Environmental Fate and Effects Division's Risk Assessment for the Reregistration Eligibility Document for 2,4-Dichlorophenoxyacetic Acid (2,4-D)

ENVIRONMENTAL FATE AND EFFECTS DIVISION REREGISTRATION ELIGIBILITY DECISION TEAM for 2,4-Dichlorophenoxyacetic Acid (2,4-D)

Environmental Risk Branch I

Prepared by:

Mark Corbin	Environmental Scientist
William Evans	Biologist
James Hetrick	Senior Scientist

Approved by:

Sid Abel	Branch Chief

Peer Reviewed by:

Ed Odenkirchen	Senior Biologist
Norm Birchfield	Senior Biologist
Pat Jennings	Risk Assessment Process Leader (RAPL)

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I. Environmental Risk Conclusions

The Environmental Fate and Effects Division (EFED) of the Office of Pesticide Programs (OPP) has considered available information on 2,4-dichlorophenoxyacetic acid (2,4-D) toxicity, potential use areas, fate properties, and application methods in characterizing ecological risks related to labeled use. **Upon review and synthesis of this information, EFED concludes use of 2,4-D on terrestrial sites presents the greatest potential risks to: (1) non-target terrestrial plants, (2) mammals, and (3) birds, while the use of 2,4-D for aquatic weed control presents risk to aquatic organisms and aquatic plants.** Modeling results also indicated potential risks to endangered species including freshwater fish and invertebrates, estuarine invertebrates, birds, mammals, aquatic vascular plants, and terrestrial non-target plants. Based on the toxicity studies submitted, the potential for 2,4-D to have adverse effects on pollinators and other beneficial insects is low. Risks to soil and sediment dwelling organisms was not assessed as part of this assessment.

The 2,4-D Task Force identified a number of registrations which are outdated or inconsistent with respect to the technical labels. EFED has completed modeling as part of this assessment which has relied on maximum single and seasonal application rates derived from the 2,4-D Master Label. In accordance with a memorandum dated March 18, 2003 from the Special Review and Reregistration Division (SRRD), this exposure assessment for 2,4-D has used maximum application rates derived from the 2,4-D Master Label. The 2,4-D Master Label represents all currently registered technical forms of 2,4-D and all data submitted in support of 2,4-D (including esters and salts) has been created at these rates. It is an underlying assumption of this exposure assessment that any labels for formulated products which exceed these maximum application rates will be revised to comply with the Master Label. Use of rates from currently registered end use products which exceed those of the 2,4-D Master Label would result in higher predicted exposures and hence greater potential risk.

Environmental Fate Strategy

EFED proposed an environmental fate strategy for bridging of laboratory studies from 2,4-D to the esters and amine salts of 2,4-D. This document includes an assessment of potential risks to aquatic and terrestrial organisms resulting from the use of 2,4-D and its associated chemical forms including 2,4-D dimethylamine salt (2,4-D DMAS), 2,4-D isopropylamine salt (2,4-D IPA), 2,4-D triisopropanolamine salt (2,4-D TIPA), 2,4-D ethylhexyl ester (2,4-D EHE), 2,4-D butoxyethyl ester (2,4-D BEE), 2,4-D-diethanolamine salt (2,4-D DEA), 2,4-D isopropyl ester (2,4-D IPE) and 2,4-D sodium salt. In this document, the term chemical form is used to refer to the supported technical formulations listed above, while the term formulation refers to the physical nature (e.g. granular or emulsifiable concentrate) of the applied product, and the term end use product is used to refer to any formulated product including mixtures of pesticide sold in the Untied States. This document refers throughout to concentrations in acid equivalents (ae) unless otherwise noted. All reported concentrations and toxicity values are in acid equivalents unless otherwise noted. Conversion from active ingredient to acid equivalents was completed in accordance with conversion factors found in individual labels and based on molecular weight

differences.

The environmental fate strategy for 2,4-D is based on bridging the degradation of 2,4-D esters and 2,4-D amine salts to 2,4-D acid. The registrant submitted bridging data on the dissociation of 2,4-D amine salts and hydrolysis of 2,4-D esters. There were bridging data for 2,4-D dimethylamine salt (2,4-D DMAS), 2,4-D isopropylamine salt (2,4-D IPA), 2,4-D triisopropanolamine salt (2,4-D TIPA), 2,4-D ethylhexyl ester (2,4-D EHE), 2,4-D butoxyethyl ester (2,4-D BEE), 2,4-D-diethanolamine salt (2,4-D DEA), 2,4-D isopropyl ester (2,4-D IPE) and 2,4-D sodium salt. The registrant submitted bridging data indicate esters of 2,4-D are rapidly hydrolyzed in alkaline aquatic environments, soil/water slurries, and moist soils. The 2,4-D amine salts have been shown to dissociate rapidly in water. However, 2,4-D esters may persist under acidic abiotic aquatic conditions. These bridging data indicate under most environmental conditions 2,4-D esters and 2,4-D amine will degrade rapidly to form 2,4-D acid.

The weight of evidence from open-literature and registrant sponsored data reviewed subsequent to establishment of the bridging strategy indicates that 2,4-D amine salts and 2,4-D esters are not persistent under most environmental conditions including those associated with most sustainable agricultural conditions. 2,4-D amine salt dissociation is expected to be instantaneous (< 3 minutes) under most environmental conditions. Although the available data on de-esterification of 2,4-D esters may not support instantaneous conversion from the 2,4-D ester to 2,4-D acid under all conditions, it does show 2,4-D esters in normal agriculture soil and natural water are short lived compounds (< 2.9 days). Under these conditions, the environmental exposure from 2,4-D esters and 2,4-D amines is expected to minimal in both terrestrial and aquatic environments. Further analysis is required on reason(s) for 2,4-D BEE persistence in sediments from aquatic field studies. Additionally, the persistence of 2,4-D EHE on foliage and in leaf litter from registrant submitted forest field dissipation studies requires additional investigation. No field dissipation data (terrestrial, forest, or aquatic) have been submitted for the amine salts, 2,4-D IPA, 2,4-D TIPA, and 2,4-D DEA, or for the esters 2,4-D BEE (aquatic field dissipation data is available for this chemical form) and 2,4-D IPE to determine their persistence under field conditions. A more detailed discussion of the environmental fate of 2,4-D and its associated forms may be found in the Environmental Fate Assessment or in Appendix A.

Based on the physical chemical properties of the ester forms of 2,4-D and on evidence from the open literature there may be a concern for impacts to non-target organisms due to volatilization and off-site deposition of 2,4-D esters. Currently, EFED includes an assessment of the effect of spray drift in both the aquatic and terrestrial risk assessments. However, EFED does not currently assess the impact of volatility, long-range transport and deposition as a route of exposure in its risk assessment process. Therefore, the effect of volatility of the 2,4-D esters on non-target organisms has not been quantified in this assessment.

The ecological effects data for the 2,4-D acid and amine salts was pooled and analyzed as a group for fish, aquatic invertebrates, and aquatic plants while the 2,4-D esters were analyzed separately. This decision was based on the fact that the amine salts rapidly dissociate to the acid form of 2,4-D under most conditions and that when the acid and amine salts toxicity values are

compared to the aquatic toxicity values of the esters, the toxicity of esters tend to be from two to three orders of magnitude greater. In addition, data indicate that the 2,4-D esters may not hydrolyze rapidly in sterile acidic conditions. For these reasons, the aquatic data for the esters have been pooled and analyzed separately from the acid and amine salts.

For the bird and mammal assessments the toxicity values of the 2,4-D acid, amine salts, and esters were primarily pooled because of the tendency of the amine salts and esters to rapidly convert to the acid form in the terrestrial environment under most conditions. Consideration for pooling data based on toxicity alone was not done because of the limited number of definitive studies on birds. However, for terrestrial plant risk assessments the potential for risk was evaluated separately for the esters and the acid and amine salts since there are distinct differences in the solubilities of the two groups.

Environmental Risks Summary

EFED has considered available information on 2,4-D toxicity, potential use areas, fate properties, and application methods in characterizing ecological risks related to labeled use. **Upon review and synthesis of this information, EFED concludes 2,4-D exposures through spray drift and runoff present the greatest potential risks to terrestrial plants, mammals, and birds compared to the other taxonomic groups evaluated in this assessment, while exposures to 2,4-D through the direct application to water for aquatic weed control present the greatest potential risk to aquatic plants and animals.** Modeling results also indicated potential risks to endangered species including freshwater fish and invertebrates, estuarine invertebrates, birds, mammals, aquatic vascular plants, and terrestrial non-target plants. Based on the toxicity studies submitted, the potential for 2,4-D to have adverse effects on pollinators and other beneficial insects is low. Risks to soil and sediment dwelling organisms were not assessed as part of this assessment.

The findings summarized in this risk assessment are based on the maximum label rate for all uses modeled. Exceedances of Levels of Concern (LOC) based on the maximum label rate for minor crops (i.e. apples, filberts, and asparagus) may not be representative of overall risk for all uses of 2,4-D. The majority of 2,4-D use is on rangeland/pasture, turf, wheat, corn, and soybeans which have a maximum label rate which is roughly 1.5 to 2 times less than many of the minor crops. Generally, lower application rates will result in a linear reduction in risk quotients (RQs). Although the potential risk to ecological organisms from use of 2,4-D on minor crops are higher than the RQs resulting from use on major crops, there is less area associated with these minor crops relative to the major crops. Therefore, the potential risks associated with minor crops are not as widespread as the potential risks associated with major crops. However, any differences between risk associated with minor and major uses is tempered by the fact that the highest 2,4-D use (based on percentage of total 2,4-D used) is rangeland/pasture which has one of the highest maximum application rates and a wide geographic use pattern, which indicates that a comparison based on major versus minor uses cannot be used to characterize the potential risk from the use of 2,4-D in a quantitative manner. Regardless, it should be noted that there will still be exceedances of LOCs for **non-target terrestrial plants, small mammals, and birds for**

the lower label rates for major uses.

The mammalian chronic risk assessment utilized a toxicity endpoint from a rat two-generation reproduction test (NOAEL for growth rate reductions in F1b offspring which the Agency considers as a potentially important effect with implications for the survivability of offspring and therefore a potential impact on fecundity). Because the endpoint is the no effect level for this measured parameter, evaluations of the significance of any exposure excursions above this endpoint were conducted. From these comparisons it can be seen that daily oral dose estimates for wild mammals are sufficiently high to exceed toxicity endpoints ranging from fetal growth reduction to skeletal malformations. Moreover, the analysis suggests that daily exposure estimates for wild mammals are sufficiently high to exceed effects thresholds for developmental effects tested over very short durations of exposure.

Similarly, potential risk is further reduced when evaluating typical rates (see the Quantitative Usage Analysis (QUA) prepared by the Biological and Economic Analysis Division (BEAD) of OPP for details on these rates) which are typically less than one pound per application (lb/app) with one application per year for major crops while minor crops are typically less than 1.5 lb/app with as many as two applications per year. For major uses this will further reduce the RQs, however, exceedances for LOCs still occur for both major and minor uses on **non-target terrestrial plants, small mammals, and birds**.

Drinking Water Summary

EFED conducted an evaluation of the concentrations of 2,4-D to which humans potentially may be exposed through ingestion of drinking water and included modeling and an evaluation of surface water and groundwater monitoring data. A number of modeling approaches were used to provide estimated exposure concentrations (EEC) for drinking water. The highest exposure scenario is the direct application of 2,4-D to surface water bodies for the control of aquatic weeds with an EEC of **4000 ug ae/l** for peak (acute) exposure and **627 ug ae/l** for the annual mean (chronic) exposure. 2,4-D is regulated under the Safe Drinking Water Act (SDWA) and has a Maximum Contaminant Level (MCL) of **70 ug ae/l**, a One-Day Health Advisory (HA) for children of **1000 ug ae/l**, and a Ten-Day HA for children of **300 ug ae/l**. Although of high quality, EFED deemed monitoring data non-targeted to 2,4-D use. However, the data provide context to model results and indicate that there is little evidence that concentrations are likely to be found exceeding these standards.

2,4-D acid is non-persistent (half life = 6.2 days) in terrestrial environments, moderately persistent (half life = 45 days) in aerobic aquatic environments, and highly persistent (half life = 231 days) in anaerobic terrestrial and aquatic environments. Because 2,4-D acid will be anionic ($X\text{-}COO^- H^+$) under most environmental conditions, it is expected to be highly mobile with a K_{oc} of 41 (using the classification scheme of McCall) in soil and aquatic environments.

As an upper bound estimate on exposure due to the direct application of 2,4-D to aquatic water bodies, including drinking water reservoirs, a screening level model was used to estimate

concentrations in the index reservoir assuming uniform application over the entire reservoir at the maximum label rate. Based on the result of the direct application scenario, the estimated maximum surface water derived drinking water concentrations for the use of 2,4-D acid are:

4000 ug ae/l for the peak concentration (acute), and
627 ug ae/l for the annual mean concentration (chronic)

As a refinement of this scenario a screening level model incorporating an advection dispersion equation was used to estimate concentrations in the index reservoir for aquatic weed control in water bodies used for potable water with a setback. The EECs were based on treatment of an area of the index reservoir with a setback distance of 1500 feet and at the target application concentration of **4000 ug ae/l**. Using this approach, the predicted peak concentration at a drinking water intake in the EFED index reservoir with a setback of 1500 feet is **811 ug ae/l** 79 days after application while the annual average concentration is **102 ug ae/l**. Application to larger reservoirs could result in higher estimates of exposure.

The direct application of 2,4-D to rice paddies was modeled using the EFED approach for screening level estimates for pesticides with rice uses. Based on the results of the screening level rice model, the estimated 2,4-D maximum surface water derived drinking water concentrations for the direct application of 2,4-D to rice paddies is **1431 ug ae/l.** This concentration is currently used for the acute and chronic exposure estimates for these rice pesticides. However, the chronic estimate does not account for dilution and degradation as rice paddy water is released into and mixed with flowing surface water and therefore the chronic concentration is likely to be lower due to rapid degradation and dilution of 2,4-D acid.

Surface water concentrations resulting from terrestrial uses were modeled using PRZM version 3.12 and EXAMS version 2.98.04 model and the EFED graphical interface (PE4.pl dated January 9, 2003). Fifteen different crop scenarios were modeled using PRZM/EXAMS. Based on modeling results, the maximum predicted surface water derived drinking water concentrations for the use of 2,4-D are:

118.0 ug/l for the 1 in 10 year annual peak concentration (acute)
63.2 ug/l for the 1 in 10 year 90-day average
22.6 ug/l for the 1 in 10 year annual mean concentration (non-cancer chronic) and
8.9 ug/l for the 36 year annual mean concentration (cancer chronic).

The PRZM/EXAMS surface water-derived drinking water model estimates to be used for acute exposure are approximately two times the peak concentration of **58 ug ae/l** detected in the surface water monitoring data evaluated as part of this assessment and five times greater than the maximum time weighted annual mean (TWAM) concentration of **1.45 ug ae/l**. The monitoring data provide context to model predictions however, these values are deemed non-targeted to 2,4-D use because analysis indicates that, while of high quality, the data were not collected with sample frequency, timing, or geographic coverage designed specifically to capture peak 2,4-D concentrations.

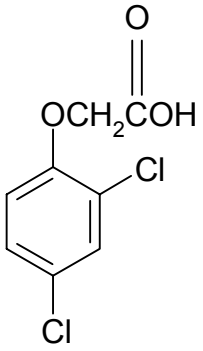
The 2,4-D concentration in ground water estimated using SCIGROW is **0.0311 ug ae/l**. This model prediction, however, is much lower than maximum 2,4-D concentrations in monitoring data. The maximum 2,4-D concentration detected in ground water is **14.89 ug ae/l** based on the United States Geological Survey (USGS) National Water-Quality Assessment (NAWQA) Program and **8 ug ae/l** based on the USEPA National Contaminant Occurrence Database (NCOD) monitoring data. The model prediction from SCIGROW is nearly three orders of magnitude less than the peak concentrations detected in the monitoring data. SCIGROW is a regression based model developed using data from a set of small scale prospective groundwater (PGW) studies and is intended to provide a preliminary screening level estimate of a high end concentration in a vulnerable hydrogeologic setting. In this instance, SCIGROW appears to underpredict exposures to 2,4-D from terrestrial uses and is not a reliable indicator of potential exposure.

II. Introduction

Physical and Chemical Properties

Common name:	2,4-D
Chemical name:	2,4-Dichlorophenoxyacetic acid
Molecular formula:	$C_8H_6Cl_2O_3$
CAS Number:	94-75-7
Molecular weight:	221.04
Physical state:	white crystalline solid
Melting point:	138 - 141 ^oC
Vapor pressure:	1.47 x 10^{-7} mm Hg @25 ^0C
Henry's Law:	Henry's Law: 4.74 x 10^{-10} atm-m3/mol @ 25C
Solubility:	569 mg/L @ 20^oC
Log K_{ow}:	2.81

Chemical structure of 2,4-D:



A summary of the physical chemical properties for the chemical forms of 2,4-D are presented in Appendix A.

Mode of Action

2,4-D is an herbicide in the phenoxy or phenoxyacetic acid family that is used postemergence for selective control of broadleaf weeds. 2,4-D, a synthetic auxin herbicide, causes disruption of plant hormone responses. Endogenous auxins are plant growth regulator hormones. These growth-regulating chemicals cause disruption of multiple growth processes in susceptible plants by affecting proteins in the plasma membrane, interfering with RNA production, and changing the properties and integrity of the plasma membrane. The plant's vascular system becomes blocked due to excessive cell division and the resulting growth crushes the vascular transport system. The most susceptible tissues are those that are undergoing active cell division and growth (Gibson and Liebman, 2002).

Plant injuries include growth and reproduction abnormalities, especially on new growth. Stem and petiole twisting (epinasty), leaf malformations (parallel venation, leaf strapping, and cupping), undifferentiated cell masses and adventitious root formation on stems, and stunted root growth is experienced by broadleaf plants. Rolled leaves (onion leafing), fused brace roots, leaning stems, and stalk brittleness are observed on grass plants. Disruption of reproductive processes may occur resulting in sterile or multiple florets and nonviable seed production. Symptoms may appear on young growth almost immediately after application, but death may not occur for several weeks.

2,4-D Chemical Forms and Use Characterization

For this risk assessment, 2,4-D comes in multiple chemical forms and is found in numerous end use products intended for use in a wide range of use patterns. 2,4-D is an ingredient in several

agricultural and home use products, as a sole active ingredient and in conjunction with other active ingredients. 2,4-D is formulated primarily as an amine salt in an aqueous solution or as an ester in an emulsifiable concentrate. Chemical forms covered by this risk assessment are as 2,4-D acid, 2,4-D DMAS, 2,4-D IPA, 2,4-D TIPA, 2,4-D EHE, 2,4-D BEE, 2,4-D DEA, 2,4-D IPE, and 2,4-D sodium salt. Copies of all labels may be found at http://www.cdpr.ca.gov/docs/epa/m2.htm.

2,4-D is a herbicide used as a plant growth regulator for multiple active ingredients. 2,4-D is thought to increase cell-wall plasticity, biosynthesis of proteins and the production of ethylene. The abnormal increase in these processes is thought to result in uncontrolled cell division and growth which damages vascular tissue. Target pests include a wide variety of broadleaf weeds and aquatic weeds. Formulation types registered include emulsifiable concentrate, granular, soluble concentrate/solid, water dispersible granules (dry flowable), and wettable powder. 2,4-D may be applied with a wide range of application equipment including aircraft, backpack sprayer, band sprayer, boom sprayer, granule applicator, ground, hand held sprayer, helicopter; injection equipment, tractor-mounted granule applicator, and tractor-mounted sprayers. Methods of application of 2,4-D may include band treatment, basal spray treatment, broadcast, frill treatment, girdle treatment, ; ground spray, soil band treatment, soil broadcast treatment, spot treatment, stump treatment, tree injection treatment, and water related surface treatment. Timing of 2,4-D application can include at emergence, before bud break, dormant, dough, established plantings, foliar, post-emergence, pre-emergence, pre-harvest, pre-plant. Table 1 presents a summary of the registered 2,4-D uses.

Table 1. Registered 2,4-D Uses

Crop Grouping	Representative Crops
Terrestrial food crop	Pear, Pistachio, Stone fruits
Terrestrial food and feed crop	Agricultural fallow/idleland, Agricultural rights-of-way/fencerows/hedgerows, Agricultural uncultivated areas, Apple, Barley, Citrus fruits, Corn (unspecified),Corn, field, Corn, pop, Corn, sweet, Fruits (unspecified), Grapefruit, Lemon, Oats, Orange, Pome fruits, Rice, Rye, Small fruits, Soil, preplant/outdoor, Sorghum, Sorghum (unspecified), Soybeans (unspecified), Sugarcane, Tangelo, Tree nuts, Wheat,
Terrestrial and greenhouse food crop	Pear, Stone fruits
Terrestrial feed crop	Grass forage/fodder/hay, Pastures, Rangeland, Rye, Sorghum

Table 1. Registered 2,4-D Uses	
Crop Grouping	**Representative Crops**
Terrestrial non-food crop	Agricultural fallow/idleland, Agricultural rights-of-way/fencerows/hedgerows, Agricultural uncultivated areas, Airports/landing fields, Christmas tree plantations, Commercial/industrial lawns, Commercial/institutional/industrial, premises/equipment (outdoor), Forest nursery plantings (for transplant purposes), Golf course turf, Grasses grown for seed, Industrial areas (outdoor),Nonagricultural outdoor buildings/structures, Nonagricultural rights-of-way/fencerows/hedgerows, Nonagricultural uncultivated areas/soils, Ornamental and/or shade trees, Ornamental lawns and turf, Ornamental sod farm (turf), Ornamental woody shrubs and vines, Paved areas (private roads/sidewalks), Potting soil/topsoil, Recreation area lawns, Recreational areas, Soil, preplant/outdoor, Urban areas
Terrestrial non-food and outdoor residential	Fencerows/hedgerows, Nonagricultural rights-of-way/fencerows/hedgerows, Ornamental and/or shade trees, Ornamental lawns and turf, Ornamental woody shrubs and vines, Paths/patios, Paved areas (private roads/sidewalks), Urban areas
Aquatic food crop	Agricultural drainage systems, Aquatic areas/water, Commercial fishery water systems, Irrigation systems, Lakes/ponds/reservoirs (with human or wildlife use), Rice, Streams/rivers/channeled water, Swamps/marshes/wetlands/stagnant water
Aquatic non-food outdoor	Aquatic areas/water, Streams/rivers/channeled water, Swamps/marshes/wetlands/stagnant water

Table 1. Registered 2,4-D Uses	
Crop Grouping	**Representative Crops**
Aquatic non-food industrial	Drainage systems, Industrial waste disposal systems, Lakes/ponds/reservoirs (without human or wildlife use)
Forestry	Conifer release, Forest plantings (reforestation programs)(tree farms, tree plantations, etc.), Forest tree management/forest pest management, Forest trees (all or unspecified), Forest trees (hardwoods, broadleaf trees), Pine (forest/shelterbelt)
Outdoor residential	Residential lawns
Indoor non-food	Commercial transportation facilities-nonfeed/nonfood

Based primarily on pesticide usage information from 1992 through 2000 for agriculture and 1993 through 1999 for non-agriculture, total annual domestic usage of 2,4-D is approximately 46 million pounds, with 30 million pounds (66%) used by agriculture and 16 million pounds (34%) used by non-agriculture (see the BEAD QUA). In terms of pounds, total 2,4-D usage is allocated mainly to pasture/rangeland (24%), lawn by homeowners with fertilizer (12%), Spring wheat (8%), Winter wheat (7%), lawn/garden by lawn care operators/landscape maintenance contractors (7%), lawn by homeowners alone (without fertilizer) (6%), field corn (6%), soybeans (4%), summer fallow (3%), hay other than alfalfa (3%) and roadways (3%). Agricultural sites with at least 10% of U.S. acreage treated include Spring wheat (51%), filberts (49%), sugarcane (36%), barley (36%), seed crops (29%), apples (20%), rye (16%), Winter wheat (15%), cherries (15%), oats (15%), millet (15%), rice (13%), soybeans (12%) and pears (10%). For 2,4-D, rates per application and rates per year are generally less than 1.50 pounds a.e. per acre and 2.00 pounds a.e. per acre (lbs ae/A), respectively. 2,4-D is used predominantly in the Midwest, Great Plains, and Northwestern United States (Figure 1).

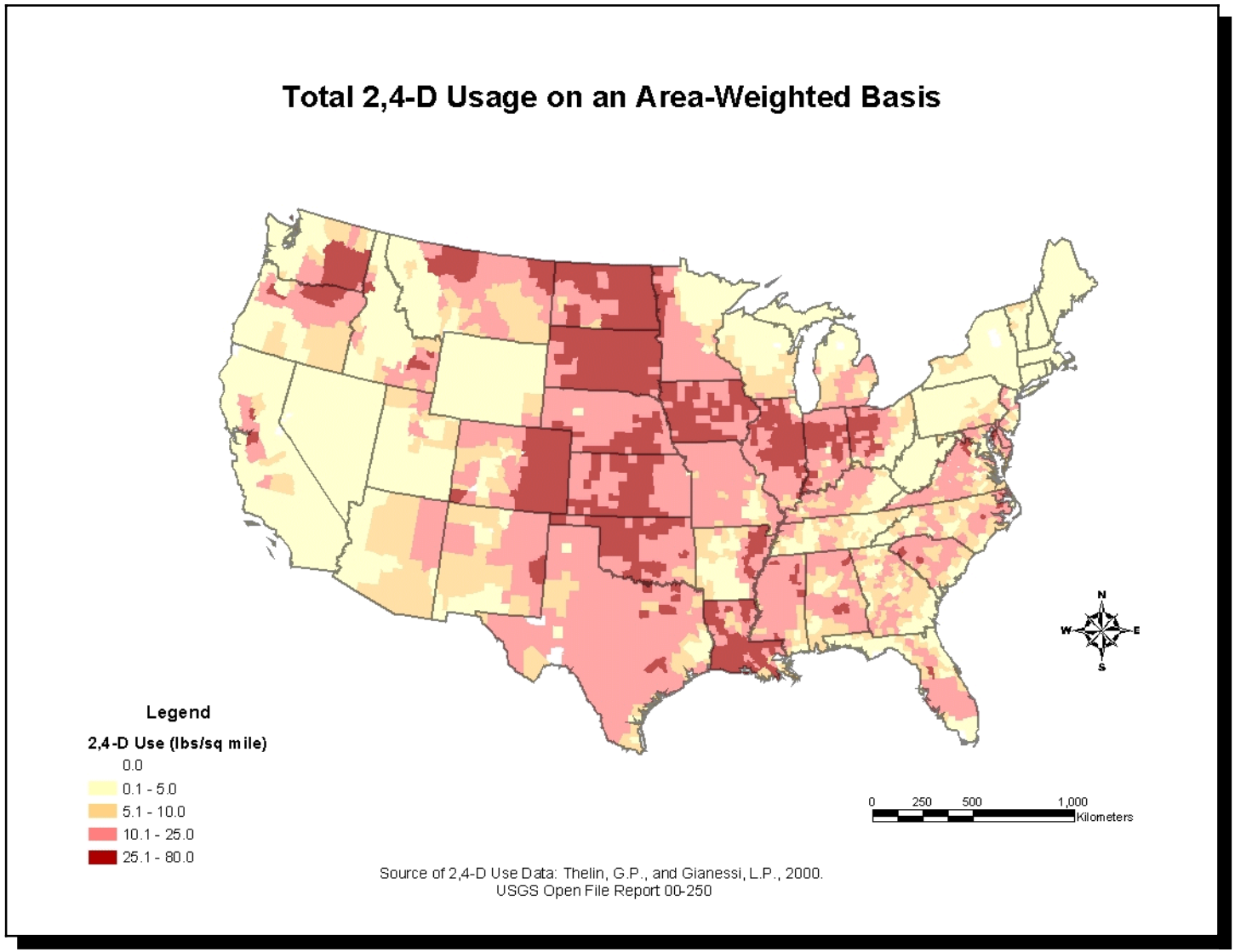


Figure 1. Estimated 2,4-D usage (lbs ae/square mile). The estimates are based on pesticide use rates compiled by the National Center for Food and Agricultural Policy (NCFAP) and modified by Thelin, G.P. and Gianessi, L.P., 2000 (USGS Open-File Report 00-250)

Risk Assessment Approach and Scenarios

This document includes an assessment of the potential risks to aquatic and terrestrial organisms resulting from the use of 2,4-D. This document also includes a summary of the assessment of potential exposure to 2,4-D residues in drinking water based on modeled EECs and surface water and groundwater monitoring data. The risk assessment approach included an evaluation of available surface water and groundwater monitoring data as well as environmental modeling. Several different aquatic exposure scenarios were evaluated. The EEC used for the risk assessment are based on model predictions. EFED determined that the available monitoring data is non-targeted to 2,4-D use for the purposes of exposure assessments because it was not collected with the intention of capturing maximum acute and chronic 2,4-D concentrations. Targeted monitoring data should be collected with a sampling frequency designed to capture peak runoff events coinciding with a specific pesticide use, with a duration designed to provide sufficient data to estimate long term exposures, and be specifically tailored to the individual geography and crop uses of the target pesticide. The monitoring data used in this assessment, while plentiful and of high quality, was not collected specifically with 2,4-D use in mind and is therefore considered to be non-targeted to 2,4-D use. The monitoring data evaluated in this assessment was used for comparison against model predictions. 2,4-D is a widely used herbicide with both terrestrial and aquatic uses. Potential risks to aquatic organisms (fish, invertebrates, and plants) and terrestrial organisms (birds, mammals, and plants) are assessed based on modeled EECs. In this assessment, all reported EECs are expressed as acid equivalents (ae).

EECs from aquatic exposure modeling for terrestrial uses of 2,4-D were based on modeling with PRZM/EXAMS. Specific uses chosen for aquatic exposure modeling include sugarcane in Florida, turf in Florida and Pennsylvania, spring wheat in North Dakota, winter wheat in Oregon, corn in Illinois and California, sorghum in Kansas and Texas, soybean in Mississippi, pasture in North Carolina, apples in North Carolina, Oregon, and Pennsylvania, and filberts in Oregon. An additional California citrus scenario was modeled for ecological exposure (but not drinking water because of the low application rate) for comparison with toxicity data for 2,4-D IPE. The Tier II scenarios chosen for this assessment represent all available PRZM/EXAMS scenarios for the uses of 2,4-D and its chemical forms. Although these only represents a portion of the crops for which 2,4-D has a labeled use, they represent crops with higher application rates and crops which have a large percentage of their total acreage treated with 2,4-D. Some crops with large total acreage treated were also included as modeled scenarios. These crops were also chosen to represent a wide geographic area, thus encompassing a variety of environmental conditions. By encompassing crops with large percentages of acreage treated with 2,4-D and a large geographic area, some crops with lower maximum application rates were also covered in the set of scenarios. EFED evaluated the relationship of these scenarios to runoff and 2,4-D use and determined that there are areas of high and moderate runoff vulnerability (greater than 5 inches per year) that correlate with moderate 2,4-D use areas. Included in the moderate runoff vulnerability areas is an area stretching in an arc from east Texas north to Missouri and east to Ohio, as well as discrete areas in Alabama, Georgia and eastern Oregon. These areas correspond closely with the PRZM/EXAMS scenario locations discussed above and summarized in Table 2.

Direct aquatic weed control uses of 2,4-D were evaluated assuming a direct application to the index reservoir for drinking water assessment and the standard pond for ecological assessment. To assess potential exposures for aquatic herbicides, a first approximation of a drinking water EEC was modeled assuming direct application to the index reservoir. EFED developed an approach using a simple spreadsheet model that incorporates degradation based on an acceptable aerobic aquatic metabolism study and flow through the Index Reservoir.

In order to assess the potential exposure of aquatic organisms to 2,4-D chemical forms from the direct application to water bodies for aquatic weed control a modification of the screening level approach used in the drinking water assessment was implemented. A first approximation of an aquatic ecological EEC was predicted assuming direct application to the standard pond with no flow. The scenario evaluated includes an assumption that 2,4-D is uniformly applied to the EFED standard pond with a surface area of 1 hectare and a volume of 20,000,000 liters. In this model, the 21-day average and 60-day average concentrations were calculated assuming first-order dissipation from aerobic aquatic degradation. An first order decay model was used to estimate average concentrations. The equation is Co/-k*(1-e^-k*t)/t where Co=initial concentration, k=first-order aerobic aquatic degradation rate (hr-1), t=time.

The rice use EEC of 2,4-D was predicted using the EFED rice paddy model. A more complete discussion of the screening level rice model may be found in the EFED policy memorandum dated October 29, 2002 attached to this assessment. The model involves an assumption of uniform application of pesticide to a rice paddy and calculates an EEC in the water column that could potentially be released from the paddy. The EEC is recommended for both acute and chronic exposures from 2,4-D use on rice. The model assumes partitioning of the pesticide between water and the upper 1 cm of sediment but does not include degradation. The model uses the following equation:

$$EEC = (10^9 * M_T) / (V_T + m_{sed} * K_d)$$

In this equation M_T is the total mass of pesticide applied in kg per hectare, V_T is the volume of water in the paddy (1,067,000 liter per hectare) assuming a paddy 4 inches deep and includes pare space in a 1 cm interaction zone, m_{sed} is the mass of sediment in the top 1 cm, K_d is the sorption coefficient, and 10^9 is the conversion factor from kilograms to micrograms.

Table 2. 2,4-D Modeling Application Information for Various Scenarios Derived from the 2,4-D Master Label (Assumes all other registered labels will be adjusted to match the 2,4-D Master Label)

Crop Scenario	Application Rate in Acid Equivalents per Acre (ae/A)	Number of Applications per Year	Application Timing	PCA Adjustment Factor (Drinking Water Only)
FL Sugarcane	2.0 lb ae/A	2	January 1, 19xx April 1, 19xx	0.87
FL Turf	2.0 lb ae/A	2	April 1, 19xx September 28, 19xx	1.0
PA Turf	2.0 lb ae/A	2	May 1, 19xx August 29, 19xx	1.0
ND Spring Wheat	1.25 lb ae/A	1	June 1, 19xx	0.56
OR Wheat	1.25 lb ae/A	1	April 1, 19xx	0.56
IL Corn	1.0 lb ae/A 1.0 lb ae/A 1.0 lb ae/A	3	April 15, 19xx May 30, 19xx September 27, 19xx	0.46
CA Corn	1.0 lb ae/A 1.0 lb ae/A 1.0 lb ae/A	3	March 15, 19xx April 29, 19xx August 27, 19xx	0.46
TX Sorghum	1.0 lb ae/A	1	June 7, 19xx	0.87
KS Sorghum	1.0 lb ae/A	1	June 7, 19xx	0.87
MS soybean	1.0 lb ae/A	1	March 10, 19xx	0.41
NC pasture	2.0 lb ae/A	2	June 1, 19xx	0.87
NC apples	2.0 lb ae/A	2	June 1, 19xx August 15, 19xx	0.87
OR apples	2.0 lb ae/A	2	July 1, 19xx September 14, 19xx	0.87
PA apples	2.0 lb ae/A	2	July 1, 19xx September 14, 19xx	0.87
OR filberts	1.0 lb ae/A	4	June 1, 19xx July 1, 19xx July 31, 19xx August 30, 19xx	0.87
CA citrus	0.21 lb ae/A	1	NA	1.0
Aquatic Use	10.8 lb ae/acre-foot (target concentration of 4 ppm)	1	NA	1.0
Rice Use	1.5 lb ae/A	1	NA	1.0

EFED established a fate strategy for bridging the laboratory fate data requirements for the 2,4-D esters and amine salts to the 2,4-D acid. Bridging data were submitted to verify that the esters and amine salts will be rapidly converted to the free acid in the environment, however there were exceptions noted such as dry soil conditions and sterile acidic environments. Additional data were reviewed subsequent to the establishment of the bridging strategy including registrant submitted studies and open literature data.

The weight of evidence from open-literature and registrant sponsored data indicates that 2,4-D amine salts and 2,4-D esters are not persistent under most environmental conditions including those associated with most sustainable agricultural conditions. 2,4-D amine salt dissociation is expected to be instantaneous (< 3 minutes) under most environmental conditions. Although the available data on de-esterification of 2,4-D ester may not support instantaneous conversion from the 2,4-D ester to 2,4-D acid, it does show 2,4-D esters in normal agriculture soil and natural water conditions are short lived compounds (< 2.9 days). Under these conditions, the environmental exposure from 2,4-D esters and 2,4-D amines is expected to minimal in both terrestrial and aquatic environments. Further analysis is required on reason(s) for 2,4-D BEE persistence in sediments from aquatic field studies. Additionally, the persistence of 2,4-D EHE on foliage and in leaf litter from registrant submitted forest field dissipation studies requires additional investigation. No field dissipation data (terrestrial, forest, or aquatic) have been submitted for the amine salts, 2,4-D IPA, 2,4-D TIPA, and 2,4-D DEA, or for the esters 2,4-D BEE (aquatic field dissipation data is available for this chemical form) and 2,4-D IPE to confirm their persistence under field conditions. A more detailed discussion of the environmental fate of 2,4-D and its associated forms may be found in the Environmental Fate Assessment or in Appendix A.

The abiotic hydrolysis studies for the 2,4-D esters indicate that ester hydrolysis to 2,4-D acid is pH dependent with no hydrolysis occurring under acid or neutral conditions (as an example 2,4-D EHE hydrolyzes at pH 5 with a half-life of 99 days and the hydrolysis half-life at pH 7 is 48 days, while hydrolysis at pH 9 was 52 hours). In order to account for the potential impact of the spray application of 2,4-D esters to aquatic environments, EFED completed an estimation of the drift of 2,4-D EHE consistent with EFED standard assumptions for each scenario used in the standard aquatic ecological exposure assessment (see above for scenarios). The estimation of drift of 2,4-D esters to the standard aquatic pond was assumed for each scenario assuming 5% spray drift for aerial application and 1% spray drift for ground application (as per EFED guidance). The amount of loading for each scenario was estimated by converting the application rate (determined by reviewing ester labels only) to the drift loading and multiplying the application amount (2.24 kilograms per hectare for pasture) by the drift (5% for aerial application). The resulting loading to the standard pond (0.112 kg to the 1 hectare pond as an example) was converted to an acute concentration by dividing the loading to the standard pond with a surface area of one hectare by the volume of the pond (20,000,000 liters). The resulting concentration represents the maximum instantaneous concentration predicted by direct drift from the application to the pond. Runoff of 2,4-D esters to aquatic systems was not considered here given the assumption discussed above which indicates rapid conversion of the esters to the acid in terrestrial systems. Only the peak (acute) EECs for 2,4-D esters were estimated for each

scenario. A chronic EEC was not provided in this scenario because the hydrolysis soil slurry data indicate that dissipation in a non-sterile water body will occur at all pHs and therefore long-term exposures are unlikely.

There is evidence for the phenoxy esters as a class to suggest that the conversion of the esters to the acid may not be rapid under all conditions. As evidence of this, Smith and Hayden noted that conversion of MCPA EHE did not occur immediately under dry condition at 15% field capacity. Additionally, an analysis of terrestrial field dissipation data collected for 2,4-D EHE indicates that the ester remains in the field with half lives between one and 14 days. It is important to note that these dry conditions will effect crop yield and it is likely that in a typical setting a farmer will irrigate to add moisture to the soil or abandon the crop. These facts, coupled with the increased toxicity to certain organisms for 2,4-D esters, raises questions about whether exposure to the 2,4-D esters via runoff might occur. In order to account for the potential for runoff during the time in which 2,4-D esters may remain in the field, EFED conducted additional modeling with PRZM/EXAMS to assess the potential for aquatic organisms to be exposed to 2,4-D esters when applied to the same terrestrial crops as modeled in the ester drift scenario.

For birds and mammals, toxicant concentrations on food items, based on data from by Hoerger and Kenaga (1972) and Fletcher et al. (1994), are predicted using a first-order residue decline method. EFEDs "FATE5" model predicted maximum and mean EECs resulting from single or multiple applications. Acute and Chronic RQs are calculated using these EECs and appropriate toxicity data.

EFED's TerrPlant.xls model (Version 1.0) models pesticide exposure to terrestrial plants inhabiting dry and semi-aquatic environments through runoff and spray drift. The model incorporates water solubility, amount of pesticide present on the soil surface and top one inch of soil, and method of application. EECs are calculated for the following application methods: (1) unincorporated ground applications, (2) incorporated ground application, and (3) aerial, airblast, forced-air, and chemigation applications. Runoff from granular applications is similarly modeled.

Based on the physical chemical properties of the ester forms of 2,4-D and on evidence from the open literature there may be a concern for impacts to non-target organisms due to volatilization and off-site deposition of 2,4-D esters. The state of Florida recently passed the Organo-Auxin Herbicide Rule which restricts the use of highly volatile esters based on concerns over volatility, however, these banned esters are high volatility esters and do not include the 2,4-D esters (except 2,4-D isopropyl ester, which is a high volatile ester labeled for use as a plant growth regulator on citrus) included in this assessment (email from Dale Dubberly, Florida Department of Agriculture and Consumer Services, dated August 12, 2003). Other states report incidences of off-site impact from the use of 2,4-D through a combination of drift and volatility and have banned, restricted or issued warnings on the use of phenoxy esters in warm or dry conditions. Currently, EFED includes an assessment of the effect of drift in both the aquatic and terrestrial risk assessments. However, EFED does not typically assess the impact of volatility, transport and deposition as a route of exposure in its risk assessment process unless there is evidence to

suggest a potential for this route of exposure. The effect of volatility of 2,4-D esters on non-target organisms should be viewed as a source of uncertainty in this assessment.

III. Integrated Environmental Risk Characterization

EFED has considered available information on 2,4-D's toxicity, use areas, usage, fate properties, and application methods and formulations in characterizing ecological risks related to normal use. **Upon review and synthesis of this information, EFED concludes use of 2,4-D on terrestrial sites presents the greatest potential risks to: (1) non-target terrestrial plants, (2) small mammals, and (3) birds, while the use of 2,4-D for aquatic weed control presents risk to aquatic plants and animals.**

There are a number of general assumptions and uncertainties associated with this risk assessment that help characterize the risks for both aquatic and terrestrial organisms. The overall effect of the assumptions and uncertainties on the risk conclusions are not expected to change the findings of this assessment. While there are instances where characterization indicates an overestimation or underestimation of risk, the effect of this characterization cannot be quantified at this time. In addition, because of the widespread use of 2,4-D geographically and the fact that 2,4-D is used on so many different use sites, it is difficult to further characterize the effect of these assumptions and uncertainties other than qualitatively at this time. Additional information on the use of 2,4-D will be needed to refine this assessment. More detail on the individual aspects of the risk characterization follow.

A number of uncertainties may result in an underestimation of the risks associated with 2,4-D including the following examples. There are a number of degradates of 2,4-D which were not included in the risk assessment and if these degradates are as toxic or more toxic than 2,4-D, inclusion would result in greater risk. Modeling has relied on a limited number of scenarios which, though representative of 2,4-D use, do not capture all potential exposures and therefore, there may be situations where higher exposures occur. The risk assessment has relied on the 2,4-D Master Label for application rates. As noted previously, there are a number of currently registered 2,4-D products which include higher application rates than those modeled in this assessment and hence the risk associated with these application rates would be greater. Currently, EFED surface water models require a discrete date of application as input to estimate exposure, however, in reality application timing is a varied across use sites and therefore the selection of a single day for application of 2,4-D could result in an underestimation of exposures. This risk assessment has relied on standard assumptions of spray drift from use of 2,4-D. In reality, 2,4-D may be applied under a wide variety of settings and application conditions many of which can result in higher exposures for non-target organisms. Finally, most toxicity testing has been conducted using technical forms of 2,4-D, while 2,4-D is typically applied in the field in an end use product mixed with surfactants, inert ingredients and other pesticides. Often, toxicity testing with an end use product may result in lower endpoints (i.e., greater toxicity) for risk assessment.

Conversely, there are a number of assumptions and uncertainties in this risk assessment that may

result in an overestimation of risk including the following examples. Currently EFED models do not account for the uptake of 2,4-D by plants and therefore assume that all non-dissipated pesticide applied to the field is present for exposure to organisms. In fact, many pesticides, including 2,4-D, are systemic and are absorbed by plants in the field and therefore, the current approach may overestimate the amount of 2,4-D available for exposure in terrestrial and aquatic systems. Typically, EFED will select the endpoint for risk assessment based on the most sensitive species. There may be instances where use of the most sensitive species may not be representative of risk under actual use conditions and may overestimate risk. As an example, EFED has relied on risk estimates from oral gavage studies on birds to assess risk because no definitive endpoint was determined from dietary studies. Therefore, it is likely that the risks estimates associated with the gavage studies overestimate the actual exposure of birds in the field. Finally, the initial assessment described in this document has relied on maximum applications rates derived from the 2,4-D Master Label. However, on average, applicators do not typically use the maximum rate in the field and an assessment of the comparison of risk between maximum application rates and typical, or average, application rates will indicate a lower risk although typical rates do not preclude the use of the maximum rates. Examples of this type of quantitative characterization are presented below.

There are a number of assumptions and uncertainties whose effect on the risk assessment are unknown including the following examples. The environmental fate bridging strategy is founded on the principle of rapid conversion of esters and amine salts to 2,4-D acid. However, the fate assessment reveals that there may be selected conditions under which the conversion of 2,4-D esters and amine salts to 2,4-D acid may not be rapid including dry soil and acidic abiotic aquatic systems. The extent of these systems in the real world and the likelihood that 2,4-D would be used in these systems is unknown. Finally, there is uncertainty associated with the behavior of 2,4-D BEE in the environment. In aquatic system when applied in a granular formulation, 2,4-D BEE resides in the sediment and does not appear to dissipate rapidly. It is unclear from the available data if 2,4-D BEE remains in granular form or disseminates into the sediment leaving the granule carrier in the sediment. Regardless, the persistence and higher toxicity of 2,4-D BEE relative to the other 2,4-D chemical forms is an uncertainty. This fact coupled with a lack of data on the behavior of 2,4-D BEE in terrestrial systems and the extent to which this product is used is an uncertainty whose effect on the conclusions of this risk assessment cannot be quantified. The scenarios used in EFED models have been developed to represent high end exposure scenarios however, the level of conservativeness in this assumption cannot be quantified. In addition, several scenarios are used as surrogates for 2,4-D use patterns (e.g. alfalfa as a surrogate for rangeland/pasture) which adds uncertainty to the assessment.

This risk assessment is based on model results using the maximum application rates on the 2,4-D Master Label. These use rates represent labeled maximum rates and may not reflect the use rate actually being applied in the field. When considering the lower rates associated with major 2,4-D uses and the more typical (average) use rate as reported by BEAD (see the QUA dated August 9, 2001) RQs are reduced by a factor of 2 to 3 times. **Regardless of this characterization, potential risk is still considered greatest to non-target terrestrial plants, small mammals, and birds**.

Additional characterization of the potential risks due to the direct application of 2,4-D for aquatic weed control was completed by back-calculating the target concentration needed to reduce RQs below LOCs. This type of consideration indicates that for all 2,4-D chemical forms the target concentration would need to be reduced nearly ten-fold to reduce EECs below all LOCs for fish and invertebrates and by nearly a factor of 100 to reduce EECs below LOCs for aquatic plants.

2,4-D represents several chemical forms broadly classified as acid, salts, amine salts, and esters. In general, 2,4-D acid and amine salts are practically non-toxic to freshwater and estuarine/marine fish, freshwater amphibians, freshwater invertebrates, and estuarine/marine invertebrates, while, conversely, the available data indicate that the ester forms of 2,4-D are moderately-toxic to highly-toxic to freshwater and estuarine/marine fish and slightly to very highly-toxic to freshwater and estuarine/marine invertebrates. Additionally, the data indicate that 2,4-D acid, salts, amine salts are less toxic to aquatic plants than the ester forms.

The drinking water and aquatic exposure assessment has relied on a combination of monitoring data and modeling. Both Tier I (SCIGROW and screening level models for aquatic uses) and Tier II (PRZM/EXAMS) models have been used to estimate exposure to 2,4-D and it various chemical forms in a variety of exposure scenarios. Uses evaluated with the Tier II model are presented in Table 2. The Tier II scenarios chosen for this assessment represent all available PRZM/EXAMS scenarios for the uses of 2,4-D and its chemical forms. Although these represent only a portion of the crops for which 2,4-D has a labeled use, they represent crops with higher application rates and crops which have a large percentage of their total acreage treated with 2,4-D. Additionally, aquatic herbicide uses of 2,4-D were evaluated with a simple screening level model assuming a direct application to the index reservoir and the rice use was modeled using an EFED screening level tool. EFED has developed a suite of PRZM scenarios for specific crop state combinations. These scenarios are not limited to the particular county and soil series on which they were created but are in fact intended to be representative of a more regional use pattern for the particular crop modeled.

There are a number of assumptions and uncertainties associated with the models used in this risk assessment. In general, the effect of these uncertainties on the risk findings is unknown. PRZM/EXAMS requires a number of inputs which are estimated from fate data and from an understanding of the use pattern and typical agronomic practices associated with 2,4-D use. Several scenarios are used as surrogates for specific 2,4-D uses. As an example, an alfalfa scenario is used as a surrogate for rangeland/pasture uses. In addition, the various orchard scenarios used in this assessment have as an underlying assumption that when the pesticide is applied foliarly, it is applied to the orchard foliage, which may not be adequate for estimating runoff from 2,4-D which is applied to the orchard floor. The effect of these assumptions on the magnitude of predicted risk is unknown. The potential exposure of aquatic organisms due to the use of 2,4-D on rice is estimated using a screening level model which provides an estimated concentration in tailwater at the point of release from a rice paddy but does not account for dispersion, dilution and degradation after release. Therefore, this estimate is likely conservative although there may be settings where the exposure may be representative. A screening level

model was used to predict concentrations in water systems due to aquatic weed control. The model is based on the maximum target application rate (4000 ug ae/l), however it should be noted that in registrant submitted aquatic dissipation studies, higher concentrations were observed and therefore, it may be concluded that in some situations the model may underestimate risk. Finally, many of the uncertainties and assumptions for aquatic models are applicable to the terrestrial models used in this assessment. In addition to the uncertainties listed above, the terrestrial models rely on default parameters for spray drift. The assumptions in this assessment are based on a default spray drift value of 1 percent for ground applications and 5 percent for aerial applications. In reality, 2,4-D will be applied in the field under a wide variety of conditions and higher drift values may occur.

As noted above, the EECs used for the aquatic organism risk assessment are based on model predictions and that monitoring data has been relied on to provide context to these estimates. EFED believes that the available monitoring data is non-targeted to 2,4-D use because it was not collected with the intention of capturing maximum acute and chronic 2,4-D concentrations. Targeted monitoring data should be collected with a sampling frequency designed to capture peak runoff events coinciding with a specific pesticide use, with a duration designed to provide sufficient data to estimate long term exposures, and be specifically tailored to the individual geography and crop uses of the target pesticide. The monitoring data used in this assessment, while plentiful and of high quality, was not collected specifically with 2,4-D use in mind and is therefore considered to be non-targeted to 2,4-D use. The monitoring data evaluated in this assessment was used for comparison against model predictions. 2,4-D has been detected in monitoring data from several areas of the country with **58 ug ae/l** from the NCOD being the highest value from all data. In particular, 2,4-D was detected along the Mississippi River Valley stretching from Louisiana north to Minnesota, in Ohio, Indiana, and Pennsylvania possibly associated with use on corn and wheat, in Florida possibly associated with use on sugarcane, in Washington and Oregon possibly associated with use on wheat, in the Central Valley of California possibly associated with corn, wheat and rice, and scattered locations in Michigan, Texas, Georgia, and Colorado.

The ecological effects data for the 2,4-D acid and amine salts was pooled and analyzed as a group for fish, aquatic invertebrates, and aquatic plants while the 2,4-D esters were analyzed separately. This decision was based on the fact that the amine salts rapidly dissociate to the acid form of 2,4-D under most conditions and that when the acid and amine salts toxicity values are compared to the aquatic toxicity values of the esters, the toxicity of esters tend to be from two to three orders of magnitude greater. In addition, data indicate that the 2,4-D esters may not hydrolyze rapidly in sterile acidic conditions. For these reasons, the aquatic data for the esters have been pooled and analyzed separately from the acid and amine salts.

For the bird and mammal assessments the toxicity values of the 2,4-D acid, amine salts, and esters were primarily pooled because of the tendency of the amine salts and esters to rapidly convert to the acid form in the terrestrial environment under most conditions. Consideration for pooling data based on toxicity alone was not done because of the limited number of definitive studies on birds. However, for terrestrial plant risk assessments the potential for risk was

evaluated separately for the esters and the acid and amine salts since there are distinct differences in the solubilities of the two groups.

There are a number of assumptions and uncertainties associated with the terrestrial risk assessment which provide context to the assessment. For acute exposures to birds the assessment has relied on two types of data, a suite of dietary studies and a suite of gavage studies. For avian acute exposures the dietary studies result in non-definitive endpoints which are not appropriate for estimating risk. Therefore, the assessment has relied on the gavage studies to estimate avian acute risks. EFED recognizes that this approach may overestimate risk to birds due to the fact that birds would not typically be expected to consume 2,4-D in this manner, however, for granular formulations this may be an appropriate approach. The assessment has also evaluated the impact of banded exposure on terrestrial organisms. Banded applications were assessed using an adjusted and unadjusted approach with the unadjusted approach assuming that the entire per acre rate would be added to the band and thus result in higher than normal exposures. In general, the banded applications do not represent major 2,4-D uses and also are unlikely to be routinely applied in the unadjusted manner in the field and thus these risks are likely overestimated. Similarly, granular applications to water were assessed as a potential route of exposure to terrestrial organisms because it is assumed animals might feed in shallow water bodies where the granules have been applied at a high application rate. As with the unadjusted banded application, the likelihood of this scenario being encountered in the field is considered low and therefore probably overestimates the risk. Also, EFED has used a foliar dissipation half life for 2,4-D from open literature (Willis and McDowell, 1987) of 8.8 days as opposed to the default value of 35 days. However, it is worth noting that in two forest field dissipation studies 2,4-D dissipated with half lives of 42 days in foliage and 72 days in leaf litter suggesting that the use of the 8.8 day half life may underestimate risk. Finally, for terrestrial plants over 100 endpoints were available for use in estimating risk with the most sensitive species used. Analysis of the distribution of the entire data indicate that more than half of these endpoints result in exceedances and therefore for terrestrial plants the use of the most sensitive species does not overestimate risk.

Spray Drift Risks to Non-target Terrestrial Plants

The risk assessment suggests potential concern for non-target terrestrial plants across all use sites. These non-target plant effects are to be expected because 2,4-D is used to control broadleaf weeds. The Acute Endangered Terrestrial Plant RQs and the Acute Non-Endangered Terrestrial Plant RQs exceeded the LOC for all the modeled scenarios. The risk assessment for terrestrial plants was based on RQs calculated from toxicity studies using the technical grade of 2,4-D acid, amine salt, and esters instead of a typical end-use product (TEP). Often the TEPs include surfactants or adjuvants to increase the herbicide's absorption into the plant, thereby increasing its efficacy. If the toxicity tests were conducted using a TEP of 2,4-D at the same application rates as the technical grade, the toxicity endpoints are likely to be much lower. Furthermore, if the toxicity endpoints were reduced in studies using the TEP, the RQs and the potential risks would be higher than those estimated based on the technical grade.

2,4-D uptake is primarily through the foliage and it is translocated throughout the plant in the xylem and phloem. Therefore, even if 2,4-D contacts a small portion of the surface area of the plant, there is a possibility that the plant may be severely damaged or die as a result. Even if the plant only exhibits minor damage, the damage may be sufficient to prevent the plant from competing successfully with other plants for resources and water.

Although EPA currently does not require plant reproduction studies, reproduction abnormalities are some of the plant injuries that can occur due to 2,4-D exposure. This may have effects on the non-target plant populations in future years. Also, plant material serves as a primary food source for many species of animals. If the available plant material (including seeds) are reduced due to the effects of 2,4-D, this may have negative effects throughout the food chain.

Adverse effects on non-target terrestrial plants are most likely to occur as a result of spray drift from aerial and ground applications of the liquid formulation. The percent of spray drift is an important factor in determining magnitude of potential risk of 2,4-D to non-target plants. There is as much as a 5-fold increase in the RQs when aerial application is used as opposed to ground application. 2,4-D applied according to label directions as a liquid spray for ground or aerial applications may impact non-target plants for some distance from the application site depending on droplet size, wind speed, and other factors. Not all 2,4-D product labels with directions for spray applications specify a required or recommended droplet size. 2,4-D applied as a fine or medium spray has the potential to cause more widespread damage to off-target plants than 2,4-D applied as a coarse spray because finer sprays tend to drift farther from the application site than coarse sprays. Coarse sprays may also damage non-target plants through drift, but generally damage is to plants closer to the target site and is less widespread than that caused by fine and medium sprays. Spray drift exposure from ground application is assumed to be 1% of the application rate and the EECs and RQs were calculated using EFED's TerrPlant.xls model (Version 1.0). EFEDs TerrPlant model can be interpreted to represent exposure to non-target terrestrial plants as either drift from ground spray at a distance of 25 ft from the edge of the field, or as an average exposure across a swath 175 feet wide starting at the edge of the field. In both scenarios, exposures can be expected to decrease with increasing distance from the edge of field of application.

Analysis of the relative importance of spray drift on the overall risk to non-target terrestrial plants from 2,4-D use was evaluated. In order to provide some context to the potential risk the terrestrial non-target plant toxicity value was used as an input into the AgDRIFT model as a percentage of the application rate to determine the distance beyond which no risk is predicted to occur assuming a fine to medium spray. This analysis was conducted for both seedling emergence and vegetative vigor using both the EC_{25} and the $NOAEC/EC_{05}$ and assuming a fine to medium droplet size. Using the most sensitive endpoint and the maximum application rate for asparagus (the highest use rate) and rangeland/pastureland (the largest use of 2,4-D) indicates that the downwind distance beyond which no adverse effect to endangered non-target terrestrial plants would occur cannot be predicted by AgDRIFT but is beyond 997 feet from the application area. Using the most sensitive endpoint and typical application rates yields similar results. Finally, the analysis suggests that increasing the droplet size spectrum for 2,4-D is not likely to

reduce exposures and that overall, offsite impacts to non-target terrestrial plants are likely far beyond the application area regardless of droplet size and application rate.

Based on the physical chemical properties of the ester forms of 2,4-D and on evidence from the open literature there may be a concern for impacts to non-target organisms due to volatilization and off-site deposition of 2,4-D esters. Long-range transport and deposition could lead to more widespread exposure than accounted for by considering spray drift alone. Currently, EFED includes an assessment of the effect of drift in both the aquatic and terrestrial risk assessments. However, EFED does not currently assess the impact of volatility, long-range transport, and deposition as a route of exposure in its risk assessment process. Therefore, the effect of volatility of the esters of 2,4-D on non-target organisms is a source of uncertainty in this assessment.

For 2,4-D, a total of 106 terrestrial plant studies were selected for use in the 2,4-D risk assessment using various chemical forms and species. Typically, EFED evaluates risk to non-target terrestrial plants using the EC_{25} for the most sensitive species tested. Although a range of sensitivities was observed in the studies, a majority of the tests indicated that all dicot plant species are sensitive. In order to test the conservativeness of using the most sensitive species, EFED evaluated the full range of EC_{25} results by preparing a distribution of all 106 EC_{25} values. EFED then compared the values within the distribution to determine which values would result in RQs which exceed the LOC. In this instance, the 57_{th} percentile of the definitive EC_{25}s (0.12 lbs ae/acre) for 2,4-D results in an RQ which just exceeds the LOC. In other words, 57 percent of the EC_{25} values used in this risk assessment will result in RQs which exceed the LOC while 43 percent will not exceed the LOC. This indicates that although there is a range of plant sensitivities to 2,4-D, a majority of the tested species have a high sensitivity to 2,4-D, and therefore, the assessment of potential risk to terrestrial plants from use of 2,4-D is not overly conservative.

The exceedances discussed above were calculated using maximum applications rates derived from the 2,4-D Master Label. EFED completed a characterization of potential risks by assessing the effect of calculating RQ using EECs predicted from modeling with average application rates as reported in the BEAD QUA report. Consideration of average application rates does not reduce EECs below the LOCs for non-target terrestrial plants.

Risks to Aquatic Organisms

The results of the risk assessment suggest potential concern for various aquatic species depending on the use pattern assessed. Several use patterns and transport processes were assessed individually including, runoff and drift from terrestrial crop/non-crop use sites for both acid/amine salts and esters, drift only from use of the ester forms in terrestrial crops/non-crops, direct application of 2,4-D DMAS for aquatic weed control, direct application of 2,4-D BEE for aquatic weed control, and the use of the acid and amine salts of 2,4-D on rice paddies.

The results of the assessment indicate that no aquatic acute or chronic LOCs are exceeded

through use of 2,4-D acid and amine salts due to runoff/drift from use on terrestrial crops, or due to drift alone of 2,4-D esters to water bodies (assuming 5% drift) from use on terrestrial crops.

There are no LOC exceedances for aquatic plants due to drift or runoff when using the ester forms on terrestrial crops. However, for the runoff/drift of 2,4-D acid and amine salts from use on terrestrial crops indicate that the aquatic vascular plant endangered species LOCs are exceeded for use of 2,4-D acid and amine salts on pasture and apples only.

For the direct application of 2,4-D acid and amine salts to water bodies the results indicate that the restricted use acute LOC is exceeded for freshwater invertebrates and the acute LOC is exceeded for endangered species for estuarine fish and invertebrates. The results also indicate that for the use of 2,4-D BEE in aquatic weed control there are exceedances of the acute LOCs for freshwater fish and invertebrates and exceedances of the chronic LOCs for freshwater and estuarine fish and freshwater invertebrates.

The use of 2,4-D acid and amine salts in rice paddies indicate potential acute endangered species risk for freshwater invertebrates. The rice model used to predict these EECs is a screening level model which predicts concentration in tailwater at the point of release from the paddy. It is anticipated that once released, the concentration will be reduced and subsequently, these RQs will decrease.

The scenario for direct application to water for weed control for the acid and amine salts indicates a potential risk to aquatic vascular plants. The RQs range from 1.03 for acute risk to 83.33 for endangered species risk. Use of 2,4-D BEE for direct application to water for weed control results in exceedances of LOCs for all risk categories for both vascular and non-vascular plants. Potential risk to endangered non-vascular plants is not evaluated because at this time there are no federally listed endangered nonvascular plant species.

Often in many end-use products, surfactants and adjuvants are added to increase the effect of the active ingredient. If end-use products containing 2,4-D also contain these performance-enhancing inert ingredients and these inerts also reach the non-target aquatic plants, this quantitative risk assessment may underestimate the potential risks.

Characterization of the potential risks to aquatic organisms from the use of 2,4-D and its chemical forms was completed by considering average application rates. For aquatic organisms all RQs were below LOCs for average application rates for use of 2,4-D on terrestrial sites.

Additional characterization of the potential risks due to the direct application of 2,4-D for aquatic weed control was completed by back-calculating the target concentration needed to reduce RQs below LOCs. This type of consideration indicates that for all 2,4-D chemical forms the target concentration would need to be reduced nearly ten-fold to reduce RQs below all LOCs to fish and invertebrates and by nearly a factor of 100 to reduce RQs below all LOC for aquatic plants. It should be noted that data from registrant submitted field dissipation studies indicate that concentrations as high as 13000 ug/l have been occasionally detected in individual samples

collected immediately after application and therefore, estimates of risk based on the target concentration of 4000 ug/l should be tempered by the fact that higher exposures are possible with an associated higher RQ.

For the rice use of 2,4-D the characterization of risk by considering average application rates indicate that no LOC exceedances occur for freshwater invertebrates. However, consideration of average application rates does not reduce EECs below LOCs for aquatic vascular and non-vascular plants from the use of 2,4-D on rice and terrestrial sites.

Risks to Birds and Mammals

Birds

Due to the differences in the toxicity values of acute oral and dietary studies and the lack of a definitive dietary LC_{50} (a non-definitive study shows no mortality at the highest concentration tested), it was determined that the acute oral LD_{50} would be a more conservative indicator of risk than the dietary LD_{50}. Hence, the oral LD_{50} of 415 mg ae/kg-diet was used to calculate the acute RQs for non-granular spray applications. These RQs ranged from <0.01 to 3.8. LOC exceedances occurred for short grass, tall grass, and broadleaf, forage, and small insect scenarios for all sites with the exception of potatoes and citrus. Granular broadcast applications which indicate RQs ranging from 13.6 to 0.05 in aquatic areas for 20 g and 1000 g birds respectively.

In addition to broadcast applications a number of labels permit the application of banded sprays and granular formulations. For these applications, the acute LOC was exceeded for uses on forests, blueberries, sorghum, corn, soybeans and asparagus, while the restricted use and endangered species LOC was exceeded for all these sites plus potatoes. Exceedances of LOCs occurred for predicted exposures assuming adjusted and unadjusted concentrations. Unadjusted concentrations assume that the applicator will not adjust the application amount applied in the field with a result that the concentration of pesticide in the band will be higher than if applied uniformly across the field. The adjusted concentration assumes that the applicator will correct and apply within the band at the label rate. The adjusted concentration is assumed by EFED to be more typical of actual use practices, however current labels do not restrict the practice of apply at unadjusted concentrations. The RQs for these applications vary from 4.0 to < 0.01 for the adjusted band rate scenario. If the use rate is not adjusted by dividing the width of the band by the row width of the field banded sprays, the RQs will be as high as 20.1.

For banded spray applications, the acute LOC was exceeded for uses on forests, blueberries, sorghum, corn, soybeans and asparagus, while the restricted use and endangered species LOC was exceeded for all these sites plus potatoes. Exceedances of LOCs occurred for predicted exposures assuming adjusted and unadjusted concentrations. Unadjusted concentrations assume that the applicator will not adjust the application amount applied in the field with a result that the concentration of pesticide in the band will be higher than if applied uniformly across the field. The adjusted concentration assumes that the applicator will correct and apply within the band at the label rate. The adjusted concentration is assumed by EFED to be more typical of actual use

practices, however current labels do not restrict the practice of apply at unadjusted concentrations.

Granular and banded applications do not include as many use sites as the broadcast non-granular spray applications. The higher RQs for the banded applications result from the higher use rates such as forestry and asparagus. The only expected banded application for the forestry use would be applications to seedlings grown in rows or outdoor nurseries where boom sprayers might be used to treat growing plants.

For granular uses, the acute risk LOC was exceeded for uses in aquatic systems (including ditchbanks), turf, and non-cropland settings. For granular applications, the highest RQs are associated with direct applications to water. The concentrations in the water were estimated from surface applications and sub-surface injection at the rates of 10.8 lbs. ae per acre foot to attain a maximum concentration of 4 ppm. It is presumed that the granules will descend to the bottom of the water body and reach an equilibrium in the water column to attain a concentration of 4 ppm. Birds inhabiting or using this habitat would have to ingest or consume a large amount of water or sediment to approach an acute LD_{50} of 500 mg/kg. Further, the number of waterfowl which exclusively feed or forage in water would be limited to a few species of ducks and other waterfowl. These species are larger birds where the influence of larger body weight and energy needs tends to lower the potential risk significantly. The two other use sites which remain a potential concern are the non-cropland and turf uses. These sites account for a large quantity of 2,4-D used in the U.S. Many birds utilize these habitats during migration, thus the potential risk to birds from these uses is expected to be more serious.

Potential chronic risks to birds is limited to a few use sites. These include non-cropland, forest, asparagus, and cranberry. The RQs for these sites range from 1 -1.09. Further characterization of these use sites by evaluating average application rates versus maximum application rates lower these RQs to below the LOCs.

Characterization of the potential risks to birds from the use of 2,4-D and its chemical forms was completed by considering EECs generated using average application rates. In general, for non-granular spray applications all EECs from average application rates are not decreased below the LOCs for the use of 2,4-D on terrestrial sites. A similar consideration for granular and banded applications of 2,4-D does not result in a reduction below LOCs for birds due to the use on terrestrial sites.

For example, for non-granular spray application avian acute concerns, the highest RQ (3.50) was cranberries for birds feeding on short grass based on a maximum application rate of 4 lbs ae/acre; however, the average application rate was 1.83 lbs ae/acre (see the BEAD QUA). If the modeled application rate was reduced to 1.83 lbs ae/acre for cranberries, and there was an assumption that the resulting EEC will be reduced linearly, the RQ would be 1.60 which is still above the acute LOC. A similar consideration for other uses results in some reduction of EECs but only a few uses are reduced below the respective LOCs. However, consideration of average application rates for chronic exposures does result in reduction of the RQs below the chronic

LOC.

Mammals

There were exceedances of both the acute and chronic LOCs for mammals for all use sites evaluated for non-granular spray, banded spray, and granular applications with a few exceptions as noted below. For example, for herbivorous/insectivorous mammals, acute LOCs were exceeded for all use sites evaluated except potatoes and citrus. There were no acute LOC exceedances for granivorous mammals.

For banded applications, acute LOCs were exceeded for all use sites and animal sizes when unadjusted rates are used, while acute LOCs were exceeded for only small and medium size animals when adjusted. Finally, for granular applications, there were no exceedances for large animals for uses on turf and ditchbanks. A similar pattern of exceedances for chronic LOCs is noted.

The LOC exceedances for herbivores and insectivores can be explained by the larger percentage of body weight consumption and higher predicted residue levels than those of the granivores. The percent of the body weights consumed for 15, 35, and 1000 g herbivorous/insectivorous mammals are 95, 66, and 15% respectively in contrast to 21, 15, and 3% consumed for granivorous mammals. In addition, the predicted residue levels on short grass, broadleaf forage/small insects are, in most cases, are an order of magnitude higher than those of large insects and seeds.

The labels for crops such as asparagus, cranberries, non-cropland, and forestry use sites allow maximum applications rates of 4 lb ae/A. In addition, asparagus applications can be applied 2 times per year. These use rates account for the higher RQs for herbivores and insectivores.

Banded applications are not addressed in the 2,4-D Master Label. However, a number of labels which are approved provide for the use of unincorporated banded applications to selected row crops. The row crops on the master label which could potentially be applied as a band treatment include forest uses, sorghum, blueberry, corn, soybean, asparagus, and potato. As discussed above for birds, if the use rate is not adjusted by dividing the width of the band by the row width of the field, the RQs will be 5 times higher for the unadjusted use rates (see the previous discussion on adjusted and unadjusted banded application rates under risk to birds). If one considers the adjusted rate RQs only, the acute risk LOCs are exceeded for all but 1000 g mammals. The RQs range from <0.01 for potatoes to 3.48 for asparagus. Reducing the use rates linearly reduces associated RQs.

The 2,4-D Master Label allows granular applications on non-cropland, turf, cranberry, and aquatic use sites. As explained above for birds, the concentrations for the aquatic uses were estimated from surface applications and sub-surface injection at rates of 10.8 lbs. ae per acre foot to attain a maximum concentration of 4 ppm. It is presumed that the granules will descend to the bottom of the water body and reach an equilibrium in the water column to attain a concentration

of 4 ppm. Mammals inhabiting or using this habitat would have to ingest or consume a large amount of water or sediment to approach an acute LD_{50} of 433 mg/kg, and it is likely that risk to mammals would be unlikely from aquatic applications. The cranberry use which would be restricted to aquatic areas would also presumably pose no risk to mammals. The two other use sites (non-cropland and turf) remain a concern for mammals and these uses account for major uses of 2,4-D over wide geographic areas. These RQs range from 0.04 to 4.8.

Chronic Risks

Mammalian chronic RQs range from 0.05 to 200 and chronic LOCs were exceeded for all uses with the exception of those based on mammals foraging on large insects and seeds or as a result of use of 2,4-D on potatoes and citrus. These RQs result from chronic data that exhibit a NOAEC of 5 milligram per kilogram per day (mg/kg/day) from a 2-generation reproduction rat toxicity study. The toxic endpoints for the parental toxicity in this study was based on decreased female body weight/body-weight gain (F1) and male renal tubule alteration in the F0 and F1 generations. The toxic endpoints of 5 mg/kg/day for the offspring toxicity is based on decreased pup body weight [F1b]. At the 80 mg/kg/day dose there was an increase in pup deaths.

Additional developmental toxicity studies on rats and rabbits indicate that the NOAEC of < 10 mg ae/kg/day does not differ greatly from the 2-generation reproductive study NOAEC. These developmental toxicity studies were performed on the 2,4-D acid, all the amine salts, as well as two of the esters.

The mammalian chronic risk assessment utilized a toxicity endpoint from a rat two-generation reproduction test. This endpoint was the NOAEL for growth rate reductions in F1b offspring. The agency considers that reduced growth (reductions in pup body weight gains relative to controls) in offspring as a potentially important effect with implications for the survivability of offspring and therefore a potential impact on fecundity. Because the endpoint is the no effect level for this measured parameter, evaluations of the significance of any exposure excursions above this endpoint were conducted. Daily wild mammal oral dose estimates for dietary sources (both upper bound and mean estimates) have been compared with a number of toxicity endpoints including (1) the 5 mg/kg-bw/day threshold (NOAEL pup growth rate) used for RQ calculations, (2) a 25 mg/kg-bw/day endpoint associated with a NOAEL for skeletal malformations and, (3) a 75 mg/kg-bw/day endpoint associated with skeletal malformations. From these comparisons it can be seen that daily oral dose estimates for wild mammals are sufficiently high to exceed toxicity endpoints ranging from fetal growth reduction to skeletal malformations. Moreover, the analysis suggests that daily exposure estimates for wild mammals are sufficiently high to exceed effects thresholds for developmental effects tested over very short durations of exposure.

The risk assessment and calculated RQs assume 100% of the diet is relegated to single food types foraged only from treated fields. The assumption of 100% diet from a single food type may be realistic for acute exposures, but diets are likely to be more variable over longer periods of time. However, even if there is variation in diet over time, when the Chronic LOCs are exceeded for multiple food categories, exposure will still be high enough to warrant potential concern.

This assumption is likely to be conservative and will tend to overestimate potential risks for chronic exposure, especially for larger organisms that have larger home ranges. These large animals (e.g., deer and geese) will tend to forage from a variety of areas and move on and off of treated fields. Small animals (e.g., mice, voles, and small birds) may have home ranges smaller than the size of a treated field and will have little or no opportunity to obtain foodstuffs that have not been treated with 2,4-D. Even if their home range does cover area outside the treated field, 2,4-D may have drifted to areas adjacent to the treated field.

Other uncertainties with the dietary exposure are the assumption of a foliar degradation rate of 8.8 days from available published literature. This is less conservative than the EFED standard default value of 35 days and represents a median value reported by Willis and McDowell. There is also data from forest field dissipation studies which indicate longer half lives for 2,4-D on foliage and leaf litter but the relevance of these data to terrestrial exposures in unknown and these values were not used. Also, the risk assessment considers toxicity data from only two species of birds. The underlying assumption of this strategy is that these species are representative of the hundred of bird species in North America, however, the conservativeness of this strategy is unknown.

The current risk assessment considers only dietary exposure. Other exposure routes are possible for animals residing in or moving through treated areas. Ingestion of contaminated soils, dermal contact, and inhalation appear to be routes of low risk based on available toxicity data and screening methods. Consumption of drinking water would appear to be inconsequential if water concentrations were equivalent to the concentrations from PRZM/EXAMS; however, concentrations in puddled water sources on treated fields are likely to be higher than concentrations in modeled ponds. Preening and grooming exposures, involving the oral ingestion of material from the feathers or fur remains an unquantified, but potentially important, exposure route.

If 2,4-D was applied as a band between rows of a crop, the RQs would be higher than those presented in this risk assessment. Banded applications of herbicides typically are not used for small grains (wheat and barley, etc.) as the row widths are too narrow to allow banded applications between the rows. However, in typical banded applications, the application rate of the chemical applied to the band is adjusted from the label rate (lbs ae/ac, assuming broadcast distribution over the entire field) by the ratio of the width of the band of pesticide and the width of the non-treated row of the field. For example, if the crop is planted in rows 30 inches apart and the width of the pesticide band is 6 inches, then the pesticide application rate in the treated band can be five times greater than the label rate for broadcast application since only one-fifth of the field is treated. In this particular example, animals foraging in the treated bands would be exposed to pesticide concentrations 5 times greater than those modeled in broadcast applications.

Further characterization of the potential risks to mammals from the use of 2,4-D and its chemical forms was completed by considering EECs generated using average application rates. While there was some reduction in EECs for non-granular spray applications, in general, there was no overall reduction in EECs below LOCs from use of 2,4-D in terrestrial systems due to average

application rates.

Risks to Terrestrial Non-Target Insects

EFED currently does not quantify risks to terrestrial non-target insects. RQs are therefore not calculated for these organisms. Since the test results from 2,4-D DMAS and 2,4-D EHE was practically non-toxic to honey bees (LD_{50} of >100 µg/bee), the potential for 2,4-D and its salts and esters is not likely to have adverse effects on pollinators and other beneficial insects. However, there is significant uncertainty with extrapolating from one species of insect to all insects in the United States.

Uncertainties in the Ecological Risk Assessment

There are a number of areas of uncertainty in the terrestrial and the aquatic organism risk assessments that could potentially cause an underestimation of risk. First, this assessment accounts only for exposure to 2,4-D, but not to its degradates. The risks presented in this assessment could be underestimated if degradates also exhibit toxicity under the conditions of use proposed on the label. The Metabolite Assessment Review Committee (MARC) of the Health Effects Division (HED) of OPP has determined that none of these degradates are of concern for the human health risk assessment, therefore, no degradates were included in the drinking water assessment or in the ecological risk assessment. Second, the risk assessment only considers a limited number of species tested and only a subset of possible use scenarios. For the aquatic organism risk assessment, there are uncertainties associated with the PRZM/EXAMS model, input values, and scenarios including the use of surrogate scenarios such as using alfalfa to represent pasture, which could result in higher or lower exposures. Also, there may be environments where the environmental fate bridging strategy is not applicable, such as dry soils and acid environments which may limit the abiotic hydrolysis of the 2,4-D esters and hence may underestimate exposure to the more toxic forms of 2,4-D.

Endocrine Disruption Assessment

The potential for endocrine disruptor related effects was observed in several mammalian toxicity studies submitted to the Agency. In the 2-generation reproduction study with rats (MRID 2529442, 259446, and 265489), decreased body weight gains were observed in the F0 parental animals in the high dose range as well as male renal tubule alteration in the F0 and F1 generations. Reproductive toxicity based on increases in gestation length was also observed. In addition, an increase in decreased pup body weight was observed for the offspring. Avian reproduction effects of cracked eggs and numbers of eggs laid was observed in an avian chronic study on 2,4-D acid. The NOEC was 962 ppm. These reproductive effects could be an indicator of potential endocrine disruption in birds.

2,4-dichlorophenol (2,4-DCP) is a degradate of 2,4-D. The registrant has not submitted, nor has the Agency requested, studies on the potential for endocrine disruption for 2,4-DCP resulting from the use of 2,4-D. Until such time as the Agency determines that 2,4-DCP is an endocrine

disruptor, this risk assessment has not included an evaluation of the relative risk of 2,4-DCP endocrine disruption due to use of 2,4-D.

EPA is required under the Federal Food, Drug, and Cosmetic Act (FFDCA), as amended by the Food Quality Protection Act (FQPA), to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) *"may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen, or other such endocrine effects as the Administrator may designate."* Following the recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there was scientific bases for including, as part of the program, the androgen and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that the Program include evaluations of potential effects in wildlife. For pesticide chemicals, EPA will use The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and, to the extent that effects in wildlife may help determine whether a substance may have an effect in humans, FFDCA authority to require the wildlife evaluations. As the science develops and resources allow, screening of additional hormone systems may be added to the Endocrine Disruptor Screening Program (EDSP). When the appropriate screening and/or testing protocols being considered under the Agency's EDSP have been developed, 2,4-D and 2,4-DCP may be subjected to additional screening and/or testing to better characterize effects related to endocrine disruption.

Endangered Species Assessment

The Agency has developed the Endangered Species Protection Program to identify pesticides whose use may cause adverse impacts on endangered and threatened species, and to implement mitigation measures that address these impacts. The Endangered Species Act requires federal agencies to ensure that their actions are not likely to jeopardize listed species or adversely modify designated critical habitat. To analyze the potential of registered pesticide uses to affect any particular species, EPA puts basic toxicity and exposure data developed for REDs into context for individual listed species and their locations by evaluating important ecological parameters, pesticide use information, the geographic relationship between specific pesticide uses and species locations, and biological requirements and behavioral aspects of the particular species. This analysis will take into consideration any regulatory changes recommended in the RED that are being implemented at this time. A determination that there is a likelihood of potential impact to a listed species may result in limitations on use of the pesticide, other measures to mitigate any potential impact, or consultations with the Fish and Wildlife Service and/or the National Marine Fisheries Service as necessary.

The Endangered Species Protection Program as described in a Federal Register notice (54 FR 27984-28008, July 3, 1989) is currently being implemented on an interim basis. As part of the interim program, the Agency has developed County Specific Pamphlets that articulate many of the specific measures outlined in the Biological Opinions issued to date. The Pamphlets are available for voluntary use by pesticide applicators on EPA's website at www.epa.gov/espp.

The preliminary risk assessment for endangered species indicates that 2,4-D exceeds the endangered species LOCs for the following combinations of analyzed uses and species:

- Use of 2,4-D DMAS in weed control through direct subsurface application to water bodies results in an exceedance of the endangered species LOC for freshwater and estuarine fish, and estuarine invertebrates. However, there are currently no endangered estuarine/marine invertebrates.

- Use of 2,4-D BEE in weed control through direct subsurface application to water bodies results in exceedances of the endangered species LOC for freshwater fish and invertebrates and estuarine fish.

- Use of 2,4-D acid and amine salts in rice paddies result in exceedances of endangered species LOCs for freshwater invertebrates. **The rice model used to predict these EECs is a screening level model which predicts concentration in tailwater at the point of release from the paddy. It is anticipated that once released, the concentration will be reduced and subsequently, these RQs will decrease**.

- The scenario of the direct application to water for weed control for the acid and amine salts indicates a endangered species concern for aquatic vascular plants. Use of 2,4-D BEE for direct application to water for weed control results in exceedances of all LOCs for both vascular and non-vascular plants. Potential risk to endangered non-vascular plants is not evaluated because at this time there are no listed endangered nonvascular plant species.

- Acute RQs for birds and mammals were exceeded for endangered species risks for multiple crops and multiple animal weights. Banded and granular applications result in higher RQs at more use sites.

- Acute LOCs for both non endangered and endangered plants were exceeded for non-granular and granular for multiple uses.

The Agency's level of concern for endangered and threatened freshwater fish and invertebrates, estuarine invertebrates, birds, mammals, aquatic vascular plants, and terrestrial non-target plants is exceeded for the use of 2,4-D. The Agency recognizes that there are no Federally listed estuarine/marine invertebrates. The registrant must provide information on the proximity of Federally listed freshwater vascular plants, birds, mammals, and non-target terrestrial plants (there are no listed estuarine/marine invertebrates) to the 2,4-D use sites. This requirement may be satisfied in one of three ways: 1) having membership in the FIFRA Endangered Species Task Force (Pesticide Registration [PR] Notice 2000-2); 2) citing FIFRA Endangered Species Task Force data; or 3) independently producing these data, provided the information is of sufficient quality to meet FIFRA requirements. The information will be used by the OPP Endangered Species Protection Program to develop recommendations to avoid adverse effects to listed species.

IV. Environmental Fate Assessment

EFED proposed an environmental fate strategy in the 1988 Registration Standard for bridging the degradation of 2,4-D esters and 2,4-D amine salts to 2,4-D acid. The bridging data provides information on the dissociation of 2,4-D amine salts and hydrolysis of 2,4-D esters included in the risk assessment. The bridging data indicate esters of 2,4-D are rapidly hydrolyzed in alkaline aquatic environments, soil/water slurries, and moist soils. The 2,4-D amine salts have been shown to dissociate rapidly in water. However, 2,4-D esters may persist under sterile acidic aquatic conditions and on dry soil. These bridging data indicate under most environmental conditions 2,4-D esters and 2,4-D amine will degrade rapidly to form 2,4-D acid.

Additional data submitted subsequent to establishment of the environmental fate bridging strategy generally support the strategy for the amine salts. Direct evidence of the stability of 2,4-D amine salts in soil and aquatic environments is difficult due to the lack of analytical methods. Based on maximum application rates for 2,4-D amine salts (at 4 lbs ae/A), 2,4-D amine salts are expected to fully dissociate in soil environments because their theoretical concentrations in soil solution does not exceed water solubilities. Additionally, dissociation studies indicate the time for complete dissociation is rapid (less than 3 minutes). Although the analytical methods in the field studies for 2,4-D DMAS were not capable of separating and identifying 2,4-D DMAS from 2,4-D acid, the most conservative half-lives of 2,4-D DMAS would be equivalent to the 2,4-D acid half-lives in field studies. Half-lives of 2,4-D in 2,4-DMAS field studies ranged from 1.1 days to 30.5 days with a median half-life of 5.6 days.

The de-esterification of 2,4-D esters is more difficult to generalize because it is dependent on heterogenous hydrolysis (microbial-mediated and surface-catalyzed hydrolysis) and homogenous hydrolysis (alkaline catalyzed) (Schwarzenbach, et al.1993). The deesterification of 2,4-D ester leads to formation of 2,4-D acid and an associated alcohol moiety. Unlike the physical dissociation mechanism of 2,4-D amine salts, the de-esterification of 2,4-D esters is dependent on abiotic and microbial-mediated processes. Any environmental variable influencing microbial populations or microbial activity could theoretically influence the persistence of the 2,4-D ester. Soil properties including clay mineralogy, organic carbon content, temperature, and moisture content are known to influence hydrolysis rates (Wolfe, et al, 1989 and Wolfe, 1990).

Paris, et al (1981) found the average de-esterification half-life of 2,4-D BEE in natural waters from 31 sites with varying temperature and pH conditions (5.4 to 8.2) was 2.6 hours. They found that 2,4-D BEE degradation could be explained using second-order kinetics accounting for microbial population numbers and aqueous concentration of 2,4-D BEE. Further research indicated second-order de-esterfication rates can be predicted through a linear regression [log $k_b=(0.799\pm0.098)^*$ log $K_{ow}-(11.643\pm0.204)$ $r^2=0.94$] using the octanol:water coefficient (log K_{ow}) as the independent variable.

Additionally, various mineral surfaces (Fe, Al, Ti oxides) have been shown to influence hydrolysis of carboxylate esters (Torrent and Stone, 1994). Abiotic hydrolysis of 2,4-D esters, however, is expected to be more predictable in alkaline environments. Several field studies

show phenoxy herbicide esters are more persistent under extremely dry soil [less than soil wilting point (~15 bars)] conditions (Smith and Hayden, 1980; Smith, 1972; Smith,1976). In moist soils [~50 to 80% field capacity (~0.3 bars)] and soil slurries, phenoxy herbicide esters degraded rapidly (>85% degradation) during a 48 hour incubation period. These hydrolysis studies indicate the alkyl chain configuration affected hydrolysis rates in soils and soil slurries. The iso-octyl ester of 2,4-D (2,4-D EHE) had slower hydrolysis rates when compared to n-butyl and isopropyl esters of 2,4-D. In field studies, Harrison, et al (1993) found no detections of 2,4-D and 2,4-DP esters in runoff water (though detection limits were relatively high at 20 micrograms acid equivalent per liter (ug ae/l) for 2,4-D EHE) from turf sites where 2,4-DP and 2,4-D esters were applied.

Registrant sponsored research indicates the 2,4-D esters (ethylhexyl, isopropyl, butoxyethyl) degrade rapidly (half life less than 24 hours) in soil slurries, aerobic aquatic environments, and anaerobic, acidic aquatic environments. In terrestrial field dissipation studies for 2,4-D EHE, the half-lives for 2,4-D EHE ranged from 1 to 14 days with median half-life of 2.9 days. 2,4-D BEE, applied as granules, degraded rapidly in the water column in aquatic field dissipation studies under alkaline conditions. However, the 2,4-D BEE residues were detected in sediment samples from Day 0 (immediately posttreatment) to 186 days posttreatment. It is unclear whether 2,4-D BEE persistence in sediment is due to the slow release of the granule formulation or to slow deesterification of sediment bound 2,4-D BEE. Available open-literature and registrant sponsored laboratory data would suggest slow granule dissolution prolonged the persistence of 2,4-D BEE. In forest dissipation studies, the 2,4-D EHE ester degraded slowly on foliage and in leaf litter.

The weight of evidence from open-literature and registrant sponsored data indicates that 2,4-D amine salts and 2,4-D esters are not persistent under most environmental conditions including those associated with most sustainable agricultural conditions. 2,4-D amine salt dissociation is expected to be instantaneous (< 3 minutes) under most environmental conditions. Although the available data on de-esterification of 2,4-D ester may not support instantaneous conversion from the 2,4-D ester to 2,4-D acid under all conditions, it does show 2,4-D esters in normal agriculture soil and natural water conditions are short lived compounds (< 2.9 days). Under these conditions, the environmental exposure from 2,4-D esters and 2,4-D amines is expected to minimal in both terrestrial and aquatic environments. Further analysis is required on reason(s) for 2,4-D BEE persistence in sediments from aquatic field studies. Additionally, the persistence of 2,4-D EHE on foliage and in leaf litter from registrant submitted forest field dissipation studies requires additional investigation. No field dissipation data (terrestrial, forest, or aquatic) have been submitted for the amine salts, 2,4-D IPA, 2,4-D TIPA, and 2,4-D DEA, or for the esters 2,4-D BEE (aquatic field dissipation data is available for this chemical form) and 2,4-D IPE to determine their persistence under field conditions

A complete database has been assembled for 2,4-D acid. The dissipation of 2,4-D appears to be dependent on oxidative microbial-mediated mineralization, photodegradation in water, and leaching. 2,4-D is stable to abiotic hydrolysis. Photodegradation of 2,4-D was observed ($t_{1/2}$=12.9 calendar days or 7.57 days of constant light) in pH 5 buffer solution. However, the

2,4-D photodegradation half-life on soil was 68 calendar days. Photodegradates of 2,4-D were identified as 1,2,4-benezenetriol (37% of applied) and CO_2 (25% of applied).

The degradation of 2,4-D was rapid ($t_{1/2}$= 6.2 days) in aerobic mineral soils. Soil degradates were 2,4-DCP and 2,4-dichloroanisol (2,4-DCA). The half-life of 2,4-D in aerobic aquatic environments was 15 days. Degradates in sediment/water test systems were 2,4-dichlorophenol, 4-chlorophenol, 4-chlorophenoxyacetic acid, and chlorohydroquinone. The major volatile degradate in soil and aquatic environments was CO_2. Unidentified radiolabeled residues were detected in non-labile soil organic matter fractions (*e.g.*, fulvic acid, humic acid, and humin). Unaltered 2,4-D was detected in fulvic acid fractions of the soil organic matter.

2,4-D was moderately persistent to persistent ($t_{1/2}$=41 to 333 days) in anaerobic aquatic laboratory studies. Intermediate degradates were 2,4-DCP, 4-chlorophenol , and 2-chlorophenol. Volatile degradates were identified as CO_2, 2,4-DCA, and 4-chlorophenol.

As noted above, several degradates were detected in the laboratory fate studies reviewed. The degradates detected were 1,2,4-benzenetriol, 2,4-DCP, 2,4-DCA, chlorohydroquinone (CHQ), 4-chlorophenol, Volatile Organics, Bound residues, and Carbon Dioxide. 1,2,4-benzenetriol is a photodegradate which was observed under abiotic conditions and is less likely to occur under natural conditions where microbially- mediated degradation occurs. The MARC has determined that these degradates are not of concern, therefore, no degradates were included in the drinking water assessment.

2,4-D has a low binding affinity (K_{ad} < 3 and K_{de} < 1) in mineral soils and sediment. The mobility of 2,4-D in supplemental soil thin layer chromatography (TLC) studies was classified as intermediately mobile (R_f=0.41) to very mobile (R_f=1.00) in "sieved" mineral soils. Aged radiolabeled residues of 2,4-D appeared to be immobile in supplemental soil column studies. 2,4-D was studied in sandy loam, sand, silty clay loam and loam soil. Freundlich K_{ads} values were 0.17 for the sandy loam soil, 0.36 for the sand soil, 0.52 for the silty clay loam soil, and 0.28 for the loam soil. Corresponding K_{oc} values were 70, 76, 59 and 117 mL/g. 2,4-DCP had freundlich K_{ads} values were 2.0 for the sandy loam soil, 1.7 for the sand soil, 3.3 for the silty clay loam soil, and 2.9 for the loam soil. Corresponding K_{oc} values were 821, 368, 374 and 1204 mL/g. 2,4-DCA had freundlich K_{ads} values of 1.6 for the sandy loam soil, 2.1 for the sand soil, 5.4 for the silty clay loam soil, and 3.5 for the loam soil. Corresponding K_{oc} values were 667, 436, 616 and 1442 mL/g.

In order to address the field behavior of 2,4-D under actual use conditions, 15 terrestrial field dissipation studies were conducted using 2,4-D DMAS and 15 terrestrial field dissipation studies were conducted using 2,4-D EHE. No terrestrial field dissipation studies were conducted using 2,4-D IPA, 2,4-D TIPA, 2,4-D DEA, 2,4-D BEE, or 2,4-D IPE. Field studies were conducted using 2,4-D DMAS on bareground, pasture, corn, turf, and wheat. Field studies were conducted using 2,4-D EHE on bareground, pasture, corn, turf, and wheat to represent major uses of 2,4-D. In addition, three aquatic field dissipation studies and one forest field dissipation study were conducted using 2,4-D DMAS, while two forest field dissipation studies were

conducted using 2,4-D EHE. An additional aquatic dissipation study was conducted using 2,4-D BEE.

The registrant conducted a total of 30 terrestrial field dissipation studies in CA, CO, NC, ND, NE, OH and TX on bareground plots as well as plots cropped to corn, pasture, turf and wheat (see Figure1 for locations relative to 2,4-D use). The first-order 2,4-D acid half-lives ranged from 1.1 days to 42.5 days with a median half-life of 6.1 days. These half-lives reflect dissipation from the surface soil layer (0 to 6 inches) and do not include residues which have leached below the surface layer. The data indicate a rapid to moderately rapid dissipation rate for 2,4-D acid. Dissipation rates for 2,4-D degradation products (2,4-DCP and 2,4-DCA) were not estimated because of their sporadic occurrence patterns in surface soils. The results of this study are also consistent with half-lives from laboratory studies. Results from laboratory studies indicate rapid to moderately rapid degradation under aerobic soil conditions with half-lives ranging from 1.4 days to 12.4 days with a median half-life of 2.9 days.

EFED believes that little information on the behavior of 2,4-D DMAS and 2,4-D EHE will be gained from the submission of additional field dissipation studies. Sufficient data has been presented that demonstrates 2,4-D has a moderate to high potential for soil mobility under normal agricultural practices. 2,4-D residues were detected below a depth of 18 inches in eleven of the terrestrial field dissipation studies reviewed and was detected below 30 inches in five studies (MRID 43914701, 43762402, 43831703, 43849101, and 43872702). Leaching appears to be a route of dissipation when precipitation or irrigation exceed evapotranspiration demands. NAWQA data reported maximum 2,4-D concentrations in surface and groundwater of 15 and 14.8 ug ae/L, respectively. It should be noted that the next highest concentration detected in the NAWQA groundwater data is 4.54 ug ae/L while the highest concentration detected in drinking water derived from groundwater reported in the US EPA Office of Water's NCOD is 8 ug ae/L.

EFED conducted comparative analysis of all 2,4-D acid half-lives estimated from the 30 field dissipation studies reviewed. Comparisons were done between granular formulations versus concentrates, between bare soil and cropped fields, and between the 2,4-D acid half lives from studies conducted with 2,4-D DMAS and 2,4-D EHE forms separately. Each analysis is discussed below and all half lives are for 2,4-D acid.

- Comparison of descriptive statistics for the granular versus concentrate half-lives suggests that the granular applications will result in longer half-lives than the concentrate forms. The granular half-lives ranged from a maximum of 24.6 days to a minimum of 5.1 days with a median half-life of 11.9 days, while the concentrate form had half-lives ranging from a maximum of 42.5 days to a minimum of 1.1 days with a median half-life of 5.5 days. The median granular half-life is approximately twice the concentrate form suggesting a longer half-life.

- Comparison of descriptive statistics for the bare soil half-lives versus cropped plot half-lives suggests that there is no appreciable difference in dissipation rates based on the presence of plants (including turf). The bare soil half-lives ranged from a maximum of

42.5 days to a minimum of 1.1 days with a median half-life of 5.1 days, while the cropped half-lives ranged from a maximum of 39.2 days to a minimum of 2.2 days with a median half-life of 7.8 days.

- Comparison of descriptive statistics for the 2,4-D acid half lives determined when applying 2,4-D DMAS versus the applying 2,4-D EHE chemical form suggests that there is no appreciable difference in dissipation rates between 2,4-D DMAS and 2,4-D EHE forms. The 2,4-D acid half-lives from the 2,4-D DMAS studies ranged from a maximum of 30.5 days to a minimum of 1.1 days with a median half-life of 5.6 days, while the 2,4-D acid half lives from studies using the 2,4-D EHE form had half-lives ranging from a maximum of 42.5 days to a minimum of 1.2 days with a median half-life of 6.2 days.

In order to address the behavior of 2,4-D in aquatic water systems a series of aquatic field dissipation studies were conducted. Three studies were conducted using 2,4-D DMAS while a fourth study was conducted using 2,4-D BEE. Two additional dispersion and dissipation studies using 2,4-D DMAS were recently submitted and are currently under review.

In three supplemental aquatic field dissipation studies conducted in North Dakota, North Carolina, and Louisiana 2,4-D DMAS immediately converted to 2,4-D acid. EFED estimated a 2,4-D half life in water from the North Carolina pond after the first application of 20.4 days and after the second application of 2.7 days. EFED estimated a half life of 2,4-D in water from the North Dakota pond after the first application of 14.0 days and after the second application of 6.1 days. EFED estimated a half life in water from the Louisiana rice paddy after the single application of 1.0 day. The aquatic dissipation studies for 2,4-D DMAS confirm that 2,4-D DMAS quickly converts to 2,4-D acid and dissipates rapidly from the water column.

In addition, the 2,4-D Task Force recently submitted two dispersion and dissipation studies for the application of 2,4-D DMAS to control aquatic weeds. The first study was for the surface application of 2,4-D DMAS to a lake in Lake Woodruff, Florida for the control of water hyacinth. This study is currently under review, however, a summary of the results is presented below along with the previously reviewed studies. In this study, 2,4-D DMAS was surface applied at a rate of 3.8 lbs ae/acre to approximately 3.9 acres within an overall water body of 2200 acres. The highest single concentration detected was 270 ug ae/l at three hours after application within the application area. The highest concentration detected outside the application area was 122 ug ae/l approximately 18.4 meters from the application area. The study authors calculated a dissipation half life for 2,4-D from the application area of 2.3 days, however, this half life does not distinguish between degradation, sorption, and transport away from the application area.

In the second dispersion and dissipation study, 2,4-D DMAS was applied by subsurface injection to a water body located in Green Lake, Minnesota for the control of Eurasian watermilfoil. 2,4-D was applied as 2,4-D DMAS by subsurface injection at a rate of 10.8 pounds of acid equivalent per acre-foot (lbs ae/acre-foot) to achieve a target concentration in the application area of 4 parts per million (ppm). 2,4-D DMAS was applied on September 11, 2002 to

approximately 4.5 acres with a dense stand of Eurasian watermilfoil. Green Lake is located in Chisago County, Minnesota and is a 1714 acre lake and is reportedly a "low-flow" lake. The study authors report that the location, test site (static to low-flow lake) and application method were chosen because they represent a typical use pattern for 2,4-D DMAS. The highest single concentration detected was 13,193 ug ae/l at one hour after application within the application area. The highest concentration detected outside the application area was 3374 ug ae/l approximately immediately outside the application area. The furthest detection of 2,4-D outside the application area greater than the MCL was on day 11 at 82.3 ug ae/l while the furthest concentration detected above the LOQ was 1605 meters. The study authors calculated a dissipation half life for 2,4-D from the application area of 3.23 days, however, this half life does not distinguish between degradation, sorption, and transport away from the application area.

In a supplemental study, the aquatic field dissipation of 2,4-D BEE was studied in ponds in North Carolina, Minnesota and Washington. A single aquatic field dissipation study conducted on three separate ponds was submitted for 2,4-D BEE. All three ponds used in this study were alkaline (pH ranged from 7.9 to 8.1). As noted in the environmental fate assessment, the esters of 2,4-D convert to 2,4-D acid by abiotic hydrolysis however, the rate is pH dependent. 2,4-D BEE was detected in water and sediment in these studies, however 2,4-D BEE was not present for a sufficient time to estimate half lives in water. Half lives for 2,4-D acid in water from the three ponds ranged from 2 to 40 days, while the half lives of 2,4-D acid in sediment ranged from 5 to 29 days. EFED also estimated half-lives in sediment from the North Carolina pond of 9.6 days for 2,4-D BEE and 80.5 days for the degradate 2,4-DCP. Data from this aquatic field dissipation study in granular form in the North Carolina pond suggest that the granular formulation of BEE is more persistent than the DMAS chemical form. The maximum concentration detected of 2,4-D acid in water was 2,700 ug ae/l at 15 days post-treatment from the North Carolina site.

Additional data on the behavior of 2,4-D BEE in aquatic systems was submitted in a supplemental anaerobic aquatic metabolism study. Radiolabeled 2,4-D BEE, at 7 ug/g, had a first-order half-life of 14.4 hours in a strongly acidic, rice paddy water and sediment test system. The major degradate of 2,4-D BEE was 2,4-D. The degradate 2,4-D was stable during a 12 month incubation period. Unidentified residues were also detected (<4% of applied) in sediment and water samples. The reported results suggest that 2,4-D BEE should not persist in acidic, anaerobic aquatic environments.

Finally, four aquatic field dissipation studies were previously submitted and reviewed which provide additional information on the behavior of 2,4-D in field environments. These studies were submitted and reviewed previously as part of the Registration Standard issued in 1988. These studies provided supplemental data on the aquatic field dissipation and accumulation in non-target organisms of 2,4-D DMAS and 2,4-D BEE. 2,4-D acid, formulated as Weedar 64 and applied at 20 and 40 lb/A, had a field dissipation half-life of < 3 days in reservoirs at Banks Lake, Washington and Fort Cobb, Oklahoma. In the Rock Ranch canal and the Cherry Creek lateral 2,4-D had half-life of < 133 minutes for locations 7 miles downstream from the application site. In the Guntersville reservoir on the Tennessee River amended with 2,4-D

DMAS at 20 and 40 lb/A, the water concentration of 2,4-D was 4.8 ug/ml at 8 hours posttreatment and declined to <0.11 ug/ml at 6 months posttreatment. In two ponds, a bayou, a lagoon, and a lake (located in Louisiana) amended with 2,4-D DMAS at 1, 4, or 10 lbs/A, 2,4-D "residues" had a dissipation half-life of < 14 days. The concentration of 2,4-D residues at 7 days posttreatment ranged from 8 to 999 ug/l and then declined to 1 to 45 ug/l at 28 days posttreatment.

In order to address the behavior of 2,4-D in forest systems two forest field dissipation studies were conducted. One study was conducted using 2,4-D DMAS while the second was conducted using 2,4-D EHE. In a supplemental forest field dissipation study in Oregon, 2,4-D DMAS also converted rapidly to 2,4-D acid. Parent 2,4-D DMAS broadcast applied as a spray (by helicopter) at a nominal rate of 4.0 lb a.e./A onto a forest plot of loam soil planted with fir trees, dissipated with EFED estimated half-lives for 2,4-D acid using linear regression of log transformed data (mean concentrations of data from 0 to 6 inches collected through 398 days) of 59 days ($r^2 = 0.74$) in exposed soil, 68 days ($r^2 = 0.63$) in protected soil, 42 days ($r^2 = 0.81$) on foliage, and 72 days ($r^2 = 0.82$) on leaf litter. In a supplemental forest field dissipation study in Georgia, parent 2,4-D EHE was broadcast applied as a spray at a nominal rate of 4.0 lb a.e./A to a forested plot of sandy clay loam soil in Georgia. EFED attempted to estimate half-lives of 2,4-D and 2,4-D EHE in soil (exposed and protected) using linear regression of log transformed data (mean concentrations of data from 0 to 6 inches collected through 398 days), however, the half-lives of 2,4-D acid in soil are questionable due to variability in the data. EFED estimated half-lives in foliage for 2,4-D of 32.5 days ($r^2 = 0.80$) and for 2,4-D EHE of 32.7 days ($r^2 = 0.51$). EFED estimated half-lives in leaf litter for 2,4-D of 51.7 days ($r^2 = 0.55$) and for 2,4-D EHE of 50.5 days ($r^2 = 0.53$).

A series of fate studies were submitted for the moieties of various chemical forms of 2,4-D. These moeities included dimethylamine (DMA), isopropylamine (IPA), triisopropylamine (TIPA), diethanolamine (DEA), ethylhexyl ester (EHE), butoxyethanol (BEE), and isopropanol (IPE). Fate studies were conducted for aerobic soil metabolism, aerobic aquatic metabolism, and anaerobic aquatic metabolism. The studies indicated that under aerobic soil conditions DMAS degraded with half-lives between 4 and 14 days, EHE degraded with a half-life of 5.3 hours, IPA degraded with half-lives between 11.8 to 18.2 hours, TIPA degraded with half-lives between 0.9 to 1.6 days, BEE degraded with half-lives between 13.3 to 35.5 hours, DEA degraded with half-life of 1.7 days, and IPE degraded with half-life of 0.9 hours. The studies indicated that under aerobic aquatic conditions DMAS degraded with half-lives between 2.8 days, IPA degraded with half-life of 21.6 hours, TIPA degraded with half-life of 14.3 days, BEE degraded with half-lives between 0.6 to 3.4 days, DEA degraded with half-life of 5.8 days, and IPE degraded with half-life of 13 hours. Finally, the studies indicated that under anaerobic aquatic conditions DMAS degraded with half-life of 1732 days, EHE degraded with a half-life of 15.3 days, IPA degraded with half-life of 408 days, TIPA degraded with half-life of 15.3 days, BEE degraded with half-life of 1.4 days, DEA degraded with half-life of 10.9 days, and IPE degraded with half-life of 14.55 days. These data suggest that degradation products of 2,4-D moeities should not accumulate under normal agricultural conditions.

A detailed assessment of 2,4-D's environmental fate is given in Appendix A

Atmospheric Transport of 2,4-D

The process by which pesticides may be transported away from the target site include spray drift at the time of application and volatilization. Spray drift has been well studied and the Agency spray drift exposure assessment is considered in EFEDs risk assessment models. However, transport after volatilization is not as well studied and the impact of the potential transport of 2,4-D esters away from the target site is not included quantitatively in this assessment.

Much evidence reported in open literature suggests concern for impact to non-target organisms due to drift and volatilization of the ester forms of the phenoxy herbicides. The state of Florida passed the Organo-Auxin Herbicide Rule which restricts the use of highly volatile esters based on concerns over volatility, however, these banned esters are high volatility esters and do not include 2,4-D EHE and BEE (email from Dale Dubberly, Florida Department of Agriculture and Consumer Services, dated August 12, 2003). Other states have similarly banned or restricted the use of certain phenoxy herbicides including esters while other states have issued warnings on the use of phenoxy herbicides particularly under dry moisture conditions and warmer temperatures (Feitshans, T.A. 1999). Finally, the Association of American Pesticide Control Officials (AAPCO) report in the 1999 Pesticide Enforcement Survey (http://aapco.ceris.perdue.edu/doc/surveys/drift99.html) that 2,4-D is the most commonly confirmed active ingredient by state agencies as regards to drift complaints. However the survey does not distinguish between 2,4-D chemical forms, does not differentiate between drift and volatility, and indicates that the most common confirmation technique is visual examination and residue confirmation.

Data collected in the 1960s and 1970s, and summarized in Majewski and Capel (1995), indicate that 2,4-D has been detected in rainwater samples at concentrations between 50 nanograms per liter (ng/l) and 204000 ng/l, while 2,4-D was detected in air samples at concentrations between 1.15 nanograms per gram (ng/g) and 1410 ng/g. Majewski and Capel noted that the higher concentrations were infrequently detected and the authors also noted that the high detections were located near areas where pesticides were applied and may have resulted from unusual conditions. More recent data reported by Anderson, et. al. (2002) on water and rainfall samples in a wetland environment in Alberta, Canada indicate that 2,4-D was one of the most frequently detected pesticides in rainfall samples with a frequency of detection of 65%, however concentrations did not exceed 1 ug/l. In a study conducted in southern Manitoba by Rawn et al (1999) 2,4-D was detected in rainfall at concentrations less than 1 ug/l and was detected in air as both vapor and particle phase at a maximum concentration of 3500 picograms per cubic meter (pg/m^3). Both rainfall and air detections were closely associated with local use, however the authors noted that the relative contribution of these compartments to surface water was low compared to runoff.

An important consideration resulting from these data is that any analysis of surface water monitoring data cannot distinguish between sources of contamination. In other words, the

analysis of surface water concentrations discussed below cannot distinguish the source of the contaminant whether the source be from runoff, drift, or deposition from rainfall. The reported value likely includes all sources of input into the surface water body and thus the effect of volatilization of 2,4-D in the aquatic exposure scenarios is lessened. However, the impact of volatilization and the potential impact on off-site, non-target terrestrial organisms in unknown and cannot be quantified.

To assess the potential for 2,4-D to partition into various media, EFED performed an estimation of partitioning of 2,4-D acid and 2,4-D EHE with a simple fugacity model in USEPA EpiSuite software. The fugacity model predicts that the relative percentage of 2,4-D acid that will partition into air is 0.37 percent while the relative percentage for 2,4-D EHE is 0.48 percent. The results of the fugacity model suggest that for 2,4-D acid and 2,4-D EHE that volatilization is not predicted to be a major route of exposure. Uncertainties associated with the use of a fugacity model are that partitioning of 2,4-D esters to soil is estimated and that the effect of intercept and volatilization from plant surfaces is not accounted for. These facts could result in an underestimation of the amount partitioning to air.

It is noted that EFEDs current risk assessment does account for spray drift as a process effecting exposure through the use of PRZM/EXAMS and the drift component. However, longer-range transport coupled with volatility and ultimately deposition via rainfall is not accounted for in this assessment and lends additional uncertainty to the risk assessment.

V. Drinking Water Assessment Summary

In accordance with the memorandum dated March 18, 2003 from the SRRD, this drinking water assessment for 2,4-D has used maximum application rates derived from the 2,4-D Master Label rather than from labels for individual products. The 2,4-D Master Label represents all currently registered technical forms of 2,4-D and all data submitted in support of 2,4-D (including esters and amine salts) has been created at these rates. It is an underlying assumption of this drinking water assessment that any labels for formulated products which exceed these maximum application rates will be revised to comply with the Master Label.

Concentrations of 2,4-D to which humans potentially may be exposed through ingestion of drinking water are assessed through an evaluation of surface water and groundwater monitoring data and modeling. Existing 2,4-D monitoring data were evaluated for magnitude and frequency of 2,4-D occurrence. Annual maximum concentrations and frequencies of detection were determined from each data set. In addition, TWAM concentrations were calculated for selected data. In order to augment this monitoring data, an additional set of drinking water exposure assessments were completed using model predictions.

EFED conducted an evaluation of the concentrations of 2,4-D to which humans potentially may be exposed through ingestion of drinking water and included modeling and an evaluation of surface water and groundwater monitoring data. A number of modeling approaches were used to provide EECs for drinking water. The highest exposure scenario is the direct application of 2,4-

D to surface water bodies for the control of aquatic weeds with an EEC of **4000 ug ae/l** for peak (acute) exposure and **627 ug ae/l** for the annual mean (chronic) exposure. Additional modeling was conducted which resulted in lower predicted EECs including a second direct application scenario using an advection/dispersion equation was modeled with a setback distance of 1500 feet which predicted an acute EEC of **811 ug ae/l** and a chronic EEC of **102 ug ae/l**, a rice model which predicted an EEC of **1431 ug ae/l**, and PRZM/EXAMS modeling of terrestrial uses which predicts acute EECs between **118 ug ae/l** and **6.9 ug ae/l** and chronic EECs between **8.9 ug ae/l** and **1.0 ug ae/l**. 2,4-D is regulated under the SDWA and has a MCL of **70 ug ae/l**, a One-Day HA for children of **1000 ug ae/l**, and a Ten-Day HA for children of **300 ug ae/l**. Maximum concentrations of 2,4-D in the monitoring data reviewed were **58 ug ae/l** in finished drinking water from NCOD and **14.8 ug ae/l** from NAWQA in groundwater. Although higher concentrations are reported in the EPA STOrage and RETrieval System for Water and Biological Monitoring Data (STORET), the highest value reported is higher than that for any other monitoring data and the lack of documentation of QA/QC in STORET limits the ability to confirm the validity of the measurement. The highest median 2,4-D concentration of **1.18 ug ae/l** was derived from finished water samples in the NCOD database. The highest TWAM concentration was **1.45 ug ae/l** from the NAWQA data. Although of high quality, EFED deemed monitoring data non-targeted to 2,4-D use. However, the data provide context to model results and indicate that there is little evidence that concentrations are likely to be found exceeding these standards.

Surface Water and Groundwater Monitoring Data for 2,4-D

Concentrations of 2,4-D to which humans potentially may be exposed through ingestion of drinking water are assessed through an evaluation of surface water and groundwater monitoring data and modeling. 2,4-D monitoring data were available from the USGS NAWQA Program, the EPA STORET, and recently released data from the USGS/EPA Pilot Reservoir Monitoring Study. The data were evaluated for magnitude and frequency of 2,4-D occurrence. Annual maximum concentrations and frequencies of detection were determined from each data set. In addition, TWAM concentrations were calculated for selected data including NAWQA and the USGS Pilot Reservoir Monitoring Study. Finally, the USEPA Office of Water NCOD was reviewed for 2,4-D occurrence data in public water systems (PWS).

2,4-D was detected in both source and finished ground and surface waters. However, EFED has determined that the available monitoring data is non-targeted to 2,4-D use because it was not collected with the intention of capturing maximum acute and chronic 2,4-D concentrations. Targeted monitoring data should be collected with a sampling frequency designed to capture peak runoff events coinciding with a specific pesticide use, with a duration designed to provide sufficient data to estimate long term exposures, and be specifically tailored to the individual geography and crop uses of the target pesticide. The monitoring data used in this assessment, while plentiful and of high quality, was not collected specifically with 2,4-D use in mind and is therefore considered to be non-targeted to 2,4-D use but was used in this assessment for comparison against model predictions. As an example, 2,4-D has been detected in monitoring data from several areas of the country with **58 ug ae/l** from NCOD being the highest value from

all data, however, this detection from NCOD is based on quarterly sampling results. In particular, 2,4-D was detected along the Mississippi River Valley stretching from Louisiana north to Minnesota, in Ohio, Indiana, and Pennsylvania possibly associated with use on corn and wheat, in Florida possibly associated with use on sugarcane, in Washington and Oregon possibly associated with use on wheat, in the Central Valley of California possibly associated with corn, wheat and rice, and scattered locations in Michigan, Texas, Georgia, and Colorado.

Maximum concentrations of 2,4-D in the monitoring data reviewed were **58 ug ae/l** in finished drinking water from NCOD and **14.8 ug ae/l** from NAWQA in groundwater. Although higher concentrations are reported in STORET, the highest value reported is higher than that for any other monitoring data and the lack of documentation of QA/QC in STORET limits the ability to confirm the validity of the measurement. The highest median 2,4-D concentration of 1.18 ug ae/l was derived from finished water samples in the NCOD database. The highest TWAM concentration was **1.45 ug ae/l** from the NAWQA data. It is important to note the MCL and Maximum Contaminant Level Goal (MCLG) for 2,4-D are both **70 ug ae/l**, while the One-Day HA is **1000 ug ae/l** and the Ten-Day HA is **300 ug ae/l**. A summary of the monitoring data is presented in Table 3.

Table 3: Summary of Available Monitoring Data			
Data Source	**Peak Concentration (ug ae/L)**	**Median Concentration (ug ae/L)**	**Time Weighted Mean Concentration (ug ae/L)**
Groundwater			
NAWQA	**14.8**	0.035	NA
NCOD (finished)	8	0.87	NA
STORET	7500*	0.1	NA
Surface Water			
NAWQA	15	0.035	**1.45**
USGS/EPA Reservoir			
Raw Water	0.414	0.077	0.15
Finish Water	0.634	0.077	0.12
NCOD (finished)	**58**	1.18	NA
STORET	330*	0.01	NA

*Maximum values in STORET are not recommended for exposure estimates given uncertainty in data quality. Values reported are for comparison with model estimates and other monitoring data only

In order to augment the existing monitoring data, an additional set of drinking water exposure assessments were completed using modeling predictions.

Surface Water Modeling of 2,4-D using PRZM/EXAMS & EFED Index Reservoir

A drinking water assessment for the use of 2,4-D was performed using Tier II PRZM/EXAMS with an index reservoir (IR) and a percent crop area (PCA) scenario. For a description of the IR/PCA scenarios and the uncertainties associated with these, see the science policy document at the following URL : http://www.epa.gov/oppfead1/trac/science/reservoir.pdf. Table 2 presents the application information for the scenarios modeled using PRZM/EXAMS. Table 4 presents the input parameters for 2,4-D for PRZM/EXAMS, while Table 5 present the EEC for 2,4-D from the scenarios modeled. Fifteen different crop scenarios were modeled using PRZM/EXAMS. These scenarios were chosen to estimate the concentration of 2,4-D in surface drinking water sources over a geographically dispersed range of surface water concentrations modeled in areas representative of heavy 2,4-D use (Northwest, Central Valley of California, Midwest, Great Plains, and Eastern US). Figure 2 presents the location of the fifteen scenarios relative to 2,4-D use information obtained from Thelin and Gianessi, 2000 (USGS Open File Report 00-250). The PRZM/EXAMS scenarios selected for modeling represent all available EFED scenarios for registered 2,4-D uses.

Crops modeled by the Tier II model were sugarcane in Florida, turf in Florida and Pennsylvania, spring wheat in North Dakota, winter wheat in Oregon, corn in Illinois and California, sorghum in Kansas and Texas, soybean in Mississippi, pasture in North Carolina, apples in North Carolina, Oregon, and Pennsylvania, and filberts in Oregon. Typically if available, a PCA factor is applied to PRZM/EXAMS as an adjustment for the percent of crop in the watershed. A default PCA adjustment factor of 0.87 was applied to the EECs for sugarcane, sorghum, pasture, apples, and filberts because a specific PCA factor for these crops was not available. A PCA adjustment of 0.56 was applied to the wheat scenarios, a PCA factor of 0.41 was applied to soybeans, and a PCA adjustment factor of 0.46 was applied to the corn scenarios. It should be noted that there may be instances where a single crop co-occurs with other crops within a watershed (i.e., wheat and turf). In these instances the default PCA of 0.87 is used. The EECs presented below for the scenarios do not capture this co-occurrence and could underestimate concentrations that result from watersheds where other crops to which 2,4-D is applied are present. No PCA adjustment was applied to the turf scenarios thereby indicating that the entire watershed is assumed to grow turf to which 2,4-D is applied.

PRZM/EXAMS surface water modeling predicts **118.0 ug ae/l** for peak 2,4-D acid concentrations, **63.2 ug ae/l** for the 90 day average concentration, **22.6 ug ae/l** for the annual mean concentration, and **8.9 ug ae/l** for the 30 year annual mean concentration. These 2,4-D concentrations are predicted based on the use of 2,4-D on North Carolina apples and are higher than reported monitoring data. These PRZM/EXAMS EECs have been revised relative to the EECs provided in the Drinking Water Memorandum dated May 15, 2003. Subsequent to issuance of the Drinking Water Memorandum EFED added values for the foliar extraction coefficient (FEXTRC) of 0.5 and the same foliar half life of 8.8 days as in the terrestrial assessment (representing the maximum mean value reported from Willis and McDowell, 1987 for total 2,4-D residues using first order kinetics) for PRZM/EXAMS EECs for ecological assessment. In order to maintain consistency in model inputs, the drinking water EECs were revised incorporating these new inputs.

The PRZM/EXAMS model results provide the highest EECs in this assessment for terrestrial uses of 2,4-D. Available monitoring data for 2,4-D are not believed to be targeted to areas or timing of 2,4-D use. The highest concentrations for surface water were derived from the North Carolina apple scenario which has the highest labeled application rate (2 lbs ai/acre twice per year) of the scenarios modeled. The predicted surface water derived drinking water concentrations will vary depending on regional climate, soil, environmental characteristics, and watershed characteristics. These model predictions are approximately two times the peak (acute) concentration of **58 ug ae/l** detected in monitoring data and five times the maximum TWAM concentration of **1.45 ug ae/l**.

Table 4. PRZM/EXAMS Input Parameters for 2,4-D acid			
MODEL PARAMETER	**VALUE**	**COMMENTS**	**SOURCE**
Aerobic Soil Metabolism $t_{½}$	6.2 days [1]	estimated upper 90 th percentile	MRID 00116625 MRID 43167501
Aerobic Aquatic Degradation $t_{½}$ (KBACW)	45 days [2]	estimated upper 90 th percentile	MRID 42045301 MRID 42979201 MRID 44188601
Anaerobic Aquatic Degradation $t_{½}$ (KBACS)	231 days [3]	estimated upper 90 th percentile (3 x anaerobic aquatic metabolism half-life)	MRID 43356001
Aqueous Photolysis $t_{½}$	13 days		MRID 41125306
Hydrolysis $t_{½}$	Stable		MRID 41007301
Koc	61.7 ml/g [4]	Average Koc using all acceptable and supplemental Koc [5]	MRID 42045302 MRID 00112937 MRID 44117901
Molecular Weight	221		Product Chemistry
Water Solubility	569 mg/l	10 x solubility	Product Chemistry
Foliar Extraction (FEXTRC)	0.5	Default Value[5]	
Foliar Half Life (PLDKRT)	8.8 days		Open Literature[6]
Henry's Law Constant	1.02 E-8 torr		Product Chemistry

1 - Upper 90th Percentile based on acceptable aerobic metabolism half lives of 1.44, 2.92, 4.5, 12.4,4.38, 1.99, and 1.7 days.
2 - Upper 90th Percentile based on three times a single half life of 15 days from whole system data.
3 - Upper 90th Percentile based on acceptable anaerobic aquatic metabolism half lives of 333, 6.39, and 41 days.
4 - From all acceptable and supplemental adsorption/desorption data including Koc values of 29.62, 20.22, 52.68, 72.91, 13.23, 104.96, 76.60, 70.83, 116.67, and 59.09
5- From "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002
6- From "Pesticide persistence on foliage" by G.H Willis and L.L. McDowell 1987 from Reviews of Environmental Contamination and Toxicology, Vol. 100, p 23- 73.

Table 5: PRZM/EXAMS EECs for 2,4-D acid in the Index Reservoir with a PCA adjustment				
PRZM/EXAMS Runoff Scenarios	**1/10 Peak Concentration (ug ae/l)**	**1/10 Year 90 Day Average (ug ae/l)**	**1/10 Yearly Annual Concentration (ug ae/l)**	**30 Year Annual Mean Concentration (ug ae/l)**
FL Sugarcane	86.6	30.7	9.3	5.2
FL Turf	43.0	22.8	8.2	3.8
PA Turf	18.8	11.4	5.8	3.9
ND Spring Wheat	8.3	5.0	2.0	1.5
OR Wheat	9.9	6.6	2.4	1.5
IL Corn	18.6	11.0	5.5	3.3
CA Corn	10.1	7.5	3.5	2.4
TX Sorghum	25.0	9.8	2.7	1.3
KS Sorghum	32.0	15.5	5.0	2.4
MS Soybean	14.4	7.7	2.2	1.0
NC Pasture	104.1	58.5	18.9	8.8
NC Apples	**118.0**	**63.2**	**22.6**	**8.9**
OR Apples	14.6	9.9	5.8	3.3
PA Apples	42.9	27.7	12.1	6.5
OR Filberts	6.9	5.5	3.3	2.6

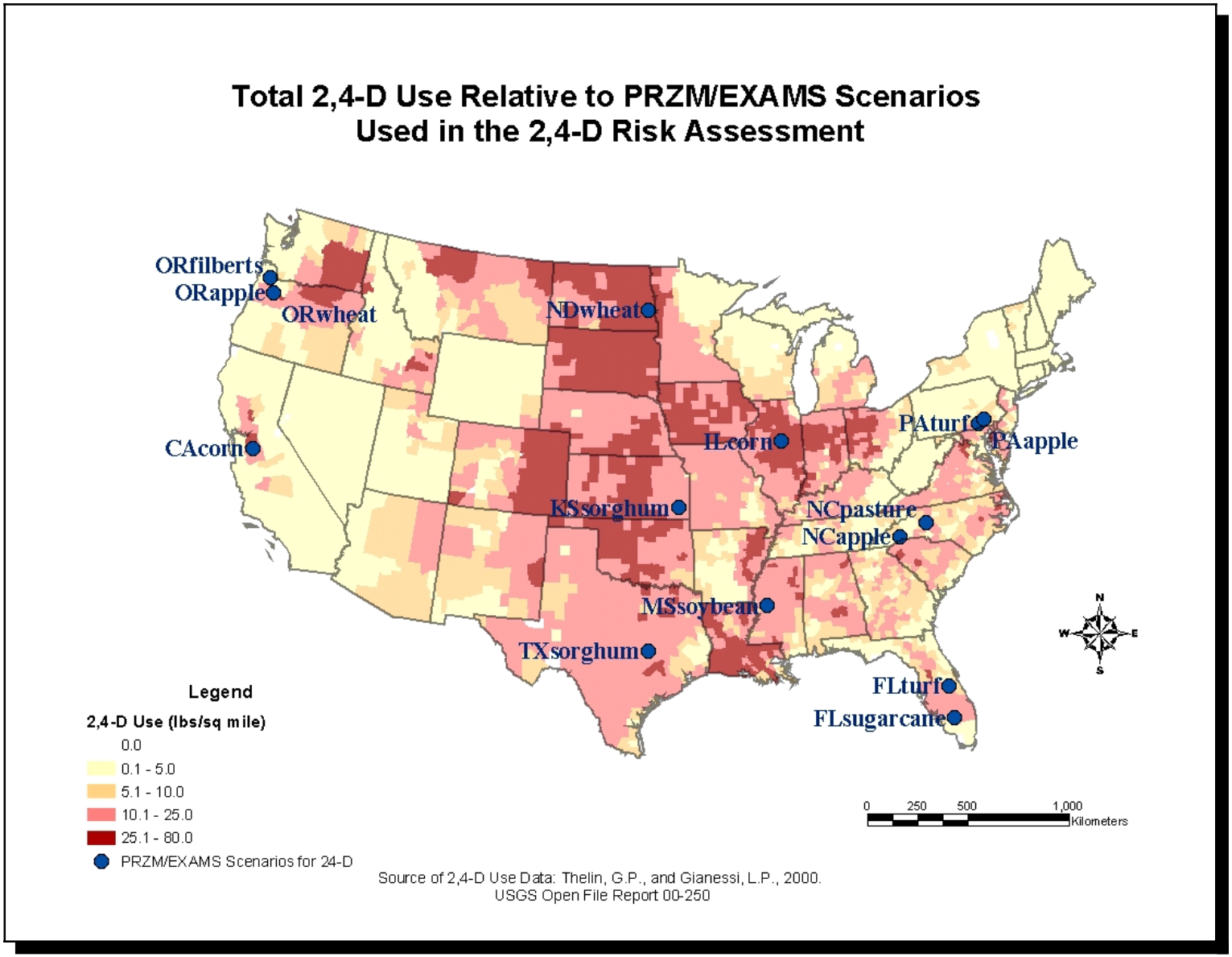


Figure 2. PRZM/EXAMS Scenarios Relative to 2,4-D Use (USGS Open-File Report 00-250)

Modeling of Direct Application of 2,4-D for Control of Aquatic Weeds

To assess potential exposures for aquatic herbicides, a first approximation of a drinking water EEC was modeled assuming direct application to the index reservoir. For this assessment, EFED developed an approach using a simple spreadsheet model that incorporates degradation based on an acceptable aerobic aquatic metabolism study and flow through the Index Reservoir. Each of the scenarios evaluated includes that assumption that 2,4-D is uniformly applied to the index reservoir with a surface area of 5.3 hectares and a volume of 144,000,000 liters. In this model, the 90 day average and annual mean concentrations were calculated assuming first-order dissipation from aerobic aquatic degradation and reservoir flow-through. Reservoir flow-through rates were estimated for all fifteen crop scenarios using PRZM/EXAMS consistent with the EFED policy for developing new Index Reservoir scenarios. See the EFED policy memorandum dated November 16, 1999 *Guidance for Use of the Index Reservoir in Drinking Water Exposure Assessments* located at the following URL:

http://www.epa.gov/oppfead1/trac/science/reservoir.pdf

An integrated equation of first order decay model was used to estimate average concentrations. The equation is C_o / [-k(1-e^{-kt}) / t] where C_o = initial concentration, k = aggregate first-order degradation rate (hr-1), and t = time.

The scenario evaluated with the simple spreadsheet model approach relied on an interpretation of the label for aquatic weed control requiring a target rate for 2,4-D use based on target concentration and not application rate. In order to account for this interpretation it was assumed that 2,4-D would be applied at a rate to meet the target concentration of 2,4-D acid of 4000 ug ae/l. This assumption would be applicable across all water bodies since the target rate is based on a rate 10.8 lbs ae/acre foot (see the 2,4-D Master Label) and would be independent of water body geometry/volume. This scenario included the assumption of uniform application across the entire water body without any setbacks from drinking water intakes. Modeling for this scenario predicts direct water application of 2,4-D will yield surface water concentrations of 2,4-D in reservoir water of **4000 ug ae/l** for peak, **2018 ug ae/l** for the 90 day average, and **627 ug ae/l** for the annual mean.

By way of comparison to this scenario, data from supplemental aquatic field dissipation studies (MRID 43908302, 43954701, and 43491601) confirm that 2,4-D DMAS quickly converts to 2,4-D acid and dissipates rapidly from the water column. However, the high application rates consistent with those used in the direct application model result in peak concentrations in the water bodies of 4800 ug ae/l at day 1 in the North Dakota pond at an application rate of 41.8 lb ae/acre, of 2800 ug ae/l on day 0 in the North Carolina pond at an application rate of 41.8 lb ae/acre, and of 2300 ug ae/l on day 0 in the Louisiana pond at an application rate of 1.8 lbs ae/acre. These concentrations are significantly higher than the MCL for 2,4-D of 70 ug ae/l. These data indicate that at these application rates, the concentrations of 2,4-D in water remained above the MCL until at least 30 days after application (1500 ug ae/l) at the North Dakota pond, until at least 29 days after application (860 ug ae/l) at the North Carolina pond, and until at least

3 days after application (390 ug ae/l) at the Louisiana pond. These concentrations are comparable to those estimated by the direct application model scenario discussed above.

Also, four aquatic field dissipation studies reviewed previously as part of the Registration Standard issued in 1988 provide additional information on the behavior of 2,4-D in field environments. In these studies, 2,4-D (applied as both 2,4-D DMAS and 2,4-D BEE) had reported dissipation half lives between 133 minutes and 14 days with the maximum concentration of 2,4-D acid detected at 4800 ug ae/l in the Tennessee River. In addition, the 2,4-D Task Force recently submitted two dispersion and dissipation studies. In the first study (MRID 45897101) for the surface application of 2,4-D DMAS to control water hyacinth 2,4-D acid, surface applied at 3.8 lbs ae/acre, was detected at a maximum concentration of 270 ug ae/l and was detected over 900 meters downstream from the application area. In the second study (MRID 45931801) for the subsurface application of 2,4-D DMAS to control Eurasian watermilfoil 2,4-D acid, surface applied at 10.8 lbs ae/acre-foot, was detected at a maximum concentration of 13,193 ug ae/l and was detected over 1600 meters downstream from the application area.

A second interpretation of label language for aquatic weed control indicates that in water bodies used for potable water a setback of 1500 feet should be observed and that no 2,4-D will be applied within this zone. To account for the setback restriction on potable water bodies EFED has utilized an interim approach developed by Ian Kennedy (currently with Pesticide Management Regulatory Agency of Health Canada and formerly with EFED) which was utilized for a previous risk assessment of triclopyr for aquatic weed control that utilizes the one-dimensional convection/dispersion equation. The EECs were based on treatment of an area of the index reservoir with a setback distance of 1500 feet and at the maximum application rate of **4000 ug ae/l**.

Estimates were made using the one-dimensional convection-dispersion equation

$$\frac{\partial C}{\partial \tau} = \frac{1}{P}\frac{\partial^2 C}{\partial Z^2} - \frac{\partial C}{\partial Z} - \mu C$$

Using this approach, the predicted peak concentration at a drinking water intake in the EFED index reservoir with a setback of 1500 feet is **811 ug ae/l** 79 days after application while the annual average concentration is **102 ug ae/l**. Application to larger reservoirs could result in higher estimates of exposure.

Modeling of 2,4-D Use on Rice

The use of 2,4-D on rice was modeled using an screening level model developed by EFED. A more complete discussion of the screening level rice model may be found in the EFED policy memorandum dated October 29, 2002. The model involves an assumption of uniform application of pesticide to a rice paddy and calculates an EEC in the water column that could potentially be released from the paddy. The EEC is recommended for both acute and chronic

exposures from 2,4-D use on rice. The model assumes partitioning of the pesticide between water and the upper 1 cm of sediment but does not include degradation. The model uses the following equation:

$$EEC = (10^9 * M_T) / (V_T + m_{sed} * K_d)$$

In this equation M_T is the total mass of pesticide applied in kg per hectare, V_T is the volume of water in the paddy (1,067,000 liter per hectare) assuming a paddy 4 inches deep and includes pore space in a 1 cm interaction zone, m_{sed} is the mass of sediment in the top 1 cm, K_d is the sorption coefficient, and 10^9 is the conversion factor from kilograms to micrograms.

2,4-D is registered for use in rice paddies for the acid and amine salt forms of 2,4-D (esters are not registered for rice use) with a maximum seasonal application rate of 1.5 lbs ae/A. Modeling of this use rate results in an estimated 2,4-D concentration in the rice paddy of **1431 ug ae/l**. This value is expected to represent upper percentile concentrations for edge of paddy concentrations because of the lack of consideration for degradation, dilution and dispersion. However, the exact level of conservativeness has not been fully evaluated in the context of regionally-dependent management practices, pesticide management practices, and universe of pesticide fate properties. Once released from the paddy, the concentrations are expected to decrease due to degradation, dilution and dispersion.

As with the direct application model, the EEC derived by modeling 2,4-D use on rice is higher than concentrations detected in the surface water monitoring data evaluated as part of this assessment. However, analytical results of pond water after the direct application of 2,4-D reported in an aquatic field dissipation study (MRID 43491601) on rice submitted by the registrant indicate that initial concentrations (equivalent to the instantaneous estimate above) were as high as 2343 ug ae/l with a mean concentration reported as 1372 ug ae/l, suggesting that the model estimates are not unreasonable.

EFED has developed a refined screening level model for rice use which incorporates site specific characteristics of rice agriculture and allows for an evaluation of the effect of degradation and holding times for rice paddy water on EECs. The refined screening level model incorporates separate scenarios for Arkansas, California, and Louisiana and incorporates adsorption to sediment, a pre-flood aerobic degradation period, and a post-flood degradation period. Sorption was modeled using Kd of 0.82 (as was the screening level model discussed above) and the pre-flood period is modeled using the aerobic soil metabolism half life of 6.2 days consistent with PRZM/EXAMS modeling while the post-flood period was modeled with the aerobic aquatic metabolism half life consistent with PRZM/EXAMS modeling. EFED conducted a preliminary evaluation of the effect of degradation and holding times on EECs for the use of 2,4-D on rice. As with the previous rice model, this refined model provides a single EEC which represents both an acute and chronic exposure and is an approximation of the EEC at the point of release into a receiving water body. Modeling with all three scenarios predict initial concentrations in the paddy water between **678 ug ae/l** (California) and **762 ug ae/l** (Louisiana) and decreasing concentrations with holding times based on degradation due to aerobic aquatic metabolism.

Groundwater Modeling of Parent 2,4-D

Based on SCIGROW modeling the 2,4-D concentration in ground water is estimated to be **0.0311 ug ae/l**. This model prediction, however, is much lower than maximum 2,4-D concentrations in monitoring data. The maximum 2,4-D concentration in ground water is **14.89 ug ae/l** from data collected by the USGS NAWQA program and **8 ug ae/l** for NCOD. It should be noted that the next highest concentration detected in the NAWQA groundwater data is 4.54 ug ae/l which is consistent with the NCOD reported concentration. Table 6 presents SCIGROW model inputs.

Table 6. SCIGROW Input Parameters

Model Input Parameters	Input Value	Comments	Source
Aerobic Soil Metabolism $t_{1/2}$	6.2 days 2,4-D	Average value	MRID 00116625 MRID 43167501
K_{OC}	13.23 2,4-D	Lowest non-sand value because all Koc exhibit greater than 3-fold variation[1]	MRID 42045302 MRID 00112937 MRID 44117901
Application Rate	2.0 lbs ai/acre	Various	Label 62719-260
Max. Number of Application Per Season	2 applications		Label 62719-260

From "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002

A detailed discussion of available data and modeling for drinking water sources is in Appendix B.

VI. Aquatic Hazard, Exposure, and Risk Assessment

The ecological effects data for the 2,4-D acid and amine salts was pooled, expressed as 2,4-D acid equivalents, and analyzed as a group for fish, aquatic invertebrates, and aquatic plants. This decision was based on the similar toxicities of these compounds and the tendency for the amine salts to rapidly dissociate to the acid form. Most of the comparable toxicity endpoints are within one order of magnitude for these compounds. However, when the acid and amine salts toxicity values are compared to the aquatic toxicity values of the esters, the toxicity of esters tend to be from two to three orders of magnitude greater. In addition, current data indicate that the 2,4-D EHE may not hydrolyze rapidly under abiotic acidic conditions. For these reasons, the aquatic data for the esters have been pooled and analyzed separately from the acid and amine salts. All data reported below are presented in acid equivalents in order to allow for comparison with modeled EECs which are reported in micro grams acid equivalent per liter (ug ae/l) or milligrams acid equivalent per liter (mg ae/l). Conversion of toxicity values to acid equivalents was completed by calculating a ratio of molecular weight of the various chemical forms relative to 2,4-D acid. A summary of all ecological effects data may be found in Appendix C.

Hazard Summary

Toxicity to Fish

Acute toxicity to freshwater or marine fish can be summarized as practically non-toxic for the acid and amine salts and highly toxic for the esters. Toxicities for the acid and amine salts range from a LC_{50} of >80.24 to 2244 milligrams acid equivalent per liter (mg ae/l). The ester toxicities range from a LC_{50} of >0.1564 to 14.5 mg ae/L.

Chronic toxicity, based on length and larval survival from the early life stage studies range from a NOEC of 14.2 to 63.4 mg ae/l for 2,4-D acid, 2,4-D DEA and 2,4-D DMAS. The NOEC based on fish survival for the fish full life cycle studies ranged from 0.0555 to 0.0792 mg ae/l for 2,4-D BEE and 2,4-D EHE.

Toxicity to Invertebrates

Acute toxicity to freshwater aquatic invertebrates ranges from a LC_{50} of 25 to 642.8 mg ae/l for the 2,4-D acid and amine salts. Marine invertebrate LC_{50} s range from 49.6 to 830 mg ae/l. The freshwater toxicities of the esters range from 2.2 mg ae/L for the 2,4-D IPE to 11.88 mg ae/l for the 2,4-D EHE while the marine LC_{50} s range from >0.092 to >66 mg ae/l for the 2,4-D BEE. These toxicities indicate that the esters are more toxic than the acid and amine salts. Even though acute data are missing for some of the amine salts these studies will not be required because none of the RQs exceed the aquatic levels of concern for the acid amine salts.

Chronic toxicity tests were performed on 2,4-D acid, 2,4-D DEA, and 2,4-D DMAS. The toxicity ranged from a NOEC of 16.05 mg ae/l for 2,4-D DEA and 79 mg ae/l for the acid. The chronic freshwater NOEC is 0.20 mg ae/l for the 2,4-D BEE. There are no other freshwater or

marine chronic toxicity data for any of the other esters.

Toxicity to Aquatic Plants

The vascular plant EC_{50} toxicity data for the acid and amine salts range from 0.29 mg ae/1 for 2,4-D DEA to 1.28 mg ae/1 for 2,4-D TIPA. The EC_{50} toxicity data for the more toxic esters range from 0.33 mg ae/1 for 2,4-D EHE to 0.3974 mg ae/1 for 2,4-D BEE. The same trend is shown for the non-vascular plant EC_{50}. The range for the acid and amine salts is 3.88 to 156.5 mg ae/1 for 2,4-D DMA. The range for the esters is 0.066 mg ae/1 for 2,4-D EHE to 19.8 mg ae/1 for 2,4-D EHE. In addition, based on the data available, it appears that the vascular plants are more than 2 orders of magnitude more sensitive than the non-vascular plants. Toxicity to aquatic vascular and non-vascular plants is summarized in the Table 7.

Table 7. Aquatic Plant Toxicity Summary

Sensitivity Range	Vascular Plant Species	EC_{50} / NOEC (mg ae/l)	Non-Vascular Plant Species	EC_{50} / NOEC (mg ae/l)
2,4-D Acid and Amine Salts				
Most Sensitive	Duckweed (*Lemna gibbons*)	0.29 / 0.0476	freshwater diatom (*Navicula pelliculosa*	3.88 / 1.41
Least Sensitive	Duckweeed (*Lemna gibba*)	1.28 / 1.28	Blue green (*flos-aquae anabaena*)	156 / 56.32
2,4-D Esters				
Most Sensitive	Duckweeed (*Lemna gibba*)	0.33 / 0.062	marine algae *Skeletonema costatum*	0.066 / 0.062
Least Sensitive	Duckweeed (*Lemna gibba*)	0.3974 / 0.281	marine diatom *Skeletonema capricornutum*	>19.8 / 2.48

Aquatic plant Tier II studies are required for all low dose herbicides (those with the maximum use rate of 0.5 lbs ai/A or less) and any pesticide showing a negative response equal to or greater than 50% in Tier I tests. The following species should be tested at Tier II: *Kirchneria subcapitata, Lemna gibba, Skeletonema costatum, Anabaena flosaquae,* and a freshwater diatom. *Lemna gibba* is the vascular plant species, and data are available for all active ingredients of 2,4-D except IPA, IPE and Sodium salt. However, a green algae study is available for all active ingredients of 2,4-D except the sodium salt. The data gaps for all the active ingredients of 2,4-D in the aquatic plant toxicity database are summarized in the Table 8."

Table 8. Aquatic Plant Toxicity Data Gaps	
Active Ingredient	**Data Gaps**
2,4-D Acid	None
2,4-D Sodium Salt	No valid data
2,4-D DEA	None
2,4-D DMA	None
2,4-D IPA	Lacks valid data expect green algae
2,4-D TIPA	None
2,4-D BEE	None
2,4-D EHE	None
2,4-D IPE	No valid data except green algae.

Although there are some data missing from the EPA database, EFED believes that the data base is adequate to access risk to aquatic plants.

Reported Aquatic Incidents

The EFED Ecological Incident Information System (EIIS) database reports pesticide incidents which have been voluntarily submitted to the EPA by state agencies. The report assigns a certainty index of 0 (unrelated), 1 (unlikely), 2 (possible) 3 (probable) or 4 (highly probable) to each incident. In addition a judgement of registered use, accidental misuse, intentional misuse, or undetermined is assigned. There was 227 incidents reported for 2,4-D, and 24 of these incidents were reported as aquatic incidents under the 2,4-D acid only. Two incidents were reported as both terrestrial and aquatic.

Among the aquatic incidents 8 were reported as accidental misuse or intentional misuse with a certainty ranging from "possible" to "probable". Nine incidents were reported as undetermined and certainty ranging from "unrelated" to "highly probable", while the remaining seven were recorded as registered uses with the same range of certainty. The two "highly probable" registered uses were applied to corn (#B000150-001) and a railroad right-of-way (# I000925-001). The corn application resulted in bluegill and largemouth bass mortalities in Missouri, while the right-of-way application resulted in a kill of 23,000 (presumably) fish.

One of the two incidents which were recorded as terrestrial/aquatic showed an application to corn in Illinois (#B000150-002) which affected bluegill, catfish, crappie, fox squirrel, greengill, largemouth bass, silver minnow, smallmouth bass, sunfish and watersnake. This incident was "highly probable" and was not listed as a misuse, however, no residue analysis was obtained. The remaining incident was recorded as "possible" and the use was "undetermined". The species affected included bass, catfish, crappie, grass carp, and perch.

Results from these incidents should be regarded with caution since it is not clear exactly which products or tank mixes might be involved. In addition, residue analysis was not available in almost all instances.

Aquatic Exposure

Aquatic EECs for the use of 2,4-D on terrestrial use sites for aquatic ecological exposures were estimated using PRZM 3.12/EXAMS 2.98 employing the standard EFED field pond scenario, a Tier 2 screening model designed to estimate pesticide concentrations found in water at the edge of a treated field. As such, it provides high-end values of the pesticide concentrations that might be found in ecologically sensitive environments following pesticide application.

The aquatic exposure assessment has relied on a combination of monitoring data and modeling. Both Tier I (SCIGROW and screening level models for aquatic uses) and Tier II (PRZM/EXAMS) models have been used to estimate exposure to 2,4-D and it various chemical forms in a variety of exposure scenarios. Uses evaluated with the Tier II model were sugarcane in Florida, turf in Florida and Pennsylvania, spring wheat in North Dakota, winter wheat in Oregon, corn in Illinois and California, sorghum in Kansas and Texas, soybean in Mississippi, pasture in North Carolina, apples in North Carolina, Oregon, and Pennsylvania, and filberts in Oregon. An additional scenario was modeled for citrus in California for comparison with toxicity data for 2,4-D IPE. The Tier II scenarios chosen for this assessment represent all available PRZM/EXAMS scenarios for the labeled uses of 2,4-D and its chemical forms. Although the modeled scenarios only represents a portion of the crops for which 2,4-D has a labeled use, it does represent crops with higher application rates and crops which have a large percentage of their total acreage treated with 2,4-D.

PRZM-EXAMS is a multi-year runoff model that also accounts for spray drift from multiple applications. In the ecological exposure assessment, PRZM-EXAMS simulates a 10 hectare (ha) field immediately adjacent to a 1 ha pond, 2 meters deep with no outlet. The location of the field is specific to the crop being simulated using site specific information on the soils, weather, cropping, and management factors associated with the scenario. Based on historical rainfall patterns, the pond receives multiple runoff events during the years simulated. Additionally, aquatic herbicide uses of 2,4-D were evaluated with a simple screening level model assuming a direct application to the standard pond, potential exposure to drift of 2,4-D esters to aquatic water bodies were evaluated using a simple screening level model, and the rice use was modeled using an EFED screening level tool. Each of these additional exposure scenarios are discussed below. Acute risk assessments are performed using peak EEC values for single and multiple applications. Chronic risk assessments for invertebrates and fish are performed using the average 021-day and 60-day EECs, respectively.

Surface Water Modeling of 2,4-D using PRZM/EXAMS & EFED Standard Pond

Modeling results are the source of the EECs for use in the aquatic exposure assessment. Sixteen different crop scenarios were chosen to estimate the concentration of 2,4-D in surface water over a geographic range of areas representative of where 2,4-D is heavily used (Midwest, Great Plains, and Eastern US). Input parameters for PRZM/EXAMS modeling of 2,4-D acid for aquatic exposure (see Table 4 above) were selected according to current EFED guidance. Predicted EECs for 2,4-D acid for use in the ecological assessment are presented in Table 9 for each scenario modeled.

PRZM/EXAMS surface water modeling from use on apples predicts the highest 2,4-D acid concentrations in surface water for ecological assessment are **62.8 ug ae/L** for peak, **55.1 ug ae/L** for the 21-day average concentration, and **45.4 ug ae/L** for the 60-day average. The predicted 2,4-D concentrations in surface water are slightly higher than reported monitoring data. The modeling predictions are expected to indicate upper bound concentration ranges for 2,4-D. Model input and output files for the ecological assessment may be found in Appendix D.

Table 9. PRZM/EXAMS Predicted EECs for 2,4-D acid in Surface Water from Terrestrial Uses for Ecological Assessment.			
	1 in 10 year Concentration (ug ae/L)		
Crop and Location	**Peak**	**21 Day Average**	**60 Day Average**
FL Sugarcane	42.4	38.4	31.7
FL Turf	24.5	21.7	17.3
PA Turf	8.1	7.2	6.0
ND Spring Wheat	7.6	6.8	5.5
OR Wheat	9.0	8.4	7.5
IL Corn	21.2	19.7	16.1
CA Corn	9.7	8.8	8.2
TX Sorghum	12.1	10.1	7.4
KS Sorghum	16.3	14.3	11.2
MS soybean	15.6	14.6	12.6
NC pasture	54.9	48.4	40.0
NC Apples	**62.8**	**55.1**	**45.4**
OR Apples	12.2	11.2	9.9
PA Apples	25.8	23.5	21.8
OR Filberts	8.8	8.1	7.4

Modeling of Drift of 2,4-D Esters to EFED Standard Pond

EFED established a fate strategy for bridging the fate data requirements for the ester and amine salt forms of 2,4-D to the 2,4-D acid. However, the hydrolysis studies for the 2,4-D esters indicates that ester hydrolysis to 2,4-D acid is pH dependent with no hydrolysis occurring under acid or neutral conditions (as an example 2,4-D EHE hydrolyzes at pH 5 with a half-life of 99 days and the hydrolysis half-life at pH 7 is 48 days, while hydrolysis at pH 9 was 52 hours). This raises the concern of the impact of the drift of the esters of 2,4-D to aquatic environments when spray applied to terrestrial systems. In order to account for the potential impact of the spray application of the 2,4-D esters to aquatic environments, EFED completed an estimation of the drift of 2,4-D esters for each scenario used in the standard aquatic ecological exposure assessment (see above for scenarios). The estimation of drift of 2,4-D esters to the standard aquatic pond was assumed for each scenario assuming 5% spray drift for aerial application and 1% spray drift for ground application (as per EFED guidance). The amount of loading for each scenario was estimated by converting the application rate (determined by reviewing ester labels only) to the drift loading and multiplying the application amount (2.24 kilograms per hectare for pasture) by the drift (5% for aerial application). The resulting loading to the standard pond (0.112 kg to the 1 hectare pond as an example) was converted to an acute concentration by dividing the loading to the standard pond with a surface area of one hectare by the volume of the pond (20,000,000 liters). The resulting concentration represents the maximum instantaneous concentration predicted by direct drift from the application to the pond. Only the peak (acute) EECs for the 2,4-D esters was estimated for each scenario and is presented in acid equivalents. A chronic EEC was not provided in this scenario because the hydrolysis soil slurry data indicate that dissipation in a non-sterile water body will occur at all pHs and therefore long-term exposures are unlikely. Also published literature indicates that 2,4-D esters in natural waters degrade rapidly with an average half life of less than 3 hours. Results of the drift loading of the 2,4-D esters to the standard aquatic pond are presented in Table 10.

Table 10. Acute Only EECs of 2,4-D Ester Forms Only in Surface Water Due to Drift from All Applicable Uses for Ecological Assessment.			
Simulation Scenario			Peak Concentration (ug ae/L)
Crop and Location	Application Method	Application Rate	
FL Turf	Ground Application	2.0 lbs ae/acre	1.1
PA Turf	Ground Application	2.0 lbs ae/acre	1.1
ND Spring Wheat	Aerial Application	1.0 lbs ae/acre	2.8
OR Wheat	Aerial Application	1.0 lbs ae/acre	2.8
IL Corn	Aerial Application	1.0 lbs ae/acre	2.8
CA Corn	Aerial Application	1.0 lbs ae/acre	2.8
TX Sorghum	Aerial Application	0.5 lbs ae/acre	1.4
KS Sorghum	Aerial Application	0.5 lbs ae/acre	1.4
MS soybean	Aerial Application	1.0 lbs ae/acre	2.8
NC pasture	Aerial Application	2.0 lbs ae/acre	5.6
NC Apples	Aerial Application	1.0 lbs ae/acre	2.8
OR Apples	Aerial Application	1.0 lbs ae/acre	2.8
PA Apples	Aerial Application	1.0 lbs ae/acre	2.8
OR Filberts	Aerial Application	1.0 lbs ae/acre	2.8
CA Citrus	Aerial Application	0.21 lbs ae/acre	0.6

Surface Water Modeling of 2,4-D Esters using PRZM/EXAMS & EFED Standard Pond

EFED's strategy for bridging the fate data requirements for the ester and amine salt forms of 2,4-D to the acid form was supported by laboratory data which indicated rapid conversion of the amine and ester forms of 2,4-D to the acid form. However, it was noted at the time of the establishment of the fate strategy that 2,4-D esters may persist under acidic aquatic conditions. A condition of the establishment of the bridging strategy was that terrestrial field dissipation studies should be conducted using 2,4-D DMAS and 2,4-D EHE. Review of the terrestrial field dissipation studies indicate that the study authors reported that 2,4-D DMAS converts rapidly to 2,4-D acid (in many instances conversion occurred in the tank mix), however, it appears the analytical method may not have been able to detect 2,4-D DMAS. However, terrestrial field

dissipation data for 2,4-D EHE indicate that the ester form may persist in the field for several days with half lives ranging between 1 and 14 days with a median half life of 2.9 days. Therefore, in order to account for the potential for runoff during the time in which 2,4-D EHE may remain in the field, EFED conducted additional modeling with PRZM/EXAMS to assess the potential for aquatic organisms to be exposed to 2,4-D EHE when applied to the same terrestrial crops as modeled in the ester drift scenario. In comparison with drift only estimates for 2,4-D EHE, the results of PRZM/EXAMS modeling for 2,4-D EHE did not increase EECs by more than a factor of 2 to 3 with the exception of the Pennsylvania apple scenario which increased the EEC by a factor of 10. Model inputs for modeling of 2,4-D EHE are listed in the Table 11 while the results are presented in Table 12. As with the previous scenario chronic EECs were not generated.

Table 11. PRZM/EXAMS Input Parameters for 2,4-D EHE

MODEL PARAMETER	VALUE	COMMENTS	SOURCE
Aerobic Soil Metabolism $t_{½}$	24 days [1]	estimated upper 90 th percentile	MRID 42059601
Aerobic Aquatic Degradation $t_{½}$ (KBACW)	48 days	½ the aerobic soil metabolism degradation rate	Estimated per EFED Guidance [2]
Anaerobic Aquatic Degradation $t_{½}$ (KBACS)	stable	No data	Estimated per EFED Guidance [2]
Aqueous Photolysis $t_{½}$	128 days		MRID 42749702
Hydrolysis $t_{½}$	48 days		MRID 42735401
Koc	10500 ml/g		Estimated by EpiSuite Software
Molecular Weight	333.26		Product Chemistry
Water Solubility	0.32 mg/l		Product Chemistry
Vapor Pressure	4.57 E-6 mm Hg		Product Chemistry
Henry's Law Constant	5.78 E-5 atm-m3/mole		Product Chemistry

1 - Three times (Upper 90th Percentile) based on single soil half life estimated from acceptable laboratory volatility study of 8 days.
2- From "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002.

Table 12. Acute Only EECs of 2,4-D Ester Forms Only in Surface Water Due to Runoff & Drift from All Applicable Uses for Ecological Assessment.		
Simulation Scenario		**Peak Concentration (ug ae/L)**
Crop and Location	**Application Rate (Label #)**	
FL Turf	2.0 lbs ae/acre	1.6
PA Turf	2.0 lbs ae/acre	1.2
ND Spring Wheat	1.0 lbs ae/acre	2.8
OR Wheat	1.0 lbs ae/acre	2.8
IL Corn	1.0 lbs ae/acre	6.4
CA Corn	1.0 lbs ae/acre	3.4
TX Sorghum	0.5 lbs ae/acre	2.6
KS Sorghum	0.5 lbs ae/acre	1.9
MS soybean	1.0 lbs ae/acre	2.8
NC pasture	2.0 lbs ae/acre	**7.4**
NC Apples	1.0 lbs ae/acre	7.2
OR Apples	1.0 lbs ae/acre	2.9
PA Apples	1.0 lbs ae/acre	6.8
OR Filberts	1.0 lbs ae/acre	3.2
CA Citrus	0.21 lbs ae/acre	0.6

Modeling of Direct Application of 2,4-D for Control of Aquatic Weeds

Because there are no aquatic herbicide model scenarios, a first approximation of an aquatic ecological EEC was predicted assuming direct application to the standard pond. For this assessment, EFED developed a simple spreadsheet model that incorporates degradation based on an acceptable aerobic aquatic metabolism study for the EFED standard pond with no flow. Each of the scenarios evaluated includes that assumption that 2,4-D is uniformly applied to the EFED standard pond with a surface area of 1 hectare and a volume of 20,000,000 liters. In this model, the 21-day average and 60-day average concentrations were calculated assuming first-order dissipation from aerobic aquatic degradation. An equation of first order decay model was used to estimate average concentrations. The equation is Co/-k*(1-e^-k*t)/t where Co=initial concentration, k=first-order aerobic aquatic degradation rate (hr-1), t=time.

The interpretation of the label for aquatic weed control is that the target rate for 2,4-D use is based on concentration and not application rate. In order to account for this scenario it was assumed that 2,4-D would be applied at a rate to meet the target concentration of 4000 ug/l. This assumption would be applicable across all water bodies since the target rate is based on a rate per acre foot of water (10.8 lbs ae/acre foot) and would be independent of water body geometry/volume. This scenario included the assumption of uniform application across the entire water body. Modeling for this scenario predicts direct water application of 2,4-D will yield surface water concentrations of 2,4-D concentrations in the EFED standard pond of **4000 ug ae/l** for peak, **3417 ug ae/l** for the 21-day average, and **2610 ug ae/l** for the 60-day average.

Data from supplemental aquatic field dissipation studies (MRID 43908302, 43954701, and 43491601) suggest that 2,4-D DMAS quickly converts to 2,4-D acid and dissipates rapidly from the water column. However, the high application rates (consistent with those used in the direct application model) result in peak concentrations in the respective water bodies of 4800 ug ae/l at day 1 in the North Dakota pond (application rate of 41.8 lb ae/acre), of 2800 ug ae/l on day 0 in the North Carolina pond (application rate of 41.8 lb ae/acre), and of 2300 ug ae/l on day 0 in the Louisiana pond (application rate of 1.8 lbs ae/acre). The data indicate that at these application rates the concentrations of 2,4-D in water remained above 1500 ug ae/l at 30 days after application in the North Dakota pond, at 860 ug ae/l at 29 days after application in the North Carolina pond, and at 390 ug ae/l at 3 days after application in the Louisiana pond. These concentrations are comparable to those estimated by the direct application model scenarios discussed above.

Also, four aquatic field dissipation studies were previously submitted and reviewed which provide additional information on the behavior of 2,4-D in field environments. These studies were submitted and reviewed previously as part of the Registration Standard issued in 1988. In these studies, 2,4-D (applied as both 2,4-D DMAS and 2,4-D BEE) had reported dissipation half lives between 133 minutes and 14 days with the maximum concentration of 2,4-D acid detected at 4800 ug ae/l in the Tennessee River. In addition, the 2,4-D Task Force recently submitted two dispersion and dissipation studies for the surface application of 2,4-D DMAS to control water hyacinth in Florida (MRID 45897101) and for the subsurface injection of 2,4-D DMAS (MRID

45931801) to control Eurasian watermilfoil in Minnesota. In the Florida study, 2,4-D acid, surface applied at 3.8 lbs ae/acre as 2,4-D DMAS, was detected at a maximum concentration of 270 ug ae/l and was detected over 900 meters downstream from the application area. In the Minnesota study, 2,4-D acid subsurface applied at 10.8 lbs ae per acre-foot of water as 2,4-D DMAS, was detected at a maximum concentration of 13193 ug ae/l one hour after application and was detected 1600 meters downstream from the application area.

EFED evaluated the potential for exposure to 2,4-D BEE using a similar approach. As noted in the environmental fate summary there are data which suggests that 2,4-D BEE (as well as all phenoxy esters) will degrade primarily by pH dependent hydrolysis and will degrade more slowly under abiotic acidic conditions. However, there is evidence from open literature that in natural waters 2,4-D BEE will rapidly hydrolyze to 2,4-D acid. Paris, et al (1989) and Paris, et al (1990) studied the degradation of 2,4-D BEE in natural waters under a range of pH conditions and found an average half life of 2.6 hours. EFED used this half life in a similar manner to the direct application screening level model discussed above and estimated concentrations of 2,4-D BEE in aquatic systems. Modeling for this scenario predicts direct water application of 2,4-D BEE will yield surface water concentrations of 2,4-D BEE concentrations in the EFED standard pond of **624 ug/l** for peak (24 hour average), **30 ug/l** for the 21-day average, and **10 ug/l** for the 60-day average.

By way of comparison to this scenario, data from a supplemental aquatic field dissipation study (MRID 44525001) suggest that 2,4-D BEE quickly converts to 2,4-D acid. The application rates result in peak concentrations of 2,4-D BEE in the respective water bodies of 42.2 ug/l at day 0 in the North Carolina pond (application rate of 200 lb ai/acre), of 71.1 ug/l on day 1 in the Minnesota pond (application rate of 200 lb ai/acre), and of 14.5 ug/l on day 0 in the Washington pond (application rate of 200 lbs ai/acre). Further evaluation indicates that peak concentrations of 2,4-D acid in the respective water bodies were 2725 ug ae/l at day 15 in the North Carolina pond, of 237 ug ae/l on day 1 in the Minnesota pond, and of 117 ug ae/l on day 0 in the Washington pond. Comparison with the analytical results from this study should be viewed with caution because two of the ponds (Minnesota and Washington) maintained flow through the system and all three ponds were alkaline (pH between 7.9 and 8.1) which has the fastest hydrolysis degradation. Hence, the dissipation time may be faster than in static water bodies or more acidic water bodies.

Modeling of 2,4-D Use on Rice

Finally, the use of 2,4-D on rice was evaluated using a screening level model. 2,4-D is registered for use in rice paddies for the acid and amine salt forms of 2,4-D (esters are not registered for rice use) with a maximum seasonal application rate of 1.5 pounds acid equivalents per acre. Modeling of this use rate results in an estimated 2,4-D concentration in the rice paddy of **1431 ug ae/l**. This value is expected to represent upper percentile concentrations for edge of paddy concentrations because of the lack of consideration for degradation, dilution and dispersion. However, the exact level of conservativeness has not been fully evaluated in the context of regionally-dependent management practices, pesticide management practices, and

universe of pesticide fate properties. Once released from the paddy, the concentrations are expected to decrease due to degradation, dilution and dispersion.

As with the direct application model, the EEC derived by modeling 2,4-D use on rice is higher than concentrations detected in the surface water monitoring data evaluated as part of this assessment. However, analytical results of pond water after the direct application of 2,4-D reported in an aquatic field dissipation study (MRID 43491601) on rice submitted by the registrant indicate that initial concentrations (equivalent to the instantaneous estimate above) were as high as 2343 ug ae/l with a mean concentration reported as 1372 ug ae/l, suggesting that the model estimates are not unreasonable.

EFED has developed a refined screening level model for rice use which incorporates site specific characteristics of rice agriculture and allows for an evaluation of the effect of degradation and holding times for rice paddy water on EECs. The refined screening level model incorporates separate scenarios for Arkansas, California, and Louisiana and incorporates adsorption to sediment, a pre-flood aerobic degradation period, and a post-flood degradation period. Sorption was modeled using Kd of 0.82 (as was the screening level model discussed above) and the pre-flood period is modeled using the aerobic soil metabolism half life of 6.2 days consistent with PRZM/EXAMS modeling while the post-flood period was modeled with the aerobic aquatic metabolism half life consistent with PRZM/EXAMS modeling. EFED conducted a preliminary evaluation of the effect of degradation and holding times on EECs for the use of 2,4-D on rice. As with the previous rice model, this refined model provides an single EEC which represents both an acute and chronic exposure and is an approximation of the EEC at the point of release into a receiving water body. Modeling with all three scenarios predict initial concentrations in the paddy water between **678 ug ae/l** (California) and **762 ug ae/l** (Louisiana) and decreasing concentrations with holding times based on degradation due to aerobic aquatic metabolism.

Risk Quotients

Fish and Invertebrates

As discussed in the surface water modeling section under the standard pond scenario, the 2,4-D amine salts dissociate rapidly to the acid form. Consequently, the toxicity threshold values used in this section were chosen from the most toxic definitive aquatic study available among the 2,4-D acid and amine salts for each class of aquatic animal. Fifteen crop scenarios were chosen to estimate the concentrations of 2,4-D acid in surface water from use on terrestrial crops. The methodology for calculating RQs is presented in Appendix E. **The resulting RQs are presented in detail in Appendix F, and show that acute and chronic LOCs are not exceeded for freshwater and marine fish and aquatic invertebrates.**

The esters, however, generally have higher aquatic toxicity and may not readily hydrolyze to the acid form at pH 7 and lower, and as a consequence, separate modeling scenarios were used for esters. The estimation of drift from the 2,4-D esters was used to calculate the RQs below for aquatic animals. A chronic EEC was not provided in this scenario because it is felt that the

hydrolysis soil slurry data indicate that dissipation in a non-sterile water body will occur at all pHs and therefore, long-term exposures are unlikely and only acute RQs were calculated for each of the scenarios (see Appendix F). **The results from this analysis indicate that acute LOCs are not exceeded for freshwater and marine fish and aquatic invertebrates from the use of 2,4-D EHE.** A similar estimation of drift from the 2,4-D IPE generated a peak water concentration of 0.58 µg/L indicated that LOCs were also not exceeded for the 2,4-D IPE. Finally, an additional scenario was modeled using PRZM/EXAMS for the 2,4-D EHE and the 2,4-D IPE forms due to the concern that terrestrial field dissipation data indicate that the esters may persist in the field for up to 14 days.

A screening level model was used to predict exposure to 2,4-D use for direct application to water for weed control. Separate exposure scenarios were completed for use of 2,4-D DMAS and 2,4-D BEE. As explained in the modeling of direct application of 2,4-D to control aquatic weeds, peak water, 21-day average, and 60-day average concentrations were generated using the first order decay model. The RQs resulting from these concentrations are presented in Table 13 for the most toxic aquatic animal studies from the 2,4-D acid, salts, and amine data. **The resulting RQs exceed the endangered species LOCs for estuarine fish and invertebrates. In addition, the Restricted Use and Endangered Species LOC is exceeded for freshwater invertebrates**. Chronic data are lacking for estuarine/marine fish and invertebrates. However, acute and chronic data are available for freshwater fish and invertebrates. Therefore, a ratio of acute to chronic toxicity was calculated for freshwater fish and a separate ratio was calculated using freshwater invertebrate toxicity data. Each ratio was applied to the acute toxicity data for estuarine/marine fish and invertebrates and a chronic toxicity value was estimated for fish and invertebrates separately. Using this approach the chronic RQs will also be below LOCs.

Table 13: Aquatic Organism Risk Quotient Calculations for 2,4-D Acid and Amine Salts for Aquatic Weed Control.							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Chronic Toxicity Threshold, NOEC (mg ae/L) [1]**	**Peak Water Conc. (mg ae/L)**	**21-day Average Water Conc. (mg ae/L)**	**60-day Average Water Conc. (mg ae/L)**	**Acute RQ[a]**	**Chronic RQ [b]**
Aquatic Weed Control (10.8 lbae per acre foot)							
Freshwater Fish	101	14.2	4.000	3.417	2.610	0.04	0.18
Estuarine fish	80.2	11.2	4.000	3.417	2.610	0.05	0.23
Freshwater Invert.	25	16.4	4.000	3.417	2.610	0.16**	0.20
Estuarine Invert.	49.6	32.4	4.000	3.42	2.61	0.08*	0.11

[1] The ratio of acute to chronic freshwater fish data were used to estimate chronic estuarine/marine fish toxicity data and the ratio of acute to chronic invertebrate data were used to estimate chronic estuarine/marine invertebrate toxicity data

[a] * indicates an exceedance of Endangered Species Level of Concern (LOC).
** indicates an exceedance of Acute Restricted Use LOC.
*** indicates an exceedance of Acute Risk LOC.

[b] + indicates an exceedance of Chronic LOC.

According to the 2,4-D Master Label, in addition to the 2,4-D DMAS form, 2,4-D BEE is used for aquatic weed control, and is formulated as a granular. Assumptions and uncertainties associated with the modeling of 2,4-D BEE for direct application to water bodies is explained in detail in the aquatic exposure section. The first approach to generating these water concentrations was to use the same water concentrations as used above for the 2,4-D acid and amine salts. The resulting RQs for this approach are presented in Table 14. These RQs indicate that all acute LOCs and the chronic LOCs are exceeded for fish and invertebrates. This exceedance is directly related to the high acute and chronic toxicity of the 2,4-D BEE and the exposures generated as a result of labeled directions.

Table 14: Aquatic Organism Risk Quotient Calculations for 2,4-D BEE for Aquatic Weed Control.							
Scenario	**Acute Toxicity Threshold LC_{50} or EC_{50} (mg ae/L)**	**Chronic Toxicity Threshold, NOEC (mg ae/L)**	**Peak Water Conc. (mg ae/L)**	**21-day Average Water Conc. (mg ae/L)**	**60-day Average Water Conc. (mg ae/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Aquatic Weed Control (10.8 lbae per acre foot)							
Freshwater Fish	0.43	0.0600	4.000	3.417	2.610	9.30***	43.50+
Estuarine fish	No data	0.0600	4.000	3.417	2.610	--	43.50+
Freshwater Invert.	4.97	0.2000	4.000	3.417	2.610	0.81***	13.05+
Estuarine Invert.	No data	No data	4.000	3.42	2.61	--	--

[a] * indicates an exceedance of Endangered Species Level of Concern (LOC).
** indicates an exceedance of Acute Restricted Use LOC.
*** indicates an exceedance of Acute Risk LOC.

[b] + indicates an exceedance of Chronic LOC.

By way of comparison, EFED compared screening level EECs for concentrations of 2,4-D BEE in surface water through direct application and toxicity values in active ingredient for 2,4-D BEE. The comparison indicates that there will still be an exceedance of the acute risk LOC for freshwater fish and an exceedance of the acute endangered species LOC for freshwater invertebrates. There are no acute data for 2,4-D BEE for either the estuarine fish or invertebrates. This evaluation suggests no chronic risks for any aquatic organisms although there is no data for 2,4-D BEE for estuarine invertebrates. A summary table for this analysis is presented in Appendix F.

The rice screening level model was used to estimate the water concentrations for the 2,4-D acid and amine salts, and salts. The esters are not registered for use on rice. The RQs are presented in Table 15, and indicate that RQs are only exceeded for endangered species freshwater invertebrates. However, it should be pointed out that there is uncertainty about the data for the estuarine invertebrates. The highest definitive acute toxicity level test was 49.6 mg ae/L. However, another study which only tested to 0.14 mg ae/L. showed no effects, there remains some uncertainty as to what the most toxic acute level might be.

Table 15: Aquatic Organism Risk Quotient Calculations for 2,4-D Acid and Amine Salts for Rice.					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Chronic Toxicity Threshold, NOEC (mg ae/L)**	**Maximum Surface Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Rice (1.5 lbae/A; 1 broadcast or aerial application)					
Freshwater Fish	101	14.2	1.431	0.01	0.10
Estuarine fish	80.2	No data[c]	1.431	0.01	–
Freshwater Invert.	25	16.4	1.431	0.06*	0.09
Estuarine Invert.	49.6	No data[c]	1.431	0.03	--

[a] * indicates an exceedance of Endangered Species Level of Concern (LOC).
** indicates an exceedance of Acute Restricted Use LOC.
*** indicates an exceedance of Acute Risk LOC.

[b] + indicates an exceedance of Chronic LOC.

[c] No chronic studies submitted for estuarine fish or invertebrates.

Aquatic Plants

The toxicity threshold values used for aquatic plants were chosen from the most toxic definitive aquatic plant study available among the 2,4-D acid and amine salts for each class of aquatic plant. **The results indicate that for terrestrial uses no acute LOCs are exceeded, while the aquatic vascular plant endangered species LOCs are only exceeded from use on pasture and apples.**

As previously discussed for fish and aquatic invertebrates EFED used the estimation of drift from the 2,4-D esters to calculate the RQs for aquatic plants. The acute and endangered species RQs are presented in Appendix F. **The results from this analysis indicate that acute and endangered species LOCs are not exceeded for any of the scenarios for the 2,4-D EHE from drift.**

Finally, an additional scenario was modeled using PRZM/EXAMS for 2,4-D EHE and 2,4-D IPE forms due to the concern that terrestrial field dissipation data indicate that the esters persists in the field for up to 14 days. **This scenario added a runoff component to the EECs, and indicate the same results as the drift only ester scenario (i.e. no LOC exceedances for any of the scenarios).** A summary table for this analysis is presented in Appendix F.

The ester scenarios for direct application of 2,4-D to control aquatic weeds, were generated for peak water concentrations using the first order decay model. Since there are no aquatic herbicide model scenarios for direct applications to water, weed control poses special problems. As explained in the modeling of direct application of 2,4-D to control aquatic weeds, peak water concentrations were generated using the first order decay model. The RQs resulting from these

peak concentrations are presented in Table 16 and in Appendix F for the most toxic aquatic plant studies from the 2,4-D acid, salts, and amine data. **The resulting LOCs are exceeded for acute and endangered species for vascular and non-vascular plants.**

Table 16: Aquatic Plant Risk Quotient Calculations for 2,4-D Acid and Amine Salts for Aquatic Weed Control

Scenario	Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)	Endangered Species Toxicity Threshold, NOEC (mg ae /L)	Peak Water Concentration (mg ae/L)	Acute RQ[a]	Endangered Species RQ[bc]
Aquatic Weed Control (10.8 lbae per acre foot)					
Aquatic Vascular Plant (*Lemna gibba*)	0.300	0.048	4	13.33*	83.33**
Aquatic Nonvascular Plant (*Skeletonema costatum*)	3.880	1.400	4	1.03*	2.86**

[a] * indicates an exceedance of Acute Risk LOC

[b] ** indicates an exceedance of Endangered Species LOC.

[c] There are currently no endangered nonvascular plant species

The 2,4-D BEE scenario for weed control for the same concentrations as the 2,4-D acid and amine salts is summarized below. The resulting RQs for this approach are presented in Table 17, and indicate that the LOCs are exceeded for acute and endangered plants. This exceedance is directly related to the high toxicity of the 2,4-D BEE and the exposure generated as a result of labeled directions.

Table 17: Aquatic Plant Risk Quotient Calculations for 2,4-D BEE for Aquatic Weed Control.					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Aquatic Weed Control (10.8 lb ae per acre foot)					
Aquatic Vascular Plant (*Lemna gibba*)	0.4	0.280	4	10.00*	14.29**
Aquatic Nonvascular Plant (*Skeletonema costatum*)	1.02	0.538	4	3.92*	7.43**

[a] * indicates an exceedance of Acute Risk LOC

[b] ** indicates an exceedance of Endangered Species LOC.

[c] There are currently no endangered nonvascular plant species

By way of comparison, EFED compared screening level EECs for concentrations of 2,4-D BEE in surface water through direct application and toxicity values in active ingredient for 2,4-D BEE. The comparison indicates that there will still be exceedances of the acute risk LOC and endangered species LOC for aquatic vascular plants. This evaluation suggests no acute risks for aquatic non-vascular plants.

The rice screening level model was used to estimate the water concentrations for the 2,4-D acid and amine salts, and salts. The esters are not registered for use on rice. The RQs indicate that acute and endangered LOCs are exceeded for aquatic vascular plants. There are no endangered non-vascular plants listed at this time.

Table 18: Aquatic Plant Risk Quotient Calculations for 2,4-D Acid and Amine Salts for Rice.					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered SpeciesToxicity Threshold, NEC (mg ae/L)**	**Maximum Surface Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Rice (1.5 lbae/A; 1 broadcast or aerial application)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	1.431	4.77*	29.81**
Aquatic Nonvascular Plant (*Skeletonema costatum*)	3.88	1.4	1.431	0.37	1.02**

[a] * indicates an exceedance of Acute Risk LOC

[b] ** indicates an exceedance of Endangered Species LOC.

[c] There are currently no endangered nonvascular plant species

Aquatic Organism Risk Assessment

The results of the risk assessment suggest potential concern for aquatic animals and plants primarily for the direct application of 2,4-D and 2,4-D BEE (no other 2,4-D esters are used) to water for aquatic weed control. In addition, there is also the same potential concern for the 2,4-D acid and amine salts for rice use. Potential risk concerns for aquatic animals and plants arise from the fact that available data indicate that the toxicity of the esters is in some cases more than two orders of magnitude more toxic than the amine salts. These toxicity levels combined with screening level exposure values result in LOC exceedances.

In order to characterize the potential risk associated with the direct application of 2,4-D and its chemical forms to water bodies for aquatic weed control EFED conducted a two part evaluation. First, acute exceedances were characterized by evaluating the impact of a reduction in the target application rate for subsurface injection of 2,4-D from 4000 ug/l. For this characterization, a hypothetical target concentration was determined for each set of organisms evaluated in this risk assessment, including aquatic organisms exposed to 2,4-D acid and amine salts, aquatic plants exposed to 2,4-D acid and amine salts, aquatic organisms exposed to 2,4-D BEE, and aquatic plants exposed to 2,4-D BEE. For each scenario a ratio between the calculated RQ and the LOC was conducted and the 4000 ug/l target concentration was adjusted to reflect the concentration below which no exceedance would occur. It should be noted that data from registrant submitted field dissipation studies indicate that isolated concentrations as high as 13000 ug/l have been detected in individual samples collected immediately after application and therefore, estimates of risk based on the target concentration of 4000 ug/l should be tempered by the fact that higher exposures are possible with an associated higher RQ.

The second approach was to characterize the potential chronic risks to aquatic organisms. A chronic risk characterization was not performed for aquatic plants because chronic toxicity data are not available. In order to complete this characterization, EFED compiled all the aquatic dissipation half lives for 2,4-D acid from all registrant submitted studies, including six aquatic field dissipation studies conducted using 2,4-D DMAS, three aquatic field dissipation studies conducted using 2,4-D BEE, two dispersion and dissipation studies using 2,4-D DMAS, a single anaerobic aquatic metabolism study, and a single aerobic aquatic metabolism study. EFED used the screening level model described above for predicting EECs from the direct application of 2,4-D to water bodies. In the previous scenario, EFED estimated dissipation in the screening level model using the single aerobic aquatic half life of 45 days. In the current characterization, EFED created a ranked percentile profile for the half lives from all field and laboratory studies. EFED then used the distribution of half lives to create a distribution of predicted EECs. Table 19 presents a summary of the half lives and predicted EECs used in this characterization.

Table 19 Predicted Concentrations of 2,4-D acid in Aquatic Water Bodies Using a Distribution of Registrant Submitted Aquatic Dissipation Half Lives					
EEC Distribution Percentile	**Peak Concentration (ug ae/l)**	**21 day average Concentration (ug ae/l)**	**60 day average Concentration (ug ae/l)**	**Pond First-Order Half Life (days)**	**Aquatic Dissipation Rate (hrs^{-1})**
max	4000	3352	2485	39.9	0.000724
99th	4000	3313	2413	37.4	0.000773
95th	4000	3098	2050	27.2	0.001061
90th	4000	2768	1590	18.5	0.001563
80th	4000	2487	1278	14.0	0.002063
70th	4000	2249	1060	11.3	0.002555
60th	4000	1410	531	5.5	0.005225
50th	4000	848	300	3.1	0.00927
40th	4000	755	266	2.8	0.010462
30th	4000	623	218	2.3	0.01272
20th	4000	440	154	1.6	0.018047
10th	4000	198	69	0.7	0.040104
5th	4000	117	41	0.43	0.067941
Upper 90th*	4000	2071	920	9.7	0.002978

* estimated using EFED Input Parameter Guidance for estimating upper 90th confidence bound

Risks to Fish

For aquatic organisms exposed to 2,4-D acid and amine salts the highest acute RQ for fish was 0.05 for estuarine fish. This RQ is at the endangered species LOC, therefore the target concentration would need to be only slightly reduced.

The risks quotients are particularly high for fish when 2,4-D BEE is applied as a surface application or subsurface injection for weed control. For aquatic organisms exposed to 2,4-D BEE the highest acute RQ was for freshwater fish at 9.3. In order to reduce this RQ to below the endangered species LOC the target concentration would need to be reduced from 4000 ug ae/l to 430 ug ae/l.

EFED then conducted an evaluation of the potential chronic risks similar to the acute characterization discussed above for the aquatic organisms exposed to 2,4-D BEE. There were no chronic risks based on the use of 2,4-D acid and amine salts and thus no characterization of these chronic risks were necessary. For aquatic organisms exposed to 2,4-D BEE the highest chronic RQ was 43.5 for freshwater and estuarine fish based on a predicted long term EEC of 2610 ppb. In order to reduce the RQ to below the chronic LOC, the long term EEC will need to be below 60 ppb. Evaluation of the predicted EEC distribution (Table 19) indicates that the modeling would need to be conducted using the half life between the 10^{th} percentile half life (0.7 days) with a 60-day EEC of 69 ppb and the 5^{th} percentile (0.43 days) with a 60-day EEC of 41 ppb. Therefore, it appears from this analysis that the chronic exceedance would be predicted by the field dissipation data as well as the models used.

Risks to Invertebrates

The potential risks to aquatic invertebrates are similar to the risks to fish for the use of 2,4-BEE for aquatic weed control, but due to the lower toxicity values RQs are much lower. The acute and chronic levels of concern are exceeded for freshwater invertebrates for aquatic weed control. The acute RQ of 0.81 exceeded the acute LOC, while the chronic RQ was 13.05. Acute and chronic marine invertebrate data are not available for the 2,4-D BEE, and the generation of comparative data would help to reduce the uncertainty of risk to aquatic invertebrates.

For aquatic organisms exposed to 2,4-D acid and amine salts from the direct application to water for aquatic weed control the highest acute RQ was for freshwater invertebrates at 0.13, while the RQ for estuarine invertebrates was 0.08. In order to for this RQ to be below the endangered species LOC for invertebrates the target concentration would need to be 1250 ppb. This target concentration results in EECs for both the freshwater and estuarine invertebrate below the Endangered Species LOC.

Risks to Sediment Dwelling Organisms

The aquatic use of the granular formulation of 2,4-D BEE poses a potential risk to sediment dwelling organisms due to its potential persistence and higher toxicity. Available environmental fate data suggest that the granules sink to bottom of the water column and do not readily dissolve into solution. It is not known at what point this ester is hydrolyzing to the acid form nor what impact the ester granule has on the sediment dwelling organisms. To characterize the risk to these organisms EFED will need toxicity data which demonstrates the measured toxicity of the sediment and the surrounding interstitial water. To obtain this data, studies which follow the EPA protocols resulting from the direct spiking of the sediment, and in which pore (interstitial) water as well as sediment concentrations are measured, would assist in fully evaluating the risks from 2,4-D BEE.

Risks to Aquatic Plants

Using the most toxic definitive aquatic plant study available among the 2,4-D acid and amine salts for each class of aquatic plants it was concluded that aquatic vascular plant endangered species LOCs are only exceeded from terrestrial use on pasture and apples.

For the 2,4-D EHE the results from the ester drift analysis scenario, the acute and endangered species LOCs are not exceeded for any of the scenarios. Additionally, the acute and endangered species levels of concern were not exceeded for the IPE which is only registered for use on citrus.

The direct application to water for weed control for the acid and amine salts indicates potential risk to aquatic vascular plants. **These RQs range from 13.33 for acute risk to 83.33 for endangered species risk**. These potential risks appear to be due to the high sensitivity and toxicity of the aquatic vascular plants.

For 2,4-D BEE used for direct application to water for weed control, all LOCs are exceeded for both vascular and non-vascular plants. The acute RQs of 3.92 and 10 indicate potential acute risk to vascular and non-vascular plants. The RQ of 14.29 indicate a potential risk to endangered vascular plants. Potential risks to endangered non-vascular plants is not evaluated because there are no listed endangered nonvascular plant species. By comparison, the RQs using EECs for 2,4-D BEE as active ingredient derived from the screening level model using a open literature data half life of 2.6 hours results in reduced RQ. However, the analysis still indicates exceedances of the acute LOC for freshwater fish and invertebrates and exceedances of the chronic LOC for freshwater fish and invertebrates and estuarine fish as described above.

The RQs due to rice applications range from 4.77 to 29.81 for aquatic vascular plants. Although the levels of concern for the endangered non-vascular plants are exceeded for endangered species, there are currently no listed endangered vascular plants.

For aquatic vascular and non-vascular plants, there were no exceedances of Acute LOCs for use

of 2,4-D acid and amine salts on terrestrial use sites, however, there were exceedances of the Endangered Species LOC for aquatic vascular plants due to use of 2,4-D on apples and pasture. The highest RQ for Endangered Species was 1.31 for use of 2,4-D on apples based on a maximum application rate of 2.0 lbs ae/acre, however, the average application rate was only 1.21 lbs ae/acre/yr (BEAD QUA). If the modeled application rate was reduced to 1.21 lbs ae/acre for apples, the Endangered Species RQ for the apple scenario would be reduced to 0.79 which is below the LOC.

For the rice use of 2,4-D acid and amine salts, all the calculated RQs were based on maximum labeled application rates. The QUA from BEAD suggests that the average application rates for many crops are considerably less than the modeled maximum application rates. For freshwater invertebrates, the highest RQ was 0.06 based on a maximum application rate of 1.5 lbs ae/acre; however, the average application rate was 0.92 lbs ae/acre/yr (BEAD QUA). If the modeled application rate was reduced to 0.92 lbs ae/acre for rice, the RQ for the rice scenario would be 0.03 which is less than the endangered species LOC for freshwater invertebrates.

For aquatic vascular plants, the highest acute RQ was 4.77 while the highest endangered species RQ was 29.81 based on a maximum application rate of 1.5 lbs ae/acre; however, the average application rate was only 0.92 lbs ae/acre/yr (BEAD QUA). If the modeled application rate was reduced to 0.92 lbs ae/acre for rice, and there was an assumption that the resulting EEC will be reduced linearly, the acute RQ for the rice scenario would be reduced to 2.9 and the endangered species RQ would be reduced to 18.2 which are still exceedances of the respective LOCs.

For aquatic plants exposed to 2,4-D acid and amine salts through the direct application to water bodies for aquatic weed control, the highest acute RQ was for the aquatic vascular plants at 13.33 while the endangered species RQ was 83.33. Evaluating the adjustment needed to the target concentration indicates that the target concentration would need to be reduced to 300 ppb to reduce the acute RQ below the LOC while the concentration would need to be reduced to 48 ppb to be below the Endangered Species LOC. For aquatic plants exposed to 2,4-D BEE the highest acute RQ was for the aquatic vascular plants at 10.00 while the endangered species RQ was 14.29. The target concentration would need to be reduced to 400 ppb to reduce the acute RQ below the LOC while the concentration would need to be reduced to 280 ppb to be below the Endangered Species LOC.

There were no exceedances for any of the non-plant, aquatic organism acute or chronic LOCs due to use of 2,4-D acid and amine salts, or esters on terrestrial use sites, therefore, no refinement is necessary.

Uncertainties in the Aquatic Assessment

There are a number of areas of uncertainty in the aquatic organism risk assessment that merit discussion. These include the following:

1. **There may be differences in the risks from use of 2,4-D BEE if the water concentrations vary according to pH.** Exposure estimates for the direct application of 2,4-D BEE to water bodies for aquatic weed control include a number of uncertainties and assumptions. Under certain conditions the degradation of 2,4-D BEE to 2,4-D acid may be dependent on the pH of the water body. EFED relied on open literature data for a general estimate of the rate of conversion of 2,4-D BEE to 2,4-D acid which may not represent the highest possible exposure. In addition, when 2,4-D BEE is applied in granular form there is a lack of data on the rate at which 2,4-D BEE is released from the granule into sediment and water. These factors lead to uncertainty of the direct application scenario used for evaluating 2,4-D BEE.
2. **This assessment accounts only for exposure of aquatic organisms to 2,4-D, but not to its degradates.** The potential toxicity of degradates of 2,4-D is unknown. The potential toxicity of degradates of 2,4-D is unknown. However, one study was reviewed which derived freshwater quality criteria measured as acute toxicity of 2,4-DCP to nine species of fish and aquatic invertebrates using EPA protocols (Yin et. al., 2002). The toxicity levels ranged from 2.12 to 9.89 mg/L which indicates that the toxicity is greater than the amine salts, but less than the esters. When these toxicity levels are compared to the runoff, direct application, and rice EECs derived from the drinking water assessment, the resulting risk quotients are below the aquatic levels of concern.
3. **Some general uncertainties are associated with the use of PRZM/EXAMS standard runoff scenario (a 10 hectare field draining into a 1 hectare Georgia farm pond) with regional specific crop and pesticide management practices, weather, and soil types.** Although there are uncertainties with the use of a standard runoff scenario for a regional aquatic exposure assessment, it is designed to represent pesticide exposure from an agricultural watershed impacting a vulnerable aquatic environment. Extrapolating the risk conclusions from this standard pond scenario may either underestimate or overestimate the potential risks.

   Major uncertainties with the standard runoff scenario are associated with the physical construct of the watershed and representation of vulnerable aquatic environments for different geographic regions. The physicochemical properties (pH, redox conditions, etc.) of the standard farm pond are based on a Georgia farm pond. These properties are likely to be regionally specific because of local hydrogeological conditions. Any alteration in water quality parameters may impact the environmental behavior of the pesticide. The farm pond represents a well mixed, static water body. Because the farm pond is a static water body (no flow through), it does not account for pesticide removal through flow through or accidental water releases. However, the lack of water flow in the farm pond provides an environmental condition for accumulation of persistent pesticides. The assumption of uniform mixing does not account for stratification due to thermoclines

(e.g., seasonal stratification in deep water bodies). Additionally, the physical construct of the standard runoff scenario assumes a watershed:pond area ratio of 10. This ratio is recommended to maintain a sustainable pond in the Southeastern United States. The use of higher watershed: pond ratios (as recommended for sustainable ponds in drier regions of the United States) may lead to higher pesticide concentrations when compared to the standard watershed:pond ratio.

The standard pond scenario assumes uniform environmental and management conditions exist over the standard 10 hectare watershed. Soils can vary substantially across even small areas, and thus, this variation is not reflected in the model simulations. Additionally, the impact of unique soil characteristics (e.g., fragipan) and soil management practices (e.g., tile drainage) are not considered in the standard runoff scenario. The assumption of uniform site and management conditions is not expected to represent some site-specific conditions. Extrapolating the risk conclusions from the standard pond scenario to other aquatic habitats (e.g., marshes, streams, creeks, and shallow rivers, intermittent aquatic areas) may either underestimate or overestimate the potential risks in those habitats.

The EEC predicted by the screening level rice model represents a bounding concentration for acute and chronic exposures. The concentration represents a predicted concentration in rice paddy tailwater which would then be released immediately after pesticide application to aquatic environments where exposures typically occur. As such, the acute concentration predicted will represent an exposure estimate near the point of release from the paddy. Acute concentrations would be expected to decrease away from the release point due to degradation, dilution, and dispersion. Chronic EECs would also be expected to be lowered once released into an aquatic environment unless multiple releases occurred over time.

4. **The risk assessment only considers the most sensitive species tested**. Aquatic acute and chronic risks are based on toxicity data for the most sensitive fish, invertebrate, and plant species tested. Responses to a toxicant can be expected to be variable across species. Sensitivity differences between species can be considerable (even up to four orders of magnitude) for some chemicals (Mayer and Ellersieck 1986). The position of the tested species relative to the distribution of all species' sensitivities to 2,4-D is unknown. Extrapolating the risk conclusions from the most sensitive tested species to non-tested species may either underestimate or overestimate the potential risks to those species.
5. **The risk assessment only considered a subset of possible use scenarios.** 2,4-D uses being considered under this re-registration assessment are for a variety of crops that are grown over a large geographic area. For this risk assessment, the scenarios were selected to represent a range of crops and geographic areas. Some of the labeled uses that were not modeled may have a greater risk to the environment than those included in this risk assessment. Other uses that may pose higher risks are those occurring in sensitive locations (close proximity to aquatic environments and high runoff potentials).
6. **EFED has modeled the terrestrial use of 2,4-D for postemergent weed control in**

several orchard scenarios, including apples and filberts, assuming a foliar application (CAM = 2). However, the orchard scenarios used in this assessment were developed with an assumption of a foliar pesticide application to the orchard foliage, while 2,4-D is applied weeds at the ground surface. Therefore, for the orchard scenarios modeled, 2,4-D is applied to the orchard foliage rather than the undercanopy resulting in a washoff and extraction potential that may be different than that encountered under actual use conditions. The effect of the use of CAM 2 on orchard scenarios cannot be quantified at this time. EFED will investigate this effect in currently approved scenarios and propose corrective action. Until such time as this investigation is complete the effect of foliar intercept and washoff in orchard scenarios for undercanopy applications should be considered an uncertainty in this assessment.

7. **The ester drift scenario relies on the assumption that the only route of exposure to the ester form is via drift and that only acute exposures to the ester form are likely.** There is uncertainty with this assumption because there is data suggesting that under certain conditions the esters of 2,4-D may persist in the field. However, the assumption of acute only exposures is supported by the hydrolysis bridging study conducted on the soil slurry at approximately pH 6 which indicated rapid conversion in non-sterile water and by open literature data which suggests that 2,4-D BEE dissipates rapidly when applied to a range of aquatic environments. It should be noted that the hydrolysis study conducted on sterile waters at pH 5, 7, and 9 did indicate that hydrolysis is pH dependent with rapid hydrolysis in alkaline water and no hydrolysis in acidic waters.
8. **Data submitted by the registrant support the bridging of 2,4-D amine salts and 2,4-D esters to 2,4-D acid.** However, a limitation on this is the lack of field data on the ester hydrolysis in acid and near-neutral aquatic environments. In the absence of these field data, it is assumed that deesterification will occur in acid and near-neutral environments due to surface catalyzed and microbially mediated processes.
9. **Concentrations of 2,4-D for direct aquatic uses are estimated assuming a fixed water body size (the EFED index reservoir) is representative of hydrologic and dissipation processes (aerobic aquatic metabolism and flow-through) for all aquatic uses**. Complete mixing and no photodegradation are assumed in this scenario. Comparison of model estimates with field data, where possible, has been completed to ensure water models are appropriate.

VII. Terrestrial Hazard, Exposure, and Risk Assessment

For the bird and mammal assessments the toxicity values of the 2,4-D acid, amine salts, and esters were primarily pooled because of the tendency of the amine salts and esters to rapidly convert to the acid form in the terrestrial environment under most conditions. Consideration for pooling data based on toxicity alone was not done because of the limited number of definitive studies on birds. However, for terrestrial plant risk assessments the potential for risk was evaluated separately for the esters and the acid and amine salts since there are distinct differences in the solubilities of the two groups.

Hazard Summary

Toxicity to Birds

Toxicity ranges for birds and mammals do not show distinct differences between the acid, salts, amine salts, and esters as indicated for aquatic animals. All studies have been conducted with the active ingredient, and have been converted to the acid equivalent since all use rates on the master label are given in lb acid equivalent per acre. The oral LD_{50} ranges from to 500 mg ai/kg (415 mg ae/kg) for 2,4-D DMAS to >1000 mg ae/kg for the 2,4-D acid as outlined below. It should be noted that although the lowest LD_{50} is > 398 mg ai/kg, EFED has used the lowest definitive value for RQ calculations. The bobwhite quail was more sensitive than the mallard duck.

Table 20. Avian Acute Oral Toxicity Summary

Active Ingredient	Sensitivity Range	Acute Species Tested	LD_{50} (mg ae/Kg)
2,4-D DMAS	Most Sensitive	Northern bobwhite quail *(Colinus virginianus*	415
2,4-D Acid	Least Sensitive	Mallard duck *(Anas platyrhynchos)*	>1000

The dietary LC_{50} is greater than 5620 ppm for all active ingredients tested and classifies 2,4-D as practically non-toxic on an acute dietary basis. A definitive LC_{50} was not obtained for any of the chemical forms tested.

Table 21. Avian Acute Dietary Toxicity Summary

Active Ingredient	Sensitivity Range	Acute Species Tested	LC_{50} (mg ae/Kg-diet)
2,4-D TIPA	Most Sensitive	Northern bobwhite quail *(Colinus virginianus)* Mallard duck *(Anas platyrhynchos)*	>3035

Table 21. Avian Acute Dietary Toxicity Summary			
Active Ingredient	**Sensitivity Range**	**Acute Species Tested**	**LC_{50} (mg ae/Kg-diet)**
2,4-D Acid, Salts, and Esters	Least Sensitive	Mallard duck *(Anas platyrhynchos)*	>5620

The chronic NOEC of 962 ppm is based on the endpoints of eggs cracked and eggs laid for the 2,4-D acid. There is no comparable study for the mallard duck and no other avian chronic study was performed on any of the other active ingredients.

Table 22. Avian Chronic Toxicity Summary			
Active Ingredient	**Chronic Species Tested**	**NOEC / LOEC (ppm)**	**LOEC Enpoints**
2-4 Acid	Northern bobwhite quail *(Colinus virginianus)*	962 / >962	Eggs cracked/ eggs laid

Toxicity to Mammals

The rat LD_{50} ranged from 579 to 1300 mg ae/kg. as outlined below.

Table 23. Mammalian Acute Oral Toxicity Summary			
Active Ingredient	**Sensitivity Range**	**Acute Species Tested**	**LD_{50} (mg ae/Kg)**
2,4-D DMAS	Most Sensitive	laboratory rat *(Rattus norvegicus)*	579
2,4-D IPA	Least Sensitive	Laboratory rat *(Rattus norvegicus)*	1300

Mammalian chronic toxicity values are from rat and rabbit developmental toxicity studies for the 2,4-D acid and all amine salts, and esters. In addition, the 2-generation rat study is also available for the 2,4-D acid. The results are summarized below.

Table 24. Mammalian Chronic Toxicity Summary					
Active Ingredient	**Type Study**	**Sensitivity Range**	**Chronic Species Tested**	**NOEL / LOEC (mg ae/kg/day)**	**Chronic Endpoints**
2-4 D IPA	Developmental toxicity	Most sensitive	Rabbit	<10 / 10	Body weight gain
2,4-D IPA	Developmental toxicity	Least sensitive	Rat	51 / 150	Body wt. Gain & food consumption
2,4-D Acid	2-generation Reproductive	N/A	Rat	5 / 20	Body wt. gain & male renal tubule alterations

Toxicity to Non-Target Insects

There are two recently submitted honey bee acute contact studies which categorize the 2,4-D DMAS and the 2,4-D EHE as practically non-toxic to bees on an acute contact basis. The studies are summarized below, and have been converted to the acid equivalent.

Table 25. Honeybee Acute Contact Toxicity Summary			
Active Ingredient	**Species Tested**	**LD_{50} (µg/bee)**	**Toxicity Category**
2,4-D DMAS	Honeybee (Apis mellifera)	>100	Practically non-toxic
2,4-D EHE	*Honeybee (Apis mellifera)*	>100	Practically non-toxic

Toxicity to Terrestrial Plants

For purposes of calculating the non-target plant RQs for 2,4-D it must first be noted that the water solubilities differ greatly between the esters and the acid and amine salts. The esters range from 0.087 mg/L at 25 ^{0}C for the 2,4-D EHE to 11.0 mg/L for the 2,4-D IPE. The 2,4-D acid and amine salts range from 569 mg/L for the 2,4-D acid to 6.6 x 10^6 mg/L for the 2,4-D DMAS. Since the EFED terrestrial plant runoff exposure scenario is based on the solubility of the compound, the environmental concentrations must be calculated separately for the esters and the acid and amine salts. The toxicity values too must be summarized separately for the 2,4-D acid, amine salts and the esters. The terrestrial plant toxicity values for 2,4-D acid and amine salts is summarized in Table 26, and have been listed as the acid equivalent. The sensitivity ranges for the monocot and dicot species are listed for the seedling emergence and vegetative vigor studies.

Table 26. Terrestrial Plant Toxicity Summary for 2,4-D Acid and amine salts					
Study Type		**Most sensitive Crop / Active Ingredient**	**EC25 / NOEC (lb ae/A)**	**Least sensitive Crop / Active Ingredient**	**EC25 / NOEC (lb ae/A)**
Seedling Emergence	Monocot	Sorghum / 2,4-D DMAS	0.026 / 0.015	Oats, Corn / 2,4-D Acid	>4.2 / 0.375
	Dicot	Mustard /2,4-D DEA	0.045 / <0.045	Tomato / 2,4-D Acid	>4.2
Vegetative Vigor	Monocot	Onion / 2,4-D Acid	<0.0075 / <0.0075	Corn / 2,4-D Acid	> 4.2 /2.1
	Dicot	Tomato / 2,4-D DEA	0.003 / 0.002	Soybean / 2,4-D DEA	0.045 / 0.005

The terrestrial plant toxicity for the 2,4-D esters is summarized in Table 27. The sensitivity ranges for the monocot and dicot species are listed for the seedling emergence and vegetative vigor studies.

Table 27. Terrestrial Plant Toxicity Summary for 2,4-D Esters					
Study Type		**Most sensitive Crop / Active Ingredient**	**EC25 / NOEC (lb ae/A)**	**Least sensitive Crop / Active Ingredient**	**EC25 / NOEC (lb ae/A)**
Seedling Emergence	Monocot	Onion / 2,4-D IPE	0.01 / 0.005628	Oats, Corn / 2,4-D EHE	>0.96
	Dicot	Lettuce / 2,4-D IPE	0.00081 / 0.00047	Tomato / 2,4-D EHE	>0.96
Vegetative Vigor	Monocot	Corn /2,4-D IPE	0.2016 / 0.0252	Oats, Corn / 2,4-D EHE	>0.96
	Dicot	Lettuce / 2,4-D IPE	0.00126 / 0.006132	Buckwheat / 2,4-D EHE	0.21 / 0.015

A number of 2,4-D active ingredients lack valid data for some plant toxicity studies. In addition, nearly all of the current EPA studies submitted have been on the technical formulation instead of the required typical end use product (TEP). However, since EFED has pooled the data for terrestrial plants for the acid and amine salts and the esters, EFED will only require the TEP testing of a representative from the acid and amine group and one from the ester group. Factors which might affect the selection of the TEPs include the product which represents the largest use based on total poundage, the largest number of acreage treated, and/or the toxicity level of the product. The test products should include the most common and most active surfactants and

adjuvants which might affect the toxicity of the product. The 2,4-D Task Force may want to confer with the agency before finalizing on which products they prefer to test.

Table 28. Missing Terrestrial Plant Data for Active Ingredients of 2,4-D[1]

Active Ingredient	Seedling Emergence		Vegetative Vigor	
	Monocot	Dicot	Monocot	Dicot
2,4-D Acid				
2,4-D Sodium Salt	No data	No data	No data	No data
2,4-D DEA				
2,4-D DMAS			No data	No data
2,4-D IPA	No data	No data	No data	No data
2,4-D TIPA	No data	No data	No data	No data
2,4-D BEE			No data	No data
2,4-D EHE				
2,4-D IPE	Corn and sorghum		Onion, ryegrass, oats, sorghum	Soybean buckwheat, lettuce

[1] A blank space indicates complete data is available

Reported Incidents

As explained in the aquatic incidents section, the EIIS database reports pesticide incidents which have been voluntarily submitted to the EPA by state agencies. The report assigns a certainty index of 0 (unrelated), 1 (unlikely), 2 (possible) 3 (probable) or 4 (highly probable) to each incident. In addition a judgement of registered use, accidental misuse, intentional misuse, or undetermined is assigned. There was 227 terrestrial incidents were reported for 2,4-D, and 155 for these incidents were reported as plant incidents under the acid form only. Two incidents were reported as both terrestrial and aquatic.

Among the terrestrial incidents 10 were reported as accidental misuse with a certainty index of "possible". Forty three incidents were reported as undetermined and possible, while seven were recorded as registered uses and possible. The remaining incident (#1003151-001) was recorded as a probable registered use on corn. However, the affected species was also listed as corn, and no residue analysis was conducted.

One of the two incidents which were recorded as terrestrial/aquatic showed an application to corn in Illinois (#B000150-002) which affected bluegill, catfish, crappie, fox squirrel, greengill, largemouth bass, silver minnow, smallmouth bass, sunfish and watersnake. This incident was "highly probable" and was not listed as a misuse, however, no residue analysis was obtained.

The remaining incident was recorded as "possible" and the use was "undetermined". The species affected included bass, catfish, crappie, grass carp, and perch.

The terrestrial plant incidents reported 42 incidents as misuse and most all were listed as probable. Twenty-nine incidents were recorded as undetermined and ranged from possible to probable. The remaining 84 incidents to plants were listed as registered uses and most were considered probable to have occurred. Crop damage was reported to have occurred on numerous crops, but most common non-target plant damages occurred on grass and corn. However, one must caution these observations since most of these incidents resulted from applications to lawns/turf and corn, respectively.

Results from these incidents should be regarded with caution since it is not clear exactly which products or tank mixes might be involved. In addition, residue analysis was not available in almost all instances, although several reasons may account for the lack of residue data. These include the elapse of time involved between the collection, storage, and the analysis of the collected tissues. Residue analysis may also be cost prohibitive in many cases. Also in cases in which court action was executed required that the results including residue analysis, be sealed and confidential as a part of the settlement.

Exposure

In contrast to the aquatic organism assessment, the bird and mammal toxicity values of the 2,4-D acid, salts, amine salts, and esters were pooled because the toxicity values were within one to two orders of magnitude for all the chemical forms. For terrestrial plant assessments, due to the differences in the solubilities of the acid and amine salts when compared to the solubilities of the esters, risks for these two groups were calculated separately. However, the terrestrial plant toxicity data for the 2,4-D acid and amine salts were bridged as one group while that of the esters were bridged separately since toxicity values of each group were similar.

Terrestrial exposure estimations differ for the groups of terrestrial organisms. One major difference in the way in which exposure scenarios are evaluated for terrestrial species is the methodology used for non-granular and granular applications. These methodologies are discussed in detail in Appendix F and are summarized below.

Birds and Mammals

Toxicant concentrations resulting from liquid spray applications on terrestrial food items are based on data from by Hoerger and Kenaga (1972) as modified by Fletcher et al. (1994) that determined residue levels on various terrestrial items immediately following toxicant application in the field. These values are summarized in the table below.

Estimated Environmental Concentrations on Avian and Mammalian Food Items (ppm) Following a Single Application at 1 lb ai/A)

Food Items	EEC (ppm) Predicted Maximum Residue[1]	EEC (ppm) Predicted Mean Residue[1]
Short grass	240	85
Tall grass	110	36
Broadleaf/forage plants and small insects	135	45
Fruits, pods, seeds, and large insects	15	7

[1] Predicted maximum and mean residues are for a 1 lb ai/a application rate and are based on Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994).

Toxicant concentrations on food items following multiple applications are predicted using a first-order residue decline method, EFED's "FATE5" model, which allows determination of residue dissipation over time incorporating degradation half-life. Predicted maximum and mean EECs resulting from multiple applications estimates the highest one-day residue, based on the maximum or mean initial EEC from the first application, the total number of applications, interval between applications, and a first-order degradation rate, consistent with EFED policy. A foliar half life of 8.8 days taken from Willis and McDowell (1987) was used in the FATE5 model to estimate EECs. The half life represents the maximum mean foliar half life for total 2,4-D residue data reported by Willis and McDowell and was selected as an upper bound from this data. It is worth noting that in two forest field dissipation studies 2,4-D dissipated with half lives of 42 days in foliage and 72 days in leaf litter suggesting that the use of the 8.8 day half life may underestimate exposure.

Unincorporated banded treatments are also applied to selected row crops. Many 2,4-D labels adjust application rates according to band width and row spaces, but many others do not. For the labels which do not adjust the application rates, the treatments are more concentrated and the resulting exposure to birds and mammals may increase. EFED asked the 2,4-D Task Force to identify labels with the narrowest band width and widest row spaces but the Task Force opted to require all formulators to adjust the application rates according to the following formula.

$$\frac{\text{band width in inches}}{\text{row width in inches}} \times \text{Broadcast rate per acre} = \text{Rate per banded acre}$$

A 6 inch band and 30 inch row space as a typical banded application and the following formulas were used to calculate LD_{50} s per square foot.

$$\text{mg ae per ft}^2 = \text{App. Rate lbs ae/Acre} \times 435{,}590 \text{ mg/lbs} \times \text{Acre}/43{,}560 \text{ ft}^2 \times \%\text{unincorporated} \times \text{untreated row space (ft)}/\text{Bandwidth (ft)}$$

$$RQ = \frac{\text{mg ae}}{\text{ft}^2} \times \frac{1}{\text{Weight of Animal (g)}} \times \frac{1000 \text{ g}}{\text{kg}} \times \frac{\text{kg}}{\text{LD50 mg}}$$

Granular exposure to birds can occur when birds are foraging for food or grit. They also may be exposed by other routes, such as by walking on exposed granules or drinking water contaminated by granules. The number of doses (LD_{50}) that are available within one square foot immediately after application (LD_{50}/ft^2)is used as the RQ for granular products. RQs are calculated for three separate weight class of birds: 1000 g (*e.g.*, waterfowl), 180 g (*e.g.*, upland gamebird), and 20 g (*e.g.*, songbird).

Dietary exposure to mammals from liquid sprays is based upon EFEDs draft 1995 SOP of mammalian risk assessments and methods used by Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994). The concentration of 2,4-D in the diet that is expected to be acutely lethal to 50% of the test population (LC_{50}) is determined by dividing the LD_{50} value (usually rat LD_{50}) by the amount of food, as percent (decimal of) body weight consumed. A RQ is then determined by dividing the EEC by the derived LC_{50} value. Acute RQs are calculated for three separate weight classes of mammals (15, 35, and 1000 g), each presumed to consume four different kinds of food (grass, forage, insects, and seeds). Chronic mammalian RQs are calculated using the most sensitive NOEC from the 2-generation rat study and the residue concentration expected on food items from Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994).

Unincorporated banded treatments of sprays to row crops use the same methodology and assumptions when evaluating risks to small mammals using the LD_{50} per square foot. These LD_{50} s per square foot are calculated for the three separate weight classes of mammals. Mammalian species also may be exposed to granular pesticides by ingesting granules. They also may be exposed by other routes, such as by walking on exposed granules and drinking water contaminated by granules. The number of lethal doses (LD_{50}) that are available within one square foot immediately after application are used as a RQ (LD_{50}/ft^2) for the various types of exposure to pesticides. RQs are calculated for three separate weight classes of mammals: 15 g, 35 g, and 1000 g.

Terrestrial Plants

Exposure to terrestrial plants inhabiting dry and semi-aquatic areas may be exposed to pesticides from runoff, spray drift or volatilization. Volatilization is not included in this assessment. Semi-aquatic areas are those low-lying wet areas that may be dry at certain times of the year. EFED's runoff exposure estimate is: (1) based on a pesticide's water solubility and the amount of pesticide present on the soil surface and its top one inch, (2) characterized as "sheet runoff" (one treated acre to an adjacent acre) for dry areas, (3) characterized as "channelized runoff" (10 treated acres to a distant low-lying acre) for semi-aquatic areas, and (4) based on percent runoff

values of 0.01, 0.02, and 0.05 for water solubility of <10 ppm, 10-100 ppm, and >100 ppm, respectively.

Spray drift exposure from ground and overhead chemigation applications is assumed to be 1% of the application rate. Spray drift from aerial, airblast, and forced-air applications is assumed to be 5% of the application rate with an application efficiency of 60%. The effects of multiple applications are addressed by summing the application rates from individual applications.

EECs are calculated for the following application methods: (1) unincorporated ground applications, (2) incorporated ground application, and (3) aerial, airblast, forced-air, and chemigation applications. Formulas for calculating EECs for dry areas adjacent to treatment sites and EECs for semi-aquatic areas follow.

EEC Formulas:

Calculating EECs for terrestrial plants inhabiting dry areas adjacent to treatment sites

Unincorporated ground application:

Runoff = maximum application rate (lbs ai/A) x runoff value x number of applications
Drift = maximum application rate x 0.01
Total Loading = runoff (lbs ai/acre) + drift (lbs ai/A)

Incorporated ground application:

Runoff = [maximum application rate (lbs ai/A) ÷ minimum incorporation depth (cm.)] x runoff value x number of applications
Drift = maximum application rate x 0.01
(Note: drift is not calculated if the product is incorporated at the time of application.)
Total Loading = runoff (lbs ai/A) + drift (lbs ai/A)

Aerial, airblast, forced-air, and chemigation applications:

Runoff = maximum application rate (lbs ai/A) x 0.6 (60% application efficiency assumed) x runoff value x number of applications
Drift = maximum application rate (lbs ai/A) x 0.05
Total Loading = runoff (lbs ai/A) + drift (lbs ai/A)

Calculating EECs for terrestrial plants inhabiting semi-aquatic low-lying areas

Unincorporated ground application:

Runoff = maximum application rate (lbs ai/A) x runoff value x 10 acres x number of applications

Drift = maximum application rate x 0.01
Total Loading = runoff (lbs ai/A) + drift (lbs ai/A)

Incorporated ground application:
Runoff = [maximum application rate (lbs ai/A)/minimum incorporation depth (cm)] x runoff value x 10 acres x number of applications
Drift = maximum application rate x 0.01
(Note: drift is not calculated if the product is incorporated at the time of application.)
Total Loading = runoff (lbs ai/A) + drift (lbs ai/A)

Aerial, airblast, and forced-air applications:

Runoff = maximum application rate (lbs ai/acre) x 0.6 (60% application efficiency assumed) x runoff value x 10 acres x number of applications
Drift = maximum application rate (lbs ai/A) x 0.05
Total Loading = runoff (lbs ai/A) + drift (lbs ai/A)

runoff values = 0.01, 0.02, and 0.05 for water solubility of <10 ppm, 10-100 ppm, and >100 ppm, respectively

Incorporation depth: Use the minimum incorporation depth prescribed in the label.

For purposes of calculating the non-target plant RQs for 2,4-D it must first be noted that the water solubilities differ greatly between the esters and the acid and amine salts. The esters range from 0.087 mg/L at 25 ^{0}C for the 2,4-D EHE to 11.0 mg/L for the 2,4-D IPE. The 2,4-D acid and amine salts range from 569 mg/L for the 2,4-D acid to 6.6 x 10^{6} mg/L for the 2,4-D DMAS. Since the EFED runoff scenario is based on the solubility of the compound as discussed above, the environmental concentrations must be calculated separately for the esters and the acid and amine salts. The environmental calculations for the esters will be calculated separately at a percent runoff value of 0.01, while that of the acid and amine salts were calculated at a value of 0.05. The estimated environmental concentrations for dry and semi-aquatic areas for the acid and amine salts as well as the esters are tabulated in Appendix F.

Banded spray applications are allowed on a number of labels and instruct the applicators to apply unincorporated banded treatments of sprays to row crops. Many labels adjust application rates according to band width and row spaces, but many others do not. For the labels which do not adjust the application rates, the treatments are more concentrated in the bands. Since non-target plants do not migrate from treated to untreated bands as is the case with birds and mammals, exposure to plants is characterized as "sheet runoff" (one treated acre to an adjacent acre) for dry areas and "channelized runoff" (10 treated acres to a distant low-lying acre) for semi-aquatic areas. Therefore, the higher per acre rates in the concentrated bands do not effect the exposure to non-target bands when label rates are not adjusted.

The 2,4-D Task Force proposal to require all formulators to adjust the application rates

according to the previously discussed formula will reduce the exposure to non-target plants. Using the banded application formula provided by the 2,4-D Task Force, the banded per acre application rate can be significantly reduced.

Applications of granular formulations may pose risks to terrestrial plants inhabiting dry and semi-aquatic areas. Exposure is assumed to be from runoff only, and drift is assumed not to occur with granular applications of pesticides. Therefore, EFED's runoff scenario is essentially the same as that used in the non-granular scenario described above, with the exception that the drift component is removed.

The estimated environmental concentrations for the acid and amine salts as well as the esters to dry and semi-aquatic areas are tabulated in Appendix F for single applications to the targeted use sites. As discussed above, the percent runoff value based on water solubility is assumed to be 5% for the acid and amines and 1% for the esters. The estimated environmental concentrations for the 2,4-D esters for dry and semi-aquatic areas are based on the low water solubility of the esters to be 0.1. The estimated concentrations are tabulated in Appendix F.

The estimated environmental concentrations for the 2,4-D esters for dry and semi-aquatic areas are tabulated below for single applications to the targeted use sites. As discussed above, the percent runoff value based on the low water solubility of the esters is assumed to be 0.01.

Many of the 2,4-D products on the 2,4-D Master Label allow a second application at prescribed intervals ranging from 7 to 30 days with the exception of pome fruit which allows a 75 day interval. For multiple spray applications the environmental concentrations would be expected to double in concentration at the most conservative level. In this scenario the RQs would be expected to double. The estimated environmental concentrations for the acid and amine salts and the esters for dry and semi-aquatic areas with an assumed runoff of 5% for the acid and amine salts, and 1% for the esters are tabulated in the appropriate sections of Appendix F.

Risk Quotients

Birds

The RQs for birds are presented in detail in Appendix F. Potential risks were evaluated for non-granular and granular formulations applied both as banded and broadcast applications.

Non-granular Broadcast Applications - The maximum residues from Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994) were used as the basis for the calculations of residue concentrations for non-granular spray applications.

Since a definitive dietary LC_{50} was not obtained in any of the studies, it is believed that the oral LD_{50} may be a better indication of potential acute risk. Therefore, the definitive LD_{50} of 415 mg ae/kg-bw was used to calculate the acute RQs. The acute RQs were exceeded in short grass, tall grass, and broadleaf, forage, and small insect scenarios for all sites with the exception of

potatoes and citrus. The RQs ranged from <0.01 to 3.83. The chronic toxicity endpoint used was the 2,4-D acid NOEC of 962 mg ai/kg. The chronic RQs bracket the LOCs for birds foraging in short grass for asparagus, cranberry, forest, and non-cropland sites. A summary of these RQs is presented in Table 29. Detailed RQs appear in separate tables in Appendix F.

Table 29. Avian Risk Quotient Summaries for Non-granular Spray Applications of 2,4-D acid, amine salts and esters

Use Site (Acute & Chronic Risk)	Scenario				
	Short Grass	**Tall Grass**	**Broadleaf, forage, small insects**	**Fruit, large insects**	**Pods, seeds,**
Fallow areas and Crop Stubble; Turf (Golf courses, residential lawns, grasses grown for seed, and sod); Pastures, Rangeland, Perennial Grassland; Sugarcane -(2 lbs ae/ac/app, 2 app., ground/aerial, 30 day interval)					
Acute RQ Exceedance	0.1* - 1.91***	0.04 - 0.88***	0.04 - 0.78***		
Chronic RQ Exceedance					
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.); Forest Uses, Cranberry (4.0 lbs ae/A/app, 1 app., ground/aerial,)					
Acute RQ Exceedance	0.18* - 3.5***	0.07 - 1.6***	0.07 - 1.43***	0.01 - 0.15*	
Chronic RQ Exceedance	1.0+				
Pome fruit/Stone fruit/Nuts (2.0 lbs ae/A/app, 2 app., ground/aerial; 75 day application interval)					
Acute RQ Exceedance	0.09 - 1.75***	0.04 - 0.81***	0.03 - 0.72***		
Chronic RQ Exceedance					
Strawberry; Rice (1.5 lbs ae/ac/app, 1 app., ground or aerial)					
Acute RQ Exceedance	0.09 - 1.75***	0.04 - 0.81***	0.03 - 0.72***		
Chronic RQ Exceedance					
Blueberry (1.4 lbs ae/ac/app, 2 app., ground, 30 day interval)					
Acute RQ Exceedance	0.09 - 1.75***	0.04 - 0.81***	0.03 - 0.72***		
Chronic RQ Exceedance					
Grapes (1.36 lbs ae/ac/app, 1 app., ground)					
Acute RQ Exceedance	0.09 - 1.75***	0.04 - 0.81***	0.03 - 0.72***		
Chronic RQ Exceedance					
Sorghum, Soybean (1.0 lbs ae/ac/app, 1 app., ground or aerial)					

Table 29. Avian Risk Quotient Summaries for Non-granular Spray Applications of 2,4-D acid, amine salts and esters					
Use Site (Acute & Chronic Risk)	**Scenario**				
	Short Grass	**Tall Grass**	**Broadleaf, forage, small insects**	**Fruit, large insects**	**Pods, seeds,**
Acute RQ Exceedance	0.09 - 1.75***	0.04 - 0.81***	0.03 - 0.72***		
Chronic RQ Exceedance					
Wheat, Oats, Barley, Rye, Millet, Triticale (1.25 lbs ai/ac/app, 2 app., assumed 30 day interval, ground or aerial)					
Acute RQ Exceedance	0.09 - 1.75***	0.04 - 0.95***	0.04 - 0.84***		
Chronic RQ Exceedance					
Corn (1.5 lbs ai/ac/app, 2 app., 7 day interval, ground or aerial)					
Acute RQ Exceedance	0.1* - 2.07***	0.04 - 0.81***	0.03 - 0.72***		
Chronic RQ Exceedance					
Asparagus (4.0 lbs ae/A/app, 2 app., ground or aerial, 30 day interval)					
Acute RQ Exceedance	0.19* - 3.83***	0.08 - 1.75***	0.07 - 1.56***	0.01 - 0.16*	
Chronic RQ Exceedance	1.09+				

* indicates an exceedance of Endangered Species Level of Concern (LOC).
** indicates an exceedance of Acute Restricted Use LOC.
*** indicates an exceedance of Acute Risk LOC.
+ indicates an exceedance of Chronic LOC.

Non-granular Banded Applications - Banded applications of sprays to row crops require all formulators to adjust the application rates according to the previously described formula. Many labels do not adjust the application rates and the resulting treatment concentrates the per acre application rate into a narrow band. Birds, at least in theory, could be exposed to the higher concentration of toxicant by foraging or wandering into the treated band. EFED evaluated the banded risk by comparing the RQs from unadjusted band rates to those using the adjusted band rates to illustrate the increased risk. EFED assumed a 6 inch band and 30 inch row space as a typical banded application. The RQs indicate that levels of concern are not exceeded for 1000 g birds for rates adjusted due to band widths. LOCs are also not exceeded for these adjusted rates for potatoes for all weight classes of birds. The unadjusted band width rate, however, exceeds LOCs for all weight classes of birds with the exception of potatoes.

Granular Broadcast Applications - Acute RQs for granular products are calculated for three separate weight classes of birds using the LD_{50}/ft^2: 1000 g (*e.g.*, waterfowl), 180 g (*e.g.*, upland gamebird), and 20 g (*e.g.*, songbird). The acute RQs for broadcast applications of granular

products are tabulated below for the use sites from the 2,4-D Master Label which support granular formulations.

Table 30: Avian Acute Risk Quotient Calculations for Granular Broadcast Applications

Bird Body Weight (g)	Acute Toxicity Threshold, LD_{50} (mg/kg)	Acute RQ (LD_{50} per ft^2) [a]
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) (4.0 lbs ae/A/app, 1 app., ground/aerial,)		
20	415	5.02***
180	415	0.55***
1000	415	0.1*
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) (2.0 lbs ae/A/app, 2 app., ground/aerial, 30 day interval)		
20	415	2.5***
180	415	0.3**
1000	415	0.05
(Aquatic areas - Ditchbank applications (2.0 lb ae/acre/app., 2 app., ground)		
20	415	2.5***
180	415	0.3**
1000	415	0.05
(Aquatic areas - Surface applications (ponds, lakes reservoirs, marches, bayous, drainage ditches, canals, slow moving rivers and streams, bank of irrigation ditches) (4.0 lb ae/acre/app. 3 weeks between applications)		
20	415	5.02***
180	415	0.55***
1000	415	0.10**
(Aquatic areas - Surface application or subsurface injection (ponds, lakes reservoirs, marches, bayous, drainage ditches, canals, slow moving rivers and streams, bank of irrigation ditches) (10.8 lb ae/acre foot to an average pond depth of 5 feet)		
20	415	13.55***
180	415	1.5***
1000	415	0.27**
Cranberry (4.0 lbs ae/A/app, 1 app., ground)		

Table 30: Avian Acute Risk Quotient Calculations for Granular Broadcast Applications		
Bird Body Weight (g)	**Acute Toxicity Threshold, LD_{50} (mg/kg)**	**Acute RQ (LD_{50} per ft^2) [a]**
20	415	5.02***
180	415	0.55***
1000	415	0.10*

[a] RQ = App. Rate (lbs ae) / Acre x 453,590 mg / Lb x Acre / 43,560 ft^2 x 1 / Animal weight (g) x 1000 g / 1 kg x Kg / LD50 mg

* indicates an exceedance of Endangered Species Level of Concern (LOC).
** indicates an exceedance of Acute Restricted Use LOC.
*** indicates an exceedance of Acute Risk LOC.

Granular Banded Applications - In addition to broadcast applications of granular formulations, a number of labels instruct the applicators to apply unincorporated banded treatments of granular products to crops. As explained for banded spray treatments above, many labels adjust application rates according to band width and row spaces, but many others do not. However. the 2,4-D Master Label only supports the use sites for granular applications listed above under table for granular broadcast applications, and none of these use sites typically employ banded applications. If banded granular applications were used at the same sites as banded spray applications, the risk would be similar.

Mammals

The acute RQs for broadcast applications of nongranular products are tabulated for herbivores/insectivores and granivores in Appendix F. When the LD_{50} of 697 mg ai/kg (579 mg ae/kg) is used for in herbivore/insectivore RQ calculations endangered species LOCs are exceeded at many sites for mammals foraging on short and tall grass, broadleaf plants, and small insects. **The RQs range from 1.72 for asparagus to < 0.01 for potatoes.** However, there are no LOC exceedances for granivorous mammals.

The chronic RQs for broadcast applications of nongranular products are tabulated in Appendix F for all classes of mammals. The parental toxicity NOAELs ranged from 5 mg/kg/day based on female body weight gain and male renal tubule alteration for the 2,4-D acid. The FATE program was used to determine the maximum and 56 day average residues which occur in a one year time period. The application rate, minimum number of applications, and the interval between applications were determined from the 2,4-D Master Label and represent the highest single application rate. **Levels of concern were exceeded in all cases with the exception of potatoes and citrus (large insects, seeds) and RQs ranged from 0.1 to 200.**

As described above for avian risk, in addition to broadcast spray, a number of labels instruct the applicators to apply unincorporated banded treatments of sprays to row crops. Using the same assumptions as described above for birds, the RQs for mammals are presented in Table 31.

Again, for purposes of comparison, the unadjusted rates that appear on many of the current labels have been included. The LD_{50} of 579 mg ae/kg, and again, for purposes of comparison, the unadjusted rates that appear on many of the current labels have been included. **Acute levels of concern are exceeded at all use sites and for 15, 35, and 1000 g mammals when banded rates are not adjusted. When the banded rates are adjusted, LOCs are not exceeded for 1000 g mammals.** The results of these calculations are tabulated in Appendix F.

Mammalian species also may be exposed to granular pesticides by ingesting granules. They also may be exposed by other routes, such as by walking on exposed granules and drinking water contaminated by granules. The number of lethal doses (LD_{50}) that are available within one square foot immediately after application can be used as a RQ ($LD_{50}/ft^{2)}$ for the various types of exposure to pesticides. RQs are calculated for three separate weight classes of mammals: 15 g, 35 g, and 1000 g. The LOCs are exceeded for all sites with the following exceptions.

- No LOCs are exceeded for 1000 g mammals in turf and aquatic areas (ditchbanks).
- Only endangered species LOCs are exceeded at all other sites except as noted above.

The acute RQs for broadcast applications of granular products are tabulated below for the use sites from the master label which support granular formulations.

Table 31: Mammalian Acute Risk Quotient Calculations for Granular Broadcast Applications

Animal Body Weight (g)	Acute Toxicity Threshold, LD_{50} (mg/kg)	Acute RQ (LD_{50} per ft^2) [a]	
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) (4.0 lbs ae/A/app, 1 app., ground/aerial,)			
15	579	4.8	***
35	579	2.1	***
1000	579	0.1	*
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) (2.0 lbs ae/A/app, 2 app., ground/aerial, 30 day interval)			
15	579	2.4	***
35	579	1.0	***
1000	579	0.04	
(Aquatic areas - Ditchbank applications (2.0 lb ae/acre/app., 2 app., ground)			
15	579	2.4	***
35	579	1.0	***
1000	579	0.04	

Table 31: Mammalian Acute Risk Quotient Calculations for Granular Broadcast Applications		
Animal Body Weight (g)	**Acute Toxicity Threshold, LD_{50} (mg/kg)**	**Acute RQ (LD_{50} per ft^2) [a]**
(Aquatic areas - Surface applications (ponds, lakes reservoirs, marches, bayous, drainage ditches, canals, slow moving rivers and streams, bank of irrigation ditches) (4.0 lb ae/acre/app. 3 weeks between applications)		
15	579	4.795 ***
35	579	2.05 ***
1000	579	0.072
(Aquatic areas - Surface application or subsurface injection (ponds, lakes reservoirs, marches, bayous, drainage ditches, canals, slow moving rivers and streams, bank of irrigation ditches) (10.8 lb ae/acre foot to an average pond depth of 5 feet)		
15	579	12.9 ***
35	579	5.5 ***
1000	579	0.2 **
Cranberry (4.0 lbs ae/A/app, 1 app., ground)		
15	579	4.795 ***
35	579	2.05 ***
1000	579	0.072

[a] $RQ = \frac{\text{App. Rate (lbs ae)}}{\text{Acre}} \times \frac{453{,}590 \text{ mg}}{\text{Lb}} \times \frac{\text{Acre}}{43{,}560 \text{ ft}^2} \times \frac{1}{\text{Animal weight (g)}} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{\text{Kg}}{\text{LD50 mg}}$

* indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

In addition to broadcast applications of granular formulations, a number of labels instruct the applicators to apply unincorporated banded treatments of granular products to crops. As explained for banded spray treatments above for birds, many labels adjust application rates according to band width and row spaces, but many others do not. However. the master label only supports the use sites for granular applications listed above under table for granular broadcast applications, and none of these use sites typically employ banded applications. If banded granular applications were used at the same sites as banded spray applications, the risk would be similar since the rat LD_{50} of 579 mg ae/kg-diet closely approaches the bird LD_{50} of 415 mg ae/kg-diet.

Terrestrial Non-Target Insects

EFED currently does not quantify risks to terrestrial non-target insects; therefore, RQs are not

calculated for these organisms. Risks are qualitatively discussed in the Terrestrial Organism Risk Characterization section of this document.

Terrestrial Plants

RQs for terrestrial plants in dry and semi-aquatic areas are calculated for multiple and single spray applications for endangered and non-endangered species. As mentioned above in the exposure section, the runoff scenarios are based on solubility, and as a consequence, the environmental concentrations must be calculated separately for the esters and the acid and amine salts. The environmental concentrations for the esters were calculated separately at a percent runoff value of 0.01, while that of the acid and amine salts were calculated at a value of 0.05. A 60% efficiency factor is also included for aerial applications. In addition, banded applications granular and non-granular formulations are also calculated. The detailed calculations for terrestrial plants are tabulated in Appendix F.

Risk Quotient Calculations - To calculate the RQs for non-endangered plants the EC_{25} value of the most sensitive species in the seedling emergence study is compared to runoff and drift exposure to determine the RQ (EEC/toxicity value). The EC_{25} value of the most sensitive species in the vegetative vigor study is compared to the drift exposure to determine the acute RQ. RQs are calculated for the most sensitive monocot and dicot species.

To calculate the RQs for endangered plants the NOEC or EC_{05} value of the most sensitive species in the seedling emergence study is compared to runoff and drift exposure (EEC/toxicity value). The NOEC or EC_{05} value of the most sensitive species in the vegetative vigor study is compared to the drift exposure to determine the acute RQ. RQs are calculated for the most sensitive monocot and dicot species. The RQ ranges for single and multiple applications are summarized below for non-endangered and endangered plants for the acid, salts , and amine salts, and separately for the esters.

Single Spray Applications - Most use sites on the 2,4-D Master Label allow multiple applications. However, the following use sites are restricted to single applications.

Table 32. 2,4 Use Sites With Single Application Restrictions	
Use Site	**Application Rate/Method**
Non-crop [1]	Ground & Aerial Applications (4.0 lbs ae/A/app, 1 app.,)
Forest Uses	Ground & Aerial Applications (4.0 lbs ae/A/app, 1 app.,)
Strawberry	Ground & Aerial Applications (1.5 lbs ai/ac/app, 1 app.,)
Cranberry	Ground & Aerial Applications (4.0 lbs ae/A/app, 1 app.,
Grapes	Ground Applications (1.36 lbs ae/A/app, 1 app.,)
Sorghum	Ground and Aerial Applications (1.0 lbs ae/A/app, 1 app.,)
Soybean	Ground & Aerial Applications (1.0 lbs ae/A/app, 1 app.,
Citrus	Ground or Aerial Applications (0.1 lbs ae/A/app, 1 app.)
Rice	Ground & Aerial Applications (1.5 lbs ae/A/app, 1 app.,)

[1] Woody plants in rights-of-way. Other non-crop sites may have 2 applications of 2 lbs each.

The detailed RQ calculations for single applications are tabulated in detail in Appendix F, and a summary is presented below.

Table 33. Terrestrial Plant Risk Quotients for Single Applications				
Chemical Group (acid / ester)	**Plant Group (non-endangered / endangered)**	**Least Sensitive Use Site**	**Most Sensitive Use Site**	**Risk Quotient Range**
2,4-D Acid and Amine Salt	non-endangered	Citrus	Asparagus, Cranberry, Forest Use	0.18 - 67
	endangered	Citrus	Asparagus, Cranberry, Forest Use	0.13 - 136
2,4-D Ester	non-endangered	Citrus	Cranberry, Forest Use	<0.01 - 543.21
	endangered	Citrus	Cranberry, Forest Use	0.04 - 936.17

Multiple spray applications - Most of the 2,4-D products on the 2,4-D Master Label allow second applications at prescribed intervals ranging from 7 to 30 days with the exception of pome fruit which allows a 75 day interval. The RQs for multiple applications follow a linear pattern for changes in application rates, and since all applications only allow one additional application, the RQ doubles for these applications. The detailed calculations are tabulated in detail in Appendix F, and a summary is presented below.

Table 34. Terrestrial Plant Risk Quotients for Multiple Applications				
Chemical Group (acid / ester)	**Plant Group (non-endangered / endangered)**	**Least Sensitive Use Site**	**Most Sensitive Use Site**	**Risk Quotient Range**
2,4-D Acid and Amine Salt	non-endangered	Potato	Asparagus	0.19 - 157
	endangered	Potato	Asparagus	0.19 - 272
2,4-D Ester	non-endangered	Potato	Fallow areas, pastures, turf	0.01 - 12
	endangered	Potato	Asparagus	0.01 - 33

Banded Spray Applications - Banded spray applications are allowed on a number of labels and instruct the applicators to apply unincorporated banded treatments of sprays to row crops. Many labels adjust application rates according to band width and row spaces, but many others do not. For the labels which do not adjust the application rates, the treatments are more concentrated in the bands. Since non-target plants do not migrate from treated to untreated bands as is the case with birds and mammals, exposure to plants is characterized as "sheet runoff" (one treated acre to an adjacent acre) for dry areas and"channelized runoff" (10 treated acres to a distant low-lying acre) for semi-aquatic areas. Therefore, the higher per acre rates in the concentrated bands do not effect the exposure to non-target bands when label rates are not adjusted.

The 2,4-D Task Force proposal to require all formulators to adjust the application rates according to the previously discussed formula will actually reduce the exposure to non-target plants. Using the previously described formula, the banded per acre application rate can be significantly reduced. If we assume use the same 6 inch band and 30 inch row space that we used for the analysis of birds and mammals, the per acre banded application rate would be reduced by 1/5 of the broadcast application rate. The RQs are detailed in Appendix F, and summarized for multiple and single applications in the following table.

Table 35. Non-target Plant Risk Quotient Summary of Adjusted Band Applications to Selected Row Crops.					
Chemical Group (acid / ester)	**Plant Group (non-endangered / endangered)**	**Least Sensitive Row Crop**	**Most Sensitive Row Crop**	**Risk Quotient Range (Single Applications)**	**Risk Quotient Range (Multiple Applications)**
2,4-D Acid and Amine Salt	non-endangered	Potato	Asparagus	0.02 - 60	0.04 - 120
	endangered	Potato	Asparagus	0.02 - 439	0.04 - 878
2,4-D Ester	non-endangered	Potato	Soybean	<0.01 - 27	<0.01 - 54
	endangered	Potato	Soybean	<0.01 - 47	<0.01 - 94

Granular Applications - According to the master label the only crops which allow applications of granular formulations are the non-crop land sites, turf, and cranberries. The RQ summaries for the acid and amine salts for and the esters are presented below. Detailed RQs are presented in Appendix F.

Table 36. Non-target Plant Risk Quotient Summary of Granular Applications to Selected Uses.					
Chemical Group (acid / ester)	**Plant Group (non-endangered / endangered)**	**Least Sensitive Crop**	**Most Sensitive Crop**	**Risk Quotient Range (Single Applications)**	**Risk Quotient Range (Multiple Applications)[1]**
2,4-D Acid and Amine Salt	non-endangered	Turf	Non-cropland, cranberry, turf	2.2 - 77	4.4 - 154
	endangered	Turf	Non-cropland, cranberry, turf	2.2 - 133	4.4 - 266
2,4-D Ester	non-endangered	Cranberry	Non-cropland, cranberry, turf	2.0- 494	4.0 - 987.62
	endangered	Turf	Non-cropland, cranberry, turf	3.57 - 851	7.14 - 1702.12

[1] Turf is only site for multiple applications of granular products.

Banded Granular Applications - Banded granular applications are typically applied to row crops, and since the master label only allows granular applications to non-cropland, turf, and cranberries, there are no banded applications of granular formulations of 2,4-D.

Terrestrial Organism Risk Assessment

Risks to Birds

Due to the differences in the toxicity values of acute oral and dietary studies and the lack of a definitive dietary LC_{50}, it was decided that the acute oral LD_{50} would be a suitable indicator of potential risk in the absence of a definitive dietary LD_{50}. Hence, the oral LD_{50} of 415 mg ae/kg-diet was used to calculate the acute RQs as outlined in Appendix F for non-granular spray applications. These RQs ranged from <0.01 to 3.83 and were exceeded in short grass, tall grass, and broadleaf, forage, and small insect scenarios for all sites with the exception of potatoes and citrus.

As noted above, there is a large differential in the acute toxicity when 2,4-D is administered as a single gavage or when mixed in the feed. For the dietary studies, there was no mortality observed and no definitive LC_{50} was available. With no mortalities in the dietary studies at the highest dose, acute risks to birds are low. The disparity in mortality between the two studies suggest that the dietary matrix may have a lowering effect on the toxicity of 2,4-D.

By contrast, granular broadcast applications which indicate RQs ranging from 13.6 to 0.05 in aquatic areas for 20 g and 1000 g birds respectively. In addition to broadcast applications a number of labels permit the application of banded sprays and granular formulations. The RQs for these applications vary from 4.0 to < 0.01 for the adjusted band rate scenario. If the use rate is not adjusted by dividing the width of the band by the row width of the field banded sprays, the RQs will be as high as 20.1.

To better understand these risks one must understand that risk to granular and banded applications do not include as many use sites as the broadcast non-granular spray applications. The higher risks for the banded applications result from the higher use rates such as forestry and asparagus. The only conceivable banded application for the forestry use would be applications to seedlings grown in rows or outdoor nurseries where boom sprayers might be used to treat growing plants.

Regarding the granular applications, the highest RQs are associated with direct applications to water. The concentrations in the water were estimated from surface applications sub-surface injection at the rates of 10.8 lbs. ae per acre foot to attain a maximum concentration of 4 ppm. It is presumed that the granules will descend to the bottom of the water body and reach an equilibrium in the water column to attain a concentration of 4 ppm. Birds inhabiting or using this habitat would have to ingest or consume a large amount of water, selectively ingest enough granules, or sediment to approach an acute LD_{50} of 415 mg/kg. Further, the number of waterfowl which exclusively feed or forage in water would be limited to a few species of ducks and other waterfowl and these species are larger birds where the influence of larger body weight tends to lower the risk significantly. The two other use sites which remain a concern are the non-cropland and turf uses. These sites account for a large quantity of 2,4-D used in the U.S. Many birds utilize these habitats during migration.

Chronic risks to birds is limited to a very few use sites. These include non-cropland, forest, asparagus, and cranberry. The RQs for these sites just bracket the LOCs and range from 1 -1.09.

All the calculated RQs for Avian acute risk for the non-granular use of 2,4-D were based on maximum labeled application rates. The QUA from BEAD suggests that the average application rates for many crops are considerably less than the modeled maximum application rates. For non-granular spray application avian acute concerns, one of the highest RQ (3.50) was for birds feeding on short grass after application of 2,4-D on cranberries and based on a maximum application rate of 4 lbs ae/acre; however, the average application rate was only 1.83 lbs ae/acre (BEAD QUA). If the modeled application rate was reduced to 1.83 lbs ae/acre for cranberries, and there was an assumption that the resulting EEC will be reduced linearly, the RQ would be 1.60 which is still above the acute LOCs. A similar consideration of average application rates for other uses results in reduction of EECs but, in general, not below the respective LOCs. Consideration of average application rates for chronic exposures results in reduction of the EECs below the chronic LOC.

Alternatively, consideration of average application rates for estimating avian acute exposure for banded and granular applications results in a reduction of some EECs below the acute LOC but does not reduce EECs below either the restricted use or endangered species LOCs. Acute LOCs are still exceeded for banded unadjusted applications for most sites for small and medium birds while acute LOCs are still exceeded for non-cropland and cranberry granular use. No average use rate information is available for granular applications to turf and aquatic sites.

Risks to Mammals

Acute Risk

The rat LD_{50} ranges from 579 mg ae/kg bw for 2,4-D DMAS to 1300 mg/kg bw for the 2,4-D IPA. Since all chemical forms of 2,4-D are converted to 2,4-D acid in the terrestrial environment, the LD_{50} of 579 mg/kg bw was used for the calculations of the RQs. When this LD_{50} was used for herbivore/insectivore RQ calculations the endangered species LOCs are exceeded at many sites for mammals foraging on short and tall grass, broadleaf plants, and small insects. The RQs range from 1.72 for asparagus to 0.01 for potatoes. However, there are no LOC exceedances for granivorous mammals in any of the weight classes for all scenarios.

The LOC exceedances for herbivores and insectivores can be explained by the larger percentage of body weight consumption and higher predicted residue levels than those of the granivores. The percent of the body weights consumed for 15, 35, and 1000 g herbivorous/insectivorous mammals are 95, 66, and 15% respectively in contrast to 21, 15, and 3% consumed for granivorous mammals. In addition, the predicted residue levels short grass, broadleaf forage/small insects are, in most cases, an order of magnitude higher than those of large insects and seeds.

The uses with higher application rates such as asparagus, cranberries, non-cropland, and forestry

allow maximum applications rates of up to 4 lb ae/A. In addition, asparagus applications can be applied 2 times per year. These use rates account for the higher LOC exceedances for herbivores and insectivores.

Although banded applications are not addressed in the master label, a number of labels which are currently registered provide for the use of unincorporated banded applications to selected row crops. The row crops on the master label which could potentially be applied as a band treatment include forest uses, sorghum, blueberry, corn, soybean, asparagus, and potato. As discussed above for birds, if the use rate is not adjusted by dividing the width of the band by the row width of the field banded sprays, the RQs will be 5 times higher for the unadjusted use rates. If one considers the adjusted rate RQs only, the acute risk LOCs are exceeded for all but 1000 g mammals. The RQs range from 0.01 for potatoes to 6.19 for asparagus, considering the effect of lower applications rates on RQs indicate that they will not be reduced below LOCs.

The 2,4-D Master Label allows granular applications on non-cropland, turf, cranberry, and aquatic sites. As explained above for birds, the concentrations for the aquatic uses were estimated from surface applications sub-surface injection at the rates of 10.8 lbs. ae per acre foot to attain a maximum concentration of 4 ppm. It is presumed that the granules will descend to the bottom of the water body and reach an equilibrium in the water column to attain a concentration of 4 ppm. Mammals inhabiting or using this habitat would have to ingest or consume a large amount of water, selectively ingest enough granules, or sediment to approach an acute LD_{50} of 579 mg/kg, and it is likely that negligible potential risk to mammals would result from aquatic applications. The cranberry use which would be restricted to aquatic areas would also presumably pose no potential risk to mammals. The two other use sites (non-cropland and turf) remain a potential concern for mammals and these uses account for very wide spread use of 2,4-D over large areas. These RQs range from 0.04 to 4.8.

Chronic Risks

The mammalian chronic risk assessment utilized a toxicity endpoint from a rat two-generation reproduction test. This endpoint was the NOAEL for growth rate reductions in F1b offspring. The agency considers that reduced growth (reductions in pup body weight gains relative to controls) in offspring as a potentially important effect with implications for the survivability of offspring and therefore a potential impact on fecundity. Because the endpoint is the no effect level for this measured parameter, evaluations of the significance of any exposure excursions above this endpoint were conducted. From the same two-generation rat reproduction study, the LOAEL associated with F1b pup growth rate reduction was 20 mg/kg-bw/day. This LOAEL corresponds with body-weight gain reductions of 15 to 17 % (males and females) relative to controls. The 20 mg/kg-bw/day dose level also represents a NOAEL for increased gestational length and incidents of skeletal anomalies and reduced ossification in F1b pups. The LOAEL for these gestational and skeletal effects is 80 mg/kg-bw/day.

In addition to the available rat two generation reproduction study, number of developmental toxicity studies are available in rats and rabbits for the acid, amine salts and esters. These data

are from studies involving short-term exposures during critical periods of fetal development and are useful to determine if long-term or short-term exposure events are necessary for the types of effects observed in the two-generation reproduction study. MRID 41747601, developmental toxicity in rabbits with the acid, shows a NOAEL of 30 mg/kg-be/day for increased rate of fetal abortions, with a LOAEL 90 mg/kg-day. Similar NOAEL and LOAEL thresholds were observed in studies rabbits with the amine salts and esters of 2,4-D. MRID 000251031, developmental toxicity in rats with the acid, showed a NOAEL of 25 mg/kg-bw/day and a LOAEL of 75 mg/kg-bw/day for increased incidence of skeletal malformations. Similar results are reported in other studies with rats involving the amine salt and esters of 2,4-D.

Daily wild mammal oral dose estimates for dietary sources (both upper bound and mean estimates) have been compared with a number of toxicity endpoints from the above discussion. Figures (see Appendix H) showing comparisons of daily dose estimates with (1) the 5 mg/kg-bw/day threshold (NOAEL pup growth rate) used for RQ calculations, (2) a 25 mg/kg-bw/day endpoint associated with a NOAEL for skeletal malformations and reasonably close to the established LOAEL for pup growth reductions and gestational effects (actually 20 mg/kg-bw/day) and, (3) a 75 mg/kg-bw/day endpoint associated with skeletal malformations. From these comparisons it can be seen that daily oral dose estimates for wild mammals are sufficiently high to exceed toxicity endpoints ranging from fetal growth reduction to skeletal malformations. Moreover, the analysis suggests that daily exposure estimates for wild mammals are sufficiently high to exceed effects thresholds for developmental effects tested over very short durations of exposure.

Because of the high proportion of body weight consumed each day, daily dietary dose estimates are the highest for the 15 and 35 gram mammals and they exceed levels associated with frank skeletal malformations, gestational length effects, and growth reductions for all 2,4-D use scenarios considered (except potatoes and citrus). The concerns for these small mammal classes are still evident, even when daily dose estimates are based on mean residues. Most of these small mammals have multiple reproduction events in a given year, suggesting that altering the timing of application may not be an effective strategy for avoiding reproduction events in such small mammals. For larger size classes of mammals (e.g. 1000 gram) daily dietary estimates exceed the skeletal malformation endpoint for non-crop/forest uses (4 lbs/1 app.) , asparagus (4 lbs/2 app./30-d interval), and pasture, rangeland and grassland uses (2 lbs/2 app./30-day interval). Other uses exceed the NOAEL for gestational effects and the LOAEL for pup growth rate reductions, with these concerns extending to considerations of both upper bound and mean residues of dietary 2,4-D. Again, only potatoes and citrus uses are associated with daily dose estimates below chronic effects levels for 1000 gram mammals.

Mammalian chronic RQs range from 0.1 to 200 and chronic levels of concern were exceeded in all cases with the exception of potatoes and citrus (large insects, seeds). These RQs result from chronic data that exhibit a NOAEL of 5 mg /kg/day from a 2-generation reproduction rat toxicity study and exposures at maximum application rates and maximum food item residue data. The toxic endpoints for the parental toxicity in this study were based on decreased female body weight/body- weight gain (F1) and male renal tubule alteration in the F0 and F1 generations.

The toxic endpoints of 5 mg/kg/day for the offspring toxicity is decreased pup body weight [F1b]. At the 80 mg/kg/day dose there was an increase in pup deaths.

Additional developmental toxicity studies on rats and rabbits indicate that the NOAEL of < 10 mg ae/kg/day does not differ greatly from the 2-generation reproductive study NOAEL. These developmental toxicity studies were performed on the 2,4-D acid, all the amine salts, as well as two of the esters.

All the calculated RQs for mammalian acute risk for the non-granular use of 2,4-D were based on maximum labeled application rates. The QUA from BEAD suggests that the average application rates for many crops are considerably less than the modeled maximum application rates. For non-granular spray application mammalian acute concerns, the highest RQ was 1.72 for use on asparagus for small mammals feeding on short grass based on a maximum application rate of 4 lbs ae/acre; however, the average application rate was only 1.10 lbs ae/acre (BEAD QUA). If the modeled application rate was reduced to the reported average application rate of 1.10 lbs ae/acre for asparagus, the RQ would be 1.08 which is still above the acute LOC of 0.5.

Asparagus is representative of a minor 2,4-D use. To add context to the mammalian assessment, a consideration of the effect of assuming an average application rate was completed to provide context to the risk assessment. Major 2,4-D crops include pasture/rangeland, turf, wheat, corn, and soybeans. For pasture/rangeland, the highest acute RQ was 0.86 for small mammals feeding on short grass based on a maximum application rate of 4 lbs ae/acre. However, the average application rate was only 0.62 lbs ae/acre (BEAD QUA). If the modeled application rate was reduced to 0.62 lbs ae/acre for pasture/rangeland resulting in a RQ of 0.31 which is below the acute LOC but still above the restricted use LOC of 0.2. Similar trends are noted for other major use sites.

For chronic exposure to non-granular spray applications, the RQs for mammals based on maximum residue levels ranged from 0.39 to 200, while the RQ based on mean residue levels ranged from 0.02 to 71. Consideration of average application rates results in some reduction in EECs but not below the chronic LOCs.

Alternatively, consideration of average application rates for avian acute exposures for banded and granular applications results in a reduction of some EECs below the acute LOC but does not reduce the EEC below either the restricted use or endangered species LOCs. Acute LOCs are still exceeded for banded adjusted and unadjusted applications for many sites for small and medium birds. No typical use rate information is available for granular applications to turf and aquatic sites.

Risks to Non-Target Insects

EFED currently does not quantify risks to terrestrial non-target insects. RQs are therefore not calculated for these organisms. Since the test results from one of the salts (2,4-D DMAS) and 2,4-D EHE was practically non-toxic to honey bees (LD_{50} of >100 µg/bee), the potential for 2,4-

D and its salts and esters is not likely to have adverse effects on pollinators and other beneficial insects. However, extrapolating risk conclusions from a single tested species to all insect species is an uncertainty in this risk assessment.

Risks to Terrestrial Plants

Based on the available data, potential risks to terrestrial plants are possible based on LOC exceedances. RQs were evaluated for multiple and single applications of plants inhabiting dry and semi-aquatic areas for non-endangered and endangered plants. These RQs included risk to monocots and dicots applied as non-granular and granular sprays. Most chemical forms are applied as broadcast spray applications, however, many of the currently registered labels allow banded applications to row crops. In addition, since the water solubility for the esters is notably lower than that of the acid and amine salts, and the EFED runoff scenario is based on the solubility of the compound, the environmental concentrations must be calculated separately for the esters.

The RQs resulting from granular broadcast applications range from 2.2 (single application) to 266 (multiple applications) for the acid and amine salts to 2.0 to 1702 for the esters. According to the 2,4-D Master Label the only use sites which allow applications of granular formulations are the non-crop land sites, turf, and cranberries. Since these use sites are not considered as row crops, it is presumed that banded applications will not occur.

A large number of terrestrial plant studies were evaluated using various chemical forms, active ingredients, and plant species. It should also be noted that a number of 2,4-D active ingredients lack valid data for some studies. Additionally, there appears to be no valid vegetative vigor data for the 2,4-D DMAS , 2,4-D IPA, 2,4-D TIPA, and 2,4-D BEE. However, due to the fairly rapid conversion of the amine salts and esters to the acid in the terrestrial environment a decision was made to consider the most sensitive plant from the acid and amine salts when calculating RQs. The most sensitive plant from the ester studies was used to calculate the RQs separately due to the solubility differences between the acid/amine salts and the esters. Therefore, as a result of collectively broadening the toxicity values to the acid and amine salts as well as examining the combined ester toxicity values, EFED believes that requiring additional data for these amine salts and esters will not add much value to a deterministic risk assessment.

The range in terrestrial plant RQs can be accounted for by the greater sensitivities of the dicots when compared to the monocots sensitivities. In all cases the dicot EC_{25} and NOECs are far more sensitive than the dicot values. In addition, the maximum use rates differ widely for the various use sites. RQs are lowest for the potato and citrus use sites where rates range from 0.07 to 0.1 lb ae/A respectively.

2,4-D is a plant growth regulator that is absorbed through the roots and foliage within 4-6 hours and distributed throughout the plant *via* the xylem and phloem. Once in the plant it selectively eliminates broadleaf plants by mimicking the effect of plant growth regulating hormones. This action stimulates growth which leads to an abnormal growth pattern and death in some plants.

Therefore, if even a portion of the surface area of a non-target plant comes into contact with 2,4-D there is a possibility that the plant may be severely damaged or die as a result. Even if the plant only exhibits minor damage, the damage may be sufficient to prevent the plant from reproducing or competing successfully or with other plants for resources, including water. The use of 2,4-D could apply selective pressure against dicots along field edges resulting in changes in species composition.

Application timing is a consequential factor to consider. Reproduction abnormalities are some of the plant injuries that can occur due to 2,4-D exposure during particular developmental stages. Although the plant may survive, sterile florets or non-viable seed production can occur. This will have effects on the non-target plant populations in future years. Also, plant material serves as a primary food source for many species of animals. If the available plant material (including seeds) are reduced due to the effects of 2,4-D, this may have negative effects throughout the food chain.

Spray drift can also be an important factor in estimating the risk of 2,4-D to non-target plants. There may be a 5-fold increase in the RQs when aerial application is used as opposed to ground application.

Spray drift exposure from ground application is assumed to be 1% of the application rate and the EECs and RQs were calculated using EFED's TerrPlant.xls model (Version 1.0). The AgDrift Tier 1 model (ground application, fine to medium coarse nozzle, and low boom height) was used to determine what conditions are represented by a 1% spray drift exposure from ground application. 2,4-D labels do not restrict applications to these conditions so actual values could be higher. AgDrift provided both the 50^{th} and 90^{th} percentiles estimates based on the distribution of field measurements at different distances from the edge of field and averaged over a swath of given width from the edge of the field. The 50^{th} and 90^{th} percentile drift estimates from AgDrift were 0.8 and 1.3% of applied at a distance 25 ft from the edge of the field. The 50^{th} and 90^{th} percentile drift estimates were 1.0 and 1.3% averaged over a swath 175 feet from the edge of the field. Therefore, EFED's TerrPlant model can be interpreted to represent exposure to non-target terrestrial plants in either of two ways. First, TerrPlant models the exposure to drift from ground spray at a distance of 25 ft from the edge of the field. Distances closer to the field than 25 ft would have an exposure higher than modeled by TerrPlant and distances farther from the field than 25 ft would have an exposure lower than modeled. A second interpretation is that TerrPlant models the average exposure across a swath 175 feet wide starting at the edge of the field. Within this swath, the exposure is higher close to the edge of the field than it is at distances further from the field.

The risk assessment for terrestrial plants was based on RQs calculated from toxicity studies using the technical grade of 2,4-D acid, salt, and esters instead of TEPs (typical end-use product). Often the TEPs include surfactants or adjuvants to increase the herbicide's absorption into the plant, thereby increasing its efficacy. If the toxicity tests were conducted using a TEP of 2,4-D at the same rates as the technical grade, the toxicity endpoints are likely to be much lower. Furthermore, if the toxicity endpoints were reduced in studies using the TEP, the RQs and the risks would be higher than currently estimated.

For 2,4-D, a total of 106 terrestrial plant studies were selected for use in the 2,4-D risk assessment using various chemical forms and species. Typically, EFED evaluates risk to non-target terrestrial plants using the EC_{25} for the most sensitive species tested. Although a range of sensitivities was observed in the studies, a majority of the tests indicated that all plant species are sensitive. In order to test the conservativeness of this approach, EFED evaluated the full range of EC_{25} results by preparing a distribution of all 106 EC_{25} values. EFED then compared the values within the distribution to determine which values would result in RQs which exceed the LOC. In this instance, the 57_{th} percentile of the definitive EC_{25}s (0.12 lbs ae/acre) for 2,4-D results in an RQ which just exceeds the LOC. In other words, 57 percent of the EC_{25} values used in this risk assessment will result in RQs which exceed the LOC while 43 percent will not exceed the LOC. This indicates that although there is a range of plant sensitivities to 2,4-D, a majority of the tested species have a high sensitivity to 2,4-D, and therefore, this assessment for terrestrial plants is not overly conservative.

Several refinements and comparative analyses were conducted to provide context to the exceedances discussed above. The analyses were completed to provide context to the exceedances and to provide characterization of the potential risk and where further refinement and mitigation might be focused. In this risk assessment, additional analysis was conducted to evaluate the effect of spray drift on the potential risk to terrestrial plants and to evaluate the relative risk when comparing potential exposures predicted using maximum label rates versus typical application rates.

Analysis of the relative importance of spray drift on the overall risk to non-target terrestrial plants from 2,4-D use was evaluated. In order to provide some context to the potential risk the terrestrial non-target plant toxicity value was used as an input into the AgDRIFT model as a percentage of the application rate to determine the distance beyond which no risk is predicted to occur assuming a fine to medium spray. This analysis was conducted for both seedling emergence and vegetative vigor using both the EC_{25} and the $NOAEC/EC_{05}$ and assuming a fine to medium droplet size.

Initially, the model was run using the maximum labeled application rate (4.0 lbs ae/acre for use on asparagus) and compared against endangered plants toxicity values. These values are input into AgDRIFT and a downwind distance was calculated beyond which no effect, based on the most sensitive endpoint, would be expected to occur. In the case of endangered plants the most sensitive endpoint was the vegetative vigor value for 2,4-D DEA on dicots (NOEC = 0.002 lbs ae/acre on tomatoes). Using this value and an assumed droplet size spectrum of fine to medium (the default value in AgDRIFT) the downwind distance was beyond the range of the model (997 feet). In other words, for 2,4-D use the downwind distance beyond which no adverse effect to endangered non-target terrestrial plants would occur cannot be predicted but is beyond 997 feet from the application area. The major use of 2,4-D is on rangeland/pastureland with an application rate of 2 lbs ae/acre and comparing this use against the most sensitive endpoint yields a downwind distance beyond 997 feet from the application area. By way of comparison, the least sensitive endpoint for a non-target crop from all reviewed toxicity values was 4.2 lbs

ae/acre for vegetative vigor (tomatoes). Using this value yields a downwind distance of 0 feet.

Similarly, using typical application rates versus labeled maximum application rates provides additional context to the analysis. In the case described above, it is assumed that the maximum label rate is 4.0 lbs ae/acre for asparagus and the percentage of applied for the toxicity value is estimated from this rate. As noted in the aquatic assessment additional data is available on the typical rates for most uses. The maximum typical rate is 1.10 lbs ae/acre for asparagus and 0.62 lbs ae/acre for rangeland/pastureland. Using the asparagus rate of 1.10 lbs ae/acre and applying the percent of applied technique to the terrestrial non-target plant data yields a downwind distance for the most sensitive endpoint (0.002 lbs ae/acre for vegetative vigor) that is still beyond the range of AgDRIFT. A similar distance is noted for the rangeland/pastureland application rate. This analysis indicates that even using the typical use rates the distance downwind beyond which potential effects are expected is large.

Increasing the droplet size in AgDRIFT to the coarse to very coarse droplet size spectrum still results in downwind distances that are beyond the range of AgDRIFT for the most sensitive endpoints using the maximum application rate (4.0 lbs ae/acre) and the typical application rate (1.10 lbs/acre). This suggests that increasing the droplet size spectrum for 2,4-D is not likely to reduce exposures and that overall, offsite impacts to non-target terrestrial plants are likely far beyond the application area.

Overall, the risk assessment for terrestrial plants has been conducted using EEC generated with maximum label rates. Consideration of average application rates for exposure estimates for terrestrial plants has not been conducted. RQs for terrestrial plants for single non-granular applications range from 0.13 to 136 for the acid and amine salts while the RQs for the esters range from <0.01 to 936. Consideration of average application rates may reduce these EECs but will not result in reductions below LOCs.

Uncertainties in the Terrestrial Assessment

There are a number of general areas of uncertainty in the terrestrial risk assessment including:

1. **This assessment accounts only for exposure of terrestrial organisms to 2,4-D, but not to its degradates.** The potential toxicity of degradates of 2,4-D is unknown. The risks presented in this assessment could be underestimated if degradates also exhibit toxicity under the conditions of use proposed on the label. Since 2,4-D can only be applied to a field once per year, the acute terrestrial assessment would not change if some or all degradates were assumed equipotent. For the chronic assessment, the risks would be higher if all degradates were assumed equipotent. Although the EECs used for calculating the RQs would be the same (since there is only one application per year), the length of exposure in exceedance of the toxicological endpoints would be longer. The concentration of the parent material would decline according to the estimated half-live, but as the parent material degrades, the concentration of the degradates would increase. HEDs Metabolite Assessment Review Committee (MARC) has determined that none of

these degradates are of concern, therefore, no degradates were included in the drinking water assessment. A table presenting all environmental fate degradates detected is in Appendix A.

2. **The risk assessment only considers the most sensitive species tested.** Terrestrial acute and chronic risks are based on toxicity data for the most sensitive bird, mammal, and plant species tested. Responses to a toxicant can be expected to be variable across species. In the case of 2,4-D, only two bird, three mammalian, one beneficial insect, and 10 agricultural plant species were tested. Sensitivity differences between species can be considerable (even up to two orders of magnitude) for some chemicals (ECOFRAM 1999). The position of the tested species relative to the distribution of all species' sensitivities to 2,4-D is unknown. In addition, the toxicity of 2,4-D to wild (non-laboratory) species relative to laboratory species is unknown. Extrapolating the risk conclusions from the most sensitive species tested to non-tested species may either underestimate or overestimate the potential risks to those species.
3. **The risk assessment only considered a subset of possible use scenarios.** For this risk assessment, the scenarios were selected to represent a range of application rates, crops, and geographic areas. An attempt was made to examine scenarios that are expected to cause the greatest risks based on geographic and application-related factors. It is possible, however, that some of the labeled uses (crop-geographic region combinations) that were not modeled will have a greater risk to the environment than those included in this risk assessment. These uses that may exhibit a greater risk to the environment would include those occurring in or near sensitive environments (e.g., close proximity to habitat that supports or has the potential to support endangered or threatened terrestrial species).

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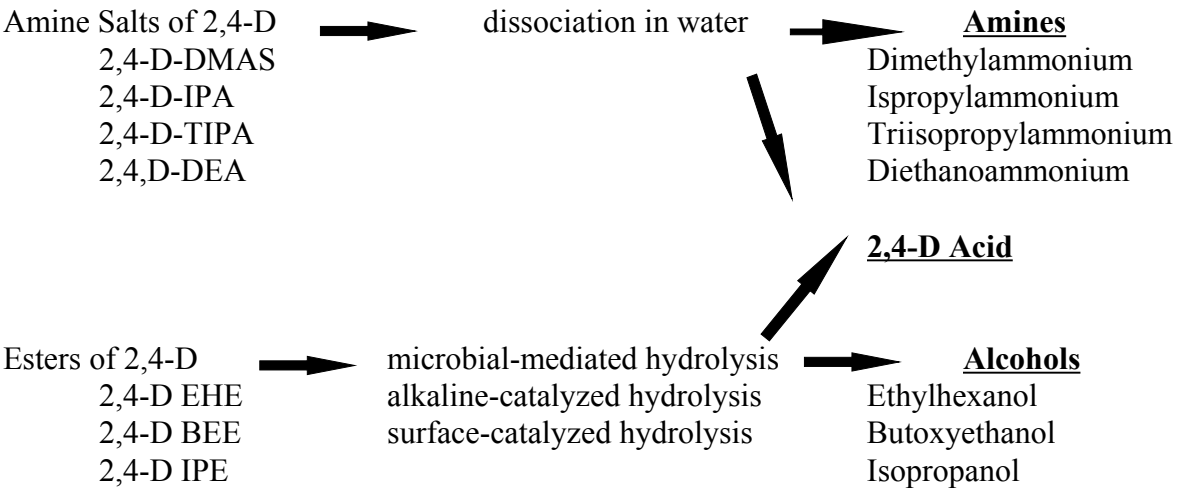
APPENDIX A: Environmental Fate Assessment

Environmental Fate Assessment

General Fate Strategy

An environmental fate strategy was proposed to bridge degradation of 2,4-D esters and amine salts to the formation of 2,4-D acid (Registration Standard for 2,4-Dichlorophenoxyacetic acid (2,4-D), 1988, 540/RS-88-115). The bridging data provides information on the time of dissociation of 2,4-D amine salts and rate of hydrolysis of 2,4-D esters (Figure 1). There are acceptable bridging data for 2,4-D DMAS, 2,4-D IPA, 2,4-D TIPA, 2,4-D EHE, 2,4-D BEE, 2,4-D DEA, 2,4-D IPE. The sodium salt of 2,4-D is considered to be equivalent to 2,4-D. The bridging data indicate esters of 2,4-D are rapidly hydrolyzed in alkaline aquatic environments, soil/water slurries, and moist soils and that the 2,4-D amine salts have been shown to dissociate rapidly in water. Under extremely dry soil conditions, these degradation mechanisms may be inhibited to increase persistence of 2,4-D esters . The laboratory bridging data indicate under most environmental conditions 2,4-D esters and 2,4-D amine will degrade rapidly to form 2,4-D acid.

Figure 1. Schematic of Bridging Strategy of 2,4-D amine salts and 2,4-D esters to 2,4-D



Additional data submitted subsequent to establishment of the environmental fate bridging strategy generally support the strategy for the amine salts. Direct evidence of the stability of 2,4-D amine salts in soil and aquatic environments is difficult due to the lack of analytical methods. Based on maximum application rates for 2,4-D amine salts (@ 4 lbs ai/A), 2,4-D amine salts are expected to fully dissociate in soil environments because their theoretical concentrations in soil solution does not exceed water solubilities. Additionally, dissociation studies indicate the time for complete dissociation is rapid (< 3 minutes). Although the analytical methods in the field studies for 2,4-D DMA were not capable of separating and identifying 2,4-D DMAS from 2,4-D acid, the most conservative half-lives of 2,4-D DMAS would be equivalent to the 2,4-D acid half-lives in field studies. Half-lives of 2,4-D in 2,4-DMAS field studies ranged from 1.1 days to 30.5 days with a median half-life of 5.6 days.

The de-esterification of 2,4-D esters is more difficult to generalize because it is dependent on heterogenous hydrolysis (microbial-mediated and surface-catalyzed hydrolysis) and homogenous hydrolysis (alkaline catalyzed) (Schwarzenbach, et al.1993). The deesterification of 2,4-D ester leads to formation of 2,4-D acid and an associated alcohol moiety. Unlike the physical dissociation mechanism of 2,4-D amine salts, the de-esterification of 2,4-D esters is dependent on abiotic and microbial-mediated processes. Any environmental variable influencing microbial populations or microbial activity could theoretically influence the persistence of the 2,4-D ester. Soil properties including clay mineralogy, organic carbon content, temperature, and moisture content are known to influence hydrolysis rates (Wolfe, et al, 1989 and Wolfe, 1990).

Paris, et al (1981) found the average de-esterification half-life of 2,4-D BEE in natural waters from 31 sites with varying temperature and pH conditions (5.4 to 8.2) was 2.6 hours. They found that 2,4-D BEE degradation could be explained using second-order kinetics accounting for microbial population numbers and aqueous concentration of 2,4-D BEE. Further research indicated second-order de-esterfication rates can be predicted through a linear regression [log k_b=(0.799±0.098)* log K_{ow}-(11.643±0.204) r^2=0.94] using the octanol:water coefficient (log K_{ow}) as the independent variable.

Additionally, various mineral surfaces (Fe, Al, Ti oxides) have been shown to influence hydrolysis of carboxylate esters (Torrent and Stone, 1994). Abiotic hydrolysis of 2,4-D esters, however, is expected to be more predictable in alkaline environments. Several field studies show phenoxy herbicide esters are more persistent under extremely dry soil [< soil wilting point (~15 bars)] conditions (Smith and Hayden, 1980; Smith, 1972; Smith,1976). In moist soils [~50 to 80% field capacity (~0.3 bars)] and soil slurries, phenoxy herbicide esters degraded rapidly (>85% degradation) during a 48 hour incubation period. These hydrolysis studies indicate the alkyl chain configuration affected hydrolysis rates in soils and soil slurries. The iso-octyl ester of 2,4-D (2,4-D EHE) had slower hydrolysis rates when compared to n-butyl and isopropyl esters of 2,4-D. In field studies, Harrison, et al (1993) found no detections of 2,4-D and 2,4-DP esters in runoff water (though detection limits were relatively high @ 20 ug ae/l for 2,4-D EHE) from turf sites where 2,4-DP and 2,4-D esters were applied.

Registrant sponsored research indicates the 2,4-D esters (ethylhexyl, isopropyl, butylethyl) degrade rapidly ($t_{1/2}$< 24 hours) in soil slurries, aerobic aquatic environments, and anaerobic, acidic aquatic environments. In terrestrial field dissipation studies for 2,4-D EHE, the half-lives for 2,4-D EHE ranged from 1 to 14 days with median half-life of 2.9 days. 2,4-D BEE, applied as granules, degraded rapidly in the water column in aquatic field dissipation studies under alkaline conditions. However, the 2,4-D BEE residues were detected in sediment samples from Day 0 (immediately posttreatment) to 186 days posttreatment. It is unclear whether 2,4-D BEE persistence in sediment is due to the slow release of the granule formulation or to slow deesterification of sediment bound 2,4-D BEE. Available open-literature and registrant sponsored laboratory data would suggest slow granule dissolution prolonged the persistence of 2,4-D BEE. In forest dissipation studies, the 2,4-D EHE ester degraded slowly on foliage and in leaf litter.

The weight of evidence from open-literature and registrant sponsored data indicates that 2,4-D amine salts and 2,4-D esters are not persistent under most environmental conditions including those associated with most sustainable agricultural conditions. 2,4-D amine salt dissociation is expected to be instantaneous (< 3 minutes) under most environmental conditions. Although the available data on de-esterification of 2,4-D ester may not support instantaneous conversion from the 2,4-D ester to 2,4-D acid under all conditions, it does show 2,4-D esters in normal agriculture soil and natural water conditions are short lived compounds (< 2.9 days). Under these conditions, the environmental exposure from 2,4-D esters and 2,4-D amines is expected to be minimal in both terrestrial and aquatic environments. Further analysis is required on reason(s) for 2,4-D BEE persistence in sediments from aquatic field studies. Additionally, the persistence of 2,4-D EHE on foliage and in leaf litter from registrant submitted forest field dissipation studies requires additional investigation. No field dissipation data (terrestrial, forest, or aquatic) have been submitted for the amine salts, 2,4-D IPA, 2,4-D TIPA, and 2,4-D DEA, or for the esters 2,4-D BEE (aquatic field dissipation data is available for this chemical form) and 2,4-D IPE to confirm their persistence under field conditions.

2,4-D Chemical Forms

Amine Salts

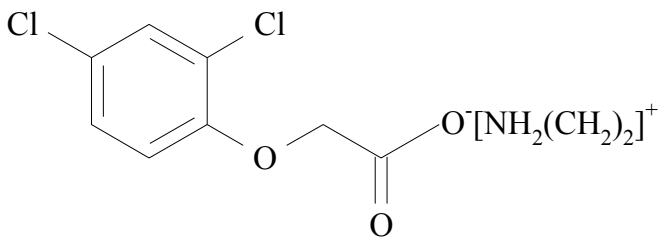
General: The EFED strategy for assessing the environmental fate of 2,4-D amine salts is based on bridging of laboratory fate data from the 2,4-D amine salt to 2,4-D. Dissociation data were required to document the rapid conversion of 2,4-D amine salts to 2,4-D acid. In addition, terrestrial field dissipation studies were required to document environmental fate of 2,4-D amine and 2,4-D under actual use conditions. It is important to note the analytical methods in field dissipation studies were designed to detect only 2,4-D, 2,4-DCP and, 2,4-DCA. Therefore, a half-life of 2,4-D amine salts could not be determined from the terrestrial, aquatic, and forest field dissipation studies.

2,4-D DMAS

Physical and Chemical Properties

Common name:	2,4-D DMAS
Chemical name:	dimethylamine 2,4-dichlorophenoxyacetate
Molecular formula:	$C_{10}H_{13}Cl_2NO_3$
CAS Number:	2008-39-1
Molecular weight:	266.13
Vapor pressure (20°C):	Dissociates rapidly to acid
Henry's Law:	Not reported. Dissociates rapidly to acid
Solubility (25°C):	72.9 g/100 mL @ 20 ^{0}C
Log K_{ow}:	Not reported. Dissociates rapidly to acid

Chemical structure of dimethylamine 2,4-dichlorophenoxyacetate:



2,4-D-DMAS

- **Dissociation Study (MRID 41308901)**

Analytical grade 2,4-D and 2,4-DMAS, in HPLC grade water had dissociation times of 120 minutes and 1minute, respectively. Complete dissociation was determined through a comparison of theoretical and estimated electrical conductance measurements at infinite dilution. Conductance at infinite dilution was estimated using the Onsager equation; this equation is linear for fully dissociated compounds or strong electrolytes. 2,4-D DMAS had an estimated and theoretical conductance of 77 ：mhos and 73 ：mhos, respectively. 2,4-D had an estimated conductance of 379 ：mhos and theoretical conductance of 360 ：mhos.

- **Batch Equilibrium (Accession No. 00023098)**

The Freundlich adsorption coefficient of 2,4-DMA, at 20 to 50 ：g/L, was 0.99 (n=1.00;0.M.=10.5%) in a Melfort loam, 0.45 (n=1.05;O.M.=6.46%) in a Weyburn Oxburn loam, 0.19 (n=1.22; O.M.=4.15) in a Regina heavy clay, 0.53 (n=0.97;O.M.=4.1) in Indian Head loam, and 0.00 in a Asquith sandy loam (O.M.=1.77%).

- **Field Drift Evaluation (Accession No. 235247; Phipps, F.E and Emenegger, no MRID or Accession #; Acc. No. 249863)**

2,4-D DMA (4 lbs ai/gal), at 1 lb/A using a straight stream system or a microfoil boom from a helicopter at a spray height of 100 feet and crosswinds of 4-8 mph, had drifted 400 yards from the application site in Belle Rose, LA. The application of Nalco-Trol, at < 0.5%, reduced drift from a straight stream system. Comparative drift was less with the microfoil boom than with the straight stream system.

DED-WEED 2,4-D Amine SULV, at 0.75 to 2.00 a.i. lb/A as 5 GPA using D-4 and D-8 nozzles at 25 psi at spray heights of 15 to 20 feet and crosswinds of 2 to 13 mph, had drifted 1320 feet

downwind at a site in Dallas, OR.

Dimethylamine and Diethylamine salts of 2,4-D (formulated as Estemine, Standard, Ultra-SULV), at 1.9 a.i. lb/A as 5 GPA using D-4-46 for ULV formulations and D10-40 nozzles at 25 psi at spray heights of 10 feet and crosswinds of 2 to 16 mph, had drifted downwind 200 feet at a site in Olathe, KS. Airborne 2,4-D was detected (0.17 to 0.20 mg/filter) 200-feet downwind from the application site.

- **Terrestrial Field Dissipation Studies (MRIDs 4705201;43864002;43831703; 43500301;43470401;43849101;43612101;43592802;43810701;43797902;43872401; 43676803;43872701;43872702;4383301)**

General: In order to address the field behavior of 2,4-D under actual use conditions a total of 15 terrestrial field dissipation studies were conducted using 2,4-D DMAS. Field studies were conducted using 2,4-D DMAS on bareground, pasture, turf, and wheat. In addition, three aquatic field dissipation studies and one forest field dissipation study were conducted using 2,4-D DMAS.

The registrant submitted 15 terrestrial field dissipation studies in CA, CO, NC, ND, NE, OH and TX on bareground plots as well as plots cropped to corn, pasture, turf and wheat. **For all studies conducted using 2,4-D DMAS, the first-order 2,4-D half-lives ranged from 1.1 days to 30.5 days with a median half-life of 5.6 days**. These half-lives reflect dissipation from the surface soil layer (0 to 6 inches) and do not include residues which have leached below the surface layer. The data indicate a rapid to moderately rapid dissipation rate for 2,4-D acid. The analytical methods in the field studies were not capable of separating and identifying 2,4-D DMAS from 2,4-D acid. Therefore, the half-lives of 2,4-D DMAS can be considered to be equivalent or less than those found for 2,4-D acid. Available data on the solubility and the time for complete dissociation of 2,4-D DMAS indicate it should fully dissociate in soil solution at maximum application rates (4 lbs/A). At the maximum application rate, the theoretical concentration in soil solution does not exceed the water solubility of 2,4-D DMAS. Dissipation rates for 2,4-D degradation products (2,4-DCP and 2,4-DCA) were not estimated because of their sporadic occurrence patterns in surface soils. The results of the field studies are consistent with half-lives from laboratory studies (**MRIDs 00116625 and 43167501**); 2,4-D half-lives under aerobic conditions ranged from 1.4 days to 12.4 days with a median half-life of 2.9 days.

2,4-D residues were detected below a depth of 18 inches in eleven of the terrestrial field dissipation studies reviewed and was detected below 30 inches in five studies **(MRID 43914701, 43762402, 43831703, 43849101, and 43872702**). Leaching appears to be a route of dissipation when precipitation or irrigation exceed evapotranspiration demands.

The following summary table presents the basic results of the individual field dissipation studies submitted for 2,4-D DMAS and 2,4-D. For a more detailed review of the individual studies the reader is directed to review individual Date Evaluation Records (DER).

MRID #	ST	County	EUP	Form	Use	Single App Rate (lbs ae/A)	No of Apps	Annual App Rate (lbs ae/A)	Surface Soil Half-life (First Application)-Days		Surface Soil Half-life (Second Application)-Days		Surface Soil Half-life (Third Application)-Days		Surface Soil Half-life (Fourth Application)-Days		Maximum Depth of Detection (inches)				Precip + Irrig (in)	Pan Evap (in)
									DMAS	2,4-D	DMAS	2,4-D	DMAS	2,4-D	DMAS	2,4-D	DMAS	2,4-D	2,4-DCP	2,4-DCA		
43705201	CA	Tulare	**DMAS**	Conc	Bare	2.2	2	4.4	NA	6.8	NA	4.1					NA	12	NA	6	26.8	
43864002	CA	Tulare	**DMAS**	Conc	Past	2.2	2	4.4	NA	4.1	NA	30.5					NA	12	6	6	56	
43831703	CA	Tulare	**DMAS**	Conc	Turf	2.2	2	4.4	NA	29.1	NA	8					NA	30	6	6	26.16	
43500301	CO	Eaton	**DMAS**	Conc	Bare	1.25	2	2.5	NA	5.6	NA	5.1					NA	6	6	NA	14.3	28.3
43470401	CO	Eaton	**DMAS**	Conc	wheat	1.25	2	2.5	NA	9.4	NA	6.1					NA	18			14.2	27.9
43849101	NE	York	**DMAS**	Conc	Bare	variable	4	5.5	NA	8.6	NA	3.9	NA	1.1	NA	2.8	NA	48	12	12	31.28	26
43612101	NC	Rowland	**DMAS**	Conc	Bare	1.25	2	2.5	NA	3.6	NA	3.1					NA	6	6	6	33.7	43.3
43592802	NC	Rowland	**DMAS**	Conc	wheat	1.25	2	2.5	NA	5.5	NA	2.7					NA	12	6	6	33.7	43.3
43810701	NC	Rowland	**DMAS**	Conc	Bare	2	2	4	NA	3.4	NA	2.5					NA	12	6	6		
43797902	NC	Rowland	**DMAS**	Conc	turf	2	2	4	NA	6.4	NA	12.1					NA	6	6	6		
43872401	ND	Northwood	**DMAS**	Conc	Bare	1.375	2	2.75	NA	7	NA	4.5					NA	24	6	6	16.016	
43676803	TX	Pattison	**DMAS**	Conc	Past	2	2	4	NA	3.5	NA	10.2					NA	12	6	NA	37.11	
43872701	ND	Northwood	**DMAS**	Gran	Turf	2.2	2	4.4	NA	10.3	NA	5.1					NA	18	6	6	12.9	
43872702	ND	Northwood	**DMAS**	Gran	Bare	2.2	2	4.4	NA	16.7	NA	15.2					NA	30	30	18	12.86	
43834301	OH	New Holland	**DMAS**	Conc	Bare	variable	4	5.5	NA	26	NA	4.4	NA	NA	NA	21	NA	12	6	12	26.6	52

- **Aquatic Field Dissipation Studies (MRID 43908302; 43954701; 43491601; Accession No. 00115741, 00128148, 00043278, 00115748**)

In aquatic field dissipation studies in ND, NC, and LA, 2,4-D acid, at 1.8 to 41.8 lbs ae/A, had an EFED estimated dissipation half lives of 20.7 and 2.7 days in water from the North Carolina pond after the first and second applications, 14 days and 6.1 days in water from a North Dakota pond after the first and second applications, and 1.0 day in water from the Louisiana rice paddy after the single application (**MRID 43908302; 43954701; 43491601)**. The analytical methods in the field studies were not capable of separating and identifying 2,4-D DMAS from 2,4-D acid. Therefore, the half-lives of 2,4-D DMAS can be considered to be equal or less than 2,4-D acid half-lives. Available laboratory data on the solubility and the time for complete dissociation of 2,4-D DMAS indicate it should completely dissociate in aquatic environments. At the maximum application rate, the target concentration in aquatic environments does not exceed the solubility concentration for 2,4-D DMAS Several issues limit interpretation of the aquatic field dissipation data including unreported flow rates through the ponds (if any), frozen storage stability data (none were submitted but surrogate data is available from other field dissipation studies), and low method recoveries for degradation products.

The high application rates result in peak concentrations of 4,800 ug/l at day 1 in the ND pond (application rate of 41.8 lb ae/acre), of 2,800 ug/l on day 0 in the NC pond (application rate of 41.8 lb ae/acre), and of 2,300 ug/l on day 0 in the LA pond (application rate of 1.8 lbs ae/acre). These concentrations are higher than the 2,4-D Maximum Contaminant Level (MCL) of 70 ug/l. 2,4-D concentrations in water did not decrease to below the MCL until after day 30 (1,500 ug/l) at the North Dakota pond, until after day 29 (860 ug/l) at the North Carolina pond, and until after day 3 (390 ug/l) at the Louisiana pond.

North Dakota

2,4-D DMAS (Gordon's Amine 400, 38.6% a.e.), applied twice (31-day interval) as a subsurface injection to a 14-acre pond at a nominal rate of 41.8 lb a.e./A/application, dissipated with registrant-calculated half-lives for 2,4-D acid (incorrectly reported as DT_{50}'s) of 29.5 days ($r^2 = 0.80$) in the sandy loam sediment and 6.5 days ($r^2 = 0.82$) in the pond water following the second application; however, the half-lives are questionable because greater than 50% of the residues dissipated between two sampling intervals (30 and 59 days posttreatment). EFED estimated a half life for 2,4-D acid in the total sediment column after the first application of 17.4 days ($r^2 = 0.56$) and after the second application of 28.8 days ($r^2 = 0.80$). EFED estimated a half life for 2,4-D acid in water after the first application of 14.0 days ($r^2 = 0.85$) and after the second application of 6.1 days ($r^2 = 0.84$). EFED estimates were done using linear regression on log-transformed data.

Following the first application, 2,4-D acid was initially present in the 0- to 5-cm sediment

depth at 0.25 ppm, was 1.2 ppm at 14 days posttreatment, and was 0.78 ppm at 30 days (1 day prior to the second application). In the 5- to 10-cm depth, 2,4-D acid was initially (day 1) present at 0.011 ppm and was 0.12 ppm at 30 days. The parent was present in the 10- to 15-cm depth at 0.027-0.033 ppm from 21 to 30 days posttreatment and in the 15- to 20-cm depth at #0.022 ppm from 0 to 30 days. The degradate 2,4-DCP was present in the 0- to 5-cm depth at #0.043 ppm at 0-14 days posttreatment and was 0.14 ppm at 21-30 days; 2,4-DCP was only detected once in the 5- to 10-cm depth at 0.025 ppm (one of three replicates) and was not detected below that depth. The degradates 2,4-DCA; 4-CPA; and 4-CP were not detected following the first application.

Following the second application, 2,4-D acid was initially present in the 0- to 5-cm depth at 1.0 ppm, was 1.5-1.6 ppm at 1- 30 days posttreatment, decreased to 0.068 ppm by 59 days (the next sampling interval) and was 0.016 ppm at 180 days. In the 5- to 10-cm depth, 2,4-D acid was present at 0.067-0.10 ppm from 0 to 30 days posttreatment, decreased with variability to 0.015 ppm by 120 days, then was 0.040 ppm at 180 days. The parent was present in the 10- to 15-cm and 15- to 20-cm depths at #0.014 ppm and #0.048 ppm, respectively, from 0 to 21 days posttreatment. The degradate 2,4-DCP was present in the 0- to 5-cm depth at 0.10-0.19 ppm from 0 to 21 days posttreatment, was a maximum of 0.40 ppm at 30 days, and was 0.14-0.26 ppm from 59 to 180 days. In the 5- to 10-cm depth, 2,4-DCP was detected twice at #0.011 ppm from 0 to 30 days posttreatment, was a maximum of 0.22 ppm at 90 days, and was 0.11 ppm at 180 days; 2,4-DCP was not detected below the 5- to 10-cm depth. The degradates 4-CP and 4-CPA were each detected only once in the sediment, at 0.021 ppm (one of three replicates) at 60 days (10- to 15-cm depth) and 21 days posttreatment (5- to 10-cm depth), respectively. The degradate 2,4-DCA was not detected following the second application.

In the pond water following the first application, 2,4-D acid was initially present at 4.7 ppm, was a maximum of 4.8 ppm at 1 day posttreatment, and was 1.2 ppm at 30 days (1 day prior to the second application). The degradate 2,4-DCP was present at 0.004-0.010 ppm from 0 to 30 days posttreatment. The degradate 4-CPA was present at 0.005-0.009 ppm from 0 to 3 days posttreatment.

Following the second application, 2,4-D acid was initially present at 3.1 ppm, was 3.4 ppm at 1 day posttreatment, decreased to 2.1 ppm by 21 days and 1.5 ppm by 30 days, and was last detected at 0.003 ppm at 59 days (the next sampling interval). The degradate 2,4-DCP was present at 0.004 initially and was 0.007-0.010 ppm from 3 to 30 days posttreatment. The minor degradate 4-CPA was present at 0.005-0.008 ppm from 0 to 59 days posttreatment. The degradates 2,4-DCA and 4-CP were not detected at any sampling interval.

North Carolina

Parent 2,4-D DMAS (Weedar® 64, 39.0% a.e.), applied twice (30-day interval) as a subsurface spray to a 2.4-acre pond at a nominal rate of 41.8 lb a.e./A/application,

dissipated with registrant-calculated half-lives for 2,4-D acid (incorrectly reported as DT_{50}'s) of 2.0 days ($r^2 = 0.92$) and 2.7 days ($r^2 = 0.98$) in the sandy loam sediment and water, respectively, following the second application. The parent compound (2,4-D DMAS) converted to the acid equivalent (a.e.), 2,4-D acid, during application, and all half-life calculations are based on the concentration of 2,4-D acid present in the sediment and water. EFED estimated a half life for 2,4-D acid in the total sediment column after the first application of 8.0 days ($r^2 = 0.94$) and after the second application of 15.8 days ($r^2 = 0.46$). EFED estimated a half life for 2,4-D acid in water after the first application of 20.4 days ($r^2 = 0.90$) and after the second application of 2.7 days ($r^2 = 0.98$). EFED estimates were done using linear regression on log-transformed data.

Following the first application, 2,4-D acid was initially present in the 0- to 5-cm sediment depth at 1.1 ppm, was 1.2-1.5 ppm at 1-7 days posttreatment, and decreased to 0.10 ppm by 29 days (1 day prior to the second application). In the 5- to 10-cm depth, 2,4-D acid was initially (day 0) present at 0.95 ppm and decreased with variability to 0.021 ppm by 29 days posttreatment. The parent was present in the 10- to 15-cm and 15- to 20-cm depths at #0.035 ppm and #0.021 ppm, respectively, from 0 to 29 days posttreatment. The degradate 2,4-DCP was initially (day 0) present in the 0- to 5-cm depth at 0.013 ppm, was a maximum of 0.48 ppm at 14 days posttreatment and was 0.040 at 29 days; 2,4-DCP was detected in the 5- to 10-cm, 10- to 15-cm, and 15- to 20-cm depths at #0.027 ppm at 14 and 21 days posttreatment. The degradate 4-CP was present in the 0- to 5-cm depth at 0.010-0.019 ppm from 14 to 29 days posttreatment.

Following the second application, 2,4-D acid was initially present in the 0- to 5-cm sediment depth at 0.62 ppm, was a maximum of 1.8 ppm at 1 day posttreatment, was 0.80 ppm at 3 days, and was last detected at 0.013 ppm at 14 days posttreatment. The parent was initially (day 0) present in the 5- to 10-cm depth at 0.11 ppm, was a maximum of 0.73 ppm at 1 day posttreatment, and was last detected at 0.019 ppm at 7 days. The parent was present in the 10- to 15-cm and 15- to 20-cm depths at #0.083 ppm from 0 to 3 days posttreatment and was not detected at any other sampling intervals at those depths. The degradate 2,4-DCP was initially (day 0) present in the 0- to 5-cm depth at 0.044 ppm, was 0.34 ppm at day 1 and 0.14 ppm at 3 days posttreatment, was not detected at 14-57 days, and was last detected at 0.011 ppm at 90 days. 2,4-DCP was present in the 5- to 10-cm depth at 0.17 ppm at 1 day posttreatment and was #0.029 ppm at 3-14 days; in the 10- to 15-cm depth, 2,4-DCP was #0.038 ppm from 1 to 3 days posttreatment. The degradate 4-CP was initially (day 0) present in the 0- to 5-cm depth at 0.020 ppm, was a maximum of 0.55 ppm at 3 days posttreatment and was last detected at 0.26 ppm at 7 days. 4-CP was present in the 5- to 10-cm depth at 0.047 ppm at 1 day posttreatment and was #0.017 ppm at 3-7 days; 4-CP was detected once in the 10- to 15-cm depth at 0.023 ppm (one of three replicates) at day 1. The degradates 2,4-DCA and 4-CPA were not detected in the sediment at any sampling interval or depth.

In the pond water following the first application, 2,4-D acid was initially present at 0.65 ppm, was 2.2 ppm at 3 days posttreatment, and was 0.86 ppm at 29 days. Following the

second application, 2,4-D acid was initially present at a maximum of 2.8 ppm, was 1.8 ppm at 3 days and 0.63 ppm at 7 days posttreatment, and was last detected at 0.011 ppm at 21 days. The degradate 4-CPA was present at 0.003-0.012 ppm from initially following the first application to 14 days following the second application. The minor degradate 2,4-DCP was present at 0.003-0.006 ppm from initially following the first application to 14 days following the second application. The minor degradate 4-CP was present at 0.001-0.003 ppm at 14-21 days following the second application. The degradate 2,4-DCA was not detected at any sampling interval..

Louisiana

2,4-D DMAS, applied at the targeted maximum label rate of 1.5 lb a.e./A, dissipated with a registrant-calculated half-life for 2,4-D acid of 1.1 days ($r^2 = 0.97$) in floodwater and 1.5 days ($r^2 = 0.88$) in soil on a flooded plot of Mowata silt loam soil planted to rice in south central Louisiana in Evangeline Parish.

In the floodwater, 2,4-D acid was initially present at a mean concentration of 1.3717 µg/mL at day 0, decreased to 0.5377 µg/mL by 1 day, and was last detected above the LOQ at 0.1945 µg/mL at 3 days posttreatment. Mean values are registrant-calculated averages of five replicate samples. The degradates 2,4-DCP, 2,4-DCA, 4-CPA, and 4-CP were not detected above the LOQ in any replicate water samples at any sampling intervals.

2,4-D acid was initially present in the 0- to 4-inch soil depth at a concentration of 0.011-0.017 µg/g (two of three replicates) at day 0, was 0.014 µg/g at day 1, and was detected below the LOQ by 3 days posttreatment. 2,4-D acid was detected in the 4- to 8-inch and 8- to 12-inch soil depths at 0.013 µg/g and 0.015-0.016 µg/g (two of three replicates), respectively, at 1 day posttreatment and was detected below the LOQ by 3 days posttreatment. Soil samples were not analyzed for residues of 2,4-D acid below the 0- to 4-inch soil depth at day 0. Total 2,4-D acid residues in all soil depths at 3 days posttreatment were 0.015 µg/g; however, no individual replicate samples were detected above the LOQ. The degradates 2,4-DCP and 2,4-DCA were not detected above the LOQ in any replicate soil samples at any sampling intervals.

2,4-D acid, formulated as Weedar 64 and applied at 20 and 40 lb/A, had a field dissipation half-life of < 3 days in reservoirs at Banks Lake, Washington and Fort Cobb, Oklahoma (**Accession No. 00115741**). The degradate dimethyl-nitrosamine was detected at pretreatment concentrations of 0.2 to 0.4 ug/l and post-treatment concentrations of 0.2 to 1.6 ug/l. The degradate 2,4-DCP was sporadically detected in hydrosoil samples from 7 days to 56 days post-treatment at 0.0078 to 0.0686 ug/g. The concentration of 2,4-DCP in a pretreatment control sample was 0.0114 ug/g. 2,4-D acid residue accumulation was observed < 0.0421 ug/g in carp and largemouth bass. No 2,4-D residues were detected in white suckers.

In the Rock Ranch canal and the Cherry Creek lateral (location unspecified in EFGWB review)

amended with 0.433 lbs acid equivalence (ae) and 1.20 lbs ae, respectively, as 2,4-D DMAS, 2,4-D had half-life of < 133 minutes for locations 7 miles downstream from the application site (**Accession. No. 00128148)**.

In the Guntersville reservoir on the Tennessee River amended with 2,4-D DMAS (4 lb/gal soluble concentrate/liquid) at 20 and 40 lb/A, the water concentration of 2,4-D was 4.8 ug/ml at 8 hours posttreatment and declined to < 0.11 ug/ml at 6 months posttreatment **(Accession No. 00043278**). Sediment concentrations of 2,4-D, at a 5 to 7-foot depth were < 0.37 ug/g at 3 months post-treatment. (Reviewer Note: EFGWB notes that "volatile solids" of sediment bound 2,4-D comprised 2.3 to 9.3% of the 2,4-D.) The concentration of 2,4-D in raw and treated waters from the reservoir was < 5.9 ug/ml.

In two ponds, a bayou, a lagoon, and a lake in LA, 2,4-D DMAS, applied at 1, 4, or 10 lbs/A, had a 2,4-D "residue" dissipation half-life of < 14 days (**Study Accession No. 00115748**). The concentration of 2,4-D residues at 7 days post-treatment ranged from 8 to 999 ug/l and then declined to 1 to 45 ug/l at 28 days post-treatment.

- **Aquatic Dispersion Studies (MRID 45897101)**

General: The 2,4-D Task Force recently submitted two dispersion and dissipation studies for the application of 2,4-D DMAS to control aquatic weeds. Although this study is currently under review in EFED, a study summary of the results is presented for additional information. The analytical methods in the field studies were not capable of separating and identifying 2,4-D DMAS from 2,4-D acid. Therefore, the dispersion and dissipation of 2,4-D DMAS can be considered to be equal or less than those found for 2,4-D acid. Available laboratory data on the solubility and the time for complete dissociation of 2,4-D DMAS indicate it should completely dissociate in aquatic environments. At the maximum application rate, the target 2,4-D DMAS concentration in aquatic environments does not exceed the solubility concentration for 2,4-D DMAS.

<u>Florida</u>

The first study was for the surface application of 2,4-D DMAS to a lake in Lake Woodruff, Florida for the control of water hyacinth. 2,4-D DMAS was surface applied, at a rate of 3.8 lbs ae/acre, to approximately 3.9 acres within an overall water body area of 2200 acres. Water samples were collected along 6 transect lines originating from the edge of the application area and extending up to 1600 meters away from the treated area. Samples were collected from near surface (25 centimeters below surface) and from near the bottom (25 centimeters above bottom when water was 58 inches deep or less, or 48 inches below surface when water was deeper then 58 inches). No sediment or plant samples were analyzed for 2,4-D acid. Residues of 2,4-D acid were analyzed using the RaPID Assay technique and were confirmed in selected samples using GC/MS. In transect A, the highest 2,4-D concentration was 270 ug/l at 3 hours post-treatment within the application site. Outside the application area, the highest 2,4-D concentration along

transect A was at 122 ug/l at Day 3, which is approximately 18.4 meters from the application area. All samples collected along transects B, C, D, E, and F were < 50 ug/l. The furthest point along the transects for 2,4-D detections (LOQ = 1.0 ug/l) was 911 meters from the application site along transect B on Day 5. The study authors calculated a dissipation half life for 2,4-D from the application area of 2.3 days ($r^2 = 0.65$). This half life does not distinguish between degradation, sorption, and transport away from the application area.

Minnesota

In the second dispersion and dissipation study, 2,4-D DMAS was applied by subsurface injection to a water body located in Green Lake, Minnesota for the control of Eurasian watermilfoil. 2,4-D was applied as 2,4-D DMAS by subsurface injection at a rate of 10.8 pounds of acid equivalent per acre-foot (lbs ae/acre-foot) to achieve a target concentration in the application area of 4 parts per million (ppm). 2,4-D DMAS was applied on September 11, 2002 to approximately 4.5 acres with a dense stand of Eurasian watermilfoil. Green Lake is located in Chisago County, Minnesota and is a 1714 acre lake and is reportedly a "low-flow" lake. The study authors report that the location, test site (static to low-flow lake) and application method were chosen because they represent a typical use pattern for 2,4-D DMAS. The highest single concentration detected was 13,193 ug ae/l at one hour after application within the application area. The highest concentration detected outside the application area was 3374 ug ae/l approximately immediately outside the application area. The furthest detection of 2,4-D outside the application area greater than the MCL was on day 11 at 82.3 ug ae/l while the furthest concentration detected above the LOQ was at 1605 meters. The study authors calculated a dissipation half life for 2,4-D from the application area of 3.23 days, however, this half life does not distinguish between degradation, sorption, and transport away from the application area.

- **Forest Field Dissipation Studies (MRID 43954702)**

2,4-D DMAS (Amine 400 2,4-D Weed Killer; 3.8 lb a.e./gal), broadcast applied as a spray (by helicopter) at a nominal rate of 4.0 lb a.e./A onto a forest plot of loam soil planted with fir trees, dissipated with registrant-calculated half-lives for 2,4-D acid of 38.7 days ($r^2 = 0.68$) in exposed soil, 50.8 days ($r^2 = 0.77$) in protected soil, 37.4 days ($r^2 = 0.84$) on foliage, and 65.7 days ($r^2 = 0.84$) on leaf litter. However, the apparent first half-lives occurred between 0 and 1 day posttreatment in the exposed soil, 1 and 3 days in the protected soil, 3 and 7 days on the foliage, and 7 and 14 days on the leaf litter; dissipation was observed to be biphasic in each case. EFED estimated half lives for 2,4-D acid using linear regression of log transformed data (mean concentrations of data from 0 to 6 inches collected through 398 days) of 59 days ($r^2 = 0.74$) in exposed soil, 68 days ($r^2 = 0.63$) in protected soil, 42 days ($r^2 = 0.81$) on foliage, and 72 days ($r^2 = 0.82$) on leaf litter.

The parent compound (2,4-D DMAS) converted to the acid equivalent (a.e.), 2,4-D acid, during

application. In the exposed soil, 2,4-D acid (detected as the methyl ester, but reported in acid equivalents) was initially present in the 0- to 6-inch depth at 2.5 ppm, was 1.2 ppm at 1 day posttreatment, was present at 0.17-0.88 ppm from 3 to 120 days (with the exception of 0.086 ppm at 90 days), and was last detected at 0.025 ppm at 181 days. The parent was detected only three times in the 6- to 12-inch depth in one of three replicates each at 0.12 ppm (day 1), 0.11 ppm (7 days) and 0.011 ppm (14 days). The parent was detected only once in the 12- to 18-inch depth at 0.065 ppm (one of three replicates) at 120 days posttreatment. The major degradate 2,4-DCP was initially (day 1) present in the 0- to 6-inch depth at 0.015-0.024 ppm (two of three replicates), was not detected at 3 days, was a maximum of 0.031 ppm at 7 days, and was last detected at 0.017 ppm at 181 days posttreatment. 2,4-DCP was detected once below the LOQ in the 12- to 18-inch depth at 120 days posttreatment and was not detected at any other sampling interval below the 0- to 6-inch depth. The major degradate 2,4-DCA was detected once in the 0- to 6-inch depth at 0.021 ppm at 181 days posttreatment and was not detected at any other sampling interval or depth.

In the protected soil, the parent was initially present in the 0- to 6-inch depth at 0.69 ppm, was a maximum of 1.0 ppm at 1 day posttreatment, was 0.40 ppm at 3 days and 0.23-0.28 ppm from 7 to 14 days, and was last detected at 0.012 ppm (one of three replicates) at 360 days. The parent was detected once in the 6- to 12-inch depth at 0.038 ppm (one of three replicates) at 7 days posttreatment and was not detected at any other sampling interval below the 0- to 6-inch depth. The major degradate 2,4-DCP was detected sporadically in the 0- to 6-inch depth at #0.021 ppm from 1 to 181 days posttreatment; 2,4-DCP was not detected below the 0- to 6-inch depth. The major degradate 2,4-DCA was detected sporadically in the 0- to 6-inch depth at #0.020 ppm from 14 to 181 days posttreatment and was not detected below that depth.

In the foliage, the parent was initially present 172 ppm, was 110-121 ppm at 1-3 days and 24-51 ppm at 7-30 days, and was 0.22 ppm at 360 days. The major degradate 2,4-DCP was initially (day 0) present at 0.44 ppm, was a maximum of 1.1 ppm at 14 days posttreatment, and was 0.049 ppm at 360 days. The major degradate 2,4-DCA was initially (day 0) present at 0.010-0.011 ppm (two of three replicates), was a maximum of 0.087 ppm at 3 days posttreatment, and was last detected at 0.016 ppm at 59 days.

In the leaf litter, the parent was initially present 27 ppm, was a maximum of 43 ppm at 7 days posttreatment, was 9.5 ppm at 14 days (the next sampling interval) and 7.4-8.9 ppm from 30 to 90 days, and was 0.71 ppm at 360 days. The major degradate 2,4-DCP was initially (day 0) present at 0.59 ppm, was a maximum of 2.8 ppm at 7 days posttreatment, was 0.68-1.0 ppm from 14 to 90 days, and was 0.17 ppm at 360 days. The major degradate 2,4-DCA was present at 0.066-0.15 ppm from 3 to 181 days posttreatment, and was 0.039 ppm at 360 days.

Residues of the parent or degradates were not detected in any samples of the pond water or sediment.

- **Field Accumulation in Aquatic Organisms** (**Acc. No. 00115745**)

  In the Spring Creek arm of Lake Seminole in Georgia, amended with 2,4-DMAS at 22.5 and 45 kg/ha as Weedar 64, 2,4-D accumulation was not detected in gizzard shad, largemouth bass, redeadr sunfish, flathead catfish, bluegill sunfish, catfish, bowfin, bream, harmouth, and nelam.

Dimethylamine (DMA)

- **Aerobic Soil Metabolism** (Open literature-Smith and Aubin, 1992 J. Agric. Food Chem. 40:2299-2301; Ayanaba, et al. 1973 Soil Sci. Soc. Am. Proc. 37:565-568; Greber, 1973, Handbook of Microbiology. Microbial Products CRC Press; Niimura, et al., 1986 Agric. Biol. Chem. 50: 1447-1443)

Dimethylamine was rapidly degraded (DT_{50}= 4 to 14 days) in acid and near-neutral moist soils. However, DMA was persistent in air-dried mineral soils. The major degradate of DMA was CO_2. Dimethylnitrosamine (DMNA) was also identified as degradate of DMA. This degradation product was detected in soils with high concentrations of DMA and nitrite-N. The degradate DMNA degraded rapidly (DT_{50} 6 to 15 days) in soil. The mechanism of DMA degradation appears to be controlled by microbial-mediated deamination, beta-oxidation of carboxylic acids and oxidative mineralization through the Krebs cycle.

- **Aerobic Aquatic (MRID 43779601)**

Radiolabeled [^{14}C]dimethylamine, at a nominal application rate of 10 ppm, degraded with a registrant-calculated half-life of 2.8 days (r^2 = 0.99) in aerobic flooded silt loam sediment that was incubated in darkness at 25 ± 1 ^{o}C for up to 14 days. All data, designated as percent of the applied radioactivity, represent percentages of the nominal application. Based on HPLC analysis, the parent compound was initially detected in the total sediment/water system at 88.2% of the applied radioactivity, decreased to 45.9% of the applied by 2 days posttreatment and 37.7% of the applied by 3 days, and was last detected at 13.4-15.9% of the applied at 7 days posttreatment. In the water phase, the parent was initially present at 11.3% of the applied radioactivity, decreased to 4.7% by 2 days posttreatment and was last detected at 3.6% at 3 days. The minor degradate monomethylamine was present at a maximum of 0.73% of the applied radioactivity at 1 day posttreatment. In the sediment, extractable parent compound initially present at 76.9% of the applied radioactivity, decreased to 34.2% by 3 days and was last detected at 13.4-15.9% at 7 days. The minor degradate monomethylamine was a maximum of 5.3% of the applied radioactivity at day 0. Nonextractable [^{14}C]residues were a maximum of 41.0% of the applied radioactivity at 5 days posttreatment. [^{14}C]Residues associated with humic acid, fulvic acid and humin fractions (day 5) were 3.1%, 4.0% and 5.1% of the applied, respectively. Radiolabeled $^{14}CO_2$ accounted for 2.4% of the applied radioactivity at 1 day posttreatment, increased to 33.8% by 7 days, and was 63.2% at 14 days.

- **Anaerobic Aquatic Metabolism (MRID 43908301)**

Radiolabeled [^{14}C]dimethylamine, at a nominal application rate of 10 ppm, had a registrant-calculated half-life of 1612 days (EFED calculated half-life is 1732 days with r^2 of 0.59) . In the total sediment/water system, the parent compound was initially 99.4% of the applied radioactivity and varied from 87.9 to 91.3% at 60-180 days. In the water phase, the parent compound was initially present at 67.0% of the applied radioactivity, was 60.1-61.9% from 3 to 60 days posttreatment and 54.0-54.7% at 119-180 days. The minor degradate monomethylamine was present at 2.0-3.5% of the applied from 0 to 180 days posttreatment. In the sediment extracts, the parent compound was present at 29.2-37.3% of the applied radioactivity from 0 to 180 days posttreatment with no apparent pattern of increase or decrease. The minor degradate monomethylamine was present at 1.2-2.3% of the applied radioactivity throughout the incubation.

Nonextractable [^{14}C]residues were a maximum of 8.8% of the applied radioactivity at 119 days posttreatment; [^{14}C]residues removed by acid hydrolysis were 7.0% of the applied radioactivity and [^{14}C] residues associated with humic acid, fulvic acid and humin fractions were 0.38%, 0.51% and 0.87% of the applied, respectively. Evolved ^{14}CO2 accounted for #2.0% of the applied radioactivity.

- **Batch Equilibrium** (**Accession No. 00023098**)

Radiolabeled dimethylamine had Freundlich adsorption coefficients of 32 (n=1) in a Melfort loam, 11.47 (n=1.0) in a Weyburn Oxburn loam, 12 (n=1.0) in a Regina heavy clay, 9.2 (n=0.99) in a Indian Head loam, and 4.5 in a Asquith sandy loam (O.M.=1.77%).

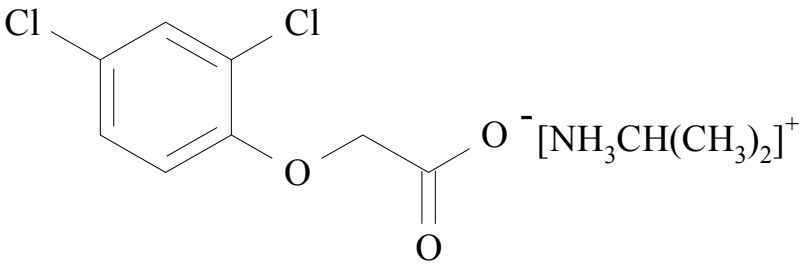
2,4-D Acid- Please see environmental fate data on 2,4-D acid

2,4-D IPA

Physical and Chemical Properties

Common name:	2,4-D IPA
Chemical name:	isopropylamine 2,4-dichlorophenoxyacetate
Molecular formula:	$C_{11}H_{15}Cl_2NO_3$
CAS Number:	5742-17-6
Molecular weight:	280.04
Vapor pressure (20/C):	Decomposed to acid (-3.9 to 24/C) MRID 41431101
Henry's Law:	Not reported. Dissociates rapidly to acid
Solubility (25°C):	37.3 g/100 mL @ 20^0C
Log K_{ow}:	Not reported. Dissociates rapidly to acid

Chemical structure of isopropylamine 2,4- dichlorophenoxyacetate



- **Dissociation Study (MRID 41353702)**

Dissociation times were 120 minutes for 2,4-D and 1minute for 2,4-D IPA and 2,4-D TIPA. Complete dissociation was determined through a comparison of theoretical and estimated electrical conductance measurements at infinite dilution. Conductance at infinite dilution was estimated using the Onsager equation; this equation is linear for fully dissociated compounds or strong electrolytes. The estimated and theoretical conductance were 379 ：mhos and 360 ：mhos for 2,4-D, 60 ：mhos and 64.9 ：mhos for 2,4-D IPA and 39 ：mhos and 45.7 ：mhos for 2,4-D TIPA.

- **Field Dissipation Studies (No field dissipation studies were submitted for 2,4-D IPA)**

- **Aquatic Field Dissipation Studies (No aquatic field dissipation studies were submitted for 2,4-D IPA)**

Isopropylamine

- **Aerobic Soil (MRID 43821501)**

Isotopic diluted radiolabeled [2-^{14}C]isopropylamine hydrochloride, at a nominal application rate of 0.93 ppm, degraded with a registrant-calculated half-life of 11.8 hours ($r^2 = 0.90$) in Commerce silt loam soil (fine-silty, mixed, superactive, nonacid, thermic Aeric Fluvaquents collected from Washington County, MS) and 18.2 hours ($r^2 = 0.95$) in Hanford sandy loam soil (coarse- loamy, mixed, superactive, nonacid, thermic Typic Xerorthents collected from Fresno County, CA) initially adjusted to 75% of 0.33 bar moisture content and incubated in darkness at 25°C for up to 120 hours; however, the apparent half-life occurred between 24 and 32 hours in the sandy loam soil.

In the Commerce silt loam soil, the parent compound was initially present at 84.9% (0.79 ppm) of the applied radioactivity, decreased to 41.9% (0.39 ppm) by 24 hours and 6.5% (0.06 ppm) by 32 hours, and was 1.8-2.5% (0.02 ppm) from 48 to 120 hours posttreatment. Nonextractable [^{14}C]residues were initially 29% of the applied radioactivity at 24 hours, were a maximum of 53% at 56 hours posttreatment, and were 41% at 120 days. The radioactivity associated with the fulvic acid, humic acid, and humin fractions was 9.5%, 3.4%, and 41% of the applied, respectively, at 120 hours posttreatment. Evolved $^{14}CO_2$ accounted for 9% of the applied radioactivity at 24 hours and increased to 36% by 120 hours posttreatment.

In the Hanford sandy loam soil, the parent compound was initially present at 96.1% (0.89 ppm) of the applied radioactivity, decreased to 59.4% (0.55 ppm) by 24 hours and 28.3% (0.26 ppm) by 32 hours, and was 0.4% (<0.01 ppm) at 120 hours posttreatment. Nonextractable [^{14}C]residues were a maximum of 49% of the applied radioactivity at 48 hours posttreatment and were 34% at 120 days. The radioactivity associated with the fulvic acid, humic acid, and humin fractions was 10.9%, 4.8%, and 34% of the applied, respectively, at 120 hours posttreatment.

Evolved $^{14}CO_2$ accounted for 5% of the applied radioactivity at 24 hours and increased to 35% by 120 hours posttreatment.

- **Aerobic Aquatic Metabolism (MRID 43799107)**

Isotopically diluted radiolabeled [2-^{14}C]isopropylamine hydrochloride, at a nominal application rate of 0.74 µg/mL, degraded with a registrant-calculate half-life of 21.6 hours ($r^2 = 0.89$) in aerobic flooded silt loam sediment that was incubated in darkness at 25°C for up to 146 hours; however, the parent was present at 86.1% of the applied radioactivity at 26 hours posttreatment. In the total sediment/water system, the parent compound was initially present at 90.4% of the applied radioactivity, decreased to 86.1% by 26 hours and 55.1% by 72 hours, was 3.9% at 104 hours (the next sampling interval), and was 0.6% at 146 hours posttreatment. In the water phase, the parent compound was initially present at 47.7% of the applied radioactivity, increased to a maximum of 55% by 14 hours posttreatment, decreased to 30.2% by 72 hours and 1.4% by 104 hours, and was 0.1% at 146 hours. In the sediment phase, the parent compound was initially present at 42.7% of the applied radioactivity, decreased to 33.7% by 14 hours, increased to 42.1% by 26 hours, decreased to 24.9% by 72 hours and 2.5% by 104 hours, and was 0.5% by 146 hours posttreatment. Radioactivity present in the sediment NaOH extract was initially 2% of the applied radioactivity at 72 hours and increased to a maximum of 20% by 72 hours posttreatment; however, [^{14}C]residues were not characterized.

Nonextractable [^{14}C] residues were 22% of the applied radioactivity at 72 hours, increased to a maximum of 44% by 104 hours, and were 36% at 146 hours posttreatment. Radioactivity associated with the fulvic acid, humic acid and humin fractions was 9%, 8% and 35% of the applied, respectively, at 146 hours posttreatment. Evolved $^{14}CO_2$ initially accounted for 3% of the applied radioactivity at 72 hours posttreatment and increased to 24% by 146 hours.

- **Anaerobic Aquatic Metabolism (MRID 43799104)**

Isotopically diluted radiolabeled isopropylamine, at a nominal application rate of 0.74 ug/mL, had registrant calculated half-life of 320 days (EFED calculated a half-life of 408 days with $r^2 = 0.91$) in anaerobic aquatic environment. In the total sediment/water system, the parent compound was initially present at 92.0% of the applied radioactivity, decreased to 82.1% by 33 days posttreatment, and was 67.1% at 181 days. In the water phase, the parent compound was initially present at 26.2% of the applied radioactivity, decreased to 20.1% by 33 days posttreatment, and was 15.8% at 181 days. In the sediment phase, the parent compound was initially present at 65.8% of the applied radioactivity, decreased to 59.7% by 60 days posttreatment, and was 51.3% at 181 days. Radioactivity present in the sediment NaOH extract was initially 10-12% of the applied radioactivity from 60 to 111 days and was a maximum of 24% at 181 days posttreatment; [^{14}C]residues were not characterized.

Nonextractable [^{14}C]residues were a maximum of 23% of the applied radioactivity at 33 days and were 5% (one replicate) at 60 days posttreatment. Radioactivity associated with the fulvic acid, humic acid, and humin fractions was 9%, 1%, and 5% of the applied, respectively, at 60 days

posttreatment. Evolved $^{14}CO_2$ accounted for 2-4% of the applied radioactivity from 33 to 181 days posttreatment. The distribution ratio of [^{14}C]residues between the sediment and water fractions was not reported, but the majority of [^{14}C]residues was observed in the sediment phase throughout the incubation (0 to 181 days); [^{14}C]residues in the water phase were initially 26% of the applied radioactivity and decreased to 16% by 181 days posttreatment and [^{14}C]residues in the sediment phase were 66-85% of the applied throughout the incubation period (reviewer-calculated).

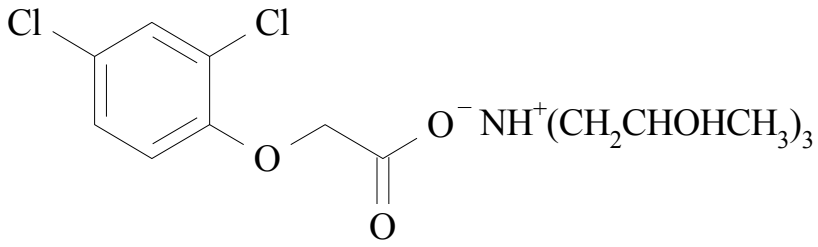
<u>2,4-D Acid</u>- Please see environmental fate data on 2,4-D acid

2,4-D TIPA

Physical and Chemical Properties

Common name:	2,4-D TIPA
Chemical name:	triisopropanolamine 2,4-dichlorophenoxyacetate
Molecular formula:	$C_{17}H_{27}Cl_2NO_6$
CAS Number:	32341-80-3
Molecular weight:	412.31
Vapor pressure (20°C):	<1 x 10-7 mmHg @ 14 – 28/C MRID 41431201
Henry's Law:	Not reported. Dissociates rapidly to acid
Solubility (25°C):	
Log K_{ow}:	Not reported. Dissociates rapidly to acid

Chemical structure of triisopropanolamine 2,4-dichlorophenoxyacetate:



Dissociation Study (MRID 41353702)

Dissociation times were 120 minutes for 2,4-D and 1minute for 2,4-D IPA and 2,4-D TIPA. Complete dissociation was determined through a comparison of theoretical and estimated electrical conductance measurements at infinite dilution. Conductance at infinite dilution was estimated using the Onsager equation; this equation is linear for fully dissociated compounds or strong electrolytes. The estimated and theoretical conductance were 379 ：mhos and 360 ：mhos for 2,4-D, 60 ：mhos and 64.9 ：mhos for 2,4-D IPA and 39 ：mhos and 45.7 ：mhos for 2,4-D TIPA.

- **Field Dissipation Studies- (No field dissipation studies were submitted for 2,4-D IPA)**

- **Aquatic Field Dissipation Studies-(No aquatic field dissipation studies were submitted for 2,4-D IPA)**

Triisopropanolamine

- **Aerobic Soil (MRID 43799102)**

Isotopic diluted radiolabeled [1-^{14}C]triisopropanolamine, at a nominal application rate of 3.3 ppm, degraded with a registrant-calculated half-life of 1.6 days (0-13 day data; $r^2 = 0.74$) in Catlin silty clay loam soil and 1.7 days (0-13 day data; $r^2 = 0.86$) in Commerce silt loam soil adjusted to 75% of the soil moisture content at 0.33 bar and incubated in darkness at 25 ± 1°C for up to 20 days. EFED, using nonlinear regression on all of the data (untransformed), calculated similar half-lives of 0.9 ($r^2 = 0.978$) and 1.6 ($r^2 = 0.987$) days, respectively, for the Catlin and Commerce soils. The major degradate, diisopropanolamine (DIPA) degraded with EFED calculated half-lives of 2.3 ($r^2 = 0.962$) and 1.6 ($r^2 = 0.970$) days, respectively, in the Catlin and Commerce soils.

Based on HPLC analysis of the Catlin silty clay loam soil extracts, the parent compound was initially present at 97.1% (3.2 ppm) of the applied radioactivity, decreased to 72.2% (2.4 ppm) by 2 hours and 39.3% (1.3 ppm) by 1 day, and was 1.5% (one of two replicates; 0.05 ppm) at 20 days posttreatment. The major degradate, diisopropanolamine (DIPA) was initially present at 15.9% (0.52 ppm) of the applied radioactivity at 1 day posttreatment, increased to a maximum of 24.2% (0.80 ppm) by 3 days, decreased to 2.7% (0.09 ppm) by 13 days, and was 0.32% (one of two replicates; 0.01 ppm) at 20 days. Nonextractable [^{14}C]residues were initially (day 0) 10.5% of the applied radioactivity, increased to a maximum of 30.6% by 13 days posttreatment, and were 25.2% at 20 days. Radioactivity associated with the humic acid, fulvic acid, and humin fractions was 2.0%, 9.8%, and 20.4% of the applied, respectively, at 6 days posttreatment. Evolved $^{14}CO_2$ accounted for 7.5% of the applied radioactivity at 1 day posttreatment and increased to 70.2% by 20 days.

Based on HPLC analysis of the aqueous:methanol extracts, the parent compound was initially present at 97.7% (3.2 ppm) of the applied radioactivity, decreased to 57.9% (1.9 ppm) by 1 day and 30.2% (1.0 ppm) by 3 days, was 2.7% (0.09 ppm) of the applied at 6 days posttreatment, and was last detected at 0.74% (0.02 ppm) of the applied at 13 days posttreatment. The major degradate, diisopropanolamine (DIPA) was initially present at 15.3% (0.50 ppm) of the applied radioactivity at 1 day posttreatment, increased to a maximum of 20.1% (0.66 ppm) of the applied by 3 days posttreatment, and was last detected at 0.81% (0.03 ppm) of the applied at 13 days posttreatment. Nonextractable [^{14}C]residues were initially (day 0) 5.9% of the applied radioactivity, increased to a maximum of 25.2% of the applied by 6 days posttreatment, and were 20.6% of the applied at 20 days posttreatment. Radioactivity associated with the humic acid, fulvic acid, and humin fractions was 1.2%, 6.2%, and 23.7% of the applied, respectively, at 6 days posttreatment. Evolved $^{14}CO_2$ accounted for 3.4% of the applied radioactivity at 1 day posttreatment and increased to 66.9% of the applied by 20 days posttreatment.

- **Aerobic Aquatic Metabolism (MRID 43799108)**

Radiolabeled [1-^{14}C]triisopropanolamine, at a nominal application rate of ppm, degraded with a registrant calculated half-life of 14.3 days. The half-life of the minor degradate, (2-oxopropyl)diisopropanolamine was 13.1 days as calculated by EFED. In the total sediment/water system, the parent compound was initially present at 66.1% of the applied radioactivity, increased to 71.6% by 2 days, decreased to 24.5% by 11 days, increased to 42.0% by 21 days, and decreased to 14.1% by 30 days posttreatment. In the aqueous phase, the parent compound was initially present at 36.5% of the applied radioactivity, increased to a maximum of 50.1% by 2 days, decreased to 13.2% by 11 days, increased to 24.8% by 21 days, and decreased to 6.0% by 30 days posttreatment. Unidentified radioactivity (designated as M4) was detected at a maximum of 16.2% of the applied radioactivity at 11 days posttreatment and was 3.8% at 30 days; M4 was composed of two degradates occurring at an approximate ratio of 70:30. The minor degradate (2-oxopropyl)diisopropanolamine was present at a maximum of 6.5% of the applied radioactivity at 25 days posttreatment and was 2.3% at 30 days. In the sediment extracts, the parent compound was initially present at 29.6% of the applied radioactivity, decreased to 11.4% by 11 days, was 16.8-18.0% from 14 to 21 days, and was 8.1% at 30 days posttreatment. The minor degradate (2-oxopropyl)diisopropanolamine was present at a maximum of 4.6% of the applied radioactivity at 17 days posttreatment and was 4.4% at 30 days.

Nonextractable [^{14}C]residues were a maximum of 30.8% of the applied radioactivity at day 0 and were 19.2-25.1% of the applied from 2 to 30 days posttreatment. Radioactivity associated with the fulvic acid, humic acid, and humin fractions was 12%, 12%, and 6% of the applied, respectively, at day 0. Evolved $^{14}CO_2$ accounted for 0.3% of the applied radioactivity at 2 days posttreatment and increased with variability to 39.3% by 30 days.

- **Anaerobic Aquatic Metabolism (MRID 43799105)**

Radiolabeled [1-^{14}C]triisopropanolamine, at a nominal application rate of ppm is stable under anaerobic aquatic conditions. In the total sediment/water system, the parent compound was

initially present at 58.5% of the applied radioactivity, decreased to 49.7% by 112 days posttreatment, and was 52.4% at 192 days. In the water phase, the parent compound was initially present at 21.4% of the applied radioactivity and was 13.6-16.8% from 19 to 192 days posttreatment. In the alkaline sediment extracts, the parent compound was present at 25.1-29.7% of the applied radioactivity from 0 to 192 days posttreatment.

Radioactivity in the acidic sediment extract accounted for 8.3-9.6% of the applied from 0 to 192 days posttreatment; ^{14}C residues were not characterized. Nonextractable ^{14}C residues were initially (day 0) 34.8% of the applied radioactivity and increased to a maximum of 49.5% by 192 days posttreatment. Radioactivity associated with the humic acid, fulvic acid, and humin fractions was initially (day 0) 1.6%, 23.6%, and 9.6% of the applied, respectively, and was 1.3%, 28.2%, and 20.0% of the applied, respectively, at 192 days posttreatment. Evolved $^{14}CO_2$ accounted for a maximum of 0.6% of the applied radioactivity by 192 days posttreatment.

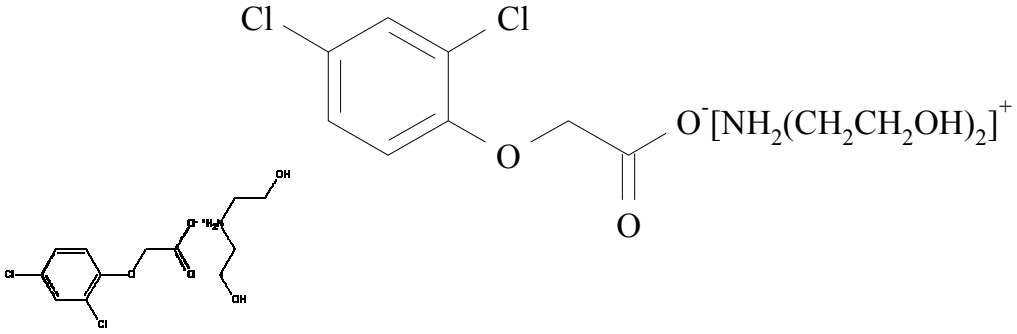
2,4-D Acid- **Please see environmental fate data on 2,4-D acid**

2,4-D DEA

Physical and Chemical Properties

Common name:	2,4-D DEA
Chemical name:	Diethanolamine 2,4-dichlorophenoxyacetate
Molecular formula:	$C_{12}H_{17}Cl_2NO_5$
CAS Number:	5742-19-8
Molecular weight:	326.18
Vapor pressure (20°C):	1.33E-5 pa @ 25C MRID 42857206
Henry's Law:	5.38E-9 pa m3/mol
Solubility (25°C):	806 mg/g
Log K_{ow}:	-1.65@ 25 C MRID 42857207

Chemical structure of Diethanolamine 2,4-dichlorophenoxyacetate



Dissociation Study (MRID 41972501)

Dissociation times were 3 minutes for 2,4-D sodium salt, 3 minutes for 2,4-D DEA and 200 minutes for 2,4-D acid. Complete dissociation was determined through a comparison of theoretical and estimated electrical conductance measurements at infinite dilution. Conductance at infinite dilution was estimated using the Onsager equation; this equation is linear for fully dissociated compounds or strong electrolytes. The estimated and theoretical conductance were 83 cm^2 : mhos mol^{-1} and 82 cm^2 : mhos $mol^{-1}$for 2,4-D, 65 cm^2 : $mhos^{-1}$ and 63 cm^2 : mhos mol^{-1} for 2,4-D DEA, and 303 cm^2 : mhos mol^{-1} and 401 cm^2 : mhos mol^{-1} for 2,4-D acid. The discrepancy between theoretical and estimated equivalent conductances for 2,4-D acid may be explained by incomplete dissociation of the carboxylic acid (pKa).

- **Field Dissipation Studies- (No field dissipation studies were submitted for 2,4-D DEA)**

- **Aquatic Field Dissipation Studies-(No aquatic field dissipation studies were submitted for 2,4-D DEA)**

Diethanolamine

Aerobic Soil Metabolism(MRID 43685901)

Radiolabeled [^{14}C]diethanolamine, at a nominal application rate of 10 ppm, degraded with a registrant-calculated half-life of 1.4 days (r^2 = 0.98; 0-7 day data) in Hanford sandy loam soil (Coarse-loamy, mixed, superactive, nonacid, thermic Typic Xerorthents) adjusted to 75% of 0.33 bar moisture content and incubated in darkness at 25 ± 1°C for up to 90 days; degradation was observed to be biphasic with slower degradation occurring from 7 to 90 days posttreatment. EFED calculated a similar half-life (1.7 days) using nonlinear regression with all the data.

The parent compound was initially present at 81.6% (8.2 ppm) of the applied radioactivity, decreased to 70.6% (7.1 ppm) by 1 day and 38.0% (3.8 ppm) by 2 days, and was 0.54-1.1% (0.054-0.11 ppm) from 14 to 90 days posttreatment. The minor degradate glycine (M4) was a maximum of 5.0% (0.50 ppm) of the applied radioactivity at 3 days posttreatment. The minor degradate ethanolamine (M5) was a maximum of 2.6% (0.26 ppm) of the applied radioactivity at 2 days posttreatment. An unidentified degradate (M2) was a maximum of 9.9% (0.99 ppm) of the applied radioactivity at day 0. Seven additional unidentified minor degradates were a combined maximum of 11.7% (1.2 ppm) of the applied radioactivity at 2-3 days posttreatment and were 1.4% (0.14 ppm) at 90 days. Nonextractable [^{14}C]residues were initially 6.6% of the applied radioactivity, increased to a maximum of 33.1% by 7 days posttreatment, and were 24.2% at 90 days. Radioactivity associated with the humic acid, fulvic acid, and humin fractions were 3.7%, 4.4%, and 5.0% of the applied, respectively, at 7 days posttreatment. Evolved $^{14}CO_2$ accounted for 1.1% of the applied radioactivity at 1 day posttreatment, was 14.1% at 2 days, and

accounted for 59.9% at 90 days.

- **Aerobic Aquatic Metabolism (MRID 43685902 & 44439401)**

Radiolabeled [^{14}C]diethanolamine, at a nominal application rate of 10 ppm (10 µg/g), degraded with a registrant-calculated half-life of 10.3 days (r^2 = 0.96; 0-21 day data) in aerobic flooded silt loam sediment that was incubated in darkness at 25 ± 1°C for up to 30 days. EFED calculated a half-life of 5.8 days (r^2 = 0.86; 0-30 day data). In the total sediment/water system, the parent compound was initially present at 67.3% of the applied radioactivity, decreased to 63.4% by 7 days and 27.2% by 14 days, and was 1.4% at 30 days posttreatment. In the water phase, the parent compound was initially present at 20.5% of the applied radioactivity, was a maximum of 28.7% at 3 days posttreatment, decreased to 23.0% by 7 days and 6.7% by 14 days, and was 0.24% at 30 days. The minor degradate ethanolamine (M5) was a maximum of 0.13% of the applied radioactivity at 14 days posttreatment and was 0.07% at 30 days. In the sediment extracts, the parent compound was initially present at 46.8% of the applied radioactivity, decreased to 34.2% by 3 days posttreatment, increased to 40.4% by 7 days, decreased to 20.4% by 14 days, and was 1.2% at 30 days. The minor degradate ethanolamine (M5) was a maximum of 2.1% of the applied radioactivity at 7 days posttreatment and was 0.24% at 30 days. The NaOH filter rinsate initially (day 0) accounted for 19.9% of the applied radioactivity and accounted for 6.9-13.9% from 3 to 30 days.

Nonextractable [^{14}C]residues were initially (day 0) 6.0% of the applied radioactivity, increased to a maximum of 26.7% by 21 days, and were 24.0% at 30 days posttreatment. Most (12.7% of the applied) of the radioactivity associated with the nonextractable [^{14}C]residues (day 14) was extracted by acid reflux; however, residues were not characterized. Radioactivity associated with the humin, humic acid, and fulvic acid fractions was 5.5%, 3.4%, and 2.2% of the applied, respectively, at 14 days posttreatment. Evolved $^{14}CO_2$ accounted for 0.59% of the applied radioactivity at 3 days posttreatment, increased to 18.7% by 14 days, and was 55.0% at 30 days; [^{14}C]organic volatiles were negligible. The distribution ratio of [^{14}C]residues between the water and sediment fractions was not reported, but the majority of [^{14}C]residues was observed in the sediment phase. In the water phase, [^{14}C]residues were a maximum of 29.1% of the applied radioactivity at 3 days and decreased to 1.7% by 30 days. In the sediment phase, [^{14}C]residues were 67.7-82.1% of the applied radioactivity from 0 to 7 days and were 40.0-53.2% of the applied from 21 to 30 days.

- **Anaerobic Aquatic Metabolism (MRID 43882901)**

Radiolabeled [^{14}C]diethanolamine degraded with a registrant-calculated half-life of 1050 days (EFED calculated half-life is 990 days with r^2 of 0.42). In the total sediment/water system, the parent compound was initially present at 81.2% of the applied radioactivity, was 73.3-76.6% from 3 to 59 days posttreatment, and was 82.7% at 120 days. In the water phase, the parent compound was initially present at 57.5% of the applied radioactivity, decreased to 48.7% by 59 days posttreatment, and was 54.1% at 120 days. In the sediment phase, the parent compound was initially present at 23.6% of the applied radioactivity and increased with variability to a

maximum of 28.6% by 120 days posttreatment.

The minor degradate ethanolamine (M5) was detected three times at #0.80% of the applied radioactivity (7, 30 and 59 days). The NaOH filter rinsate accounted for 7.4-16.8% of the applied radioactivity throughout the incubation period; however, ^{14}C residues were not characterized. Nonextractable ^{14}Cresidues were initially (day 0) 12.3% of the applied radioactivity, increased to a maximum of 19.8% by 59 days posttreatment, and were 11.3% at 120 days. Most of the radioactivity (14.1% of the applied) associated with the nonextractable ^{14}C residues in selected samples (59 days) was extracted by acid reflux; residues were not characterized. Radioactivity associated with the humic acid, fulvic acid, and humin fractions was 1.4%, 2.8%, and 1.4% of the applied, respectively, at 59 days posttreatment. Evolved $^{14}CO_2$ accounted for #0.03% of the applied radioactivity at each sampling interval.

2,4-D Acid- Please see environmental fate data on 2,4-D acid

Esters

General: The EFED strategy for assessing the environmental fate of 2,4-D esters is based on bridging of laboratory fate data from 2,4-D ester to 2,4-D acid. EFED required hydrolysis data and terrestrial field dissipation data to confirm rapid de-esterification in aquatic and terrestrial environments.

The de-esterification of 2,4-D esters is more difficult to generalize because it is dependent on heterogenous hydrolysis (microbial-mediated hydrolysis and surface-catalyzed) and homogenous hydrolysis (alkaline catalyzed) (Schwarzenbach, et al.1993). The deesterification of 2,4-D ester leads to formation of 2,4-D acid and an associated alcohol moiety. Unlike the physical dissociation mechanism of 2,4-D amine salts, the de-esterification of 2,4-D esters is dependent on abiotic processes and microbial-mediated processes. Any environmental variable influencing microbial populations or microbial activity could theoretically influence the persistence of the 2,4-D ester. Soil properties including clay mineralogy, organic carbon content, temperature, and moisture content are known to influence hydrolysis rates (Wolfe, et al, 1989 and Wolfe, 1990).

Paris, et al (1981) found the average de-esterification half-life of 2,4-D BEE in natural waters from 31 sites with varying temperature and pH conditions (5.4 to 8.2) was 2.6 hours. They found that 2,4-D BEE degradation could be explained using second-order kinetics accounting for microbial population numbers and aqueous concentration of 2,4-D BEE. Further research indicated second-order de-esterfication rates can be predicted through a linear regression [log k_b=(0.799±0.098)* log K_{ow}-(11.643±0.204) r^2=0.94] using the octanol:water coefficient (log K_{ow}) as the independent variable.

Additionally, various mineral surfaces (Fe, Al, Ti oxides) have been shown to influence hydrolysis of carboxylate esters (Torrent and Stone, 1994). Abiotic hydrolysis of 2,4-D esters, however, is expected to be more predictable in alkaline environments. Several field studies show phenoxy herbicide esters are more persistent under extremely dry soil [< soil wilting point (~15 bars)] conditions (Smith and Hayden, 1980; Smith, 1972; Smith,1976). In moist soils [~50 to 80% field capacity (~0.3 bars)] and soil slurries, phenoxy herbicide esters degraded rapidly (>85% degradation) during a 48 hour incubation period. These hydrolysis studies indicate the alkyl chain configuration affected hydrolysis rates in soils and soil slurries. The iso-octyl ester of 2,4-D (2,4-D EHE) had slower hydrolysis rates when compared to n-butyl and isopropyl esters of 2,4-D. In field studies, Harrison, et al (1993) found no 2,4-D and 2,4-DP esters were detected in runoff water (though detection limits were relatively high @ 20 ug ae/l for 2,4-D EHE) from turf sites with 2,4-DP and 2,4-D ester applications.

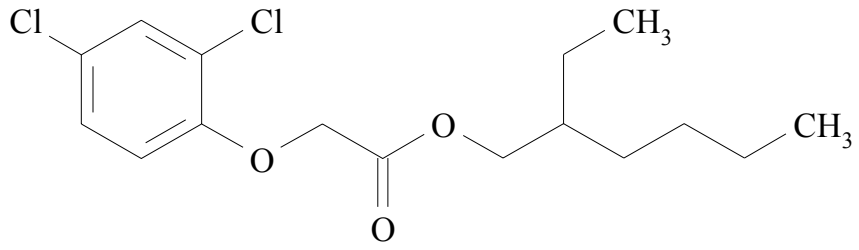
Registrant sponsored research indicates the 2,4-D esters (ethylhexyl, isopropyl, butylethyl) degrade rapidly ($t_{1/2}$< 24 hours) in soil slurries, aerobic aquatic environments, and anaerobic, acidic aquatic environments. In terrestrial field dissipation studies for 2,4-D EHE, the half-lives for 2,4-D EHE ranged from 1 to 14 days with median half-life of 2.9 days. 2,4-D BEE, applied as granules, degraded rapidly in the water column in aquatic field dissipation studies under alkaline conditions. However, the 2,4-D BEE residues were detected in sediment samples from

Day 0 (immediately posttreatment) to 186 days posttreatment. It is unclear whether 2,4-D BEE persistence in sediment is due to the slow release of the granule formulation or to slow deesterification of sediment bound 2,4-D BEE. Available open-literature and registrant sponsored laboratory data would suggest slow granule dissolution prolonged the persistence of 2,4-D BEE. In forest dissipation studies, the 2,4-D EHE ester degraded slowly on foliage and in leaf litter.

2,4-D EHE

Physical and Chemical Properties

Common name:	2,4-D EHE
Chemical name:	2-ethyhexyl 2,4-dichlorophenoxyacetate
Molecular formula:	$C_{16}H_{22}Cl_2O_3$
CAS Number:	1928-43-4
Molecular weight:	333.26
Vapor pressure (20°C):	3.6 E-6 mm Hg
Henry's Law:	1.82 E-5 atm-m^3/mole
Solubility (25°C):	86.7 ppb @ 20 ^{0}C
Log K_{ow}:	5.78



Chemical structure of 2- Ethylhexyl 2,4-dichlorophenoxyacetate:

- **Abiotic Hydrolysis** (**MRID 42735401**)

Radiolabeled 2,4-D EHE, at 30 ug/L, had a first-order half-life of 99.7 days (R^2=0.931) in pH 5 buffer solution, 48.3 days (R^2=0.929) in pH 7 buffer solution, and 52.2 hours (R^2=0.975) in pH 9 buffer solution The major degradate was identified as 2,4-D. Unknown radiolabeled degradates were also detected (<2.5% of applied).

- **Microbial-mediated and Surface-catalyzed Hydrolysis** (MRID 42770502; 42770501; Grover, 1973. Weed Research 13:51-58; Smith, 1972. Weed Science 12:364-372; Smith , 1976. Weed Research 16:19-22; Wilson and Cheng. 1978 J. Environ. Qual. 7:281-286; Schwarzenbach et al. 1993; Paris et al, 1981; (Wolfe, et al, 1989 and Wolfe, 1990).

Radiolabeled 2,4-D EHE, at 30 ug/L, had a first-order half-life of 6.2 hours (R^2=0.997) in nonsterile, Tittabawasse River water (pH=8.0), 1.25 hours in a Catlin silty loam slurry, and 1.45 hours in Hanford sandy loam slurry. The major degradate product was 2,4-D.

Open literature data indicate that carboxylic acid esters are prone to both surface-catalyzed hydrolysis and microbial mediated hydrolysis (Schwarzenbach, et al.1993). Sediment and soils may promote hydrolysis through reactions with surface hydroxyl groups from transition metal oxide and hydroxide mineral coatings on sediments or soils. Another theory is that the diffuse double layer at the interface of sediment or soil surfaces has higher hydroxide concentrations causing alkaline-catalyzed hydrolysis.

Microbial-mediated hydrolysis of carboxylic acid esters is an enzymatic controlled process (Schwarzenbach, et al.1993). Paris, et al (1981) tested the rate of microbial degradation of 2,4-D BEE in natural waters from 31 sites with varying temperature and pH conditions (5.4 to 8.2). The authors found that in waters typical of natural conditions and at concentrations normally encountered in rivers and lakes, the rate constants from all sites were within a factor of eight and estimated a mean half life of 2.6 hours. Degradation kinetics could be described using second order kinetics. Paris, et al (1983) found hydrolysis rates of 2,4-D n-alkyl esters in natural waters could be predicted using a linear regression equation using log Kow as the independent variable [log kb=(0.799±0.098)* log Kow-(11.643±0.204)]. Although the available data indicate rapid degradation of 2,4-D esters in natural waters, microbial mediated hydrolysis rates in soils may be dependent on clay mineralogy, organic carbon content, temperature, and moisture content (Wolfe, et al, 1989 and Wolfe, 1990).

Phenoxyacetate esters of 2,4-D (iso-propyl, –butyl, iso-octyl) rapidly hydrolyzed ($t_{1/2}$= 30 minutes) in alkaline salt solutions (Smith, 1972**)**. Phenoxyacetate esters of 2,4-D, 2,4,5-T, 2,4-DP and 2,4-DB (iso-propyl, iso-octyl, –butyl) rapidly hydrolyzed in moist Canadian soils and soil slurries (Smith, 1976**)**. The rate of hydrolysis of the phenoxyacetate esters was reduced in soils with a low moisture content (Smith, 1976, Smith, 1972, Groom, 1973).

- **Photodegradation in Water (MRID 42749702)**

Radiolabeled 2,4-D EHE, at 30 ug/L, had a first-order half-life of 128.2 days in pH 5 buffer solution irradiated with natural light. The degradation half-life of 2,4-D EHE was 252.5 days in dark controls. Photodegradate were identified as 2,4-D (0.3 to 6.0% of applied), 2,4-dichlorophenol (2,4-DCP) (0.5 to 7.6% of applied), 2-ethylhexyl 4-chlorophenoxyacetate (0.1 to 1.5% of applied). Unknown degradates (0.3 to 6.6% of applied) were also detected. The main degradate in dark control samples was 2,4-D. The reported data indicate 2,4-D EHE should not rapidly photodegrade in acidic aquatic environments.

- **Laboratory Volatility (MRID 42059601**)

Radiolabeled 2,4-D EHE, applied as Esteron 99 Concentrate at a rate of 15.8 lbs ae/A, was not volatile (< 0.22% of applied) from sandy loam soil. At 1 to 1.5 days posttreatment, the observed volatilization rate and air concentration of 2,4-D EHE was 8.06×10^{-4} ug/cm^2/hr and 34.84 ug/m^3 and 3.45×10^{-3} ug/cm^2/hr during air flow rates of 100 ml/min and 300 ml/min, respectively. During the volatility study, 2,4-D EHE was rapidly degraded ($t_{1/2}$= 8 days) to form 2,4-D. The reported data indicate 2,4-D, EHE, formulated in ESTERON 99 Concentrate, and its major degradate 2,4-D are not volatile from soil.

- **Terrestrial Field Dissipation** (**MRIDs 43914701; 43762401; 43762402; 43514601; 43533401;43864001;43592801;43762403;43762404;43640601;43831702;43872703;43849102;43831701; 43705202)**

General: The registrant submitted 15 terrestrial field dissipation using 2,4-D EHE. Field studies were conducted on bareground, pasture, corn, turf, and wheat. In addition, two forest field dissipation studies were conducted using 2,4-D EHE.

The registrant conducted a total of 15 terrestrial field dissipation studies in CA, CO, NC, ND, NE, OH and TX on bareground plots as well as plots cropped to corn, pasture, turf and wheat. **2,4-D EHE had first-order half lives ranging between 0.9 days to 14.3 days with a median half-life of 2.9 days**. **The first-order half-life of 2,4-D acid ranging from 1.2 days to 42.5 days with a median half-life of 6.2 days**. These half-lives reflect dissipation from the surface soil layer (0 to 6 inches) and do not include residues which have leached below the surface layer. The data indicate a rapid to moderately rapid dissipation rate for 2,4-D. Similar degradation rates were found in aerobic soil metabolism laboratory studies (MRIDs 00116625 and 43167501) Dissipation rates for 2,4-D degradation products (2,4-DCP and 2,4-DCA) were not estimated because of their sporadic occurrence patterns in surface soils. 2,4-D EHE was not persistent (median half-life =2.9 days) under field conditions.

2,4-D residues were detected below a depth of 18 inches in eleven of the terrestrial field dissipation studies reviewed and was detected below 30 inches in five studies **(MRID 43914701, 43762402, 43831703, 43849101, and 43872702**). Leaching appears to be a route of dissipation

when precipitation or irrigation exceed evapotranspiration.

The registrant submitted storage stability studies for 2,4-D, 2,4-DCP, and 2,4-DCA. These studies were conducted on soils taken from field dissipation studies in Colorado, North Carolina, and Texas. An analysis of storage stability studies indicate that 2,4-D and 2,4-DCA are stable (average half-lives 2605 to 2876 days), respectively, during frozen storage for up to 454 days. However, the frozen storage stability half-lives for 2,4-D 2-EHE (114, 194, and 1066 days) and 2,4-DCP (85, 257, 2310 and 3465 days) indicate that 2,4-D 2-EHE and 2,4-DCP may not be stable under all storage conditions. Thus, there is uncertainty about the quality of the 2,4-D 2-EHE and 2,4-DCP field dissipation data because of the variable nature of the storage stability studies.

The following summary table presents the basic results of the individual field dissipation studies submitted for 2,4-D EHE. For a more detailed review of the individual studies the reader is directed to review individual Date Evaluation Records (DER).

MRID #	ST	County	EUP	Form	Use	Single App Rate (lbs ae/A)	No of Apps	Annual App Rate (lbs ae/A)	Surface Soil Half-life (First Application)-Days		Surface Soil Half-life (Second Application)-Days		Surface Soil Half-life (Third Application)-Days		Surface Soil Half-life (Fourth Application)-Days		Maximum Depth of Detection (inches)				Precip + Irrig (in)	Pan Evap (in)
									2,4-D EHE	2,4-D	2,4-D EHE	2,4-D	2,4-D EHE	2,4-D	2,4-D EHE	2,4-D	2,4-D EHE	2,4-D	2,4-DCP	2,4-DCA		
43914701	CA	Tulare	**EHE**	Conc	Bare	2.2	2	4.4	2.3	3.8	2.6	6.2					30	48	6	18	26.8	
43762401	CA	Tulare	**EHE**	Conc	Bare/ Past	2.2	2	4.4	3.5	7.5	5.1	39.2					12	24	6	6		
43762402	CA	Tulare	**EHE**	Conc	Turf	2.2	2	4.4	2.1	6.2	2.2	9.7					6	42	18	NA		
43514601	CO	Eaton	**EHE**	Conc	Bare	1.25	2	2.5	1.7	6.6	1.7	2.2					6	12	6	NA	12.7	26.2
43533401	CO	Eaton	**EHE**	Conc	winter wheat	1.25	2	2.5	3.4	6.5	2	2.8					6	6	6	6	12.7	27
43864001	NE	York	**EHE**	Conc	Bare	variable rates	4	5.5	2.6	42.5	5.8	4.4	2.9	4.7	7.5	4.5	12	18	6	6	31.3	
43592801	NC	Rowland	**EHE**	Conc	Bare	1.25	2	2.5	14.2	5.5	2.8	**3.2**					6	6	6	6	33.1	42.5
43762403	NC	Rowland	**EHE**	Conc	Bare	2.2	2	4.4	0.9	2.7	1.2	1.8					12	12	6	6	20.4	31.99
43762404	NC	Rowland	**EHE**	Conc	Turf	2.2	2	4.4	NA	4.5	NA	2.2					6	18	6	6	31	34.04
43640601	NC	Rowland	**EHE**	Conc	Wheat	1.25	2	2.5	11.4	9.4	1.8	9.6					6	6	6	6	33.1	41
43831702	ND	Northwood	**EHE**	Conc	Bare	1.4	2	2.8	4.4	6.1	3.6	5.6					12	12	6	6	16.02	
43872703	OH	New Holland	**EHE**	Gran	Bare	2.2	2	4.4	6	10.7	6.3	10.3					12	12	6	6	18.72	
43849102	OH	New Holland	**EHE**	Conc	Bare	variable rates	4	5.68	10.9	31.5	6.6	5.4	2.8	1.2	2.9	9	12	12	6	NA	30.8	
43831701	OH	New Holland	**EHE**	Gran	Turf	2.2	2	4.4	14.3	24.6	1.1	13					12	12	6	6	18.67	
43705202	TX	Eagle Lake	**EHE**	Conc	Past	2	2	4	1.4	4.2	1.1	13.1					6	12	6	NA	36.9	39.9

- **Forest Field Dissipation (MRID 43908303 & 43927101)**

2,4-D EHE, broadcast applied as a spray at a nominal rate of 4.0 lb a.e./A to a forested plot of sandy clay loam soil in Georgia, dissipated with registrant-calculated half-lives for 2,4-D acid of 1.7 days (r^2 = 0.92; 0-7 day data) in protected soil, 7.2 days (r^2 = 0.75; 0-62 day data) in foliage, and 51.0 days (r^2 = 0.55) in leaf litter. The 2,4-D EHE was detected in the exposed soil at only two sampling intervals and was not detected after 3 days posttreatment. The major degradate 2,4-D acid dissipated with registrant-calculated half-lives of 4.0 days (r^2 = 0.61; 0-30 day data) in exposed soil, 3.6 days (r^2 = 0.51; 0-15 day data) in protected soil, 23.5 days (r^2 = 0.73; 0-180 day data) in foliage, and 52.2 days (r^2 = 0.57) in leaf litter. EFED estimated half-lives on foliage for 2,4-D of 32.5 days (r^2 = 0.80) and for 2,4-D EHE of 32.7 days (r^2 = 0.51). EFED estimated half-lives in leaf litter for 2,4-D of 51.7 days (r^2 = 0.55) and for 2,4-D EHE of 50.5 days (r^2 = 0.53).

In the exposed soil, the parent was initially present in the 0- to 6-inch depth at 0.14 ppm, was not detected at 1 day posttreatment, and was last detected at 0.029 ppm at 3 days; the parent was not detected below the 0- to 6-inch depth. The major degradate 2,4-D acid was initially (day 0) present in the 0- to 6-inch depth at a maximum of 0.15 ppm, was not detected at 1 day posttreatment, was 0.074 ppm at 3 days, and was last detected at 0.010 ppm (one of three replicates) at 15 and 30 days; 2,4-D acid was not detected below the 0- to 6-inch depth. The degradates 2,4-DCP and 2,4-DCA were not detected at any sampling interval or depth.

In the protected soil, the parent was initially present in the 0- to 6-inch depth at 0.058 ppm, decreased to 0.036 ppm by 1 day posttreatment, and was last detected at 0.010 ppm (one of three replicates) at 7 days. The parent was detected once in the 6- to 12 inch depth, at 0.016 ppm (one of three replicates) at 1 day posttreatment; the parent was not detected at any other sampling interval below the 0- to 6-inch depth. The major degradate 2,4-D acid was initially (day 0) present in the 0- to 6-inch depth at 0.11 ppm, was a maximum of 0.19 ppm at 1 day posttreatment, and was last detected at 0.012 ppm (two of three replicates) at 15 days; 2,4-D acid was detected once in the 6- to 12 inch depth, at 0.014 ppm (two of three replicates) at 1 day posttreatment. The degradates 2,4-DCP and 2,4-DCA were not detected at any sampling interval or depth.

In the foliage, the parent was initially present at 36.9 ppm, decreased to 15.5 ppm by 1 day and 11.1 ppm by 3 days, was 0.36-2.5 ppm at 7-30 days posttreatment, and was last detected at 0.13 ppm (one of three replicates) at 62 days. The major degradate 2,4-D acid was initially (day 0) present at a maximum of 43.0 ppm, decreased to 25.0 ppm by 3 days and 4.3 ppm by 7 days, was 0.33-0.90 ppm at 62-118 days, and was last detected at 0.33 ppm at 180 days posttreatment. The major degradate 2,4-DCP was initially (day 0) present at 0.34 ppm, increased to a maximum of 0.39 ppm by 1 day posttreatment, was 0.12-0.34 ppm at 3-91 days, and was last detected at 0.24 ppm (one of three replicates) at 118 days. The major degradate 2,4-DCA was only detected twice, at 0.16 ppm at 7 days posttreatment and at 0.10 ppm (two of three replicates) at 180 days.

In the leaf litter, the parent was initially present at 50.6 ppm, was 11.1-13.9 ppm at 1-7 days and 0.25-1.0 ppm at 15-180 days, and was 0.12 ppm at 359 days posttreatment. The major degradate

2,4-D acid was initially (day 0) present at a maximum of 30.6 ppm, decreased to 15.9 ppm by 7 days and 1.5-1.9 ppm by 15-30 days, and was 0.18 ppm at 359 days posttreatment. The major degradate 2,4-DCP was initially (day 0) present at a maximum of 2.9 ppm, was 0.95-2.2 ppm at 1-7 days and 0.046-0.21 ppm at 15-180 days posttreatment, and was 0.036 ppm at 359 days. The major degradate 2,4-DCA was initially (day 0) present at 0.24 ppm, was a maximum of 0.37 ppm at 7 days, was 0.042-0.11 ppm at 15-180 days, and was 0.015 ppm (two of three replicates) at 359 days.

2,4-D EHE and its degradates were not detected in the adjoining pond water or pond sediment at any sampling interval.

2-Ethylhexanol

- **Aerobic Soil Metabolism (MRID 43415901)**

Radiolabeled 2-ethylhexanol, at 10.8 ug/g, degraded with half-life of 5.34 hours in a Hanford sandy loam. Radiolabeled residues were distributed in methanol/acetonitrile soil extracts (91 % applied immediately posttreatment), post extractable residues (49% of applied at 48 hours posttreatment), and KOH gas trap (70% applied at 14 days posttreatment). Residues in methanol/acetonitrile soil extracts were identified as 2-ethylhexanol (90% of applied immediately posttreatment) and 2-ethylhexanoic acid (84% of applied at 48 hours posttreatment). Five unidentified peaks (R_t ranged from 2.3 to 27.15 minutes) in methanol /acetonitrile soil extracts were also detected.

- **Anaerobic Aquatic Metabolism (MRID 43691001)**

Radiolabeled [1-^{14}C]2-ethylhexanol, at a nominal concentration of 10 ppm, degraded with a registrant-calculated half-life of 14.0 days (0 to 60 day data; $r^2 = 1.0$) in anaerobic flooded silty clay loam sediment that was incubated in darkness at 25 ± 1 ^{o}C for 270 days. The degradation was biphasic, with the slower phase beginning by 120 days posttreatment; the registrant-calculated half-life was based only on water and soil sample parent data (volatile parent data were not included) through 60 days posttreatment. Based on HPLC analysis, parent compound was initially present in the total sediment/water system at 99.6% of the applied radioactivity, decreased to 53.5% by 14 days posttreatment and 23.7% by 30 days, and was last detected at 1.6% of the applied at 120-179 days.

In the water phase, parent compound was initially present at 75.3% of the applied radioactivity, decreased to 40.0% by 14 days posttreatment, and was last detected at 1.1% of the applied at 179 days. The major degradate 2-EH Acid was initially present in the water phase at 9.3% of the applied radioactivity at 7 days posttreatment, increased to a maximum of 60.5% of the applied by 120 days, and was 58.5-59.5% at 179-270 days. In the sediment extracts, the parent compound was present at 23.7-24.9% of the applied radioactivity from 0 to 7 days posttreatment, decreased to 13.5% by 14 days and 2.0% by 30 days, and was not detected from 60-270 days with the exception of 0.53% of the applied at 179 days. The major degradate 2-EH acid was initially

present at 2.4% of the applied radioactivity at 7 days posttreatment, increased to a maximum of 19.4% of the applied by 30 days, and was 9.2-14.6% from 60 to 270 days.

Nonextractable [^{14}C]residues (bound) were a maximum of 6.7% of the applied radioactivity at 3 days posttreatment Total [^{14}C]volatiles accounted for 6.3-8.1% of the applied radioactivity from 3 to 14 days posttreatment and increased to 24.5-25.4% by 179 to 270 days. Based on analysis following precipitation with $BaCl_2$, evolved $^{14}CO_2$ accounted for 1.1-2.0% of the applied radioactivity from 3 to 29 days posttreatment and 6.3-9.1% from 60 to 270 days. [^{14}C]Volatiles were present at 4.9-7.1% of the applied radioactivity from 3 to 14 days posttreatment and 11.8-16.4% from 29 to 270 days; in the only sample for which residues were characterized (224 days), only parent compound was detected in the volatile traps following precipitation to remove $^{14}CO_2$.

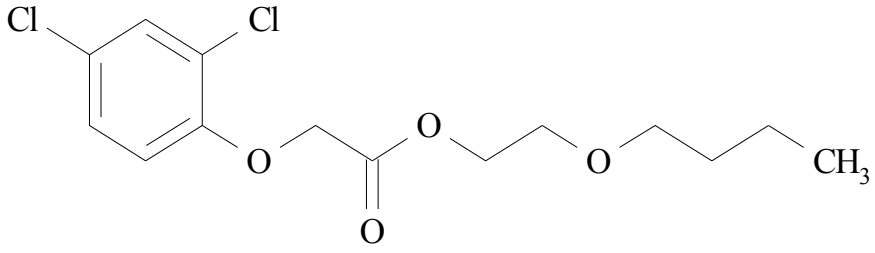
2,4-D Acid- Please see environmental fate data on 2,4-D acid

2,4-D BEE

Physical and Chemical Properties

Common name:	2,4-D BEE
Chemical name:	2,4-D butoxyethyl ester
Molecular formula:	$C_{14}H_{18}Cl_2O_4$
CAS Number:	1929-73-3
Molecular weight:	321.20
Vapor pressure (20°C):	2.4 E-6 mm Hg @ 25^0C
Henry's Law:	not calculated due to insolubility
Solubility (25°C):	12.7 ± 1 ug/L Based on MRID #41669501
Log K_{ow}:	4.35

Chemical structure of 2,4-D Butoxyethyl Ester:



- **Abiotic Hydrolysis** (**MRID 41353701**)

Radiolabeled 2,4-D BEE had first-order half-life of 196 days in pH 5 buffer solution, 47.5 hours in pH 7 buffer solution, and 55 minutes in pH 9 buffer solution. The major degradation product was 2,4-D acid.

- Microbial-Mediated and Surface-Catalyzed Hydrolysis (**Grover, 1973. Weed Research 13:51-58; Smith, 1972. Weed Science 12:364-372; Smith , 1976. Weed Research 16:19-22; Wilson and Cheng. 1978 J. Environ. Qual. 7:281-286.; Schwarzenbach et al. 1993; Paris et al, 1981; Paris et al., 1983; (Wolfe, et al, 1989 and Wolfe, 1990**).

Open literature data indicate that carboxylic acid esters are prone to both surface-catalyzed hydrolysis and microbial mediated hydrolysis (Schwarzenbach, et al.1993). Sediment and soils may promote hydrolysis through reactions with surface hydroxyl groups from transition metal oxide and hydroxide mineral coatings on sediments or soils. Another theory is that the diffuse double layer at the interface of sediment or soil surfaces has higher hydroxide concentrations causing alkaline-catalyzed hydrolysis.

Microbial-mediated hydrolysis of carboxylic acid esters is an enzymatic controlled process (Schwarzenbach, et al.1993). Paris, et al (1981) tested the rate of microbial degradation of 2,4-D BEE in natural waters from 31 sites with varying temperature and pH conditions (5.4 to 8.2). The authors found that in waters typical of natural conditions and at concentrations normally encountered in rivers and lakes, the rate constants from all sites were within a factor of eight and estimated a mean half life of 2.6 hours. Degradation kinetics could be described using second order kinetics. Paris, et al (1983) found hydrolysis rates of 2,4-D n-alkyl esters in natural waters could be predicted using a linear regression equation using log Kow as the independent variable [log kb=(0.799±0.098)* log Kow-(11.643±0.204)]. Although the available data indicate rapid degradation of 2,4-D esters in natural waters, microbial mediated hydrolysis rates in soils may be dependent on clay mineralogy, organic carbon content, temperature, and moisture content (Wolfe, et al, 1989 and Wolfe, 1990).

Phenoxyacetate esters of 2,4-D (iso-propyl, –butyl, iso-octyl) rapidly hydrolyzed ($t_{1/2}$= 30 minutes) in alkaline salt solutions (Smith, 1972**)**. Phenoxyacetate esters of 2,4-D, 2,4,5-T, 2,4-DP and 2,4-DB (iso-propyl, iso-octyl, –butyl) rapidly hydrolyzed in moist Canadian soils and soil slurries (Smith, 1976**)**. The rate of hydrolysis of the phenoxyacetate esters was reduced in soils with a low moisture content (Smith, 1976, Smith, 1972, Groom, 1973).

- **Photodegradation in Water (MRID 41483101)**

Radiolabeled 2,4-D BEE had a half-life of 74 days in both irradiated and dark control samples. The major degradate identified was 2,4-D acid at less than 17% of applied 2,4-D BEE. The data indicate that 2,4-D BEE does not photodegrade in slightly acid aqueous environments.

- **Photodegradation in Air (MRID 41483103**)

The non-volatile nature of 2,4-D BEE prevented an estimation of the photodegradation rate in air (where less than 1.4% of the applied 2,4-D BEE volatilized). No photodegradates were identified.

- **Anaerobic Aquatic Metabolism (MRID 42574701**)

Radiolabeled 2,4-D BEE, at 7 ：g/g, degraded with a first-order half-life of 14.4 hours in a strongly acidic, rice paddy water and sediment test system. The major degradation product was 2,4-D. The degradate 2,4-D was stable during a 12 month incubation period. Unidentified residues were also detected (<4% of applied) in sediment and water samples.

- **Aquatic Field Dissipation (MRID 44525001, Accession No. 00115741)**

General: Aquatic dissipation of 2,4-D BEE was studied in ponds in NC, MN , and WA (**MRID 44525001**). Several issues limit interpretation of the aquatic field dissipation data including unreported flow rates for test ponds (if any); residues in outflow samples were not analyzed; pond water pH conditions are only representative of alkaline environments (pH~8.0), and 2,4-D BEE granules may persist in sediments.

North Carolina

Parent 2,4-D 2-butoxyethyl ester (AQUAKLEEN®, 27.6% a.i.), broadcast applied once at a nominal rate of 200 lb a.i./A onto a man-made pond of Norfolk loam sediment in North Carolina, dissipated with registrant-calculated half-lives of 40 days (15 to 189 day data; $r^2 = 0.95$) in water and 27 days ($r^2 = 0.78$) in sediment. EFED estimated the half-life in water from the North Carolina pond using linear regression of log transformed data (mean concentrations across both depths) of 39.9 days ($r^2 = 0.99$) and 28.5 days ($r^2 = 0.86$) in the sediment. EFED also estimated half-lives in sediment from the North Carolina pond of 9.6 days ($r^2 = 0.87$) for 2,4-D BEE and 80.5 days ($r^2 = 0.84$) for the degradate 2,4-DCP.

2,4-D BEE was initially (day 0) present in the 0- to 5-cm sediment depth at 6.6 ppm, increased to a maximum of 7.7 ppm by 1 day posttreatment, decreased to 1.4 ppm by 7 days, and was last present at 0.87 ppm at 30 days. The parent compound was detected twice in the 5- to 10-cm depth, at 0.04 ppm at 0 and 3 days posttreatment (one replicate each). Parent was not present in the 10- to 15-cm depth and was detected twice in the 15-

to 20-cm depth, at 0.03-0.05 ppm (one replicate each) from 0 to 1 day posttreatment.

2,4-D was initially (day 0) present in the 0- to 5-cm depth at 7.1 ppm, was a maximum of 8.3 ppm at 3 days posttreatment, decreased to 4.5 ppm by 15 days and 0.14 ppm by 59 days, and was 0.07 ppm at 189 days. In the 5- to 10-cm depth, 2,4-D was initially (day 0) present at 0.13 ppm, decreased to 0.05 ppm (two replicates) by 1 day posttreatment, increased to a maximum of 0.35 ppm by 30 days, and was 0.03 ppm (one replicate) at 189 days. In the 10- to 15-cm depth, 2,4-D was initially (day 0) present at a maximum of 0.31 ppm (two replicates) and was last present at 0.10 ppm (one replicate) at 90 days. In the 15- to 20-cm depth, 2,4-D was initially (day 0) present at a maximum of 0.36 ppm (one replicate), was 0.03-0.04 ppm (one or two replicates) from 3 to 30 days posttreatment, and was last present at 0.23 ppm at 90 days. The major degradate 2,4-DCP was present in the 0- to 5-cm depth at a maximum of 0.41 ppm at 15 days posttreatment and was 0.05 ppm at 189 days. In the 5- to 10-cm depth, 2,4-DCP was a maximum of 0.10 ppm (one replicate) at 0 day posttreatment and was 0.03 ppm (one replicate) at 189 days; 2,4-DCP was present in the 10- to 15-cm depth twice at 0.05 ppm (59 days) and 0.09 ppm (90 days; one replicate), and was present in the 15- to 20-cm depth once at 0.22 ppm (90 days; one replicate). The major degradate 4-CP was present in the 0- to 5-cm depth at a maximum of 0.18 ppm at 59 days posttreatment and was 0.06 ppm (three replicates) at 189 days. In the 5- to 10-cm depth, 4-CP was a maximum of 0.52 ppm (one replicate) at 30 days posttreatment and was 0.05 ppm (three replicates) at 189 days. 4-CP was present in the 10- to 15-cm depth at a maximum of 0.20 ppm (one replicate) at 59 days posttreatment and was last present at 0.05 ppm (one replicate) at 153 days; 4-CP was present in the 15- to 20-cm depth once at 0.07 ppm (90 days; one replicate). The major degradate 4-CPA was initially (day 0) present in the 0- to 5-cm depth at a maximum of 0.05 ppm (three replicates) and was last present at 0.03 ppm (one replicate) at 15 days. In the 5- to 10-cm depth, 4-CPA was present twice at 0.05 ppm (59 days; one replicate) and 0.04 ppm (122 days; one replicate); 4-CPA was present in the 10- to 15-cm depth twice at 0.16 ppm (59 days; one replicate) and 0.13 ppm (90 days; one replicate), and was present in the 15- to 20-cm depth once at 0.10 ppm (90 days; one replicate).

At the North Carolina site, the parent compound was present (day 0) in the surface and subsurface water once at 3.9 ppb (one replicate) and 42.2 ppb (one replicate), respectively. 2,4-D was present in the surface water at a maximum of 2750 ppb at 15 days posttreatment and decreased to 134 ppb by 189 days; 2,4-D was present in the subsurface water at a maximum of 2725 ppb at 15 days posttreatment and decreased to 135 ppb by 189 days. The major degradate 2,4-DCP was present in the surface water at 2.5-4.0 ppb from 3 to 30 days posttreatment and in the subsurface water at 3.8-9.3 ppb from 1 to 30 days posttreatment. The major degradate 4-CPA was present in the surface water at a maximum of 127 ppb at 122 days posttreatment and was 58.6 ppb at 189 days; 4-CPA was present in the subsurface water at a maximum of 122 ppb at 122 days posttreatment and was 59.5 ppb at 189 days. The major degradate 4-CP was present only in the subsurface water once at 3.1 ppb (three replicates) at 1 day posttreatment.

Minnesota

2,4-D EHE (AQUAKLEEN®, 27.6% a.i.), broadcast applied once at a nominal rate of 200 lb a.i./A onto a man-made pond of clay loam sediment in Minnesota, dissipated with registrant-calculated half-lives of 11 days ($r^2 = 0.75$) in water and 26 days ($r^2 = 0.68$) in sediment. The parent compound rapidly hydrolyzes to the acid equivalent 2,4-D following release from the granule; therefore, half-lives were based on 2,4-D data. Parent compound was initially (day 0) present in the 0- to 5-cm sediment depth at 29.5 ppm, was 5.7-12.0 ppm from 1 to 28 days posttreatment, was 24.1 ppm (two replicates) at 60 days, and was 1.6 ppm (two replicates) at 186 days. In the 5- to 10-cm depth, parent compound was initially (day 0) present at 0.15 ppm (three replicates), was a maximum of 0.45 ppm (two replicates) at 1 day, and was 0.06 ppm (one replicate) at 186 days. Parent was present in the 10- to 15-cm depth twice at 0.40 ppm (0 day) and 0.29 ppm (1 day; one replicate), and in the 15- to 20-cm depth once at 0.03 ppm (14 days; one replicate). 2,4-D was initially (day 0) present in the 0- to 5-cm depth at 26.3 ppm, increased to a maximum of 30.7 ppm by 1 day posttreatment, decreased to 18.9 ppm by 3 days, and was 0.65 ppm at 186 days. In the 5- to 10-cm depth, 2,4-D was present at a maximum of 0.81 ppm at 1 day posttreatment, decreased to 0.48 ppm by 3 days posttreatment, and was 0.09-0.41 ppm (one to four replicates) from 7 to 189 days with the exception of 111 days (detected <limit of quantitation). In the 10- to 15-cm depth, 2,4-D was initially (day 0) present at 0.84 ppm (three replicates), decreased to 0.11 ppm by 1 day, and was last present at 0.04 ppm at 111 days. In the 15- to 20-cm depth, 2,4-D was initially (day 0) present at 0.08 ppm (two replicates), was detected below the limit of quantitation (all replicates) at 1 day posttreatment, was 0.04-0.13 ppm from 3 to 28 days, and was last present at 0.04 ppm (one replicate) at 111 days. The major degradate 2,4-DCP was present in the 0- to 5-cm depth at 0.41 ppm from 0 to 1 day posttreatment, was a maximum of 1.2 ppm (three replicates) at 60 days posttreatment, and was 0.14 ppm at 186 days. In the 5- to 10-cm depth, 2,4-DCP was present sporadically at 0.04-0.16 ppm at 1, 3, 7, 60, and 122 to 186 days (one or two replicates). 2,4-DCP was present in the 10- to 15-cm and 15- to 20-cm depths once at 0.11 ppm (150 days; one replicate) and 0.04 ppm (150 days; one replicate), respectively. The major degradate 4-CP was initially (day 0) present in the 0- to 5-cm depth at 0.15 ppm (three replicates) and was 0.11-0.49 ppm (one to four replicates) from 1 to 28 days; 4-CP was not detected below the 0- to 5-cm depth. The major degradate 4-CPA was present in the 0- to 5-cm depth at 0.21-0.23 ppm (one or two replicates) from 0 to 3 days posttreatment, was detected below the limit of quantitation from 7 to 14 days, was a maximum of 5.9 ppm at 60 days, and was 0.45 ppm (two replicates) at 186 days. In the 5- to 10-cm depth, 4-CPA was initially present at 0.06 ppm at 60 days and was 0.05-0.12 ppm (one to four replicates) from 111 to 186 days; 4-CPA was not present below the 5- to 10-cm depth.

The parent compound was present in the surface water at 6.0 ppb (day 0; two replicates) and 40.4 ppb (1 day; two replicates) only, and in the subsurface water at 2.2 ppb (day 0; one replicate) only. 2,4-D was present in the surface water at a maximum of 237 ppb at 1 day posttreatment, decreased variably to 109 ppb by 14 days, was detected below the

limit of quantitation at 28 days, and was last present at 5.6 ppb at 60 days. 2,4-D was initially (day 0) present in the subsurface water at 42.2 ppb, increased to a maximum of 164 ppb by 14 days posttreatment, and was last present at 5.7 ppb at 60 days. The major degradate 4-CPA was present only in the subsurface water twice at 3.0-4.2 ppb from 14 to 28 days posttreatment.

Washington

2,4-D 2-butoxyethyl ester (AQUAKLEEN®, 27.6% a.i.), broadcast applied once at a nominal rate of 200 lb a.i./A onto a man-made pond of Quincy loamy sand sediment in Washington, dissipated with registrant-calculated half-lives of 2 days ($r^2 = 0.70$) in water and 5 days ($r^2 = 0.24$) in sediment. The parent compound rapidly hydrolyzes to the acid equivalent 2,4-D following release from the granule; therefore, half-lives were based on 2,4-D data. Parent compound was initially (day 0) present in the 0- to 5-cm sediment depth at 8.8 ppm (three replicates), was 0.03-0.07 ppm (one to three replicates) from 1 to 7 days posttreatment, and was last present at 1.5 ppm (two replicates) at 14 days; parent was not present below the 0- to 5-cm depth. 2,4-D was initially (day 0) present in the 0- to 5-cm depth at 5.9 ppm, was 0.30-1.1 ppm from 1 to 7 days posttreatment, and was last present at 1.6 ppm (three replicates) at 14 days. In the 5- to 10-cm depth, 2,4-D was initially (day 0) present at 0.53 ppm and was last present at 0.08 ppm at 3 days. In the 10- to 15-cm depth, 2,4-D was initially (day 0) present at 0.23 ppm (three replicates) and was last present at 0.04 ppm (three replicates) at 7 days. In the 15- to 20-cm depth, 2,4-D was initially (day 0) present at 0.16 ppm (three replicates) and was last present at 0.03 ppm (three replicates) at 7 days. The major degradate 2,4-DCP was present in the 0- to 5-cm and 5- to 10-cm depths once at 0.07 ppm (0 day; two replicates) and 0.06 ppm (1 day; one replicate), respectively; 2,4-DCP was not present below the 5- to 10-cm depth. The major degradate 4-CPA was present in the 0- to 5-cm depth once at 0.04 ppm (one replicate) at 0 day posttreatment; 4-CPA was not present below the 0- to 5-cm depth.

At the Washington site, the parent compound was present (day 0) in the surface and subsurface water once at 8.3 ppb (0 day; two replicates) and 4.5 ppb (three replicates), respectively. 2,4-D was initially (day 0) present in the surface water at 117 ppb, decreased to 37.8 ppb by 1 day posttreatment, and was last present at 4.0 ppb at 7 days. 2,4-D was initially (day 0) present in the subsurface water at 102 ppb, decreased to 18.6 ppb by 1 day posttreatment, and was last present at 2.8 ppb (two replicates) at 14 days.

2,4-D acid, formulated as Weedar 64, applied at 20 and 40 lb/A, dissipated with half-lives of < 3 days in reservoirs at Banks Lake, Washington and Fort Cobb, Oklahoma **(Accession No. 00115741)**. The degradate dimethyl-nitrosamine was detected at pretreatment concentrations of 0.2 to 0.4 ug/l and posttreatment concentrations of 0.2 to 1.6 ug/l. The degradate 2,4-DCP was sporadically detected in hydrosoil samples from 7 days to 56 days posttreatment at 0.0078 to 0.0686 ug/g. The 2,4-DCP concentration in a pretreatment control sample was 0.0114 ug/g. 2,4-D acid residue accumulation was observed < 0.0421 ug/g in carp and largemouth bass. No 2,4-D residues were detected in white suckers.

2-Butoxyethanol

- **Aerobic Soil Metabolism (MRID 43799101)**

Radiolabeled 2-butoxyethanol, at a nominal application rate of 6 µg/g, degraded with a registrant-calculated half-life of 13.3 hours ($r^2 = 0.93$) in Hanford sandy loam soil and 35.5 hours ($r^2 = 0.90$) in Commerce silt loam soil adjusted to 75% of 0.33 bar moisture content and incubated in darkness at 25 ± 1°C for up to 4 and 10 days, respectively. The parent was found to have converted primarily to the acid equivalent, 2-butoxyacetic acid, immediately following application, and the half-life calculation is based on the concentration of 2-butoxyacetic acid present in the test samples.

The parent compound was initially present in the Hanford sandy loam soil at 92.0% (5.5 ppm) of the applied radioactivity, decreased to 57.3% (3.4 ppm) by 1 hour, and was last detected at 19.3% (1.2 ppm) at 2 hours posttreatment. The major degradate 2-butoxyacetic acid was a maximum of 84.6% (5.1 ppm) of the applied radioactivity at 4 hours and decreased to 1.7% (0.10 ppm) by 96 hours posttreatment. Nonextractable [^{14}C]residues were initially (day 0) 1.9% of the applied radioactivity, increased to a maximum of 18.0% by 84 hours, and were 14.3% at 96 hours posttreatment. Evolved $^{14}CO_2$ initially accounted for 5.3% of the applied radioactivity at 12 hours, increased to 29.2% by 48 hours, and was 48.7% at 96 hours posttreatment.

The parent compound was initially present in the Commerce silt loam soil at 93.6% (5.6 ppm) of the applied radioactivity, decreased to 67.8% (4.1 ppm) by 1 hour and 45.8% (2.7 ppm) by 2 hours, and was last detected at 13.3% (0.80 ppm) at 4 hours posttreatment. The major degradate 2-butoxyacetic acid was a maximum of 91.9% (5.5 ppm) of the applied at 24 hours and decreased to 7.2% (0.43 ppm) by 6 days posttreatment. Nonextractable [^{14}C]residues were initially (day 0) 1.5% of the applied radioactivity, increased to a maximum of 18.6% by 6 days, and were 16.5% at 10 days posttreatment. Evolved $^{14}CO_2$ initially accounted for 4.1% of the applied radioactivity at 24 hours, increased to 25.0% by 96 hours, and was 59.6% at 10 days posttreatment.

- **Aerobic Aquatic Metabolism (MRID 43799106)**

Isotopically diluted [^{14}C]2-butoxyethanol, at a nominal application rate of 4 ppm, degraded with a registrant-calculated half-lives of 0.6 days ($r^2 = 0.96$) and 3.4 days ($r^2 = 0.88$) in aerobic flooded silty loam sediment that was incubated in darkness at 25 ± 1°C for up to 10 days; however, the observed half-life occurred between 1 and 3 days posttreatment. The parent was found to have converted primarily to the acid equivalent, 2-butoxyacetic acid, by 3 days posttreatment. Residue characterization data were reported for the total sediment/water system only; reported data are reviewer-calculated means of two replicates. The parent compound was initially present at 92.9% of the applied radioactivity, decreased to 56.4% by 1 day posttreatment, and was last present at 3.5% at 3 days. The major degradate 2-butoxyacetic acid was initially (day 0) present at 2.2% of the applied radioactivity, increased to a maximum of

60.9% by 3 days, decreased to 52.7% by 7 days, and was 1.3% at 10 days posttreatment. EFED calculated a half-life of 1.3 days for 2-butoxyacetic acid, although an accurate half-life was not possible since the degradate was being degraded and formed at the same time.

Nonextractable [^{14}C]residues increased to a maximum of 9.6% of the applied radioactivity by 10 days posttreatment. Evolved $^{14}CO_2$ accounted for #3.8% of the applied radioactivity from 0 to 3 days, increased to 25.9% by 7 days, and was 66.9% at 10 days posttreatment.

- **Anaerobic Aquatic Metabolism (MRID 43799103)**

Isotopically diluted [4-^{14}C]2-butoxyethanol, at a nominal application rate of 4 µg/mL, degraded with a registrant-calculated half-life of 1.4 days (0-14 day data; $r^2 = 0.99$) in anaerobic flooded silt loam sediment that was incubated in darkness at 25 ± 1°C for up to 193 days (EFED estimated the half-life of 1.3 days with $r^2 = 0.99$). The parent was found to have converted primarily to the acid equivalent, 2-butoxyacetic acid, by 7 days posttreatment; EFED calculated an approximate half-life for 2-butoxyacetic acid as 74 days.

The parent compound was initially present at 90.3% of the applied radioactivity, decreased to 72.0% by 1 day and 39.2% by 2 days, and was last detected at 0.1% of the applied at 20 days posttreatment. The major degradate, 2-butoxyacetic acid, was initially (day 0) present at 1.2% of the applied radioactivity, increased to a maximum of 71.0% of the applied by 7 days posttreatment, decreased to 51.8% by 9 days and 45.5% by 29 days, and was 10.5% of the applied at 193 days posttreatment. Unidentified radioactivity was #2.0% of the applied radioactivity throughout the incubation period. Nonextractable [^{14}C]residues were initially (day 0) 0.3% of the applied radioactivity, increased to a maximum of 7.0% of the applied by 29 days posttreatment, and were 4.5% of the applied at 193 days posttreatment. Evolved $^{14}CO_2$ initially accounted for 0.1% of the applied radioactivity at 0.5 days posttreatment, increased with variability to 20.2% of the applied by 29 days, and was 57.3% of the applied at 193 days posttreatment. The distribution ratio of [^{14}C]residues between the sediment and water phases was not reported, but the majority of [^{14}C]residues were observed in the water phase from 0 to 29 days posttreatment and in the volatile fraction at 193 days posttreatment (the next sampling interval); $^{14}CO_2$ generally increased over time and the distribution of [^{14}C]residues between sediment, water, and volatile fractions was 1:1.3:7 (sediment:water:volatile; reviewer-calculated) at 193 days. Material balances (based on LSC analyses of individual replicates) generally decreased throughout the incubation period. Material balances were 89.5-96.4% of the applied radioactivity from 0 to 7 days posttreatment and were 70.7-89.7% of the applied from 9 to 193 days posttreatment.

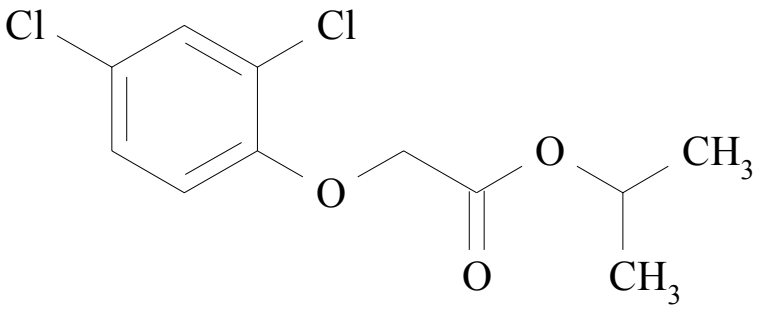
<u>2,4-D Acid</u>- Please see environmental fate data on 2,4-D acid

2,4-D IPE

Physical and Chemical Properties

Common name:	2,4-D IPE
Chemical name:	2,4-D isopropyl ester
Molecular formula:	$C_{11}H_{12}Cl_2O_3$
CAS Number:	94-11-1
Molecular weight:	263.12
Vapor pressure (20°C):	5.3 E-6 mbar
Henry's Law:	6.3 E-5 atm-m^3/mole
Solubility (25°C):	0.023 g/100mL
Log K_{ow}:	3.81

Chemical structure of 2,4-D Isopropyl Ester:



- **Abiotic Hydrolysis (MRID 41349601, 43441201)**

The dissipation of 2,4-D IPE appears to be dependent on de-esterification through alkaline-catalyzed abiotic hydrolysis and microbial-mediated or soil surface catalyzed de-esterification processes. The abiotic hydrolysis half-life of 2,4-D IPE was >30 days at pH 5, 89.2 days at pH 7, and 22.4 hours at pH 9.

- **Microbial-Mediated and Surface-Catalyzed Hydrolysis** (Grover, 1973. Weed Research 13:51-58; Smith, 1972. Weed Science 12:364-372; Smith , 1976. Weed Research 16:19-22; Wilson and Cheng. 1978 J. Environ. Qual. 7:281-286.)

Isopropyl 2,4-dichlorophenoxyacetate was rapidly de-esterified ($t_{1/2}$ < 13 hours) in an aerobic sandy loam soil and aerobic sediment-water test system. Alkaline catalyzed abiotic hydrolysis and de-esterification in soil of phenoxyacetate esters has been reported in open scientific literature. De-esterification of phenoxyacetate esters was not observed in soils with a low moisture content. Phenoxyacetate esters were also stable from de-esterification in formulated end-use products. The de-esterification of 2,4-D IPE will form 2,4-D and isopropanol (IPE).

Open literature data indicate that carboxylic acid esters are prone to both surface-catalyzed hydrolysis and microbial mediated hydrolysis (Schwarzenbach, et al.1993). Sediment and soils may promote hydrolysis through reactions with surface hydroxyl groups from transition metal oxide and hydroxide mineral coatings on sediments or soils. Another theory is that the diffuse double layer at the interface of sediment or soil surfaces has higher hydroxide concentrations causing alkaline-catalyzed hydrolysis.

Microbial-mediated hydrolysis of carboxylic acid esters is an enzymatic controlled process (Schwarzenbach, et al.1993). Paris, et al (1981) tested the rate of microbial degradation of 2,4-D BEE in natural waters from 31 sites with varying temperature and pH conditions (5.4 to 8.2). The authors found that in waters typical of natural conditions and at concentrations normally encountered in rivers and lakes, the rate constants from all sites were within a factor of eight and estimated a mean half life of 2.6 hours. Degradation kinetics could be described using second order kinetics. Paris, et al (1983) found hydrolysis rates of 2,4-D n-alkyl esters in natural waters could be predicted using a linear regression equation using log Kow as the independent variable [log kb=(0.799±0.098)* log Kow-(11.643±0.204)]. Although the available data indicate rapid degradation of 2,4-D esters in natural waters, microbial mediated hydrolysis rates in soils may be dependent on clay mineralogy, organic carbon content, temperature, and moisture content (Wolfe, et al, 1989 and Wolfe, 1990).

Phenoxyacetate esters of 2,4-D (iso-propyl, –butyl, iso-octyl) rapidly hydrolyzed ($t_{1/2}$= 30 minutes) in alkaline salt solutions (Smith, 1972**)**. Phenoxyacetate esters of 2,4-D, 2,4,5-T, 2,4-DP and 2,4-DB (iso-propyl, iso-octyl, –butyl) rapidly hydrolyzed in moist Canadian soils and soil slurries (Smith, 1976**)**. The rate of hydrolysis of the phenoxyacetate esters was reduced in soils with a low moisture content (Smith, 1976, Smith, 1972, Groom, 1973).

- **Aerobic Soil and Aerobic Aquatic Metabolism (MRID 43149601)**

Radiolabeled 2,4-D IPE degraded with first-order degradation half-lives 0.9 hours and 13 hours in a sandy loam soil and sediment-water environment, respectively. The major degradate was identified as 2,4-D (60 to 96% of applied ^{14}C-2,4-D IPE).

Isopropanol

- **Anaerobic Aquatic Metabolism** (MRID 43606301)

Radiolabeled IPA, at 10 ppm, had an anaerobic aquatic half-life of 14.55 days in a silty clay loam sediment. The major degradate was identified as acetone (34.62% of total radioactivity at 30 days posttreatment). Volatile radiolabeled residues were identified as isopropanol and acetone (cumulative concentration of 49.55% of applied at 120 days posttreatment) and ^{14}C-CO_2 (15.86% of applied at 120 days posttreatment).

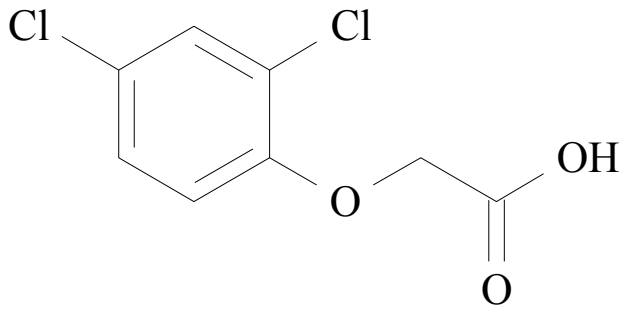
2,4-D Acid- Please see environmental fate data on 2,4-D acid

2,4-D

Physical and Chemical Properties

Common name:	2,4-D
Chemical name:	2,4-Dichlorophenoxy Acetic Acid
Molecular formula:	$C_8H_6Cl_2O_3$
CAS Number:	94-75-7
Molecular weight:	221.0
Physical state:	colorless crystals
Melting point:	138 ^oC
Vapor pressure (20°C):	1.4 E-7 mm Hg @25 ^0C
Henry's Law:	1.02 E-8 atm-m^3/mol
Solubility (25°C):	569 mg/L @ 20^oC
Log K_{ow}:	2.81

Chemical structure of 2,4-D:



- **Abiotic hydrolysis study (MRID 41007301)**

Radiolabeled 2,4-D acid, at 21 ug/ml, was stable ($t_{1/2}$ 1 to 2 years) in pH 5, 7, and 9 buffer solutions. The reported data indicate 2,4-D should not hydrolyze under normal environmental conditions.

- **Photodegradation in water study (MRID 41125306)**

Radiolabeled 2,4-D, at 5.00 ug/ml, had a first-order half-life of 12.98 calendar days or 7.57 days of constant light in pH 7 buffer solution. Major photodegradates were identified as 1,2,4-benzenetriol (37% of applied) and CO_2 (25% of applied). Many unidentified non-polar and polar degradates (<10% of applied) also were separated by TLC.

- **Photodegradation on soil study (MRID 41125305)**

Radiolabeled 2,4-D, 4.31 ug/g, in sterile, loam had an extrapolated photolysis half-life of 68 calendar days. The major photodegradate was identified as CO_2 (5% of applied). Many unidentified degradates (<10% of applied) also were separated by TLC.

- **Aerobic soil metabolism study (MRID 43167501, Accession No. 00116625**)

Radiolabeled 2,4-D, at 5 ug/g, in a Catlin silty clay loam had a first-order half-life of 1.7 days. Soil degradates were identified as 2,4-dichlorophenol (2,4-DCP) (3.5% of applied at 2 days posttreatment) and 2,4-DCA (2.5 to 2.8% of applied at Day 9 to 1.4 to 1.6% at Day 16). Unidentified extractable residues (several HPLC peaks) were also detected (<0.8% of applied at Day 16). Radiolabeled residues were detected (45 to 60% of applied at Day 5) in non-labile soil organic matter. Radiolabeled residues in the fulvic acid fraction was identified as 2,4-D. Volatile degradates were identified as [^{14}C]-CO_2 (50% of applied at Day 16) and organic volatiles in foam plug trap (0.3% of applied at Day 16). Radiolabeled residue in the foam plug was identified as 2,4-DCA. The reported data indicate that 2,4-D rapidly degrades in aerobic mineral soil.

- **Aerobic aquatic metabolism (MRID 42045301**, **42979201**, **44188601**)

Radiolabeled 2,4-D, at 4.63 ug/g, had a first-order degradation half-life of 15 days (R^2=0.7318) in a sediment and water system. Soluble degradates were identified as chlorohydroquinone (CHQ)(0.76 ppm) and 2,4-dichlorophenol (2,4-DP) (0.23 ppm). The major volatile degradate was identified as CO_2. Radolabeled residues were also found in nonlabile organic matter fractions. The reported data suggest 2,4-D acid should not persist in aerobic aquatic environments.

Radiolabeled 2,4-D, at 5 ug/ml, had a Monod-with-growth kinetic model half-life of 4.5 days in anaerobic sediment- aerobic water system. The DT_{50} of 2,4-D was estimated at 28.5 days. The

degradates of [^{14}C]-2,4-D in sediment and water were 2,4-dichlorophenol (2,4-DCP) [1.25% of applied] , 4-chlorophenoxyacetic acid (4-CPA)(1.61% of applied), and 4-chlorophenol (4-CPP) (1.13% of applied). An unknown degradate (separate HPLC peak) also was detected (1.58% of applied at Day 46) in water samples at 35 days posttreatment. Additional unknowns (several small HPLC peaks) were also detected (4.02% of applied immediately posttreatment). The major volatile degradate was tentatively identified as CO_2 (64% of applied at 46 days posttreatment). Unidentified sediment bound residues accounted for 17% of applied [^{14}C]-2,4-D at 46 days posttreatment.

The degradation of 2,4-D acid under aerobic aquatic conditions was studied in sediment and lake water collected from Lake Mendota, Madison, Wisconsin 2,4-D was stable during a 30 day study. Due to the lack of degradation observed in the system a half-life could not be determined. Aerobic conditions were demonstrated during the course of the study through collection of pH, Eh, and dissolved oxygen content. Eh values decreased from a high of 367 mV at day 0 to a low of 88.1 mV at day 30, while dissolved oxygen fluctuated from a high of 9.7 to a low of 2.1 with no clear trend, and pH ranged from 7.77 at day 0 to 9.06 at day 30. Also, microbial analysis indicated that aerobic micro-organisms increased through the course of the study. In the 30 day study 2,4-D was determined to be present in the whole system at 103.0% at day 0 and declined to 97.6% at day 30. Of the parent remaining in the system at day 30, 95.1% was determined to be present in the water phase while 2.5% was present in the sediment. One minor degradate was detected (Region I) at 0.1% of applied at day 30 while a small amount of CO_2 (0.28%) was present at day 30.

- **Anaerobic aquatic metabolism (MRID 43356001, MRID 41557901)**

Radiolabeled 2,4-D, 4.9 ug/ml, degraded with a first-order half-life of 333 days in anaerobic aquatic environments. The major degradate product in soil and water samples was 2,4-DCP (10.6 to 32% applied at 30 day posttreatment). Unidentified radiolabeled residues in sediment and water samples were also detected (7.9% of applied at 35 days). The major volatile degradate in KOH gas traps was tentatively identified as CO_2 (30% of applied at 42 and 365 days posttreatment). The degradates 4 chlorophenol (4-CPA) and 2,4-DCA were also detected (0.7% and 1.9% of applied at 365 days posttreatment) in the polyurethane foam plug. Radiolabeled residues were also detected (40.8% of applied at 240 days posttreatment) in non-labile organic matter fractions. Radiolabeled residue in the fulvic acid fraction was identified as 2,4-D.

- **Unaged Mobility (MRIDS 42045302, 44117901, 44105201; Accession No. 0012937, 00057313**)

The Freundlich coefficient for 2,4-D is 1.27 ml g^{-1} (1/n= 0.827; K_{oc}=58.1) in a clay sediment. The desorption coefficient of 2,4-D is 1.64 ml g^{-1} (1/n=0.74;K_{oc}=78.1).

Nonradiolabeled plus uniformly phenyl ring-labeled [^{14}C]2,4-D, at nominal concentrations of 1.0, 2.5, 5.0 and 10.0 ug/mL, was studied in sandy loam, sand, silty clay loam and loam soil:solution slurries that were equilibrated for 24 hours at 25 ± 1 °C. Freundlich K_{ads} values

were 0.17 for the sandy loam soil, 0.36 for the sand soil, 0.52 for the silty clay loam soil (1.5% O.M.) and 0.28 for the loam soil (0.4% o.m.); corresponding K_{oc} values were 70, 76, 59 and 117 mL/g. Respective 1/N values were 0.68, 0.82, 0.82 and 0.80 for adsorption. Freundlich K_{des} values determined following a 24-hour equilibration period were 0.87 for the sandy loam soil, 1.2 for the sand soil, 2.0 for the silty clay loam soil and 1.6 for the loam soil; corresponding K_{oc} values were 362, 247, 226 and 658 mL/g. Respective 1/N values were 0.73, 0.94, 0.93 and 1.0 for desorption. The reviewer-calculated coefficient of determination (r^2) values for the relationships K_{ads} *vs*. organic matter, K_{ads} *vs*. pH and K_{ads} *vs*. clay content were 0.34, 0.19 and 0.59, respectively.

Carbonyl labeled 2,4-D had Freundlich adsorption coefficient of 0.291 (1/n=1.18; OM=1.7%) in a Leon sand, 0.36 (1/n=0.63;OM=3.1%) in a Cosad sandy loam, 1.18 (1/n=0.74;OM=3.9%) in a Dunkirk silt loam, 2.18 (1/n=0.693;OM=5.2%) in a Jefferson clay loam, and 0.943 (1/n=0.94;OM=12.4%) in a Rosebury sandy loam. The desorption coefficient of 2,4-D was 0.82 in a Leon sand, 0.517 in Cosad sandy loam, 0.88 in Dunkirk silt loam, 0.66 in a Jefferson clay loam, and 13.3 in a Rosebury sandy loam (**Acc. No 0012937**).

Carbonyl labeled 2,4-D in finely sieved mineral soil had an R_f of 1.00 in Leon sand, 0.77 in a Cosad sandy loam, 0.60 in a Dunkirk silt loam, and 0.41 in a North Bend loam. According to Helling's Mobility Classification, 2,4-D mobility ranged from intermediately mobile (R_f=0.41) to very mobile (R_f=1.00) (**Acc. No. 00057313**).

- **Degradation Product Batch Equilibrium and Soil Colunm Leaching (MRID 44158501 ; Accession No. 00080124)**

Nonradiolabeled plus uniformly phenyl ring-labeled [^{14}C]2,4-DCP, at nominal concentrations of 1.0, 2.5, 5.0 and 10.0 ug/mL, was studied in sandy loam, sand, silty clay loam and loam soil:solution slurries that were equilibrated for 24 hours at 25 ± 1 °C. Freundlich K_{ads} values were 2.0 for the sandy loam soil (0.4% o.m.), 1.7 for the sand soil, 3.3 for the silty clay loam soil (1.5% o.m.) and 2.9 for the loam soil (0.4% o.m.); corresponding K_{oc} values were 821, 368, 374 and 1204 mL/g. Respective 1/N values were 0.84, 0.91, 0.74 and 0.80 for adsorption. Freundlich K_{des} values determined following a 24-hour equilibration period were 6.3 for the sandy loam soil, 3.8 for the sand soil, 7.1 for the silty clay loam soil and 5.6 for the loam soil; corresponding K_{oc} values were 2625, 813, 807 and 2325 mL/g. Respective 1/N values were 0.89, 0.79, 0.81 and 0.73 for desorption. The reviewer-calculated coefficient of determination (r^2) values for the relationships K_{ads} *vs*. organic matter, K_{ads} *vs*. pH and K_{ads} *vs*. clay content were 0.28, 0.98 and 0.64, respectively.

Isotopically diluted phenyl ring-labeled [^{14}C]2,4-DCA, at nominal concentrations of 0.5, 1.0, 2.5 and 5.0 ug/mL, was studied in sandy loam, sand, silty clay loam and loam soil:solution slurries that were equilibrated for 24 hours at 25 ± 1 °C. Freundlich K_{ads} values were 1.6 for the sandy loam soil, 2.1 for the sand soil, 5.4 for the silty clay loam soil (1.5% o.m.) and 3.5 for the loam soil (0.4% o.m.); corresponding K_{oc} values were 667, 436, 616 and 1442 mL/g. Respective 1/N values were 0.98, 0.96, 0.81 and 0.85 for adsorption. Freundlich K_{des} values determined

following a 24-hour equilibration period were 2.4 for the sandy loam soil, 3.4 for the sand soil, 8.6 for the silty clay loam soil and 4.4 for the loam soil; corresponding K_{oc} values were 996, 721, 975 and 1850 mL/g. Respective 1/N values were 0.65, 0.98, 0.74 and 0.79 for desorption. The reviewer-calculated coefficient of determination (r^2) values for the relationships K_{ads} *vs*. organic matter, K_{ads} *vs*. pH and K_{ads} *vs*. clay content were 0.24, 0.68 and 0.80, respectively.

Radiolabeled aged 2,4-D residues were immobile in a 30 cm column of Lawrenceville silt loam soil. The majority of radioactivity was detected in the surface 5 cm of the soil column and no radioactivity was detected in column leachate fractions.

APPENDIX B: Detailed Drinking Water Assessment Memo

NOTE: This appendix is a reproduction of the body of the Revised Drinking Water Assessment submitted to the Health Effects Division (HED) and the Special Review and Reregistration Division (SRRD). The complete input and output data files for the PRZM/EXAMS model runs can be found in the original drinking water memo. This memo was revised based on error correction comments received from the 2,4-D Task Force. The revised memorandum was addressed from Mark Corbin (EFED) to Jeff Dawson (HED) and Mark Seaton (SRRD), dated on May 20, 2004, with the DP Barcode D286666.

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

Date: May 20, 2004
Chemical: 2,4-D
PC Code: 030001, 030004, 030016, 030019, 030025, 030035, 030053, 030063, 030066
DP Barcode: D286666

Subject: **Revised 2,4-D – Drinking Water Assessment for the Health Effects Division (HED) Reregistration Eligibility Decision Document**

To: Jeff Dawson
Reregistration Branch I
Health Effects Division (7509C)

Mark Seaton, Chemical Review Manager
Reregistration Branch II
Special Review and Reregistration Division (7508C)

From: Mark Corbin, Environmental Scientist
James Hetrick, Ph.D., Senior Physical Scientist
Environmental Risk Branch I
Environmental Fate and Effects Division (7507C)

Approved By: Sid Abel, Branch Chief
Environmental Risk Branch I
Environmental Fate and Effects Division (7507C)

Summary

This memorandum presents the revised results of the Environmental Fate and Effects Division's (EFED) estimated drinking water concentrations for the human health risk assessment for 2,4-dichlorophenoxyacetic acid (2,4-D). The drinking water assessment presents EEC for 2,4-D alone and has also been revised based on comments from the 2,4-D Task Force Error-Only comments. This estimated environmental concentrations (EEC) in this memorandum represent changes from the original drinking water assessment and are based on a revised Koc and solubility value.

In accordance with the memorandum dated March 18, 2003 from the Special Review and Reregistration Division (SRRD), this drinking water assessment for 2,4-D has used maximum application rates derived from the 2,4-D Task Force Master Label rather than from labels for individual product formulations. The 2,4-D Master Label represents all currently registered technical forms of 2,4-D and all data submitted in support of 2,4-D (including esters and amine salts) has been created at these rates. It is an underlying assumption of this drinking water assessment that any labels for formulated products which exceed these maximum application rates will be revised to comply with the Master Label.

The environmental fate strategy for 2,4-D is based on bridging the degradation of 2,4-D esters and 2,4-D amine salts to 2,4-D acid. The bridging data provides information on the rate of dissociation of 2,4-D amine salts and rate of hydrolysis of 2,4-D esters. There are acceptable bridging data for 2,4-D dimethylamine (2,4-D DMAS) in MRID 41308901, 2,4-D isopropylamine (2,4-D IPA) in MRID 41353702, 2,4-D triisopropanolamine (2,4-D TIPA) in MRID 41353702, 2,4-D ethylhexyl ester (2,4-D EHE) in MRIDs 42735401, 42770501, 42770502, 2,4-D butoxyethyl ester (2,4-D BEE) in MRID 41353701, 2,4-D-diethanolamine (2,4-D DEA) in MRID 41972501, and 2,4-D isopropyl ester (2,4-D IPE) in MRIDs 41349601, 43441201. The bridging data indicate that esters of 2,4-D are rapidly hydrolyzed in alkaline aquatic environments, soil/water slurries, and moist soils. The 2,4-D amine salts have been shown to dissociate rapidly in water. These data indicate that under most environmental conditions, 2,4-D esters and 2,4-D amine salts will degrade rapidly to form 2,4-D acid. However, EFED noted that there may be environments where this bridging strategy is not applicable, such as dry soils which may limit the dissociation of the 2,4-D amine salts and acid environments which may limit the abiotic hydrolysis of the 2,4-D esters.

EFED conducted an evaluation of the concentrations of 2,4-D to which humans potentially may be exposed through ingestion of drinking water and included modeling and an evaluation of surface water and groundwater monitoring data. A number of modeling approaches were used to provide estimated exposure concentrations (EEC) for drinking water. The highest exposure scenario is the direct application of 2,4-D to surface water bodies for the control of aquatic weeds with an EEC of **4000 ug ae/l** for peak (acute) exposure and **627 ug ae/l** for the annual mean (chronic) exposure. 2,4-D is regulated under the Safe Drinking Water Act (SDWA) and has a Maximum Contaminant Level (MCL) of **70 ug ae/l**, a One-Day Health Advisory (HA) for children of **1000 ug ae/l**, and a Ten-Day HA for children of **300 ug ae/l**. Although of high quality, EFED deemed monitoring data non-targeted to 2,4-D use. However, the data provide context to model results and indicate that there is little evidence that concentrations are likely to be found exceeding these standards. Note that all concentrations reported in this assessment are in acid equivalents (ae) unless otherwise specified.

2,4-D acid is non-persistent ($t_{1/2}$=6.2 days) in terrestrial environments, moderately persistent ($t_{1/2}$=45 days) in aerobic aquatic environments, and highly persistent ($t_{1/2}$= 231 days) in anaerobic terrestrial and aquatic environments. Because 2,4-D acid will be anionic ($X\text{-}COO^- H^+$) under most environmental conditions, it is expected to be highly mobile with a K_{oc} of 61.7 (using the classification scheme of McCall) in soil and aquatic environments. Additional environmental

fate data on other 2,4-D degradation products (i.e. 2,4-dichloroanisole and 4-chlorophenol) are limited to field dissipation studies that track these degradates under field conditions. There is no additional fate data for 1,2,4-benzenetriol and chlorohydroquinone other than the laboratory fate studies in which they were detected (aqueous photolysis for 1,2,4-benzenetriol and aerobic aquatic metabolism study for chlorohydroquinone).

Concentrations of 2,4-D to which humans potentially may be exposed through ingestion of drinking water are assessed through an evaluation of surface water and groundwater monitoring data and modeling. 2,4-D monitoring data were available from the United States Geological Survey (USGS) National Water-Quality Assessment (NAWQA) Program, the United States Environmental Protection Agency (USEPA) STOrage and RETrieval System for Water and Biological Monitoring Data (STORET), and recently released data from the USGS/EPA Pilot Reservoir Monitoring Study. Annual maximum concentrations and frequencies of detection were determined from each data set. In addition, time weighted annual mean (TWAM) concentrations were calculated for selected data including NAWQA and the USGS Pilot Reservoir Monitoring Study. Finally, the USEPA Office of Water National Contaminant Occurrence Database (NCOD) was reviewed for occurrence of 2,4-D data in public water systems (PWS).

2,4-D was detected in both source and finished ground and surface waters. Maximum concentrations of 2,4-D in the monitoring data reviewed were **58 ug/l** in surface water and **14.8 ug/l** in groundwater. Although higher concentrations are reported in STORET, the highest value reported is higher than that for any other monitoring data and the lack of documentation of QA/QC in STORET limits the ability to confirm the validity of the measurement. The highest median 2,4-D concentration of 1.18 ug/l was derived from finished water samples in the NCOD database. The highest TWAM concentration was **1.45 ug/l** from the NAWQA data. It is important to note the Maximum Contaminant Level (MCL) and Maximum Contaminant Level Goal (MCLG) for 2,4-D are both **70 ug/l**.

The direct application of 2,4-D to aquatic water bodies, including drinking water reservoirs, was modeled assuming uniform application over the entire reservoir at the maximum label rate. Based on the result of the direct application scenario, the estimated maximum surface water derived drinking water concentrations for the use of 2,4-D are:

4000 ug/l for the peak concentration (acute), and
627 ug/l for the annual mean concentration (chronic)

The EEC derived by modeling the direct application of 2,4-D for aquatic weed control in water bodies is higher than concentrations detected in the surface water monitoring data (i.e. NAWQA) evaluated as part of this assessment. This is not unexpected because the NAWQA data do not target specific pesticides or use patterns and are typically from flowing water bodies while the direct application scenario represents ponds and reservoirs. However, analytical results of pond water samples after the direct application of 2,4-D DMAS and 2,4-D BEE reported in several aquatic field dissipation studies submitted by the registrant indicate that initial concentrations

equivalent to the instantaneous estimate above were as high as 4800 ug/l suggesting that the model estimates based on uniform, direct application are not unreasonable.

The direct application of 2,4-D to rice paddies was modeled using EFED interim approach for screening level estimates for pesticides with rice uses (See Appendix B for the policy memorandum). Based on the results of the screening level rice model, the estimated 2,4-D maximum surface water derived drinking water concentrations for the direct application of 2,4-D to rice paddies is **1431 ug/l.** This concentration is currently used for the acute and chronic exposure estimates for these rice pesticides. However, the chronic estimate does not account for dilution and degradation as rice paddy water is released into and mixed with flowing surface water and therefore the chronic concentration is likely to be lower due to rapid degradation and dilution of 2,4-D acid.

As with the model for direct application to water bodies, the EEC derived by modeling 2,4-D use on rice is higher than concentrations detected in the surface water monitoring data evaluated as part of this assessment. However, analytical results submitted by the registrant of pond water concentrations after the direct application of 2,4-D on rice reported in an aquatic field dissipation study indicate that initial concentrations, equivalent to the instantaneous estimate above, were as high as 2343 ug/l with a mean concentration reported as 1372 ug/l, suggesting that the model estimate is not unreasonable.

Surface water concentrations were modeled using PRZM version 3.12 and EXAMS version 2.98.04 model and the EFED graphical interface (PE4v01.pl dated August 13, 2003). Ground water concentrations were modeled using SCIGROW version 2.3. Fifteen different crop scenarios were modeled using PRZM/EXAMS. Based on modeling results, the estimated surface water derived drinking water concentrations for the use of 2,4-D are:

118.0 ug/l for the 1 in 10 year annual peak concentration (acute)
63.2 ug/l for the 1 in 10 year 90-day average
22.6 ug/l for the 1 in 10 year annual mean concentration (non-cancer chronic) and
8.9 ug/l for the 36 year annual mean concentration (cancer chronic).

The PRZM/EXAMS surface water-derived drinking water model estimates to be used for acute exposure are approximately two times the peak concentration of **58 ug/l** detected in the surface water monitoring data evaluated as part of this assessment and six times greater than the maximum TWAM concentration of **1.45 ug/l**.

The d 2,4-D concentration in ground water estimated using SCIGROW is **0.0311 ug/l**. This model prediction, however, is much lower than maximum 2,4-D concentrations in monitoring data. The maximum 2,4-D concentration detected in ground water is **14.89 ug/l** based on the USGS NAWQA program and **8 ug/l** based on the NCOD monitoring data.

Uncertainties, limitations, and assumptions in the drinking water assessment are as follows:

- Data submitted by the registrant support the bridging of 2,4-D amines and 2,4-D esters to 2,4-D acid. However, a limitation on this is the lack of field data on the ester hydrolysis in acid and near-neutral aquatic environments. In the absence of these field data, it is assumed that deesterification will occur in acid and near-neutral environments due to surface catalyzed and microbially mediated processes. Open literature data support the rapid dissociation of 2,4-D amine salts and the rapid hydrolysis of 2,4-D esters.
- Concentrations of 2,4-D for direct aquatic uses are estimated assuming a fixed water body size (the EFED index reservoir) is representative of hydrologic and dissipation processes (aerobic aquatic metabolism and flow-through) for all aquatic uses. Complete mixing and no photodegradation are assumed in this scenario. Comparison of model estimates with field data, where possible, has been completed to ensure water models are appropriate.
- No degradates have been considered in this assessment.
- Drinking water treatment effects are not incorporated in this assessment.

VULNERABILITY ASSESSMENT

As a first step in determining the potential for 2,4-D to occur in drinking water, a vulnerability assessment of 2,4-D was completed as part of this drinking water assessment. 2,4-D county level use data (Thelin and Gianessi, 2000) was compared against community water system (CWS) location information, runoff vulnerability and leaching potential (Kellogg, et al, 1998), sampling locations from monitoring data evaluated in this assessment, and the location of PRZM/EXAMS scenarios. It is important to note that the use of 2,4-D is widespread and can be found in most regions of the United States. Quantitative analysis was conducted by comparing sources of potential exposure (i.e. CWS intakes and NAWQA sample locations) against 2,4-D county level use data greater than 10 pounds active ingredient per square mile (lbs ai/sq mile) representing areas of moderate 2,4-D use. Results of each analysis are presented below. The limitations with the data used in this vulnerability assessment are discussed in the uncertainty section of this document.

Community Water System (CWS) Intakes

Figure 1 illustrates the location of surface water intakes for CWS relative to 2,4-D use areas. The analysis indicates that 2,4-D use is widespread and likely in most watersheds. The analysis also indicates that, while the areas of high 2,4-D use (greater than 25 lbs ai/sq mile) do not correlate well with the location of CWS, there are CWS intakes that correlate with moderate 2,4-D use. In general, high 2,4-D use areas correspond with winter/spring wheat and grain areas and the Midwestern corn belt. In particular, the high 2,4-D use area corresponds with CWS intakes in an arc running from Texas north to Iowa and east to Ohio, as well as an areas in western Oregon and the Central Valley of California. This type of analysis indicates that there is likely to be a significant population that could potentially be exposed to 2,4-D in surface water. A more quantitative evaluation indicates that 35.4% (i.e., 2252 out of a total of 6361 CWS intakes) are located in areas where 2,4-D is used at greater than 10 lbs ai/sq. mile, hereafter referred to as the moderate 2,4-D use area. The population served by these CWS intakes is approximately 36,000,000 out of a total population served of 116,000,000. These estimates are approximations from available data and it should be noted that more than one intake may be associated with a public water system. The percentage of the population served by CWS intakes in areas of moderate 2,4-D use is approximately 31%. The average population served for CWS intakes in the 2,4-D use area is approximately 22,000 and the median population is approximately 3,700. Figure 2 illustrates where the CWS intakes and 2,4-D use areas overlap.

Runoff and Leaching Vulnerability

Figure 3 illustrates the location of counties with greater than 10 lbs ai/sq mile of 2,4-D use (defined above as moderate use) relative to the surface water runoff vulnerability index of Kellogg, et al, 1998. This analysis indicates that the areas of highest runoff vulnerability (defined as greater than 10 inches per year) are in the southern states stretching from eastern Texas across to Florida. As with the analysis of CWS intakes, most of the high 2,4-D use area lies outside this high vulnerability area. There are, however, some areas of moderate 2,4-D use

in Mississippi, Florida, and Louisiana with high runoff vulnerability and there are many areas of moderate runoff vulnerability (greater than 5 inches per year) that correlate with moderate 2,4-D use areas. Included in the moderate runoff vulnerability areas are an area stretching in an arc from east Texas north to Missouri and east to Ohio, as well as discrete areas in Alabama, Georgia and eastern Oregon. These areas correspond closely with the PRZM/EXAMS scenario locations discussed below.

Figure 4 illustrates the location of counties with greater than 10 lbs ai/sq mile of 2,4-D use relative to the leaching potential index of Kellogg, et al, 1998. This analysis indicates that the areas of highest leaching potential (defined as greater then 10000 pounds per year per watershed) are in the Mississippi river valley, southeastern coastal plain, central great plains, and the southern portion of the central valley of California. Unlike the comparison of 2,4-D use with runoff vulnerability, most of the 2,4-D use area lies within the high leaching potential areas. Examples are the lower Mississippi river valley, the coastal plain from Alabama to Virginia, southern San Joaquin valley of California, northern Illinois, and isolated watersheds in the great plains. This suggests that there is a potential for 2,4-D migration to groundwater in these areas. This is not unexpected given that 2,4-D acid is an anion under most environmental conditions and hence likely to be mobile in the environment.

Surface Water and Groundwater Monitoring Sites

Figure 5 presents a summary of all NAWQA surface water monitoring locations relative to 2,4-D use. This analysis provides some context to the analysis of surface water data from NAWQA. In particular the analysis indicates that, while many NAWQA surface water sites are within the high 2,4-D use area, there are some of the 2,4-D use areas that are not in the vicinity of the NAWQA surface water monitoring locations. Quantitative evaluation of the analysis indicates that a total of 39.1% of the NAWQA surface water sites (i.e., 1604 NAWQA surface water sites out of a total of 4101 sites) are located within the moderate 2,4-D use area (> 10 lbs ai/sq mile). Figure 6 illustrates where the NAWQA surface water locations and 2,4-D use areas overlap.

Figure 7 presents the location of the 12 reservoirs in the USGS Pilot Reservoir Monitoring study relative to 2,4-D use areas. This analysis indicates that most of the Pilot Reservoir sites are within high 2,4-D use areas (> 25 lbs ai/sq mile). However, there are many high 2,4-D use areas which are not represented by the 12 reservoirs. It is important to note that the USGS Pilot Reservoir Monitoring study was not targeted to 2,4-D use. Therefore, caution should be exercised when evaluating data from the Pilot Reservoir surface water samples for 2,4-D because these data may not reflect the complete range of 2,4-D occurrence in surface water.

Figure 8 presents an analysis of the location of all NAWQA groundwater monitoring sites relative to 2,4-D use. As with the NAWQA surface water monitoring sites, an analysis of the relationship between NAWQA groundwater sites and data relative to 2,4-D use was conducted. This analysis provides some context to the analysis of groundwater data from NAWQA. In particular, the analysis indicates that, while many NAWQA groundwater monitoring sites are within the high 2,4-D use area, there is a significant portion of the 2,4-D use area not in the

vicinity of the NAWQA monitoring locations. Quantitative evaluation indicates that a total of 50.8% of the NAWQA groundwater monitoring sites (i.e., 3458 NAWQA groundwater sites out of a total of 6804 sites) are located within the moderate 2,4-D use area (> 10 lb ai/sq mile). Figure 9 illustrates where the NAWQA groundwater monitoring locations and 2,4-D use areas overlap.

Model Scenarios

Figure 10 presents the location of all PRZM/EXAMS scenarios used in this assessment relative to 2,4-D use areas. This analysis indicates that the scenarios regionally represent 2,4-D use areas and provide reasonable coverage of the 2,4-D use pattern with an emphasis on the mid-Atlantic, southeast, Great Plains, northwest, and Central Valley of California.

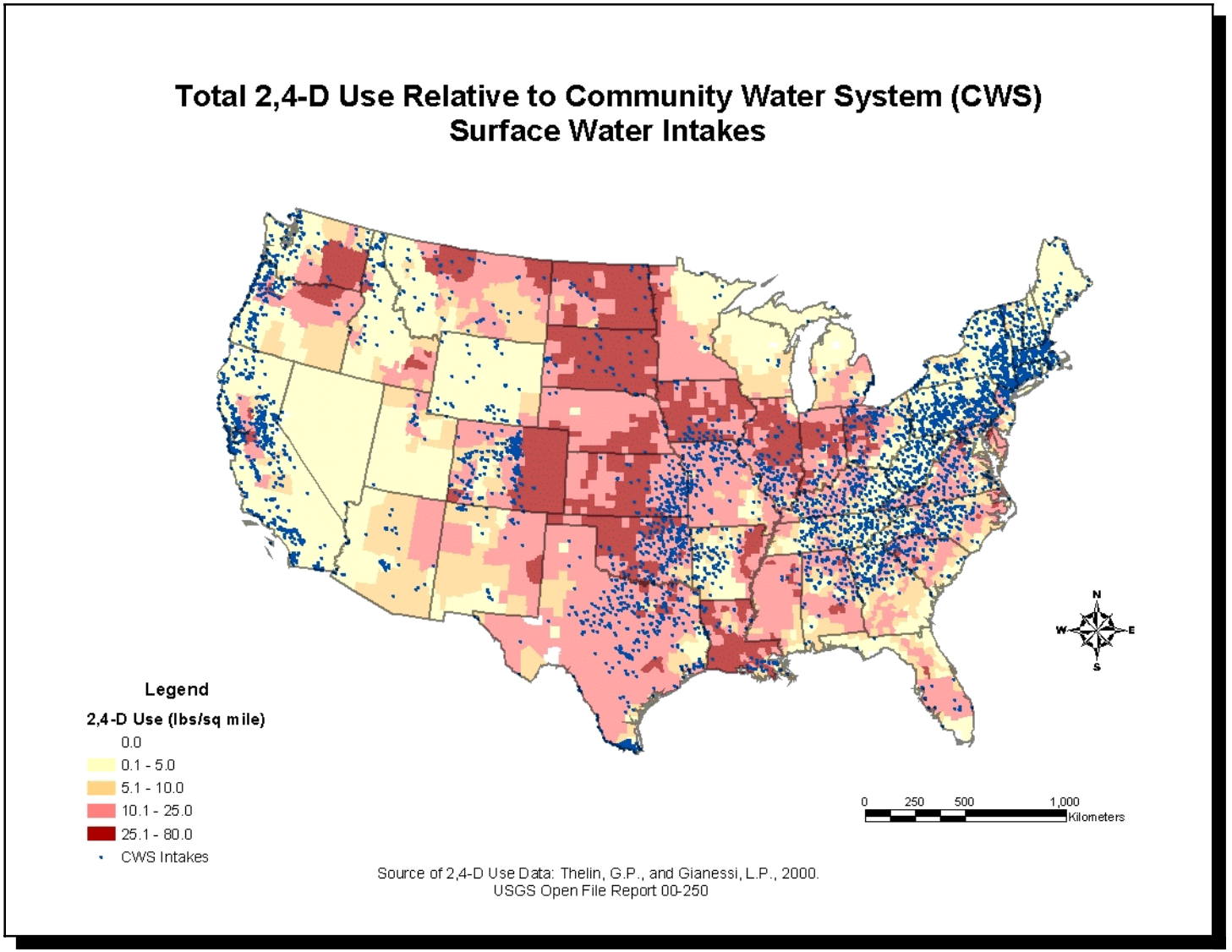


Figure 1. Community Water System (CWS) Intakes from Surface Water versus 2,4-D County Level Use Information (USGS Open File Report 00-250)

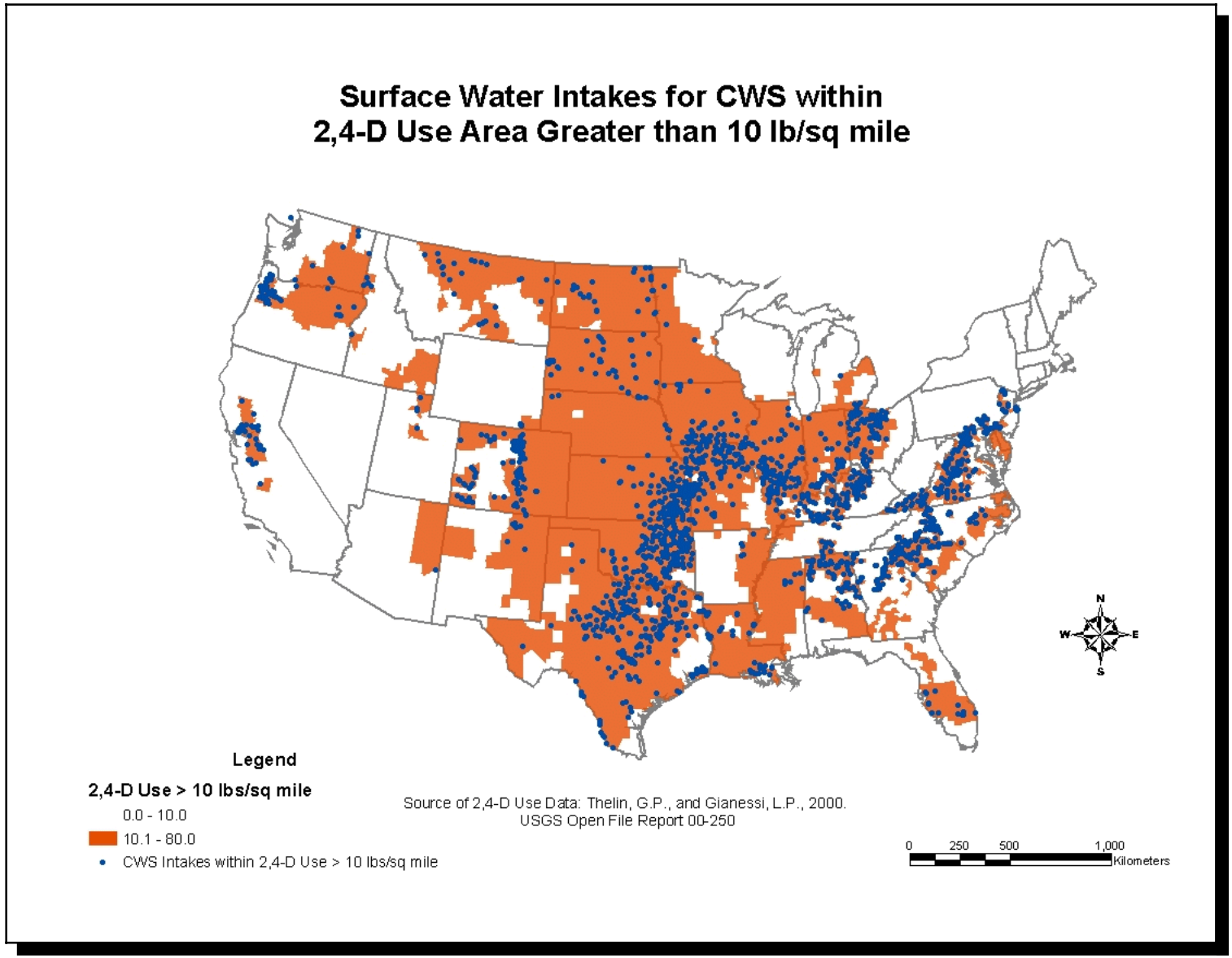


Figure 2. Community Water System (CWS) Intakes from Surface Water within Areas of 2,4-D County Level Use Greater Than 10 lbs/sq. mile (USGS Open File Report 00-250)

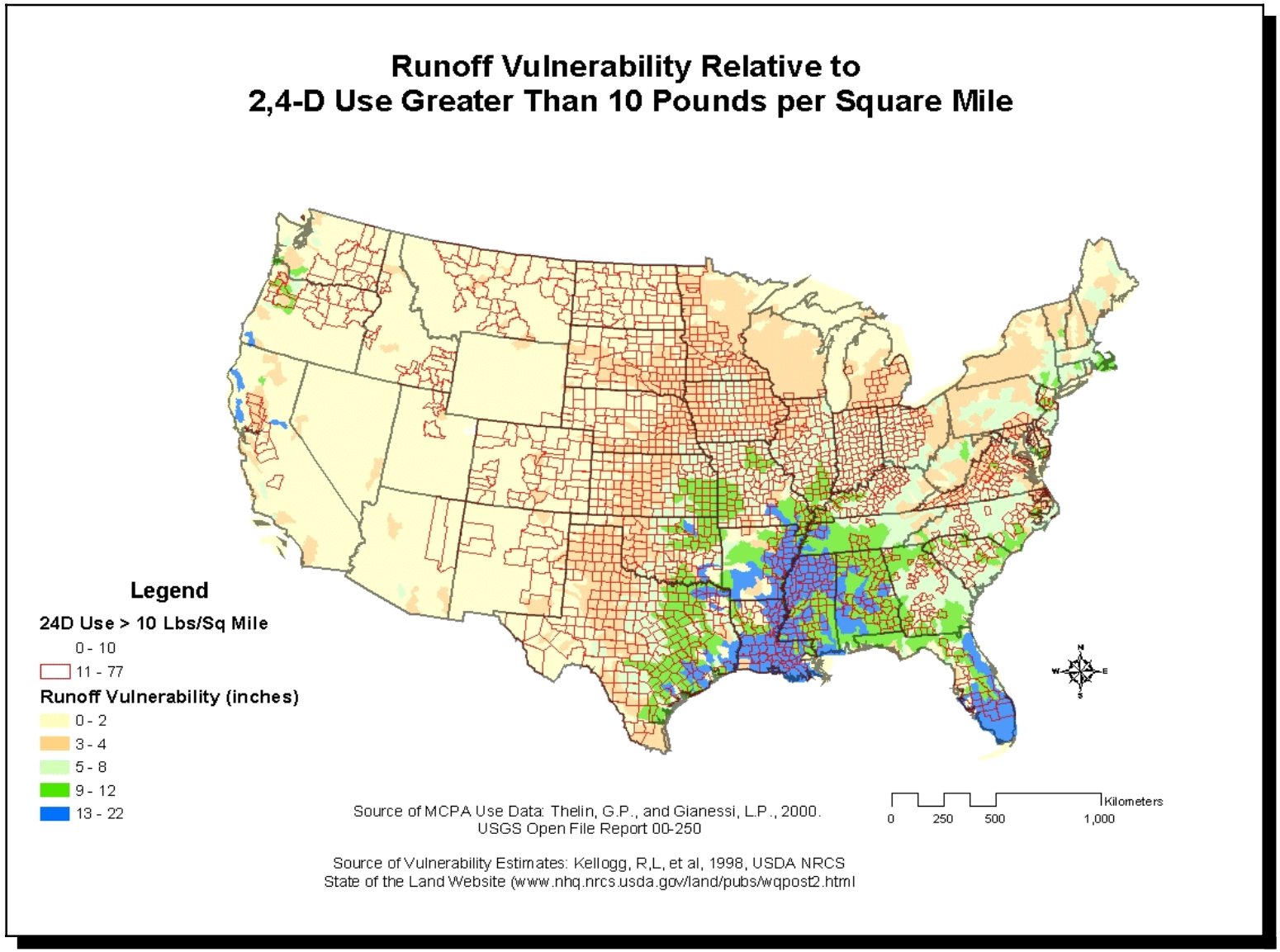


Figure 3. Runoff Vulnerability (Kellogg, et al, 1998) versus 2,4-D County Level Use Greater than 10 lbs/sq mile (USGS Open File Report 00-250)

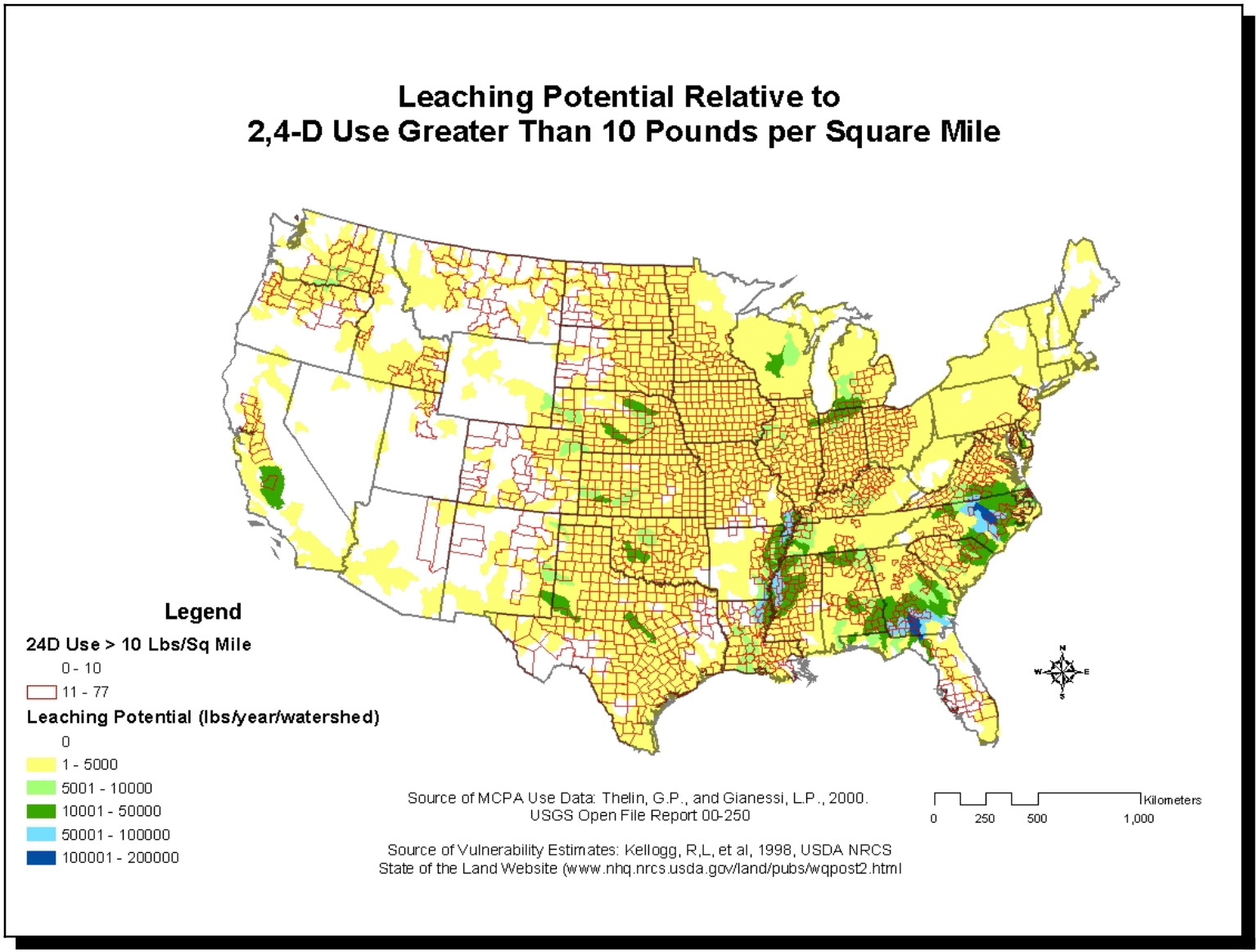


Figure 4. Leaching Potential (Kellogg, et al, 1998) versus 2,4-D County Level Use Greater than 10 lbs/sq mile (USGS Open File Report 00-250)

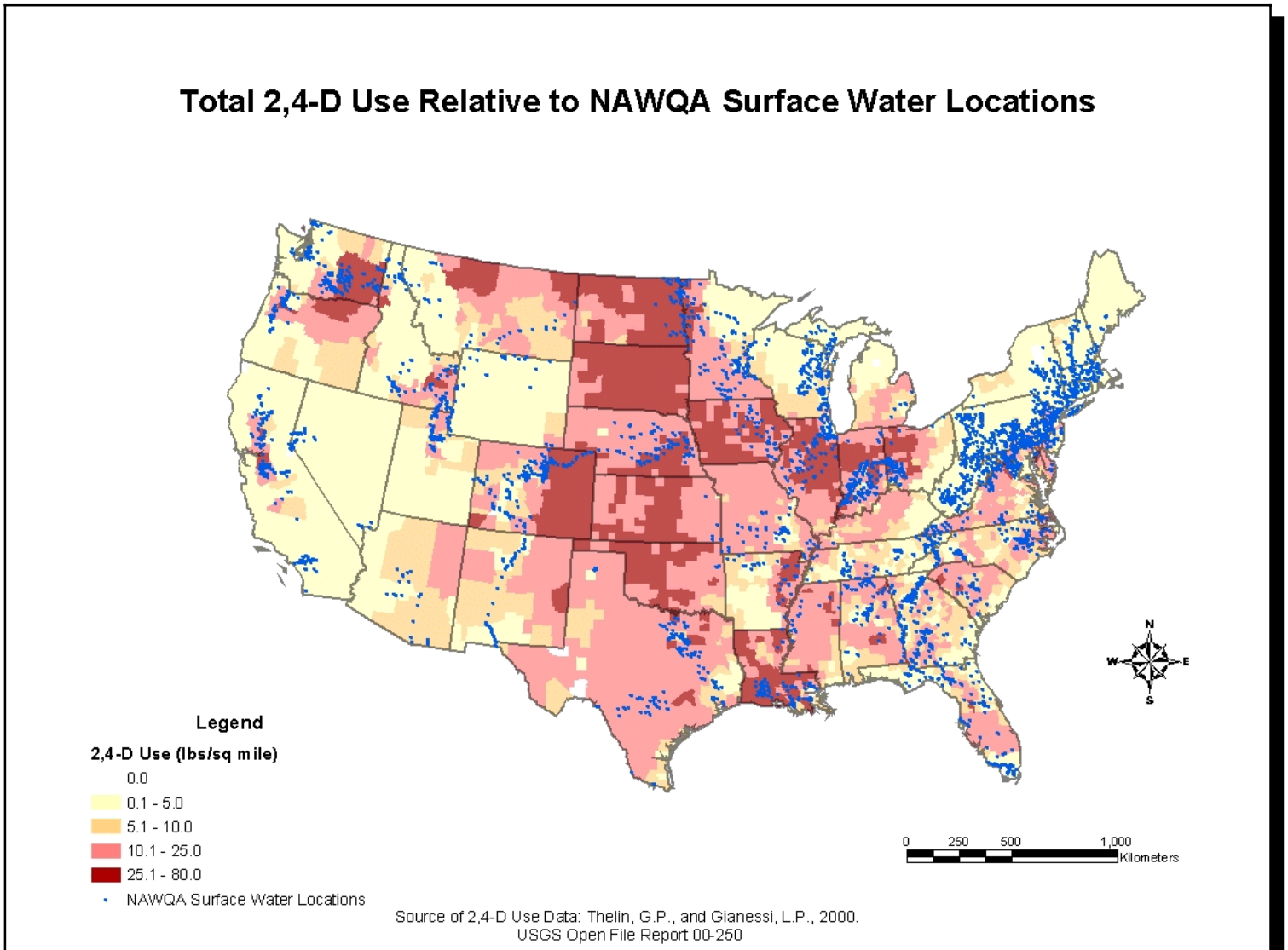


Figure 5. NAWQA Surface Water Locations Relative to Total 2,4-D County Level Use (USGS Open-File Report 00-250)

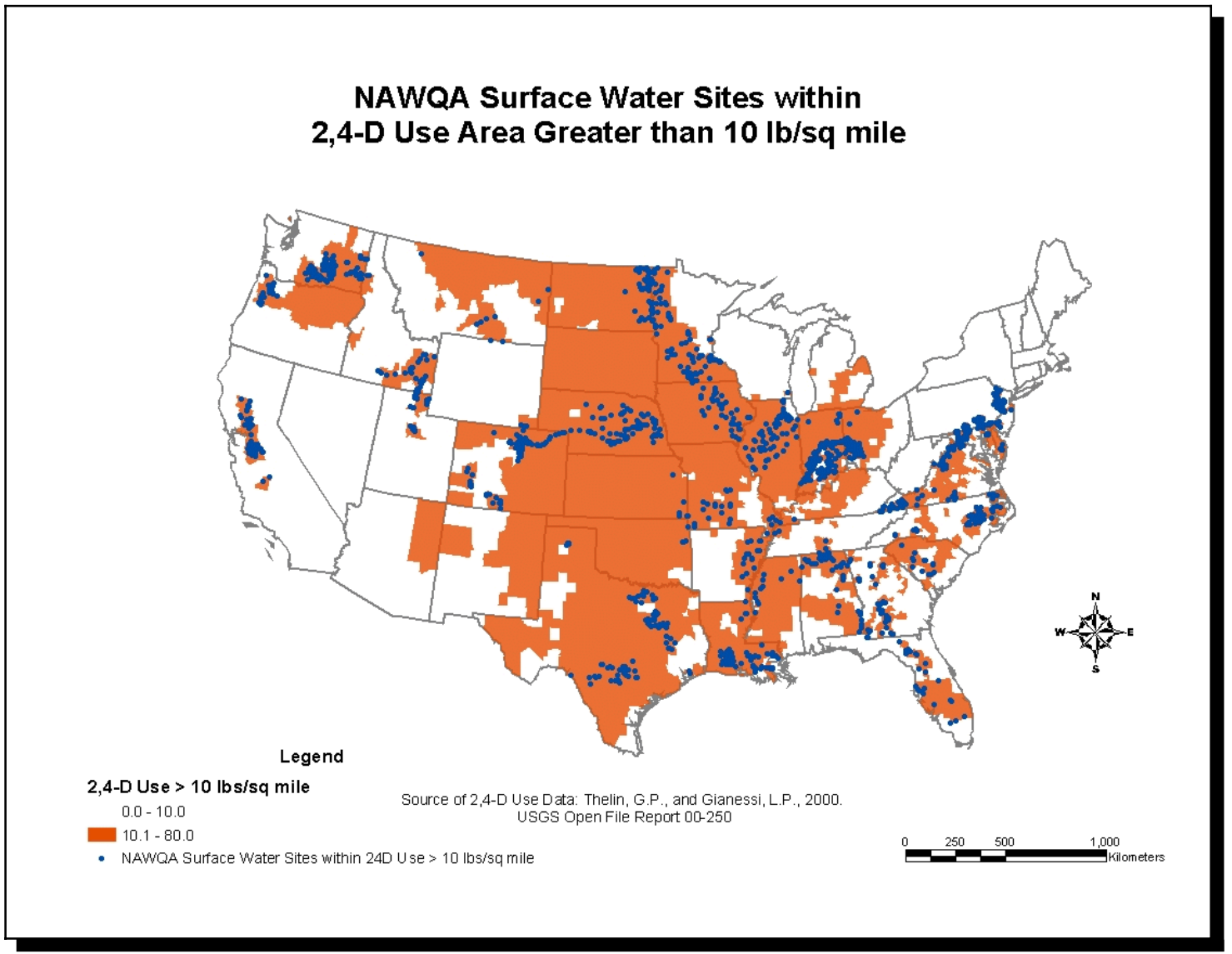


Figure 6. NAWQA Surface Water Locations within Areas of 2,4-D County Level Use Greater than 10 lbs/sq. mile (USGS Open File Report 00-250)

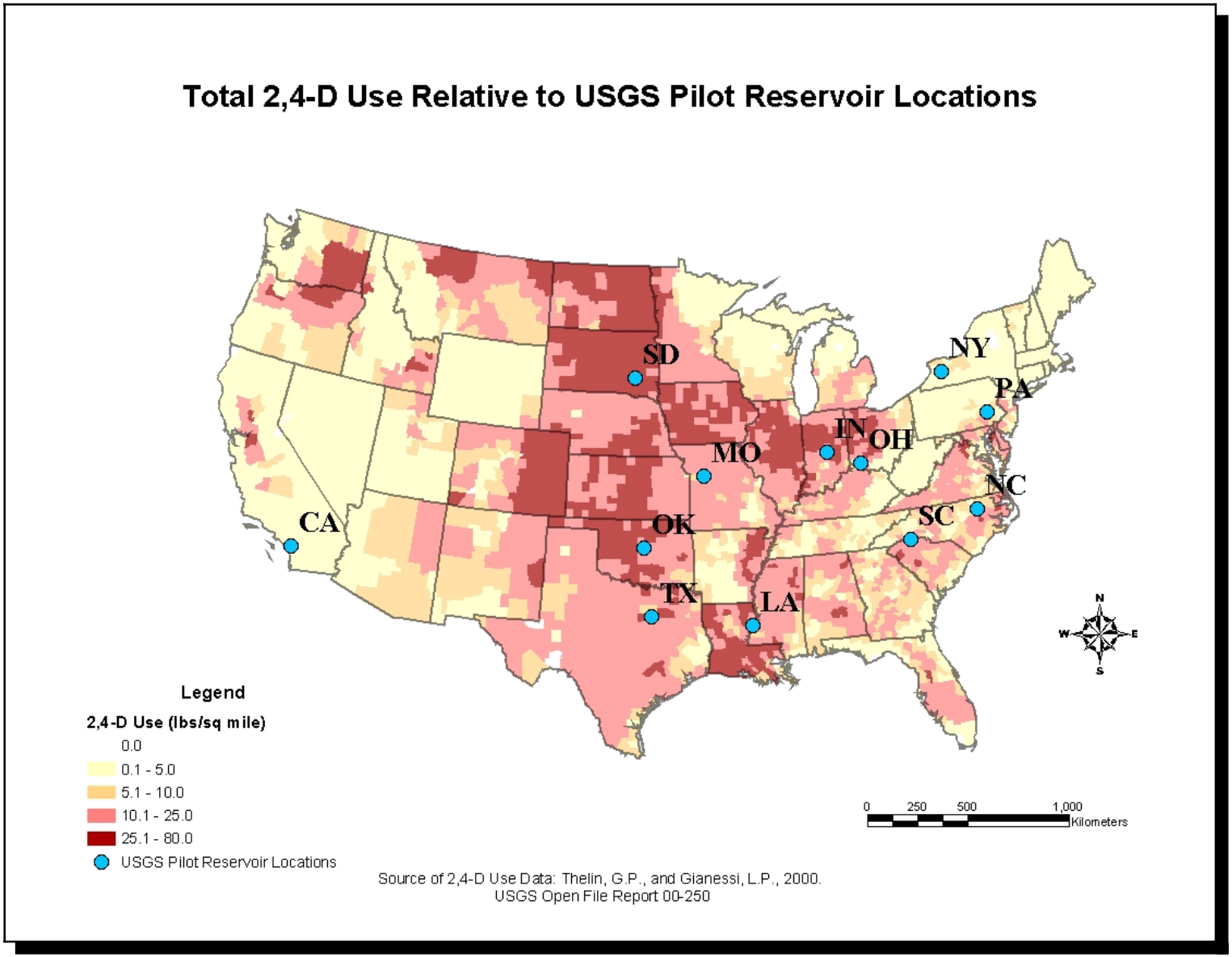


Figure 7. USGS Pilot Reservoir Locations relative to 2,4-D County Level Use (USGS Open-File Report 00-250)

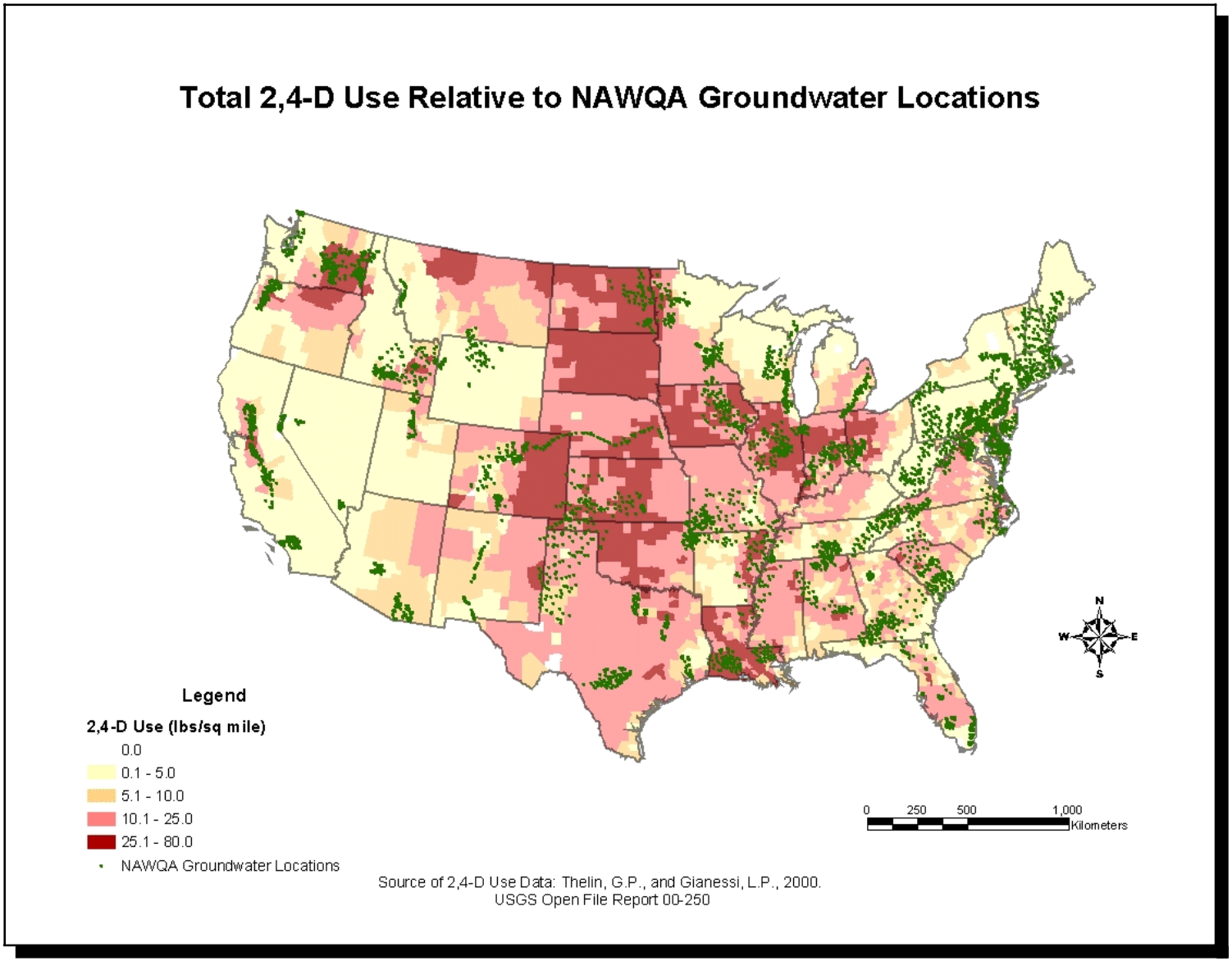


Figure 8. NAWQA Groundwater Locations Relative to 2,4-D County Level Use (USGS Open-File Report 00-250)

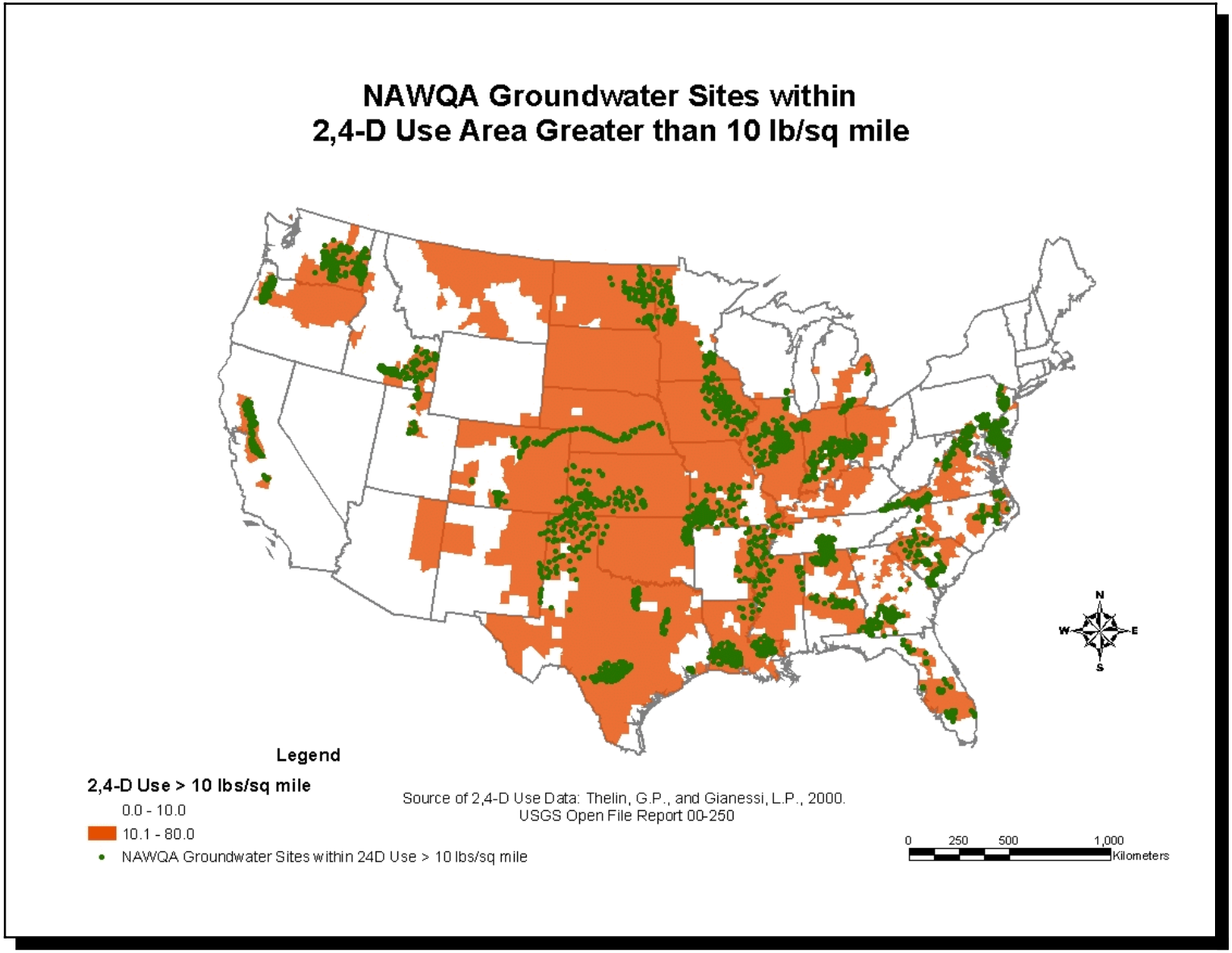


Figure 9. NAWQA Groundwater Locations versus 2,4-D County Level Use Information (USGS Open File Report 00-250)

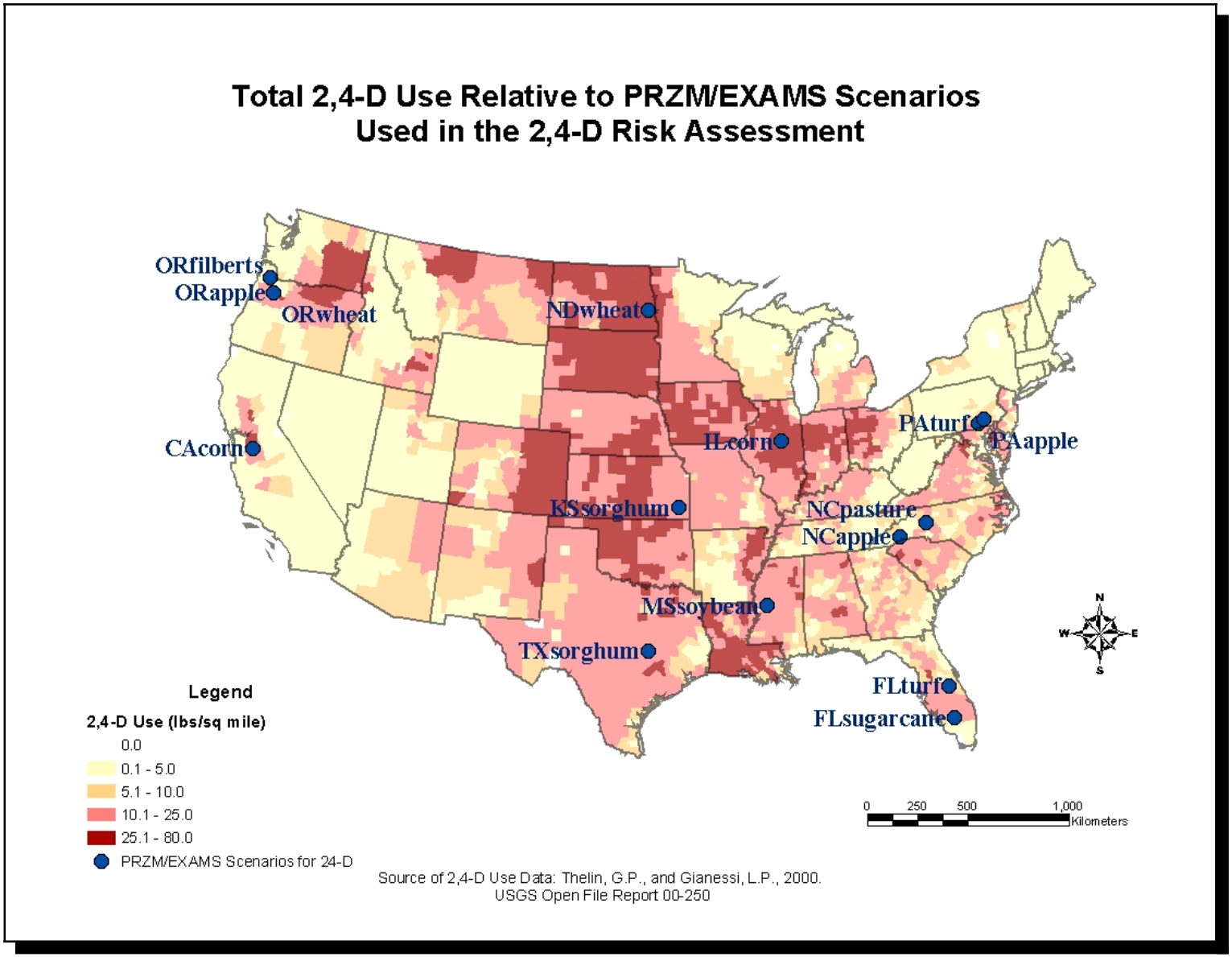


Figure 10. PRZM/EXAMS Scenarios Relative to 2,4-D County Level Use (USGS Open-File Report 00-250)

SURFACE WATER MONITORING DATA ASSESSMENT

Existing monitoring data considered in this assessment were the NAWQA groundwater and surface water database, USGS/EPA reservoir monitoring database, National Drinking Water Contaminant Occurrence Database (NCOD), and STORET. A preliminary review of the databases was conducted to provide measured peak and median concentrations in micrograms of acid equivalents per liter (ug ae/l) and is summarized in Table 1. A more extensive review of the data is presented in the sections which follow. The data were evaluated for magnitude and frequency of 2,4-D occurrence. Each surface water data set was separated by location and year of sampling and an analysis was conducted to tabulate the annual maximum concentration and to estimate the time weighted annual mean (TWAM) concentration from each set. The minimum for calculating TWAM concentration for each sampling station was at least 4 samples in a single year. The equation used for calculating the time weighted annual mean is as follows:

$$[((T_{0+1}-T_0) + ((T_{0+2}-T_{0+1})/2))*C\ t_{0+1})] + (((T_{i+1}-T_{i-1})/2)*C_i) + [((T_{end}-T_{end-1}) + ((T_{end-1}-T_{end-2})/2)*C_{Tend-1})]/365$$

where: Ci=Concentration of pesticide at sampling time (Ti)
Ti= Julian time of sample with concentration Ci
T_0 =Julian time at start of year=0
T_{end} =Julian time at end of year=365

The annual maximum and TWAM concentrations from the NAWQA and USGS Pilot Reservoir studies were ranked and percentiles were generated for each distribution for each data set. TWAM concentrations were not estimated from the STORET data. Data from the individual studies were not combined and the results from each data set are presented separately.

The monitoring data indicate that 2,4-D is detected in ground and surface water and is also detected in finished drinking water. Maximum concentrations of 2,4-D detected in surface source water was **58 ug/l** and **14.8 ug/l** in groundwater. The highest 2,4-D concentrations (20000 ug/l) determined to be present in the preliminary analysis from the STORET database reflect the detection limit rather than a measured concentration. Without qualification, the highest measured concentration reported in STORET above the detection limit is 7500 ug/l in groundwater. However, because this concentration far exceeds all other detections, this value is considered to be of questionable validity and is not recommended for use in the risk assessment. The highest median 2,4-D concentrations of 1.18 ug/l was derived from finished water samples in the NCOD database. The highest TWAM concentration was **1.45 ug/l** from the NAWQA database. It is important to note the Maximum Contaminant Level (MCL) and the Maximum Contaminant Level Goal (MCLG) for 2,4-D are both **70 ug/l**. The MCL is the highest level of a contaminant that is allowed in drinking water and is set as close to MCLGs as feasible with the best available treatment technology and benefits for the chemical taken into consideration. The MCLG is the level of a contaminant in drinking water below which there is no known or anticipated adverse health effects expected to occur. MCLGs allow for a margin of safety and are non-enforceable public health goals. The MCL and MCLG represent long term rolling average concentrations mandated by the Safe Drinking Water Act. MCLs are enforceable standards.

Table 1: Preliminary Analysis of Available Monitoring Data			
Data Source	**Peak Concentration (ug ae/L)**	**Median Concentration (ug ae/L)**	**TWAM Concentration (ug ae/L)**
Groundwater			
NAWQA	**14.8**	0.035	NA
NCOD (finished)	8	0.87	NA
STORET	7500*	0.1	NA
Surface Water			
NAWQA	15	0.035	1.45
USGS/EPA Reservoir			
Raw Water	0.414	0.077	0.15
Finish Water	0.634	0.077	0.12
NCOD (finished)	**58**	1.18	NA
STORET	330*	0.01	NA

*Maximum values in STORET are not recommended for exposure estimates given uncertainty in data quality. Values reported are for comparison with model estimates and other monitoring data only

National NAWQA Data

The USGS began collecting surface and groundwater data from selected watersheds to catalog the quality of water resources in the United States. The NAWQA program began in 1991 and consists of chemical, biological and physical water quality data from 59 study units across the United States. The NAWQA analytical method had a median 2,4-D recovery of 101.8 % with a standard deviation of 43.6.6%. The method detection limit (MDL) for 2,4-D was 0.0057 ug/l in groundwater and 0.0463 ug/l in surface water. The limit of quantitation (LOQ) was 0.035 ug/l. More details on the QA/QC of 2,4-D data in the NAWQA database may be found in Furlong, E.T., et al, 2001 (USGS WRI-Report 01-4134).

EFED evaluated the occurrence of 2,4-D in surface water from the national data. 2,4-D was detected in surface water from locations in 14 states. 2,4-D was detected in 23.5% (i.e. 1030 samples from a total national data set of 4377 samples). The annual maximum concentrations of 2,4-D ranged from 0.003 ug/l to 15.0 ug/l. Annual maximum concentrations are presented in Table 2. TWAM concentrations ranged from 1.45 ug/l to 0.035 ug/l and are presented in Table 3. Figure 5 presents a summary of all NAWQA surface water locations relative to 2,4-D use, while Figure 6 illustrates those locations within 2,4-D use area greater than 10 lbs/sq. mile. This analysis provides some context to the analysis of surface water data from NAWQA. In particular the analysis indicates that while many NAWQA surface water sites are within the 2,4-D use area, much of the 2,4-D use area is not well represented by the NAWQA data. Figure 11 is a graphical representation of the frequency of detection of 2,4-D at all NAWQA surface water sites which

indicates that 2,4-D is generally detected at a frequency of detection less than 25%. Figure 12 is a graphical representation of all maximum concentrations from the NAWQA database of 2,4-D in surface water greater than the LOQ of 0.035 ug/l and indicates that the highest detections are associated with the Midwest and Mississippi river valley. Figure 13 is a graphical representation of all concentrations of 2,4-D greater than 1.0 ug/l at NAWQA surface water sites.

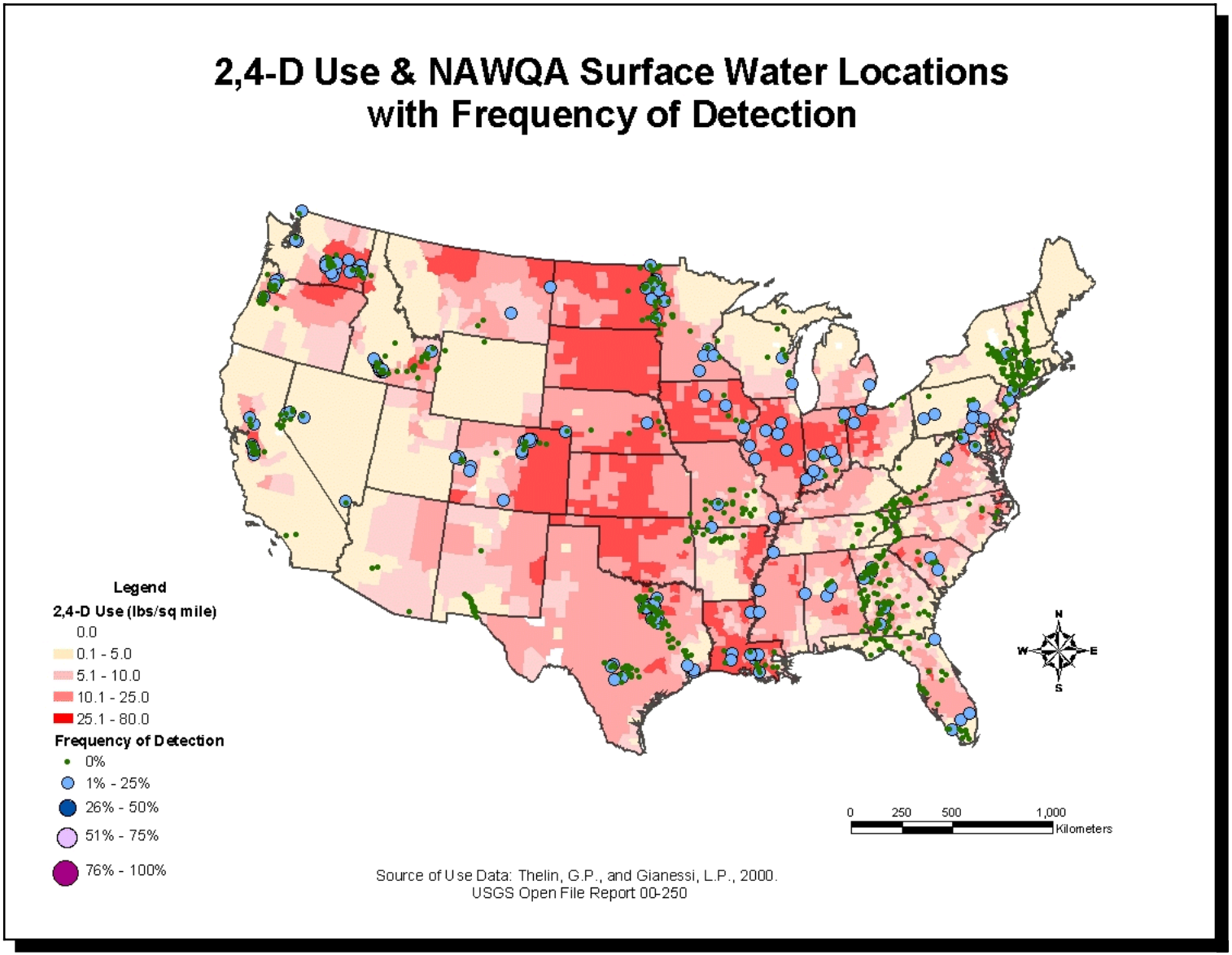


Figure 11 Frequency of Detection of 2,4-D at NAWQA Surface Water Locations Relative to 2,4-D County Level Use (USGS Open-File Report 00-250)

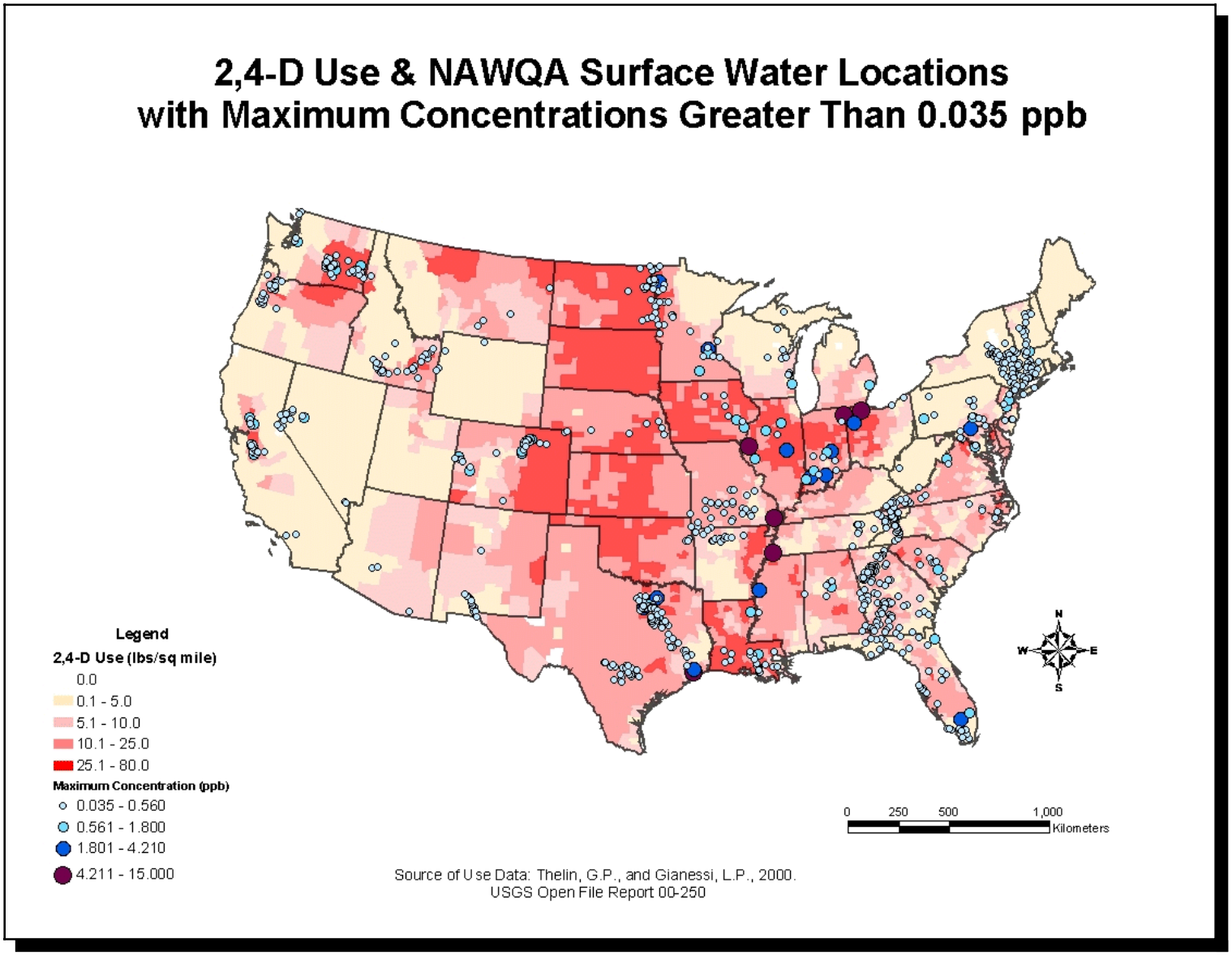


Figure 12. Maximum Concentrations of 2,4-D Greater Than 0.035 ppb at NAWQA Surface Water Locations Relative to 2,4-D County Level Use (USGS Open-File Report 00-250)

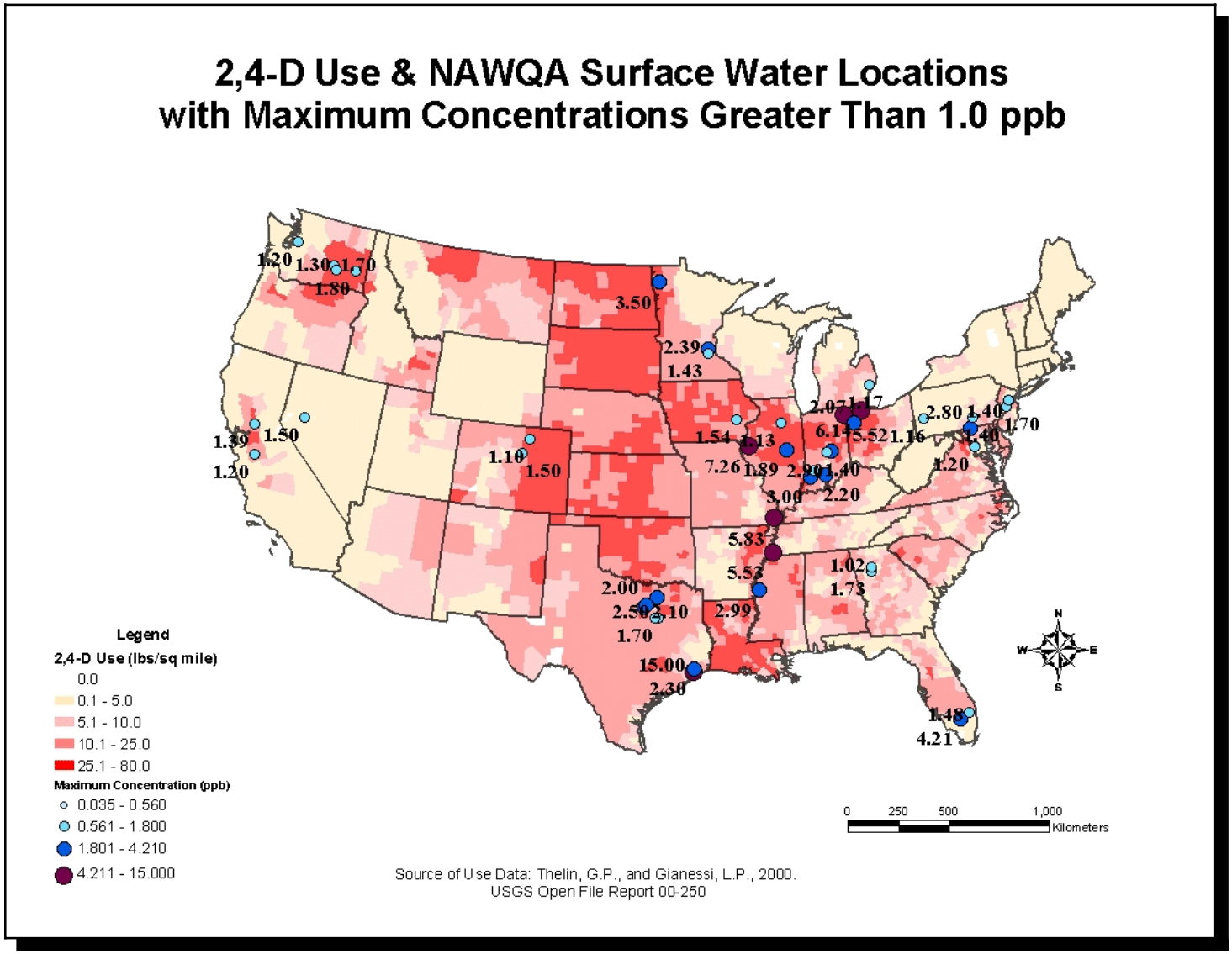


Figure 13. Maximum Concentrations of 2,4-D Greater than 1.0 ppb at NAWQA Surface Water Locations Relative to 2,4-D County Level Use (USGS Open-File Report 00-250)

STORET Data

STORET is a database of surface water detections compiled and maintained by the USEPA Office of Water. EFED uses STORET data with caution due to inherent limitations in STORET. Issues of concern for STORET include that the nature of study objectives from which data were generated is variable, the data are generally not targeted to areas of specific pesticide or chemical use, information on QA/QC of the data is inadequate, and ancillary data are not available for more detailed analysis.

2,4-D was present above the LOQ in 9780 samples from a total national data set of 49295 samples. A total of 17666 samples were reported as zero while 21849 samples were reported below the detection limit. The detection frequency of 2,4-D was 19.8% which is comparable to that of the NAWQA data. The annual maximum concentrations ranged from 0.0003 ug/l to 330 ug/l. No 2,4-D degradate data in surface water were available from STORET. Annual maximum concentrations are presented in Table 2. No QA/QC data are available for the 2,4-D monitoring data reported in STORET.

USGS Reservoir and Finished Water - Pilot Monitoring Study, 1999-2000

The USGS recently issued data from a cooperative study between the USGS and USEPA for "Pesticides in Water-supply Reservoirs and Finished Drinking Water - A Pilot Monitoring Program" (Blomquist, et al, 2001). The study consists of the analysis of raw and finished (treated) water samples from 12 drinking water reservoirs.

The detection frequency of 2,4-D in raw (untreated) water samples, including estimated detections below the LOQ, was 58%, while 2,4-D was detected in finished (treated) water samples, including estimated detections below the LOQ, at a detection frequency of 43%. The overall frequency of detection for all samples analyzed including intake and finished as well as estimated detections below the LOQ was 51.2%. The highest peak concentration of 2,4-D from these data was 0.634 ug/l detected in the treated water from Lake Mitchell, South Dakota. The annual maximum concentrations of 2,4-D ranged from 0.007 ug/l to 0.634 ug/l. TWAM concentrations in intake water ranged from 0.15 ug/l to 0.06 ug/l and from treated water ranged from 0.12 ug/l to 0.03 ug/l. Figure 7 above represents the location of the 12 reservoirs in this study relative to 2,4-D use. More details on the Pilot Reservoir Monitoring Study may be found in Blomquist et al, 2001 (USGS Open-File Report 01-456).

NCOD Surface Water Source - Summary of Data

The NCOD has been developed by the USEPA Office of Groundwater and Drinking Water to address the requirements of the 1996 amendments to the SDWA. The NCOD contains occurrence data from Public Water Systems (PWS) and other sources and includes information on physical, chemical, biological, and radiological contaminants. The database does not include data from all PWS or from all states. Additional data is available from PWS using mixed surface and groundwater but is not included in this discussion. Only information which has been forwarded

by the States to the Safe Drinking Water Information System (SDWIS) is included. EFED accessed the database on the occurrence of 2,4-D in finished drinking water as reported by the states to the SDWIS. 2,4-D was reported in NCOD as being analyzed for in surface water in eight states/territories and was detected in three of these states (Alabama, Illinois, and Massachusetts). A total of 3175 surface water samples were analyzed for 2,4-D and of these 2,4-D was present above the method detection limit in 83 samples (2.6%). A total of 415 PWSs using surface water only reported analyzing for 2,4-D and of these, 60 PWSs detected 2,4-D. The state reporting the highest number of detections of 2,4-D in all PWSs using surface water was Illinois, with 56 out of 1245 samples (i.e. 4.5%). The maximum 2,4-D concentration from all reported surface water data was 58 ug/l, while the average concentration from all reported data was 1.18 ug/l. These concentrations are consistent with maximum concentrations from other monitoring data and sources examined and are lower than the model predictions using PRZM/EXAMS. The reported average concentration should be viewed with caution because no information is available at this time to evaluate timing and location of the reported detections relative to dates and sources of 2,4-D use.

Table 2. Summary of Percentiles for Surface Water Annual Maximum Parent 2,4-D Concentrations.				
Percentile	**National NAWQA Data (ug/l)**	**STORET Data (ug/l)**	**USGS Pilot Reservoir Intake Data (ug/l)**	**USGS Pilot Reservoir Treated Data (ug/l)**
Maximum	15.00	330.00	0.414	0.634
99.9%	5.717	22.00	0.396	0.615
99%	1.442	2.30	0.199	0.332
95%	0.372	0.34	0.158	0.132
90%	0.150	0.12	0.122	0.100
75%	0.035	0.03	0.083	0.077
50%	0.035	0.00	0.077	0.077

Table 3. Summary of Percentiles for Surface Water TWAM Parent 2,4-D Concentrations in ug/l using the Annual Method for Calculating TWAMs.			
Percentile	**National NAWQA Data (ug/l)**	**USGS Pilot Reservoir Intake Data (ug/l)**	**USGS Pilot Reservoir Treated Data (ug/l)**
Maximum	1.45	0.15	0.12
99.9%	1.34	0.15	0.12
99%	0.63	0.14	0.12
95%	0.33	0.12	0.11
90%	0.20	0.09	0.10
75%	0.15	0.08	0.08
50%	0.05	0.08	0.07

GROUNDWATER MONITORING DATA ASSESSMENT

NAWQA Data

The USGS began collecting groundwater data from selected watersheds to catalog the quality of water resources in the United States. The NAWQA program began in 1991 and consists of chemical, biological and physical water quality data from 59 study units across the United States. EFED evaluated the occurrence of 2,4-D in groundwater from the national data. 2,4-D was detected above the LOQ in 20 out of a total of 4340 samples (i.e. 0.5%). The maximum concentration detected was **14.8 ug/l**. It should be noted that the next highest concentration detected in the NAWQA groundwater data are 4.54 ug/l followed by 0.54 ug/l. TWAM concentrations were not calculated for groundwater data due to the limited temporal data available.

An analysis of the relationship between NAWQA groundwater sites and data relative to 2,4-D use was conducted. This assessment provides some context to the analysis of groundwater data from NAWQA. In particular, this assessment indicates that, while many NAWQA groundwater sites are within the 2,4-D use area, there is a significant portion of 2,4-D use area not in the vicinity of the NAWQA groundwater monitoring locations. As part of the assessments of the NAWQA groundwater data, Figure 8 presents the location of all NAWQA groundwater sites relative to 2,4-D use, while Figure 9 illustrates those locations within 2,4-D use area greater than 10 lbs/sq. mile. Figure 14 is a graphical representation of the frequency of detection of 2,4-D at all NAWQA groundwater sites and indicates that at most sites 2,4-D is not detected. Figure 15 is a graphical representation of all maximum concentrations of 2,4-D in groundwater greater than the LOQ of 0.15 ug/l from the NAWQA data and indicates that most detections of 2,4-D in groundwater are between 0.15 ug/l and 1.0 ug/l. Figure 16 is a graphical representation of the concentrations of 2,4-D greater than 0.25 ug/l at NAWQA groundwater sites.

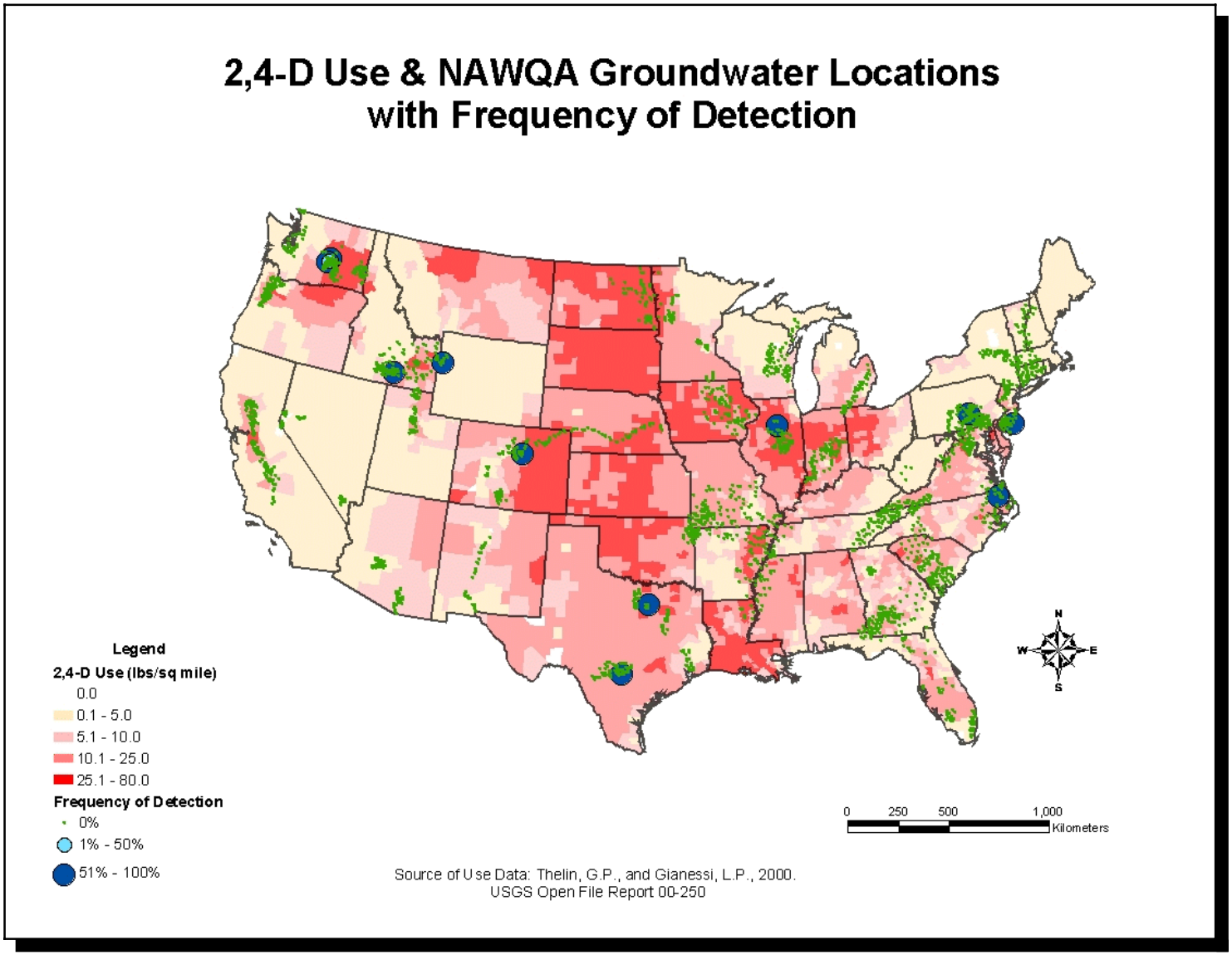


Figure 14. Frequency of Detection of 2,4-D at NAWQA Groundwater Locations Relative to 2,4-D County Level Use (USGS Open-File Report 00-250)

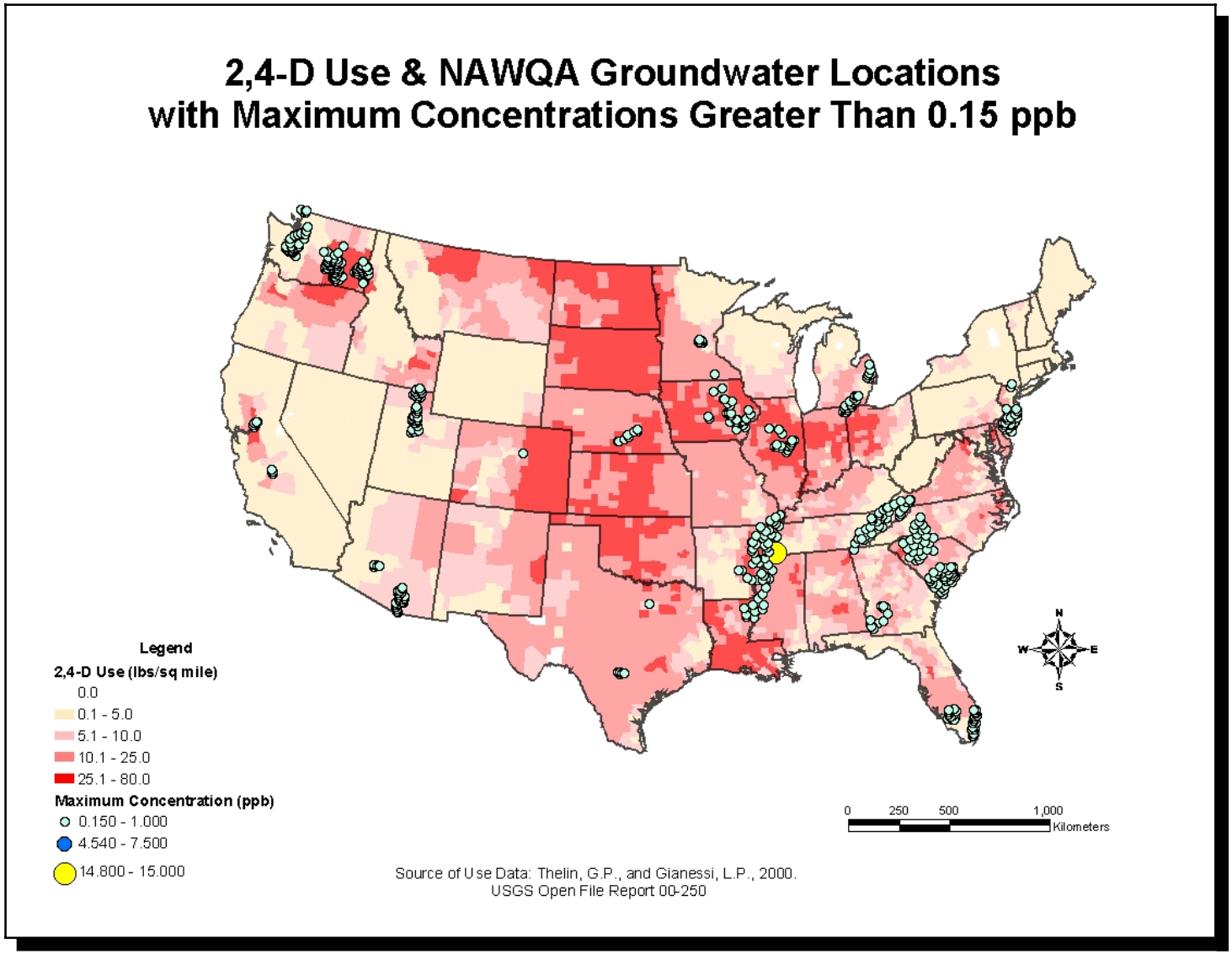


Figure 15. Concentration of 2,4-D in Groundwater Greater than 0.15 ppb at NAWQA Groundwater Locations Relative to 2,4-D County Level Use (USGS Open-File Report 00-250)

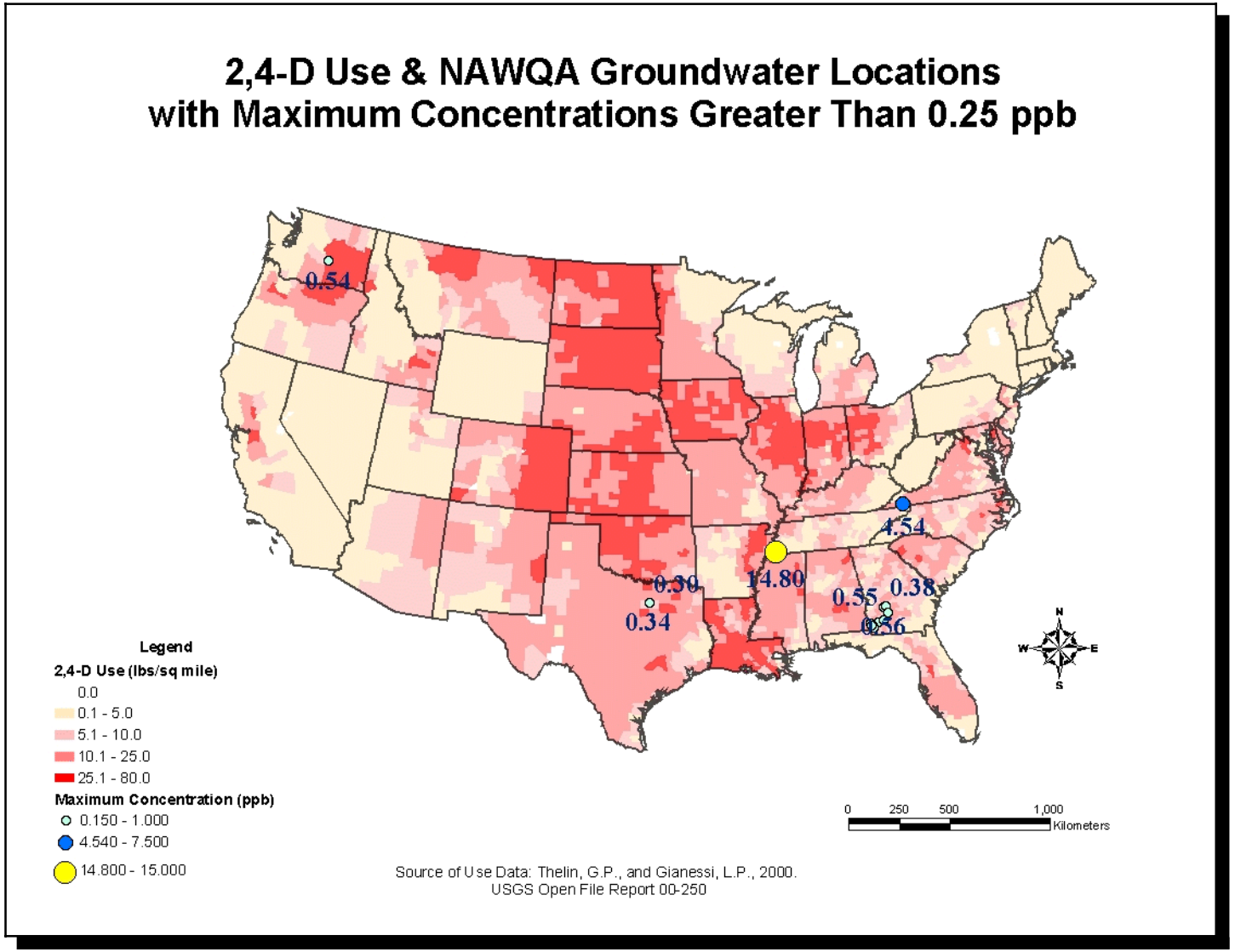


Figure 16. Concentration of 2,4-D in Groundwater Greater than 0.25 ppb at NAWQA Groundwater Locations Relative to 2,4-D County Level Use (USGS Open-File Report 00-250)

STORET Data

2,4-D was detected above the LOQ in 596 samples from 21232 samples (i.e. 2.8%). A total of 4320 samples were reported as zero while 16316 samples were reported below detection limit. The annual maximum concentrations ranged from 0.0006 ug/l to 7500 ug/l. No 2,4-D degradate data were found in groundwater samples from STORET.

Pesticides in Groundwater Database - 1992 Report, National Summary

The Pesticides in Groundwater Database (PGWD) was created by the Agency to provide a more complete picture of the occurrence of pesticides in groundwater at the time of publication of the report in 1992. The PGWD is a collection of groundwater monitoring studies conducted by federal, state, and local governments as well as industry and private institutions. The database represent groundwater data collected between 1971 and 1991, providing an overview of the pesticide monitoring in groundwater efforts as of the date of the summary.

2,4-D was detected in wells from 15 out 32 states where 2,4-D was analyzed. 2,4-D was detected in 2.3% (i.e., 141 analyses from a total of 6142 analyses) with no detections greater than the MCL of 70 ug/l. Concentrations range from 0.0079 to 57.1 ug/l. There is limited QA/QC information on these data and LOQs were not reported.

NCOD Groundwater Source - Summary of Data

The National Drinking Water Contaminant Occurrence Database (NCOD) has been developed by the USEPA Office of Groundwater and Drinking Water to address the requirements of the 1996 amendments to the Safe Drinking Water Act (SDWA). The NCOD contains occurrence data from Public Water Systems (PWS) and other sources and includes information on physical, chemical, biological, and radiological contaminants. The database does not include data from all PWS or from all states. Additional data are available from PWS using mixed surface and groundwater but is not included in this discussion. Only information which has been forwarded by the States to the Safe Drinking Water Information System (SDWIS) is included. EFED accessed the database on the occurrence of 2,4-D in finished drinking water as reported by the states to the SDWIS. 2,4-D was analyzed for in groundwater in eight states/territories and was detected in four of the states (Alabama, Illinois, Massachusetts, and Oregon). A total of 12654 groundwater samples were analyzed for 2,4-D and of these 2,4-D was present above the method detection limit in 70 samples (0.6%). A total of 3029 PWS using groundwater only reported analyzing for 2,4-D and of these, 52 PWS detected 2,4-D. The state reporting the highest number of detections of 2,4-D in all PWS using groundwater was Illinois with 43 out of 4404 samples (i.e. 1.0%). The maximum 2,4-D concentration was 8 ug/l from all groundwater data reported, while the average concentration was 0.87 ug/l from all data reported. These concentrations are consistent with maximum concentrations from other monitoring data and are higher than the model predictions using SCIGROW (i.e. 0.056 ug/l for acute and chronic). The reported average concentration should be viewed with caution because no information is available at this time to evaluate timing and location of the reported detections relative to dates and sources of 2,4-D use.

MODELING ASSESSMENT

Several surface water and groundwater monitoring data sources (NAWQA, STORET, USGS Pilot Reservoir Monitoring Study) were available for analysis as part of this assessment. To augment these monitoring data, drinking water concentrations were estimated using Tire II modeling for 2,4-D.

Surface Water Modeling of 2,4-D using PRZM/EXAMS

A drinking water assessment for the use of 2,4-D was performed using Tier II PRZM/EXAMS with an index reservoir (IR) and a percent crop area (PCA) scenario. For a description of the IR/PCA scenarios and the uncertainties associated with these, see the science policy document at the following URL : http://www.epa.gov/oppfead1/trac/science/reservoir.pdf. Table 4 presents the application information for the scenarios modeled using PRZM/EXAMS. Table 5 presents the input parameters for 2,4-D for PRZM/EXAMS, while Table 6 present the EECs for 2,4-D from the scenarios modeled. Fifteen different crop scenarios were modeled using PRZM/EXAMS. These scenarios were chosen to estimate the concentration of 2,4-D in surface drinking water sources over a geographically dispersed range of surface water concentrations modeled in areas representative of heavy 2,4-D use (Northwest, Central Valley of California, Midwest, Great Plains, and Eastern US). Figure 10 presents the location of the fifteen scenarios relative to 2,4-D use information obtained from Thelin and Gianessi, 2000 (USGS Open File Report 00-250). The PRZM/EXAMS scenarios selected for modeling represent all available EFED scenarios for registered 2,4-D uses.

Crops modeled by the Tier II model were sugarcane in Florida, turf in Florida and Pennsylvania, spring wheat in North Dakota, winter wheat in Oregon, corn in Illinois and California, sorghum in Kansas and Texas, soybean in Mississippi, pasture in North Carolina, apples in North Carolina, Oregon, and Pennsylvania, and filberts in Oregon. Typically if available, a PCA adjustment factor is applied to PRZM/EXAMS as an adjustment for the percent of crop in the watershed. A default PCA adjustment factor of 0.87 was applied to the EECs for sugarcane, sorghum, pasture, apples, and filberts because a specific PCA factor for these crops was not available. A PCA adjustment of 0.56 was applied to the wheat scenarios, a PCA factor of 0.41 was applied to soybeans, and a PCA adjustment factor of 0.46 was applied to the corn scenarios. It should be noted that there may be instances where a single crop co-occurs with other crops within a watershed (i.e., wheat and turf). In these instances the default PCA of 0.87 is used. The EECs presented below for the scenarios do not capture this co-occurrence and could underestimate concentrations that result from watersheds where other crops to which 2,4-D is applied are present. No PCA adjustment was applied to the turf scenarios thereby indicating that the entire watershed is assumed to grow turf to which 2,4-D is applied. Copies of PRZM/EXAMS input and output files are presented in Appendix A. Copies of the Metadata files for each individual model scenario are located at http://www.epa.gov/oppefed1/models/water/metadata.htm.

TABLE 4. 2,4-D TIER II Modeling Application Information for IR/PCA PRZM/EXAMS Scenarios Derived from the 2,4-D Task Force Master Label (Assumes all other registered labels will be adjusted to match the Master Label)

Crop Scenario	Application Rate in Acid Equivalents per Acre (Label #)	Number of Applications per Year	Timing of Applications	PCA Adjustment Factor
FL Sugarcane	2.0 lb ae/A	2	January 1, 19xx April 1, 19xx	0.87
FL Turf	2.0 lb ae/A	2	April 1, 19xx September 28, 19xx	1.0
PA Turf	2.0 lb ae/A	2	May 1, 19xx August 29, 19xx	1.0
ND Spring Wheat	1.25 lb ae/A	1	June 1, 19xx	0.56
OR Wheat	1.25 lb ae/A	1	April 1, 19xx	0.56
IL Corn	1.0 lb ae/A 1.0 lb ae/A 1.0 lb ae/A	3	April 15, 19xx May 30, 19xx September 27, 19xx	0.46
CA Corn	1.0 lb ae/A 1.0 lb ae/A 1.0 lb ae/A	3	March 15, 19xx April 29, 19xx August 27, 19xx	0.46
TX Sorghum	1.0 lb ae/A	1	June 7, 19xx	0.87
KS Sorghum	1.0 lb ae/A	1	June 7, 19xx	0.87
MS soybean	1.0 lb ae/A	1	March 10, 19xx	0.46
NC pasture	2.0 lb ae/A	2	June 1, 19xx	0.87
NC apples	2.0 lb ae/A	2	June 1, 19xx August 15, 19xx	0.87
OR apples	2.0 lb ae/A	2	July 1, 19xx September 14, 19xx	0.87
PA apples	2.0 lb ae/A	2	July 1, 19xx September 14, 19xx	0.87
OR filberts	1.0 lb ae/A	4	June 1, 19xx July 1, 19xx July 31, 19xx August 30, 19xx	0.87
Aquatic Use	10.8 lb ae/acre-foot (target concentration of 4 ppm)	1	NA	1.0
Rice Use	1.5 lb ae/A	1	NA	1.0

PRZM/EXAMS surface water modeling predicts **118.0 ug/l** for peak 2,4-D acid concentrations,

63.2 ug/l for the 90 day average concentration, **22.6 ug/l** for the annual mean concentration, and **8.9 ug/l** for the 30 year annual mean concentration. These 2,4-D concentrations are predicted based on the use of 2,4-D on North Carolina apples and are higher than reported monitoring data.

Table 5. PRZM/EXAMS Input Parameters for 2,4-D

MODEL PARAMETER	VALUE	COMMENTS	SOURCE
Aerobic Soil Metabolism $t_{½}$	6.2 days [1]	estimated upper 90 th percentile	MRID 00116625 MRID 43167501
Aerobic Aquatic Degradation $t_{½}$ (KBACW)	45 days [2]	estimated upper 90 th percentile	MRID 42045301 MRID 42979201 MRID 44188601
Anaerobic Aquatic Degradation $t_{½}$ (KBACS)	231 days [3]	estimated upper 90 th percentile (3 x anaerobic aquatic metabolism half-life)	MRID 43356001
Aqueous Photolysis $t_{½}$	13 days		MRID 41125306
Hydrolysis $t_{½}$	Stable		MRID 41007301
Koc	61.7 ml/g [4]	Average Koc using all acceptable and supplemental Koc [5]	MRID 42045302 MRID 00112937 MRID 44117901
Molecular Weight	221		Product Chemistry
Water Solubility	569 mg/l	10 x solubility	Product Chemistry
Foliar Extraction (FEXTRC)	0.5	Default Value[5]	

1 - Upper 90th Percentile based on acceptable aerobic metabolism half lives of 1.44, 2.92, 4.5, 12.4,4.38, 1.99, and 1.7 days.
2 - Upper 90th Percentile based on three times a single half life of 15 days from whole system data.
3 - Upper 90th Percentile based on acceptable anaerobic aquatic metabolism half lives of 333, 6.39, and 41 days.
4 - From all acceptable and supplemental adsorption/desorption data including Koc values of 29.62, 20.22, 52.68, 72.91, 13.23, 104.96, 76.60, 70.83, 116.67, and 59.09
5- From "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002.

Table 6: Predicted Concentrations for 2,4-D (ug/l) using PRZM/EXAMS				
PRZM/EXAMS Scenarios	**1/10 Peak Concentration (ug ae/l)**	**1/10 Year 90 Day Average (ug ae/l)**	**1/10 Yearly Annual Concentration (ug ae/l)**	**30 Year Annual Mean Concentration (ug ae/l)**
FL Sugarcane	86.6	30.7	9.3	5.2
FL Turf	43.0	22.8	8.2	3.8
PA Turf	18.8	11.4	5.8	3.9
ND Spring Wheat	8.3	5.0	2.0	1.5
OR Wheat	9.9	6.6	2.4	1.5
IL Corn	18.6	11.0	5.5	3.3
CA Corn	10.1	7.5	3.5	2.4
TX Sorghum	25.0	9.8	2.7	1.3
KS Sorghum	32.0	15.5	5.0	2.4
MS Soybean	14.4	7.7	2.2	1.0
NC Pasture	104.1	58.5	18.9	8.8
NC Apples	**118.0**	**63.2**	**22.6**	**8.9**
OR Apples	14.6	9.9	5.8	3.3
PA Apples	42.9	27.7	12.1	6.5
OR Filberts	6.9	5.5	3.3	2.6

Modeling of Direct Application of 2,4-D for Control of Aquatic Weeds

To assess potential exposures for aquatic herbicides, a first approximation of a drinking water EEC was modeled assuming direct application to the index reservoir. EFED developed an approach using a simple spreadsheet model that incorporates degradation based on an acceptable aerobic aquatic metabolism study and flow through the Index Reservoir. In reviewing the labels for aquatic weed control it was apparent that there could be several interpretations of what maximum application rate is allowed for this use. Therefore, EFED has evaluated several possible scenarios for this approach for modeling the direct application of 2,4-D to aquatic water bodies used as drinking water sources.

Each of the scenarios evaluated includes that assumption that 2,4-D is uniformly applied to the index reservoir with a surface area of 5.3 hectares and a volume of 144,000,000 liters. In this model, the 90 day average and annual mean concentrations were calculated assuming first-order dissipation from aerobic aquatic degradation and reservoir flow-through. Reservoir flow-through rates were estimated for all fifteen crop scenarios using PRZM/EXAMS consistent with the EFED policy for developing new Index Reservoir scenarios. See the EFED policy memorandum dated November 16, 1999 *Guidance for Use of the Index Reservoir in Drinking Water Exposure Assessments* located at the following URL:

http://www.epa.gov/oppfead1/trac/science/reservoir.pdf

An integrated equation of first order decay model was used to estimate average concentrations. The equation is C_o / [-k(1-e^{-kt}) / t] where C_o = initial concentration, k = first-order degradation rate (hr-1), and t = time. The first scenario evaluated with the simple spreadsheet model approach relied on an interpretation of the label for aquatic weed control requiring a target rate for 2,4-D use based on target concentration and not application rate. In order to account for this interpretation it was assumed that 2,4-D would be applied at a rate to meet the target concentration of 2,4-D acid of 4000 ug/l. This assumption would be applicable across all water bodies since the target rate is based on a rate 10.8 lbs ae/acre foot (see the 2,4-D Task Force Master Label) and would be independent of water body geometry/volume. This scenario included the assumption of uniform application across the entire water body without any setbacks from drinking water intakes. Modeling for this scenario predicts direct water application of 2,4-D will yield surface water concentrations of 2,4-D concentrations in reservoir water of **4000 ug ae/l** for peak, **2018 ug ae/l** for the 90 day average, and **627 ug ae/l** for the annual mean. The results of the direct application modeling under these assumptions are presented in Table 7.

Table 7: Direct Application of 2,4-D to the Index Reservoir to Control Aquatic Weeds (ug/l) Assuming a Uniform Application Across the Entire Index Reservoir			
Concentrations for 2,4-D (ug/l)			
Direct Aquatic Applications Scenarios	**Peak Concentration**	**90 Day Average Concentration**	**Annual Mean Concentration**
FL Sugarcane	4000	1200	309
FL Turf	4000	1910	573
PA Turf	**4000**	**2018**	**627**
ND Spring Wheat	4000	1974	605
OR Wheat	4000	1894	566
IL Corn	4000	1739	497
CA Corn	4000	1986	611
TX Sorghum	4000	1667	468
KS Sorghum	4000	1774	512
MS Soybean	4000	1575	432
NC Pasture	4000	1705	483
NC Apples	4000	1818	531
OR Apples	4000	1988	612
PA Apples	4000	1905	571
OR Filberts	4000	1931	584

Note - The maximum results of the settings modeled are in bold

By way of comparison to this scenario, data from supplemental aquatic field dissipation studies (MRID 43908302, 43954701, and 43491601) confirm that 2,4-D DMAS quickly converts to 2,4-D acid and dissipates rapidly from the water column. However, the high application rates consistent with those used in the direct application model result in peak concentrations in the water bodies of 4800 ug/l at day 1 in the North Dakota pond at an application rate of 41.8 lb ae/acre, of 2800 ug/l on day 0 in the North Carolina pond at an application rate of 41.8 lb ae/acre, and of 2300 ug/l on day 0 in the Louisiana pond at an application rate of 1.8 lbs ae/acre. These concentrations are significantly higher than the MCL for 2,4-D of 70 ug/l. These data indicate that at these application rates, the concentrations of 2,4-D in water remained above the MCL until at least 30 days after application (1500 ug/l) at the North Dakota pond, until at least 29 days after application (860 ug/l) at the North Carolina pond, and until at least 3 days after application (390 ug/l) at the Louisiana pond. These concentrations are comparable to those estimated by the direct application model scenario discussed above.

Also, four aquatic field dissipation studies reviewed previously as part of the Registration Standard issued in 1988 provide additional information on the behavior of 2,4-D in field environments. In these studies, 2,4-D (applied as both 2,4-D DMAS and 2,4-D BEE) had reported dissipation half lives between 133 minutes and 14 days with the maximum concentration of 2,4-D acid detected at 4800 ug/l in the Tennessee River. In addition, the 2,4-D Task Force recently submitted a dispersion and dissipation study (MRID 45897101) for the surface application of 2,4-D DMAS to control water hyacinth. In this study, 2,4-D acid, surface applied at 3.8 lbs ae/acre, was detected at a maximum concentration of 270 ug/l and was detected over 900 meters downstream from the application area.

An alternative scenario of the simple spreadsheet model for the direct application to water bodies is based on the interpretation that 2,4-D concentrations in aquatic water bodies may be limited by the USEPA MCL. The current 2,4-D labels for aquatic weed control stipulate that 2,4-D concentrations in potable surface water cannot exceed the Maximum Contaminant Level (MCL) of 70 ug/l for human consumption**.** The label language implies, but does not state conclusively, that the instantaneous concentration of 2,4-D will not exceed 70 ug/l in a water body used for drinking water. Therefore, the peak concentration for reservoirs used for drinking water were set equal to 70 ug/l for 2,4-D. Predicted 2,4-D concentrations in reservoir water are **70.0 ug/l** for the peak, **35.3 ug/l** for the 90 day average, and **11.0 ug/l** for the annual mean. Clarification of label language should be considered for this scenario to be accurate. The results of the direct application modeling under these assumptions are presented in Table 8.

Table 8: Direct Application of 2,4-D to the Index Reservoir to Control Aquatic Weeds (ug/l) Assuming a Limit to the Peak Concentration of the MCL			
Concentrations for 2,4-D (ug/l)			
Direct Aquatic Applications Scenarios	**Peak Concentration**	**90 Day Average Concentration**	**Annual Mean Concentration**
FL Sugarcane	70.0	21.0	5.4
FL Turf	70.0	33.4	10.0
PA Turf	70.0	35.3	11.0
ND Spring Wheat	70.0	34.6	10.6
OR Wheat	70.0	33.1	9.9
IL Corn	70.0	30.4	8.7
CA Corn	70.0	34.8	10.7
TX Sorghum	70.0	29.2	8.2
KS Sorghum	70.0	31.0	9.0
MS Soybean	70.0	27.6	7.6
NC Pasture	70.0	29.8	8.5
NC Apples	70.0	31.8	9.3
OR Apples	70.0	34.8	10.7
PA Apples	70.0	33.3	10.0
OR Filberts	70.0	33.8	10.2

A final interpretation of label language for aquatic weed control indicates that in water bodies used for potable water a setback of 1500 feet should be observed and that no 2,4-D will be applied within this zone. To account for the setback restriction on potable water bodies EFED has utilized an approach developed by Ian Kennedy formerly of EFED (currently with PMRA) which was utilized for a previous risk assessment of triclopyr for aquatic weed control that utilizes the one-dimensional convection/dispersion equation. The EECs were based on treatment of an area of the index reservoir with a setback distance of 1500 feet and at the maximum application rate of **4000 ug/l**.

Estimates were made using the one-dimensional convection-dispersion equation

$$\frac{\partial C}{\partial \tau} = \frac{1}{P}\frac{\partial^2 C}{\partial Z^2} - \frac{\partial C}{\partial Z} - \mu C$$

The dimensionless parameters in this equation are $C = c/c_0$, J = vt/L, $Z = x/L$, $P = vL/D$, ∴ = $\ln(2)L/vt_{1/2}$, where c is the concentration, c_0 the initial concentration, L the length of the water body, x is distance along the water body, v is the water flow rate, D is a dispersion coefficient and $t_{1/2}$ is the half-life of the chemical. The dimensionless parameter P is known as the Peclet number and can be used to tell how much a pulse will spread as it flows the length of the system.

The solution to this equation, assuming an initial constant concentration between two points is (Toride et al., 1995)

$$\frac{C}{C_0} = \sum_{i=0}^{1} (-1)^i \left[e^{-\mu\tau} \left\{ 1 - \frac{1}{2} erfc\left(\frac{(Z - Z_i) - \tau}{\sqrt{4\tau / P}} \right) - \sqrt{\frac{P\tau}{\pi}} e^{PZ - \frac{P[(Z-Z_i)+\tau]^2}{4\tau}} \right.\right.$$
$$\left.\left. + \frac{1}{2}\left[1 + P(Z + Z_i) + P\tau\right] e^{PZ} erfc\left(\frac{(Z + Z_i) + \tau}{\sqrt{4\tau / P}} \right) \right\} \right]$$

where the Z_i are the start and end of the application zone, converted to dimensionless parameters in the same manner as Z, above. The function $erfc(x)$ is the complementary error function and is defined as

$$erfc(x) = \frac{2}{\sqrt{\pi}} \int_x^{\infty} e^{-\xi^2} d\xi.$$

Parameters used for this calculation were $D = 0.0005$ m^2/s and an aerobic aquatic half-life for 2,4-D of 45 days. As in the triclopyr risk assessment, the flow velocity was set conservatively at 6.28 m/day to maximize the annual average concentration. Higher water velocities would move the chemical more quickly and result in lower annual average concentrations. Lower water velocities will allow more time for the chemical to degrade before reaching the setback point.

The dispersion value of 0.0005 m^2/s is fairly small and was chosen because small dispersion values result in more conservative EEC's. This value is on the low end of dispersion values for lakes (Chapra, 1997). Decreasing the dispersion to zero would result in plug flow, where the chemical moves in a single slug the size of the application area without spreading. Such a circumstance would result in somewhat higher annual average and peak concentrations. Using this approach, the predicted peak concentration at a drinking water intake in the EFED index reservoir with a setback of 1500 feet is **811 ug/l** 79 days after application while the annual average concentration is **102 ug/l**. Application to larger reservoirs could result in higher estimates of exposure.

Modeling Use of 2,4-D on Rice

The use of 2,4-D on rice was modeled using an interim screening level model developed by EFED. A more complete discussion of the screening level rice model may be found in the EFED policy memorandum dated October 29, 2002 attached to this assessment (Appendix B). The model involves an assumption of uniform application of pesticide to a rice paddy and calculates an EEC in the water column that could potentially be released from the paddy. The EEC is recommended for both acute and chronic exposures from 2,4-D use on rice. The model assumes partitioning of the pesticide between water and the upper 1 cm of sediment but does not include degradation. The model uses the following equation:

$$EEC = (10^9 * M_T) / (V_T + m_{sed} * K_d)$$

In this equation M_T is the total mass of pesticide applied in kg per hectare, V_T is the volume of water in the paddy (1,067,000 liter per hectare) assuming a paddy 4 inches deep and includes pare space in a 1 cm interaction zone, m_{sed} is the mass of sediment in the top 1 cm, K_d is the sorption coefficient, and 10^9 is the conversion factor from kilograms to micrograms.

2,4-D is registered for use in rice paddies for the acid and amine salt formulations of 2,4-D (esters are not registered for rice use) with a maximum seasonal application rate of 1.5 pounds acid equivalents per acre. Modeling of this use rate results in an estimated 2,4-D concentration in the rice paddy of **1431 ug/l**. This value is expected to represent upper percentile concentrations for edge of paddy concentrations because of the lack of consideration for degradation, dilution and dispersion. However, the exact level of conservativeness has not been fully evaluated in the context of regionally-dependent management practices, pesticide management practices, and universe of pesticide fate properties. Once released from the paddy, the concentrations are expected to decrease due to degradation, dilution and dispersion.

As with the direct application model, the EEC derived by modeling 2,4-D use on rice is higher than concentrations detected in the surface water monitoring data evaluated as part of this assessment. However, analytical results of pond water after the direct application of 2,4-D reported in an aquatic field dissipation study (MRID 43491601) on rice submitted by the registrant indicate that initial concentrations (equivalent to the instantaneous estimate above) were as high as 2343 ug/l with a mean concentration reported as 1372 ug/l, suggesting that the model estimates are not unreasonable.

Groundwater Modeling of Parent 2,4-D using SCI-GROW

Based on SCI-GROW modeling the 2,4-D concentration in ground water is estimated to be **0.0311 ug/l**. This model prediction, however, is much lower than maximum 2,4-D concentrations in monitoring data. The maximum 2,4-D concentration in ground water is **14.89 ug/l** from data collected by the USGS NAWQA program and **8 ug/l** for NCOD. It should be noted that the next highest concentration detected in the NAWQA groundwater data is 4.54 ug/l which is consistent with the NCOD reported concentration. Table 9 presents SCI-GROW model inputs.

Table 9. SCIGROW Input Parameters

Model Input Parameters	Input Value	Comments	Source
Aerobic Soil Metabolism $t_{1/2}$	6.2 days 2,4-D	Average value	MRID 00116625 MRID 43167501
K_{OC}	13.23 2,4-D	Lowest non-sand value because all Koc exhibit greater than 3-fold variation[1]	MRID 42045302 MRID 00112937 MRID 44117901
Application Rate	2.0 lbs ai/acre	Various	Label 62719-260
Max. Number of Application Per Season	2 applications		Label 62719-260

1- From "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002.

Uncertainty

The drinking water assessment for 2,4-D relied on both an analysis of monitoring data and modeling to predict potential concentrations to which humans may be exposed. There are uncertainties in this assessment for both types of analysis

Modeling relies on estimated fate parameters and assumed agricultural practices to predict concentrations of 2,4-D to which humans may be exposed. In this instance, the fate database is essentially complete although terrestrial field dissipation studies were deemed supplemental but given the weight of evidence repeating the studies was not deemed necessary. Sufficient information was available to estimate all fate parameters required as model inputs for both PRZM/EXAMS and SCIGROW for 2,4-D. However, the data for 2,4-D is limited to those studies submitted and therefore to insure that an EEC is predicted which is protective of all populations, many of the model inputs used in this assessment were estimated at the upper 90th percentile in accordance with EFED guidance (see EFED "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002).

PRZM/EXAMS requires information on agricultural practices as inputs. In the case of PRZM/EXAMS, the model requires a specific application date and rate to be applied for a number of scenarios. In reality, application dates and rates applied across the United States will vary depending on geography, pest pressure, climatic factors, and changes in agricultural cropping patterns. EFED attempts to capture some of this variability by modeling as many representative scenarios as possible and by using meteorological data which covers a time span sufficient to capture climatic variations which are likely to occur. However, the model is limited in its ability to capture all of the natural variation which occurs for any pesticide application and this adds uncertainty to the drinking water assessment.

No surface water or groundwater monitoring studies which specifically targeted 2,4-D use were available for analysis as part of this assessment. EFED has relied on an evaluation of monitoring data for 2,4-D collected by others. Each monitoring data set evaluated in this assessment was collected with a different study objective. The NAWQA data represents surface-water and groundwater concentrations collected on a national basis with an emphasis on high agricultural use areas. Typically, STORET data represent a compilation of several studies, each with different objectives and quality of data, both of which add uncertainty to the use of these data. The USGS/EPA Reservoir Pilot Monitoring study represents raw and treated water from twelve different states but is not targeted to 2,4-D use. Analysis of 2,4-D by CWS is required and therefore data from the NCOD is available for this assessment. However, these data are limited in that they are collected quarterly, sample timing is not uniform across CWS and is not targeted to 2,4-D use, and the dataset represents self-reporting data from the CWS with only summary statistics available. Individual data results are not available in NCOD.

2,4-D, a herbicide used on multiple crop and non-crop uses over a wide geographic range, has been frequently detected in surface water and groundwater. However, none of these monitoring data were specifically targeted to 2,4-D use. Non-targeted monitoring data is typically used by

EFED as a check against modeling estimates and not as drinking water estimates for use in the human health dietary assessment. As noted in the vulnerability assessment, many of the sample locations from the monitoring data evaluated were not targeted to areas of highest 2,4-D use and consequently, extrapolation of concentrations of 2,4-D in groundwater and surface water from these data may not be representative of concentrations in all areas of highest 2,4-D use.

The frequency of sampling from the monitoring data evaluated also adds uncertainty to this assessment. Estimates from monitoring data of acute exposure have varying sample frequencies and it is unclear what affect this has on peak estimates from monitoring data. Therefore, it is likely that the monitoring data has not captured the maximum peak concentration from the locations sampled. This fact, coupled with the fact that monitoring data are not targeted to 2,4-D use areas, adds uncertainty to the estimation of EECs from the monitoring data.

County level use data for 2,4-D data have been derived from an approach developed by Thelin and Gianessi, 2000. In this approach Thelin and Gianessi relied on a combination of state level pesticide use data derived from the National Center on Food and Agricultural Policy (NCFAP) and county level information on harvested crop acreage taken from the USDA Census of Agriculture. This approach is limited by the fact that state level coefficients of pesticide use cannot provide precise county level estimates and do not account for local variations in cropping and management practices. Finally, the approach is limited in that the Census of Agriculture may under-report certain crops and regions due to non-disclosure. All of these factors add uncertainty to the assessment.

Analysis of CWS intake data in the vulnerability assessment relied on preliminary data developed by Oak Ridge National Laboratory (ORNL) under contract to the USEPA. The data set used by EFED in this drinking water assessment is preliminary and may not include all CWS intakes. In addition, the analysis of population served is based on self reported data and may not represent the entire population served by surface water. These facts can add uncertainty to the assessment of potential exposure to 2,4-D through surface water supplied CWS intakes.

The runoff and leaching vulnerability schemes used in this assessment were adapted from a vulnerability scheme developed by the USDA (Kellogg et al, 1998). USDA identified several caveats to be considered when using this vulnerability scheme which could contribute to the uncertainty associated with this assessment. Among these are that estimates of runoff and leaching vulnerability are estimated through the use of algorithms (i.e. they represent estimates of vulnerability and not actual field measurements), fate and transport processes (i.e. dilution and recharge) are not included, farm management practices are not considered, and some watershed estimates are based on major crops only. The effect of these factors on the vulnerability assessment is unknown.

The use of 2,4-D as an herbicide is not the only source of 2,4-D in the environment. Another source is, the phenoxy herbicide, 2,4-DB, which degrades to 2,4-D. An analysis of the use patterns (Figure 17) from the data collected by Thelin and Giannessi (USGS Open-File Report 00-250) indicates that while 2,4-DB is not used in all of the highest 2,4-D use areas, there is geographic overlap between the two uses. It is likely that some percentage of the 2,4-D detected

in surface water and groundwater monitoring data may result from degradation of 2,4-DB to 2,4-D. However, there are insufficient data to determine what impact the degradation of 2,4-DB to 2,4-D has on an evaluation of monitoring data, adding more uncertainty to this assessment.

Research is underway to investigate the effect of drinking water treatment processes (i.e. chlorination, activated carbon, etc..) on pesticides. There is some evidence that treatment processes may reduce the concentration of selected pesticides in finished (treated) drinking water. However, research also suggests that some pesticides are converted to more toxic by-products by treatment processes. The best available treatment technology (BAT) for 2,4-D is granular activate carbon (GAC). However, it is important to note that GAC is not a common treatment process (see the September 2000 SAP at http:www.epa.gov/scipoly/sap/2000/index.htm for details). Therefore, EFED has not incorporated treatment effects into the drinking water assessment.

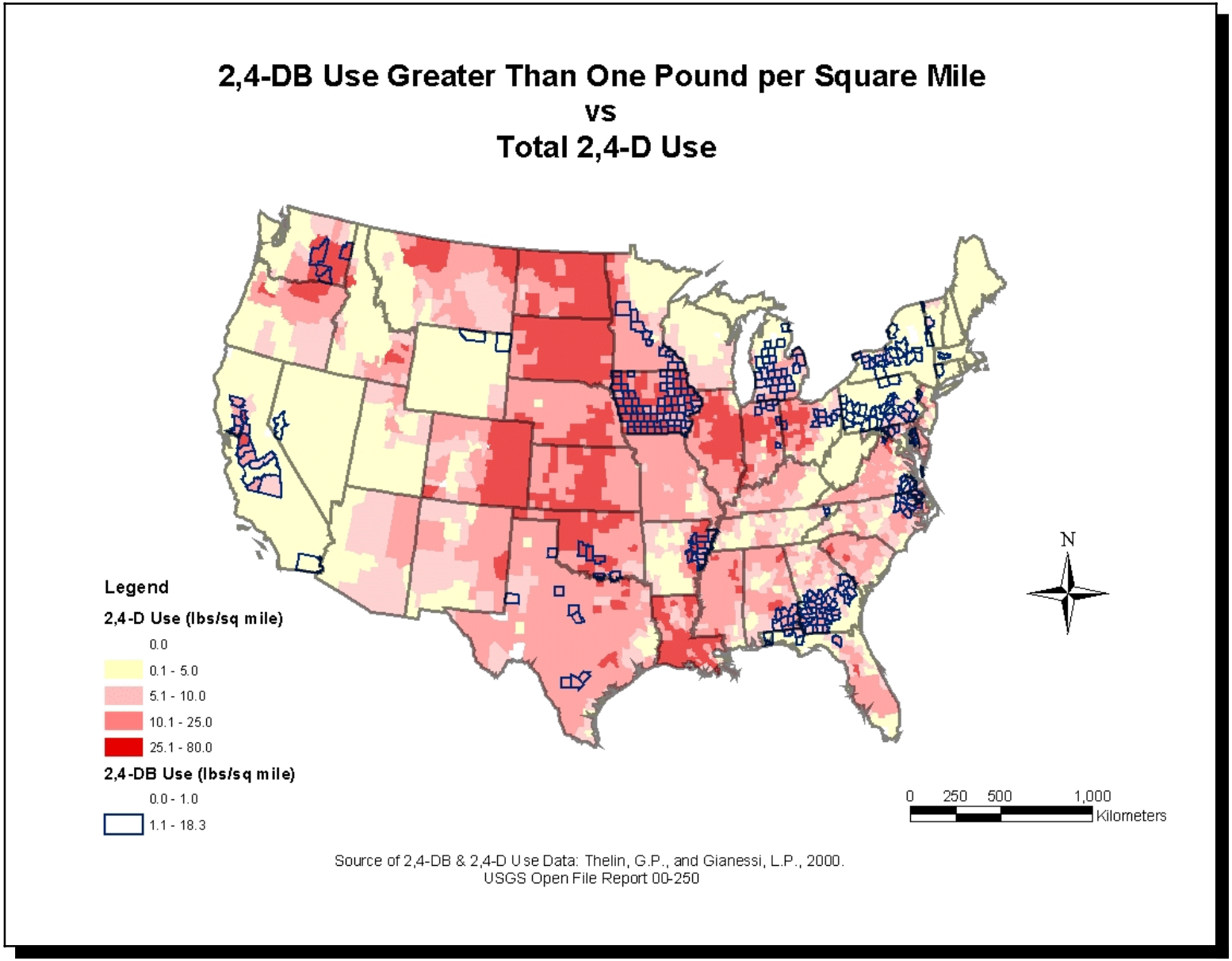


Figure 17. Comparison of 2,4-DB Use Greater than One lb/sq mile Relative to 2,4-D Use

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APPENDIX C: Ecological Hazard Data

AQUATIC DATA

Freshwater Fish, Acute

Two freshwater fish toxicity studies using the TGAI are required to establish the toxicity of products containing the 2,4-D acid, salts, amines, or esters to freshwater fish. The preferred test species are rainbow trout (a coldwater fish) and bluegill sunfish (a warmwater fish). Results of these tests are tabulated below.

2,4-D acid (PC Code: 030001)

Freshwater Fish Acute Toxicity					
Species/ Flow-through or Static	% ai	96-hour LC50 (mg ae/L) (measured/nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout *(Oncorhynchus mykiss)* static	98.7	358 (measured)	Practically non-toxic	411583-01, Alexander et. al., 1983	Supplemental
Bluegill sunfish *(Lepomis macrochirus)*	98.7	263 (measured)	Practically non-toxic	411583-01, Alexander et. al., 1983	Supplemental
Fathead minnow (*Pimephales promelas*)	98.7	320 (measured)	Practically non-toxic	411583-01, Alexander et. al., 1983	Supplemental

[1] Based on acid equivalent of 100% of ai

Since the LC50 falls in the range of 263 to 358 mg ae/L, the 2,4-D acid is categorized as practically non-toxic to freshwater fish on an acute basis. The guideline (72-1) is fulfilled.

2,4-D Sodium Salt (PC Code: 030004)

Freshwater Fish Acute Toxicity

Species/ Flow-through or Static	% ai	96-hour LC50 (mg ai/L) (measured/ nominal)	96-hour LC50 (mg ae/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout *(Oncorhynchus mykiss)* static	80	>100 (nominal)	>91 (nominal)	Practically non-toxic	53986, McCann, 1973	Core

[1] Based on acid equivalent of 91% of ai

Since the LC50 is >91 mg ae/L, the 2,4-D sodium salt is categorized as practically non-toxic to freshwater fish on an acute basis. This characterization is solely based on the rainbow trout and the guideline (72-1) is not fulfilled, however, available environmental fate data indicates that the salts and amines of 2,4-D rapidly degrade to the acid equivalent. Therefore, additional data will not be required at this time.

2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)

Freshwater Fish Acute Toxicity

Species/ Flow-through or Static	% ai	96-hour LC50 (mg ai/L) (measured)	96-hour LC50 (mg ae/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout *(Oncorhynchus mykiss)* static	73.1	>120	>81.6	Practically non-toxic	419751-05, Graves. et. al., 1991.	Core
Bluegill sunfish *(Lepomis macrochirus)*	73.1	>121	>82.3	Practically non-toxic	419751-04, Graves. et. al., 1991.	Core
Fatahead minnow (*Pimephales promelas*)	73.1	344	234	Practically non-toxic	41975`-04, Graves, et. al, 1991	Core
Bluegill sunfish *(Lepomis macrochirus)*	Not Reported	149	101	Practically non-toxic	0073-091-01, Sleight, B., 1971.	Supplemental

[1] based on acid equivalent of 68% ai

Since the LC50 falls in the range of 81.6 to 234 mg ae/L, the 2,4-D diethanolamine salt is categorized practically non-toxic to freshwater fish on an acute basis. The guideline (72-1) is fulfilled.

2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)

Freshwater Fish Acute Toxicity

Species/ Flow-through or Static	% ai	96-hour LC50 (mg ai/L) (measured)	96-hour LC50 (mg ae/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout (Oncorycus salmo)	67.3	>1000	>830	Practically non-toxic	233350, Vilkas, A,G,, 1977.	Core
Bluegill sunfish (*Lepomis macrochrus*)	73.1	>121	>100	Practically non-toxic	419751-04, Graves, et. al., 1991.	Core
Bluegill sunfish *(Lepomis macrochirus)*	67.3	250	207.5	Practically non-toxic	411583-11, Alexander, et. al., `983.	Core
Bluegill sunfish *(Lepomis macrochirus)*	51.1 9TEP)	>1000	>830	Practically non-toxic	234027, Vilkas, A.G., 1978.	Supplemental
Fathead minnow (*Pimephales promelas*)	67.3	318	264	Practically non-toxic	419751-04, Graves. et. al., 1991.	Core

[1] based on acid equivalent of 83% ai

Since the LC50 falls in the range of 207.5 to >830 mg ae/L, the 2,4-D dimethylamine salt is categorized as practically non-toxic to freshwater fish on an acute basis. The guideline (72-1) is fulfilled..

2,4-D Isoproylamine (IPA) (PC Code: 030025)

Freshwater Fish Acute Toxicity						
Species/ Flow-through or Static	% ai	96-hour LC50 (mg ai/L) (measured)	96-hour LC50 (mg ae/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout (Oncorhynchus mykiss)	48.7 (TEP)	2840	2244	Practically non-toxic	01338869, 1983.	Core
Bluegill sunfish *(Lepomis macrochirus)*	48.7 (TEP)	1700	1343	Practically non-toxic	01338869, 1983.	Core
Fathead minnow (*Pimephales promelas*)	48.7 (TEP)	2180	1722	Practically non-toxic	01338869, 1983.	Supplemental

[1] Based on acid equivalent factor of 79% a.i.

Since the LC50 falls in the range of 1343 to 2244 mg ae/L, the 2,4-D isoproylamine salt is categorized as practically non-toxic to freshwater fish on an acute basis. The guideline (72-1) is fulfilled.

2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)

Freshwater Fish Acute Toxicity

Species/ Flow-through or Static	% ai	96-hour LC50 (mg ai/L) (measured)	96-hour LC50 (mg ae/L) (measured)	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout (Oncorhynchus mykiss)	69.2	300	162	Practically non-toxic	413538-03, Mayes, et. al., 1989.	Core
Bluegill sunfish *(Lepomis macrochirus)*	69.2	401	217	Practically non-toxic	413538-04, Mayes, et al., 1989	Core

[1] Based on acid equivalent of 54% ai

Since the LC50 falls in the range of 162 to 217 mg ae/L, 2,4-D triisopropanolamine salt is categorized as practically non-toxic to freshwater fish on an acute basis. The guideline (72-1) is fulfilled.

2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)

Freshwater Fish Acute Toxicity

Species/ Flow-through or Static	% ai	96-hour LC50 (mg ai/L) (measured)	96-hour LC50 (mg ae/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout *(Oncorhynchus mykiss)* static	97.4	2.09	1.44	Moderately toxic	413538-01, Alexander, et. al, 1983.	Core
Rainbow trout *(Oncorhynchus mykiss)* static	77.5	0.65 (56-hour LC50)	0.45	Highly toxic	00050674, Pitcher, F.G., 1974.	Supplemental
Bluegill sunfish *(Lepomis macrochirus)*	Not reported	1.2	0.828	Moderately toxic	400980-01, Mayer, 1986.	Supplemental
Bluegill sunfish *(Lepomis macrochirus)*	97.4	0.62	0.428	Highly toxic	413538-01, Alexander, et. al, 1983.	Core
Bluegill sunfish *(Lepomis macrochirus)*	29.0 (TEP)	>100	0.69	Practically non-toxic	400980-01, Mayer, 1986 J.A.,1969	Supplemental
Fathead minnow (*Pimephales promelas*)	97.4	2.60	1.79	Moderately toxic	413538-01, Alexander, et. al, 1983.	Core

[1] Based on acid equivalent of 69% ai

Since the LC50 falls in the range of 0.428 to 1.79 mg ae/L, 2,4-D butoxyethyl ester is categorized as highly toxic to freshwater fish on an acute basis. The guideline (72-1) is fulfilled.

2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)

Freshwater Fish Acute Toxicity

Species/ Flow-through or Static	% ai	96-hour LC50 (mg ai/L) (measured/nominal)	96-hour LC50 (mg ae/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout *(Oncorhynchus mykiss)* static	66.9 (TEP)	4.82 (measured EHE)	3.2 (measured)	Moderately toxic	417373-03, Mayes, et. al., 1990.	Core
Rainbow trout *(Oncorhynchus mykiss)* static	92	22 (nominal)	14.5	Slightly toxic	45068, Buccafusco, R.J., 1976.	Core
Bluegill sunfish *(Lepomis macrochirus)*	92	18 (nominal)	11.9	Slightly toxic	45069, Buccafusco, R.J., 1976.	Core

[1] Based on acid equivalent of 66%

Since the LC50 falls in the range of 3.2 to 14.5 mg ae/L, 2,4-D 2-ethylhexyl ester is categorized as slightly to moderately toxic to freshwater fish on an acute basis. The guideline (72-1) is fulfilled.

2,4-D Isopropyl Ester (IPE) (PC code: 030066)

Freshwater Fish Acute Toxicity

Species/ Flow-through or Static	% ai	96-hour LC50 (mg ai/L) (measured/nominal)	96-hour LC50 (mg ae/L) (measured/nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout *(Oncorhynchus mykiss)* static	98.2	0.69 (measured)	0.58	Highly toxic	439331-01, Drottar, et. al., 1996.	Core
Rainbow trout *(Oncorhynchus mykiss)* static	45.8 (TEP)	0.78 ((measured)	0.66	Highly toxic	439332-01, Drottar, et. al., 1996.	Core
Bluegill sunfish *(Lepomis macrochirus)* static	98.2	0.31 (measured)	0.26	Highly toxic	439307-01, Drottar, et. al., 1996.	Core
Bluegill sunfish *(Lepomis macrochirus)*	45.8 (TEP)	0.31 (measured)	0.26	Slightly toxic	439103-01, Drottar, et. al., 1996.	Core

[1] Based on acid equivalent of 84%

Since the LC50 falls in the range of 0.26 to 0.66 mg ae/L, 2,4-D isopropyl ester is categorized as slightly to highly toxic to freshwater fish on an acute basis. The guideline (72-1) is fulfilled.

Estuarine and Marine Fish, Acute

Acute toxicity testing with estuarine/marine fish using the TGAI is required to establish the toxicity of products containing the 2,4-D acid, salts, amines, or esters because the active ingredient is expected to reach this environment because of its use in coastal counties. The preferred test species is sheepshead minnow. Results of these tests are tabulated below.

2,4-D Acid (PC Code: 030001)

Estuarine/Marine Fish Acute Toxicity

Species/Static or Flow-through	% ai	96-hour LC50 (mg ae/L) (measured/nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Tidewater silverside (*Menidia beryllina*)	96.1	175 (measured)	Practically non-toxic	417373-07, Vaishnav et. al., 1990.	Core

[1] Based on acid equivalent of 100% of ai

Since the LC50 is 175 mg ae/L, the 2,4-D acid is categorized as practically non-toxic to estuarine/marine fish on an acute basis. Although the preferred test species is the sheepshead minnow, due to the low toxicity of the tidewater silverside, the guideline (72-3a) is fulfilled and additional data will not be required at this time.

2,4-D Sodium Salt (PC Code: 030004)

Since no data was submitted on the 2,4-D sodium salt can not be categorized. on an acute basis. However, since the environmental fate data indicates that the salts and amines of 2,4-D rapidly degrade to the acid equivalent, the data from the 2,4-D acid may be used to characterize the risk to marine fish. No data will be required at this time.

2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)

Estuarine/Marine Fish Acute Toxicity

Species/Static or Flow-through	% ai	96-hour LC50 (mg ai/L) (measured)	96-hour LC50 (mg ae/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Tidewater silverside (*Menidia beryllina*)	73.8	>118	>80.24	Practically non-toxic	420183-01, Graves, et; al., 1991.	Core

[1]Based on acid equivalent of 68% ai

Since the LC50 is >80.24 mg ae/L, the 2,4-D diethanolamine salt is categorized as practically non-toxic to estuarine/marine fish on an acute basis. Although the preferred test species is the sheepshead minnow, due to the low toxicity of the tidewater silverside, the guideline (72-3a) is fulfilled and additional data will not be required at this time.

2,4-D Dimethylamine (DMA) Salt (PC Code:030019)

Estuarine/Marine Fish Acute Toxicity

Species/Static or Flow-through	% ai	96-hour LC50 (mg ai/L) (measured)	96-hour LC50 (mg ai/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Tidewater silverside (*Menidia beryllina*)	66.8	469	389	Practically non-toxic	418352-09,Ward, S.C., 1991.	Supplemental
Sheepshead minnow *(Cyprinodon variegatus)*	51 (TEP)	>560	465	Practically non-toxic	233351, Vilkas, A.G., 1978,	Core

[1]Based on acid equivalent of 83% ai

Since the LC50 falls in the range of 389 to >465 mg ai/L, 2,4-D dimethylamine salt is categorized as practically non-toxic to estuarine/marine fish on an acute basis. The guideline (72-3a) is fulfilled.

2,4-D Isopropylamine (IPA) Salt (PC Code 030025)

Estuarine/Marine Fish Acute Toxicity

Species/Static or Flow-through	% ai	96-hour LC50 (mg ai/L) (measured)	96-hour LC50 (mg ae/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Tidewater silverside (*Menidia beryllina*)	50.2	237	187	Practically non-toxic	414290-01, Sousa, J.V., 1990.	Core

[1] Based on acid equivalent of 79% of ai

Since the LC50 is 187 mg ae/L, 2,4-D isopropylamine salt is categorized as practically not-toxic to estuarine/marine fish on an acute basis. Although the preferred test species is the sheepshead minnow, due to the low toxicity of the tidewater silverside, the guideline (72-3a) is fulfilled and additional data will not be required at this time.

2,4-D Triisopropylamine (TIPA) Salt (PC Code: 030035)

Estuarine/Marine Fish Acute Toxicity

Species/Static or Flow-through	% ai	96-hour LC50 (mg ai/L) (measured)	96-hour LC50 (mg ae/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Tidewater silverside (*Menidia beryllina*)	70.4	376	203	Practically non-toxic	414290-04, Sousa, J.V., 1990.	Core

[1] Based on acid equivalent of 54% of ai

Since the LC50 is 203 mg ae/L, the 2,4-D triisopropylamine salt is categorized as practically non-toxic to estuarine/marine fish on an acute basis. The guideline (72-3a) is fulfilled,

2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)

Since no data have been submitted for this compound, the toxicity can not be characterized. As the data for the 2,4-D 2-Ethylhexyl ester indicate a much higher toxicity than the salt or amines, further testing should be required to reduce the uncertainty associated with the risk. In addition, environmental fate data indicate that the 2,4-D esters exhibit much longer half lives than the acid equivalents at lower pHs and RQs associated with freshwater fish indicate significant risk to fish.

2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)

Estuarine/Marine Fish Acute Toxicity

Species/Static or Flow-through	% ai	96-hour LC50 (mg ai/L) (measured/ nominal)	96-hour LC50 (mg ae/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Tidewater silverside (*Menidia beryllina*)	95.39	>0.24	>0.1564	Highly toxic	418352-05, Ward et al., 1991.	Supplemental
Tidewater silverside (*Menidia beryllina*)	66.6 (TEP)	>0.73 (measured EHE)	>0.48	Moderately toxic	418352-02, Ward, et. al., 1991.	Core

[1] Based on acid equivalent of 66% of ai

Since the LC50 falls in the range of >0.1584 to >0.48 mg ae/L, the 2,4-D 2-ethylhexyl ester is categorized as moderately to highly toxic to estuarine/marine fish on an acute basis. Although the preferred test species is the sheepshead minnow, the tidewater silverside data may be used to characterize the risk, and additional data will not be required at this time.

2,4-D Isopropyl Ester (IPE) (PC Code 030066)

Since no data have been submitted for this compound, the toxicity can not be characterized. As the data for the 2,4-D 2-Ethylhexyl ester indicate a much higher toxicity than the salt or amines, further testing should be required to reduce the uncertainty associated with the risk. In addition, environmental fate data indicate that the 2,4-D esters exhibit much longer half lives than the acid equivalents at lower pHs. However, because this ester is only used on citrus at a rate of 0.1 lb ae/A, risk is expected to be low, and a study will not be required at this time.

Freshwater Fish, Chronic

A freshwater fish early life-stage test using the TGAI is required to establish the toxicity of products containing the 2,4-D acid, salts, amines or esters because the end-use product is expected to be transported to water from the intended use site, and the following conditions are met: (1) the pesticide is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity, (2) any aquatic acute LC50 or EC50 is less than 1 mg/L, (3) the EEC in water is equal to or greater than 0.01 of any acute LC50 or EC50 value, or, (4) the actual or estimated environmental concentration in water resulting from use is less than 0.01 of any acute LC50 or EC50 value and any one of the following conditions exist: studies of other organisms indicate the reproductive physiology of fish may be affected, physicochemical properties indicate cumulative effects, or the pesticide is persistent in water (*i.e.*, half-life greater than 4 days). The preferred test species is rainbow trout. Results of this test are tabulated below.

2,4-D Acid (PC Code:030001)

Freshwater Fish Early Life-Stage Toxicity Under Flow-through Conditions

Species/ Study Duration	% ai	NOEC/LOEC (mg ae/L)[2]	MATC[1] (ppm)	Endpoints Affected	MRID No. Author/Year	Study Classification
Fathead minnow (*Pimephales promelas*)	96.1	63.4/<102	80.4	Larval survival	417373-04, Mayes, et. al.,1990.	Core

[1] defined as the geometric mean of the NOEC and LOEC.
[2] Based on acid equivalent of 100% of ai

The NOEC of the 2,4-D acid is 0.63 mg ae/L based on larval survival. The guideline (72-4) is fulfilled.

2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)

Freshwater Fish Early Life-Stage Toxicity Under Flow-through Conditions

Species/ Study Duration	% ai	NOEC/LOEC (mg ae/L)[2]	MATC[1] (mg ae/L)	Endpoints Affected	MRID No. Author/Year	Study Classification
Fathead minnow (*Pimephales promelas*)	73.8	19.8/66.6	36.3	Larval survival	420183-04, Graves, et. al., 1991.	Core

[1] defined as the geometric mean of the NOEC and LOEC.
[2] Based on acid equivalent of 68% of ai

The NOEC of the 2,4-D DMA is 19.8 mg ae/L based on larval survival. The guideline (72-4) is fulfilled.

2,4-D Dimethylamine (DMA)Salt (PC Code: 030019)

Freshwater Fish Early Life-Stage Toxicity Under Flow-through Conditions

Species/ Study Duration	% ai	NOEC/LOEC (mg ae/L)[2]	MATC[1] (mg ae/L)	Endpoints Affected	MRID No. Author/Year	Study Classification
Fathead minnow (*Pimephales promelas*)	66.5	14.2/ 23.6	18.3	Length	417677-01, Dill, et. al., 1990.	Core

[1] defined as the geometric mean of the NOEC and LOEC.
[2] Based on acid equivalent of 83% of ai

The NOEC of the 2,4-D DMA is 14.2 mg ae/L based on fish length. The guideline (72-4) is fulfilled.

A freshwater fish life-cycle test using the TGAI is required to establish the toxicity of products containing the 2,4-D acid, salts, or esters because the end-use product is expected to be transported to water from the intended use site, and the following conditions are met: (1) the EEC is equal to or greater than one-tenth of the NOEL in the fish early life-stage or invertebrate life-cycle test, or, (2) studies of other organisms indicate the reproductive physiology of fish may be affected. The preferred test species is fathead minnow. Results of this test are tabulated below.

2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)

Since no data have been submitted for this compound, the toxicity can not be characterized. As the data for the 2,4-D 2-Ethylhexyl ester indicate a much higher toxicity than the salt or amines, further testing should be required to reduce the uncertainty associated with the risk. In addition, environmental fate data indicate that the 2,4-D esters exhibit much longer half lives than the acid equivalents at lower pHs and RQs associated with freshwater fish indicate significant risk to fish.

2,4-D Ethylhexyl Ester (EHE) (PC code: 030063)

Freshwater Fish Life-Cycle Toxicity Under Flow-through Conditions

Species/ Study Duration	% ai	NOEC/LOEC (mg ae/L)[2]	MATC[1] (mg ae/L)	Endpoints Affected	MRID No. Author/Year	Study Classification
Fathead minnow *(Pimephales promelas)*	94.7	0.0792 / <0.1452	0.1056	Larval fish survival	417373-05, Mayes, et. al., 1990.	Supplemental

[1] defined as the geometric mean of the NOEC and LOEC.
[2] Based on acid equivalent of 66% of ai

The NOEC for the 2,4-D EHE is 0.0792 mg ae/L based on larval survival. The guideline (72-5) is not fulfilled.

No chronic data have been submitted for the following 2,4-D salts, amines, or esters. Even though the NOEC for the esters appear to be at least 2 orders of magnitude higher than the salts and amines tested, a full life-cycle study will not be required for the 2,4-D Isopropyl Ester because this ester is only used on citrus at a rate of 0.1 lb ae/A, and risk would be expected to be low. In addition, due to the low RQs associated with the acid, salts, and amines, a fish early life-stage test on a product of the acid or one of the salts need not be completed.

2,4-D Sodium Salt (PC Code:030004)
2,4-D Isopropylamine (IPA) Salt (PC Code 030025)
2,4-D Triisopropylamine (TIPA) Salt (PC Code 030035)
2,4-D Butoxyethyl (BEE) Ester (PC Code 030053)
2,4-D Isopropyl Ester (IPE) (PC Code 030066)

Estuarine and Marine Fish, Chronic

An estuarine/marine fish early life-stage toxicity test using the TGAI is required for the 2,4-D acid, salts, amines, and esters because the end-use product may be applied directly to the estuarine/marine environment or is expected to be transported to this environment from the intended use site, and the following conditions are met: (1) the pesticide is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity, (2) any aquatic acute LC50 or EC50 is less than 1 mg/L, (3) the EEC in water is equal to or greater than 0.01 of any acute LC50 or EC50 value, or, (4) the actual or estimated environmental concentration in water resulting from use is less than 0.01 of any acute LC50 or EC50 value and any of the following conditions exist: studies of other organisms indicate the reproductive physiology of fish and/or invertebrates may be affected, physicochemical properties indicate cumulative effects, or the pesticide is persistent in water (*i.e.*, half-life greater than 4 days). The preferred test species is sheepshead minnow. Results of this test are tabulated below.

2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)

Estuarine/Marine Fish Early Life-Stage Toxicity Under Flow-through Conditions

Species/ Study Duration	% ai	NOEC/LOEC (mg ae/L)[2]	MATC[1] (mg ae/L)	Endpoints Affected	MRID No. Author/Year	Study Classification
Sheepshead Minnow *(Cyprinodon variegatus)*	96	0.05554/ 0.0791	0.0662	Survival	413457-01, Mayes, E, et.al., 1989	Core

[1] defined as the geometric mean of the NOEC and LOEC.
[2] Based on acid equivalent of 69% of ai

The NOEC for the 2,4-D BEE ester based on survival is 0.05554 mg ae/L. The guideline (72-4) is fulfilled.

No further chronic data have been submitted for the following 2,4-D salts, amines, or esters. Even thought the freshwater fish NOECs for the esters appear to be at least 2 orders of magnitude higher than the salts and amines tested, a full life-cycle study will not be required for the 2,4-D Isopropyl Ester because this ester is only used on citrus at a rate of 0.1 lb ae/A, and risk would be expected to below the levels of concern. In addition, due to the low RQs associated with the acid, salts, and amines, a fish early life-stage test on a product of the acid or one of the salts need not be completed.

2,4-D Acid (PC Code:030001)
2,4-D Sodium Salt (PC Code:030004)
2,4-D Diethanolamine (DEA) Salt (PC Code:0300016)
2,4-D Dimethylamine (DMA)Salt (PC Code:0300019)
2,4-D Isopropylamine (IPA) Salt (PC Code 030025)
2,4-D Triisopropylamine (TIPA) Salt (PC Code 030035)
2,4-D Butoxyethyl (BEE) Ester (PC Code:030053)
2,4-D Ethylhexyl Ester (EHE) (PC Code:030063)
2,4-D Isopropyl Ester (IPE) (PC Code 030066)

Freshwater Amphibian, Acute

Although not currently required by the agency, freshwater amphibian studies were conducted on frog tadpoles (*Rana pipiens*). Tests were conducted using the ASTM (American Society for Testing and Materials) Standard E729-88a. The data is presented in the table below.

2,4-D acid (PC Code: 030001)

Freshwater Amphibian Acute Toxicity

Species/ Flow-through or Static	% ai	96-hour LC50 (mg ae/L) (measured/nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Leopard frog tadpoles *(Rana pipiens)* static	97.5	359 (measured)	Practically non-toxic	445173-07, Palmer, S.J. et. al., 1997.	Supplemental

[1] Based on acid equivalent of 100% of ai

Since the LC50/EC50 falls in the range of 359 mg ae/L, the 2,4-D acid is categorized practically non-toxic to aquatic invertebrates on an acute basis.

2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)

Freshwater Amphibian Acute Toxicity

Species/ Flow-through or Static	% ai	96-hour LC50 (mg ai/L) (measured/ nominal)	96-hour LC50 (mg ae/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Leopard frog tadpoles *(Rana pipiens)* static	67.3	337	278 (measured)	Practically non-toxic	445173-06, Palmer, S.J. et. al., 1997.	Supplemental

[1] Based on acid equivalent of 83% of ai

Since the LC50/EC50 falls in the range of 278 mg ae/L, the 2,4-D acid is categorized practically non-toxic to aquatic invertebrates on an acute basis.

2,4-D 2-Ethylhexyl Ester (2-EHE) (PC Code: 030063)

Freshwater Amphibian Acute Toxicity

Species/ Flow-through or Static	% ai	96-hour LC50 (mg ai/L) (measured/ nominal)	96-hour LC50 (mg ae/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Leopard frog tadpoles *(Rana pipiens)* static	99.6	0.765	0.505 (measured)	Practically non-toxic	445173-05, Palmer, S.J. et. al., 1997.	Supplemental

[1] Based on acid equivalent of 66% of ai

Since the LC50/EC50 falls in the range of 0.505 mg ae/L, the 2,4-D acid is categorized practically non-toxic to aquatic invertebrates on an acute basis.

Freshwater Invertebrates, Acute

A freshwater aquatic invertebrate toxicity test using the TGAI is required to establish the toxicity of products containing the 2,4-D acid, salts, or esters to aquatic invertebrates. The preferred test species is *Daphnia magna*. Results of this test are tabulated below.

2,4-D acid (PC Code: 030001)

Freshwater Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai	48-hour LC50/ EC50 (mg ae/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	98.7	25 (measured)	Slightly toxic	411583-01, Alexander et. al., 1983	Core

[1] Based on acid equivalent of 100% of ai

Since the LC50/EC50 falls in the range of 25 mg ae/L, the 2,4-D acid is categorized slightly toxic to aquatic invertebrates on an acute basis. The guideline (72-2) is fulfilled.

2,4-D Sodium salt (PC Code: 030004)

Since no data have been submitted for this compound, the toxicity can not be characterized. However, environmental fate data indicate that the 2,4-D salts and amines rapidly degradate to the acid equivalent, therefore further testing will not be required at this time.

2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)

Freshwater Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai	48-hour LC50/ EC50 (mg ai/L) (measured/ nominal)	48-hour LC50/ EC50 (mg ae/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	71.3	>100 (measured)	>68	Practically non-toxic	419751-06, Graves, et. al., 1991.	Core

[1] Based on acid equivalent of 68% of ai

Since the LC50/EC50 falls in the range of > 68 mg ae/L, the 2,4-D diethanolamine salt is categorized as practically non-toxic to aquatic invertebrates on an acute basis. The guideline (72-2) is fulfilled.

2,4-D Dimethylamine (DMA)Salt (PC Code: 030019)

Freshwater Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai	48-hour LC50/ EC50 (mg ai/L) (measured/ nominal)	48-hour LC50/ EC50 (mg ai/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	51.1 (TEP)	774.5	642.8	Practically non-toxic	232630, Vilkas, A.G., 1977.	Core
Waterflea (_ *Daphnia magna*)	67.3	184	153	Practically non-toxic	411583-11	Core

[1] Based on acid equivalent of 83% of ai

Since the LC50/EC50 falls in the range of 153 to 642.8 mg ae/L, the 2,4-D dimethylamine salt is categorized as practically non-toxic to aquatic invertebrates on an acute basis. The guideline (72-2) is fulfilled.

2,4-D Isoproylamine (IPA) (PC Code: 030025)

Freshwater Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai	48-hour LC50/ EC50 (mg ai/L) (measured/ nominal)	48-hour LC50/ EC50 (mg ai/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	48.7	583	461	Practically non-toxic	00138869, Alexander et. al., 1983.	Core

[1] Based on acid equivalent of 79% of ai

Since the LC50/EC50 falls is 460 mg ae/L, the 2,4-D dimethylamine salt is categorized as practically non-toxic to aquatic invertebrates on an acute basis. The guideline (72-2) is fulfilled.

2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)

Freshwater Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai	48-hour LC50/ EC50 (mg ai/L) (measured)	48-hour LC50/ EC50 (mg ai/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	69.2	630	340.2	Practically non-toxic	413538-05, Mayes, 1989	Core

[1] Based on acid equivalent of 54% of ai

Since the LC50/EC50 falls in the range of 340.2 mg ae/L, the triisopropanolamine salt is categorized practically non-toxic to aquatic invertebrates on an acute basis. The guideline (72-2) is fulfilled.

2,4-D Butoxyethyl (BEE) Ester (PC Code: 030053)

Freshwater Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai	48-hour LC50/ EC50 (mg ai/L) (measured)	48-hour LC50/ EC50 (mg ai/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	97.4	7.2	4.97	Moderately toxic	413538-01, Alexander, et. al, 1983.	Core

[1] Based on acid equivalent of 69% of ai

Since the LC50/EC50 falls in the range of 4.97 mg ae/L, the 2,4-D butoxyethyl ester is categorized as moderately toxic to aquatic invertebrates on an acute basis. The guideline (72-2) is fulfilled.

2,4-D 2-Ethylhexyl Ester (2-EHE) (PC Code: 030063)

Freshwater Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai	48-hour LC50/ EC50 (mg ai/L) (measured)	48-hour LC50/ EC50 (mg ae/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	92	18	11.88	Slightly toxic	67328, Kuc, W.J., 1977.	Core
Waterflea *(Daphnia magna)*	96.2	5.2	3.4	Moderately toxic	411583-06, Alexander, et. al., 1983.	Core

[1] Based on acid equivalent of 66% ai

Since the LC50/EC50 falls in the range of 3.4 to 11.88 mg ae/L, the 2,4-D 2-ethylhexyl ester is categorized as slightly to highly toxic to aquatic invertebrates on an acute basis. The guideline (72-2) is fulfilled.

2,4-D Isopropyl Ester (IPE) (PC Code: 030066)

Freshwater Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai	48-hour LC50/ EC50 (mg ai/L) (measured)	48-hour LC50/ EC50 (mg ae/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	98.2	2.6	2..2	Moderately toxic	439306-01, Drottar, et.al., 1996.	Core

[1] Based on acid equivalent of 84% of ai

Since the LC50/EC50 falls in the range of 2.2 mg ae/L, the 2,4-D isopropyl ester is categorized as moderately toxic to aquatic invertebrates on an acute basis. The guideline (72-2) is fulfilled.

Freshwater Invertebrate, Chronic

A freshwater aquatic invertebrate life-cycle test using the TGAI is required to establish the toxicity of products containing the 2,4-D acid, salts, amines, and esters since the end-use product may be applied directly to water or is expected to be transported to water from the intended use site, and the following conditions are met: (1) the pesticide is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity, (2) any aquatic acute LC50 or EC50 is less than 1 mg/L, or, (3) the EEC in water is equal to or greater than 0.01 of any acute EC50 or LC50 value, or, (4) the actual or estimated environmental concentration in water resulting from use is less than 0.01 of any aquatic acute EC50 or LC50 value and any of the following conditions exist: studies of other organisms indicate the reproductive physiology of invertebrates may be affected, physicochemical properties indicate cumulative effects, or the pesticide is persistent in water (*i.e.*, half-life greater than 4 days). The preferred test species is *Daphnia magna*. Results of this test are tabulated below.

2,4-D acid (PC Code: 030001)

Freshwater Aquatic Invertebrate Life-Cycle Toxicity

Species/Static Renewal or Flow-through	% ai	21-day NOEC/LOEC (mg ae/L)[2]	MATC[1] (mg ae/L)	Endpoints Affected	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	91.3	79/151	109	No of young	418352-11, Ward T.J. et.al., 1991	Core

[1] defined as the geometric mean of the NOEC and LOEC.
[2] Based on acid equivalent of 100% of ai

The NOEC for the 2,4-D acid is 79 mg ae/L based on the number of young produced. The guideline (72-4) is fulfilled.

2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)

Freshwater Aquatic Invertebrate Life-Cycle Toxicity

Species/Static Renewal or Flow-through	% ai	21-day NOEC/LOEC (mg ae/L)[2]	MATC[1] (mg ae/L)	Endpoints Affected	MRID No. Author/Year	
Waterflea *(Daphnia magna)*	73.8	16.05/25.64	>16.05	Survival & Reproduction	420183-03, Holmes, et. al., 1991	Core

[1] defined as the geometric mean of the NOEC and LOEC.
[2] Based on acid equivalent of 68% of ai

The NOEC for the 2,4-D DEA is 16.5 mg ae/L based on survival and reproduction. The guideline (72-4) is fulfilled.

2,4-D Dimethylamine (DMA)Salt (PC Code: 030019)

Freshwater Aquatic Invertebrate Life-Cycle Toxicity

Species/Static Renewal or Flow-through	% ai	21-day NOEC/LOEC (mg ae/L)[2]	MATC[1] (mg ae/L)	Endpoints Affected	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	66.8	LC50=75.7 (NOEC not established)	N/A	Survival	418352-10, Ward, S. C., 1991.	Supplemental

[1] defined as the geometric mean of the NOEC and LOEC.
[2] Based on acid equivalent of 83% of ai

The NOEC for the 2,4-D DMA could not be established and the guideline (72-4) is not fulfilled. However, environmental fate data indicate that the 2,4-D salts and amines rapidly degradate to the acid equivalent, therefore further testing will not be required at this time.

2,4-D Butoxyethyl (BEE) Ester (030053)

Freshwater Aquatic Invertebrate Life-Cycle Toxicity

Species/Static Renewal or Flow-through	% ai	21-day NOEC/LOEC (mg ae/L)[2]	MATC[1] (ppm)	Endpoints Affected	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	96	LC50>0.869 NOEC = 0.20/ LOEC = 0.483	0.311	Survival and reproduction	413538-02, Gersich, et. al.,, 1989.	Core

[1] defined as the geometric mean of the NOEC and LOEC.
[2] Based on acid equivalent of 69% of ai

The NOEC for the 2,4-D BEE ester is 0.20 mg ae/L based on survival and reproduction. The guideline (72-4) is fulfilled.

No further chronic data have been submitted for the following 2,4-D salts, amines, or esters. Even though the freshwater fish NOECs for the esters appear to be at least 2 orders of magnitude higher than the salts and amines tested, a full life-cycle study will not be required for the 2,4-D Isopropyl Ester because this ester is only used on citrus at a rate of 0.1 lb ae/A, and risk would be expected to be low. In addition, due to the low RQs associated with the acid, salts, and

amines, a life-cycle test on a product of the acid or one of the salts need not be completed.

2,4-D Sodium Salt (PC Code:030004)
2,4-D Isopropylamine (IPA) Salt (PC Code 030025)
2,4-D Triisopropanolamine (TIPA) Salt (PC Code 030035)
2,4-D Ethylhexyl Ester (EHE) (PC Code:030063)
2,4-D Isopropyl Ester (IPE) (PC Code 030066)

Estuarine and Marine Invertebrates, Acute

Acute toxicity testing with estuarine/marine invertebrates using the TGAI is required establish the toxicity of products containing the 2,4-D acid, salts, amines, and esters because the end-use product is intended for direct application to the marine/estuarine environment or the active ingredient is expected to reach this environment because of its use in coastal counties. The preferred test species are mysid shrimp and eastern oyster. Results of these tests are tabulated below.

2,4-D acid (PC Code: 030001)

Estuarine/Marine Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai.	96-hour LC50/EC50 (mg ae/L) (measured)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern oyster (shell deposition) *(Crassostrea virginica)*	95.1	57 (measured)	Slightly toxic	429797-01, Ward et. al., 1993	Core
Pink shrimp (*Penaeus duorarum*)	96.1	467 (measured)	Practically non-toxic	417373-06, Vaishnav et. al., 1990	Core

[1] Based on acid equivalent of 100% ai

Since the range of the LC50 is 57 to 467 ppm, the 2,4-D acid is categorized as practically non-toxic to slightly toxic to estuarine/marine invertebrates on an acute basis. Although one of the generally more sensitive mysid test was not conducted, data from the pink shrimp can be used to fulfill this requirement, and additional data will not be required at this time.

2,4-D Diethanolamine (DEA) Salt (PC code: 030016)

Estuarine/Marine Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai.	96-hour LC50/EC50 (mg ai/L) (measured/ nominal)	96-hour LC50/EC50 (mg ae/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern oyster (shell deposition) *(Crassostrea virginica)*	73.8	>112	>76.16	Practically non-toxic	420183-02, Graves, et. al., 1991.	Core
Pink shrimp (*Penaeus duorarum*)	73.1	>99.6	>67.73	Slightly toxic	419751-07, Graves, et. al., 1991	Core

[1] Based on acid equivalent of 68% of ai

Since the LC50/EC50 falls in the range of 67.73 to 76.16 mg ae/L, the 2,4-D DEA is categorized as practically non-toxic to slightly toxic to estuarine/marine invertebrates on an acute basis. Although one of the generally more sensitive mysid test was not conducted, data from the pink shrimp can be used to fulfill this requirement, and additional data will not be required at this time.

2,4-D Dimethylamine (DMA)Salt (PC code: 030019)

Estuarine/Marine Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai.	96-hour LC50/EC50 (mg ai/L) (measured/ nominal)	96-hour LC50/EC50 (mg ae/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern oyster (shell deposition)s *(Crassostrea virginica)*	49.3	>210	>174.3	Practically non-toxic`	411583-10, Heitmuller, T., 1975.	Supplemental
Eastern oyster (shell deposition)s *(Crassostrea virginica)*	66.8	102	84.66	Practically non-toxic`	419734-01, Ward, G.W., et. al., 1991.	Core
Mysid *(Americamysis bahia)*	67.3	184	152.7	Practically non-toxic	411583-11,Aleander, et.al., 1982.	Core
Pink shrimp (*Penaeus duorarum*)	66.8	181	150.2	Practically non-toxic	418252-08, Ward, S.C., 1991.	Core
Pink shrimp (*Penaeus duorarum*)	73.1	>99.6	>82.7	Practically non-toxic	419751-07, Graves, et. al., 1991.	
Fiddler Crab (*Uca pugilator*)	51.1 (TEP)	1000	830	Practically non-toxic	232630. Vilkas, A.G., 1977.	Supplemental
Grass shrimp (*Palaemonetes pugio*)	51.1 (TEP)	125.9	104.5	Practically non-toxic	232630, Vilkas, A.G., 1977	Core

[1] Based on acid equivalent of 83% of ai

Since the LC50/EC50 falls in the range of 84.66 to 830 mg ae/L, the 2,4-D DMA is categorized as practically non-toxic to highly toxic to estuarine/marine invertebrates on an acute basis. The guideline (72-3b and 72-3c) is fulfilled.

2,4-D Isoproylamine (IPA) Salt (PC Code: 030025)

Estuarine/Marine Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai.	96-hour LC50/EC50 (mg ai/L) (measured/ nominal)	96-hour LC50/EC50 (mg ae/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern oyster (shell deposition)s *(Crassostrea virginica)*	50.2	62.8	49.6	Slightly toxic	414290-03, Dionne, E., 1990.	Core
Pink shrimp (*Penaeus duorarum*)	50.2	605	478	Practically non-toxic	414290-02,Sousa, V.J., 1990.	Core

[1] Based on acid equivalent of 79% of ai

Since the LC50/EC50 falls in the range of 49.6 to 478 mg ae/L, the 2,4-D IPA is categorized as practically non-toxic to slightly toxic to estuarine/marine invertebrates on an acute basis. Although one of the generally more sensitive mysid test was not conducted, data from the pink shrimp can be used to fulfill this requirement, and additional data will not be required at this time.

2,4-D Triisopropanolamine (TIPA) Salt (PC code: 030035)

Estuarine/Marine Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai.	96-hour LC50/EC50 (mg ai/L) (measured/ nominal)	96-hour LC50/EC50 (mg ae/L) (measured /nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern oyster (shell deposition)s *(Crassostrea virginica)*	7.04	165	89.1	practically non-toxic	414290-06, Dionne, E., 1990.	Core
Pink shrimp (*Penaeus duorarum*)	70.4	744	401.8	Practically non-toxic	414290-05, Sousa, V.J., 1990.	Core

[1] Based on acid equivalent of 54% of ai

Since the LC50/EC50 falls in the range of 89.1 to 401.8 mg ae/L, the 2,4-D TIPA is categorized as practically non-toxic to estuarine/marine invertebrates on an acute basis. Although one of the generally more sensitive mysid test was not conducted, data from the pink shrimp can be used to fulfill this requirement, and additional data will not be required at this time.

2,4-D 2-Butoxyethyl ester (BEE)(PC code: 030053)

Estuarine/Marine Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai.	96-hour LC50/EC50 (mg ai/L) (measured/ nominal)	96-hour LC50/EC50 (mg ae/L) (measured /nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern oyster (shell deposition)s *(Crassostrea virginica)*	70	2.6	1.8	Moderately toxic	402284-01, Mayer, 1986.	Core

Estuarine/Marine Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai.	96-hour LC50/EC50 (mg ai/L) (measured/ nominal)	96-hour LC50/EC50 (mg ae/L) (measured /nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Pink shrimp (*Penaeus duorarum*)	70	5.6	3.8	Moderately toxic	402284-01, Mayer, 1986.	Core

[1] Based on acid equivalent of 69% of ai

Since the LC50/EC50 falls in the range of 2.6 to 5.6 mg ai/L, the 2,4-D BEE categorized as moderately toxic to estuarine/marine invertebrates on an acute basis. Although one of the generally more sensitive mysid test was not conducted, data from the shrimp can be used to fulfill this requirement, and additional data will not be required at this time."

2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)

Estuarine/Marine Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai.	96-hour LC50/EC50 (mg ai/L) (measured/ nominal)	96-hour LC50/EC50 (mg ae/L) (measured/ nominal)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern oyster (shell deposition) *(Crassostrea virginica)*	95.39	>100 (measured)	>66	Practically non-toxic	418352-04, Ward, et. al., 1991.	Supplemental
Eastern oyster (shell deposition) *(Crassostrea virginica)*	66.6 (TEP)	>0.71 (measured)	>0.469	Highly toxic	418352-01, Ward, et. al., 1991.	Core
Grass shrimp (*Palaemonetes pugio*)	95.39	> 0.14	>0.092	Highly toxic	418352-06, Ward et. al., 1991.	Supplemental
Grass shrimp (*Palaemonetes pugio*)	66.6 (TEP)	>1.4 (measured)	>0.942	Moderately toxic	418352-03, Ward, et. al., 1991.	Core

[1] Based on acid equivalent of 66% of ai

Since the LC50/EC50 falls in the range of >0.092 to >66 mg ae/L, the 2,4-D 2-EHE is categorized as practically non-toxic to highly toxic to estuarine/marine invertebrates on an acute basis. The guideline (72-3b and 72-3c) is fulfilled.

2,4-D Isopropyl Ester (IPE) (PC code: 030066)

Since no data have been submitted for this compound, the toxicity can not be characterized. Even thought the data for the 2,4-D isopropyl ester indicate a much higher toxicity than the salt or amines, further testing will not be required for the 2,4-D Isopropyl ester because this ester is only used on citrus at a rate of 0.1 lb ae/A, and risk would be expected to be low. In addition, due to the low RQs associated with the acid, salts, and amines, an acute aquatic invertebrate test on a product of the acid or one of the salts need not be completed.

Estuarine and Marine Invertebrate, Chronic

Although an estuarine/marine invertebrate life-cycle toxicity test using the TGAI is required to establish the toxicity of products containing the 2,4-D acid, salts, and amines, a chronic study will not be required because the RQs for the freshwater chronic studies were well below the levels of concern, and the chronic risk would be expected to be low. However, chronic RQs are significantly exceeded for the BEE, and a chronic study will be required to reduce the uncertainty to marine invertebrates.

Aquatic Plants

Tier 1 Testing

Aquatic plant testing is required for any herbicide that has outdoor non-residential terrestrial uses that may move off-site by runoff (solubility >10 ppm in water), by drift (aerial or irrigation), or that is applied directly to aquatic use sites (except residential). The following species should be tested at Tier I: *Kirchneria subcapitata* and *Lemna gibba.* Aquatic plant testing is required for products containing the 2,4-D acid, salts, amines, and esters because most formulations of 2,4-D are soluble, applied by air, and in some cases, applied directly to aquatic use sites.

Results of Tier I toxicity testing on the technical/TEP material are tabulated below. It should be noted that many registrants opt to proceed directly to Tier 2 testing.

2,4-D acid (PC code: 030001)

Nontarget Aquatic Plant Toxicity (Tier I)

Species	% ai	Dose (mg ae/L)	% Response	MRID No. Author/Year	Study Classification
Non-Vascular Plant- Green algae *Selenastrum capricornutum*	96.1	26.4	24	414200-01, Hughes, 1990	Core[1]
Non-Vascular Plant- Blue-green algae *Anabaena flos-aquae*	96.9	>2.02	0.488	43307901, Hughes, 1994	Core[1]
Non-Vascular Plant- Freshwater diatom *Navicula pelliculosa*	96.9	>2.13	24	433079-02, Hughes, 1990	Core[1]
Non-Vascular Plant- Marine diatom *Skeletonema costatum*	96.9	2.08	-10	433079-03, Hughes, 1990	Core[1]

[1]This application greatly exceeds the maximum application rate for 2,4-D acid. and a Tier 2 test is therefore not required.

2,4-D Isopropyl Ester (IPE) (PC code: 030066)

Nontarget Aquatic Plant Toxicity (Tier I)

Species	% ai	Dose (mg ae/L)	% Response	MRID No. Author/Year	Study Classification
Non-Vascular Plant- Green algae *Selenastrum capricornutum*	98.2	0.130[1]	-11 % inhibition	437680-01, Hughes, et. al., 1995.	Core

[1] NOEC was determined to be 26.4 ppm which would be equivalent to a direct application of 35.9 lb ai to a 6 inch water column. This application greatly exceeds the maximum application rate for 2,4-D acid. and a Tier 2 test is therefore not required.

Based on the results for the one species tested for the 2,4-D acid and the 2,4-D IPE, Tier 2 testing would not be required.. However, the guideline (122-2) is not fulfilled for either of the two compounds tested because only one of the three species required was tested..

Tier 2 Testing

Aquatic Tier II studies are required for all low dose herbicides (those with the maximum use rate of 0.5 lbs ai/A or less) and any pesticide showing a negative response equal to or greater than 50% in Tier I tests. The following species should be tested at Tier II: *Kirchneria subcapitata*, *Lemna gibba*, *Skeletonema costatum*, *Anabaena flos-aquae*, and a freshwater diatom.

Results of Tier II toxicity testing on the technical/TEP material are tabulated below.

2,4-D acid (PC code: 030001)

Nontarget Aquatic Plant Toxicity (Tier II)

Species	% ai	EC50/ NOEC (mg ai/L)	EC50/ NOEC (mg ae/L)[1]	MRID No. Author/Year	Study Classification
Vascular Plants					
Duckweed *Lemna gibba*	96.2	0.695 / 0.0581	0.695 / 0.0581	442951-01, Hughes et al, 1997	Core

[1] Based on acid equivalent of 100% of ai

The Tier II results indicate that the duckweed was the only species tested in this study. The guideline (123-2) is not fulfilled.

2,4-D Diethanolamine (DEA) Salt (PC code: 030016)

Nontarget Aquatic Plant Toxicity (Tier II)

Species	% ai	EC50/ NOEC (mg ai/L)	EC50/ NOEC (mg ae/L)[1]	MRID No. Author/Year	Study Classification
Vascular Plants					
Duckweed *Lemna gibba*	73.8	0.44/ 0.07	0.2992/ 0.0476	427122-04, Thompson et. al., 1993.	Core
Nonvascular Plants					
Green Algae *Selnastrum capricornutum*	73.8	11/ 0.50	7.48/ 0.34	427122-05, Thompson et. al., 1993.	Core
Marine diatom *Skeletonema costatum*	73.8	>95/ 95	>64.6/ 64.6	427122-01, Thompson et. al., 1993	Core
Freshwater diatom *Navicula pelliculosa*	73.8	>97/ 97	>66/ 66	427122-02, Thompson et. al., 1993.	Core
Blue-green algae *Anabaena flos-aquae*	73.8	>96/ 96	>65.3/ 65.3	427122-03, Thompson et. al., 1993.	Core

[1] Based on acid equivalent of 68% of ai

The Tier II results indicate that the duckweed plant is the most sensitive aquatic plant. The guideline (123-2) is fulfilled for the 2,4-D Diethanolamine salt.

2,4-D Dimethylamine (DMA) Salt (PC code: 030019)

Nontarget Aquatic Plant Toxicity (Tier II)

Species	% ai	EC50/ NOEC (mg ai/L)	EC50/ NOEC (mg ae/L)[1]	MRID No. Author/Year	Study Classification
Vascular Plants					
Duckweed *Lemna gibba*	66.7	0.58/ 0.27	0.48/ 0.23	415059-04, Hughes, J.S., 1990.	Core
Nonvascular Plants					
Green Algae *Selnastrum capricornutum*	66.7	51.2/ 19.2	42.5/ 16	414200-02, Hughes, J.sS, 1990.	Core
Marine diatom *Skeletonema costatum*	66.7	148.5/ 96.25	123.3/ 79.89	415059-01, Hughes, J.sS, 1990.	Core
Freshwater diatom *Navicula pelliculosa*	66.7	4.67/ 1.70	3.88/ 1.41	415059-03, Hughes, J.S., 1990.	Core
Blue-green algae *Anabaena flos-aquae*	66.7	188.5/ 67.86	156.5/ 56.32	415059-02, Hughes, J.S., 1990.	Core

[1] Based on acid equivalent of 83% ai

The Tier II results indicate that the duckweed plant is the most sensitive aquatic plant. The guideline (123-2) is fulfilled for the 2,4-D Dimethylamine salt.

2,4-D Isopropylamine (IPA) Salt (PC code: 030025)

Nontarget Aquatic Plant Toxicity (Tier II)

Species	% ai	EC50/ NOEC (mg ai/L)	EC50/ NOEC (mg ae/L)[1]	MRID No. Author/Year	Study Classification
Nonvascular Plants					
Green Algae *Selenastrum capricornutum*	51.3	43.4/ 13.9	34.29/ 10.98	417321-02, Hughes, J.S., 1990.	Core

[1] Based on acid equivalent of 79% of ai

The Tier II results indicate that the green algae was the only species tested in this study and is, therefore the most sensitive nonvascular aquatic plant. However, no testing has been conducted on the remaining species including, blue-green algae, freshwater diatom, and duckweed, and therefore the guideline (123-2) is not fulfilled."

2,4-D Triisopropylamine (TIPA) Salt (PC code: 030035)

Nontarget Aquatic Plant Toxicity (Tier II)

Species	% ai	EC50/ NOEC (mg ai/L)	EC50/ NOEC (mg ae/L)[1]	MRID No. Author/Year	Study Classification
Vascular Plants					
Duckweed *Lemna gibba*	70.9	2.37 2.38	1.28/ 1.28	434886-02, Hughes, et. al., 1994.	Core
Nonvascular Plants					
Green Algae *Selenastrum capricornutum*	73.8	75.7 55.4	40.88/ 29.92	417321-01, Hughes, J.S., 1990.	Core
Marine diatom *Skeletonema costatum*	70.9	79.7 50.4	38.29/	434886-03, Hughes, et. al., 1994	Core
Freshwater diatom *Navicula pelliculosa*	70.9	94.4 5.35	50.98/ 2.89	434886-01, Hughes, et. al., 1994.	Core
Blue-green algae *Anabaena flos-aquae*	70.9	133 47.9	71.82/ 25.87	434886-04, Hughes, et. al., 1994.	Core

[1] Based on acid equivalent of 54% of ai

The Tier II results indicate that the duckweed plant is the most sensitive aquatic plant. The guideline (123-2) is fulfilled for the 2,4-D triisopropanolamine salt.

2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)

Nontarget Aquatic Plant Toxicity (Tier II)

Species	% ai	EC50/ NOEC (mg ai/L)	EC50/ NOEC (mg ae/L)[1]	MRID No. Author/Year	Study Classification
Vascular Plants					
Duckweed *Lemna gibba*	96	0.576/ 0.204	0.3974/ 0.141	4206884-02, Hughes, J.S., 1990.	Core
Nonvascular Plants					
Green Algae *Selenastrum capricornutum*	96	24.9/ 12.5	17.14/ 8.6	431882-01, Hughes, J.S., 1990.	Core
Marine diatom *Skeletonema costatum*	96	1.48/ 0.78	1.02/ 0.538	42-684-04, Hughes,J.S., 1990.	Core
Freshwater diatom *Navicula pelliculosa*	96	1.86/ 0.86	1.28/ 0.59	420684-03, Hughes, J.S., 1990	Core
Blue-green algae *Anabaena flos-aquae*	96	6.37/ 3.14	4.4/ 2.2	420684-03, Hughes, J.S., 1990.	Core

[1] Based on acid equivalent of 69% of ai

The Tier II results indicate that the duckweed plant is the most sensitive aquatic plant. The guideline (123-2) is fulfilled for the 2,4-D butoxyethyl ester.

2,4-D 2-Ethylhexyl Ester (2-EHE) (PC Code: 030063)

Nontarget Aquatic Plant Toxicity (Tier II)

Species	% ai	EC50/ NOEC (mg ai/L)	EC50/ NOEC (mg ae/L)[1]	MRID No. Author/Year	Study Classification
Vascular Plants					
Duckweed *Lemna gibba*	94.7 (62.8 a. eq.)	0.50 / <0.0938	0.33/ 0.062	417352-03, Hughes, J.S., 1990.	Core
Nonvascular Plants					
Green algae *Selenastrum capricornutum*	94.7 (62.8 a. eq.)	>30 / 3.75	19.8/ 2.48	417352-06, Hughes, J.S., 1990.	Core
Marine diatom *Skeletonema costatum*	94.7 (62.8 a. eq.)	0.10 / 0.0938	0.066/ 0.062	417352-04, Hughes, J.S., 1990.	Core
Freshwater diatom *Navicula pelliculosa*	94.7 (62.8 a. eq.)	1.9 / 1.875	1.25/ 1.24	417352-05, Hughes, J.S., 1990.	Core
Blue-green algae *Anabaena flos-aquae*	94.7 (62.8 a. eq.)	>0.32 / 0.32	>0.21/ 0.21	417352-02, Hughes, J.S., 1990.	Core

[1] Based on acid equivalent of 66% of ai

The Tier II results indicate that the marine diatom is the most sensitive aquatic plant in this study. The guideline (123-2) is fulfilled for the 2,4-D 2-ethylhexyl ester.

EPA aquatic plant toxicity data is missing for the 2,4-D Sodium Salt (PC Code:030004) and the 2,4-D Isopropyl Ester (IPE) (PC Code 030066). Further, aquatic plant toxicity data is missing for all active ingredients with the exception of the 2,4-D 2-ethylhexyl ester. However, based on the data available from the most sensitive vascular and nonvascular plant studies, the RQs for the acid, salts, and amines do not exceed the levels of concern for any of the use sites with the exception of filberts and apples and further testing for the sodium salt will not be required at this time.

Concerning the missing data for the 2,4-D isopropyl ester, additional testing will not be required because the maximum use rate on citrus (the only use site) is only 0.1 lb ae/A and risk would be expected to be low.

TERRESTRIAL DATA

Birds, Acute

An acute oral toxicity study using the technical grade of the active ingredient (TGAI) is required to establish the toxicity of the 2,4-D acid to birds. The preferred test species is either mallard duck (a waterfowl) or bobwhite quail (an upland gamebird). Results of this test are tabulated below.

2,4-D acid (PC Code: 030001)

Avian Acute Oral Toxicity

Species	% ai	LD50 (mg ae/kg)[1]	Toxicity Category	MRID No. Author/Year	Study Classification[2]
Mallard duck *(Anas platyrhynchos)*	96.1	>5620	Practically non-toxic	415462-02, Culotta et.al., 1990	Core

[1] Based on acid equivalent of 100% of ai
[2] Test organisms observed an additional three days while on untreated feed.

Since the LD50 is >5620 mg ae/kg for the mallard duck, the 2,4-D acid is categorized as practically non-toxic to avian species on an acute oral basis. There is no equivalent study for the bobwhite quail. The guideline (71-1) is not fulfilled.

2,4-D Diethanolamine (DEA) Salt (PC Code:030016)

Avian Acute Oral Toxicity

Species	% ai	LD50 (mg ai/kg)	LD50 (mg ae/kg)[1]	Toxicity Category	MRID No. Author/Year	Study Classification[2]
Northern bobwhite quail *(Colinus virginianus)*	73.1	595	404.6	Slightly toxic	419751-01, Cambell, et. al, 1991.	Core

[1] Based on acid equivalent of 68% ai
[1] Core (study satisfies guideline). Supplemental (study is scientifically sound, but does not satisfy guideline)

Since the LD50 is 404.6 mg ae/kg for the bobwhite quail, the 2,4-D Diethanolamine salt is categorized slightly toxic to avian species on an acute oral basis. There is no comparable study for the mallard duck. The guideline (71-1) is not fulfilled.

2,4-D Dimethylamine (DMA)Salt (PC Code:030019)

Avian Acute Oral Toxicity

Species	% ai	LD50 (mg ai/kg)	LD50 (mg ae/kg)[1]	Toxicity Category	MRID No. Author/Year	Study Classification[2]
Northern bobwhite quail *(Colinus virginianus)*	66.8	500	415	Moderately toxic	415462-01, Hoxter et. all., 1990.	Core
Mallard duck *(Anas platyrhynchos)*	100	>4640	>3851.2	Practically non-toxic	233351, Fink, R., 1978	Core

[1] Based on acid equivalent of 83% of ai

[2] Core (study satisfies guideline). Supplemental (study is scientifically sound, but does not satisfy guideline)

Since the LD50 falls in the range of 415 to >3851.2 mg ae/kg, the 2,4-D diethylamine salt is categorized moderately toxic to practically non-toxic to avian species on an acute oral basis. The guideline (71-1) is fulfilled (MRID 415462-01, 233351).

2,4-D Isopropylamine (IPA) Salt (PC Code:030025)

Avian Acute Oral Toxicity

Species	% ai	LD50 (mg ai/kg)	LD50 (mg ae/kg)[1]	Toxicity Category	MRID No. Author/Year	Study Classification[2]
Mallard duck *(Anas platyrhynchos)*	48.7	>398	>314.4	Moderately toxic	00138871, Beavers, et. al., 1983,	Supplemental

[1] Based on acid equivalent of 79% ai

[2] Core (study satisfies guideline). Supplemental

Since the LD50 is >314.4 mg ae/kg for the mallard duck, 2,4-D the isopropylamine salt is categorized as moderately toxic to avian species on an acute oral basis. A comparable study for the bobwhite quail has not been submitted. The guideline (71-1) is not fulfilled.

2,4-D Triisopropanolamine (TIPA) Salt (PC Code:030035)

Avian Acute Oral Toxicity

Species	% ai	LD50 (mg ai/kg)	LD50 (mg ae/kg)[1]	Toxicity Category	MRID No. Author/Year	Study Classification[2]
Northern bobwhite quail *(Colinus virginianus)*	70.4	>405	>218.7	Moderately toxic	416444-01, Hoxter, K.A., 1990.	Core

[1] Based on acid equivalent of 54% of ai

[2] Core (study satisfies guideline). Supplemental (study is scientifically sound, but does not satisfy guideline)

Since the LD50 is >218.7 mg ae/kg for the bobwhite quail, the 2,4-D triisopropanolamine salt is categorized moderately toxic to avian species on an acute oral basis. An equivalent study for the mallard duck has not been submitted. The guideline (71-1) is not fulfilled.

2,4-D Butoxyethyl (BEE) Ester (PC Code:030053)

Avian Acute Oral Toxicity

Species	% ai	LD50 (mg ai/kg)	LD50 (mg ae/kg)[1]	Toxicity Category	MRID No. Author/Year	Study Classification[2]
Northern bobwhite quail *(Colinus virginianus)*	96	>2000	>1380	Practically non-toxic	414541-01, Lloyd, D., 1989.	Core

[1] Based on acid equivalent of 69% of ai

[2] Core (study satisfies guideline). Supplemental (study is scientifically sound, but does not satisfy guideline)

Since the LD50 is >1380 mg ae/kg for the bobwhite quail, the 2,4 -D butoxyethyl ester is categorized as practically non-toxic to avian species on an acute oral basis. There is no comparable study for the mallard duck. The guideline (71-1) is not fulfilled.

2,4-D Ethylhexyl (2-EHE) Ester (PC Code: 030063)

Avian Acute Oral Toxicity

Species	% ai	LD50 (mg ai/kg)	LD50 (mg ae/kg)[1]	Toxicity Category	MRID No. Author/Year	Study Classification[2]
Northern bobwhite quail *(Colinus virginianus)*	96.2	633	417.78	Slightly toxic	411583-03, Beavers, J.B., 1984.	Core
Mallard duck *(Anas platyrhynchos)*	92	.>3000	>1980	Practically non-toxic	72472, Fink, R., 1976.	Core
Mallard duck *(Anas platyrhynchos)*	92	.>4640	>3062	Practically non-toxic	226397, Fink, R., 1976.	Core

[1] Based on acid equivalent of 66% of ai

[2] Core (study satisfies guideline). Supplemental (study is scientifically sound, but does not satisfy guideline)

Since the LD50 falls in the range of 417 to >3062 mg ae/kg, the 2,4-D ethylhexyl ester is categorized as slightly toxic to practically non-toxic to avian species on an acute oral basis. The guideline (71-1) is fulfilled (MRID 411583-03, 72472, 226397).

2,4-D Isopropyl Ester (IPE) (PC Code: 030066)

Avian Acute Oral Toxicity

Species	% ai	LD50 (mg ai/kg)	LD50 (mg ae/kg)[1]	Toxicity Category	MRID No. Author/Year	Study Classification[2]
Northern bobwhite quail *(Colinus virginianus)*	98.2	1879	1578	Slightly toxic	439350-01, Palmer, et. al., 1996.	Core

[1] Based on acid equivalent of 84% of ai

[2] Core (study satisfies guideline). Supplemental (study is scientifically sound, but does not satisfy guideline)

Since the LD50 is 1578 mg ae/kg, 2,4-D isopropyl ester is categorized as slightly toxic to avian species on an acute oral basis. There is no comparable study for the mallard duck. The guideline (71-1) is not fulfilled.

Birds, Subacute

Two subacute dietary studies using the TGAI are required to establish the toxicity of products containing the 2,4-D acid, salts, amines, and esters to birds. The preferred test species are mallard duck and bobwhite quail. Results of these tests are tabulated below.

2,4-D acid (PC Code: 030001)

Avian Subacute Dietary Toxicity

Species	% ai	5-Day LC50 (mg ae/kg-diet)[12]	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	96.1	>5620	Practically nontoxic	415861-01, Culotta J., 1989.	Core
Mallard duck *(Anas platyrhynchos)*	96.1	>5620	Practically non-toxic	415462-02, Culotta et.al., 1990	Core

[1] Test organisms observed an additional three days while on untreated feed.
[2] Based on acid equivalent of 100% of ai

Since the LC50 is >5620 mg ae/kg-diet, 2,4-D acid is categorized as practically non-toxic to avian species on a subacute dietary basis. The guideline (71-2) is fulfilled (MRID 415861-01, 415462-02).

2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)

Avian Subacute Dietary Toxicity

Species	% ai	5-Day LC50 (mg ai/kg-diet)[1]	5-Day LC50 (mg ae/kg-diet)[2]	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	73.1	>5620	>3821.6	Practically non-toxic	419751-02, Hoxter, et. al., 1991.	Core
Mallard duck *(Anas platyrhynchos)*	73.1	>5620	>3820.6	Practically non-toxic	419751-03, Hoxter, et. al., 1991.	Core

[1] Test organisms observed an additional three days while on untreated feed.
[2] Based on acid equivalent of 68% of ai

Since the LC50 is >3821 mg ae/kg-diet, 2,4-D diethanolamine salt is categorized as practically non-toxic to avian species on a subacute dietary basis. The guideline (71-2) is fulfilled (MRID 419751-02, 419751-03).

2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)

Avian Subacute Dietary Toxicity

Species	% ai	5-Day LC50 (mg ai/kg-diet)[1]	5-Day LC50 (mg ae/kg-diet)[2]	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	66.8	>5620	>4665	Practically non-toxic	417495-01, Long, et. al., 1990.	Core
Northern bobwhite quail *(Colinus virginianus)*	100	>10,000	>8300	Practically non-toxic	233351, Fink, R., 1978.	Core
Mallard duck *(Anas platyrhynchos)*	66.8	>5620	>4665	Practically non-toxic	417495-02, Long, et. al., 1990.	Core

[1] Test organisms observed an additional three days while on untreated feed.
[1] Based on acid equivalent of 83% of ai

Since the LC50 falls in the range of >4665 and >8300 mg ae/kg-diet, 2,4-D dimethylamine salt is categorized as practically non-toxic to avian species on a subacute dietary basis. The guideline (71-2) is fulfilled (MRID 417495-01, 417495-02, 2333351).

2,4-D Isopropylamine (IPA) Salt (PC Code: 030025)

Avian Subacute Dietary Toxicity

Species	% ai	5-Day LC50 (mg ai/kg-diet)[1]	5-Day LC50 (mg ae/kg-diet)[2]	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	48.7	>5620	>4440	Practically non-toxic	00138870, Beavers, J.B., 1983.	Core
Mallard duck *(Anas platyrhynchos)*	48.7	>5620	>4440	Practically non-toxic	00138872, Beavers, J.B., 1983.	Core

[1] Test organisms observed an additional three days while on untreated feed.
[2] Based on acid equivalent of 79% of ai

Since the LC50 is >4440 mg ae/kg-diet, 2,4-D isopropylamine salt is categorized as practically non-toxic to avian species on a subacute dietary basis. The guideline (71-2) is fulfilled (MRID 00138870, 00138872).

2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)

Avian Subacute Dietary Toxicity

Species	% ai	5-Day LC50 (mg ai/kg-diet)[1]	5-Day LC50 (mg ai/kg-diet)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	70.4	>5620	>3035	Practically non-toxic	416444-02, Driscoll, et., al. 1990.	Core
Mallard duck *(Anas platyrhynchos)*	70.4	>5620	>3035	Practically non-toxic	416444-03, Driscoll, et., al. 1990.	Core

[1] Test organisms observed an additional three days while on untreated feed.
[2] Based on acid equivalent of 54% of ai

Since the LC50 is >3035 kg ae/mg-diet, 2,4-D triisopropanolamine salt is categorized as practically non-toxic to avian species on a subacute dietary basis. The guideline (71-2) is fulfilled (MRID 416444-02, 416444-03).

2,4-D Butoxyethyl (BEE) Ester (PC Code: 030053)

Avian Subacute Dietary Toxicity

Species	% ai	5-Day LC50 (mg ai/kg-diet)[1]	5-Day LC50 (mg ae/kg-diet)[2]	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	96	>5620	>3878	Practically non-toxic	414484-01, Grimes, J.., 1989.	Core
Mallard duck *(Anas platyrhynchos)*	96	>5620	>3866	Practically non-toxic	414290-07, Grimes, J., 1989.	Core

[1] Test organisms observed an additional three days while on untreated feed.
[2] Based on acid equivalent of 69% of ai

Since the LC50 is >3866 mg ae/kg-diet, 2,4,-D butoxyethyl ester is categorized as practically non-toxic to avian species on a subacute dietary basis. The guideline (71-2) is fulfilled (MRID 414484-01, 414290-07).

2,4-D 2-Ethylhexyl (2-EHE) Ester(PC Code: 030063)

Avian Subacute Dietary Toxicity

Species	% ai	5-Day LC50 (mg ai/kg-diet)[1]	5-Day LC50 (mg ai/kg-diet)[2]	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	96.2	>5620	>3709	Practically non-toxic	411583-05, Beavers, J.B., 1984.	Core
Northern bobwhite quail *(Colinus virginianus)*	92	>10,000	>6600	Practically non-toxic	45070, Fink, R., 1977	Core
Mallard duck *(Anas platyrhynchos)*	92	>5620	>3709	Practically non-toxic	411583-04, Beavers, J.B., 1984.	Core
Mallard duck *(Anas platyrhynchos)*	92	>10,000	>6600	Practically non-toxic	226397, Fink, R., 1976.	Core

[1] Test organisms observed an additional three days while on untreated feed.
[2] Based on acid equivalent of 66% of ai

Since the LC50 falls in the range of >3709 to 6600 mg ae/kg-diet, 2,4-D 2-ethylhexyl ester is categorized as practically non-toxic to avian species on a subacute dietary basis. The guideline (71-2) is fulfilled (MRID 411583-05, 45070, 411583-04, 226397).

2,4-D Isopropyl Ester (PC Code: 030066)

Avian Subacute Dietary Toxicity

Species	% ai	5-Day LC50 (mg ai/kg-diet)[1]	5-Day LC50 (mg ae/kg-diet)[2]	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	98.2	>5456	>4583	Practically non-toxic	439349-01, Palmer, et. al., 1996.	Core
Mallard duck *(Anas platyrhynchos)*	98.2	>5218	>4383	Practically non-toxic	439352-01, Palmer, et. al., 1996.	Core

[1] Test organisms observed an additional three days while on untreated feed.
[2] based on acid equivalent of 84% of ai

Since the LC50 is >4383 mg ae/kg-diet, 2,4-D isopropyl ester is categorized as practically non-toxic
to avian species on a subacute dietary basis. The guideline (71-2) is fulfilled (MRID 439349-01, 439352-01).

Birds, Chronic

Avian reproduction studies using the TGAI are required for the proposed reregistrations of products containing the 2,4-D acid, salts, or esters because the following conditions are met: (1) birds may be subject to repeated or continuous exposure to the pesticide, especially preceding or

during the breeding season, (2) the pesticide is stable in the environment to the extent that potentially toxic amounts may persist in animal feed, (3) the pesticide is stored or accumulated in plant or animal tissues, and/or, (4) information derived from mammalian reproduction studies indicates reproduction in terrestrial vertebrates may be adversely affected by the anticipated use of the product. The preferred test species are mallard duck and bobwhite quail. Results of these tests are tabulated below.

2,4-D Acid (PC Code: 030001)

Avian Reproduction

Species/ Study Duration	% ai	NOEC/LOEC (ppm)	LOEC Endpoints	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	96.9	962/>962	Eggs cracked/eggs laid	453364-01, Mitchell, L.R., et. al., 2000	Core

The NOEC of 962 ppm is based on the endpoints of eggs cracked and eggs laid for the 2,4-D acid. There is no comparable study for the mallard duck. The guideline (71-1) is not fulfilled.

Mammals, Acute

Wild mammal testing is required on a case-by-case basis, depending on the results of lower tier laboratory mammalian studies, intended use pattern and pertinent environmental fate characteristics. In most cases, rat or mouse toxicity values obtained from the Agency's Health Effects Division (HED) substitute for wild mammal testing. These toxicity values are reported below.

2,4-D acid (PC Code: 030001)

Mammalian Toxicity

Species/ Study Duration	% ai	Test Type	Toxicity Value	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	Not available	Oral LD50	LD_{50} = 699 mg ae/kg	Mortality	00101605

An analysis of the results indicate that the 2,4-D acid is categorized as slightly toxic to small mammals on an acute oral basis.

2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)

Mammalian Toxicity

Species/ Study Duration	% ai	Test Type	Toxicity Value (mg ai/kg)	Toxicity Value (mg ae/kg)[1]	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	73.09	Oral LD50	910	618.8	Mortality	41920901

[1] Based on acid equivalent of 68% of ai

An analysis of the results indicate that the 2,4-D DEA Salt is categorized as slightly toxic to small mammals on an acute oral basis.

2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)

Mammalian Toxicity

Species/ Study Duration	% ai	Test Type	Toxicity Value (mg ai/kg)	Toxicity Value (mg ae/kg)[1]	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	66.2	Oral LD50	433	359	Mortality	41642801

[1] Based on acid equivalent of 83% of ai

An analysis of the results indicate that the 2,4-D DMA Salt is categorized as moderately toxic to small mammals on an acute oral basis.

2,4-D Isopropylamine (IPA) Salt (PC Code: 030025)

Mammalian Toxicity

Species/ Study Duration	% ai	Test Type	Toxicity Value (mg ai/kg)	Toxicity Value (mg ae/kg)[1]	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	50.02	Oral LD50	1646	1300	Mortality	00252291

[1] Based on acid equivalent of 79% of ai

An analysis of the results indicate that the 2,4-D IPA Salt is categorized as slightly toxic to small mammals on an acute oral basis.

2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)

Mammalian Toxicity

Species/ Study Duration	% ai	Test Type	Toxicity Value (mg ai/kg)	Toxicity Value (mg ae/kg)[1]	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	72.2	Oral LD50	1072	579	Mortality	41413501

[1] Based on acid equivalent of 54% of ai

An analysis of the results indicate that the 2,4-D TIPA Salt is categorized as slightly toxic to small mammals on an acute oral basis.

2,4-D Butoxyethyl (BEE) Ester (PC Code: 030053)

Mammalian Toxicity

Species/ Study Duration	% ai	Test Type	Toxicity Value (mg ai/kg)	Toxicity Value (mg ae/kg)[1]	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	95.6	Oral LD50	866	598	Mortality	40629801

[1] Based on acid equivalent of 69% of ai

An analysis of the results indicate that the 2,4-D BEE Ester is categorized as slightly toxic to small mammals on an acute oral basis.

2,4-D 2-Ethylhexyl (2-EHE) Ester(PC Code: 030063)

Mammalian Toxicity

Species/ Study Duration	% ai	Test Type	Toxicity Value (mg ai/kg)	Toxicity Value (mg ai/kg)[1]	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	94.4	Oral LD50	896	591	Mortality	Not available

[1] Based on acid equivalent of 66% of ai

An analysis of the results indicate that the 2,4-D 2-EHE is categorized as slightly toxic to small mammals on an acute oral basis.

Mammals, chronic

When conducting a chronic risk assessment for mammals it is important to use studies that are comparable to avian reproduction studies. Therefore, the two generation rat or mouse studies, and/or, the developmental rabbit study are more relevant to use than the longer term mammalian carcinogenicity/oncogenicity studies. Accordingly, EFED has obtained the rat and rabbit developmental toxicity studies for the 2,4-D acid and all salts, amines, and esters (exception: IPE ester). In addition, the 2-generation rat study is also available for the 2,4-D acid..

2,4-D acid (PC Code: 030001)

Mammalian Toxicity

Species/ Study Duration	% ai	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	97.7	Developmental Toxicity	25 / 75	Body wt. Gain	00251031

An analysis of the results indicate that no treatment related deaths occurred throughout the duration of the study. The maternal NOAEL and LOAEL were observed to be 25 and 75 mg/kg/da respectively based on body weight gains. The developmental NOAEL and LOAEL was 25 and 75 mg/kg/da based on skeletal variations.

2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	45.6	Developmental Toxicity	10.2 / 50.6	Body wt. Gain	41920906

An analysis of the results indicate that no treatment related deaths occurred throughout the duration of the study. The maternal NOAEL and LOAEL were observed to be 10.2 and 50.6 mg ae/kg/da respectively based on decreased body weight gains. The developmental NOAEL and LOAEL was 10.2 and 50.6 mg ae/kg/da based on skeletal variations.

2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	55.5	Developmental Toxicity	12.5 / 50	Body wt. Gain	41735201

An analysis of the results indicate that no treatment related deaths occurred throughout the duration of the study. The maternal NOAEL and LOAEL were observed to be 12.5 and 50 mg ae/kg/da respectively based on decreased body weight gain and food consumption. The developmental NOAEL and LOAEL was 50 and 100 mg ae/kg/da based on decreased fetal body weight.

2,4-D Isopropylamine (IPA) Salt (PC Code: 030025)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	50.2	Developmental Toxicity	51 / 150	Body wt. Gain & food consumption	41527103

An analysis of the results indicate that no treatment related deaths occurred throughout the duration of the study. The maternal NOAEL and LOAEL were observed to be 52 and 150 mg ae/kg/da respectively based on decreased body weight gain and food consumption and one mortality. The developmental NOAEL and LOAEL was 52 and 150 mg ae/kg/da based on slight increase in the incidence of skeletal formations, skeletal variations and external malformations.

2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	38.7	Developmental Toxicity	17 (LOAEL)	Body wt. Gain	41527102

An analysis of the results indicate that no treatment related deaths occurred throughout the duration of the study. The maternal NOAEL could not be determined and LOAEL was observed to be 17 mg ae/kg/da based on decreased body weight and two deaths. The developmental NOAEL and LOAEL was 17 and 51 mg ae/kg/da based on significant increase in the incidence of skeletal formations.

2,4-D Butoxyethyl (BEE) Ester (PC Code: 030053)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	65.1	Developmental Toxicity	51 / 125	Body wt. Gain & food consumption	42158706

An analysis of the results indicate that no treatment related deaths occurred throughout the duration of the study. The maternal NOAEL and LOAEL was observed to be 51 and 125 mg ae/kg/da respectively based on decreased body weight and decreased food consumption, RBC, increased reticulocytes. One non-pregnant dam displayed ataxia and negative activity. The developmental NOAEL and LOAEL was also observed to be 51 and 125 mg ae/kg/da based on significant increase in the incidence of skeletal formations.

2,4-D 2-Ethylhexyl (2-EHE) Ester(PC Code: 030063)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	63.25	Developmental Toxicity	10 / 30	Body wt. Gain & clinical signs.	42304601

An analysis of the results indicate that no treatment related deaths occurred throughout the duration of the study. The maternal NOAEL and LOAEL was observed to be 10 and 30 mg ae/kg/da respectively based on decreased body weight and increased incidence of clinical signs (perivagina staining). At HTD, additional clinical signs (ataxia, decreased motor activity, bradypnea) and lower food intake during dosing period) One abortion occurred. The developmental NOAEL and LOAEL were also observed to be 15.1 and 45.2 mg ai/kg/day, based on an increased incidence of delayed sternebrae ossification.

2,4-D acid (PC Code: 030001)

Mammalian Toxicity

Species/ Study Duration	% ai	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
Rabbit	96.1	Developmental Toxicity	30 / 90	Clinical signs & Body wt. Gain	41747601

An analysis of the results indicate that no treatment related deaths occurred throughout the duration of the study. The maternal NOAEL and LOAEL were observed to be 30 and 90 mg/kg/da respectively based on clinical signs (ataxia, decreased motor activity, loss of righting reflex, cold extremities), abortions (2), and decreased body weight gains. The developmental NOAEL was 90 mg/kg/da.

2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
Rabbit	45.6	Developmental Toxicity	15 / 30	Body wt. Gain & food consumption	42055501

An analysis of the results indicate that only one treatment related death occurred throughout the duration of the study. The maternal NOAEL and LOAEL were observed to be 15 and 30 mg ae/kg/da respectively based on decreased body weight gains and food consumption. At HDT, one doe died, slight increase in resorption/post implantation lost. The developmental NOAEL and LOAEL was 30 and 65 mg ae/kg/da based on number of litters with fetuses with 7^{th} cervical ribs.

2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
Rabbit	55.5	Developmental Toxicity	30 / 90	Mortality morbitity, & clinicl signs	42224001

An analysis of the results indicate that 2 deaths occurred on day 10, 2 on day 18, and one was sacrificed on day 17. The maternal NOAEL and LOAEL were observed to be 30 and 90 mg ae/kg/da respectively based on mortality /morbidity, clinical signs of toxicity (decreased motor activity, ataxia, impaired/loss of righting reflex, myotonia) and decreased body weight gain and food consumption. The clinical signs occurred by day 7. The developmental NOAEL was 90 mg ae/kg/da [HDT].

2,4-D Isopropylamine (IPA) Salt (PC Code: 030025)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
Rabbit	39.6	Developmental Toxicity	10 (LOAEL) NOAEL could not be determined	Body wt. Gain	42158704

An analysis of the results indicate that two does died at mid-dose and high dose levels on days16 and 24, and 3 high dose deaths on days 12, 20. 21, and 4 high-dose does were sacrificed on days 12, 13, 14, and 20..The maternal NOAEL could not be determined but a LOAEL of 10 mg ae/kg/da was observed based on decreased body weight gain The developmental NOAEL was 75 mg ae/kg/da.

2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
Rabbit	39.2	Developmental Toxicity	10 / 30	Mortality/morbidity, and clinical signs	42158705

An analysis of the results indicate that one death occurred at mid-dose on day 18, 3 high-dose does with sacrificed on days 12, 14, and 15. The maternal NOAEL and LOAEL was observed to be 10 and 30 mg ae/kg/da respectively based on mortality/morbidity, clinical sing so toxicity (lateral recumbency, myotonia, perineal staining, blood in urine) and decreased body weight gain. At HDT, stiffness of limbs was displayed. The developmental NOAEL was 75 mg ae/kg/da.

2,4-D Butoxyethyl (BEE) Ester (PC Code: 030053)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
Rabbit	65.8	Developmental Toxicity	10 / 30	Mortality morbitity, & clinicl signs	41527101

An analysis of the results indicate that 1 doe sacrificed on day 21, 1 deaths occurred on day 24. Four were sacrified at the HDT on days 14, 15, 18, and 21 and 4were sacrificed on day 11, 12, 13, and 19. The maternal NOAEL and LOAEL were observed to be 10 and 30 mg ae/kg/da respectively based on mortality /morbidity, clinical signs of toxicity (decreased activity, prostation, myotonia, transient lateral recumbency, cold to touch, perineal soiling/blood, red urine) and

decreased body weight gain. The developmental NOAEL was 110 mg ae/kg/da.

2,4-D 2-Ethylhexyl (2-EHE) Ester(PC Code: 030063)

Mammalian Toxicity

Species/ Study Duration	% ae	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
Rabbit	63.5	Developmental Toxicity	30 / 75	Mortality morbitity, & clinicl signs	42304603

An analysis of the results indicate that 1 death occurred at mid-dose on day 21, and one doe aborted on day 23. Two were sacrificed at the HDT on days 15 and 16. The maternal NOAEL and LOAEL were observed to be 30 and 75 mg ae/kg/da respectively based on mortality /morbidity, clinical signs of toxicity (decreased motor activity, ataxia, impaired loss of righting reflex, bradypnea) and decreased body weight gain. The developmental NOAEL was 75 mg ae/kg/da.

2,4-D acid (PC Code: 030001)

Mammalian Toxicity

Species/ Study Duration	% ai	Test Type	(NOAEL/ LOAEL (mg kg/da	Affected Endpoints	MRID No.
Rat	97.5	2-gerneration Reproductive Toxicity	5 / 20	Increased gestation length	259442, 259446, 265489

Reproductive Toxicity Study Conclusions

Reproductive Toxicity Study: EXECUTIVE SUMMARY: In a 2-generation reproduction study [MRID (Accession No. 259442-259446, 265489)], 30 male/30 female F0 Fischer 344 rats/sex/group were administered 2,4-D [97.5% a.i.] *via* the diet for 105 days prior to mating and through gestation and lactation of two litters and for 30 days after weaning the last litter at target dose levels of 0, 5, 20, and 80 mg/kg/day. Rats were mated, one male with one female. The resulting F1a litters were weaned at day 28 *post partum*. After a 2-week rest period, the F0 parental rats were re-bred using different male/female combinations to produce the F1b litters, from which 30 males/30 females/group were selected to become the F1 parents. The F1 generation [30 rats/sex/group] was administered the test material at target dose levels of 0, 5, and 20 mg/kg/day [**high-dose level dropped due to excess toxicity**; there were an insufficient number of F1b pups] *in utero* and continuously *via* the milk or feed for 125 days postnatally and prior to mating and through gestation and lactation of two litters [F2a and F2b] and for 30 days after weaning the last litter.

There were no apparent treatment-related deaths, and clinical signs were comparable

among the groups throughout the study. During the *pre-mating dosing period*, body weights of the **F0 parental animals** were slightly lower [males 95%-97% (by week 6)/females 95%-96% (by week 13) of control] at the high-dose level for both sexes. Body-weight gains of the F0 high-dose males were decreased initially [weeks 2-3 (86% of control] and overall [weeks 0-13 and weeks 0-40 (93% of control], as were those of the high-dose females [weeks 0-1 (79% of control); weeks 0-13 (92% of control) and weeks 0-40 (94% of control)] compared to the controls.

The high-dose **F0 dams** displayed a significantly lower body weight throughout [F1A litter] gestation (94%-95% of control) and by gestation day 20 during F1b pregnancy [90% of control]. The high-dose F0 dams displayed significantly reduced body-weight gains compared to the controls during both gestation periods, with the greater deficit being observed during the second gestation period [F1a litters: days 0-7 (67%* of control); days 13-20 (95% of control; days 0-20 (87% of control); F1b litters: days 0-7 (70%* of control); days 13-20 (59%** of control); days 0-20 (67%** of control)]. The high-dose F0 dams displayed decreased body weight on day 7 of lactation [both litters; 92%-93% of control], but body weights were significantly increased compared to the controls at day 28 of lactation [F1a (108%/F1b 111% of control]. Body-weight gains were significantly reduced during lactation days 1-7 for both litters [F1a (40% of control); F1b (6% of control)]. Overall, however, the high-dose dams displayed positive body-weight gain during lactation days 1-28 compared to negative body-weight gains in the control and other dose groups.

Food consumption [g/rat/day] during the pre-mating period was slightly lower [94%-95% of control] in the high-dose females during a few weeks, but on a g/kg/day basis, both sexes at the high-dose level displayed a slight increase [104% of control] in food consumption compared to the controls. During the first week of the two-week rest period following the weaning of the first litter, the F0 dams displayed a significant decrease in food consumption [83%-84% of control]. Food consumption was decreased at the high-dose level during both gestation periods [F1a during first 2 weeks (91%-93% of control); F1b during third week (82% of control)]. A significant decrease in food consumption was observed throughout lactation [both litters] at the high-dose level [F1a litter (58% of control for days 1-28); F1b litter (71%-83% of control)]. At necropsy, no treatment-related adverse effects were observed at any dose level, although the F0 females displayed increased kidney weights at all dose levels but there was no dose response.

There were no apparent, treatment-related, adverse effects on body weights or body-weight gains of the **F1 parental animals** during the pre-mating dosing period at the two remaining dose levels, although the mid-dose [20 mg/kg/day; the highest dose in the F1 generation] males displayed an initial decrease in body-weight gain [weeks 35-36 (91%** of control) and weeks 36-37 (89%** of control)]. At 20 mg/kg/day, there were no significant differences in body weights in the **F1 dams** during gestation [F2a litters 95%-99%; F2b litters 95%-96% of control] or body-weight gains F2a litters 85% (days 7-13); F2b litters 83% (days 0-7); 86% (days 13-20); 90% (days 0-20) of control], and comparable body weights/gains were observed during lactation [both litters]. Food consumption was comparable among the groups [both sexes] throughout the study. At necropsy, no

treatment-related adverse effects were observed at either dose level, although the F1 males and females displayed slightly increased kidney weights at the 20 mg/kg/day dose level, and the females at this dose level displayed a slight increase in liver weight.

F0 Generation. No apparent adverse effect was observed on fertility. Pre-coital intervals were comparable among the groups. The duration of gestation was significantly increased in the high-dose [80 mg/kg/day] F0 females producing the F1b pups [22.5 days *vs* 21.9 days]. The gestation survival index was comparable among the groups for the F1a pups but significantly decreased for the F1b litters [31.7% *vs* 97.8%]. There was a significant decrease in the number of F1a female fetuses at the high-dose level [39% *vs*54%]. The number of F1b pups born dead/dying by day 1 [110] was significantly increased at the high-dose level compared to the control [5]. F1a litter size was slightly lower at the high-dose level compared to the control [9.0 *vs* 10.1], but F1b litter size was significantly lower than the control [5.1** *vs* 9.5]. F1a pup viability was comparable throughout weaning, but F1b pup viability was significantly lower throughout the weaning period. There was a significant decrease in F1b pup survival to lactation day 4 at the high-dose level [86.3%] compared to the control [100%] and other dose levels [98% and 99.6%], as well as survival to lactation day 28 [71.4% *vs* 100% (control) and other dose groups 99.4% and 100%]. Decreased pup body weight [F1a males 89%/females 90% of control (day 1), 75%/81% of control (day 28); F1b males 78%/females 85% of control (day 1), 73%/76% of control (day 28)] and body-weight gains [F1a males 68%/females 70% of control (days 1-4), 75%/80% of control (days 4-28); F1b males 26%/females 43% of control (days 1-4), 76%/78% of control (days 4-28)] were observed at the high-dose level, with the F1b litters displaying the greater effect. At the mid-dose level, there was a slight decrease in body weight [F1a males93%/females 94% of control (day 28); F1b males 84%/females 87% of control (day 28)] and body-weight gains [F1a males 92%/females 93% of control (days 4-28); F1b males 83%/females 85% of control (days 4-28)], with the deficits being greater in the F1b litters.

Skeletal anomalies and reduced ossification were observed in the high-dose F1b pups [80 mg/kg/day] that were dead at birth [only dose level examined].

F1 Generation. No apparent adverse effect was observed on fertility at either dose level. Pre-coital intervals and gestation lengths were comparable among the groups. The gestation survival index and the viability index were comparable among the groups for both the F2a and F2b litters. Litter size, body weights, and the sex ratio were comparable among the groups in both the F2a and F2b litters.

Degenerative changes in the tubules of the cortical region [high-dose F0 males] and outer medullary regions [mid- and high-dose F0 males, mid-dose F1 males (highest dose tested in this generation)] of the kidneys were found in a subsequent histopathological examination. The original reviewer noted that these effects on the kidney were not found originally but during a subsequent re-examination of the tissues, casting doubt on the quality of the histopathological examination of the reproductive organs. However, the RfD/QA Peer Review Committee determined that, based on the lack of effects on

reproductive organs in the chronic and subchronic studies at similar or higher dose levels, reevaluation of these tissues [testes and ovaries] is not necessary [HED Document No. 011908, dated 5/9/96].

The NOAEL for parental toxicity is 5 mg/kg/day (target dose; actual dose range 3.8-13.5 mg/kg/day) and the parental LOAEL is 20 mg/kg/day (target dose; actual dose range 14-48 mg/kg/day), based on decreased female body weight/body- weight gain (F1) and male renal tubule alteration (F0 and F1).

The NOAEL for reproductive toxicity is 20 mg/kg/day (target dose; actual dose range 18-35 mg/kg/day), and the LOAEL for reproductive toxicity is 80 mg/kg/day (target dose; actual dose range 69-114 mg/kg/day), based on an increase in gestation length.

The NOAEL for offspring toxicity is 5 mg/kg/day (target dose; actual dose range 7.2-13.5 mg/kg/day), and the LOAEL for offspring toxicity is 20 mg/kg/day (target dose; actual dose range 26-48 mg/kg/day), based on decreased pup body weight [F1b]. At 80 mg/kg/day (target dose; actual dose range 76.1-133 mg/kg/day), there was an increase in pup deaths.

This reproduction study is classified **Acceptable/Guideline**, and it satisfies the guideline requirement [OPPTS 870.3800; §83-4] for a 2-generation reproduction study in the rat.

Insects

A honey bee acute contact study using the TGAI is required for 2,4-D on many of its use sites will result in honey bee exposure. Results of this test are tabulated below.

2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)

Nontarget Insect Acute Contact Toxicity

Species	% ai	LD50 (µg/bee)	Toxicity Category	MRID No. Author/Year	Study Classification
Honey bee *(Apis mellifera)*	67.3	>100	Practically non-toxic	445173-04, Palmer S. et al., 1997	Core

An analysis of the results indicate that the 2,4-D DMA Salt is categorized as practically non-toxic to bees on an acute contact basis. The guideline (141-1) is fulfilled

2,4-D 2-Ethylhexyl (2-EHE) Ester(PC Code: 030063)

Nontarget Insect Acute Contact Toxicity

Species	% ai	LD50 (µg/bee)	Toxicity Category	MRID No. Author/Year	Study Classification
Honey bee *(Apis mellifera)*	96.96	>100	Practically non-toxic	445173-01, Palmer S. et al., 1997	Core

An analysis of the results indicate that the 2,4-D EHE is categorized as practically non-toxic to bees on an acute contact basis. The guideline (141-1) is fulfilled.

Terrestrial Plants

Terrestrial plant testing (seedling emergence and vegetative vigor) is required for herbicides that have terrestrial non-residential outdoor use patterns and that may move off the application site through volatilization (vapor pressure >1.0 x 10^{-5}mm Hg at 25ºC) or drift (aerial or irrigation) and/or that may have endangered or threatened plant species associated with the application site.

Currently, terrestrial plant testing is not required for pesticides other than herbicides except on a case-by-case basis (*e.g.*, labeling bears phytotoxicity warnings incident data or literature that demonstrate phytotoxicity).

For seedling emergence and vegetative vigor testing the following plant species and groups should be tested: (1) six species of at least four dicotyledonous families, one species of which is soybean (*Glycine max*) and the second is a root crop, and (2) four species of at least two monocotyledonous families, one of which is corn (*Zea mays*).

Tier I tests measure the response of plants, relative to a control, at a test level that is equal to the highest use rate (expressed as lbs ai/A). If effects are observed in this test, the registrant is required to proceed to the Tier 2 level.

Terrestrial Tier II studies are required for all low dose herbicides (those with the maximum use rate of 0.5 lbs ai/A or less) and any pesticide showing a negative response equal to or greater than 25% in Tier I tests. The registrant may opt to proceed directly to Tier 2 testing, and in the

case of 2,4-D the Tier 1 test was not performed.

Tier II tests measure the response of plants, relative to a control, and five or more test concentrations. Results of Tier II toxicity testing on the technical/TEP material are tabulated below.

2,4,-D acid (PC Code: 030001)

Nontarget Terrestrial Plant Seedling Emergence Toxicity (Tier II)

Species	% ai (as acid equilvalent)	EC25/EC05 (lbs ae/A) Endpoint Affected	MRID No. Author/Year	Study Classification
Monocot- Corn	96.7	Š4.2 (fresh wt.)	424168-02, Backus P. et. al., 1992.	Core
Monocot- Onion	96.7	Š2.1 (fresh wt.)	424168-02, Backus P. et. al., 1992.	Core
Monocot- Oats	96.7	Š4.2 (fresh wt.)	424168-02, Backus P. et. al., 1992.	Core
Monocot- Sorghum	96.7	Š2.1 (fresh wt.)	424168-02, Backus P. et. al., 1992.	Core
Dicot- Root Crop (Radish)	96.7	0.03 - 0.065 (fresh wt.)	424168-02, Backus P. et. al., 1992.	Core
Dicot- Soybean	96.7	1.7 (fresh wt.)	424168-02, Backus P. et. al., 1992.	Core
Dicot- cucumber	96.7	0.53 - 1.05 (fresh wt.)	424168-02, Backus P. et. al., 1992.	Core
Dicot- Mustard	96.7	0.033 (fresh wt.)	424168-02, Backus P. et. al., 1992.	Core
Dicot- Buckwheat	96.7	1.29 (fresh wt.)	424168-02, Backus P. et. al., 1992.	Core
Dicot- Tomato	96.7	Š4.2 (fresh wt.)	424168-02, Backus P. et. al., 1992.	Core

For Tier II seedling emergence mustard and radish are the most sensitive dicots and onion and sorghum are the most sensitive monocots. The guideline (123-1) is fulfilled. (MRID 424168-02).

Nontarget Terrestrial Plant Vegetative Vigor Toxicity (Tier II)

Species	% ai	EC25 (lbs ai/A) Endpoint Affected[1]	NOEC or EC05 (lbs ai/A) Endpoint Affected	MRID No. Author/Year	Study Classification
Monocot- Corn	96.7	>4.2	2.1	424168-01, Backus P., 1991	Core
Monocot- Onion	96.7	<0.0075	<0.0075	424168-01, Backus P., 1991	Core
Monocot- Oats	96.7	>4.2	4.2	424168-01, Backus P., 1991	Core
Monocot- Sorghum	96.7	1.34	0.53	424168-01, Backus P., 1991	Core
Dicot- Root Crop (Radish)	96.7	0.016	0.0075	424168-01, Backus P., 1991	Core
Dicot- Soybean	96.7	0.008	<0.0075	424168-01, Backus P., 1991	Core
Dicot- Buckwheat	96.7	0.023	0.0075	424168-01, Backus P., 1991	Core
Dicot- Cucumber	96.7	0.015	<0.0075	424168-01, Backus P., 1991	Core
Dicot- Mustard	96.7	0.011	<0.0075	424168-01, Backus P., 1991	Core
Dicot- Tomato	96.7	0.0075	<0.0075	424168-01, Backus P., 1991	Core

[1] Fresh weight was the most sensitive endpoint affected.

For Tier II vegetative vigor tomato is the most sensitive dicot and onion is the most sensitive monocot. The guideline (123-1) is fulfilled.

2,4-D Sodium Salt (PC Code: 030004)

There is no valid EPA data for this active ingredient. The guideline (123-1) is not fulfilled.

2,4-D Diethanolamine (DEA) Salt (PC code: 030016)

Nontarget Terrestrial Plant Seedling Emergence Toxicity (Tier II)

Species	% ai (as acid equilvalent)	EC25/NOEL(EC5) (lbs aei/A) Endpoint Affected	MRID No. Author/Year	Study Classification
Monocot- Corn	50.2	1.32 (freshweight) 0.75	426091-01, Backus P., 1992.	Core
Monocot- Onion	50.2	0.38 (dry weight) 0.27	442756-01, Crosby, K., 1996.	Core
Monocot- Oats	50.2	1.5 (fresh weight) 0.375	426091-01, Backus P., 1992.	Core
Monocot- Sorghum	50.2	1.01 (fresh weight) 0.75	426091-01, Backus P., 1992.	Core
Dicot- Root Crop (Radish)	50.2	0.19 (percent emergence) 0.09	426091-01, Backus P., 1992.	Core
Dicot- Soybean	50.2	>0357 (fresh weight0 0.19	426091-01, Backus P., 1992.	Core
Dicot- cucumber	50.2	0.21 (fresh weight) 0.19	426091-01, Backus P., 1992.	Core
Dicot- Mustard	50.2	0.045 (fresh weight) <0.045	426091-01, Backus P., 1992.	Core
Dicot- Buckwheat	50.2	0.045 (fresh weight) >0.045	426091-01, Backus P., 1992.	Core
Dicot- Tomato	50.2	0.45 (percent emergence) 0.375	426091-01, Backus P., 1992.	Core

[1] NOEL was not determined for these species.

For Tier II seedling emergence mustard is the most sensitive dicot and onion is the most sensitive monocot. The guideline (123-1) is fulfilled. (MRID 435269-01 and-01).

Nontarget Terrestrial Plant Vegetative Vigor Toxicity (Tier II)

Species	% ai	EC25/EC05 (lbs ai/A) Endpoint Affected	MRID No. Author/Year	Study Classification
Monocot- Corn	50.2	>1.5 (fresh weight)/ 0.75	426091-02, Backus,P., 1992.	Core
Monocot- Sorghum	50.2	0.23 (fresh weight)/ 0.19	426091-02, Backus,P., 1992.	Core
Monocot- Oat	50.2	>1.5 (fresh weight)/ >1.5	426091-02, Backus,P., 1992.	Core
Monocot- Onion	50.2	0.04 (fresh weight)/ 0.01	426091-02, Backus,P., 1992.	Core
Dicot- Root Crop (Radish)	50.2	0.01 (fresh weight)/ 0.0025	426091-02, Backus,P., 1992.	Core
Dicot- Soybean	50.2	0.045 (fresh weight)/ 0.005	426091-02, Backus,P., 1992.	Core
Dicot- Tomato	50.2	0.003 (fresh weight)/ 0.002	426091-02, Backus,P., 1992.	Core
Dicot-Buckwheat	50.2	0.039 (fresh weight)/ 0.0025	426091-02, Backus,P., 1992.	Core
Dicot- Mustard	50.2	0.01 (fresh weight)/ 0.005	426091-02, Backus,P., 1992.	Core
Dicot- cucumber	50.2	0.008 (fresh weight)/ <0.0025	426091-02, Backus,P., 1992.	Core

For Tier II vegetative vigor tomato is the most sensitive dicot and onion is the most sensitive monocot. The guideline (123-1) is fulfilled.

2,4-D Dimethylamine (DMA)Salt (PC Code:- 030019)

Nontarget Terrestrial Plant Seedling Emergence Toxicity (Tier II)

Species	% ai (as acid equilvalent)	EC25/NOE:L (lbs aei/A) Endpoint Affected	MRID No. Author/Year	Study Classification
Monocot- Corn	55.5	>0.96/ (Fresh wt.) 0.96	423895-01, Backus, et. al., 1992	Core
Monocot- Onion	55.5	0.0994/ (Fresh wt.t) 0.06	423895-01, Backus, et. al., 1992	Core
Monocot- Oats	55.5	>0.961 (Fresh wt.) 0.96	423895-01, Backus, et. al., 1992	Core
Monocot - Sorghum	55.5	0.026/ (Fresh wt) 0.015	423895-01, Backus, et. al., 1992	Core
Dicot- Root Crop (Radish)	55.5	0.02347/ (Fresh wt.) 0.015	423895-01, Backus, et. al., 1992	Core
Dicot- Soybean	55.5	>0.96/ (Fresh wt) 0.96	423895-01, Backus, et. al., 1992	Core
Dicot - Buckwheat	55.5	>0.96/ (Fresh wt) 0.96	423895-01, Backus, et. al., 1992	Core
Dicot- Cucumber	55.5	0.11885/ (Fresh wt.) 0.06	423895-01, Backus, et. al., 1992	Core
Dicot- Mustard	55.5	0.00953/ (Fresh wt) <0.015	423895-01, Backus, et. al., 1992	Supplemental
Dicot- Tomato	55.5	>0.96/ (Fresh wt) 0.96	423895-01, Backus, et. al., 1992	Core

* Can be up-graded to core if study authors can confirm that seeds were not treated.

For Tier II seedling emergence lettuce is the most sensitive dicot and onion is the most sensitive monocot. The guideline (123-1) is partially fulfilled. (MRID 430167-02). The study can be up-graded to core status and fulfill the guideline if the study author can confirm that the seed s used for testing were not treated. However, if the seeds were treated, the results for those species are invalid.

2,4-D Isopropylamine (IPA) Salt (PC Code: 030025)

There is no valid EPA data for this active ingredient. The guideline (123-1) is not fulfilled.

2,4-D Triisopropanolamine (TIPA) (PC code: 030035)

There is no valid EPA data for this active ingredient. The guideline (123-1) is not fulfilled.

2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)

Nontarget Terrestrial Plant Seedling Emergence Toxicity (Tier II)

Species	% ai (as acid equilvalent)	EC25/EC05 (lbs ae/A) Endpoint Affected	MRID No. Author/Year	Study Classification
Monocot- Corn	65.6	>0.73 (Dry weight.) 0.05	431970-01, Narnish, W.N., 1994.	Supplemental
Monocot- Onion	65.6	0.36 (Survival) 0.22	431970-01, Narnish, W.N., 1994.	Supplemental
Monocot- Oats	65.6	0.70 (Dry weight) 0.36	431970-01, Narnish, W.N., 1994.	Supplemental
Monocot- Wheat	65.6	>0.73 (Survival) 0.36	431970-01, Narnish, W.N., 1994.	Supplemental
Dicot- Root Crop (Radish)	65.6	0.40 (Survival) 0.18	431970-01, Narnish, W.N., 1994.	Supplemental
Dicot- Soybean	65.6	>0.73 (Dry weight) 0.02	431970-01, Narnish, W.N., 1994.	Supplemental
Dicot- cucumber	65.6	>0.73 (Survival, Dry wt.) 0.73	431970-01, Narnish, W.N., 1994.	Supplemental
Dicot- Carrot	65.6	0.55 (Survival) 0.34	431970-01, Narnish, W.N., 1994.	Supplemental
Dicot- Sunflower	65.6	0.53 Dry weight) 0.01	431970-01, Narnish, W.N., 1994.	Supplemental
Dicot- Tomato	65.6	0.05 (Dry weight) 0.01	431970-01, Narnish, W.N., 1994.	Supplemental

For Tier II seedling emergence radish is the most sensitive dicot and onion is the most sensitive monocot. The guideline (123-1) is partially fulfilled.

Nontarget Terrestrial Plant Vegetative Vigor Toxicity (Tier II)

Species	% ai (as acid equilvalent)	EC25/EC05 (lbs ae/A) Endpoint Affected	MRID No. Author/Year	Study Classification
Monocot- Onion	65.6	0.19 (Dry weight.) 0.03	430671-03, Narnish, W.N., 1993.	Supplemental
Monocot- Corn	65.6	0.4 (Dry weight) >0.5	430671-03, Narnish, W.N., 1993.	Supplemental
Monocot- Oats	65.6	>0.5 (Dry weight) >0.5	430671-03, Narnish, W.N., 1993.	Supplemental
Monocot- Wheat	65.6	>0.5 (Dry weight) >0.5	430671-03, Narnish, W.N., 1993.	Supplemental
Dicot- Root Crop (Radish)	65.6	0.02 (Survival) 0.03	430671-03, Narnish, W.N., 1993.	Supplemental
Dicot- Cucumber	65.6	>0.5 (Dry weight) 0.03	430671-03, Narnish, W.N., 1993.	Supplemental
Dicot- Sunflower	65.6	0.04 (Dry weight) 0.03	430671-03, Narnish, W.N., 1993.	Supplemental
Dicot- Tomato	65.6	0.04 (Survival) 0.03	430671-03, Narnish, W.N., 1993.	Supplemental
Dicot- Carrot	65.6	0.08 Dry weight) 0.03	430671-03, Narnish, W.N., 1993.	Supplemental
Dicot- Tomato	65.6	0.05 (Dry weight) 0.01	430671-03, Narnish, W.N., 1993.	Supplemental

For Tier II vegetative vigor radish is the most sensitive dicot and onion is the most sensitive monocot. The guideline (123-1) is partially fulfilled.

2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)

Nontarget Terrestrial Plant Seedling Emergence Toxicity (Tier II)

Species	% ai (as acid equilvalent)	EC25/EC05 (lbs aei/A) Endpoint Affected	MRID No. Author/Year	Study Classification
Monocot- Corn	63.5	>0.96 (Fresh shoot wt)	424492-01, Backus, et. al., 1992.	Core
Monocot- Onion	60.7	0.218 (Fresh shoot wt)	435269-01, Backus, P., 1995.	Core
Monocot- Oats	63.5	>0.96 (Fresh shoot wt)	424492-01, Backus, et. al., 1992.	Core
Monocot- Sorghum	63.5	0.26 (Fresh shoot wt)	424492-01, Backus, et. al., 1992.	Core
Dicot- Root Crop (Radish)	63.5	0.037 (Fresh shoot wt)	424492-01, Backus, et. al., 1992.	Core
Dicot- Soybean	63.5	>0.24 (Fresh shoot wt)	424492-01, Backus, et. al., 1992.	Core
Dicot- cucumber	60.7	0.045 (Fresh shoot wt)	435269-01, Backus, P., 1995.	Core
Dicot- Mustard	63.5	0.14 (Fresh shoot wt0	424492-01, Backus, et. al., 1992.	Core
Dicot- Buckwheat	63.5	>0.48 (Fresh shoot wt)	424492-01, Backus, et. al., 1992.	Core
Dicot- Tomato	63.5	>0.96 (Fresh shoot wt)	424492-01, Backus, et. al., 1992.	Core

For Tier II seedling emergence radish is the most sensitive dicot and onion is the most sensitive monocot. The guideline (123-1) is fulfilled. (MRID 435269-01 and 424492-01).

Nontarget Terrestrial Plant Vegetative Vigor Toxicity (Tier II)

Species	% ai (as acid equivlent)	EC25/EC05 (lbs ai/A) Endpoint Affected	MRID No. Author/Year	Study Classification
Monocot- Corn	63.5	$0.96 / (Fresh weight) $0.96	423439-02, Backus, P., et. al., 1992.	Core
Monocot- Oat	63.5	$0.96 / (Fresh weight) $0.96	423439-02, Backus, P., et. al., 1992.	Core
Monocot- Onion	63.5	$0.24 / (Fresh weight) 0.24	423439-02, Backus, P., et. al., 1992.	Core
Monocot- Sorghum	63.5	0.218 / (Fresh weight) 0.06	423439-02, Backus, P., et. al., 1992.	Core
Dicot- Root Crop- Radish	63.5	0.03 / (Fresh weight) 0.015	423439-02, Backus, P., et. al., 1992.	Core
Dicot- Soybean	63.5	0.02 / (Fresh weight) 0.0075	423439-02, Backus, P., et. al., 1992.	Core
Dicot- Tomato	63.5	0.034 / (Fresh weight) 0.006	423439-02, Backus, P., et. al., 1992.	Core
Dicot-Buckwheat	63.5	0.21 / (Fresh weight) 0.015	423439-02, Backus, P., et. al., 1992.	Core
Dicot- Cucumber	63.5	0.192 / (Fresh weight) 0.015	423439-02, Backus, P., et. al., 1992.	Core
Dicot- Mustard	63.5	>0.03 / (Fresh weight) 0.03	423439-02, Backus, P., et. al., 1992.	Core

For Tier II vegetative vigor soybean is the most sensitive dicot and sorghum is the most sensitive monocot. The guideline (123-1) is fulfilled.

2,4-D Isopropyl ester (IPE) (PC code: 030066)

Nontarget Terrestrial Plant Seedling Emergence Toxicity (Tier II)

Species	% ai	EC25/EC05 (lbs ai/A) Endpoint Affected	EC25/EC05 (lbs ae/A) Endpoint Affected[1]	MRID No. Author/Year	Study Classification
Monocot- Corn					
Monocot- Onion	98.2	0.012 (Shoot length) 0.0067	0.010 (Shoot length) 0.005628	439821-01, Hoberg, J.R., 1996.	Core
Monocot- Oats	98.2	(Shoot length) 0.11	(Shoot length) 0.0924	439821-01, Hoberg, J.R., 1996.	
Monocot- Sorghum					
Dicot- Root Crop (Turnip)	98.2	(Shoot length) 0.007	(Shoot length) 0.00588	439821-01, Hoberg, J.,R., 1996.	
Dicot- Soybean	98.2	0.12 (NOEC)	0.1008 (NOEC)		
Dicot-Cabbage	98.2	0.029 (Emergence) 0.0011	0.02436 (Emergence) 0.000924	439821-01, Hoberg, J.,R., 1996.	Core
Dicot- Lettuce	98.2	0.00097 (Shoot length) 0.00056	0.00081 (Shoot length) 0.00047	439821-01, Hoberg, J.,R., 1996.	Supplemental
Dicot- Cucumber	98.2	(Shoot length) 0.028	(Shoot length) 0.02352	439821-01, Hoberg, J.,R., 1996.	
Dicot- Tomato	98.2	0.024 (Shoot length) 0.013	0.02016 (Shoot length) 0.01092	439821-01, Hoberg, J.,R., 1996.	Core

[1] Based on acid equivalent of 84% of ai

For Tier II seedling emergence lettuce is the most sensitive dicot and onion is the most sensitive monocot. The guideline (123-1) is not fulfilled due to the lack of valid data on the required number of test species.

Nontarget Terrestrial Plant Vegetative Vigor Toxicity (Tier II)

Species	% ai	EC25/EC05 (lbs ai/A) Endpoint Affected	EC25/EC05 (lbs ae/A) Endpoint Affected[1]	MRID No. Author/Year	Study Classification
Monocot- Corn	82.7	0.24 (Shoot weight) 0.03	0.2016 (Shoot weight) 0.0252	437882-01, Hoberg, J. R., 1995.	Core
Monocot- Onion					
Monocot- Ryegrass					
Monocot- Oat					
Dicot- Root Crop- Radish	82.7	0.005 (Root weight) 0.004	0.0042 (Root weight0 0.0036	437882-01, Hoberg, J. R., 1995.	Core
Dicot- Soybean					
Dicot- Cabbage	82.7	0.011 (Root weight) 0.008	0.00924 (Root weight) 0.00672	437882-01, Hoberg, J. R., 1995.	Core
Dicot- Cucumber	82.7	0.154 (Shoot weight) 0.068	0.12936 (Shoot weight) 0.05712	437882-01, Hoberg, J. R., 1995.	Core
Dicot- Tomato	82.7	0.021 (Root weight) 0.008	0.01764 (Root weight) 0.00672	437882-01, Hoberg, J. R., 1995.	Core
Dicot- Lettuce					

[1] Based on acid equivalent of 84% of ai

For Tier II vegetative vigor radish is the most sensitive dicot and corn is the most sensitive monocot. The guideline (123-1) is not fulfilled due to the lack of valid data on the required number of test species.

Nontarget Terrestrial Plant Vegetative Vigor Toxicity (Tier II)

Species	% ai	EC25/EC05 (lbs ai/A) Endpoint Affected	EC25/EC05 (lbs ae/A) Endpoint Affected[1]	MRID No. Author/Year	Study Classification
Monocot- Corn					
Monocot- Onion					
Monocot- Oats					
Monocot- Sorghum					
Dicot- Root Crop (Turnip)	98.2	0.019 (Dry weight) 0.006	0.01596 (Dry weight) 0.00504	439821-01, Hoberg, J.,R., 1996.	Supplemental
Dicot- Soybean	98.2	0.12 (NOEC)	0.1008 NOEC		
Dicot-Cabbage	98.2	0.013 (Dry weight) 0.003	0.01092 (Dry weight) 0.00252	439821-01, Hoberg, J.,R., 1996.	Supplemental
Dicot- Lettuce	98.2	0.0015 (Dry weight) 0.0073	0.00126 (Dry weight) 0.006132	439821-01, Hoberg, J.,R., 1996.	Supplemental
Dicot- Buckwheat	98.2				
Dicot- Tomato	98.2	0.048 (Dry weight) 0.031	0.04032 (Dry weight) 0.02604	439821-01, Hoberg, J.,R., 1996.	Supplemental

[1] Based on acid equivalent of 84% of ai

For Tier II vegetative vigor corn is the most sensitive monocot. The guideline (123-1) is not fulfilled due to the lack of valid data on the required number of test species.

APPENDIX D: PRZM/EXAMS Input & Output Files for Ecological Assessment

```
Fl Sugarcane; 8/10/2001
"Hendry County;  MLRA 156A; Metfile: W12844.dvf (old: Met156A.met),"
*** Record 3:
    0.78       0       0      33       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
     0.1   0.093       1      10               4       1     354
*** Record 8
       1
*** Record 9
       1     0.1     100     100       3  94  91  92       0     300
*** Record 9a-d
       1      25
0101 1601 0102 1602 0103 1603 0104 1604 2504 0105 1605 0106 1606 0107 1607 0108
.194 .215 .240 .268 .300 .334 .358 .584 .638 .673 .675 .666 .662 .650 .631 .636
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
1608 0109 1609 0110 1610 0111 1611 0112 1612
.659 .680 .699 .717 .699 .669 .624 .551 .468
.014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  020161  010661  151261       1
  020162  010662  151262       1
  020163  010663  151263       1
  020164  010664  151264       1
  020165  010665  151265       1
  020166  010666  151266       1
  020167  010667  151267       1
  020168  010668  151268       1
  020169  010669  151269       1
  020170  010670  151270       1
  020171  010671  151271       1
  020172  010672  151272       1
  020173  010673  151273       1
  020174  010674  151274       1
  020175  010675  151275       1
  020176  010676  151276       1
  020177  010677  151277       1
  020178  010678  151278       1
  020179  010679  151279       1
  020180  010680  151280       1
  020181  010681  151281       1
  020182  010682  151282       1
  020183  010683  151283       1
  020184  010684  151284       1
  020185  010685  151285       1
  020186  010686  151286       1
  020187  010687  151287       1
  020188  010688  151288       1
  020189  010689  151289       1
  020190  010690  151290       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 2.24 kg/ha
*** Record 13
      60       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  010161  0 2  0.0  2.24 0.95 0.05
  010461  0 2  0.0  2.24 0.95 0.05
  010162  0 2  0.0  2.24 0.95 0.05
  010462  0 2  0.0  2.24 0.95 0.05
  010163  0 2  0.0  2.24 0.95 0.05
  010463  0 2  0.0  2.24 0.95 0.05
  010164  0 2  0.0  2.24 0.95 0.05
  010464  0 2  0.0  2.24 0.95 0.05
  010165  0 2  0.0  2.24 0.95 0.05
  010465  0 2  0.0  2.24 0.95 0.05
  010166  0 2  0.0  2.24 0.95 0.05
  010466  0 2  0.0  2.24 0.95 0.05
  010167  0 2  0.0  2.24 0.95 0.05
  010467  0 2  0.0  2.24 0.95 0.05
  010168  0 2  0.0  2.24 0.95 0.05
  010468  0 2  0.0  2.24 0.95 0.05
  010169  0 2  0.0  2.24 0.95 0.05
  010469  0 2  0.0  2.24 0.95 0.05
  010170  0 2  0.0  2.24 0.95 0.05
  010470  0 2  0.0  2.24 0.95 0.05
  010171  0 2  0.0  2.24 0.95 0.05
  010471  0 2  0.0  2.24 0.95 0.05
  010172  0 2  0.0  2.24 0.95 0.05
  010472  0 2  0.0  2.24 0.95 0.05
  010173  0 2  0.0  2.24 0.95 0.05
  010473  0 2  0.0  2.24 0.95 0.05
  010174  0 2  0.0  2.24 0.95 0.05
  010474  0 2  0.0  2.24 0.95 0.05
  010175  0 2  0.0  2.24 0.95 0.05
  010475  0 2  0.0  2.24 0.95 0.05
  010176  0 2  0.0  2.24 0.95 0.05
  010476  0 2  0.0  2.24 0.95 0.05
  010177  0 2  0.0  2.24 0.95 0.05
  010477  0 2  0.0  2.24 0.95 0.05
  010178  0 2  0.0  2.24 0.95 0.05
  010478  0 2  0.0  2.24 0.95 0.05
  010179  0 2  0.0  2.24 0.95 0.05
  010479  0 2  0.0  2.24 0.95 0.05
  010180  0 2  0.0  2.24 0.95 0.05
  010480  0 2  0.0  2.24 0.95 0.05
  010181  0 2  0.0  2.24 0.95 0.05
  010481  0 2  0.0  2.24 0.95 0.05
  010182  0 2  0.0  2.24 0.95 0.05
  010482  0 2  0.0  2.24 0.95 0.05
  010183  0 2  0.0  2.24 0.95 0.05
  010483  0 2  0.0  2.24 0.95 0.05
  010184  0 2  0.0  2.24 0.95 0.05
  010484  0 2  0.0  2.24 0.95 0.05
  010185  0 2  0.0  2.24 0.95 0.05
  010485  0 2  0.0  2.24 0.95 0.05
  010186  0 2  0.0  2.24 0.95 0.05
  010486  0 2  0.0  2.24 0.95 0.05
  010187  0 2  0.0  2.24 0.95 0.05
  010487  0 2  0.0  2.24 0.95 0.05
  010188  0 2  0.0  2.24 0.95 0.05
  010488  0 2  0.0  2.24 0.95 0.05
  010189  0 2  0.0  2.24 0.95 0.05
  010489  0 2  0.0  2.24 0.95 0.05
```

```
  010190  0 2  0.0  2.24 0.95 0.05
  010490  0 2  0.0  2.24 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
Wabasso Fine Sand;  HYDG: D
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       2
       1      10    1.45   0.066       0       0       0
        0.1117980.111798       0
             0.1   0.066   0.036    2.32       0
       2      90    1.75   0.178       0       0       0
        0.1117980.111798       0
               5   0.178   0.078    0.29       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
FL Turf 8/09/2001
Osceola County; Representation of the Lake Kissimmee/Indian River Region; MLRA
156A; Metfile: W12834.dvf [Daytona Beach] (old: Met156A.met)
*** Record 3:
    0.78       0       0      25       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.04   0.303       1      10               4       2     354
*** Record 8
       1
*** Record 9
       1     0.1      10     100       3  74  74  74       0       5
*** Record 9a-d
       1      25
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1507 1607 0108
.023 .026 .030 .035 .042 .050 .056 .060 .063 .068 .074 .079 .082 .125 .148 .189
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
1608 0109 1609 0110 1610 0111 1611 0112 1612
.229 .265 .294 .314 .326 .017 .018 .019 .021
.023 .023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  010261  150261  151261       1
  010262  150262  151262       1
  010263  150263  151263       1
  010264  150264  151264       1
  010265  150265  151265       1
  010266  150266  151266       1
  010267  150267  151267       1
  010268  150268  151268       1
  010269  150269  151269       1
  010270  150270  151270       1
  010271  150271  151271       1
  010272  150272  151272       1
  010273  150273  151273       1
  010274  150274  151274       1
  010275  150275  151275       1
  010276  150276  151276       1
  010277  150277  151277       1
  010278  150278  151278       1
  010279  150279  151279       1
  010280  150280  151280       1
  010281  150281  151281       1
  010282  150282  151282       1
  010283  150283  151283       1
  010284  150284  151284       1
  010285  150285  151285       1
  010286  150286  151286       1
  010287  150287  151287       1
  010288  150288  151288       1
  010289  150289  151289       1
  010290  150290  151290       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 2.24 kg/ha
*** Record 13
      60       1       0       0
*** Record 15 -- PSTNAM
```

```
2,4-D
*** Record 16
  010461  0 2  0.0  2.24 0.95 0.05
  280961  0 2  0.0  2.24 0.95 0.05
  010462  0 2  0.0  2.24 0.95 0.05
  280962  0 2  0.0  2.24 0.95 0.05
  010463  0 2  0.0  2.24 0.95 0.05
  280963  0 2  0.0  2.24 0.95 0.05
  010464  0 2  0.0  2.24 0.95 0.05
  280964  0 2  0.0  2.24 0.95 0.05
  010465  0 2  0.0  2.24 0.95 0.05
  280965  0 2  0.0  2.24 0.95 0.05
  010466  0 2  0.0  2.24 0.95 0.05
  280966  0 2  0.0  2.24 0.95 0.05
  010467  0 2  0.0  2.24 0.95 0.05
  280967  0 2  0.0  2.24 0.95 0.05
  010468  0 2  0.0  2.24 0.95 0.05
  280968  0 2  0.0  2.24 0.95 0.05
  010469  0 2  0.0  2.24 0.95 0.05
  280969  0 2  0.0  2.24 0.95 0.05
  010470  0 2  0.0  2.24 0.95 0.05
  280970  0 2  0.0  2.24 0.95 0.05
  010471  0 2  0.0  2.24 0.95 0.05
  280971  0 2  0.0  2.24 0.95 0.05
  010472  0 2  0.0  2.24 0.95 0.05
  280972  0 2  0.0  2.24 0.95 0.05
  010473  0 2  0.0  2.24 0.95 0.05
  280973  0 2  0.0  2.24 0.95 0.05
  010474  0 2  0.0  2.24 0.95 0.05
  280974  0 2  0.0  2.24 0.95 0.05
  010475  0 2  0.0  2.24 0.95 0.05
  280975  0 2  0.0  2.24 0.95 0.05
  010476  0 2  0.0  2.24 0.95 0.05
  280976  0 2  0.0  2.24 0.95 0.05
  010477  0 2  0.0  2.24 0.95 0.05
  280977  0 2  0.0  2.24 0.95 0.05
  010478  0 2  0.0  2.24 0.95 0.05
  280978  0 2  0.0  2.24 0.95 0.05
  010479  0 2  0.0  2.24 0.95 0.05
  280979  0 2  0.0  2.24 0.95 0.05
  010480  0 2  0.0  2.24 0.95 0.05
  280980  0 2  0.0  2.24 0.95 0.05
  010481  0 2  0.0  2.24 0.95 0.05
  280981  0 2  0.0  2.24 0.95 0.05
  010482  0 2  0.0  2.24 0.95 0.05
  280982  0 2  0.0  2.24 0.95 0.05
  010483  0 2  0.0  2.24 0.95 0.05
  280983  0 2  0.0  2.24 0.95 0.05
  010484  0 2  0.0  2.24 0.95 0.05
  280984  0 2  0.0  2.24 0.95 0.05
  010485  0 2  0.0  2.24 0.95 0.05
  280985  0 2  0.0  2.24 0.95 0.05
  010486  0 2  0.0  2.24 0.95 0.05
  280986  0 2  0.0  2.24 0.95 0.05
  010487  0 2  0.0  2.24 0.95 0.05
  280987  0 2  0.0  2.24 0.95 0.05
  010488  0 2  0.0  2.24 0.95 0.05
  280988  0 2  0.0  2.24 0.95 0.05
  010489  0 2  0.0  2.24 0.95 0.05
```

```
  280989  0 2  0.0  2.24 0.95 0.05
  010490  0 2  0.0  2.24 0.95 0.05
  280990  0 2  0.0  2.24 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
Adamsville Sand; Hydrologic Group C
*** Record 20
     102           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       4
       1       2    0.37    0.47       0       0       0
        0.1117980.111798       0
             0.1    0.47    0.27     7.5       0
       2      10    1.44   0.086       0       0       0
        0.1117980.111798       0
             0.1   0.086   0.036    0.58       0
       3      10    1.44   0.086       0       0       0
        0.1117980.111798       0
             0.1   0.086   0.036    0.58       0
       4      80    1.58    0.03       0       0       0
        0.1117980.111798       0
               5    0.03   0.023   0.116       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
PA Turf; 9/28/01
"York Co, MLRA 148; Metfile: W14737.dvf (old: Met148.met),
*** Record 3:
    0.76     0.3       0    12.5       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.33   0.123       1      10               3      12     354
*** Record 8
       1
*** Record 9
       1     0.1      10     100       3  74  74  74       0       5
*** Record 9a-d
       1      26
0101 1601 0102 1602 0103 1503 1603 0104 1604 0105 1605 0106 1506 1606 0107 1607
.015 .015 .015 .015 .015 .017 .012 .006 .002 .007 .004 .002 .007 .005 .003 .001
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.005 .003 .003 .005 .009 .013 .013 .014 .014 .015
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  010461  150461  011161       1
  010462  150462  011162       1
  010463  150463  011163       1
  010464  150464  011164       1
  010465  150465  011165       1
  010466  150466  011166       1
  010467  150467  011167       1
  010468  150468  011168       1
  010469  150469  011169       1
  010470  150470  011170       1
  010471  150471  011171       1
  010472  150472  011172       1
  010473  150473  011173       1
  010474  150474  011174       1
  010475  150475  011175       1
  010476  150476  011176       1
  010477  150477  011177       1
  010478  150478  011178       1
  010479  150479  011179       1
  010480  150480  011180       1
  010481  150481  011181       1
  010482  150482  011182       1
  010483  150483  011183       1
  010484  150484  011184       1
  010485  150485  011185       1
  010486  150486  011186       1
  010487  150487  011187       1
  010488  150488  011188       1
  010489  150489  011189       1
  010490  150490  011190       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 2.24 kg/ha
*** Record 13
      60       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  010561  0 2  0.0  2.24 0.99 0.01
  290861  0 2  0.0  2.24 0.99 0.01
  010562  0 2  0.0  2.24 0.99 0.01
  290862  0 2  0.0  2.24 0.99 0.01
  010563  0 2  0.0  2.24 0.99 0.01
  290863  0 2  0.0  2.24 0.99 0.01
  010564  0 2  0.0  2.24 0.99 0.01
  290864  0 2  0.0  2.24 0.99 0.01
  010565  0 2  0.0  2.24 0.99 0.01
  290865  0 2  0.0  2.24 0.99 0.01
  010566  0 2  0.0  2.24 0.99 0.01
  290866  0 2  0.0  2.24 0.99 0.01
  010567  0 2  0.0  2.24 0.99 0.01
  290867  0 2  0.0  2.24 0.99 0.01
  010568  0 2  0.0  2.24 0.99 0.01
  290868  0 2  0.0  2.24 0.99 0.01
  010569  0 2  0.0  2.24 0.99 0.01
  290869  0 2  0.0  2.24 0.99 0.01
  010570  0 2  0.0  2.24 0.99 0.01
  290870  0 2  0.0  2.24 0.99 0.01
  010571  0 2  0.0  2.24 0.99 0.01
  290871  0 2  0.0  2.24 0.99 0.01
  010572  0 2  0.0  2.24 0.99 0.01
  290872  0 2  0.0  2.24 0.99 0.01
  010573  0 2  0.0  2.24 0.99 0.01
  290873  0 2  0.0  2.24 0.99 0.01
  010574  0 2  0.0  2.24 0.99 0.01
  290874  0 2  0.0  2.24 0.99 0.01
  010575  0 2  0.0  2.24 0.99 0.01
  290875  0 2  0.0  2.24 0.99 0.01
  010576  0 2  0.0  2.24 0.99 0.01
  290876  0 2  0.0  2.24 0.99 0.01
  010577  0 2  0.0  2.24 0.99 0.01
  290877  0 2  0.0  2.24 0.99 0.01
  010578  0 2  0.0  2.24 0.99 0.01
  290878  0 2  0.0  2.24 0.99 0.01
  010579  0 2  0.0  2.24 0.99 0.01
  290879  0 2  0.0  2.24 0.99 0.01
  010580  0 2  0.0  2.24 0.99 0.01
  290880  0 2  0.0  2.24 0.99 0.01
  010581  0 2  0.0  2.24 0.99 0.01
  290881  0 2  0.0  2.24 0.99 0.01
  010582  0 2  0.0  2.24 0.99 0.01
  290882  0 2  0.0  2.24 0.99 0.01
  010583  0 2  0.0  2.24 0.99 0.01
  290883  0 2  0.0  2.24 0.99 0.01
  010584  0 2  0.0  2.24 0.99 0.01
  290884  0 2  0.0  2.24 0.99 0.01
  010585  0 2  0.0  2.24 0.99 0.01
  290885  0 2  0.0  2.24 0.99 0.01
  010586  0 2  0.0  2.24 0.99 0.01
  290886  0 2  0.0  2.24 0.99 0.01
  010587  0 2  0.0  2.24 0.99 0.01
  290887  0 2  0.0  2.24 0.99 0.01
  010588  0 2  0.0  2.24 0.99 0.01
  290888  0 2  0.0  2.24 0.99 0.01
  010589  0 2  0.0  2.24 0.99 0.01
  290889  0 2  0.0  2.24 0.99 0.01
```

```
  010590  0 2  0.0  2.24 0.99 0.01
  290890  0 2  0.0  2.24 0.99 0.01
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
"Glenville, Silt Loam, HYDG: C"
*** Record 20
     102           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       4
       1       2    0.37    0.47       0       0       0
        0.1117980.111798       0
             0.1    0.47    0.27     7.5       0
       2      10     1.4   0.254       0       0       0
        0.1117980.111798       0
             0.1   0.254   0.094    1.74       0
       3      12     1.4   0.254       0       0       0
        0.1117980.111798       0
              2   0.254   0.094    1.74       0
       4      78     1.8   0.201       0       0       0
        0.1117980.111798       0
              2   0.201   0.121   0.174       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
North Dakota Spring Wheat MLRA F56 Cass County Bearden silty clay loam
"Red River Valley of the North MLRA 56 MN, ND, SD 1948-1983; Metfile:
W14914.dvf (old: Met56.met),
*** Record 3:
    0.75     0.5       0      12       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.28    0.17       1      10               3     1.5     354
*** Record 8
       1
*** Record 9
       1     0.1      22     100       1  91  85  87       0     100
*** Record 9a-d
       1      28
0101 1601 0102 1602 0103 1603 0104 1604 2004 0105 0505 1605 0106 1606 0107 1607
.583 .581 .579 .577 .574 .574 .575 .575 .611 .617 .610 .562 .468 .268 .092 .064
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
0108 0508 1008 1608 0109 1609 0110 1610 0111 1611 0112 1612
.065 .036 .098 .110 .126 .139 .152 .162 .168 .170 .171 .171
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  150561  250761  050861       1
  150562  250762  050862       1
  150563  250763  050863       1
  150564  250764  050864       1
  150565  250765  050865       1
  150566  250766  050866       1
  150567  250767  050867       1
  150568  250768  050868       1
  150569  250769  050869       1
  150570  250770  050870       1
  150571  250771  050871       1
  150572  250772  050872       1
  150573  250773  050873       1
  150574  250774  050874       1
  150575  250775  050875       1
  150576  250776  050876       1
  150577  250777  050877       1
  150578  250778  050878       1
  150579  250779  050879       1
  150580  250780  050880       1
  150581  250781  050881       1
  150582  250782  050882       1
  150583  250783  050883       1
  150584  250784  050884       1
  150585  250785  050885       1
  150586  250786  050886       1
  150587  250787  050887       1
  150588  250788  050888       1
  150589  250789  050889       1
  150590  250790  050890       1
*** Record 12 -- PTITLE
2,4-D - 1 applications @ 1.60 kg/ha
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
```

```
2,4-D
*** Record 16
  010661  0 2  0.0   1.6 0.95 0.05
  010662  0 2  0.0   1.6 0.95 0.05
  010663  0 2  0.0   1.6 0.95 0.05
  010664  0 2  0.0   1.6 0.95 0.05
  010665  0 2  0.0   1.6 0.95 0.05
  010666  0 2  0.0   1.6 0.95 0.05
  010667  0 2  0.0   1.6 0.95 0.05
  010668  0 2  0.0   1.6 0.95 0.05
  010669  0 2  0.0   1.6 0.95 0.05
  010670  0 2  0.0   1.6 0.95 0.05
  010671  0 2  0.0   1.6 0.95 0.05
  010672  0 2  0.0   1.6 0.95 0.05
  010673  0 2  0.0   1.6 0.95 0.05
  010674  0 2  0.0   1.6 0.95 0.05
  010675  0 2  0.0   1.6 0.95 0.05
  010676  0 2  0.0   1.6 0.95 0.05
  010677  0 2  0.0   1.6 0.95 0.05
  010678  0 2  0.0   1.6 0.95 0.05
  010679  0 2  0.0   1.6 0.95 0.05
  010680  0 2  0.0   1.6 0.95 0.05
  010681  0 2  0.0   1.6 0.95 0.05
  010682  0 2  0.0   1.6 0.95 0.05
  010683  0 2  0.0   1.6 0.95 0.05
  010684  0 2  0.0   1.6 0.95 0.05
  010685  0 2  0.0   1.6 0.95 0.05
  010686  0 2  0.0   1.6 0.95 0.05
  010687  0 2  0.0   1.6 0.95 0.05
  010688  0 2  0.0   1.6 0.95 0.05
  010689  0 2  0.0   1.6 0.95 0.05
  010690  0 2  0.0   1.6 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
Bearden silty clay loam; HTDG: C
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       3
       1      10     1.4   0.377       0       0       0
        0.1117980.111798       0
             0.1   0.377   0.207    1.74       0
       2      52     1.5   0.292       0       0       0
        0.1117980.111798       0
               1   0.292   0.132   0.116       0
       3      38     1.8   0.285       0       0       0
        0.1117980.111798       0
               2   0.285   0.125   0.058       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
```

```
   1  -----
   7    YEAR
PRCP    TCUM   0   0
RUNF    TCUM   0   0
INFL    TCUM   1   1
ESLS    TCUM   0   0  1.0E3
RFLX    TCUM   0   0  1.0E5
EFLX    TCUM   0   0  1.0E5
RZFX    TCUM   0   0  1.0E5
```

```
OR Wheat; 8/07/2001
"Willamette Valley; MLRA 2; Metfile: W24232.dvf (old: Met2.met),"
*** Record 3:
    0.74    0.36       0      17       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.13    1.34       1      10               2       6     354
*** Record 8
       1
*** Record 9
       1     0.1      23     100       1  92  86  87       0     100
*** Record 9a-d
       1      27
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1507 1607 0108
.226 .240 .254 .259 .265 .262 .224 .154 .101 .089 .091 .092 .092 .017 .017 .051
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
1008 1508 1608 0109 1609 0110 1610 0111 1611 0112 1612
.154 .223 .228 .231 .220 .210 .230 .267 .302 .323 .336
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  010961  100361  010761       1
  010962  100362  010762       1
  010963  100363  010763       1
  010964  100364  010764       1
  010965  100365  010765       1
  010966  100366  010766       1
  010967  100367  010767       1
  010968  100368  010768       1
  010969  100369  010769       1
  010970  100370  010770       1
  010971  100371  010771       1
  010972  100372  010772       1
  010973  100373  010773       1
  010974  100374  010774       1
  010975  100375  010775       1
  010976  100376  010776       1
  010977  100377  010777       1
  010978  100378  010778       1
  010979  100379  010779       1
  010980  100380  010780       1
  010981  100381  010781       1
  010982  100382  010782       1
  010983  100383  010783       1
  010984  100384  010784       1
  010985  100385  010785       1
  010986  100386  010786       1
  010987  100387  010787       1
  010988  100388  010788       1
  010989  100389  010789       1
  010990  100390  010790       1
*** Record 12 -- PTITLE
2,4-D - 1 applications @ 1.60 kg/ha
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  010461  0 2  0.0   1.6 0.95 0.05
  010462  0 2  0.0   1.6 0.95 0.05
  010463  0 2  0.0   1.6 0.95 0.05
  010464  0 2  0.0   1.6 0.95 0.05
  010465  0 2  0.0   1.6 0.95 0.05
  010466  0 2  0.0   1.6 0.95 0.05
  010467  0 2  0.0   1.6 0.95 0.05
  010468  0 2  0.0   1.6 0.95 0.05
  010469  0 2  0.0   1.6 0.95 0.05
  010470  0 2  0.0   1.6 0.95 0.05
  010471  0 2  0.0   1.6 0.95 0.05
  010472  0 2  0.0   1.6 0.95 0.05
  010473  0 2  0.0   1.6 0.95 0.05
  010474  0 2  0.0   1.6 0.95 0.05
  010475  0 2  0.0   1.6 0.95 0.05
  010476  0 2  0.0   1.6 0.95 0.05
  010477  0 2  0.0   1.6 0.95 0.05
  010478  0 2  0.0   1.6 0.95 0.05
  010479  0 2  0.0   1.6 0.95 0.05
  010480  0 2  0.0   1.6 0.95 0.05
  010481  0 2  0.0   1.6 0.95 0.05
  010482  0 2  0.0   1.6 0.95 0.05
  010483  0 2  0.0   1.6 0.95 0.05
  010484  0 2  0.0   1.6 0.95 0.05
  010485  0 2  0.0   1.6 0.95 0.05
  010486  0 2  0.0   1.6 0.95 0.05
  010487  0 2  0.0   1.6 0.95 0.05
  010488  0 2  0.0   1.6 0.95 0.05
  010489  0 2  0.0   1.6 0.95 0.05
  010490  0 2  0.0   1.6 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
Bashaw Clay; HYDG: D
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       3
       1      10     1.3   0.487       0       0       0
        0.1117980.111798       0
             0.1   0.487   0.347    4.64       0
       2      26     1.3   0.487       0       0       0
        0.1117980.111798       0
               2   0.487   0.347    4.64       0
       3      64     1.3   0.441       0       0       0
        0.1117980.111798       0
               2   0.441   0.301    0.29       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
```

```
   7    YEAR
PRCP    TCUM   0   0
RUNF    TCUM   0   0
INFL    TCUM   1   1
ESLS    TCUM   0   0  1.0E3
RFLX    TCUM   0   0  1.0E5
EFLX    TCUM   0   0  1.0E5
RZFX    TCUM   0   0  1.0E5
```

```
"IL Corn; created August 7, 2001"
"McLean County, Illinois - MLRA 108; Metfile: W14923.dvf (old: Met108.met),
*** Record 3:
    0.77    0.36       0      16       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.32   1.126       1      10               3       6     354
*** Record 8
       1
*** Record 9
       1    0.25      90     100       3  91  87  88       0     100
*** Record 9a-d
       1      28
0101 1601 0102 1602 0103 1603 0104 1504 1604 2504 0105 1605 0106 1606 2506 0107
.278 .285 .292 .301 .316 .345 .382 .538 .555 .618 .638 .609 .436 .252 .162 .128
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
1607 0108 1608 0109 1609 0110 1610 2010 0111 1611 0112 1612
.119 .123 .125 .126 .127 .173 .195 .017 .048 .058 .066 .072
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  010561  210961  201061       1
  010562  210962  201062       1
  010563  210963  201063       1
  010564  210964  201064       1
  010565  210965  201065       1
  010566  210966  201066       1
  010567  210967  201067       1
  010568  210968  201068       1
  010569  210969  201069       1
  010570  210970  201070       1
  010571  210971  201071       1
  010572  210972  201072       1
  010573  210973  201073       1
  010574  210974  201074       1
  010575  210975  201075       1
  010576  210976  201076       1
  010577  210977  201077       1
  010578  210978  201078       1
  010579  210979  201079       1
  010580  210980  201080       1
  010581  210981  201081       1
  010582  210982  201082       1
  010583  210983  201083       1
  010584  210984  201084       1
  010585  210985  201085       1
  010586  210986  201086       1
  010587  210987  201087       1
  010588  210988  201088       1
  010589  210989  201089       1
  010590  210990  201090       1
*** Record 12 -- PTITLE
2,4-D - 3 applications @ 1.12 kg/ha
*** Record 13
      90       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  150461  0 2  0.0  1.12 0.95 0.05
  300561  0 2  0.0  1.12 0.95 0.05
  270961  0 2  0.0  1.12 0.95 0.05
  150462  0 2  0.0  1.12 0.95 0.05
  300562  0 2  0.0  1.12 0.95 0.05
  270962  0 2  0.0  1.12 0.95 0.05
  150463  0 2  0.0  1.12 0.95 0.05
  300563  0 2  0.0  1.12 0.95 0.05
  270963  0 2  0.0  1.12 0.95 0.05
  150464  0 2  0.0  1.12 0.95 0.05
  300564  0 2  0.0  1.12 0.95 0.05
  270964  0 2  0.0  1.12 0.95 0.05
  150465  0 2  0.0  1.12 0.95 0.05
  300565  0 2  0.0  1.12 0.95 0.05
  270965  0 2  0.0  1.12 0.95 0.05
  150466  0 2  0.0  1.12 0.95 0.05
  300566  0 2  0.0  1.12 0.95 0.05
  270966  0 2  0.0  1.12 0.95 0.05
  150467  0 2  0.0  1.12 0.95 0.05
  300567  0 2  0.0  1.12 0.95 0.05
  270967  0 2  0.0  1.12 0.95 0.05
  150468  0 2  0.0  1.12 0.95 0.05
  300568  0 2  0.0  1.12 0.95 0.05
  270968  0 2  0.0  1.12 0.95 0.05
  150469  0 2  0.0  1.12 0.95 0.05
  300569  0 2  0.0  1.12 0.95 0.05
  270969  0 2  0.0  1.12 0.95 0.05
  150470  0 2  0.0  1.12 0.95 0.05
  300570  0 2  0.0  1.12 0.95 0.05
  270970  0 2  0.0  1.12 0.95 0.05
  150471  0 2  0.0  1.12 0.95 0.05
  300571  0 2  0.0  1.12 0.95 0.05
  270971  0 2  0.0  1.12 0.95 0.05
  150472  0 2  0.0  1.12 0.95 0.05
  300572  0 2  0.0  1.12 0.95 0.05
  270972  0 2  0.0  1.12 0.95 0.05
  150473  0 2  0.0  1.12 0.95 0.05
  300573  0 2  0.0  1.12 0.95 0.05
  270973  0 2  0.0  1.12 0.95 0.05
  150474  0 2  0.0  1.12 0.95 0.05
  300574  0 2  0.0  1.12 0.95 0.05
  270974  0 2  0.0  1.12 0.95 0.05
  150475  0 2  0.0  1.12 0.95 0.05
  300575  0 2  0.0  1.12 0.95 0.05
  270975  0 2  0.0  1.12 0.95 0.05
  150476  0 2  0.0  1.12 0.95 0.05
  300576  0 2  0.0  1.12 0.95 0.05
  270976  0 2  0.0  1.12 0.95 0.05
  150477  0 2  0.0  1.12 0.95 0.05
  300577  0 2  0.0  1.12 0.95 0.05
  270977  0 2  0.0  1.12 0.95 0.05
  150478  0 2  0.0  1.12 0.95 0.05
  300578  0 2  0.0  1.12 0.95 0.05
  270978  0 2  0.0  1.12 0.95 0.05
  150479  0 2  0.0  1.12 0.95 0.05
  300579  0 2  0.0  1.12 0.95 0.05
  270979  0 2  0.0  1.12 0.95 0.05
  150480  0 2  0.0  1.12 0.95 0.05
```

```
  300580  0 2  0.0  1.12 0.95 0.05
  270980  0 2  0.0  1.12 0.95 0.05
  150481  0 2  0.0  1.12 0.95 0.05
  300581  0 2  0.0  1.12 0.95 0.05
  270981  0 2  0.0  1.12 0.95 0.05
  150482  0 2  0.0  1.12 0.95 0.05
  300582  0 2  0.0  1.12 0.95 0.05
  270982  0 2  0.0  1.12 0.95 0.05
  150483  0 2  0.0  1.12 0.95 0.05
  300583  0 2  0.0  1.12 0.95 0.05
  270983  0 2  0.0  1.12 0.95 0.05
  150484  0 2  0.0  1.12 0.95 0.05
  300584  0 2  0.0  1.12 0.95 0.05
  270984  0 2  0.0  1.12 0.95 0.05
  150485  0 2  0.0  1.12 0.95 0.05
  300585  0 2  0.0  1.12 0.95 0.05
  270985  0 2  0.0  1.12 0.95 0.05
  150486  0 2  0.0  1.12 0.95 0.05
  300586  0 2  0.0  1.12 0.95 0.05
  270986  0 2  0.0  1.12 0.95 0.05
  150487  0 2  0.0  1.12 0.95 0.05
  300587  0 2  0.0  1.12 0.95 0.05
  270987  0 2  0.0  1.12 0.95 0.05
  150488  0 2  0.0  1.12 0.95 0.05
  300588  0 2  0.0  1.12 0.95 0.05
  270988  0 2  0.0  1.12 0.95 0.05
  150489  0 2  0.0  1.12 0.95 0.05
  300589  0 2  0.0  1.12 0.95 0.05
  270989  0 2  0.0  1.12 0.95 0.05
  150490  0 2  0.0  1.12 0.95 0.05
  300590  0 2  0.0  1.12 0.95 0.05
  270990  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
"Adair Clay Loam - Hydg. C (Selected in conversation with Roger Winhorn, USDA-
NRCS McLean County Field Office)"
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       4
       1      10    1.45   0.355       0       0       0
        0.1117980.111798       0
             0.1   0.355   0.185    2.32       0
       2      34     1.5   0.355       0       0       0
        0.1117980.111798       0
             6.8   0.355   0.185    2.32       0
       3      44     1.6   0.338       0       0       0
        0.1117980.111798       0
             11   0.338   0.208   0.174       0
       4      12     1.7   0.307       0       0       0
        0.1117980.111798       0
             12   0.307   0.167   0.116       0
```

```
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
CAcorn.inp
"California field corn, MLRA 17 Stanislaus/San Joaquin Counties; Metfile:
W23232.dvf (old: Met18.met or Met17.met),
*** Record 3:
    0.73    0.45       0      15       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.34    0.79       1      10               1     4.5     354
*** Record 8
       1
*** Record 9
       1    0.25      90     100       3  89  86  87       0     300
*** Record 9a-d
       1      25
0101 1601 0102 0502 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108
.316 .352 .376 .537 .565 .611 .575 .418 .235 .133 .107 .109 .109 .108 .127 .176
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
1608 0109 1609 0110 1610 0111 1611 0112 1612
.018 .018 .018 .019 .051 .064 .080 .097 .113
.023 .023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  080461  270761  080961       1
  080462  270762  080962       1
  080463  270763  080963       1
  080464  270764  080964       1
  080465  270765  080965       1
  080466  270766  080966       1
  080467  270767  080967       1
  080468  270768  080968       1
  080469  270769  080969       1
  080470  270770  080970       1
  080471  270771  080971       1
  080472  270772  080972       1
  080473  270773  080973       1
  080474  270774  080974       1
  080475  270775  080975       1
  080476  270776  080976       1
  080477  270777  080977       1
  080478  270778  080978       1
  080479  270779  080979       1
  080480  270780  080980       1
  080481  270781  080981       1
  080482  270782  080982       1
  080483  270783  080983       1
  080484  270784  080984       1
  080485  270785  080985       1
  080486  270786  080986       1
  080487  270787  080987       1
  080488  270788  080988       1
  080489  270789  080989       1
  080490  270790  080990       1
*** Record 12 -- PTITLE
2,4-D - 3 applications @ 1.12 kg/ha
*** Record 13
      90       1       0       0
*** Record 15 -- PSTNAM
```

```
2,4-D
*** Record 16
  150361  0 2  0.0  1.12 0.95 0.05
  290461  0 2  0.0  1.12 0.95 0.05
  270861  0 2  0.0  1.12 0.95 0.05
  150362  0 2  0.0  1.12 0.95 0.05
  290462  0 2  0.0  1.12 0.95 0.05
  270862  0 2  0.0  1.12 0.95 0.05
  150363  0 2  0.0  1.12 0.95 0.05
  290463  0 2  0.0  1.12 0.95 0.05
  270863  0 2  0.0  1.12 0.95 0.05
  150364  0 2  0.0  1.12 0.95 0.05
  290464  0 2  0.0  1.12 0.95 0.05
  270864  0 2  0.0  1.12 0.95 0.05
  150365  0 2  0.0  1.12 0.95 0.05
  290465  0 2  0.0  1.12 0.95 0.05
  270865  0 2  0.0  1.12 0.95 0.05
  150366  0 2  0.0  1.12 0.95 0.05
  290466  0 2  0.0  1.12 0.95 0.05
  270866  0 2  0.0  1.12 0.95 0.05
  150367  0 2  0.0  1.12 0.95 0.05
  290467  0 2  0.0  1.12 0.95 0.05
  270867  0 2  0.0  1.12 0.95 0.05
  150368  0 2  0.0  1.12 0.95 0.05
  290468  0 2  0.0  1.12 0.95 0.05
  270868  0 2  0.0  1.12 0.95 0.05
  150369  0 2  0.0  1.12 0.95 0.05
  290469  0 2  0.0  1.12 0.95 0.05
  270869  0 2  0.0  1.12 0.95 0.05
  150370  0 2  0.0  1.12 0.95 0.05
  290470  0 2  0.0  1.12 0.95 0.05
  270870  0 2  0.0  1.12 0.95 0.05
  150371  0 2  0.0  1.12 0.95 0.05
  290471  0 2  0.0  1.12 0.95 0.05
  270871  0 2  0.0  1.12 0.95 0.05
  150372  0 2  0.0  1.12 0.95 0.05
  290472  0 2  0.0  1.12 0.95 0.05
  270872  0 2  0.0  1.12 0.95 0.05
  150373  0 2  0.0  1.12 0.95 0.05
  290473  0 2  0.0  1.12 0.95 0.05
  270873  0 2  0.0  1.12 0.95 0.05
  150374  0 2  0.0  1.12 0.95 0.05
  290474  0 2  0.0  1.12 0.95 0.05
  270874  0 2  0.0  1.12 0.95 0.05
  150375  0 2  0.0  1.12 0.95 0.05
  290475  0 2  0.0  1.12 0.95 0.05
  270875  0 2  0.0  1.12 0.95 0.05
  150376  0 2  0.0  1.12 0.95 0.05
  290476  0 2  0.0  1.12 0.95 0.05
  270876  0 2  0.0  1.12 0.95 0.05
  150377  0 2  0.0  1.12 0.95 0.05
  290477  0 2  0.0  1.12 0.95 0.05
  270877  0 2  0.0  1.12 0.95 0.05
  150378  0 2  0.0  1.12 0.95 0.05
  290478  0 2  0.0  1.12 0.95 0.05
  270878  0 2  0.0  1.12 0.95 0.05
  150379  0 2  0.0  1.12 0.95 0.05
  290479  0 2  0.0  1.12 0.95 0.05
  270879  0 2  0.0  1.12 0.95 0.05
```

```
  150380  0 2  0.0  1.12 0.95 0.05
  290480  0 2  0.0  1.12 0.95 0.05
  270880  0 2  0.0  1.12 0.95 0.05
  150381  0 2  0.0  1.12 0.95 0.05
  290481  0 2  0.0  1.12 0.95 0.05
  270881  0 2  0.0  1.12 0.95 0.05
  150382  0 2  0.0  1.12 0.95 0.05
  290482  0 2  0.0  1.12 0.95 0.05
  270882  0 2  0.0  1.12 0.95 0.05
  150383  0 2  0.0  1.12 0.95 0.05
  290483  0 2  0.0  1.12 0.95 0.05
  270883  0 2  0.0  1.12 0.95 0.05
  150384  0 2  0.0  1.12 0.95 0.05
  290484  0 2  0.0  1.12 0.95 0.05
  270884  0 2  0.0  1.12 0.95 0.05
  150385  0 2  0.0  1.12 0.95 0.05
  290485  0 2  0.0  1.12 0.95 0.05
  270885  0 2  0.0  1.12 0.95 0.05
  150386  0 2  0.0  1.12 0.95 0.05
  290486  0 2  0.0  1.12 0.95 0.05
  270886  0 2  0.0  1.12 0.95 0.05
  150387  0 2  0.0  1.12 0.95 0.05
  290487  0 2  0.0  1.12 0.95 0.05
  270887  0 2  0.0  1.12 0.95 0.05
  150388  0 2  0.0  1.12 0.95 0.05
  290488  0 2  0.0  1.12 0.95 0.05
  270888  0 2  0.0  1.12 0.95 0.05
  150389  0 2  0.0  1.12 0.95 0.05
  290489  0 2  0.0  1.12 0.95 0.05
  270889  0 2  0.0  1.12 0.95 0.05
  150390  0 2  0.0  1.12 0.95 0.05
  290490  0 2  0.0  1.12 0.95 0.05
  270890  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
Madera loam
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       4
       1      10    1.55   0.223       0       0       0
        0.1117980.111798       0
             0.1   0.223   0.083    0.58       0
       2      12    1.55   0.223       0       0       0
        0.1117980.111798       0
              4   0.223   0.083    0.58       0
       3      40    1.55   0.226       0       0       0
        0.1117980.111798       0
              5   0.226   0.186    0.29       0
       4      38     1.6   0.163       0       0       0
        0.1117980.111798       0
              2   0.163   0.073   0.174       0
```

```
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
TX Sorghum - 08/06/2001
"Texas Claypan Area, Milam County, Texas: MLRA J-87; Metfile: W13958.dvf (old:
Met87.met),
*** Record 3:
    0.71    0.36       0      25       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.43   0.402       1      10               4     2.5     354
*** Record 8
       1
*** Record 9
       1     0.1      22      85       1  92  86  87       0      70
*** Record 9a-d
       1      25
0101 1601 0102 1602 0103 1603 0104 1604 0105 1005 1605 0106 1606 0107 1607 0108
.293 .318 .345 .373 .399 .428 .468 .519 .647 .690 .704 .669 .478 .265 .134 .099
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
1608 0109 1609 0110 1610 0111 1611 0112 1612
.098 .099 .101 .050 .132 .166 .196 .224 .252
.014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  110561  120961  220961       1
  110562  120962  220962       1
  110563  120963  220963       1
  110564  120964  220964       1
  110565  120965  220965       1
  110566  120966  220966       1
  110567  120967  220967       1
  110568  120968  220968       1
  110569  120969  220969       1
  110570  120970  220970       1
  110571  120971  220971       1
  110572  120972  220972       1
  110573  120973  220973       1
  110574  120974  220974       1
  110575  120975  220975       1
  110576  120976  220976       1
  110577  120977  220977       1
  110578  120978  220978       1
  110579  120979  220979       1
  110580  120980  220980       1
  110581  120981  220981       1
  110582  120982  220982       1
  110583  120983  220983       1
  110584  120984  220984       1
  110585  120985  220985       1
  110586  120986  220986       1
  110587  120987  220987       1
  110588  120988  220988       1
  110589  120989  220989       1
  110590  120990  220990       1
*** Record 12 -- PTITLE
2,4-D - 1 applications @ 1.12 kg/ha
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
```

```
2,4-D
*** Record 16
  070661  0 2  0.0  1.12 0.95 0.05
  070662  0 2  0.0  1.12 0.95 0.05
  070663  0 2  0.0  1.12 0.95 0.05
  070664  0 2  0.0  1.12 0.95 0.05
  070665  0 2  0.0  1.12 0.95 0.05
  070666  0 2  0.0  1.12 0.95 0.05
  070667  0 2  0.0  1.12 0.95 0.05
  070668  0 2  0.0  1.12 0.95 0.05
  070669  0 2  0.0  1.12 0.95 0.05
  070670  0 2  0.0  1.12 0.95 0.05
  070671  0 2  0.0  1.12 0.95 0.05
  070672  0 2  0.0  1.12 0.95 0.05
  070673  0 2  0.0  1.12 0.95 0.05
  070674  0 2  0.0  1.12 0.95 0.05
  070675  0 2  0.0  1.12 0.95 0.05
  070676  0 2  0.0  1.12 0.95 0.05
  070677  0 2  0.0  1.12 0.95 0.05
  070678  0 2  0.0  1.12 0.95 0.05
  070679  0 2  0.0  1.12 0.95 0.05
  070680  0 2  0.0  1.12 0.95 0.05
  070681  0 2  0.0  1.12 0.95 0.05
  070682  0 2  0.0  1.12 0.95 0.05
  070683  0 2  0.0  1.12 0.95 0.05
  070684  0 2  0.0  1.12 0.95 0.05
  070685  0 2  0.0  1.12 0.95 0.05
  070686  0 2  0.0  1.12 0.95 0.05
  070687  0 2  0.0  1.12 0.95 0.05
  070688  0 2  0.0  1.12 0.95 0.05
  070689  0 2  0.0  1.12 0.95 0.05
  070690  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
Axtell Sandy Loam; HYDG: D
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       3
       1      10     1.6   0.174       0       0       0
        0.1117980.111798       0
             0.1   0.174   0.064    0.58       0
       2      10     1.6   0.174       0       0       0
        0.1117980.111798       0
             0.1   0.174   0.064    0.58       0
       3      80     1.7   0.235       0       0       0
        0.1117980.111798       0
               5   0.235   0.165    0.29       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
```

```
   1  -----
   7    YEAR
PRCP    TCUM   0   0
RUNF    TCUM   0   0
INFL    TCUM   1   1
ESLS    TCUM   0   0  1.0E3
RFLX    TCUM   0   0  1.0E5
EFLX    TCUM   0   0  1.0E5
RZFX    TCUM   0   0  1.0E5
```

```
KSSorghum; 10/09/02
"Osage County in MLRA 112; County nearest weather station Topeka (W13996) and
still in MLRA 112 (East Central KS); Metfile: W13996.dvf, (old metfile:
Met112.met)"
*** Record 3:
    0.73     0.3       0      17       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.43   0.264       1      10               3       4     354
*** Record 8
       1
*** Record 9
       1     0.1     120     100       3  89  86  87       0     120
*** Record 9a-d
       1      26
0101 1601 0102 1602 0103 1603 0104 1604 0105 0505 1605 2005 0106 1606 0107 1607
.161 .163 .165 .168 .174 .185 .199 .217 .231 .372 .425 .449 .448 .385 .224 .117
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.076 .076 .078 .186 .194 .171 .162 .171 .175 .178
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  200561  200961  011061       1
  200562  200962  011062       1
  200563  200963  011063       1
  200564  200964  011064       1
  200565  200965  011065       1
  200566  200966  011066       1
  200567  200967  011067       1
  200568  200968  011068       1
  200569  200969  011069       1
  200570  200970  011070       1
  200571  200971  011071       1
  200572  200972  011072       1
  200573  200973  011073       1
  200574  200974  011074       1
  200575  200975  011075       1
  200576  200976  011076       1
  200577  200977  011077       1
  200578  200978  011078       1
  200579  200979  011079       1
  200580  200980  011080       1
  200581  200981  011081       1
  200582  200982  011082       1
  200583  200983  011083       1
  200584  200984  011084       1
  200585  200985  011085       1
  200586  200986  011086       1
  200587  200987  011087       1
  200588  200988  011088       1
  200589  200989  011089       1
  200590  200990  011090       1
*** Record 12 -- PTITLE
2,4-D - 1 applications @ 1.12 kg/ha
*** Record 13
      30       1       0       0
```

```
*** Record 15 -- PSTNAM
2,4-D
*** Record 16
  070661  0 2  0.0  1.12 0.95 0.05
  070662  0 2  0.0  1.12 0.95 0.05
  070663  0 2  0.0  1.12 0.95 0.05
  070664  0 2  0.0  1.12 0.95 0.05
  070665  0 2  0.0  1.12 0.95 0.05
  070666  0 2  0.0  1.12 0.95 0.05
  070667  0 2  0.0  1.12 0.95 0.05
  070668  0 2  0.0  1.12 0.95 0.05
  070669  0 2  0.0  1.12 0.95 0.05
  070670  0 2  0.0  1.12 0.95 0.05
  070671  0 2  0.0  1.12 0.95 0.05
  070672  0 2  0.0  1.12 0.95 0.05
  070673  0 2  0.0  1.12 0.95 0.05
  070674  0 2  0.0  1.12 0.95 0.05
  070675  0 2  0.0  1.12 0.95 0.05
  070676  0 2  0.0  1.12 0.95 0.05
  070677  0 2  0.0  1.12 0.95 0.05
  070678  0 2  0.0  1.12 0.95 0.05
  070679  0 2  0.0  1.12 0.95 0.05
  070680  0 2  0.0  1.12 0.95 0.05
  070681  0 2  0.0  1.12 0.95 0.05
  070682  0 2  0.0  1.12 0.95 0.05
  070683  0 2  0.0  1.12 0.95 0.05
  070684  0 2  0.0  1.12 0.95 0.05
  070685  0 2  0.0  1.12 0.95 0.05
  070686  0 2  0.0  1.12 0.95 0.05
  070687  0 2  0.0  1.12 0.95 0.05
  070688  0 2  0.0  1.12 0.95 0.05
  070689  0 2  0.0  1.12 0.95 0.05
  070690  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
"Dennis Silt Loam; Benchmark Soil, Hydrologic Group C"
*** Record 20
     120           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       4
       1      10    1.55   0.247       0       0       0
        0.1117980.111798       0
             0.1   0.247   0.097    1.74       0
       2      24    1.55   0.247       0       0       0
        0.1117980.111798       0
                2   0.247   0.097    1.74       0
       3      10     1.6   0.316       0       0       0
        0.1117980.111798       0
                5   0.316   0.166   0.174       0
       4      76     1.6   0.348       0       0       0
        0.1117980.111798       0
                2   0.348   0.198   0.116       0
```

```
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
MS soybean; 8/9/01
"Yazoo Co. MLRA 134; Metfile: W13893.dvf (old: Met134.met),"
*** Record 3:
    0.75    0.25       0      17       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.42  0.0151       1      10               3       2     354
*** Record 8
       1
*** Record 9
       1     0.2      30     100       3  87  84  86       0      76
*** Record 9a-d
       1      27
0101 1601 0102 1602 0103 1603 0104 1604 2004 0105 0505 1605 0106 1606 0107 1607
.245 .276 .306 .337 .373 .418 .468 .498 .575 .627 .654 .620 .484 .361 .220 .094
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
0108 1608 0109 1609 0110 1510 1610 0111 1611 0112 1612
.109 .110 .046 .053 .040 .203 .239 .316 .394 .464 .524
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  150461  010961  101061       1
  150462  010962  101062       1
  150463  010963  101063       1
  150464  010964  101064       1
  150465  010965  101065       1
  150466  010966  101066       1
  150467  010967  101067       1
  150468  010968  101068       1
  150469  010969  101069       1
  150470  010970  101070       1
  150471  010971  101071       1
  150472  010972  101072       1
  150473  010973  101073       1
  150474  010974  101074       1
  150475  010975  101075       1
  150476  010976  101076       1
  150477  010977  101077       1
  150478  010978  101078       1
  150479  010979  101079       1
  150480  010980  101080       1
  150481  010981  101081       1
  150482  010982  101082       1
  150483  010983  101083       1
  150484  010984  101084       1
  150485  010985  101085       1
  150486  010986  101086       1
  150487  010987  101087       1
  150488  010988  101088       1
  150489  010989  101089       1
  150490  010990  101090       1
*** Record 12 -- PTITLE
2,4-D - 1 applications @ 1.12 kg/ha
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  100361  0 2  0.0  1.12 0.95 0.05
  100362  0 2  0.0  1.12 0.95 0.05
  100363  0 2  0.0  1.12 0.95 0.05
  100364  0 2  0.0  1.12 0.95 0.05
  100365  0 2  0.0  1.12 0.95 0.05
  100366  0 2  0.0  1.12 0.95 0.05
  100367  0 2  0.0  1.12 0.95 0.05
  100368  0 2  0.0  1.12 0.95 0.05
  100369  0 2  0.0  1.12 0.95 0.05
  100370  0 2  0.0  1.12 0.95 0.05
  100371  0 2  0.0  1.12 0.95 0.05
  100372  0 2  0.0  1.12 0.95 0.05
  100373  0 2  0.0  1.12 0.95 0.05
  100374  0 2  0.0  1.12 0.95 0.05
  100375  0 2  0.0  1.12 0.95 0.05
  100376  0 2  0.0  1.12 0.95 0.05
  100377  0 2  0.0  1.12 0.95 0.05
  100378  0 2  0.0  1.12 0.95 0.05
  100379  0 2  0.0  1.12 0.95 0.05
  100380  0 2  0.0  1.12 0.95 0.05
  100381  0 2  0.0  1.12 0.95 0.05
  100382  0 2  0.0  1.12 0.95 0.05
  100383  0 2  0.0  1.12 0.95 0.05
  100384  0 2  0.0  1.12 0.95 0.05
  100385  0 2  0.0  1.12 0.95 0.05
  100386  0 2  0.0  1.12 0.95 0.05
  100387  0 2  0.0  1.12 0.95 0.05
  100388  0 2  0.0  1.12 0.95 0.05
  100389  0 2  0.0  1.12 0.95 0.05
  100390  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
"The Loring, silt loam, HYDG C"
*** Record 20
     155           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       6
       1      13     1.4   0.385       0       0       0
        0.1117980.111798       0
             0.1   0.385   0.151    2.18       0
       2      23     1.4    0.37       0       0       0
        0.1117980.111798       0
              1    0.37   0.146    0.49       0
       3      33     1.4    0.37       0       0       0
        0.1117980.111798       0
              3    0.37   0.146    0.16       0
       4      30    1.45    0.34       0       0       0
        0.1117980.111798       0
              5    0.34   0.125   0.124       0
       5      23    1.49   0.335       0       0       0
        0.1117980.111798       0
```

```
               1   0.335   0.137    0.07       0
       6      33    1.51   0.343       0       0       0
        0.1117980.111798       0
               3   0.343   0.147    0.06       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
NC Alfalfa
"Western North Carolina, MLRA 130; Metfile: W03812.dvf (old: Met130.met),
*** Record 3:
    0.76     0.2       0      17       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.29    1.34     0.5      10               3       6     354
*** Record 8
       1
*** Record 9
       1    0.25     100     100       3  87  83  86       0      76
*** Record 9a-d
       1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108 1608
.004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110
0109 1609 0110 1610 0111 1611 0112 1612
.004 .004 .004 .004 .004 .004 .004 .004
.110 .110 .110 .110 .110 .110 .110 .110
*** Record 10 -- NCPDS, the number of cropping periods
      26
*** Record 11
  050465  280565  280865       1
  050466  280566  280866       1
  050467  280567  280867       1
  050468  280568  280868       1
  050469  280569  280869       1
  050470  280570  280870       1
  050471  280571  280871       1
  050472  280572  280872       1
  050473  280573  280873       1
  050474  280574  280874       1
  050475  280575  280875       1
  050476  280576  280876       1
  050477  280577  280877       1
  050478  280578  280878       1
  050479  280579  280879       1
  050480  280580  280880       1
  050481  280581  280881       1
  050482  280582  280882       1
  050483  280583  280883       1
  050484  280584  280884       1
  050485  280585  280885       1
  050486  280586  280886       1
  050487  280587  280887       1
  050488  280588  280888       1
  050489  280589  280889       1
  050490  280590  280890       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 2.24 kg/ha
*** Record 13
      52       1       0       0
*** Record 15 -- PSTNAM
2,4-D
*** Record 16
  010665  0 2  0.0  2.24 0.95 0.05
  010765  0 2  0.0  2.24 0.95 0.05
  010666  0 2  0.0  2.24 0.95 0.05
```

```
  010766  0 2  0.0  2.24 0.95 0.05
  010667  0 2  0.0  2.24 0.95 0.05
  010767  0 2  0.0  2.24 0.95 0.05
  010668  0 2  0.0  2.24 0.95 0.05
  010768  0 2  0.0  2.24 0.95 0.05
  010669  0 2  0.0  2.24 0.95 0.05
  010769  0 2  0.0  2.24 0.95 0.05
  010670  0 2  0.0  2.24 0.95 0.05
  010770  0 2  0.0  2.24 0.95 0.05
  010671  0 2  0.0  2.24 0.95 0.05
  010771  0 2  0.0  2.24 0.95 0.05
  010672  0 2  0.0  2.24 0.95 0.05
  010772  0 2  0.0  2.24 0.95 0.05
  010673  0 2  0.0  2.24 0.95 0.05
  010773  0 2  0.0  2.24 0.95 0.05
  010674  0 2  0.0  2.24 0.95 0.05
  010774  0 2  0.0  2.24 0.95 0.05
  010675  0 2  0.0  2.24 0.95 0.05
  010775  0 2  0.0  2.24 0.95 0.05
  010676  0 2  0.0  2.24 0.95 0.05
  010776  0 2  0.0  2.24 0.95 0.05
  010677  0 2  0.0  2.24 0.95 0.05
  010777  0 2  0.0  2.24 0.95 0.05
  010678  0 2  0.0  2.24 0.95 0.05
  010778  0 2  0.0  2.24 0.95 0.05
  010679  0 2  0.0  2.24 0.95 0.05
  010779  0 2  0.0  2.24 0.95 0.05
  010680  0 2  0.0  2.24 0.95 0.05
  010780  0 2  0.0  2.24 0.95 0.05
  010681  0 2  0.0  2.24 0.95 0.05
  010781  0 2  0.0  2.24 0.95 0.05
  010682  0 2  0.0  2.24 0.95 0.05
  010782  0 2  0.0  2.24 0.95 0.05
  010683  0 2  0.0  2.24 0.95 0.05
  010783  0 2  0.0  2.24 0.95 0.05
  010684  0 2  0.0  2.24 0.95 0.05
  010784  0 2  0.0  2.24 0.95 0.05
  010685  0 2  0.0  2.24 0.95 0.05
  010785  0 2  0.0  2.24 0.95 0.05
  010686  0 2  0.0  2.24 0.95 0.05
  010786  0 2  0.0  2.24 0.95 0.05
  010687  0 2  0.0  2.24 0.95 0.05
  010787  0 2  0.0  2.24 0.95 0.05
  010688  0 2  0.0  2.24 0.95 0.05
  010788  0 2  0.0  2.24 0.95 0.05
  010689  0 2  0.0  2.24 0.95 0.05
  010789  0 2  0.0  2.24 0.95 0.05
  010690  0 2  0.0  2.24 0.95 0.05
  010790  0 2  0.0  2.24 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
"Helena sandy loam, HYDG:C"
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
```

```
*** Record 30
       4    61.7
*** Record 33
       4
       1      10    1.55   0.153        0       0       0
        0.1117980.111798        0
             0.1   0.153   0.053    1.16       0
       2      20    1.55   0.153        0       0       0
        0.1117980.111798        0
              1   0.153   0.053    1.16       0
       3      18    1.51    0.25        0       0       0
        0.1117980.111798        0
              1    0.25    0.12   0.174       0
       4      52     1.5   0.322        0       0       0
        0.1117980.111798        0
              2   0.322   0.192   0.116       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
NC Apple 8/07/2001
"Henderson County MLRA 130; Metfile: W03812.dvf (old: Met130.met),"
*** Record 3:
    0.76     0.2       0      17       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
     0.2    3.04       1      10               3      12     354
*** Record 8
       1
*** Record 9
       1    0.25     150      90       3  84  79  82       0     425
*** Record 9a-d
       1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108 1608
.011 .012 .017 .018 .025 .031 .035 .041 .045 .046 .048 .048 .046 .043 .043 .045
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
0109 1609 0110 1610 0111 1611 0112 1612
.049 .052 .055 .057 .008 .009 .010 .010
.023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      26
*** Record 11
  070465  030565  251065       1
  070466  030566  251066       1
  070467  030567  251067       1
  070468  030568  251068       1
  070469  030569  251069       1
  070470  030570  251070       1
  070471  030571  251071       1
  070472  030572  251072       1
  070473  030573  251073       1
  070474  030574  251074       1
  070475  030575  251075       1
  070476  030576  251076       1
  070477  030577  251077       1
  070478  030578  251078       1
  070479  030579  251079       1
  070480  030580  251080       1
  070481  030581  251081       1
  070482  030582  251082       1
  070483  030583  251083       1
  070484  030584  251084       1
  070485  030585  251085       1
  070486  030586  251086       1
  070487  030587  251087       1
  070488  030588  251088       1
  070489  030589  251089       1
  070490  030590  251090       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 2.24 kg/ha
*** Record 13
      52       1       0       0
*** Record 15 -- PSTNAM
2,4-D
*** Record 16
  010665  0 2  0.0  2.24 0.95 0.05
  150865  0 2  0.0  2.24 0.95 0.05
  010666  0 2  0.0  2.24 0.95 0.05
```

```
  150866  0 2  0.0  2.24 0.95 0.05
  010667  0 2  0.0  2.24 0.95 0.05
  150867  0 2  0.0  2.24 0.95 0.05
  010668  0 2  0.0  2.24 0.95 0.05
  150868  0 2  0.0  2.24 0.95 0.05
  010669  0 2  0.0  2.24 0.95 0.05
  150869  0 2  0.0  2.24 0.95 0.05
  010670  0 2  0.0  2.24 0.95 0.05
  150870  0 2  0.0  2.24 0.95 0.05
  010671  0 2  0.0  2.24 0.95 0.05
  150871  0 2  0.0  2.24 0.95 0.05
  010672  0 2  0.0  2.24 0.95 0.05
  150872  0 2  0.0  2.24 0.95 0.05
  010673  0 2  0.0  2.24 0.95 0.05
  150873  0 2  0.0  2.24 0.95 0.05
  010674  0 2  0.0  2.24 0.95 0.05
  150874  0 2  0.0  2.24 0.95 0.05
  010675  0 2  0.0  2.24 0.95 0.05
  150875  0 2  0.0  2.24 0.95 0.05
  010676  0 2  0.0  2.24 0.95 0.05
  150876  0 2  0.0  2.24 0.95 0.05
  010677  0 2  0.0  2.24 0.95 0.05
  150877  0 2  0.0  2.24 0.95 0.05
  010678  0 2  0.0  2.24 0.95 0.05
  150878  0 2  0.0  2.24 0.95 0.05
  010679  0 2  0.0  2.24 0.95 0.05
  150879  0 2  0.0  2.24 0.95 0.05
  010680  0 2  0.0  2.24 0.95 0.05
  150880  0 2  0.0  2.24 0.95 0.05
  010681  0 2  0.0  2.24 0.95 0.05
  150881  0 2  0.0  2.24 0.95 0.05
  010682  0 2  0.0  2.24 0.95 0.05
  150882  0 2  0.0  2.24 0.95 0.05
  010683  0 2  0.0  2.24 0.95 0.05
  150883  0 2  0.0  2.24 0.95 0.05
  010684  0 2  0.0  2.24 0.95 0.05
  150884  0 2  0.0  2.24 0.95 0.05
  010685  0 2  0.0  2.24 0.95 0.05
  150885  0 2  0.0  2.24 0.95 0.05
  010686  0 2  0.0  2.24 0.95 0.05
  150886  0 2  0.0  2.24 0.95 0.05
  010687  0 2  0.0  2.24 0.95 0.05
  150887  0 2  0.0  2.24 0.95 0.05
  010688  0 2  0.0  2.24 0.95 0.05
  150888  0 2  0.0  2.24 0.95 0.05
  010689  0 2  0.0  2.24 0.95 0.05
  150889  0 2  0.0  2.24 0.95 0.05
  010690  0 2  0.0  2.24 0.95 0.05
  150890  0 2  0.0  2.24 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
Hayesville Loam; HYDG: C
*** Record 20
     150           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
```

```
*** Record 30
       4    61.7
*** Record 33
       4
       1      10     1.3   0.392       0       0       0
        0.1117980.111798       0
             0.1   0.392   0.192    0.58       0
       2       6     1.3   0.392       0       0       0
        0.1117980.111798       0
               2   0.392   0.192    0.58       0
       3      84     1.3   0.475       0       0       0
        0.1117980.111798       0
               2   0.475   0.275   0.116       0
       4      50     1.3   0.259       0       0       0
        0.1117980.111798       0
               5   0.259   0.109   0.058       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
orapple.inp 8/7/2001
"Marion Co. OR MLRA A2; Metfile: W24229.dvf (old: Met2.met),"
*** Record 3:
    0.74    0.15       0      15       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.33    3.64       1      10               2      12     354
*** Record 8
       1
*** Record 9
       1    0.25      45      98       3  84  79  82       0     240
*** Record 9a-d
       1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108 1608
.008 .009 .013 .015 .020 .026 .029 .032 .034 .033 .031 .028 .024 .020 .018 .018
.040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040
0109 1609 0110 1610 0111 1611 0112 1612
.018 .020 .022 .024 .005 .006 .006 .007
.040 .040 .040 .040 .040 .040 .040 .040
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  250461  310561  071161       1
  250462  310562  071162       1
  250463  310563  071163       1
  250464  310564  071164       1
  250465  310565  071165       1
  250466  310566  071166       1
  250467  310567  071167       1
  250468  310568  071168       1
  250469  310569  071169       1
  250470  310570  071170       1
  250471  310571  071171       1
  250472  310572  071172       1
  250473  310573  071173       1
  250474  310574  071174       1
  250475  310575  071175       1
  250476  310576  071176       1
  250477  310577  071177       1
  250478  310578  071178       1
  250479  310579  071179       1
  250480  310580  071180       1
  250481  310581  071181       1
  250482  310582  071182       1
  250483  310583  071183       1
  250484  310584  071184       1
  250485  310585  071185       1
  250486  310586  071186       1
  250487  310587  071187       1
  250488  310588  071188       1
  250489  310589  071189       1
  250490  310590  071190       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 2.24 kg/ha
*** Record 13
      60       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  010761  0 2  0.0  2.24 0.95 0.05
  140961  0 2  0.0  2.24 0.95 0.05
  010762  0 2  0.0  2.24 0.95 0.05
  140962  0 2  0.0  2.24 0.95 0.05
  010763  0 2  0.0  2.24 0.95 0.05
  140963  0 2  0.0  2.24 0.95 0.05
  010764  0 2  0.0  2.24 0.95 0.05
  140964  0 2  0.0  2.24 0.95 0.05
  010765  0 2  0.0  2.24 0.95 0.05
  140965  0 2  0.0  2.24 0.95 0.05
  010766  0 2  0.0  2.24 0.95 0.05
  140966  0 2  0.0  2.24 0.95 0.05
  010767  0 2  0.0  2.24 0.95 0.05
  140967  0 2  0.0  2.24 0.95 0.05
  010768  0 2  0.0  2.24 0.95 0.05
  140968  0 2  0.0  2.24 0.95 0.05
  010769  0 2  0.0  2.24 0.95 0.05
  140969  0 2  0.0  2.24 0.95 0.05
  010770  0 2  0.0  2.24 0.95 0.05
  140970  0 2  0.0  2.24 0.95 0.05
  010771  0 2  0.0  2.24 0.95 0.05
  140971  0 2  0.0  2.24 0.95 0.05
  010772  0 2  0.0  2.24 0.95 0.05
  140972  0 2  0.0  2.24 0.95 0.05
  010773  0 2  0.0  2.24 0.95 0.05
  140973  0 2  0.0  2.24 0.95 0.05
  010774  0 2  0.0  2.24 0.95 0.05
  140974  0 2  0.0  2.24 0.95 0.05
  010775  0 2  0.0  2.24 0.95 0.05
  140975  0 2  0.0  2.24 0.95 0.05
  010776  0 2  0.0  2.24 0.95 0.05
  140976  0 2  0.0  2.24 0.95 0.05
  010777  0 2  0.0  2.24 0.95 0.05
  140977  0 2  0.0  2.24 0.95 0.05
  010778  0 2  0.0  2.24 0.95 0.05
  140978  0 2  0.0  2.24 0.95 0.05
  010779  0 2  0.0  2.24 0.95 0.05
  140979  0 2  0.0  2.24 0.95 0.05
  010780  0 2  0.0  2.24 0.95 0.05
  140980  0 2  0.0  2.24 0.95 0.05
  010781  0 2  0.0  2.24 0.95 0.05
  140981  0 2  0.0  2.24 0.95 0.05
  010782  0 2  0.0  2.24 0.95 0.05
  140982  0 2  0.0  2.24 0.95 0.05
  010783  0 2  0.0  2.24 0.95 0.05
  140983  0 2  0.0  2.24 0.95 0.05
  010784  0 2  0.0  2.24 0.95 0.05
  140984  0 2  0.0  2.24 0.95 0.05
  010785  0 2  0.0  2.24 0.95 0.05
  140985  0 2  0.0  2.24 0.95 0.05
  010786  0 2  0.0  2.24 0.95 0.05
  140986  0 2  0.0  2.24 0.95 0.05
  010787  0 2  0.0  2.24 0.95 0.05
  140987  0 2  0.0  2.24 0.95 0.05
  010788  0 2  0.0  2.24 0.95 0.05
  140988  0 2  0.0  2.24 0.95 0.05
  010789  0 2  0.0  2.24 0.95 0.05
  140989  0 2  0.0  2.24 0.95 0.05
```

```
  010790  0 2  0.0  2.24 0.95 0.05
  140990  0 2  0.0  2.24 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
"Cornelius silt loam, hydrologic group C"
*** Record 20
     148           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       5
       1      15     1.3   0.329       0       0       0
        0.1117980.111798       0
             0.1   0.329   0.099     2.3       0
       2      13    1.38   0.338       0       0       0
        0.1117980.111798       0
              1   0.338   0.108    1.11       0
       3      15    1.58    0.34       0       0       0
        0.1117980.111798       0
              1    0.34    0.11    0.21       0
       4      55    1.52   0.358       0       0       0
        0.1117980.111798       0
              5   0.358   0.148   0.145       0
       5      50    1.46   0.202       0       0       0
        0.1117980.111798       0
              5   0.202   0.142    0.07       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
PA Apple; 8/08/2001
"Lancaster County; MLRA 148; Metfile: W14737.dvf (old: Met148.met),"
*** Record 3:
    0.76     0.2       0      17       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.42     3.6       1      10               3      12     354
*** Record 8
       1
*** Record 9
       1    0.25     100      90       3  84  79  82       0     425
*** Record 9a-d
       1      26
0101 1601 0102 1602 0103 1603 0104 1504 1604 0105 1605 0106 1606 0107 1507 1607
.134 .144 .153 .156 .247 .261 .279 .320 .334 .357 .378 .419 .439 .453 .459 .463
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.478 .493 .503 .504 .509 .515 .103 .115 .121 .128
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  200461  100561  151061       1
  200462  100562  151062       1
  200463  100563  151063       1
  200464  100564  151064       1
  200465  100565  151065       1
  200466  100566  151066       1
  200467  100567  151067       1
  200468  100568  151068       1
  200469  100569  151069       1
  200470  100570  151070       1
  200471  100571  151071       1
  200472  100572  151072       1
  200473  100573  151073       1
  200474  100574  151074       1
  200475  100575  151075       1
  200476  100576  151076       1
  200477  100577  151077       1
  200478  100578  151078       1
  200479  100579  151079       1
  200480  100580  151080       1
  200481  100581  151081       1
  200482  100582  151082       1
  200483  100583  151083       1
  200484  100584  151084       1
  200485  100585  151085       1
  200486  100586  151086       1
  200487  100587  151087       1
  200488  100588  151088       1
  200489  100589  151089       1
  200490  100590  151090       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 2.24 kg/ha
*** Record 13
      60       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  010761  0 2  0.0  2.24 0.95 0.05
  140961  0 2  0.0  2.24 0.95 0.05
  010762  0 2  0.0  2.24 0.95 0.05
  140962  0 2  0.0  2.24 0.95 0.05
  010763  0 2  0.0  2.24 0.95 0.05
  140963  0 2  0.0  2.24 0.95 0.05
  010764  0 2  0.0  2.24 0.95 0.05
  140964  0 2  0.0  2.24 0.95 0.05
  010765  0 2  0.0  2.24 0.95 0.05
  140965  0 2  0.0  2.24 0.95 0.05
  010766  0 2  0.0  2.24 0.95 0.05
  140966  0 2  0.0  2.24 0.95 0.05
  010767  0 2  0.0  2.24 0.95 0.05
  140967  0 2  0.0  2.24 0.95 0.05
  010768  0 2  0.0  2.24 0.95 0.05
  140968  0 2  0.0  2.24 0.95 0.05
  010769  0 2  0.0  2.24 0.95 0.05
  140969  0 2  0.0  2.24 0.95 0.05
  010770  0 2  0.0  2.24 0.95 0.05
  140970  0 2  0.0  2.24 0.95 0.05
  010771  0 2  0.0  2.24 0.95 0.05
  140971  0 2  0.0  2.24 0.95 0.05
  010772  0 2  0.0  2.24 0.95 0.05
  140972  0 2  0.0  2.24 0.95 0.05
  010773  0 2  0.0  2.24 0.95 0.05
  140973  0 2  0.0  2.24 0.95 0.05
  010774  0 2  0.0  2.24 0.95 0.05
  140974  0 2  0.0  2.24 0.95 0.05
  010775  0 2  0.0  2.24 0.95 0.05
  140975  0 2  0.0  2.24 0.95 0.05
  010776  0 2  0.0  2.24 0.95 0.05
  140976  0 2  0.0  2.24 0.95 0.05
  010777  0 2  0.0  2.24 0.95 0.05
  140977  0 2  0.0  2.24 0.95 0.05
  010778  0 2  0.0  2.24 0.95 0.05
  140978  0 2  0.0  2.24 0.95 0.05
  010779  0 2  0.0  2.24 0.95 0.05
  140979  0 2  0.0  2.24 0.95 0.05
  010780  0 2  0.0  2.24 0.95 0.05
  140980  0 2  0.0  2.24 0.95 0.05
  010781  0 2  0.0  2.24 0.95 0.05
  140981  0 2  0.0  2.24 0.95 0.05
  010782  0 2  0.0  2.24 0.95 0.05
  140982  0 2  0.0  2.24 0.95 0.05
  010783  0 2  0.0  2.24 0.95 0.05
  140983  0 2  0.0  2.24 0.95 0.05
  010784  0 2  0.0  2.24 0.95 0.05
  140984  0 2  0.0  2.24 0.95 0.05
  010785  0 2  0.0  2.24 0.95 0.05
  140985  0 2  0.0  2.24 0.95 0.05
  010786  0 2  0.0  2.24 0.95 0.05
  140986  0 2  0.0  2.24 0.95 0.05
  010787  0 2  0.0  2.24 0.95 0.05
  140987  0 2  0.0  2.24 0.95 0.05
  010788  0 2  0.0  2.24 0.95 0.05
  140988  0 2  0.0  2.24 0.95 0.05
  010789  0 2  0.0  2.24 0.95 0.05
  140989  0 2  0.0  2.24 0.95 0.05
```

```
  010790  0 2  0.0  2.24 0.95 0.05
  140990  0 2  0.0  2.24 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
Elioak Silt Loam; HYDG: C
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       3
       1      10     1.7   0.218       0       0       0
        0.1117980.111798       0
             0.1   0.218   0.098    1.16       0
       2      28     1.7   0.218       0       0       0
        0.1117980.111798       0
              7   0.218   0.098    1.16       0
       3      62     1.8   0.243       0       0       0
        0.1117980.111798       0
             7.75   0.243   0.163   0.174       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
OR Filberts (developed from OR Walnuts); 8/15/2001
"Washington County; MLRA 2; Metfile: W24232.dvf (old: Met2.met),"
*** Record 3:
    0.74     0.2       0      17       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.33    3.62       1      10               4      12     354
*** Record 8
       1
*** Record 9
       1    0.25      90      75       3  84  79  82       0     500
*** Record 9a-d
       1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108 1608
.008 .009 .013 .015 .020 .026 .029 .032 .034 .033 .031 .028 .024 .020 .018 .018
.040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040
0109 1609 0110 1610 0111 1611 0112 1612
.018 .020 .022 .024 .005 .006 .006 .007
.040 .040 .040 .040 .040 .040 .040 .040
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  050361  150461  101161       1
  050362  150462  101162       1
  050363  150463  101163       1
  050364  150464  101164       1
  050365  150465  101165       1
  050366  150466  101166       1
  050367  150467  101167       1
  050368  150468  101168       1
  050369  150469  101169       1
  050370  150470  101170       1
  050371  150471  101171       1
  050372  150472  101172       1
  050373  150473  101173       1
  050374  150474  101174       1
  050375  150475  101175       1
  050376  150476  101176       1
  050377  150477  101177       1
  050378  150478  101178       1
  050379  150479  101179       1
  050380  150480  101180       1
  050381  150481  101181       1
  050382  150482  101182       1
  050383  150483  101183       1
  050384  150484  101184       1
  050385  150485  101185       1
  050386  150486  101186       1
  050387  150487  101187       1
  050388  150488  101188       1
  050389  150489  101189       1
  050390  150490  101190       1
*** Record 12 -- PTITLE
2,4-D - 4 applications @ 1.12 kg/ha
*** Record 13
     120       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  010661  0 2  0.0  1.12 0.95 0.05
  010761  0 2  0.0  1.12 0.95 0.05
  310761  0 2  0.0  1.12 0.95 0.05
  300861  0 2  0.0  1.12 0.95 0.05
  010662  0 2  0.0  1.12 0.95 0.05
  010762  0 2  0.0  1.12 0.95 0.05
  310762  0 2  0.0  1.12 0.95 0.05
  300862  0 2  0.0  1.12 0.95 0.05
  010663  0 2  0.0  1.12 0.95 0.05
  010763  0 2  0.0  1.12 0.95 0.05
  310763  0 2  0.0  1.12 0.95 0.05
  300863  0 2  0.0  1.12 0.95 0.05
  010664  0 2  0.0  1.12 0.95 0.05
  010764  0 2  0.0  1.12 0.95 0.05
  310764  0 2  0.0  1.12 0.95 0.05
  300864  0 2  0.0  1.12 0.95 0.05
  010665  0 2  0.0  1.12 0.95 0.05
  010765  0 2  0.0  1.12 0.95 0.05
  310765  0 2  0.0  1.12 0.95 0.05
  300865  0 2  0.0  1.12 0.95 0.05
  010666  0 2  0.0  1.12 0.95 0.05
  010766  0 2  0.0  1.12 0.95 0.05
  310766  0 2  0.0  1.12 0.95 0.05
  300866  0 2  0.0  1.12 0.95 0.05
  010667  0 2  0.0  1.12 0.95 0.05
  010767  0 2  0.0  1.12 0.95 0.05
  310767  0 2  0.0  1.12 0.95 0.05
  300867  0 2  0.0  1.12 0.95 0.05
  010668  0 2  0.0  1.12 0.95 0.05
  010768  0 2  0.0  1.12 0.95 0.05
  310768  0 2  0.0  1.12 0.95 0.05
  300868  0 2  0.0  1.12 0.95 0.05
  010669  0 2  0.0  1.12 0.95 0.05
  010769  0 2  0.0  1.12 0.95 0.05
  310769  0 2  0.0  1.12 0.95 0.05
  300869  0 2  0.0  1.12 0.95 0.05
  010670  0 2  0.0  1.12 0.95 0.05
  010770  0 2  0.0  1.12 0.95 0.05
  310770  0 2  0.0  1.12 0.95 0.05
  300870  0 2  0.0  1.12 0.95 0.05
  010671  0 2  0.0  1.12 0.95 0.05
  010771  0 2  0.0  1.12 0.95 0.05
  310771  0 2  0.0  1.12 0.95 0.05
  300871  0 2  0.0  1.12 0.95 0.05
  010672  0 2  0.0  1.12 0.95 0.05
  010772  0 2  0.0  1.12 0.95 0.05
  310772  0 2  0.0  1.12 0.95 0.05
  300872  0 2  0.0  1.12 0.95 0.05
  010673  0 2  0.0  1.12 0.95 0.05
  010773  0 2  0.0  1.12 0.95 0.05
  310773  0 2  0.0  1.12 0.95 0.05
  300873  0 2  0.0  1.12 0.95 0.05
  010674  0 2  0.0  1.12 0.95 0.05
  010774  0 2  0.0  1.12 0.95 0.05
  310774  0 2  0.0  1.12 0.95 0.05
  300874  0 2  0.0  1.12 0.95 0.05
  010675  0 2  0.0  1.12 0.95 0.05
  010775  0 2  0.0  1.12 0.95 0.05
```

```
310775  0 2  0.0  1.12 0.95 0.05
300875  0 2  0.0  1.12 0.95 0.05
010676  0 2  0.0  1.12 0.95 0.05
010776  0 2  0.0  1.12 0.95 0.05
310776  0 2  0.0  1.12 0.95 0.05
300876  0 2  0.0  1.12 0.95 0.05
010677  0 2  0.0  1.12 0.95 0.05
010777  0 2  0.0  1.12 0.95 0.05
310777  0 2  0.0  1.12 0.95 0.05
300877  0 2  0.0  1.12 0.95 0.05
010678  0 2  0.0  1.12 0.95 0.05
010778  0 2  0.0  1.12 0.95 0.05
310778  0 2  0.0  1.12 0.95 0.05
300878  0 2  0.0  1.12 0.95 0.05
010679  0 2  0.0  1.12 0.95 0.05
010779  0 2  0.0  1.12 0.95 0.05
310779  0 2  0.0  1.12 0.95 0.05
300879  0 2  0.0  1.12 0.95 0.05
010680  0 2  0.0  1.12 0.95 0.05
010780  0 2  0.0  1.12 0.95 0.05
310780  0 2  0.0  1.12 0.95 0.05
300880  0 2  0.0  1.12 0.95 0.05
010681  0 2  0.0  1.12 0.95 0.05
010781  0 2  0.0  1.12 0.95 0.05
310781  0 2  0.0  1.12 0.95 0.05
300881  0 2  0.0  1.12 0.95 0.05
010682  0 2  0.0  1.12 0.95 0.05
010782  0 2  0.0  1.12 0.95 0.05
310782  0 2  0.0  1.12 0.95 0.05
300882  0 2  0.0  1.12 0.95 0.05
010683  0 2  0.0  1.12 0.95 0.05
010783  0 2  0.0  1.12 0.95 0.05
310783  0 2  0.0  1.12 0.95 0.05
300883  0 2  0.0  1.12 0.95 0.05
010684  0 2  0.0  1.12 0.95 0.05
010784  0 2  0.0  1.12 0.95 0.05
310784  0 2  0.0  1.12 0.95 0.05
300884  0 2  0.0  1.12 0.95 0.05
010685  0 2  0.0  1.12 0.95 0.05
010785  0 2  0.0  1.12 0.95 0.05
310785  0 2  0.0  1.12 0.95 0.05
300885  0 2  0.0  1.12 0.95 0.05
010686  0 2  0.0  1.12 0.95 0.05
010786  0 2  0.0  1.12 0.95 0.05
310786  0 2  0.0  1.12 0.95 0.05
300886  0 2  0.0  1.12 0.95 0.05
010687  0 2  0.0  1.12 0.95 0.05
010787  0 2  0.0  1.12 0.95 0.05
310787  0 2  0.0  1.12 0.95 0.05
300887  0 2  0.0  1.12 0.95 0.05
010688  0 2  0.0  1.12 0.95 0.05
010788  0 2  0.0  1.12 0.95 0.05
310788  0 2  0.0  1.12 0.95 0.05
300888  0 2  0.0  1.12 0.95 0.05
010689  0 2  0.0  1.12 0.95 0.05
010789  0 2  0.0  1.12 0.95 0.05
310789  0 2  0.0  1.12 0.95 0.05
300889  0 2  0.0  1.12 0.95 0.05
010690  0 2  0.0  1.12 0.95 0.05
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  010790  0 2  0.0  1.12 0.95 0.05
  310790  0 2  0.0  1.12 0.95 0.05
  300890  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0 0.07875     0.5
*** Record 19 -- STITLE
"Cornelius silt loam, hydrologic group C"
*** Record 20
     148           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4    61.7
*** Record 33
       5
       1      15     1.3   0.329       0       0       0
        0.1117980.111798       0
             0.1   0.329   0.099     2.3       0
       2      13    1.38   0.338       0       0       0
        0.1117980.111798       0
              1   0.338   0.108    1.11       0
       3      15    1.58    0.34       0       0       0
        0.1117980.111798       0
              1    0.34    0.11    0.21       0
       4      55    1.52   0.358       0       0       0
        0.1117980.111798       0
              5   0.358   0.148   0.145       0
       5      50    1.46   0.202       0       0       0
        0.1117980.111798       0
              5   0.202   0.142    0.07       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

stored as FLsugEco.out
Chemical: 2,4-D
PRZM environment: FLsugarcaneC.txt modified Satday, 12 October 2002 at 16:42:14
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w12844.dvf modified Wedday, 3 July 2002 at 09:04:30
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	58.46	56.79	50.41	38.78	31.92	13.68
1962	14.38	13.98	12.46	10.06	8.501	4.132
1963	11.37	11.12	9.776	7.643	6.99	3.316
1964	26.74	25.91	23.22	18.02	14.91	5.915
1965	9.718	9.502	8.709	7.328	6.463	3.198
1966	42.87	41.94	38.87	32.06	27.94	12.84
1967	9.187	8.926	7.929	6.407	6.106	3.042
1968	8.042	7.806	6.907	5.677	4.834	2.556
1969	32.84	32.1	30.57	25.73	22.85	9.517
1970	16.14	15.63	13.72	10.68	10.47	5.148
1971	10.12	9.846	8.841	7.259	6.085	2.933
1972	26.11	25.36	23.21	19.24	16.35	8.82
1973	10.58	10.27	9.319	7.563	6.777	3.578
1974	21.08	20.6	18.42	14.82	13.91	6.523
1975	7.429	7.21	6.376	4.933	4.1	2.177
1976	12.51	12.16	10.81	8.82	7.456	3.426
1977	16.07	15.88	14.76	12.26	11.3	5.58
1978	10.59	10.29	9.474	7.957	7.885	3.855
1979	27	26.21	23.17	17.5	14.81	7.245
1980	14.55	14.16	13.28	10.95	9.106	4.208
1981	8.01	7.766	6.854	5.395	4.559	2.409
1982	17.95	17.54	15.47	11.87	10.54	5.625
1983	30.4	29.55	26.8	21.8	18.17	9.17
1984	49.98	48.6	43.6	34.24	28.49	10.15
1985	20.41	19.83	17.82	13.69	11.54	5.006
1986	38.26	37.45	34.56	28.29	24.78	9.593
1987	26.45	25.84	23.28	17.91	14.84	6.242
1988	15.13	14.72	13.5	11.27	9.802	5.614
1989	37.91	37.33	33.31	24.77	20.08	7.352
1990	11.54	11.21	10.09	8.34	6.976	3.771

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	58.46	56.79	50.41	38.78	31.92	13.68

0.064516	49.98	48.6	43.6	34.24	28.49	12.84
0.096774	42.87	41.94	38.87	32.06	27.94	10.15
0.129032	38.26	37.45	34.56	28.29	24.78	9.593
0.16129	37.91	37.33	33.31	25.73	22.85	9.517
0.193548	32.84	32.1	30.57	24.77	20.08	9.17
0.225806	30.4	29.55	26.8	21.8	18.17	8.82
0.258065	27	26.21	23.28	19.24	16.35	7.352
0.290323	26.74	25.91	23.22	18.02	14.91	7.245
0.322581	26.45	25.84	23.21	17.91	14.84	6.523
0.354839	26.11	25.36	23.17	17.5	14.81	6.242
0.387097	21.08	20.6	18.42	14.82	13.91	5.915
0.419355	20.41	19.83	17.82	13.69	11.54	5.625
0.451613	17.95	17.54	15.47	12.26	11.3	5.614
0.483871	16.14	15.88	14.76	11.87	10.54	5.58
0.516129	16.07	15.63	13.72	11.27	10.47	5.148
0.548387	15.13	14.72	13.5	10.95	9.802	5.006
0.580645	14.55	14.16	13.28	10.68	9.106	4.208
0.612903	14.38	13.98	12.46	10.06	8.501	4.132
0.645161	12.51	12.16	10.81	8.82	7.885	3.855
0.677419	11.54	11.21	10.09	8.34	7.456	3.771
0.709677	11.37	11.12	9.776	7.957	6.99	3.578
0.741935	10.59	10.29	9.474	7.643	6.976	3.426
0.774194	10.58	10.27	9.319	7.563	6.777	3.316
0.806452	10.12	9.846	8.841	7.328	6.463	3.198
0.83871	9.718	9.502	8.709	7.259	6.106	3.042
0.870968	9.187	8.926	7.929	6.407	6.085	2.933
0.903226	8.042	7.806	6.907	5.677	4.834	2.556
0.935484	8.01	7.766	6.854	5.395	4.559	2.409
0.967742	7.429	7.21	6.376	4.933	4.1	2.177
0.1	42.409	41.491	38.439	31.683	27.624	10.0943
					Average of yearly averages:	5.887367

Inputs generated by pe4.pl - 8-August-2003

stored as FLtrfEco.out
Chemical: 2,4-D
PRZM environment: modified Monday, 16 June 2003 at 14:48:06
FLturfC.txt
EXAMS environment: modified Thuday, 29 August 2002 at 16:33:29
pond298.exv
Metfile: w12834.dvf modified Wedday, 3 July 2002 at 09:04:28
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	5.986	5.78	5.133	4.066	3.518	1.929
1962	6.585	6.432	5.835	4.631	3.863	2.473
1963	6.714	6.534	5.845	4.589	3.812	2.5
1964	6.776	6.598	5.875	5.514	4.766	2.946
1965	12.11	11.71	10.45	8.355	7.293	3.537
1966	18.16	17.71	16	12.68	10.7	5.367
1967	7.043	6.852	6.118	4.779	4.001	2.731
1968	6.732	6.55	5.85	4.608	4.115	2.622
1969	11.85	11.53	10.17	7.919	6.917	3.497
1970	10.18	9.897	8.812	7.025	5.844	3.643
1971	14.63	14.27	12.91	10.26	8.704	4.616
1972	7.107	6.924	6.218	4.917	4.116	2.805
1973	8.797	8.646	7.941	6.395	5.357	3.287
1974	6.828	6.655	5.99	4.717	3.935	2.61
1975	8.081	7.874	7.096	5.891	4.955	2.983
1976	26.58	25.93	23.39	18.52	15.53	6.525
1977	7.124	6.941	6.237	4.919	4.096	2.767
1978	13.26	12.87	11.47	9.06	7.908	4.301
1979	21.37	20.65	18.32	14.5	12.58	5.465
1980	11.6	11.38	10.31	8.251	6.944	4.421
1981	6.834	6.655	5.964	4.699	3.921	2.531
1982	22.14	21.58	19.4	15.24	12.7	5.617
1983	10.2	10.03	9.31	7.661	6.534	4.186
1984	24.77	24.24	21.99	17.58	14.81	6.506
1985	6.939	6.765	6.409	5.334	4.46	2.688
1986	9.294	9.007	7.92	6.325	5.462	2.94
1987	7.138	6.985	6.386	5.164	4.514	3.034
1988	6.992	6.818	6.147	4.898	4.111	2.787
1989	31.95	31.15	27.87	22.36	19.11	6.389
1990	13.74	13.49	12.5	10.51	9.209	5.295

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	31.95	31.15	27.87	22.36	19.11	6.525
0.064516	26.58	25.93	23.39	18.52	15.53	6.506

0.096774	24.77	24.24	21.99	17.58	14.81	6.389
0.129032	22.14	21.58	19.4	15.24	12.7	5.617
0.16129	21.37	20.65	18.32	14.5	12.58	5.465
0.193548	18.16	17.71	16	12.68	10.7	5.367
0.225806	14.63	14.27	12.91	10.51	9.209	5.295
0.258065	13.74	13.49	12.5	10.26	8.704	4.616
0.290323	13.26	12.87	11.47	9.06	7.908	4.421
0.322581	12.11	11.71	10.45	8.355	7.293	4.301
0.354839	11.85	11.53	10.31	8.251	6.944	4.186
0.387097	11.6	11.38	10.17	7.919	6.917	3.643
0.419355	10.2	10.03	9.31	7.661	6.534	3.537
0.451613	10.18	9.897	8.812	7.025	5.844	3.497
0.483871	9.294	9.007	7.941	6.395	5.462	3.287
0.516129	8.797	8.646	7.92	6.325	5.357	3.034
0.548387	8.081	7.874	7.096	5.891	4.955	2.983
0.580645	7.138	6.985	6.409	5.514	4.766	2.946
0.612903	7.124	6.941	6.386	5.334	4.514	2.94
0.645161	7.107	6.924	6.237	5.164	4.46	2.805
0.677419	7.043	6.852	6.218	4.919	4.116	2.787
0.709677	6.992	6.818	6.147	4.917	4.115	2.767
0.741935	6.939	6.765	6.118	4.898	4.111	2.731
0.774194	6.834	6.655	5.99	4.779	4.096	2.688
0.806452	6.828	6.655	5.964	4.717	4.001	2.622
0.83871	6.776	6.598	5.875	4.699	3.935	2.61
0.870968	6.732	6.55	5.85	4.631	3.921	2.531
0.903226	6.714	6.534	5.845	4.608	3.863	2.5
0.935484	6.585	6.432	5.835	4.589	3.812	2.473
0.967742	5.986	5.78	5.133	4.066	3.518	1.929
0.1	24.507	23.974	21.731	17.346	14.599	6.3118
					Average of yearly averages:	3.7666

Inputs generated by pe4.pl - 8-August-2003

stored as PAtrfEco.out
Chemical: 2,4-D
PRZM environment: PAturfC.txt modified Satday, 12 October 2002 at 17:27:02
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14737.dvf modified Wedday, 3 July 2002 at 09:06:12
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	1.389	1.351	1.213	0.9901	0.8896	0.4838
1962	1.506	1.468	1.356	1.168	1.069	0.7755
1963	5.706	5.598	5.212	4.48	4.088	1.741
1964	3.033	2.975	2.852	2.709	2.593	1.796
1965	1.738	1.702	1.561	1.286	1.113	0.9244
1966	2.291	2.247	2.136	1.934	1.808	1.1
1967	4.291	4.228	4.036	3.372	2.914	1.748
1968	1.893	1.864	1.749	1.567	1.374	1.099
1969	1.64	1.608	1.48	1.254	1.148	0.8868
1970	1.654	1.624	1.503	1.256	1.083	0.8672
1971	4.182	4.085	3.709	3.145	2.88	1.541
1972	2.495	2.45	2.371	2.103	1.895	1.52
1973	3.112	3.044	2.781	2.388	2.189	1.272
1974	4.128	4.047	3.809	3.321	3.066	2.086
1975	2.548	2.497	2.299	1.982	1.897	1.623
1976	4.285	4.197	3.862	3.395	3.161	1.66
1977	2.616	2.563	2.378	2.258	2.15	1.533
1978	3.306	3.253	3.011	2.425	2.118	1.283
1979	8.332	8.147	7.493	6.453	5.888	2.503
1980	4.01	3.988	3.898	3.705	3.55	2.243
1981	4.264	4.182	3.971	3.213	2.729	1.592
1982	2.38	2.336	2.143	1.892	1.723	1.275
1983	1.683	1.654	1.54	1.296	1.109	0.8674
1984	5.006	4.916	4.612	3.848	3.278	1.606
1985	8.315	8.139	7.452	6.152	5.299	2.657
1986	2.515	2.464	2.249	2.086	1.866	1.638
1987	10.92	10.68	9.768	8.401	7.719	3.008
1988	5.461	5.431	5.307	5.04	4.82	3.603
1989	5.641	5.54	5.3	4.432	3.836	2.805
1990	3.192	3.138	2.946	2.579	2.27	1.751

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	10.92	10.68	9.768	8.401	7.719	3.603

0.064516	8.332	8.147	7.493	6.453	5.888	3.008
0.096774	8.315	8.139	7.452	6.152	5.299	2.805
0.129032	5.706	5.598	5.307	5.04	4.82	2.657
0.16129	5.641	5.54	5.3	4.48	4.088	2.503
0.193548	5.461	5.431	5.212	4.432	3.836	2.243
0.225806	5.006	4.916	4.612	3.848	3.55	2.086
0.258065	4.291	4.228	4.036	3.705	3.278	1.796
0.290323	4.285	4.197	3.971	3.395	3.161	1.751
0.322581	4.264	4.182	3.898	3.372	3.066	1.748
0.354839	4.182	4.085	3.862	3.321	2.914	1.741
0.387097	4.128	4.047	3.809	3.213	2.88	1.66
0.419355	4.01	3.988	3.709	3.145	2.729	1.638
0.451613	3.306	3.253	3.011	2.709	2.593	1.623
0.483871	3.192	3.138	2.946	2.579	2.27	1.606
0.516129	3.112	3.044	2.852	2.425	2.189	1.592
0.548387	3.033	2.975	2.781	2.388	2.15	1.541
0.580645	2.616	2.563	2.378	2.258	2.118	1.533
0.612903	2.548	2.497	2.371	2.103	1.897	1.52
0.645161	2.515	2.464	2.299	2.086	1.895	1.283
0.677419	2.495	2.45	2.249	1.982	1.866	1.275
0.709677	2.38	2.336	2.143	1.934	1.808	1.272
0.741935	2.291	2.247	2.136	1.892	1.723	1.1
0.774194	1.893	1.864	1.749	1.567	1.374	1.099
0.806452	1.738	1.702	1.561	1.296	1.148	0.9244
0.83871	1.683	1.654	1.54	1.286	1.113	0.8868
0.870968	1.654	1.624	1.503	1.256	1.109	0.8674
0.903226	1.64	1.608	1.48	1.254	1.083	0.8672
0.935484	1.506	1.468	1.356	1.168	1.069	0.7755
0.967742	1.389	1.351	1.213	0.9901	0.8896	0.4838
0.1	8.0541	7.8849	7.2375	6.0408	5.2511	2.7902
					Average of yearly averages:	1.649603

Inputs generated by pe4.pl - 8-August-2003

stored as NDwhtEco.out
Chemical: 2,4-D
PRZM environment: NDwheatC.txt modified Satday, 12 October 2002 at 17:15:08
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14914.dvf modified Wedday, 3 July 2002 at 09:05:52
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	3.999	3.871	3.475	2.769	2.351	0.8798
1962	6.451	6.301	5.96	5.011	4.363	1.922
1963	4.817	4.696	4.346	3.469	2.942	1.563
1964	5.398	5.271	4.755	4.093	3.577	1.702
1965	6.913	6.764	6.186	5.092	4.403	2.186
1966	5.395	5.272	4.89	3.983	3.405	1.853
1967	5.988	5.866	5.388	4.536	3.948	1.927
1968	5.853	5.736	5.322	4.472	3.872	1.948
1969	5.016	4.928	4.581	3.946	3.415	1.745
1970	5.268	5.145	4.671	4.079	3.525	1.733
1971	5.866	5.722	5.187	4.311	3.742	1.834
1972	4.698	4.583	4.136	3.332	2.862	1.524
1973	4.542	4.441	4.046	3.299	2.831	1.399
1974	4.536	4.434	4.036	3.252	2.784	1.395
1975	6.154	6.019	5.489	4.592	4.043	1.933
1976	4.795	4.677	4.221	3.363	2.843	1.543
1977	4.435	4.332	3.933	3.305	2.885	1.437
1978	7.648	7.48	6.813	5.517	4.906	2.275
1979	5.03	4.915	4.597	4.155	3.625	1.992
1980	4.644	4.551	4.293	3.534	3.032	1.59
1981	4.568	4.474	4.205	3.507	3.016	1.503
1982	4.56	4.474	4.287	3.596	3.105	1.54
1983	4.626	4.522	4.13	3.39	2.884	1.447
1984	10.8	10.55	9.646	7.77	6.662	2.872
1985	5.252	5.156	4.97	4.256	3.718	2.233
1986	5.564	5.432	4.919	4.37	3.82	1.99
1987	4.714	4.592	4.121	3.25	2.764	1.515
1988	4.465	4.329	3.911	3.061	2.561	1.244
1989	4.428	4.33	3.949	3.205	2.709	1.272
1990	17.88	17.47	15.86	12.82	10.94	4.38

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	17.88	17.47	15.86	12.82	10.94	4.38

0.064516	10.8	10.55	9.646	7.77	6.662	2.872
0.096774	7.648	7.48	6.813	5.517	4.906	2.275
0.129032	6.913	6.764	6.186	5.092	4.403	2.233
0.16129	6.451	6.301	5.96	5.011	4.363	2.186
0.193548	6.154	6.019	5.489	4.592	4.043	1.992
0.225806	5.988	5.866	5.388	4.536	3.948	1.99
0.258065	5.866	5.736	5.322	4.472	3.872	1.948
0.290323	5.853	5.722	5.187	4.37	3.82	1.933
0.322581	5.564	5.432	4.97	4.311	3.742	1.927
0.354839	5.398	5.272	4.919	4.256	3.718	1.922
0.387097	5.395	5.271	4.89	4.155	3.625	1.853
0.419355	5.268	5.156	4.755	4.093	3.577	1.834
0.451613	5.252	5.145	4.671	4.079	3.525	1.745
0.483871	5.03	4.928	4.597	3.983	3.415	1.733
0.516129	5.016	4.915	4.581	3.946	3.405	1.702
0.548387	4.817	4.696	4.346	3.596	3.105	1.59
0.580645	4.795	4.677	4.293	3.534	3.032	1.563
0.612903	4.714	4.592	4.287	3.507	3.016	1.543
0.645161	4.698	4.583	4.221	3.469	2.942	1.54
0.677419	4.644	4.551	4.205	3.39	2.885	1.524
0.709677	4.626	4.522	4.136	3.363	2.884	1.515
0.741935	4.568	4.474	4.13	3.332	2.862	1.503
0.774194	4.56	4.474	4.121	3.305	2.843	1.447
0.806452	4.542	4.441	4.046	3.299	2.831	1.437
0.83871	4.536	4.434	4.036	3.252	2.784	1.399
0.870968	4.465	4.332	3.949	3.25	2.764	1.395
0.903226	4.435	4.33	3.933	3.205	2.709	1.272
0.935484	4.428	4.329	3.911	3.061	2.561	1.244
0.967742	3.999	3.871	3.475	2.769	2.351	0.8798
0.1	7.5745	7.4084	6.7503	5.4745	4.8557	2.2708
					Average of yearly averages:	1.81256

Inputs generated by pe4.pl - 8-August-2003

stored as ORwhtEco.out
Chemical: 2,4-D
PRZM environment: ORwheatC.txt modified Satday, 12 October 2002 at 17:22:28
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w24232.dvf modified Wedday, 3 July 2002 at 09:06:10
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	4.051	4.003	3.88	3.679	3.37	1.416
1962	4.474	4.411	4.162	3.821	3.498	1.644
1963	7.169	7.087	6.815	6.041	5.48	2.508
1964	4.783	4.722	4.478	3.964	3.586	1.752
1965	4.51	4.448	4.264	3.968	3.628	1.687
1966	4.5	4.437	4.254	3.762	3.391	1.56
1967	4.432	4.381	4.176	3.722	3.354	1.478
1968	4.37	4.315	4.094	3.624	3.274	1.49
1969	5.157	5.089	4.815	4.245	3.791	1.715
1970	5.458	5.393	5.134	4.614	4.185	1.9
1971	16.36	16.24	15.46	13.63	12.33	5.371
1972	7.002	6.923	6.634	5.962	5.426	2.812
1973	4.776	4.713	4.535	4.101	3.709	1.795
1974	4.52	4.462	4.227	3.744	3.386	1.565
1975	4.436	4.383	4.173	3.735	3.386	1.568
1976	4.481	4.424	4.196	3.718	3.375	1.589
1977	4.496	4.433	4.18	3.688	3.336	1.543
1978	4.61	4.551	4.368	3.898	3.505	1.56
1979	4.458	4.397	4.152	3.638	3.263	1.479
1980	9.171	9.042	8.559	7.6	6.883	3.073
1981	6.43	6.343	5.996	5.338	4.893	2.382
1982	7.328	7.257	6.972	6.385	5.771	2.614
1983	5.835	5.756	5.594	4.965	4.469	2.092
1984	9.423	9.318	8.843	7.87	7.14	3.222
1985	5.074	5.004	4.725	4.155	3.746	1.869
1986	4.503	4.445	4.211	3.741	3.367	1.553
1987	4.501	4.437	4.267	3.927	3.536	1.593
1988	7.243	7.141	6.764	6.041	5.476	2.412
1989	4.713	4.64	4.35	3.78	3.387	1.621
1990	4.438	4.372	4.108	3.656	3.303	1.477

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	16.36	16.24	15.46	13.63	12.33	5.371

0.064516	9.423	9.318	8.843	7.87	7.14	3.222
0.096774	9.171	9.042	8.559	7.6	6.883	3.073
0.129032	7.328	7.257	6.972	6.385	5.771	2.812
0.16129	7.243	7.141	6.815	6.041	5.48	2.614
0.193548	7.169	7.087	6.764	6.041	5.476	2.508
0.225806	7.002	6.923	6.634	5.962	5.426	2.412
0.258065	6.43	6.343	5.996	5.338	4.893	2.382
0.290323	5.835	5.756	5.594	4.965	4.469	2.092
0.322581	5.458	5.393	5.134	4.614	4.185	1.9
0.354839	5.157	5.089	4.815	4.245	3.791	1.869
0.387097	5.074	5.004	4.725	4.155	3.746	1.795
0.419355	4.783	4.722	4.535	4.101	3.709	1.752
0.451613	4.776	4.713	4.478	3.968	3.628	1.715
0.483871	4.713	4.64	4.368	3.964	3.586	1.687
0.516129	4.61	4.551	4.35	3.927	3.536	1.644
0.548387	4.52	4.462	4.267	3.898	3.505	1.621
0.580645	4.51	4.448	4.264	3.821	3.498	1.593
0.612903	4.503	4.445	4.254	3.78	3.391	1.589
0.645161	4.501	4.437	4.227	3.762	3.387	1.568
0.677419	4.5	4.437	4.211	3.744	3.386	1.565
0.709677	4.496	4.433	4.196	3.741	3.386	1.56
0.741935	4.481	4.424	4.18	3.735	3.375	1.56
0.774194	4.474	4.411	4.176	3.722	3.37	1.553
0.806452	4.458	4.397	4.173	3.718	3.367	1.543
0.83871	4.438	4.383	4.162	3.688	3.354	1.49
0.870968	4.436	4.381	4.152	3.679	3.336	1.479
0.903226	4.432	4.372	4.108	3.656	3.303	1.478
0.935484	4.37	4.315	4.094	3.638	3.274	1.477
0.967742	4.051	4.003	3.88	3.624	3.263	1.416
0.1	8.9867	8.8635	8.4003	7.4785	6.7718	3.0469
					Average of yearly averages:	2.011333

Inputs generated by pe4.pl - 8-August-2003

stored as ILcrnEco.out
Chemical: 2,4-D
PRZM environment: ILCornC.txt modified Satday, 12 October 2002 at 17:01:38
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14923.dvf modified Wedday, 3 July 2002 at 09:04:40
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	5.034	4.932	4.409	3.909	3.704	2.148
1962	11.81	11.62	10.92	9.792	9.216	4.842
1963	10.93	10.78	10.43	9.673	8.887	5.865
1964	12.66	12.49	11.74	10.59	9.852	5.3
1965	12.98	12.65	11.93	10.64	9.923	5.624
1966	11.49	11.33	10.7	9.742	8.961	6.172
1967	23.2	22.62	20.34	16.13	13.91	9.577
1968	10.26	10.07	9.342	8.893	8.319	6.075
1969	11.97	11.8	11.16	10.22	9.443	5.983
1970	12.65	12.32	11.23	9.293	9.085	6.438
1971	8.351	8.224	7.262	6.631	6.127	4.148
1972	24.52	24.22	23.2	20.85	19.52	9.797
1973	21.37	21.09	19.92	18.48	17.07	9.598
1974	11.83	11.6	10.65	8.823	8.347	5.829
1975	7.744	7.575	6.974	6.317	6.063	4.094
1976	11.91	11.77	11.21	10.28	9.707	5.627
1977	9.497	9.403	8.996	8.229	7.771	6.477
1978	8.276	8.114	7.316	6.826	6.466	4.87
1979	7.959	7.815	7.422	6.439	6.205	4.082
1980	10.1	9.892	9.037	7.222	6.301	4.226
1981	7.357	7.263	6.896	6.356	5.913	4.15
1982	18.92	18.7	17.76	15.54	14.44	7.94
1983	7.867	7.717	6.907	6.302	6.063	4.548
1984	11.09	10.77	9.55	7.914	7.441	5.272
1985	13.94	13.78	13.34	12.22	11.23	6.46
1986	13.09	12.9	12.37	11.22	10.61	8.323
1987	8.89	8.841	8.639	8.177	7.788	5.419
1988	6.192	6.049	5.372	4.564	4.383	3.347
1989	11.98	11.68	10.96	8.925	8.38	5.091
1990	8.309	8.153	7.923	6.976	6.7	4.465

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	24.52	24.22	23.2	20.85	19.52	9.797

0.064516	23.2	22.62	20.34	18.48	17.07	9.598
0.096774	21.37	21.09	19.92	16.13	14.44	9.577
0.129032	18.92	18.7	17.76	15.54	13.91	8.323
0.16129	13.94	13.78	13.34	12.22	11.23	7.94
0.193548	13.09	12.9	12.37	11.22	10.61	6.477
0.225806	12.98	12.65	11.93	10.64	9.923	6.46
0.258065	12.66	12.49	11.74	10.59	9.852	6.438
0.290323	12.65	12.32	11.23	10.28	9.707	6.172
0.322581	11.98	11.8	11.21	10.22	9.443	6.075
0.354839	11.97	11.77	11.16	9.792	9.216	5.983
0.387097	11.91	11.68	10.96	9.742	9.085	5.865
0.419355	11.83	11.62	10.92	9.673	8.961	5.829
0.451613	11.81	11.6	10.7	9.293	8.887	5.627
0.483871	11.49	11.33	10.65	8.925	8.38	5.624
0.516129	11.09	10.78	10.43	8.893	8.347	5.419
0.548387	10.93	10.77	9.55	8.823	8.319	5.3
0.580645	10.26	10.07	9.342	8.229	7.788	5.272
0.612903	10.1	9.892	9.037	8.177	7.771	5.091
0.645161	9.497	9.403	8.996	7.914	7.441	4.87
0.677419	8.89	8.841	8.639	7.222	6.7	4.842
0.709677	8.351	8.224	7.923	6.976	6.466	4.548
0.741935	8.309	8.153	7.422	6.826	6.301	4.465
0.774194	8.276	8.114	7.316	6.631	6.205	4.226
0.806452	7.959	7.815	7.262	6.439	6.127	4.15
0.83871	7.867	7.717	6.974	6.356	6.063	4.148
0.870968	7.744	7.575	6.907	6.317	6.063	4.094
0.903226	7.357	7.263	6.896	6.302	5.913	4.082
0.935484	6.192	6.049	5.372	4.564	4.383	3.347
0.967742	5.034	4.932	4.409	3.909	3.704	2.148
0.1	21.125	20.851	19.704	16.071	14.387	9.4516
					Average of yearly averages:	5.726233

Inputs generated by pe4.pl - 8-August-2003

stored as CAcrnEco.out
Chemical: 2,4-D
PRZM environment: CAcornC.txt modified Satday, 12 October 2002 at 16:32:58
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w23232.dvf modified Wedday, 3 July 2002 at 09:04:22
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	5.015	4.924	4.549	3.738	3.38	1.958
1962	5.44	5.339	4.93	4.091	3.815	2.472
1963	7.789	7.672	7.111	6.198	6.066	3.354
1964	5.639	5.542	5.122	4.272	4	2.563
1965	5.609	5.514	5.072	4.225	3.92	2.541
1966	5.447	5.34	4.895	4.012	3.803	2.426
1967	10.36	10.21	9.393	8.946	8.507	4.146
1968	6.201	6.089	5.606	4.651	4.551	2.749
1969	5.746	5.646	5.159	4.237	3.994	2.502
1970	5.454	5.359	4.877	3.959	3.725	2.347
1971	5.621	5.529	5.124	4.283	3.963	2.49
1972	5.442	5.345	4.892	4	3.761	2.422
1973	6.034	5.917	5.367	4.406	4.272	2.559
1974	5.524	5.431	5.01	4.16	3.863	2.48
1975	7.099	6.986	6.358	5.413	5.183	2.848
1976	5.478	5.377	4.864	3.896	3.711	2.301
1977	6.924	6.806	6.411	5.402	5.268	3.06
1978	5.578	5.482	5	4.079	3.854	2.469
1979	7.129	7.005	6.397	5.529	5.407	2.981
1980	5.668	5.566	5.14	4.299	4.014	2.594
1981	8.77	8.618	7.925	7.381	7.056	3.627
1982	7.208	7.089	6.521	5.604	5.489	3.265
1983	12.41	12.21	11.22	9.249	7.968	4.298
1984	5.58	5.474	4.942	3.969	3.832	2.381
1985	5.418	5.316	4.897	4.016	3.775	2.378
1986	9.808	9.635	8.95	8.293	7.848	3.97
1987	5.656	5.541	5.026	4.068	3.954	2.52
1988	5.369	5.268	4.898	4.029	3.728	2.331
1989	6.432	6.283	5.708	4.81	4.426	3.169
1990	6.071	5.952	5.463	4.608	4.491	2.894

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	12.41	12.21	11.22	9.249	8.507	4.298

0.064516	10.36	10.21	9.393	8.946	7.968	4.146
0.096774	9.808	9.635	8.95	8.293	7.848	3.97
0.129032	8.77	8.618	7.925	7.381	7.056	3.627
0.16129	7.789	7.672	7.111	6.198	6.066	3.354
0.193548	7.208	7.089	6.521	5.604	5.489	3.265
0.225806	7.129	7.005	6.411	5.529	5.407	3.169
0.258065	7.099	6.986	6.397	5.413	5.268	3.06
0.290323	6.924	6.806	6.358	5.402	5.183	2.981
0.322581	6.432	6.283	5.708	4.81	4.551	2.894
0.354839	6.201	6.089	5.606	4.651	4.491	2.848
0.387097	6.071	5.952	5.463	4.608	4.426	2.749
0.419355	6.034	5.917	5.367	4.406	4.272	2.594
0.451613	5.746	5.646	5.159	4.299	4.014	2.563
0.483871	5.668	5.566	5.14	4.283	4	2.559
0.516129	5.656	5.542	5.124	4.272	3.994	2.541
0.548387	5.639	5.541	5.122	4.237	3.963	2.52
0.580645	5.621	5.529	5.072	4.225	3.954	2.502
0.612903	5.609	5.514	5.026	4.16	3.92	2.49
0.645161	5.58	5.482	5.01	4.091	3.863	2.48
0.677419	5.578	5.474	5	4.079	3.854	2.472
0.709677	5.524	5.431	4.942	4.068	3.832	2.469
0.741935	5.478	5.377	4.93	4.029	3.815	2.426
0.774194	5.454	5.359	4.898	4.016	3.803	2.422
0.806452	5.447	5.345	4.897	4.012	3.775	2.381
0.83871	5.442	5.34	4.895	4	3.761	2.378
0.870968	5.44	5.339	4.892	3.969	3.728	2.347
0.903226	5.418	5.316	4.877	3.959	3.725	2.331
0.935484	5.369	5.268	4.864	3.896	3.711	2.301
0.967742	5.015	4.924	4.549	3.738	3.38	1.958
0.1	9.7042	9.5333	8.8475	8.2018	7.7688	3.9357
					Average of yearly averages:	2.803167

Inputs generated by pe4.pl - 8-August-2003

stored as TXsorEco.out
Chemical: 2,4-D
PRZM environment: TXsorghumC.txt modified Satday, 12 October 2002 at 17:29:44
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w13958.dvf modified Wedday, 3 July 2002 at 09:06:24
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	6.36	6.148	5.61	4.195	3.407	1.083
1962	11.17	10.79	9.361	6.662	5.276	1.737
1963	2.939	2.824	2.642	1.974	1.563	0.6309
1964	14.12	13.59	11.72	8.297	6.576	2.118
1965	3.034	2.925	2.52	1.813	1.447	0.6877
1966	3.276	3.16	2.82	2.104	1.692	0.5804
1967	2.847	2.731	2.305	1.692	1.359	0.4873
1968	2.852	2.753	2.441	1.894	1.538	0.5411
1969	3.572	3.441	2.906	2.372	1.934	0.6695
1970	2.874	2.771	2.387	1.722	1.369	0.4974
1971	3.724	3.578	3.023	2.404	1.97	0.6701
1972	5.191	4.996	4.272	3.217	2.651	0.9078
1973	8.496	8.208	7.197	5.26	4.284	1.459
1974	2.925	2.819	2.423	1.744	1.404	0.5941
1975	12.24	11.81	10.2	7.453	6.017	1.98
1976	3.708	3.578	3.114	2.63	2.209	0.9538
1977	2.905	2.794	2.394	1.712	1.353	0.5189
1978	2.837	2.727	2.319	1.63	1.29	0.4369
1979	2.844	2.742	2.362	1.914	1.593	0.5611
1980	2.859	2.737	2.294	1.574	1.23	0.4336
1981	37.63	36.7	32.17	22.95	18.18	5.616
1982	4.932	4.747	4.129	3.045	2.416	1.289
1983	2.879	2.78	2.42	1.786	1.434	0.5239
1984	2.841	2.729	2.316	1.634	1.29	0.4448
1985	5.831	5.618	4.801	3.526	2.924	0.9682
1986	2.89	2.781	2.378	1.682	1.33	0.5068
1987	7.872	7.66	6.83	4.959	3.976	1.275
1988	2.924	2.817	2.436	1.822	1.453	0.5723
1989	6.354	6.198	5.381	3.906	3.139	1.015
1990	2.883	2.755	2.292	1.66	1.338	0.5121

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	37.63	36.7	32.17	22.95	18.18	5.616

0.064516	14.12	13.59	11.72	8.297	6.576	2.118
0.096774	12.24	11.81	10.2	7.453	6.017	1.98
0.129032	11.17	10.79	9.361	6.662	5.276	1.737
0.16129	8.496	8.208	7.197	5.26	4.284	1.459
0.193548	7.872	7.66	6.83	4.959	3.976	1.289
0.225806	6.36	6.198	5.61	4.195	3.407	1.275
0.258065	6.354	6.148	5.381	3.906	3.139	1.083
0.290323	5.831	5.618	4.801	3.526	2.924	1.015
0.322581	5.191	4.996	4.272	3.217	2.651	0.9682
0.354839	4.932	4.747	4.129	3.045	2.416	0.9538
0.387097	3.724	3.578	3.114	2.63	2.209	0.9078
0.419355	3.708	3.578	3.023	2.404	1.97	0.6877
0.451613	3.572	3.441	2.906	2.372	1.934	0.6701
0.483871	3.276	3.16	2.82	2.104	1.692	0.6695
0.516129	3.034	2.925	2.642	1.974	1.593	0.6309
0.548387	2.939	2.824	2.52	1.914	1.563	0.5941
0.580645	2.925	2.819	2.441	1.894	1.538	0.5804
0.612903	2.924	2.817	2.436	1.822	1.453	0.5723
0.645161	2.905	2.794	2.423	1.813	1.447	0.5611
0.677419	2.89	2.781	2.42	1.786	1.434	0.5411
0.709677	2.883	2.78	2.394	1.744	1.404	0.5239
0.741935	2.879	2.771	2.387	1.722	1.369	0.5189
0.774194	2.874	2.755	2.378	1.712	1.359	0.5121
0.806452	2.859	2.753	2.362	1.692	1.353	0.5068
0.83871	2.852	2.742	2.319	1.682	1.338	0.4974
0.870968	2.847	2.737	2.316	1.66	1.33	0.4873
0.903226	2.844	2.731	2.305	1.634	1.29	0.4448
0.935484	2.841	2.729	2.294	1.63	1.29	0.4369
0.967742	2.837	2.727	2.292	1.574	1.23	0.4336
0.1	12.133	11.708	10.1161	7.3739	5.9429	1.9557
					Average of yearly averages:	1.009023

Inputs generated by pe4.pl - 8-August-2003

stored as KSsorEco.out
Chemical: 2,4-D
PRZM environment: KSsorghumC.txt modified Satday, 12 October 2002 at 15:57:56
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w13996.dvf modified Wedday, 3 July 2002 at 09:04:44
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	5.646	5.488	4.881	3.762	3.184	1.146
1962	4.485	4.36	4.035	3.255	2.763	1.272
1963	3.884	3.755	3.268	2.606	2.149	0.952
1964	14.12	13.91	12.54	9.766	8.059	2.918
1965	8.877	8.624	7.694	5.955	4.965	2.375
1966	17.59	17.16	15.25	11.63	9.555	3.715
1967	16.56	16.17	14.48	11.29	9.553	4.226
1968	9.376	9.093	8.429	6.514	5.468	2.826
1969	14.3	13.93	13.01	9.967	8.242	3.377
1970	11.98	11.65	10.39	7.843	6.434	2.91
1971	7.64	7.387	6.435	4.935	4.142	1.933
1972	4.098	3.975	3.507	2.883	2.443	1.185
1973	3.09	2.994	2.631	2.211	1.866	0.8763
1974	19.03	18.55	16.65	12.51	10.29	3.762
1975	14.21	13.79	12.48	9.509	7.808	3.547
1976	3.56	3.458	3.134	2.491	2.071	1.303
1977	10.51	10.32	9.546	7.293	6.013	2.265
1978	8.259	8.057	7.125	5.351	4.542	2.106
1979	8.041	7.82	6.956	5.368	4.455	1.944
1980	3.266	3.158	2.751	1.965	1.567	0.8668
1981	11.8	11.43	10.22	7.688	6.375	2.349
1982	6.868	6.698	6.157	4.823	4.007	1.943
1983	4.911	4.768	4.335	3.358	2.744	1.237
1984	4.115	3.994	3.6	3.019	2.528	1.071
1985	3.117	3.045	2.839	2.346	1.971	0.9043
1986	3.474	3.36	2.98	2.509	2.123	0.9212
1987	8.2	7.939	7.12	5.402	4.496	1.755
1988	3.775	3.689	3.245	2.814	2.412	1.222
1989	3.378	3.33	3.044	2.611	2.22	1.006
1990	4.677	4.523	3.961	3.162	2.639	1.108

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	19.03	18.55	16.65	12.51	10.29	4.226

0.064516	17.59	17.16	15.25	11.63	9.555	3.762
0.096774	16.56	16.17	14.48	11.29	9.553	3.715
0.129032	14.3	13.93	13.01	9.967	8.242	3.547
0.16129	14.21	13.91	12.54	9.766	8.059	3.377
0.193548	14.12	13.79	12.48	9.509	7.808	2.918
0.225806	11.98	11.65	10.39	7.843	6.434	2.91
0.258065	11.8	11.43	10.22	7.688	6.375	2.826
0.290323	10.51	10.32	9.546	7.293	6.013	2.375
0.322581	9.376	9.093	8.429	6.514	5.468	2.349
0.354839	8.877	8.624	7.694	5.955	4.965	2.265
0.387097	8.259	8.057	7.125	5.402	4.542	2.106
0.419355	8.2	7.939	7.12	5.368	4.496	1.944
0.451613	8.041	7.82	6.956	5.351	4.455	1.943
0.483871	7.64	7.387	6.435	4.935	4.142	1.933
0.516129	6.868	6.698	6.157	4.823	4.007	1.755
0.548387	5.646	5.488	4.881	3.762	3.184	1.303
0.580645	4.911	4.768	4.335	3.358	2.763	1.272
0.612903	4.677	4.523	4.035	3.255	2.744	1.237
0.645161	4.485	4.36	3.961	3.162	2.639	1.222
0.677419	4.115	3.994	3.6	3.019	2.528	1.185
0.709677	4.098	3.975	3.507	2.883	2.443	1.146
0.741935	3.884	3.755	3.268	2.814	2.412	1.108
0.774194	3.775	3.689	3.245	2.611	2.22	1.071
0.806452	3.56	3.458	3.134	2.606	2.149	1.006
0.83871	3.474	3.36	3.044	2.509	2.123	0.952
0.870968	3.378	3.33	2.98	2.491	2.071	0.9212
0.903226	3.266	3.158	2.839	2.346	1.971	0.9043
0.935484	3.117	3.045	2.751	2.211	1.866	0.8763
0.967742	3.09	2.994	2.631	1.965	1.567	0.8668
0.1	16.334	15.946	14.333	11.1577	9.4219	3.6982
					Average of yearly averages:	1.967387

Inputs generated by pe4.pl - 8-August-2003

stored as MSsoyEco.out
Chemical: 2,4-D
PRZM environment: MSsoybeanC.txt modified Satday, 12 October 2002 at 17:07:44
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w13893.dvf modified Wedday, 3 July 2002 at 09:06:20
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	3.631	3.573	3.435	3.007	2.657	0.9537
1962	3.57	3.522	3.344	3.064	2.675	0.9505
1963	19.42	19.08	18.17	15.23	13.14	4.516
1964	3.382	3.333	3.154	2.76	2.399	0.9506
1965	4.101	4.064	3.834	3.345	2.914	1.023
1966	2.929	2.884	2.706	2.313	2.027	0.7367
1967	3.535	3.475	3.188	2.795	2.47	0.9065
1968	11.16	11.03	10.78	9.317	8.111	2.809
1969	4.052	4.005	3.82	3.355	2.967	1.105
1970	2.943	2.904	2.838	2.468	2.137	0.7654
1971	2.93	2.902	2.805	2.437	2.139	0.7593
1972	4.811	4.738	4.465	3.764	3.302	1.17
1973	15.75	15.54	14.76	12.76	11.17	3.84
1974	6.348	6.235	5.934	5.049	4.38	1.626
1975	28.51	28.17	26.7	22.7	19.59	6.758
1976	4.48	4.403	4.048	3.594	3.236	1.355
1977	5.303	5.205	4.82	4.064	3.467	1.171
1978	13.65	13.48	12.83	10.69	9.178	3.105
1979	3.749	3.692	3.493	3.097	2.729	1.023
1980	12.63	12.49	11.89	10.17	8.743	2.866
1981	3.219	3.167	2.917	2.643	2.303	0.8293
1982	10.73	10.6	10.13	8.648	7.435	2.525
1983	3.087	3.042	2.864	2.619	2.331	0.8707
1984	3.998	3.951	3.803	3.346	2.946	1.033
1985	4.489	4.411	4.257	3.58	3.169	1.124
1986	14.36	14.12	13.36	11.2	9.623	3.212
1987	8.323	8.189	7.646	6.382	5.432	1.913
1988	3.484	3.431	3.23	2.797	2.424	0.8583
1989	3.184	3.152	2.925	2.676	2.369	0.8544
1990	7.442	7.322	6.859	5.811	5.047	1.753

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	28.51	28.17	26.7	22.7	19.59	6.758

0.064516	19.42	19.08	18.17	15.23	13.14	4.516
0.096774	15.75	15.54	14.76	12.76	11.17	3.84
0.129032	14.36	14.12	13.36	11.2	9.623	3.212
0.16129	13.65	13.48	12.83	10.69	9.178	3.105
0.193548	12.63	12.49	11.89	10.17	8.743	2.866
0.225806	11.16	11.03	10.78	9.317	8.111	2.809
0.258065	10.73	10.6	10.13	8.648	7.435	2.525
0.290323	8.323	8.189	7.646	6.382	5.432	1.913
0.322581	7.442	7.322	6.859	5.811	5.047	1.753
0.354839	6.348	6.235	5.934	5.049	4.38	1.626
0.387097	5.303	5.205	4.82	4.064	3.467	1.355
0.419355	4.811	4.738	4.465	3.764	3.302	1.171
0.451613	4.489	4.411	4.257	3.594	3.236	1.17
0.483871	4.48	4.403	4.048	3.58	3.169	1.124
0.516129	4.101	4.064	3.834	3.355	2.967	1.105
0.548387	4.052	4.005	3.82	3.346	2.946	1.033
0.580645	3.998	3.951	3.803	3.345	2.914	1.023
0.612903	3.749	3.692	3.493	3.097	2.729	1.023
0.645161	3.631	3.573	3.435	3.064	2.675	0.9537
0.677419	3.57	3.522	3.344	3.007	2.657	0.9506
0.709677	3.535	3.475	3.23	2.797	2.47	0.9505
0.741935	3.484	3.431	3.188	2.795	2.424	0.9065
0.774194	3.382	3.333	3.154	2.76	2.399	0.8707
0.806452	3.219	3.167	2.925	2.676	2.369	0.8583
0.83871	3.184	3.152	2.917	2.643	2.331	0.8544
0.870968	3.087	3.042	2.864	2.619	2.303	0.8293
0.903226	2.943	2.904	2.838	2.468	2.139	0.7654
0.935484	2.93	2.902	2.805	2.437	2.137	0.7593
0.967742	2.929	2.884	2.706	2.313	2.027	0.7367
0.1	15.611	15.398	14.62	12.604	11.0153	3.7772
					Average of yearly averages:	1.778747

Inputs generated by pe4.pl - 8-August-2003

stored as NCpasEco.out
Chemical: 2,4-D
PRZM environment: NCalfalfaC.txt modified Satday, 12 October 2002 at 17:08:44
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w03812.dvf modified Wedday, 3 July 2002 at 09:05:50
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1965	13.23	12.91	12.22	10.12	9.155	3.706
1966	17.36	16.91	15.19	13.47	12.08	5.931
1967	53.63	52.44	47.55	39.32	36.49	16.82
1968	32.48	31.61	28.44	24.96	22.82	13.56
1969	14.02	13.61	12.43	10.99	10.08	6.587
1970	12.44	12.08	10.84	10.01	9.343	5.036
1971	14.67	14.28	12.86	10.68	9.445	4.816
1972	16.68	16.24	15.23	13.16	11.74	5.731
1973	19.37	18.83	17.31	14.06	12.45	6.418
1974	24.93	24.3	21.92	17.36	14.96	7.368
1975	12.17	11.86	11.23	9.298	8.636	5.153
1976	16.44	16.02	14.83	12.92	11.89	5.915
1977	12.3	11.93	10.53	8.587	7.927	4.59
1978	12.63	12.28	10.94	9.288	8.649	4.268
1979	20.09	19.74	17.96	14.69	13.28	6.241
1980	12.69	12.28	10.74	8.665	7.904	4.475
1981	57.92	56.24	50.23	41.51	35.68	13.95
1982	24.77	24.08	22.12	18.26	16.4	9.983
1983	16.57	16.07	14.21	12.84	11.3	6.234
1984	15.51	15.12	13.74	12.15	10.75	5.499
1985	20.74	20.19	18.08	14.46	12.48	6.233
1986	12	11.64	10.25	8.555	7.876	4.443
1987	120	117	105	86.68	73.95	27.73
1988	18.77	18.68	18.32	17.41	16.53	10.65
1989	43.14	41.96	38.25	30.31	26.11	11.89
1990	20.66	20.1	18.25	15.01	13.11	8.433

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.037037	120	117	105	86.68	73.95	27.73
0.074074	57.92	56.24	50.23	41.51	36.49	16.82
0.111111	53.63	52.44	47.55	39.32	35.68	13.95
0.148148	43.14	41.96	38.25	30.31	26.11	13.56
0.185185	32.48	31.61	28.44	24.96	22.82	11.89

0.222222	24.93	24.3	22.12	18.26	16.53	10.65
0.259259	24.77	24.08	21.92	17.41	16.4	9.983
0.296296	20.74	20.19	18.32	17.36	14.96	8.433
0.333333	20.66	20.1	18.25	15.01	13.28	7.368
0.37037	20.09	19.74	18.08	14.69	13.11	6.587
0.407407	19.37	18.83	17.96	14.46	12.48	6.418
0.444444	18.77	18.68	17.31	14.06	12.45	6.241
0.481481	17.36	16.91	15.23	13.47	12.08	6.234
0.518519	16.68	16.24	15.19	13.16	11.89	6.233
0.555556	16.57	16.07	14.83	12.92	11.74	5.931
0.592593	16.44	16.02	14.21	12.84	11.3	5.915
0.62963	15.51	15.12	13.74	12.15	10.75	5.731
0.666667	14.67	14.28	12.86	10.99	10.08	5.499
0.703704	14.02	13.61	12.43	10.68	9.445	5.153
0.740741	13.23	12.91	12.22	10.12	9.343	5.036
0.777778	12.69	12.28	11.23	10.01	9.155	4.816
0.814815	12.63	12.28	10.94	9.298	8.649	4.59
0.851852	12.44	12.08	10.84	9.288	8.636	4.475
0.888889	12.3	11.93	10.74	8.665	7.927	4.443
0.925926	12.17	11.86	10.53	8.587	7.904	4.268
0.962963	12	11.64	10.25	8.555	7.876	3.706
0.1	54.917	53.58	48.354	39.977	35.923	14.811
					Average of yearly averages:	8.140769

Inputs generated by pe4.pl - 8-August-2003

stored as NCappEco.out
Chemical: 2,4-D
PRZM environment: NCappleC.txt modified Satday, 12 October 2002 at 17:09:36
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w03812.dvf modified Wedday, 3 July 2002 at 09:05:50
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1965	10.37	10.11	9.282	7.965	7.185	3.371
1966	14.3	13.99	12.76	10.3	10.22	6.327
1967	47.38	46.55	42.82	36.53	33.12	15.94
1968	24.95	24.35	23.07	18.8	17.9	14.07
1969	11.09	10.81	10.07	8.615	7.748	6.141
1970	8.69	8.459	7.576	6.116	5.683	4.291
1971	8.618	8.396	7.543	6.158	5.433	3.694
1972	9.9	9.642	8.652	7.11	7.024	4.326
1973	9.437	9.178	8.192	6.811	6.55	4.343
1974	9.017	8.867	8.036	6.714	6.02	4.084
1975	12.55	12.22	11.13	9.305	8.323	4.81
1976	29.22	28.49	25.71	21.41	19.28	9.263
1977	11.61	11.55	11.3	10.69	10.08	8.099
1978	11.74	11.44	10.27	8.319	7.97	5.614
1979	10.76	10.5	9.759	8.301	7.836	5.203
1980	9.126	8.869	8.192	6.832	6.101	4.315
1981	40.53	39.36	35.26	27.43	24.03	10.64
1982	12.29	11.98	10.95	9.077	8.706	6.595
1983	10.71	10.45	9.443	7.64	7.302	4.977
1984	15	14.62	13.33	11.23	10.2	5.861
1985	62.31	60.73	54.71	45.21	40.02	15.89
1986	57.36	55.91	50.35	41.15	36.51	20.54
1987	104	101	90.66	71.51	61.07	29.4
1988	17.46	17.38	17.04	16.18	15.36	9.897
1989	41.71	40.63	36.68	30.28	27.04	12.84
1990	63.9	62.42	55.97	45.83	40.74	19.76

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.037037	104	101	90.66	71.51	61.07	29.4
0.074074	63.9	62.42	55.97	45.83	40.74	20.54
0.111111	62.31	60.73	54.71	45.21	40.02	19.76
0.148148	57.36	55.91	50.35	41.15	36.51	15.94
0.185185	47.38	46.55	42.82	36.53	33.12	15.89

0.222222	41.71	40.63	36.68	30.28	27.04	14.07
0.259259	40.53	39.36	35.26	27.43	24.03	12.84
0.296296	29.22	28.49	25.71	21.41	19.28	10.64
0.333333	24.95	24.35	23.07	18.8	17.9	9.897
0.37037	17.46	17.38	17.04	16.18	15.36	9.263
0.407407	15	14.62	13.33	11.23	10.22	8.099
0.444444	14.3	13.99	12.76	10.69	10.2	6.595
0.481481	12.55	12.22	11.3	10.3	10.08	6.327
0.518519	12.29	11.98	11.13	9.305	8.706	6.141
0.555556	11.74	11.55	10.95	9.077	8.323	5.861
0.592593	11.61	11.44	10.27	8.615	7.97	5.614
0.62963	11.09	10.81	10.07	8.319	7.836	5.203
0.666667	10.76	10.5	9.759	8.301	7.748	4.977
0.703704	10.71	10.45	9.443	7.965	7.302	4.81
0.740741	10.37	10.11	9.282	7.64	7.185	4.343
0.777778	9.9	9.642	8.652	7.11	7.024	4.326
0.814815	9.437	9.178	8.192	6.832	6.55	4.315
0.851852	9.126	8.869	8.192	6.811	6.101	4.291
0.888889	9.017	8.867	8.036	6.714	6.02	4.084
0.925926	8.69	8.459	7.576	6.158	5.683	3.694
0.962963	8.618	8.396	7.543	6.116	5.433	3.371
0.1	62.787	61.237	55.088	45.396	40.236	19.994
					Average of yearly averages:	9.241962

Inputs generated by pe4.pl - 8-August-2003

stored as ORappEco.out
Chemical: 2,4-D
PRZM environment: ORappleC.txt modified Satday, 12 October 2002 at 17:16:34
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w24229.dvf modified Wedday, 3 July 2002 at 09:06:10
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	7.903	7.76	7.201	6.299	5.822	2.407
1962	8.866	8.692	8.057	7.25	6.7	4.346
1963	9.123	8.933	8.198	7.14	6.583	4.597
1964	9.276	9.119	8.501	7.452	6.905	4.712
1965	8.858	8.696	8.061	6.975	6.386	4.559
1966	9.248	9.061	8.332	7.249	6.665	4.562
1967	8.527	8.341	7.646	6.716	6.188	4.32
1968	9.327	9.156	8.681	7.728	7.146	4.516
1969	17.34	17	15.68	13.7	12.6	6.476
1970	9.504	9.335	8.671	8.005	7.497	6.216
1971	8.832	8.671	8.061	7.111	6.578	4.639
1972	10.04	9.858	9.197	8.282	7.671	4.77
1973	9.421	9.296	8.836	7.925	7.345	5.028
1974	8.867	8.664	7.887	6.826	6.288	4.637
1975	8.897	8.709	7.982	6.947	6.404	4.367
1976	9.014	8.835	8.137	7.061	6.486	4.432
1977	8.879	8.72	8.206	7.219	6.672	4.517
1978	8.89	8.732	8.111	7.057	6.536	4.495
1979	8.693	8.504	7.772	6.812	6.307	4.461
1980	8.87	8.694	8.007	6.915	6.336	4.358
1981	8.624	8.449	7.823	7.104	6.575	4.311
1982	20.36	19.94	18.42	16.05	14.8	6.792
1983	10.87	10.77	10.36	9.482	8.833	6.829
1984	8.771	8.597	7.92	6.961	6.425	4.586
1985	9.198	9.033	8.389	7.359	6.846	4.506
1986	12.33	12.11	11.29	9.918	9.269	5.397
1987	9.001	8.813	8.082	6.923	6.318	5.154
1988	9.965	9.765	9.049	7.958	7.304	4.568
1989	9.042	8.852	8.117	7.042	6.468	4.641
1990	8.503	8.315	7.591	6.616	6.088	4.219

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	20.36	19.94	18.42	16.05	14.8	6.829

0.064516	17.34	17	15.68	13.7	12.6	6.792
0.096774	12.33	12.11	11.29	9.918	9.269	6.476
0.129032	10.87	10.77	10.36	9.482	8.833	6.216
0.16129	10.04	9.858	9.197	8.282	7.671	5.397
0.193548	9.965	9.765	9.049	8.005	7.497	5.154
0.225806	9.504	9.335	8.836	7.958	7.345	5.028
0.258065	9.421	9.296	8.681	7.925	7.304	4.77
0.290323	9.327	9.156	8.671	7.728	7.146	4.712
0.322581	9.276	9.119	8.501	7.452	6.905	4.641
0.354839	9.248	9.061	8.389	7.359	6.846	4.639
0.387097	9.198	9.033	8.332	7.25	6.7	4.637
0.419355	9.123	8.933	8.206	7.249	6.672	4.597
0.451613	9.042	8.852	8.198	7.219	6.665	4.586
0.483871	9.014	8.835	8.137	7.14	6.583	4.568
0.516129	9.001	8.813	8.117	7.111	6.578	4.562
0.548387	8.897	8.732	8.111	7.104	6.575	4.559
0.580645	8.89	8.72	8.082	7.061	6.536	4.517
0.612903	8.879	8.709	8.061	7.057	6.486	4.516
0.645161	8.87	8.696	8.061	7.042	6.468	4.506
0.677419	8.867	8.694	8.057	6.975	6.425	4.495
0.709677	8.866	8.692	8.007	6.961	6.404	4.461
0.741935	8.858	8.671	7.982	6.947	6.386	4.432
0.774194	8.832	8.664	7.92	6.923	6.336	4.367
0.806452	8.771	8.597	7.887	6.915	6.318	4.358
0.83871	8.693	8.504	7.823	6.826	6.307	4.346
0.870968	8.624	8.449	7.772	6.812	6.288	4.32
0.903226	8.527	8.341	7.646	6.716	6.188	4.311
0.935484	8.503	8.315	7.591	6.616	6.088	4.219
0.967742	7.903	7.76	7.201	6.299	5.822	2.407
0.1	12.184	11.976	11.197	9.8744	9.2254	6.45
					Average of yearly averages:	4.7806

Inputs generated by pe4.pl - 8-August-2003

stored as PAappEco.out
Chemical: 2,4-D
PRZM environment: PAappleC.txt modified Satday, 12 October 2002 at 17:24:46
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14737.dvf modified Wedday, 3 July 2002 at 09:06:12
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	12.56	12.19	10.89	8.573	8.825	3.831
1962	9.168	9.032	8.551	7.961	7.466	5.238
1963	13.11	12.88	12.35	11.17	10.36	6.128
1964	9.397	9.196	8.819	7.931	7.371	6.161
1965	9.806	9.676	9.398	8.685	8.208	5.404
1966	24.24	23.78	22.93	20.47	19.01	8.806
1967	23.49	22.87	20.5	16.4	15.22	11.88
1968	9.258	9.211	9.016	8.589	8.23	6.382
1969	8.947	8.768	8.109	7.207	6.705	4.744
1970	10.12	9.896	9.276	8.544	8.04	5.288
1971	8.811	8.611	7.839	7.359	6.927	5.361
1972	9.256	9.06	8.308	7.568	7.095	5.143
1973	46.54	45.51	41.64	35.76	32.78	12.47
1974	23.67	23.55	23.02	21.88	20.93	13.67
1975	19.13	18.77	17.51	15.27	14.05	8.656
1976	28.73	28.14	25.92	22.81	21.25	11.06
1977	16.48	16.38	16.01	15.2	14.48	9.432
1978	15.96	15.51	13.8	10.83	10.24	6.72
1979	25.45	24.89	23.02	20.21	18.63	8.839
1980	14	13.93	13.61	12.93	12.38	8.112
1981	10.78	10.57	9.775	8.72	8.126	5.037
1982	9.257	9.068	8.428	7.408	6.835	5.355
1983	8.635	8.441	7.962	7.061	6.542	4.578
1984	17.84	17.32	15.39	12.23	11.35	6.698
1985	25.82	25.23	23.52	20.64	19.15	8.813
1986	15.22	15.14	14.79	14.03	13.4	9.086
1987	15.1	14.89	13.73	12.13	11.27	6.599
1988	9.801	9.611	8.878	7.919	7.535	6.522
1989	20.36	19.92	18.36	16.03	14.84	7.373
1990	13.68	13.29	11.8	10.4	9.845	8.517

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	46.54	45.51	41.64	35.76	32.78	13.67

0.064516	28.73	28.14	25.92	22.81	21.25	12.47
0.096774	25.82	25.23	23.52	21.88	20.93	11.88
0.129032	25.45	24.89	23.02	20.64	19.15	11.06
0.16129	24.24	23.78	23.02	20.47	19.01	9.432
0.193548	23.67	23.55	22.93	20.21	18.63	9.086
0.225806	23.49	22.87	20.5	16.4	15.22	8.839
0.258065	20.36	19.92	18.36	16.03	14.84	8.813
0.290323	19.13	18.77	17.51	15.27	14.48	8.806
0.322581	17.84	17.32	16.01	15.2	14.05	8.656
0.354839	16.48	16.38	15.39	14.03	13.4	8.517
0.387097	15.96	15.51	14.79	12.93	12.38	8.112
0.419355	15.22	15.14	13.8	12.23	11.35	7.373
0.451613	15.1	14.89	13.73	12.13	11.27	6.72
0.483871	14	13.93	13.61	11.17	10.36	6.698
0.516129	13.68	13.29	12.35	10.83	10.24	6.599
0.548387	13.11	12.88	11.8	10.4	9.845	6.522
0.580645	12.56	12.19	10.89	8.72	8.825	6.382
0.612903	10.78	10.57	9.775	8.685	8.23	6.161
0.645161	10.12	9.896	9.398	8.589	8.208	6.128
0.677419	9.806	9.676	9.276	8.573	8.126	5.404
0.709677	9.801	9.611	9.016	8.544	8.04	5.361
0.741935	9.397	9.211	8.878	7.961	7.535	5.355
0.774194	9.258	9.196	8.819	7.931	7.466	5.288
0.806452	9.257	9.068	8.551	7.919	7.371	5.238
0.83871	9.256	9.06	8.428	7.568	7.095	5.143
0.870968	9.168	9.032	8.308	7.408	6.927	5.037
0.903226	8.947	8.768	8.109	7.359	6.835	4.744
0.935484	8.811	8.611	7.962	7.207	6.705	4.578
0.967742	8.635	8.441	7.839	7.061	6.542	3.831
0.1	25.783	25.196	23.47	21.756	20.752	11.798
					Average of yearly averages:	7.396767

Inputs generated by pe4.pl - 8-August-2003

stored as ORfilEco.out
Chemical: 2,4-D
PRZM environment: ORfilberts C.txt modified Satday, 12 October 2002 at 17:18:04
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w24232.dvf modified Wedday, 3 July 2002 at 09:06:10
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	7.118	6.96	6.483	5.729	5.488	2.58
1962	8.265	8.101	7.488	6.788	6.426	4.221
1963	8.432	8.259	7.581	6.925	6.489	4.373
1964	8.288	8.13	7.577	6.848	6.512	4.39
1965	8.119	7.951	7.393	6.71	6.354	4.372
1966	8.102	7.928	7.311	6.653	6.263	4.252
1967	7.64	7.45	6.829	6.233	5.902	4.006
1968	8.85	8.675	8.1	7.313	7.066	4.535
1969	8.495	8.33	7.835	7.281	7.065	4.95
1970	8.195	8.032	7.498	6.799	6.497	4.663
1971	12.61	12.42	11.54	10.02	9.229	5.535
1972	8.419	8.241	7.714	7.091	6.776	5.35
1973	8.355	8.196	7.592	6.881	6.543	4.555
1974	8.175	7.997	7.33	6.692	6.3	4.335
1975	8.324	8.163	7.533	6.816	6.436	4.289
1976	8.445	8.282	7.667	6.966	6.588	4.453
1977	8.04	7.858	7.319	6.696	6.375	4.408
1978	7.861	7.691	7.279	6.535	6.231	4.247
1979	11.02	10.8	9.961	8.576	7.862	4.997
1980	8.743	8.574	7.925	7.253	6.873	4.993
1981	8.765	8.573	7.94	7.409	7.153	4.868
1982	8.218	8.046	7.449	6.787	6.405	4.56
1983	8.223	8.044	7.449	6.737	6.373	4.272
1984	8.416	8.236	7.625	7.004	6.676	4.459
1985	8.689	8.517	7.949	7.298	7.013	4.856
1986	8.037	7.855	7.317	6.7	6.351	4.495
1987	8.457	8.271	7.639	7.049	6.631	4.356
1988	8.142	7.97	7.362	6.696	6.305	4.276
1989	8.177	8.01	7.379	6.688	6.301	4.201
1990	7.765	7.588	6.961	6.312	5.945	4.075

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	12.61	12.42	11.54	10.02	9.229	5.535

0.064516	11.02	10.8	9.961	8.576	7.862	5.35
0.096774	8.85	8.675	8.1	7.409	7.153	4.997
0.129032	8.765	8.574	7.949	7.313	7.066	4.993
0.16129	8.743	8.573	7.94	7.298	7.065	4.95
0.193548	8.689	8.517	7.925	7.281	7.013	4.868
0.225806	8.495	8.33	7.835	7.253	6.873	4.856
0.258065	8.457	8.282	7.714	7.091	6.776	4.663
0.290323	8.445	8.271	7.667	7.049	6.676	4.56
0.322581	8.432	8.259	7.639	7.004	6.631	4.555
0.354839	8.419	8.241	7.625	6.966	6.588	4.535
0.387097	8.416	8.236	7.592	6.925	6.543	4.495
0.419355	8.355	8.196	7.581	6.881	6.512	4.459
0.451613	8.324	8.163	7.577	6.848	6.497	4.453
0.483871	8.288	8.13	7.533	6.816	6.489	4.408
0.516129	8.265	8.101	7.498	6.799	6.436	4.39
0.548387	8.223	8.046	7.488	6.788	6.426	4.373
0.580645	8.218	8.044	7.449	6.787	6.405	4.372
0.612903	8.195	8.032	7.449	6.737	6.375	4.356
0.645161	8.177	8.01	7.393	6.71	6.373	4.335
0.677419	8.175	7.997	7.379	6.7	6.354	4.289
0.709677	8.142	7.97	7.362	6.696	6.351	4.276
0.741935	8.119	7.951	7.33	6.696	6.305	4.272
0.774194	8.102	7.928	7.319	6.692	6.301	4.252
0.806452	8.04	7.858	7.317	6.688	6.3	4.247
0.83871	8.037	7.855	7.311	6.653	6.263	4.221
0.870968	7.861	7.691	7.279	6.535	6.231	4.201
0.903226	7.765	7.588	6.961	6.312	5.945	4.075
0.935484	7.64	7.45	6.829	6.233	5.902	4.006
0.967742	7.118	6.96	6.483	5.729	5.488	2.58
0.1	8.8415	8.6649	8.0849	7.3994	7.1443	4.9966
					Average of yearly averages:	4.464067

Inputs generated by pe4.pl - 8-August-2003

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FL Citrus 8/09/2001
Osceola County; Representation of the Lake Kissimmee/Indian River Region; MLRA
156A; Metfile: W12834.dvf [Daytona Beach] (old: Met156A.met)
*** Record 3:
    0.78       0       0      25       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.04   0.303       1      10               4       2     354
*** Record 8
       1
*** Record 9
       1     0.1      10     100       3  74  74  74       0       5
*** Record 9a-d
       1      25
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1507 1607 0108
.023 .026 .030 .035 .042 .050 .056 .060 .063 .068 .074 .079 .082 .125 .148 .189
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
1608 0109 1609 0110 1610 0111 1611 0112 1612
.229 .265 .294 .314 .326 .017 .018 .019 .021
.023 .023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  010261  150261  151261       1
  010262  150262  151262       1
  010263  150263  151263       1
  010264  150264  151264       1
  010265  150265  151265       1
  010266  150266  151266       1
  010267  150267  151267       1
  010268  150268  151268       1
  010269  150269  151269       1
  010270  150270  151270       1
  010271  150271  151271       1
  010272  150272  151272       1
  010273  150273  151273       1
  010274  150274  151274       1
  010275  150275  151275       1
  010276  150276  151276       1
  010277  150277  151277       1
  010278  150278  151278       1
  010279  150279  151279       1
  010280  150280  151280       1
  010281  150281  151281       1
  010282  150282  151282       1
  010283  150283  151283       1
  010284  150284  151284       1
  010285  150285  151285       1
  010286  150286  151286       1
  010287  150287  151287       1
  010288  150288  151288       1
  010289  150289  151289       1
  010290  150290  151290       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 2.24 kg/ha
*** Record 13
      60       1       0       0
*** Record 15 -- PSTNAM
```

```
2,4-D
*** Record 16
  010461  0 2  0.0  2.24 0.95 0.01
  280961  0 2  0.0  2.24 0.95 0.01
  010462  0 2  0.0  2.24 0.95 0.01
  280962  0 2  0.0  2.24 0.95 0.01
  010463  0 2  0.0  2.24 0.95 0.01
  280963  0 2  0.0  2.24 0.95 0.01
  010464  0 2  0.0  2.24 0.95 0.01
  280964  0 2  0.0  2.24 0.95 0.01
  010465  0 2  0.0  2.24 0.95 0.01
  280965  0 2  0.0  2.24 0.95 0.01
  010466  0 2  0.0  2.24 0.95 0.01
  280966  0 2  0.0  2.24 0.95 0.01
  010467  0 2  0.0  2.24 0.95 0.01
  280967  0 2  0.0  2.24 0.95 0.01
  010468  0 2  0.0  2.24 0.95 0.01
  280968  0 2  0.0  2.24 0.95 0.01
  010469  0 2  0.0  2.24 0.95 0.01
  280969  0 2  0.0  2.24 0.95 0.01
  010470  0 2  0.0  2.24 0.95 0.01
  280970  0 2  0.0  2.24 0.95 0.01
  010471  0 2  0.0  2.24 0.95 0.01
  280971  0 2  0.0  2.24 0.95 0.01
  010472  0 2  0.0  2.24 0.95 0.01
  280972  0 2  0.0  2.24 0.95 0.01
  010473  0 2  0.0  2.24 0.95 0.01
  280973  0 2  0.0  2.24 0.95 0.01
  010474  0 2  0.0  2.24 0.95 0.01
  280974  0 2  0.0  2.24 0.95 0.01
  010475  0 2  0.0  2.24 0.95 0.01
  280975  0 2  0.0  2.24 0.95 0.01
  010476  0 2  0.0  2.24 0.95 0.01
  280976  0 2  0.0  2.24 0.95 0.01
  010477  0 2  0.0  2.24 0.95 0.01
  280977  0 2  0.0  2.24 0.95 0.01
  010478  0 2  0.0  2.24 0.95 0.01
  280978  0 2  0.0  2.24 0.95 0.01
  010479  0 2  0.0  2.24 0.95 0.01
  280979  0 2  0.0  2.24 0.95 0.01
  010480  0 2  0.0  2.24 0.95 0.01
  280980  0 2  0.0  2.24 0.95 0.01
  010481  0 2  0.0  2.24 0.95 0.01
  280981  0 2  0.0  2.24 0.95 0.01
  010482  0 2  0.0  2.24 0.95 0.01
  280982  0 2  0.0  2.24 0.95 0.01
  010483  0 2  0.0  2.24 0.95 0.01
  280983  0 2  0.0  2.24 0.95 0.01
  010484  0 2  0.0  2.24 0.95 0.01
  280984  0 2  0.0  2.24 0.95 0.01
  010485  0 2  0.0  2.24 0.95 0.01
  280985  0 2  0.0  2.24 0.95 0.01
  010486  0 2  0.0  2.24 0.95 0.01
  280986  0 2  0.0  2.24 0.95 0.01
  010487  0 2  0.0  2.24 0.95 0.01
  280987  0 2  0.0  2.24 0.95 0.01
  010488  0 2  0.0  2.24 0.95 0.01
  280988  0 2  0.0  2.24 0.95 0.01
  010489  0 2  0.0  2.24 0.95 0.01
```

```
  280989  0 2  0.0  2.24 0.95 0.01
  010490  0 2  0.0  2.24 0.95 0.01
  280990  0 2  0.0  2.24 0.95 0.01
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
Adamsville Sand; Hydrologic Group C
*** Record 20
     102           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       4
       1       2    0.37    0.47       0       0       0
        0.0288810.028881       0
             0.1    0.47    0.27     7.5       0
       2      10    1.44   0.086       0       0       0
        0.0288810.028881       0
             0.1   0.086   0.036    0.58       0
       3      10    1.44   0.086       0       0       0
        0.0288810.028881       0
             0.1   0.086   0.036    0.58       0
       4      80    1.58    0.03       0       0       0
        0.0288810.028881       0
               5    0.03   0.023   0.116       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
PA Turf; 9/28/01
"York Co, MLRA 148; Metfile: W14737.dvf (old: Met148.met),
*** Record 3:
    0.76     0.3       0    12.5       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.33   0.123       1      10               3      12     354
*** Record 8
       1
*** Record 9
       1     0.1      10     100       3  74  74  74       0       5
*** Record 9a-d
       1      26
0101 1601 0102 1602 0103 1503 1603 0104 1604 0105 1605 0106 1506 1606 0107 1607
.015 .015 .015 .015 .015 .017 .012 .006 .002 .007 .004 .002 .007 .005 .003 .001
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.005 .003 .003 .005 .009 .013 .013 .014 .014 .015
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  010461  150461  011161       1
  010462  150462  011162       1
  010463  150463  011163       1
  010464  150464  011164       1
  010465  150465  011165       1
  010466  150466  011166       1
  010467  150467  011167       1
  010468  150468  011168       1
  010469  150469  011169       1
  010470  150470  011170       1
  010471  150471  011171       1
  010472  150472  011172       1
  010473  150473  011173       1
  010474  150474  011174       1
  010475  150475  011175       1
  010476  150476  011176       1
  010477  150477  011177       1
  010478  150478  011178       1
  010479  150479  011179       1
  010480  150480  011180       1
  010481  150481  011181       1
  010482  150482  011182       1
  010483  150483  011183       1
  010484  150484  011184       1
  010485  150485  011185       1
  010486  150486  011186       1
  010487  150487  011187       1
  010488  150488  011188       1
  010489  150489  011189       1
  010490  150490  011190       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 2.24 kg/ha
*** Record 13
      60       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  010561  0 2  0.0  2.24 0.95 0.01
  290861  0 2  0.0  2.24 0.95 0.01
  010562  0 2  0.0  2.24 0.95 0.01
  290862  0 2  0.0  2.24 0.95 0.01
  010563  0 2  0.0  2.24 0.95 0.01
  290863  0 2  0.0  2.24 0.95 0.01
  010564  0 2  0.0  2.24 0.95 0.01
  290864  0 2  0.0  2.24 0.95 0.01
  010565  0 2  0.0  2.24 0.95 0.01
  290865  0 2  0.0  2.24 0.95 0.01
  010566  0 2  0.0  2.24 0.95 0.01
  290866  0 2  0.0  2.24 0.95 0.01
  010567  0 2  0.0  2.24 0.95 0.01
  290867  0 2  0.0  2.24 0.95 0.01
  010568  0 2  0.0  2.24 0.95 0.01
  290868  0 2  0.0  2.24 0.95 0.01
  010569  0 2  0.0  2.24 0.95 0.01
  290869  0 2  0.0  2.24 0.95 0.01
  010570  0 2  0.0  2.24 0.95 0.01
  290870  0 2  0.0  2.24 0.95 0.01
  010571  0 2  0.0  2.24 0.95 0.01
  290871  0 2  0.0  2.24 0.95 0.01
  010572  0 2  0.0  2.24 0.95 0.01
  290872  0 2  0.0  2.24 0.95 0.01
  010573  0 2  0.0  2.24 0.95 0.01
  290873  0 2  0.0  2.24 0.95 0.01
  010574  0 2  0.0  2.24 0.95 0.01
  290874  0 2  0.0  2.24 0.95 0.01
  010575  0 2  0.0  2.24 0.95 0.01
  290875  0 2  0.0  2.24 0.95 0.01
  010576  0 2  0.0  2.24 0.95 0.01
  290876  0 2  0.0  2.24 0.95 0.01
  010577  0 2  0.0  2.24 0.95 0.01
  290877  0 2  0.0  2.24 0.95 0.01
  010578  0 2  0.0  2.24 0.95 0.01
  290878  0 2  0.0  2.24 0.95 0.01
  010579  0 2  0.0  2.24 0.95 0.01
  290879  0 2  0.0  2.24 0.95 0.01
  010580  0 2  0.0  2.24 0.95 0.01
  290880  0 2  0.0  2.24 0.95 0.01
  010581  0 2  0.0  2.24 0.95 0.01
  290881  0 2  0.0  2.24 0.95 0.01
  010582  0 2  0.0  2.24 0.95 0.01
  290882  0 2  0.0  2.24 0.95 0.01
  010583  0 2  0.0  2.24 0.95 0.01
  290883  0 2  0.0  2.24 0.95 0.01
  010584  0 2  0.0  2.24 0.95 0.01
  290884  0 2  0.0  2.24 0.95 0.01
  010585  0 2  0.0  2.24 0.95 0.01
  290885  0 2  0.0  2.24 0.95 0.01
  010586  0 2  0.0  2.24 0.95 0.01
  290886  0 2  0.0  2.24 0.95 0.01
  010587  0 2  0.0  2.24 0.95 0.01
  290887  0 2  0.0  2.24 0.95 0.01
  010588  0 2  0.0  2.24 0.95 0.01
  290888  0 2  0.0  2.24 0.95 0.01
  010589  0 2  0.0  2.24 0.95 0.01
  290889  0 2  0.0  2.24 0.95 0.01
```

```
  010590  0 2  0.0  2.24 0.95 0.01
  290890  0 2  0.0  2.24 0.95 0.01
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
"Glenville, Silt Loam, HYDG: C"
*** Record 20
     102           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       4
       1       2    0.37    0.47       0       0       0
        0.0288810.028881       0
             0.1    0.47    0.27     7.5       0
       2      10     1.4   0.254       0       0       0
        0.0288810.028881       0
             0.1   0.254   0.094    1.74       0
       3      12     1.4   0.254       0       0       0
        0.0288810.028881       0
              2   0.254   0.094    1.74       0
       4      78     1.8   0.201       0       0       0
        0.0288810.028881       0
              2   0.201   0.121   0.174       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
North Dakota Spring Wheat MLRA F56 Cass County Bearden silty clay loam
"Red River Valley of the North MLRA 56 MN, ND, SD 1948-1983; Metfile:
W14914.dvf (old: Met56.met),
*** Record 3:
    0.75     0.5       0      12       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.28    0.17       1      10               3     1.5     354
*** Record 8
       1
*** Record 9
       1     0.1      22     100       1  91  85  87       0     100
*** Record 9a-d
       1      28
0101 1601 0102 1602 0103 1603 0104 1604 2004 0105 0505 1605 0106 1606 0107 1607
.583 .581 .579 .577 .574 .574 .575 .575 .611 .617 .610 .562 .468 .268 .092 .064
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
0108 0508 1008 1608 0109 1609 0110 1610 0111 1611 0112 1612
.065 .036 .098 .110 .126 .139 .152 .162 .168 .170 .171 .171
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  150561  250761  050861       1
  150562  250762  050862       1
  150563  250763  050863       1
  150564  250764  050864       1
  150565  250765  050865       1
  150566  250766  050866       1
  150567  250767  050867       1
  150568  250768  050868       1
  150569  250769  050869       1
  150570  250770  050870       1
  150571  250771  050871       1
  150572  250772  050872       1
  150573  250773  050873       1
  150574  250774  050874       1
  150575  250775  050875       1
  150576  250776  050876       1
  150577  250777  050877       1
  150578  250778  050878       1
  150579  250779  050879       1
  150580  250780  050880       1
  150581  250781  050881       1
  150582  250782  050882       1
  150583  250783  050883       1
  150584  250784  050884       1
  150585  250785  050885       1
  150586  250786  050886       1
  150587  250787  050887       1
  150588  250788  050888       1
  150589  250789  050889       1
  150590  250790  050890       1
*** Record 12 -- PTITLE
2,4-D - 1 applications @ 1.12 kg/ha
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
```

```
2,4-D
*** Record 16
  010661  0 2  0.0  1.12 0.95 0.05
  010662  0 2  0.0  1.12 0.95 0.05
  010663  0 2  0.0  1.12 0.95 0.05
  010664  0 2  0.0  1.12 0.95 0.05
  010665  0 2  0.0  1.12 0.95 0.05
  010666  0 2  0.0  1.12 0.95 0.05
  010667  0 2  0.0  1.12 0.95 0.05
  010668  0 2  0.0  1.12 0.95 0.05
  010669  0 2  0.0  1.12 0.95 0.05
  010670  0 2  0.0  1.12 0.95 0.05
  010671  0 2  0.0  1.12 0.95 0.05
  010672  0 2  0.0  1.12 0.95 0.05
  010673  0 2  0.0  1.12 0.95 0.05
  010674  0 2  0.0  1.12 0.95 0.05
  010675  0 2  0.0  1.12 0.95 0.05
  010676  0 2  0.0  1.12 0.95 0.05
  010677  0 2  0.0  1.12 0.95 0.05
  010678  0 2  0.0  1.12 0.95 0.05
  010679  0 2  0.0  1.12 0.95 0.05
  010680  0 2  0.0  1.12 0.95 0.05
  010681  0 2  0.0  1.12 0.95 0.05
  010682  0 2  0.0  1.12 0.95 0.05
  010683  0 2  0.0  1.12 0.95 0.05
  010684  0 2  0.0  1.12 0.95 0.05
  010685  0 2  0.0  1.12 0.95 0.05
  010686  0 2  0.0  1.12 0.95 0.05
  010687  0 2  0.0  1.12 0.95 0.05
  010688  0 2  0.0  1.12 0.95 0.05
  010689  0 2  0.0  1.12 0.95 0.05
  010690  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
Bearden silty clay loam; HTDG: C
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       3
       1      10     1.4   0.377       0       0       0
        0.028881 0.028881       0
             0.1   0.377   0.207    1.74       0
       2      52     1.5   0.292       0       0       0
        0.028881 0.028881       0
               1   0.292   0.132   0.116       0
       3      38     1.8   0.285       0       0       0
        0.028881 0.028881       0
               2   0.285   0.125   0.058       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
```

```
   1  -----
   7    YEAR
PRCP    TCUM   0   0
RUNF    TCUM   0   0
INFL    TCUM   1   1
ESLS    TCUM   0   0  1.0E3
RFLX    TCUM   0   0  1.0E5
EFLX    TCUM   0   0  1.0E5
RZFX    TCUM   0   0  1.0E5
```

```
OR Wheat; 8/07/2001
"Willamette Valley; MLRA 2; Metfile: W24232.dvf (old: Met2.met),"
*** Record 3:
    0.74    0.36       0      17       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.13    1.34       1      10               2       6     354
*** Record 8
       1
*** Record 9
       1     0.1      23     100       1  92  86  87       0     100
*** Record 9a-d
       1      27
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1507 1607 0108
.226 .240 .254 .259 .265 .262 .224 .154 .101 .089 .091 .092 .092 .017 .017 .051
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
1008 1508 1608 0109 1609 0110 1610 0111 1611 0112 1612
.154 .223 .228 .231 .220 .210 .230 .267 .302 .323 .336
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  010961  100361  010761       1
  010962  100362  010762       1
  010963  100363  010763       1
  010964  100364  010764       1
  010965  100365  010765       1
  010966  100366  010766       1
  010967  100367  010767       1
  010968  100368  010768       1
  010969  100369  010769       1
  010970  100370  010770       1
  010971  100371  010771       1
  010972  100372  010772       1
  010973  100373  010773       1
  010974  100374  010774       1
  010975  100375  010775       1
  010976  100376  010776       1
  010977  100377  010777       1
  010978  100378  010778       1
  010979  100379  010779       1
  010980  100380  010780       1
  010981  100381  010781       1
  010982  100382  010782       1
  010983  100383  010783       1
  010984  100384  010784       1
  010985  100385  010785       1
  010986  100386  010786       1
  010987  100387  010787       1
  010988  100388  010788       1
  010989  100389  010789       1
  010990  100390  010790       1
*** Record 12 -- PTITLE
2,4-D - 1 applications @ 1.12 kg/ha
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  010461  0 2  0.0  1.12 0.95 0.05
  010462  0 2  0.0  1.12 0.95 0.05
  010463  0 2  0.0  1.12 0.95 0.05
  010464  0 2  0.0  1.12 0.95 0.05
  010465  0 2  0.0  1.12 0.95 0.05
  010466  0 2  0.0  1.12 0.95 0.05
  010467  0 2  0.0  1.12 0.95 0.05
  010468  0 2  0.0  1.12 0.95 0.05
  010469  0 2  0.0  1.12 0.95 0.05
  010470  0 2  0.0  1.12 0.95 0.05
  010471  0 2  0.0  1.12 0.95 0.05
  010472  0 2  0.0  1.12 0.95 0.05
  010473  0 2  0.0  1.12 0.95 0.05
  010474  0 2  0.0  1.12 0.95 0.05
  010475  0 2  0.0  1.12 0.95 0.05
  010476  0 2  0.0  1.12 0.95 0.05
  010477  0 2  0.0  1.12 0.95 0.05
  010478  0 2  0.0  1.12 0.95 0.05
  010479  0 2  0.0  1.12 0.95 0.05
  010480  0 2  0.0  1.12 0.95 0.05
  010481  0 2  0.0  1.12 0.95 0.05
  010482  0 2  0.0  1.12 0.95 0.05
  010483  0 2  0.0  1.12 0.95 0.05
  010484  0 2  0.0  1.12 0.95 0.05
  010485  0 2  0.0  1.12 0.95 0.05
  010486  0 2  0.0  1.12 0.95 0.05
  010487  0 2  0.0  1.12 0.95 0.05
  010488  0 2  0.0  1.12 0.95 0.05
  010489  0 2  0.0  1.12 0.95 0.05
  010490  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
Bashaw Clay; HYDG: D
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       3
       1      10     1.3   0.487       0       0       0
        0.0288810.028881       0
             0.1   0.487   0.347    4.64       0
       2      26     1.3   0.487       0       0       0
        0.0288810.028881       0
               2   0.487   0.347    4.64       0
       3      64     1.3   0.441       0       0       0
        0.0288810.028881       0
               2   0.441   0.301    0.29       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
```

```
   7    YEAR
PRCP    TCUM   0   0
RUNF    TCUM   0   0
INFL    TCUM   1   1
ESLS    TCUM   0   0  1.0E3
RFLX    TCUM   0   0  1.0E5
EFLX    TCUM   0   0  1.0E5
RZFX    TCUM   0   0  1.0E5
```

```
"IL Corn; created August 7, 2001"
"McLean County, Illinois - MLRA 108; Metfile: W14923.dvf (old: Met108.met),
*** Record 3:
    0.77    0.36       0      16       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.32   1.126       1      10               3       6     354
*** Record 8
       1
*** Record 9
       1    0.25      90     100       3  91  87  88       0     100
*** Record 9a-d
       1      28
0101 1601 0102 1602 0103 1603 0104 1504 1604 2504 0105 1605 0106 1606 2506 0107
.278 .285 .292 .301 .316 .345 .382 .538 .555 .618 .638 .609 .436 .252 .162 .128
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
1607 0108 1608 0109 1609 0110 1610 2010 0111 1611 0112 1612
.119 .123 .125 .126 .127 .173 .195 .017 .048 .058 .066 .072
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  010561  210961  201061       1
  010562  210962  201062       1
  010563  210963  201063       1
  010564  210964  201064       1
  010565  210965  201065       1
  010566  210966  201066       1
  010567  210967  201067       1
  010568  210968  201068       1
  010569  210969  201069       1
  010570  210970  201070       1
  010571  210971  201071       1
  010572  210972  201072       1
  010573  210973  201073       1
  010574  210974  201074       1
  010575  210975  201075       1
  010576  210976  201076       1
  010577  210977  201077       1
  010578  210978  201078       1
  010579  210979  201079       1
  010580  210980  201080       1
  010581  210981  201081       1
  010582  210982  201082       1
  010583  210983  201083       1
  010584  210984  201084       1
  010585  210985  201085       1
  010586  210986  201086       1
  010587  210987  201087       1
  010588  210988  201088       1
  010589  210989  201089       1
  010590  210990  201090       1
*** Record 12 -- PTITLE
2,4-D - 3 applications @ 1.12 kg/ha
*** Record 13
      90       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  150461  0 2  0.0  1.12 0.95 0.05
  300561  0 2  0.0  1.12 0.95 0.05
  270961  0 2  0.0  1.12 0.95 0.05
  150462  0 2  0.0  1.12 0.95 0.05
  300562  0 2  0.0  1.12 0.95 0.05
  270962  0 2  0.0  1.12 0.95 0.05
  150463  0 2  0.0  1.12 0.95 0.05
  300563  0 2  0.0  1.12 0.95 0.05
  270963  0 2  0.0  1.12 0.95 0.05
  150464  0 2  0.0  1.12 0.95 0.05
  300564  0 2  0.0  1.12 0.95 0.05
  270964  0 2  0.0  1.12 0.95 0.05
  150465  0 2  0.0  1.12 0.95 0.05
  300565  0 2  0.0  1.12 0.95 0.05
  270965  0 2  0.0  1.12 0.95 0.05
  150466  0 2  0.0  1.12 0.95 0.05
  300566  0 2  0.0  1.12 0.95 0.05
  270966  0 2  0.0  1.12 0.95 0.05
  150467  0 2  0.0  1.12 0.95 0.05
  300567  0 2  0.0  1.12 0.95 0.05
  270967  0 2  0.0  1.12 0.95 0.05
  150468  0 2  0.0  1.12 0.95 0.05
  300568  0 2  0.0  1.12 0.95 0.05
  270968  0 2  0.0  1.12 0.95 0.05
  150469  0 2  0.0  1.12 0.95 0.05
  300569  0 2  0.0  1.12 0.95 0.05
  270969  0 2  0.0  1.12 0.95 0.05
  150470  0 2  0.0  1.12 0.95 0.05
  300570  0 2  0.0  1.12 0.95 0.05
  270970  0 2  0.0  1.12 0.95 0.05
  150471  0 2  0.0  1.12 0.95 0.05
  300571  0 2  0.0  1.12 0.95 0.05
  270971  0 2  0.0  1.12 0.95 0.05
  150472  0 2  0.0  1.12 0.95 0.05
  300572  0 2  0.0  1.12 0.95 0.05
  270972  0 2  0.0  1.12 0.95 0.05
  150473  0 2  0.0  1.12 0.95 0.05
  300573  0 2  0.0  1.12 0.95 0.05
  270973  0 2  0.0  1.12 0.95 0.05
  150474  0 2  0.0  1.12 0.95 0.05
  300574  0 2  0.0  1.12 0.95 0.05
  270974  0 2  0.0  1.12 0.95 0.05
  150475  0 2  0.0  1.12 0.95 0.05
  300575  0 2  0.0  1.12 0.95 0.05
  270975  0 2  0.0  1.12 0.95 0.05
  150476  0 2  0.0  1.12 0.95 0.05
  300576  0 2  0.0  1.12 0.95 0.05
  270976  0 2  0.0  1.12 0.95 0.05
  150477  0 2  0.0  1.12 0.95 0.05
  300577  0 2  0.0  1.12 0.95 0.05
  270977  0 2  0.0  1.12 0.95 0.05
  150478  0 2  0.0  1.12 0.95 0.05
  300578  0 2  0.0  1.12 0.95 0.05
  270978  0 2  0.0  1.12 0.95 0.05
  150479  0 2  0.0  1.12 0.95 0.05
  300579  0 2  0.0  1.12 0.95 0.05
  270979  0 2  0.0  1.12 0.95 0.05
  150480  0 2  0.0  1.12 0.95 0.05
```

```
  300580  0 2  0.0  1.12 0.95 0.05
  270980  0 2  0.0  1.12 0.95 0.05
  150481  0 2  0.0  1.12 0.95 0.05
  300581  0 2  0.0  1.12 0.95 0.05
  270981  0 2  0.0  1.12 0.95 0.05
  150482  0 2  0.0  1.12 0.95 0.05
  300582  0 2  0.0  1.12 0.95 0.05
  270982  0 2  0.0  1.12 0.95 0.05
  150483  0 2  0.0  1.12 0.95 0.05
  300583  0 2  0.0  1.12 0.95 0.05
  270983  0 2  0.0  1.12 0.95 0.05
  150484  0 2  0.0  1.12 0.95 0.05
  300584  0 2  0.0  1.12 0.95 0.05
  270984  0 2  0.0  1.12 0.95 0.05
  150485  0 2  0.0  1.12 0.95 0.05
  300585  0 2  0.0  1.12 0.95 0.05
  270985  0 2  0.0  1.12 0.95 0.05
  150486  0 2  0.0  1.12 0.95 0.05
  300586  0 2  0.0  1.12 0.95 0.05
  270986  0 2  0.0  1.12 0.95 0.05
  150487  0 2  0.0  1.12 0.95 0.05
  300587  0 2  0.0  1.12 0.95 0.05
  270987  0 2  0.0  1.12 0.95 0.05
  150488  0 2  0.0  1.12 0.95 0.05
  300588  0 2  0.0  1.12 0.95 0.05
  270988  0 2  0.0  1.12 0.95 0.05
  150489  0 2  0.0  1.12 0.95 0.05
  300589  0 2  0.0  1.12 0.95 0.05
  270989  0 2  0.0  1.12 0.95 0.05
  150490  0 2  0.0  1.12 0.95 0.05
  300590  0 2  0.0  1.12 0.95 0.05
  270990  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
"Adair Clay Loam - Hydg. C (Selected in conversation with Roger Winhorn, USDA-
NRCS McLean County Field Office)"
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       4
       1      10    1.45   0.355       0       0       0
        0.028881 0.028881       0
             0.1   0.355   0.185    2.32       0
       2      34     1.5   0.355       0       0       0
        0.028881 0.028881       0
             6.8   0.355   0.185    2.32       0
       3      44     1.6   0.338       0       0       0
        0.028881 0.028881       0
             11   0.338   0.208   0.174       0
       4      12     1.7   0.307       0       0       0
        0.028881 0.028881       0
             12   0.307   0.167   0.116       0
```

```
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
CAcorn.inp
"California field corn, MLRA 17 Stanislaus/San Joaquin Counties; Metfile:
W23232.dvf (old: Met18.met or Met17.met),
*** Record 3:
    0.73    0.45       0      15       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.34    0.79       1      10               1     4.5     354
*** Record 8
       1
*** Record 9
       1    0.25      90     100       3  89  86  87       0     300
*** Record 9a-d
       1      25
0101 1601 0102 0502 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108
.316 .352 .376 .537 .565 .611 .575 .418 .235 .133 .107 .109 .109 .108 .127 .176
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
1608 0109 1609 0110 1610 0111 1611 0112 1612
.018 .018 .018 .019 .051 .064 .080 .097 .113
.023 .023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  080461  270761  080961       1
  080462  270762  080962       1
  080463  270763  080963       1
  080464  270764  080964       1
  080465  270765  080965       1
  080466  270766  080966       1
  080467  270767  080967       1
  080468  270768  080968       1
  080469  270769  080969       1
  080470  270770  080970       1
  080471  270771  080971       1
  080472  270772  080972       1
  080473  270773  080973       1
  080474  270774  080974       1
  080475  270775  080975       1
  080476  270776  080976       1
  080477  270777  080977       1
  080478  270778  080978       1
  080479  270779  080979       1
  080480  270780  080980       1
  080481  270781  080981       1
  080482  270782  080982       1
  080483  270783  080983       1
  080484  270784  080984       1
  080485  270785  080985       1
  080486  270786  080986       1
  080487  270787  080987       1
  080488  270788  080988       1
  080489  270789  080989       1
  080490  270790  080990       1
*** Record 12 -- PTITLE
2,4-D - 3 applications @ 1.12 kg/ha
*** Record 13
      90       1       0       0
*** Record 15 -- PSTNAM
```

```
2,4-D
*** Record 16
  150361  0 2  0.0  1.12 0.95 0.05
  290461  0 2  0.0  1.12 0.95 0.05
  270861  0 2  0.0  1.12 0.95 0.05
  150362  0 2  0.0  1.12 0.95 0.05
  290462  0 2  0.0  1.12 0.95 0.05
  270862  0 2  0.0  1.12 0.95 0.05
  150363  0 2  0.0  1.12 0.95 0.05
  290463  0 2  0.0  1.12 0.95 0.05
  270863  0 2  0.0  1.12 0.95 0.05
  150364  0 2  0.0  1.12 0.95 0.05
  290464  0 2  0.0  1.12 0.95 0.05
  270864  0 2  0.0  1.12 0.95 0.05
  150365  0 2  0.0  1.12 0.95 0.05
  290465  0 2  0.0  1.12 0.95 0.05
  270865  0 2  0.0  1.12 0.95 0.05
  150366  0 2  0.0  1.12 0.95 0.05
  290466  0 2  0.0  1.12 0.95 0.05
  270866  0 2  0.0  1.12 0.95 0.05
  150367  0 2  0.0  1.12 0.95 0.05
  290467  0 2  0.0  1.12 0.95 0.05
  270867  0 2  0.0  1.12 0.95 0.05
  150368  0 2  0.0  1.12 0.95 0.05
  290468  0 2  0.0  1.12 0.95 0.05
  270868  0 2  0.0  1.12 0.95 0.05
  150369  0 2  0.0  1.12 0.95 0.05
  290469  0 2  0.0  1.12 0.95 0.05
  270869  0 2  0.0  1.12 0.95 0.05
  150370  0 2  0.0  1.12 0.95 0.05
  290470  0 2  0.0  1.12 0.95 0.05
  270870  0 2  0.0  1.12 0.95 0.05
  150371  0 2  0.0  1.12 0.95 0.05
  290471  0 2  0.0  1.12 0.95 0.05
  270871  0 2  0.0  1.12 0.95 0.05
  150372  0 2  0.0  1.12 0.95 0.05
  290472  0 2  0.0  1.12 0.95 0.05
  270872  0 2  0.0  1.12 0.95 0.05
  150373  0 2  0.0  1.12 0.95 0.05
  290473  0 2  0.0  1.12 0.95 0.05
  270873  0 2  0.0  1.12 0.95 0.05
  150374  0 2  0.0  1.12 0.95 0.05
  290474  0 2  0.0  1.12 0.95 0.05
  270874  0 2  0.0  1.12 0.95 0.05
  150375  0 2  0.0  1.12 0.95 0.05
  290475  0 2  0.0  1.12 0.95 0.05
  270875  0 2  0.0  1.12 0.95 0.05
  150376  0 2  0.0  1.12 0.95 0.05
  290476  0 2  0.0  1.12 0.95 0.05
  270876  0 2  0.0  1.12 0.95 0.05
  150377  0 2  0.0  1.12 0.95 0.05
  290477  0 2  0.0  1.12 0.95 0.05
  270877  0 2  0.0  1.12 0.95 0.05
  150378  0 2  0.0  1.12 0.95 0.05
  290478  0 2  0.0  1.12 0.95 0.05
  270878  0 2  0.0  1.12 0.95 0.05
  150379  0 2  0.0  1.12 0.95 0.05
  290479  0 2  0.0  1.12 0.95 0.05
  270879  0 2  0.0  1.12 0.95 0.05
```

```
  150380  0 2  0.0  1.12 0.95 0.05
  290480  0 2  0.0  1.12 0.95 0.05
  270880  0 2  0.0  1.12 0.95 0.05
  150381  0 2  0.0  1.12 0.95 0.05
  290481  0 2  0.0  1.12 0.95 0.05
  270881  0 2  0.0  1.12 0.95 0.05
  150382  0 2  0.0  1.12 0.95 0.05
  290482  0 2  0.0  1.12 0.95 0.05
  270882  0 2  0.0  1.12 0.95 0.05
  150383  0 2  0.0  1.12 0.95 0.05
  290483  0 2  0.0  1.12 0.95 0.05
  270883  0 2  0.0  1.12 0.95 0.05
  150384  0 2  0.0  1.12 0.95 0.05
  290484  0 2  0.0  1.12 0.95 0.05
  270884  0 2  0.0  1.12 0.95 0.05
  150385  0 2  0.0  1.12 0.95 0.05
  290485  0 2  0.0  1.12 0.95 0.05
  270885  0 2  0.0  1.12 0.95 0.05
  150386  0 2  0.0  1.12 0.95 0.05
  290486  0 2  0.0  1.12 0.95 0.05
  270886  0 2  0.0  1.12 0.95 0.05
  150387  0 2  0.0  1.12 0.95 0.05
  290487  0 2  0.0  1.12 0.95 0.05
  270887  0 2  0.0  1.12 0.95 0.05
  150388  0 2  0.0  1.12 0.95 0.05
  290488  0 2  0.0  1.12 0.95 0.05
  270888  0 2  0.0  1.12 0.95 0.05
  150389  0 2  0.0  1.12 0.95 0.05
  290489  0 2  0.0  1.12 0.95 0.05
  270889  0 2  0.0  1.12 0.95 0.05
  150390  0 2  0.0  1.12 0.95 0.05
  290490  0 2  0.0  1.12 0.95 0.05
  270890  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
Madera loam
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       4
       1      10    1.55   0.223       0       0       0
        0.028881 0.028881       0
             0.1   0.223   0.083    0.58       0
       2      12    1.55   0.223       0       0       0
        0.028881 0.028881       0
                4   0.223   0.083    0.58       0
       3      40    1.55   0.226       0       0       0
        0.028881 0.028881       0
                5   0.226   0.186    0.29       0
       4      38     1.6   0.163       0       0       0
        0.028881 0.028881       0
                2   0.163   0.073   0.174       0
```

```
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
TX Sorghum - 08/06/2001
"Texas Claypan Area, Milam County, Texas: MLRA J-87; Metfile: W13958.dvf (old:
Met87.met),
*** Record 3:
    0.71    0.36       0      25       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.43   0.402       1      10               4     2.5     354
*** Record 8
       1
*** Record 9
       1     0.1      22      85       1  92  86  87       0      70
*** Record 9a-d
       1      25
0101 1601 0102 1602 0103 1603 0104 1604 0105 1005 1605 0106 1606 0107 1607 0108
.293 .318 .345 .373 .399 .428 .468 .519 .647 .690 .704 .669 .478 .265 .134 .099
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
1608 0109 1609 0110 1610 0111 1611 0112 1612
.098 .099 .101 .050 .132 .166 .196 .224 .252
.014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  110561  120961  220961       1
  110562  120962  220962       1
  110563  120963  220963       1
  110564  120964  220964       1
  110565  120965  220965       1
  110566  120966  220966       1
  110567  120967  220967       1
  110568  120968  220968       1
  110569  120969  220969       1
  110570  120970  220970       1
  110571  120971  220971       1
  110572  120972  220972       1
  110573  120973  220973       1
  110574  120974  220974       1
  110575  120975  220975       1
  110576  120976  220976       1
  110577  120977  220977       1
  110578  120978  220978       1
  110579  120979  220979       1
  110580  120980  220980       1
  110581  120981  220981       1
  110582  120982  220982       1
  110583  120983  220983       1
  110584  120984  220984       1
  110585  120985  220985       1
  110586  120986  220986       1
  110587  120987  220987       1
  110588  120988  220988       1
  110589  120989  220989       1
  110590  120990  220990       1
*** Record 12 -- PTITLE
2,4-D - 1 applications @ 0.56 kg/ha
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
```

```
2,4-D
*** Record 16
  070661  0 2  0.0  0.56 0.95 0.05
  070662  0 2  0.0  0.56 0.95 0.05
  070663  0 2  0.0  0.56 0.95 0.05
  070664  0 2  0.0  0.56 0.95 0.05
  070665  0 2  0.0  0.56 0.95 0.05
  070666  0 2  0.0  0.56 0.95 0.05
  070667  0 2  0.0  0.56 0.95 0.05
  070668  0 2  0.0  0.56 0.95 0.05
  070669  0 2  0.0  0.56 0.95 0.05
  070670  0 2  0.0  0.56 0.95 0.05
  070671  0 2  0.0  0.56 0.95 0.05
  070672  0 2  0.0  0.56 0.95 0.05
  070673  0 2  0.0  0.56 0.95 0.05
  070674  0 2  0.0  0.56 0.95 0.05
  070675  0 2  0.0  0.56 0.95 0.05
  070676  0 2  0.0  0.56 0.95 0.05
  070677  0 2  0.0  0.56 0.95 0.05
  070678  0 2  0.0  0.56 0.95 0.05
  070679  0 2  0.0  0.56 0.95 0.05
  070680  0 2  0.0  0.56 0.95 0.05
  070681  0 2  0.0  0.56 0.95 0.05
  070682  0 2  0.0  0.56 0.95 0.05
  070683  0 2  0.0  0.56 0.95 0.05
  070684  0 2  0.0  0.56 0.95 0.05
  070685  0 2  0.0  0.56 0.95 0.05
  070686  0 2  0.0  0.56 0.95 0.05
  070687  0 2  0.0  0.56 0.95 0.05
  070688  0 2  0.0  0.56 0.95 0.05
  070689  0 2  0.0  0.56 0.95 0.05
  070690  0 2  0.0  0.56 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
Axtell Sandy Loam; HYDG: D
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       3
       1      10     1.6   0.174       0       0       0
        0.028881 0.028881       0
             0.1   0.174   0.064    0.58       0
       2      10     1.6   0.174       0       0       0
        0.028881 0.028881       0
             0.1   0.174   0.064    0.58       0
       3      80     1.7   0.235       0       0       0
        0.028881 0.028881       0
               5   0.235   0.165    0.29       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
```

```
   1  -----
   7    YEAR
PRCP    TCUM   0   0
RUNF    TCUM   0   0
INFL    TCUM   1   1
ESLS    TCUM   0   0  1.0E3
RFLX    TCUM   0   0  1.0E5
EFLX    TCUM   0   0  1.0E5
RZFX    TCUM   0   0  1.0E5
```

```
KSSorghum; 10/09/02
"Osage County in MLRA 112; County nearest weather station Topeka (W13996) and
still in MLRA 112 (East Central KS); Metfile: W13996.dvf, (old metfile:
Met112.met)"
*** Record 3:
    0.73     0.3       0      17       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.43   0.264       1      10               3       4     354
*** Record 8
       1
*** Record 9
       1     0.1     120     100       3  89  86  87       0     120
*** Record 9a-d
       1      26
0101 1601 0102 1602 0103 1603 0104 1604 0105 0505 1605 2005 0106 1606 0107 1607
.161 .163 .165 .168 .174 .185 .199 .217 .231 .372 .425 .449 .448 .385 .224 .117
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.076 .076 .078 .186 .194 .171 .162 .171 .175 .178
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  200561  200961  011061       1
  200562  200962  011062       1
  200563  200963  011063       1
  200564  200964  011064       1
  200565  200965  011065       1
  200566  200966  011066       1
  200567  200967  011067       1
  200568  200968  011068       1
  200569  200969  011069       1
  200570  200970  011070       1
  200571  200971  011071       1
  200572  200972  011072       1
  200573  200973  011073       1
  200574  200974  011074       1
  200575  200975  011075       1
  200576  200976  011076       1
  200577  200977  011077       1
  200578  200978  011078       1
  200579  200979  011079       1
  200580  200980  011080       1
  200581  200981  011081       1
  200582  200982  011082       1
  200583  200983  011083       1
  200584  200984  011084       1
  200585  200985  011085       1
  200586  200986  011086       1
  200587  200987  011087       1
  200588  200988  011088       1
  200589  200989  011089       1
  200590  200990  011090       1
*** Record 12 -- PTITLE
2,4-D - 1 applications @ 0.56 kg/ha
*** Record 13
      30       1       0       0
```

```
*** Record 15 -- PSTNAM
2,4-D
*** Record 16
  070661  0 2  0.0  0.56 0.95 0.05
  070662  0 2  0.0  0.56 0.95 0.05
  070663  0 2  0.0  0.56 0.95 0.05
  070664  0 2  0.0  0.56 0.95 0.05
  070665  0 2  0.0  0.56 0.95 0.05
  070666  0 2  0.0  0.56 0.95 0.05
  070667  0 2  0.0  0.56 0.95 0.05
  070668  0 2  0.0  0.56 0.95 0.05
  070669  0 2  0.0  0.56 0.95 0.05
  070670  0 2  0.0  0.56 0.95 0.05
  070671  0 2  0.0  0.56 0.95 0.05
  070672  0 2  0.0  0.56 0.95 0.05
  070673  0 2  0.0  0.56 0.95 0.05
  070674  0 2  0.0  0.56 0.95 0.05
  070675  0 2  0.0  0.56 0.95 0.05
  070676  0 2  0.0  0.56 0.95 0.05
  070677  0 2  0.0  0.56 0.95 0.05
  070678  0 2  0.0  0.56 0.95 0.05
  070679  0 2  0.0  0.56 0.95 0.05
  070680  0 2  0.0  0.56 0.95 0.05
  070681  0 2  0.0  0.56 0.95 0.05
  070682  0 2  0.0  0.56 0.95 0.05
  070683  0 2  0.0  0.56 0.95 0.05
  070684  0 2  0.0  0.56 0.95 0.05
  070685  0 2  0.0  0.56 0.95 0.05
  070686  0 2  0.0  0.56 0.95 0.05
  070687  0 2  0.0  0.56 0.95 0.05
  070688  0 2  0.0  0.56 0.95 0.05
  070689  0 2  0.0  0.56 0.95 0.05
  070690  0 2  0.0  0.56 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
"Dennis Silt Loam; Benchmark Soil, Hydrologic Group C"
*** Record 20
     120           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       4
       1      10    1.55   0.247       0       0       0
        0.0288810.028881       0
             0.1   0.247   0.097    1.74       0
       2      24    1.55   0.247       0       0       0
        0.0288810.028881       0
               2   0.247   0.097    1.74       0
       3      10     1.6   0.316       0       0       0
        0.0288810.028881       0
               5   0.316   0.166   0.174       0
       4      76     1.6   0.348       0       0       0
        0.0288810.028881       0
               2   0.348   0.198   0.116       0
```

```
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
MS soybean; 8/9/01
"Yazoo Co. MLRA 134; Metfile: W13893.dvf (old: Met134.met),"
*** Record 3:
    0.75    0.25       0      17       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.42  0.0151       1      10               3       2     354
*** Record 8
       1
*** Record 9
       1     0.2      30     100       3  87  84  86       0      76
*** Record 9a-d
       1      27
0101 1601 0102 1602 0103 1603 0104 1604 2004 0105 0505 1605 0106 1606 0107 1607
.245 .276 .306 .337 .373 .418 .468 .498 .575 .627 .654 .620 .484 .361 .220 .094
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
0108 1608 0109 1609 0110 1510 1610 0111 1611 0112 1612
.109 .110 .046 .053 .040 .203 .239 .316 .394 .464 .524
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  150461  010961  101061       1
  150462  010962  101062       1
  150463  010963  101063       1
  150464  010964  101064       1
  150465  010965  101065       1
  150466  010966  101066       1
  150467  010967  101067       1
  150468  010968  101068       1
  150469  010969  101069       1
  150470  010970  101070       1
  150471  010971  101071       1
  150472  010972  101072       1
  150473  010973  101073       1
  150474  010974  101074       1
  150475  010975  101075       1
  150476  010976  101076       1
  150477  010977  101077       1
  150478  010978  101078       1
  150479  010979  101079       1
  150480  010980  101080       1
  150481  010981  101081       1
  150482  010982  101082       1
  150483  010983  101083       1
  150484  010984  101084       1
  150485  010985  101085       1
  150486  010986  101086       1
  150487  010987  101087       1
  150488  010988  101088       1
  150489  010989  101089       1
  150490  010990  101090       1
*** Record 12 -- PTITLE
2,4-D - 1 applications @ 1.12 kg/ha
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  100361  0 2  0.0  1.12 0.95 0.05
  100362  0 2  0.0  1.12 0.95 0.05
  100363  0 2  0.0  1.12 0.95 0.05
  100364  0 2  0.0  1.12 0.95 0.05
  100365  0 2  0.0  1.12 0.95 0.05
  100366  0 2  0.0  1.12 0.95 0.05
  100367  0 2  0.0  1.12 0.95 0.05
  100368  0 2  0.0  1.12 0.95 0.05
  100369  0 2  0.0  1.12 0.95 0.05
  100370  0 2  0.0  1.12 0.95 0.05
  100371  0 2  0.0  1.12 0.95 0.05
  100372  0 2  0.0  1.12 0.95 0.05
  100373  0 2  0.0  1.12 0.95 0.05
  100374  0 2  0.0  1.12 0.95 0.05
  100375  0 2  0.0  1.12 0.95 0.05
  100376  0 2  0.0  1.12 0.95 0.05
  100377  0 2  0.0  1.12 0.95 0.05
  100378  0 2  0.0  1.12 0.95 0.05
  100379  0 2  0.0  1.12 0.95 0.05
  100380  0 2  0.0  1.12 0.95 0.05
  100381  0 2  0.0  1.12 0.95 0.05
  100382  0 2  0.0  1.12 0.95 0.05
  100383  0 2  0.0  1.12 0.95 0.05
  100384  0 2  0.0  1.12 0.95 0.05
  100385  0 2  0.0  1.12 0.95 0.05
  100386  0 2  0.0  1.12 0.95 0.05
  100387  0 2  0.0  1.12 0.95 0.05
  100388  0 2  0.0  1.12 0.95 0.05
  100389  0 2  0.0  1.12 0.95 0.05
  100390  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
"The Loring, silt loam, HYDG C"
*** Record 20
     155           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       6
       1      13     1.4   0.385       0       0       0
        0.0288810.028881       0
             0.1   0.385   0.151    2.18       0
       2      23     1.4    0.37       0       0       0
        0.0288810.028881       0
               1    0.37   0.146    0.49       0
       3      33     1.4    0.37       0       0       0
        0.0288810.028881       0
               3    0.37   0.146    0.16       0
       4      30    1.45    0.34       0       0       0
        0.0288810.028881       0
               5    0.34   0.125   0.124       0
       5      23    1.49   0.335       0       0       0
        0.0288810.028881       0
```

```
                1   0.335   0.137    0.07       0
       6       33    1.51   0.343       0       0       0
         0.0288810.028881       0
                3   0.343   0.147    0.06       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
NC Alfalfa
"Western North Carolina, MLRA 130; Metfile: W03812.dvf (old: Met130.met),
*** Record 3:
    0.76     0.2       0      17       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.29    1.34     0.5      10               3       6     354
*** Record 8
       1
*** Record 9
       1    0.25     100     100       3  87  83  86       0      76
*** Record 9a-d
       1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108 1608
.004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004 .004
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110
0109 1609 0110 1610 0111 1611 0112 1612
.004 .004 .004 .004 .004 .004 .004 .004
.110 .110 .110 .110 .110 .110 .110 .110
*** Record 10 -- NCPDS, the number of cropping periods
      26
*** Record 11
  050465  280565  280865       1
  050466  280566  280866       1
  050467  280567  280867       1
  050468  280568  280868       1
  050469  280569  280869       1
  050470  280570  280870       1
  050471  280571  280871       1
  050472  280572  280872       1
  050473  280573  280873       1
  050474  280574  280874       1
  050475  280575  280875       1
  050476  280576  280876       1
  050477  280577  280877       1
  050478  280578  280878       1
  050479  280579  280879       1
  050480  280580  280880       1
  050481  280581  280881       1
  050482  280582  280882       1
  050483  280583  280883       1
  050484  280584  280884       1
  050485  280585  280885       1
  050486  280586  280886       1
  050487  280587  280887       1
  050488  280588  280888       1
  050489  280589  280889       1
  050490  280590  280890       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 2.24 kg/ha
*** Record 13
      52       1       0       0
*** Record 15 -- PSTNAM
2,4-D
*** Record 16
  010665  0 2  0.0  2.24 0.95 0.05
  150865  0 2  0.0  2.24 0.95 0.05
  010666  0 2  0.0  2.24 0.95 0.05
```

```
  150866  0 2  0.0  2.24 0.95 0.05
  010667  0 2  0.0  2.24 0.95 0.05
  150867  0 2  0.0  2.24 0.95 0.05
  010668  0 2  0.0  2.24 0.95 0.05
  150868  0 2  0.0  2.24 0.95 0.05
  010669  0 2  0.0  2.24 0.95 0.05
  150869  0 2  0.0  2.24 0.95 0.05
  010670  0 2  0.0  2.24 0.95 0.05
  150870  0 2  0.0  2.24 0.95 0.05
  010671  0 2  0.0  2.24 0.95 0.05
  150871  0 2  0.0  2.24 0.95 0.05
  010672  0 2  0.0  2.24 0.95 0.05
  150872  0 2  0.0  2.24 0.95 0.05
  010673  0 2  0.0  2.24 0.95 0.05
  150873  0 2  0.0  2.24 0.95 0.05
  010674  0 2  0.0  2.24 0.95 0.05
  150874  0 2  0.0  2.24 0.95 0.05
  010675  0 2  0.0  2.24 0.95 0.05
  150875  0 2  0.0  2.24 0.95 0.05
  010676  0 2  0.0  2.24 0.95 0.05
  150876  0 2  0.0  2.24 0.95 0.05
  010677  0 2  0.0  2.24 0.95 0.05
  150877  0 2  0.0  2.24 0.95 0.05
  010678  0 2  0.0  2.24 0.95 0.05
  150878  0 2  0.0  2.24 0.95 0.05
  010679  0 2  0.0  2.24 0.95 0.05
  150879  0 2  0.0  2.24 0.95 0.05
  010680  0 2  0.0  2.24 0.95 0.05
  150880  0 2  0.0  2.24 0.95 0.05
  010681  0 2  0.0  2.24 0.95 0.05
  150881  0 2  0.0  2.24 0.95 0.05
  010682  0 2  0.0  2.24 0.95 0.05
  150882  0 2  0.0  2.24 0.95 0.05
  010683  0 2  0.0  2.24 0.95 0.05
  150883  0 2  0.0  2.24 0.95 0.05
  010684  0 2  0.0  2.24 0.95 0.05
  150884  0 2  0.0  2.24 0.95 0.05
  010685  0 2  0.0  2.24 0.95 0.05
  150885  0 2  0.0  2.24 0.95 0.05
  010686  0 2  0.0  2.24 0.95 0.05
  150886  0 2  0.0  2.24 0.95 0.05
  010687  0 2  0.0  2.24 0.95 0.05
  150887  0 2  0.0  2.24 0.95 0.05
  010688  0 2  0.0  2.24 0.95 0.05
  150888  0 2  0.0  2.24 0.95 0.05
  010689  0 2  0.0  2.24 0.95 0.05
  150889  0 2  0.0  2.24 0.95 0.05
  010690  0 2  0.0  2.24 0.95 0.05
  150890  0 2  0.0  2.24 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
"Helena sandy loam, HYDG:C"
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
```

```
*** Record 30
       4   10510
*** Record 33
       4
       1      10    1.55   0.153        0       0       0
        0.0288810.028881        0
             0.1   0.153   0.053    1.16       0
       2      20    1.55   0.153        0       0       0
        0.0288810.028881        0
               1   0.153   0.053    1.16       0
       3      18    1.51    0.25        0       0       0
        0.0288810.028881        0
               1    0.25    0.12   0.174       0
       4      52     1.5   0.322        0       0       0
        0.0288810.028881        0
               2   0.322   0.192   0.116       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
NC Apple 8/07/2001
"Henderson County MLRA 130; Metfile: W03812.dvf (old: Met130.met),"
*** Record 3:
    0.76     0.2       0      17       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
     0.2    3.04       1      10               3      12     354
*** Record 8
       1
*** Record 9
       1    0.25     150      90       3  84  79  82       0     425
*** Record 9a-d
       1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108 1608
.011 .012 .017 .018 .025 .031 .035 .041 .045 .046 .048 .048 .046 .043 .043 .045
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
0109 1609 0110 1610 0111 1611 0112 1612
.049 .052 .055 .057 .008 .009 .010 .010
.023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      26
*** Record 11
  070465  030565  251065       1
  070466  030566  251066       1
  070467  030567  251067       1
  070468  030568  251068       1
  070469  030569  251069       1
  070470  030570  251070       1
  070471  030571  251071       1
  070472  030572  251072       1
  070473  030573  251073       1
  070474  030574  251074       1
  070475  030575  251075       1
  070476  030576  251076       1
  070477  030577  251077       1
  070478  030578  251078       1
  070479  030579  251079       1
  070480  030580  251080       1
  070481  030581  251081       1
  070482  030582  251082       1
  070483  030583  251083       1
  070484  030584  251084       1
  070485  030585  251085       1
  070486  030586  251086       1
  070487  030587  251087       1
  070488  030588  251088       1
  070489  030589  251089       1
  070490  030590  251090       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 1.12 kg/ha
*** Record 13
      52       1       0       0
*** Record 15 -- PSTNAM
2,4-D
*** Record 16
  010665  0 2  0.0  1.12 0.95 0.05
  150865  0 2  0.0  1.12 0.95 0.05
  010666  0 2  0.0  1.12 0.95 0.05
```

```
  150866  0 2  0.0  1.12 0.95 0.05
  010667  0 2  0.0  1.12 0.95 0.05
  150867  0 2  0.0  1.12 0.95 0.05
  010668  0 2  0.0  1.12 0.95 0.05
  150868  0 2  0.0  1.12 0.95 0.05
  010669  0 2  0.0  1.12 0.95 0.05
  150869  0 2  0.0  1.12 0.95 0.05
  010670  0 2  0.0  1.12 0.95 0.05
  150870  0 2  0.0  1.12 0.95 0.05
  010671  0 2  0.0  1.12 0.95 0.05
  150871  0 2  0.0  1.12 0.95 0.05
  010672  0 2  0.0  1.12 0.95 0.05
  150872  0 2  0.0  1.12 0.95 0.05
  010673  0 2  0.0  1.12 0.95 0.05
  150873  0 2  0.0  1.12 0.95 0.05
  010674  0 2  0.0  1.12 0.95 0.05
  150874  0 2  0.0  1.12 0.95 0.05
  010675  0 2  0.0  1.12 0.95 0.05
  150875  0 2  0.0  1.12 0.95 0.05
  010676  0 2  0.0  1.12 0.95 0.05
  150876  0 2  0.0  1.12 0.95 0.05
  010677  0 2  0.0  1.12 0.95 0.05
  150877  0 2  0.0  1.12 0.95 0.05
  010678  0 2  0.0  1.12 0.95 0.05
  150878  0 2  0.0  1.12 0.95 0.05
  010679  0 2  0.0  1.12 0.95 0.05
  150879  0 2  0.0  1.12 0.95 0.05
  010680  0 2  0.0  1.12 0.95 0.05
  150880  0 2  0.0  1.12 0.95 0.05
  010681  0 2  0.0  1.12 0.95 0.05
  150881  0 2  0.0  1.12 0.95 0.05
  010682  0 2  0.0  1.12 0.95 0.05
  150882  0 2  0.0  1.12 0.95 0.05
  010683  0 2  0.0  1.12 0.95 0.05
  150883  0 2  0.0  1.12 0.95 0.05
  010684  0 2  0.0  1.12 0.95 0.05
  150884  0 2  0.0  1.12 0.95 0.05
  010685  0 2  0.0  1.12 0.95 0.05
  150885  0 2  0.0  1.12 0.95 0.05
  010686  0 2  0.0  1.12 0.95 0.05
  150886  0 2  0.0  1.12 0.95 0.05
  010687  0 2  0.0  1.12 0.95 0.05
  150887  0 2  0.0  1.12 0.95 0.05
  010688  0 2  0.0  1.12 0.95 0.05
  150888  0 2  0.0  1.12 0.95 0.05
  010689  0 2  0.0  1.12 0.95 0.05
  150889  0 2  0.0  1.12 0.95 0.05
  010690  0 2  0.0  1.12 0.95 0.05
  150890  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
Hayesville Loam; HYDG: C
*** Record 20
     150           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
```

```
*** Record 30
       4   10510
*** Record 33
       4
       1      10     1.3   0.392       0       0       0
        0.0288810.028881       0
             0.1   0.392   0.192    0.58       0
       2       6     1.3   0.392       0       0       0
        0.0288810.028881       0
               2   0.392   0.192    0.58       0
       3      84     1.3   0.475       0       0       0
        0.0288810.028881       0
               2   0.475   0.275   0.116       0
       4      50     1.3   0.259       0       0       0
        0.0288810.028881       0
               5   0.259   0.109   0.058       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
orapple.inp 8/7/2001
"Marion Co. OR MLRA A2; Metfile: W24229.dvf (old: Met2.met),"
*** Record 3:
    0.74    0.15       0      15       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.33    3.64       1      10               2      12     354
*** Record 8
       1
*** Record 9
       1    0.25      45      98       3  84  79  82       0     240
*** Record 9a-d
       1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108 1608
.008 .009 .013 .015 .020 .026 .029 .032 .034 .033 .031 .028 .024 .020 .018 .018
.040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040
0109 1609 0110 1610 0111 1611 0112 1612
.018 .020 .022 .024 .005 .006 .006 .007
.040 .040 .040 .040 .040 .040 .040 .040
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  250461  310561  071161       1
  250462  310562  071162       1
  250463  310563  071163       1
  250464  310564  071164       1
  250465  310565  071165       1
  250466  310566  071166       1
  250467  310567  071167       1
  250468  310568  071168       1
  250469  310569  071169       1
  250470  310570  071170       1
  250471  310571  071171       1
  250472  310572  071172       1
  250473  310573  071173       1
  250474  310574  071174       1
  250475  310575  071175       1
  250476  310576  071176       1
  250477  310577  071177       1
  250478  310578  071178       1
  250479  310579  071179       1
  250480  310580  071180       1
  250481  310581  071181       1
  250482  310582  071182       1
  250483  310583  071183       1
  250484  310584  071184       1
  250485  310585  071185       1
  250486  310586  071186       1
  250487  310587  071187       1
  250488  310588  071188       1
  250489  310589  071189       1
  250490  310590  071190       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 1.12 kg/ha
*** Record 13
      60       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  010761  0 2  0.0  1.12 0.95 0.05
  150861  0 2  0.0  1.12 0.95 0.05
  010762  0 2  0.0  1.12 0.95 0.05
  150862  0 2  0.0  1.12 0.95 0.05
  010763  0 2  0.0  1.12 0.95 0.05
  150863  0 2  0.0  1.12 0.95 0.05
  010764  0 2  0.0  1.12 0.95 0.05
  150864  0 2  0.0  1.12 0.95 0.05
  010765  0 2  0.0  1.12 0.95 0.05
  150865  0 2  0.0  1.12 0.95 0.05
  010766  0 2  0.0  1.12 0.95 0.05
  150866  0 2  0.0  1.12 0.95 0.05
  010767  0 2  0.0  1.12 0.95 0.05
  150867  0 2  0.0  1.12 0.95 0.05
  010768  0 2  0.0  1.12 0.95 0.05
  150868  0 2  0.0  1.12 0.95 0.05
  010769  0 2  0.0  1.12 0.95 0.05
  150869  0 2  0.0  1.12 0.95 0.05
  010770  0 2  0.0  1.12 0.95 0.05
  150870  0 2  0.0  1.12 0.95 0.05
  010771  0 2  0.0  1.12 0.95 0.05
  150871  0 2  0.0  1.12 0.95 0.05
  010772  0 2  0.0  1.12 0.95 0.05
  150872  0 2  0.0  1.12 0.95 0.05
  010773  0 2  0.0  1.12 0.95 0.05
  150873  0 2  0.0  1.12 0.95 0.05
  010774  0 2  0.0  1.12 0.95 0.05
  150874  0 2  0.0  1.12 0.95 0.05
  010775  0 2  0.0  1.12 0.95 0.05
  150875  0 2  0.0  1.12 0.95 0.05
  010776  0 2  0.0  1.12 0.95 0.05
  150876  0 2  0.0  1.12 0.95 0.05
  010777  0 2  0.0  1.12 0.95 0.05
  150877  0 2  0.0  1.12 0.95 0.05
  010778  0 2  0.0  1.12 0.95 0.05
  150878  0 2  0.0  1.12 0.95 0.05
  010779  0 2  0.0  1.12 0.95 0.05
  150879  0 2  0.0  1.12 0.95 0.05
  010780  0 2  0.0  1.12 0.95 0.05
  150880  0 2  0.0  1.12 0.95 0.05
  010781  0 2  0.0  1.12 0.95 0.05
  150881  0 2  0.0  1.12 0.95 0.05
  010782  0 2  0.0  1.12 0.95 0.05
  150882  0 2  0.0  1.12 0.95 0.05
  010783  0 2  0.0  1.12 0.95 0.05
  150883  0 2  0.0  1.12 0.95 0.05
  010784  0 2  0.0  1.12 0.95 0.05
  150884  0 2  0.0  1.12 0.95 0.05
  010785  0 2  0.0  1.12 0.95 0.05
  150885  0 2  0.0  1.12 0.95 0.05
  010786  0 2  0.0  1.12 0.95 0.05
  150886  0 2  0.0  1.12 0.95 0.05
  010787  0 2  0.0  1.12 0.95 0.05
  150887  0 2  0.0  1.12 0.95 0.05
  010788  0 2  0.0  1.12 0.95 0.05
  150888  0 2  0.0  1.12 0.95 0.05
  010789  0 2  0.0  1.12 0.95 0.05
  150889  0 2  0.0  1.12 0.95 0.05
```

```
  010790  0 2  0.0  1.12 0.95 0.05
  150890  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
"Cornelius silt loam, hydrologic group C"
*** Record 20
     148           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       5
       1      15     1.3   0.329       0       0       0
        0.0288810.028881       0
             0.1   0.329   0.099     2.3       0
       2      13    1.38   0.338       0       0       0
        0.0288810.028881       0
              1   0.338   0.108    1.11       0
       3      15    1.58    0.34       0       0       0
        0.0288810.028881       0
              1    0.34    0.11    0.21       0
       4      55    1.52   0.358       0       0       0
        0.0288810.028881       0
              5   0.358   0.148   0.145       0
       5      50    1.46   0.202       0       0       0
        0.0288810.028881       0
              5   0.202   0.142    0.07       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
PA Apple; 8/08/2001
"Lancaster County; MLRA 148; Metfile: W14737.dvf (old: Met148.met),"
*** Record 3:
    0.76     0.2       0      17       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.42     3.6       1      10               3      12     354
*** Record 8
       1
*** Record 9
       1    0.25     100      90       3  84  79  82       0     425
*** Record 9a-d
       1      26
0101 1601 0102 1602 0103 1603 0104 1504 1604 0105 1605 0106 1606 0107 1507 1607
.134 .144 .153 .156 .247 .261 .279 .320 .334 .357 .378 .419 .439 .453 .459 .463
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.478 .493 .503 .504 .509 .515 .103 .115 .121 .128
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  200461  100561  151061       1
  200462  100562  151062       1
  200463  100563  151063       1
  200464  100564  151064       1
  200465  100565  151065       1
  200466  100566  151066       1
  200467  100567  151067       1
  200468  100568  151068       1
  200469  100569  151069       1
  200470  100570  151070       1
  200471  100571  151071       1
  200472  100572  151072       1
  200473  100573  151073       1
  200474  100574  151074       1
  200475  100575  151075       1
  200476  100576  151076       1
  200477  100577  151077       1
  200478  100578  151078       1
  200479  100579  151079       1
  200480  100580  151080       1
  200481  100581  151081       1
  200482  100582  151082       1
  200483  100583  151083       1
  200484  100584  151084       1
  200485  100585  151085       1
  200486  100586  151086       1
  200487  100587  151087       1
  200488  100588  151088       1
  200489  100589  151089       1
  200490  100590  151090       1
*** Record 12 -- PTITLE
2,4-D - 2 applications @ 1.12 kg/ha
*** Record 13
      60       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  010761  0 2  0.0  1.12 0.95 0.05
  150861  0 2  0.0  1.12 0.95 0.05
  010762  0 2  0.0  1.12 0.95 0.05
  150862  0 2  0.0  1.12 0.95 0.05
  010763  0 2  0.0  1.12 0.95 0.05
  150863  0 2  0.0  1.12 0.95 0.05
  010764  0 2  0.0  1.12 0.95 0.05
  150864  0 2  0.0  1.12 0.95 0.05
  010765  0 2  0.0  1.12 0.95 0.05
  150865  0 2  0.0  1.12 0.95 0.05
  010766  0 2  0.0  1.12 0.95 0.05
  150866  0 2  0.0  1.12 0.95 0.05
  010767  0 2  0.0  1.12 0.95 0.05
  150867  0 2  0.0  1.12 0.95 0.05
  010768  0 2  0.0  1.12 0.95 0.05
  150868  0 2  0.0  1.12 0.95 0.05
  010769  0 2  0.0  1.12 0.95 0.05
  150869  0 2  0.0  1.12 0.95 0.05
  010770  0 2  0.0  1.12 0.95 0.05
  150870  0 2  0.0  1.12 0.95 0.05
  010771  0 2  0.0  1.12 0.95 0.05
  150871  0 2  0.0  1.12 0.95 0.05
  010772  0 2  0.0  1.12 0.95 0.05
  150872  0 2  0.0  1.12 0.95 0.05
  010773  0 2  0.0  1.12 0.95 0.05
  150873  0 2  0.0  1.12 0.95 0.05
  010774  0 2  0.0  1.12 0.95 0.05
  150874  0 2  0.0  1.12 0.95 0.05
  010775  0 2  0.0  1.12 0.95 0.05
  150875  0 2  0.0  1.12 0.95 0.05
  010776  0 2  0.0  1.12 0.95 0.05
  150876  0 2  0.0  1.12 0.95 0.05
  010777  0 2  0.0  1.12 0.95 0.05
  150877  0 2  0.0  1.12 0.95 0.05
  010778  0 2  0.0  1.12 0.95 0.05
  150878  0 2  0.0  1.12 0.95 0.05
  010779  0 2  0.0  1.12 0.95 0.05
  150879  0 2  0.0  1.12 0.95 0.05
  010780  0 2  0.0  1.12 0.95 0.05
  150880  0 2  0.0  1.12 0.95 0.05
  010781  0 2  0.0  1.12 0.95 0.05
  150881  0 2  0.0  1.12 0.95 0.05
  010782  0 2  0.0  1.12 0.95 0.05
  150882  0 2  0.0  1.12 0.95 0.05
  010783  0 2  0.0  1.12 0.95 0.05
  150883  0 2  0.0  1.12 0.95 0.05
  010784  0 2  0.0  1.12 0.95 0.05
  150884  0 2  0.0  1.12 0.95 0.05
  010785  0 2  0.0  1.12 0.95 0.05
  150885  0 2  0.0  1.12 0.95 0.05
  010786  0 2  0.0  1.12 0.95 0.05
  150886  0 2  0.0  1.12 0.95 0.05
  010787  0 2  0.0  1.12 0.95 0.05
  150887  0 2  0.0  1.12 0.95 0.05
  010788  0 2  0.0  1.12 0.95 0.05
  150888  0 2  0.0  1.12 0.95 0.05
  010789  0 2  0.0  1.12 0.95 0.05
  150889  0 2  0.0  1.12 0.95 0.05
```

```
  010790  0 2  0.0  1.12 0.95 0.05
  150890  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
Elioak Silt Loam; HYDG: C
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       3
       1      10     1.7   0.218       0       0       0
        0.0288810.028881       0
             0.1   0.218   0.098    1.16       0
       2      28     1.7   0.218       0       0       0
        0.0288810.028881       0
              7   0.218   0.098    1.16       0
       3      62     1.8   0.243       0       0       0
        0.0288810.028881       0
            7.75   0.243   0.163   0.174       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

```
OR Filberts (developed from OR Walnuts); 8/15/2001
"Washington County; MLRA 2; Metfile: W24232.dvf (old: Met2.met),"
*** Record 3:
    0.74     0.2       0      17       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.33    3.62       1      10               4      12     354
*** Record 8
       1
*** Record 9
       1    0.25      90      75       3  84  79  82       0     500
*** Record 9a-d
       1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108 1608
.008 .009 .013 .015 .020 .026 .029 .032 .034 .033 .031 .028 .024 .020 .018 .018
.040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040 .040
0109 1609 0110 1610 0111 1611 0112 1612
.018 .020 .022 .024 .005 .006 .006 .007
.040 .040 .040 .040 .040 .040 .040 .040
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  050361  150461  101161       1
  050362  150462  101162       1
  050363  150463  101163       1
  050364  150464  101164       1
  050365  150465  101165       1
  050366  150466  101166       1
  050367  150467  101167       1
  050368  150468  101168       1
  050369  150469  101169       1
  050370  150470  101170       1
  050371  150471  101171       1
  050372  150472  101172       1
  050373  150473  101173       1
  050374  150474  101174       1
  050375  150475  101175       1
  050376  150476  101176       1
  050377  150477  101177       1
  050378  150478  101178       1
  050379  150479  101179       1
  050380  150480  101180       1
  050381  150481  101181       1
  050382  150482  101182       1
  050383  150483  101183       1
  050384  150484  101184       1
  050385  150485  101185       1
  050386  150486  101186       1
  050387  150487  101187       1
  050388  150488  101188       1
  050389  150489  101189       1
  050390  150490  101190       1
*** Record 12 -- PTITLE
2,4-D - 4 applications @ 1.12 kg/ha
*** Record 13
     120       1       0       0
*** Record 15 -- PSTNAM
2,4-D
```

```
*** Record 16
  010661  0 2  0.0  1.12 0.95 0.05
  010761  0 2  0.0  1.12 0.95 0.05
  310761  0 2  0.0  1.12 0.95 0.05
  300861  0 2  0.0  1.12 0.95 0.05
  010662  0 2  0.0  1.12 0.95 0.05
  010762  0 2  0.0  1.12 0.95 0.05
  310762  0 2  0.0  1.12 0.95 0.05
  300862  0 2  0.0  1.12 0.95 0.05
  010663  0 2  0.0  1.12 0.95 0.05
  010763  0 2  0.0  1.12 0.95 0.05
  310763  0 2  0.0  1.12 0.95 0.05
  300863  0 2  0.0  1.12 0.95 0.05
  010664  0 2  0.0  1.12 0.95 0.05
  010764  0 2  0.0  1.12 0.95 0.05
  310764  0 2  0.0  1.12 0.95 0.05
  300864  0 2  0.0  1.12 0.95 0.05
  010665  0 2  0.0  1.12 0.95 0.05
  010765  0 2  0.0  1.12 0.95 0.05
  310765  0 2  0.0  1.12 0.95 0.05
  300865  0 2  0.0  1.12 0.95 0.05
  010666  0 2  0.0  1.12 0.95 0.05
  010766  0 2  0.0  1.12 0.95 0.05
  310766  0 2  0.0  1.12 0.95 0.05
  300866  0 2  0.0  1.12 0.95 0.05
  010667  0 2  0.0  1.12 0.95 0.05
  010767  0 2  0.0  1.12 0.95 0.05
  310767  0 2  0.0  1.12 0.95 0.05
  300867  0 2  0.0  1.12 0.95 0.05
  010668  0 2  0.0  1.12 0.95 0.05
  010768  0 2  0.0  1.12 0.95 0.05
  310768  0 2  0.0  1.12 0.95 0.05
  300868  0 2  0.0  1.12 0.95 0.05
  010669  0 2  0.0  1.12 0.95 0.05
  010769  0 2  0.0  1.12 0.95 0.05
  310769  0 2  0.0  1.12 0.95 0.05
  300869  0 2  0.0  1.12 0.95 0.05
  010670  0 2  0.0  1.12 0.95 0.05
  010770  0 2  0.0  1.12 0.95 0.05
  310770  0 2  0.0  1.12 0.95 0.05
  300870  0 2  0.0  1.12 0.95 0.05
  010671  0 2  0.0  1.12 0.95 0.05
  010771  0 2  0.0  1.12 0.95 0.05
  310771  0 2  0.0  1.12 0.95 0.05
  300871  0 2  0.0  1.12 0.95 0.05
  010672  0 2  0.0  1.12 0.95 0.05
  010772  0 2  0.0  1.12 0.95 0.05
  310772  0 2  0.0  1.12 0.95 0.05
  300872  0 2  0.0  1.12 0.95 0.05
  010673  0 2  0.0  1.12 0.95 0.05
  010773  0 2  0.0  1.12 0.95 0.05
  310773  0 2  0.0  1.12 0.95 0.05
  300873  0 2  0.0  1.12 0.95 0.05
  010674  0 2  0.0  1.12 0.95 0.05
  010774  0 2  0.0  1.12 0.95 0.05
  310774  0 2  0.0  1.12 0.95 0.05
  300874  0 2  0.0  1.12 0.95 0.05
  010675  0 2  0.0  1.12 0.95 0.05
  010775  0 2  0.0  1.12 0.95 0.05
```

```
310775  0 2  0.0  1.12 0.95 0.05
300875  0 2  0.0  1.12 0.95 0.05
010676  0 2  0.0  1.12 0.95 0.05
010776  0 2  0.0  1.12 0.95 0.05
310776  0 2  0.0  1.12 0.95 0.05
300876  0 2  0.0  1.12 0.95 0.05
010677  0 2  0.0  1.12 0.95 0.05
010777  0 2  0.0  1.12 0.95 0.05
310777  0 2  0.0  1.12 0.95 0.05
300877  0 2  0.0  1.12 0.95 0.05
010678  0 2  0.0  1.12 0.95 0.05
010778  0 2  0.0  1.12 0.95 0.05
310778  0 2  0.0  1.12 0.95 0.05
300878  0 2  0.0  1.12 0.95 0.05
010679  0 2  0.0  1.12 0.95 0.05
010779  0 2  0.0  1.12 0.95 0.05
310779  0 2  0.0  1.12 0.95 0.05
300879  0 2  0.0  1.12 0.95 0.05
010680  0 2  0.0  1.12 0.95 0.05
010780  0 2  0.0  1.12 0.95 0.05
310780  0 2  0.0  1.12 0.95 0.05
300880  0 2  0.0  1.12 0.95 0.05
010681  0 2  0.0  1.12 0.95 0.05
010781  0 2  0.0  1.12 0.95 0.05
310781  0 2  0.0  1.12 0.95 0.05
300881  0 2  0.0  1.12 0.95 0.05
010682  0 2  0.0  1.12 0.95 0.05
010782  0 2  0.0  1.12 0.95 0.05
310782  0 2  0.0  1.12 0.95 0.05
300882  0 2  0.0  1.12 0.95 0.05
010683  0 2  0.0  1.12 0.95 0.05
010783  0 2  0.0  1.12 0.95 0.05
310783  0 2  0.0  1.12 0.95 0.05
300883  0 2  0.0  1.12 0.95 0.05
010684  0 2  0.0  1.12 0.95 0.05
010784  0 2  0.0  1.12 0.95 0.05
310784  0 2  0.0  1.12 0.95 0.05
300884  0 2  0.0  1.12 0.95 0.05
010685  0 2  0.0  1.12 0.95 0.05
010785  0 2  0.0  1.12 0.95 0.05
310785  0 2  0.0  1.12 0.95 0.05
300885  0 2  0.0  1.12 0.95 0.05
010686  0 2  0.0  1.12 0.95 0.05
010786  0 2  0.0  1.12 0.95 0.05
310786  0 2  0.0  1.12 0.95 0.05
300886  0 2  0.0  1.12 0.95 0.05
010687  0 2  0.0  1.12 0.95 0.05
010787  0 2  0.0  1.12 0.95 0.05
310787  0 2  0.0  1.12 0.95 0.05
300887  0 2  0.0  1.12 0.95 0.05
010688  0 2  0.0  1.12 0.95 0.05
010788  0 2  0.0  1.12 0.95 0.05
310788  0 2  0.0  1.12 0.95 0.05
300888  0 2  0.0  1.12 0.95 0.05
010689  0 2  0.0  1.12 0.95 0.05
010789  0 2  0.0  1.12 0.95 0.05
310789  0 2  0.0  1.12 0.95 0.05
300889  0 2  0.0  1.12 0.95 0.05
010690  0 2  0.0  1.12 0.95 0.05
```

```
  010790  0 2  0.0  1.12 0.95 0.05
  310790  0 2  0.0  1.12 0.95 0.05
  300890  0 2  0.0  1.12 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
"Cornelius silt loam, hydrologic group C"
*** Record 20
     148           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10510
*** Record 33
       5
       1      15     1.3   0.329       0       0       0
        0.0288810.028881       0
             0.1   0.329   0.099     2.3       0
       2      13    1.38   0.338       0       0       0
        0.0288810.028881       0
              1   0.338   0.108    1.11       0
       3      15    1.58    0.34       0       0       0
        0.0288810.028881       0
              1    0.34    0.11    0.21       0
       4      55    1.52   0.358       0       0       0
        0.0288810.028881       0
              5   0.358   0.148   0.145       0
       5      50    1.46   0.202       0       0       0
        0.0288810.028881       0
              5   0.202   0.142    0.07       0
***Record 40
       0
            YEAR      10            YEAR      10            YEAR      10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

stored as eheFLtrf.out
Chemical: 2,4-D
PRZM environment: FLturfC.txt modified Satday, 12 October 2002 at 16:44:48
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w12834.dvf modified Wedday, 3 July 2002 at 09:04:28
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	1.111	0.6893	0.2302	0.112	0.08872	0.04725
1962	1.133	0.7163	0.2541	0.1315	0.1069	0.07335
1963	1.133	0.704	0.2438	0.1396	0.1394	0.08837
1964	1.154	0.7194	0.3002	0.2247	0.1831	0.1166
1965	1.14	0.7703	0.276	0.145	0.1329	0.09263
1966	1.15	0.8123	0.3388	0.1854	0.1596	0.1054
1967	1.14	0.7131	0.2547	0.1344	0.1165	0.08874
1968	1.162	0.7452	0.3085	0.2448	0.202	0.1255
1969	1.163	0.9147	0.366	0.2121	0.1788	0.1213
1970	1.153	0.7393	0.2995	0.1595	0.1295	0.09244
1971	1.134	0.7141	0.3981	0.2641	0.2122	0.1127
1972	1.161	0.7426	0.2875	0.222	0.1865	0.1195
1973	1.156	0.7489	0.2936	0.1572	0.1293	0.09774
1974	1.143	0.719	0.2521	0.1311	0.1102	0.08111
1975	1.129	0.7188	0.2762	0.1398	0.1141	0.07878
1976	1.645	1.055	0.5114	0.2681	0.2323	0.1253
1977	1.146	0.7262	0.2658	0.1459	0.121	0.09148
1978	1.144	0.734	0.4146	0.2365	0.1904	0.1153
1979	1.391	0.9934	0.3797	0.2811	0.2306	0.1393
1980	1.17	0.7906	0.3054	0.1744	0.1457	0.1081
1981	1.137	0.7313	0.2623	0.1386	0.1133	0.08379
1982	1.416	0.9124	0.4828	0.2433	0.2025	0.1169
1983	1.64	1.073	0.4879	0.3206	0.2713	0.1363
1984	1.503	1.071	0.4598	0.2669	0.2225	0.1461
1985	1.15	0.7367	0.2899	0.1563	0.1314	0.0946
1986	1.144	0.742	0.3177	0.1678	0.1372	0.09679
1987	1.141	0.7343	0.2884	0.1591	0.1298	0.08849
1988	1.136	0.7237	0.2648	0.1618	0.1435	0.08984
1989	4.166	2.679	0.9808	0.5155	0.413	0.1673
1990	1.218	0.8001	0.3337	0.2057	0.191	0.1387

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	4.166	2.679	0.9808	0.5155	0.413	0.1673
0.064516	1.645	1.073	0.5114	0.3206	0.2713	0.1461

0.096774	1.64	1.071	0.4879	0.2811	0.2323	0.1393
0.129032	1.503	1.055	0.4828	0.2681	0.2306	0.1387
0.16129	1.416	0.9934	0.4598	0.2669	0.2225	0.1363
0.193548	1.391	0.9147	0.4146	0.2641	0.2122	0.1255
0.225806	1.218	0.9124	0.3981	0.2448	0.2025	0.1253
0.258065	1.17	0.8123	0.3797	0.2433	0.202	0.1213
0.290323	1.163	0.8001	0.366	0.2365	0.191	0.1195
0.322581	1.162	0.7906	0.3388	0.2247	0.1904	0.1169
0.354839	1.161	0.7703	0.3337	0.222	0.1865	0.1166
0.387097	1.156	0.7489	0.3177	0.2121	0.1831	0.1153
0.419355	1.154	0.7452	0.3085	0.2057	0.1788	0.1127
0.451613	1.153	0.7426	0.3054	0.1854	0.1596	0.1081
0.483871	1.15	0.742	0.3002	0.1744	0.1457	0.1054
0.516129	1.15	0.7393	0.2995	0.1678	0.1435	0.09774
0.548387	1.146	0.7367	0.2936	0.1618	0.1394	0.09679
0.580645	1.144	0.7343	0.2899	0.1595	0.1372	0.0946
0.612903	1.144	0.734	0.2884	0.1591	0.1329	0.09263
0.645161	1.143	0.7313	0.2875	0.1572	0.1314	0.09244
0.677419	1.141	0.7262	0.2762	0.1563	0.1298	0.09148
0.709677	1.14	0.7237	0.276	0.1459	0.1295	0.08984
0.741935	1.14	0.7194	0.2658	0.145	0.1293	0.08874
0.774194	1.137	0.719	0.2648	0.1398	0.121	0.08849
0.806452	1.136	0.7188	0.2623	0.1396	0.1165	0.08837
0.83871	1.134	0.7163	0.2547	0.1386	0.1141	0.08379
0.870968	1.133	0.7141	0.2541	0.1344	0.1133	0.08111
0.903226	1.133	0.7131	0.2521	0.1315	0.1102	0.07878
0.935484	1.129	0.704	0.2438	0.1311	0.1069	0.07335
0.967742	1.111	0.6893	0.2302	0.112	0.08872	0.04725
0.1	1.6263	1.0694	0.48739	0.2798	0.23213	0.13924
					Average of yearly averages:	0.10599

Inputs generaged by pe4.pl - 14-May-2003

stored as ehePAtrf.out
Chemical: 2,4-D
PRZM environment: PAturfC.txt modified Satday, 12 October 2002 at 17:27:02
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14737.dvf modified Wedday, 3 July 2002 at 09:06:12
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	1.122	0.7226	0.257	0.1302	0.1055	0.05524
1962	1.147	0.7418	0.2826	0.1557	0.1329	0.09279
1963	1.147	0.7442	0.404	0.2335	0.1948	0.1169
1964	1.163	0.7546	0.2888	0.1634	0.1359	0.1138
1965	1.147	0.7407	0.2805	0.158	0.1305	0.09573
1966	1.14	0.7277	0.2929	0.1823	0.1497	0.09835
1967	1.165	0.7605	0.307	0.1807	0.151	0.1119
1968	1.163	0.7604	0.3017	0.1871	0.1534	0.1129
1969	1.161	0.7606	0.2981	0.1716	0.1464	0.1075
1970	1.149	0.7444	0.279	0.1655	0.1421	0.1041
1971	1.179	0.7624	0.3701	0.2172	0.1867	0.1195
1972	1.184	0.7759	0.3115	0.2179	0.1876	0.1417
1973	1.176	0.7701	0.3983	0.2385	0.1995	0.1433
1974	1.17	0.7757	0.3474	0.2013	0.1676	0.1275
1975	1.151	0.7458	0.2945	0.2331	0.1934	0.1187
1976	1.152	0.7466	0.3288	0.2051	0.1691	0.115
1977	1.153	0.7513	0.2848	0.1656	0.1407	0.1088
1978	1.163	0.7661	0.3167	0.1711	0.142	0.1098
1979	1.156	0.7436	0.4329	0.2798	0.23	0.1338
1980	1.166	0.7582	0.2968	0.166	0.1408	0.1172
1981	1.151	0.7459	0.31	0.1644	0.1337	0.1013
1982	1.181	0.7773	0.3134	0.2012	0.1678	0.1206
1983	1.148	0.7402	0.2766	0.1554	0.1317	0.1011
1984	1.175	0.7777	0.3078	0.2167	0.1819	0.1216
1985	2.646	1.708	0.6422	0.3742	0.3148	0.1639
1986	1.209	0.7916	0.3257	0.2054	0.1922	0.1557
1987	3.516	2.29	0.9272	0.5007	0.4063	0.1848
1988	1.249	0.8526	0.4651	0.3128	0.2615	0.2019
1989	1.178	0.7704	0.3845	0.2444	0.2043	0.1527
1990	1.169	0.761	0.2992	0.1884	0.1564	0.121

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	3.516	2.29	0.9272	0.5007	0.4063	0.2019

0.064516	2.646	1.708	0.6422	0.3742	0.3148	0.1848
0.096774	1.249	0.8526	0.4651	0.3128	0.2615	0.1639
0.129032	1.209	0.7916	0.4329	0.2798	0.23	0.1557
0.16129	1.184	0.7777	0.404	0.2444	0.2043	0.1527
0.193548	1.181	0.7773	0.3983	0.2385	0.1995	0.1433
0.225806	1.179	0.7759	0.3845	0.2335	0.1948	0.1417
0.258065	1.178	0.7757	0.3701	0.2331	0.1934	0.1338
0.290323	1.176	0.7704	0.3474	0.2179	0.1922	0.1275
0.322581	1.175	0.7701	0.3288	0.2172	0.1876	0.1216
0.354839	1.17	0.7661	0.3257	0.2167	0.1867	0.121
0.387097	1.169	0.7624	0.3167	0.2054	0.1819	0.1206
0.419355	1.166	0.761	0.3134	0.2051	0.1691	0.1195
0.451613	1.165	0.7606	0.3115	0.2013	0.1678	0.1187
0.483871	1.163	0.7605	0.31	0.2012	0.1676	0.1172
0.516129	1.163	0.7604	0.3078	0.1884	0.1564	0.1169
0.548387	1.163	0.7582	0.307	0.1871	0.1534	0.115
0.580645	1.161	0.7546	0.3017	0.1823	0.151	0.1138
0.612903	1.156	0.7513	0.2992	0.1807	0.1497	0.1129
0.645161	1.153	0.7466	0.2981	0.1716	0.1464	0.1119
0.677419	1.152	0.7459	0.2968	0.1711	0.1421	0.1098
0.709677	1.151	0.7458	0.2945	0.166	0.142	0.1088
0.741935	1.151	0.7444	0.2929	0.1656	0.1408	0.1075
0.774194	1.149	0.7442	0.2888	0.1655	0.1407	0.1041
0.806452	1.148	0.7436	0.2848	0.1644	0.1359	0.1013
0.83871	1.147	0.7418	0.2826	0.1634	0.1337	0.1011
0.870968	1.147	0.7407	0.2805	0.158	0.1329	0.09835
0.903226	1.147	0.7402	0.279	0.1557	0.1317	0.09573
0.935484	1.14	0.7277	0.2766	0.1554	0.1305	0.09279
0.967742	1.122	0.7226	0.257	0.1302	0.1055	0.05524
0.1	1.245	0.8465	0.46188	0.3095	0.25835	0.16308
					Average of yearly averages:	0.122304

Inputs generaged by pe4.pl - 14-May-2003

stored as eheNDwht.out
Chemical: 2,4-D
PRZM environment: NDwheatC.txt modified Satday, 12 October 2002 at 17:15:08
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14914.dvf modified Wedday, 3 July 2002 at 09:05:52
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	2.73	1.672	0.5313	0.2439	0.1906	0.07358
1962	2.772	1.784	0.693	0.4052	0.3344	0.1588
1963	2.806	1.752	0.6029	0.2999	0.2555	0.1505
1964	2.784	1.741	0.7795	0.4457	0.365	0.186
1965	2.827	1.83	0.6458	0.3386	0.2767	0.1722
1966	2.795	1.734	0.5916	0.2934	0.247	0.1435
1967	2.788	1.754	0.6173	0.3008	0.2366	0.1275
1968	2.77	1.725	0.593	0.2858	0.2236	0.1124
1969	2.78	1.74	0.5853	0.3499	0.2827	0.1439
1970	2.796	1.729	0.6366	0.322	0.2569	0.1482
1971	2.79	1.778	0.6237	0.3115	0.2459	0.1383
1972	2.787	1.725	0.5769	0.2887	0.2365	0.1321
1973	2.778	1.688	0.5487	0.2677	0.2147	0.1212
1974	2.78	1.707	0.563	0.3085	0.2755	0.1493
1975	2.803	1.739	0.715	0.5027	0.4125	0.2188
1976	2.834	1.737	0.5947	0.3058	0.2447	0.1672
1977	2.781	1.715	0.571	0.3597	0.2939	0.1579
1978	2.802	1.75	0.7762	0.4194	0.3438	0.1879
1979	2.814	1.757	0.6261	0.3573	0.2919	0.1744
1980	2.8	1.742	0.6057	0.3005	0.2477	0.1469
1981	2.784	1.753	0.6021	0.3056	0.2435	0.127
1982	2.78	1.747	0.5973	0.2955	0.2329	0.1231
1983	2.778	1.719	0.5721	0.325	0.2629	0.1404
1984	2.794	1.865	1.102	0.5722	0.4606	0.2269
1985	2.829	1.803	0.6557	0.358	0.296	0.1865
1986	2.804	1.753	0.7252	0.4027	0.3299	0.185
1987	2.811	1.751	0.602	0.3185	0.2636	0.1596
1988	2.78	1.684	0.5532	0.2667	0.2176	0.1268
1989	2.778	1.722	0.5741	0.2776	0.2284	0.1319
1990	3.738	2.325	0.8485	0.4492	0.3596	0.1821

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	3.738	2.325	1.102	0.5722	0.4606	0.2269

0.064516	2.834	1.865	0.8485	0.5027	0.4125	0.2188
0.096774	2.829	1.83	0.7795	0.4492	0.365	0.1879
0.129032	2.827	1.803	0.7762	0.4457	0.3596	0.1865
0.16129	2.814	1.784	0.7252	0.4194	0.3438	0.186
0.193548	2.811	1.778	0.715	0.4052	0.3344	0.185
0.225806	2.806	1.757	0.693	0.4027	0.3299	0.1821
0.258065	2.804	1.754	0.6557	0.3597	0.296	0.1744
0.290323	2.803	1.753	0.6458	0.358	0.2939	0.1722
0.322581	2.802	1.753	0.6366	0.3573	0.2919	0.1672
0.354839	2.8	1.752	0.6261	0.3499	0.2827	0.1596
0.387097	2.796	1.751	0.6237	0.3386	0.2767	0.1588
0.419355	2.795	1.75	0.6173	0.325	0.2755	0.1579
0.451613	2.794	1.747	0.6057	0.322	0.2636	0.1505
0.483871	2.79	1.742	0.6029	0.3185	0.2629	0.1493
0.516129	2.788	1.741	0.6021	0.3115	0.2569	0.1482
0.548387	2.787	1.74	0.602	0.3085	0.2555	0.1469
0.580645	2.784	1.739	0.5973	0.3058	0.2477	0.1439
0.612903	2.784	1.737	0.5947	0.3056	0.247	0.1435
0.645161	2.781	1.734	0.593	0.3008	0.2459	0.1404
0.677419	2.78	1.729	0.5916	0.3005	0.2447	0.1383
0.709677	2.78	1.725	0.5853	0.2999	0.2435	0.1321
0.741935	2.78	1.725	0.5769	0.2955	0.2366	0.1319
0.774194	2.78	1.722	0.5741	0.2934	0.2365	0.1275
0.806452	2.778	1.719	0.5721	0.2887	0.2329	0.127
0.83871	2.778	1.715	0.571	0.2858	0.2284	0.1268
0.870968	2.778	1.707	0.563	0.2776	0.2236	0.1231
0.903226	2.772	1.688	0.5532	0.2677	0.2176	0.1212
0.935484	2.77	1.684	0.5487	0.2667	0.2147	0.1124
0.967742	2.73	1.672	0.5313	0.2439	0.1906	0.07358
0.1	2.8288	1.8273	0.77917	0.44885	0.36446	0.18776
					Average of yearly averages:	0.153329

Inputs generaged by pe4.pl - 14-May-2003

stored as eheORwht.out
Chemical: 2,4-D
PRZM environment: ORwheatC.txt modified Satday, 12 October 2002 at 17:22:28
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w24232.dvf modified Wedday, 3 July 2002 at 09:06:10
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	2.73	1.738	0.5924	0.2939	0.2291	0.09158
1962	2.763	1.77	0.6092	0.3139	0.2486	0.1112
1963	2.769	1.778	0.6659	0.3667	0.2951	0.1365
1964	2.778	1.792	0.6297	0.3083	0.2447	0.1142
1965	2.769	1.787	0.6358	0.3137	0.2485	0.1125
1966	2.768	1.786	0.6254	0.3012	0.2364	0.106
1967	2.764	1.78	0.6176	0.2979	0.2339	0.103
1968	2.766	1.815	0.648	0.3167	0.2511	0.1115
1969	2.768	1.798	0.628	0.3053	0.2415	0.1107
1970	2.77	1.775	0.6318	0.3071	0.2423	0.1096
1971	2.766	1.79	1.036	0.5428	0.4428	0.2014
1972	2.808	1.83	0.717	0.3802	0.3085	0.1555
1973	2.787	1.829	0.6681	0.3331	0.2649	0.1263
1974	2.771	1.788	0.6255	0.3032	0.2387	0.11
1975	2.767	1.793	0.6293	0.3094	0.2444	0.1106
1976	2.768	1.815	0.6484	0.3153	0.2492	0.1142
1977	2.772	1.816	0.6497	0.319	0.2522	0.1157
1978	2.772	1.797	0.6365	0.3274	0.261	0.1225
1979	2.78	1.822	0.6555	0.3278	0.2596	0.1226
1980	2.776	1.824	0.7936	0.4061	0.3272	0.1502
1981	2.789	1.801	0.696	0.3528	0.286	0.1389
1982	2.78	1.844	0.7107	0.3582	0.2871	0.1339
1983	2.809	1.839	0.6678	0.3307	0.2625	0.1224
1984	2.774	1.799	0.7873	0.4095	0.3324	0.1535
1985	2.79	1.814	0.6498	0.3236	0.2663	0.1301
1986	2.774	1.772	0.612	0.3015	0.2378	0.1102
1987	2.768	1.794	0.6491	0.318	0.2509	0.1139
1988	2.769	1.837	0.652	0.3222	0.2556	0.1147
1989	2.768	1.772	0.6112	0.2939	0.2303	0.1043
1990	2.765	1.797	0.6322	0.3118	0.2453	0.1085

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	2.809	1.844	1.036	0.5428	0.4428	0.2014

0.064516	2.808	1.839	0.7936	0.4095	0.3324	0.1555
0.096774	2.79	1.837	0.7873	0.4061	0.3272	0.1535
0.129032	2.789	1.83	0.717	0.3802	0.3085	0.1502
0.16129	2.787	1.829	0.7107	0.3667	0.2951	0.1389
0.193548	2.78	1.824	0.696	0.3582	0.2871	0.1365
0.225806	2.78	1.822	0.6681	0.3528	0.286	0.1339
0.258065	2.778	1.816	0.6678	0.3331	0.2663	0.1301
0.290323	2.776	1.815	0.6659	0.3307	0.2649	0.1263
0.322581	2.774	1.815	0.6555	0.3278	0.2625	0.1226
0.354839	2.774	1.814	0.652	0.3274	0.261	0.1225
0.387097	2.772	1.801	0.6498	0.3236	0.2596	0.1224
0.419355	2.772	1.799	0.6497	0.3222	0.2556	0.1157
0.451613	2.771	1.798	0.6491	0.319	0.2522	0.1147
0.483871	2.77	1.797	0.6484	0.318	0.2511	0.1142
0.516129	2.769	1.797	0.648	0.3167	0.2509	0.1142
0.548387	2.769	1.794	0.6365	0.3153	0.2492	0.1139
0.580645	2.769	1.793	0.6358	0.3139	0.2486	0.1125
0.612903	2.768	1.792	0.6322	0.3137	0.2485	0.1115
0.645161	2.768	1.79	0.6318	0.3118	0.2453	0.1112
0.677419	2.768	1.788	0.6297	0.3094	0.2447	0.1107
0.709677	2.768	1.787	0.6293	0.3083	0.2444	0.1106
0.741935	2.768	1.786	0.628	0.3071	0.2423	0.1102
0.774194	2.767	1.78	0.6255	0.3053	0.2415	0.11
0.806452	2.766	1.778	0.6254	0.3032	0.2387	0.1096
0.83871	2.766	1.775	0.6176	0.3015	0.2378	0.1085
0.870968	2.765	1.772	0.612	0.3012	0.2364	0.106
0.903226	2.764	1.772	0.6112	0.2979	0.2339	0.1043
0.935484	2.763	1.77	0.6092	0.2939	0.2303	0.103
0.967742	2.73	1.738	0.5924	0.2939	0.2291	0.09158
0.1	2.7899	1.8363	0.78027	0.40351	0.32533	0.15317
					Average of yearly averages:	0.122206

Inputs generaged by pe4.pl - 14-May-2003

stored as eheILcrn.out
Chemical: 2,4-D
PRZM environment: ILCornC.txt modified Satday, 12 October 2002 at 17:01:38
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14923.dvf modified Wedday, 3 July 2002 at 09:04:40
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	3.094	2.085	1.053	0.8798	0.8346	0.4377
1962	3.556	2.588	1.7	1.183	1.094	0.9011
1963	3.406	2.412	1.337	1.097	0.9976	0.8821
1964	3.824	2.94	1.669	1.281	1.274	0.9463
1965	4.029	2.836	1.771	1.438	1.288	0.9799
1966	5.248	3.745	2.164	1.628	1.525	1.165
1967	10.75	7.186	3.24	2.116	1.845	1.446
1968	3.588	2.526	1.567	1.533	1.381	1.065
1969	6.429	4.276	2.227	1.605	1.403	1.107
1970	3.797	3.131	1.911	1.488	1.375	1.084
1971	3.741	2.797	1.517	1.156	1.064	0.8854
1972	5.773	4.004	2.54	1.826	1.783	1.215
1973	8.507	5.874	3.104	2.268	2.143	1.415
1974	4.848	3.711	2.411	1.973	1.748	1.256
1975	3.47	2.421	1.419	1.103	1.078	0.9262
1976	3.474	2.39	1.525	1.161	1.013	0.8092
1977	3.674	2.54	1.495	1.149	1.075	0.8913
1978	3.477	2.432	1.399	1.157	1.065	0.8356
1979	3.274	2.263	1.366	0.9756	0.8815	0.7229
1980	3.954	3.167	1.776	1.234	1.078	0.8004
1981	3.283	2.272	1.425	1.13	1.05	0.8088
1982	4.807	3.355	1.895	1.532	1.382	1.041
1983	4.888	3.391	1.651	1.176	1.066	0.9277
1984	5.843	3.943	2.224	1.533	1.453	1.138
1985	5.245	3.658	2.207	1.624	1.5	1.122
1986	3.762	2.956	1.781	1.588	1.472	1.22
1987	3.508	2.416	1.408	1.106	0.9766	0.8538
1988	3.293	2.229	1.076	0.8779	0.7632	0.6429
1989	3.88	2.752	2.004	1.319	1.144	0.7643
1990	5.068	3.814	2.074	1.605	1.462	0.9803

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	10.75	7.186	3.24	2.268	2.143	1.446

0.064516	8.507	5.874	3.104	2.116	1.845	1.415
0.096774	6.429	4.276	2.54	1.973	1.783	1.256
0.129032	5.843	4.004	2.411	1.826	1.748	1.22
0.16129	5.773	3.943	2.227	1.628	1.525	1.215
0.193548	5.248	3.814	2.224	1.624	1.5	1.165
0.225806	5.245	3.745	2.207	1.605	1.472	1.138
0.258065	5.068	3.711	2.164	1.605	1.462	1.122
0.290323	4.888	3.658	2.074	1.588	1.453	1.107
0.322581	4.848	3.391	2.004	1.533	1.403	1.084
0.354839	4.807	3.355	1.911	1.533	1.382	1.065
0.387097	4.029	3.167	1.895	1.532	1.381	1.041
0.419355	3.954	3.131	1.781	1.488	1.375	0.9803
0.451613	3.88	2.956	1.776	1.438	1.288	0.9799
0.483871	3.824	2.94	1.771	1.319	1.274	0.9463
0.516129	3.797	2.836	1.7	1.281	1.144	0.9277
0.548387	3.762	2.797	1.669	1.234	1.094	0.9262
0.580645	3.741	2.752	1.651	1.183	1.078	0.9011
0.612903	3.674	2.588	1.567	1.176	1.078	0.8913
0.645161	3.588	2.54	1.525	1.161	1.075	0.8854
0.677419	3.556	2.526	1.517	1.157	1.066	0.8821
0.709677	3.508	2.432	1.495	1.156	1.065	0.8538
0.741935	3.477	2.421	1.425	1.149	1.064	0.8356
0.774194	3.474	2.416	1.419	1.13	1.05	0.8092
0.806452	3.47	2.412	1.408	1.106	1.013	0.8088
0.83871	3.406	2.39	1.399	1.103	0.9976	0.8004
0.870968	3.293	2.272	1.366	1.097	0.9766	0.7643
0.903226	3.283	2.263	1.337	0.9756	0.8815	0.7229
0.935484	3.274	2.229	1.076	0.8798	0.8346	0.6429
0.967742	3.094	2.085	1.053	0.8779	0.7632	0.4377
0.1	6.3704	4.2488	2.5271	1.9583	1.7795	1.2524
					Average of yearly averages:	0.975663

Inputs generaged by pe4.pl - 14-May-2003

stored as eheCAcrn.out
Chemical: 2,4-D
PRZM environment: modified Satday, 12 October 2002 at 16:32:58
CAcornC.txt
EXAMS environment: modified Thuday, 29 August 2002 at 16:33:29
pond298.exv
Metfile: modified Wedday, 3 July 2002 at 09:04:22
w23232.dvf
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	2.83	1.802	0.6355	0.4445	0.3508	0.203
1962	7.256	4.92	2.098	1.211	0.9975	0.4848
1963	3.376	2.385	1.429	1.149	0.9839	0.6625
1964	3.044	2.014	0.8471	0.6858	0.5774	0.3965
1965	2.981	1.966	0.7831	0.6289	0.5178	0.3314
1966	2.937	1.911	0.7421	0.5756	0.4721	0.312
1967	3.356	2.508	1.015	0.775	0.6417	0.3855
1968	2.953	1.939	0.765	0.5964	0.4923	0.317
1969	2.944	1.924	0.7479	0.5825	0.4771	0.3038
1970	2.935	1.92	0.7393	0.5657	0.4631	0.3091
1971	2.955	1.94	0.7695	0.592	0.4894	0.3106
1972	2.927	1.909	0.7466	0.565	0.4647	0.3059
1973	2.947	1.915	0.755	0.59	0.4858	0.319
1974	2.951	1.947	0.7731	0.5915	0.488	0.3111
1975	2.954	1.93	0.7951	0.6069	0.4955	0.3038
1976	2.933	1.91	0.7259	0.564	0.4584	0.29
1977	2.928	1.98	0.7526	0.577	0.474	0.3002
1978	2.952	1.95	0.7614	0.5898	0.4841	0.3138
1979	3.058	2.032	0.8441	0.6448	0.5289	0.3341
1980	2.947	1.929	0.7565	0.5812	0.4787	0.3052
1981	3.098	2.169	0.9241	0.68	0.5568	0.3577
1982	3.128	2.108	1.128	0.8869	0.7346	0.467
1983	3.55	2.351	0.9702	0.7533	0.6309	0.4107
1984	2.968	1.936	0.7699	0.5971	0.4958	0.3299
1985	2.939	1.921	0.7443	0.5751	0.4712	0.3093
1986	3.295	2.151	0.8201	0.6391	0.5263	0.3223
1987	2.937	1.926	0.7427	0.5719	0.4675	0.3048
1988	2.956	1.957	0.7735	0.5878	0.4844	0.3029
1989	2.964	1.963	0.8184	0.6415	0.5579	0.379
1990	3.011	2.003	0.8308	0.6576	0.5732	0.3782

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	7.256	4.92	2.098	1.211	0.9975	0.6625

0.064516	3.55	2.508	1.429	1.149	0.9839	0.4848
0.096774	3.376	2.385	1.128	0.8869	0.7346	0.467
0.129032	3.356	2.351	1.015	0.775	0.6417	0.4107
0.16129	3.295	2.169	0.9702	0.7533	0.6309	0.3965
0.193548	3.128	2.151	0.9241	0.6858	0.5774	0.3855
0.225806	3.098	2.108	0.8471	0.68	0.5732	0.379
0.258065	3.058	2.032	0.8441	0.6576	0.5579	0.3782
0.290323	3.044	2.014	0.8308	0.6448	0.5568	0.3577
0.322581	3.011	2.003	0.8201	0.6415	0.5289	0.3341
0.354839	2.981	1.98	0.8184	0.6391	0.5263	0.3314
0.387097	2.968	1.966	0.7951	0.6289	0.5178	0.3299
0.419355	2.964	1.963	0.7831	0.6069	0.4958	0.3223
0.451613	2.956	1.957	0.7735	0.5971	0.4955	0.319
0.483871	2.955	1.95	0.7731	0.5964	0.4923	0.317
0.516129	2.954	1.947	0.7699	0.592	0.4894	0.3138
0.548387	2.953	1.94	0.7695	0.5915	0.488	0.312
0.580645	2.952	1.939	0.765	0.59	0.4858	0.3111
0.612903	2.951	1.936	0.7614	0.5898	0.4844	0.3106
0.645161	2.947	1.93	0.7565	0.5878	0.4841	0.3093
0.677419	2.947	1.929	0.755	0.5825	0.4787	0.3091
0.709677	2.944	1.926	0.7526	0.5812	0.4771	0.3059
0.741935	2.939	1.924	0.7479	0.577	0.474	0.3052
0.774194	2.937	1.921	0.7466	0.5756	0.4721	0.3048
0.806452	2.937	1.92	0.7443	0.5751	0.4712	0.3038
0.83871	2.935	1.915	0.7427	0.5719	0.4675	0.3038
0.870968	2.933	1.911	0.7421	0.5657	0.4647	0.3029
0.903226	2.928	1.91	0.7393	0.565	0.4631	0.3002
0.935484	2.927	1.909	0.7259	0.564	0.4584	0.29
0.967742	2.83	1.802	0.6355	0.4445	0.3508	0.203
0.1	3.374	2.3816	1.1167	0.87571	0.72531	0.46137
					Average of yearly averages:	0.34537

Inputs generaged by pe4.pl - 14-May-2003

stored as eheTXsor.out
Chemical: 2,4-D
PRZM environment: TXsorghumC.txt modified Satday, 12 October 2002 at 17:29:44
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w13958.dvf modified Wedday, 3 July 2002 at 09:06:24
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	2.647	2.015	1.026	0.5708	0.457	0.1661
1962	1.659	1.123	0.5589	0.3102	0.2623	0.1411
1963	1.404	0.8692	0.3287	0.1654	0.1323	0.07576
1964	4.753	3.024	1.208	0.6271	0.5013	0.199
1965	1.434	0.9043	0.3289	0.1761	0.1473	0.1105
1966	1.394	0.8666	0.3027	0.1566	0.1434	0.07507
1967	1.386	0.8458	0.2751	0.1348	0.113	0.05941
1968	1.383	0.8506	0.3003	0.2181	0.1772	0.07908
1969	1.39	0.8447	0.3345	0.1795	0.1652	0.08194
1970	1.391	0.8553	0.2833	0.1365	0.1085	0.05871
1971	1.379	0.8337	0.3261	0.1754	0.1549	0.06838
1972	1.387	0.8588	0.4999	0.2614	0.2112	0.09323
1973	1.394	0.9858	0.5429	0.3198	0.2592	0.1192
1974	1.402	0.8608	0.2896	0.1559	0.1677	0.09416
1975	2.46	1.545	0.7249	0.443	0.3608	0.1557
1976	1.416	0.909	0.4513	0.3288	0.2742	0.1417
1977	1.41	0.8719	0.3016	0.153	0.1221	0.07775
1978	1.383	0.8542	0.2806	0.1509	0.127	0.06239
1979	1.386	0.8856	0.454	0.2941	0.2516	0.1139
1980	1.406	0.8645	0.2933	0.1475	0.1182	0.07583
1981	5.463	4.174	1.82	0.9353	0.748	0.2883
1982	1.463	0.932	0.3995	0.2287	0.1898	0.1396
1983	1.398	0.8797	0.3054	0.1758	0.1451	0.07682
1984	1.386	0.8569	0.2833	0.1349	0.1057	0.05482
1985	1.516	0.9768	0.498	0.2901	0.2339	0.09945
1986	1.401	0.8879	0.31	0.153	0.1218	0.07278
1987	2.249	1.457	0.8405	0.4397	0.351	0.1446
1988	1.416	0.9019	0.3271	0.1733	0.141	0.08497
1989	1.384	0.8475	0.4675	0.233	0.1879	0.08266
1990	1.39	0.8519	0.2806	0.1691	0.1373	0.07073

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	5.463	4.174	1.82	0.9353	0.748	0.2883

0.064516	4.753	3.024	1.208	0.6271	0.5013	0.199
0.096774	2.647	2.015	1.026	0.5708	0.457	0.1661
0.129032	2.46	1.545	0.8405	0.443	0.3608	0.1557
0.16129	2.249	1.457	0.7249	0.4397	0.351	0.1446
0.193548	1.659	1.123	0.5589	0.3288	0.2742	0.1417
0.225806	1.516	0.9858	0.5429	0.3198	0.2623	0.1411
0.258065	1.463	0.9768	0.4999	0.3102	0.2592	0.1396
0.290323	1.434	0.932	0.498	0.2941	0.2516	0.1192
0.322581	1.416	0.909	0.4675	0.2901	0.2339	0.1139
0.354839	1.416	0.9043	0.454	0.2614	0.2112	0.1105
0.387097	1.41	0.9019	0.4513	0.233	0.1898	0.09945
0.419355	1.406	0.8879	0.3995	0.2287	0.1879	0.09416
0.451613	1.404	0.8856	0.3345	0.2181	0.1772	0.09323
0.483871	1.402	0.8797	0.3289	0.1795	0.1677	0.08497
0.516129	1.401	0.8719	0.3287	0.1761	0.1652	0.08266
0.548387	1.398	0.8692	0.3271	0.1758	0.1549	0.08194
0.580645	1.394	0.8666	0.3261	0.1754	0.1473	0.07908
0.612903	1.394	0.8645	0.31	0.1733	0.1451	0.07775
0.645161	1.391	0.8608	0.3054	0.1691	0.1434	0.07682
0.677419	1.39	0.8588	0.3027	0.1654	0.141	0.07583
0.709677	1.39	0.8569	0.3016	0.1566	0.1373	0.07576
0.741935	1.387	0.8553	0.3003	0.1559	0.1323	0.07507
0.774194	1.386	0.8542	0.2933	0.153	0.127	0.07278
0.806452	1.386	0.8519	0.2896	0.153	0.1221	0.07073
0.83871	1.386	0.8506	0.2833	0.1509	0.1218	0.06838
0.870968	1.384	0.8475	0.2833	0.1475	0.1182	0.06239
0.903226	1.383	0.8458	0.2806	0.1365	0.113	0.05941
0.935484	1.383	0.8447	0.2806	0.1349	0.1085	0.05871
0.967742	1.379	0.8337	0.2751	0.1348	0.1057	0.05482
0.1	2.6283	1.968	1.00745	0.55802	0.44738	0.16506
					Average of yearly averages:	0.105455

Inputs generaged by pe4.pl - 14-May-2003

stored as eheKSsor.out
Chemical: 2,4-D
PRZM environment: KSsorghumC.txt modified Satday, 12 October 2002 at 15:57:56
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w13996.dvf modified Wedday, 3 July 2002 at 09:04:44
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	1.365	0.8326	0.3252	0.1898	0.1548	0.06063
1962	1.393	0.874	0.3732	0.206	0.1755	0.08897
1963	1.398	0.8592	0.3223	0.1901	0.1547	0.08438
1964	1.822	1.128	0.6416	0.3313	0.2741	0.1242
1965	1.461	1.111	0.4657	0.3177	0.2643	0.144
1966	1.852	1.291	0.7387	0.4003	0.3306	0.1671
1967	2.187	1.538	1.03	0.5865	0.4866	0.2337
1968	1.458	1.02	0.512	0.342	0.2988	0.1924
1969	1.597	1.037	0.6806	0.386	0.3192	0.1756
1970	1.426	0.892	0.4539	0.2427	0.1987	0.1218
1971	1.404	0.9455	0.3692	0.1986	0.1611	0.0878
1972	1.393	0.8666	0.3126	0.173	0.142	0.07649
1973	1.391	0.8528	0.2813	0.2303	0.1975	0.1024
1974	2.121	1.435	0.5482	0.2959	0.2454	0.1261
1975	1.841	1.314	0.5142	0.2706	0.219	0.1181
1976	1.402	0.8719	0.3037	0.1601	0.129	0.07556
1977	1.559	1.191	0.7627	0.4139	0.342	0.151
1978	1.436	0.9046	0.4934	0.2871	0.2431	0.1525
1979	1.513	1.126	0.4251	0.3062	0.2563	0.1428
1980	1.416	0.8742	0.3023	0.1581	0.1421	0.09467
1981	1.392	0.8578	0.5172	0.3253	0.2721	0.1288
1982	1.474	1.035	0.4457	0.2957	0.25	0.1413
1983	1.409	0.8841	0.3788	0.2326	0.1897	0.1031
1984	1.892	1.212	0.5897	0.367	0.3031	0.1418
1985	1.424	0.8975	0.3417	0.2032	0.1787	0.1159
1986	1.404	0.8856	0.3405	0.2079	0.1826	0.09933
1987	1.402	0.8896	0.4531	0.2451	0.2033	0.1032
1988	1.403	0.88	0.3042	0.2139	0.1755	0.09396
1989	1.396	0.8862	0.3715	0.2383	0.202	0.1048
1990	1.402	0.8544	0.4253	0.2375	0.2029	0.1073

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	2.187	1.538	1.03	0.5865	0.4866	0.2337

0.064516	2.121	1.435	0.7627	0.4139	0.342	0.1924
0.096774	1.892	1.314	0.7387	0.4003	0.3306	0.1756
0.129032	1.852	1.291	0.6806	0.386	0.3192	0.1671
0.16129	1.841	1.212	0.6416	0.367	0.3031	0.1525
0.193548	1.822	1.191	0.5897	0.342	0.2988	0.151
0.225806	1.597	1.128	0.5482	0.3313	0.2741	0.144
0.258065	1.559	1.126	0.5172	0.3253	0.2721	0.1428
0.290323	1.513	1.111	0.5142	0.3177	0.2643	0.1418
0.322581	1.474	1.037	0.512	0.3062	0.2563	0.1413
0.354839	1.461	1.035	0.4934	0.2959	0.25	0.1288
0.387097	1.458	1.02	0.4657	0.2957	0.2454	0.1261
0.419355	1.436	0.9455	0.4539	0.2871	0.2431	0.1242
0.451613	1.426	0.9046	0.4531	0.2706	0.219	0.1218
0.483871	1.424	0.8975	0.4457	0.2451	0.2033	0.1181
0.516129	1.416	0.892	0.4253	0.2427	0.2029	0.1159
0.548387	1.409	0.8896	0.4251	0.2383	0.202	0.1073
0.580645	1.404	0.8862	0.3788	0.2375	0.1987	0.1048
0.612903	1.404	0.8856	0.3732	0.2326	0.1975	0.1032
0.645161	1.403	0.8841	0.3715	0.2303	0.1897	0.1031
0.677419	1.402	0.88	0.3692	0.2139	0.1826	0.1024
0.709677	1.402	0.8742	0.3417	0.2079	0.1787	0.09933
0.741935	1.402	0.874	0.3405	0.206	0.1755	0.09467
0.774194	1.398	0.8719	0.3252	0.2032	0.1755	0.09396
0.806452	1.396	0.8666	0.3223	0.1986	0.1611	0.08897
0.83871	1.393	0.8592	0.3126	0.1901	0.1548	0.0878
0.870968	1.393	0.8578	0.3042	0.1898	0.1547	0.08438
0.903226	1.392	0.8544	0.3037	0.173	0.1421	0.07649
0.935484	1.391	0.8528	0.3023	0.1601	0.142	0.07556
0.967742	1.365	0.8326	0.2813	0.1581	0.129	0.06063
0.1	1.888	1.3117	0.73289	0.39887	0.32946	0.17475
					Average of yearly averages:	0.12199

Inputs generaged by pe4.pl - 14-May-2003

stored as eheMSsoy.out
Chemical: 2,4-D
PRZM environment: MSsoybeanC.txt modified Satday, 12 October 2002 at 17:07:44
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w13893.dvf modified Wedday, 3 July 2002 at 09:06:20
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	2.73	1.657	0.5271	0.2585	0.1999	0.07643
1962	2.757	1.753	0.6118	0.3054	0.2367	0.09811
1963	2.759	2.036	0.706	0.3397	0.2672	0.115
1964	2.765	1.733	0.5801	0.3101	0.244	0.108
1965	2.764	1.76	0.6449	0.3149	0.2505	0.1085
1966	2.762	1.732	0.5787	0.2791	0.2205	0.09466
1967	2.756	1.716	0.578	0.2746	0.2154	0.09157
1968	2.757	1.852	0.6853	0.3343	0.2619	0.1105
1969	2.764	1.76	0.6215	0.3424	0.2692	0.1164
1970	2.766	1.755	0.6012	0.3052	0.2394	0.1042
1971	2.759	1.717	0.5684	0.2704	0.214	0.09207
1972	2.756	1.734	0.5922	0.2838	0.2219	0.09461
1973	3.009	1.876	0.6572	0.3368	0.2642	0.112
1974	2.762	1.751	0.5847	0.2917	0.233	0.1029
1975	3.701	2.615	1.04	0.5016	0.396	0.1646
1976	2.777	1.73	0.6232	0.3262	0.2601	0.1171
1977	2.765	1.696	0.5439	0.2797	0.2199	0.09914
1978	2.761	1.831	0.6708	0.3207	0.2559	0.112
1979	2.769	1.735	0.6056	0.3784	0.3019	0.1328
1980	2.77	1.75	0.8813	0.4583	0.3624	0.1542
1981	2.778	1.77	0.6278	0.3144	0.2496	0.1129
1982	2.764	1.731	0.6421	0.3194	0.252	0.1095
1983	2.764	1.764	0.6037	0.3158	0.2577	0.1122
1984	2.764	1.743	0.6017	0.3082	0.2464	0.1072
1985	2.764	1.721	0.6054	0.3243	0.2547	0.1127
1986	2.766	1.924	0.6969	0.3453	0.271	0.115
1987	2.765	1.76	0.6541	0.339	0.2663	0.1167
1988	2.766	1.755	0.5963	0.2884	0.2252	0.09837
1989	2.76	1.75	0.6145	0.3063	0.2392	0.1033
1990	2.761	1.759	0.6325	0.3105	0.2427	0.1032

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	3.701	2.615	1.04	0.5016	0.396	0.1646

0.064516	3.009	2.036	0.8813	0.4583	0.3624	0.1542
0.096774	2.778	1.924	0.706	0.3784	0.3019	0.1328
0.129032	2.777	1.876	0.6969	0.3453	0.271	0.1171
0.16129	2.77	1.852	0.6853	0.3424	0.2692	0.1167
0.193548	2.769	1.831	0.6708	0.3397	0.2672	0.1164
0.225806	2.766	1.77	0.6572	0.339	0.2663	0.115
0.258065	2.766	1.764	0.6541	0.3368	0.2642	0.115
0.290323	2.766	1.76	0.6449	0.3343	0.2619	0.1129
0.322581	2.765	1.76	0.6421	0.3262	0.2601	0.1127
0.354839	2.765	1.76	0.6325	0.3243	0.2577	0.1122
0.387097	2.765	1.759	0.6278	0.3207	0.2559	0.112
0.419355	2.764	1.755	0.6232	0.3194	0.2547	0.112
0.451613	2.764	1.755	0.6215	0.3158	0.252	0.1105
0.483871	2.764	1.753	0.6145	0.3149	0.2505	0.1095
0.516129	2.764	1.751	0.6118	0.3144	0.2496	0.1085
0.548387	2.764	1.75	0.6056	0.3105	0.2464	0.108
0.580645	2.764	1.75	0.6054	0.3101	0.244	0.1072
0.612903	2.762	1.743	0.6037	0.3082	0.2427	0.1042
0.645161	2.762	1.735	0.6017	0.3063	0.2394	0.1033
0.677419	2.761	1.734	0.6012	0.3054	0.2392	0.1032
0.709677	2.761	1.733	0.5963	0.3052	0.2367	0.1029
0.741935	2.76	1.732	0.5922	0.2917	0.233	0.09914
0.774194	2.759	1.731	0.5847	0.2884	0.2252	0.09837
0.806452	2.759	1.73	0.5801	0.2838	0.2219	0.09811
0.83871	2.757	1.721	0.5787	0.2797	0.2205	0.09466
0.870968	2.757	1.717	0.578	0.2791	0.2199	0.09461
0.903226	2.756	1.716	0.5684	0.2746	0.2154	0.09207
0.935484	2.756	1.696	0.5439	0.2704	0.214	0.09157
0.967742	2.73	1.657	0.5271	0.2585	0.1999	0.07643
0.1	2.7779	1.9192	0.70509	0.37509	0.29881	0.13123
					Average of yearly averages:	0.109862

Inputs generaged by pe4.pl - 14-May-2003

stored as eheNCpas.out
Chemical: 2,4-D
PRZM environment: NCalfalfaC.txt modified Satday, 12 October 2002 at 17:08:44
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w03812.dvf modified Wedday, 3 July 2002 at 09:05:50
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1965	5.642	3.648	1.403	0.7964	0.7201	0.3046
1966	5.86	3.842	1.49	0.9346	0.8607	0.4804
1967	7.207	5.517	3.226	1.74	1.42	0.7229
1968	6.048	4.013	1.698	1.008	1.074	0.6705
1969	5.861	3.921	1.857	1.054	1.007	0.5623
1970	5.816	3.838	1.501	0.8441	0.8721	0.5112
1971	5.791	3.804	1.471	0.8536	0.8724	0.4832
1972	5.883	3.884	1.54	0.9884	1.009	0.5469
1973	6.086	3.979	1.553	0.8957	0.9197	0.5072
1974	5.833	3.863	1.512	0.8612	0.8599	0.4683
1975	5.762	3.902	1.53	0.9786	0.8411	0.49
1976	6.368	4.192	1.645	0.9679	0.9539	0.5224
1977	5.835	3.84	1.492	1.162	0.9863	0.5833
1978	5.94	3.925	1.55	0.997	0.919	0.5748
1979	5.792	3.801	1.562	0.9254	0.8817	0.509
1980	5.811	3.866	1.578	0.9166	0.9109	0.499
1981	5.839	4.65	1.78	0.9057	0.9882	0.5145
1982	5.843	3.853	1.521	0.8899	0.9384	0.5287
1983	5.783	3.789	1.512	0.9769	0.8652	0.5235
1984	5.915	3.91	1.627	0.911	0.9298	0.5152
1985	7.992	5.527	2.455	1.291	1.054	0.5853
1986	6.635	5.007	2.183	1.213	1.006	0.5854
1987	9.967	6.439	2.371	1.226	1.216	0.6848
1988	5.825	3.825	1.526	0.9345	0.8876	0.5617
1989	5.873	4.234	1.905	1.161	1.113	0.609
1990	6.322	4.403	2.617	1.431	1.209	0.6846

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.037037	9.967	6.439	3.226	1.74	1.42	0.7229
0.074074	7.992	5.527	2.617	1.431	1.216	0.6848
0.111111	7.207	5.517	2.455	1.291	1.209	0.6846
0.148148	6.635	5.007	2.371	1.226	1.113	0.6705
0.185185	6.368	4.65	2.183	1.213	1.074	0.609

0.222222	6.322	4.403	1.905	1.162	1.054	0.5854
0.259259	6.086	4.234	1.857	1.161	1.009	0.5853
0.296296	6.048	4.192	1.78	1.054	1.007	0.5833
0.333333	5.94	4.013	1.698	1.008	1.006	0.5748
0.37037	5.915	3.979	1.645	0.997	0.9882	0.5623
0.407407	5.883	3.925	1.627	0.9884	0.9863	0.5617
0.444444	5.873	3.921	1.578	0.9786	0.9539	0.5469
0.481481	5.861	3.91	1.562	0.9769	0.9384	0.5287
0.518519	5.86	3.902	1.553	0.9679	0.9298	0.5235
0.555556	5.843	3.884	1.55	0.9346	0.9197	0.5224
0.592593	5.839	3.866	1.54	0.9345	0.919	0.5152
0.62963	5.835	3.863	1.53	0.9254	0.9109	0.5145
0.666667	5.833	3.853	1.526	0.9166	0.8876	0.5112
0.703704	5.825	3.842	1.521	0.911	0.8817	0.509
0.740741	5.816	3.84	1.512	0.9057	0.8724	0.5072
0.777778	5.811	3.838	1.512	0.8957	0.8721	0.499
0.814815	5.792	3.825	1.501	0.8899	0.8652	0.49
0.851852	5.791	3.804	1.492	0.8612	0.8607	0.4832
0.888889	5.783	3.801	1.49	0.8536	0.8599	0.4804
0.925926	5.762	3.789	1.471	0.8441	0.8411	0.4683
0.962963	5.642	3.648	1.403	0.7964	0.7201	0.3046
0.1	7.4425	5.52	2.5036	1.333	1.2111	0.68466
					Average of yearly averages:	0.547258

Inputs generaged by pe4.pl - 14-May-2003

stored as eheNCapp.out
Chemical: 2,4-D
PRZM environment: NCappleC.txt modified Satday, 12 October 2002 at 17:09:36
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w03812.dvf modified Wedday, 3 July 2002 at 09:05:50
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1965	2.836	1.838	0.7391	0.4365	0.3855	0.1682
1966	2.995	1.98	0.8264	0.5942	0.5161	0.3026
1967	6.893	5.27	2.625	1.471	1.213	0.5757
1968	3.202	2.265	1.126	0.7031	0.7362	0.5045
1969	2.999	2.024	1.099	0.6633	0.6017	0.3614
1970	2.941	1.952	0.7819	0.451	0.4715	0.3016
1971	2.936	1.942	0.7739	0.4639	0.4919	0.2814
1972	3.403	2.218	0.9169	0.6708	0.6783	0.3669
1973	3.194	2.11	0.8712	0.5478	0.5509	0.3223
1974	2.964	1.974	0.7951	0.4762	0.4861	0.2737
1975	2.894	1.992	0.7967	0.5433	0.4628	0.2737
1976	4.01	2.649	1.05	0.6339	0.5899	0.328
1977	2.976	1.977	1.101	0.7996	0.6951	0.3972
1978	3.059	2.044	0.869	0.5961	0.5389	0.3726
1979	2.932	1.936	0.8253	0.5136	0.4869	0.299
1980	2.943	1.971	0.8404	0.5069	0.507	0.2856
1981	4.106	3.08	1.246	0.6473	0.655	0.3284
1982	2.991	1.995	0.8264	0.5367	0.5611	0.3281
1983	2.918	1.92	0.7876	0.5304	0.4671	0.2965
1984	3.02	2.01	0.9558	0.551	0.5362	0.3059
1985	7.068	4.624	1.936	1.023	0.8364	0.4109
1986	5.479	3.618	1.625	0.913	0.7641	0.4295
1987	8.666	5.62	2.158	1.137	1.046	0.5781
1988	2.993	1.992	0.8402	0.5492	0.5342	0.3915
1989	3.537	2.458	1.293	0.8031	0.7476	0.4161
1990	7.629	5.14	2.329	1.291	1.09	0.5502

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.037037	8.666	5.62	2.625	1.471	1.213	0.5781
0.074074	7.629	5.27	2.329	1.291	1.09	0.5757
0.111111	7.068	5.14	2.158	1.137	1.046	0.5502
0.148148	6.893	4.624	1.936	1.023	0.8364	0.5045
0.185185	5.479	3.618	1.625	0.913	0.7641	0.4295

0.222222	4.106	3.08	1.293	0.8031	0.7476	0.4161
0.259259	4.01	2.649	1.246	0.7996	0.7362	0.4109
0.296296	3.537	2.458	1.126	0.7031	0.6951	0.3972
0.333333	3.403	2.265	1.101	0.6708	0.6783	0.3915
0.37037	3.202	2.218	1.099	0.6633	0.655	0.3726
0.407407	3.194	2.11	1.05	0.6473	0.6017	0.3669
0.444444	3.059	2.044	0.9558	0.6339	0.5899	0.3614
0.481481	3.02	2.024	0.9169	0.5961	0.5611	0.3284
0.518519	2.999	2.01	0.8712	0.5942	0.5509	0.3281
0.555556	2.995	1.995	0.869	0.551	0.5389	0.328
0.592593	2.993	1.992	0.8404	0.5492	0.5362	0.3223
0.62963	2.991	1.992	0.8402	0.5478	0.5342	0.3059
0.666667	2.976	1.98	0.8264	0.5433	0.5161	0.3026
0.703704	2.964	1.977	0.8264	0.5367	0.507	0.3016
0.740741	2.943	1.974	0.8253	0.5304	0.4919	0.299
0.777778	2.941	1.971	0.7967	0.5136	0.4869	0.2965
0.814815	2.936	1.952	0.7951	0.5069	0.4861	0.2856
0.851852	2.932	1.942	0.7876	0.4762	0.4715	0.2814
0.888889	2.918	1.936	0.7819	0.4639	0.4671	0.2737
0.925926	2.894	1.92	0.7739	0.451	0.4628	0.2737
0.962963	2.836	1.838	0.7391	0.4365	0.3855	0.1682
0.1	7.2363	5.179	2.2093	1.1832	1.0592	0.55785
					Average of yearly averages:	0.363446

Inputs generaged by pe4.pl - 14-May-2003

stored as eheORapp.out
Chemical: 2,4-D
PRZM environment: ORappleC.txt modified Satday, 12 October 2002 at 17:16:34
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w24229.dvf modified Wedday, 3 July 2002 at 09:06:10
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	2.81	1.791	0.6337	0.4291	0.3418	0.1217
1962	2.859	1.851	0.6896	0.4829	0.3932	0.195
1963	2.88	1.862	0.7022	0.509	0.4175	0.2139
1964	2.879	1.882	0.7175	0.5105	0.4184	0.211
1965	2.881	1.874	0.7118	0.5093	0.4183	0.2187
1966	2.881	1.851	0.6933	0.5112	0.4181	0.2201
1967	2.874	1.854	0.6944	0.4968	0.4057	0.2138
1968	2.881	1.877	0.8451	0.5506	0.4626	0.2339
1969	2.907	1.918	0.7518	0.5474	0.4781	0.267
1970	2.908	1.911	0.7462	0.5409	0.4474	0.2507
1971	2.895	1.886	0.7691	0.5321	0.4578	0.2409
1972	2.881	1.862	0.7022	0.5043	0.4167	0.2182
1973	2.875	1.866	0.7066	0.5032	0.4145	0.2169
1974	2.878	1.859	0.6988	0.502	0.4094	0.2221
1975	2.882	1.859	0.6995	0.5076	0.4139	0.2155
1976	2.937	1.916	0.7263	0.508	0.4161	0.2035
1977	2.866	1.833	0.8794	0.5408	0.4662	0.2281
1978	2.883	1.863	0.7031	0.5098	0.419	0.2188
1979	2.875	1.863	0.7068	0.4977	0.4085	0.2099
1980	2.868	1.854	0.6937	0.4925	0.4018	0.2107
1981	2.879	1.846	0.6887	0.4998	0.408	0.2332
1982	2.888	1.879	0.7164	0.5139	0.4524	0.2444
1983	2.893	1.887	0.7503	0.5287	0.442	0.2346
1984	2.88	1.873	0.7103	0.5039	0.4128	0.2243
1985	2.885	1.879	0.7165	0.5107	0.428	0.2254
1986	2.883	1.876	0.7139	0.5186	0.4455	0.2314
1987	2.884	1.859	0.7003	0.5086	0.4174	0.238
1988	2.902	1.882	0.7215	0.5282	0.439	0.2484
1989	2.88	1.867	0.7055	0.5084	0.4155	0.2131
1990	2.873	1.862	0.7008	0.4991	0.4084	0.2055

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	2.937	1.918	0.8794	0.5506	0.4781	0.267

0.064516	2.908	1.916	0.8451	0.5474	0.4662	0.2507
0.096774	2.907	1.911	0.7691	0.5409	0.4626	0.2484
0.129032	2.902	1.887	0.7518	0.5408	0.4578	0.2444
0.16129	2.895	1.886	0.7503	0.5321	0.4524	0.2409
0.193548	2.893	1.882	0.7462	0.5287	0.4474	0.238
0.225806	2.888	1.882	0.7263	0.5282	0.4455	0.2346
0.258065	2.885	1.879	0.7215	0.5186	0.442	0.2339
0.290323	2.884	1.879	0.7175	0.5139	0.439	0.2332
0.322581	2.883	1.877	0.7165	0.5112	0.428	0.2314
0.354839	2.883	1.876	0.7164	0.5107	0.419	0.2281
0.387097	2.882	1.874	0.7139	0.5105	0.4184	0.2254
0.419355	2.881	1.873	0.7118	0.5098	0.4183	0.2243
0.451613	2.881	1.867	0.7103	0.5093	0.4181	0.2221
0.483871	2.881	1.866	0.7068	0.509	0.4175	0.2201
0.516129	2.881	1.863	0.7066	0.5086	0.4174	0.2188
0.548387	2.88	1.863	0.7055	0.5084	0.4167	0.2187
0.580645	2.88	1.862	0.7031	0.508	0.4161	0.2182
0.612903	2.88	1.862	0.7022	0.5076	0.4155	0.2169
0.645161	2.879	1.862	0.7022	0.5043	0.4145	0.2155
0.677419	2.879	1.859	0.7008	0.5039	0.4139	0.2139
0.709677	2.878	1.859	0.7003	0.5032	0.4128	0.2138
0.741935	2.875	1.859	0.6995	0.502	0.4094	0.2131
0.774194	2.875	1.854	0.6988	0.4998	0.4085	0.211
0.806452	2.874	1.854	0.6944	0.4991	0.4084	0.2107
0.83871	2.873	1.851	0.6937	0.4977	0.408	0.2099
0.870968	2.868	1.851	0.6933	0.4968	0.4057	0.2055
0.903226	2.866	1.846	0.6896	0.4925	0.4018	0.2035
0.935484	2.859	1.833	0.6887	0.4829	0.3932	0.195
0.967742	2.81	1.791	0.6337	0.4291	0.3418	0.1217
0.1	2.9065	1.9086	0.76737	0.54089	0.46212	0.248
					Average of yearly averages:	0.220957

Inputs generaged by pe4.pl - 14-May-2003

stored as ehePAapp.out
Chemical: 2,4-D
PRZM environment: PAappleC.txt modified Satday, 12 October 2002 at 17:24:46
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14737.dvf modified Wedday, 3 July 2002 at 09:06:12
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	6.035	3.952	1.822	1.276	1.07	0.4109
1962	3.601	2.477	1.564	1.033	0.8944	0.5862
1963	6.344	4.33	2.007	1.303	1.169	0.7095
1964	3.194	2.181	1.059	0.9078	0.8303	0.631
1965	3.266	2.157	1.559	0.9779	0.8387	0.5029
1966	6.799	4.41	1.872	1.31	1.128	0.6324
1967	5.376	3.59	1.7	1.341	1.2	0.7562
1968	3.092	2.078	0.9055	0.7256	0.6599	0.5196
1969	4.614	3.558	1.814	1.322	1.127	0.5999
1970	3.317	2.299	1.264	1.08	0.9479	0.6536
1971	7.939	6.051	2.926	2.085	1.833	0.94
1972	4.072	2.986	1.644	1.419	1.259	0.9458
1973	5.244	3.562	1.615	1.102	0.9848	0.7035
1974	9.946	6.703	3.152	2.08	1.806	0.9323
1975	3.456	2.451	1.549	1.254	1.197	0.8533
1976	3.796	2.599	1.65	1.154	1.029	0.6734
1977	3.239	2.224	1.454	1.025	0.9267	0.651
1978	4.279	2.935	1.662	1.255	1.111	0.6679
1979	5.973	4.093	2.121	1.471	1.329	0.7981
1980	3.139	2.108	0.9546	0.9359	0.8539	0.6148
1981	2.99	1.969	0.7952	0.5997	0.5272	0.3556
1982	3.968	2.996	1.876	1.095	0.9251	0.475
1983	3.406	2.261	1.05	0.7253	0.6248	0.4469
1984	6.279	4.143	2.162	1.453	1.219	0.6259
1985	4.436	3.085	1.557	1.225	1.197	0.7185
1986	3.255	2.225	1.126	0.91	0.8306	0.6488
1987	6.7	4.578	2.105	1.48	1.303	0.7133
1988	3.659	2.691	1.654	1.485	1.343	0.8838
1989	3.393	2.329	1.197	1.01	0.9882	0.7374
1990	4.77	3.137	1.574	1.313	1.138	0.6593

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	9.946	6.703	3.152	2.085	1.833	0.9458

0.064516	7.939	6.051	2.926	2.08	1.806	0.94
0.096774	6.799	4.578	2.162	1.485	1.343	0.9323
0.129032	6.7	4.41	2.121	1.48	1.329	0.8838
0.16129	6.344	4.33	2.105	1.471	1.303	0.8533
0.193548	6.279	4.143	2.007	1.453	1.259	0.7981
0.225806	6.035	4.093	1.876	1.419	1.219	0.7562
0.258065	5.973	3.952	1.872	1.341	1.2	0.7374
0.290323	5.376	3.59	1.822	1.322	1.197	0.7185
0.322581	5.244	3.562	1.814	1.313	1.197	0.7133
0.354839	4.77	3.558	1.7	1.31	1.169	0.7095
0.387097	4.614	3.137	1.662	1.303	1.138	0.7035
0.419355	4.436	3.085	1.654	1.276	1.128	0.6734
0.451613	4.279	2.996	1.65	1.255	1.127	0.6679
0.483871	4.072	2.986	1.644	1.254	1.111	0.6593
0.516129	3.968	2.935	1.615	1.225	1.07	0.6536
0.548387	3.796	2.691	1.574	1.154	1.029	0.651
0.580645	3.659	2.599	1.564	1.102	0.9882	0.6488
0.612903	3.601	2.477	1.559	1.095	0.9848	0.6324
0.645161	3.456	2.451	1.557	1.08	0.9479	0.631
0.677419	3.406	2.329	1.549	1.033	0.9267	0.6259
0.709677	3.393	2.299	1.454	1.025	0.9251	0.6148
0.741935	3.317	2.261	1.264	1.01	0.8944	0.5999
0.774194	3.266	2.225	1.197	0.9779	0.8539	0.5862
0.806452	3.255	2.224	1.126	0.9359	0.8387	0.5196
0.83871	3.239	2.181	1.059	0.91	0.8306	0.5029
0.870968	3.194	2.157	1.05	0.9078	0.8303	0.475
0.903226	3.139	2.108	0.9546	0.7256	0.6599	0.4469
0.935484	3.092	2.078	0.9055	0.7253	0.6248	0.4109
0.967742	2.99	1.969	0.7952	0.5997	0.5272	0.3556
0.1	6.7891	4.5612	2.1579	1.4845	1.3416	0.92745
					Average of yearly averages:	0.668227

Inputs generaged by pe4.pl - 14-May-2003

stored as eheORfil.out
Chemical: 2,4-D
PRZM environment: ORfilberts C.txt modified Satday, 12 October 2002 at 17:18:04
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w24232.dvf modified Wedday, 3 July 2002 at 09:06:10
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	2.991	2.015	0.8585	0.6616	0.6187	0.2669
1962	3.076	2.076	0.904	0.7289	0.7005	0.4014
1963	3.113	2.125	0.9574	0.7743	0.7418	0.4452
1964	3.108	2.118	0.9509	0.7667	0.7306	0.4458
1965	3.121	2.131	0.9614	0.7791	0.745	0.4639
1966	3.103	2.096	0.9428	0.7601	0.7313	0.4529
1967	3.105	2.104	0.9284	0.7548	0.7256	0.4395
1968	3.285	2.235	1.089	0.8552	0.7968	0.487
1969	3.136	2.138	1.021	0.8417	0.8006	0.5072
1970	3.134	2.136	0.9724	0.792	0.7608	0.4855
1971	3.856	2.863	1.379	0.9538	0.8729	0.5149
1972	3.141	2.152	0.9929	0.8061	0.7714	0.491
1973	3.13	2.141	0.9674	0.7921	0.7587	0.475
1974	3.131	2.151	0.981	0.7951	0.7596	0.4739
1975	3.133	2.139	0.9805	0.7972	0.7711	0.4751
1976	3.146	2.174	0.9977	0.8123	0.7767	0.4689
1977	3.131	2.139	0.9781	0.7927	0.76	0.4629
1978	3.132	2.147	1.016	0.8116	0.7765	0.4732
1979	3.129	2.318	1.158	0.8619	0.8015	0.5028
1980	3.155	2.171	0.9983	0.8152	0.781	0.503
1981	3.162	2.179	1.008	0.8461	0.8059	0.5427
1982	3.168	2.179	1.001	0.8237	0.7935	0.512
1983	3.223	2.2	0.9933	0.8005	0.7676	0.472
1984	3.137	2.151	0.9813	0.798	0.7648	0.4815
1985	3.135	2.139	0.9766	0.7931	0.7601	0.4811
1986	3.097	2.093	0.9316	0.7519	0.7219	0.4359
1987	3.109	2.103	0.9596	0.7725	0.7516	0.4728
1988	3.138	2.131	0.9718	0.7914	0.7613	0.5054
1989	3.108	2.11	0.9469	0.7637	0.7294	0.4607
1990	3.106	2.103	0.9456	0.763	0.7324	0.4567

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	3.856	2.863	1.379	0.9538	0.8729	0.5427

0.064516	3.285	2.318	1.158	0.8619	0.8059	0.5149
0.096774	3.223	2.235	1.089	0.8552	0.8015	0.512
0.129032	3.168	2.2	1.021	0.8461	0.8006	0.5072
0.16129	3.162	2.179	1.016	0.8417	0.7968	0.5054
0.193548	3.155	2.179	1.008	0.8237	0.7935	0.503
0.225806	3.146	2.174	1.001	0.8152	0.781	0.5028
0.258065	3.141	2.171	0.9983	0.8123	0.7767	0.491
0.290323	3.138	2.152	0.9977	0.8116	0.7765	0.487
0.322581	3.137	2.151	0.9933	0.8061	0.7714	0.4855
0.354839	3.136	2.151	0.9929	0.8005	0.7711	0.4815
0.387097	3.135	2.147	0.9813	0.798	0.7676	0.4811
0.419355	3.134	2.141	0.981	0.7972	0.7648	0.4751
0.451613	3.133	2.139	0.9805	0.7951	0.7613	0.475
0.483871	3.132	2.139	0.9781	0.7931	0.7608	0.4739
0.516129	3.131	2.139	0.9766	0.7927	0.7601	0.4732
0.548387	3.131	2.138	0.9724	0.7921	0.76	0.4728
0.580645	3.13	2.136	0.9718	0.792	0.7596	0.472
0.612903	3.129	2.131	0.9674	0.7914	0.7587	0.4689
0.645161	3.121	2.131	0.9614	0.7791	0.7516	0.4639
0.677419	3.113	2.125	0.9596	0.7743	0.745	0.4629
0.709677	3.109	2.118	0.9574	0.7725	0.7418	0.4607
0.741935	3.108	2.11	0.9509	0.7667	0.7324	0.4567
0.774194	3.108	2.104	0.9469	0.7637	0.7313	0.4529
0.806452	3.106	2.103	0.9456	0.763	0.7306	0.4458
0.83871	3.105	2.103	0.9428	0.7601	0.7294	0.4452
0.870968	3.103	2.096	0.9316	0.7548	0.7256	0.4395
0.903226	3.097	2.093	0.9284	0.7519	0.7219	0.4359
0.935484	3.076	2.076	0.904	0.7289	0.7005	0.4014
0.967742	2.991	2.015	0.8585	0.6616	0.6187	0.2669
0.1	3.2175	2.2315	1.0822	0.85429	0.80141	0.51152
					Average of yearly averages:	0.46856

Inputs generaged by pe4.pl - 14-May-2003

APPENDIX E: The Risk Quotient Method

The Risk Quotient Method is the means used by EFED to integrate the results of exposure and ecotoxicity data. For this method, RQs (RQs) are calculated by dividing exposure estimates by ecotoxicity values (i.e., RQ = EXPOSURE/TOXICITY), both acute and chronic. These RQs are then compared to OPP's levels of concern (LOCs). These LOCs are criteria used by OPP to indicate potential risk to non-target organisms and the need to consider regulatory action. EFED has defined LOCs for acute risk, potential restricted use classification, and for endangered species.

The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories:

(1) acute - there is a potential for acute risk; regulatory action may be warranted in addition to restricted use classification;

(2) acute restricted use - the potential for acute risk is high, but this may be mitigated through restricted use classification

(3) acute endangered species - the potential for acute risk to endangered species is high, regulatory action may be warranted, and

(4) chronic risk - the potential for chronic risk is high, regulatory action may be warranted.

Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to non-target insects, or chronic risk from granulart formulations to mammalian or avian species.

The ecotoxicity test values (i.e., measurement endpoints) used in the acute and chronic RQs are derived from required studies. Examples of ecotoxicity values derived from short-term laboratory studies that assess acute effects are: (1) LC_{50} (fish and birds), (2) LD_{50} (birds and mammals), (3) EC_{50} (aquatic plants and aquatic invertebrates), and (4) EC_{25} (terrestrial plants). Examples of toxicity test effect levels derived from the results of long-term laboratory studies that assess chronic effects are: (1) LOEL (birds, fish, and aquatic invertebrates), and (2) NOEL (birds, fish and aquatic invertebrates). The NOEL is generally used as the ecotoxicity test value in assessing chronic effects.

Risk presumptions, along with the corresponding RQs and LOCs are summarized in Table D1.

Table E-1: Risk Presumptions and LOCs		
Risk Presumption	**RQ**	**LOC**
Birds[1]		
Acute Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOEC	1
Wild Mammals[1]		
Acute Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOEC	1
Aquatic Animals[2]		
Acute Risk	EEC/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Endangered Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/NOEC	1
Terrestrial and Semi-Aquatic Plants		
Acute Risk	EEC/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1
Aquatic Plants[2]		
Acute Risk	EEC/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1

[1] LD_{50}/sqft = (mg/sqft) / (LD_{50} * wt. of animal)
LD_{50}/day = (mg of toxicant consumed/day) / (LD_{50} * wt. of animal)

[2] EEC = (ppm or ppb) in water

APPENDIX F: Detailed Risk Quotients

Risk Quotients - Nontarget Aquatic Animals

Table F-1: Aquatic Organism Risk Quotient Calculations for 2,4-D Acid and amine salts							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Chronic Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**21-day Average Water Concentration (mg ae/L)**	**60-day Average Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Sugarcane - Florida (2 lbs ae/A/app, 2 broadcast or aerial applications)							
Freshwater Fish	101	14.2	0.04240	–	0.03170	0.00	0.00
Estuarine Fish	175	No Data	0.04240	--	0.03170	0.00	--
Freshwater Invert.	25	16.4	0.04240	0.03840	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.04240	0.03840	--	0.00	--
Turf - Florida(2 lbs ae/A/app, 2 broadcast or aerial applications)							
Freshwater Fish	101	14.2	0.02540	--	0.01730	0.00	0.00
Estuarine Fish	175	No Data	0.02540	--	0.01730	0.00	--
Freshwater Invert.	25	16.4	0.02540	0.02170	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.02540	0.02170	--	0.00	--
Turf - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications)							
Freshwater Fish	101	14.2	0.08100	--	0.00600	0.00	0.00
Estuarine Fish	175	No Data	0.08100	–	0.00600	0.00	--
Freshwater Invert.	25	16.4	0.08100	0.00720	--	0.00	0.00

Table F-1: Aquatic Organism Risk Quotient Calculations for 2,4-D Acid and amine salts							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Chronic Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**21-day Average Water Concentration (mg ae/L)**	**60-day Average Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Estuarine Invert.	49.6	No Data	0.08100	0.00720	--	0.00	--
Wheat - North Dakota (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)							
Freshwater Fish	101	14.2	0.00742	–	0.00540	0.00	0.00
Estuarine Fish	175	No Data	0.00742	--	0.00540	0.00	--
Freshwater Invert.	25	16.4	0.00742	0.00663	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.00742	0.00663	--	0.00	--
Wheat - Oregon (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)							
Freshwater Fish	101	14.2	0.00760	--	0.00750	0.00	0.00
Estuarine Fish	175	No Data	0.00760	--	0.00750	0.00	--
Freshwater Invert.	25	16.4	0.00760	0.00840	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.00760	0.00840	--	0.00	--
Corn - Illinois (1 lbs ae/A/app, 3 broadcast or aerial applications.)							
Freshwater Fish	101	14.2	0.02120	--	0.01610	0.00	0.00
Estuarine Fish	175	No Data	0.02120	--	0.01610	0.00	--
Freshwater Invert.	25	16.4	0.02120	0.01924	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.02120	0.01924	--	0.00	--
Corn - California (1 lbs ae/A/app, 3 broadcast or aerial applications.)							

Table F-1: Aquatic Organism Risk Quotient Calculations for 2,4-D Acid and amine salts							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Chronic Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**21-day Average Water Concentration (mg ae/L)**	**60-day Average Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Freshwater Fish	101	14.2	0.00970	--	0.00880	0.00	0.00
Estuarine Fish	175	No Data	0.00970	--	0.00880	0.00	--
Freshwater Invert.	25	16.4	0.00970	0.00910	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.00970	0.00910	--	0.00	--
Sorghum - Texas (1 lbs ae/A/app, 1 broadcast or aerial application.)							
Freshwater Fish	101	14.2	0.01210	--	0.00740	0.00	0.00
Estuarine Fish	175	No Data	0.01210	--	0.00740	0.00	--
Freshwater Invert.	25	16.4	0.01210	0.01010	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.01210	0.01010	--	0.00	--
Sorghum - Kansas (1 lbs ae/A/app, 1 broadcast or aerial application.)							
Freshwater Fish	101	14.2	0.01630	--	0.01120	0.00	0.00
Estuarine Fish	175	No Data	0.01630	--	0.01120	0.00	--
Freshwater Invert.	25	16.4	0.01630	0.01430	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.01630	0.01430	--	0.00	--
Soybean - Mississippi (1 lbs ae/A/app, 1 broadcast or aerial application.)							
Freshwater Fish	101	14.2	0.01560	--	0.01260	0.00	0.00
Estuarine Fish	175	No Data	0.01560	--	0.01260	0.00	--

Table F-1: Aquatic Organism Risk Quotient Calculations for 2,4-D Acid and amine salts							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Chronic Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**21-day Average Water Concentration (mg ae/L)**	**60-day Average Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Freshwater Invert.	25	16.4	0.01560	0.01460	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.01560	0.01460	--	0.00	--
Pasture - North Carolina(2 lbs ae/A/app, 2 broadcast or aerial applications.)							
Freshwater Fish	101	14.2	0.05490	--	0.04840	0.00	0.00
Estuarine Fish	175	No Data	0.05490	--	0.04840	0.00	--
Freshwater Invert.	25	16.4	0.05490	0.04891	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.05490	0.04891	--	0.00	--
Apples - North Carolina (2 lbs ae/A/app, 2 broadcast or aerial applications.)							
Freshwater Fish	101	14.2	0.06280	--	0.04540	0.00	0.00
Estuarine Fish	175	No Data	0.06280	--	0.04540	0.00	--
Freshwater Invert.	25	16.4	0.06280	0.05510	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.06280	0.05510	--	0.00	--
Apples - Oregon (2 lbs ae/A/app, 2 broadcast or aerial applications.)							
Freshwater Fish	101	14.2	0.01220	–	0.00990	0.00	0.00
Estuarine Fish	175	No Data	0.01220	--	0.0099	0.00	--
Freshwater Invert.	25	16.4	0.01220	0.01120	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.01220	0.01120	--	0.00	--

Table F-1: Aquatic Organism Risk Quotient Calculations for 2,4-D Acid and amine salts							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Chronic Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**21-day Average Water Concentration (mg ae/L)**	**60-day Average Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Apples - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications.)							
Freshwater Fish	101	14.2	0.02580	--	0.02180	0.00	0.00
Estuarine Fish	175	No Data	0.02580	--	0.0218	0.00	--
Freshwater Invert.	25	16.4	0.02580	0.02350	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.02580	0.02350	--	0.00	--
Filberts - Oregon (1 lbs ae/A/app, 4 broadcast or aerial applications.)							
Freshwater Fish	101	14.2	0.00880	--	0.00740	0.00	0.00
Estuarine Fish	175	No Data	0.00880	--	0.00740	0.00	--
Freshwater Invert.	25	16.4	0.00880	0.00810	--	0.00	0.00
Estuarine Invert.	49.6	No Data	0.00880	0.00810	–	0.00	--

[a] * indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

[b] + indicates an exceedence of Chronic LOC.

Table F-2: Aquatic Organism Risk Quotient Calculations for 2,4-D Ethylhexyl Ester from Drift			
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**
Turf - Florida(2 lbs ae/A/app, 2 broadcast or aerial applications)			
Freshwater Fish	3.2	0.00110	0.00
Estuarine Fish	>0.1564	0.00110	< 0.01
Freshwater Invert.	3.4	0.00110	0.00
Estuarine Invert.	121.4	0.00110	0.00
Turf - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications)			
Freshwater Fish	3.2	0.00110	0.00
Estuarine Fish	>0.1564	0.00110	< 0.01
Freshwater Invert.	3.4	0.00110	0.00
Estuarine Invert.	121.4	0.00110	0.00
Wheat - North Dakota (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)			
Freshwater Fish	3.2	0.00280	0.00
Estuarine Fish	>0.1564	0.00280	< 0.02
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00
Wheat - Oregon (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)			
Freshwater Fish	3.2	0.00280	0.00

Table F-2: Aquatic Organism Risk Quotient Calculations for 2,4-D Ethylhexyl Ester from Drift			
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**
Estuarine Fish	>0.1564	0.00280	< 0.02
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00
Corn - Illinois (1 lbs ae/A/app, 3 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00280	0.00
Estuarine Fish	>0.1564	0.00280	< 0.02
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00
Corn - California (1 lbs ae/A/app, 3 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00280	0.00
Estuarine Fish	>0.1564	0.00280	< 0.02
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00
Sorghum - Texas (1 lbs ae/A/app, 1 broadcast or aerial application.)			
Freshwater Fish	3.2	0.00140	0.00
Estuarine Fish	>0.1564	0.00140	< 0.01
Freshwater Invert.	3.4	0.00140	0.00
Estuarine Invert.	121.4	0.00140	0.00

Table F-2: Aquatic Organism Risk Quotient Calculations for 2,4-D Ethylhexyl Ester from Drift			
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**
Sorghum - Kansas (1 lbs ae/A/app, 1 broadcast or aerial application.)			
Freshwater Fish	3.2	0.00140	0.00
Estuarine Fish	>0.1564	0.00140	< 0.01
Freshwater Invert.	3.4	0.00140	0.00
Estuarine Invert.	121.4	0.00140	0.00
Soybean - Mississippi (1 lbs ae/A/app, 1 broadcast or aerial application.)			
Freshwater Fish	3.2	0.00280	0.00
Estuarine Fish	>0.1564	0.00280	< 0.02
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00
Pasture - North Carolina(2 lbs ae/A/app, 2 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00560	0.00
Estuarine Fish	>0.1564	0.00560	< 0.04
Freshwater Invert.	3.4	0.00560	0.00
Estuarine Invert.	121.4	0.00560	0.00
Apples - North Carolina (2 lbs ae/A/app, 2 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00280	0.00
Estuarine Fish	>0.1564	0.00280	< 0.02

Table F-2: Aquatic Organism Risk Quotient Calculations for 2,4-D Ethylhexyl Ester from Drift			
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00
Apples - Oregon (2 lbs ae/A/app, 2 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00280	0.00
Estuarine Fish	>0.1564	0.00280	< 0.02
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00
Apples - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00280	0.00
Estuarine Fish	>0.1564	0.00280	< 0.02
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00
Filberts - Oregon (1 lbs ae/A/app, 4 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00280	0.00
Estuarine Fish	>0.1564	0.00280	< 0.02
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00

[a] * indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

Table F-3: Aquatic Organism Acute Risk Quotient Calculations for 2,4-D Ethylhexyl Ester from Drift & Runoff			
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**
Turf - Florida(2 lbs ae/A/app, 2 broadcast or aerial applications)			
Freshwater Fish	3.2	0.00160	0.00
Estuarine Fish	>0.1564	0.00160	< 0.01
Freshwater Invert.	3.4	0.00160	0.00
Estuarine Invert.	121.4	0.00160	0.00
Turf - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications)			
Freshwater Fish	3.2	0.00120	0.00
Estuarine Fish	>0.1564	0.00120	< 0.01
Freshwater Invert.	3.4	0.00120	0.00
Estuarine Invert.	121.4	0.00120	0.00
Wheat - North Dakota (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)			
Freshwater Fish	3.2	0.00280	0.00
Estuarine Fish	>0.1564	0.00280	< 0.02
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00
Wheat - Oregon (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)			
Freshwater Fish	3.2	0.00280	0.00

Table F-3: Aquatic Organism Acute Risk Quotient Calculations for 2,4-D Ethylhexyl Ester from Drift & Runoff			
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**
Estuarine Fish	>0.1564	0.00280	< 0.02
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00
Corn - Illinois (1 lbs ae/A/app, 3 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00640	0.00
Estuarine Fish	>0.1564	0.00640	< 0.04
Freshwater Invert.	3.4	0.00640	0.00
Estuarine Invert.	121.4	0.00640	0.00
Corn - California (1 lbs ae/A/app, 3 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00340	0.00
Estuarine Fish	>0.1564	0.00340	< 0.02
Freshwater Invert.	3.4	0.00340	0.00
Estuarine Invert.	121.4	0.00340	0.00
Sorghum - Texas (1 lbs ae/A/app, 1 broadcast or aerial application.)			
Freshwater Fish	3.2	0.00260	0.00
Estuarine Fish	>0.1564	0.00260	< 0.02
Freshwater Invert.	3.4	0.00260	0.00
Estuarine Invert.	121.4	0.00260	0.00

Table F-3: Aquatic Organism Acute Risk Quotient Calculations for 2,4-D Ethylhexyl Ester from Drift & Runoff			
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**
Sorghum - Kansas (1 lbs ae/A/app, 1 broadcast or aerial application.)			
Freshwater Fish	3.2	0.00190	0.00
Estuarine Fish	>0.1564	0.00190	< 0.01
Freshwater Invert.	3.4	0.00190	0.00
Estuarine Invert.	121.4	0.00190	0.00
Soybean - Mississippi (1 lbs ae/A/app, 1 broadcast or aerial application.)			
Freshwater Fish	3.2	0.00280	0.00
Estuarine Fish	>0.1564	0.00280	< 0.02
Freshwater Invert.	3.4	0.00280	0.00
Estuarine Invert.	121.4	0.00280	0.00
Pasture - North Carolina(2 lbs ae/A/app, 2 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00740	0.00
Estuarine Fish	>0.1564	0.00740	< 0.05
Freshwater Invert.	3.4	0.00740	0.00
Estuarine Invert.	121.4	0.00740	0.00
Apples - North Carolina (2 lbs ae/A/app, 2 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00720	0.00
Estuarine Fish	>0.1564	0.00720	< 0.05

Table F-3: Aquatic Organism Acute Risk Quotient Calculations for 2,4-D Ethylhexyl Ester from Drift & Runoff			
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**
Freshwater Invert.	3.4	0.00720	0.00
Estuarine Invert.	121.4	0.00720	0.00
Apples - Oregon (2 lbs ae/A/app, 2 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00290	0.00
Estuarine Fish	>0.1564	0.00290	< 0.02
Freshwater Invert.	3.4	0.00290	0.00
Estuarine Invert.	121.4	0.00290	0.00
Apples - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00680	0.00
Estuarine Fish	>0.1564	0.00680	< 0.04
Freshwater Invert.	3.4	0.00680	0.00
Estuarine Invert.	121.4	0.00680	0.00
Filberts - Oregon (1 lbs ae/A/app, 4 broadcast or aerial applications.)			
Freshwater Fish	3.2	0.00320	0.00
Estuarine Fish	>0.1564	0.00320	< 0.02
Freshwater Invert.	3.4	0.00320	0.00
Estuarine Invert.	121.4	0.00320	0.00

[a] * indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

Table F-4: Aquatic Organism Risk Quotient Calculations for 2,4-D Acid and amine salts for Aquatic Weed Control.							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Chronic Toxicity Threshold, NOEC (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**21-day Average Water Concentration (mg ae/L)**	**60-day Average Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Aquatic Weed Control (10.8 lbae per acre foot)							
Freshwater Fish	101	14.2	4.000	3.417	2.610	0.04	0.18
Estuarine fish	175	No data	4.000	3.417	2.610	0.02	--
Freshwater Invert.	25	16.4	4.000	3.417	2.610	0.16 **	0.24
Estuarine Invert.	49.6	No data	4.000	3.42	2.61	0.08 *	--

[a] * indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

[b] + indicates an exceedence of Chronic LOC.

Table F-5: Aquatic Organism Risk Quotient Calculations for Butoxyethanol Ester for Aquatic Weed Control.							
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Chronic Toxicity Threshold, NOEC (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**21-day Average Water Concentration (mg ae/L)**	**60-day Average Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Aquatic Weed Control (10.8 lbae per acre foot)							
Freshwater Fish	0.43	0.0600	4.000	3.417	2.610	9.30***	43.50+
Estuarine fish	No data	0.0600	4.000	3.417	2.610	--	43.50+
Freshwater Invert.	4.96	0.2000	4.000	3.417	2.610	0.81***	13.05+
Estuarine Invert.	No data	No data	4.000	3.42	2.61	--	--

[a] * indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

[b] + indicates an exceedence of Chronic LOC.

Table F-6: Aquatic Organism Risk Quotient Calculations for 2,4-D Acid and amine salts for Rice.					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Chronic Toxicity Threshold, NOEC (mg ae/L)**	**Maximum Surface Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Chronic RQ[b]**
Rice (1.5 lbae/A; 1 broadcast or aerial application)					
Freshwater Fish	101	14.2	1.431	0.01	0.10
Estuarine fish	175	No data[c]	1.431	0.01	–
Freshwater Invert.	25	16.4	1.431	0.06*	0.09
Estuarine Invert.	49.6	No data[c]	1.431	0.03	--

[a] * indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

[b] + indicates an exceedence of Chronic LOC.

[c] No chronic studies submitted for estuarine fish or invertebrates.

Risk to Nontarget Aquatic Plants

Table F-7: Aquatic Plant Risk Quotient Calculations for 2,4-D Acid and amine salts					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Sugarcane - Florida (2 lbs ae/A/app, 2 broadcast or aerial applications)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.04240	0.14	0.88
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.04240	0.01	N/A
Turf - Florida(2 lbs ae/A/app, 2 broadcast or aerial applications)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.02450	0.08	0.51
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.02450	0.01	N/A
Turf - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.00810	0.03	0.17
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.00810	0.00	N/A
Wheat - North Dakota (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.00760	0.03	0.16

Table F-7: Aquatic Plant Risk Quotient Calculations for 2,4-D Acid and amine salts					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.00760	0.00	N/A
Wheat - Oregon (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.00900	0.03	0.19
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.00900	0.00	N/A
Corn - Illinois (1 lbs ae/A/app, 3 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.02120	0.07	0.44
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.02120	0.01	N/A
Corn - California (1 lbs ae/A/app, 3 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.00970	0.03	0.20
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.00970	0.00	N/A
Sorghum - Texas (1 lbs ae/A/app, 1 broadcast or aerial application.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.01210	0.04	0.25
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.01210	0.00	N/A

Table F-7: Aquatic Plant Risk Quotient Calculations for 2,4-D Acid and amine salts					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Sorghum - Kansas (1 lbs ae/A/app, 1 broadcast or aerial application.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.01630	0.05	0.34
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.01630	0.00	N/A
Soybean - Mississippi (1 lbs ae/A/app, 1 broadcast or aerial application.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.01560	0.05	0.33
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.01560	0.00	N/A
Pasture - North Carolina(2 lbs ae/A/app, 2 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.05490	0.18	1.14 **
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.05490	0.01	N/A
Apples - North Carolina (2 lbs ae/A/app, 2 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.06280	0.21	1.31 **
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.06280	0.02	N/A
Apples - Oregon (2 lbs ae/A/app, 2 broadcast or aerial applications.)					

Table F-7: Aquatic Plant Risk Quotient Calculations for 2,4-D Acid and amine salts					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.01220	0.04	0.25
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.01220	0.00	N/A
Apples - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.02580	0.09	0.54
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.02580	0.01	N/A
Filberts - Oregon (1 lbs ae/A/app, 4 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	0.00880	0.03	0.18
Aquatic Nonvascular Plant (*Navicula pelliculosa*)	3.88	1.4	0.00880	0.00	N/A

[a] * indicates an exceedence of Acute Risk LOC

[b] ** indicates an exceedence of Endangered Species LOC.

[c] There are currently no endangered nonvascular plant species

Table F-8: Aquatic Plant Risk Quotient Calculations for 2,4-D EHE from Drift					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Turf - Florida(2 lbs ae/A/app, 2 broadcast or aerial applications)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00110	0.00	0.02
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00110	0.02	0.02
Turf - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00110	0.00	0.02
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00110	0.02	0.02
Wheat - North Dakota (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00280	0.01	0.05
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00280	0.04	0.05
Wheat - Oregon (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00280	0.01	0.05
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00280	0.04	0.05
Corn - Illinois (1 lbs ae/A/app, 3 broadcast or aerial applications.)					

Table F-8: Aquatic Plant Risk Quotient Calculations for 2,4-D EHE from Drift					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00280	0.01	0.05
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00280	0.04	0.05
Corn - California (1 lbs ae/A/app, 3 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00280	0.01	0.05
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00280	0.04	0.05
Sorghum - Texas (1 lbs ae/A/app, 1 broadcast or aerial application.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00140	0.00	0.02
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00140	0.02	0.02
Sorghum - Kansas (1 lbs ae/A/app, 1 broadcast or aerial application.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00140	0.00	0.02
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00140	0.02	0.02
Soybean - Mississippi (1 lbs ae/A/app, 1 broadcast or aerial application.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00280	0.01	0.05

Table F-8: Aquatic Plant Risk Quotient Calculations for 2,4-D EHE from Drift					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00280	0.04	0.05
Pasture - North Carolina(2 lbs ae/A/app, 2 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00560	0.02	0.09
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00560	0.08	0.09
Apples - North Carolina (2 lbs ae/A/app, 2 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00560	0.02	0.09
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00560	0.08	0.09
Apples - Oregon (2 lbs ae/A/app, 2 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00280	0.01	0.05
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00280	0.04	0.05
Apples - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00280	0.01	0.05
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00280	0.04	0.05

Table F-8: Aquatic Plant Risk Quotient Calculations for 2,4-D EHE from Drift					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Filberts - Oregon (1 lbs ae/A/app, 4 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00280	0.01	0.05
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00280	0.04	0.05

[a] * indicates an exceedence of Acute Risk LOC

[b] ** indicates an exceedence of Endangered Species LOC.

[c] There are currently no endangered nonvascular plant species

Table F-9: Aquatic Plant Risk Quotient Calculations for 2,4-D EHE from Drift & Runoff.					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Turf - Florida(2 lbs ae/A/app, 2 broadcast or aerial applications)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00160	0.00	0.03
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00160	0.02	0.03
Turf - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00120	0.00	0.02
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00120	0.02	0.02
Wheat - North Dakota (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00280	0.01	0.05
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00280	0.04	0.05
Wheat - Oregon (1.25 lbs ae/A/app, 2 broadcast or aerial applications up to 1.75 lbs ae/A/Yr)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00280	0.01	0.05
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00280	0.04	0.05
Corn - Illinois (1 lbs ae/A/app, 3 broadcast or aerial applications.)					

Table F-9: Aquatic Plant Risk Quotient Calculations for 2,4-D EHE from Drift & Runoff.					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00640	0.02	0.10
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00640	0.10	0.10
Corn - California (1 lbs ae/A/app, 3 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00340	0.01	0.05
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00340	0.05	0.05
Sorghum - Texas (1 lbs ae/A/app, 1 broadcast or aerial application.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00260	0.01	0.04
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00260	0.04	0.04
Sorghum - Kansas (1 lbs ae/A/app, 1 broadcast or aerial application.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00190	0.01	0.03
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00190	0.03	0.03
Soybean - Mississippi (1 lbs ae/A/app, 1 broadcast or aerial application.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00280	0.01	0.05

Table F-9: Aquatic Plant Risk Quotient Calculations for 2,4-D EHE from Drift & Runoff.					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00280	0.04	0.05
Pasture - North Carolina(2 lbs ae/A/app, 2 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00740	0.02	0.12
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00740	0.11	0.12
Apples - North Carolina (2 lbs ae/A/app, 2 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00720	0.02	0.12
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00720	0.11	0.12
Apples - Oregon (2 lbs ae/A/app, 2 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00290	0.01	0.05
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00290	0.04	0.05
Apples - Pennsylvania(2 lbs ae/A/app, 2 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00680	0.02	0.11
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00680	0.10	0.11

Table F-9: Aquatic Plant Risk Quotient Calculations for 2,4-D EHE from Drift & Runoff.					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Filberts - Oregon (1 lbs ae/A/app, 4 broadcast or aerial applications.)					
Aquatic Vascular Plant (*Lemna gibba*)	0.33	0.062	0.00060	0.00	0.01
Aquatic Nonvascular Plant (*Skeletonema costatum*)	0.066	0.062	0.00060	0.01	0.01

[a] * indicates an exceedence of Acute Risk LOC

[b] ** indicates an exceedence of Endangered Species LOC.

[c] There are currently no endangered nonvascular plant species

Table F-10: Aquatic Plant Risk Quotient Calculations for 2,4-D Acid and amine salts for Aquatic Weed Control					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae /L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Aquatic Weed Control (10.8 lbae per acre foot)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	4.00000	13.33*	83.33**
Aquatic Nonvascular Plant (*Skeletonema costatum*)	3.88	1.4	4.00000	1.03*	2.86**

[a] * indicates an exceedence of Acute Risk LOC

[b] ** indicates an exceedence of Endangered Species LOC.

[c] There are currently no endangered nonvascular plant species

Table F-11: Aquatic Plant Risk Quotient Calculations for Butoxyethanol Ester for Aquatic Weed Control.					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered Species Toxicity Threshold, NOEC (mg ae/L)**	**Peak Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Aquatic Weed Control (10.8 lbae per acre foot)					
Aquatic Vascular Plant (*Lemna gibba*)	0.4	0.28000	4.000	10.00*	14.29**
Aquatic Nonvascular Plant (*Skeletonema costatum*)	1.02	0.53820	4.000	3.92*	7.43**

[a] * indicates an exceedence of Acute Risk LOC

[b] ** indicates an exceedence of Endangered Species LOC.

[c] There are currently no endangered nonvascular plant species

Table F-12: Aquatic Plant Risk Quotient Calculations for 2,4-D Acid and amine salts for Rice.					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (mg ae/L)**	**Endangered SpeciesToxicity Threshold, NOEC (mg ae/L)**	**Maximum Surface Water Concentration (mg ae/L)**	**Acute RQ[a]**	**Endangered Species RQ[bc]**
Rice (1.5 lbae/A; 1 broadcast or aerial application)					
Aquatic Vascular Plant (*Lemna gibba*)	0.30	0.048	1.431	4.77*	29.81**
Aquatic Nonvascular Plant (*Skeletonema costatum*)	3.88	1.4	1.431	0.37	1.02**

[a] * indicates an exceedence of Acute Risk LOC

[b] ** indicates an exceedence of Endangered Species LOC.

[c] There are currently no endangered nonvascular plant species

Risk Quotients - Nontarget Terrestrial Animals

i. Birds, acute and chronic

Non-granular Broadcast Applications

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)

Food Type	LD_{50}	Weight Class	Adjusted LD_{50}[a]	Water Fraction[b]	Food Intake (g)[c]	Predicted Maximum Residues				Predicted Mean Residues			
						EEC (mg/kg-diet)[d]	Exposure (mg/kg-BW)[e]	Acute RQ[f]		EECe (mg/kg-diet)	Exposure (mg/kg-BW)	Acute RQ[f]	
Fallow areas and Crop Stubble; Turf (Golf courses, residential lawns, grasses grown for seed, and sod); Pastures, Rangeland, Perennial Grassland; Sugarcane -(2 lbs ae/ac/app, 2 app., ground/aerial, 30 day interval)													
Short grass	415	20	297.50	0.79	21.69	525	569.45	1.91	***	185.94	201.68	0.68	**
		100	378.73		61.85		324.72	0.86	***		115.01	0.30	*
		1000	534.97		276.92		145.38	0.27	**		51.49	0.10	
Tall grass	415	20	297.50	0.79	21.69	241	261.40	0.88	***	78.87	85.55	0.29	*
		100	378.73		61.85		149.06	0.39	**		48.78	0.13	
		1000	534.97		276.92		66.74	0.12			21.84	0.04	
Broadleaf forage, small insects	415	20	297.50	0.71	15.71	295	231.71	0.78	***	98.33	77.24	0.26	
		100	378.73		44.79		132.13	0.35	**		44.04	0.12	
		1000	534.97		200.53		59.16	0.11	**		19.72	0.04	
Fruit, Large insects	415	20	297.50	0.69	14.70	33	24.25	0.08		15.40	11.32	0.04	
		100	378.73		41.90		13.83	0.04			6.45	0.02	

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)

Food Type	LD_{50}	Weight Class	Adjusted LD_{50}[a]	Water Fraction[b]	Food Intake (g)[c]	Predicted Maximum Residues				Predicted Mean Residues			
						EEC (mg/kg-diet)[d]	Exposure (mg/kg-BW)[e]	Acute RQ[f]		EECe (mg/kg-diet)	Exposure (mg/kg-BW)	Acute RQ[f]	
Seeds, Pods	415	1000	534.97	0.1	187.59	33	6.19	0.01		15.40	2.89	0.01	
		20	297.50		5.06		8.35	0.03			3.90	0.01	
		100	378.73		14.43		4.76	0.01			2.22	0.01	
		1000	534.97		64.61		2.13	0.00			1.00	0.00	
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.); Forest Uses; Cranberry (4.0 lbs ae/A/app, 1 app., ground/aerial,)													
Short grass	415	20	297.50	0.79	21.69	960	1041.28	3.50	***	340.00	368.79	1.24	***
		100	378.73		61.85		593.78	1.57	***		210.30	0.56	***
		1000	534.97		276.92		265.84	0.50	***		94.15	0.18	*
Tall grass	415	20	297.50	0.79	21.69	440	477.25	1.60	***	144.00	156.19	0.53	***
		100	378.73		61.85		272.15	0.72	***		89.07	0.24	**
		1000	534.97		276.92		121.85	0.23	**		39.88	0.07	
Broadleaf forage, small insects	415	20	297.50	0.71	15.71	540	424.14	1.43	***	180.00	141.38	0.48	**
		100	378.73		44.79		241.86	0.64	***		80.62	0.21	**
		1000	534.97		200.53		108.29	0.20	**		36.10	0.07	
Fruit, Large insects	415	20	297.50	0.69	14.70	60	44.09	0.15	*	28.00	20.57	0.07	
		100	378.73		41.90		25.14	0.07			11.73	0.03	

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)

Food Type	LD_{50}	Weight Class	Adjusted LD_{50}[a]	Water Fraction[b]	Food Intake (g)[c]	Predicted Maximum Residues				Predicted Mean Residues			
						EEC (mg/kg-diet)[d]	Exposure (mg/kg-BW)[e]	Acute RQ[f]		EECe (mg/kg-diet)	Exposure (mg/kg-BW)	Acute RQ[f]	
Seeds, Pods	415	1000	534.97	0.1	187.59	60	11.26	0.02		28.00	5.25	0.01	
		20	297.50		5.06		15.19	0.05			7.09	0.02	
		100	378.73		14.43		8.66	0.02			4.04	0.01	
		1000	534.97		64.61		3.88	0.01			1.81	0.00	
Pome fruit/Stone fruit/Nuts (2.0 lbs ae/A/app, 2 app., ground/aerial; 75 day application interval)													
Short grass	415	20	297.50	0.79	21.69	481	521.72	1.75	***	170.35	184.78	0.62	***
		100	378.73		61.85		297.51	0.79	***		105.37	0.28	**
		1000	534.97		276.92		133.20	0.25	**		47.17	0.09	
Tall grass	415	20	297.50	0.79	21.69	221	239.71	0.81	***	72.33	78.45	0.26	**
		100	378.73		61.85		136.69	0.36	**		44.74	0.12	*
		1000	534.97		276.92		61.20	0.11	*		20.03	0.04	
Broadleaf forage, small insects	415	20	297.50	0.71	15.71	271	212.86	0.72	***	90.33	70.95	0.24	**
		100	378.73		44.79		121.38	0.32	**		40.46	0.11	*
		1000	534.97		200.53		54.34	0.10	*		18.11	0.03	
Fruit, Large insects	415	20	297.50	0.69	14.70	30	22.04	0.07		14.00	10.29	0.03	
		100	378.73		41.90		12.57	0.03			5.87	0.02	
		1000	534.97		187.59		5.63	0.01			2.63	0.00	

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)

Food Type	LD_{50}	Weight Class	Adjusted LD_{50}[a]	Water Fraction[b]	Food Intake (g)[c]	Predicted Maximum Residues				Predicted Mean Residues			
						EEC (mg/kg-diet)[d]	Exposure (mg/kg-BW)[e]	Acute RQ[f]		EECe (mg/kg-diet)	Exposure (mg/kg-BW)	Acute RQ[f]	
Seeds, Pods	415	20	297.50	0.1	5.06	30	7.59	0.03		14.00	3.54	0.01	
		100	378.73		14.43		4.33	0.01			2.02	0.01	
		1000	534.97		64.61		1.94	0.00			0.90	0.00	
Strawberry; Rice (1.5 lbs ai/ac/app, 1 app., ground or aerial)													
Short grass	415	20	297.50	0.79	21.69	360	390.48	1.31	***	127.50	138.30	0.46	**
		100	378.73		61.85		222.67	0.59	***		78.86	0.21	**
		1000	534.97		276.92		99.69	0.19	*		35.31	0.07	
Tall grass	415	20	297.50	0.79	21.69	165	178.97	0.60	***	54.00	58.57	0.20	**
		100	378.73		61.85		102.06	0.27	**		33.40	0.09	
		1000	534.97		276.92		45.69	0.09			14.95	0.03	
Broadleaf forage, small insects	415	20	297.50	0.71	15.71	203	159.45	0.54	***	67.67	53.15	0.18	*
		100	378.73		44.79		90.92	0.24	**		30.31	0.08	
		1000	534.97		200.53		40.71	0.08			13.57	0.03	
Fruit, Large insects	415	20	297.50	0.69	14.70	23	16.90	0.06		10.73	7.89	0.03	
		100	378.73		41.90		9.64	0.03			4.50	0.01	
		1000	534.97		187.59		4.31	0.01			2.01	0.00	

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)													
Food Type	**LD_{50}**	**Weight Class**	**Adjusted LD_{50}[a]**	**Water Fraction[b]**	**Food Intake (g)[c]**	**Predicted Maximum Residues**				**Predicted Mean Residues**			
						EEC (mg/kg-diet)[d]	**Exposure (mg/kg-BW)[e]**	**Acute RQ[f]**		**EECe (mg/kg-diet)**	**Exposure (mg/kg-BW)**	**Acute RQ[f]**	
Seeds, Pods	415	20	297.50	0.1	5.06	23	5.82	0.02		10.73	2.72	0.01	
		100	378.73		14.43		3.32	0.01			1.55	0.00	
		1000	534.97		64.61		1.49	0.00			0.69	0.00	
Blueberry (1.4 lbs ae/A/app, 2 app., ground; 30 day interval)													
Short grass	415	20	297.50	0.79	21.69	368	399.16	1.34	***	130.33	141.37	0.48	**
		100	378.73		61.85		227.62	0.60	***		80.61	0.21	**
		1000	534.97		276.92		101.91	0.19	*		36.09	0.07	
Tall grass	415	20	297.50	0.79	21.69	169	183.31	0.62	***	55.31	59.99	0.20	**
		100	378.73		61.85		104.53	0.28	**		34.21	0.09	
		1000	534.97		276.92		46.80	0.09			15.32	0.03	
Broadleaf forage, small insects	415	20	297.50	0.71	15.71	207	162.59	0.55	***	69.00	54.20	0.18	*
		100	378.73		44.79		92.71	0.24	**		30.90	0.08	
		1000	534.97		200.53		41.51	0.08			13.84	0.03	
Fruit, Large insects	415	20	297.50	0.69	14.70	23	16.90	0.06		10.73	7.89	0.03	
		100	378.73		41.90		9.64	0.03			4.50	0.01	
		1000	534.97		187.59		4.31	0.01			2.01	0.00	

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)													
Food Type	**LD_{50}**	**Weight Class**	**Adjusted LD_{50}[a]**	**Water Fraction[b]**	**Food Intake (g)[c]**	**Predicted Maximum Residues**				**Predicted Mean Residues**			
						EEC (mg/kg-diet)[d]	**Exposure (mg/kg-BW)[e]**	**Acute RQ[f]**		**EECe (mg/kg-diet)**	**Exposure (mg/kg-BW)**	**Acute RQ[f]**	
Seeds, Pods	415	20	297.50	0.1	5.06	23	5.82	0.02		10.73	2.72	0.01	
		100	378.73		14.43		3.32	0.01			1.55	0.00	
		1000	534.97		64.61		1.49	0.00			0.69	0.00	
Grapes (1.36 lbs ae/A/app, 1 app., ground)													
Short grass	415	20	297.50	0.79	21.69	326	353.60	1.19	***	115.46	125.23	0.42	**
		100	378.73		61.85		201.64	0.53	***		71.41	0.19	*
		1000	534.97		276.92		90.28	0.17	*		31.97	0.06	
Tall grass	415	20	297.50	0.79	21.69	150	162.70	0.55	***	49.09	53.25	0.18	*
		100	378.73		61.85		92.78	0.25	**		30.36	0.08	
		1000	534.97		276.92		41.54	0.08			13.59	0.03	
Broadleaf forage, small insects	415	20	297.50	0.71	15.71	184	144.52	0.49	**	61.33	48.17	0.16	*
		100	378.73		44.79		82.41	0.22	**		27.47	0.07	
		1000	534.97		200.53		36.90	0.07			12.30	0.02	
Fruit, Large insects	415	20	297.50	0.69	14.70	20	14.70	0.05		9.33	6.86	0.02	
		100	378.73		41.90		8.38	0.02			3.91	0.01	
		1000	534.97		187.59		3.75	0.01			1.75	0.00	

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)													
Food Type	**LD_{50}**	**Weight Class**	**Adjusted LD_{50}[a]**	**Water Fraction[b]**	**Food Intake (g)[c]**	**Predicted Maximum Residues**				**Predicted Mean Residues**			
						EEC (mg/kg-diet)[d]	**Exposure (mg/kg-BW)[e]**	**Acute RQ[f]**		**EECe (mg/kg-diet)**	**Exposure (mg/kg-BW)**	**Acute RQ[f]**	
Seeds, Pods	415	20	297.50		5.06		5.06	0.02			2.36	0.01	
		100	378.73	0.1	14.43	20	2.89	0.01		9.33	1.35	0.00	
		1000	534.97		64.61		1.29	0.00			0.60	0.00	
Sorghum; Soybean (1.0 lbs ae/A/app, 1 app., ground or aerial)													
Short grass	415	20	297.50		21.69		260.32	0.88	***		92.20	0.31	**
		100	378.73	0.79	61.85	240	148.45	0.39	**	85.00	52.57	0.14	
		1000	534.97		276.92		66.46	0.12	*		23.54	0.04	
Tall grass	415	20	297.50		21.69		119.31	0.40	**		39.05	0.13	*
		100	378.73	0.79	61.85	110	68.04	0.18	*	36.00	22.27	0.06	
		1000	534.97		276.92		30.46	0.06			9.97	0.02	
Broadleaf forage, small insects	415	20	297.50		15.71		106.04	0.36	**		35.35	0.12	*
		100	378.73	0.71	44.79	135	60.47	0.16	*	45.00	20.16	0.05	
		1000	534.97		200.53		27.07	0.05			9.02	0.02	
Fruit, Large insects	415	20	297.50		14.70		11.02	0.04			5.14	0.02	
		100	378.73	0.69	41.90	15	6.29	0.02		7.00	2.93	0.01	
		1000	534.97		187.59		2.81	0.01			1.31	0.00	

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)

Food Type	LD_{50}	Weight Class	Adjusted LD_{50}[a]	Water Fraction[b]	Food Intake (g)[c]	Predicted Maximum Residues				Predicted Mean Residues			
						EEC (mg/kg-diet)[d]	Exposure (mg/kg-BW)[e]	Acute RQ[f]		EECe (mg/kg-diet)	Exposure (mg/kg-BW)	Acute RQ[f]	
Seeds, Pods	415	20	297.50	0.1	5.06	15	3.80	0.01		7.00	1.77	0.01	
		100	378.73		14.43		2.16	0.01			1.01	0.00	
		1000	534.97		64.61		0.97	0.00			0.45	0.00	
Wheat, Oats, Barley, Rye, Millet, Triticale (1.25 lbs ae/A/app, 2 app., assumed 30 day interval, ground or aerial)													
Short grass	415	20	297.50	0.79	21.69	328	355.77	1.20	***	116.17	126.00	0.42	**
		100	378.73		61.85		202.88	0.54	***		71.85	0.19	
		1000	534.97		276.92		90.83	0.17	0.00		32.17	0.06	
Tall grass	415	20	297.50	0.79	21.69	150	162.70	0.55	***	49.09	53.25	0.18	*
		100	378.73		61.85		92.78	0.25	**		30.36	0.08	
		1000	534.97		276.92		41.54	0.08			13.59	0.03	
Broadleaf forage, small insects	415	20	297.50	0.71	15.71	185	145.31	0.49	**	61.67	48.44	0.16	*
		100	378.73		44.79		82.86	0.22	**		27.62	0.07	
		1000	534.97		200.53		37.10	0.07			12.37	0.02	
Fruit, Large insects	415	20	297.50	0.69	14.70	21	15.43	0.05		9.80	7.20	0.02	
		100	378.73		41.90		8.80	0.02			4.11	0.01	
		1000	534.97		187.59		3.94	0.01			1.84	0.00	

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)													
Food Type	**LD_{50}**	**Weight Class**	**Adjusted LD_{50}[a]**	**Water Fraction[b]**	**Food Intake (g)[c]**	**Predicted Maximum Residues**				**Predicted Mean Residues**			
						EEC (mg/kg-diet)[d]	**Exposure (mg/kg-BW)[e]**	**Acute RQ[f]**		**EECe (mg/kg-diet)**	**Exposure (mg/kg-BW)**	**Acute RQ[f]**	
Seeds, Pods	415	20	297.50		5.06		5.31	0.02			2.48	0.01	
		100	378.73	0.1	14.43	21	3.03	0.01		9.80	1.41	0.00	
		1000	534.97		64.61		1.36	0.00			0.63	0.00	
Corn (1.5 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)													
Short grass	415	20	297.50		21.69		615.01	2.07	***		217.81	0.73	***
		100	378.73	0.79	61.85	567	350.70	0.93	***	200.81	124.21	0.33	**
		1000	534.97		276.92		157.01	0.29	**		55.61	0.10	*
Tall grass	415	20	297.50		21.69		282.01	0.95	***		92.30	0.31	**
		100	378.73	0.79	61.85	260	160.82	0.42	**	85.09	52.63	0.14	*
		1000	534.97		276.92		72.00	0.13	*		23.56	0.04	
Broadleaf forage, small insects	415	20	297.50		15.71		250.56	0.84	***		83.52	0.28	**
		100	378.73	0.71	44.79	319	142.88	0.38	**	106.33	47.63	0.13	*
		1000	534.97		200.53		63.97	0.12	*		21.32	0.04	
Fruit, Large insects	415	20	297.50		14.70		25.72	0.09			12.00	0.04	
		100	378.73	0.69	41.90	35	14.67	0.04		16.33	6.84	0.02	
		1000	534.97		187.59		6.57	0.01			3.06	0.01	

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)													
Food Type	**LD_{50}**	**Weight Class**	**Adjusted LD_{50}[a]**	**Water Fraction[b]**	**Food Intake (g)[c]**	**Predicted Maximum Residues**				**Predicted Mean Residues**			
						EEC (mg/kg-diet)[d]	**Exposure (mg/kg-BW)[e]**	**Acute RQ[f]**		**EECe (mg/kg-diet)**	**Exposure (mg/kg-BW)**	**Acute RQ[f]**	
Seeds, Pods	415	20	297.50	0.1	5.06	35	8.86	0.03		16.33	4.13	0.01	
		100	378.73		14.43		5.05	0.01			2.36	0.01	
		1000	534.97		64.61		2.26	0.00			1.06	0.00	
Asparagus (4.0 lbs ae/A/app, 2 app., ground or aerial, 30 day interval)													
Short grass	415	20	297.50	0.79	21.69	1050	1138.90	3.83	***	371.88	403.36	1.36	***
		100	378.73		61.85		649.45	1.71	***		230.01	0.61	***
		1000	534.97		276.92		290.77	0.54	***		102.98	0.19	*
Tall grass	415	20	297.50	0.79	21.69	481	521.72	1.75	***	157.42	170.75	0.57	***
		100	378.73		61.85		297.51	0.79	***		97.37	0.26	**
		1000	534.97		276.92		133.20	0.25	**		43.59	0.08	
Broadleaf forage, small insects	415	20	297.50	0.71	15.71	591	464.20	1.56	***	197.00	154.73	0.52	***
		100	378.73		44.79		264.71	0.70	***		88.24	0.23	**
		1000	534.97		200.53		118.51	0.22	**		39.50	0.07	
Fruit, Large insects	415	20	297.50	0.69	14.70	66	48.50	0.16	*	30.80	22.63	0.08	
		100	378.73		41.90		27.65	0.07			12.91	0.03	
		1000	534.97		187.59		12.38	0.02			5.78	0.01	

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)												
Food Type	**LD_{50}**	**Weight Class**	**Adjusted LD_{50}[a]**	**Water Fraction[b]**	**Food Intake (g)[c]**	**Predicted Maximum Residues**			**Predicted Mean Residues**		
						EEC (mg/kg-diet)[d]	**Exposure (mg/kg-BW)[e]**	**Acute RQ[f]**	**EECe (mg/kg-diet)**	**Exposure (mg/kg-BW)**	**Acute RQ[f]**
Seeds, Pods	415	20	297.50	0.1	5.06	66	16.70	0.06	30.80	7.80	0.03
		100	378.73		14.43		9.53	0.03		4.45	0.01
		1000	534.97		64.61		4.26	0.01		1.99	0.00
Potato (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)											
Short grass	415	20	297.50	0.79	21.69	26	28.20	0.09	9.21	9.99	0.03
		100	378.73		61.85		16.08	0.04		5.70	0.02
		1000	534.97		276.92		7.20	0.01		2.55	0.00
Tall grass	415	20	297.50	0.79	21.69	12	13.02	0.04	3.93	4.26	0.01
		100	378.73		61.85		7.42	0.02		2.43	0.01
		1000	534.97		276.92		3.32	0.01		1.09	0.00
Broadleaf forage, small insects	415	20	297.50	0.71	15.71	15	11.78	0.04	5.00	3.93	0.01
		100	378.73		44.79		6.72	0.02		2.24	0.01
		1000	534.97		200.53		3.01	0.01		1.00	0.00
Fruit, Large insects	415	20	297.50	0.69	14.70	2	1.47	0.00	0.93	0.69	0.00
		100	378.73		41.90		0.84	0.00		0.39	0.00
		1000	534.97		187.59		0.38	0.00		0.18	0.00

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)												
Food Type	**LD_{50}**	**Weight Class**	**Adjusted LD_{50}[a]**	**Water Fraction[b]**	**Food Intake (g)[c]**	**Predicted Maximum Residues**			**Predicted Mean Residues**		
						EEC (mg/kg-diet)[d]	**Exposure (mg/kg-BW)[e]**	**Acute RQ[f]**	**EECe (mg/kg-diet)**	**Exposure (mg/kg-BW)**	**Acute RQ[f]**
Seeds, Pods	415	20	297.50	0.1	5.06	2	0.51	0.00	0.93	0.24	0.00
		100	378.73		14.43		0.29	0.00		0.13	0.00
		1000	534.97		64.61		0.13	0.00		0.06	0.00
Citrus (0.1 lbs ae/A/app, 1 app., ground or aerial)											
Short grass	415	20	297.50	0.79	21.69	24	26.03	0.09	8.50	9.22	0.03
		100	378.73		61.85		14.84	0.04		5.26	0.01
		1000	534.97		276.92		6.65	0.01		2.35	0.00
Tall grass	415	20	297.50	0.79	21.69	11	11.93	0.04	3.60	3.90	0.01
		100	378.73		61.85		6.80	0.02		2.23	0.01
		1000	534.97		276.92		3.05	0.01		1.00	0.00
Broadleaf forage, small insects	415	20	297.50	0.71	15.71	14	11.00	0.04	4.67	3.67	0.01
		100	378.73		44.79		6.27	0.02		2.09	0.01
		1000	534.97		200.53		2.81	0.01		0.94	0.00
Fruit, Large insects	415	20	297.50	0.69	14.70	1.5	1.10	0.00	0.70	0.51	0.00
		100	378.73		41.90		0.63	0.00		0.29	0.00
		1000	534.97		187.59		0.28	0.00		0.13	0.00

Table F-13: Avian Acute Risk Quotient Calculations (based on multiple and single applications an LD_{50} of 415 mg ae/kg-BW)

Food Type	LD_{50}	Weight Class	Adjusted LD_{50}[a]	Water Fraction[b]	Food Intake (g)[c]	Predicted Maximum Residues			Predicted Mean Residues		
						EEC (mg/kg-diet)[d]	Exposure (mg/kg-BW)[e]	Acute RQ[f]	EECe (mg/kg-diet)	Exposure (mg/kg-BW)	Acute RQ[f]
Seeds, Pods	415	20	297.50	0.1	5.06	1.5	0.38	0.00	0.70	0.18	0.00
		100	378.73		14.43		0.22	0.00		0.10	0.00
		1000	534.97		64.61		0.10	0.00		0.05	0.00

[a] adjusted $LD_{50\ (XXgm\ bird)} = LD_{50\ (Test\ bird)} * ([XX(g) / [bwt\ of\ test\ bird(g)])^{(1.15\ -1)}$ where avg bwt of test birds was 184g and LD_{50} = 221 mg/kg-bwt (MRID 400192-02), Mineau et al 1996

[b] water fraction as determined from Exposure Factors Handbook

[c] food intake (g-diet/day) = (0.648 * $BW^{0.651}$) / (1-water fraction in food), from Nagy's (1987) allometric equations, adjusted for percentage of water contained in the food source

[d] EEC calculated from FATE5 using 8.8 day foliar dissipation half-life.

[e] exposure (mg/kg-bwt) = food intake (g-diet/day) x EEC (mg/kg-diet) / BW (g-bwt) x (1000g-bwt/1kg-bwt) x (1kg-diet/1000g-diet)

[f] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 0.10.
** indicates an exceedance of Acute Restricted Use LOC; RQ > 0.20.
*** indicates an exceedance of Acute Risk LOC; RQ > 1.0.

Table F-14: Avian Chronic Risk Quotient Calculations for Spray Applications			
Scenario	**Chronic Toxicity Threshold, NOEC (mg ae/kg-diet)**	**Predicted Maximum Residue Levels (EEC) (mg ae/kg-diet)**	**Chronic RQ [a]**
Fallow areas and Crop Stubble, Turf (Golf courses, residential lawns, grasses grown for seed, and sod); Pastures, Rangeland, Perennial Grassland; Sugarcane -(2 lbs ae/ac/app, 2 app., ground/aerial, 30 day interval)			
Short grass	962	745	0.77
Tall grass	962	341	0.35
Broadleaf forage, small insects	962	419	0.44
Fruit, pods, seeds, large insects	962	47	0.05
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.), Forest Uses, Cranberry (4.0 lbs ae/A/app, 1 app., ground/aerial,)			
Short grass	962	960	1.00+
Tall grass	962	440	0.46
Broadleaf forage, small insects	962	540	0.56
Fruit, pods, seeds, large insects	962	60	0.06
Pome fruit/Stone fruit/Nuts (2.0 lbs ae/A/app, 2 app., ground/aerial; 75 day application interval)			
Short grass	962	589	0.61
Tall grass	962	270	0.28
Broadleaf forage, small insects	962	331	0.34
Fruit, pods, seeds, large insects	962	37	0.04
Strawberry, Rice (1.5 lbs ai/ac/app, 1 app., ground or aerial)			
Short grass	962	360	0.37
Tall grass	962	165	0.17
Broadleaf forage, small insects	962	203	0.21

Table F-14: Avian Chronic Risk Quotient Calculations for Spray Applications			
Scenario	**Chronic Toxicity Threshold, NOEC (mg ae/kg-diet)**	**Predicted Maximum Residue Levels (EEC) (mg ae/kg-diet)**	**Chronic RQ [a]**
Fruit, pods, seeds, large insects	962	23	0.02
Blueberry (1.4 lbs ae/A/app, 2 app., ground; 30 day interval)			
Short grass	962	521	0.54
Tall grass	962	239	0.25
Broadleaf forage, small insects	962	293	0.30
Fruit, pods, seeds, large insects	962	33	0.03
Grapes (1.36 lbs ae/A/app, 1 app., ground)			
Short grass	962	326	0.34
Tall grass	962	150	0.16
Broadleaf forage, small insects	962	184	0.19
Fruit, pods, seeds, large insects	962	20	0.02
Sorghum, Soybean (1.0 lbs ae/A/app, 1 app., ground or aerial)			
Short grass	962	240	0.25
Tall grass	962	110	0.11
Broadleaf forage, small insects	962	135	0.14
Fruit, pods, seeds, large insects	962	15	0.02
Wheat, Oats, Barley, Rye, Millet, Triticale (1.25 lbs ae/A/app, 2 app., assumed 30 day interval, ground or aerial)			
Short grass	962	46 6	0.05
Tall grass	962	213	0.22

Table F-14: Avian Chronic Risk Quotient Calculations for Spray Applications			
Scenario	**Chronic Toxicity Threshold, NOEC (mg ae/kg-diet)**	**Predicted Maximum Residue Levels (EEC) (mg ae/kg-diet)**	**Chronic RQ [a]**
Broadleaf forage, small insects	962	262	0.27
Fruit, pods, seeds, large insects	962	29	0.03
Corn (1.5 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)			
Short grass	962	561	0.58
Tall grass	962	257	0.27
Broadleaf forage, small insects	962	315	0.33
Fruit, pods, seeds, large insects	962	35	0.04
Asparagus (4.0 lbs ae/A/app, 2 app., ground or aerial, 30 day interval)			
Short grass	962	1490	1.09+
Tall grass	962	683	0.71
Broadleaf forage, small insects	962	838	0.87
Fruit, pods, seeds, large insects	962	93	0.10
Potato (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)			
Short grass	962	31	0.03
Tall grass	962	14	0.01
Broadleaf forage, small insects	962	18	0.02
Fruit, pods, seeds, large insects	962	2	0.00
Sugarcane (2.0 lbs ae/A/app, 2 app., ground or aerial)			
Short grass	962	745	0.77
Tall grass	962	341	0.35

Table F-14: Avian Chronic Risk Quotient Calculations for Spray Applications			
Scenario	**Chronic Toxicity Threshold, NOEC (mg ae/kg-diet)**	**Predicted Maximum Residue Levels (EEC) (mg ae/kg-diet)**	**Chronic RQ [a]**
Broadleaf forage, small insects	962	419	0.44
Fruit, pods, seeds, large insects	962	47	0.05
Citrus (0.1 lbs ae/A/app, 1 app., ground or aerial)			
Short grass	962	24	0.02
Tall grass	962	11	0.01
Broadleaf forage, small insects	962	14	0.01
Fruit, pods, seeds, large insects	962	2	0.00

a + indicates an exceedence of Chronic LOC.

Non-granular Banded Applications - In addition to broadcast spray applications, a number of labels instruct the applicators to apply unincorporated banded treatments of sprays to row crops. When bands are sprayed on row crops the amount of pesticide is concentrated in a small band and the amount per treated acre is increased. Theoretically, birds forage and carry out other daily activities inside and outside the band, and thus may be exposed to the higher more concentrated band treatments. To calculate RQs for banded treatments, EFED calculates the number of lethal doses (LD50s) that are available within one square foot immediately after application (LD50s/$ft^{2)}$. The RQs are calculated for three separate weight class of birds: 1000 g (*e.g.*, waterfowl), 180 g (*e.g.*, upland gamebird), and 20 g (*e.g.*, songbird).

For 2,4-D products which are applied as band treatments, many labels adjust application rates according to band width and row spaces, but many other labels do not. For the labels which do not adjust the application rates, the treatments are more concentrated and the resulting exposure to birds increases as discussed above. The EFED asked the phenoxy Task Force to identify the labels with the narrowest band width and widest row spaces but the Task Force opted to require all formulators to adjust the application rates according to the following formula.

$$\frac{\textit{band width in inches}}{\textit{row width in inches}} \quad X \quad \textit{Broadcast rate per acre} \quad = \quad \textit{Rate per banded acre}$$

Using this formula, RQs for these adjusted rates have been calculated below for banded spray applications. The most sensitive LD50 of 500 mg ai/kg for the DMA salt is adjusted to the acid equivalent of 415 mg ae/kg, and this value is used for the calculations. For purposes of comparison, the unadjusted rates that appear on many of the current labels have also been included. To simplify the process, and illustrated the point, EFED has opted to use a 6 inch band and 30 inch row space as a typical banded application.

Table F-15: Avian Acute Risk Quotient Calculations for Banded Spray Applications									
Bird Body Weight (g)	Band width (ft.)	Untreated Row Space (ft)	Adjusted Appl. Rate[a]	Unadjusted Appl. Rate (from label)	Mg ae per ft^2 [b]		Acute Toxicity Threshold, LD_{50} (mg ae/kg)	Acute RQ (LD_{50} per ft^2)[c]	
					Adjusted	Unadjusted		Adjusted	Unadjusted
Forest Uses (4.0 lbs ae/A/app, 1 app., ground/aerial)									
20	0.5	2	0.8	4.0	33.3216	166.6079	415	4.0***	20.1***
180	0.5	2	0.8	4.0	33.3216	166.6079	415	0.446***	2.2***
1000	0.5	2	0.8	4.0	33.3216	166.6079	415	0.080	0.4**
Blueberry (1.4 lbs ae/A/app, 2 app., ground; 30 day interval									
20	0.5	2	0.28	1.4	11.6626	58.312764	415	1.41***	7.0***
180	0.5	2	0.28	1.4	11.6626	58.312764	415	0.16*	0.8***
1000	0.5	2	0.28	1.4	11.6626	58.312764	415	0.03	0.1*
Sorghum (1.0 lbs ae/A/app, 1 app., ground or aerial)									
20	0.5	2	0.2	1.0	8.33039	41.651974	415	1.00***	5.02***
180	0.5	2	0.2	1.0	8.33039	41.651974	415	0.11*	0.56***
1000	0.5	2	0.2	1.0	8.33039	41.651974	415	0.02	0.10*
Corn (1.5 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)									
20	0.5	2	0.3	1.5	12.4956	62.477961	415	1.51***	7.53***
180	0.5	2	0.3	1.5	12.4956	62.477961	415	0.17*	0.84***
1000	0.5	2	0.3	1.5	12.4956	62.477961	415	0.03	0.15*
Soybean (1.0 lbs ae/A/app, 1 app., ground or aerial)									
20	0.5	2	0.2	1.0	8.33039	41.651974	415	1.00***	5.02***
180	0.5	2	0.2	1.0	8.33039	41.651974	415	0.11*	0.56***

Table F-15: Avian Acute Risk Quotient Calculations for Banded Spray Applications									
Bird Body Weight (g)	Band width (ft.)	Untreated Row Space (ft)	Adjusted Appl. Rate[a]	Unadjusted Appl. Rate (from label)	Mg ae per ft^2 [b]		Acute Toxicity Threshold, LD_{50} (mg ae/kg)	Acute RQ (LD_{50} per ft^2)[c]	
					Adjusted	Unadjusted		Adjusted	Unadjusted
1000	0.5	2	0.2	1.0	8.33039	41.651974	415	0.02	0.10*
Asparagus (4.0 lbs ae/A/app, 2 app., ground or aerial, 30 day interval)									
20	0.5	2	0.8	4.0	33.3216	166.6079	415	4.01***	20.07***
180	0.5	2	0.8	4.0	33.3216	166.6079	415	0.45**	2.23***
1000	0.5	2	0.8	4.0	33.3216	166.6079	415	0.08	0.40**
Potato (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)									
20	0.5	2	0.014	0.07	0.58313	2.9156382	415	0.07	0.35**
180	0.5	2	0.014	0.07	0.58313	2.9156382	415	0.01	0.04
1000	0.5	2	0.014	0.07	0.58313	2.9156382	415	0.00	0.01

[a] $\textit{Rate per banded acre} = \frac{\textit{band width in inches}}{\textit{row width in inches}} \times \textit{Broadcast rate per acre}$

[b] $\textit{mg ae per ft}^2 = \frac{\textit{App. Rate lbs ae}}{\textit{Acre}} \times \frac{\textit{453,590 mg}}{\textit{Lbs}} \times \frac{\textit{Acre}}{\textit{43,560 ft}^2} \times \textit{\% unincorporated} \times \frac{\textit{untreated row space (ft)}}{\textit{Bandwidth (ft)}}$

[c] $RQ = \frac{\text{Mg ae}}{\text{ft}^2} \times \frac{1}{\text{Weight of Animal (g)}} \times \frac{1000\ \text{g}}{\text{kg}} \times \frac{\text{kg}}{\text{LD50 mg}}$

* indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

Granular Exposure

Granular Broadcast Applications - Birds may be exposed to granular pesticides ingesting granules when foraging for food or grit. They also may be exposed by other routes, such as by walking on exposed granules or drinking water contaminated by granules. The number of lethal doses (LD50s) that are available within one square foot immediately after application (LD50s/ft$^{2)}$ is used as the RQ for granular

products. RQs are calculated for three separate weight class of birds: 1000 g (*e.g.*, waterfowl), 180 g (*e.g.*, upland gamebird), and 20 g (*e.g.*, songbird).

Table F-16: Avian Acute Risk Quotient Calculations for Granular Broadcast Applications		
Bird Body Weight (g)	**Acute Toxicity Threshold, LD_{50} (mg ae/kg)**	**Acute RQ (LD_{50} per ft^2) [a]**
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) (4.0 lbs ae/A/app, 1 app., ground/aerial,)		
20	415	5.02***
180	415	0.55***
1000	415	0.10**
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) (2.0 lbs ae/A/app, 2 app., ground/aerial, 30 day interval)		
20	415	2.5***
180	415	0.3**
1000	415	0.05
(Aquatic areas - Ditchbank applications (2.0 lb ae/acre/app., 2 app., ground)		
20	415	2.5***
180	415	0.3**
1000	415	0.05
(Aquatic areas - Surface applications (ponds, lakes reservoirs, marches, bayous, drainage ditches, canals, slow moving rivers and streams, bank of irrigation ditches) (4.0 lb ae/acre/app. 3 weeks between applications)		
20	415	5.02***
180	415	0.55***
1000	415	0.10**

Table F-16: Avian Acute Risk Quotient Calculations for Granular Broadcast Applications		
Bird Body Weight (g)	**Acute Toxicity Threshold, LD_{50} (mg ae/kg)**	**Acute RQ (LD_{50} per ft^2) [a]**
(Aquatic areas - Surface application or subsurface injection (ponds, lakes reservoirs, marches, bayous, drainage ditches, canals, slow moving rivers and streams, bank of irrigation ditches) (10.8 lb ae/acre foot to an average pond depth of 5 feet)		
20	415	13.55***
180	415	1.5***
1000	415	0.27**
Cranberry (4.0 lbs ae/A/app, 1 app., ground)		
20	415	5.02***
180	415	0.55***
1000	415	0.10**

[a] $RQ = \frac{\text{App. Rate (lbs ae)}}{\text{Acre}} \times \frac{453{,}590 \text{ mg}}{\text{Lb}} \times \frac{\text{Acre}}{43{,}560 \text{ ft}^2} \times \frac{1}{\text{Animal weight (g)}} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{\text{Kg}}{\text{LD50 mg}}$

* indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

ii. Mammals, acute and chronic

Nongranular Exposure

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
Fallow areas and Crop Stubble -(2 lbs ae/ac/app, 2 app., ground/aerial, 30 day interval)									
15	95	Short grass	579	525	0.86	***	186	0.31	**
		Broadleaf forage, small insects	579	295	0.48	**	98	0.16	*
		Large insects	579	33	0.05		15	0.03	
35	66	Short grass	579	525	0.60	***	186	0.21	**
		Broadleaf forage, small insects	579	295	0.34	**	98	0.11	*
		Large insects	579	33	0.04		15	0.02	
1000	15	Short grass	579	525	0.14	*	186	0.05	
		Broadleaf forage, small insects	579	295	0.08		98	0.03	
		Large insects	579	33	0.01		15	0.00	

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) (4.0 lbs ae/A/app, 1 app., ground/aerial,)									
		Short grass	579	960	1.58	***	340	0.56	***
15	95	Broadleaf forage, small insects	579	540	0.89	***	180	0.30	**
		Large insects	579	60	0.10	*	28	0.05	
		Short grass	579	960	1.09	***	340	0.39	**
35	66	Broadleaf forage, small insects	579	540	0.62	***	180	0.21	**
		Large insects	579	60	0.07		28	0.03	
		Short grass	579	960	0.25	**	340	0.09	
1000	15	Broadleaf forage, small insects	579	540	0.14	*	180	0.05	
		Large insects	579	60	0.02		28	0.01	
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) (2.0 lbs ae/A/app, 2 app., ground/aerial, 30 day interval)									
15	95	Short grass	579	525	0.86	***	186	0.31	**

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
		Broadleaf forage, small insects	579	295	0.48	**	98	0.16	*
		Large insects	579	33	0.05		15	0.03	
		Short grass	579	525	0.60	***	186	0.21	**
35	66	Broadleaf forage, small insects	579	295	0.34	**	98	0.11	*
		Large insects	579	33	0.04		15	0.02	
		Short grass	579	525	0.14	*	186	0.05	
1000	15	Broadleaf forage, small insects	579	295	0.08		98	0.03	
		Large insects	579	33	0.01		15	0.00	
Pastures, Rangeland, Perennial Grassland (2 lbs ae/A/app, 2 app., ground/aerial; 30 day interval)									
		Short grass	579	525	0.86	***	186	0.31	**
15	95	Broadleaf forage, small insects	579	295	0.48	**	98	0.16	*
		Large insects	579	33	0.05		15	0.03	
35	66	Short grass	579	525	0.60	***	186	0.21	**

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
		Broadleaf forage, small insects	579	295	0.34	**	98	0.11	*
		Large insects	579	33	0.04		15	0.02	
		Short grass	579	525	0.14	*	186	0.05	
1000	15	Broadleaf forage, small insects	579	295	0.08	*	98	0.03	
		Large insects	579	33	0.01		15	0.00	
Forest Uses (4.0 lbs ae/A/app, 1 app., ground/aerial)									
		Short grass	579	960	1.58	***	340	0.56	***
15	95	Broadleaf forage, small insects	579	540	0.89	***	180	0.30	**
		Large insects	579	60	0.10	*	28	0.05	
		Short grass	579	960	1.09	***	340	0.39	**
35	66	Broadleaf forage, small insects	579	540	0.62	***	180	0.21	**
		Large insects	579	60	0.07		28	0.03	
1000	15	Short grass	579	960	0.25	**	340	0.09	

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
		Broadleaf forage, small insects	579	540	0.14	*	180	0.05	
		Large insects	579	60	0.02		28	0.01	
Pome fruit/Stone fruit/Nuts (2.0 lbs ae/A/app, 2 app., ground/aerial; 75 day application interval)									
		Short grass	579	481	0.79	***	170	0.28	**
15	95	Broadleaf forage, small insects	579	271	0.44	**	90	0.15	*
		Large insects	579	30	0.05		14	0.02	
		Short grass	579	481	0.55	***	170	0.19	*
35	66	Broadleaf forage, small insects	579	271	0.31	**	90	0.10	*
		Large insects	579	30	0.03		14	0.02	
		Short grass	579	481	0.12	*	170	0.04	
1000	15	Broadleaf forage, small insects	579	271	0.07		90	0.02	
		Large insects	579	30	0.01		14	0.00	
Strawberry (1.5 lbs ai/ac/app, 1 app., ground or aerial)									

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	**% Body Weight Consumed**	**Scenario**	**Acute Toxicity Threshold, LD_{50} (mg/kg-bw)**	**Predicted Maximum Residue Levels**			**Predicted Mean Residue Levels**		
				EEC (mg/kg-diet)	**Acute RQ [a]**		**EEC (mg/kg-diet)**	**Acute RQ [a]**	
		Short grass	579	360	0.59	***	128	0.21	**
15	95	Broadleaf forage, small insects	579	203	0.33	**	68	0.11	*
		Large insects	579	23	0.04		11	0.02	
		Short grass	579	360	0.41	**	128	0.15	*
35	66	Broadleaf forage, small insects	579	203	0.23	**	68	0.08	
		Large insects	579	23	0.03		11	0.01	
		Short grass	579	360	0.09		128	0.03	
1000	15	Broadleaf forage, small insects	579	203	0.05		68	0.02	
		Large insects	579	23	0.01		11	0.00	
Blueberry (1.4 lbs ae/A/app, 2 app., ground; 30 day interval)									
		Short grass	579	368	0.60	***	130	0.21	**
15	95	Broadleaf forage, small insects	579	207	0.34	**	69	0.11	*
		Large insects	579	23	0.04		11	0.02	

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
		Short grass	579	368	0.42	**	130	0.15	*
35	66	Broadleaf forage, small insects	579	207	0.24	**	69	0.08	
		Large insects	579	23	0.03		11	0.01	
		Short grass	579	368	0.10	*	130	0.03	
1000	15	Broadleaf forage, small insects	579	207	0.05		69	0.02	
		Large insects	579	23	0.01		11	0.00	
Cranberry (4.0 lbs ae/A/app, 1 app., ground)									
		Short grass	579	960	1.58	***	340	0.56	***
15	95	Broadleaf forage, small insects	579	540	0.89	***	180	0.30	**
		Large insects	579	60	0.10	*	28	0.05	
		Short grass	579	960	1.09	***	340	0.39	**
35	66	Broadleaf forage, small insects	579	540	0.62	***	180	0.21	**
		Large insects	579	60	0.07		28	0.03	

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
		Short grass	579	960	0.25	**	340	0.09	
1000	15	Broadleaf forage, small insects	579	540	0.14	0.00	180	0.05	
		Large insects	579	60	0.02		28	0.01	
Grapes (1.36 lbs ae/A/app, 1 app., ground)									
		Short grass	579	326	0.53	***	115	0.19	*
15	95	Broadleaf forage, small insects	579	184	0.30	**	61	0.10	*
		Large insects	579	21	0.03		10	0.02	
		Short grass	579	326	0.37	**	115	0.13	*
35	66	Broadleaf forage, small insects	579	184	0.21	**	61	0.07	
		Large insects	579	21	0.02		10	0.01	
		Short grass	579	326	0.08		115	0.03	
1000	15	Broadleaf forage, small insects	579	184	0.05		61	0.02	
		Large insects	579	21	0.01		10	0.00	

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
Sorghum (1.0 lbs ae/A/app, 1 app., ground or aerial)									
15	95	Short grass	579	240	0.39	**	85	0.14	*
		Broadleaf forage, small insects	579	135	0.22	**	45	0.07	
		Large insects	579	15	0.02		7	0.01	
35	66	Short grass	579	240	0.27	**	85	0.10	*
		Broadleaf forage, small insects	579	135	0.15	*	45	0.05	
		Large insects	579	15	0.02		7	0.01	
1000	15	Short grass	579	240	0.10*		85	0.02	
		Broadleaf forage, small insects	579	135	0.04		45	0.01	
		Large insects	579	15	0.00		7	0.00	
Wheat, Oats, Barley, Rye, Millet, Triticale (1.25 lbs ae/A/app, 2 app., ground or aerial)									
15	95	Short grass	579	325	0.53	***	115	0.19	*
		Broadleaf forage, small insects	579	185	0.30	**	62	0.10	*

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
		Large insects	579	21	0.03		10	0.02	
		Short grass	579	325	0.37	**	115	0.13	*
35	66	Broadleaf forage, small insects	579	185	0.21	**	62	0.07	
		Large insects	579	21	0.02		10	0.01	
		Short grass	579	325	0.08		115	0.03	
1000	15	Broadleaf forage, small insects	579	185	0.05		62	0.02	
		Large insects	579	21	0.01		10	0.00	
Corn (1.5 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)									
		Short grass	579	567	0.93	***	201	0.33	**
15	95	Broadleaf forage, small insects	579	319	0.52	***	106	0.17	*
		Large insects	579	35	0.06		16	0.03	
		Short grass	579	567	0.65	***	201	0.23	**
35	66	Broadleaf forage, small insects	579	319	0.36	**	106	0.12	*

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
		Large insects	579	35	0.04		16	0.02	
		Short grass	579	567	0.15	*	201	0.05	
1000	15	Broadleaf forage, small insects	579	319	0.08		106	0.03	
		Large insects	579	35	0.01		16	0.00	
Soybean (1.0 lbs ae/A/app, 1 app., ground or aerial)									
		Short grass	579	240	0.39	**	85	0.14	*
15	95	Broadleaf forage, small insects	579	135	0.22	**	45	0.07	
		Large insects	579	15	0.02		7	0.01	
		Short grass	579	240	0.27	**	85	0.10	*
35	66	Broadleaf forage, small insects	579	135	0.15	*	45	0.05	
		Large insects	579	15	0.02		7	0.01	
		Short grass	579	240	0.06		85	0.02	
1000	15	Broadleaf forage, small insects	579	135	0.04		45	0.01	

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
		Large insects	579	15	0.00		7	0.00	
Asparagus (4.0 lbs ae/A/app, 2 app., ground or aerial, 30 day interval)									
		Short grass	579	1050	1.72	***	372	0.61	***
15	95	Broadleaf forage, small insects	579	591	0.97	***	197	0.32	**
		Large insects	579	66	0.11	*	31	0.05	
		Short grass	579	1050	1.20	***	372	0.42	**
35	66	Broadleaf forage, small insects	579	591	0.67	***	197	0.22	**
		Large insects	579	66	0.08	*	31	0.04	
		Short grass	579	1050	0.27	**	372	0.10	*
1000	15	Broadleaf forage, small insects	579	591	0.15	*	197	0.05	
		Large insects	579	66	0.02		31	0.01	
Potato (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)									
15	95	Short grass	579	26	0.04		9	0.02	

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
		Broadleaf forage, small insects	579	15	0.02		5	0.01	
		Large insects	579	1.7	0.00		1	0.00	
		Short grass	579	26	0.03		9	0.01	
35	66	Broadleaf forage, small insects	579	15	0.02		5	0.01	
		Large insects	579	1.7	0.00		1	0.00	
		Short grass	579	26	0.01		9	0.00	
1000	15	Broadleaf forage, small insects	579	15	0.00		5	0.00	
		Large insects	579	1.7	0.00		1	0.00	
Sugarcane (2.0 lbs ae/A/app, 2 app., ground or aerial)									
		Short grass	579	525	0.86	***	186	0.31	**
15	95	Broadleaf forage, small insects	579	295	0.48	**	98	0.16	*
		Large insects	579	33	0.12*		15	0.03	
35	66	Short grass	579	525	0.60	***	186	0.21	**

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels			Predicted Mean Residue Levels		
				EEC (mg/kg-diet)	Acute RQ [a]		EEC (mg/kg-diet)	Acute RQ [a]	
		Broadleaf forage, small insects	579	295	0.34	**	98	0.11	*
		Large insects	579	33	0.04		15	0.02	
		Short grass	579	525	0.14	0.00	186	0.05	*
1000	15	Broadleaf forage, small insects	579	295	0.08		98	0.03	
		Large insects	579	33	0.01		15	0.00	
Citrus (0.1 lbs ae/A/app, 1 app., ground or aerial)									
		Short grass	579	24	0.04		9	0.01	
15	95	Broadleaf forage, small insects	579	14	0.02		5	0.01	
		Large insects	579	1.5	0.00		1	0.00	
		Short grass	579	24	0.03		9	0.01	
35	66	Broadleaf forage, small insects	579	14	0.02		5	0.01	
		Large insects	579	1.5	0.00		1	0.00	
1000	15	Short grass	579	24	0.01		9	0.00	

Table F-17: Mammalian (Herbivore/Insectivore) Acute Risk Quotient Calculations for Spray Applications									
Animal Body Weight (g)	**% Body Weight Consumed**	**Scenario**	**Acute Toxicity Threshold, LD_{50} (mg/kg-bw)**	**Predicted Maximum Residue Levels**			**Predicted Mean Residue Levels**		
				EEC (mg/kg-diet)	**Acute RQ [a]**		**EEC (mg/kg-diet)**	**Acute RQ [a]**	
		Broadleaf forage, small insects	579	14	0.00		5	0.00	
		Large insects	579	1.5	0.00		1	0.00	
Rice (1.5 lbs ae/A/app, 1 app., ground or aerial)									
		Short grass	579	360	0.59	***	128	0.21	**
15	95	Broadleaf forage, small insects	579	203	0.33	**	68	0.11	*
		Large insects	579	23	0.04		11	0.02	
		Short grass	579	360	0.41	**	128	0.15	*
35	66	Broadleaf forage, small insects	579	203	0.23	**	68	0.08	
		Large insects	579	23	0.03		11	0.01	
		Short grass	579	360	0.09		128	0.03	
1000	15	Broadleaf forage, small insects	579	203	0.05		68	0.02	
		Large insects	579	23	0.01		11	0.00	

Table F-18: Mammalian (Granivore) Acute Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC (mg/kg-diet)	Acute RQ [a]	EEC (mg/kg-diet)	Acute RQ [a]
Fallow areas and Crop Stubble -(2 lbs ae/ac/app, 2 app., ground/aerial, 30 day interval)							
15	21	Seeds	579	33	0.01	15	0.01
35	15	Seeds	579	33	0.01	15	0.00
1000	3	Seeds	579	33	0.00	15	0.00
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) (4.0 lbs ae/A/app, 1 app., ground/aerial,)							
15	21	Seeds	579	60	0.02	28	0.01
35	15	Seeds	579	60	0.00	28	0.00
1000	3	Seeds	579	60	0.00	28	0.00
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) (2.0 lbs ae/A/app, 2 app., ground/aerial, 30 day interval)							
15	21	Seeds	579	33	0.01	15	0.01
35	15	Seeds	579	33	0.01	15	0.00
1000	3	Seeds	579	33	0.00	15	0.00
Pastures, Rangeland, Perennial Grassland (2 lbs ae/A/app, 2 app., ground/aerial; 30 day interval)							
15	21	Seeds	579	33	0.01	15	0.01
35	15	Seeds	579	33	0.01	15	0.00
100	3	Seeds	579	33	0.00	15	0.00
Forest Uses (4.0 lbs ae/A/app, 1 app., ground/aerial)							

Table F-18: Mammalian (Granivore) Acute Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC (mg/kg-diet)	Acute RQ [a]	EEC (mg/kg-diet)	Acute RQ [a]
15	21	Seeds	579	60	0.02	28	0.01
35	15	Seeds	579	60	0.02	28	0.01
1000	3	Seeds	579	60	0.00	28	0.00
Pome fruit/Stone fruit/Nuts (2.0 lbs ae/A/app, 2 app., ground/aerial; 75 day application interval)							
15	21	Seeds	579	30	0.01	14	0.01
35	15	Seeds	579	30	0.01	14	0.00
1000	3	Seeds	579	30	0.00	14	0.00
Strawberry (1.5 lbs ai/ac/app, 1 app., ground or aerial)							
15	21	Seeds	579	22.5	0.01	11	0.00
35	15	Seeds	579	22.5	0.01	11	0.00
1000	3	Seeds	579	22.5	0.00	11	0.00
Blueberry (1.4 lbs ae/A/app, 2 app., ground; 30 day interval)							
15	21	Seeds	579	23	0.01	11	0.00
35	15	Seeds	579	23	0.01	11	0.00
1000	3	Seeds	579	23	0.00	11	0.00
Cranberry (4.0 lbs ae/A/app, 1 app., ground)							
15	21	Seeds	579	60	0.02	28	0.01
35	15	Seeds	579	60	0.02	28	0.01

Table F-18: Mammalian (Granivore) Acute Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC (mg/kg-diet)	Acute RQ [a]	EEC (mg/kg-diet)	Acute RQ [a]
1000	3	Seeds	579	60	0.00	28	0.00
Grapes (1.36 lbs ae/A/app, 1 app., ground)							
15	21	Seeds	579	20.4	0.01	10	0.00
35	15	Seeds	579	20.4	0.01	10	0.00
1000	3	Seeds	579	20.4	0.00	10	0.00
Sorghum (1.0 lbs ae/A/app, 1 app., ground or aerial)							
15	21	Seeds	579	15	0.01	7	0.00
35	15	Seeds	579	15	0.00	7	0.00
1000	3	Seeds	579	15	0.00	7	0.00
Wheat, Oats, Barley, Rye, Millet, Triticale (1.25 lbs ae/A/app, 2 app., ground or aerial)							
15	21	Seeds	579	20.5	0.01	10	0.00
35	15	Seeds	579	20.5	0.01	10	0.00
1000	3	Seeds	579	20.5	0.00	10	0.00
Corn (1.5 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)							
15	21	Seeds	579	35	0.01	16	0.01
35	15	Seeds	579	35	0.01	16	0.00
1000	3	Seeds	579	35	0.00	16	0.00
Soybean (1.0 lbs ae/A/app, 1 app., ground or aerial)							

Table F-18: Mammalian (Granivore) Acute Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Acute Toxicity Threshold, LD_{50} (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC (mg/kg-diet)	Acute RQ [a]	EEC (mg/kg-diet)	Acute RQ [a]
15	21	Seeds	579	15	0.01	7	0.00
35	15	Seeds	579	15	0.00	7	0.00
1000	3	Seeds	579	15	0.00	7	0.00
Asparagus (4.0 lbs ae/A/app, 2 app., ground or aerial, 30 day interval)							
15	21	Seeds	579	66	0.02	31	0.01
35	15	Seeds	579	66	0.02	31	0.01
1000	3	Seeds	579	66	0.00	31	0.00
Potato (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)							
15	21	Seeds	579	1.7	0.00	1	0.00
35	15	Seeds	579	1.7	0.00	1	0.00
1000	3	Seeds	579	1.7	0.00	1	0.00
Sugarcane (2.0 lbs ae/A/app, 2 app., ground or aerial)							
15	21	Seeds	579	33	0.01	15	0.01
35	15	Seeds	579	33	0.01	15	0.00
1000	3	Seeds	579	33	0.00	15	0.00
Citrus (0.1 lbs ae/A/app, 1 app., ground or aerial)							
15	21	Seeds	579	1.5	0.00	1	0.00
35	15	Seeds	579	1.5	0.00	1	0.00

Table F-18: Mammalian (Granivore) Acute Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	**% Body Weight Consumed**	**Scenario**	**Acute Toxicity Threshold, LD_{50} (mg/kg-bw)**	**Predicted Maximum Residue Levels**		**Predicted Mean Residue Levels**	
				EEC (mg/kg-diet)	**Acute RQ [a]**	**EEC (mg/kg-diet)**	**Acute RQ [a]**
1000	3	Seeds	579	1.5	0.00	1	0.00
Rice (1.5 lbs ae/A/app, 1 app., ground or aerial)							
15	21	Seeds	579	22.5	0.01	11	0.00
35	15	Seeds	579	22.5	0.01	11	0.00
1000	3	Seeds	579	22.5	0.00	11	0.00

[a] $RQ = \frac{EEC}{LD_{50} / \%\ \text{Body wt. consumed}}$

* indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
Fallow areas and Crop Stubble -(2 lbs ae/ac/app, 2 app., ground/aerial, 30 day interval)							
15	95	Short grass	5	525	99.75	185.94	35.33
		Broadleaf forage, small insects	5	295	56.05	98.33	18.68
		Large insects	5	32	6.08	14.93	2.84
35	66	Short grass	5	525	69.30	185.94	24.54
		Broadleaf forage, small insects	5	295	38.94	98.33	12.98
		Large insects	5	32	4.22	14.93	1.97
1000	15	Short grass	5	525	15.75	185.94	5.58
		Broadleaf forage, small insects	5	295	8.85	98.33	2.95
		Large insects	5	32	0.96	14.93	0.45
Non-cropland (fencerwos, hedgerows, roadsides, ditches, rights-ofway, utiolity power lines, railroads, airports, industrial sites, etc.) (4.0 lbs ae/A/app, 1 app., ground/aerial/ 30 day interval)							

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
15	95	Short grass	5	960	182.40	340.00	64.60
		Broadleaf forage, small insects	5	540	102.60	180.00	34.20
		Large insects	5	60	11.40	28.00	5.32
35	66	Short grass	5	960	126.72	340.00	44.88
		Broadleaf forage, small insects	5	540	71.28	180.00	23.76
		Large insects	5	60	7.92	28.00	3.70
1000	15	Short grass	5	960	28.80	340.00	10.20
		Broadleaf forage, small insects	5	540	16.20	180.00	5.40
		Large insects	5	60	1.80	28.00	0.84
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) (2.0 lbs ae/A/app, 2 app., ground/aerial, 30 day interval)							
15	95	Short grass	5	525	99.75	185.94	35.33

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	295	56.05	98.33	18.68
		Large insects	5	32	6.08	14.93	2.84
		Short grass	5	525	69.30	185.94	24.54
35	66	Broadleaf forage, small insects	5	295	38.94	98.33	12.98
		Large insects	5	32	4.22	14.93	1.97
		Short grass	5	525	15.75	185.94	5.58
1000	15	Broadleaf forage, small insects	5	295	8.85	98.33	2.95
		Large insects	5	32	0.96	14.93	0.45
Pastures, Rangeland, Perennial Grassland (2 lbs ae/A/app, 2 app., ground/aerial; 30 day interval)							
15	95	Short grass	5	525	99.75	185.94	35.33

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	295	56.05	98.33	18.68
		Large insects	5	32	6.08	14.93	2.84
		Short grass	5	525	69.30	185.94	24.54
35	66	Broadleaf forage, small insects	5	295	38.94	98.33	12.98
		Large insects	5	32	4.22	14.93	1.97
		Short grass	5	525	15.75	185.94	5.58
1000	15	Broadleaf forage, small insects	5	295	8.85	98.33	2.95
		Large insects	5	32	0.96	14.93	0.45
Forest Uses (4.0 lbs ae/A/app., ground/aerial)							
15	95	Short grass	5	960	182.40	340.00	64.60

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	540	102.60	180.00	34.20
		Large insects	5	60	11.40	28.00	5.32
		Short grass	5	960	126.72	340.00	44.88
35	66	Broadleaf forage, small insects	5	540	71.28	180.00	23.76
		Large insects	5	60	7.92	28.00	3.70
		Short grass	5	960	28.80	340.00	10.20
1000	15	Broadleaf forage, small insects	5	540	16.20	180.00	5.40
		Large insects	5	60	1.80	28.00	0.84
Pome fruit/Stone fruit/Nuts (2.0 lbs ae/A/App., 2 app., ground/aerial; 75 day application interval)							
15	95	Short grass	5	481	91.39	170.35	32.37

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	270	51.30	90.00	17.10
		Large insects	5	30	5.70	14.00	2.66
		Short grass	5	481	63.49	170.35	22.49
35	66	Broadleaf forage, small insects	5	270	35.64	90.00	11.88
		Large insects	5	30	3.96	14.00	1.85
		Short grass	5	481	14.43	170.35	5.11
1000	15	Broadleaf forage, small insects	5	270	8.10	90.00	2.70
		Large insects	5	30	0.90	14.00	0.42
Strawberry (1.5 lbs ae A/App. 1 app.,, groundor aerial)							
15	95	Short grass	5	360	68.40	127.50	24.23

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	203	38.57	67.67	12.86
		Large insects	5	23	4.37	10.73	2.04
		Short grass	5	360	47.52	127.50	16.83
35	66	Broadleaf forage, small insects	5	203	26.80	67.67	8.93
		Large insects	5	23	3.04	10.73	1.42
		Short grass	5	360	10.80	127.50	3.83
1000	15	Broadleaf forage, small insects	5	203	6.09	67.67	2.03
		Large insects	5	23	0.69	10.73	0.32
Blueberry (1.4 lbs ae/A/app, 2 app., ground; 30 day interval)							
15	95	Short grass	5	368	69.92	130.33	24.76

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	207	39.33	69.00	13.11
		Large insects	5	23	4.37	10.73	2.04
		Short grass	5	368	48.58	130.33	17.20
35	66	Broadleaf forage, small insects	5	207	27.32	69.00	9.11
		Large insects	5	23	3.04	10.73	1.42
		Short grass	5	368	11.04	130.33	3.91
1000	15	Broadleaf forage, small insects	5	207	6.21	69.00	2.07
		Large insects	5	23	0.69	10.73	0.32
Grapes (1.36 lbs ae/A/app, 1 app., ground)							
15	95	Short grass	5	326	61.94	115.46	21.94

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	184	34.96	61.33	11.65
		Large insects	5	20	3.80	9.33	1.77
		Short grass	5	326	43.03	115.46	15.24
35	66	Broadleaf forage, small insects	5	184	24.29	61.33	8.10
		Large insects	5	20	2.64	9.33	1.23
		Short grass	5	326	9.78	115.46	3.46
1000	15	Broadleaf forage, small insects	5	184	5.52	61.33	1.84
		Large insects	5	20	0.60	9.33	0.28
Sorghum (1.0 lbs ae/A/app., ground or aerial)							
15	95	Short grass	5	240	45.60	85.00	16.15

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	**% Body Weight Consumed**	**Scenario**	**Chronic Toxicity Threshold, NOEC (mg/kg-bw)**	**Predicted Maximum Residue Levels**		**Predicted Mean Residue Levels**	
				EEC [a] (mg/kg-diet)	**Chronic RQ [a]**	**EEC (mg/kg-diet)**	**Chronic RQ [a]**
		Broadleaf forage, small insects	5	135	25.65	45.00	8.55
		Large insects	5	15	2.85	7.00	1.33
		Short grass	5	240	31.68	85.00	11.22
35	66	Broadleaf forage, small insects	5	135	17.82	45.00	5.94
		Large insects	5	15	1.98	7.00	0.92
		Short grass	5	240	7.20	85.00	2.55
1000	15	Broadleaf forage, small insects	5	135	4.05	45.00	1.35
		Large insects	5	15	0.45	7.00	0.21
Wheat, Oats, Barley, Rye, Millet, Triticale (1.25 lbs ae/A/app, 2 app., ground or aerial)							
15	95	Short grass	5	328	62.32	116.17	22.07

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	185	35.15	61.67	11.72
		Large insects	5	21	3.99	9.80	1.86
		Short grass	5	328	43.30	116.17	15.33
35	66	Broadleaf forage, small insects	5	185	24.42	61.67	8.14
		Large insects	5	21	2.77	9.80	1.29
		Short grass	5	328	9.84	116.17	3.49
1000	15	Broadleaf forage, small insects	5	185	5.55	61.67	1.85
		Large insects	5	21	0.63	9.80	0.29
Corn (1.5 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)							
15	95	Short grass	5	394	74.86	139.54	26.51

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	222	42.18	74.00	14.06
		Large insects	5	25	4.75	11.67	2.22
		Short grass	5	394	52.01	139.54	18.42
35	66	Broadleaf forage, small insects	5	222	29.30	74.00	9.77
		Large insects	5	25	3.30	11.67	1.54
		Short grass	5	394	11.82	139.54	4.19
1000	15	Broadleaf forage, small insects	5	222	6.66	74.00	2.22
		Large insects	5	25	0.75	11.67	0.35
Soybean (1.0 lbs ae/A/app, 1 app., ground or aerial)							
15	95	Short grass	5	240	45.60	85.00	16.15

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	135	25.65	45.00	8.55
		Large insects	5	15	2.85	7.00	1.33
		Short grass	5	240	31.68	85.00	11.22
35	66	Broadleaf forage, small insects	5	135	17.82	45.00	5.94
		Large insects	5	15	1.98	7.00	0.92
		Short grass	5	240	7.20	85.00	2.55
1000	15	Broadleaf forage, small insects	5	135	4.05	45.00	1.35
		Large insects	5	15	0.45	7.00	0.21
Asparagus (4.0 lbs ae/A/app, 2 app., ground or aerial, 30 day interval)							
15	95	Short grass	5	1050	199.50	371.88	70.66

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	591	112.29	197.00	37.43
		Large insects	5	66	12.54	30.80	5.85
		Short grass	5	1050	138.60	371.88	49.09
35	66	Broadleaf forage, small insects	5	591	78.01	197.00	26.00
		Large insects	5	66	8.71	30.80	4.07
		Short grass	5	1050	31.50	371.88	11.16
1000	15	Broadleaf forage, small insects	5	591	17.73	197.00	5.91
		Large insects	5	66	1.98	30.80	0.92
Potato (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)							
15	95	Short grass	5	26	4.94	9.21	1.75

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	14.8	2.81	4.93	0.94
		Large insects	5	1.7	0.32	0.79	0.15
		Short grass	5	26	3.43	9.21	1.22
35	66	Broadleaf forage, small insects	5	14.8	1.95	4.93	0.65
		Large insects	5	1.7	0.22	0.79	0.10
		Short grass	5	26	0.78	9.21	0.28
1000	15	Broadleaf forage, small insects	5	14.8	0.44	4.93	0.15
		Large insects	5	1.7	0.05	0.79	0.02
Sugarcane (2.0 lbs ae/A/app, 2 app., ground or aerial)							
15	95	Short grass	5	525	99.75	185.94	35.33

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	295	56.05	98.33	18.68
		Large insects	5	32	6.08	14.93	2.84
		Short grass	5	525	69.30	185.94	24.54
35	66	Broadleaf forage, small insects	5	295	38.94	98.33	12.98
		Large insects	5	32	4.22	14.93	1.97
		Short grass	5	525	15.75	185.94	5.58
1000	15	Broadleaf forage, small insects	5	295	8.85	98.33	2.95
		Large insects	5	32	0.96	14.93	0.45
Citrus (0.1 lbs ae/A/app, 1 app., ground or aerial)							
15	95	Short grass	5	24	4.56	8.50	1.62

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC [a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
		Broadleaf forage, small insects	5	14	2.66	4.67	0.89
		Large insects	5	2	0.38	0.93	0.18
		Short grass	5	24	3.17	8.50	1.12
35	66	Broadleaf forage, small insects	5	14	1.85	4.67	0.62
		Large insects	5	2	0.26	0.93	0.12
		Short grass	5	24	0.72	8.50	0.26
1000	15	Broadleaf forage, small insects	5	14	0.42	4.67	0.14
		Large insects	5	2	0.06	0.93	0.03
Rice (1.5 lbs ae/A/app, 1 app., ground or aerial)							
15	95	Short grass	5	360	68.40	127.50	24.23

Table F -19 : Mammalian (Herbivore/Insectivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	**% Body Weight Consumed**	**Scenario**	**Chronic Toxicity Threshold, NOEC (mg/kg-bw)**	**Predicted Maximum Residue Levels**		**Predicted Mean Residue Levels**	
				EEC [a] (mg/kg-diet)	**Chronic RQ [a]**	**EEC (mg/kg-diet)**	**Chronic RQ [a]**
35	66	Broadleaf forage, small insects	5	203	38.57	67.67	12.86
		Large insects	5	23	4.37	10.73	2.04
		Short grass	5	360	47.52	127.50	16.83
		Broadleaf forage, small insects	5	203	26.80	67.67	8.93
		Large insects	5	23	3.04	10.73	1.42
		Short grass	5	360	10.80	127.50	3.83
1000	15	Broadleaf forage, small insects	5	203	6.09	67.67	2.03
		Large insects	5	23	0.69	10.73	0.32

Table F -20 : Mammalian (Granivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC[a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
Fallow areas and Crop Stubble -(2 lbs ae/ac/app, 2 app., ground/aerial, 30 day interval)							
15	21	Seeds	5	32	1.34	14.93	0.63
35	15	Seeds	5	32	0.96	14.93	0.45
1000	3	Seeds	5	32	0.19	14.93	0.09
Non-cropland (fencerwos, hedgerows, roadsides, ditches, rights-ofway, utiolity power lines, railroads, airports, industrial sites, etc.) (4.0 lbs ae/A/app, 1 app., ground/aerial/ 30 day interval)							
15	21	Seeds	5	60	2.52	28.00	1.18
35	15	Seeds	5	60	1.80	28.00	0.84
1000	3	Seeds	5	60	0.36	28.00	0.17
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) (2.0 lbs ae/A/app, 2 app., ground/aerial, 30 day interval)							
15	21	Seeds	5	32	1.34	14.93	0.63
35	15	Seeds	5	32	0.96	14.93	0.45
1000	3	Seeds	5	32	0.19	14.93	0.09
Pastures, Rangeland, Perennial Grassland (2 lbs ae/A/app, 2 app., ground/aerial; 30 day interval)							
15	21	Seeds	5	32	1.34	14.93	0.63
35	15	Seeds	5	32	0.96	14.93	0.45
1000	3	Seeds	5	32	0.19	14.93	0.09

Table F -20 : Mammalian (Granivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC[a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
Forest Uses (4.0 lbs ae/A/app., ground/aerial)							
15	21	Seeds	5	60	2.52	28.00	1.18
35	15	Seeds	5	60	1.80	28.00	0.84
1000	3	Seeds	5	60	0.36	28.00	0.17
Pome fruit/Stone fruit/Nuts (2.0 lbs ae/A/App., 2 app., ground/aerial; 75 day application interval)							
15	21	Seeds	5	30	1.26	14.00	0.59
35	15	Seeds	5	30	0.90	14.00	0.42
1000	3	Seeds	5	30	0.18	14.00	0.08
Strawberry (1.5 lbs ae A/App. 1 app.,, ground or aerial)							
15	21	Seeds	5	23	0.97	10.73	0.45
35	15	Seeds	5	23	0.69	10.73	0.32
1000	3	Seeds	5	23	0.14	10.73	0.06
Blueberry (1.4 lbs ae/A/app, 2 app., ground; 30 day interval)							
15	21	Seeds	5	23	0.97	10.73	0.45
35	15	Seeds	5	23	0.69	10.73	0.32
1000	3	Seeds	5	23	0.14	10.73	0.06
Grapes (1.36 lbs ae/A/app, 1 app., ground)							

Table F -20 : Mammalian (Granivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC[a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
15	21	Seeds	5	20	0.84	9.33	0.39
35	15	Seeds	5	20	0.60	9.33	0.28
1000	3	Seeds	5	20	0.12	9.33	0.06
Sorghum (1.0 lbs ae/A/app., ground or aerial)							
15	21	Seeds	5	15	0.63	7.00	0.29
35	15	Seeds	5	15	0.45	7.00	0.21
1000	3	Seeds	5	15	0.09	7.00	0.04
Wheat, Oats, Barley, Rye, Millet, Triticale (1.25 lbs ae/A/app, 2 app., ground or aerial)							
15	21	Seeds	5	25	1.05	11.67	0.49
35	15	Seeds	5	25	0.75	11.67	0.35
1000	3	Seeds	5	25	0.15	11.67	0.07
Corn (1.5 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)							
15	21	Seeds	5	35.5	1.49	16.57	0.70
35	15	Seeds	5	35.5	1.07	16.57	0.50
1000	3	Seeds	5	35.5	0.21	16.57	0.10
Soybean (1.0 lbs ae/A/app, 1 app., ground or aerial)							
15	21	Seeds	5	15	0.63	7.00	0.29

Table F -20 : Mammalian (Granivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC[a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
35	15	Seeds	5	15	0.45	7.00	0.21
1000	3	Seeds	5	15	0.09	7.00	0.04
Asparagus (4.0 lbs ae/A/app, 2 app., ground or aerial, 30 day interval)							
15	21	Seeds	5	66	2.77	30.80	1.29
35	15	Seeds	5	66	1.98	30.80	0.92
1000	3	Seeds	5	66	0.40	30.80	0.18
Potato (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)							
15	21	Seeds	5	1.7	0.07	0.79	0.03
35	15	Seeds	5	1.7	0.05	0.79	0.02
1000	3	Seeds	5	1.7	0.01	0.79	0.00
Sugarcane (2.0 lbs ae/A/app, 2 app., ground or aerial)							
15	21	Seeds	5	33	1.39	15.40	0.65
35	15	Seeds	5	33	0.99	15.40	0.46
1000	3	Seeds	5	33	0.20	15.40	0.09
Citrus (0.1 lbs ae/A/app, 1 app., ground or aerial)							
15	21	Seeds	5	1.5	0.06	0.70	0.03
35	15	Seeds	5	1.5	0.05	0.70	0.02

Table F -20 : Mammalian (Granivore) Chronic Risk Quotient Calculations for Spray Applications							
Animal Body Weight (g)	% Body Weight Consumed	Scenario	Chronic Toxicity Threshold, NOEC (mg/kg-bw)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
				EEC[a] (mg/kg-diet)	Chronic RQ [a]	EEC (mg/kg-diet)	Chronic RQ [a]
1000	3	Seeds	5	1.5	0.01	0.70	0.00
Rice (1.5 lbs ae/A/app, 1 app., ground or aerial)							
15	21	Seed	5	23	0.97	10.73	0.45
35	15	Seed	5	23	0.69	10.73	0.32
1000	3	Seed	5	23	0.14	10.73	0.06

[a] Based on FATE 5 program using 8.8 day foliar dissipation half-life.

[b] $RQ = \frac{EEC \times \%\ body\ weight\ consumed}{NOEL}$

* indicates an exceedence of Chronic Level of Concern (LOC).

Table F-21: Mammalian Acute Risk Quotient Calculations for Banded Spray Applications											
Animal Body Weight (g)	Band width (ft.)	Untreated Row Space (ft)	Adjusted Appl. Rate[a]	Unadjusted Appl. Rate (from label)	Mg ae per ft^2 [b]		Acute Toxicity Threshold, LD_{50} (mg/kg)	Acute RQ (LD_{50} per ft^2)[c]			
					Adjusted	Unadjusted		Adjusted		Unadjusted	
Forest Uses (4.0 lbs ae/A/app, 1 app., ground/aerial)											
15	0.5	2	0.8	4.0	33.3216	166.6079	579	3.84	***	19.18	***
35	0.5	2	0.8	4.0	33.3216	166.6079	579	1.64	***	8.22	***
1000	0.5	2	0.8	4.0	33.3216	166.6079	579	0.06		0.29	**
Blueberry (1.4 lbs ae/A/app, 2 app., ground; 30 day interval											
15	0.5	2	0.28	1.4	11.6626	58.312764	579	1.34	***	6.71	***
35	0.5	2	0.28	1.4	11.6626	58.312764	579	0.58	***	2.88	***
1000	0.5	2	0.28	1.4	11.6626	58.312764	579	0.02		0.10	*
Sorghum (1.0 lbs ae/A/app, 1 app., ground or aerial)											
15	0.5	2	0.2	1.0	8.33039	41.651974	579	0.96	***	4.80	***
35	0.5	2	0.2	1.0	8.33039	41.651974	579	0.41	***	2.06	***
1000	0.5	2	0.2	1.0	8.33039	41.651974	579	0.01		0.07	
Corn (1.5 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)											
15	0.5	2	0.3	1.5	12.4956	62.477961	579	1.44	***	7.19	***
35	0.5	2	0.3	1.5	12.4956	62.477961	579	0.62	***	3.08	***
1000	0.5	2	0.3	1.5	12.4956	62.477961	579	0.02		0.11	*
Soybean (1.0 lbs ae/A/app, 1 app., ground or aerial)											
15	0.5	2	0.2	1.0	8.33039	41.651974	579	0.96	***	4.80	***

Table F-21: Mammalian Acute Risk Quotient Calculations for Banded Spray Applications											
Animal Body Weight (g)	Band width (ft.)	Untreated Row Space (ft)	Adjusted Appl. Rate[a]	Unadjusted Appl. Rate (from label)	Mg ae per ft^2 [b]		Acute Toxicity Threshold, LD_{50} (mg/kg)	Acute RQ (LD_{50} per ft^2)[c]			
					Adjusted	Unadjusted		Adjusted		Unadjusted	
35	0.5	2	0.2	1.0	8.33039	41.651974	579	0.41	***	2.06	***
1000	0.5	2	0.2	1.0	8.33039	41.651974	579	0.01		0.07	
Asparagus (4.0 lbs ae/A/app, 2 app., ground or aerial, 30 day interval)											
15	0.5	2	0.8	4.0	33.3216	166.6079	579	3.84	***	19.18	***
35	0.5	2	0.8	4.0	33.3216	166.6079	579	1.64	***	8.22	***
1000	0.5	2	0.8	4.0	33.3216	166.6079	579	0.06		0.29	**
Potato (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)											
15	0.5	2	0.014	0.07	0.58313	2.9156382	579	0.11*		0.34	***
180	0.5	2	0.014	0.07	0.58313	2.9156382	579	0.01		0.03	
1000	0.5	2	0.014	0.07	0.58313	2.9156382	579	0.00		0.01	

[a] *Rate per banded acre* = $\frac{\text{band width in inches}}{\text{row width in inches}}$ x *Broadcast rate per acre*

[b] *mg ae per ft^2* = $\frac{\text{App. Rate lbs ae}}{\text{Acre}}$ x $\frac{\text{453,590 mg}}{\text{Lbs}}$ x $\frac{\text{Acre}}{\text{43,560 ft}^2}$ x *% unincorporated* x $\frac{\text{untreated row space (ft)}}{\text{Bandwidth (ft)}}$

[c] RQ = $\frac{\text{Mg ae}}{\text{ft}^2}$ x $\frac{1}{\text{Weight of Animal (g)}}$ x $\frac{\text{1000 g}}{\text{kg}}$ x $\frac{\text{kg}}{\text{LD50 mg}}$

* indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

Granular Exposure

Table F-22: Mammalian Acute Risk Quotient Calculations for Granular Broadcast Applications		
Animal Body Weight (g)	**Acute Toxicity Threshold, LD_{50} (mg/kg)**	**Acute RQ (LD_{50} per ft^2) [a]**
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) (4.0 lbs ae/A/app, 1 app., ground/aerial,)		
15	579	4.8 ***
35	579	2.1 ***
1000	579	0.1 *
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) (2.0 lbs ae/A/app, 2 app., ground/aerial, 30 day interval)		
15	579	2.4 ***
35	579	1.0 ***
1000	579	0.04
(Aquatic areas - Ditchbank applications (2.0 lb ae/acre/app., 2 app., ground)		
15	579	2.4 ***
35	579	1.0 ***
1000	579	0.04
(Aquatic areas - Surface applications (ponds, lakes reservoirs, marches, bayous, drainage ditches, canals, slow moving rivers and streams, bank of irrigation ditches) (4.0 lb ae/acre/app. 3 weeks between applications)		
15	579	4.795 ***
35	579	2.05 ***
1000	579	0.072

Table F-22: Mammalian Acute Risk Quotient Calculations for Granular Broadcast Applications		
Animal Body Weight (g)	**Acute Toxicity Threshold, LD_{50} (mg/kg)**	**Acute RQ (LD_{50} per ft^2) [a]**
(Aquatic areas - Surface application or subsurface injection (ponds, lakes reservoirs, marches, bayous, drainage ditches, canals, slow moving rivers and streams, bank of irrigation ditches) (10.8 lb ae/acre foot to an average pond depth of 5 feet)		
15	579	12.9 ***
35	579	5.5 ***
1000	579	0.2 **
Cranberry (4.0 lbs ae/A/app, 1 app., ground)		
15	579	4.795 ***
35	579	2.05 ***
1000	579	0.072

[a] $RQ = \frac{\text{App. Rate (lbs ae)}}{\text{Acre}} \times \frac{453{,}590 \text{ mg}}{\text{Lb}} \times \frac{\text{Acre}}{43{,}560 \text{ ft}^2} \times \frac{1}{\text{Animal weight (g)}} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{\text{Kg}}{\text{LD50 mg}}$

* indicates an exceedence of Endangered Species Level of Concern (LOC).
** indicates an exceedence of Acute Restricted Use LOC.
*** indicates an exceedence of Acute Risk LOC.

In addition to broadcast applications of granular formulations, a number of labels instruct the applicators to apply unincorporated banded treatments of granular products to crops. As explained for banded spray treatments above for birds, many labels adjust application rates according to band width and row spaces, but many others do not. However. the master label only supports the use sites for granular applications listed above under table for granular broadcast applications, and none of these use sites typically employ banded applications. If banded granular applications were used at the same sites as banded spray applications, the risk would be similar.

Exposure and Risk to Nontarget Terrestrial Plants

i. Dry and Semi-aquatic Areas

Nongranular Exposures

Table F-23: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for a Single Application of the 2,4-D Acid, salt, or Amine.

Site/ Application Method/ Rate of Application in lbs ae/A	Minimum Incorporation Depth (cm)	Runoff Value	Sheet Run-off (lbs ae/A)	Channelized Runoff (lbs ae/A)	Drift (lbs ae/A)	Total Loading to Adjacent Area (Sheet Run-off+Drift)	Total Loading to Semi-aquatic Area (Channel Run-off+ Drift)
Fallow areas and Crop Stubble - *ground Applications* (2 lbs ae/ac/app, 2 app., 30 day interval, unincorporated)							
2	0	0.05	0.10	1.00	0.02	0.12	1.02
Fallow areas and Crop Stubble - *aerial applications* (2 lbs ae/ac/app, 2 app., 30 day interval, unincorporated)							
2	0	0.05	0.06	0.60	0.10	0.16	0.70
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)							
4	0	0.05	0.2	2	0.04	0.24	2.04
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *Aerial Applications* (4.0 lbs ae/A/app, 1 app.,)							
4	0	0.05	0.12	1.2	0.2	0.32	1.4
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)							
2	0	0.05	0.1	1	0.02	0.12	1.02
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)							
2	0	0.05	0.06	0.6	0.1	0.16	0.7

Table F-23: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for a Single Application of the 2,4-D Acid, salt, or Amine.

Site/ Application Method/ Rate of Application in lbs ae/A	Minimum Incorporation Depth (cm)	Runoff Value	Sheet Run-off (lbs ae/A)	Channelized Runoff (lbs ae/A)	Drift (lbs ae/A)	Total Loading to Adjacent Area (Sheet Run-off+Drift)	Total Loading to Semi-aquatic Area (Channel Run-off+ Drift)
Pastures, Rangeland, Perennial Grassland - *Ground Applications* (2 lbs ae/A/app, 2 app., 30 day interval)							
2	0	0.05	0.1	1	0.02	0.12	1.02
Pastures, Rangeland, Perennial Grassland - *Aerial Applications* (2 lbs ae/A/app, 2 app., 30 day interval)							
2	0	0.05	0.06	0.6	0.1	0.16	0.7
Forest Uses - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)							
4	0	0.05	0.2	2	0.04	0.24	2.04
Forest Uses - *Aerial Applications* (4.0 lbs ae/A/app, 1 app.,)							
4	0	0.05	0.12	1.2	0.2	0.32	1.4
Pome fruit/Stone fruit/Nuts - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)							
2	0	0.05	0.1	1	0.02	0.12	1.02
Pome fruit/Stone fruit/Nuts - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)							
2	0	0.05	0.06	0.6	0.1	0.16	0.7
Strawberry - *Ground Applications* (1.5 lbs ai/ac/app, 1 app.,)							
1.5	0	0.05	0.075	0.75	0.015	0.09	0.765
Strawberry - *Aerial Applications* (1.5 lbs ai/ac/app, 1 app.,)							
1.5	0	0.05	0.045	0.45	0.075	0.12	0.525
Blueberry - *Ground Applications* (1.4 lbs ae/A/app, 2 app., 30 day interval)							

Table F-23: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for a Single Application of the 2,4-D Acid, salt, or Amine.

Site/ Application Method/ Rate of Application in lbs ae/A	Minimum Incorporation Depth (cm)	Runoff Value	Sheet Run-off (lbs ae/A)	Channelized Runoff (lbs ae/A)	Drift (lbs ae/A)	Total Loading to Adjacent Area (Sheet Run-off+Drift)	Total Loading to Semi-aquatic Area (Channel Run-off+ Drift)
1.4	0	0.05	0.07	0.7	0.014	0.084	0.714
Cranberry - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)							
4	0	0.05	0.2	2	0.04	0.24	2.04
Grapes - *Ground Applications* (1.36 lbs ae/A/app, 1 app.,)							
1.36	0	0.05	0.068	0.68	0.0136	0.0816	0.6936
Sorghum - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)							
1	0	0.05	0.05	0.5	0.01	0.06	0.51
Sorghum - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)							
1	0	0.05	0.03	0.3	0.05	0.08	0.35
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)							
1.25	0	0.05	0.0625	0.625	0.0125	0.075	0.6375
Wheat, Oats, Barley, Rye, Millet, Triticale - *Aerial Applications* (1.25 lbs ae/A/app, 2 app.,)							
1.25	0	0.05	0.0375	0.375	0.0625	0.1	0.4375
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)							
1.5	0	0.05	0.075	0.75	0.015	0.09	0.765
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)							
1.5	0	0.05	0.045	0.45	0.075	0.12	0.525

Table F-23: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for a Single Application of the 2,4-D Acid, salt, or Amine.

Site/ Application Method/ Rate of Application in lbs ae/A	Minimum Incorporation Depth (cm)	Runoff Value	Sheet Run-off (lbs ae/A)	Channelized Runoff (lbs ae/A)	Drift (lbs ae/A)	Total Loading to Adjacent Area (Sheet Run-off+Drift)	Total Loading to Semi-aquatic Area (Channel Run-off+ Drift)
Soybean - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)							
1	0	0.05	0.05	0.5	0.01	0.06	0.51
Soybean - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)							
1	0	0.05	0.03	0.3	0.05	0.08	0.35
Asparagus - *Ground Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)							
4	0	0.05	0.2	2	0.04	0.24	2.04
Asparagus - *Aerial Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)							
4	0	0.05	0.12	1.2	0.2	0.32	1.4
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., 7 day interval)							
0.07	0	0.05	0.0035	0.035	0.0007	0.0042	0.0357
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., 7 day interval)							
0.07	0	0.05	0.0021	0.021	0.0035	0.0056	0.0245
Sugarcane - *Ground Applications* (2.0 lbs ae/A/app, 2 app.,)							
2	0	0.05	0.1	1	0.02	0.12	1.02
Sugarcane - *Aerial Applications* (2.0 lbs ae/A/app, 2 app.,)							
2	0	0.05	0.06	0.6	0.1	0.16	0.7
Citrus - *Ground Applications* (0.1 lbs ae/A/app, 1 app.,)							

Table F-23: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for a Single Application of the 2,4-D Acid, salt, or Amine.							
Site/ Application Method/ Rate of Application in lbs ae/A	**Minimum Incorporation Depth (cm)**	**Runoff Value**	**Sheet Run-off (lbs ae/A)**	**Channelized Runoff (lbs ae/A)**	**Drift (lbs ae/A)**	**Total Loading to Adjacent Area (Sheet Run-off+Drift)**	**Total Loading to Semi-aquatic Area (Channel Run-off+ Drift)**
1	0	0.05	0.05	0.5	0.01	0.06	0.51
Citrus - *Aerial Applications* (0.1 lbs ae/A/app, 1 app.,)							
1	0	0.05	0.03	0.3	0.05	0.08	0.35
Rice - *Ground Applications* (1.5 lbs ae/A/app, 1 app.,)							
1.5	0	0.05	0.075	0.75	0.015	0.09	0.765
Rice - *Aerial Applications* (1.5 lbs ae/A/app, 1 app.,)							
1.5	0	0.05	0.045	0.45	0.075	0.12	0.525

The table below estimates environmental concentrations for the 2,4-D esters for dry and semi-aquatic areas.

Table F-24: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for a Single Application of the 2,4-D Esters.

Site/ Application Method/ Rate of Application in lbs ae/A	Minimum Incorporation Depth (cm)	Runoff Value	Sheet Run-off (lbs ae/A)	Channelized Runoff (lbs ae/A)	Drift (lbs ae/A)	Total Loading to Adjacent Area (Sheet Run-off+Drift)	Total Loading to Semi-aquatic Area (Channel Run-off+ Drift)
Fallow areas and Crop Stubble - *ground Applications* (2 lbs ae/ac/app, 2 app., 30 day interval, unincorporated)							
2	0	0.01	0.02	0.20	0.02	0.04	0.22
Fallow areas and Crop Stubble - *aerial applications* (2 lbs ae/ac/app, 2 app., 30 day interval, unincorporated)							
2	0	0.01	0.01	0.10	0.10	0.11	0.20
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)							
4	0	0.01	0.04	0.4	0.04	0.08	0.44
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *Aerial Applications* (4.0 lbs ae/A/app, 1 app.,)							
4	0	0.01	0.024	0.24	0.2	0.224	0.44
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)							
2	0	0.01	0.02	0.2	0.02	0.04	0.22
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)							
2	0	0.01	0.012	0.12	0.1	0.112	0.22
Pastures, Rangeland, Perennial Grassland - *Ground Applications* (2 lbs ae/A/app, 2 app., 30 day interval)							
2	0	0.01	0.02	0.2	0.02	0.04	0.22
Pastures, Rangeland, Perennial Grassland - *Aerial Applications* (2 lbs ae/A/app, 2 app., 30 day interval)							
2	0	0.01	0.012	0.12	0.1	0.112	0.22

Table F-24: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for a Single Application of the 2,4-D Esters.

Site/ Application Method/ Rate of Application in lbs ae/A	Minimum Incorporation Depth (cm)	Runoff Value	Sheet Run-off (lbs ae/A)	Channelized Runoff (lbs ae/A)	Drift (lbs ae/A)	Total Loading to Adjacent Area (Sheet Run-off+Drift)	Total Loading to Semi-aquatic Area (Channel Run-off+ Drift)
Forest Uses - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)							
4	0	0.01	0.04	0.4	0.04	0.08	0.44
Forest Uses - *Aerial Applications* (4.0 lbs ae/A/app, 1 app.,)							
4	0	0.01	0.024	0.24	0.2	0.224	0.44
Cranberry - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)							
4	0	0.01	0.04	0.4	0.04	0.08	0.44
Sorghum - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)							
1	0	0.01	0.01	0.1	0.01	0.02	0.11
Sorghum - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)							
1	0	0.01	0.006	0.06	0.05	0.056	0.11
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)							
1.25	0	0.01	0.0125	0.125	0.0125	0.025	0.1375
Wheat, Oats, Barley, Rye, Millet, Triticale - *Aerial Applications* (1.25 lbs ae/A/app, 2 app.,)							
1.25	0	0.01	0.0075	0.075	0.0625	0.07	0.1375
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)							
1.5	0	0.01	0.015	0.15	0.015	0.03	0.165

Table F-24: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for a Single Application of the 2,4-D Esters.

Site/ Application Method/ Rate of Application in lbs ae/A	Minimum Incorporation Depth (cm)	Runoff Value	Sheet Run-off (lbs ae/A)	Channelized Runoff (lbs ae/A)	Drift (lbs ae/A)	Total Loading to Adjacent Area (Sheet Run-off+Drift)	Total Loading to Semi-aquatic Area (Channel Run-off+ Drift)
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)							
1.5	0	0.01	0.009	0.09	0.075	0.084	0.165
Soybean - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)							
1	0	0.01	0.01	0.1	0.01	0.02	0.11
Soybean - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)							
1	0	0.01	0.006	0.06	0.05	0.056	0.11
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., 7 day interval)							
0.07	0	0.01	0.0007	0.007	0.0007	0.0014	0.0077
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., 7 day interval)							
0.07	0	0.01	0.00042	0.0042	0.0035	0.00392	0.0077
Citrus - *Ground Applications* (0.1 lbs ae/A/app, 1 app.,)							
1	0	0.01	0.01	0.1	0.01	0.02	0.11
Citrus - *Aerial Applications* (0.1 lbs ae/A/app, 1 app.,)							
1	0	0.01	0.006	0.06	0.05	0.056	0.11

Non-endangered Plant Risk Quotients - Single Spray Applications (2,4-D Acid and amine salts)

The EC_{25} value of the most sensitive species in the seedling emergence study is compared to runoff and drift exposure to determine the RQ (EEC/toxicity value). The EC_{25} value of the most sensitive species in the vegetative vigor study is compared to the drift exposure to determine the acute RQ. RQs are calculated for the most sensitive monocot and dicot species.

Table F-25: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]		Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Fallow areas and Crop Stubble, Turf (Golf courses, residential lawns, grasses grown for seed, and sod), Pastures, Rangeland, Perennial grassland - *Ground Applications* (2 lbs ae/ac/app, 2 app., ground, 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.12	4.62	*	N/A	1.02	39.23	*
	Dicot	<0.045	N/A	0.12	> 2.67	*	N/A	1.02	> 22.67	*
Veg Vigor	Monocot	<0.0075	0.02	N/A	> 2.67	*	0.02	N/A	> 2.67	*
	Dicot	0.003	0.02	N/A	6.67	*	0.02	N/A	6.67	*
Fallow areas and Crop Stubble, Turf (Golf courses, residential lawns, grasses grown for seed, and sod), Pastures, Rangeland, Perennial grassland - *Aerial Applications* (2 lbs ae/ac/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.16	6.15	*	N/A	0.70	26.92	*
	Dicot	<0.045	N/A	0.16	> 3.56	*	N/A	0.70	> 15.56	*
Veg Vigor	Monocot	<0.0075	0.10	N/A	> 13.33	*	0.10	N/A	> 13.33	*
	Dicot	0.003	0.10	N/A	33.33	*	0.10	N/A	33.33	*

Table F-25: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**		**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.), Forest Uses, Cranberry - *ground Applications* (4.0 lbs ae/A/app, 1 app.,)										
Seed Emerg.	Monocot	0.026	N/A	0.24	9.23	*	N/A	2.04	78.46	*
	Dicot	<0.045	N/A	0.24	> 5.33	*	N/A	2.04	> 45.33	*
Veg Vigor	Monocot	<0.0075	0.04	N/A	> 5.33	*	0.04	N/A	> 5.33	*
	Dicot	0.003	0.04	N/A	13.33	*	0.04	N/A	13.33	*
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.), Forest Uses, Cranberry - *Aerial Applications* (4.0 lbs ae/A/app, 1 app.,)										
Seed Emerg.	Monocot	0.026	N/A	0.32	12.31	*	N/A	1.40	53.85	*
	Dicot	<0.045	N/A	0.32	> 7.11	*	N/A	1.40	> 31.11	*
Veg Vigor	Monocot	<0.0075	0.20	N/A	> 26.67	*	0.20	N/A	> 26.67	*
	Dicot	0.003	0.20	N/A	66.67	*	0.2	N/A	66.67	*
Pome fruit/Stone fruit/Nuts - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)										
Seed Emerg.	Monocot	0.026	N/A	0.12	4.62	*	N/A	1.02	39.23	*
	Dicot	<0.045	N/A	0.12	> 2.67	*	N/A	1.02	> 22.67	*
Veg Vigor	Monocot	<0.0075	0.02	N/A	> 2.67	*	0.02	N/A	> 2.67	*
	Dicot	0.003	0.02	N/A	6.67	*	0.02	N/A	6.67	*

Table F-25: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**	**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
Pome fruit/Stone fruit/Nuts - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)									
Seed Emerg.	Monocot	0.026	N/A	0.16	6.15	N/A	0.70	26.92	*
	Dicot	<0.045	N/A	0.16	> 3.56	N/A	0.70	> 15.56	*
Veg Vigor	Monocot	<0.0075	0.10	N/A	> 13.33	0.10	N/A	> 13.33	*
	Dicot	0.003	0.10	N/A	33.33	0.10	N/A	33.33	*
Strawberry - *Ground Applications* (1.5 lbs ai/ac/app, 1 app.,)									
Seed Emerg.	Monocot	0.026	N/A	0.09	3.46	N/A	0.765	29.42	*
	Dicot	<0.045	N/A	0.09	> 2.00	N/A	0.765	> 17.00	*
Veg Vigor	Monocot	<0.0075	0.015	N/A	> 2.00	0.015	N/A	> 2.00	*
	Dicot	0.003	0.015	N/A	5.00	0.015	N/A	5.00	*
Strawberry - *Aerial Applications* (1.5 lbs ai/ac/app, 1 app.,)									
Seed Emerg.	Monocot	0.026	N/A	0.12	4.62	N/A	0.525	20.19	*
	Dicot	<0.045	N/A	0.12	> 2.67	N/A	0.525	> 11.67	*
Veg Vigor	Monocot	<0.0075	0.075	N/A	> 10.00	0.075	N/A	> 10.00	*
	Dicot	0.003	0.075	N/A	25.00	0.075	N/A	25.00	*
Blueberry - *Ground Applications* (1.4 lbs ae/A/app, 2 app.,; 30 day interval)									

Table F-25: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Seed Emerg.	Monocot	0.026	N/A	0.084	3.23 *	N/A	0.714	27.46 *	
	Dicot	<0.045	N/A	0.084	> 1.87 *	N/A	0.714	> 15.87 *	
Veg Vigor	Monocot	<0.0075	0.014	N/A	> 1.87 *	0.014	N/A	> 1.87 *	
	Dicot	0.003	0.014	N/A	4.67 *	0.014	N/A	4.67 *	
- *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.026	N/A	0.24	9.23 *	N/A	2.04	78.46 *	
	Dicot	<0.045	N/A	0.24	> 5.33 *	N/A	2.04	> 45.33 *	
Veg Vigor	Monocot	<0.0075	0.04	N/A	> 5.33 *	0.04	N/A	> 5.33 *	
	Dicot	0.003	0.04	N/A	13.33 *	0.04	N/A	13.33 *	
Grapes- *Ground Applications* (1.36 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.026	N/A	0.0816	3.14 *	N/A	0.6936	26.68 *	
	Dicot	<0.045	N/A	0.0816	> 1.81 *	N/A	0.6936	> 15.41 *	
Veg Vigor	Monocot	<0.0075	0.0136	N/A	> 1.81 *	0.0136	N/A	> 1.81 *	
	Dicot	0.003	0.0136	N/A	4.53 *	0.0136	N/A	4.53 *	
Sorghum - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.026	N/A	0.06	2.31 *	N/A	0.51	19.62 *	

Table F-25: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Dicot	<0.045	N/A	0.06	> 1.33 *	N/A	0.51	> 11.33 *	
	Monocot	<0.0075	0.01	N/A	> 1.33 *	0.01	N/A	> 1.33 *	
	Dicot	0.003	0.01	N/A	3.33 *	0.01	N/A	3.33 *	
Sorghum - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.026	N/A	0.08	3.08 *	N/A	0.35	13.46 *	
	Dicot	<0.045	N/A	0.08	> 1.78 *	N/A	0.35	> 7.78 *	
Veg Vigor	Monocot	<0.0075	0.05	N/A	> 6.67 *	0.05	N/A	> 6.67 *	
	Dicot	0.003	0.05	N/A	16.67 *	0.05	N/A	16.67 *	
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)									
Seed Emerg.	Monocot	0.026	N/A	0.075	2.88 *	N/A	0.6375	24.52 *	
	Dicot	<0.045	N/A	0.075	> 1.67 *	N/A	0.6375	> 14.17 *	
Veg Vigor	Monocot	<0.0075	0.0125	N/A	> 1.67 *	0.0125	N/A	> 1.67 *	
	Dicot	0.003	0.0125	N/A	4.17 *	0.0125	N/A	4.17 *	
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)									
Seed Emerg.	Monocot	0.026	N/A	0.10	3.85 *	N/A	0.4375	16.83 *	
	Dicot	<0.045	N/A	0.10	> 2.22 *	N/A	0.4375	> 9.72 *	

Table F-25: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	<0.0075	0.0625	N/A	> 8.33 *	0.0625	N/A	> 8.33 *	
	Dicot	0.003	0.0625	N/A	20.83 *	0.0625	N/A	20.83 *	
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)									
Seed Emerg.	Monocot	0.026	N/A	0.09	3.46 *	N/A	0.765	29.42 *	
	Dicot	<0.045	N/A	0.09	> 2.00 *	N/A	0.765	> 17.00 *	
Veg Vigor	Monocot	<0.0075	0.015	N/A	> 2.00 *	0.015	N/A	> 2.00 *	
	Dicot	0.003	0.015	N/A	5.00 *	0.015	N/A	5.00 *	
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)									
Seed Emerg.	Monocot	0.026	N/A	0.12	4.62 *	N/A	0.525	20.19 *	
	Dicot	<0.045	N/A	0.12	> 2.67 *	N/A	0.525	> 11.67 *	
Veg Vigor	Monocot	<0.0075	0.075	N/A	> 10.00 *	0.075	N/A	> 10.00 *	
	Dicot	0.003	0.075	N/A	25.00 *	0.075	N/A	25.00 *	
Soybean - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.026	N/A	0.06	2.31 *	N/A	0.51	19.62 *	
	Dicot	<0.045	N/A	0.06	> 1.33 *	N/A	0.51	> 11.33 *	
Veg Vigor	Monocot	<0.0075	0.01	N/A	> 1.33 *	0.01	N/A	> 1.33 *	

Table F-25: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
	Dicot	0.003	0.01	N/A	3.33	*	0.01	N/A	3.33	*
Soybean - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)										
Seed Emerg.	Monocot	0.026	N/A	0.08	3.08	*	N/A	0.35	13.46	*
	Dicot	<0.045	N/A	0.08	> 1.78	*	N/A	0.35	> 7.78	*
Veg Vigor	Monocot	<0.0075	0.05	N/A	> 6.67	*	0.05	N/A	> 6.67	*
	Dicot	0.003	0.05	N/A	16.67	*	0.05	N/A	16.67	*
Asparagus - *Ground Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.24	9.23	*	N/A	2.04	78.46	*
	Dicot	<0.045	N/A	0.24	> 5.33	*	N/A	2.04	> 45.33	*
Veg Vigor	Monocot	<0.0075	0.04	N/A	> 5.33	*	0.04	N/A	> 5.33	*
	Dicot	0.003	0.04	N/A	13.33	*	0.04	N/A	13.33	*
Asparagus - *Aerial Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.32	12.31	*	N/A	1.40	53.85	*
	Dicot	<0.045	N/A	0.32	> 7.11	*	N/A	1.40	> 31.11	*
Veg Vigor	Monocot	<0.0075	0.2	N/A	> 26.67	*	0.2	N/A	> 26.67	*
	Dicot	0.003	0.2	N/A	66.67	*	0.2	N/A	66.67	*

Table F-25: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**		**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.0042	0.16		N/A	0.0357	1.37	*
	Dicot	<0.045	N/A	0.0042	> 0.09		N/A	0.0357	> 0.79	
Veg Vigor	Monocot	<0.0075	0.007	N/A	> 0.93		0.007	N/A	> 0.93	
	Dicot	0.003	0.007	N/A	2.33	*	0.007	N/A	2.33	*
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.0056	0.22		N/A	0.0245	0.94	
	Dicot	<0.045	N/A	0.0056	> 0.12		N/A	0.0245	> 0.54	
Veg Vigor	Monocot	<0.0075	0.0035	N/A	> 0.47		0.0035	N/A	> 0.47	
	Dicot	0.003	0.0035	N/A	1.17	*	0.0035	N/A	1.17	*
Citrus - *Ground Applications* (0.1 lbs ae/A/app, 1 app., ground or aerial)										
Seed Emerg.	Monocot	0.026	N/A	0.006	0.23		N/A	0.051	1.96	*
	Dicot	<0.045	N/A	0.006	> 0.13		N/A	0.051	> 1.13	*
Veg Vigor	Monocot	<0.0075	0.001	N/A	> 0.13		0.001	N/A	> 0.13	
	Dicot	0.003	0.001	N/A	0.33		0.001	N/A	0.33	
Citrus - *Aerial Applications* (0.1 lbs ae/A/app, 1 app., ground or aerial)										

Table F-25: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Seed Emerg.	Monocot	0.026	N/A	0.008	0.31 *	N/A	0.035	1.35 *	
	Dicot	<0.045	N/A	0.008	> 0.18	N/A	0.035	> 0.78	
Veg Vigor	Monocot	<0.0075	0.005	N/A	> 0.67	0.005	N/A	> 0.67	
	Dicot	0.003	0.005	N/A	1.67 *	0.005	N/A	1.67 *	
Rice - *Ground Applications* (1.5 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.026	N/A	0.09	3.46 *	N/A	0.765	29.42 *	
	Dicot	<0.045	N/A	0.09	> 2.00 *	N/A	0.765	> 17.00 *	
Veg Vigor	Monocot	<0.0075	0.015	N/A	> 2.00 *	0.015	N/A	> 2.00 *	
	Dicot	0.003	0.015	N/A	5.00 *	00.15	N/A	50.00 *	
Rice - *Aerial Applications* (1.5 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.026	N/A	0.12	4.62 *	N/A	0.525	20.19 *	
	Dicot	<0.045	N/A	0.12	> 2.67 *	N/A	0.525	> 11.67 *	
Veg Vigor	Monocot	<0.0075	0.075	N/A	> 10.00 *	0.075	N/A	> 10.00 *	
	Dicot	0.003	0.075	N/A	25.00 *	0.075	N/A	25.00 *	

* indicates an exceedence of Acute Risk LOC.

Endangered Plant Risk Quotients - Single Spray Applications (2,4-D Acid and amine salts)

The endangered plant RQs are calculated by comparing the NOEC or EC_{05} value of the most sensitive species in the seedling emergence study to runoff and drift exposure (EEC/toxicity value). The NOEC or EC_{05} value of the most sensitive species in the vegetative vigor study is compared to the drift exposure to determine the acute RQ. RQs are calculated for the most sensitive monocot and dicot species.

Table F-26: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Fallow areas and Crop Stubble, Turf (Golf courses, residential lawns, grasses grown for seed, and sod), Pastures, Rangeland, Perennial Grassland, Sugarcane - *Ground Applications* (2 lbs ae/ac/app, 2 app., ground, 30 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.12	8.00	N/A	1.02	68.00	
	Dicot	<0.045	N/A	0.12	> 2.67	N/A	1.02	> 22.67	
Veg Vigor	Monocot	<0.0075	0.02	N/A	2.67	0.02	N/A	2.67	
	Dicot	0.002	0.02	N/A	10.00	0.02	N/A	10.00	
Fallow areas and Crop Stubble, Turf (Golf courses, residential lawns, grasses grown for seed, and sod), Pastures, Rangeland, Perennial Grassland, Sugarcane - *Aerial Applications* (2 lbs ae/ac/app, 2 app., 30 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.16	10.67	N/A	0.70	46.67	
	Dicot	<0.045	N/A	0.16	> 3.56	N/A	0.70	> 15.56	
Veg Vigor	Monocot	<0.0075	0.10	N/A	13.33	0.10	N/A	13.33	

Table F-26: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts								
		Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas		
Scenario	Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]		Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Dicot	0.002	0.10	N/A	50.00	(	0.10	N/A	50.00	(
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.), Forest Uses - *ground Applicaations* (4.0 lbs ae/A/app, 1 app.,)									
Seed Emerg. Monocot	0.015	N/A	0.24	16.00	(	N/A	2.04	136.00	(
Seed Emerg. Dicot	<0.045	N/A	0.24	> 5.33	(	N/A	2.04	> 45.33	(
Veg Vigor Monocot	<0.0075	0.04	N/A	5.33	(	0.04	N/A	5.33	(
Veg Vigor Dicot	0.002	0.04	N/A	20.00	(	0.04	N/A	20.00	(
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.), Forest Uses - *Aerial Applicaations* (4.0 lbs ae/A/app, 1 app.,)									
Seed Emerg. Monocot	0.015	N/A	0.32	21.33	(	N/A	1.4	93.33	(
Seed Emerg. Dicot	<0.045	N/A	0.32	> 7.11	(	N/A	1.4	> 31.11	(
Veg Vigor Monocot	<0.0075	0.20	N/A	26.67	(	0.20	N/A	26.67	(
Veg Vigor Dicot	0.002	0.20	N/A	100.00	(	0.2	N/A	100.00	(
Pome fruit/Stone fruit/Nuts - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)									
Seed Emerg. Monocot	0.015	N/A	0.12	8.00	(	N/A	1.02	68.00	(
Seed Emerg. Dicot	<0.045	N/A	0.12	> 2.67	(	N/A	1.02	> 22.67	(

Table F-26: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	<0.0075	0.02	N/A	2.67	0.02	N/A	2.67	
	Dicot	0.002	0.02	N/A	10.00	0.02	N/A	10.00	
Pome fruit/Stone fruit/Nuts - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)									
Seed Emerg.	Monocot	0.015	N/A	0.16	10.67	N/A	0.70	46.67	
	Dicot	<0.045	N/A	0.16	> 3.56	N/A	0.70	> 15.56	
Veg Vigor	Monocot	<0.0075	0.10	N/A	13.33	0.10	N/A	13.33	
	Dicot	0.002	0.10	N/A	50.00	0.10	N/A	50.00	
Strawberry, Rice - *Ground Applications* (1.5 lbs ai/ac/app, 1 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.09	6.00	N/A	0.765	51.00	
	Dicot	<0.045	N/A	0.09	> 2.00	N/A	0.765	> 17.00	
Veg Vigor	Monocot	<0.0075	0.015	N/A	2.00	0.015	N/A	2.00	
	Dicot	0.002	0.015	N/A	7.50	0.015	N/A	7.50	
Strawberry, Rice - *Aerial Applications* (1.5 lbs ai/ac/app, 1 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.12	8.00	N/A	0.525	35.00	
	Dicot	<0.045	N/A	0.12	> 2.67	N/A	0.525	> 11.67	

Table F-26: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	<0.0075	0.075	N/A	10.00	0.075	N/A	10.00	
	Dicot	0.002	0.075	N/A	37.50	0.075	N/A	37.50	
Blueberry - *Ground Applications* (1.4 lbs ae/A/app, 2 app.,; 30 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.084	5.60	N/A	0.714	47.60	
	Dicot	<0.045	N/A	0.084	> 1.87	N/A	0.714	> 15.87	
Veg Vigor	Monocot	<0.0075	0.014	N/A	1.87	0.014	N/A	1.87	
	Dicot	0.002	0.014	N/A	7.00	0.014	N/A	7.00	
Cranberry - *Ground Aoplications* (4.0 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.24	16.00	N/A	2.04	136.00	
	Dicot	<0.045	N/A	0.24	> 5.33	N/A	2.04	> 45.33	
Veg Vigor	Monocot	<0.0075	0.04	N/A	5.33	0.04	N/A	5.33	
	Dicot	0.002	0.04	N/A	20.00	0.04	N/A	20.00	
Grapes- *Ground Applications* (1.36 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.0816	5.44	N/A	0.6936	46.24	
	Dicot	<0.045	N/A	0.0816	> 1.81	N/A	0.6936	> 15.41	

Table F-26: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	<0.0075	0.0136	N/A	1.81	0.0136	N/A	1.81	
	Dicot	0.002	0.0136	N/A	6.80	0.0136	N/A	6.80	
Sorghum - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.06	4.00	N/A	0.51	34.00	
	Dicot	<0.045	N/A	0.06	> 1.33	N/A	0.51	> 11.33	
Veg Vigor	Monocot	<0.0075	0.01	N/A	1.33	0.01	N/A	1.33	
	Dicot	0.002	0.01	N/A	5.00	0.01	N/A	5.00	
Sorghum - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.08	5.33	N/A	0.35	23.33	
	Dicot	<0.045	N/A	0.08	> 1.78	N/A	0.35	> 7.78	
Veg Vigor	Monocot	<0.0075	0.05	N/A	6.67	0.05	N/A	6.67	
	Dicot	0.002	0.05	N/A	25.00	0.05	N/A	25.00	
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.075	5.00	N/A	0.6375	42.50	
	Dicot	<0.045	N/A	0.075	> 1.67	N/A	0.6375	> 14.17	

Table F-26: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	<0.0075	0.0125	N/A	1.67	0.0125	N/A	1.67	
	Dicot	0.002	0.0125	N/A	6.25	0.0125	N/A	6.25	
Wheat, Oats, Barley, Rye, Millet, Triticale - *Aerial Applications* (1.25 lbs ae/A/app, 2 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.10	6.67	N/A	0.4375	29.17	
	Dicot	<0.045	N/A	0.10	> 2.22	N/A	0.4375	> 9.72	
Veg Vigor	Monocot	<0.0075	0.0625	N/A	8.33	0.0625	N/A	8.33	
	Dicot	0.002	0.0625	N/A	31.25	0.0625	N/A	31.25	
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.09	6.00	N/A	0.765	51.00	
	Dicot	<0.045	N/A	0.09	> 2.00	N/A	0.765	> 17.00	
Veg Vigor	Monocot	<0.0075	0.015	N/A	2.00	0.015	N/A	2.00	
	Dicot	0.002	0.015	N/A	7.50	0.015	N/A	7.50	
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.12	8.00	N/A	0.525	35.00	
	Dicot	<0.045	N/A	0.12	> 2.67	N/A	0.525	> 11.67	

Table F-26: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	<0.0075	0.075	N/A	10.00	0.075	N/A	10.00	
	Dicot	0.002	0.075	N/A	37.50	0.075	N/A	37.50	
Soybean - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.06	4.00	N/A	0.51	34.00	
	Dicot	<0.045	N/A	0.06	> 1.33	N/A	0.51	> 11.33	
Veg Vigor	Monocot	<0.0075	0.01	N/A	1.33	0.01	N/A	1.33	
	Dicot	0.002	0.01	N/A	5.00	0.01	N/A	5.00	
Soybean - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.08	5.33	N/A	0.35	23.33	
	Dicot	<0.045	N/A	0.08	> 1.78	N/A	0.35	> 7.78	
Veg Vigor	Monocot	<0.0075	0.05	N/A	6.67	0.05	N/A	6.67	
	Dicot	0.002	0.05	N/A	25.00	0.05	N/A	25.00	
Asparagus - *Ground Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.24	16.00	N/A	2.04	136.00	
	Dicot	<0.045	N/A	0.24	> 5.33	N/A	2.04	> 45.33	

Table F-26: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	<0.0075	0.04	N/A	5.33	0.04	N/A	5.33	
	Dicot	0.002	0.04	N/A	20.00	0.04	N/A	20.00	
Asparagus - *Aerial Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.32	21.33	N/A	1.40	93.33	
	Dicot	<0.045	N/A	0.32	> 7.11	N/A	1.40	> 31.11	
Veg Vigor	Monocot	<0.0075	0.2	N/A	26.67	0.2	N/A	26.67	
	Dicot	0.002	0.2	N/A	100.00	0.2	N/A	100.00	
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.0042	0.28	N/A	0.0357	2.38	
	Dicot	<0.045	N/A	0.0042	> 0.09	N/A	0.0357	> 0.79	
Veg Vigor	Monocot	<0.0075	0.007	N/A	0.93	0.007	N/A	0.93	
	Dicot	0.002	0.007	N/A	3.50	0.007	N/A	3.50	
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.0056	0.37	N/A	0.0245	1.63	
	Dicot	<0.045	N/A	0.0056	> 0.12	N/A	0.0245	> 0.54	

Table F-26: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	<0.0075	0.0035	N/A	0.47	0.0035	N/A	0.47	
	Dicot	0.002	0.0035	N/A	1.75	0.0035	N/A	1.75	
Citrus - *Ground Applications* (0.1 lbs ae/A/app, 1 app., ground or aerial)									
Seed Emerg.	Monocot	0.015	N/A	0.006	0.40	N/A	0.051	3.40	
	Dicot	<0.045	N/A	0.006	> 0.13	N/A	0.051	> 1.13	
Veg Vigor	Monocot	<0.0075	0.001	N/A	0.13	0.001	N/A	0.13	
	Dicot	0.002	0.001	N/A	0.50	0.001	N/A	0.50	
Citrus - *Aerial Applications* (0.1 lbs ae/A/app, 1 app., ground or aerial)									
Seed Emerg.	Monocot	0.015	N/A	0.008	0.53	N/A	0.035	2.33	
	Dicot	<0.045	N/A	0.008	> 0.18	N/A	0.035	> 0.78	
Veg Vigor	Monocot	<0.0075	0.005	N/A	0.67	0.005	N/A	0.67	
	Dicot	0.002	0.005	N/A	2.50	0.005	N/A	2.50	
Rice - *Ground Applications* (1.5 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.09	6.00	N/A	0.765	51.00	
	Dicot	<0.045	N/A	0.09	> 2.00	N/A	0.765	> 17.00	

Table F-26: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	<0.0075	0.015	N/A	2.00	0.015	N/A	2.00	
	Dicot	0.002	0.015	N/A	7.50	00.15	N/A	75.00	
Rice - *Aerial Applications* (1.5 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.12	8.00	N/A	0.525	35.00	
	Dicot	<0.045	N/A	0.12	> 2.67	N/A	0.525	> 11.67	
Veg Vigor	Monocot	<0.0075	0.075	N/A	10.00	0.075	N/A	10.00	
	Dicot	0.002	0.075	N/A	37.50	0.075	N/A	37.50	

[a] Indicates acute risk to endangered plants

Non-endangered Plant Risk Quotients - Single Spray Applications (2,4-D Esters)

As mentioned above, the most sensitive species among the seedling emergence studies are compared to runoff and drift exposure to determine the RQ (EEC/toxicity value). The EC_{25} value of the most sensitive species in the vegetative vigor study is compared to the drift exposure to determine the acute RQ. RQs are calculated for the most sensitive monocot and dicot species.

Table F-27: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters

			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**	**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**
Fallow areas and Crop Stubble - *Ground Applications* (2 lbs ae/ac/app, 2 app., ground, 30 day interval)								
Seed Emerg.	Monocot	0.010	N/A	0.04	4.00	N/A	0.22	22.00
	Dicot	0.00081	N/A	0.04	49.38	N/A	0.22	271.60
Veg Vigor	Monocot	0.218	0.02	N/A	0.09	0.02	N/A	0.09
	Dicot	0.0013	0.02	N/A	15.38	0.02	N/A	15.38
Fallow areas and Crop Stubble - *Aerial Applications* (2 lbs ae/ac/app, 2 app., 30 day interval)								
Seed Emerg.	Monocot	0.010	N/A	0.1120	11.20	N/A	0.22	22.00
	Dicot	0.00081	N/A	0.1120	138.27	N/A	0.22	271.60
Veg Vigor	Monocot	0.218	0.10	N/A	0.46	0.10	N/A	0.46
	Dicot	0.0013	0.10	N/A	76.92	0.10	N/A	76.92
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *ground Applicaations* (4.0 lbs ae/A/app, 1 app.,)								

Table F-27: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
Seed Emerg.	Monocot	0.010	N/A	0.08	8.00	N/A	0.44	44.00
	Dicot	0.00081	N/A	0.08	98.77	N/A	0.44	543.21
Veg Vigor	Monocot	0.218	0.04	N/A	0.18	0.04	N/A	0.18
	Dicot	0.0013	0.04	N/A	30.77	0.04	N/A	30.77
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *Aerial Applicaations* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.010	N/A	0.08	8.00	N/A	0.44	44.00
	Dicot	0.00081	N/A	0.08	98.77	N/A	0.44	543.21
Veg Vigor	Monocot	0.218	0.20	N/A	0.92	0.20	N/A	0.92
	Dicot	0.0013	0.20	N/A	153.85	0.2	N/A	153.85
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)								
Seed Emerg.	Monocot	0.010	N/A	0.04	4.00	N/A	0.22	22.00
	Dicot	0.00081	N/A	0.04	49.38	N/A	0.22	271.60
Veg Vigor	Monocot	0.218	0.02	N/A	0.09	0.02	N/A	0.09
	Dicot	0.0013	0.02	N/A	15.38	0.02	N/A	15.38
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)								

Table F-27: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
Seed Emerg.	Monocot	0.010	N/A	0.1120	11.20	N/A	0.22	22.00
	Dicot	0.00081	N/A	0.112	138.27	N/A	0.22	271.60
Veg Vigor	Monocot	0.218	0.1	N/A	0.46	0.10	N/A	0.46
	Dicot	0.0013	0.1	N/A	76.92	0.10	N/A	76.92
Pastures, Rangeland, Perennial Grassland - *Ground Applications* (2 lbs ae/A/app, 2 app., 30 day interval)								
Seed Emerg.	Monocot	0.010	N/A	0.04	4.00	N/A	0.22	22.00
	Dicot	0.00081	N/A	0.04	49.38	N/A	0.22	271.60
Veg Vigor	Monocot	0.218	0.02	N/A	0.09	0.02	N/A	0.09
	Dicot	0.0013	0.02	N/A	15.38	0.02	N/A	15.38
Pastures, Rangeland, Perennial Grassland - *Aerial Applications* (2 lbs ae/A/app, 2 app., 30 day interval)								
Seed Emerg.	Monocot	0.010	N/A	0.112	11.20	N/A	0.22	22.00
	Dicot	0.00081	N/A	0.112	138.27	N/A	0.22	271.60
Veg Vigor	Monocot	0.218	0.10	N/A	0.46	0.10	N/A	0.46
	Dicot	0.0013	0.10	N/A	76.92	0.10	N/A	76.92
Forest Uses - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.010	N/A	0.08	8.00	N/A	0.44	44.00

Table F-27: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
Veg Vigor	Dicot	0.00081	N/A	0.08	98.77	N/A	0.44	543.21
	Monocot	0.218	0.04	N/A	0.18	0.04	N/A	0.18
	Dicot	0.0013	0.04	N/A	30.77	0.04	N/A	30.77
Forest Uses - *Aerial Applications* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.010	N/A	0.224	22.40	N/A	0.44	44.00
	Dicot	0.00081	N/A	0.224	276.54	N/A	0.44	543.21
Veg Vigor	Monocot	0.218	0.20	N/A	0.92	0.20	N/A	0.92
	Dicot	0.0013	0.20	N/A	153.85	0.20	N/A	153.85
Cranberry - *Ground Aoplications* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.010	N/A	0.08	8.00	N/A	0.44	44.00
	Dicot	0.00081	N/A	0.08	98.77	N/A	0.44	543.21
Veg Vigor	Monocot	0.218	0.04	N/A	0.18	0.04	N/A	0.18
	Dicot	0.0013	0.04	N/A	30.77	0.04	N/A	30.77
Sorghum - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.010	N/A	0.02	2.00	N/A	0.11	11.00
	Dicot	0.00081	N/A	0.02	24.69	N/A	0.11	135.80

Table F-27: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
Veg Vigor	Monocot	0.218	0.01	N/A	0.05	0.01	N/A	0.05
	Dicot	0.0013	0.01	N/A	7.69	0.01	N/A	7.69
Sorghum - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.010	N/A	0.056	5.60	N/A	0.11	11.00
	Dicot	0.00081	N/A	0.056	69.14	N/A	0.11	135.80
Veg Vigor	Monocot	0.218	0.05	N/A	0.23	0.05	N/A	0.23
	Dicot	0.0013	0.05	N/A	38.46	0.05	N/A	38.46
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)								
Seed Emerg.	Monocot	0.010	N/A	0.025	2.50	N/A	0.1375	13.75
	Dicot	0.00081	N/A	0.025	30.86	N/A	0.1375	169.75
Veg Vigor	Monocot	0.218	0.0125	N/A	0.06	0.0125	N/A	0.06
	Dicot	0.0013	0.0125	N/A	9.62	0.0125	N/A	9.62
Wheat, Oats, Barley, Rye, Millet, Triticale - *Aerial Applications* (1.25 lbs ae/A/app, 2 app.,)								
Seed Emerg.	Monocot	0.010	N/A	0.07	7.00	N/A	0.1375	13.75
	Dicot	0.00081	N/A	0.07	86.42	N/A	0.1375	169.75
Veg Vigor	Monocot	0.218	0.0625	N/A	0.29	0.0625	N/A	0.29

Table F-27: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
	Dicot	0.0013	0.0625	N/A	48.08	0.0625	N/A	48.08
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)								
Seed Emerg.	Monocot	0.010	N/A	0.03	3.00	N/A	0.165	16.50
	Dicot	0.00081	N/A	0.03	37.04	N/A	0.165	203.70
Veg Vigor	Monocot	0.218	0.015	N/A	0.07	0.015	N/A	0.07
	Dicot	0.0013	0.015	N/A	11.54	0.015	N/A	11.54
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)								
Seed Emerg.	Monocot	0.010	N/A	0.084	8.40	N/A	0.165	16.50
	Dicot	0.00081	N/A	0.084	103.70	N/A	0.165	203.70
Veg Vigor	Monocot	0.218	0.075	N/A	0.34	0.075	N/A	0.34
	Dicot	0.0013	0.075	N/A	57.69	0.075	N/A	57.69
Soybean - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.010	N/A	0.02	2.00	N/A	0.11	11.00
	Dicot	0.00081	N/A	0.02	24.69	N/A	0.11	135.80
Veg Vigor	Monocot	0.218	0.01	N/A	0.05	0.01	N/A	0.05
	Dicot	0.0013	0.01	N/A	7.69	0.01	N/A	7.69

Table F-27: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**	**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**
Soybean - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.010	N/A	0.056	5.60	N/A	0.11	11.00
	Dicot	0.00081	N/A	0.056	69.14	N/A	0.11	135.80
Veg Vigor	Monocot	0.218	0.05	N/A	0.23	0.05	N/A	0.23
	Dicot	0.0013	0.05	N/A	38.46	0.05	N/A	38.46
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)								
Seed Emerg.	Monocot	0.010	N/A	0.0014	0.14	N/A	0.0077	0.77
	Dicot	0.00081	N/A	0.0014	1.73	N/A	0.0077	9.51
Veg Vigor	Monocot	0.218	0.007	N/A	0.03	0.007	N/A	0.03
	Dicot	0.0013	0.007	N/A	5.38	0.007	N/A	5.38
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)								
Seed Emerg.	Monocot	0.010	N/A	0.0039	0.39	N/A	0.0077	0.77
	Dicot	0.00081	N/A	0.0039	4.81	N/A	0.0077	9.51
Veg Vigor	Monocot	0.218	0.0035	N/A	0.02	0.0035	N/A	0.02
	Dicot	0.0013	0.0035	N/A	2.69	0.0035	N/A	2.69
Citrus - *Ground Applications* (0.1 lbs ae/A/app, 1 app., ground or aerial)								

Table F-27: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
Seed Emerg.	Monocot	0.010	N/A	0.002	0.20	N/A	0.011	1.10
	Dicot	0.00081	N/A	0.002	2.47	N/A	0.011	13.58
Veg Vigor	Monocot	0.218	0.001	N/A	0.00	0.001	N/A	0.00
	Dicot	0.0013	0.001	N/A	0.77	0.001	N/A	0.77
Citrus - *Aerial Applications* (0.1 lbs ae/A/app, 1 app., ground or aerial)								
Seed Emerg.	Monocot	0.010	N/A	0.0056	0.56	N/A	0.011	1.10
	Dicot	0.00081	N/A	0.0056	6.91	N/A	0.011	13.58
Veg Vigor	Monocot	0.218	0.005	N/A	0.02	0.005	N/A	0.02
	Dicot	0.0013	0.005	N/A	3.85	0.005	N/A	3.85

[a] * indicates an exceedance of Acute Risk LOC.

Endangered Plant Risk Quotients - Single Spray Applications (2,4-D Esters)

Table F-28: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
Fallow areas and Crop Stubble - *Ground Applications* (2 lbs ae/ac/app, 2 app., ground, 30 day interval)								
Seed Emerg.	Monocot	0.0056	N/A	0.04	7.14	N/A	0.22	39.29
	Dicot	0.00047	N/A	0.04	85.11	N/A	0.22	468.09
Veg Vigor	Monocot	0.025	0.02	N/A	0.80	0.02	N/A	0.80
	Dicot	0.006132	0.02	N/A	3.26	0.02	N/A	3.26
Fallow areas and Crop Stubble - *Aerial Applications* (2 lbs ae/ac/app, 2 app., 30 day interval)								
Seed Emerg.	Monocot	0.0056	N/A	0.1120	20.00	N/A	0.22	39.29
	Dicot	0.00047	N/A	0.1120	238.30	N/A	0.22	468.09
Veg Vigor	Monocot	0.025	0.10	N/A	4.00	0.10	N/A	4.00
	Dicot	0.006132	0.10	N/A	16.31	0.10	N/A	16.31
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *Ground Applicaations* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.0056	N/A	0.08	14.29	N/A	0.44	78.57
	Dicot	0.00047	N/A	0.08	170.21	N/A	0.44	936.17
Veg Vigor	Monocot	0.025	0.04	N/A	1.60	0.04	N/A	1.60
	Dicot	0.006132	0.04	N/A	6.52	0.04	N/A	6.52

Table F-28: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *Aerial Applicaations* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.0056	N/A	0.08	14.29	N/A	0.44	78.57
	Dicot	0.00047	N/A	0.08	170.21	N/A	0.44	936.17
Veg Vigor	Monocot	0.025	0.20	N/A	8.00	0.20	N/A	8.00
	Dicot	0.006132	0.20	N/A	32.62	0.2	N/A	32.62
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)								
Seed Emerg.	Monocot	0.0056	N/A	0.04	7.14	N/A	0.22	39.29
	Dicot	0.00047	N/A	0.04	85.11	N/A	0.22	468.09
Veg Vigor	Monocot	0.025	0.02	N/A	0.80	0.02	N/A	0.80
	Dicot	0.006132	0.02	N/A	3.26	0.02	N/A	3.26
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)								
Seed Emerg.	Monocot	0.0056	N/A	0.1120	20.00	N/A	0.22	39.29
	Dicot	0.00047	N/A	0.112	238.30	N/A	0.22	468.09
Veg Vigor	Monocot	0.025	0.1	N/A	4.00	0.10	N/A	4.00
	Dicot	0.006132	0.1	N/A	16.31	0.10	N/A	16.31
Pastures, Rangeland, Perennial Grassland - *Ground Applications* (2 lbs ae/A/app, 2 app., 30 day interval)								

Table F-28: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
Seed Emerg.	Monocot	0.0056	N/A	0.04	7.14	N/A	0.22	39.29
	Dicot	0.00047	N/A	0.04	85.11	N/A	0.22	468.09
Veg Vigor	Monocot	0.025	0.02	N/A	0.80	0.02	N/A	0.80
	Dicot	0.006132	0.02	N/A	3.26	0.02	N/A	3.26
Pastures, Rangeland, Perennial Grassland - *Aerial Applications* (2 lbs ae/A/app, 2 app., 30 day interval)								
Seed Emerg.	Monocot	0.0056	N/A	0.112	20.00	N/A	0.22	39.29
	Dicot	0.00047	N/A	0.112	238.30	N/A	0.22	468.09
Veg Vigor	Monocot	0.025	0.10	N/A	4.00	0.10	N/A	4.00
	Dicot	0.006132	0.10	N/A	16.31	0.10	N/A	16.31
Forest Uses - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.0056	N/A	0.08	14.29	N/A	0.44	78.57
	Dicot	0.00047	N/A	0.08	170.21	N/A	0.44	936.17
Veg Vigor	Monocot	0.025	0.04	N/A	1.60	0.04	N/A	1.60
	Dicot	0.006132	0.04	N/A	6.52	0.04	N/A	6.52
Forest Uses - *Aerial Applications* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.0056	N/A	0.224	40.00	N/A	0.44	78.57
	Dicot	0.00047	N/A	0.224	476.60	N/A	0.44	936.17

Table F-28: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
Veg Vigor	Monocot	0.025	0.20	N/A	8.00	0.20	N/A	8.00
	Dicot	0.006132	0.20	N/A	32.62	0.20	N/A	32.62
Cranberry - *Ground Aoplications* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.0056	N/A	0.08	14.29	N/A	0.44	78.57
	Dicot	0.00047	N/A	0.08	170.21	N/A	0.44	936.17
Veg Vigor	Monocot	0.025	0.04	N/A	1.60	0.04	N/A	1.60
	Dicot	0.006132	0.04	N/A	6.52	0.04	N/A	6.52
Sorghum - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.0056	N/A	0.02	3.57	N/A	0.11	19.64
	Dicot	0.00047	N/A	0.02	42.55	N/A	0.11	234.04
Veg Vigor	Monocot	0.025	0.01	N/A	0.40	0.01	N/A	0.40
	Dicot	0.006132	0.01	N/A	1.63	0.01	N/A	1.63
Sorghum - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.0056	N/A	0.056	10.00	N/A	0.11	19.64
	Dicot	0.00047	N/A	0.056	119.15	N/A	0.11	234.04
Veg Vigor	Monocot	0.025	0.05	N/A	2.00	0.05	N/A	2.00
	Dicot	0.006132	0.05	N/A	8.15	0.05	N/A	8.15

Table F-28: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)								
Seed Emerg.	Monocot	0.0056	N/A	0.025	4.46	N/A	0.1375	24.55
	Dicot	0.00047	N/A	0.025	53.19	N/A	0.1375	292.55
Veg Vigor	Monocot	0.025	0.0125	N/A	0.50	0.0125	N/A	0.50
	Dicot	0.006132	0.0125	N/A	2.04	0.0125	N/A	2.04
Wheat, Oats, Barley, Rye, Millet, Triticale - *Aerial Applications* (1.25 lbs ae/A/app, 2 app.,)								
Seed Emerg.	Monocot	0.0056	N/A	0.07	12.50	N/A	0.1375	24.55
	Dicot	0.00047	N/A	0.07	148.94	N/A	0.1375	292.55
Veg Vigor	Monocot	0.025	0.0625	N/A	2.50	0.0625	N/A	2.50
	Dicot	0.006132	0.0625	N/A	10.19	0.0625	N/A	10.19
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)								
Seed Emerg.	Monocot	0.0056	N/A	0.03	5.36	N/A	0.165	29.46
	Dicot	0.00047	N/A	0.03	63.83	N/A	0.165	351.06
Veg Vigor	Monocot	0.025	0.015	N/A	0.60	0.015	N/A	0.60
	Dicot	0.006132	0.015	N/A	2.45	0.015	N/A	2.45
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)								
Seed Emerg.	Monocot	0.0056	N/A	0.084	15.00	N/A	0.165	29.46

Table F-28: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
	Dicot	0.00047	N/A	0.084	178.72	N/A	0.165	351.06
	Monocot	0.025	0.075	N/A	3.00	0.075	N/A	3.00
Veg Vigor	Dicot	0.006132	0.075	N/A	12.23	0.075	N/A	12.23
Soybean - *Ground Applications* (1.0 lbs ae/A/app, 1 app.,)								
	Monocot	0.0056	N/A	0.02	3.57	N/A	0.11	19.64
Seed Emerg.	Dicot	0.00047	N/A	0.02	42.55	N/A	0.11	234.04
	Monocot	0.025	0.01	N/A	0.40	0.01	N/A	0.40
Veg Vigor	Dicot	0.006132	0.01	N/A	1.63	0.01	N/A	1.63
Soybean - *Aerial Applications* (1.0 lbs ae/A/app, 1 app.,)								
	Monocot	0.0056	N/A	0.056	10.00	N/A	0.11	19.64
Seed Emerg.	Dicot	0.00047	N/A	0.056	119.15	N/A	0.11	234.04
	Monocot	0.025	0.05	N/A	2.00	0.05	N/A	2.00
Veg Vigor	Dicot	0.006132	0.05	N/A	8.15	0.05	N/A	8.15
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)								
	Monocot	0.0056	N/A	0.0014	0.25	N/A	0.0077	1.38
Seed Emerg.	Dicot	0.00047	N/A	0.0014	2.98	N/A	0.0077	16.38
Veg Vigor	Monocot	0.025	0.007	N/A	0.28	0.007	N/A	0.28

Table F-28: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Spray Applications of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]
	Dicot	0.006132	0.007	N/A	1.14	0.007	N/A	1.14
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)								
Seed Emerg.	Monocot	0.0056	N/A	0.0039	0.70	N/A	0.0077	1.38
	Dicot	0.00047	N/A	0.0039	8.30	N/A	0.0077	16.38
Veg Vigor	Monocot	0.025	0.0035	N/A	0.14	0.0035	N/A	0.14
	Dicot	0.006132	0.0035	N/A	0.57	0.0035	N/A	0.57
Citrus - *Ground Applications* (0.1 lbs ae/A/app, 1 app., ground or aerial)								
Seed Emerg.	Monocot	0.0056	N/A	0.002	0.36	N/A	0.011	1.96
	Dicot	0.00047	N/A	0.002	4.26	N/A	0.011	23.40
Veg Vigor	Monocot	0.025	0.001	N/A	0.04	0.001	N/A	0.04
	Dicot	0.006132	0.001	N/A	0.16	0.001	N/A	0.16
Citrus - *Aerial Applications* (0.1 lbs ae/A/app, 1 app., ground or aerial)								
Seed Emerg.	Monocot	0.0056	N/A	0.0056	1.00	N/A	0.011	1.96
	Dicot	0.00047	N/A	0.0056	11.91	N/A	0.011	23.40
Veg Vigor	Monocot	0.025	0.005	N/A	0.20	0.005	N/A	0.20
	Dicot	0.006132	0.005	N/A	0.82	0.005	N/A	0.82

[a] * indicates an exceedance of Acute Risk LOC.

Non-endangered Plant Risk Quotients - Multiple Spray Applications (2,4-D Acid and amine salts)

Many of the 2,4-D products on the 2,4-D Master Label allow a second application at prescribed intervals ranging from 7 to 30 days with the exception of pome fruit which allows a 75 day interval. For multiple spray applications the environmental concentrations would be based expected to double in concentration at the most conservative level. In this scenario the RQs would be expected to double. The estimated environmental concentrations for the acid and amine salts for dry and semi-aquatic areas with an assumed runoff of 5% are tabulated below.

Table F-29: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for Multiple Applications of the 2,4-D Acid, salt, or Amine.

Site/ Application Method/ Rate of Application in lbs ai/A From FATE Program	Minimum Incorporation Depth (cm)	Runoff Value	Sheet Run-off (lbs ae/A)	Channelized Runoff (lbs ae/A)	Drift (lbs ae/A)	Total Loading to Adjacent Area (Sheet Run-off+Drift)	Total Loading to Semi-aquatic Area (Channel Run-off + Drift)
Fallow areas and Crop Stubble - *ground Applications* (2 lbs ae/ac/app, 2 app., 30 day interval, unincorporated)							
4.0	0	0.05	0.20	2.00	0.04	0.24	2.04
Fallow areas and Crop Stubble - *aerial applications* (2 lbs ae/ac/app, 2 app., 30 day interval, unincorporated)							
4.0	0	0.05	0.12	1.20	0.20	0.32	1.40
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)							
4.0	0	0.05	0.2	2	0.04	0.24	2.04
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)							
4.0	0	0.05	0.12	1.2	0.2	0.32	1.4
Pastures, Rangeland, Perennial Grassland - *Ground Applications* (2 lbs ae/A/app, 2 app., 30 day interval)							
4.0	0	0.05	0.2	2	0.04	0.24	2.04
Pastures, Rangeland, Perennial Grassland - *Aerial Applications* (2 lbs ae/A/app, 2 app., 30 day interval)							

Table F-29: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for Multiple Applications of the 2,4-D Acid, salt, or Amine.

Site/ Application Method/ Rate of Application in lbs ai/A From FATE Program	Minimum Incorporation Depth (cm)	Runoff Value	Sheet Run-off (lbs ae/A)	Channelized Runoff (lbs ae/A)	Drift (lbs ae/A)	Total Loading to Adjacent Area (Sheet Run-off+Drift)	Total Loading to Semi-aquatic Area (Channel Run-off + Drift)
4.0	0	0.05	0.12	1.2	0.2	0.32	1.4
Pome fruit/Stone fruit/Nuts - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)							
4.0	0	0.05	0.2	2	0.04	0.24	2.04
Pome fruit/Stone fruit/Nuts - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)							
4.0	0	0.05	0.12	1.2	0.2	0.32	1.4
Blueberry - *Ground Applications* (1.4 lbs ae/A/app, 2 app., 30 day interval)							
2.8	0	0.05	0.14	1.4	0.028	0.168	1.428
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)							
2.50	0	0.05	0.125	1.25	0.025	0.15	1.275
Wheat, Oats, Barley, Rye, Millet, Triticale - *Aerial Applications* (1.25 lbs ae/A/app, 2 app.,)							
2.50	0	0.05	0.075	0.75	0.125	0.2	0.875
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)							
3.00	0	0.05	0.15	1.5	0.03	0.18	1.53
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)							
3.00	0	0.05	0.09	0.9	0.15	0.24	1.05
Asparagus - *Ground Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)							

Table F-29: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for Multiple Applications of the 2,4-D Acid, salt, or Amine.							
Site/ Application Method/ Rate of Application in lbs ai/A From FATE Program	**Minimum Incorporation Depth (cm)**	**Runoff Value**	**Sheet Run-off (lbs ae/A)**	**Channelized Runoff (lbs ae/A)**	**Drift (lbs ae/A)**	**Total Loading to Adjacent Area (Sheet Run-off+Drift)**	**Total Loading to Semi-aquatic Area (Channel Run-off + Drift)**
8.00	0	0.05	0.4	4	0.08	0.48	4.08
Asparagus - *Aerial Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)							
8.00	0	0.05	0.24	2.4	0.4	0.64	2.8
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., 7 day interval)							
0.14	0	0.05	0.007	0.07	0.0014	0.0084	0.0714
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., 7 day interval)							
0.14	0	0.05	0.0042	0.042	0.007	0.0112	0.049
Sugarcane - *Ground Applications* (2.0 lbs ae/A/app, 2 app.,)							
4.00	0	0.05	0.2	2	0.04	0.24	2.04
Sugarcane - *Aerial Applications* (2.0 lbs ae/A/app, 2 app.,)							
4.00	0	0.05	0.12	1.2	0.2	0.32	1.4

The EC_{25} value of the most sensitive species in the seedling emergence study is compared to runoff and drift exposure to determine the RQ (EEC/toxicity value). The EC_{25} value of the most sensitive species in the vegetative vigor study is compared to the drift exposure to determine the acute RQ. RQs are calculated for the most sensitive monocot and dicot species.

Table F-30: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**		**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
Fallow areas and Crop Stubble - *Ground Applications* (2 lbs ae/ac/app, 2 app., ground, 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.24	9.23	*	N/A	2.04	78.46	*
	Dicot	0.045	N/A	0.24	5.33	*	N/A	2.04	45.33	*
Veg Vigor	Monocot	<0.0075	0.04	N/A	> 5.33	*	0.2	N/A	> 26.67	*
	Dicot	0.003	0.04	N/A	13.33	*	0.2	N/A	66.67	*
Fallow areas and Crop Stubble - *Aerial Applications* (2 lbs ae/ac/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.32	12.31	*	N/A	1.4	53.85	*
	Dicot	0.045	N/A	0.32	7.11	*	N/A	1.4	31.11	*
Veg Vigor	Monocot	<0.0075	0.2	N/A	> 26.67	*	0.04	N/A	> 5.33	*
	Dicot	0.003	0.2	N/A	66.67	*	0.04	N/A	13.33	*
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.24	9.23	*	N/A	2.04	78.46	*
	Dicot	0.045	N/A	0.24	5.33	*	N/A	2.04	45.33	*
Veg Vigor	Monocot	<0.0075	0.04	N/A	> 5.33	*	0.2	N/A	> 26.67	*
	Dicot	0.003	0.04	N/A	13.33	*	0.2	N/A	66.67	*
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)										

Table F-30: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**		**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
Seed Emerg.	Monocot	0.026	N/A	0.32	12.31	*	N/A	1.4	53.85	*
	Dicot	0.045	N/A	0.32	7.11	*	N/A	1.4	31.11	*
Veg Vigor	Monocot	<0.0075	0.2	N/A	> 26.67	*	0.2	N/A	> 26.67	*
	Dicot	0.003	0.2	N/A	66.67	*	0.2	N/A	66.67	*
Pastures, Rangeland, Perennial Grassland - *Ground Applications* (2 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.24	9.23	*	N/A	2.04	78.46	*
	Dicot	0.045	N/A	0.24	5.33	*	N/A	2.04	45.33	*
Veg Vigor	Monocot	<0.0075	0.04	N/A	> 5.33	*	0.2	N/A	> 26.67	*
	Dicot	0.003	0.04	N/A	13.33	*	0.2	N/A	66.67	*
Pastures, Rangeland, Perennial Grassland - *Aerial Applications* (2 lbs ae/A/app, 2 app., ground/aerial; 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.32	12.31	*	N/A	1.4	53.85	*
	Dicot	0.045	N/A	0.32	7.11	*	N/A	1.4	31.11	*
Veg Vigor	Monocot	<0.0075	0.2	N/A	> 26.67	*	0.2	N/A	> 26.67	*
	Dicot	0.003	0.2	N/A	66.67	*	0.2	N/A	66.67	*
Pome fruit/Stone fruit/Nuts - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)										
Seed Emerg.	Monocot	0.026	N/A	0.24	9.23	*	N/A	2.04	78.46	*

Table F-30: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**		**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
Veg Vigor	Dicot	0.045	N/A	0.24	5.33	*	N/A	2.04	45.33	*
	Monocot	<0.0075	0.04	N/A	> 5.33	*	0.2	N/A	> 26.67	*
	Dicot	0.003	0.04	N/A	13.33	*	0.2	N/A	66.67	*
Pome fruit/Stone fruit/Nuts - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)										
Seed Emerg.	Monocot	0.026	N/A	0.32	12.31	*	N/A	1.4	53.85	*
	Dicot	0.045	N/A	0.32	7.11	*	N/A	1.4	31.11	*
Veg Vigor	Monocot	<0.0075	0.2	N/A	> 26.67	*	0.2	N/A	> 26.67	*
	Dicot	0.003	0.2	N/A	66.67	*	0.2	N/A	66.67	*
Blueberry - *Ground Applications* (1.4 lbs ae/A/app, 2 app.,; 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.168	6.46	*	N/A	1.42	54.62	*
	Dicot	0.045	N/A	0.168	3.73	*	N/A	1.42	31.56	*
Veg Vigor	Monocot	<0.0075	0.28	N/A	> 37.33	*	0.28	N/A	> 37.33	*
	Dicot	0.003	0.28	N/A	93.33	*	0.28	N/A	93.33	*
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)										
Seed Emerg.	Monocot	0.026	N/A	0.15	5.77	*	N/A	1.275	49.04	*
	Dicot	0.045	N/A	0.15	3.33	*	N/A	1.275	28.33	*

Table F-30: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Applications of 2,4-D Acid and amine salts										
			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]		Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	<0.0075	0.025	N/A	> 3.33	*	0.025	N/A	> 3.33	*
	Dicot	0.003	0.025	N/A	8.33	*	0.025	N/A	8.33	*
Wheat, Oats, Barley, Rye, Millet, Triticale - *AerialGround Applications* (1.25 lbs ae/A/app, 2 app.,)										
Seed Emerg.	Monocot	0.026	N/A	0.2	7.69	*	N/A	0.875	33.65	*
	Dicot	0.045	N/A	0.2	4.44	*	N/A	0.875	19.44	*
Veg Vigor	Monocot	<0.0075	0.125	N/A	> 16.67	*	0.125	N/A	> 16.67	*
	Dicot	0.003	0.125	N/A	41.67	*	0.125	N/A	41.67	*
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.18	6.92	*	N/A	1.53	58.85	*
	Dicot	0.045	N/A	0.18	4.00	*	N/A	1.53	34.00	*
Veg Vigor	Monocot	<0.0075	0.03	N/A	> 4.00	*	0.03	N/A	> 4.00	*
	Dicot	0.003	0.03	N/A	10.00	*	0.03	N/A	10.00	*
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.24	9.23	*	N/A	1.05	40.38	*
	Dicot	0.045	N/A	0.24	5.33	*	N/A	1.05	23.33	*
Veg Vigor	Monocot	<0.0075	0.15	N/A	> 20.00	*	0.15	N/A	> 20.00	*

Table F-30: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**		**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
	Dicot	0.003	0.15	N/A	50.00	*	0.15	N/A	50.00	*
Asparagus - *Ground Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.48	18.46	*	N/A	4.08	156.92	*
	Dicot	0.045	N/A	0.48	10.67	*	N/A	4.08	90.67	*
Veg Vigor	Monocot	<0.0075	0.08	N/A	> 10.67	*	0.08	N/A	> 10.67	*
	Dicot	0.003	0.08	N/A	26.67	*	0.08	N/A	26.67	*
Asparagus - *Aerial Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.64	24.62	*	N/A	2.8	107.69	*
	Dicot	0.045	N/A	0.64	14.22	*	N/A	2.8	62.22	*
Veg Vigor	Monocot	<0.0075	0.4	N/A	> 53.33	*	0.4	N/A	> 53.33	*
	Dicot	0.003	0.4	N/A	133.33	*	0.4	N/A	133.33	*
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.0084	0.32	*	N/A	0.0704	2.71	*
	Dicot	0.045	N/A	0.0084	0.19	*	N/A	0.0704	1.56	*
Veg Vigor	Monocot	<0.0075	0.0014	N/A	> 0.19	*	0.0014	N/A	> 0.19	*
	Dicot	0.003	0.0014	N/A	0.47	*	0.0014	N/A	0.47	*

Table F-30: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]		Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)										
Seed Emerg.	Monocot	0.026	N/A	0.0112	0.43	*	N/A	0.49	18.85	*
	Dicot	0.045	N/A	0.0112	0.25	*	N/A	0.49	10.89	*
Veg Vigor	Monocot	<0.0075	0.007	N/A	> 0.93	*	0.007	N/A	> 0.93	*
	Dicot	0.003	0.007	N/A	2.33	*	0.007	N/A	2.33	*
Sugarcane - *Ground Applications* (2.0 lbs ae/A/app, 2 app.,)										
Seed Emerg.	Monocot	0.026	N/A	0.24	9.23	*	N/A	2.04	78.46	*
	Dicot	0.045	N/A	0.24	5.33	*	N/A	2.04	45.33	*
Veg Vigor	Monocot	<0.0075	0.04	N/A	> 5.33	*	0.2	N/A	> 26.67	*
	Dicot	0.003	0.04	N/A	13.33	*	0.2	N/A	66.67	*
Sugarcane - *Aerial Applications* (2.0 lbs ae/A/app, 2 app.,)										
Seed Emerg.	Monocot	0.026	N/A	0.32	12.31	*	N/A	1.4	53.85	*
	Dicot	0.045	N/A	0.32	7.11	*	N/A	1.4	31.11	*
Veg Vigor	Monocot	<0.0075	0.2	N/A	> 26.67	*	0.2	N/A	> 26.67	*
	Dicot	0.003	0.2	N/A	66.67	*	0.2	N/A	66.67	*

[a] Indicates an exceedance of Acute Risk LOC when RQ Š 1.

Endangered Plant Risk Quotients - Multiple Spray Applications (2,4-D Acid and amine salts)

The endangered plant RQs are calculated by comparing the NOEC or EC_{05} value of the most sensitive species in the seedling emergence study to runoff and drift exposure (EEC/toxicity value). The NOEC or EC_{05} value of the most sensitive species in the vegetative vigor study is compared to the drift exposure to determine the acute RQ. RQs are calculated for the most sensitive monocot and dicot species.

Table F-31: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]		Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Fallow areas and Crop Stubble - *Ground Applications* (2 lbs ae/ac/app, 2 app., ground, 30 day interval)										
Seed Emerg.	Monocot	0.015	N/A	0.24	16.00	*	N/A	2.04	136.00	*
	Dicot	<0.045	N/A	0.24	> 5.33	*	N/A	2.04	> 45.33	*
Veg Vigor	Monocot	<0.0075	0.04	N/A	5.33	*	0.2	N/A	26.67	*
	Dicot	0.002	0.04	N/A	20.00	*	0.2	N/A	100.00	*
Fallow areas and Crop Stubble - *Aerial Applications* (2 lbs ae/ac/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.015	N/A	0.32	21.33	*	N/A	1.4	93.33	*
	Dicot	<0.045	N/A	0.32	> 7.11	*	N/A	1.4	> 31.11	*
Veg Vigor	Monocot	<0.0075	0.2	N/A	26.67	*	0.04	N/A	5.33	*
	Dicot	0.002	0.2	N/A	100.00	*	0.04	N/A	20.00	*

Table F-31: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**		**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.015	N/A	0.24	16.00	*	N/A	2.04	136.00	*
	Dicot	<0.045	N/A	0.24	> 5.33	*	N/A	2.04	> 45.33	*
Veg Vigor	Monocot	<0.0075	0.04	N/A	5.33	*	0.2	N/A	26.67	*
	Dicot	0.002	0.04	N/A	20.00	*	0.2	N/A	100.00	*
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.015	N/A	0.32	21.33		N/A	1.4	93.33	*
	Dicot	<0.045	N/A	0.32	> 7.11	*	N/A	1.4	> 31.11	*
Veg Vigor	Monocot	<0.0075	0.2	N/A	26.67	*	0.2	N/A	26.67	*
	Dicot	0.002	0.2	N/A	100.00	*	0.2	N/A	100.00	*
Pastures, Rangeland, Perennial Grassland - *Ground Applications* (2 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.015	N/A	0.24	16.00	*	N/A	2.04	136.00	*
	Dicot	<0.045	N/A	0.24	> 5.33	*	N/A	2.04	> 45.33	*
Veg Vigor	Monocot	<0.0075	0.04	N/A	5.33	*	0.2	N/A	26.67	*
	Dicot	0.002	0.04	N/A	20.00	*	0.2	N/A	100.00	*

Table F-31: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**		**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
Pastures, Rangeland, Perennial Grassland - *Aerial Applications* (2 lbs ae/A/app, 2 app., ground/aerial; 30 day interval)										
Seed Emerg.	Monocot	0.015	N/A	0.32	21.33		N/A	1.4	93.33	
	Dicot	<0.045	N/A	0.32	> 7.11		N/A	1.4	> 31.11	
Veg Vigor	Monocot	<0.0075	0.2	N/A	26.67		0.2	N/A	26.67	
	Dicot	0.002	0.2	N/A	100.00		0.2	N/A	100.00	
Pome fruit/Stone fruit/Nuts - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)										
Seed Emerg.	Monocot	0.015	N/A	0.24	16.00	*	N/A	2.04	136.00	*
	Dicot	<0.045	N/A	0.24	> 5.33	*	N/A	2.04	> 45.33	*
Veg Vigor	Monocot	<0.0075	0.04	N/A	5.33	*	0.2	N/A	26.67	*
	Dicot	0.002	0.04	N/A	20.00	*	0.2	N/A	100.00	*
Pome fruit/Stone fruit/Nuts - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 75 day application interval)										
Seed Emerg.	Monocot	0.015	N/A	0.32	21.33	*	N/A	1.4	93.33	*
	Dicot	<0.045	N/A	0.32	> 7.11	*	N/A	1.4	> 31.11	*
Veg Vigor	Monocot	<0.0075	0.2	N/A	26.67	*	0.2	N/A	26.67	*
	Dicot	0.002	0.2	N/A	100.00	*	0.2	N/A	100.00	*

Table F-31: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]		Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Blueberry - *Ground Applications* (1.4 lbs ae/A/app, 2 app.,; 30 day interval)										
Seed Emerg.	Monocot	0.015	N/A	0.168	11.20	*	N/A	1.42	94.67	*
	Dicot	<0.045	N/A	0.168	> 3.73	*	N/A	1.42	> 31.56	*
Veg Vigor	Monocot	<0.0075	0.28	N/A	37.33	*	0.28	N/A	37.33	*
	Dicot	0.002	0.28	N/A	140.00	*	0.28	N/A	140.00	*
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)										
Seed Emerg.	Monocot	0.015	N/A	0.15	10.00	*	N/A	1.275	85.00	*
	Dicot	<0.045	N/A	0.15	> 3.33	*	N/A	1.275	> 28.33	*
Veg Vigor	Monocot	<0.0075	0.025	N/A	3.33	*	0.025	N/A	3.33	*
	Dicot	0.002	0.025	N/A	12.50	*	0.025	N/A	12.50	*
Wheat, Oats, Barley, Rye, Millet, Triticale - *Aerial Applications* (1.25 lbs ae/A/app, 2 app.,)										
Seed Emerg.	Monocot	0.015	N/A	0.2	13.33	*	N/A	0.875	58.33	*
	Dicot	<0.045	N/A	0.2	> 4.44	*	N/A	0.875	> 19.44	*
Veg Vigor	Monocot	<0.0075	0.125	N/A	16.67	*	0.125	N/A	16.67	*
	Dicot	0.002	0.125	N/A	62.50	*	0.125	N/A	62.50	*

Table F-31: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.18	12.00 *	N/A	1.53	102.00 *	
	Dicot	<0.045	N/A	0.18	> 4.00 *	N/A	1.53	> 34.00 *	
Veg Vigor	Monocot	<0.0075	0.03	N/A	4.00 *	0.03	N/A	4.00 *	
	Dicot	0.002	0.03	N/A	15.00 *	0.03	N/A	15.00 *	
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.24	16.00 *	N/A	1.05	70.00 *	
	Dicot	<0.045	N/A	0.24	> 5.33 *	N/A	1.05	> 23.33 *	
Veg Vigor	Monocot	<0.0075	0.15	N/A	20.00 *	0.15	N/A	20.00 *	
	Dicot	0.002	0.15	N/A	75.00 *	0.15	N/A	75.00 *	
Asparagus - *Ground Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)									
Seed Emerg.	Monocot	0.015	N/A	0.48	32.00 *	N/A	4.08	272.00 *	
	Dicot	<0.045	N/A	0.48	> 10.67 *	N/A	4.08	> 90.67 *	
Veg Vigor	Monocot	<0.0075	0.08	N/A	10.67 *	0.08	N/A	10.67 *	
	Dicot	0.002	0.08	N/A	40.00 *	0.08	N/A	40.00 *	

Table F-31: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Acid and amine salts

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**		**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
Asparagus - *Aerial Applications* (4.0 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.015	N/A	0.64	42.67	*	N/A	2.8	186.67	*
	Dicot	<0.045	N/A	0.64	> 14.22	*	N/A	2.8	> 62.22	*
Veg Vigor	Monocot	<0.0075	0.4	N/A	53.33	*	0.4	N/A	53.33	*
	Dicot	0.002	0.4	N/A	200.00	*	0.4	N/A	200.00	*
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)										
Seed Emerg.	Monocot	0.015	N/A	0.0084	0.56		N/A	0.0704	4.69	*
	Dicot	<0.045	N/A	0.0084	> 0.19		N/A	0.0704	> 1.56	*
Veg Vigor	Monocot	<0.0075	0.0014	N/A	0.19		0.0014	N/A	0.19	
	Dicot	0.002	0.0014	N/A	0.70		0.0014	N/A	0.70	
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)										
Seed Emerg.	Monocot	0.015	N/A	0.0112	0.75		N/A	0.49	32.67	
	Dicot	<0.045	N/A	0.0112	> 0.25		N/A	0.49	> 10.89	*
Veg Vigor	Monocot	<0.0075	0.007	N/A	0.93		0.007	N/A	0.93	
	Dicot	0.002	0.007	N/A	3.50	*	0.007	N/A	3.50	*

Table F-31: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Acid and amine salts									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Sugarcane - *Ground Applications* (2.0 lbs ae/A/app, 2 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.24	16.00 *	N/A	2.04	136.00 *	
	Dicot	<0.045	N/A	0.24	> 5.33 *	N/A	2.04	> 45.33 *	
Veg Vigor	Monocot	<0.0075	0.04	N/A	5.33 *	0.2	N/A	26.67 *	
	Dicot	0.002	0.04	N/A	20.00 *	0.2	N/A	100.00 *	
Sugarcane - *Aerial Applications* (2.0 lbs ae/A/app, 2 app.,)									
Seed Emerg.	Monocot	0.015	N/A	0.32	21.33 *	N/A	1.4	93.33 *	
	Dicot	<0.045	N/A	0.32	> 7.11 *	N/A	1.4	> 31.11 *	
Veg Vigor	Monocot	<0.0075	0.2	N/A	26.67 *	0.2	N/A	26.67 *	
	Dicot	0.002	0.2	N/A	100.00 *	0.2	N/A	100.00 *	

[a] Indicates acute risk to endangered plants when RQ Š 1.

Non-endangered Plant Risk Quotients - Multiple Spray Applications (2,4-D Esters)

As mentioned above, the water solubilities of the esters are much lower than those of the acid and amine salts. And since the runoff scenarios are based on solubility, the environmental concentrations must be calculated separately at a % runoff value of 0.01. For multiple spray applications the environmental concentrations would be based expected to double in concentration at the most conservative level. In this scenario the RQs would also be expected to double. The estimated environmental concentrations for the acid

and amine salts for dry and semi-aquatic areas with an assumed runoff of 1% are tabulated below.

Table F-32: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for Multiple Applications of the 2,4-D Esters.

Site/ Application Method/ Rate of Application in lbs ai/A	Minimum Incorporation Depth (cm)	Runoff Value	Sheet Run-off (lbs ae/A)	Channelized Runoff (lbs ae/A)	Drift (lbs ae/A)	Total Loading to Adjacent Area (Sheet Run-off+Drift)	Total Loading to Semi-aquatic Area (Channel Run-off+ Drift)
Fallow areas and Crop Stubble - *ground Applications* (2 lbs ae/ac/app, 2 app., 30 day interval, unincorporated)							
4.0	0	0.01	0.04	0.40	0.04	0.08	0.44
Fallow areas and Crop Stubble - *aerial applications* (2 lbs ae/ac/app, 2 app., 30 day interval, unincorporated)							
4.0	0	0.01	0.02	0.20	0.20	0.22	0.40
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)							
4.0	0	0.01	0.04	0.4	0.04	0.08	0.44
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)							
4.0	0	0.01	0.024	0.24	0.2	0.224	0.44
Pastures, Rangeland, Perennial Grassland - *Ground Applications* (2 lbs ae/A/app, 2 app., 30 day interval)							
4.0	0	0.01	0.04	0.4	0.04	0.08	0.44
Pastures, Rangeland, Perennial Grassland - *Aerial Applications* (2 lbs ae/A/app, 2 app., 30 day interval)							
4.0	0	0.01	0.024	0.24	0.2	0.224	0.44
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)							
2.5	0	0.01	0.025	0.25	0.025	0.05	0.275

Table F-32: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for Multiple Applications of the 2,4-D Esters.							
Site/ Application Method/ Rate of Application in lbs ai/A	**Minimum Incorporation Depth (cm)**	**Runoff Value**	**Sheet Run-off (lbs ae/A)**	**Channelized Runoff (lbs ae/A)**	**Drift (lbs ae/A)**	**Total Loading to Adjacent Area (Sheet Run-off+Drift)**	**Total Loading to Semi-aquatic Area (Channel Run-off+ Drift)**
Wheat, Oats, Barley, Rye, Millet, Triticale - *Aerial Applications* (1.25 lbs ae/A/app, 2 app.,)							
2.5	0	0.01	0.015	0.15	0.125	0.14	0.275
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)							
3.0	0	0.01	0.03	0.3	0.03	0.06	0.33
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)							
3.0	0	0.01	0.018	0.18	0.15	0.168	0.33
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., 7 day interval)							
0.14	0	0.01	0.0014	0.014	0.0014	0.0028	0.0154
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., 7 day interval)							
0.14	0	0.01	0.00084	0.0084	0.007	0.00784	0.0154

As mentioned above, the most sensitive species among the seedling emergence studies are compared to runoff and drift exposure to determine the RQ (EEC/toxicity value). The EC_{25} value of the most sensitive species in the vegetative vigor study is compared to the drift exposure to determine the acute RQ. RQs are calculated for the most sensitive monocot and dicot species.

Table F-33: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Esters

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**		**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
Fallow areas and Crop Stubble - *Ground Applications* (2 lbs ae/ac/app, 2 app., ground, 30 day interval)										
Seed Emerg.	Monocot	0.26	N/A	0.08	0.31		N/A	0.44	1.69	*
	Dicot	0.037	N/A	0.08	2.16	*	N/A	0.44	11.89	*
Veg Vigor	Monocot	0.218	0.04	N/A	0.18		0.04	N/A	0.18	
	Dicot	0.02	0.04	N/A	2.00	*	0.04	N/A	2.00	*
Fallow areas and Crop Stubble - *Aerial Applications* (2 lbs ae/ac/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.26	N/A	0.224	0.86		N/A	0.44	1.69	*
	Dicot	0.037	N/A	0.224	6.05	*	N/A	0.44	11.89	*
Veg Vigor	Monocot	0.218	0.2	N/A	0.92		0.2	N/A	0.92	
	Dicot	0.02	0.2	N/A	10.00	*	0.2	N/A	10.00	*
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.26	N/A	0.08	0.31		N/A	0.44	1.69	*
	Dicot	0.037	N/A	0.08	2.16	*	N/A	0.44	11.89	*
Veg Vigor	Monocot	0.218	0.04	N/A	0.18		0.04	N/A	0.18	
	Dicot	0.02	0.04	N/A	2.00	*	0.04	N/A	2.00	*
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)										

Table F-33: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Esters

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		**Toxicity Threshold, EC_{25} (lb ai/ac)**	**Total Drift (lb ai/ac)**	**Total Loading(Sheet runoff + Drift) (lb ai/ac)**	**RQ[a]**		**Total Drift (lb ai/ac)**	**Total Loading (Channel runoff + Drift) (lb ai/ac)**	**RQ[a]**	
Seed Emerg.	Monocot	0.26	N/A	0.224	0.86		N/A	0.44	1.69	*
	Dicot	0.037	N/A	0.224	6.05	*	N/A	0.44	11.89	*
Veg Vigor	Monocot	0.218	0.2	N/A	0.92		0.2	N/A	0.92	
	Dicot	0.02	0.2	N/A	10.00	*	0.2	N/A	10.00	*
Pastures, Rangeland, Perennial Grassland - *Ground Applications* (2 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.26	N/A	0.08	0.31		N/A	0.44	1.69	*
	Dicot	0.037	N/A	0.08	2.16	*	N/A	0.44	11.89	*
Veg Vigor	Monocot	0.218	0.04	N/A	0.18		0.04	N/A	0.18	
	Dicot	0.02	0.04	N/A	2.00	*	0.04	N/A	2.00	*
Pastures, Rangeland, Perennial Grassland - *Aerial Applications* (2 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.26	N/A	0.224	0.86		N/A	0.44	1.69	*
	Dicot	0.037	N/A	0.224	6.05	*	N/A	0.44	11.89	*
Veg Vigor	Monocot	0.218	0.2	N/A	0.92		0.2	N/A	0.92	
	Dicot	0.02	0.2	N/A	10.00	*	0.2	N/A	10.00	*
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)										
Seed Emerg.	Monocot	0.26	N/A	0.05	0.19		N/A	0.275	1.06	*

Table F-33: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Esters									
			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]		Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Dicot	0.037	N/A	0.05	1.35	*	N/A	0.275	7.43	*
	Monocot	0.218	0.025	N/A	0.11		0.025	N/A	0.11	
	Dicot	0.02	0.025	N/A	1.25	*	0.025	N/A	1.25	*
Wheat, Oats, Barley, Rye, Millet, Triticale - *AerialGround Applications* (1.25 lbs ae/A/app, 2 app.,)										
Seed Emerg.	Monocot	0.26	N/A	0.14	0.54		N/A	0.275	1.06	*
	Dicot	0.037	N/A	0.14	3.78	*	N/A	0.275	7.43	*
Veg Vigor	Monocot	0.218	0.125	N/A	0.57		0.125	N/A	0.57	
	Dicot	0.02	0.125	N/A	6.25	*	0.125	N/A	6.25	*
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)										
Seed Emerg.	Monocot	0.26	N/A	0.06	0.23		N/A	0.33	1.27	*
	Dicot	0.037	N/A	0.06	1.62	*	N/A	0.33	8.92	*
Veg Vigor	Monocot	0.218	0.03	N/A	0.14		0.03	N/A	0.14	
	Dicot	0.02	0.03	N/A	1.50	*	0.03	N/A	1.50	*
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)										
Seed Emerg.	Monocot	0.26	N/A	0.168	0.65		N/A	0.33	1.27	*
	Dicot	0.037	N/A	0.168	4.54	*	N/A	0.33	8.92	*

Table F-33: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Esters									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	0.218	0.15	N/A	0.69	0.15	N/A	0.69	
	Dicot	0.02	0.15	N/A	7.50 *	0.15	N/A	7.50 *	
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)									
Seed Emerg.	Monocot	0.26	N/A	0.0028	0.01	N/A	0.0154	0.06	
	Dicot	0.037	N/A	0.0028	0.08	N/A	0.0154	0.42	
Veg Vigor	Monocot	0.218	0.0014	N/A	0.01	0.0014	N/A	0.01	
	Dicot	0.02	0.0014	N/A	0.07	0.0014	N/A	0.07	
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)									
Seed Emerg.	Monocot	0.26	N/A	0.0078	0.03	N/A	0.0154	0.06	
	Dicot	0.037	N/A	0.0078	0.21	N/A	0.0154	0.42	
Veg Vigor	Monocot	0.218	0.007	N/A	0.03	0.007	N/A	0.03	
	Dicot	0.02	0.007	N/A	0.35	0.007	N/A	0.35	

[a] * indicates an exceedance of Acute Risk LOC.

Endangered Plant Risk Quotients - Multiple Spray Applications (2,4-D Esters)

Table F-34: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Esters

			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]		Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Fallow areas and Crop Stubble - *Ground Applications* (2 lbs ae/ac/app, 2 app., ground, 30 day interval)										
Seed Emerg.	Monocot	0.24	N/A	0.08	0.33		N/A	0.44	1.83	*
	Dicot	0.015	N/A	0.08	5.33	*	N/A	0.44	29.33	*
Veg Vigor	Monocot	0.06	0.04	N/A	0.67		0.04	N/A	0.67	
	Dicot	0.006	0.04	N/A	6.67	*	0.04	N/A	6.67	*
Fallow areas and Crop Stubble - *Aerial Applications* (2 lbs ae/ac/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.24	N/A	0.224	0.93		N/A	0.44	1.83	*
	Dicot	0.015	N/A	0.224	14.93	*	N/A	0.44	29.33	*
Veg Vigor	Monocot	0.06	0.2	N/A	3.33	*	0.2	N/A	3.33	*
	Dicot	0.006	0.2	N/A	33.33	*	0.2	N/A	33.33	*
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *ground Applicaations* (4.0 lbs ae/A/app, 1 app.,)										
Seed Emerg.	Monocot	0.24	N/A	0.08	0.33		N/A	0.44	1.83	*
	Dicot	0.015	N/A	0.08	5.33	*	N/A	0.44	29.33	*
Veg Vigor	Monocot	0.06	0.04	N/A	0.67		0.04	N/A	0.67	
	Dicot	0.006	0.04	N/A	6.67	*	0.04	N/A	6.67	*

Table F-34: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Esters									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *Aerial Applicaations* (4.0 lbs ae/A/app, 1 app.,)									
Seed Emerg.	Monocot	0.24	N/A	0.224	0.93	N/A	0.44	1.83	*
	Dicot	0.015	N/A	0.224	14.93 *	N/A	0.44	29.33	*
Veg Vigor	Monocot	0.06	0.2	N/A	3.33 *	0.2	N/A	3.33	*
	Dicot	0.006	0.2	N/A	33.33 *	0.2	N/A	33.33	*
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)									
Seed Emerg.	Monocot	0.24	N/A	0.08	0.33	N/A	0.44	1.83	*
	Dicot	0.015	N/A	0.08	5.33 *	N/A	0.44	29.33	*
Veg Vigor	Monocot	0.06	0.04	N/A	0.67	0.04	N/A	0.67	
	Dicot	0.006	0.04	N/A	6.67 *	0.04	N/A	6.67	*
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Aerial Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)									
Seed Emerg.	Monocot	0.24	N/A	0.224	0.93	N/A	0.44	1.83	*
	Dicot	0.015	N/A	0.224	14.93 *	N/A	0.44	29.33	*
Veg Vigor	Monocot	0.06	0.2	N/A	3.33 *	0.2	N/A	3.33	*
	Dicot	0.006	0.2	N/A	33.33 *	0.2	N/A	33.33	*
Pastures, Rangeland, Perennial Grassland - *Ground Applications* (2 lbs ae/A/app, 2 app., 30 day interval)									

Table F-34: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Esters									
			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]		Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Seed Emerg.	Monocot	0.24	N/A	0.08	0.33		N/A	0.44	1.83	*
	Dicot	0.015	N/A	0.08	5.33	*	N/A	0.44	29.33	*
Veg Vigor	Monocot	0.06	0.04	N/A	0.67		0.04	N/A	0.67	
	Dicot	0.006	0.04	N/A	6.67	*	0.04	N/A	6.67	*
Pastures, Rangeland, Perennial Grassland - *Aerial Applications* (2 lbs ae/A/app, 2 app., 30 day interval)										
Seed Emerg.	Monocot	0.24	N/A	0.224	0.93		N/A	0.44	1.83	*
	Dicot	0.015	N/A	0.224	14.93	*	N/A	0.44	29.33	*
Veg Vigor	Monocot	0.06	0.2	N/A	3.33	*	0.2	N/A	3.33	*
	Dicot	0.006	0.2	N/A	33.33	*	0.2	N/A	33.33	*
Wheat, Oats, Barley, Rye, Millet, Triticale - *Ground Applications* (1.25 lbs ae/A/app, 2 app.,)										
Seed Emerg.	Monocot	0.24	N/A	0.05	0.21		N/A	0.275	1.15	*
	Dicot	0.015	N/A	0.05	3.33	*	N/A	0.275	18.33	*
Veg Vigor	Monocot	0.06	0.025	N/A	0.42		0.025	N/A	0.42	
	Dicot	0.006	0.025	N/A	4.17	*	0.025	N/A	4.17	*
Wheat, Oats, Barley, Rye, Millet, Triticale - *AerialGround Applications* (1.25 lbs ae/A/app, 2 app.,)										
Seed Emerg.	Monocot	0.24	N/A	0.14	0.58		N/A	0.275	1.15	*
	Dicot	0.015	N/A	0.14	9.33	*	N/A	0.275	18.33	*

Table F-34: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Esters									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Veg Vigor	Monocot	0.06	0.125	N/A	2.08 *	0.125	N/A	2.08 *	
	Dicot	0.006	0.125	N/A	20.83 *	0.125	N/A	20.83 *	
Corn - *Ground Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)									
Seed Emerg.	Monocot	0.24	N/A	0.031	0.13	N/A	0.1705	0.71	
	Dicot	0.015	N/A	0.031	2.07 *	N/A	0.1705	11.37 *	
Veg Vigor	Monocot	0.06	0.0155	N/A	0.26	0.0155	N/A	0.26	
	Dicot	0.006	0.0155	N/A	2.58 *	0.0155	N/A	2.58 *	
Corn - *Aerial Applications* (1.5 lbs ae/A/app, 2 app., 7 day interval)									
Seed Emerg.	Monocot	0.24	N/A	0.06	0.25	N/A	0.33	1.38 *	
	Dicot	0.015	N/A	0.06	4.00 *	N/A	0.33	22.00 *	
Veg Vigor	Monocot	0.06	0.03	N/A	0.50	0.03	N/A	0.50	
	Dicot	0.006	0.03	N/A	5.00 *	0.03	N/A	5.00 *	
Potato - *Ground Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)									
Seed Emerg.	Monocot	0.24	N/A	0.0028	0.01	N/A	0.0154	0.06	
	Dicot	0.015	N/A	0.0028	0.19	N/A	0.0154	1.03 *	
Veg Vigor	Monocot	0.06	0.0014	N/A	0.02	0.0014	N/A	0.02	
	Dicot	0.006	0.0014	N/A	0.23	0.0014	N/A	0.23	

Table F-34: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Multiple Spray Applications of 2,4-D Esters									
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas			
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Drift (lb ai/ac)	Total Loading(Sheet runoff + Drift) (lb ai/ac)	RQ[a]	Total Drift (lb ai/ac)	Total Loading (Channel runoff + Drift) (lb ai/ac)	RQ[a]	
Potato - *Aerial Applications* (0.07 lbs ae/A/app, 2 app., ground or aerial, 7 day interval)									
Seed Emerg.	Monocot	0.24	N/A	0.0078	0.03	N/A	0.0154	0.06	
	Dicot	0.015	N/A	0.0078	0.52	N/A	0.0154	1.03	*
Veg Vigor	Monocot	0.06	0.007	N/A	0.12	0.007	N/A	0.12	
	Dicot	0.006	0.007	N/A	1.17 *	0.007	N/A	1.17	*

* Indicates an exceedance of Acute Risk LOC when RQ $1.

Banded applications - As discussed in the RQ sections for birds and mammals a number of labels instruct the applicators to apply unincorporated banded treatments of sprays to row crops. Many labels adjust application rates according to band width and row spaces, but many others do not. For the labels which do not adjust the application rates, the treatments are more concentrated in the bands. Potential exposure to birds and mammals increases because these organisms do not distinguish between treaded area and untreated areas. However, non-target plants do not migrate from treated to untreated bands and exposure to these plants is characterized as "sheet runoff" (one treated acre to an adjacent acre) for dry areas and"channelized runoff" (10 treated acres to a distant low-lying acre) for semi-aquatic areas. Therefore, the higher per acre rates in the concentrated bands do not effect the exposure to non-target bands when label rates are not adjusted.

The phenoxy Task Force proposal to require all formulators to adjust the application rates according to the following formula will actually reduce the exposure to non-target plants.

$$\frac{\text{band width in inches}}{\text{row width in inches}} \times \text{Broadcast rate per acre} = \text{Rate per banded acre}$$

Using this formula, the banded per acre application rate can be significantly reduced. If we assume use the same 6 inch band and 30 inch row space that we used for the analysis of birds and mammals, the per acre banded application rate would be reduced by 1/5 of the broadcast application rate. Under this scenario the RQs would be significantly reduced. To illustrate this point, the RQs for the 6 inch treated band at the proposed adjusted rate for row crops where banded treatments could occur is compared to the broadcast application rate.

Table 35: Non-target Plant Risk Quotient Comparison of Broadcast Spray Applications to Adjusted Band Applications[a] to Selected Row Crops.

Corn

Single Application - Non- Endangered Plants
2,4-D Acid and amine salts

Broadcast Spray Application 1.5 lbs ae/A/app, 2 app., 7 day interval				Adjusted Band Application (0.3 lbs ae/A/app, 2 app., 7 day interval)			
	Emergence RQs		Drift RQs		Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas		Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	3.46*	29.42*	2.00*	**Monocots**	0.69	5.88*	0.4
Dicots	13.24*	112.5*	3.0*	**Dicots**	2.65*	22.5*	0.6*

Single Application - Non- Endangered Plants
2,4-D Esters

Broadcast Spray Application 1.5 lbs ae/A/app, 2 app., 7 day interval	Adjusted Band Application (0.3 lbs ae/A/app, 2 app., 7 day interval)

Table 35: Non-target Plant Risk Quotient Comparison of Broadcast Spray Applications to Adjusted Band Applications[a] to Selected Row Crops.

	Emergence RQs		Drift RQs		Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas		Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	3.0*	16.5*	0.07	**Monocots**	0.6	3.30*	0.01
Dicots	37.04*	203.7*	11.09*	**Dicots**	7.41*	40.74*	2.83

Single Application - Endangered Plants
2,4-D Acid and amine salts

Broadcast Spray Application 1.5 lbs ae/A/app, 2 app., 7 day interval				**Adjusted Band Application (0.3 lbs ae/A/app, 2 app., 7 day interval)**			
	Emergence RQs		Drift RQs		Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas		Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	6.00*	51.00*	2.00*	**Monocots**	1.20*	10.20*	0.4
Dicots	96.77*	822.58*	7.50*	**Dicots**	19.35*	164.52*	1.5*

Single Application - Endangered Plants
2,4-D Esters

Broadcast Spray Application 1.5 lbs ae/A/app, 2 app., 7 day interval	**Adjusted Band Application (0.3 lbs ae/A/app, 2 app., 7 day interval)**

Table 35: Non-target Plant Risk Quotient Comparison of Broadcast Spray Applications to Adjusted Band Applications[a] to Selected Row Crops.

	Emergence RQs		Drift RQs		Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas		Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	5.33*	29.32*	0.6	**Monocots**	1.07*	5.86*	0.12
Dicots	63.83*	351.06*	2.45*	**Dicots**	12.77*	70.21*	0.49

Soybean

Single Application - Non- Endangered Plants
2,4-D Acid and amine salts

Broadcast Spray Application 1.0 lbs ae/A/app, 2 app., 30 day interval				**Adjusted Band Application (0.2 lbs ae/A/app, 2 app., 30 day interval)**			
	Emergence RQs		Drift RQs		Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas		Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	2.31*	19.62*	1.33*	**Monocots**	0.46	3.92*	0.27
Dicots	8.82*	75.0*	2.0*	**Dicots**	1.76*	15.00*	0.4

Single Application - Non-Endangered Plants
2,4-D Esters

Table 35: Non-target Plant Risk Quotient Comparison of Broadcast Spray Applications to Adjusted Band Applications[a] to Selected Row Crops.

Broadcast Spray Application 1.0 lbs ae/A/app, 2 app., 7 day interval				Adjusted Band Application (0.2 lbs ae/A/app, 2 app., 30 day interval)			
	Emergence RQs		Drift RQs		Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas		Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	2.00*	11.00*	.05	**Monocots**	0.40	2.20*	0.01
Dicots	24.69*	135.80*	7.94*	**Dicots**	4.94*	27.16*	1.59*

Single Application - Endangered Plants
2,4-D Acid and amine salts

Broadcast Spray Application 1.0 lbs ae/A/app, 2 app., 7 day interval				Adjusted Band Application (0.2 lbs ae/A/app, 2 app., 30 day interval)			
	Emergence RQs		Drift RQs		Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas		Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	4.00*	34.00*	1.33*	**Monocots**	0.80	6.80*	0.27
Dicots	64.52*	548.39*	5.00*	**Dicots**	12.90*	109.68*	1.00*

Single Application - Endangered Plants
2,4-D Esters

Table 35: Non-target Plant Risk Quotient Comparison of Broadcast Spray Applications to Adjusted Band Applications[a] to Selected Row Crops.

Broadcast Spray Application 1.0 lbs ae/A/app, 2 app., 30 day interval

	Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	3.55*	19.55*	0.40
Dicots	42.45*	234.04*	1.63*

Adjusted Band Application (0.2 lbs ae/A/app, 2 app., 30 day interval)

	Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	0.71	3.91*	0.08
Dicots	8.51*	46.81*	0.33

Potato

Single Application - Non- Endangered Plants
2,4-D Acid and amine salts

Broadcast Spray Application 0.07 lbs ae/A/app, 2 app., 7 day interval

	Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	0.16	1.37*	0.09
Dicots	0.62*	5.25*	0.14

Adjusted Band Application (0.014 lbs ae/A/app, 2 app., 7 day interval)

	Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	0.03	0.27	0.02
Dicots	0.12	1.05*	0.03

Table 35: Non-target Plant Risk Quotient Comparison of Broadcast Spray Applications to Adjusted Band Applications[a] to Selected Row Crops.

Single Application - Non-Endangered Plants
2,4-D Esters

Broadcast Spray Application 0.07 lbs ae/A/app, 2 app., 7 day interval				Adjusted Band Application (0.014 lbs ae/A/app, 2 app., 7 day interval)			
	Emergence RQs		Drift RQs		Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas		Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	0.142	0.77	<0.01	**Monocots**	0.032	0.15	<0.01
Dicots	1.73*	9.51*	0.56	**Dicots**	0.35	1.90*	0.11

Single Application - Endangered Plants
2,4-D Acid and amine salts

Broadcast Spray Application 0.07 lbs ae/A/app, 2 app., 7 day interval				Adjusted Band Application (0.014 lbs ae/A/app, 2 app., 30 day interval)			
	Emergence RQs		Drift RQs		Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas		Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	0.28	2.38*	0.09	**Monocots**	0.06	0.5	0.02
Dicots	4.52*	38.39*	0.35	**Dicots**	0.90	7.68*	0.07

Table 35: Non-target Plant Risk Quotient Comparison of Broadcast Spray Applications to Adjusted Band Applications[a] to Selected Row Crops.

Single Application - Endangered Plants
2,4-D Esters

Broadcast Spray Application 0.07 lbs ae/A/app, 2 app., 7 day interval				Adjusted Band Application (0.014 lbs ae/A/app, 2 app., 7 day interval)			
	Emergence RQs		Drift RQs		Emergence RQs		Drift RQs
	Adjacent Areas	Semi-Aquatic Areas	All Areas		Adjacent Areas	Semi-Aquatic Areas	All Areas
Monocots	0.25	1.37*	0.03	**Monocots**	0.05	0.27	0.01
Dicots	2.98*	16.38*	0.11	**Dicots**	0.60	3.58*	0.02

[a] Assumed 6 inch band width to a 30 in row space.

Granular Exposures`

Applications of granular formulations may pose risks to terrestrial plants inhabiting dry and semi-aquatic areas. Exposure is assumed to be from runoff only, and drift is assumed not to occur with granular applications of pesticides. Therefore, EFED's runoff scenario is essentially the same as that used in the non-granular scenario described above, with the exception that the drift component is removed. The estimated environmental concentrations and RQs are calculated below.

Non-endangered Plant Risk Quotients - Single Applications of Granular Formulations (2,4-D Acid and amine salts)

The estimated environmental concentrations for the acid and amine salts for dry and semi-aquatic areas are tabulated below for single applications to the targeted use sites. As discussed above, the % runoff value based on water solubility is assumed to be 0.05. According to the master label the only crops which allow applications of granular formulations are the non-crop land sites, turf, and

cranberries.

Table F-36: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for a Single Application of Granular Formulations of the 2,4-D Acid, salt, or Amine.						
Site/ Application Method/ Rate of Application in lbs ai/A	**Minimum Incorporation Depth (cm)**	**Runoff Value**	**Sheet Run-off (lbs ae/A)**	**Channelized Runoff (lbs ae/A)**	**Total Loading to Adjacent Area (Sheet Run-off)**	**Total Loading to Semi-aquatic Area (Channel Run-off)**
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)						
4	0	0.05	0.2	2	0.2	2
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)						
2	0	0.05	0.1	1	0.1	1
Cranberry - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)						
4	0	0.05	0.2	2	0.2	2

The RQs for the acid and amine salts for resulting from single applications of granular formulations for non-endangered and endangered species are tabulated below.

Table F-37: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Granular Applications of the 2,4-D Acid and amine salts								
			Plants Adjacent to Treated Sites				Plants in Semi-aquatic Areas	
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Loading(Sheet runoff) (lb ai/ac)	RQ[a]		Total Loading (Channel runoff) (lb ai/ac)	RQ[a]	
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *ground Applicaations* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.026	0.2	7.69	*	2.0	76.92	*
	Dicot	0.045	0.2	4.44	*	2.0	44.44	*
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)								
Seed Emerg.	Monocot	0.026	0.1	3.85	*	1.0	38.46	*
	Dicot	0.045	0.1	2.22	*	1.0	22.22	*
Cranberry - *Ground Aoplications* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.026	0.2	7.69	*	2.0	76.92	*
	Dicot	0.045	0.2	4.44	*	2.0	44.44	*

[a] * indicates an exceedance of Acute Risk LOC.

Table F-38-: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Granular Applications of 2,4-D Acid and amine salts								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, NOEC or EC_{05} (lb ai/ac)	Total Loading(Sheet runoff) (lb ai/ac)	RQ[a]		Total Loading (Channel runoff) (lb ai/ac)	RQ[a]	
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *ground Applicaations* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.015	0.2	13.33	*	2.0	133.33	
	Dicot	<0.045	0.2	> 4.44	*	2.0	> 44.44	
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)								
Seed Emerg.	Monocot	0.015	0.1	6.67	*	1.0	66.67	
	Dicot	<0.045	0.1	> 2.22	*	1.0	> 22.22	
Cranberry - *Ground Aoplications* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.015	0.2	13.33	*	2.0	133.33	
	Dicot	<0.045	0.2	> 4.44	*	2.0	> 44.44	

[a] Indicates acute risk to endangered plants

Non-endangered Plant Risk Quotients - Single Applications of Granular Formulations (2,4-D Esters)

The estimated environmental concentrations for the 2,4-D esters for dry and semi-aquatic areas are tabulated below for single applications to the targeted use sites. As discussed above, the % runoff value based on the low water solubility of the esters is assumed to be 0.01.

Table F-39: Estimated Environmental Concentrations (lbs ae/A) For Dry and Semi-Aquatic Areas for a Single Application of Granular Formulations of the 2,4-D Esters.						
Site/ Application Method/ Rate of Application in lbs ai/A	**Minimum Incorporation Depth (cm)**	**Runoff Value**	**Sheet Run-off (lbs ae/A)**	**Channelized Runoff (lbs ae/A)**	**Total Loading to Adjacent Area (Sheet Run-off)**	**Total Loading to Semi-aquatic Area (Channel Run-off)**
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)						
4	0	0.01	0.04	0.4	0.04	0.4
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)						
2	0	0.01	0.02	0.2	0.02	0.2
Cranberry - *Ground Applications* (4.0 lbs ae/A/app, 1 app.,)						
4	0	0.01	0.04	0.4	0.04	0.4

The RQs for the 2,4-D esters from single applications of granular formulations for non-endangered and endangered species are tabulated below.

Table F-40: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations For Single Applications of Granular Formulations of 2,4-D Esters						
			Plants Adjacent to Treated Sites		Plants in Semi-aquatic Areas	
Scenario		Toxicity Threshold, EC_{25} (lb ai/ac)	Total Loading(Sheet runoff) (lb ai/ac)	RQ[a]	Total Loading (Channel runoff) (lb ai/ac)	RQ[a]
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *ground Applicaations* (4.0 lbs ae/A/app, 1 app.,)						
Seed Emerg.	Monocot	0.010	0.04	4.00*	0.4	40.00*
	Dicot	0.00081	0.04	49.38*	0.4	493.83*
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)						
Seed Emerg.	Monocot	0.010	0.02	2.00*	0.2	20.00*
	Dicot	0.00081	0.02	24.69*	0.2	246.91*
Cranberry - *Ground Aoplications* (4.0 lbs ae/A/app, 1 app.,)						
Seed Emerg.	Monocot	0.010	0.04	4.00*	0.4	40.00*
	Dicot	0.00081	0.04	49.38*	0.4	493.83*

* indicates an exceedance of Acute Risk LOC.

Table F-41: Acute Endangered Terrestrial Plant Risk Quotient Calculations For Single Applications of Granular Formulations of 2,4-D Esters								
			Plants Adjacent to Treated Sites			Plants in Semi-aquatic Areas		
Scenario		Toxicity Threshold, NOEC (lb ai/ac)	Total Loading(Sheet runoff) (lb ai/ac)	RQ[a]		Total Loading (Channel runoff) (lb ai/ac)	RQ[a]	
Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, industrial sites, etc.) - *ground Applicaations* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.0056	0.04	7.14	***	0.4	71.43	***
	Dicot	0.00047	0.04	85.11	***	0.4	851.06	***
Turf (Golf courses, residential lawns, grasses grown for seed, and sod) - *Ground Applications* (2.0 lbs ae/A/app, 2 app., 30 day interval)								
Seed Emerg.	Monocot	0.0056	0.02	3.57	***	0.2	35.71	***
	Dicot	0.00047	0.02	42.55	***	0.2	425.53	***
Cranberry - *Ground Aoplications* (4.0 lbs ae/A/app, 1 app.,)								
Seed Emerg.	Monocot	0.0056	0.04	7.14	***	0.4	71.43	***
	Dicot	0.00047	0.04	85.11	***	0.4	851.06	***

[a] * indicates an exceedance of Acute Risk LOC.

Multiple Broadcast Applications of Granular Formulations

Only the turf uses of the 2,4-D granular formulations on the 2,4-D Master Label allow a second application at a 30 day interval. In this scenario the RQs would be expected to double. This would indicate that the RQs range from 4.0 for endangered monocots to 1702 for non-endangered plants.

Banded Granular Applications - Banded granular applications are typically applied to row crops, and since the master label only allows granular applications to non-cropland, turf, and cranberries, there are no banded applications of granular formulations of 2,4-D

APPENDIX G: Status of Fate and Ecological Effects Data Requirements for Chemical Forms of 2,4-D

Table G-1: Environmental Fate Data Requirements for 2,4-D			
Guideline #	**Data Requirement**	**2,4-D acid**	**Study Classification**
161-1	Hydrolysis	410073-01	acceptable
161-2	Photodegradation in Water	411253-06	acceptable
161-3	Photodegradation on Soil	411253-05	acceptable
161-4	Photodegradation in Air		waived
162-1	Aerobic Soil Metabolism	431675-01	acceptable
162-2	Anaerobic Soil Metabolism	433560-01	acceptable
162-3	Anaerobic Aquatic Metabolism	415579-01 433560-01	acceptable
162-4	Aerobic Aquatic Metabolism	420453-01 429792-01 441886-01	acceptable
		420253-02 441179-01	
163-1	Leaching-Adsorption/Desorption	441585-01 (2,4-DCA)	acceptable
		441052-01 (2,4-DCP)	
163-2	Laboratory Volatility		waived
163-3	Field Volatility		waived
164-1	Terrestrial Field Dissipation		reserved
164-2	Aquatic Field Dissipation		reserved
164-3	Forestry Dissipation		reserved
165-4	Accumulation in Fish		waived
165-5	Accumulation- aquatic non-target		waived
166-1	Ground Water- small prospective		reserved
201-1	Droplet Size Spectrum		a
202-1	Drift Field Evaluation		a

[a] Member of Spray-Drift Task Force.

Table G-1: Environmental Fate Data Requirements for 2,4-D							
Guideline #	**Data Requirement**	**2,4-D BEE**	**Study Classification**	**2,4-D IPE**	**Study Classification**	**2,4-D EHE**	**Study Classification**
161-1	Hydrolysis	413537-01 414831-01	acceptable	413496-01 434412-01	acceptable	427354-01 427705-02 427705-01	acceptable
161-2	Photodegradation in Water	414831-02	acceptable		waived	427497-02	acceptable
161-3	Photodegradation on Soil		waived		waived	427497-02	acceptable
161-4	Photodegradation in Air	414831-03	supplemental		waived		waived
162-1	Aerobic Soil Metabolism	437991-01 (moeity)	acceptable	431496-01 (moeity)	acceptable	434159-01	acceptable
162-2	Anaerobic Soil Metabolism		reserved		reserved	434159-01 (moeity)	acceptable
162-3	Anaerobic Aquatic Metabolism	425747-01 437991-03 (moeity)	acceptable	436063-01 (moeity)	acceptable		reserved
162-4	Aerobic Aquatic Metabolism	437991-06 (moeity)	acceptable	431496-01 (moeity)	acceptable	436910-01 (moeity)	acceptable
163-1	Leaching-Adsorption/Desorption		waived		waived		waived
163-2	Laboratory Volatility	417180-01	acceptable		reserved	420596-01	acceptable

Table G-1: Environmental Fate Data Requirements for 2,4-D							
Guideline #	**Data Requirement**	**2,4-D BEE**	**Study Classification**	**2,4-D IPE**	**Study Classification**	**2,4-D EHE**	**Study Classification**
163-3	Field Volatility		reserved		reserved		waived
164-1	Terrestrial Field Dissipation		reserved		reserved	435146-01 435334-01 435428-01 436406-01 437052-02 437624-04 437624-03 437624-01 438317-02 438317-01 438491-02 438640-01 439147-01 438727-03 437634-02 446031-01 (stor. stab.)	supplemental
164-2	Aquatic Field Dissipation	445250-01	supplemental		reserved		reserved
164-3	Forestry Dissipation		reserved		reserved	439083-03 439271-01	supplemental
165-4	Accumulation in Fish		waived		waived		waived
165-5	Accumulation-aquatic non-target		waived		waived		waived

Table G-1: Environmental Fate Data Requirements for 2,4-D							
Guideline #	**Data Requirement**	**2,4-D BEE**	**Study Classification**	**2,4-D IPE**	**Study Classification**	**2,4-D EHE**	**Study Classification**
166-1	Ground Water-small prospective		reserved		reserved		reserved
201-1	Droplet Size Spectrum		a		a		a
202-1	Drift Field Evaluation		a		a		a

[a] Member of Spray-Drift Task Force.

Table G-1: Environmental Fate Data Requirements for 2,4-D					
Guideline #	**Data Requirement**	**2,4-D DEA**	**Study Classification**	**2,4-D DMAS**	**Study Classification**
	Dissociation study	419725-01	acceptable	413089-01	acceptable
161-1	Hydrolysis		waived		waived
161-2	Photodegradation in Water		waived		waived
161-3	Photodegradation on Soil		waived		waived
161-4	Photodegradation in Air		waived		waived
162-1	Aerobic Soil Metabolism	436859-01 (moeity)	supplemental	Open Literature (moeity)	supplemental
162-2	Anaerobic Soil Metabolism		reserved		reserved
162-3	Anaerobic Aquatic Metabolism	438829-01 (moeity)	supplemental	439083-01 (moeity)	acceptable
162-4	Aerobic Aquatic Metabolism	436859-02 (moeity) 444394-01	supplemental	437796-01 (moeity)	supplemental
163-1	Leaching-Adsorption/Desorption		waived		waived

Table G-1: Environmental Fate Data Requirements for 2,4-D					
Guideline #	**Data Requirement**	**2,4-D DEA**	**Study Classification**	**2,4-D DMAS**	**Study Classification**
163-2	Laboratory Volatility		waived		waived
163-3	Field Volatility		waived		waived
164-1	Terrestrial Field Dissipation		reserved	434704-01 (436697-02) 435003-01 (436697-01) 435928-02 436121-01 436768-03 437052-01 437979-02 438107-01 438317-03 438343-01 438491-01 438640-02 438727-02 438727-01 438724-01 446031-02 (stor. stab.)	supplemental
164-2	Aquatic Field Dissipation		reserved	439083-02 439547-01 434916-01	supplemental
164-3	Forestry Dissipation		reserved	439547-02	supplemental

Table G-1: Environmental Fate Data Requirements for 2,4-D					
Guideline #	**Data Requirement**	**2,4-D DEA**	**Study Classification**	**2,4-D DMAS**	**Study Classification**
165-4	Accumulation in Fish		waived		waived
165-5	Accumulation-aquatic non-target		waived		waived
166-1	Ground Water-small prospective		reserved		reserved
201-1	Droplet Size Spectrum		a		a
202-1	Drift Field Evaluation		a		a

[a] Member of Spray-Drift Task Force.

Table G-1: Environmental Fate Data Requirements for 2,4-D					
Guideline #	**Data Requirement**	**2,4-D TIPA**	**Study Classification**	**2,4-D IPA**	**Study Classification**
	Dissociation study	413537-02	acceptable	413537-02	acceptable
161-1	Hydrolysis		waived		waived
161-2	Photodegradation in Water		waived		waived
161-3	Photodegradation on Soil		waived		waived
161-4	Photodegradation in Air		waived		waived
162-1	Aerobic Soil Metabolism	437991-02 (moeity)	acceptable	438215-01 (moeity)	supplemental
162-2	Anaerobic Soil Metabolism		reserved		reserved
162-3	Anaerobic Aquatic Metabolism	437991-05 (moeity)	acceptable	437991-04 (moeity)	supplemental
162-4	Aerobic Aquatic Metabolism	437991-08 (moeity)	supplemental	437991-07 (moeity)	supplemental
163-1	Leaching-Adsorption/Desorption		waived		waived
163-2	Laboratory Volatility		waived		waived
163-3	Field Volatility		waived		waived

Table G-1: Environmental Fate Data Requirements for 2,4-D					
Guideline #	**Data Requirement**	**2,4-D TIPA**	**Study Classification**	**2,4-D IPA**	**Study Classification**
164-1	Terrestrial Field Dissipation		reserved		reserved
164-2	Aquatic Field Dissipation		reserved		reserved
164-3	Forestry Dissipation		reserved		reserved
165-4	Accumulation in Fish		waived		waived
165-5	Accumulation- aquatic non-target		waived		waived
166-1	Ground Water- small prospective		reserved		reserved
201-1	Droplet Size Spectrum		a		a
202-1	Drift Field Evaluation		a		a

[a] Member of Spray-Drift Task Force.

Table G-2: Ecological Effects Data Requirements for 2,4-D					
Guideline #		**Data Requirement**	**Formulation**	**MRID #'s**	**Study Classification**
71-1	850.21	Avian Oral LD_{50}	2,4-D Acid	415462-02	Core
			DEA	419751-01	Core
			DMA	415462-01	Core
			DMA	233351	Core
			IPA	00138871	Supplemental
			TIPA	416444-01	Core
			BEE	414541-01	Core
			2-EHE	411583-03	Core
			2-EHE	72472	Core
			2-EHE	226397	Core
			IPE	439350-01	Core
71-2	850.22	Avian Dietary LC_{50}	2,4-D Acid	415861-01	Core
			2,4-D Acid	415462-02	Core
			Sodium Salt	waived	n/a
			DEA	419751-02	Core
			DEA	419751-03	Core
			DMA	417495-01	Core
			DMA	233351	Core
			DMA	417495-02	Core
			IPA	00138870	Core
			IPA	00138872	Core
			TIPA	416444-02	Core
			TIPA	416444-03	Core
			BEE	414484-01	Core
			BEE	414290-07	Core
			2-EHE	411583-05	Core
			2-EHE	45070	Core
			2-EHE	411583-04	Core
			2-EHE	226397	Core
			IPE	439349-01	Core
			IPE	439352-01	Core

Table G-2: Ecological Effects Data Requirements for 2,4-D					
Guideline #		**Data Requirement**	**Formulation**	**MRID #'s**	**Study Classification**
71-4	850.23	Avian Reproduction	2,4-D Acid	453364-01	Core
			All other formulations	waived	n/a
72-1	850.1075	Freshwater Fish LC_{50}	2,4-D Acid	411583-01	Supplemental
			2,4-D Acid	411583-01	Supplemental
			2,4-D Acid	411583-01	Supplemental
			Sodium salt	53986	Core
			DEA	419751-05	Core
			DEA	419751-04	Supplemental
			DEA	0073-091-01	Core
			DMA	233350	Core
			DMA	411583-11	Core
			DMA	419751-04	Core
			DMA	234027	Supplemental
			DMA	419751-04	Core
			IPA	01338869	Core
			IPA	01338869	Core
			IPA	01338869	Supplemental
			TIPA	413538-03	Core
			TIPA	413538-04	Core
			BEE[a]	413538-01	Core
			BEE	00050674	Supplemental
			BEE	00050674	Supplemental
			BEE	0073-091-01	Supplemental
			BEE	413538-01	Core
			BEE	00053988	Supplementaal
			BEE	413538-01	Core
			2-EHE	417373-03	Core
			2-EHE	45068	Core
			2-EHE	45069	Core
			IPE	439331-01	Core
			IPE	439332-01	Core
			IPE	439307-01	Core
			IPE	439103-01	Core

Table G-2: Ecological Effects Data Requirements for 2,4-D					
Guideline #		**Data Requirement**	**Formulation**	**MRID #'s**	**Study Classification**
72-2	850.101	Freshwater Invertebrate Acute LC_{50}	2,4-D Acid	411583-01	Core
			Sodium salt	waived	n/a
			DEA	419751-06	Core
			DMA	232630	Core
			IPA	waived	n/a
			TIPA	413538-03	Core
			BEE[a]	413538-01	Core
			2-EHE	67328	Core
			IPE	xxxxxx-01	Core
72-3(a)	850.1075	Estuarine/Marine Fish LC_{50}	2,4-D Acid	429797-01	Core
			2,4-D Acid	417373-06	Core
			Sodium Salt	waived	n/a
			DEA	420183-02	Core
			DEA	419751-07	Core
			DMA	411583-10	Supplemental
			DMA	419734-01	Core
			DMA	411583-11	Core
			DMA	418252-08	Core
			DMA	232630	Supplementsal
			DMA	232630	Core
			IPA	414290-03	Core
			IPA	414290-02	Core
			TIPA	414290-06	Core
			TIPA	414290-02	Core
			BEE[a]	No data	Data gap
			2-EHE	411583-10	Supplemental
			2-EHE	418352-04	Supp;lemental
			2-EHE	418352-01	Core
			2-EHE	411583-11	Core
			2-EHE	418352-06	Supplemental
			2-EHE	418352-03	Core
			IPE	waived	n/a

Table G-2: Ecological Effects Data Requirements for 2,4-D					
Guideline #		**Data Requirement**	**Formulation**	**MRID #'s**	**Study Classification**
72-3(b)	850.1025	Estuarine/Marine Mollusk EC_{50}	2,4-D Acid	429797-01	Core
			Sodium Salt	waived	n/a
			DEA	420183-02	Core
			DMA	411583-11	Supplemental
			DMA	419734-01	Core
			IPA	414290-03	Core
			TIPA	414290-06	Core
			BEE[a]	No data	Data requirement
			2-EHE	411583-10	Supplemental
			2-EHE	418352-04	Supplemental
			2-EHE	418352-01	Core
			IPE	waived	n/a
72-3©	850.1035 850.1045	Estuarine/Marine Shrimp EC_{50}	2.,4-D Acid	417373-06	Core
			Sodium Salt	waived	n/a
			DEA	419751-07	Core
			DMA	411583-11	Core
			DMA	419252-08	Core
			DMA	232630	Supplemental
			IPA	414290-02	Core
			TIPA	414290-05	Core
			BEE[a]	No data	Data requirement
			2-EHE	411583-11	Core
			2-EHE	418352-06	Supplemental
			2-EHE	418352-03	Core
			IPE	waived	n/a
72-4(a)	850.14	Freshwater Fish Early Life-Stage	2,4-D Acid	417373-04	Core
			Sodium Salt	waived	n/a
			DEA	420183-04	Core
			DMA	417677-01	Core
			IPA	waived	n/a
			TIPA	waived	n/a
			BEE[a]	waived	n/a
			2-EHE	waived	n/a
			IPE	waived	n/a

Table G-2: Ecological Effects Data Requirements for 2,4-D					
Guideline #		**Data Requirement**	**Formulation**	**MRID #'s**	**Study Classification**
72-4(b)	850.1300 850.1350	Aquatic Invertebrate Life-Cycle	2,4-D Acid Sodium Salt DEA DMA IPA TIPA BEE[a] 2-EHE IPE	418352-11 waived 420183-03 418352-10 waived waived 413583-02 waived waived	Core n/a Core Supplemental n/a n/a Core n/a n/a
72-5	850.15	Freshwater Fish Full Life-Cycle	2,4-D Acid Sodium Salt DEA DMA IPA TIPA BEE[a] 2-EHE IPE	waived waived waived waived waived waived 413457-01 417373–05 waived	n/a n/a n/a n/a n/a n/a Core Supplemental n/a
122-1(a)	850.41	Seed Germ./Seedling Emergence	Tier 1 studies waived due to performance of Tier 2 studies		
122-1(b)	850.415	Vegetative Vigor	Tier 1 studies waived due to performance of Tier 2 studies		
122-2	850.44	Aquatic Plant Growth	Tier 1 studies waived due to performance of Tier 2 studies		

Table G-2: Ecological Effects Data Requirements for 2,4-D					
Guideline #		**Data Requirement**	**Formulation**	**MRID #'s**	**Study Classification**
123-1(a)	850.4225	Seed Germ./Seedling Emergence[b]	2,4-D Acid	424168-02	Core
			Sodium Salt	waived	n/a
			DEA	426091-1	Core
			DEA	442756-01	Core
			DMA	430167-02	Supplemental
			DMA	423895-01	Core
			DMA	423895-01	Core
			IPA	431970-03	Core
			TIPA	431970-02	Core
			BEE	431970-01	Supplemental
			2-EHE	424492-01	Core
			IPE	439821-01	Core
123-1(b)	850.425	Vegetative Vigor[b]	2,4-D Acid	424168-01	Core
			Sodium Salt	waived	n/a
			DEA	426091-02	Core
			DMA	waived	n/a
			IPA	waived	n/a
			TIPA	waived	n/a
			BEE	waived	n/a
			2-EHE	423439-02	Core
			IPE	437882-01	Core
			IPE	426693-04	Core
			IPE	439821-01	Supplemental

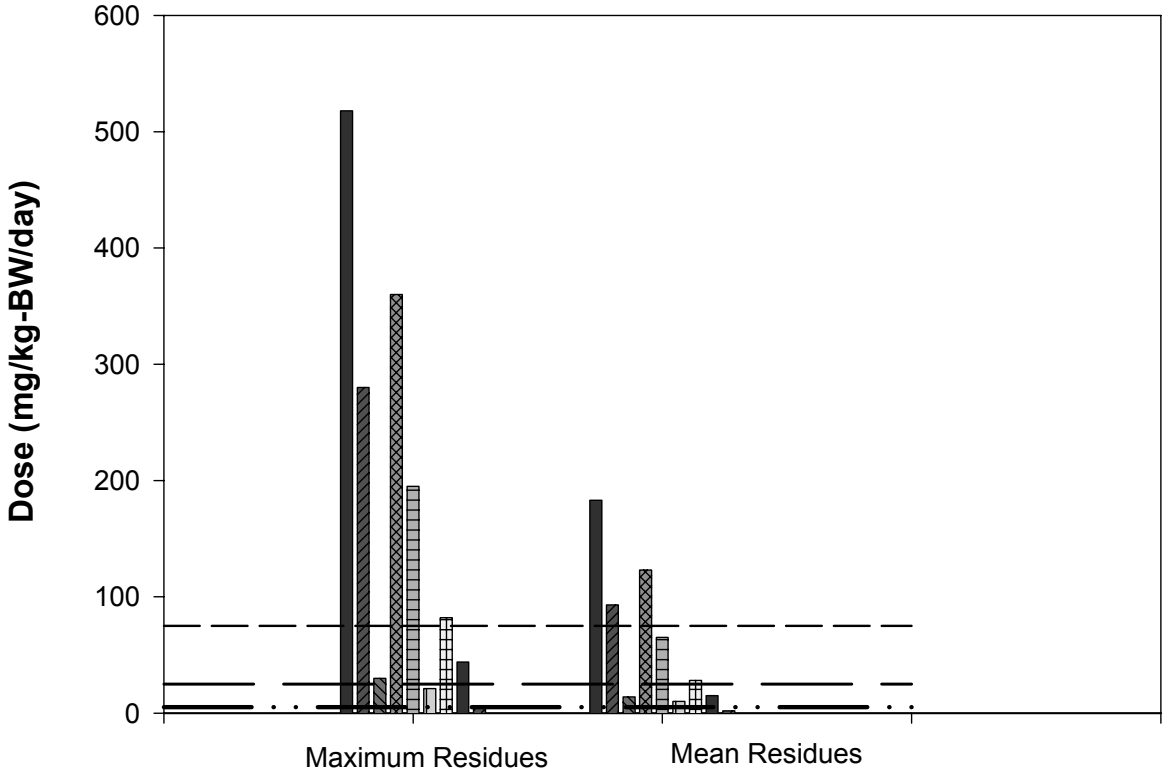
Table G-2: Ecological Effects Data Requirements for 2,4-D					
Guideline #		**Data Requirement**	**Formulation**	**MRID #'s**	**Study Classification**
123-2	850.44	Aquatic Plant Growth[a]	2,4-D Acid	442951-01	Core[c]
			Sodium Salt	waived	n/a
			DEA	427122-04	Core
			DEA	427122-05	Core
			DEA	427122-01	Core
			DEA	427122-02	Core
			DEA	427122-03	Core
			DMA	415059-04	Core
			DMA	414200-02	Core
			DMA	415059-01	Core
			DMA	415059-03	Core
			DMA	415059-02	Core
			IPA	417321-02	Core
			TIPA	434886-02	Core
			TIPA	417321-01	Core
			TIPA	434886-03	Core
			TIPA	434886-04	Core
			TIPA	434886-01	Core
			BEE	420684-04	Core
			BEE	417321-02	Core
			BEE	420684-04	Core
			BEE	420684-03	Core
			2-EHE	417352-03	Core
			2-EHE	417352-06	Core
			2-EHE	417352-04	Core
			2-EHE	417352-05	Core
			2-EHE	417352-02	Core
			IPE	waived	n/a

Table G-2: Ecological Effects Data Requirements for 2,4-D					
Guideline #		**Data Requirement**	**Formulation**	**MRID #'s**	**Study Classification**
141-1	850.302	Honey Bee Acute Contact LD_{50}	2,4-D Acid	waived	n/a
			Sodium Salt	waived	n/a
			DEA	waived	n/a
			DMA	445173-04	Core
			IPA	waived	n/a
			TIPA	waived	n/a
			BEE	waived	n/a
			2-EHE	445173-01	Core
			IPE	waived	n/a
141-2	850.303	Honey Bee Residue on Foliage	2,4-D Acid	waived	n/a
			Sodium Salt	waived	n/a
			DEA	waived	n/a
			DMA	waived	n/a
			IPA	waived	n/a
			TIPA	waived	n/a
			BEE	waived	n/a
			2-EHE	waived	n/a
			IPE	waived	n/a

[a] Additional testing may be required due to direct the direct application to water use.
[b] Additional testing is required on a typical end use product (TEP) for either the 2,4-D acid or one of the salts or amines and one of the esters.
[C] Duckweed was the only species tested.

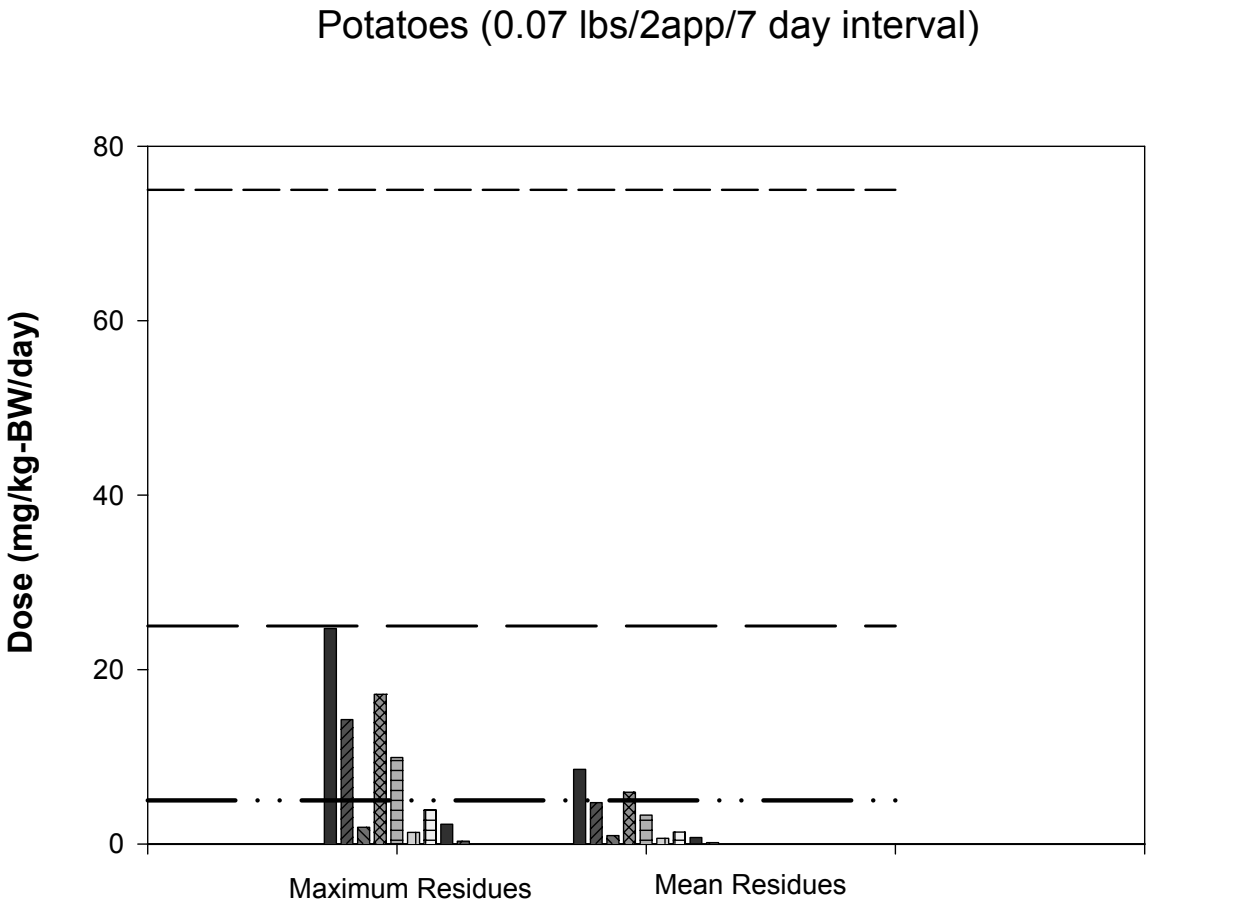
APPENDIX H: Comparisons of Daily Dose Estimates with Selected Endpoints

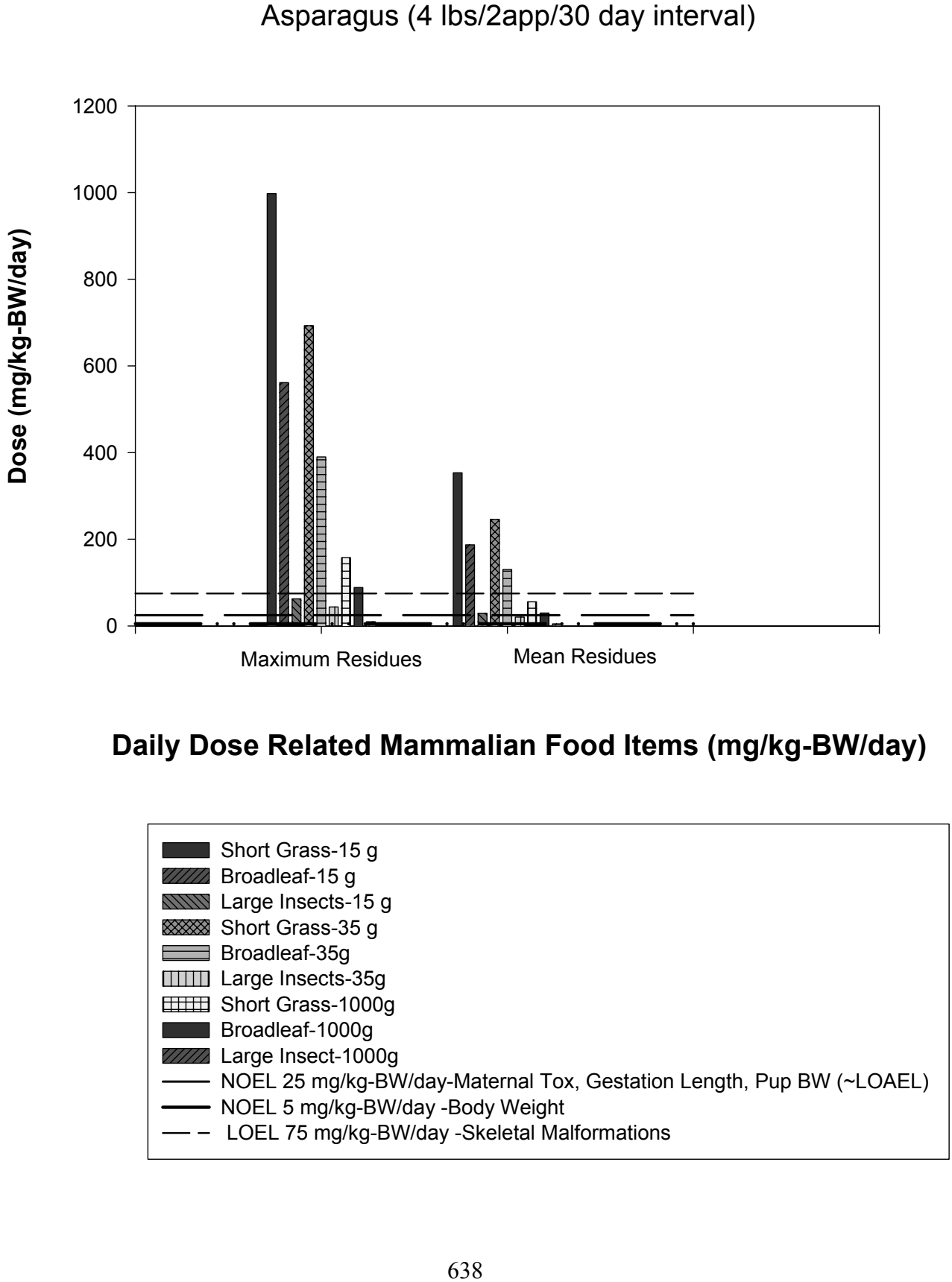
Pasture,Rangeland, Grassland (2 lbs ae/A/app* 2apps-30 day interval)



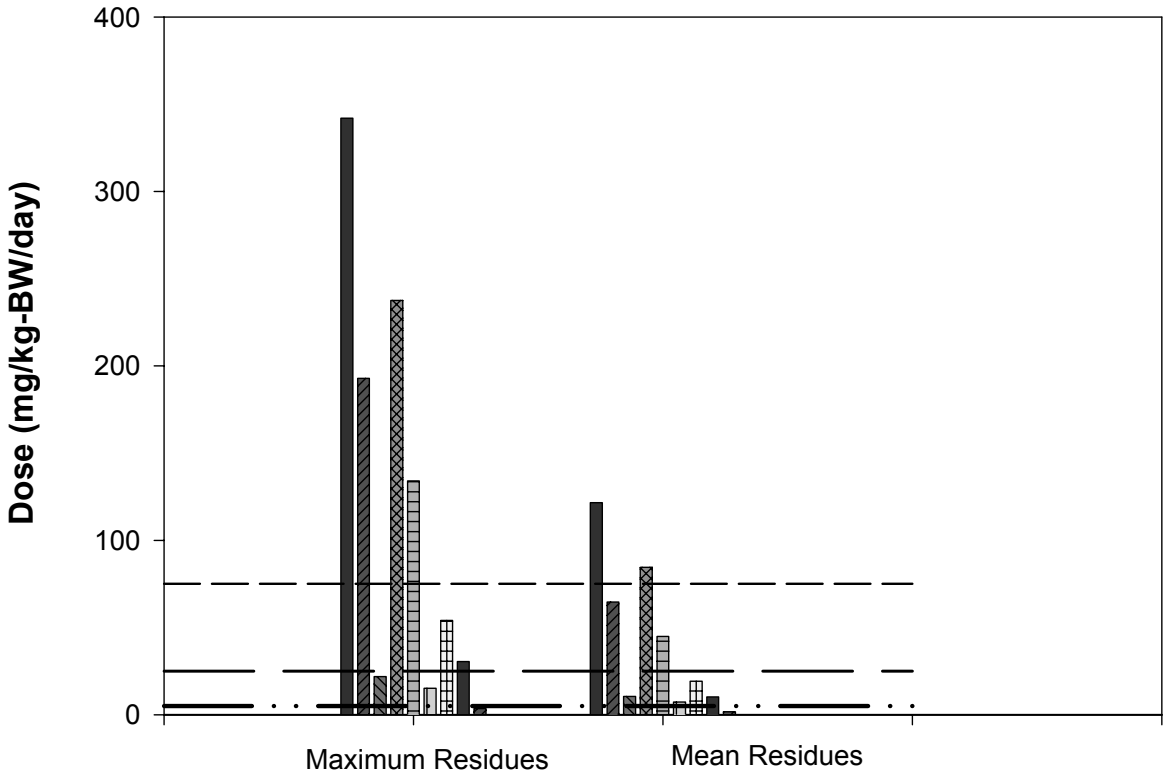
Daily Dose Related Mammalian Food Items (mg/kg-BW/day)

Short Grass-15 g
Broadleaf-15 g
Large Insects-15 g
Short Grass-35 g
Broadleaf-35g
Large Insects-35g
Short Grass-1000g
Broadleaf-1000g
Large Insect-1000g
NOEL 25 mg/kg-BW/day-Maternal Tox, Gestation Length, Pup BW (~LOAEL)
NOEL 5 mg/kg-BW/day -Body Weight
LOEL 75 mg/kg-BW/day -Skeletal Malformations


Potatoes (0.07 lbs/2app/7 day interval)
Dose (mg/kg-BW/day)
80
60
40
20
0
Maximum Residues
Mean Residues
Daily Dose Related Mammalian Food Items (mg/kg-BW/day)
Short Grass-15 g
Broadleaf-15 g
Large Insects-15 g
Short Grass-35 g
Broadleaf-35g
Large Insects-35g
Short Grass-1000g
Broadleaf-1000g
Large Insect-1000g
NOEL 25 mg/kg-BW/day-Maternal Tox, Gestation Length, Pup BW (~LOAEL)
NOEL 5 mg/kg-BW/day -Body Weight
LOEL 75 mg/kg-BW/day -Skeletal Malformations


Asparagus (4 lbs/2app/30 day interval)
Dose (mg/kg-BW/day)
1200
1000
800
600
400
200
0
Maximum Residues
Mean Residues
Daily Dose Related Mammalian Food Items (mg/kg-BW/day)
Short Grass-15 g
Broadleaf-15 g
Large Insects-15 g
Short Grass-35 g
Broadleaf-35g
Large Insects-35g
Short Grass-1000g
Broadleaf-1000g
Large Insect-1000g
NOEL 25 mg/kg-BW/day-Maternal Tox, Gestation Length, Pup BW (~LOAEL)
NOEL 5 mg/kg-BW/day -Body Weight
LOEL 75 mg/kg-BW/day -Skeletal Malformations

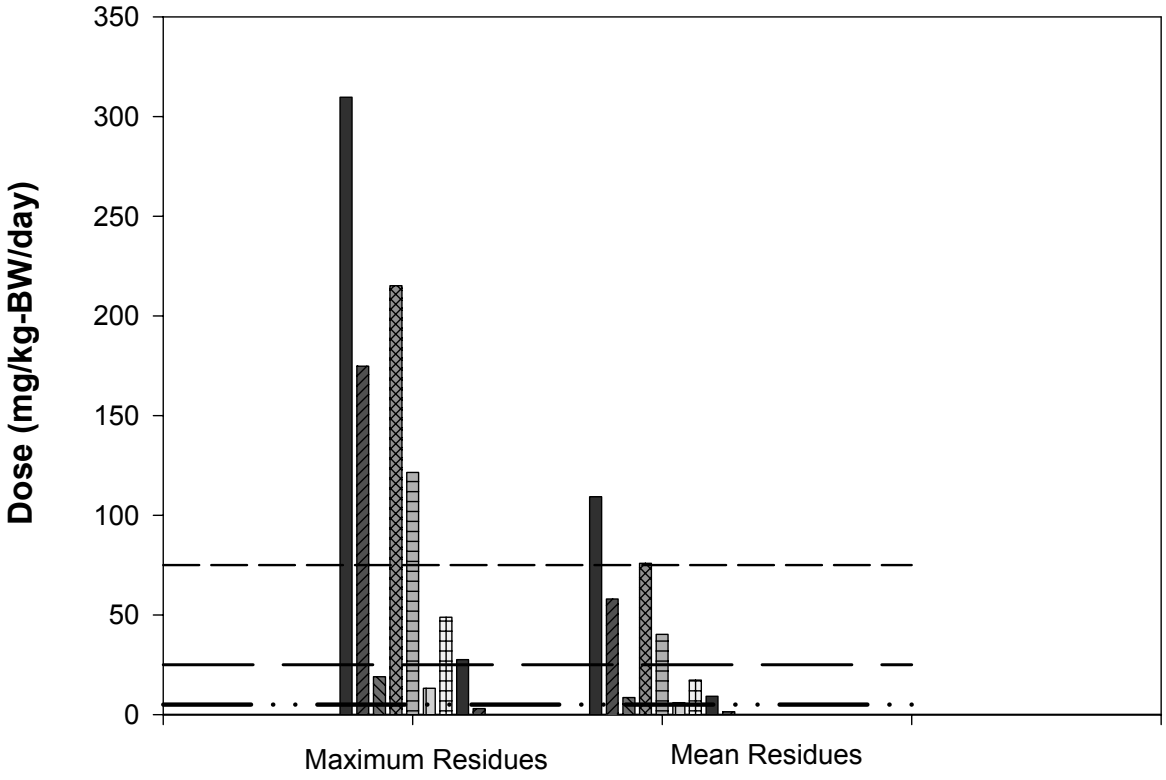
Rice (1.5 lbs/1app)



Daily Dose Related Mammalian Food Items (mg/kg-BW/day)

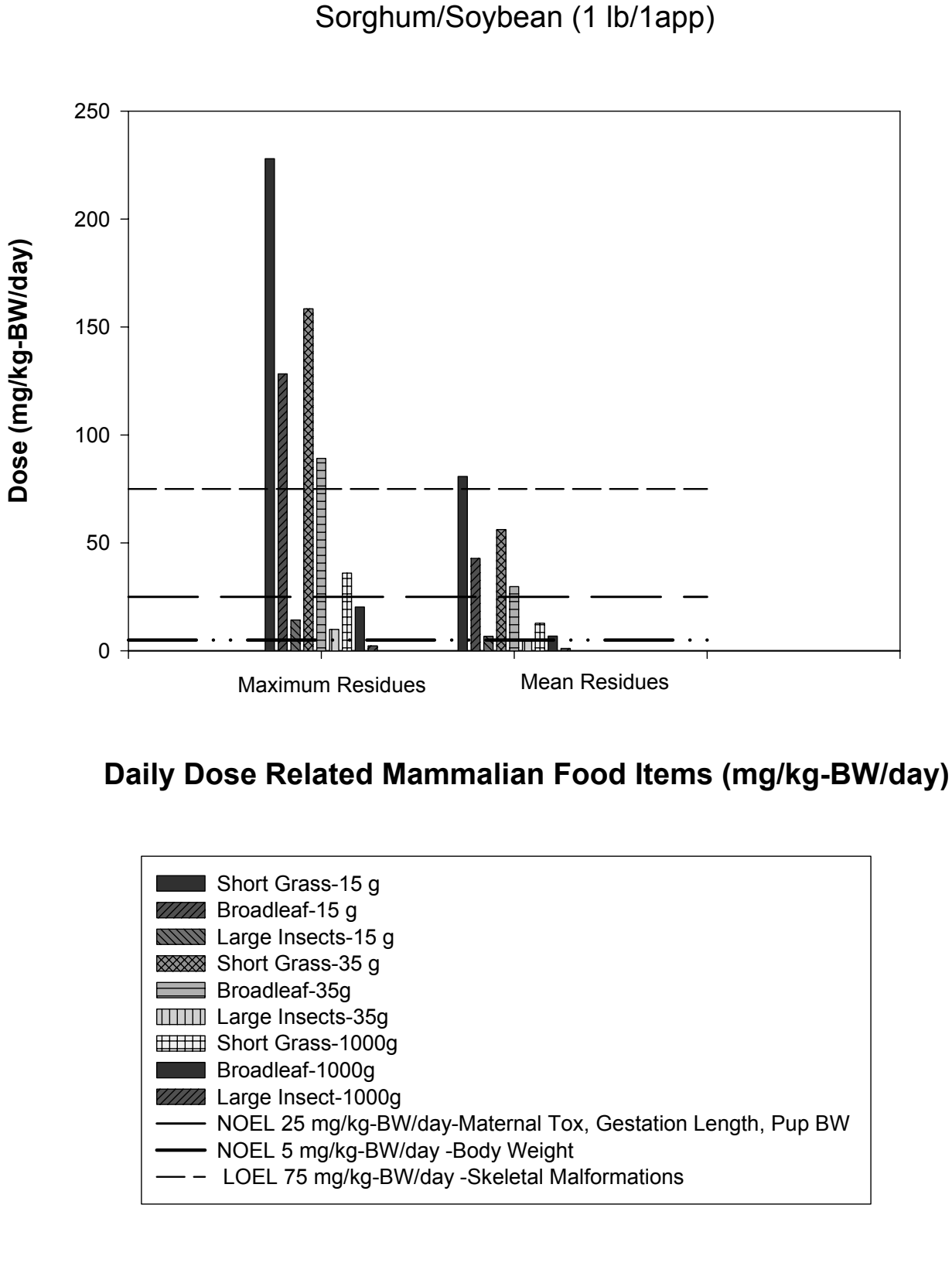
Short Grass-15 g
Broadleaf-15 g
Large Insects-15 g
Short Grass-35 g
Broadleaf-35g
Large Insects-35g
Short Grass-1000g
Broadleaf-1000g
Large Insect-1000g
NOEL 25 mg/kg-BW/day-Maternal Tox, Gestation Length, Pup BW
NOEL 5 mg/kg-BW/day -Body Weight
LOEL 75 mg/kg-BW/day -Skeletal Malformations

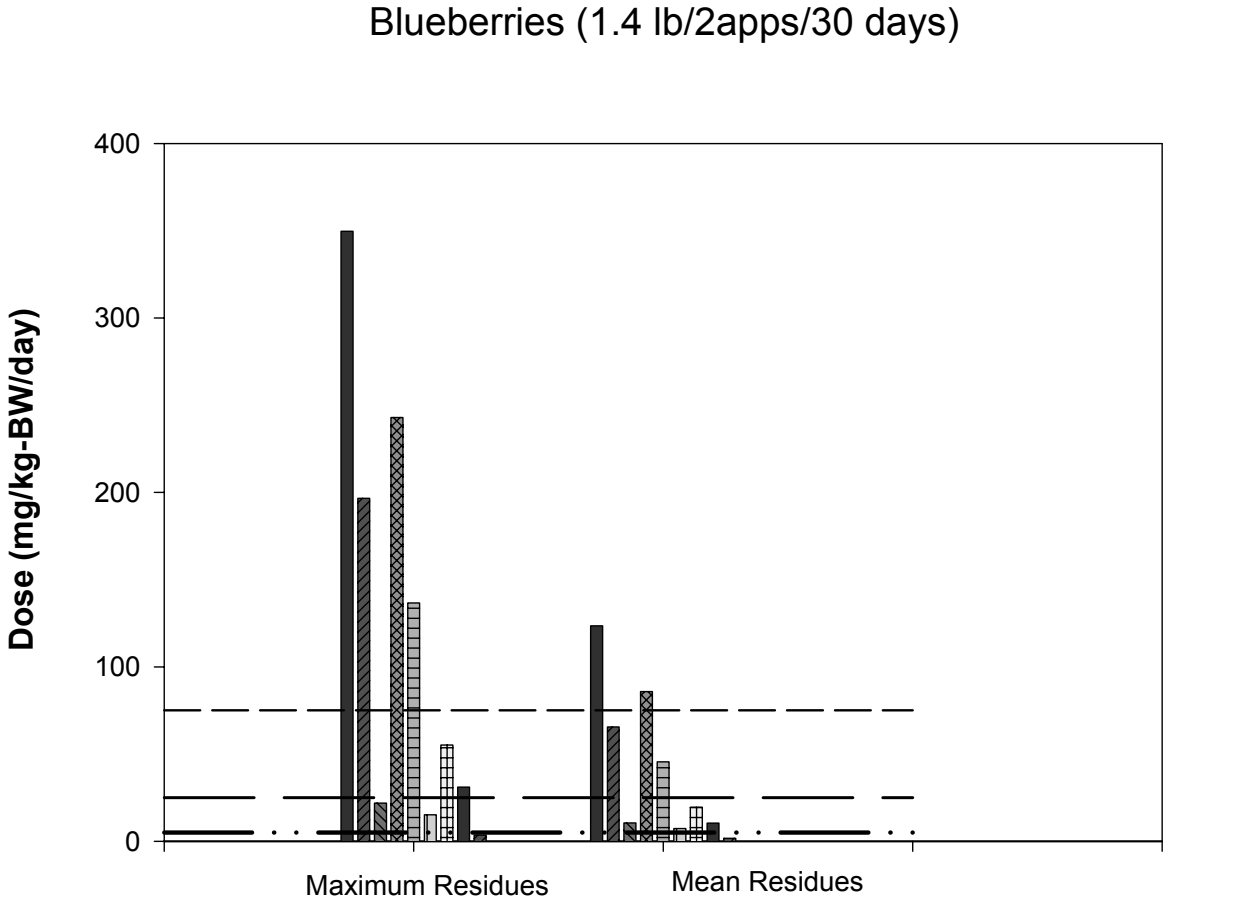
Grapes (1.36 lb/1app)

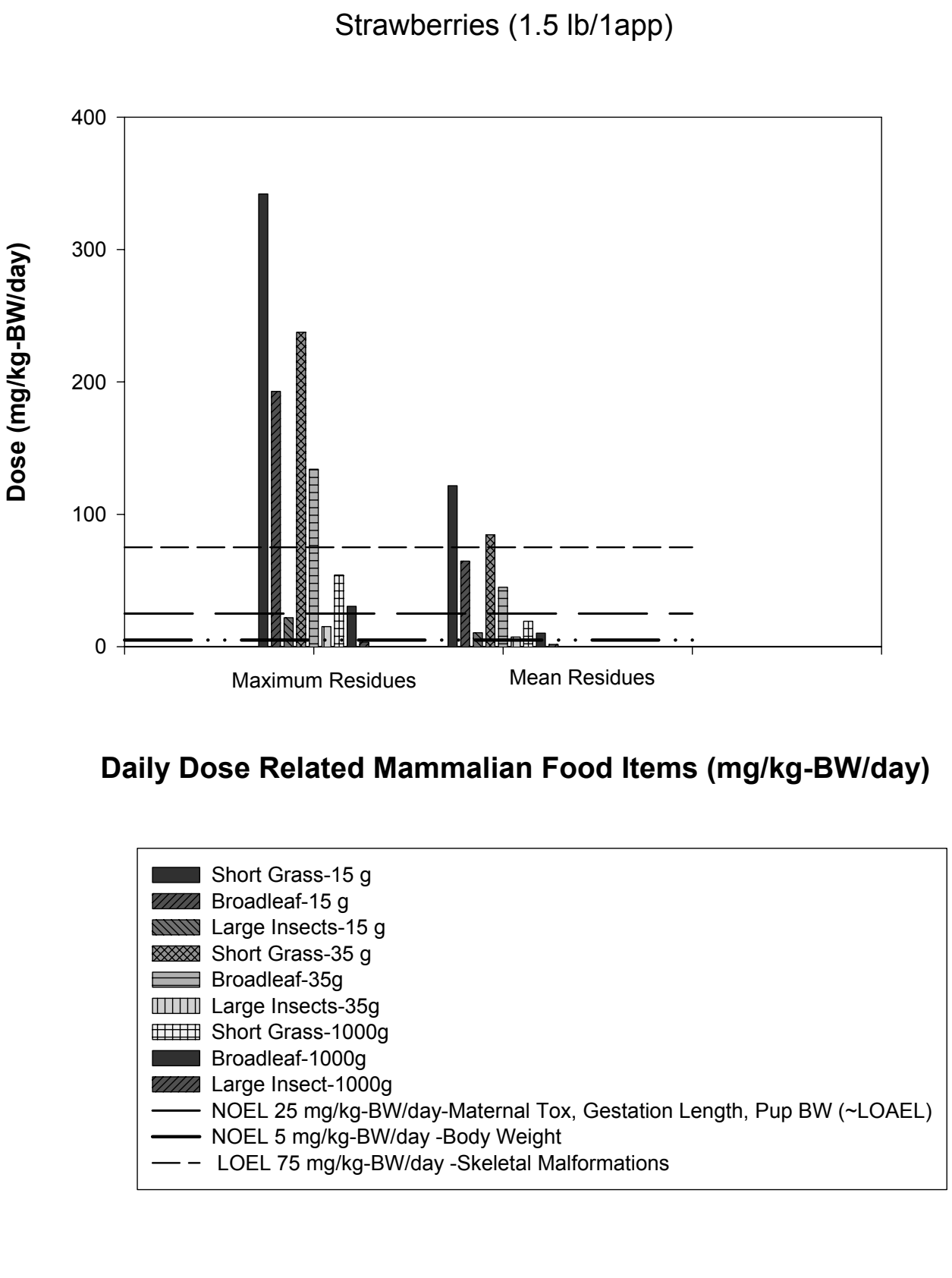


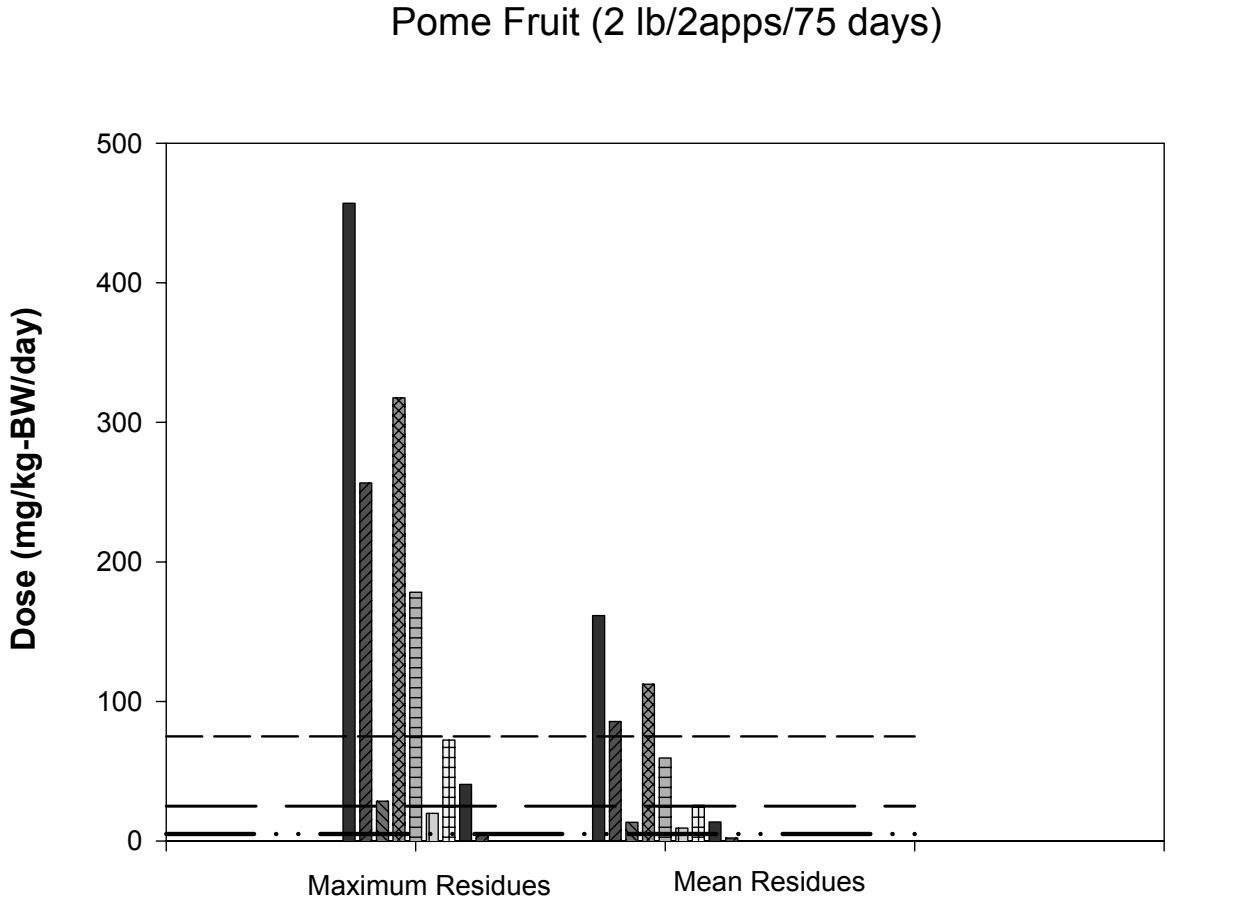
Daily Dose Related Mammalian Food Items (mg/kg-BW/day)

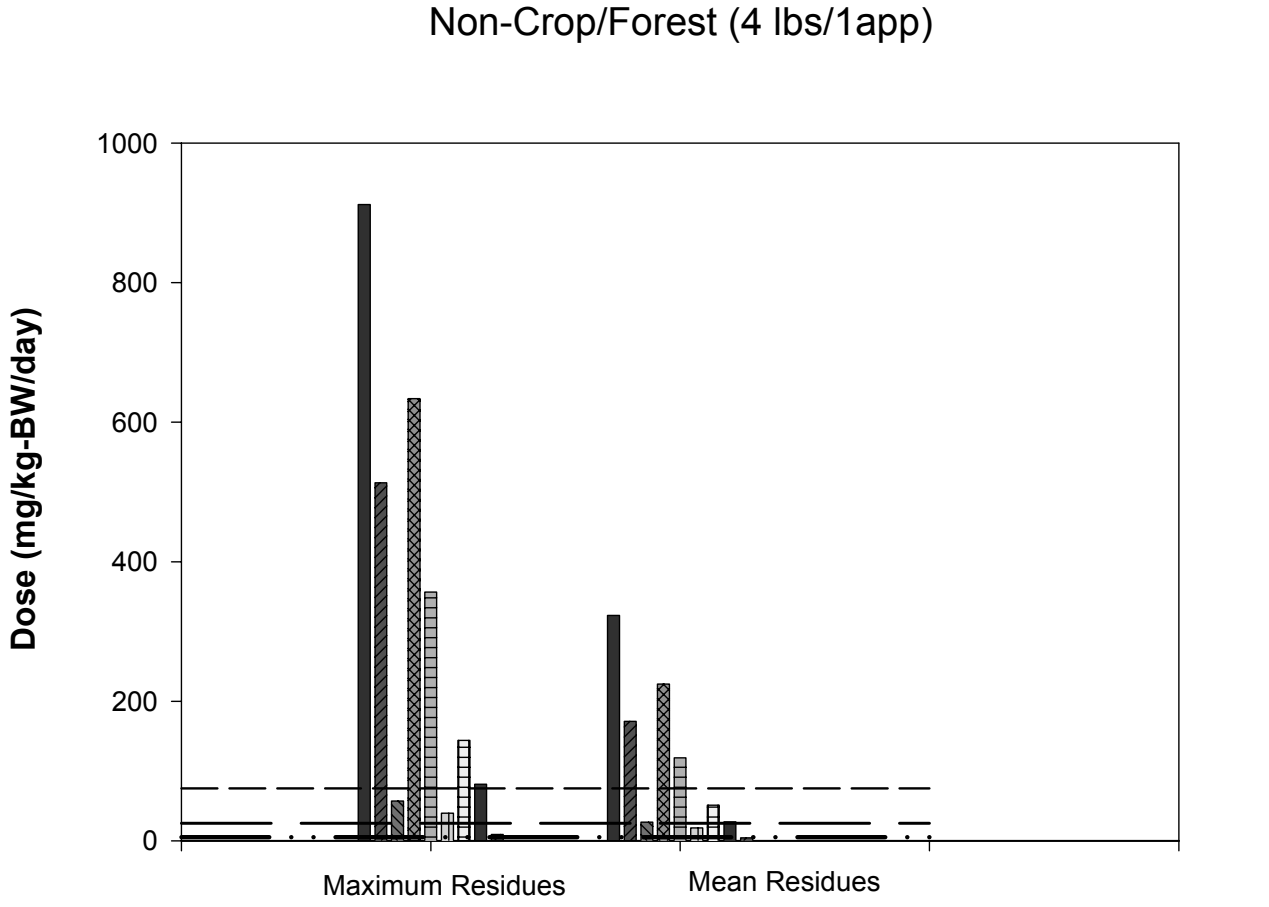
- Short Grass-15 g
- Broadleaf-15 g
- Large Insects-15 g
- Short Grass-35 g
- Broadleaf-35g
- Large Insects-35g
- Short Grass-1000g
- Broadleaf-1000g
- Large Insect-1000g
- NOEL 25 mg/kg-BW/day-Maternal Tox, Gestation Length, Pup BW (~LOAEL)
- NOEL 5 mg/kg-BW/day -Body Weight
- LOEL 75 mg/kg-BW/day -Skeletal Malformations

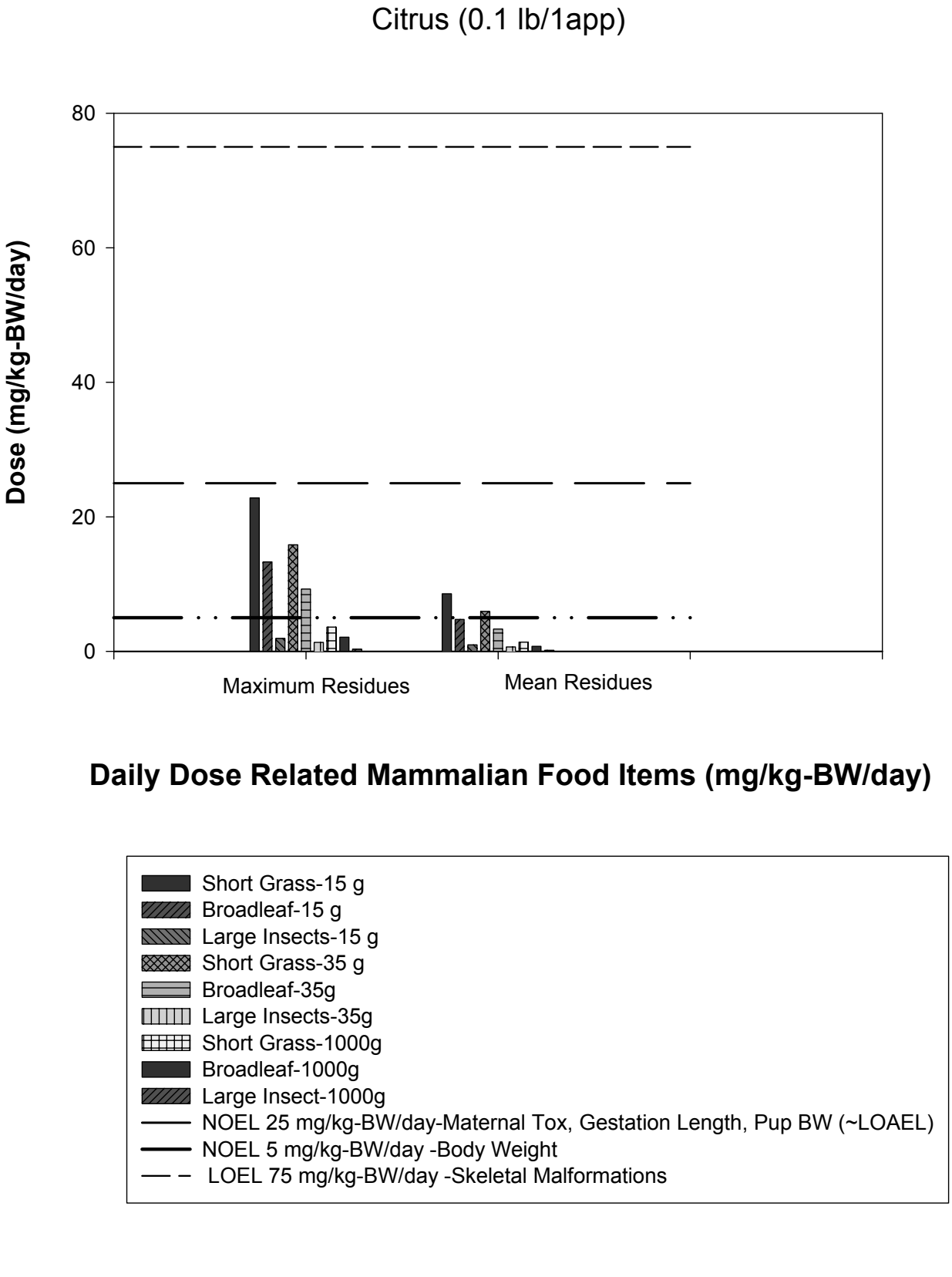

Sorghum/Soybean (1 lb/1app)
Dose (mg/kg-BW/day)
250
200
150
100
50
0
Maximum Residues
Mean Residues
Daily Dose Related Mammalian Food Items (mg/kg-BW/day)
Short Grass-15 g
Broadleaf-15 g
Large Insects-15 g
Short Grass-35 g
Broadleaf-35g
Large Insects-35g
Short Grass-1000g
Broadleaf-1000g
Large Insect-1000g
NOEL 25 mg/kg-BW/day-Maternal Tox, Gestation Length, Pup BW
NOEL 5 mg/kg-BW/day -Body Weight
LOEL 75 mg/kg-BW/day -Skeletal Malformations


Blueberries (1.4 lb/2apps/30 days)
Dose (mg/kg-BW/day)
400
300
200
100
0
Maximum Residues
Mean Residues
Daily Dose Related Mammalian Food Items (mg/kg-BW/day)
Short Grass-15 g
Broadleaf-15 g
Large Insects-15 g
Short Grass-35 g
Broadleaf-35g
Large Insects-35g
Short Grass-1000g
Broadleaf-1000g
Large Insect-1000g
NOEL 25 mg/kg-BW/day-Maternal Tox, Gestation Length, Pup BW (~LOAEL)
NOEL 5 mg/kg-BW/day -Body Weight
LOEL 75 mg/kg-BW/day -Skeletal Malformations


Strawberries (1.5 lb/1app)
Dose (mg/kg-BW/day)
400
300
200
100
0
Maximum Residues
Mean Residues
Daily Dose Related Mammalian Food Items (mg/kg-BW/day)
Short Grass-15 g
Broadleaf-15 g
Large Insects-15 g
Short Grass-35 g
Broadleaf-35g
Large Insects-35g
Short Grass-1000g
Broadleaf-1000g
Large Insect-1000g
NOEL 25 mg/kg-BW/day-Maternal Tox, Gestation Length, Pup BW (~LOAEL)
NOEL 5 mg/kg-BW/day -Body Weight
LOEL 75 mg/kg-BW/day -Skeletal Malformations


Pome Fruit (2 lb/2apps/75 days)
Dose (mg/kg-BW/day)
500
400
300
200
100
0
Maximum Residues
Mean Residues
Daily Dose Related Mammalian Food Items (mg/kg-BW/day)
Short Grass-15 g
Broadleaf-15 g
Large Insects-15 g
Short Grass-35 g
Broadleaf-35g
Large Insects-35g
Short Grass-1000g
Broadleaf-1000g
Large Insect-1000g
NOEL 25 mg/kg-BW/day-Maternal Tox, Gestation Length, Pup BW (~LOAEL)
NOEL 5 mg/kg-BW/day -Body Weight
LOEL 75 mg/kg-BW/day -Skeletal Malformations


Non-Crop/Forest (4 lbs/1app)
1000
800
600
400
200
0
Dose (mg/kg-BW/day)
Maximum Residues
Mean Residues
Daily Dose Related Mammalian Food Items (mg/kg-BW/day)
Short Grass-15 g
Broadleaf-15 g
Large Insects-15 g
Short Grass-35 g
Broadleaf-35g
Large Insects-35g
Short Grass-1000g
Broadleaf-1000g
Large Insect-1000g
NOEL 25 mg/kg-BW/day-Maternal Tox, Gestation Length, Pup BW (~LOAEL)
NOEL 5 mg/kg-BW/day -Body Weight
LOEL 75 mg/kg-BW/day -Skeletal Malformations


Citrus (0.1 lb/1app)
Dose (mg/kg-BW/day)
80
60
40
20
0
Maximum Residues
Mean Residues
Daily Dose Related Mammalian Food Items (mg/kg-BW/day)
Short Grass-15 g
Broadleaf-15 g
Large Insects-15 g
Short Grass-35 g
Broadleaf-35g
Large Insects-35g
Short Grass-1000g
Broadleaf-1000g
Large Insect-1000g
NOEL 25 mg/kg-BW/day-Maternal Tox, Gestation Length, Pup BW (~LOAEL)
NOEL 5 mg/kg-BW/day -Body Weight
LOEL 75 mg/kg-BW/day -Skeletal Malformations