.98 days, in contrast to the approximately 5 days in the absence of the sensitizer. Thus, under environmental conditions naled may photodegrade by indirect photolysis and produce DDVP.

In the direct photolysis study, the degradation of naled in a pH 5 buffered solution was controlled by hydrolytic reactions. The half-lives of degradation under irradiated and dark conditions are comparable to the abiotic hydrolysis of naled at pH 5, 25 C. The experimental halflives ranged from 3.7 days (abiotic hydrolysis study) to 4.7 and 4.4 days in the photodegradation study. The major degradate was BDCA (bromodichloroacetaldehyde), which reached 71 to 80% by 14 days (end of the study). This degradate is also the major hydrolytic degradate at pH 5 and is formed by cleavage of the P-O bond of naled. Other degradates formed in both irradiated and dark solutions were desmethylnaled at maximum 5.4 to 5.6% of the applied; DDVP at less than 5%; desmethyl-DDVP at less than 2%. Degradates that were exclusively found in irradiated solutions were formic acid and glyoxylic acid, which together reached a maximum 0f 6.2% combined.

In the indirect photolysis study, DDVP reached 20% of the applied after 1-day post treatment. The other major photolytic degradates were formic acid plus glyoxylic acid at a combined maximum of 51.5% of the applied after 6 days. Carbon dioxide totaled 22.8% after 6 days, in contrast to only 1.3% after 14 days in the non-sensitized study. The other degradates found were also present in the non-sensitized study, but at lower concentrations.

The photodegradation in water studies were conducted under natural sunlight irradiation. The studies were conducted in Richmond, CA (latitude 37°59'02" N and longitude 122°20'15"W) during the month of August. The daily average intensity was 0.125-0.187 W/cm$^2$. (41310702; 42445103)

Photodegradation on Soil

The degradation of naled on sandy loam soil surfaces was rapid, regardless of natural sunlight exposure or not. The half-lives of degradation were 0.54 and 0.58 hours under irradiated and non-irradiated conditions. A recalculation of half-life for exposed samples yielded 0.4 hours. The recalculation takes into account degradation rates in terms of total light energy (total cumulative energy) and in terms of degradation of naled per J/cm$^2$. The degradation of naled in/on soils is primarily associated with chemical and microbial processes, with small contribution of photoreactions.

The nature of degradates was essentially the same for irradiated and dark-control samples. The degradates found were DDVP, bromodichloro-acetaldehyde (BDCA) and dichloroacetic acid (DCAA). DDVP formed in about equal concentrations under both conditions throughout the duration of the study. While BDCA formed rapidly under both conditions, its concentration decreased after 2 hrs. There was a slightly higher concentration of DCAA in exposed samples. Formaldehyde, if formed, appeared to be a transient species. The higher concentration of DCA in exposed samples tends to suggest that photolytical debromination enhances the formation of DCAA from BDCA. The amount of major degradates was BDCA (67-77% between 0.5 -1 hr); DCAA (up to 26% by the end of the study); DDVP ca. 12 % from 0.5 to 2 hr.

This study was conducted with a sandy loam soil (74% sand, 18% silt, 8% clay, 2.2% OM, pH 7.4, CEC 8 meq/100 g) held at 75% water holding capacity and 25 C. The source of irradiation was natural sunlight at Richmond, CA (latitude 37° 59'02" N and 122° 20'15" W) on 8/24/89. (41310701; 42445104)

Photodegradation in Air

According to the reported data, naled exposed to natural sunlight degraded with a calculated half-life of 57.8 hours, as opposed to 99 hrs in the dark controls. In any case, data suggest that naled degrades fast under both irradiated and dark conditions.
In competition with degradation, naled and its degradates would have the tendency to diffuse into the atmosphere.

The material that entered the reaction via evaporation for exposed and dark samples ranged as follows:

| | Exposed | Dark |
|---|---|---|
| Parent naled .... | 87%(0 hr)-16.6(119hr) | 87%(0hr)-28.1(119hr) |
| DDVP ............ | 3%(0 hr)-13%(119 hr) maximum 32% after 66 hrs | 3%(0 hr)-16%(119hr) |
| BDCA ............ | 4%(0 hr)-55%(119 hr) | 4%(0 hr)-43%(119hr) |

It is not possible from the experimental set-up used for this study to assess the contribution of wall effects to the photodegradation of naled and DDVP. Therefore, the data reported can only be taken as ancillary. (41310703; 42445102)

## Biodegradation

The presence of microbial populations in soil and sediment/water systems enhance the degradation of naled and DDVP, although chemical reactions such as hydrolysis are also involved in the degradation of naled. Under both aerobic and anaerobic conditions naled and degradates mineralized as the end-product of reactions, but $CO_2$ production is slower under anaerobic than aerobic conditions. Formation of DDVP was observed under anaerobic conditions, but DDVP was not detected under aerobic conditions due to rapid mineralization. Degradates formed from DDVP by cleavage of the P-O, such as DCAA and DCE, were present at higher amounts in the samples incubated under anaerobic rather than aerobic conditions.

### Aerobic Soil Metabolism

Parent naled incubated in Oakley loam sand (85% sand, 6% silt, 9% clay; 1.4% organic matter; pH 7.3,; CEC 7.5 meq/g) at a temperature of 25 C and an initial concentration of 10 ppm degraded rapidly and was practically undetectable after 1 day. In soils under aerobic conditions, mineralization occurred rapidly, with about 50% of the applied radioactivity released as $CO_2$ after 3 days posttreatment; by 190 days, total evolved $CO_2$ was 82%; the rate of $CO_2$ release decreased with time. The volatile degradate DDVP was not detected under aerobic conditions, in contrast to studies conducted under anaerobic conditions in which DDVP is a major degradate.

The amount of extractable radioactivity decreased as $CO_2$ release progressed. The major degradate extracted from soil was DCAA, which reached about 20% by 2-days posttreatment and declined to less that 1% by 15 days. The degradate dichloroethanol (DCE) was also detected at about 23% after 1 day and to less than 1% after 15 days. This latter degradate is volatile. Non-extractable degradates increased with time, but reached about 10% by day 15 after treatment. (00085408)

### Anaerobic Aquatic Metabolism

Parent naled incubated at 5 C at a concentration of 8.3 ug/g in sand soil flooded with cranberry bog water degraded with a halflife of less than one day (0.2 to 0.5 day). The soil/water system was kept for 30-days under nitrogen prior to treatment. The amount of naled remaining after 1-day posttreatment ranged from 12-13% of the applied and was not detected after 7 days.

The major degradate at 1-day posttreatment was DDVP at 14-15% of the applied. The amount of DDVP declined to undetectable levels after 62 days. The degradate DCAA reached a maximum concentration of 19-20% after 3 days posttreatment, declining to 7% after 7-days posttreatment. Five unidentified degradates (each less than 7% of the applied) were detected. Unextractable radioactivity from soil ranged from 2.5 to 11% of the applied throughout the duration of the study. Other degradates identified were desmethyl DDVP and 2,2-dichloroethanol (DCE), each at less than 10% of the applied. Evolution of $CO_2$ increased with time, reaching 72% at 44 days and approximately 76% after 190 days.

The degradation of DDVP, once formed, was slower than that of parent naled. During the first 1-2 days after application of naled, the half-life of DDVP was about 0.9 days. After several days, the degradation rate slowed considerably, indicating that the degradation/ dissipation of DDVP is biphasic. Naled converted rapidly to DDVP, but DDVP further reacted to other products, with formation and decomposition of DDVP probably occurring simultaneously and at comparable rates. The degradation of naled under anaerobic conditions is slower than under aerobic conditions. (40618201; 41354102; 42445101)

**ii. Mobility**

<u>Mobility in Soil</u>

The rapid degradation of naled/DDVP in soil/water was not conducive to batch-equilibrium studies for these chemicals. Calculation of $K_d$ values from $R_f$ values suggests that parent naled is slightly mobile while DDVP is moderately mobile. Both naled and DDVP are less mobile in clayrich soils.

Soil column leaching studies conducted with naled aged for 0.4 to 3.0 hours showed that residues of naled were mobile in columns of sand (pH 6.7; 1.9% OM), clay loam (pH 8.1; 2.8% OM), sandy loam (pH 7.1; 1.0% OM) and two loam soils (one of pH 5.5 and 1.5% OM; the other of pH 7.2 and 0.8% OM). The highest mobility of residues was observed in the sand soil column, where 2.71% of the residues remained in the column and 67% was found in the leachates. For the other columns, the radioactive residues remaining in the columns ranged from 5.4 to 11% of the applied while 36 to 59% was found in the leachates.

In general, the radioactivity remaining in the columns was evenly distributed throughout the columns. Parent naled, which was originally applied at 10 ppm, was detected in the leachates at less than 0.02 ppm; DDVP at less than 0.093 ppm; DCE at less than 0.085 ppm; DCAA at less than 1.86 ppm and carbonates at less than 0.282 ppm. The latter is an indication of mineralization of naled and degradates, but may not account for any carbon dioxide released as a gas. Loss of DDVP or DCE by volatilization was not accounted for.

The degradate DCAA is expected to be very mobile, as suggested by supplemental batch-equilibrium adsorption studies (reported Freundlich adsorption constants of less than 1; 1/n about 1). While this could present a potential ground and/or surface water concern, it is important to realize that this degradate, which appears to form from DDVP, can also degrade rapidly in soils under aerobic and anaerobic conditions. (00161100; 40279200; 40394904; 41354104; 41354105; 41354106)

Volatility from Soil--Laboratory

Naled, applied as the 63% EC DIBROM 8 Emulsive at a rate of 2.6 lb ai per acre, volatilized from loamy sand soil at a flux ranging from $1.19 \times 10^{-4}$ to $12.5 \times 10^{-4}$ ug/cm$^2$/hour. After 12 days, 48% of the volatilized phase was identified as $CO_2$ and 8% as possibly DDVP (which is more volatile than parent naled). In soil extracts, only about 1% was parent naled, DDVP was approximately 8% and a desmethylated-DDVP (either the mono- or the di-desmethylated degradate or both) at about 17% of the applied. Several unidentified degradates at a total of less than 6% were also found. Non-extractable radioactivity was approximately 9%. Mean air concentration of naled other than $CO_2$ ranged from 0.160 to 1.674 ug/m$^3$.

It should be noted that under actual field conditions the volatilization of naled and its volatile degradates will be influenced by weather conditions such as temperature, speed and direction of the wind, humidity, etc. and by the nature of the surface in which naled is present. (41310704; 42445105)

**iii. Accumulation**

Bioaccumulation in Aquatic Organisms

Static bioaccumulation studies indicated that naled applied at 0.031, 0.063, and 0.127 mg ai/L to tanks inhabited with killifish (Fundulus heteroclitus) did not accumulate in whole body tissue over a 7-day exposure period. The degradate DDVP was found in fish tissue samples in the 0.063 and 0.127 mg ai/L tanks at 1-hour after exposure at a concentration of 0.04 ppm, but it was not detected at later sampling intervals. The half-life of dissipation of naled in the tanks was less than 1-day. The degradate DDVP was found at 0.02 ppm at 1-day posttreatment, but less than 0.01 ppm was found in all samples taken after 7-days posttreatment. (00074643; Supplemental)

**iv. Field Dissipation**

Field Dissipation Studies

The terrestrial, aquatic and forestry dissipation studies show that naled and its degradate DDVP can dissipate rapidly under environmental conditions. The half-life of dissipation is less than 2 days in all three studies. Hydrolysis, biodegradation and possibly reactions with soil surfaces are responsible for the transformation of naled and DDVP while volatilization contributes to the transport of residual naled and DDVP. There are no evidences for movement of naled or DDVP through the soil profile.

Terrestrial

A preliminary report submitted to the Agency indicated that parent naled, applied at 2.0 lb ai/A as the 8 lb/gal EC, dissipated with a half-life of less than 2 days on bare plots of sand soil (pH 6.8; CEC 3.30 mg/100g; 4.7% OM; 88.8% sand, 8.0% silt, 3.2% clay). Six applications were made during the 3-week period of the study.

The maximum concentrations of naled were 0.05-0.06 ppm 1 day after the last application in the 0-to-5 cm layer. The concentrations of naled were less than 0.01 ppm at the 0-to-10 and 10-to-15 cm depths at any sampling interval. Dichlorvos (DDVP) was detected at 0.02 ppm only at the 0-to-5 cm depth 1 day after the last application. The air temperatures ranged from 51 to 88 F and the cumulative rainfall was 5.1 cm. (0016040; Supplemental Data)

Aquatic

Naled (85% SC/L), applied at 0.4 lb ai/A/application in five aerial applications over a 2-week period to ponds in Titusville, Florida and Lexington, Mississippi, dissipated from pond water with a half-life of less than 1-day. Naled was isolated at maximum concentration of 0.018 ppm at the Florida site and at 0.006 ppm at the Mississippi site. In general, the concentration of naled decreased with the depth of the water column. Following each application, naled was less than 0.002 ppm after 1 day posttreatment at the Florida site and less than 0.001 ppm at the Mississippi site. Following the last application, naled was not detected after 2 days. The degradate DDVP was isolated in pond water at maximum concentration of 0.013 and 0.014 at the Florida and Mississippi sites, respectively. Following the last application, DDVP was not detected (less than 0.001 ppm) after 7 days. Naled and DDVP were not detected (less than 0.01 ppm) in the sediments. The sediment at the Florida site was classified as a sand (92-94% sand, 1-3% silt; 5% clay. 1.2- 2.5% OM; pH 7.7; CEC 1.4-2.9 meq/100 g). The sediment at the Mississippi site was classified as silt loam (5% sand, 75% silt, 20% clay; pH 5.2; CEC 11.9 meq/100 g). (40494101; 40976401; 40976402; 41354107)

Forestry

Naled, as DIBROM Concentrate 14% EC, applied aerially to 24-acres of loblolly pine in Madison, Georgia at a rate of 0.4 lb ai/acre, dissipated with a half-life of about 1-day. The highest concentrations of naled and/or DDVP, expressed as naled equivalents, were found at the top of the canopy at a maximum 0.3 ug/cm$^2$. In the stream and pond waters the maximum concentrations of naled/DDVP were less than 5 ppb (0, 1, 3 days posttreatment). In exposed and litter-covered soil samples, the amount of naled was less than 50 ppb. No naled/DDVP residues were found in sediments.

The site contained a stream and a pond; was 600 to 680 feet in elevation; had a 6 to 15% slope; and was underlain with deep (greater than 60 inches) sandy loam and sandy clay loam soils of the Madison-Cecil series. (40304301; 41354108)

### c. Water Resources

#### i. Ground Water

Naled, DDVP and the degradate dichloroacetic acid (DCA) are potentially mobile. They are not, however, persistent enough to trigger any studies to assess their potential for leaching to ground water. Therefore, no ground water data have been evaluated and no ground water concern is anticipated for this chemical and its degradates.

#### ii. Surface Water

Substantial amounts of naled should be available for runoff to surface waters for only one or two days post-application (aerobic soil metabolism half-life < 12 hours). Although its low persistence precludes an accurate determination of the soil/water partitioning of naled, its soil TLC $R_f$ values suggest that it has only moderate mobility with runoff probably occuring via both dissolution in runoff water and adsorption to eroding soil. The rapid hydrolysis of naled (pH dependent hydrolysis half-lives of 4 days, 15.4 hours, and 1.6 hours at pHs 5, 7 and 9, respectively) coupled with its high susceptibility to both aerobic and anaerobic degradation (anaerobic aquatic metabolism initial half-life of < 1 day) indicate that naled generally will not be persistent in surface waters or sediments, even in ones with low microbiological activities and/or long hydrological residence times. The bioaccumulation potential of naled appears to be negligible.

Based upon the results of batch equilibrium and soil column leaching studies, the major degradates of naled (DDVP and DCAA) appear to be somewhat more mobile than naled (particularly DCAA). However, both DDVP and DCAA appear to be susceptible to rapid volatilization and biodegradation. Substantial quantities of DDVP and DCAA should be available for runoff for only a short period, and runoff will probably be primarily by dissolution in runoff water. The degradates will probably partition primarily into the water columm of receiving surface waters as opposed to bottom and suspended sediment. The bioaccumulation potentials of DDVP and DCAA appear to be negligible.

EFED does not have any monitoring data on the concentrations of naled or its degradates in surface waters. However, EFED has used computer modeling to generate Tier 2 (single high exposure scenario/use over multiple years) EECs for direct application to a 1 ha, 2 m deep pond and for the same pond draining treated 10 ha fields. Scenarios modeled were direct applications to water to control hornflies, direct application to water to control mosquitoes, and applications to almonds, citrus, grapes, safflower, cotton, cole crops, and seed alfalfa. Each high exposure scenario was modeled over 36 years. The upper 10th percentile (one in 10 year) initial, 4 day average, 21 day average, 60day average, and 90 day average EEC for each modeled scenario are listed later in the text.

## 3. Exposure and Risk Characterization

### a. Ecological Exposure and Risk Characterization

#### i. Exposure and Risk to Nontarget Terrestrial Animals

Birds and mammals will be exposed to naled through the consumption of insect and plant food material containing naled residues and through direct exposure during application. To assess acute hazard to terrestrial organisms, the following formulas are used:

Risk Quotient (RQ) = $EEC/LC_{50}$
Level of Concern (LOC) = 0.5
When the RQ exceeds the LOC, acute risk is possible.

### (a) Birds

Acute Effects

For birds, the $LC_{50}$ value for the most sensitive species is 2117 ppm. The following table provides the terrestrial EEC's and the acute risk quotients for birds.

RESIDUES (ppm) and Risk Quotients (RQ's) for Birds (Acute)

| Applic. Rate* (lb a/A) | Short Grass | Short Grass RQ | Long Grass | Long Grass RQ | Leaves /Leafy Crops | Leafy Crop RQ | Forage | Forage RQ |
|---|---|---|---|---|---|---|---|---|
| 0.675 | 160 | 0.08 | 75 | 0.04 | 85 | 0.04 | 40 | 0.02 |
| 0.9 | 220 | 0.10 | 100 | 0.05 | 115 | 0.05 | 52 | 0.02 |
| 1.35 | 320 | 0.15 | 150 | 0.07 | 170 | 0.08 | 80 | 0.04 |
| 1.8 | 440 | 0.21 | 200 | 0.09 | 225 | 0.11 | 105 | 0.05 |
| 7.2 | 1700 | 0.80 | 790 | 0.37 | 900 | 0.43 | 420 | 0.20 |

*Crops with these application rates are as follows: 0.675, safflower; 0.9, grapes; 1.35, seed alfalfa; 1.8, citrus and cole crops; 7.2, almonds.

The only naled use rate which results in a RQ greater than 0.5 is application to almonds at 7.2 lb ai/acre. At this rate, the EEC is 1700 ppm and the RQ = 0.8, indicating potential risk to birds.

Two factors act to mitigate this potential risk. First, use on almonds is a single application to dormant trees. Second, this is a very minor use and represents only a small amount of the naled used on agricultural crops. Thus, the Agency does not believe that the use of naled on almonds represents a significant acute hazard to birds.

Chronic Effects

Avian reproduction studies are not available for naled.

Environmental fate data indicate that naled will not persist in the environment (half-life is 1-2 days in the field). However, because the labels provide no restrictions on number of applications or application intervals, there is still a significant potential for continuous or repeated exposure to birds. Thus, there is a potential for chronic avian risk.

In the absence of avian reproduction data, EFED cannot conduct an assessment for chronic risk to birds. These studies would provide the information necessary to assess this potential risk.

### (b) Mammals

Acute Effects

Data from the Agency toxicology database show naled to be moderately toxic to mammals on an acute basis (rat $LD_{50}$ = 92 to 325 mg/kg). In the absence of mammalian $LC_{50}$ data, the risk assessment was based on the $LD_{50}$ value, as follows:

Average food consumption for a young rat is 10 gm per day. If toxicant is present in/on the food item at 920 ppm, 10 gm of food will contain 9.2 mg of toxicant. Representative weight of a young rat is 0.1 kg. Thus, daily intake is 9.2 mg toxicant/0.1 kg body weight, or 92 mg toxicant/kg body weight. This calculated value (92 mg/kg) equals the actual $LD_{50}$ value of 92 mg/kg. For this calculation, RQ = EEC/920ppm, and acute risk is indicated when RQ > 0.5. Thus, there is potential for acute risk to mammals when terrestrial EEC's exceed 460ppm.

As can be seen in the residue table above, residues at this level will only be found following application to almonds at 7.2 lb ai/acre. Since use on almonds is a minor use and is limited to a single application to dormant trees, significant acute risk to mammals is not expected.

Chronic Effects

Environmental fate data indicate that naled will not persist in the environment (half-life is 1-2 days in the field). However, because the labels provide no restrictions on number of applications or application intervals, there is still a significant potential for continuous or repeated exposure to mammals. Thus, there is a potential for chronic risk to mammals.

EFED conducted an assessment using data from a rat reproduction study. Data from an Agency toxicology database provide a rat reproduction (progeny) NOEL of 6mg/kg/day. According to standard procedure used in OPP, this value converts to 90-120 ppm in the diet.

For assessment of chronic risk to mammals, RQ = EEC/NOEL, and LOC = 1.0. That is, whenever the EEC exceeds the NOEL, there is potential chronic risk.

The use of naled at current rates presents a potential for chronic risk to mammals. The following table outlines the expected residue levels at various application rates, and provides the chronic risk quotients for mammals. EEC's are from the Kenaga nomograph.

RESIDUES (ppm) and Risk Quotients (RQ's) for Mammals (Chronic)

| Applic. Rate* (lb a/A) | Short Grass | Short Grass RQ | Long Grass | Long Grass RQ | Leaves /Leafy Crops | Leafy Crop RQ | Forage | Forage RQ |
|---|---|---|---|---|---|---|---|---|
| 0.675 | 160 | 1.8 | 75 | 0.8 | 85 | 0.9 | 40 | 0.4 |
| 0.9 | 220 | 2.4 | 100 | 1.1 | 115 | 1.3 | 52 | 0.6 |
| 1.35 | 320 | 3.6 | 150 | 1.7 | 170 | 1.9 | 80 | 0.9 |
| 1.8 | 440 | 4.9 | 200 | 2.2 | 225 | 2.5 | 105 | 1.2 |
| 7.2 | 1700 | 18.9 | 790 | 8.8 | 900 | 10.0 | 420 | 4.7 |

* Crops with these application rates are as follows: 0.675, safflower; 0.9, grapes; 1.35, seed alfalfa; 1.8, citrus and cole crops; 7.2, almonds.

As shown in the table, residues on short grass exceed the mammalian chronic LOC at all application rates. The LOC is exceeded on long grass and leaves/leafy crops at all but the lowest rate; it is exceeded on forage at rates of 1.8 lb/A and up. These values indicate significant potential for chronic risk to mammals. The potential for chronic risk is enhanced by the fact that naled may be applied frequently at short intervals, and by the fact that some of the registered use sites (citrus, grapes, seed alfalfa) are high exposure sites for mammals.

In view of the above, EFED concludes that the use of naled at current rates presents significant potential for chronic risk to mammals.

(c) **Insects**

Data from an acute study showed 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 posttreatment. Acute risk to bees is anticipated from the use of naled, when use involves application to blooming crops. The extent of the residual hazard will vary with application rate, weather conditions, and the formulation of the specific product applied.

### ii. Exposure and Risk to Nontarget Aquatic Animals

#### (a) Freshwater Fish and Invertebrates

Fish and aquatic invertebrates will be exposed to naled through drift and runoff from treated areas, and through direct exposure of wetlands and aquatic habitats from mosquito control applications.

Acute Effects

For the aquatic acute risk assessment, RQ = EEC/$LC_{50}$, and the LOC = 0.5. Ecotoxicity values used in this assessment are lake trout $LC_{50}$ (87 ppb) and Daphnia magna $EC_{50}$ (0.3 ppb). EEC values and RQ's are provided in the tables below with the following assumptions:

1. At the application time 95% of the chemical applied reached the field.

2. 1% of the applied naled reached surface water at the application time.

3. The other 4% either remained airborne or deposited on the ground beyond the pond.

4. The aerobic soil metabolism half life was multiplied by an uncertainty factor of 3 and the result was used as anaerobic half life metabolism for naled.

The EEC's for hornflies and mosquitoes are reported with a crop as host (cotton for hornflies and cole crops for mosquitoes) and also direct application of the naled to the pond.

The following tables show the naled use for each crop and direct application of naled to the pond for control of mosquitoes and hornflies. The 1 in 10 year maximum instantaneous, 96 hour acute, and 21 day chronic average dissolved naled concentrations with 1% spray drift are reported in these tables.

Estimated Residues (ppb) and Risk Quotients (RQ's) for Freshwater Organisms

| Use Site | Appl. Rate in lb ai/acre (No. appls.) | Inst EEC (ppb)* | Fish RQ | Invert. RQ |
|---|---|---|---|---|
| Safflower | 0.675 (6) | 10.7 | 0.12 | 35 |
| Seed alfalfa | 1.35 (3) | 84.2 | 0.97 | 280 |
| Mosquitoes (Direct appl.) | 0.4 (5) | 21.0 | 0.24 | 70 |
| Hornflies (Direct appl.) | 0.4 (5) | 21.0 | 0.24 | 70 |
| Grapes | 0.9 (6) | 72.0 | 0.83 | 240 |
| Cole crops | 1.8 (5) | 328.7 | 3.78 | 1095 |
| Cotton | 0.4 (5) | 110.6 | 1.27 | 368 |
| Almonds | 7.2 (1) | 255.2 | 2.93 | 850 |
| Citrus | 1.8 (7) | 290.8 | 3.34 | 969 |

*Values based on standard EFED modeling.

The freshwater fish LOC will be exceeded for any EEC > 43.5 ppb, and the aquatic invertebrate LOC will be exceeded for any EEC > 0.15 ppb. EEC's for several naled uses (seed alfalfa, grapes, cole crops, cotton, almonds and citrus) exceed the fish LOC, indicating potential risk to freshwater fish. EEC's for all major naled uses greatly exceed the aquatic invertebrate LOC; thus, acute risk to freshwater aquatic invertebrates can be expected from all major uses of naled at current application rates.

Chronic Effects

For the aquatic chronic risk assessment, RQ = EEC/LEL, and the LOC = 1.0. Ecotoxicity values used in this assessment are the lowest effect levels (LEL's) for rainbow trout (6.9 ppb) and

Daphnia magna (0.045 ppb). From the above values, it can be determined that the chronic fish LOC will be exceeded for any EEC > 6.9 ppb, and the chronic aquatic invertebrate LOC will be exceeded for any EEC > 0.045 ppb. EEC's are provided in the following table.

Estimated Residues (ppb): Chronic Exposure

| Use Site | Appl. Rate in lb ai/acre (No. appls.) | 4-Day EEC (ppb)* | 21-Day EEC (ppb)* |
|---|---|---|---|
| Safflower | 0.675 (6) | 2.4 | 0.6 |
| Seed alfalfa | 1.35 (3) | 20.4 | 4.2 |
| Mosquitoes (Direct appl.) | 0.4 (5) | 4.6 | 0.9 |
| Hornflies (Direct appl.) | 0.4 (5) | 4.6 | 0.9 |
| Grapes | 0.9 (6) | 16.2 | 3.5 |
| Cole crops | 1.8 (5) | 81.5 | 17.3 |
| Cotton | 0.4 (5) | 24.6 | 6.3 |
| Almonds | 7.2 (1) | 62.7 | 14.5 |
| Citrus | 1.8 (7) | 64.2 | 12.8 |

*Values based on standard EFED surface water modeling.

The following table shows the chronic risk quotients for freshwater fish and aquatic invertebrates. These risk quotients are based on the above EEC's and the LEL's for rainbow trout and Daphnia magna.

Chronic Risk Quotients for Freshwater Organisms

| Use Site | Appl. Rate in lb ai/acre (No. appls.) | RQ for Fish (4/21-day) | RQ for Inverts. (4/21-day) |
|---|---|---|---|
| Safflower | 0.675 (6) | 0.3/0.1 | 53/13 |
| Mosquitoes (Direct appl.) | 0.4 (5) | 0.7/0.1 | 102/19 |
| Hornflies (Direct appl.) | 0.4 (5) | 0.7/0.1 | 102/19 |
| Grapes | 0.9 (6) | 2.3/0.5 | 360/77 |
| Seed alfalfa | 1.35 (3) | 3.0/0.6 | 453/93 |
| Cotton | 0.4 (5) | 3.6/0.9 | 546/140 |

| | | | |
|---|---|---|---|
| Almonds | 7.2 (1) | 9.1/2.1 | 1393/322 |
| Citrus | 1.8 (7) | 9.3/1.9 | 1426/284 |
| Cole crops | 1.8 (5) | 11.8/2.5 | 1811/384 |

Based on 4 and 21-day EEC values, there is significant potential for chronic risk to freshwater fish from uses on seed alfalfa, grapes, cole crops, cotton, almonds, and citrus. Chronic fish RQ's range from 0.5 for grapes to 11.8 for cole crops. There is significant potential for chronic risk to freshwater invertebrates from all major naled uses. Chronic freshwater invertebrate RQ's range from 13.3 for safflower to 1811.1 for cole crops.

**(c) Estuarine and Marine Animals**

Acute Effects

Since EEC's based on modeling are not yet available for estuarine and marine environments, freshwater EEC's are used to estimate exposure in these environments. Major uses of naled which generate estuarine concerns are citrus and mosquito control. Maximum freshwater EEC's from above are 290.8 ppb (citrus) and 21.0 ppb (mosquito control). Acute $LC_{50}$ values for estuarine organisms are as follows:

Sheepshead minnow $LC_{50}$ = 1.2 ppm;
Mysid shrimp $LC_{50}$ = 8.8 ppb;
Oyster shell deposition $EC_{50}$ = 91 ppb.

Using these data, RQ values for citrus are 0.24 (291/1200) for sheepshead minnow, 33 (291/8.8) for mysid shrimp, and 3.20 (291/91) for oyster. Since RQ values for shrimp and oyster exceed the LOC of 0.5, acute risk to estuarine/marine invertebrates is expected at rates of 1.8 lb ai/A on citrus. Acute risk to estuarine/marine fish is not expected from use on citrus.

For mosquito control, with an EEC value of 21.0 ppb, RQ's are 0.02 ( 21.0/1200) for sheepshead minnow, 2.39 (21.0/8.8) for mysid shrimp, and 0.23 (21.0/91) for oyster. The RQ for mysid shrimp (2.39) exceeds the LOC of 0.5. Thus, risk to estuarine/marine invertebrates is expected from the mosquito control use.

Chronic Effects

Since EEC's based on modeling are not yet available for estuarine and marine environments, freshwater EEC's were again used to estimate exposure in these environments. Major uses of naled which generate estuarine concerns are citrus and mosquito control. Maximum chronic EEC's from above are 64.2 ppb (citrus) and 4.6 ppb (mosquito control). Since no estuarine chronic ecotox data are available, calculations were based on the freshwater toxicology data used above.

Using these data, RQ values for citrus are 64.2/6.9 for fish and 64.2/0.045 for invertebrates. Since the RQ values for fish (9.3) and aquatic invertebrates (1426.7) exceed the LOC of 1.0, chronic risk to estuarine/marine fish and aquatic invertebrates is expected from use on citrus.

For mosquito control, with an EEC value of 4.6, chronic RQ's are 0.7 (4.6/6.9) for fish and 102.2 (4.6/0.045) for aquatic invertebrates. Since the RQ value for aquatic invertebrates exceeds the LOC of 1.0, chronic risk to estuarine/marine invertebrates is expected from the mosquito control use.

Ecotoxicology data for chronic effects in estuarine/marine animals, specifically an estuarine fish early life stage and a shrimp life cycle test, would greatly reduce the uncertainty in this assessment.

### iii. Exposure and Risk to Nontarget Plants

#### (a) Aquatic

Based on aquatic plant toxicity data and calculated aquatic EEC's, residues of naled in aquatic environments may exceed 5-day $EC_{50}$ values for Skeletonema costatum (marine alga), Navicula pelliculosa (freshwater diatom), and Selenastrum capricornutum (freshwater alga). This indicates a potential hazard to one-celled nontarget plants such as algae and diatoms. As food for aquatic organisms, these species are indicators of potential impact on nontarget aquatic organisms.

Residues of naled will not exceed the NOEC for Lemna gibba. Hazard to nontarget vascular plants is expected to be minimal.

### iv. Endangered Species

Terrestrial

The only difference between the assessments for endangered and non-endangered birds and mammals is that the acute LOC's for endangered species are more conservative (0.1 vs. 0.5). Chronic LOC's remain the same.

For birds, the $LC_{50}$ value for the most sensitive species is 2117 ppm. The following table provides the terrestrial EEC's and the acute risk quotients for birds. The same table was used in the assessment of acute effects for non-endangered birds.

RESIDUES (ppm) and Risk Quotients (RQ's) for Birds (Acute)

| Applic. Rate* (lb a/A) | Short Grass | Short Grass RQ | Long Grass | Long Grass RQ | Leaves /Leafy Crops | Leafy Crop RQ | Forage | Forage RQ |
|---|---|---|---|---|---|---|---|---|
| 0.675 | 160 | 0.08 | 75 | 0.04 | 85 | 0.04 | 40 | 0.02 |
| 0.9 | 220 | 0.10 | 100 | 0.05 | 115 | 0.05 | 52 | 0.02 |
| 1.35 | 320 | 0.15 | 150 | 0.07 | 170 | 0.08 | 80 | 0.04 |
| 1.8 | 440 | 0.21 | 200 | 0.09 | 225 | 0.11 | 105 | 0.05 |
| 7.2 | 1700 | 0.80 | 790 | 0.37 | 900 | 0.43 | 420 | 0.20 |

*Crops with these application rates are as follows: 0.675, safflower; 0.9, grapes; 1.35, seed alfalfa; 1.8, citrus and cole crops; 7.2, almonds.

As shown in the table, application to seed alfalfa, citrus, cole crops, and almonds may result in residues on short grass which exceed the acute LOC for birds. The LOC is also exceeded on leaves/leafy crops from application to citrus, cole crops, and almonds, and on long grass and forage from application to almonds. On the basis of this information, there is a potential for acute risk to endangered birds.

In the absence of mammalian $LC_{50}$ data, risk to nonendangered mammals was assessed using values extrapolated from the rat $LD_{50}$. For this endangered species calculation, RQ = EEC/920ppm, and acute risk is indicated when RQ > 0.1. Thus, acute risk to endangered mammals is expected when the terrestrial EEC exceeds 92ppm.

As can be seen from the above table, residues greater than 92ppm will be found on short grass for all applications, on long grass and leaves/leafy crops for all but the safflower use, and on forage for the citrus, cole crop, and almond uses. Thus, there is a potential for risk to endangered mammals.

In the discussion of chronic hazard to non-endangered birds and mammals, EFED concluded that the use of naled at current rates presents significant potential for chronic risk to mammals. Since avian reproduction data are lacking, an assessment of chronic risk to birds cannot be made. However, endangered mammal species associated with naled use sites may be at risk.

Aquatic

The only difference between the assessments for endangered and non-endangered aquatic organisms is that the acute LOC for endangered species is more conservative (0.05 vs. 0.5). The chronic LOC remains the same. EEC values and acute RQ's are provided in the following table.

Estimated Residues (ppb) and Risk Quotients (RQ's) for Freshwater Organisms (Acute)

| Use Site | Appl. Rate in lb ai/acre (No. appls.) | Inst EEC (ppb)* | Fish RQ | Invert. RQ |
|---|---|---|---|---|
| Safflower | 0.675 (6) | 10.7 | 0.12 | 35 |
| Mosquitoes (Direct appl.) | 0.4 (5) | 21.0 | 0.24 | 70 |
| Hornflies (Direct appl.) | 0.4 (5) | 21.0 | 0.24 | 70 |
| Grapes | 0.9 (6) | 72.0 | 0.83 | 240 |
| Seed alfalfa | 1.35 (3) | 84.2 | 0.97 | 280 |
| Cotton | 0.4 (5) | 110.6 | 1.27 | 368 |
| Almonds | 7.2 (1) | 255.2 | 2.93 | 850 |
| Citrus | 1.8 (7) | 290.8 | 3.34 | 969 |
| Cole crops | 1.8 (5) | 328.7 | 3.78 | 1095 |

*Values based on standard EFED modeling.

As shown in the table, RQ's for endangered fish exceed the LOC for all uses. RQ's for endangered aquatic invertebrates exceed the LOC for all uses. Thus, all uses of naled represent significant potential for acute risk



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to endangered aquatic organisms.

In the discussion of chronic risk to non-endangered aquatic organisms, it was concluded that the use of naled on seed alfalfa, grapes, cole crops, cotton, almonds, and citrus at current rates presents significant potential for chronic risk to fish. Thus, endangered fish species associated with naled use at these sites may be at risk.

For nontarget aquatic invertebrates, EFED concluded that all uses of naled at current rates present significant potential for chronic risk. Thus, endangered aquatic invertebrate species associated with all naled use sites may be at risk.

Plants

Use of naled may result in hazard to one-celled aquatic organisms such as algae and diatoms. These organisms represent an important food source for aquatic organisms. As such, there is a potential for adverse impact on endangered aquatic organisms via depletion of their food source.

## b. Water Resources Risk Implication for Human Health

### i. Ground Water

Naled and its major degradates may be mobile, but are not persistent enough to have triggered any ground water data requirements or assessment. The Agency does not have a ground water concern for naled at this time.

### ii. Surface Water

Naled and its degradates are not regulated under the Safe Drinking Water Act, and neither a MCL nor drinking water health advisories have been established for them. If a decision is made to generate a labeling surface water advisory for naled, recommended language is contained in a memorandum accompanying this document.