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

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

October 12, 1999

MEMORANDUM

SUBJECT: **NALED**. Revised HED Risk Assessment for RED.
PC Code 034401. DP Barcode D260129

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and

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Please find attached the revised HED Risk Assessment for the Naled RED. Thanks go to the Risk Assessment team, Rob Travaglini as the former Risk Assessor, Sue Hummel, David Hrdy, and David Soderberg for the Dietary Exposure assessment, Tim Leighton and Dave Jaquith for the Occupational and Residential Exposure Assessment, Jerry Blondell and Monica Spann for the Epidemiology assessment, and Pam Hurley for the Toxicology assessment. Thanks also to Steve Knizner and to Kathleen Martin for the editing.

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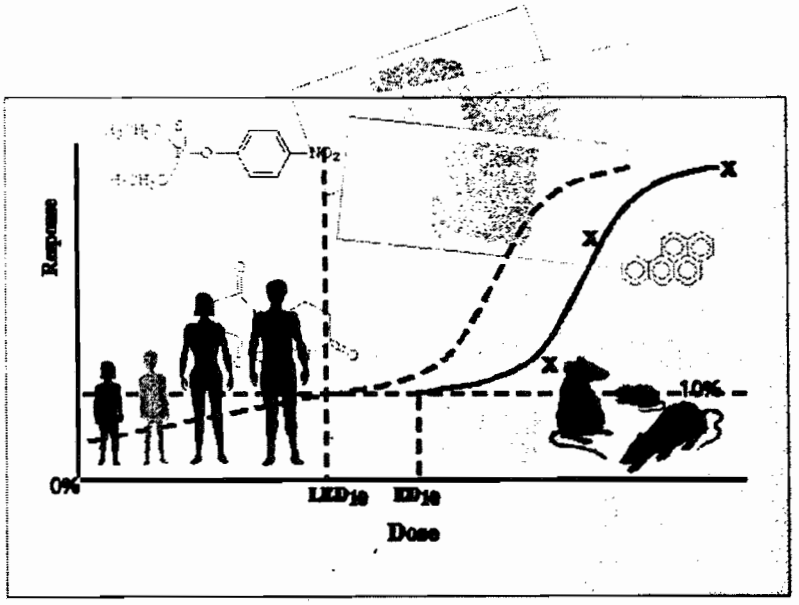
HUMAN HEALTH RISK ASSESSMENT

Naled



U.S. Environmental Protection Agency
Office of Pesticide Programs
Health Effects Division (7509C)

Susan Hummel, Risk Assessor
October 13, 1999

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HUMAN HEALTH RISK ASSESSMENT

Naled

Phase 5

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3996

Table of Contents

List of Tables

I. Executive Summary

Background

Provided in this document is a revised Risk Assessment for naled (1,2-dibromo-2,2-dichloroethyl dimethyl phosphate). Naled is an organophosphate insecticide registered for use primarily to control adult mosquito and blackfly populations. Naled is also used on food and feed crops, in greenhouses, and for pet flea collars. The insecticide acts as a contact poison to kill aphids, army worms, blackflies, cockroaches, deer flies, earwigs, fleas, gnats, grasshoppers, gypsy moth, horn fly, houseflies, lice, midges, mites, mosquitoes, ticks, and weevils.

Naled was first registered in the United States in 1959 for use as an insecticide-acaricide. The Agency issued a Registration Standard for naled in September, 1983 (NTIS #PB-84-158989). In November, 1991, the Agency issued a Data Call-In for naled requiring certain ecological effects and occupational/residential exposure data. Additional occupational and residential exposure data were called in during 1993.

Dichlorvos (DDVP), a registered organophosphate insecticide, is a metabolite of naled. A preliminary risk assessment for dichlorvos, which encompassed dichlorvos derived from naled was completed by the Health Effects Division (HED) on December 3, 1998 and addresses all exposure concerns including dietary for this metabolite. This document therefore, addresses concerns solely for naled *per se.*

Health Effects

Toxicity

The toxicological database for naled is complete. It provides evidence that naled, like other organophosphates, has anticholinesterase activity in all species tested (including dogs, rabbits, hens, rats, and mice). Clinical signs of cholinesterase (ChE) inhibition include tremors, salivation, nasal discharge, and abnormal respiration. Inhibition of plasma, erythrocyte and brain cholinesterase activity occurs by the oral, dermal, and inhalation routes of exposure, and following exposure for various durations (acute, short- intermediate-term, and chronic). In an acute delayed neurotoxicity study in hens, naled did not produce frank delayed neurotoxicity, but a degenerative neuronal effect was manifest in the spinal cord. In the hen subchronic neurotoxicity study, no delayed neuropathy was observed. No neurological effects were noted in the acute rat neurotoxicity study, however, in the subchronic rat neurotoxicity study minimal neurological effects were noted.

The FQPA Safety Factor Committee recommended that the 10X FQPA Safety Factor be removed for naled based on: the completeness of the toxicology database; toxicological data indicating no enhanced sensitivity for infants or children (as demonstrated in the developmental and reproductive toxicity studies); and availability of adequate actual data, surrogate data, and/or modeling outputs to satisfactorily assess exposures for dietary, drinking water, and residential drift to bystanders from mosquito/blackfly control applications.

By the oral, dermal, and inhalation exposure routes, technical naled is classified in Toxicity Category II. For eye and dermal irritation, naled is classified in Toxicity Category I. Naled was weakly positive in a guinea pig dermal sensitization study. In the oral acute toxicity studies, females appear to be more sensitive than males.

The chronic Population Adjusted Dose (PAD) for naled is 0.002 mg/kg/day based on: a No Observed Adverse Affect Level (NOAEL) of 0.2 mg/kg/day from a two-year gavage study in the rat; an uncertainty factor (UF) of 100 to account for interspecies extrapolation (10X) and intraspecies variability (10X) and 1X for the FQPA Safety Factor. Brain ChE inhibition was seen at the Lowest Observed Adverse Affect Level (LOAEL) of 2.0 mg/kg/day.

89

For acute dietary risk assessment, the acute PAD is 0.01 mg/kg/day. The acute PAD was calculated using: a NOAEL of 1.0 mg/kg/day; a UF of 100 that includes 10X for interspecies extrapolation and 10X for intraspecies variation; and 1X for the FQPA Safety Factor. The NOAEL is based on mild clinical cholinergic signs and plasma and brain ChE inhibition at 10 mg/kg/day (LOAEL) in a 28-day oral study with rats.

Although the Agency has determined that there is evidence of non-carcinogenicity in humans for naled *per se* (i.e., naled is a Group E chemical); dichlorvos (DDVP), a metabolite of naled, has been classified as a Group C (possible human) carcinogen.

For occupational and residential risk assessments, short- and intermediate-term dermal and inhalation toxicological endpoints were identified. The toxicological endpoint for both the short- and intermediate-term dermal risk assessment is based on the NOAEL of 1 mg/kg/day observed in a 28-day rat dermal toxicity study. Cholinesterase inhibition and neurological clinical signs were observed at the LOAEL of 20 mg/kg/day. For inhalation risk assessments (any duration of exposure) the NOAEL of 0.053 mg/kg/day (or 0.2 µg/L) derived from a 13-week rat inhalation toxicity study was used. The LOAEL in this study was 1 µg/L based on depression of plasma and erythrocyte (red blood cell) ChE activities.

Dietary Exposure and Risk Estimates

Tolerances are listed in 40 CFR §180.215 for the residues of naled and its conversion product dichlorvos (2,2-dichlorovinyl dimethyl phosphate), expressed as naled equivalents.

Acute Dietary (Food) Exposure and Risk Estimate

The acute dietary exposure and risk estimates do not exceed HED's levels of concern. A refined probabilistic (Monte Carlo) acute dietary risk analysis was performed. This assessment was refined using anticipated residues (ARs) and percent of crop treated data. The acute ARs used in the exposure analysis are based on that portion of the tolerance level attributed to naled residues (that is to say the contribution of dichlorvos residues to the tolerance expression has been removed). All naled ARs used in the acute dietary exposure analyses can thus be considered high-end estimates because they are based on field trials.

The acute dietary risk analysis estimated the distribution of single-day exposures. These analyses evaluated individual food consumption as reported by respondents in the USDA 1989-1992 Continuing Survey of Food Intake by Individuals (CSFII). At the 99.9th percentile exposure level, the percent of the acute PAD occupied ranged from 18% for the US Population to 39% for children 1-6 years old.

Chronic Dietary (Food) Exposure and Risk Estimates

Chronic dietary (food) exposure and risk estimates do not exceed HED's level of concern. Anticipated residues and percent of crop treated information were used to calculate the chronic dietary exposure to naled. Anticipated residues for the chronic dietary analysis are based on average residues of naled obtained from field trials, corrected by cooking factors where applicable. One half the limit of detection was assumed in calculating ARs if residues were not detectable and the detection limit for the RAC was available. If no AR and no detection limits were available, total residues expressed in naled equivalents were apportioned between naled and dichlorvos by extrapolating from data from another raw agricultural commodity (RAC). Reduction factors for celery, collards, oranges, strawberries, and grapes were available for naled. Where naled reduction factors were not available, reduction factors for dichlorvos were assumed. A reduction factor of 0.1X was applied to all cooked forms of naled.

The percent of the chronic PAD occupied ranged from 1.6% for the US Population to 3.2% for children 1-6 years old.

Drinking Water Exposure

Currently, HED uses drinking water levels of comparison (DWLOCs) as a surrogate to capture risk associated with exposure to pesticides in drinking water. A DWLOC is the concentration of a pesticide in drinking water that would not be of concern as an upper limit in light of total aggregate exposure to that pesticide from food, water and residential uses (if any). A DWLOC may vary with drinking water consumption patterns and body weights for specific subpopulations.

Based on the acute and chronic dietary (food) exposure estimates summarized above, DWLOCs were calculated using the Agency's default body weights and consumption values (70 kg/2L (adult male); 60 kg/2L (adult females) and 10 kg/1L (child)). Acute DWLOCs range from 61 ppb for children to 285 ppb for the US Population. Chronic DWLOCs range from 19 ppb for children to 69 ppb for the US Population.

The Ecological Fate and Effects Division (EFED) provided estimated environmental concentrations (EECs) for naled in surface water. Based on PRZM-EXAMS modeling, Tier 2 exposure analysis, the following EECs of naled for surface water were calculated: Acute - 12.7 ppb and Chronic - 0.56 ppb (based on 10 year return).

Comparing these EECs for naled to the DWLOCs, both the acute and chronic EECs do not exceed HED's DWLOC's.

EFED also provided EECs for naled in ground water. Based on SCI-GROW modeling the groundwater concentration of naled was estimated to be 0.005 ppb for acute and chronic values. These relatively low EECs of naled in groundwater do not exceed HED's levels of concern for either chronic or acute exposures.

Occupational Exposure and Risk Estimates

Mixing/Loading/Application Exposure and Risk Estimates

The occupational risk assessment identified total margins of exposure (MOEs) less than 100 for some of the agricultural and mosquito/blackfly handler activities. Some of the total MOEs may be artificially low based on the poorly defined NOAEL in the 28-day dermal rat study. The NOAEL in the 28-day dermal rat study is 1 mg/kg/day (the LOAEL is 20 mg/kg/day) compared to the NOAEL in the 28-day oral rat study of 1 mg/kg/day. Based on dermal absorption data on two very similar compounds, dichlorvos and trichlorfon, the existing dermal toxicity study likely overestimates dermal toxicity because of the 20 fold difference between the lowest adverse effect level (LOAEL) and the no adverse effect level (NOAEL).

The MOEs for the mosquito/blackfly control uses are not well defined because of the need to extrapolate exposure data from agricultural applications to mosquito control applications, due to the lack of scenario-specific data. The registrant has agreed to limit the use of naled to trained and professional applicators (i.e., not for use by homeowners) and to disallow certain high exposure application methods, such as backpack sprayers. Other uses associated with MOEs that cannot be adequately mitigated by such measures continue to exceed HED's level of concern.

Postapplication Exposure and Risk Estimates

The Agency is requiring new interim restricted-entry intervals (REIs), provided the registrant agrees to submit supplementary DFR data to determine definitive REIs for all crop groups/use sites on which naled is registered for use. The new interim REIs are two days for grapes along with all other crops with an application rate of 0.938 lb ai/acre. A three-day REI is required for all other crops with a higher application rate than grapes. Previously the REIs were 24 hours for all crops. However, the REIs of 2 and 3 days are currently on the labels. Postapplication/reentry exposure studies are required as confirmatory data to determine definitive REIs for all crop groups/use sites on which naled is registered.

Residential Exposure and Risk Estimates

The current registrant of record for naled, Amvac Chemical Corporation, has indicated to EPA in a letter of December 11, 1998, that residential and domestic uses, with the exception of flea pet collars, will not be supported for reregistration. Therefore, this document addresses only occupational exposure scenarios and residential exposures resulting from public health uses (i.e., mosquito/blackfly abatement) and exposures from flea pet collars.

To assess residential (bystander) exposures from the mosquitocide and blackfly uses of naled, HED considered dermal exposures and incidental oral exposures (hand-to-mouth, object-to-mouth, and ingestion of soil) that could result from deposition of naled on turf. The HED Residential Standard Operating Procedures (SOPs, December 17, 1997) were used with a few modifications.

Dermal MOEs for postapplication exposure for all aerial mosquito application scenarios do not exceed HED's level of concern.

- Dermal MOEs ranging from 97 for adult dermal turf contact to 1.3×10^6 for toddler soil ingestion.

The aerial blackfly rate scenario produced two MOEs less than 100. The aerial blackfly use has the highest application rate (residential rate of 0.1 lb ai/A), followed by the aerial mosquito use (residential rate of 0.05 lb ai/A).

- MOEs of ~50 for adults and toddlers contacting turf.

12 of 46

Dermal MOEs for postapplication exposures following ground-based fogger application (rate of 0.02 lb ai/A) did not exceed HED's level of concern.

- ❖ Lowest MOE of 1,500.

None of the exposure scenarios for hand-to-mouth, object-to-mouth, or ingestion of soil resulted in MOEs that exceed HED's level of concern.

Therefore, the only scenarios with MOEs less than 100 are for the dermal exposure resulting from aerial blackfly application rate at 0.1 lb ai/acre. These MOEs likely overestimate dermal toxicity because of the 20 fold difference between the lowest adverse effect level (LOAEL) and the no adverse effect level (NOAEL).

Based on information obtained from the labels of the products registered for flea pet collars, and using HED's SOPs for Residential Exposure Assessments (December 18, 1997), HED has estimated exposures of individuals exposed to naled via the flea pet collar use. None of the calculated MOEs for children were above 100 (i.e., all pet collar exposure scenarios for children exceeded HED's level of concern). Therefore, additional refinement of the pet collar scenario is warranted.

Aggregate Risk Estimates and Risk Characterization

Acute Aggregate Risk Estimates (food and water)

The acute aggregate risk assessment considers acute (single day) food and water exposures. The acute dietary (food) risk estimates do not exceed HED's level of concern. Tier 1 groundwater and Tier 2 (PRZM-EXAMS) surface water EECs do not exceed HED acute DWLOCs. Therefore, aggregate acute risk estimates for naled do not exceed HED's levels of concern.

Chronic Aggregate Risk Estimates (food and water)

The chronic aggregate risk assessment considers chronic (lifetime) food and water exposures. The chronic dietary (food) risk estimates do not exceed HED's levels of concern. Tier 1 groundwater and Tier 2 (PRZM-EXAMS) surface water EECs do not exceed HED chronic DWLOCs. Therefore, aggregate chronic risk estimates for naled do not exceed HED's levels of concern.

13946

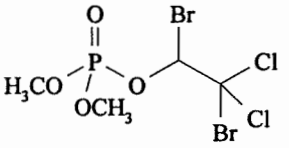
Short- and Intermediate-term Aggregate Risk Estimates (food, water, and non-occupational)

The short- and intermediate-term risk assessments consider residential exposures along with average food and water exposure. Some of the short- and intermediate-term aggregate risk estimates for naled exceed HED's level of concern. None of the estimated MOEs for children exceeded 100 using the screening-level assessment for the pet collar use (i.e., without further refinement, all pet collar exposure scenarios for children exceeded HED's level of concern). Short- and intermediate-term residential exposures exceed HED's level of concern for the ULV aerial blackfly applications. However, short- and intermediate-term residential exposures do not exceed HED's level of concern for the ULV mosquito applications, a public health use.

II. Product Chemistry

A. Description and Identification of the Active Ingredient

The chemical structure and physical/chemical characteristics of naled are described below:



Empirical Formula: $C_4H_7O_4PBr_2Cl_2$
Molecular Weight: 381 g/mole
Chemical Name: 1,2-dibromo-2,2-dichloroethyl dimethyl phosphate

Pure naled is a white solid with a melting point of 27 C. The vapor pressure has been reported to be 2 $x10^{-4}$ mm Hg at 20 C to 2 $x10^{-3}$ mm Hg. Naled is practically insoluble in water, has limited solubility in aliphatic solvents, and is highly soluble in oxygenated solvents such as ketones and alcohols.

B. Other Product Chemistry Considerations

There is one technical product for naled, the 90% technical (EPA Reg. No. 5481-478). The following data are required; these data are considered confirmatory.

- Discussion of formation of the impurities (guideline 830.1670)
- Preliminary Analysis (guideline 830.1700)
- Certification of Ingredient Limits (guideline 830.1750)
- Flammability (guideline 830.6315)
- UV/Visible Absorption (guideline 830.7050)
- Dissociation Constant (guideline 830.7370)
- Vapor Pressure (guideline 830.7960)

III. Hazard Assessment

A. Toxicology Assessment

The naled toxicology database is adequate to support reregistration eligibility. No further data are required at this time. Dichlorvos, a registered organophosphate insecticide, is a metabolite of naled. A preliminary risk assessment for dichlorvos, which encompassed dichlorvos derived from naled was completed by HED on December 3, 1998 and addresses all exposure concerns including dietary for this metabolite. This document therefore, addresses concerns solely for naled *per se*.

1. Acute Toxicity

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. Table 1 presents the acute mammalian toxicity data for naled.

Table 1. Acute Mammalian Toxicity for Technical Naled

Test	% AI	MRID	Results	Category
Oral LD_{50}--rat		00142660	Corn oil: 325 mg/kg (males); 230 mg/kg (females) Carboxymethyl-cellulose[2]: 191 mg/kg (males); 92 mg/kg (females)	II
Dermal LD_{50}--rabbit		00146493	390 mg/kg (males) 360 mg/kg (females)	II
Inhalation LC_{50}--rat		00146494	0.20 mg/L (males) 0.19 mg/L (females) for 4 hr. exposure	II
Eye irritation--rabbit[1]	85%	00074826	Severe irritation	I
Dermal irritation--rabbit[1]	85%	00074825	Corrosive (escharotic)	I
Skin sensitization--guinea pig[1]		00074657	Weakly positive	N/A

[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).

16 94

2. Subchronic Toxicity

The subchronic feeding study requirements are satisfied by the two-year rat and one-year dog studies. No further data are required at this time.

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/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/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/day. Other treatment-related findings were confined to the 80 mg/kg/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/day for dermal irritation, systemic toxicity and ChE inhibition. The LOAEL was 20 mg/kg/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).

17 8 16

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/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/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/day and a LOAEL of 10 mg/kg/day based on cholinergic effects (MRID 00088871).

3. Chronic Toxicity

A dietary stability study of naled incorporated into standard rodent feed indicated that the test material rapidly degraded at room temperature (with a half-life of 1.5 days at 21 C). Consequently, most long-term studies administered naled by gavage. Unless specified differently, all of the following studies used naled suspended in aqueous CMC (0.5% w/w) as a test material due to the increased toxicity of the CMC preparations of naled over the corn oil preparations as demonstrated by the acute toxicity studies.

In a one-year study with male and female beagle dogs, naled was administered at dose levels of 0, 0.2, 2, or 20 mg/kg/day by gavage. Clinical signs of emesis, diarrhea and statistically-significant increases in mineralization of the lumbar spinal cord in both sexes were associated with doses of 2 and 20 mg/kg/day. Plasma, RBC, and brain ChE activities were depressed at these same dose levels (brain was depressed at 2 mg/kg/day in females only). Anemia was also evident at 2 and 20 mg/kg/day. Erythrocyte count, hemoglobin and hematocrit were reduced. At the high dose only, liver and kidney weights were increased but unaccompanied by histopathological changes. The NOAEL was 0.2 mg/kg/day for ChE inhibition and systemic toxicity. The LOAEL was 2 mg/kg/day based on depressed ChE activity (43-58% RBC, 24-48% plasma and 5-17% brain), anemia and mineralization of the lumbar spinal cord (MRID 00160751).

A two-year chronic toxicity/carcinogenicity study administered naled to male and female Sprague-Dawley CD rats at doses of 0, 0.2, 2, or 10 mg/kg/day by gavage. Plasma, RBC, and brain ChE activities were depressed at dose levels of 2 and 10 mg/kg/day. At 2 mg/kg/day RBC ChE was depressed 4-33%, plasma 54-60%, and brain 24%. No other treatment-related findings were observed. The NOAEL for ChE inhibition was 0.2 mg/kg/day and the LOAEL was 2 mg/kg/day. The NOAEL for systemic toxicity was the highest dose tested, 10 mg/kg/day (MRID 00141784).

4. Carcinogenicity

The Agency has classified naled as a Group E Chemical (evidence of noncarcinogenicity for humans) based on the lack of evidence of carcinogenicity in mice and rats.

A two-year chronic toxicity/carcinogenicity study administered naled to male and female Sprague-Dawley CD rats at doses of 0, 0.2, 2, or 10 mg/kg/day by gavage. No neoplastic lesions were related to treatment. The only effect was depression of ChE activity at 2 and 10 mg/kg/day. The NOAEL for ChE inhibition was 0.2 mg/kg/day. The systemic NOAEL was 10 mg/kg/day (the highest dose tested). Dose selection was supported by the results of a 28-day pilot study demonstrating mortality at 100 mg/kg/day and mild cholinergic signs (lethargy and muscle weakness) accompanying 50% reductions in plasma and brain ChE activities at 10 mg/kg/day. Therefore, the high dose of 10 mg/kg/day was considered adequate to test for carcinogenic potential (MRID 00141784, 00088871).

An 89-week carcinogenicity study administered naled to male and female CD-1 mice at doses of 0, 3, 15, or 75 mg/kg/day by gavage. The high dose of 75 mg/kg/day was reduced to 50 mg/kg/day after 26 weeks due to high mortality. Mortality was 10 and 13% for high dose males and females, respectively, compared to 2% for control after 26 weeks. Tremors were observed in three of eight high dose females that died during the first 26 weeks. The only other treatment-related finding was a slight reduction (3-5%) in weight gain by males showing a dose-related trend at the middle- and high-dose levels. Cholinesterase activity was not determined. No neoplastic findings were related to treatment. The dose selection was supported by the results of a pilot study, which indicated the use of a high dose between 50 and 100 mg/kg/day in the carcinogenicity study to avoid excessive toxicity and mortality. In the pilot study, a dose level of 300 mg/kg/day for two weeks produced mortality (60 to 80%), 150 mg/kg/day for two weeks produced cholinergic signs and 50 mg/kg/day for four weeks produced a slight decrease in body weight gain and a significant reduction in food consumption. The mortality rate

1994

associated with the 75 mg/kg/day dose level after 26 weeks justified reduction of the high dose to 50 mg/kg/day (MRID 00148569).

5. Developmental Toxicity

A developmental toxicity study using pregnant Sprague-Dawley rats administered naled at doses of 0, 2, 10, or 40 mg/kg/day by gavage on days 6 through 19 of gestation. Dams were sacrificed on day 20 of gestation. The high dose of 40 mg/kg/day was maternally-toxic producing clinical signs and reduced weight gain. The clinical signs included tremors, hypoactivity, discharge from the mouth and eyes, and dyspnea. No developmental toxicity was related to treatment. There may have been a marginal effect on resorptions at the high dose because there were six litters with two or more resorptions. Since these resorptions were observed at a dose that was maternally toxic, they were not considered significant enough to change the NOAEL for developmental toxicity. The NOAEL for maternal toxicity was 10 mg/kg/day and the LOAEL was 40 mg/kg/day based on clinical signs and reduced weight gain. The developmental toxicity NOAEL was 40 mg/kg/day, the highest dose tested (MRIDs 00138682, 00144026).

Another developmental toxicity study using artificially inseminated New Zealand rabbits administered doses of 0, 0.2, 2, or 8 mg/kg/day of naled by gavage on days 7 through 19 of gestation. Does were sacrificed on day 29 of gestation. No maternal or developmental toxicity was related to treatment. Although no maternal toxicity was elicited by the highest dose, dose selection was supported by the results of a pilot study with inseminated animals. In the pilot study dose levels of 20 mg/kg/day and higher produced mortality, 10 mg/kg/day and above produced marked cholinergic signs, and 2 mg/kg/day produced clinical signs consistent with mild cholinergic effects. The clinical effects at 10 mg/kg/day indicated that the high dose of 8 mg/kg/day in the definitive study was sufficient for testing developmental toxicity. The NOAEL for maternal toxicity and developmental toxicity was 8 mg/kg/day, the highest dose tested (MRID 00146496).

6. Reproductive Toxicity

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/day by gavage. Systemic effects were observed in adult male rats of both generations. Body weight gain was depressed at the 18 mg/kg/day dose for F_0 males and at all dose levels for F_1 males. Reproductive indices were unaffected in both generations. Survival of pups was reduced at 18 mg/kg/day in the F_1 and F_{2b} 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/day. The LOAEL was 18 mg/kg/day based on decreased body weight gain in both generations. The reproductive toxicity NOAEL was 18 mg/kg/day, which was the highest dose tested (MRID 00146498).

7. Mutagenicity

An *in vivo* gene mutation study (mouse spot test) was conducted with pregnant C57BL/6 mice given 0, 3, 20, or 150 mg/kg/day of naled by gavage for four days of gestation (days 8-12). Litters were scored for coat color mutations ("spots") on post-partum days 12 and 28. The test was presumably indicative of mutation events consisting of intragenic base-pair changes, deletions and somatic crossing-over. The high dose of naled was very toxic producing maternal mortality, decreased maternal body weight and decreased pup survival. Naled exhibited no potential to induce coat color spots (MRID 00141571).

Naled was tested for gene mutation in the *Salmonella typhimurium* reverse mutation assay (Ames assay) using tester strain TA 100 with and without metabolic activation (PCB-induced mouse liver S9 fraction). Naled was tested at concentrations of 0.5, 1 and 2 µM. The highest concentration was toxic in the absence of metabolic activation but was mutagenic with metabolic activation. The middle concentration of 1 µM was positive both with and without metabolic activation. The low concentration of 0.5 µM was marginally positive (less than two-fold DMSO control) (MRID 00142662).

Naled was tested for DNA damage in *Proteus mirabilis* strains PG273 (wild type) and PG713 (thr^-, rec^-, hcr^-). Naled was negative in both strains at inhibitory concentrations of 10 and 40 µM (MRID 00142662).

Naled was tested for cytogenetic effects *in vivo* in the mouse bone marrow micronucleus assay. Naled was administered to male and female Swiss mice as a single oral dose by gavage. Dose levels were 0, 55, 110, or 220 mg/kg for males and 0, 55, 110, or 290 mg/kg for females. Dose selection was based on preliminary studies indicating oral LD_{50} values of 257 mg/kg for males and 336 mg/kg for females. Bone marrow cells were harvested 24, 48 and 72 hours after treatment. The highest dose produced mortality (16-24%) and clinical signs of toxicity. Naled had no cytotoxic effect on bone marrow at these dose levels and produced no nuclear anomalies (MRID 00146497).

In another *in vivo* cytogenetics study, male and female Sprague Dawley rats were administered naled as a single oral dose by gavage. Dose levels were 0, 3.88, 12.93, or 38.80 mg/kg for males and 0, 6.17, 20.57, or 61.70 mg/kg for females. Dose selection was based on preliminary studies conducted at the same laboratory indicating oral LD_{50} values of 85.1 mg/kg for males and 81.2 mg/kg for females. Bone marrow cells were harvested 6, 24 and 48 hours after treatment. High dose females showed signs of toxicity including ataxia, dyspnea and oral exudate. Cytotoxicity in bone marrow was not evident at any dose level. Naled had no clastogenic effect. The highest dose was considered to be near a maximum tolerated dose based on the clinical signs observed in females and the results of preliminary studies indicating the high dose for males was approximately one-half the oral LD_{50} (MRID 00142665).

8. Metabolism

The Agency waived the data requirement for a general rat metabolism study since existing animals studies demonstrate that naled is rapidly absorbed, distributed and excreted. No further data are required at this time.

O,O-Dimethyl-2,2-dichlorovinyl phosphate (DDVP or dichlorvos) is an expected metabolite of naled. Limited data have shown metabolites to include dichlorvos and hydrolysis products. In a study with a single cow, some metabolites were tentatively identified: methyl phosphates (mono- and di-), O-methyl 2,2-dichlorovinyl phosphate (desmethyl DDVP) and inorganic phosphate (MRID 00013546).

Three metabolites were identified in a *in vitro* study using rat liver homogenates: dichlorvos, dichloroacetaldehyde and bromodichloroacetaldehyde (BDCA) (MRID 00074857).

9. Neurotoxicity

In an acute delayed neurotoxicity study adult domestic hens (set 1) were given an acutely toxic dose of naled (42 mg/kg, LD_{50}) preceded by treatment with atropine sulfate and 2-PAM to protect from acute cholinergic effects. The hens were observed for neurotoxic signs for 21 days, re-dosed, observed an additional 21 days, then sacrificed for histopathological examination of central and peripheral nervous tissue. A second set of hens was administered a single dose of 8 or 42 mg/kg and sacrificed 24 hours later for determination of brain ChE and neurotoxic esterase activities. Two of 10 controls and 4/40 treated hens (set 1) died during the study. All treated hens (set 1) showed clinical signs of neurotoxicity (i.e., "subdued," unsteady). None displayed locomotor ataxia characteristic of delayed neurotoxicity. Axonal degeneration in the spinal cord was increased in naled-treated hens compared to controls (concurrent and historical), but it was less severe than that produced by the positive control. Brain ChE was markedly depressed (50%, 42 mg/kg) in naled treated hens. Neurotoxic esterase activity was unaffected. Naled did not produce frank delayed neurotoxicity, but a degenerative neuronal effect was manifest in the spinal cord (MRID 41630701).

A 28-day subchronic delayed neurotoxicity study was conducted with laying hens administered technical naled at oral dose levels of 0, 0.4, 2.0 and 4.0 mg/kg/day. Minimal and transient body weight depression was recorded in the high dose (4.0 mg/kg/day) and significant decreases in brain acetyl ChE were noted at both 2.0 and 4.0 mg/kg/day. No treatment related clinical or delayed neuropathy was observed (MRID 43223902).

An acute neurotoxicity study was conducted with rats given a single dose of 0, 25, 100, or 400 mg/kg of naled by gavage. Functional observational battery and motor activity evaluations were made pre-treatment, 30 minutes after treatment (time of peak effect) and seven and 14 days after treatment. The high dose of 400 mg/kg produced mortality and overt clinical signs of toxicity (e.g., orange/yellow material on body surfaces; red material around mouth/nose/eyes). Body weight gain by the high-dose group was transiently decreased (days 0-7). Animals given 100 and 400 mg/kg doses showed marked effects in the functional observational battery on the day of treatment. Observed changes included convulsions, tremors, increased secretions, exophthalmus, respiratory changes, reduced muscle strength, and slowed response to stimuli. Total motor activity was also reduced. A few treatment-related effects were observed on the day of treatment in one to two females given the low dose of 25 mg/kg. One female had tremors, two displayed exophthalmus during handling and one exhibited reduced hind limb grip strength. These changes were not observed in concurrent controls or historical controls (from three studies). No treatment-related neurological effects were observed seven or 14 days after treatment at any dose level. The NOAEL for acute neurotoxicity was 25 mg/kg in males, the lowest dose tested. The LOAEL for males was therefore 100 mg/kg. Although a NOAEL for females was not identified in this study, an estimate of this parameter can be reasonably set for females at 5 mg/kg, based upon minimal neurological compromise at 25 mg/kg in the main study, coupled with no toxicity at 5 or 25 mg/kg in the preliminary range-finding study. Therefore, the NOAEL for females was 5 mg/kg and the LOAEL for females was 25 mg/kg (MRID 42861301).

A subchronic (90-day) neurotoxicity study in Sprague-Dawley rats administered the test article (94.35%) by gavage at dose levels of 0, 0.4, 2.0 or 10.0 mg/kg/day. Neurological parameters were measured by both the functional observational battery and locomotor activity. Minimal neurological effects were observed in three out of 10 of the high dose females, but no other clinical effects were observed in either sex at any other dose level. The observed effects included sporadic occurrences of tremors (forelimb, hindlimb and/or whole body). The NOAEL for neurotoxicity was 2.0 mg/kg/day for females and 10.0 mg/kg/day for males (MRID 43223901).

10. Domestic Animal Safety

Subchronic (16-week) dermal toxicity studies were conducted with dog and cat antiflea collars containing naled (7%, cat collar; 15%, dog collar) and Propoxur (2.4%, cat collar; 4.2%, dog collar) as the active ingredients. Endpoints evaluated in each study included clinical signs, dermal irritation, body weight, urinalysis, blood chemistry, hematology and histopathology (including brain and spinal cord). Plasma and RBC ChE activities were determined on days 3 and 7 and weeks 2, 3, 4, 5, 6, 7, 8, 12 and 16.

Male and female mixed breed cats wore a placebo, one, two, or four collar(s) for 16 weeks. Cats wearing four collars exhibited more extensive flaking of the skin on the neck than controls or other treatment groups. A slight, transient decrease in plasma ChE was observed for the group wearing one (days 3 & 7), two (day 7), or four (through week 5) treated collars. RBC ChE was unaffected. No other treatment-related effects were observed (MRID 00079549).

Male and female mixed breed dogs wore a placebo, one, two, or four collar(s) for 16 weeks. Two dogs wearing four collars showed dry flaky skin on the neck during week 10. Plasma ChE was lower for dogs wearing four collars through the first four weeks of the study. No other treatment-related effects were observed (MRID 00060430).

B. Dose-Response Assessment

1. Determination of Susceptibility

The Hazard Identification Assessment Review Committee (HIARC) convened on May 12-14, 1998 to conduct a comprehensive review of 40 organophosphates, including naled.

The FQPA Safety Factor Committee met on June 15 and 16, 1998 to evaluate the hazard and exposure data for naled and recommend retention, reduction or removal of the FQPA Safety Factor (as required by Food Quality Protection Act of August 3, 1996), to ensure the protection of infants and children from exposure to these pesticides.

The FQPA Safety Factor Committee recommended that the 10X FQPA Safety Factor be removed for naled based on the following weight-of-evidence considerations:

(a). In prenatal developmental toxicity studies following *in utero* exposure in rats and rabbits, there was no evidence of developmental effects being produced in fetuses at lower doses than maternal animals nor was there evidence of an increase in severity of effects at or below maternally-toxic doses.

(b). In the pre-/post-natal two-generation reproduction study in rats, there was no evidence of enhanced susceptibility in pups when compared to adults (i.e., effects noted in offspring occurred at maternally-toxic doses or higher).

(c). There was no evidence of abnormalities in the development of the fetal nervous system in the pre-/post-natal studies submitted to the Agency.

(d). The toxicology database is complete. There are no data gaps for the Subdivision F Guideline requirements.

(e). Adequate actual data, surrogate data, and/or modeling outputs are available to satisfactorily assess exposures for dietary (food), drinking water, and residential drift to bystanders from mosquito control treatment.

2. Toxicology Endpoint Selection

a. Acute Dietary Exposure (1 day)

The acute PAD is derived from a NOAEL of 1.0 mg/kg/day and a UF of 100 that includes 10X for interspecies extrapolation, 10X for intraspecies variation and 1X for FQPA. The NOAEL is based on mild cholinergic signs and 50% decrease in plasma and brain ChE inhibition at 10 mg/kg/day (LOAEL) in a 28-day oral study with rats. This endpoint is supported by the findings in the one-year dog study where a 43% decrease in red blood cell (RBC) ChE inhibition was seen at 20 mg/kg/day for seven days and 27% plasma ChE inhibition was seen at 2 mg/kg/day for seven days.

Acute PAD = 1.0 mg/kg/day (NOAEL) = **0.01 mg/kg**
100 (UF and FQPA Safety Factor)

b. Chronic Dietary Exposure

The chronic PAD is derived from a NOAEL of 0.2 mg/kg/day and a UF of 100 that includes 10X for interspecies extrapolation, 10X for intraspecies variation and 1X for FQPA. The NOAEL is based on brain ChE inhibition at 2 mg/kg/day (LOAEL) in a chronic toxicity/carcinogenicity study in rats. This NOAEL and endpoint is supported by the findings in the 1-year dog study where plasma, RBC and brain ChE inhibition was seen at 2 mg/kg/day.

Chronic PAD = 0.2 mg/kg/day (NOAEL) = **0.002 mg/kg**
100 (UF and FQPA Safety Factor)

c. Short-Term Dermal Occupational Exposure (1-7 days)

A NOAEL of 1 mg/kg/day based on the neurotoxic clinical signs (coarse or fine tremors) and plasma, RBC, and brain ChE inhibition at 20 mg/kg/day in the 28-day dermal toxicity study with rats is selected for this risk assessment. An MOE of 100 is adequate. Since a dermal NOAEL was selected a dermal absorption factor is not required.

d. Intermediate-Term Dermal Occupational Exposure (1 week-several months)

A NOAEL of 1 mg/kg/day based on the neurotoxic clinical signs (coarse or fine tremors) and plasma, RBC and brain ChE inhibition at 20 mg/kg/day in the 28-day dermal toxicity study with rats is selected for this risk assessment. An MOE of 100 is adequate. Since a dermal NOAEL was selected a dermal absorption factor is not required.

e. Long-Term Dermal Occupational Exposure (Several Months to Life-Time)

An oral NOAEL of 0.2 mg/kg/ day based on brain ChE inhibition at 2 mg/kg/day (LOAEL) in a chronic toxicity/carcinogenicity study in rats is selected for this risk assessment. Since an oral NOAEL was selected, a oral equivalent dermal absorption factor of 100% should be used due to lack of dermal absorption data. The target MOE is 100.

f. Inhalation Exposure (Any Time Period)

A NOAEL of 0.23 µg/L (0.053 mg/kg/day) based on plasma and RBC ChE inhibition at 1.29 µg/L (0.298 mg/kg/day) in a 13-week inhalation toxicity study in rats was selected for this risk assessment.

IV. Exposure Assessment

For the purposes of exposure assessment, which includes all routes of exposure (dietary and occupational) this document solely addresses pesticidal residues of naled *per se*.

A. Dietary Exposure (Food Sources)

Tolerances are established for residues of naled (1,2-dibromo-2,2-dichloroethyl dimethyl phosphate) and its conversion product 2,2-dichlorovinyl dimethyl phosphate (dichlorvos or DDVP), calculated as naled equivalents in/on RACs (40 CFR § 180.215). Tolerances range from 0.5 ppm in almonds, dry beans, and other commodities to 10.0 ppm in forage grasses and legumes. No tolerances have been established in processed foods or feeds. Adequate enforcement methods are available for the determination of the regulated compounds in/on plant and livestock commodities.

The qualitative nature of the residue in plants is adequately understood. Naled is generally considered to be non-systemic based on studies with a variety of plants including cucumbers, cotton and Swiss chard. Metabolism studies with oranges and tomato processed fractions have also been conducted to investigate the nature and magnitude of organic brominated components of the residue derived from naled *per se* or from its bromine-containing impurities. These studies indicated that the only residues of organic bromine compounds are naled, the parent and metabolite BDCA, both of which are rapidly debrominated by sulfhydryl compounds or by hydrolysis.

The qualitative nature of the residue in animals is adequately understood based on acceptable poultry and ruminant metabolism studies reflecting oral exposure. The residues of concern in animal commodities – naled and dichlorvos – are also those which are currently included in the tolerance expression.

Adequate residue analytical methods are available for the purposes of reregistration. Two GC methods, Method I and A, are listed in the Pesticide Analytical Manual (PAM, Vol. II §180.215) for tolerance enforcement. Method I, a GC method using a thermionic detector (RM-3G), is applicable for the separate analysis of residues of naled and dichlorvos in/on crops and in animal commodities and milk. Method A, a microcoulometric GC method (RM-3C), is applicable for the combined residues of naled and dichlorvos in/on fruits and vegetables. The limits of detection are 0.01-0.02 ppm (milk and tissues) and 0.05 ppm, for Method I and Method A, respectively. Other GC methods (RM-3G-3 and the method of Boone) using thermionic detectors for separate determination of naled and dichlorvos are adequate for tolerance enforcement purposes. In addition, a GC method (RM-3G-4 revision of Method RM-3G-3) using nitrogen-phosphorous detection is adequate for enforcement of tolerances for residues in almonds, broccoli, oranges, and alfalfa. The limit of detection for both compounds is 0.01 ppm. Additional revisions to residue analytical method RM-3G-4 are required before it can be forwarded to FDA for inclusion in PAM, Vol. II. The technical registrant has agreed to make the necessary changes.

For residue data collection, adequate methods for analysis of naled and its metabolite dichlorvos either in combination or separately are available. Methods RM-3, RM-3A, and RM-3E are ChE inhibition methods, methods RM-3G and RM-3G-3 are GC methods using thermionic detection, and method RM-3C and the method of Boone are microcoulometric GC methods. Method RM-3 determines naled and dichlorvos in combination, method RM-3C determines naled and dichlorvos as dichlorvos, and methods RM-3A, RM-3E, RM-3G, and the method of Boone determine naled and dichlorvos separately. Residue data submitted for tolerance reassessment were collected using the current or proposed enforcement methods.

The requirements for storage stability data are not fully satisfied for the purposes of reregistration. Information concerning the storage intervals and conditions of residue data previously submitted in support of tolerance establishment has been submitted. Storage stability data are adequate to support all existing field trial data on RACs and to support existing livestock feeding studies for reregistration.

Data depicting the decline in levels of naled and its metabolite dichlorvos in commodities stored under the range of conditions and for the range of intervals specified are required for any remaining registered crops or for any crops for which the registrant wishes to establish or re-establish tolerances/registrations, including Brussels sprouts, eggplant and tangerines. Finally, the outstanding field trials and processing studies are required to be validated by adequate storage stability data.

1. Magnitude of the Residue in Plants

The reregistration requirements for magnitude of the residue in plants are fulfilled for the following commodities: almond hulls; almond nutmeat; beans (dry and succulent); broccoli; Brussels sprouts; celery; cottonseed; cow pea (bean) vines; eggplant; grapefruit; grapes; grass forage; hops (provided label requires a 21-day retreatment interval); lemons; melons; oranges; peaches (provided label is revised to specify a 31-day PHI); peas (succulent); pea, field, vines; peppers; safflower seed; spinach (and chard); squash, summer; strawberries; sugar beet roots and tops; tangerines; and walnuts. Adequate field trial data depicting the combined residues of naled and dichlorvos (expressed as naled) following treatments according to the maximum registered use patterns have been submitted for these commodities. The reregistration requirements for magnitude of the residue in wide area and general outdoor treatments for area pest (mosquito and fly) are also fulfilled.

The available data indicate that the established tolerances for the following commodities are too high and that the tolerance levels may be

reduced: beans, dry; beans, succulent; beets, sugar, roots; broccoli; Brussels sprouts; celery; cottonseed; grapes; and peas, succulent.

Additional field residue data are required for the following commodities before a complete tolerance reassessment can be made: cabbage; cauliflower; collards; hops; and squash, winter. The required data for collards will be translated to kale. The required data for winter squash will be translated to pumpkins.

The established tolerances on the following commodities: cucumbers, lettuce, mushrooms, rice, tomatoes, and turnip tops should be revoked since these uses are not registered. If the registrant, or any registrant intends to support the use of naled on these commodities, residue data reflecting the maximum intended use pattern is required.

The established 10-ppm crop group tolerance for "legumes, forage" is inappropriate since the registrant does not intend to support naled uses on soybeans, which is the third representative crop of the foliage of legume vegetables group. Therefore, this crop group tolerance should be revoked concomitant with the establishment of individual tolerances for beans, forage; beans, hay; peas, vines; and peas, hay.

The available data for grapefruit, lemons, and oranges suggest that a crop group tolerance of 3.0 ppm for the citrus fruits group is appropriate. The individual tolerances for grapefruit, lemons, oranges, and tangerines should be revoked concomitant with the establishment of a crop group tolerance for citrus fruits.

Based on the available field trial data, revised or new tolerances are required for the following commodities: beans (dry and succulent), broccoli, celery, cotton gin byproducts, cotton seed, grapes, grass hay, hops, peas (succulent), sugar beet roots, group tolerance for citrus, and RACs resulting from wide area and general outdoor treatment.

3/8/96

2. Magnitude of the Residue in Processed Food/Feed

The reregistration requirements for magnitude of the residue in processed food/feed commodities are fulfilled for cottonseed, grapes, oranges, sugar beets and soybeans. Processing studies involving rice, and tomatoes will not be required provided all registered uses of naled on these crops are canceled. It should be noted that revisions in the livestock feeds table for Subdivision O, require no further data on cannery waste of beans.

Adequate processing studies have been submitted for grapes, oranges and soybeans. These studies indicate that the combined residues of naled and dichlorvos are expected to concentrate only in orange oil. The orange processing study indicates that residues of dichlorvos concentrated in oil 13 times (13X) during processing of oranges treated with naled. Residues of naled were non-detectable in both unprocessed oranges and all orange processed commodities in the submitted orange processing study. The study also indicates that residues of dichlorvos did not concentrate in the citrus processed commodities wet pulp, dried pulp, molasses, and juice. The Agency previously concluded that for the purposes of establishing food additive tolerances, if appropriate, the combined residues of naled and dichlorvos will be assumed to concentrate 13X during processing of citrus treated with naled. The highest average field trial (HAFT) for naled on oranges is 2.2 ppm. The HAFT, multiplied by the concentration factor of 13X, would result in a residue of about 30 ppm in orange oil.

3. Magnitude of Residue in Meat, Milk, Poultry and Eggs

The previously established tolerances of 0.05 ppm for the combined residues of naled and dichlorvos (expressed as naled) in the eggs, milk and tissues of animals have been revoked. The contribution of the combined residues of naled and dichlorvos to eggs, milk and meat from the indirect uses of naled in livestock premises is not expected to be significant in relation to the levels which result from dietary sources.

The calculated maximum dietary burdens of naled for poultry and livestock animals are: 10 ppm (horses), 8 ppm (dairy cattle), 5 ppm (beef cattle), 5 ppm (sheep), 0.6 ppm (swine) and 0.1 ppm (poultry). As a result of tolerance reassessment as well as the possible cancellation of naled uses on rice, tomatoes and turnips which are considered feed commodities, the maximum dietary burdens are expected to be even lower. There is no reasonable expectation of finite residues in meat, milk, poultry, and eggs (Category (3) of 40 CFR §180.6 (a)).

4. Reduction of Residues

Data reflecting residue decline are available. These data include common practices such as special processing and cooking that could reduce dietary exposure to naled. These data were used in the dietary risk assessments.

5. Confined/Field Rotational Crops

Confined rotational crop studies are adequate for all products with application rates no higher than 2 lb ai/A for crops that may be rotated or intercropped. The Agency has determined that if an application rate greater than 2 lb ai/A becomes necessary, then an additional confined rotational crop study at the higher rate or additional label restrictions will be required. The maximum rate presently registered for naled on rotational crops (e.g., collard and eggplant) is 1.8 lb ai/A.

The confined rotational crop study indicated that the total radioactive residues (expressed as naled equivalents) were at most 0.03 ppm in/on mature lettuce (tops and roots), wheat (grain, bran and straw), and carrots (tops and roots) harvested at 30-day plantback interval from pots of loam soil that had been surface-treated with [ethyl 1-^{14}C]naled at a nominal application rate of 2 lb ai/A. The rapid degradation of naled and dichlorvos and the fact these materials can be readily metabolized to CO_2 indicate that there is not a large potential for naled residues to accumulate in rotational crops in soil treated with naled. Limited or extensive field rotational crop studies are not required. Furthermore, rotational crop tolerances and plantback interval restrictions are not needed.

6. Anticipated Residues

The tolerance for naled is expressed in terms of combined residues of naled and dichlorvos, expressed as naled equivalents. The acute and chronic ARs are based on that portion of the tolerance level attributed to naled residues (that is to say the contribution of dichlorvos residues to the tolerance expression has been removed). All naled ARs used in the acute and chronic dietary exposure analyses are based on tolerance levels or field trials.

Anticipated residues for the chronic dietary analysis are based on average residues of naled and dichlorvos obtained from field trials, corrected by cooking factors where applicable. One half the limit of detection was assumed in calculating ARs if residues were not detectable and the detection limit for the RAC was available. If no AR and no detection limits were available, total residues expressed in naled equivalents were apportioned between naled and dichlorvos by extrapolating from data from another RAC. Anticipated residues for cucumbers, melons, pumpkins, peppers, and eggplants were generated by extrapolating data from tomato data. Anticipated residues for collards, kale, and Swiss chard were generated by extrapolating from spinach data. Reduction factors for celery, collards, oranges, strawberries, and grapes were available for naled. Where naled reduction factors were not available, reduction factors for dichlorvos were assumed. A reduction factor of 0.1X was applied to all cooked forms of naled for the chronic analysis.

High-end ARs were used in the acute dietary exposure analysis. Field trial residues or the tolerance is generally the high-end residue estimate used in acute risk assessment. Acute ARs were calculated by using the ratios of naled residues and dichlorvos residues to total residues in naled equivalents. This ratio was used to determine an AR for naled *per se*, based on the tolerance level. As field trial data were used in generating the chronic ARs, it is reasonable to assume that the ratios between naled and dichlorvos residues observed in chronic ARs would also be appropriate for use in generating acute ARs. As per HED policy, residues on food items from the mosquitocide (widespread) use of naled were not considered in the naled acute analysis.

B. Dietary Risk Assessments and Risk Characterization

Dichlorvos, a registered organophosphorus insecticide, is a metabolite of naled. The risk assessment for dichlorvos, will encompass dichlorvos derived from naled and will address all exposure concerns including dietary for this metabolite. This document therefore, addresses concerns solely for naled *per se*.

1. Acute Dietary (Food) Exposure and Risk Estimates

A probabilistic (Monte Carlo) acute dietary risk analysis was performed, assessing exposure to residues of naled in food. This dietary assessment was refined by using percent of crop treated data. The acute ARs used in the dietary exposure analysis are based on that portion of the tolerance level attributed to naled residues (that is to say the contribution of dichlorvos residues to the tolerance expression has been removed). All naled ARs used in the acute dietary exposure analyses can thus be considered upper-bound estimates because they are based on tolerance levels. Further refinements would lead to lower dietary risk estimates.

As indicated in Table 2 below, the acute dietary exposure estimates at the 99.9th percentile exposure do not exceed HED's levels of concern.

Table 2. Acute Dietary (Food) Exposure Estimate and Percent of Acute PAD Occupied for Naled

Population	90th Percentile		99th Percentile		99.9th Percentile	
	Exposure (mg/kg/day)	% aPAD	Exposure (mg/kg/day)	% aPAD	Exposure (mg/kg/day)	% aPAD
U.S. Population	0.000231	2.3	0.000485	4.9	0.001844	18.4
Non-nursing Infants (< 1 yr)	0.000432	4.3	0.000612	6.1	0.002200	22.0
Children 1-6	0.000388	3.9	0.001059	10.6	0.003882	38.8
Children 7-12	0.000256	2.6	0.000649	6.5	0.002382	23.8

2. Chronic Dietary (Food) Exposure and Risk Estimates

Anticipated residues and refined percent of crop treated information, as described above, were used to calculate the chronic dietary exposure estimates for naled. These exposure estimates were then compared to the PADs for naled to calculate chronic dietary risk estimates.

The chronic naled dietary exposure estimate for the U.S. population is 0.000032 mg/kg bw/day, which represents 1.6% of the chronic PAD. The subgroup most highly exposed, children (aged 1-6), has an exposure estimate of 0.000063 mg/kg bw/day, or 3.2% of the PAD. Based on these analyses, HED has determined that chronic dietary risk estimates from naled do not exceed a level of concern. The chronic dietary exposure estimates are presented in Table 3 below:

Table 3. Chronic Dietary (Food) Exposure Estimates for Naled

Population	Exposure (mg/kg/day)	% PAD
U.S. Population	0.000032	1.6
Non-nursing Infants (< 1 year)	0.000022	1.1
Children (1-6)	0.000063	3.2
Children (7-12)	0.000043	2.1

3. Drinking Water Exposure and Assessment

Currently, HED uses DWLOCs as a surrogate to capture risk associated with exposure to pesticides in drinking water. A DWLOC is the concentration of a pesticide in drinking water that would not be of concern as an upper limit in light of total aggregate exposure to that pesticide from food and water. A DWLOC may vary with drinking water consumption patterns and body weights for specific subpopulations.

Based on the acute and chronic dietary exposure estimates presented in Tables 2 and 3, DWLOCs were calculated using the formulas presented below.

$$DWLOC_{acute} = \frac{acute\ water\ exposure\ (mg/kg/day) \times body\ weight\ (kg)}{consumption\ (L) \times 10^{-3}\ mg/ug}$$

where,

acute water exposure (mg/kg/day) = [aPAD - acute food exposure (mg/kg/day)]

$$DWLOC_{chronic} = \frac{chronic\ water\ exposure\ (mg/kg/day) \times body\ weight\ (kg)}{consumption\ (L) \times 10^{-3}\ mg/ug}$$

where,

chronic water exposure (mg/kg/day) = [PAD - (chronic food exposure) (mg/kg/day)]

The Agency's default body weights and consumption values used to calculate DWLOCs are as follows: 70 kg/2L (adult male); 60 kg/2L (adult females) and 10 kg/1L (child).

Since acute and chronic dietary exposures to pesticidal residues of naled do not exceed EPA's levels of concern, EPA used the acute and chronic PADs and the acute and chronic exposure values to calculate the DWLOCs for the U.S. population and the three most sensitive subgroups identified in the dietary exposure assessments for acute and chronic exposures. Provided in Tables 4 (based on acute dietary (food) exposure at the 99.9th percentile) and 5 are the acute and chronic DWLOCs.

Table 4. Acute DWLOCs

Population	DWLOC
U.S. Population (spring season)	285 ppb
Non-Nursing Infants (<1 yr)	78 ppb
Children (1-6)	61 ppb

Table 5. Chronic DWLOCs

Population	DWLOC
U.S. Population	69 ppb
Non-Nursing Infants (<1 yr)	20 ppb
Children (1-6)	19 ppb

a. Surface Water

EFED (J. Peckenpaugh, 3/18/99) EECs for naled in surface water. Based on PRZM-EXAMS modeling, Tier 2 exposure analysis, the following EECs of naled for surface water were calculated:

Acute: 12.7 ppb
Chronic: 0.56 ppb; annual average (based on 10 year return)

Comparing these EECs for naled to the DWLOCs, the acute and chronic surface water EECs do not exceed HED's level of concern for any potentially exposed subpopulation group.

b. Groundwater

EFED (J. Peckenpaugh, 3/18/99) provided EECs for naled in groundwater. Based on SCI-GROW modeling the groundwater concentration of naled was estimated to be 0.005 ppb for acute and chronic values. These relatively low EECs for naled in groundwater do not exceed HED's levels of concern for either chronic or acute exposures.

C. Occupational Exposure and Risk Assessment

Currently naled may be applied by: aerial equipment/helicopter; tractor-drawn groundboom; airblast; mist blower ultra low volume (ULV) cold fog generator; dog/cat collar; and by hot plate/pan.

The current registrant of record for naled, Amvac Chemical Corporation, has indicated to EPA in a letter of December 11, 1998, that residential and domestic uses, with the exception of flea pet collars, will not be supported for reregistration. Therefore, this document addresses only occupational exposure scenarios and residential bystander exposures resulting from public health uses (i.e., mosquito abatement) and exposures from flea pet collars.

1. Mixer/Loader/Applicator Exposure and Risk Characterization

a. Occupational Exposures and Assumptions

The Agency has determined that mixers, loaders, applicators, and other handlers may be exposed to naled from the following nine use patterns identified on the naled labels:

(1) mixing/loading liquids,

(2) applying with aerial equipment,

(3) applying with groundboom equipment,

(4) applying with airblast equipment,

(5) applying with thermal fog generator,

(6) applying with ULV cold fog generator,

(7) applying by evaporating liquid using a hot plate and pan,

(8) flagger (liquids),

(9) aerial and ground based ULV mosquito application

(i). Mixer/Loader/Applicator Exposure

Mixer/loader/applicator (M/L/A) exposure data for naled were not required in the 1983 naled registration standard or a subsequent Data Call-In. Therefore, the Agency used data from the Pesticide Handlers Exposure Database (PHED), Version 1.1, to estimate the potential exposures to M/L/A resulting from registered uses of naled.

PHED was designed by a Task Force of representatives from the U.S. EPA, Health Canada, the California Department of Pesticide Regulation, and member companies of the American Crop Protection Association. PHED is a software system consisting of two parts -- a database of measured exposure values for workers involved in the handling of pesticides under actual field conditions and a set of computer algorithms used to subset and statistically summarize the selected data. Currently, the database contains values for over 1,700 monitored individuals (i.e., replicates).

Users select criteria to subset the PHED database to reflect the exposure scenario being evaluated. The subsetting algorithms in PHED are based on the central assumption that the magnitude of handler exposures to pesticides are primarily a function of activity (e.g., mixing/loading, applying), formulation type (e.g., wettable powders, granulars), application method (e.g., aerial, groundboom), and clothing scenarios (e.g., gloves, double layer clothing). Once the data for a given exposure scenario has been selected, the data are normalized (i.e., divided by) by the amount of pesticide handled resulting in standard unit exposures (milligrams of exposure per pound of active ingredient handled). Following normalization, the data are statistically summarized. The distribution of exposure values for each body part (e.g., chest, upper arm) is categorized as normal, lognormal, or "other" (i.e., neither normal nor lognormal). A central tendency value is then selected from the distribution of the exposure values for each body part. These values are the arithmetic mean for normal distributions, the geometric mean for lognormal distributions, and the median for all "other" distributions. Once selected, the central tendency values for each body part are composited into a "best fit" exposure value representing the

entire body.

(ii). Greenhouse Use Handler Exposures

Because of a lack of chemical specific exposure data for the hot plate/pan green house use, the following four scenarios were formulated to estimate applicator exposures.

Greenhouse Handler Scenario One - Hot Plate Activated by Automatic Timer

The use directions indicate that the handler must pour the recommended amount (1 fluid ounce per 10,000 cubic feet) of formulated product into a metal pan. The pan is placed on a hot plate and heated until the liquid vaporizes. The label for Dibrom 8 Emulsive (Reg. Number 59639-15) states that it contains 62% naled (7.5 pounds per gallon). Therefore, one ounce contains 0.059 pounds of active ingredient. The handler must pour the end-use product from a 5-gallon container into a measuring container and, in turn, from the measuring container into the metal pan. The label directions do not specify how many separate hotplates per greenhouse; however, it is assumed that in larger greenhouses, hot plates would be distributed evenly throughout the floor area (every 10,000 ft^3) to promote even distribution of the vapor. Handlers in this scenario would experience possible dermal and inhalation exposure during the period of time they are opening the 5-gallon container of end-use product, pouring it into a measuring container and then pouring it into a pan. No chemical-specific data are available to estimate this exposure, but PHED data for handlers mixing/loading liquid formulations in an open system could be used as a surrogate.

4/8/

The use report for DDVP is the best estimate available at this time for the size of a greenhouse facility that grows flowers. Based on this information approximately seven greenhouses could be treated in a workday. The amount of active ingredient handled per day if all seven houses (85000 ft³ each) were treated in a single day with the slightly more concentrated product:

$$\text{Amount Handled (lb ai)} = 0.059 \frac{\text{lb ai}}{10{,}000\ \text{ft}^3} \times \frac{85{,}000\ \text{ft}^3}{\text{house}} \times \frac{7\ \text{houses}}{\text{day}} = 3.5 \frac{\text{lb ai handled}}{\text{day}}$$

The unit exposures from the PHED Surrogate Exposure Guide for single layer clothing and chemical- resistant gloves indicate that the dermal exposure component is 0.023 mg of exposure per one pound of active ingredient handled and the respiratory component is 1.2 µg/lb ai (without a respirator).

The estimated potential daily dermal and inhalation exposures (not corrected for dermal absorption) are:

$$\text{Daily Dermal Exposure (mg/kg/lb ai)} = 0.023 \frac{\text{mg}}{\text{lb ai}} \times 3.5 \frac{\text{lb ai}}{\text{day}} \times \frac{1}{70\ \text{kg}} = 0.0012\ \text{mg/kg/day}$$

With a short or intermediate NOAEL of 1.0 mg/kg/day the MOE becomes:

$$\text{Dermal MOE} = \frac{1.0\ \text{mg/kg/day}}{0.0012\ \text{mg/kg/day}} = 870$$

$$\text{Daily Respiratory Exposure (mg/kg/lb ai)} = 0.0012 \frac{\text{mg}}{\text{lb ai}} \times 3.5 \frac{\text{lb ai}}{\text{day}} \times \frac{1}{70\ \text{kg}} = 6.0\text{x}10^{-5}\ \text{mg/kg/day}$$

$$\text{Respirat o ry M OE} = \frac{0.053 \text{ mg/kg/day}}{6.0\text{x}10^{-5} \text{ mg/kg/day}} = 880$$

The total MOE is 440.

Greenhouse Handler Scenario Two - Hot Plate Activated Manually

Some naled labels specify that the hot plate must be activated by an automatic timer after all workers have vacated the greenhouse and the greenhouse is locked. However, other labels do not contain such a requirement. When the hot plate is turned on by handlers, rather than by timer, the handlers would experience potential inhalation exposure for the remainder of the time they are in the greenhouse. Particularly if the handlers do not exit the greenhouse immediately, but move to other locations in the greenhouse to measure and pour the product and activate another hot plate, the possible inhalation exposure could be significant.

However, given the small volume per greenhouse (8.5 fl. oz. - about one cup) it seems unlikely that an applicator would separately measure volumes for each of the hot plates (if multiple units are actually used), particularly if they had to be filled from a 5-gallon can. Exposure times for these workers would likely be a matter of a few minutes to a maximum of a half hour. No actual measurements exist to determine: (1) the duration of application in a large greenhouse operation if each hot plate is activated by the applicator; (2) the amount of time required to vaporize the naled formulation from the hot plate; and (3) ultimately what the air concentration in the greenhouse would be during the application period. The only information available to the Agency is the saturation concentration of naled (4.1 mg/m^3 if the vapor pressure is 2 x10^{-4} mm Hg or 41 mg/m^3 if the vapor pressure is 2x10^{-3} mm Hg). The applicator would not be sufficiently protected, even with an O/V respirator with a 10-fold protection factor, for half an hour at either of these concentrations using the inhalation NOAEL of 0.23 μg/L or the 1-day oral NOAEL of 1 mg/kg/day and a UF of 100.

Route-Specific Calculation: 90-day inhalation study
(NOAEL = 0.23 μg/L)

$$MOE = \frac{\text{NOAEL 0.00023 mg / L x 6 hr / day study x AF (rat) 1}}{\text{(saturation conc. 0.041 mg / L @ 2x10 - 3 mm Hg) x 0.1 respirator PF x 0.5 hrs. x AF (sedentary) 1.2}}$$

MOE = <1, where AF is the activity factor.

Route-to-Route Calculation: 1-day acute oral
(1 mg/kg/day)

$$\text{Exposure(mg/kg)} = 41\text{mg/m}^3\text{x}0.5\text{m}^3\text{/hr(sedentary)x}0.1\text{respiratorPFx}0.5\text{hrsx(1/70kg)}$$

$$MOE = \frac{\text{NOAEL 1 mg/kg/day}}{\text{Exposure 0.015 mg/kg}}$$

MOE = 67

It is important to note that the saturation concentration would most likely not be reached within the few minutes to half an hour it would take an applicator to complete the task. Additionally, the NOAEL of 0.23 ug/L is from a 90-day rat inhalation study and does not match the exposure duration.

Greenhouse Handler Scenario Three - Activating Ventilation System

Following treatment, the label indicates the greenhouse must be closed for at least three hours and may remain closed as long as overnight. At this point, the greenhouse must be ventilated before entry by *workers* is allowed. Often a person must enter the greenhouse to activate the ventilation system. These persons are defined as handlers under the Worker Protection Standard (WPS). Handlers in this scenario would experience possible inhalation exposure from the time they enter the greenhouse, while they activate the ventilation system, and until they exit the greenhouse. They would also experience possible dermal exposure, since the vapor may have condensed onto surfaces in the greenhouse, including the

44906

ventilation system. Activation of the ventilation system would take only a short time. The above route-to-route equation (scenario one) using the oral endpoint and a respirator providing a 10-fold PF or better should provide adequate protection. The likelihood of achieving saturation of 41 mg/m^3 is greater for the time period just prior to ventilation.

Greenhouse Handler Scenario Four - Removal of Hot Plates

The label specifies that the pan used for the application must be removed from the greenhouse before workers are allowed to enter. Persons removing the pan are defined as handlers under WPS. Handlers in this scenario would experience possible dermal exposure while handling and disposing of the pans. (They would experience possible inhalation exposure, unless the entry to retrieve the pans is delayed until the ventilation criteria are met.)

Activation of the ventilation system would take only a short time. It would be expected that the PPE would protect the worker in this scenario. The exposure discussion in the above scenario for the ventilation system would also apply to this scenario. Without any other data, this task (removal of the hot plates) should wait until the ventilation is complete, although it is unknown exactly how much protection this would provide for the worker.

b. Occupational Risk Characterization

In assessing the risks of naled due to occupational and residential exposures, the assessment calculates MOEs as the ratio of NOAEL to exposure. The occupational and residential risk assessment uses a NOAEL of 1.0 mg/kg/day from the 28-day rat dermal study to calculate the dermal MOE and a NOAEL of 0.053 mg/kg/day (or 0.2 µg/L) from the 13-week rat inhalation study to calculate the inhalation MOE. The dermal study demonstrated a LOAEL of 20 mg/kg/day based on dermal irritation, reduced weight gain and brain, plasma and RBC ChE inhibition. The LOAEL in the inhalation study was 1 µg/L based on depression of plasma and RBC ChE levels.

The agricultural use and non-agricultural use tables list the parameters that the Agency used to conduct its occupational risk assessment. The "PPE" columns in these tables show the calculated MOEs for workers wearing coveralls over long pants, long-sleeve shirts, and chemical-resistant gloves. In addition to this PPE, the airblast applicator scenario reflects the use of chemical-resistant headgear that is required by current labeling. Current naled labels require no engineering controls, such as closed mixing systems or closed tractor cabs. The "engineering controls" columns in these tables show the calculated MOEs for workers using closed mixing systems and enclosed cockpits/cabs. PPE for workers using engineering controls includes long pants, long-sleeved shirts and no gloves (except that chemical-resistant gloves are used by workers mixing liquid).

To more accurately characterize the risk to pesticide handlers exposed to naled, the assessment calculates the MOEs for each scenario for each of the crop groups provided in Table 6, below:

Table 6. Crop Groups for Handler Assessment to Naled

Crop Group Label	Crops Contained in Group	Maximum Label Rate (lb ai/A)
A	Almonds, peaches	2.813
B	Broccoli, cabbage, cauliflower, Brussels sprouts, kale, collards, eggplant, pepper, melon, squash, walnut (air only)	1.875
C	Citrus	1.875
D	Beans, peas, celery, chard, spinach, seed alfalfa (ID, WA)	1.406
E	Cotton, strawberry, sugarbeet, hops, seed alfalfa (OR), rangeland	0.938
F	grapes, walnuts	0.938
G	safflower	0.703

To determine inhalation and dermal doses for each scenario, the assessment multiplies the dermal or inhalation unit

46970

exposure by the maximum application rate for each crop group and the number of acres treated daily to develop a dermal and inhalation exposure in mg/day. The result is divided by an assumed body weight of 70 kg to yield the daily dermal or inhalation dose.

$$\text{Daily Dose (mg ai/kg BW/day)} = \frac{\text{Unit Exposure}\left(\frac{\text{mg ai}}{\text{lb ai}}\right) \times \text{Use}\left(\frac{\text{lbai}}{\text{A}}\right) \times \text{dailyAcres}\left(\frac{\text{A}}{\text{day}}\right)}{\text{Body Weight (kg)}}$$

The dermal MOEs are then calculated by dividing the NOAEL by the daily dermal dose, while the inhalation MOEs are calculated by dividing the NOAEL by the daily inhalation dose.

The resulting total MOEs for naled are below 100 in most of the exposure scenarios (see summary Table 7 and Appendix A for results). MOEs are greater than 100 for the following four agricultural exposure scenarios and crop groupings with engineering controls:

- Mixing/loading liquid formulations (closed systems) for groundboom applications on crop group (G);
- Mixing/loading liquid formulations (closed systems) for airblast applications on crop group (F);
- Applying liquid formulations (enclosed cab) by groundboom for crop groups (E) and (G);
- Flaggers (enclosed cab) for applications of liquid formulations.

Although the remaining exposure scenarios and crop groups not listed above result in MOEs that are less than 100 (see Appendix A for detailed assessment), the dermal MOEs are likely to be an overestimation based on the use of the dermal NOAEL of 1 mg/kg/day. Since a 28-day dermal toxicity study in rats (MRID 00160750) was available from the toxicology database, a NOAEL of 1.0 mg/kg is used for the short-and intermediate-term risk assessments, based on plasma, RBC, and brain ChE inhibition occurring at 20 mg/kg (LOAEL).

Based on dermal absorption data on two very similar compounds, dichlorvos and trichlorfon, the existing dermal toxicity study likely overestimates dermal toxicity because of the 20 fold

47096

difference between the lowest adverse effect level (LOAEL) and the no adverse effect level (NOAEL).

Another 28-day dermal toxicity study in rats using doses intermediate between 1 mg/kg and 20 mg/kg would better define the NOAEL and the LOAEL.

As confirmatory data, a dermal absorption study in rats may be used in conjunction with existing oral studies to better characterize the actual dermal absorption of naled.

The dermal MOEs for workers would likely increase with a better characterization of dermal absorption and toxicity.

Table 7. Summary of MOE Values for Agricultural Uses of Naled

Exposure Scenario	Crop[1] Grouping	Dermal MOE[2]		Inhalation MOE[2]		Total MOE[2]		Confidence in PHED Estimates
		PPE	Control	PPE	Control	PPE	Control	
Mixer/Loader Exposure								
Mixing All Liquids for Aerial	(B)	4.3	12	53	66	4	10	High
	(D)	5.6	16	66	88	5	14	
	(E)	8.5	23	88	133	8	20	
	(G)	11	32	133	177	10	27	
Mixing All Liquids for Groundboom	(B)	19	50	177	265	17	42	High
	(D)	25	71	265	530	23	63	
	(E)	37	100	530	589	35	85	
	(G)	50	143	530	883	46	120	
Mixing of Liquids for Airblast	(A)	25	71	265	530	23	63	High
	©	37	100	530	589	35	85	
	(F)	77	250	757	1,325	70	210	
Applicator Exposure								
Aerial equipment (liquids)	(B)	No open cockpit uses	21	No open cockpit uses	76	NA	16	Medium
	(D)		27		106	NA	22	
	(E)		43		177	NA	35	
	(G)		59		265	NA	48	
Groundboom (liquids)	(B)	48	63	265	589	41	57	Medium
	(D)	63	91	530	883	56	82	
	(E)	91	125	757	1,325	81	110	
	(G)	125	167	883	1,767	110	150	

Table 7. Summary of MOE Values for Agricultural Uses of Naled

Exposure Scenario	Crop[1] Grouping	Dermal MOE[2]		Inhalation MOE[2]		Total MOE[2]		Confidence in PHED Estimates
		PPE	Control	PPE	Control	PPE	Control	
Airblast equipment	(A)	4.8	38	66	88	4	27	High
	©	7.1	59	106	133	7	41	
	(F)	14.3	111	177	265	13	78	
Hot plate/pan (greenhouse)	See text for assessment							
Flagger Exposure								
Liquids	(B)	27	530	177	883	23	330	High
	(D)	34	710	265	1,325	30	460	
	(E)	53	1,000	530	1,767	48	640	
	(G)	71	1,400	530	5,300	63	1100	

[1]Crop groupings are: (A) almond, peach 2.8 lb ai/acre; (B) broccoli, cabbage, cauliflower, brussels sprouts, kale, collards, eggplant, pepper, melon, squash, walnut (air only) 1.9 lb ai/acre; © citrus 1.9 lb ai/acre; (D) beans, peas, celery, chard, spinach, seed alfalfa (ID, UT, WA) 1.4 lb ai/acre; (E) cotton, strawberry, sugarbeet, hops, seed alfalfa (OR), rangeland 0.94 lb ai/acre; (F) grape, walnut 0.94 lb ai/acre; and (G) safflower 0.7 lb ai/acre.

[2]Inhalation PPE exposure values based on an O/V respirator (10 fold PF). Engineering Control values are based on no respirators and using closed systems (i.e., closed mixing/loading and enclosed cabs/cockpits). The dermal PPE represents coveralls over long pants, long sleeve shirt, and chemical resistant gloves using open systems and chemical resistant head gear for airblast applicators. The engineering controls represent long pants, long-sleeve shirt, and no gloves (chemical resistant gloves used for closed mixing and enclosed cab airblast--no data are available for no glove scenarios), and closed systems (i.e., closed mixing/loading or enclosed cockpit/cabs).

In addition to the agricultural uses of naled, the non-agricultural uses (i.e., mosquito/blackfly) are also assessed. Four scenarios were selected for the mosquito/blackfly applications. The scenarios selected include:

- ❖ Mixing/loading liquids for aerial (ULV) applications;
- ❖ Mixing/loading liquids for ground-based (ULV) applications;
- ❖ Applying aerial ULV sprays; and
- ❖ Applying using ULV ground-based foggers.

No data were submitted in support of the naled mosquito/blackfly applications. Additionally, scenario-specific data for these unique types of application are not available in PHED. However, as a range finding assessment, agricultural equipment available in PHED were used as a surrogate. The mixing/loading scenarios from the agricultural scenarios are assumed to be representative of the mosquito/blackfly uses (e.g., closed mixing/loading systems). However, HED has insufficient data to determine if exposures to pilots applying pesticides in typical agricultural aerial applications are similar to the exposures to pilots applying mosquito control agents. Furthermore, PHED has no data for fogging techniques. In lieu of exposure data for fogging operations, airblast data were substituted. The representativeness of this scenario must be characterized as very uncertain. Additional data should be collected to better define the potential exposure that the ground-based fogger operator may receive.

The results of the mosquito/blackfly control uses are presented in Table 8. Total MOEs for all of the exposure scenarios are less than 100. The quality of the analytical data coupled with the number of replicates in the PHED data used to estimate exposures range from medium to high. The same discussion and concerns for using the dermal NOAEL above applies to the results of the MOEs for the mosquito scenarios.

5/9/96

Table 8. Summary of Exposure/Risk for Mosquito/Blackfly Control Uses of Naled (Short- and Intermediate-Term)

Exposure Scenario	Dermal Exposure[1] (mg/lb ai)	Inhalation Exposure[2] (μg/lb ai)	Maximum Label Rate[3] (lb ai/A)	Daily Max Treated[4] (Acres)	Dermal Dose[6] (mg/kg/day)	Inhalation Dose[6] (mg/kg/day)	Dermal MOE[7]	Inhalation MOE[7]	Total MOE
Mixer/Loader									
Mixing/loading Liquids for Aerial (ULV) for Blackfly and Mosquito Control	0.0086 (gloves)	0.083	0.05	7,500	0.046	0.00044	22	120	18
			0.1		0.092	0.00089	11	60	9
			0.25		0.23	0.0022	4	24	4
Mixing/loading Liquids for Ground-based Fogger (ULV) for Blackfly and Mosquito Control	0.0086 (gloves)	0.083	0.05	3,000	0.018	0.00018	54	300	46
			0.1		0.037	0.00036	27	150	23
			0.25		0.092	0.00089	11	60	9
Applicator Exposure									
Aerial (ULV) for Blackfly and Mosquito Control	0.005	0.068	0.05	7,500	0.027	0.00036	37	150	30
			0.1		0.054	0.00073	19	73	15
			0.25		0.13	0.0018	7	29	6
Ground-based Fogger (ULV) for Blackfly and Mosquito Control using an airblast sprayer as a surrogate because of the lack of data	0.019 (gloves)	0.45	0.05	3,000	0.041	0.00096	25	55	17
			0.1		0.081	0.0019	12	27	8
			0.25		0.20	0.0048	5	11	3

53 yrs

Note: rounding errors based on spreadsheet calculations and rounding results to two significant figures.

[1]Dermal unit exposures reported as best fit mean for mixer/loaders, aerial, and ground-based foggers are based on closed mixing and enclosed cockpits/cabs while wearing long pants, long sleeved shirts, and chemical resistant gloves (including ground-based fogger because the no glove scenario is not available) except for aerial applicators (no gloves). Handheld sprayer equipment represents handlers wearing coveralls over long pants, long-sleeved shirts, and chemical-resistant gloves.

[2]Inhalation Exposure Values are reported as geometric means (lognormal distributions). A ten fold protection factor for backpack sprayers (only) was used to simulate workers wearing organic vapor removing respirators.

[3]Dibrom 8 Emulsive Label (Reg. No. 59639-15), Trumpet EC Insecticide (59639-90), and Dibrom Concentrate 85 percent; LUIS Reports for Naled dated 08/30/94 and 08/31/94.

[4]Values represent the maximum area or the maximum volume of spray solution which can be used in a single day to complete treatments for each exposure scenario of concern. Aerial treatment of 7,500 acres using ULV consists of spraying 35 to 105 gallons (59639-90). Ground-based foggers the label (59639-90) reports the rate while driving 15 mph treating a 300 ft swath [(6 hrs/day x 15 mph x 5280 ft/mile x 300 ft swath) / 43,500 sq.ft. per acre = 3277 acres per day].

[5]Daily Inhalation Dose (mg/kg/day) = Inhalation Exposure (mg/lb ai) * Max. Appl. Rate (lb ai/acre) * Max. Treated/70 kg

[6]Daily Dermal Dose (mg/kg/day) = Exposure (mg/lb ai) * Max. Appl. Rate (lb ai/acre) * Max. Treated /70 kg

[7]MOE = NOAEL/Daily Dose (mg/kg/day). Where: Dermal NOAEL = 1 mg/kg/day, 28 day dermal study, and inhalation NOAEL = 0.053 mg/kg/day.

[8]Total MOE = 1/((1/dermal MOE) + (1/inhalation MOE)).

2. Postapplication Exposure and Risk Characterization

a. Postapplication Exposure

EPA has determined that there is a potential for exposure to persons entering treated sites. The potential for exposure exists in a variety of postapplication scenarios, including agricultural and residential settings. In agricultural settings, postapplication exposure to workers is of concern for naled use on:

(1) vine crops (grapes);

(2) low- and medium- height crops (e.g., strawberries, cotton);

(3) orchard-type tree crops (e.g., citrus, peaches);

(4) greenhouse-grown ornamentals and vegetable crops;

(5) forestry uses; and

(6) livestock sites.

Residential exposure is addressed in the residential section, below.

A potential for both dermal and inhalation postapplication exposure exists for greenhouse use scenarios because workers routinely enter greenhouses to perform a variety of cultural tasks. The Agency is particularly concerned about dermal and inhalation exposures in greenhouses following applications of naled by boiling naled in hot plates/pans.

b. Postapplication Risk Characterization

Previously, the registrant at the time, Valent, Inc., submitted dislodgeable foliar residue (DFR) data on grapes (MRIDs 43223904 and 43223907). These data were deficient since the residues were measured within the same vineyard and only in two locations. These two samples are insufficient to capture the variability between vineyards.

The Agency is requiring new interim REIs, provided the registrant agrees to submit supplementary data that captures the inherent variability between vineyards treated with naled and confirmatory data to determine definitive REIs for all crop groups/use sites on which naled is registered for use. The new interim REIs are two days for grapes and all other crops with an application rate of 0.938 lb ai/acre and three days for all other crops with a higher application rate than grapes. Previously the REIs were 24 hours for all crops. However, the REIs of 2 and 3 days are currently on the labels.

Postapplication/reentry exposure studies are required as confirmatory data to determine definitive REIs for all crop groups/use sites on which naled is registered. The interim REIs established in this document will be adjusted, if necessary, upon submission and review of the additional data. Data requirements for grapes have been satisfied; however, confirmatory data are still required to support the use of naled on the following crop groups/use sites:

- Tree crops (orchard-type, i.e., citrus, peaches)
- Medium-height crops (such as cotton, tobacco)
- Low crops (such as strawberries, broccoli, cauliflower)
- Greenhouse-grown crops (roses and other ornamental plants)

Requirements for postapplication/reentry exposure studies are addressed by Subdivision K of the Pesticide Assessment Guidelines. The required data include:

- 875.2100 Foliar Residue Dissipation
- 875.2400 Postapplication Dermal Passive Dosimetry Exposure
- 875.2500 Postapplication Inhalation Passive Dosimetry Exposure

Greenhouse Post-Application Exposure

The WPS for Agricultural Chemicals establishes generic entry restrictions when vapors are applied in a greenhouse. No entry is permitted (other than entry by pesticide handlers who are trained and equipped with personal protective equipment (PPE) -- including respirators) into the greenhouse until the one of the WPS ventilation criteria has been met. The WPS ventilation criteria include: (1) ten air exchanges are completed; (2) two hours of mechanical ventilation; (3) four hours of passive ventilation; (4) eleven hours with no ventilation followed by one hour of mechanical ventilation; (5) eleven hours with no ventilation followed by two hours of passive ventilation; or (6) twenty-four hours with no ventilation.

The naled label indicates that the application period lasts from a minimum of three hours to as long as 12 hours (overnight). If the ten-air-exchange WPS ventilation option is chosen, the ventilation criteria could be met in as little as ten minutes following the end of application. Since naled is a liquid at room temperature and must be heated to form a vapor for even dispersal, it likely condenses back into liquid form as it cools, leaving some residue on greenhouse surfaces, including plant leaves. Since the vapor pressure is approximately $2x10^{-3}$ mm Hg at 20 C, it is possible that there is an off-gassing effect from the residue that continues after ventilation clears the remnants of the initial vapor. An estimate of the DFRs and corresponding exposures and MOEs are presented in Table 9. It is evident from that table that an REI of approximately 32 hours is required before the target MOE of 100 is reached.

Greenhouse reentry exposures were derived from the DFR studies on grapes and should be considered highly conservative. Application rates to grapes are much higher than those for greenhouses. It is also unlikely that greenhouse applications would yield appreciable DFRs since the heat generated product is in vapor rather than aerosol form. Some of the labels specify to avoid direct application to plants as injury may result. While it is possible that there will be some deposition of naled on foliage due to condensation, the amount that would be deposited would be expected to be much less than that from a high application spray formulation.

Table 9. Estimates of Exposures of Workers Reentering Greenhouses Treated with Naled

Start Time of Work Period (hrs after aeration)	End Time of Work Period (hrs after aeration)	DFR ($\mu g/cm^2$)	Dermal Exposure (mg/kg/day)	MOE
0	8	0.070	0.064	16
1	9	0.066	0.060	17
2	10	0.062	0.057	18
3	11	0.059	0.053	19
4	12	0.055	0.050	20
5	13	0.052	0.047	21
6	14	0.049	0.045	22
7	15	0.046	0.042	24
8	16	0.044	0.040	25
9	17	0.041	0.038	27
10	18	0.039	0.035	28
11	19	0.037	0.033	30
12	20	0.034	0.031	32
13	21	0.033	0.030	34
14	22	0.031	0.028	36
15	23	0.029	0.026	38
16	24	0.027	0.025	40
17	25	0.026	0.023	43
18	26	0.024	0.022	45
19	27	0.023	0.021	48
20	28	0.022	0.020	51
21	29	0.020	0.018	54
22	30	0.019	0.017	57
23	31	0.018	0.016	61
24	32	0.017	0.015	65

Table 9. Estimates of Exposures of Workers Reentering Greenhouses Treated with Naled

Start Time of Work Period (hrs after aeration)	End Time of Work Period (hrs after aeration)	DFR ($\mu g/cm^2$)	Dermal Exposure (mg/kg/day)	MOE
25	33	0.016	0.015	69
26	34	0.015	0.014	73
27	35	0.014	0.013	77
28	36	0.013	0.012	82
29	37	0.013	0.012	87
30	38	0.012	0.011	92
31	39	0.011	0.010	98
32	40	0.011	0.010	104
33	41	0.010	0.009	110

Dislodgeable Foliar Residue (DFR) estimation is based on a DFR study in which naled was applied at 0.9 lb/acre to grapes. Residues declined rapidly over the first three days with apparent first order kinetics described by the equation $DFR = DFR_0e^{-kT}$ where $DFR_0 = 0.17\ \mu g/cm^2$. k = 0.059/hour and T is in hours. In greenhouses, naled is applied at a rate of 1 oz of a 7.5 lb/gal formulation per 10,000 ft^3, or 0.059 lb/10,000ft^3. For a typical greenhouse with a volume of 85,000 ft^3 and floor dimensions of 120 ft x 48 ft, this is equivalent to 0.5 lb/0.13 acre or 3.8 lb/acre. If deposition of naled at 0.9 lb/acre on grapes were normalized to deposition on greenhouse foliage at 3.8 lb/acre, DFR_0 in the decline curve would be 0.7 $\mu g/cm^2$. However, because naled in the greenhouse is generated as a vapor rather than a spray, we assume that deposition on greenhouse foliage will be much less than on grapes. HED has assumed that 90% of naled generated in the greenhouse will be off gassed via the ventilation system and that DFR_0 in the decay curve = 0.07 $\mu g/cm^2$.

Exposures were derived from the equation $0.001 \times T_C \times AUC/BW$ where T_C (Transfer Coefficient) = 10,000 cm^2/hr, BW (Body Wt.) = 70 kg and 0.001 converts µg to mg. AUC (area under the curve) in this instance refers to the area under the residue decline curve in the interval from T to T+8 hrs. In this calculation $AUC = (DFR_T - DFR_{T+8})/k$ where k=0.059/hr.

D. Residential Exposure and Risk Characterization (bystander)

In residential settings, postapplication bystander exposure to residents (children and adults) can result from treatment on pets (from treated collars), and as a mosquito and black fly control agent.

1. Residential Exposure

As discussed above under the occupational (M/L/A) risk characterization, in assessing the risks of naled due to occupational and residential exposures, the assessment calculates MOEs as the ratio of NOAEL to exposure. The occupational and residential risk assessment uses a NOAEL of 1.0 mg/kg/day from the 28-day rat dermal study to calculate the dermal MOE and a NOAEL of 0.053 mg/kg/day (or 0.2 µg/L) from the 13-week rat inhalation study to calculate the inhalation MOE. The dermal study demonstrated a LOAEL of 20 mg/kg/day based on dermal irritation, reduced weight gain and brain, plasma and RBC ChE inhibition. The LOAEL in the inhalation study was 1 µg/L based on depression of plasma and RBC ChE levels.

HED has determined that there are potential bystander postapplication exposures to residents even though residential uses have been voluntarily canceled by the registrant. The potential residential bystander exposures to adults and children result from aerial and ground-based fogger blackfly and mosquito control uses. Potential exposures are estimated because of the concern for the residues that may be deposited during the ULV aerial and ground-based fogger applications in the vicinity of residential dwellings. This assessment has been developed to ensure that the potential exposures are not underestimated and to represent a conservative model that encompasses potential exposures received in other recreational areas (e.g., school playgrounds, parks, athletic fields). The scenarios likely to result in postapplication exposures are listed in Table 10 and are as follows:

5/9/96

- ❖ Dermal exposure from residues deposited on turf (adult and child);

- ❖ Incidental nondietary ingestion of residues deposited on lawns from hand-to-mouth transfer (toddler);

- ❖ Incidental nondietary ingestion of residues deposited on lawns from object-to-mouth transfer (toddler); and

- ❖ Incidental ingestion of soil from treated areas (toddler).

Although the incidental ingestion of soil and object-to-mouth scenarios are not expected to contribute significantly in comparison to the dermal route and/or the hand-to-mouth activity, they are included in this assessment to account for all potential pathways of exposure. It is unnecessary to include these pathways in the aggregate exposure because they would be rounded out of the final value.

Chemical-specific data for mosquito uses are not available. Therefore, the equations and assumptions used for each of these four scenarios were taken from the Draft SOPs for Residential Exposure Assessments guidance document, and are provided below.

The Residential SOPs have been followed with the exception that the initial turf transferable residue level has been modified in this assessment using additional information that has become available since the publishing of the SOPs. Although the SOPs were initially developed for direct turf applications, the models are used in this assessment to determine if there is a potential concern using a screening level approach. In addition to the use of the SOPs, the unique nature of the mosquito control uses requires additional information in determining the deposition rate of naled (i.e., amount of ai deposited on residential turf) because the application technique is meant to keep the spray aloft. The determination of the deposition rates are consistent with HED's assessment developed in the fenthion mosquito use risk assessment. The following information was used to determine the deposition rates for ground-based foggers and aerial applications.

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a. Ground-based Foggers

In the study conducted by Moore *et al.,* [*Downwind Drift and Deposition of Malathion on Human Targets From Ground Ultra-Low Volume Mosquito Sprays*: J.C. Moore, J.C. Dukes, J.R. Clark, J. Malone, C.F. Hallmon, and P.G. Hester; Journal of the American Mosquito Control Association; Vol. 9, No. 2 (June, 1993)] both human exposure and deposition was quantified over five separate application events. A 91 percent formulation of malathion was applied in April and May of 1989 in the early evening (a time of day for relative atmospheric stability). A Leco HD ULV cold aerosol generator (Lowndes Engineering Company, Valdosta Georgia) was used to make each application. The application parameters included a fluid flow rate of 4.3 fluid ounces per minute, a vehicle groundspeed of 10 mph, and a nominal application rate of 0.05 lb ai/acre (i.e., equates to a theoretical 100% deposition rate of 0.56 $\mu g/cm^2$). Deposition was monitored at three locations downwind from the treatment area (i.e., 15.2 m, 30.4 m, and 91.2 m). For the events considered in the deposition calculations, "average amounts of malathion deposited on ground level at 15.2, 30.4, and 91.2 m were not significantly different." The percentage of the application rate reported to have been deposited ranged from one to 14 percent of the theoretical rate. The mean deposition value for all measurements was 4.3 percent (n=35, CV=98).

In the study conducted by Tietze *et al.,* [*Mass Recovery of Malathion in Simulated Open Field Mosquito Adulticide Tests*: N.S. Tietze, P.G. Hester, and K.R. Shaffer; Archives of Environmental Contamination and Toxicology; 26: 473-477 (1994)] only deposition was quantified over six separate application events (i.e., one event was not included in deposition calculations "due to negative air stability"). The application parameters were similar to that used by Moore *et al.* A 95 percent formulation of malathion was applied from May to August of 1993. A Leco 1600 ULV cold aerosol generator (Lowndes Engineering Company, Valdosta Georgia) was also used to make each application. The application parameters included a fluid flow rate of 4.3 fluid ounces per minute, a vehicle groundspeed of 10 mph, and a nominal application rate of 0.057 lb ai/acre (i.e., equates to a theoretical 100% deposition rate of 0.64 $\mu g/cm^2$). Deposition was monitored at four locations downwind from the treatment area (i.e., 5 m, 25 m, 100 m and 500 m). For the events considered in the deposition calculations, "malathion mass deposited differed significantly between the 500 m site and the three closer sites (df = 3; F-value = 3.42; $P<0.05$)." The

percentage of the application rate reported to have deposited (not including 500 m samples which were much less) ranged up to 5.8 percent. The mean deposition value for all measurements was 3.8 percent.

After considering the data that are available in the Tietze *et al.* and Moore *et al.* papers, an off-target deposition rate of five percent of the application rate was used by HED to evaluate ground-based ULV applications (i.e., five percent of application rate is the deposition rate of which 5 and 20 percent is assumed to be available for dislodging for dermal contact and hand to mouth activities, respectively). A value slightly higher than the mean values for both studies was selected because of the variability in the data and the limited number of data points. It should be noted that this value is also consistent with the draft modeling assessment for ground-ULV approaches completed by S.T. Perry and W.B. Petersen of EPA's Office of Research and Development (i.e., within a factor of five). Perry and Petersen used "the INPUFF Lagrangian puff model" as the basis for their assessment (Petersen and Lavdas, 1986: *INPUFF 2.0 - A Multiple Source Gaussian Puff Dispersion Algorithm, User's Guide*, EPA/600/8-86/024). Depending on the scenario selected from this document, deposition rates ranged from approximately 2.5 percent deposition 450 m downwind to 15 to 20 percent deposition immediately adjacent to the treatment zone.

62496

b. Aerial Applications

Data similar to that for ground applications discussed above were not available for the aerial deposition. Therefore, to calculate deposition from aerial ULV applications, HED used *AgDRIFT* (V 1.03 -- June 1997) which is the model that was developed as a result of the efforts of the *Spray Drift Task Force (SDTF)*. For a more comprehensive discussion of the model selection for malaria vector control applications, readers are referred to the Agency's fenthion risk assessment. In summary, the SDTF is a coalition of 38 pesticide registrants whose primary objectives were to develop a comprehensive database of off-target drift information in support of pesticide registrations and an appropriate model system. This model was selected based on the consensus of several experts in the spray drift area because it represents the current state-of-the-art. It is important to note that no proprietary SDTF data were used in the completion of this assessment. The following inputs were used as the basis of the *AgDRIFT* calculations:

- **AgDRIFT Model Tier**: 3.
- **Droplet Size Distribution**: $D_{v0.1}$ = 39.02 μm; $D_{v0.5}$ = 54.82 μm; $D_{v0.9}$ = 77.5 μm; and <141 μm = 98 percent (developed to reflect droplet spectrum requirements of Trumpet label). *Note:* The droplet distribution was developed based on the Trumpet label.

63996

- **Spray Material:** User-defined option (oil option). Inputs include: nonvolatile rate 2.5 lb per acre, specific gravity 1.2 (calculated based on approximately 10 pounds per gallon), spray rate 0.25 gallons/acre, active ingredient application rate (0.1 lb ai/acre), and evaporation rate (1 μm^2/deg C/sec). *Note*: Several of these parameters do not exactly coincide with the Trumpet label but were used because the Trumpet label inputs exceeded the allowable input parameters. These differences are not expected to significantly affect the AgDRIFT results because a nonvolatile oil was selected, hence the critical input is the active ingredient application rate. Additionally, no proprietary SDTF physical property data were used in the completion of this assessment.

- **Aircraft:** User-defined option (fixed-wing option). Inputs include: Douglas DC3, wingspan -- 94.6 ft (semispan 47.28 ft); typical application airspeed -- 228 mph; weight – 21397 pounds; planform area – 1009.63 ft^2; propeller RPM -- 2550; propeller radius -- 5.81 feet; engine vertical distance – -1.22 feet; and engine forward distance -- 6.1 feet. *Note:* DC3-specific inputs were obtained from the *FSCBG (V4)* aircraft library.

- **Nozzles**: User-defined option. Inputs include number of nozzles: 60, vertical distance of nozzles from wing: -2.66 feet, horizontal distance from wing: -0.82 feet, and horizontal distance limit: 75 percent.

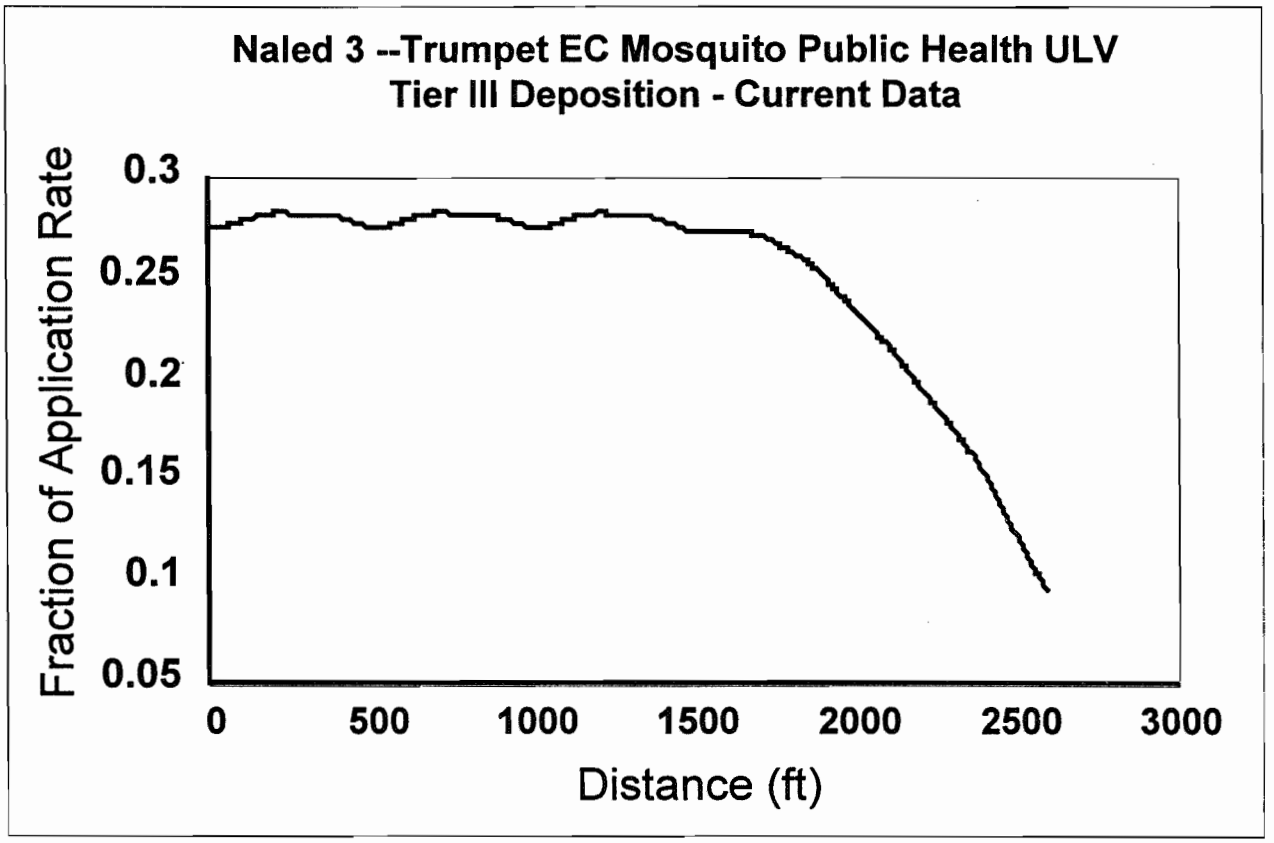
- **Meteorology**: Inputs were not changed from Tier 3 recommendations of wind speed: 2 mph, wind direction: -90 degrees (perpendicular to flight path), temperature: 86°F, and relative humidity: 50 percent.

- **Control:** Inputs were altered from the Tier 3 recommendations. The parameters that were used included a spray release height of 300 feet, 20 spray lines (aircraft passes) in each application event, a swath width of 500 feet, and a swath displacement based on the aircraft centerline.

- **Advanced Settings**: Inputs were not changed from Tier 3 recommendations of wind speed height (2 meters), maximum compute time (600 seconds), maximum downwind distance (795 meters), vortex decay rate (0.56 m/s), aircraft drag coefficient (0.1), propeller efficiency (0.8), and ambient pressure (1013 mb).

AgDRIFT is capable of producing a variety of useful outputs. The key for HED in this assessment was to determine from the model what percentage of the application volume remained aloft and what percentage of the resulting droplets deposited on the surfaces in the treatment area as well as downwind from the treatment area. AgDRIFT is generally intended to calculate deposition rates in areas that are downwind from the treatment area (i.e., presented from the border of the treatment area to areas of interest downwind). HED has used the values at the border of the treatment area to represent the deposition rate within the treated area. The results that HED used to determine the percentage of application rate that is deposited are presented in Figure 1 (Tier 3 Deposition presented as a Fraction of Application Rate vs. Distance Downwind). It is clear from Figure 1 that from the edge of the treatment area to 2000 feet downwind, approximately 30 percent of the theoretical application is deposited.

Figure 1.



c.

General Assumptions

- The amount of residue deposited on the turf from aerial application is 30 percent of the application rate and ground-based foggers are assumed to deposit five percent of the application rate.

- Five percent of the amount of residue deposited from the mosquito application is available from the turfgrass as a transferable residue for dermal exposure. Twenty percent is available for oral exposure (e.g., hand-to-mouth). The percent available for oral exposure is expected to be higher because to account for a child's "sticky" hands.

- Postapplication was assessed on the same day the pesticide is applied because it was assumed that adults and children could be exposed to turfgrass immediately after application. Therefore, postapplication exposures were based on day 0.

- Adults were assumed to weigh 70 kg. Toddlers (3 years old), used to represent the 1 to 6 year old age group, were assumed to weigh 15 kg.

- Application rates for mosquito aerial applications range from 0.05 to 0.1 lb ai/acre. The 0.05 lb ai/acre rate is the mosquito rate used for residential areas while the 0.1 lb ai/acre rate is the maximum labeled rate and is used for mosquito treatments in areas of heavy vegetation (i.e., not residential areas). The residential blackfly rate is 0.1 lb ai/acre and the labeled maximum rate for blackfly treatments is for heavy vegetation areas -- 0.25 lb ai/acre. The labeled maximum rates are not assessed for postapplication exposure because these rates are intended for heavy vegetation areas that are not likely to occur in residential areas.

- Specific assumptions related to each of the four exposure scenarios are discussed below.

(i). Dermal exposure

Potential dermal exposures to adults and toddlers engaged in a high-end exposure activity (e.g., playing and rolling on turf) are estimated using the following equation:

$$ADD = (DFR_t * CF1 * Tc * ET)/BW$$

where:

ADD	=	average daily dose (mg/kg/day)
DFR_t	=	dislodgeable foliar residue on day "t" ($\mu g/cm^2$)
CF1	=	weight unit conversion factor to convert μg units in the DFR value to mg for the daily dose (0.001 $mg/\mu g$)
Tc	=	transfer coefficient (cm^2/hr)
ET	=	exposure time (hr/day)
BW	=	body weight (kg)

and

$DFR_t = AR * F * (1-D)^t * CF2 * CF3$

where:

AR = application rate (lb ai/acre) x percentage deposited (i.e., 30 percent for aerial and five percent for ground-based foggers)

F= fraction of ai available on the foliage as dislogeable residue (0.05 for dermal and 0.20 for oral routes, unitless)

D = fraction of residue that dissipates daily (0.10, unitless)

t = postapplication day on which exposure is being assessed (day 0)

CF2= weight unit conversion factor to convert the lbs ai in the application rate to μg for the DFR value (4.54×10^8 μg/lb)

CF3= area unit conversion factor to convert the surface area units (ft^2) in the application rate to cm^2 for the DFR value (2.47×10^{-8} acre/cm^2 if the application rate is per acre)

- The mean dermal transfer coefficient representing a high contact activity (e.g., playing and rolling on turf) was assumed to be 43,000 cm^2/hr for adults and 8,700 cm^2/hr for toddlers. At this time, these transfer coefficients are the best available data to estimate potential contact to turf for these types of activities.

- The duration of exposure for toddlers and adults was assumed to be two hours per day (95th percentile duration for playing on grass, Exposure Factors Handbook).

(ii). Hand-to-Mouth

Incidental ingestion resulting from a child's hand in their mouth is estimated using the following equation and assumptions:

$$ADD = (DFR_t * SA * FQ * ET * CF1)/BW$$

where:

ADD	=	average daily dose (mg/kg/day)
DFR_t	=	dislodgeable foliar residue on day "t" ($\mu g/cm^2$ turf) -- see Dermal above
SA	=	surface area of the hands (cm^2/event)
FQ	=	frequency of hand-to-mouth activity (events/hr)
ET	=	exposure time (hr/day)
CF1	=	weight unit conversion factor to convert μg units in the DFR value to mg for the daily exposure (0.001 mg/μg)
BW	=	body weight (kg)

- The median surface area of both hands was assumed to be 350 cm^2 for a toddler (age 3 years).

- Replenishment of the hands with pesticide residues was assumed to be an implicit factor in this assessment.

- It was assumed that there is a one-to-one relationship between the dislodgeable residues on the turf and on the surface area of the skin after contact (i.e., if the dislodgeable residue on the turf is 1 mg/cm^2, then the residue on the human skin is also 1 mg/cm^2 after contacting the turf).

10996

- ❖ The mean rate of hand-to-mouth activity is 0.026 events/minute (i.e.,1.56 events/hr) for toddlers (3 to 5 years old).

- ❖ The duration of exposure for toddlers was assumed to be two hours per day (95th percentile duration for playing on grass, Exposure Factors Handbook).

(iii). Object-to-Mouth

"Mouthing" of a toy or handful of grass by a toddler is estimated using the following equation and assumptions:

$$ADD = (GR_t * IgR * CF1)/BW$$

where:

ADD	=	average daily dose (mg/kg/day)
GR_t	=	object (e.g., toy or grass) residue on day "t" ($\mu g/cm^2$)
IgR	=	surface area of object (cm^2/day)
CF1	=	weight unit conversion factor to convert the μg of residues on the object to mg to provide units of mg/day ($1x10^{-3}$ mg/μg)
BW	=	body weight (kg)

and,

11 § 96

$$GR_t = AR * F * (1-D)^t * CF2 * CF3$$

where:

AR	=	application rate (lb ai/acre) x percentage deposited (i.e., 30 percent for aerial and five percent for ground-based fogger)
F	=	fraction of ai available on the object (0.20, unitless)
D	=	fraction of residue that dissipates daily (unitless)
t	=	postapplication day on which exposure is being assessed
CF2	=	weight unit conversion factor to convert the lbs ai in the application rate to μg for the object residue value (4.54×10^8 μg/lb)
CF3	=	area unit conversion factor to convert the surface area units (ft^2) in the application rate to cm^2 for the object residue value (2.47×10^{-8} acre/cm^2 if the application rate is per acre)

- The assumed surface area of an object for mouthing for toddlers (age 3 years) is 25 cm^2/day (i.e., 2 x 2 inches or 4 in^2). This value was intended to represent the approximate area from which a child may grasp a handful of grass or mouth a toy.

72 9 96

(iv). Incidental Soil Ingestion

Ingestion of soil by a toddler is estimated using the following equation and assumptions:

$$ADD = (SR_t * IgR * CF1)/BW$$

where:

ADD	=	average daily dose (mg/kg/day)
SR_t	=	soil residue on day "t" (μg/g)
IgR	=	ingestion rate of soil (mg/day)
CF1	=	weight unit conversion factor to convert the μg of residues on the soil to grams to provide units of mg/day ($1x10^{-6}$ g/μg)
BW	=	body weight (kg)

and

$$SR_t = AR * F * (1-D)^t * CF2 * CF3 * CF4$$

where:

AR	=	application rate (lb ai/acre) x percentage deposited (i.e., 30 percent for aerial and five percent for ground-based foggers)
F	=	fraction (100 percent) of ai available in uppermost cm of soil (fraction/cm)
D	=	fraction of residue that dissipates daily (unitless)
t	=	postapplication day on which exposure is being assessed
CF2	=	weight unit conversion factor to convert the lbs ai in the application rate to μg for the soil residue value (4.54×10^8 μg/lb)
CF3	=	area unit conversion factor to convert the surface area units (ft^2) in the application rate to cm^2 for the SR value (2.47×10^{-8} acre/cm^2 if the application rate is per acre)
CF4	=	volume to weight unit conversion factor to convert the volume units (cm^3) to weight units for the SR value (U.S. EPA, 1992) (0.67 cm^3/g soil)

- On the day of application, it was assumed that 30 percent for aerial and five percent for ground-based foggers of the application rate are located within the soil's uppermost 1 cm.

- The assumed soil ingestion rate for children (ages 1-6 years) was assumed to be 100 mg/day.

2. Residential Risk Characterization

a. Risk Calculations

The exposure and risk calculations are presented in Table 10. The short- and intermediate-term MOEs were calculated as follows:

$$MOE = \frac{NOAEL}{DermalDose}$$

In summary, the short- and intermediate-term MOEs are greater than or equivalent to 100 for the following ULV aerial and ground-based fogger mosquito and blackfly applications.

- Dermal contact for adults and toddlers for mosquito aerial applications.
- Dermal contact for adults and toddlers for all ground-based foggers;
- Hand-to-mouth exposures for aerial and ground-based foggers for all application rates;
- Object-to-mouth for aerial and ground-based foggers for all application rates; and
- Incidental soil ingestion for aerial and ground-based foggers for all application rates;

The short- and intermediate-term MOEs are less than 100 for the following ULV aerial blackfly application:

- Dermal contact for adults and toddlers for blackfly aerial applications.

15 9 96

b. Discussion of Risk

The above risks are based on a screening-level assessment to ensure that the exposure/risk is not underestimated. Although this is regarded as a screening-level assessment, attempts were made to use a reasonable deposition rate determined from the literature and the Ag Drift model. The adult and toddler dermal exposure scenario for blackfly treatments, the only scenario with MOEs less than 100, is believed to be a conservative estimate and a more refined assessment could be completed with: (1) chemical-specific deposition data for the aerial applications; (2) application timing for blackfly treatments (e.g., if applications were made in the evening then residue dissipation could be accounted for in the exposure assessment); (3) HED is currently revising the Residential SOPs including the assumptions used in estimating dermal and hand-to-mouth exposures; and (4) a dermal absorption study and a new dermal toxicity study which would better characterize dermal absorption and toxicity.

Based on dermal absorption data on two very similar compounds, dichlorvos and trichlorfon, the existing dermal toxicity study likely overestimates dermal toxicity because of the 20 fold difference between the lowest adverse effect level (LOAEL) and the no adverse effect level (NOAEL).

Another 28-day dermal toxicity study in rats using doses intermediate between 1 mg/kg and 20 mg/kg would better define the NOAEL and the LOAEL.

As confirmatory data, a dermal absorption study in rats may be used in conjunction with existing oral studies to better characterize the actual dermal absorption of naled.

The dermal MOEs for bystanders would likely increase with a better characterization of dermal absorption and toxicity.

76 9 96

Table 10. Naled Residential Postapplication Estimated Risks Resulting from ULV Aerial and Ground-based Fogger Mosquito and Blackfly Applications

Scenario	Receptor	Application Rate Per Treatment (AR) (lbs ai/A)	DFR (ug/cm^2)[1]	GRt (ug/cm^2)[2]	SRt (ug/g)[3]	Transfer Coefficient (Tc) (cm^2/hr)	Exposure Time (ET) (hrs/day)	Surface Area (SA) (cm^2/event)	Freq. (FQ) (events/hr)	IgR (cm^2/day) or (mg/day)[4]	BW (kg)	Dermal Dose (mg/kg/day)[5]	MOE[6]
Dermal exposure	Adult	0.02 (Ground)	0.00062	-	-	43,000	2	-	-	-	70	0.00069	1,500
		0.05 (Aerial mosquito)	0.0084									0.010	97
		0.1 (Aerial blackfly)	0.017									0.021	48
Dermal exposure	Toddler	0.02 (Ground)	0.00062	-	-	8,700	2	-	-	-	15	0.00065	1,500
		0.05 (Aerial mosquito)	0.0084									0.0097	100
		0.1 (Aerial blackfly)	0.017									0.019	51
Hand-to-Mouth	Toddler	0.02 (Ground)	0.0022	-	-	-	2	350	1.56	-	15	0.00016	6,100
		0.05 (Aerial mosquito)	0.034									0.0024	410
		0.1 (Aerial blackfly)	0.067									0.0049	200

Scenario	Receptor	Application Rate Per Treatment (AR) (lbs ai/A)	DFR (ug/cm^2)[1]	GRt (ug/cm^2)[2]	SRt (ug/g)[3]	Transfer Coefficient (Tc) (cm^2/hr)	Exposure Time (ET) (hrs/day)	Surface Area (SA) (cm^2/event)	Freq. (FQ) (events/hr)	IgR (cm^2/day) or (mg/day)[4]	BW (kg)	Dermal Dose (mg/kg/day)[5]	MOE[6]
Object-to-mouth	Toddler	0.02 (Ground)	-	0.0022	-	-	-	-	-	25	15	$3.7x10^{-6}$	$2.7x10^5$
		0.05 (Aerial mosquito)		0.034								$5.6x10^{-5}$	18,000
		0.1 (Aerial blackfly)		0.067								0.00011	8,900
Incidental soil ingestion	Toddler	0.02 (Ground)	-	-	0.0075	-	-	-	-	100	15	$5x10^{-8}$	$2x10^7$
		0.05 (Aerial mosquito)			0.113							$7.5x10^{-7}$	$1.3x10^6$
		0.1 (Aerial blackfly)			0.225							1.5E-6	6.7E+5

Note: The ground-based fogger rate is 0.02 lb ai/acre for mosquitos, the aerial rate is 0.05 lb ai/acre for mosquitos in residential areas, and 0.1 lb ai/acre for blackflies in residential areas. Calculations were performed in spreadsheets, therefore, rounding errors may have occurred.

[1]Dislodgeable foliar residue (ug/cm^2) = [AR (lbs ai/A) * 30 percent aerial and 5 percent ground-based foggers * fraction ai available as dislodgeable (5 % dermal and 20% oral exposures) * $4.54x10^8$ ug/lb * $2.47x10^{-8}$ A/cm^2]

[2]"Object" residue (GRt) (ug/cm^2) = [AR (lbs ai/A) * 30 percent aerial and 5 percent ground-based foggers * fraction ai available on a toy or grass as dislodgeable (20%) * $4.54x10^8$ ug/lb * $2.47x10^{-8}$ A/cm^2]

[3]Soil residue (SRt) (ug/g) = [AR (lbs ai/A) * 30 percent aerial and 5 percent ground-based foggers * fraction ai retained on soil (100 %) * $4.54x10^8$ ug/lb * $2.47x10^{-8}$ A/cm^2 * 0.67 cm^3/g soil]

[4]Ingestion rate: cm^2/day for grass ingestion, and mg/day for incidental soil ingestion.

[5]Daily dermal dose (mg/kg/day)

Dermal exposure: = [DFR (ug/cm^2) * Tc (cm^2/hr) * mg/1,000 ug * ET (hrs/day) * absorption factor (1.0)] / [BW (kg)];
Hand-to-mouth: = [DFR (ug/cm^2) * SA (cm^2/event) * FQ (events/hr) * mg/1,000 ug * ET (2 hrs/day)] / [BW (kg)];
Turfgrass ingestion: =[GRt (ug/cm^2) * IgR (cm^2/day) * mg/1,000 ug] / [BW (kg)]; and
Incidental soil ingestion: = [SRt (ug/g) * IgR (mg/day) * g/1,000,000 ug] / [BW (kg)].

[6]MOE = 28-day oral rat study and 28-day dermal rat study NOAELs (both 1 mg/kg/day) / ADD. Uncertainty factors for oral and dermal routes are both 100.

c. Residential Exposure Estimates from Flea Pet Collar Application

Several flea pet collar products are marketed containing naled as the active ingredient. HED has no data addressing the exposures of individuals from the use of pet flea collar products. A number of these products are currently registered. In lieu of such data it is necessary to estimate exposures from this scenario using HED's SOPs for Residential Exposure Assessments. The SOP specifies that in the absence of actual field data "One percent (0.01) of the active ingredient applied to the pet to be available for dermal and inhalation exposure from handling flea collars. This assumption is based on the best professional judgement of the OPP/HED staff and assumed to be an upper-percentile value." Additionally "Adults are assumed to weigh 71.8 kg (use 60 kg for females when the endpoint is from a reproductive or developmental study). A body weight of 71.8 kg represents the mean body weight for all adults (i.e., male and female, ages 18 and older) and is the value recommended. A body weight of 60 kg represents the average body weight for females between ages 13 and 54 years. The average body weight for a 10 to 12 year old youth is 39.1 kg. This represents the mean of the median values for males and females at ages 10, 11, and 12 years." Body weights for age groups not included in the SOPs were obtained from the Agency's Exposure Factors Handbook. The values for children of ages 1-2 years, 3-5 years, and 6-8 years were 12.3 kg, 17 kg, and 25 kg, respectively. The estimated exposures for each of the pet collar products for each age class are presented in Table 11.

The maximum MOE based upon the exposure estimate for pet collar products was 222 for the lowest concentration of ai (1 gram) in the collar for adult long-term exposure (see Table 11). The adult exposure MOE for the collar with 1.4 grams ai was 125. However, these collars exceed the Agency's level of concern for children (MOE below 100). For the products that contain more than 1.4 grams of naled, active ingredient, the risks are a concern for both adults and children.

Table 11. Estimates of Exposure of Individuals From Naled in Pet Collar Products[1]

		EPA No. 2517-43	EPA No. 2517-44	EPA No. 2517-45	EPA No. 2517-46	EPA No. 2517-52
Grams Naled in Product		3.8	1.4	3.8	1	2.6
Total mg of exposure		38	14	38	10	26
Days of Use		150	120	150	150	150
Population Group	**BW (Kg)**	**Exposure (mg/kg/day) and MOE[2]**				
Adult	71.8	0.0035 57	0.0016 125	0.0035 57	0.0009 222	0.0024 83
Child, 1-2 Yrs.	12.3	0.0206 10	0.0095 21	0.0206 10	0.0054 37	0.0141 14
Child, 3-5 Yrs.	17	0.0149 13	0.0069 29	0.0149 13	0.0039 51	0.0102 20
Child, 6-8 Yrs.	25	0.0101 20	0.0047 43	0.0101 20	0.0027 74	0.0069 29
Child, 10-12 Yrs.	39.1	0.0065 31	0.003 67	0.0065 31	0.0017 118	0.0044 45

[1]The Residential SOPs were used (i.e., assumed that 1 percent of the ai was available for dermal and respiratory exposure) to estimate total amount of naled available for exposure. Exposures were amortized over use time assuming linear dissipation.

[2]Exposure = Total mg exposure/days of use/BW. MOE = Exposure /NOAEL; where the NOAEL was 0.2 mg/kg/day from an oral long term carcinogenicity study in rats, and assuming 100 percent dermal absorption. The dermal MOEs for pet collar products are likely to increase with a better characterization of dermal absorption and toxicity.

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V. Aggregate Risk Estimates and Risk Characterization

A. **Acute Aggregate Risk Estimate** (food and water)

The acute aggregate risk assessment considers acute (single day) food and water exposures. The acute dietary (food) risk estimates do not exceed HED's level of concern. Tier 1 groundwater and Tier 2 (PRZM-EXAMS) surface water EECs do not exceed HED acute DWLOCs. Therefore, aggregate acute risk estimates for naled do not exceed HED's levels of concern.

B. **Short and Intermediate-Term Aggregate Risk Estimate** (food, water, and non-occupational)

The short- and intermediate-term risk assessments consider residential exposures along with average food and water exposure. Some of the short- and intermediate-term risk estimates for naled exceed HED's level of concern. None of the estimated MOEs for children exceeded 100 using the screening-level assessment for the pet collar use (i.e., without further refinement, all pet collar exposure scenarios for children exceeded HED's level of concern). Short- and intermediate-term residential exposures exceed HED's level of concern for the ULV aerial blackfly applications. However, short- and intermediate-term residential exposures do not exceed HED's level of concern for the ULV mosquito applications, a public health use.

C. **Chronic Aggregate Risk Estimates** (food and water)

The chronic aggregate risk assessment considers average food and water exposures. The chronic dietary (food) risk estimates do not exceed HED's levels of concern. Tier 1 groundwater and Tier 2 (PRZM-EXAMS) surface water EECs do not exceed HED chronic DWLOCs. Therefore, aggregate chronic risk estimates for naled do not exceed HED's levels of concern.

8/9/96

D. Occupational Risk Estimates

The assessed MOEs are less than 100 for most exposure scenarios for naled except for the four following scenarios:

- Mixing/loading liquid formulations (closed systems) for groundboom applications on crop group (G);
- Mixing/loading liquid formulations (closed systems) for airblast applications on crop group (F);
- Applying liquid formulations (enclosed cab) by groundboom for crop groups (E) and (G);
- Flaggers (closed cab) for applications of liquid formulations.

Based on dermal absorption data on two very similar compounds, dichlorvos and trichlorfon, the existing dermal toxicity study likely overestimates dermal toxicity because of the 20 fold difference between the lowest adverse effect level (LOAEL) and the no adverse effect level (NOAEL).

Another 28-day dermal toxicity study in rats using doses intermediate between 1 mg/kg and 20 mg/kg would better define the NOAEL and the LOAEL.

As confirmatory data, a dermal absorption study in rats may be used in conjunction with existing oral studies to better characterize the actual dermal absorption of naled.

The dermal MOEs for workers would likely increase with a better characterization of dermal absorption and toxicity.

VI. Tolerance Reassessment

Tolerances are listed in 40 CFR §180.215 for the residues of naled and its conversion product dichlorvos (2,2-dichlorovinyl dimethyl phosphate), expressed as naled. A summary of naled tolerance reassessments is presented in the following table.

Sufficient data are available to ascertain the adequacy of the established tolerances listed in 40 CFR §180.215 for the following commodities: almonds, hulls; almonds, nutmeat; beans, dry; beans, succulent; broccoli; Brussels sprouts; celery; cottonseed; eggplant; grapefruit; grapes; grass forage; lemons; melons; oranges; peaches; peas, succulent; peppers; spinach (and chard); squash, summer; strawberries; sugar beet roots; sugar beet tops; tangerines; and walnuts. Sufficient data are also available to support the established tolerances for eggs, milk, and tissues of animals resulting from dietary sources or through exposure via animal premise treatment.

The available data indicate that the established tolerances for the following commodities are too high and that the tolerance levels may be reduced: beans, dry; beans, succulent; beets, sugar, roots; broccoli; Brussels sprouts; celery; cottonseed; grapes; and peas, succulent.

Additional field residue data are required for the following commodities before a complete tolerance reassessment can be made: cabbage; cauliflower; collards; hops; and squash, winter. The required data for collards will be translated to kale. The required data for winter squash will be translated to pumpkins.

The established tolerances on the following commodities: cucumbers, lettuce, mushrooms, rice, tomatoes, and turnip tops should be revoked since these uses are not registered. If the registrant, or any registrant intends to support the use of naled on these commodities, residue data reflecting the maximum intended use pattern is required.

The established 10-ppm crop group tolerance for "legumes, forage" is inappropriate since the registrant does not intend to support naled uses on soybeans, which is the third representative crop of the foliage of legume vegetables group. Therefore, this crop group tolerance should be revoked concomitant with the establishment of individual tolerances for beans, forage; beans, hay; peas, vines; and peas, hay.

The available data for grapefruit, lemons, and oranges suggest that a crop group tolerance of 3.0 ppm for the citrus fruits group is appropriate. The individual tolerances for grapefruit, lemons, oranges, and tangerines should be revoked concomitant with the establishment of a crop group tolerance for citrus fruits.

The Agency classifies the registered Section 24© use of naled on alfalfa grown for seed to be a non-food use as long as there is appropriate label language for disposal and record keeping of seed screenings, prohibitions for feeding any portion of the treated plant for food or feed purposes, and the tagging of conditioned seeds which forbids the use of the seeds for human consumption or animal feed. Additionally, the Agency must have evidence that the respective states to which the special local need (SLN) use is registered has adequate regulatory mechanisms in place to enforce these limitations. If there is no evidence of adequate enforcement mechanisms, the alfalfa use will be considered a food use requiring tolerances and supporting residue data.

The established 0.5-ppm tolerance from use of naled for area pest control is adequate. The current tolerance for area pest control should be revised to include residues of dichlorvos as follows:

> " A tolerance of 0.5 part per million is established for the pesticide naled and its conversion product 2,2-dichlorovinyl dimethyl phosphate, expressed as naled equivalents, in or on all RACs, except those otherwise listed in this section, from use of the pesticide for area pest (mosquito and fly) control."

Tolerances of meat, milk, poultry, and eggs have been revoked. These uses fall under Category (3) of 40 CFR §180.6 (a)), no reasonable expectation of finite residues.

A. Tolerances That Need To Be Proposed Under 40 CFR §180.215

The livestock feeds table for Subdivision O (September, 1995) indicates that data on cotton gin byproducts (commonly called gin trash) are required. The registrant must propose a tolerance for this commodity.

The registrant must also propose a tolerance for grass hay supported by adequate data.

B. Tolerances for Processed Commodities

Adequate processing studies have been submitted for cottonseed, grapes, oranges, and soybeans. Processing studies involving rice, and tomatoes will not be required provided all registered uses of naled on these crops are canceled.

The combined residues of naled and dichlorvos are not expected to concentrate in the processed commodities of grapes, oranges, and soybeans, except for orange oil. However, the available orange processing study indicates that residues of dichlorvos concentrated in oil 13X during processing of oil treated with naled; residues of dichlorvos did not concentrate in the citrus processed commodities wet pulp, dried pulp, molasses, and juice. Residues of naled were non-detectable both before and after processing of orange commodities. The Agency previously concluded that for the purposes of establishing tolerances, if appropriate, the combined residues of naled and dichlorvos will be assumed to concentrate 13X during processing of citrus treated with naled. Since this 13X concentration is less than the expected dilution of orange oil, a tolerance should be established at 30 ppm.

Table 12. Tolerance Reassessment Summary

Commodity	Current Tolerance (ppm)	Tolerance Reassessment (ppm)	[*Correct Commodity Definition*]/ Comment
Tolerances Listed Under 40 CFR §180.215			
Almonds (hulls)	0.5	0.5	[*Almonds, hulls*]
Almonds (nuts)	0.5	0.5	[*Almonds, nutmeats*]
Beans (dry)	0.5	0.05	[*Beans, dry*]
Beans (succulent)	0.5	0.05	[*Beans, succulent*]
Beets, sugar, roots	0.5	0.05	[*Sugar beets, roots*]
Beets, sugar, tops	0.5	0.5	[*Sugar beets, tops*]
Broccoli	1	TBD[1]	
Brussels sprouts	1	TBD[1]	
Cabbage	1	TBD[1]	
Cauliflower	1	TBD[1]	
Celery	3	2	
Collards	3	TBD[1]	
Cottonseed	0.5	0.05	[*Cotton, undelinted seed*]

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Table 12. Tolerance Reassessment Summary

Commodity	Current Tolerance (ppm)	Tolerance Reassessment (ppm)	[*Correct Commodity Definition*]/ Comment
Cucumbers	0.5	Revoke	The tolerance should be revoked unless registrants other than AMVAC intend to support the use of naled on cucumbers and submit additional data.
Eggplant	0.5	0.5	
Grapefruit	3	Revoke	The tolerance should be revoked concomitant with the establishment of a crop group tolerance for citrus fruits group.
Grapes	0.5	0.05	
Grasses, forage	10	10	[*Grass, forage*]
Hops	0.5	TBD[1]	[*Hops, dried*]
Kale	3	TBD[1]	
Legumes, forage	10	Revoke	
Lemons	3	Revoke	The tolerance should be revoked concomitant with the establishment of a crop group tolerance for citrus fruits group.
Lettuce	1	Revoke	The tolerance should be revoked unless AMVAC or registrants other than AMVAC intend to support the use of naled on lettuce and submit additional data.
Melons	0.5	0.5	
Mushrooms	0.5	Revoke	The tolerance should be revoked unless registrants other than AMVAC intend to support the use of naled on mushrooms and submit additional data.
Oranges	3	Revoke	The tolerance should be revoked concomitant with the establishment of a crop group tolerance for citrus fruits group.
Peaches	0.5	0.5	
Peas (succulent)	0.5	0.05	[*Peas, succulent*]
Peppers	0.5	0.5	
Pumpkins	0.5	TBD[1]	

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Table 12. Tolerance Reassessment Summary

Commodity	Current Tolerance (ppm)	Tolerance Reassessment (ppm)	[*Correct Commodity Definition*]/ Comment
Rice	0.5	Revoke	The tolerance should be revoked unless registrants other than AMVAC intend to support the use of naled on rice and submit additional data.
Safflower, seed	0.5	0.5	
Spinach	3	3	
Squash, summer	0.5	0.5	
Squash, winter	0.5	TBD[1]	
Strawberries	1	1	
Swiss chard	3	3	
Tangerines	3	3	
Tomatoes	0.5	Revoke	The tolerance should be revoked unless registrants other than AMVAC intend to support the use of naled on tomatoes and submit additional data.
Turnips, tops	3	Revoke	The tolerance should be revoked unless registrants other than AMVAC intend to support the use of naled on turnips and submit additional data.
Walnuts	0.5	0.5	
Tolerances That Need To Be Proposed Under 40 CFR §180.215			
Beans, forage	None	1	
Beans, hay	None	TBD[1]	
Citrus fruits group	None	3	
Cotton, gin byproducts	None	0.05	
Grass, hay	None	TBD[1]	
Peas, hay	None	1	
Peas, vines	None	TBD[1]	
Citrus, oil	None	30	

[1]TBD = To be determined. Reassessment of tolerance(s) cannot be made at this time because additional data are required. AMVAC plans to propose a crop group tolerance for brassica leafy vegetables.

C. CODEX Harmonization

There are no Codex MRLs established or proposed for residues of naled.

8/19/96

Therefore, there are no questions with respect to compatibility of U.S. tolerances with Codex MRLs.

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APPENDIX A

Short- And Intermediate-term Handler Exposure/Risk

Tables A-1 Through A-3

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Appendix A

Table A-1. Summary Exposure Values for Agricultural Uses of Naled (Short-Term and Intermediate-term)

Exposure Scenario	Dermal Unit Exposure[1] (mg/lb ai)		Inhalation Unit Exposure[2] (μg/lb ai)		Maximum Application Rate[3] (lb ai/A)	Daily Max. Treated[4] (acres)	Dermal Exposure[5] (mg/day)		Inhalation Exposure[5] (mg/day)	
	PPE	Eng. Controls	PPE	Eng. Controls			PPE	Eng. Controls	PPE	Eng. Controls
Mixer/Loader Exposure										
Mixing All Liquids for Aerial	0.025	0.009 (gloves)	0.12	0.08	(B/C) 1.875	350	16.4	5.9	0.079	0.053
					(D) 1.406		12.3	4.4	0.059	0.039
					(E) 0.938		8.2	3.0	0.039	0.026
					(G) 0.703		6.2	2.2	0.030	0.020
Mixing All Liquids for Groundboom					(B) 1.875	80	3.8	1.4	0.018	0.012
					(D) 1.406		2.8	1.0	0.013	0.009
					(E) 0.938		1.9	0.7	0.009	0.006
					(G) 0.703		1.4	0.5	0.007	0.004
Mixing of Liquids for Airblast					(A) 2.813	40	2.8	1.0	0.014	0.009
					© 1.875		1.9	0.7	0.009	0.006
					(F) 0.938		0.9	0.3	0.005	0.003

Appendix A

Exposure Scenario	Dermal Unit Exposure[1] (mg/lb ai)		Inhalation Unit Exposure[2] (μg/lb ai)		Maximum Application Rate[3] (lb ai/A)	Daily Max. Treated[4] (acres)	Dermal Exposure[5] (mg/day)		Inhalation Exposure[5] (mg/day)	
	PPE	Eng. Controls	PPE	Eng. Controls			PPE	Eng. Controls	PPE	Eng. Controls
Applicator Exposure										
Aerial equipment (liquids)	No open cockpit uses[7]	0.005	No open cockpit uses[7]	0.07	(B/C) 1.875	350	No open cockpit uses[7]	3.3	No open cockpit uses[7]	0.046
					(D) 1.406			2.5		0.034
					(E) 0.938			1.6		0.023
					(G) 0.703			1.2		0.017
Groundboom (liquids)	0.01	0.007	0.07	0.04	(B) 1.875	80	1.5	1.1	0.011	0.006
					(D) 1.406		1.1	0.79	0.008	0.004
					(E) 0.938		0.75	0.53	0.005	0.003
					(G) 0.703		0.56	0.39	0.004	0.002
Airblast equipment	0.13	0.016[8] (gloves)	0.5	0.4[8]	(A) 2.813	40	14.6	1.8	0.056	0.045
					© 1.875		9.8	1.2	0.038	0.030
					(F) 0.938		4.9	0.6	0.019	0.015
Hot plate/pan (greenhouse)	No data see detailed discussion in text									

Appendix A

Exposure Scenario	Dermal Unit Exposure[1] (mg/lb ai)		Inhalation Unit Exposure[2] (μg/lb ai)		Maximum Application Rate[3] (lb ai/A)	Daily Max. Treated[4] (acres)	Dermal Exposure[6] (mg/day)		Inhalation Exposure[5] (mg/day)	
	PPE	Eng. Controls	PPE	Eng. Controls			PPE	Eng. Controls	PPE	Eng. Controls
Flagger Exposure										
Liquids	0.004	0.0002	0.03	0.006	(B) 1.875	350	2.6	0.13	0.020	0.004
					(D) 1.406		2.0	0.10	0.015	0.003
					(E) 0.938		1.3	0.07	0.010	0.002
					(G) 0.703		1.0	0.05	0.007	0.001

[1]PPE is coveralls over long pants, long sleeve shirt and chemical resistant gloves with open systems and chemical resistant head gear for airblast. The engineering controls are long pants, long-sleeve shirt and no gloves (chemical resistant gloves for closed mixing and enclosed cab airblast -- no data available for no gloves scenarios), and closed systems (i.e., closed mixing/loading or enclosed cockpit/cabs).

[2]PPE Inhalation Exposure Values are for workers wearing a respirator with organic vapor removing cartridge (10 fold PF used). The engineering controls values are for workers wearing no respirators, but mixing/loading and applying the pesticide within enclosed systems (e.g., enclosed cab).

[3]Crop groupings are: (A) almond, peach; (B) broccoli, cabbage, cauliflower, brussels sprouts, kale, collards, eggplant, pepper, melon, squash, walnut (air only); © citrus; (D) beans, peas, celery, chard, spinach, seed alfalfa (ID, UT, WA); (E) cotton, strawberry, sugarbeet, hops, seed alfalfa (OR), rangeland; (F) grape, walnut; and (G) safflower.

[4]Values represent the maximum area or the maximum volume of spray solution which can be used in a single day to complete treatments for each exposure scenario of concern.

[5]Daily Inhalation Exposure (mg/day) = Unit Inhalation Exposure (mg/lb ai) * Max. Appl. Rate (lb ai/A) * Max. Treated Acres

[6]Daily Dermal Exposure (mg/day) = Unit Dermal Exposure (mg/lb ai) * Max. Appl. Rate (lb ai/A) * Max. Treated Acres x 10^{-3} mg/ug

[7]Registrant has agreed to limit aerial applications to enclosed cockpits.

[8]Although enclosed cabs for airblast equipment may not be practical because the tractor cab will not pass through some orchards without damaging trees; they are practical for citrus orchards and are commonly used.

Appendix A

Table A-2. Summary Dose/Risk Values for Agricultural Uses of Naled (Short-Term and Intermediate-Term)

Exposure Scenario	Crop Grouping[1]	Daily Dermal Dose[3,4] (mg/kg/day)		Daily Inhalation Dose[2] (mg/kg/day)		Dermal MOE[6]		Inhalation MOE[7]		Total MOE[8]	
		PPE	Controls	PPE	Controls	PPE	Controls	PPE	Controls	PPE	Controls
Mixer/Loader Exposure											
Mixing All Liquids for Aerial	(B)	0.234	0.084	0.001	0.0008	4.3	12	53	66	4	10
	(D)	0.176	0.063	0.0008	0.0006	5.7	16	66	88	5	14
	(E)	0.117	0.043	0.0006	0.0004	8.5	23	88	133	8	20
	(G)	0.089	0.031	0.0004	0.0003	11	32	133	177	10	27
Mixing All Liquids for Groundboom	(B)	0.054	0.020	0.0003	0.0002	19	50	177	265	17	42
	(D)	0.040	0.014	0.0002	0.0001	25	71	265	530	23	63
	(E)	0.027	0.010	0.0001	0.00009	37	100	530	589	35	85
	(G)	0.020	0.007	0.0001	0.00006	50	143	530	883	46	120
Mixing of Liquids for Airblast	(A)	0.040	0.014	0.0002	0.0001	25	71	265	530	23	63
	©	0.027	0.010	0.0001	0.00009	37	100	530	589	35	85
	(F)	0.013	0.004	0.00007	0.00004	77	250	757	1,325	70	210
Applicator Exposure											
Aerial equipment (liquids)	(B)	No open cockpit uses[9]	0.047	No open cockpit uses[9]	0.0007	No open cockpit uses[9]	21	No open cockpit uses[9]	76	No open cockpit uses[9]	16
	(D)		0.036		0.0005		28		106		22
	(E)		0.023		0.0003		43		177		35
	(G)		0.017		0.0002		59		265		48

Appendix A

Exposure Scenario	Crop Grouping[1]	Daily Dermal Dose[3,4] (mg/kg/day)		Daily Inhalation Dose[2] (mg/kg/day)		Dermal MOE[6]		Inhalation MOE[7]		Total MOE[8]	
		PPE	Controls	PPE	Controls	PPE	Controls	PPE	Controls	PPE	Controls
Groundboom (liquids)	(B)	0.021	0.016	0.0002	0.00009	48	63	265	589	41	57
	(D)	0.016	0.011	0.0001	0.00006	63	91	530	883	56	82
	(E)	0.011	0.008	0.00007	0.00004	91	125	757	1,325	81	110
	(G)	0.008	0.006	0.00006	0.00003	125	167	883	1,767	110	150
Airblast equipment[9]	(A)	0.209	0.026	0.0008	0.0006	5	38	66	88	4	27
	©	0.140	0.017	0.0005	0.0004	7	59	106	133	7	41
	(F)	0.070	0.009	0.0003	0.0002	14	111	177	265	13	78
Flagger Exposure											
Liquids	(B)	0.037	0.0019	0.0003	0.00006	27	530	177	883	23	330
	(D)	0.029	0.0014	0.0002	0.00004	34	710	265	1,325	30	460
	(E)	0.019	0.0010	0.0001	0.00003	53	1,000	530	1,767	48	640
	(G)	0.014	0.00071	0.0001	0.00001	71	1,400	530	5,300	63	1100

[1]Crop groupings are: (A) almond, peach; (B) broccoli, cabbage, cauliflower, brussels sprouts, kale, collards, eggplant, pepper, melon, squash, walnut (air only); © citrus; (D) beans, peas, celery, chard, spinach, seed alfalfa (ID, UT, WA); (E) cotton, strawberry, sugarbeet, hops, seed alfalfa (OR), rangeland; (F) grape, walnut; and (G) safflower.

[2]PPE inhalation exposure values based on an O/V respirator (10 fold PF). Control values are based on no respirators and using closed systems (e.g. enclosed cab).

[3]The PPE represents coveralls over long pants, long sleeve shirt, and chemical resistant gloves using open systems and chemical resistant head gear for airblast applicators. The engineering controls represents long pants, long-sleeve shirt, and no gloves (chemical resistant gloves used for closed mixing and enclosed cab airblast--no data are available for no glove scenarios), and closed systems (i.e., closed mixing/loading or enclosed cockpit/cabs).

[4]Daily Dermal Dose (mg/kg/day) = Dermal Exposure (mg/day)/70 kg

[5]Total Dose (mg/kg/day) = Daily Inhalation Dose (mg/kg/day) + Daily Dermal Dose (mg/kg/day)

[6]Dermal MOE = NOAEL / Daily Dermal Dose (mg/kg/day). Where: NOAEL = 1 mg/kg/day, 28-day dermal study.

[7]Inhalation MOE = NOAEL / Total Dose (mg/kg/day). Where: NOAEL = 0.053 mg/kg/day.

[8]Total MOE = 1/((1/dermal MOE) + (1/inhalation MOE)).

[9]Although the registrant contends that enclosed cabs for airblast applications are impractical (tractor cab will not pass through some orchards without damaging trees), the exposure/risk values for enclosed cab tractors are included.

Note: Registrant has agreed to limit aerial applications to enclosed cockpits.

Table A-3. Exposure Scenario Descriptions for Agricultural Uses of Naled

Exposure Scenario	Data Source	Standard Assumptions[1] (8-hr day)	Comments[2]
Mixer/Loader Exposure			
Mixing Liquids for Aerial, Groundboom, and Airblast Applications	PHED V1.1	350 acres aerial, 80 acres groundboom, and 40 acres airblast	PPE: "Best Available" grades: Hands, dermal, and inhalation acceptable grades. Hands = 59 replicates; Dermal = 25 to 122 replicates; Inhalation = 85 replicates. High confidence in dermal data and inhalation data. Engineering Controls: "Best Available" grades: Hands, dermal, and inhalation acceptable grades. Hands = 31 replicates; Dermal = 16 to 22 replicates; Inhalation = 27 replicates. High confidence in dermal and inhalation data. PHED data used for PPE and Engineering Controls. The following protection factors (PFs) were used for the PPE scenario: 50% to estimate the use of coveralls and a 10 fold PF for the addition of an organic vapor removing cartridge. No PFs were necessary for the Engineering Controls scenario.
Applicator Exposure			
Aerial equipment (liquids)	PHED V1.1	350 acres	Engineering Controls: "Best Available" grades: Hand grades acceptable. Dermal and inhalation grades A,B,C. Hands = 34 replicates; Dermal = 24 to 48 replicates; Inhalation = 23 replicates. Medium confidence in dermal and inhalation data. PHED data used for Engineering Controls, no PFs were necessary.
Groundboom (liquids)	PHED V1.1	80 acres	PPE: "Best Available" grades: Hand grades A,B,C, dermal and inhalation acceptable grades. Hands = 21 replicates; Dermal = 32 to 42 replicates; Inhalation = 22 replicates. Medium confidence in dermal data and high confidence in inhalation data. Engineering Controls: "Best Available" grades: Hands and dermal grades A,B,C; inhalation acceptable grades. Hands = 16 replicates; Dermal = 20 to 31 replicates; Inhalation = 16 replicates. Medium confidence in dermal data and high confidence in inhalation data. PHED data used for PPE and Engineering Controls. The following protection factors (PFs) were used for the PPE scenario: 50% to estimate the use of coveralls and 10 fold PF for the addition of an organic vapor removing cartridge. No PFs were necessary for the Engineering Controls scenario.

Appendix A

Exposure Scenario	Data Source	Standard Assumptions[1] (8-hr day)	Comments[2]
Mixer/Loader Exposure			
Airblast equipment	PHED V1.1	40 acres	PPE: "Best Available" grades: Hand, dermal, and inhalation acceptable grades. Hands = 18 replicates; Dermal = 32 to 49 replicates; Inhalation = 47 replicates. High confidence in dermal and inhalation data. Engineering Controls: "Best Available" grades: Hand and dermal acceptable grades; inhalation grades A,B,C. Hands = 20 replicates; Dermal = 20 to 30 replicates; Inhalation = 9 replicates. High confidence in dermal data, low confidence in inhalation data. PHED data used for PPE scenario. The following protection factors (PFs) were used for the PPE scenario: 50% for coveralls, 90% for chemical resistant headgear, and a 10 fold PF for the addition of an organic vapor removing cartridge. No PFs were used for the engineering controls.
Hot plate/pan	No data	3.5 lb naled/day	PPE: No data Engineering Controls: No data
Flagger			
Liquids	PHED V1.1	350 acres	PPE: "Best Available" grades: Hand, dermal, and inhalation acceptable grades. Hands = 16 replicates; Dermal = 16 to 18 replicates; Inhalation = 18 replicates. High confidence in dermal and inhalation data. PHED data used for PPE scenario. The following protection factors (PFs) were used for the PPE scenario: 50% to estimate the use of coveralls, 90% to estimate the use of chemical resistant gloves, and a 10 fold PF for the addition of an organic vapor removing cartridge. A 98% PF was necessary for the Engineering Controls scenario to estimate an enclosed truck.

[1]Standard Assumptions based on an 8-hour work day as estimated by HED. Data from the Biological and Economics Analysis Division were not available.

[2]"Best Available" grades are defined for meeting Subdivision U Guidelines. Best available grades are assigned as follows: matrices with grades A and B data and a minimum of 15 replicates; if not available, then grades A, B, and C data and a minimum of 15 replicates; if not available, then all data regardless of the quality and number of replicates. Data confidence are assigned as follows:

High = grades A and B and 15 or more replicates per body part
Medium = grades A, B, and C and 15 or more replicates per body part
Low = grades A, B, C, D, and E or any combination of grades with less than 15 replicates