United States Environmental Protection Agency

Prevention, Pesticides and Toxic Substances (7508C)

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June 2005

Reregistration Eligibility Decision for 2,4-D

Reregistration Eligibility Decision

for

2,4-D

List A
Case 0073

Approved By:

____
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Glossary of Terms and Abbreviations

A	Acre
AGDCI	Agricultural Data Call-In
ae	Acid Equivalent
ai	Active Ingredient
aPAD	Acute Population Adjusted Dose
AR	Anticipated Residue
BCF	Bioconcentration Factor
CFR	Code of Federal Regulations
cPAD	Chronic Population Adjusted Dose
CSF	Confidential Statement of Formula
CSFII USDA	Continuing Surveys for Food Intake by Individuals
DCI	Data Call-In
DEEM	Dietary Exposure Evaluation Model
DFR	Dislodgeable Foliar Residue
DWLOC	Drinking Water Level of Comparison.
EC	Emulsifiable Concentrate Formulation
EDSP	Endocrine Disruption Screening Program
EDWC	Estimated Drinking Water Concentration
EEC	Estimated Environmental Concentration
EPA	Environmental Protection Agency
EUP	End-Use Product
FDA	Food and Drug Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FFDCA	Federal Food, Drug, and Cosmetic Act
FQPA	Food Quality Protection Act
FOB	Functional Observation Battery
G	Granular Formulation
GENEEC	Tier I Surface Water Computer Model
GLN	Guideline Number
HAFT	Highest Average Field Trial
HAT	Hour After Treatment
IR	Index Reservoir
LC50	Median Lethal Concentration. A statistically derived concentration of a substance that can be expected to cause death in 50% of test animals. It is usually expressed as the weight of substance per weight or volume of water, air or feed, e.g., mg/l, mg/kg or ppm.
LD50	Median Lethal Dose. A statistically derived single dose that can be expected to cause death in 50% of the test animals when administered by the route indicated (oral, dermal, inhalation). It is expressed as a weight of substance per unit weight of animal, e.g., mg/kg.
LOC	Level of Concern
LOD	Limit of Detection
LOAEL	Lowest Observed Adverse Effect Level

MATC	Maximum Acceptable Toxicant Concentration
µg/g	Micrograms Per Gram
µg/L	Micrograms Per Liter
mg/kg/day	Milligram Per Kilogram Per Day
mg/L	Milligrams Per Liter
MOE	Margin of Exposure
MRID	Master Record Identification (number). EPA's system of recording and tracking studies submitted
MSWC	Maximum Swimming Water Concentration
MUP	Manufacturing-Use Product
NA	Not Applicable
NAWQA	USGS National Water Quality Assessment
NCOD	National Drinking Water Contaminant Occurrence Database
NPDES	National Pollutant Discharge Elimination System
NR	Not Required
NOAEL	No Observed Adverse Effect Level
OP	Organophosphate
OPP	EPA Office of Pesticide Programs
OPPTS	EPA Office of Prevention, Pesticides and Toxic Substances
ORETF	Outdoor Residential Exposure Task Force
PAD	Population Adjusted Dose
PCA	Percent Crop Area
PDIC	Product-Specific Data Call-In
PDP	USDA Pesticide Data Program
PHED	Pesticide Handler's Exposure Data
PHI	Preharvest Interval
ppb	Parts Per Billion
PPE	Personal Protective Equipment
ppm	Parts Per Million
PRZM/ EXAMS	Tier II Surface Water Computer Model
Q1*	The Carcinogenic Potential of a Compound, Quantified by the EPA's Cancer Risk Model
RAC	Raw Agriculture Commodity
RED	Reregistration Eligibility Decision
REI	Restricted Entry Interval
RfD	Reference Dose
RQ	Risk Quotient
SCI-GROW	Tier I Ground Water Computer Model
SAP	Science Advisory Panel
SF	Safety Factor
SLC	Single Layer Clothing
SLN	Special Local Need (Registrations Under Section 24(c)) of FIFRA)
STORET	Storage and Retrieval Environmental Data System

TGAI	Technical Grade Active Ingredient
TRR	Total Radioactive Residue
TWAM	Time Weighted Annual Mean
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UF	Uncertainty Factor
UV	Ultraviolet
WPS	Worker Protection Standard

2,4-D Reregistration Eligibility Decision Team

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Executive Summary

EPA has completed its review of public comments on the preliminary risk assessments and is issuing its risk management decision for 2,4-D. The revised risk assessments are based on review of the required target data base supporting the use patterns of the currently registered products and additional information received from the 2,4-D Task Force II. After considering the risks identified in the revised risk assessment and comments and mitigation suggestions from interested parties, EPA developed its risk management decision for uses of 2,4-D that pose risks of concern. The decision is discussed fully in this document.

2,4-D is an herbicide in the phenoxy or phenoxyacetic acid family that is used post-emergence for selective control of broadleaf weeds. 2,4-D is registered for use on a variety of food/feed sites including field, fruit, and vegetable crops. 2,4-D is also registered for use on turf, lawns, rights-of-way, aquatic and forestry applications. Residential homeowners may use 2,4-D on lawns.

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 for agriculture and 16 million pounds (34%) used for non-agriculture. 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 acid equivalent (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.

The Food Quality Protection Act (FQPA) requires that, when considering whether to establish, modify, or revoke a tolerance, the Agency consider "available information" concerning the cumulative effects of a particular pesticide's residues and "other substances that have a common mechanism of toxicity." Unlike other pesticides for which EPA has followed a cumulative risk approach based on a common mechanism of toxicity, EPA has not made a common mechanism of toxicity finding as to 2,4-D and any other substances. For the purposes of this tolerance action, therefore, EPA has not assumed that 2,4-D has a common mechanism of toxicity with other substances. For information regarding EPA's efforts to determine which chemicals have a common mechanism of toxicity and to evaluate the cumulative effects of such chemicals, see the policy statements released by EPA's Office of Pesticide Programs (OPP) concerning common mechanism determinations and procedures for cumulating effects from substances found to have a common mechanism on EPA's website at http://www.epa.gov/pesticides/cumulative/.

Dietary Risk

Acute and chronic dietary exposures for food and drinking water do not exceed the Agency's level of concern; therefore, no mitigation is warranted at this time for any dietary exposure to 2,4-D.

The maximum contaminant level (MCL) established by EPA's Office of Water (OW) for 2,4-D is 70 micrograms/liter (ug/l; ppb). Further, it is important to note that an MCL is an enforceable limit under the Safe Drinking Water Act (SDWA). To minimize the possibility that aquatic applications will result in drinking water concentrations in excess of the MCL, registrants and the Agency have developed label language for the direct aquatic use of 2,4-D to control aquatic weeds.

Residential Risk

Potential exposures are anticipated as a result of homeowner and commercial applications in residential areas. Applications can be made to lawns. In addition to residential areas, there are also potential postapplication exposure scenarios that may occur in public areas such as parks, recreational areas, and golf courses. The Agency evaluated 2,4-D exposures to residential handlers during mixing, loading and application to turf/ornamentals and 2,4-D postapplication exposure to residues by adults and children on treated turf.

In preliminary versions of the risk assessment, when considered alone, acute and short-term residential risks posed by the use of 2,4-D were not of concern to the Agency; however, when considered as part of an aggregate exposure with food and drinking water, exposures did exceed the Agency's level of concern. As a result, 2,4-D registrants agreed to reduce the maximum application rate to turf and residential lawns from 2.0 lbs ae/A to 1.5 lbs ae/A. Chronic residential exposures to 2,4-D are not expected due to its use pattern.

Aggregate Risk

An aggregate risk assessment looks at the combined risk from dietary exposure (food and drinking water pathways), as well as exposures from non-occupational sources (e.g., residential uses). In the preliminary and revised risk assessments, the estimated acute and short-term exposures exceeded the Agency's level of concern. As a result, 2,4-D registrants agreed to reduce the maximum application rate to turf and residential lawns from 2.0 pounds acid equivalent per acre (lbs ae/A) to 1.5 lbs ae/A. The current risk assessment considers exposures from the reduced application rate for residential turf.

Two methods of aggregate risk calculations were employed in assessing the aggregate risk of 2,4-D. The first method is the drinking water level of concern (DWLOC) method. OPP (Office of Pesticide Programs) has traditionally compared estimates of concentrations of a pesticide in drinking water to DWLOCs. A DWLOC is the portion of the acute population adjusted dose (aPAD) or chronic population adjusted dose (cPAD) remaining after estimated dietary (food only) exposures have been subtracted and the remaining exposure has been converted to a concentration (ug/liter or ppb). This concentration value (DWLOC) represents the available or allowable exposure through drinking water. The second method is the forward calculation method. In this approach, food, drinking water, and residential exposures are aggregated and compared to an appropriate endpoint. A population adjusted dose, or PAD, is the reference dose (RfD) adjusted for the FQPA safety factor. A risk estimate that is less than 100% of the acute PAD (aPAD), the dose at which an individual could be exposed over the course of a single day and no adverse health effects would be expected, does not exceed EPA's level of concern. Likewise, risk estimate that is less than 100% of the chronic PAD (cPAD), the dose at which an individual could be exposed over the course of a lifetime and no adverse health effects would be expected, does not exceed EPA's level of concern.

In the case of 2,4-D, the DWLOCs were calculated for comparison to the MCL established by the EPA Office of Water and aggregate risks were calculated using the forward calculation approach for comparison to the appropriate endpoint. The respective DWLOCs and aggregate risks are shown for acute, chronic and short term exposures in the following sections.

Acute aggregate risk. The acute aggregate risk assessments address exposure to 2,4-D residues in food and water using both the DWLOC and forward calculation approach. Acute residential exposures from swimming in treated water bodies or playing on treated turf were not included because exposures are unlikely to co-occur with acute dietary exposures. The acute DWLOCs are 432 ppb or greater with the most sensitive population being females 13-49 years old. The estimated drinking water concentrations (EDWCs) of 118 ug/liter for surface water and 15 ug/liter for groundwater are substantially less than the DWLOCs which means that the risks are not of concern.

Acute aggregate risks were also assessed by aggregating acute food exposures and acute water exposures using Lifeline. The acute aggregate risks are not of concern because they are less than 100 percent of the aPAD. The highest risks (58 percent of the aPAD) are for females 13-49 years old because these risks are based upon the lower no-observed adverse effect level (NOAEL) of 25 mg/kg/day from a developmental study in rats.

Short-term aggregate risk. Short term aggregate risk assessments were conducted by calculating DWLOCs based upon short term turf exposures, chronic food exposures and short term endpoints. Short term exposures from swimming in treated water bodies were not included because these exposures represent high-end unlikely scenarios. The short term DWLOCs were calculated only for females 13-49 and children 1-6 because these population subgroups have the highest exposure and are protective of the other subgroups. The DWLOCS range from 24 to 54 ug/liter. These DWLOCs are all greater than the EDWCs, which range from 15 to 23 ug/liter, and indicate that short term risks are not of concern.

Short term aggregate risks were also assessed by aggregating short term turf exposures, chronic food exposures and chronic water exposures using the forward calculation approach. Short term aggregate risks were calculated only for females 13-49 and children 1-6 because these population subgroups have the highest exposure and are protective of the other subgroups. The short term aggregate margins of exposure (MOEs) indicate that the short term risks are not of concern because the MOEs equal or exceed the target MOE of 1000.

Chronic (non-cancer) aggregate risk. Chronic DWLOCs were calculated based upon chronic dietary exposures. As there are no chronic residential exposures, residential exposures were not included in the chronic DWLOC calculations. The chronic DWLOCs are 47 ug/liter or greater with the most sensitive populations being infants and children. The EDWCs, which range from 1.5 to 23 ug/liter, are less than the DWLOCs which means that the risks are not of concern. It should be noted that the master label indicates that potable water consumption from a treated water body cannot begin until the 2,4-D concentration is 70 ug/liter or below, therefore an annual average exposure at the MCL of 70 ug/liter would not occur because dissipation would reduce the initial concentration of 70 ug/liter to an annual average concentration of 11 ug/liter.

Chronic aggregate risks were also assessed by aggregating chronic food exposures and chronic water exposures using the forward calculation approach. The chronic aggregate risks are presented as percent cPAD are not of concern because they are less than 100 percent of the cPAD. The highest risks (38 percent of the cPAD) are for children 1-2 years old.

Occupational Risk

Based on current use patterns, occupational handlers (mixers, loaders, and applicators) may be exposed to 2,4-D during and after normal use. The Agency identified 18 handler scenarios resulting from mixing/loading and applying 2,4-D for crop and non-crop uses. For the occupational use of 2,4-D, EPA is concerned about any Margin of Exposure (MOE) less than 100, which incorporates uncertainty factors of 10x for interspecies variation and 10x for intraspecies variation.

With the exception of mixing/loading wettable powder, all of the short-term and intermediate-term MOEs exceed the target of 100 with baseline personal protective equipment (PPE) (i.e., long-sleeved shirt, long pants, shoes plus socks, no respirator) or single layer PPE (i.e., long-sleeved shirt, long pants, shoes plus socks, gloves, no respirator) and are not of concern. The MOEs for handling wettable powder are above 100 with engineering controls (i.e., water soluble bags).

Ecological Risk

Fish and Aquatic Invertebrates: Estimated risk quotients (RQs) from use of 2,4-D acid and amine salts in aquatic weed control through direct subsurface application to water bodies exceed the restricted use LOCs for freshwater invertebrates. There are no chronic LOC exceedances for this use. Estimated RQs from use of 2,4-D BEE in weed control through direct subsurface application to water bodies exceed the acute risk level of concern (LOC) for freshwater fish and invertebrates and chronic risk LOC for freshwater and estuarine fish and freshwater invertebrates when compared on an acid equivalent basis. Estimated RQs from use of 2,4-D acid and amine salts in rice paddies exceed the acute endangered species LOCs for freshwater invertebrates.

Non-Target Aquatic Plants: For non-target aquatic plants, estimated RQs from the runoff/drift of 2,4-D acid and amine salts from use on terrestrial crops exceed the aquatic vascular plant endangered species LOCs for use of 2,4-D acid and amine salts on pasture and apples. Consideration of average application rates and assuming a proportional reduction in EECs results in RQs below the endangered species LOC. Likewise, there are no LOC exceedances from the drift of the ester forms to aquatic water bodies or from the runoff of the ester forms to water bodies from use on terrestrial sites.

Estimated RQs for the scenario of direct application to water for aquatic weed control for 2,4-D acid and amine salts exceed the acute and endangered species LOCs for aquatic vascular and acute the LOC for non-vascular plants, while estimated RQs from use of 2,4-D BEE (the only ester registered for aquatic weed control) for direct application to water for weed control exceed all LOCs for vascular and the acute LOC for non-vascular plants.

Estimated RQs for use of 2,4-D acid and amine salts in rice paddies exceed the acute and endangered species LOCs for aquatic vascular plants. Consideration of average application rates results in RQs below the endangered species LOCs.

Birds: For non-granular spray applications of 2,4-D acid, amine salts, and esters, estimated RQs exceed acute LOCs for most crop scenarios for short grass, tall grass, and broadleaf forage exposures. For birds that eat fruit and large insects, acute endangered LOCs are exceeded for non-cropland, forest, and cranberry scenarios. Chronic LOCs are exceeded for birds that forage on short grass when the application rate of 2,4-D ranges from 2.0 to 4.0 lbs ae/A such as with non-cropland areas, cranberries, or asparagus. For granular broadcast applications, acute LOCs are exceeded for several different crop scenarios and bird weights. The chronic LOC is not exceeded for granular broadcast applications.

Mammals: For non-granular formulations of 2,4-D, estimated RQs exceed acute LOCs for mammals feeding on plants and insects for all uses assessed for small and medium size mammals, except potatoes and citrus. There were no exceedances for granivores exposed to non-granular formulations of 2,4-D. LOCs for acute exposure to granular 2,4-D products are exceeded for all sites with the following exceptions: 1000 g mammals in turf, aquatic areas, and cranberries. Mammalian chronic RQs range from 0.05 to 200 and chronic LOCs were exceeded in all cases with the exception of potatoes and citrus (large insects, seeds). Consideration of average application rates results in acute RQs below the LOCs for non-granular and granular applications. However, consideration of average application rates for non-granular and granular applications did not result in RQs below the chronic LOC.

Insects: Since study results show that 2,4-D DMAS and 2,4-D EHE are practically non-toxic to honey bees, the potential for 2,4-D and its salts and esters is predicted to pose minimal risk to pollinators and other beneficial insects.

Non-Target Terrestrial Plants: Estimated RQs exceed acute LOCs for both non-endangered and endangered plants for non-granular and granular uses at many use sites. Consideration of average application rates did not result in RQs below LOCs.

In summary, some ecological risks are of concern on some sites for some species. The Agency's characterization of its assessment of ecological risk is provided in section III.B.3 of this document. The mitigation measures of (1) reducing maximum application rates, and (2) specifying a required spray droplet size of "Medium to Coarse" or coarser (i.e., prohibiting "fine" sprays) are expected to lessen, but not eliminate, the risk of 2,4-D to wildlife and plants.

Summary of Mitigation Measures

EPA has determined that 2,4-D is eligible for reregistration provided the mitigation outlined in this document is implemented.

Dietary Risk

- Acute and chronic dietary exposures for food and drinking water do not exceed the Agency's level of concern; therefore, no mitigation is warranted at this time for any dietary exposure to 2,4-D.

Residential Risk

- Maximum turf rate is reduced from 2.0 lbs ae/A to 1.5 lbs ae/A.
- At the agreed-upon maximum application rate of 1.5 lbs ae/A for residential turf, acute and short-term residential risks posed by the use of 2,4-D are not of concern to the Agency. Due to its use pattern, chronic residential exposures to 2,4-D are not expected.

Occupational Risk

- Risks from handling wettable-powder products will be mitigated by requiring wettable powder products to be packaged in water-soluble packaging.
- Personal protective equipment (PPE) prescribed in the exposure reduction plan set forth in 1992 will be replaced with the PPE requirements outlined in this document.

Ecological Risk

- The measures to control spray drift are expected to reduce the risk of 2,4-D to non-target plants.
- Maximum turf rate is reduced from 2.0 lbs ae/A to 1.5 lbs ae/A.
- Implementation of the application rates set forth in the Master Label will reduce rates (as compared to current rates on existing labels) for field corn, popcorn, sweet corn, small grains, fallowland/stubble, non-cropland, turf, aquatic applications (surface), pasture, and soybean.

I. Introduction

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was amended in 1988 to accelerate the reregistration of products with active ingredients registered prior to November 1, 1984. The amended Act calls for the development and submission of data to support the reregistration of an active ingredient, as well as a review of all submitted data by the U.S. Environmental Protection Agency (referred to as EPA or "the Agency"). Reregistration involves a thorough review of the scientific database underlying a pesticide's registration. The purpose of the Agency's review is to reassess the potential hazards arising from the currently registered uses of the pesticide; to determine the need for additional data on health and environmental effects; and to determine whether or not the pesticide meets the "no unreasonable adverse effects" criteria of FIFRA.

On August 3, 1996, the Food Quality Protection Act of 1996 (FQPA) was signed into law. This Act amends FIFRA and the Federal Food Drug and Cosmetic Act (FFDCA) to require reassessment of all existing tolerances for pesticides in food. FQPA also requires EPA to review all tolerances in effect on August 3, 1996 by August 3, 2006. In reassessing these tolerances, the Agency must consider, among other things, aggregate risks from non-occupational sources of pesticide exposure, whether there is increased susceptibility to infants and children, and the cumulative effects of pesticides with a common mechanism of toxicity. When a safety finding has been made that aggregate risks are not of concern and the Agency concludes that there is a reasonable certainty of no harm from aggregate exposure, the tolerances are considered reassessed. EPA decided that, for those chemicals that have tolerances and are undergoing reregistration, tolerance reassessment will be accomplished through the reregistration process.

As mentioned above, FQPA requires EPA to consider "available information" concerning the cumulative effects of a particular pesticide's residues and "other substances that have a common mechanism of toxicity" when considering whether to establish, modify, or revoke a tolerance. Potential cumulative effects of chemicals with a common mechanism of toxicity are considered because low-level exposures to multiple chemicals causing a common toxic effect by a common mechanism could lead to the same adverse health effect as would a higher level of exposure to any one of these individual chemicals. For information regarding EPA's efforts to determine which chemicals have a common mechanism of toxicity and to evaluate the cumulative effects of such chemicals, see the policy statements released by the EPA's Office of Pesticide Programs concerning common mechanism determinations and procedures for cumulating effects from substances found to have a common mechanism on EPA's website at http://www.epa.gov/pesticides/cumulative/.

Unlike other pesticides for which EPA has considered cumulative risk based on a common mechanism of toxicity, EPA has not made a common mechanism of toxicity finding for 2,4-dichlorophenoxyacetic acid (2,4-D). Therefore, for the purposes of tolerance reassessment and a decision on reregistration eligibility, EPA is assuming that 2,4-D does not share a common mechanism of toxicity with other compounds. In the future, if information suggests 2,4-D shares a common mechanism of toxicity with other compounds, additional testing may be required and a cumulative assessment may be necessary.

This document presents summaries of EPA's revised human health and ecological risk assessments, tolerance reregistration decision, and the reregistration eligibility decision for 2,4-D. The document consists of six sections. Section I contains the regulatory framework for reregistration/tolerance reassessment. Section II provides a profile of the use and usage of the chemical. Section III gives an overview of the revised human health and environmental effects risk assessments based on data, public comments, and other information received in response to the preliminary risk assessments. Section IV presents the Agency's reregistration eligibility and risk management decisions. Section V summarizes label changes necessary to implement the risk mitigation measures outlined in Section IV. Finally, the Appendices list related information, supporting documents. The preliminary and revised risk assessments for 2,4-D are available in the Public Docket, under docket number OPP-2004-0167 and on the Agency's web page, http://www.epa.gov/edockets.

II. Chemical Overview

A. Regulatory History

2,4-D has been used as an herbicide since the mid-1940s. Currently over 600 end-use products are registered for use on over 300 distinct agricultural and residential sites, and there are over 100 tolerances for 2,4-D listed in the Code of Federal Regulations. 2,4-D was the subject of a Registration Standard and a Registration Standard Guidance Document dated February 16, 1988 and September 9, 1988, respectively. These documents summarized the regulatory conclusions based on available data, and specified the additional data required for reregistration purposes. Numerous data submissions have been received and evaluated since the Registration Standard Guidance Document was published.

Special Review

2,4-D has been in pre-Special Review status since September 22, 1986, because of carcinogenicity concerns. More specifically, there were concerns for epidemiological links of 2,4-D to non-Hodgkin's lymphoma from both occupational and residential exposure. A proposed decision not to initiate Special Review was published (53 FR 9590) on March 23, 1988 based on findings that such a link could not be established. The final decision was deferred until reregistration. In part to address these concerns, the 2,4-D Task Force agreed to risk reduction measures in September 1992 that included an exposure reduction plan effected through modifications of technical and manufacturing-use product labels and implementation of a user education program.

A Science Advisory Board/Scientific Advisory Panel Special Joint Committee reviewed available epidemiological and other data on 2,4-D in 1992 and concluded that "the data are not sufficient to conclude that there is a cause and effect relationship between exposure to 2,4-D and non-Hodgkin's lymphoma." 2,4-D was classified as a Group D, not classifiable as to human carcinogenicity. The Agency requested further histopathological examinations of rat brain tissues and mouse spleen tissues in question. These exams were submitted and reviewed, and on March 16, 1999, the Agency notified the 2,4-D Task Force that the Agency would continue to classify 2,4-D as a Group D carcinogen.

The Agency has twice recently reviewed epidemiological studies linking cancer to 2,4-D. In the first review, completed January 14, 2004, EPA concluded there is no additional evidence that would implicate 2,4-D as a cause of cancer (EPA, 2004). The second review of available epidemiological studies occurred in response to comments received during the Phase 3 Public Comment Period for the 2,4-D RED. EPA's report, dated December 8, 2004 and authored by EPA Scientist Jerry Blondell, Ph.D., found that none of the more recent epidemiological studies definitively linked human cancer cases to 2,4-D.

Final notice of the Agency's decision not to initiate Special Review will be issued at the completion of the reregistration process.

Residue Tolerances

Tolerances for residues of 2,4-D in/on plant and processed food/feed commodities, fish, and potable water are expressed in terms of 2,4-D *per se* [40 CFR §180.142(a)(1-6 and 9-12) and (b)]. There are currently approximately 110 tolerances for 2,4-D.

The Industry Task Force II on 2,4-D Research Data (Task Force II) is supporting the reregistration of 2,4-D. The members of the Task Force currently include Agro-Gor Corp (jointly owned by Atanor, S.A. and PBI-Gordon Corp.), Dow AgroSciences, and Nufarm USA. In addition, USDA's Interregional Project No. 4 (IR-4) is supporting the reregistration of a number of minor crop uses for 2,4-D, and the California Citrus Quality Council (CCQC) is supporting selected uses of 2,4-D isopropyl ester (IPE) on citrus fruits.

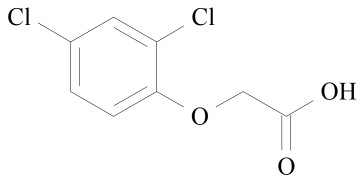
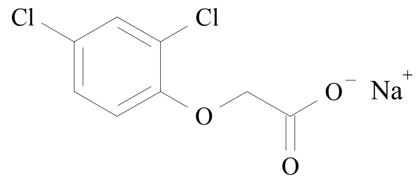
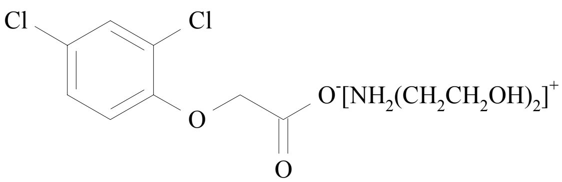
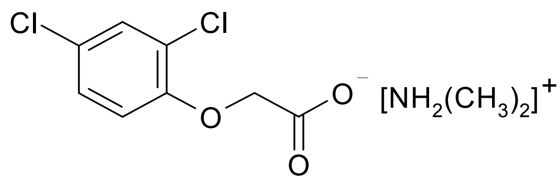
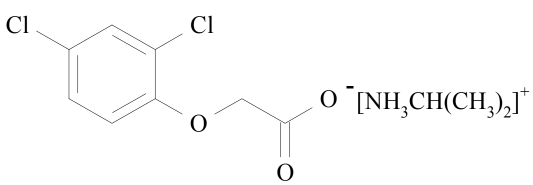
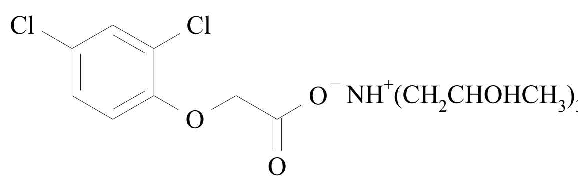
B. Chemical Identification

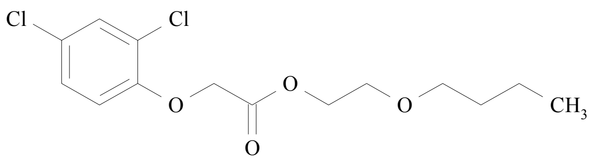
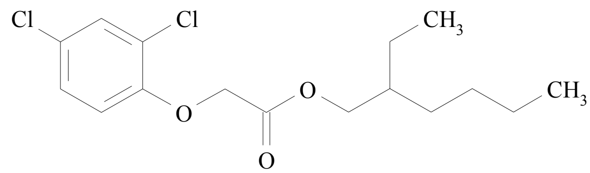
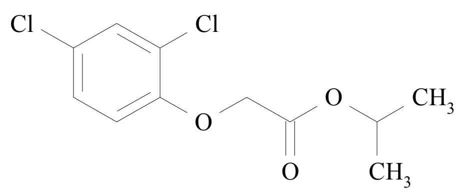
2,4-D [2,4-dichlorophenoxyacetic acid] is a List A pesticide active ingredient classified as an herbicide, a plant growth regulator, and a fungicide. It is, however, mainly used as a selective postemergence herbicide for the control of broadleaf weed species in a variety of food/feed sites including field, fruit, and vegetable crops. In addition to the acid form, there are numerous salts and esters of 2,4-D in Reregistration Case 0073, each with an assigned PC Code number, that are presently registered as active ingredients in end-use products (EPs). Nine forms of 2,4-D are currently supported; these forms are listed in Table 1 below. With regards to analytical methodology, the quantitative recovery of residues of concern are enhanced by the formation of the more polar acid form of 2,4-D. Given that results of 2,4-D analyses are typically expressed in terms of the quantified levels of the acid form, 2,4-D concentrations in product formulations are typically referred to in terms of acid equivalents (ae).

Chemical structures and information are presented in Tables 1 and 2 for 2,4-D acid and those salts and esters with registered manufacturing-use and/or end-use products (MPs/EPs) being supported by 2,4-D Task Force II and its member companies.

Table 1. Chemical Structures for Supported Forms of 2,4-D Acid, Amine Salts, and Esters

2,4-D active ingredients with registered MPs/EPs	
2,4-D acid Empirical Formula: $C_8H_6Cl_2O_3$ Molecular Weight: 221.0 CAS Registry No.: 94-75-7 PC Code: 030001	2,4-D sodium salt (Na) Empirical Formula: $C_8H_5Cl_2NaO_3$ Molecular Weight: 243.03 CAS Registry No.: 2702-72-9 PC Code: 030004

2,4-D active ingredients with registered MPs/EPs	
	
2,4-D diethanolamine salt (DEA) Empirical Formula: $C_{12}H_{17}Cl_2NO_5$ Molecular Weight: 326.18 CAS Registry No.: 5742-19-8 PC Code: 030016 	2,4-D dimethylamine salt (DMA) Empirical Formula: $C_{10}H_{13}Cl_2NO_3$ Molecular Weight: 266.13 CAS Registry No.: 2008-39-1 PC Code: 030019 
2,4-D isopropylamine salt (IPA) Empirical Formula: $C_{11}H_{15}Cl_2NO_3$ Molecular Weight: 280.04 CAS Registry No.: 5742-17-6 PC Code: 030025 	2,4-D triisopropanolamine salt (TIPA) Empirical Formula: $C_{17}H_{27}Cl_2NO_6$ Molecular Weight: 412.31 CAS Registry No.: 32341-80-3 PC Code: 030035 
2,4-D 2-butoxyethyl ester (BEE) Empirical Formula: $C_{14}H_{18}Cl_2O_4$ Molecular Weight: 321.20 CAS Registry No.: 1929-73-3 PC Code: 030053	2,4-D 2-ethylhexyl ester (2-EHE) [1] Empirical Formula: $C_{16}H_{22}Cl_2O_3$ Molecular Weight: 333.27 CAS Registry No.: 1928-43-4 PC Code: 030063

2,4-D active ingredients with registered MPs/EPs	
	
<u>2,4-D isopropyl ester (IPE)</u> Empirical Formula: $C_{11}H_{12}Cl_2O_3$ Molecular Weight: 263.12 CAS Registry No.: 94-11-1 PC Code: 030066 	

[1] Formerly identified as the isooctyl ester.

Available data concerning identification of the active ingredients are summarized in Table 2 for 2,4-D acid, salts, and esters with registered MPs/EPs.

Table 2. Available Data Concerning Identification of the Active Ingredient [1]

Active ingredient (PC Code)	Color	Physical State	Melting Point/ Boiling Point	Density/Specific Gravity	Octanol/Water Partition Coeff.	Vapor Pressure	Solubility
2,4-D acid (030001)	white	crystalline solid	m.p. 138-141 C	s.g.=1.416 at 25 C	Log $K_{O/W}$ 0.001 M sol'n pH 5 2.14 pH 7 0.177 pH 9 0.102	1.4 x 10^{-7} mm Hg at 25 C	water = 569 mg/L at 20 C
2,4-D Na salt (030004)	white	powder	m.p. 200 C	bulk = 42.2 lb/ft^3 at 25 C	N/A [2]; salt dissociates to acid in water		water = 4.5 g/100 mL at 25 C
2,4-D DEA salt (030016)	cream	powder	m.p. 83 C	bulk = 0.762 g/cm^3 at 25 C	2.24 x 10^{-2} at 25 C	<1.33 x 10^{-5} Pa at 25 C	mg/g at 25 C water = 806
2,4-D DMA salt (030019)	amber	aqueous liquid	m.p. 118-120 C (PAI)	s.g. = 1.23 at 20 C	N/A; salt dissociates to acid in water	<1 x 10^{-7} mm Hg at 26 C	g/100 mL at 20 C water = 72.9 (pH 7)
2,4-D IPA salt (030025)	amber	aqueous liquid	m.p. 121 C (PAI)	s.g. = 1.15 at 20 C	N/A; salt dissociates to acid in water		g/100 mL at 20 C water = 17.4 (pH 5.3)
2,4-D TIPA salt (030035)	amber	aqueous liquid	m.p. 87-110 C (PAI)	s.g. = 1.21 at 20 C	N/A; salt dissociates to acid in water		g/100 mL at 20 C water = 46.1 (pH 7)
2,4-D BEE (030053)	dark amber	liquid	b.p. 89 C	s.g. = 1.225 at 20 C	log = 4.13-4.17 at 25 C	2.4 x 10^{-6} mm Hg at 25 C	g/100 mL at 20 C water = insoluble
2,4-D 2-EHE (030063)	dark amber	liquid	b.p. 300 C	s.g. = 1.152 at 20 C	log = 5.78 (temp N/A)	3.6 x 10^{-6} mm Hg (temp N/A)	water = 86.7 ppb
2,4-D IPE (030066)	pale amber	liquid	b.p. 240 C	s.g. = 1.252 at 25 C	253.8 ± 44.4 (temp N/A)	5.3 x 10^{-6} mbar	water = 0.023 g/100 mL

[1] Data assembled from Agency memoranda and comprehensive review documents, including the 2,4-D Reregistration Standard.
[2] N/A = Not available.

C. Use Profile

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 approximately 660 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. The following is information on the currently registered uses including an overview of use sites and application methods. A detailed table of the uses of 2,4-D eligible for reregistration is contained in Appendix A.

Type of Pesticide: Herbicide

Target organism(s): A wide variety of broadleaf weeds and aquatic weeds

Mode of action: 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.

Use Sites: Table 3 presents a summary of the registered 2,4-D uses.

Use Classification: General use

Formulation Types: Formulation types registered include emulsifiable concentrate, granular, soluble concentrate/solid, water dispersible granules, and wettable powder.

Application Methods: 2,4-D may be applied with a wide range of application equipment including fixed-wing aircraft, backpack sprayer, band sprayer, boom sprayer, granule applicator, ground-directed sprayers, hand held sprayer, helicopter, injection equipment, tractor-mounted granule applicator, and tractor-mounted sprayers.

Application Rates: For 2,4-D, rates per application and rates per year are generally less than 1.5 pounds acid equivalent (ae) per acre per year and 2.0 pounds a.e. per acre per year (lbs ae/A), respectively. Maximum rates are 4.0 lbs ae/A per year for asparagus, forestry uses, and non-cropland uses, among others. The maximum rate for aquatic uses is 10.8 lbs ae/acre foot for submerged aquatic plants.

Application Timing: Timing of 2,4-D application can include at emergence, before bud break, during dormancy, to established plantings, foliar, post-emergence, pre-emergence, pre-harvest, and pre-plant.

Table 3. 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 feed crop	Grass forage/fodder/hay, Pastures, Rangeland, Rye, Sorghum
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
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

D. Estimated Usage of Pesticide

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 OPP Biological and Economic Assessment Division [BEAD] quantitative use analysis [QUA] which is available on EPA's Pesticide Docket OPP-2004-0167 located at:

http://www.epa.gov/edockets). 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 1.5 lbs ae/A per year and 2.0 lbs ae/A per year, respectively. 2,4-D is used predominantly in the Midwest, Great Plains, and Northwestern United States (Figure 1).

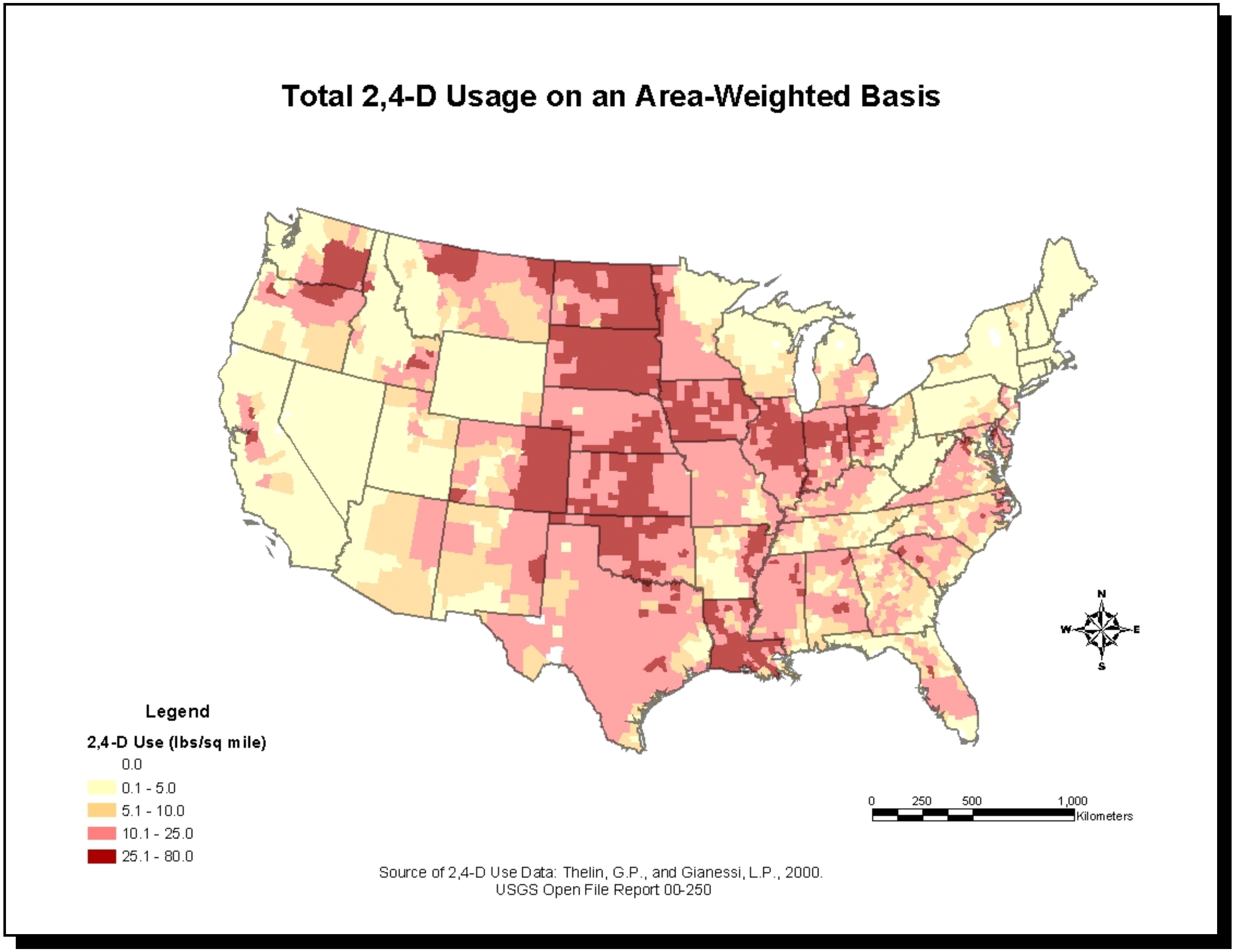


Figure 1. Estimated 2,4-D usage (lbs ae/square mile). The estimates are based on pesticide use rates compiled by the National Center for Food and Agricultural Policy (NCFAP) and modified by Thelin, G.P. and Gianessi, L.P., 2000 (USGS Open-File Report 00-250)

Application Rates, Timing and Frequency of Applications

The 2,4-D master label (available in EPA docket #OPP-2004-0167) has been developed by the 2,4-D Task Force and represents the maximum supported application rates for agricultural and non-agricultural uses. All end-use product manufacturers obtain 2,4-D starting material from companies represented by the 2,4-D Task Force. EPA used the master label rates in the 2,4-D human health and ecological risk assessments. Some master label rates are lower than the rates present on existing labels. The Agency and the task force have agreed that all of the 2,4-D labels will be updated with the new master label rates as part of the registration process. All of the registrants, including those that are not in the 2,4-D task force, will have to conform to the master label rates. The master label agreement is discussed in an internal Agency memo (EPA, March 18, 2003), which is available on EPA's Pesticide Docket OPP-2004-0167 located at: http://www.epa.gov/edockets.

Typically, one to three applications are made per growing season. Applications are made to the target weeds prior to crop emergence, after crop emergence, prior to harvest, and in the dormant season, depending upon the crop. The label required spray volumes for ground applications range from 0.0375 lbs ae/A for applications to low bush blueberries to 4.0 lbs ae/A for brush control. 2,4-D can be applied over the top to tolerant crops such as small grains and rice, but must be directed or shielded for the more sensitive crops such as fruits and berries.

The application rates on the master label are included in Table 4 for non-crop areas and Table 5 for agricultural crops. The average application rates from the 2,4-D QUA report (EPA BEAD 2001) are shown for comparison. With the exception of filberts, the QUA data indicate that only one application is made to most crops. The National Agricultural Pesticide Impact Assessment Program (NAPIAP) report on Phenoxy Herbicides indicates that on average one 2,4-D application is made annually to turfgrass.

Table 4. 2,4-D Application Rates for Non-Crop Areas

Aquatic Areas, Forestry, Non-Crop Areas and Turf	**Acid Equivalent lbs (ae) Application Rates Per Application/Per crop or Year**	
	Master Label	**Amount Used per QUA Report**
Aquatic Areas - Floating Weeds	2.0/4.0 per acre	512,000 lbs[A]
Aquatic Areas - Submerged Weeds	10.8 per acre foot	
Tree and Brush Control - Tree Injection	1 to 2 ml per inch of trunk diameter	136,000 lbs
Forestry - Weed and Brush Control	4.0/4.0 per acre	
Forestry - Conifer Release	4.0/4.0 per acre	
Irrigation Ditch Banks	2.0/4.0 per acre	
Rights of Way Areas	2.0/4.0 per acre	2.1 million lbs
Rangeland, Pastures	2.0/4.0 per acre	
Turf - Grass Grown for Seed or Sod	2.0/4.0 per acre	351,000 lbs

Aquatic Areas, Forestry, Non-Crop Areas and Turf	**Acid Equivalent lbs (ae) Application Rates Per Application/Per crop or Year**	
	Master Label	**Amount Used per QUA Report**
Turf - Ornamental	2.0/4.0 per acre [B]	11.6 million lbs
A. According to the NAPIAP report about 98,000 acres were treated for floating weeds and about 5,000 acres were treated for submerged weeds by state agencies in 1993. B. The registrants have agreed to reduce the ornamental turf rate from 2.0 to 1.5 lbs ae per acre. The new maximum yearly rate will be 3.0 lbs ae per acre.		

Table 5. 2,4-D Application Rates for Agricultural Crops

Agricultural Crops	Acid Equivalent lbs (ae) Application Rates per Acre Per Application/Per crop or Year	
	Master Label	Average Rate per QUA Report
Asparagus	2.0/4.0	1.1/1.3
Blueberries - Low Bush Wiper Bar	0.0375 lb/GA	0.46/0.51
Blueberries - High Bush	1.4/2.8	
Citrus (Growth Regulator)	0.1	No Data
Conifer Plantations	4.0/4.0	No Data
Corn (sweet) Corn (field and pop)	0.5 to 1.0/1.5 0.5 to 1.5/3.0	0.48/0.51 0.44/0.46
Cranberries - granular applications Cranberries - liquid applications	4.0/4.0 dormant season application 1.2/2.4 growing season application	1.8/2.0
Fallowland and Crop Stubble	2.0/4.0	0.69/0.89
Filberts	1.0 lb per 100 Ga/4 Apps per year	0.64/1.7
Grain Sorgum	0.5 to 1.0/1.0	0.46/0.50
Grapes	1.36/1.36	0.73/0.87
Orchard Floors (Pome and Stone Fruits, Tree Nuts)	2.0/4.0	Apples = 1.2/1.4 Pears = 1.1/1.5
Potatoes	0.07/0.14	0.10/0.17
Rice	1.0 or 1.5/1.5	0.92/0.94
Soybeans (Preplant burndown)	0.5 or 1.0/1.0	0.46/0.47
Strawberries (Except CA or FL)	1.5/1.5	1.2/1.3
Sugarcane	2.0/4.0	0.75/0.99
Cereal Grains (Wheat, Barley, Millet, Oats and Rye)	0.5 or 1.25/1.75	Wheat= 0.44/0.48 Barley =0.46/0.47 Oats = 0.46/0.46 Rye = 0.50/0.50 Millet= 0.44/0.44

Agricultural Crops	Acid Equivalent lbs (ae) Application Rates per Acre Per Application/Per crop or Year	
	Master Label	Average Rate per QUA Report
Wild Rice (MN only)	0.25/0.25	0.20/0.20

III. Summary of 2,4-D Risk Assessment

The following is a summary of EPA's human health and ecological risk findings and conclusions for 2,4-D, as presented fully in the documents "2,4-D. HED's Revised Human Health Risk Assessment for the Reregistration Eligibility Decision (RED) Revised to Reflect Public Comments" dated May 12, 2005, and the "Environmental Fate and Effects Division's Risk Assessment for the Reregistration Eligibility Decision for 2,4-D," dated October 28, 2004.

The purpose of this section is to summarize the key features and findings of the risk assessment in order to help the reader better understand the risk management decisions reached by the Agency. While the risk assessments and related addenda are not included in this document, they are available in the public docket OPP-2004-0167, and on the Agency's website at http://www.epa.gov/pesticides/reregistration/status.htm

A. Human Health Risk Assessment

EPA released its preliminary risk assessments for 2,4-D for public comment on June 23, 2004, thereby starting Phase 3 of a six phase public participation process. In response to comments received during Phase 3, the human health risk assessment was updated. EPA issued the revised risk assessments for 2,4-D for a second public comment period on January 12, 2005 (Phase 5 of the public participation process). The risk assessments were revised again in response to Phase 5 public comments, and are available for review.

The 2,4-D degradates detected in the various laboratory environmental fate studies were 1,2,4-benzenetriol, 2,4-dichlorophenol (2,4-DCP), 2,4-dichloroanisole (2,4-DCA), 4-chlorophenol, chlorohydroquinone (CHQ), volatile organics, bound residues, and carbon dioxide. The OPP Metabolism Assessment Review Committee (MARC) determined that all residues other than 2,4-D are not of risk concern due to low occurrence under environmental conditions, comparatively low toxicity, or a combination thereof. Therefore, the Agency assessed risks from 2,4-D *per se*.

1. Toxicity of 2,4-D

With very few exceptions, the effects and relative toxicities of the salt and ester forms of 2,4-D are quite similar to those of the acid form. Thus, the acid form was selected as being representative of all members of the 2,4-D reregistration case (Case No. 0073). The member chemicals in the 2,4-D case exhibit low to slight acute toxicity with the exception of the acid and salt forms being severe eye irritants. The Agency has reviewed all toxicity studies submitted for 2,4-D and has determined that the toxicological database is sufficient for reregistration. Further details on the toxicity of 2,4-D can be found in the technical support documents cited in Appendix C.

a. Toxicity Profile

Major features of the toxicology profile are presented below. In acute studies, 2,4-D generally has low acute toxicity (Toxicity Category III or IV) via the oral, dermal and inhalation routes of exposure. 2,4-D is not a skin irritant (Toxicity Category III or IV), nor a skin sensitizer. Although the 2,4-D ester forms are not eye irritants (Toxicity Category III or IV), the acid and salt forms are considered to be severe eye irritants (Toxicity Category I). The acute toxicity of all 2,4-D forms is listed in Table 6.

Table 6. Acute Toxicity Data for 2,4-D acid, 2,4-D ester forms, and 2,4-D amine salts[1].

Guideline No.	Study Type	MRID Numbers	Results	Toxicity Category
870.1100	**Acute Oral**			
	2,4-D acid	00101605	rat LD_{50} = 639 mg/kg	III
	DEA salt	41920901	rat LD_{50} = 735 mg/kg	III
	DMA salt	00157512	rat LD_{50} = 949 mg/kg	III
	IPA salt	00252291	rat LD_{50} = 1646 mg/kg	III
	IPE ester	41709901	rat LD_{50} = 1250 mg/kg	III
	TIPA salt	41413501	rat LD_{50} = 1074 mg/kg	III
	BEE ester	40629801	rat LD_{50} = 866 mg/kg	III
	EHE ester	41209001	rat LD_{50} = 896 mg/kg	III
870.1200	**Acute Dermal**			
	2,4-D acid	00101596	rabbits LD_{50} >2000 mg/kg	III
	DEA salt	41920911	rabbits LD_{50} >2000 mg/kg	III
	DMA salt	00157513	rabbit LD_{50} 1829 mg/kg	III
	IPA salt	00252291	rabbits LD_{50} >2000 mg/kg	III
	IPE ester	41709902	rabbits LD_{50} >2000 mg/kg	III
	TIPA salt	41413502	rabbits LD_{50} >2000 mg/kg	III
	BEE ester	40629802	rabbits LD_{50} >2000 mg/kg	III
	EHE ester	41209002	rabbits LD_{50} >2000 mg/kg	III
870.1300	**Acute Inhalation**			
	2,4-D acid	00161660	rat LC_{50} >1.79 mg/L	III
	DEA salt	41986601	rat LC_{50} >3.5 mg/L	IV
	DMA salt	00157514	rat LC_{50} >3.5 mg/L	IV
	IPA salt	40085501	rat LC_{50} =3.1 mg/L	IV
	IPE ester	40352701	rat LC_{50} >4.97 mg/L	IV
	TIPA salt	41957601	rat LC_{50} =0.78 mg/L	III
	BEE ester	40629803	rat LC_{50} =4.6 mg/L	IV
	EHE ester	42605202	rat LC_{50} >5.4 mg/L	IV
870.2400	**Primary Eye Irritation**			
	2,4-D acid	41125302	severe eye irritant	I
	DEA salt	41920902	severe eye irritant	I
	DMA salt	00157515	severe eye irritant	I
	IPA salt	00252291	severe eye irritant	I
	IP ester	40352702	not an eye irritant	IV
	TIPA salt	41413504	severe eye irritant	I
	BEE ester	40629804	not an eye irritant	III
	EHE ester	44725303	not an eye irritant	III
870.2500	**Primary Skin Irritation**			
	2,4-D acid	42232701	unacceptable	N/A
	DEA salt	41920903	slight skin irritant	III
	DMA salt	00157516	slight skin irritant	IV
	IPA salt	00252291	slight skin irritant	IV
	IPE ester	40352703	slight skin irritant	IV
	TIPA salt	41413505	slight skin irritant	IV
	BEE ester	40629805	very mild irritant	IV
	EHE ester	41413505	not a skin irritant	IV

Guideline No	Study Type	MRID Numbers	Results	Toxicity Category
870.2600	**Dermal Sensitization**			
	2,4-D acid	00161659	not a dermal sensitizer	N/A
	DEA salt	41920904	not a dermal sensitizer	
	DMA salt	41642805	unacceptable	
	IPA salt	41233701	unacceptable	
	IPE ester	40352704	not a dermal sensitizer	
	TIPA salt	41413506	not a dermal sensitizer	
	BEE ester	40629806	not a dermal sensitizer	
	EHE ester	41209006	unacceptable	

1. The technical acute toxicity values included in this document are for informational purposes only. The data supporting these values will be evaluated during reregistration and may or may not meet the current Agency acceptance criteria.

The mechanisms responsible for renal clearance of 2,4-D have been investigated in several species. 2,4-D is actively secreted by the proximal tubules. This mechanism of renal clearance is consistent with results seen with other phenoxy acids. It has been suggested that observed dose-dependent, non-linear, pharmacokinetics of 2,4-D are primarily due to the saturation of this renal secretory transport system. Due to a limited capacity to excrete organic acids, the dog is more sensitive to the effects of 2,4-D than the rat with respect to repeated dosing.

In laboratory animals, following subchronic, oral exposure at dose levels of 2,4-D above the threshold of saturation for renal clearance, the primary target organs are the eye, thyroid, kidney, adrenals, and ovaries/testes. Changes in these organs are also observed following exposure to the amine salts and esters of 2,4-D. Systemic toxicity was not observed following repeated dermal exposure to 2,4-D, EHE, and TIPA at or above the limit dose or following repeated dermal exposure to BEE and IPA at the highest dose tested. Liver toxicity was observed following repeated high-dose dermal exposure to DEA, and one death occurred following repeated high-dose dermal exposure to DMA.

There are no repeat-dose inhalation exposure data available on 2,4-D. The most reliable way to characterize inhalation toxicity and to quantify inhalation risk is through the use of inhalation toxicity studies. In general, chemicals tend to be more toxic by the inhalation route than by the oral route due to rapid absorption and distribution, bypassing of the liver's metabolic protection (portal circulation), and potentially serious portal-of-entry effects, such as irritation, edema, cellular transformation, degeneration, and necrosis. An inhalation risk assessment that is based on oral data generally underestimates the inhalation risk because it cannot account for these factors. However, in the case of 2,4-D, based on the limited metabolism of 2,4-D *via* the oral route, the moiety to which the body would be exposed would be the same for both routes of exposure. With regard to portal-of-entry effects, these can only be assessed in an inhalation study. Therefore, a subchronic (28-day) inhalation study is required for 2,4-D.

Developmental toxicity, characterized mainly as an increased incidence of skeletal abnormalities in the rat, was observed following exposure to 2,4-D and its amine salts and esters at dose levels that were at or above the threshold of saturation of renal clearance. Similarly, developmental toxicity was observed in the rabbit only following exposure to 2,4-D (abortions) and DEA (increased number of litters with fetuses having 7th cervical ribs) at or above the threshold of renal clearance.

Reproductive toxicity, characterized as an increase in gestation length, was observed following exposure to 2,4-D at a dose level above the threshold of saturation of renal clearance. A repeat 2-generation reproduction study (using the revised EPA protocol) is required to address concerns for endocrine disruption.

Neurotoxicity was demonstrated following exposure to 2,4-D at relatively high dose levels. Clinical signs of neurotoxicity (ataxia, decreased motor activity, myotonia, prostration, lateral recumbency, impaired/loss of the righting reflex, and skin cold to the touch) were observed in pregnant rabbits following exposure to 2,4-D and its amine salts and esters. Neuropathology (retinal degeneration) was observed following 2,4-D exposure in several studies in female rats. Incoordination and slight gait abnormalities (forepaw flexing or knuckling) were observed following acute dosing and increased forelimb grip strength was observed following chronic exposure to 2,4-D at dose levels that exceeded the threshold of saturation of renal clearance. A developmental neurotoxicity study in the rat is required for 2,4-D.

2,4-D is classified as a Group D chemical (not classifiable as to human carcinogenicity). Based on the overall pattern of responses observed in both *in vitro* and *in vivo* genotoxicity tests, 2,4-D was not mutagenic, although some cytogenic effects were observed. 2,4-D acid is currently considered to be representative of all nine member chemicals of the 2,4-D case.

The toxicological endpoints that were used to complete the risk assessments are summarized in Table 7. These endpoints were selected by the Agency from animal studies. With respect to dermal exposures, the Agency previously selected a dermal absorption factor of 5.8 percent based on the average absorbed dose value from a human dermal absorption study. That factor (5.8 percent) was used in previous versions of the human health risk assessment. Based on comments received during the Phase 5 comment period, the dermal absorption study and resulting absorption factor were reconsidered. In order to account for the variability observed in the dermal absorption study, the dermal absorption factor was changed from 5.8 percent to 10 percent. In their "Re-evaluation of the Lawn and Turf Uses of 2,4-D," which was made available to the public for review, Health Canada also selected a factor of 10 percent based upon the weight of evidence from several published studies, taking into account the variability in the data and the limitations of the various studies. These studies include the Feldman and Maibach study discussed above and studies from Harris and Solomon 1992, Moody et. al. 1990, Wester et. al. 1996, and Pelletier et al. 1988.

b. Safety and Database Uncertainty Factors

The Food Quality Protection Act (FQPA) directs the Agency to use an additional tenfold (10X) safety factor to protect for special sensitivity of infants and children to specific pesticide residues in food, drinking water, or residential exposures, or to compensate for an incomplete database. FQPA authorizes the Agency to modify the tenfold safety factor only if reliable data demonstrate that another factor would be appropriate.

FQPA Special Safety Factor. After evaluating hazard and exposure data for 2,4-D, EPA removed the default 10X FQPA special safety factor. The toxicity database for 2,4-D includes acceptable developmental and reproductive toxicity studies. Developmental toxicity studies were conducted in both rats and rabbits for most 2,4-D forms. There is qualitative evidence of susceptibility in the rat developmental toxicity study with 2,4-D acid and DEA salt where fetal effects (skeletal abnormalities) were observed at a dose level that produced less severe maternal toxicity (decreased body-weight gain and food consumption). There is no evidence of increased (quantitative or qualitative) susceptibility in the prenatal developmental toxicity study in rabbits or in the 2-generation reproduction study in rats on 2,4-D. Regarding the 2,4-D amine salt and ester forms, no evidence of increased susceptibility (quantitative or qualitative) was observed in the prenatal developmental toxicity study in rats and rabbits (except for 2,4-D DEA) dosed with any of the amine salts or esters of 2,4-D. There is evidence of increased susceptibility (qualitative) in the prenatal developmental study in rabbits for 2,4-D DEA salt.

After establishing developmental toxicity endpoints to be used in the risk assessment with traditional uncertainty factors (10x for interspecies variability and 10x for intraspecies variability), the Agency has no residual concerns for the effects seen in the developmental toxicity studies. Therefore, the 10X FQPA special safety factor was reduced to 1X.

Database Uncertainty Factor. On April 8, 2003, based on the weight of evidence presented, the Agency reaffirmed the previous conclusion that a developmental neurotoxicity (DNT) study in rats is required for 2,4-D because there is a concern for developmental neurotoxicity resulting from exposure to 2,4-D. There is evidence of neurotoxicity, including clinical signs such as ataxia and decreased motor activity in pregnant rabbits following dosing during gestation days 6-15 in studies on 2,4-D itself and 2,4-D amine salts and esters, and tremors in dogs that died on test following repeat exposure to 2,4-D. Incoordination and slight gait abnormalities (forepaw flexing or knuckling) were also observed following dosing in the acute neurotoxicity study with 2,4-D. There is also evidence of developmental toxicity, as discussed above in the FQPA Special Safety Factor section. In addition, the Agency determined that a repeat 2-generation reproduction study using the new protocol is required to address specific concerns for endocrine disruption (thyroid and immunotoxicity measures). Therefore, the Agency determined that a 10X database uncertainty factor (UF_{DB}) is needed to account for the lack of these studies.

c. Carcinogenicity

A Science Advisory Board/Scientific Advisory Panel Special Joint Committee reviewed available epidemiological and other data on 2,4-D in 1992 and concluded that "the data are not sufficient to conclude that there is a cause and effect relationship between exposure to 2,4-D and non-Hodgkin's lymphoma." 2,4-D has been classified as a Category D chemical (i.e., not classifiable as to human carcinogenicity), by the EPA/OPP Cancer Peer Review Committee in 1996. The Agency requested further histopathological examinations of rat brain tissues and mouse spleen tissues in question. These exams were submitted and reviewed and on March 16, 1999, the Agency notified the 2,4-D Task Force that the Agency would continue to classify 2,4-D as a Group D carcinogen.

The Agency has twice recently reviewed epidemiological studies linking cancer to 2,4-D. In the first review, completed January 14, 2004, EPA concluded there is no additional evidence that would implicate 2,4-D as a cause of cancer (EPA, 2004). The second review of available epidemiological studies occurred in response to comments received during the Phase 3 Public Comment Period for the 2,4-D RED. This report, dated December 8, 2004 and authored by EPA Scientist Jerry Blondell, Ph.D., found that none of the more recent epidemiological studies definitively linked human cancer cases to 2,4-D.

2,4-D Diethanolamine (DEA). The Agency recently reviewed the available toxicology data on diethanolamine (DEA) and related compounds. The Agency concluded that it was not likely that exposure to the DEA salt of 2,4-D resulting from occupational use would pose a carcinogenic risk to humans. While liver tumors were observed in mice following dermal exposure to DEA, there was no evidence of carcinogenicity in rats following dermal exposure, and there was no evidence of a genotoxic or mutagenic concern. Although no formal assessment has been performed on the proposed mode of action (choline deficiency), this mode of action was considered plausible for the mouse hepatocellular tumors observed following dermal exposure to DEA, as were other confounding factors, including the use of ethanol as a vehicle for dose administration and the fact that humans are generally refractive to choline deficiency. Additionally, the low use pattern for 2,4-D DEA indicates that there is no potential long-term dermal exposure to the diethanolamine salt of 2,4-D in agricultural uses. The Agency also determined that, at this time, no carcinogenicity studies are required for the DEA salt of 2,4-D.

d. Cumulative Assessment

FQPA requires EPA to consider "available information" concerning the cumulative effects of a particular pesticide's residues and "other substances that have a common mechanism of toxicity" when considering whether to establish, modify, or revoke a tolerance. Potential cumulative effects of chemicals with a common mechanism of toxicity are considered because low-level exposures to multiple chemicals causing a common toxic effect by a common mechanism could lead to the same adverse health effect as would a higher level of exposure to any one of these individual chemicals. 2,4-D is a member of the alkylphenoxy herbicide class of pesticides. A cumulative risk assessment has not been performed as part of this human health risk assessment because the Agency has not yet made a determination whether or not phenoxy herbicides have a common mechanism of toxicity. For information regarding EPA's efforts to determine which chemicals have a common mechanism of toxicity and to evaluate the cumulative effects of such chemicals, see the policy statements released by the EPA's Office of Pesticide Programs concerning common mechanism determinations and procedures for cumulating effects from substances found to have a common mechanism on EPA's website at http://www.epa.gov/pesticides/cumulative/

e. Endocrine Effects

EPA is required under the Federal Food, Drug, and Cosmetic Act (FDCA), 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."

When the appropriate screening and/or testing protocols being considered under the Agency's Endocrine Disruption Screening Program (EDSP) have been developed, 2,4-D may be subject to additional screening and/or testing to better characterize effects related to endocrine disruption.

Based on currently available toxicity data, which demonstrate effects on the thyroid and gonads following exposure to 2,4-D, there is concern regarding its endocrine disruption potential. There have been no studies on 2,4-D that specifically assess its endocrine disruption potential. The Agency has determined that a repeat 2-generation reproduction study using the most recent protocol is required to address both the concern for thyroid effects (comparative assessment between the young and adult animals) and immunotoxicity, as well as a more thorough assessment of the gonads and reproductive/developmental endpoints.

f. Toxicological Endpoints for Risk Assessment

The toxicological endpoints used in the human health risk assessment for 2,4-D are listed in Table 7. The safety factors used to account for interspecies extrapolation, intraspecies variability, special susceptibility of infants and children, and database uncertainties are also described in Table 7 below. This table also describes any absorption factors used to extrapolate from one route of exposure to another (e.g., oral to dermal).

Table 7. Toxicity Endpoints for Human Health Risk Assessment for 2,4-D

Exposure Scenario	Dose Used in Risk Assessment, UF	Special FQPA SF and Level of Concern for Risk Assessment	Study and Toxicological Effects
Dietary Exposures			
Acute Dietary (Females 13-49 years of age) MRID 00130407, 00130408	NOAEL = 25 mg/kg/day UF = 1000 **Acute RfD** = 0.025 mg/kg/day	FQPA SF = 1X **aPAD** = acute RfD(0.025) / FQPA SF (1) = 0.025 mg/kg/day	Rat Developmental Toxicity Study, LOAEL = 75 mg/kg/day based on skeletal abnormalities
Acute Dietary (General population including infants and children) MRID 43115201	NOAEL = 67 mg/kg/day UF = 1000 **Acute RfD** = 0.067 mg/kg/day	FQPA SF = 1X **aPAD** = acute RfD (0.067) / FQPA SF (1) = 0.067mg/kg/day	Acute Neurotoxicity Study in Rats LOAEL = 227 mg/kg/day based on gait abnormalities
Chronic Dietary (All populations) MRID 43612001	NOAEL= 5 mg/kg/day UF = 1000 **Chronic RfD** = 0.005 mg/kg/day	FQPA SF = 1X **cPAD** = chronic RfD (0.005) / FQPA SF (1) = 0.005 mg/kg/day	Rat Chronic Toxicity Study LOAEL = 75 mg/kg/day based on decreased body-weight gain (females) and food consumption (females), alterations in hematology , and clinical chemistry parameters, decreased T4 (both sexes), glucose (females), cholesterol (both sexes), and triglycerides (females).
Occupational and Residential Non-Dietary Exposures			

Exposure Scenario	Dose Used in Risk Assessment, UF	Special FQPA SF and Level of Concern for Risk Assessment	Study and Toxicological Effects
Short-Term Incidental Oral (1-30 days) MRID 00130407, 00130408	NOAEL= 25 mg/kg/day	**Residential** LOC for MOE =1000 **Occupational** = NA	Rat developmental toxicity study LOAEL = 75 mg/kg/day based on decreased maternal body-weight gain
Intermediate-Term Incidental Oral (1-6 months) MRID 41991501	NOAEL = 15 mg/kg/day	**Residential** LOC for MOE = 1000 **Occupational** = NA	Rat Subchronic Oral Toxicity LOAEL = 100 mg/kg/day based on decreased body weight/body-weight gain, alterations in some hematology, and clinical chemistry parameters, and cataract formation.
Short-Term Dermal* MRID 00130407, 00130408	Oral study NOAEL= 25 mg/kg/day	**Residential** LOC for MOE = 1000 **Occupational** LOC for MOE = 100	Rat Developmental Toxicity Study LOAEL = 75 mg/kg/day based on decreased maternal body-weight gain and skeletal abnormalities
Intermediate-Term Dermal* MRID 00130407, 00130408	Oral study NOAEL = 15 mg/kg/day		Rat Subchronic Oral Toxicity (same as for intermediate-term incidental oral)
Long-Term Dermal* MRID 43612001	Oral study NOAEL= 5 mg/kg/day		Rat Chronic Toxicity Study (same as for chronic dietary)
Short-Term Inhalation* MRID 00130407, 00130408	Oral study NOAEL= 25 mg/kg/day		Rat Developmental Toxicity Study (same as for short-term dermal)
Intermediate-Term Inhalation* MRID 00130407, 00130408	Oral study NOAEL = 15 mg/kg/day		Rat Subchronic Oral Toxicity (same as intermediate-term incidental oral)
Long-Term Inhalation* MRID 43612001	Oral study NOAEL= **5** mg/kg/day		Rat Chronic Toxicity Study (same as for chronic dietary)
Cancer	**Classification**: Group D [not classifiable as to human carcinogenicity]		

The dermal absorption factor is 10 percent and the inhalation absorption factor is 100 percent.

UF = uncertainty factor, FQPA SF = Special FQPA safety factor, NOAEL = no observed adverse effect level, LOAEL = lowest observed adverse effect level, PAD = population adjusted dose (a = acute, c = chronic), RfD = reference dose, MOE = margin of exposure, LOC = level of concern, NA = Not Applicable

Dermal Absorption. A dermal absorption study utilizing human volunteers is available. Excretion following dermal application was 5.8 ± 2.4 percent (mean ± S.D.) of the administered dose and after intravenous administration was 100 ± 2.5 percent. The Agency previously selected a dermal absorption factor of 5.8 percent based on the human dermal absorption study. This factor was used in previous versions of this risk assessment. Based on comments received during the Phase 5 comment period, this dermal absorption study and factor were reconsidered. In order to account for the variability observed in the dermal absorption study, the dermal absorption factor was changed from 5.8 percent to 10 percent. In their "Re-evaluation of the Lawn and Turf Uses of 2,4-D," which was made available to the public, Health Canada also selected a factor of 10 percent based upon the weight of evidence from several published studies, taking into account the variability in the data and the limitations of the various studies. These studies include the Feldman and Maibach study discussed above and studies from Harris and Solomon 1992, Moody et. al. 1990, Wester et. al. 1996, and Pelletier et al. 1988.

2. Dietary Exposure and Risk from Food

a. Exposure Assumptions

Acute and chronic dietary exposure and risk analyses for 2,4-D were conducted using the Lifeline ™ Model Version 2.0 and Dietary Exposure Evaluation Model software with the Food Commodity Intake Database (DEEM-FCID™, Version 1.33). DEEM incorporates consumption data from USDA's Continuing Surveys of Food Intakes by Individuals (CSFII), 1994-1996 and 1998. Lifeline ™ uses food consumption data from the United States Department of Agriculture's (USDA's) Continuing Surveys of Food Intakes by Individuals (CSFII) from 1994-1996 and 1998. Lifeline™ uses recipe files contained within the program to relate raw agricultural commodities (RACs) to foods "as-eaten." Lifeline™ converts the RAC residues into food residues by randomly selecting a RAC residue value from the "user defined" residue distribution (created from the residue, percent crop treated, and processing factors data), and calculating a net residue for that food based on the ingredients' mass contribution to that food item.

Lifeline™ models the individual's dietary exposures over a season by selecting a new CSFII diary each day from a set of similar individuals based on age and season attributes. Lifeline™ groups CSFII diaries based on the respondent's age and the season during which the food diary was recorded. Based on analysis of the 1994-96, and 1998 CSFII consumption data, which took into account dietary patterns and survey respondents, the Agency concluded that it is most appropriate to report risk for the following population subgroups: the general U.S. population, all infants (<1 year old), children 1-2, children 3-5, children 6-12, youths 13-19, adults 20-49, females 13-49, and adults 50+ years old. The most highly exposed population subgroup for 2,4-D using both DEEM and Lifeline was children 1-2 years of age.

The acute dietary assessment was only slightly refined as the following assumptions were made: tolerance-level exposure values for most commodities, the highest field trial residue value for citrus commodities, and 100% crop treated (%CT). Note that half of the average level of detection (LOD) from the United States Department of Agriculture (USDA) Pesticide Data Program (PDP) monitoring data was used as the milk residue value because no milk sample contained detectable 2,4-D residues over several years of PDP sampling.

The chronic dietary assessment was moderately refined, making use of the following assumptions: tolerance-level exposure values for most commodities; averages of field trial data and processing study factors for small grains, citrus, and sugarcane sugar and molasses; %CT information for all commodities; and the MCL (70 ppb) as well as the highest observed groundwater monitoring concentration (15 ppb) for drinking water in a forward calculation. As in the case of the acute assessment, half of the average LOD from PDP monitoring data was used for milk.

b. Population Adjusted Dose

A population adjusted dose, or PAD, is the reference dose (RfD) adjusted for the FQPA safety factor. A risk estimate that is less than 100% of the acute PAD (aPAD), the dose at which an individual could be exposed over the course of a single day and no adverse health effects would be expected, does not exceed EPA's level of concern. Likewise, a risk estimate that is less than 100% of the chronic PAD (cPAD), the dose at which an individual could be exposed over the course of a lifetime and no adverse health effects would be expected, does not exceed EPA's level of concern.

In the case of 2,4-D , the FQPA SF has been removed (equivalent to a factor of 1x), so the acute or chronic RfD is identical to the respective aPAD or cPAD. In addition, an uncertainty factor is determined for each chemical. In the acute and chronic dietary risk assessments for 2,4-D, the total uncertainty factor (UF) is 1000x; 10x for interspecies variability, 10x for intraspecies variability, and 10x for database uncertainty.

c. Food Risk Estimates

Acute: Risk to the general U.S. population was 18% and 17% of the aPAD using both DEEM and Lifeline, respectively. The most highly exposed population subgroup using both DEEM and Lifeline was children 1-2 years of age; risks were 33% and 32% of the aPAD, respectively. Risk to females 13-49 years of age was 31% of the aPAD using DEEM and 42% of the aPAD using Lifeline; these higher calculated risks for women of child-bearing age are due to the 2.7x lower toxicological point of departure for developmental effects applicable to Females 13-49 years of age. These acute dietary (food) risks are all less than the Agency's level of concern (100% of the aPAD).

Chronic: Risk to the general U.S. population was 4.1% and 3.8% of the cPAD, using DEEM and Lifeline, respectively. Risk to children 1-2 years of age, the most highly exposed population subgroup, was 8.5% of the cPAD using DEEM and Lifeline.

3. Dietary Exposure and Risk from Drinking Water

Drinking water exposure to pesticides can occur through surface and ground water contamination. EPA considers acute (one day) and chronic (lifetime) drinking water risks and uses either modeling or monitoring data, if available and of sufficient quality, to estimate those exposures. In assessing drinking water risks, EPA compares model results to concentrations that would be acceptable in drinking water from a human health perspective (e.g., DWLOCs). If the estimated drinking water concentrations (EDWCs) in water are less than the DWLOCs, EPA does not have concern from consuming drinking water. If the EDWCs are greater than DWLOCs, EPA will conduct further analysis to characterize the potential dietary risk from drinking water. Risks from exposure to 2,4-D in drinking water are further discussed in the section III.A.5.

2,4-D is an herbicide used in a wide variety of environments. As the major route of degradation is aerobic microbial metabolism, 2,4-D is non-persistent ($t_{1/2}$=6.2 days) in terrestrial (aerobic) 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 will be anionic ($X\text{-}COO^- H^+$) under most environmental conditions, it is expected to be mobile (K_{oc}=61.7) in soil and aquatic environments.

The 2,4-D degradates detected in the various laboratory environmental fate studies were 1,2,4-benzenetriol, 2,4-dichlorophenol (2,4-DCP), 2,4-dichloroanisole (2,4-DCA), 4-chlorophenol, chlorohydroquinone (CHQ), volatile organics, bound residues, and carbon dioxide. The Agency has determined that residues other than 2,4-D are not of risk concern due to low occurrence under environmental conditions, comparatively low toxicity, or a combination thereof.

Estimated Environmental Concentrations (EEC) were derived through an evaluation of monitoring data and modeling. A number of different scenarios were assessed and EECs provided for each. Scenarios evaluated included the direct application of 2,4-D to water bodies for aquatic weed control, a rice use scenario, and terrestrial uses including food and nonfood uses.

a. Surface Water

Modeling: The Tier II screening models, Pesticide Root Zone Model and Exposure Analysis Modeling System (PRZM-EXAMS),with the Index Reservoir and Percent Crop Area adjustment (IR-PCA PRZM/EXAMS) were used to estimate 2,4-D residues in surface water used for drinking water.

The Index Reservoir represents a watershed that is more vulnerable than most watersheds used as drinking water sources. It was developed from a watershed in western Illinois that has been used for drinking water purposes. The Index Reservoir is used as a standard watershed that, in combination with local soils types, weather conditions, and cropping practices, represents a vulnerable watershed that could support a drinking water supply.

For terrestrial uses of 2,4-D, EECs were calculated from aquatic exposure modeling using PRZM/EXAMS with the Index Reservoir and a percent crop area treated (PCA) adjustment (Tier II). Fifteen scenarios were chosen for aquatic exposure modeling, including 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. Although this 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.

Surface water concentrations were modeled using PRZM version 3.12 and EXAMS version

2.98.04. Ground water concentrations were modeled using SCIGROW version 2.2. The 15 crop scenarios listed above were modeled using PRZM/EXAMS. Based on the maximum modeled values, (more specifically, the North Carolina apple model scenario), the model-estimated, surface-water-derived drinking water concentrations for the use of 2,4-D are:

118 ug/L for the 1 in 10 year annual peak concentration (acute)
64 ug/L for the 1 in 10 year 90-day average
23 ug/L for the 1 in 10 year annual mean concentration (chronic)

Monitoring: Monitoring data considered in the assessment were the United States Geological Survey's (USGS) National Water Quality Assessment Program (NAWQA) groundwater and surface water database, USGS/EPA reservoir monitoring database, National Drinking Water Contaminant Occurrence Database (NCOD), and US EPA's Storage and Retrieval environmental data system (STORET). Review of these databases was conducted to provide peak and median concentrations. Additionally, the quality of data was evaluated for targeting pesticide use areas, detection limits, and analytical recoveries. The monitoring data indicate that 2,4-D is detected in groundwater and surface water. Also, 2,4-D is detected in finished drinking water. Maximum concentrations of 2,4-D in surface source water and ambient groundwater are 58 ug/L and 14.8 ug/L, respectively. The highest median 2,4-D concentration of 1.18 ug/L was derived from finished water samples in the NCOD database. The highest time weighted annual mean (TWAM) concentration was 1.45 ug/L from the NAWQA database containing nontargeted data reflecting pesticide concentrations in flowing water as opposed to more stationary bodies of water such as ponds, lakes, and reservoirs.

The PRZM/EXAMS surface water-derived drinking water model estimate that would be appropriate for acute exposure (118 ug/L) is approximately two times the peak concentration of 58 ug/L detected in the surface water monitoring data evaluated as part of this assessment. However, since 70 ug/l is the current maximum contaminant level (MCL) established under the Safe Drinking Water Act, and is the label-prescribed 2,4-D concentration in treated water to be used for drinking water, this MCL limit is a reasonable and practical value to be used for the surface water concentration of 2,4-D for acute risk assessment purposes.

Note that the peak surface water concentration of 58 ug/L is consistent with the 70-ppb label instruction (also the MCL). Although the surface water monitoring was not specifically targeted to known 2,4-D- treated sites or even areas of high 2,4-D usage, this agreement suggests that, from a practical standpoint, the MCL is a reasonable regulatory limit.

Although of high quality, the available monitoring data is not 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 levels.

b. Ground Water

Monitoring: 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. The next highest concentration detected in the NAWQA groundwater data is 4.54 ug/L which is consistent with the NCOD-reported concentration. Therefore, the Agency is using 15 ug/L based on monitoring for the groundwater EDWC.

c. EDWCs Selected for Risk Assessment

The EDWCs for 2,4-D in surface and ground water are listed in Table 8 below. The EDWCs were selected from both modeling calculations and monitoring data.

Table 8. Surface and Ground Water Estimated Drinking Water Concentrations (EDWCs)

Drinking Water Source	Duration	EDWC (ppb) (ppb = ug/liter)	Data Source
Surface Water	Acute (Peak)	70 ug/liter (aquatic applications)	Maximum Contaminant Level (MCL)
		118 ug/liter (terrestrial applications)	Modeling - PRZM-EXAMS (NC apple scenario)
	Short and Intermediate	70 ug/liter (aquatic applications)	Maximum Contaminant Level (MCL)
		64 ug/liter (terrestrial applications)	Modeling - PRZM-EXAMS (NC apple 1 in 10 year annual average)
	Chronic	11 ug/liter (aquatic application)	Modeling - Dissipation modeling of aquatic application
		23 ug/liter (terrestrial application)	Modeling - PRZM-EXAMS worst case terrestrial use (NC apple scenario)
		1.5 ug/liter (terrestrial application)	Monitoring - Maximum time weighted annual mean from NAWQA database
Ground Water	All Duration	15 ug/liter	Monitoring - Highest monitored value from NAWQA database

4. Residential and Other Non-occupational Exposure

Residential exposure assessment considers all potential pesticide exposure, other than exposure due to residues in foods or in drinking water. Exposure may occur during and after application on lawns and turf, golf courses, parks, cemeteries, and other grass areas. Exposure may also occur to recreational swimmers while swimming in waters treated with 2,4-D for aquatic weeds. Each route of exposure (oral, dermal, inhalation) is assessed, where appropriate, and risk is expressed as a Margin of Exposure (MOE), which is the ratio of estimated exposure to an appropriate NOAEL. 2,4-D products are marketed for homeowner use on residential lawns and turf. 2,4-D containing products are also marketed for use by professional applicators on residential turf, golf courses, and on other turf such as recreational or commercial areas. Based on these uses, 2,4-D has been assessed for the residential mixing/loading/applicator (or "handler") exposure for applications by homeowners to home lawns. For post-application exposure, 2,4-D has been assessed for toddlers playing on treated turf, adults performing yardwork on treated turf, adults playing golf on treated turf, and children and adults swimming in bodies of water treated with 2,4-D for aquatic weed control.

a. Toxicity

The toxicological endpoints, and associated uncertainty factors used for assessing the non-dietary risks for 2,4-D are listed in Table 9.

In a dermal absorption study utilizing human volunteers, excretion following dermal application was 5.8 ± 2.4% and after i.v. administration was 100 ± 2.5%. In previous risk assessments, the Agency selected a dermal absorption factor of 5.8 percent based on the human dermal absorption study. Based on comments received during the Phase 5 comment period, this dermal absorption study and factor were reconsidered. In order to account for the variability observed in the dermal absorption study, the dermal absorption factor was changed from 5.8 percent to 10 percent. In their "Re-evaluation of the Lawn and Turf Uses of 2,4-D," which was made available to the public, Health Canada also selected a factor of 10 percent based upon the weight of evidence from several published studies, taking into account the variability in the data and the limitations of the various studies. These studies include the Feldman and Maibach study discussed above and studies from Harris and Solomon 1992, Moody et. al. 1990, Wester et. al. 1996, and Pelletier et al. 1988.

Chronic endpoints were not used in the residential assessment because chronic occupational and residential exposures to 2,4-D are not expected to occur. Per the 2,4-D Master Label, the maximum label frequency for application of 2,4-D to turf is two times per year. 2,4-D also rapidly dissipates from foliage and is readily excreted from the human body.

A MOE greater than or equal to 1000 is considered adequately protective for the residential exposure assessment. The MOE of 1000 includes 10x for interspecies extrapolation, 10x for intraspecies variation, and 10x for a database uncertainty factor. Table 9 lists the toxicity endpoints selected for assessing residential risk for 2,4-D.

Table 9. Toxicity Endpoints Selected for Assessing Residential Risk for 2,4-D

Exposure Scenario	Dose Used in Risk Assessment, UF	Level of Concern for Risk Assessment	Study and Toxicological Effects
Occupational and Residential Non-Dietary Exposures			

Exposure Scenario	Dose Used in Risk Assessment, UF	Level of Concern for Risk Assessment	Study and Toxicological Effects
Short-Term Incidental Oral (1-30 days) MRID 00130407, 00130408	NOAEL= 25 mg/kg/day UF_{DB} = 10	**Residential** LOC for MOE =1000 **Occupational** = NA	rat developmental toxicity study LOAEL = 75 mg/kg/day based on decreased maternal body-weight gain
Intermediate-Term Incidental Oral (1- 6 months) MRID 41991501	NOAEL = 15 mg/kg/day	**Residential** LOC for MOE = 1000 **Occupational** = NA	subchronic oral toxicity - rat LOAEL = 100 mg/kg/day based on decreased body weight/body-weight gain, alterations in some hematology, and clinical chemistry parameters, and cataract formation.
Short-Term Dermal* MRID 00130407, 00130408	Oral study NOAEL= 25 mg/kg/day	**Residential** LOC for MOE = 1000 **Occupational** LOC for MOE = 100	rat developmental toxicity study LOAEL = 75 mg/kg/day based on decreased maternal body-weight gain and skeletal abnormalities
Intermediate-Term Dermal* MRID 00130407, 00130408	Oral study NOAEL = 15 mg/kg/day		subchronic oral toxicity - rat (same as for incidental oral)
Long-Term Dermal* MRID 43612001	Oral study NOAEL= 5 mg/kg/day		rat chronic toxicity study (same as for chronic dietary)
Short-Term Inhalation* MRID 00130407, 00130408	Oral study NOAEL= 25 mg/kg/day		rat developmental toxicity study (same as for short-term dermal)
Intermediate-Term Inhalation* MRID 00130407, 00130408	Oral study NOAEL = 15 mg/kg/day		subchronic oral toxicity - rat (same as incidental oral)
Long-Term Inhalation* MRID 43612001	Oral study NOAEL= **5** mg/kg/day		rat chronic toxicity study (same as for chronic dietary)
Cancer	**Classification**: Group D [not classifiable as to human carcinogenicity]		

*The dermal absorption factor is 10 percent and the inhalation absorption factor is 100 percent.

UF = uncertainty factor, FQPA SF = Special FQPA safety factor, NOAEL = no observed adverse effect level, LOAEL = lowest observed adverse effect level, PAD = population adjusted dose (a = acute, c = chronic), RfD = reference dose, MOE = margin of exposure, LOC = level of concern, NA = Not Applicable

b. Residential Handler

1) Exposure Scenarios, Data, and Assumptions

Homeowners (or others) may be exposed to 2,4-D while treating their lawns. All homeowner-use products are available in liquid or granular form. 2,4-D is applied using hose-end sprayers, pump sprayers, ready-to-use sprayers, broadcast spreaders, bellygrinders, and hand application, either before or after seasonal weed emergence, at a rate up to 1.5 lbs ae/A. A number of assumptions, or estimates, such as adult body weight and area treated per application, are made by the Agency for residential risk assessment. Also, note that residential handlers are addressed somewhat differently than occupational handlers in that homeowners are assumed to complete all elements of an application (mix/load/apply) without use of personal protective equipment (assessments are based on an assumption that individuals will be wearing short pants and short-sleeved shirts).

The quantitative exposure/risk assessment developed for residential handlers is based on these scenarios:

1) Hand application of granules
2) Belly grinder application
3) Load/apply granules with a broadcast spreader
4) Mix/load/apply with a hose-end sprayer (mix your own)
5) Mix/load/apply with a hose-end sprayer (ready-to-use)
6) Mix/load/apply with hand held pump sprayer
7) Mix/load/apply with ready-to-use sprayer

Exposure estimates for these scenarios are taken from the Pesticide Handlers Exposure Database (PHED, Version 1.1 August 1998) which is used to assess handler exposures when chemical-specific monitoring data are not available. In addition to PHED data, the residential risk assessment relies on data from the Outdoor Residential Exposure Task Force (ORETF) and proprietary studies. Three turf transferable residue studies submitted by the Broadleaf Turf Herbicide Turf Transferable Residue (TTR) Task Force. These studies measured the dissipation of several phenoxy herbicides, including 2,4-D, using the ORETF roller technique. Scenarios #1 through #5 use ORETF or PHED data; scenarios #6 and #7 use exposure data from the Carbaryl Mixer/Loader/Applicator Exposure Study (EPA MRID 444598-01).

The results of a biomonitoring study (Harris and Solomon 1992) were also used to calculate dermal MOEs for post application exposure on turf. The study was conducted with adult volunteers who were exposed to 2,4-D while performing controlled activities for one hour on turf treated with 2,4-D. The controlled activities were conducted at 1 hour after treatment (HAT) and at 24 HAT. Ten volunteers participated in the study. Five volunteers wore long pants, a tee shirt, socks and closed footwear. The other five wore shorts and a tee shirt and were barefoot. The volunteers walked on the turf for a period of 5 minutes and then sat or lay on the area for 5 minutes and then continued in this fashion for 50 more minutes. Each volunteer collected all urine for the next 96 hours immediately following the exposure. The MOEs for the DAT 1 volunteers who wore shorts and no shoes ranged from 1000 to 26000 with the lowest MOE corresponding to a volunteer who removed his shirt during the exposure period. The MOEs for the remaining volunteers ranged from 17000 to 27000.

For more information, see "2,4-D. HED's Revised Human Health Risk Assessment for the Reregistration Eligibility Decision (RED) Revised to Reflect Public Comments. PC Code 030001; DP Barcode D316597" dated May 12, 2005, and the "2,4-D: 3rd Revised Occupational and Residential Exposure and Risk Assessment and Response to Public Comments for the Registration Eligibility Decision (RED) Document" dated May 4, 2005.

Assumptions Regarding Residential Handlers

- Clothing would consist of a short-sleeved shirt, short pants and no gloves.
- Broadcast spreaders and hose end sprayers would be used for broadcast treatments and the other application methods would be used for spot treatments only.
- An area of 0.023 acre (1000 square feet) would be treated per application during spot treatments and an area of 0.5 acre would be treated during broadcast applications.
- The application rate is 1.5 lb ae/acre representing the most recent revision to the master label.
- Average body weight of an adult handler is 70 kg.
- The duration of exposure is expected to be short-term (1-30 days) for residential handlers of 2,4-D. Intermediate- and long-term exposures of residential applicators are not anticipated based on 2,4-D's residential use pattern.

2) Residential Handler Risk Estimates

Based on toxicological criteria and potential for exposure, the Agency has conducted both a dermal and an inhalation exposure assessment. Risk assessment for short-term inhalation exposure is based on a rat developmental study. An assumption is made that 100% of the estimated inhalation dose will be absorbed. A dermal absorption factor of 10 percent was selected for converting dermal exposures to oral equivalent doses. An MOE greater than or equal to 1000 (10x for interspecies extrapolation, 10x for intraspecies variation, and 10x for database uncertainty) is considered adequately protective for this assessment. Since all residential handler MOEs are greater than 1000, risk to residential handlers is not of concern. The 2,4-D risk estimates are presented in Table 10 below.

In preliminary versions of the risk assessment, when considered alone, acute and short-term residential risks posed by the use of 2,4-D were not of concern to the Agency; however, when considered as part of an aggregate exposure with food and drinking water, exposures did exceed the Agency's level of concern. As a result, 2,4-D registrants agreed to reduce the maximum application rate to turf and residential lawns from 2.0 lbs ae/A to 1.5 lbs ae/A. The revised application rate (1.5 lbs ae/A) was used in the current risk assessment.

Table 10. 2,4-D Short Term Risk Estimates for Residential Handlers

Scenario	Application Rate (lbs ae/acre)	Treated Area (acres/day)	MOE
1. Hand Application of Granules	1.5	0.023	3,700
2. Belly Grinder Application	1.5	0.023	3,900
3. Load/Apply Granules with a Broadcast Spreader	1.5	0.5	29,000
4. Mix/Load/Apply with a Hose-end Sprayer (Mix your own)	1.5	0.5	1,800
5. Mix/Load/Apply with a Hose-end Sprayer (Ready to Use)	1.5	0.5	7,400
6. Mix/Load/Apply with Hand Held Pump Sprayer	1.5	0.023	11,000

Scenario	Application Rate (lbs ae/acre)	Treated Area (acres/day)	MOE
7. Mix/Load/Apply with Ready to Use Sprayer	1.5	0.023	7,900
Note: 1000 square feet equals 0.023 acres			

For more information, see Appendix F of "2,4-D: 3rd Revised Occupational and Residential Exposure and Risk Assessment and Response to Public Comments for the Reregistration Eligibility Decision (RED) Document (PC Code 030001, DP Barcode D316596)" dated May 4, 2005.

c. Residential Postapplication Risk

1) Exposure Scenarios, Data, and Assumptions

2,4-D uses in the residential setting include applications to home lawns. The following scenarios were assessed for residential post application risks:

1) Toddlers playing on treated turf
2) Adults performing yardwork on treated turf
3) Adults playing golf on treated turf

These scenarios chosen for risk assessment represent what the Agency considers the likely upper-end estimates of possible exposure. An MOE of 1000 (or more) is considered protective for this assessment.

<u>Assumptions Regarding Residential Postapplication Risk</u>

- An assumed initial turf transferable residue (TTR) value of 5.0% of the application rate is used for assessing hand to mouth exposures.
- An assumed initial TTR value of 20% of the application is used for assessing object to mouth exposures.
- Soil residues are contained in the top centimeter and soil density (i.e., the ratio of the mass of dry solids to the bulk volume of the soil occupied by those dry solids) is 0.67 gram/mL.
- Three year old toddlers are expected to weigh 15 kg.
- Hand-to-mouth exposures are based on a frequency of 20 events/hour and a surface area per event of 20 cm^2 representing the palmar surfaces of three fingers.
- Saliva extraction efficiency is 50 percent. Every time the hand goes in the mouth approximately half of the residues on the hand are removed.
- Adults are assessed using a transfer coefficient of 14,500 cm^2/hour.
- Toddlers are assessed using a transfer coefficient of 5,200 cm^2/hour.
- Golfers are assessed using a transfer coefficient of 500 cm^2/hour.
- An exposure duration of 2 hours per day is assumed for toddlers playing on turf or adults performing heavy yardwork.

The following assumptions that are specific to 2,4-D are used for assessing residential post application exposures.

- The master label application rate of 1.5 lbs ae/acre was used.
- The exposure following the application of granular formulations was not assessed because there were no TTR data submitted for granular formulations. It was assumed this exposure would be less than or equal to the exposure from liquid formulations.

Other residential exposure standard operating procedures (SOPs) may be viewed at the following website: http://www.epa.gov/oscpmont/sap/1997/september/sopindex.htm .

Calculation Method for Postapplication Exposure for Toddlers on Treated Turf

MOEs were calculated for acute toddler exposures using the maximum TTR value along with the acute dietary NOAEL of 67 mg/kg/day. This NOAEL was adapted to acute dermal exposures by using the dermal absorption factor of 10 percent to account for route to route extrapolation. The MOEs for toddler short term exposures were calculated using the seven day average TTR value because the short term NOAEL was based upon decreased body weight gain which occurred after several days of exposure. MOEs for acute and adult short term exposures were calculated using the maximum TTR value because the acute and short term NOAELs are the same and are based upon the developmental effects which could have occurred following one day of exposure.

The quantitative exposure/risk assessment for postapplication risk to children is based on these scenarios:

1) *Dermal activity from treated turf:* Postapplication exposure to children from the dermal exposure of pesticide residues from activity on treated turf.
2) *Hand-to-mouth activity from treated turf:* Postapplication exposure to children from the "incidental" ingestion of pesticide residues on treated turf from hand-to-mouth transfer (i.e., those residues that end up in the mouth from children touching turf and then putting their hands in their mouths).
3) *Object-to-mouth activity from treated turf:* Postapplication exposure to children from incidental ingestion of pesticide residues on treated turf from object-to-mouth transfer (i.e., those residues that end up in the mouth from a child mouthing a handful of treated turf).
4) *Soil ingestion activity:* Postapplication exposure to children from incidental ingestion of soil in a treated area.

For more information on formulas used for calculating occupational and residential exposures to 2,4-D, see Appendix A of "2,4-D: 3rd Revised Occupational and Residential Exposure and Risk Assessment and Response to Public Comments for the Reregistration Eligibility Decision (RED) Document" dated May 4, 2005.

2) Postapplication Risk Estimates

Risk assessment for children's postapplication exposure is based on a NOAEL of 67 mg/kg/day from an oral study of acute neurotoxicity study in rats. A Margin of Exposure (MOE) of 1000 (10x for interspecies extrapolation, 10x for intraspecies variation, and 10x for database uncertainty) is considered adequately protective for this assessment. Table 11 below presents the MOEs for Post-Application Exposure in Children. Since all MOEs meet or exceed 1000, postapplication exposure to children is not of concern.

Table 11. Children Post-Application Exposure to Turf Treated with 2,4-D

	Application Rate (lbs ae/acre)	**Dermal MOE**	**Hand-to Mouth MOE**	**Object to Mouth MOE**	**Soil Ingestion MOE**	**Total MOE**
Acute Toddler Risks Using the Maximum TTR (North Carolina Trial 1 using 2,4-D DMA)						
DAT 0	1.5	1,900	3000	12,000	>100,000	1,100
Short Term Toddlers Risks Using California TTR Data (DMA Mix, No Rain)						
DAT 0 to DAT 6	1.5	3,900	2,100	8,500	>100,000	1,200
Short Term Toddler Risks Using North Carolina TTR Data from Trial 1 (DMA and DMA Mix, No Rain)						
DAT 0 to DAT 6	1.5	5,100	4,400	18,000	>100000	2,100
Short Term Toddler Risks Using North Carolina TTR Data from Trial 2 (DMA Mix, Some Rain)						
DAT 0 to DAT 6	1.5	12,000	7,000	28,000	>100000	3,900
The acute NOAEL is 67 mg/kg/day for neurotoxic effects observed in the acute neurotoxicity study. The short term NOAEL is 25 mg/kg/day for maternal effects observed in the developmental study.						

Table 12 below lists the adult acute/short term MOEs for exposure to turf treated with 2,4-D. The acute/short term NOAEL is 25 mg/kg/day from the rat developmental toxicity study. The LOAEL was 75 mg/kg/day based on skeletal abnormalities from a developmental toxicity study in rats. All MOEs meet or exceed 1000, so postapplication exposure to adults is not of concern.

Table 12. Adult Acute/Short Term MOEs for Exposure to Turf Treated with 2,4-D

Exposure Scenario	Application Rate (lbs ae/acre)	TTR (ug/cm^2)	Acute/Short Term Dermal MOE[1] on Day 0
Heavy Yardwork Playing Golf	1.5	0.50	1000 15000
[1.] The acute/short term NOAEL is 25 mg/kg/day for developmental effects observed in the developmental study.			

d. Recreational Swimmer Risk

1) Exposure Scenarios, Data, and Assumptions

The master label indicates that 2,4-D can be used for aquatic weed control of surface weeds such as water hyacinth and submersed weeds such as Eurasian milfoil. Surface weeds are controlled by foliar applications at a maximum rate of 4.0 lb ae/acre. Submersed weeds are controlled by subsurface injection of liquids to achieve a target concentration of 2 to 4 ppm in the water column surrounding the weeds. This requires 5.4 to 10.8 lb ae per acre foot of water depth (e.g., 5.4 lbs ae would be required to achieve 2 ppm in a one acre pond that has an average depth of 1 foot). Granular formulations of BEE (Aquakleen and Navigate) are also used to control submersed weeds. The granular formulations resist rapid decomposition in water and release the herbicide into the root zone.

Although many herbicide treatments are applied to aquatic areas where recreational swimming is not likely to occur, some of the subsurface treatments are made at recreational lakes. These treatments are made because the Eurasian milfoil interferes with recreation and other activities. This problem is particularly prevalent in the northern states such as Minnesota and Washington and in the New England region.

The following exposure scenarios are assessed for recreational swimmers:

1) Adult Recreational Swimmer
2) Child Recreational Swimmer

<u>Assumptions Regarding Recreational Swimmer Risk</u>

The following assumptions were used for the assessment of swimmer risks. Many of these assumptions were taken from the Residential SOPs and are also used in the SWIMODEL.

- The skin surface area of adults is assumed to be 21,000 cm^2 (Residential SOPs). This is the 95th percentile value for females (EPA Exposure Factors Handbook, 1997).
- The body weight for children is assumed to be 22 kg as cited in the Residential SOPs. This is a mean value for 6 year old children.
- The skin surface area for children is assumed to be 9,000 cm^2 as cited in the Residential SOPs. This is the 90th percentile value for male and female children.
- The assumed mean ingestion rate is 0.05 liters per hour for both adults and children as cited in the Residential SOP. This value may be greater for young children playing in water and accidentally ingesting a remarkable quantity of water (U.S. EPA SAP, 1999).
- The exposure time is assumed to be 3 hours per day. This is the 90th percentile value for time spent swimming in a freshwater pool (EPA Child Specific Exposure Factors Handbook, 2002).
- The body weight for female adult acute exposures is assumed to be 60 kg.
- The body weight for male adult acute exposures is assumed to be 70 kg.
- The body weight for adult short term exposure is assumed to be 60 kg because the endpoint is gender specific.
- Risks were not calculated for foliar treatments because the application rate of 2.0 lb ae/acre would result in water concentration of only 0.25 ppm in a three foot water column

even if all of the spray were to run off the leaves into the water.

Calculation Method for Recreational Swimmer Exposure

The Agency used the Swimmer Exposure Assessment Model (SWIMODEL) to calculate exposures to swimmers in water treated with 2,4-D for aquatic weed control. The SWIMODEL estimates exposure for up to six exposure routes (i.e., oral ingestion, dermal absorption, inhalation, buccal/sublingual, nasal/orbital, and aural routes), or calculates exposure as a function of any one of the three major exposure routes (i.e., oral ingestion, dermal absorption, or inhalation). Other factors used in the SWIMODEL formulae for dermal and ingestion exposure which are described in Appendix A of "2,4-D: 3rd Revised Occupational and Residential Exposure and Risk Assessment and Response to Public Comments for the Reregistration Eligibility Decision (RED) Document" dated May 4, 2005.

The SWIMODEL formulas for the other dermal pathways (aural, buccal/sublingual and orbital/nasal) were not used in the 2,4-D human health risk assessment because these formulas are based upon recreational swimmers in swimming pools who swim with their heads partially immersed. It is anticipated that recreational swimmers in weed infested areas would be less likely to swim with their heads immersed than recreational swimmers in weed- free swimming pools. In addition, the formulas for the buccal/sublingual and orbital/nasal pathways contain a default absorption factor of 0.01 which is based upon the absorption of nitroglycerin. This factor would greatly overestimate the risk of 2,4-D exposure because 2,4-D is absorbed at a much lower rate.

Because the 2,4-D water concentrations can vary depending upon the application rate and site conditions the Maximum Swimming Water Concentration (MSWC) was calculated. The MSWC is the water concentration at which the combined dermal and ingestion MOE meets or exceeds the target MOE of 1000. The MSWCs were calculated for children's acute exposures using the acute NOAEL of 67 mg/kg/day and the MSWCs for children's short term exposures were calculated using the short term NOAEL of 25 mg/kg/day for maternal effects. The MSWCs for adult acute/short term exposures were calculated using a NOAEL of 25 mg/kg/day that is based upon developmental effects which could have occurred following one day of exposure.

2) Recreational Swimmer Risk Estimates

The MSWCs are summarized in Table 13 and the detailed calculations are included in Appendix H of the 3rd Revised Occupational and Residential Exposure Assessment for 2,4-D. The acute MSWCs range from 1.2 ppm for 2,4-D BEE to 9.8 ppm for 2,4-D acid while the short term MSWCs range from 0.9 ppm for 2,4-D BEE to 3.6 ppm for 2,4-D acid or amine. The MSWCs for 2,4-D BEE are lower because based on its chemical properties, 2,4-D BEE is expected to have a much higher dermal absorption value.

Table 13. Maximum Swimming Water Concentrations for 2,4-D Aquatic Applications

Exposure Duration	NOAEL (mg/kg/day)	2,4-D Form	2,4-D MSWC* (ppm)	Dermal MOE	Ingestion MOE	Combined MOE
Adults						
Acute/Short Term	25	Acid or Amine	9.8	97000	1000	1000
	25	BEE	1.2	1200	8300	1000
Children						
Acute	67	Acid or Amine	9.8	425000	1000	1000
Acute	67	BEE	2.4	1300	4100	1000
Short Term	25	Acid or Amine	3.6	230000	1000	1000
Short Term	25	BEE	0.90	1300	4100	1000

* The MSWC is the concentration below which the combined MOE would be above 1000 and the risks would not be of concern.

The Acute MSWC of 9.8 ppm for exposures to 2,4-D acid or amine is greater than the master label application rate of 4.0 ppm, therefore, acute exposures to 2,4-D acid or amine are not of concern. The MSWC of 3.6 ppm for short-term exposures to 2,4-D acid or amine is also not of concern because some dissipation or dispersion is likely to occur which would cause the 7-day average of 2,4-D concentrations to be less than 3.6 ppm. Dissipation studies submitted to EFED indicated that the half lives following pond and lake liquid treatments ranged from 3.2 days to 27.8 days which yield 7 day average concentrations of 1.9 ppm when the half life equals 3.2 days to 3.6 ppm when the half life equals 27.8 days.

The MSWCs for 2,4-D BEE are less than the master label application rate of 4 ppm, but they are unlikely to be of concern for the following reasons:

- 2,4-D BEE degrades rapidly by abiotic hydrolysis in sterile water to form 2,4-D acid particularly when the pH is 7.5 or above.

- 2,4-D BEE degrades to 2,4-D acid by microbial hydrolysis with an average half life of 2.6 ± 1.8 hours at a bacterial concentration of 5×10^{-8} organisms per liter. Therefore, degradation of 2,4-D BEE to 2,4-D under typical environmental conditions will be rapid leading to significantly lower risk estimates because the 2,4-D acid has a lower rate of dermal absorption.

- Modeling predicts direct water application of 2,4-D BEE will yield surface water concentrations of 2,4-D BEE concentrations in the Agency 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.

- The existing label rates for 2,4-D BEE products are also lower than the master label rate.

5. Aggregate Exposure and Risk

OPP has traditionally compared estimates of concentrations of a pesticide in drinking water to DWLOCs. A DWLOC is the portion of the acute PAD or chronic PAD remaining after estimated dietary (food only) exposures have been subtracted and the remaining exposure has been converted to a concentration (ug/L or ppb). This concentration value (DWLOC) represents the available or allowable exposure through drinking water. In an acute risk assessment, the remaining portion of the aPAD is based on dietary exposures at the percentile of exposure appropriate for a given risk assessment and depends on each relevant population subgroup considered. Estimated Drinking Water Concentrations (EDWCs) of 2,4-D in ground and surface water that are less than the DWLOCs do not exceed the Agency's level of concern. DWLOC values vary for population subgroups depending on dietary exposure through foods for each subgroup, assumptions made about the volume of drinking water consumed, and default body weights for each subgroup.

More recently, OPP has adopted the forward calculation approach for the assessment of aggregate risks. In this approach, food, drinking water and residential exposures are aggregated and compared to an appropriate endpoint.

In the case of 2,4-D, the DWLOCs were calculated for comparison to the MCL established by the EPA Office of Water and aggregate risks were calculated using the forward calculation approach for comparison to the appropriate endpoint. The respective DWLOCs and aggregate risks are shown for acute, chronic and short term exposures in the following sections.

a. Acute Aggregate Risk Assessment

DWLOC Approach

Acute DWLOCs were calculated based upon acute dietary exposures. Acute residential exposures from swimming in treated water bodies or playing on treated turf were not included because exposures are unlikely to co-occur with acute dietary exposures. The acute DWLOCs are summarized in Table 14 and are 432 ppb or greater with the most sensitive population being females 13-49 years old. The EDWCs of 118 ug/liter for surface water and 15 ug/liter for groundwater are substantially less than the DWLOCs which means that the risks are not of concern.

Table 14. Acute DWLOC Calculations

Population Subgroup	Body Weight (kg)	Water Consumption (liters/day)	aPAD (mg/kg/day)	Food Exp[1] (mg/kg/day)	Max Water Exposure (mg/kg/day[2])	DWLOC (μg/L)[3]
General U.S. Population	70	2.0	0.067	0.0118	0.0552	1932
All Infants (< 1 year old)	10	1.0		0.0132	0.0538	538
Children 1-2 years old	10	1.0		0.0221	0.0449	449
Children 3-5 years old	10	1.0		0.0206	0.0464	464
Children 6-12 years old	10	1.0		0.0147	0.0523	523
Females 13-49 years old	60	2.0	0.025	0.0106	0.0144	432

1. Food exposure values are the maximum of the acute DEEM or Lifeline values.
2 . Maximum water exposure (mg/kg/day) = [(acute PAD - food exposure)]
3. DWLOC (μg/L) = [maximum water exposure x body weight] ÷ [water consumption x 10^{-3} mg/μg].

Surface Water EDWC = 70 ug/liter (aquatic applications) or 118 ug/liter (terrestrial applications)
Ground Water EDWC = 15 ug/liter

Forward Calculation Approach

Acute aggregate risks were assessed by aggregating acute food exposures and acute water exposures. The acute aggregate risks are presented in Table 15 and are not of concern because they are less than 100 percent of the aPAD. The highest risks (58 percent of the aPAD) are for females 13-49 years old because these risks are based upon the lower NOAEL of 25 mg/kg/day.

Table 15. 2,4-D Aggregate Acute MOEs

Population Subgroup	Body Weight (kg)	Water Consumption (liters/day)	Food Exposure[1] (mg/kg/day)	Drinking Water Exposure[2] (mg/kg/day)	Aggregate Exposure[3] (mg/kg/day)	aPAD[4] (mg/kg/day)	Percent aPAD[5]
General U.S. Population	70	2.0	0.0118	0.00337	0.0152	0.067	23
Females 13-49 yrs old	60	2.0	0.0106	0.0039	0.015	0.025	58

Notes for Table X
1. Food exposure values are the maximum of the DEEM or Lifeline acute values.
2. Drinking Water Exposure = (EDWC * daily water consumption) / (1000 ug/mg * Body Weight); where the EDWC = 118 ug/liter
3. Aggregate Exposure = Food Exposure + Drinking Water Exposure
4. aPAD = NOAEL/1000; where the NOAEL is 25 mg/kg/day for females 13-49 and 67 mg/kg/day for all other population subgroups
5. Percent aPAD = (Aggregate Exposure/aPAD) * 100

b. Chronic Aggregate Risk Assessment

DWLOC Approach

Chronic DWLOCs were calculated based upon chronic dietary exposures. As there are no chronic residential exposures, residential exposures were not included in the chronic DWLOC calculations. The chronic DWLOCs are summarized in Table 16 and are 46 ug/liter or greater with the most sensitive population being children. The EDWCs, which range from 1.5 to 23 ug/liter, are less than the DWLOCs which means that the risks are not of concern. It should be noted that the master label indicates that potable water consumption from a treated water body cannot begin until the 2,4-D concentration is 70 ug/liter or below, therefore an annual average exposure at the MCL of 70 ug/liter would not occur because dissipation would reduce the initial concentration of 70 ug/liter to an annual average concentration of 11 ug/liter.

Table 16. Chronic DWLOC Calculations

Population Subgroup	Body Weight (kg)	Water Consumption (liters/day)	cPAD (mg/kg/day)	Food Exp[1] (mg/kg/day)	Max Water Exposure (mg/kg/day)[2]	DWLOC (µg/L)[3]
General U.S. Population	70	2.0	0.005	0.00020	0.0048	168
All Infants (< 1 year old)	10	1.0		0.00016	0.00484	48
Children 1-2 years old	10	1.0		0.00042	0.00458	46
Children 3-5 years old	10	1.0		0.00037	0.00463	46
Children 6-12 years old	10	1.0		0.00026	0.00474	47
Youth 13-19 years old	60	2.0		0.00019	0.00481	144
Adults 20-49 years old	70	2.0		0.00019	0.00481	168
Adults 50+ years old	70	2.0		0.00018	0.00482	169
Females 13-49 years old	60	2.0		0.00020	0.0048	144

1. Food exposure values are the maximum of the DEEM or Lifeline chronic dietary values.
2. Maximum water exposure (mg/kg/day) = [(chronic PAD - food exposure)]
3. DWLOC (µg/liter) = [maximum water exposure x body weight] ÷ [water consumption x 10^{-3} mg/µg].

Surface Water EDWC (maximum time weighted annual mean from the NAWQA database) = 1.5 ug/liter
Surface Water EDWC (dissipation modeling of aquatic application when 70 ppb occurs at time zero) = 11 ug/liter
Surface Water EDWC (worst case terrestrial use PRZM-EXAMs run) = 23 ug/liter
Ground Water EDWC (the highest monitored value from the NAWQA database) = 15 ug/liter

Forward Calculation Approach

Chronic aggregate risks were also assessed by aggregating chronic food exposures and chronic water exposures in a forward calculation approach. The chronic aggregate risks are presented as percent cPAD in Table 17 and are not of concern because they are less than 100 percent of the cPAD. The highest risks (38 percent of the cPAD) are for children 1-2 years old.

Table 17. 2,4-D Aggregate Chronic Risks

Population Subgroup	Body Weight (kg)	Water Consumption (liters/day)	Food Exposure[1] (mg/kg/day)	Drinking Water Exposure[2] (mg/kg/day)	Aggregate Exposure[3] (mg/kg/day)	cPAD[4] (mg/kg/day)	Percent cPAD[5]
General U.S. Population	70	2.0	0.00020	0.00043	0.0006	0.005	13
Children 1-2 yrs old	10	1.0	0.00042	0.0015	0.002	0.005	38

1. Food exposure values are from Table X and are the maximum of the DEEM or Lifeline chronic dietary values.
2. Drinking Water Exposure = (EDWC * daily water consumption) / (1000 ug/mg * Body Weight); where the EDWC = 15 ug/liter
3. Aggregate Exposure = Food Exposure + Drinking Water Exposure
4. cPAD = NOAEL of 5 mg/kg/day / 1000
5. Percent cPAD = (Aggregate Exposure/aPAD) * 100

c. Short-term Aggregate Risk Assessments

DWLOC Approach

Short-term aggregate risks assessments were conducted by calculating DWLOCs based upon short term turf exposures, chronic food exposures and short term endpoints. Short-term exposures from swimming in treated water bodies were not included because these exposures represent episodic scenarios that are unlikely to occur the same day as an acute dietary exposure. The short-term DWLOCs were calculated only for females 13-49 and children 1-6 because these population subgroups have the highest exposure and are protective of the other subgroups. The DWLOCS are listed in Table 18 and range from 24 to 54 ug/liter. These DWLOCs are all greater than the EDWCs, which range from 15 to 23 ug/liter, and indicate that short term risks are not of concern.

Table 18. Short-Term DWLOC Calculations for 2,4-D

Pop. Subgroup	Body Weight (kg)	Water Consumption (liters/day)	NOAEL/UF (mg/kg/day)	Turf Exposure (mg/kg/day)	Food Exp[1] (mg/kg/day)	Max Water Exposure (mg/kg/day)[2]	DWLOC (µg/L)[3]
Children 1-6	15	1.0	0.025	0.021	0.00042	0.00358	54
Females 13-49	60	2.0	0.025	0.024	0.00020	0.00080	24

1. Food exposure values are the maximum of the DEEM or Lifeline chronic dietary values.
2 Maximum water exposure (mg/kg/day) = [(NOAEL/UF) - (Turf exposure + food exposure)]
3. DWLOC (µg/liter) = [maximum water exposure x body weight] ÷ [water consumption x 10^{-3} mg/µg].

Surface Water EDWC (worst case terrestrial use PRZM-EXAMs run) = 23 ug/liter
Ground Water EDWC (based upon the highest monitored value) = 15 ug/liter

Forward Calculation Approach

Short-term aggregate risks were also assessed by directly aggregating short-term turf exposures, chronic food exposures and chronic water exposures. Short-term aggregate risks were calculated only for females 13-49 and children 1-6 because these population subgroups have the highest exposure and are protective of the other subgroups. The short term aggregate MOEs are presented in Table 19 and indicate that the short term risks are not of concern because the MOEs equal or exceed the target MOE of 1000.

Table 19. 2,4-D Aggregate Short-Term MOEs Including Turf Exposures

Population Subgroup[1]	Turf Application Rate (lbs ae/acre)	Chronic Food Exposure[2] (mg/kg/day)	Short-Term Turf Exposure[3] (mg/kg/day)	Chronic EDWC[4] (ug/liter)	Drinking Water Exposure[5] (mg/kg/day)	Aggregate Exposure[6] (mg/kg/day)	Aggregate MOE[7]
Females 13 - 49	1.5	0.000195	0.024	15	0.00050	0.0247	1000
Children 1 - 6	1.5	0.000424	0.021	15	0.0010	0.0224	1100
Females 13 - 49	1.5	0.000195	0.024	23	0.00077	0.0250	1000
Children 1 - 6	1.5	0.000424	0.021	23	0.0015	0.0230	1100

1. Body weights are 60 kg (females) and 15 kg (children). Water consumption values are 2 liter/day (females) and 1.0 liter/day (children).
2. The food exposure for females is from Lifeline. The food exposure for children is from DEEM and is for 1-2 year old children
3. Female's turf exposures are from the dermal route only. Children's turf exposures are from the dermal and incidental oral routes.
4. EDWC is 15 ug/liter for ground water and 23 ug/liter for surface water.
5. Drinking Water Exposure = (EDWC * daily water consumption) / (1000 ug/mg * Body Weight)
6. Aggregate Exposure = Turf Exposure + Food Exposure + Drinking Water Exposure
7. Aggregate MOE = NOAEL/Aggregate Exposure where the NOAEL is 25 mg/kg/day.

d. Cancer Aggregate Risk

2,4-D was classified as a Category D chemical, i.e., not classifiable as to human carcinogenicity, by the EPA/OPP Cancer Peer Review Committee in 1996. Thus, no aggregate cancer assessment is warranted.

e. Aggregate Risk Characterization

The highest aggregate risks are the short term risks that include the turf exposure scenarios. For the most sensitive subpopulation (females 13-49), these risks just meet the target MOE of 1000 and the turf exposure is the risk driver as it contributes 96 percent of the risk. It is important to note, however, that the turf exposure estimate is based upon modeling and is greater than exposure measurements obtained from biomonitoring. The results of a biomonitoring study (Harris and Solomon 1992) were also used to calculate dermal MOEs for post application exposure on turf. The study was conducted with adult volunteers who were exposed to 2,4-D while performing controlled activities for one hour on turf treated with 2,4-D. The controlled activities were conducted at 1 hour after treatment (HAT) and at 24 HAT. Ten volunteers participated in the study. Five volunteers wore long pants, a tee shirt, socks and closed footwear. The other five wore shorts and a tee shirt and were barefoot. The volunteers walked on the turf for a period of 5 minutes and then sat or lay on the area for 5 minutes and then continued in this fashion for 50 more minutes. Each volunteer collected all urine for the next 96 hours immediately following the exposure. The MOEs for the DAT 1 volunteers who wore shorts and no shoes ranged from 1000 to 26000 with the lowest MOE corresponding to a volunteer who removed his shirt during the exposure period. The MOEs for the remaining volunteers ranged from 17000 to 27000. If the calculated MOE of 1000 is considered in conjunction with the biomonitoring results, it is clear that the short term risks are upper bound estimates and not likely to be of concern.

6. Occupational Risk

Workers can be exposed to a pesticide through mixing, loading, and/or applying a pesticide, or re-entering treated sites. Occupational handlers of 2,4-D include workers in agricultural areas, workers in forest areas, workers in rights-of-way and non-cropland areas, workers in lawn and turf areas (including turf grown for seed or sod), and workers applying 2,4-D for aquatic weed control. Occupational risk for all of these potentially exposed populations is measured by an MOE which determines how close the occupational exposure comes to a NOAEL. In the case of 2,4-D, MOEs greater than 100 do not exceed the Agency's level of concern. For workers entering a treated site, MOEs are calculated for each day after application to determine the minimum length of time required before workers can safely reenter.

Occupational risk estimates are expressed as MOEs, which are the ratio of estimated exposure to an established dose level (NOAEL). 2,4-D MOEs are determined by a comparison of specific exposure scenario estimates to the NOAELs for short-term assessment and intermediate-term assessment, respectively. The NOAEL for short-term dermal and inhalation exposure is 25 mg/kg/day from a rat developmental toxicity study, and the NOAEL for intermediate-term dermal and inhalation exposure is 15 mg/kg/day from a rat subchronic oral toxicity study. The dermal absorption factor is 10 percent and the inhalation absorption factor is 100 percent. For 2,4-D users an MOE of 100 has been determined to be adequately protective (for both short- and intermediate-term exposure) based on the standard uncertainty factors of 10x for interspecies extrapolation and 10x for intraspecies variability. Long-term worker exposure is not expected for 2,4-D.

Occupational risk is assessed for exposure at the time of application (termed "handler" exposure) and assessed for exposure following application, or postapplication exposure. Application parameters are generally defined by the physical nature of the formulation (e.g., formula and packaging), by the equipment required to deliver the chemical to the use site, and by the application rate required to achieve an efficacious dose. Post-application risk is assessed for activities such as scouting, irrigating, pruning, and harvesting and is based primarily on dermal exposure estimates.

Occupational risk estimates are calculated based on assumptions concerning acres treated per day and the seasonal duration of exposure. For more information on the assumptions and calculations of potential risk of 2,4-D to workers, see the Occupational Exposure Assessment (Section 7.0) in "2,4-D: 3rd Revised Occupational and Residential Exposure and Risk Assessment and Response to Public Comments for the Reregistration Eligibility Decision (RED) Document," dated May 4, 2005.

a. Occupational Toxicity

Table 20 provides a listing of the toxicological endpoints used in the 2,4-D occupational risk assessment.

Table 20. Toxicological Endpoints for the Occupational Risk Assessment

Exposure Scenario	Dose Used in Risk Assessment, UF	Level of Concern for Risk Assessment	Study and Toxicological Effects
Short-Term Dermal*	Oral study NOAEL= **25** mg/kg/day	**Occupational** LOC for MOE = 100	Rat developmental toxicity study LOAEL = 75 mg/kg/day based on decreased maternal body-weight gain and skeletal abnormalities
Intermediate-Term Dermal*	Oral study NOAEL = **15** mg/kg/day		Subchronic oral toxicity - rat LOAEL = 100 mg/kg/day based on decreased body weight/body-weight gain, alterations in some hematology, and clinical chemistry parameters, and cataract formation.
Long-Term Dermal*	Oral study NOAEL= **5** mg/kg/day		Rat Chronic Toxicity Study LOAEL = 75 mg/kg/day based on decreased body-weight gain (females) and food consumption (females), alterations in hematology , and clinical chemistry parameters, decreased T4 (both sexes), glucose (females), cholesterol (both sexes), and triglycerides (females)].
Short-Term Inhalation*	Oral study NOAEL= **25** mg/kg/day		Rat developmental toxicity study (same as for dermal)
Intermediate-Term Inhalation*	Oral study NOAEL = **15** mg/kg/day		Subchronic oral toxicity - rat (same as incidental oral)
Long-Term Inhalation*	Oral study NOAEL= **5** mg/kg/day		Rat chronic toxicity study (same as for chronic dietary)
Cancer	**Classification**: Group D [not classifiable as to human carcinogenicity]		
*The dermal absorption factor is 10 percent and the inhalation absorption factor is 100 percent. UF = uncertainty factor, FQPA SF = Special FQPA safety factor, NOAEL = no observed adverse effect level, LOAEL = lowest observed adverse effect level, PAD = population adjusted dose (a = acute, c = chronic), RfD = reference dose, MOE = margin of exposure, LOC = level of concern, NA = Not Applicable			

For more occupational toxicity information, see "2,4-D: HED's Revised Human Health Risk Assessment for the Reregistration Eligibility Decision (RED) Revised to Reflect Public Comments," dated January 4, 2005.

b. Occupational Handler Exposure

Occupational handler risk estimates have been assessed for both short- and intermediate-term exposure durations. Because 2,4-D is typically applied only a few times per season and because the agricultural scenarios occur for only a few months per year, it is anticipated that 2,4-D exposures would primarily be short-term. Intermediate-term risk estimates are provided as an upper-bound assessment.

Occupational handler assessments are conducted using increasing levels of protection. The

Agency typically evaluates all exposures with minimal protection and then considers additional protective measures using a tiered approach (going from minimal to maximum levels of protection). The lowest tier is represented by the baseline clothing scenario (i.e., single layer clothing, socks, and shoes), followed by, if MOEs are of concern, increasing levels of risk mitigation such as personal protective equipment (PPE) and engineering controls (EC). With the exception of mixing and loading wettable powders, MOEs for most occupational exposure scenarios are above 100 at baseline PPE (long-sleeved shirt, long pants, socks, and shoes) or single layer PPE (long-sleeved shirt, long pants, socks, shoes, and gloves). The MOEs for handling wettable powder are acceptable with engineering controls (i.e. water soluble bags). While the generic assessment for 2,4-D as an active ingredient does not indicate a need for additional PPE, evaluation of end-use product toxicity data may. End-use product PPE will be assessed on a product-by-product basis.

c. Occupational Handler Risk Summary

The Agency has determined that there are potential exposures to individuals who mix, load, apply, and otherwise handle 2,4-D during the usual use patterns associated with the pesticide's use. Based on the use patterns, 18 major occupational handler exposure scenarios were identified as follows:

<u>Mixer/Loader</u>

(1a) Mix/Load Wettable Powder for Aerial Application
(1b) Mix/Load Wettable Powder for Groundboom Application
(1c) Mix/Load Wettable Powder for Aquatic Subsurface Application
(1e) Mix/Load Wettable Powder for 10 Man Crew Backpack Application
(1f) Mix/Load Wettable Powder for Row Sprayer
(1g) Mix/Load Wettable Powder for Aquatic Foliar Application
(1h) Mix/Load Wettable Powder for Turfgun Application
(2a) Mix/Load Liquids for Aerial Application
(2b) Mix/Load Liquids for Groundboom
(2c) Mix/Load Liquids for Aquatic Subsurface Application
(2d) Mix/Load Liquids for Airblast Application
(2e) Mix/Load Liquids for 10 Man Crew Backpack Application
(2f) Mix/Load Liquids for Row Sprayer
(2g) Mix/Load Liquids for Aquatic Foliar Application
(2h) Mix/Load Liquids for Turfgun Application
(3) Load Granules for Broadcast Spreader

<u>Applicator</u>

(4) Aerial Application
(5) Groundboom Application
(6) Subsurface Application of Liquids to Submersed Aquatic Weeds
(7) Airblast Application
(8) Backpack Application
(9) Rights of Way (ROW) Application

(10) Foliar Application of Liquids to Floating Aquatic Weeds
(11) Turfgun Application
(12) Broadcast Spreader Application

Mixer/Loader/Applicator
(13) Mix/Load/Apply Wettable Powder with a Turfgun
(14) Mix/Load/Apply Liquids with a Turfgun
(15) Mix/Load/Apply Water Dispersable Granules with a Turfgun
(16) Mix/Load/Apply Liquids with a Backpack Sprayer
(17) Load/Apply Granules with a Push Spreader

Flagger
(18) Flag Aerial Application

Occupational Handler Exposure Assumptions

When possible, the assumptions for daily areas treated are taken from the Health Effects Division Science Advisory Committee on Exposure Policy 9: Standard Values for Daily Acres Treated in Agriculture (July 5, 2000). In other instances, the daily areas treated were defined for each handler scenario by best scientific judgement, or the best information available, as footnoted below in Table 21.

Analyses were completed using acceptable surrogate exposure data for the scenario assessed. Several handler assessments were completed using data from the Pesticide Handler Exposure Database (PHED) (version 1.1). PHED data were used primarily for the large scale agricultural and forestry scenarios. Some handler assessments (i.e., handheld handgun equipment, push-type spreader, and other lawn care scenarios) were completed using data from the Outdoor Residential Exposure Task Force (ORETF). California Department of Pesticide Regulation (CA DPR) data were used for the backpack applicator forestry scenario where multiple applicators are supplied by a nurse tank.

The following assumptions and factors were used in order to complete the exposure and risk assessments for occupational handlers and applicators:

- The average work day was 8 hours.
- A listing of application methods and amounts of acreage treated per 8 hour day is included in Table 22 and Table 23.
- The application rate for submerged aquatic weeds is based upon the master label rate of 10.8 lbs a.e. per acre foot times an average lake depth of 5 feet.
- Maximum application rates and daily acreage were used to evaluate short term exposures.
- Average application rates were used to evaluate intermediate term exposures.
- A body weight of 60 kg was assumed for short-term exposures because the short-term endpoint relates to females 13-50 years of age.
- A body weight of 70 kg was assumed for intermediate-term exposures because the

intermediate-term endpoint is not gender-specific.

- The dermal absorption rate is 10%.
- The inhalation absorption rate is 100%.
- Baseline PPE includes long sleeve shirts, long pants and no gloves or respirator.
- Single Layer PPE includes baseline PPE with gloves.
- Double Layer PPE includes coveralls over single layer PPE.
- Double Layer PPE PF5 includes above with a PF5 respirator (i.e. a dustmask).
- Double Layer PPE PF10 includes above with a PF10 cartridge respirator.
- Only closed cockpit airplanes are used for aerial application.
- There are very little exposure data to evaluate the exposure in helicopters; therefore, the exposure data for fixed-wing aircraft are used as a surrogate.
- Airplane and helicopter pilots do not wear chemical resistant gloves.

Table 21. 2,4-D Application Methods and Assumptions

Application Method	Typical Crops Treated	Treated Area[1]
Aerial	Small Grain, Field Corn, Sugarcane Citrus Growth Regulation	1200 350
Groundboom	Small Grains, Field Corn, Sugarcane Orchard/Vineyard Floors Strawberries	200 80 80
Subsurface Application of Liquids	Submersed Aquatic Weeds	30[2]
Airblast	Citrus Growth Regulation	40
Backpack Sprayer - Mix/Load/Apply	Christmas Tree Plantations	2[3]
Backpack Sprayer - Apply Only	Conifer Release	4[4]
Right of Way (ROW) Sprayer	Weed Control - 20 gallons per acre Brush Control - 400 gallons per acre	50[5] 2.5[5]
Foliar Application of Liquids	Floating Aquatic Weeds	10[6]
Broadcast Spreader - Tractor Drawn or Boat Mounted	Turf Submersed Aquatic Weeds	40 50[7]
Turfgun	Turf	5
Broadcast Spreader - Push Type	Turf	5

1. Except as noted, the acres treated per day values are from ExpoSAC Policy #9 "Standard Values for Daily Acres Treated in Agriculture", Revised 7/5/2000.
2. The area treated for aquatic application of liquids to submersed aquatic weeds is based on information provided in an email of 12/11/03 from Dr. Kurt Getsinger of the US Army Corps of Engineers to Timothy C. Dole of the US EPA Office of Pesticide Programs.
3. The area treated for Backpack Sprayer (Mix/Load/Apply) is 40 gallons per day from ExpoSAC Policy #9 divided by the label recommended spray volume of 20 gallons per acre.
4. The area treated for Backpack Sprayer (Apply Only) is 4 acres per day based upon the acreage treated in CA DPR HS-1769 normalized to an 8 hour day.
5. The area treated for ROW sprayers was determined by the dividing the daily spray volume handled (1000 gallons per

day) from ExpoSAC Policy #9 by the label recommended spray volume of 20 gallons per acre for weed control and 400 gallons per acre for woody brush control.
6. The area treated for foliar application of liquids to floating aquatic weeds is based upon use information reported in the HED Memorandum "Occupational and Residential Exposure Characterization/Risk Assessment for Triclopyr Triethylamine for Aquatic Weed Control, DP Barcode D269448 of 7/22/2002.
7. The area treated for application of granules to submersed aquatic weeds is based upon information provided in an email of 11/22/2000 from Jim Kannenburg of Marine Biochemists/Applied Biochemists to Troy Swackhammer of the US EPA Office of Pesticide Programs.

Summary of Risk Concerns and Data Gaps for Handlers

The MOEs for handlers are summarized in Tables 22 and 23 below. With the exception of mixing/loading wettable powder, all of the short-term and intermediate-term MOEs exceed the target of 100 with baseline PPE (i.e., long-sleeved shirt, long pants, shoes plus socks, no respirator) or single layer PPE (i.e., long-sleeved shirt, long pants, shoes plus socks, gloves, no respirator) and are not of concern. The MOEs for handling wettable powder are adequate with engineering controls (i.e. water soluble bags).

Table 22. MOEs for Short-Term Risk to Occupational Handlers

Exposure Scenario	Crop Type	Application Rate (lb ae/acre)	Acres/ Day	Base-line	Single Layer	Eng. Control
Mixer/Loader (M/L)						
M/L WP	All Crops	0.25 to 4	5 to 1200	**≥1**	**≥5**	≥260
M/L Liquids	All Crops	0.25 to 4	5 to 1200	**≥1**	**≥89**	≥330
M/L Liquids	Submersed Weeds	54	30	**3.2**	260	980
Load Granulars for Broadcast Spreader	Golf Courses and Aquatic Areas	2 to 54	40 or 50	≥220	≥230	>1000
Applicator (APP)						
Aerial Application	All Crops	1.25 to 4.0	1200	ND	ND	>550
Groundboom Application	All Crops	1.25 to 4	40 to 200	>1000	>1000	>1000
Subsurface Aquatic Application of Liquids	Submersed Weeds	54	30	430	430	>1000
Airblast Application	Citrus	0.1	40	>1000	>1000	>1000
Backpack Application	Conifer Release	4	4	ND	140	ND
ROW Application	Weed Control	2	50	110	350	ND
Foliar Aquatic Application of Liquids	Floating Weeds	2	10	280	870	ND
Turfgun Application	turf	1.5	5	ND	>1000	>1000
Broadcast Spreader Application	Golf Courses and Aquatic Areas	1.5 or 54	40 or 50	>250	>290	>1000
Mixer/Loader/Applicator (M/L/A)						

Exposure Scenario	Crop Type	Application Rate (lb ae/acre)	Acres/ Day	Base-line	Single Layer	Eng. Control
M/L/A Liquids with Backpack Sprayer	Christmas Trees	4	2	ND	730	ND
M/L/A WD Granules with a Turfgun	turf	1.5	5	ND	>1000	ND
M/L/A Wettable Powder with a Turf Gun	turf	1.5	5	ND	>1000	>1000
M/L/A Liquid Flowables with a Turfgun	turf	1.5	5	ND	>1000	ND
Load/Apply Granules with a Push Spreader	turf	1.5	5	ND	710	ND
Flagger						
Flag Aerial Liquid Application	All Crops	1.25 to 4.0	1200	≥210	≥200	≥1000
MOEs in bold font do not exceed the target MOE of 100 and are of concern **ND** not determined						

Table 23. MOEs for Intermediate-Term Risk to Occupational Handlers

Exposure Scenario	Crop Type	Application Rate (lb ae/acre)	Acres/ Day	Base-line	Single Layer	Eng. Control
Mixer/Loader (M/L)						
M/L WP	All Crops	0.25 to 4	5 to 1200	**≥1.1**	**≥7.3**	≥360
M/L Liquids	All Crops	0.25 to 4	5 to 1200	**≥1.5**	≥130	≥460
M/L Liquids	Submersed Weeds	54	30	**2.2**	190	690
Load Granulars for Broadcast Spreader	Golf Courses or Aquatic Areas	1.5 or 54	40 or 50	≥150	≥160	>1000
Applicator (APP)						
Aerial Application	All Crops	0.5 to 2.0	1200	ND	ND	>770
Groundboom Application	All Crops	0.5 to 4	40 to 200	>1000	>1000	>1000
Subsurface Aquatic Application	Submersed Weeds	54	30	300	300	>1000
Airblast Application	Citrus	0.1	40	>1000	>1000	>1000
Backpack Application	Conifer Release	2	4	ND	200	ND
ROW Application	Weed Control	2	50	**78**	240	ND
Foliar Aquatic Application of Liquids	Floating Weeds and Wild Rice	4 or 0.25	10	≥200	≥610	ND
Turfgun Application	turf	1.5	5	ND	>1000	ND
Broadcast Spreader Application	Golf Courses and Aquatic Areas	1.5 or 54	40 or 50	≥180	≥200	ND
Mixer/Loader/Applicator (M/L/A)						

Exposure Scenario	Crop Type	Application Rate (lb ae/acre)	Acres/ Day	Base-line	Single Layer	Eng. Control
M/L/A Liquids with Backpack Sprayer	Conifer Plantations	4	2	ND	510	ND
M/L/A WD Granules with a Turfgun	turf	1.5	5	ND	>1000	ND
M/L/A Wettable Powder with a Turf Gun	turf	1.5	5	ND	>1000	>1000
M/L/A Liquid Flowables with a Turfgun	turf	1.5	5	ND	>1000	ND
Load/Apply Granules with a Push Spreader	turf	1.5	5	ND	500	ND
Flagger						
Flag Aerial Liquid Application	All Crops	0.50 to 2.0	1200	≥660	≥610	≥1000
MOEs in bold font do not exceed the target MOE of 100 and are of concern						

d. Occupational Postapplication Risk

Post application 2,4-D exposures can occur in the agricultural environment when workers enter fields recently treated with 2,4-D to conduct tasks such as scouting and irrigation. In the Worker Protection Standard (WPS), a restricted entry interval (REI) is defined as the duration of time which must elapse before residues decline to a level so entry into a previously treated area and engaging in a specific task or activity would not result in exposures that are of concern. The WPS REI for 2,4-D is 12 hours for the ester and sodium salt forms and is 48 hours for the acid and amine salt forms.

1) Exposure Scenarios, Data, and Assumptions

Postapplication dislodgeable foliar residue (DFR) data were submittted for 2,4-D as well as turf transferable residue (TTR) data from treated turf. Three turf transferable residue (TTR) studies were submitted by the Broadleaf Turf Herbicide TTR Task Force. These studies are described in "2,4-D: 3rd Revised Occupational and Residential Exposure (ORE) and Risk Assessment and Response to Public Comments for the Reregistration Eligibility Decision (RED) Document"dated May 4, 2005, and in Appendix F of that document. These data were used in the human health risk assessment along with standard transfer coefficients based on EPA Science Advisory Council guidance to assess potential exposures to workers reentering treated sites.

For all other postapplication activities, EPA used the EPA Science Advisory Council for Exposure (Exposure SAC) policy on agricultural transfer coefficients.

The following assumptions were made regarding postapplication occupational exposure:

- Short term risks were assessed using master label rates.
- Intermediate term risks were assessed using average application rates when available.

- The transfer coefficients are from an interim transfer coefficient policy developed by HED's Science Advisory Council for Exposure using proprietary data from the Agricultural Re-entry Task Force (ARTF) database (US EPA, August 7, 2001). This policy will be periodically updated to incorporate additional information about agricultural practices in crops and new data on transfer coefficients. Much of this information will originate from exposure studies currently being conducted by the ARTF, from further analysis of studies already submitted to the Agency, and from studies in the published scientific literature.
- The transfer coefficients for turf harvesting and maintenance are based upon recently conducted ARTF studies that are being reviewed by EPA.
- In cases where applications would be made in such a way as to minimize contact with crop foliage postapplication exposures are expected to be negligible and are not assessed. These cases are included in "2,4-D: 3rd Revised Occupational and Residential Exposure and Risk Assessment and Response to Public Comments for the Reregistration Eligibility Decision (RED) Document (PC Code 030001, DP Barcode D316596)", dated May 4, 2005.
- The initial percent of application rate as Dislodgeable Foliar Residue (DFR) was assumed to be 20% for all crops except turf. This is the standard value used in the absence of chemical specific data.

2) Occupational Postapplication Risk Estimates

All short- and intermediate-term MOEs are above 100 on day zero. All occupational postapplication risk scenarios are not of concern. Short-term and intermediate-term risk estimates are shown in Tables 24 and 25 below.

Table 24. 2,4-D Postapplication Short-Term Worker Risks

Crop Group	ShortTerm MOE on Day 0			
	Application Rate (lb a.e./acre)	Low Exposure Scenarios	Medium Exposure Scenarios	High Exposure Scenarios
Field/row crop, low/med (cereal grains)	1.25	6,700	450	NA
Field/row crop, low/med (rice)	1.5	5,600	370	NA
Field/row crop, tall (corn) Pre-harvest rate for field corn Post-emergence rate for sweet corn	 1.5 0.5	 5,600 17,000	 1,400 4,200	 560 NA
Field/row crop, tall (sorghum)	1.0	8,400	2,100	NA
Sugarcane	2.0	NA	420	210
Turf - California Turf - North Carolina	2.0 2.0	1,900 860	NA NA	950 430

Table 25. 2,4-D Postapplication Intermediate Term Worker Risks

Crop Group	Intermediate Term MOE on Day 0			
	Application Rate+ (lb a.e./acre)	Low Exposure Scenarios	Medium Exposure Scenarios	High Exposure Scenarios
Field/row crop, low/med (cereal grains)	0.5	12,000	780	NA
Field/row crop, low/med (rice)	0.92	6,400	420	NA
Field/row crop, tall (field corn)	0.44	13,000	3,300	1,300
Field/row crop, tall (sweet corn)	0.48	13,000	3,100	NA
Field/row crop, tall (sorghum)	0.46	13,000	3,100	NA
Sugarcane	0.75	NA	780	390
Turf - California Turf - North Carolina	2.0 2.0	1,600 610	NA NA	810 300
+ Average application rates as reported in the QUA report or NASS report were used when available.				

7. Human Incident Data

In evaluating incidents to humans, the Agency reviewed reports from the National Poison Control Centers, the EPA OPP's Incident Data System (IDS), the California Pesticide Illness Surveillance Program, and the National Pesticide Telecommunications Network (NPTN).

The Agency reviewed 2,4-D incident reports in January 2004. A total of 45 incidents were reported in the OPP Incident Data System and many of these incidents involved irritant effects to the eyes, skin and occasionally respiratory passages. Poison Control Center Incident Data (1993 to1998) indicated that 2,4-D is generally less likely than other pesticides to cause minor, moderate or life threatening symptoms. The most common symptoms were dermal irritation and ocular problems. Incident data from the California Pesticide Illness Surveillance Program indicated that the number of cases generally ranges from 0 to 3 per year and most of these cases were due to eye or skin effects. Incident data from the National Pesticide Information Center for the years 1996 to 2002 indicated that an average of 3 cases definitely or probably related to 2,4-D exposure were reported per year.

8. Cancer Epidemiology Studies

A Science Advisory Board/Scientific Advisory Panel Special Joint Committee reviewed available epidemiological and other data on 2,4-D in 1992 and concluded that "the data are not sufficient to conclude that there is a cause and effect relationship between exposure to 2,4-D and non-Hodgkin's lymphoma" and 2,4-D was classified as a Group D, not classifiable as to human carcinogenicity. The Agency has twice recently reviewed epidemiological studies linking cancer to 2,4-D. In the first review, completed January 14, 2004, EPA concluded there is no additional evidence that would implicate 2,4-D as a cause of cancer (EPA, 2004). The second recent review of available epidemiological studies occurred in response to comments received during the Phase 3 Public Comment Period during the reregistration process for 2,4-D. EPA's report, dated December 8, 2004 and authored by Jerry Blondell, Ph.D., found that none of the more recent epidemiological studies definitively linked human cancer cases to 2,4-D.

B. Environmental Risk Assessment

A summary of the Agency's environmental risk assessment for 2,4-D is presented below. The Agency has conducted 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 United States.

2,4-D has the following registered uses, which result in environmental exposures: pasture/rangeland, turf, wheat, corn, soybeans, fallowland, hay other than alfalfa, noncropland (roadways, rights-of-way, ditches, industrial sites, etc.), forestry, rice, sugarcane, pome fruits, stone fruits, nut orchards, filberts, grass grown for seed and sod, aquatic weed control, potatoes, asparagus, strawberries, blueberries, grapes, cranberries, and citrus.

This summary will present exposure estimates and hazard determinations associated with 2,4-D and its various chemical forms. In addition, risks of concern, as determined in the environmental assessment, will be identified and characterized. More detailed information associated with the potential environmental risk from the use of 2,4-D can be found in the Environmental Fate and Effects Division's Risk Assessment for the Reregistration Eligibility Document for 2,4-Dichlorphenoxyacetic Acid, (2,4-D), dated October 28, 2004. The complete environmental risk assessment is not included in this RED, but may be accessed in the OPP Public Docket (OPP-2004-0167) and on the Agency's website at http://www.epa.gov/pesticides/reregistration/status.htm.

1. Environmental Exposure

a. Environmental Fate and Transport

The environmental fate database is sufficient to characterize the environmental exposure associated with 2,4-D use. However, there are some studies that will be required as a result of the reregistration process. An aerobic aquatic metabolism study for 2,4-D BEE in acidic aquatic environments is required, along with several other dissipation studies. See section V.A.1 of this reregistration eligibility decision (RED) document for a complete list of all required studies. EPA intends to issue a DCI as part of this RED to require submission of additional data to address areas of uncertainty. These data are expected to confirm the conclusions of this environmental risk assessment.

Database

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 [half life ($t_{1/2}$) =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 days.

Degradation Summary

The degradation of 2,4-D was rapid ($t_{1/2}$= 6.2 days) in aerobic mineral soils. The half-life of 2,4-D in aerobic aquatic environments was 15 days. 2,4-D was moderately persistent to persistent ($t_{1/2}$ = 41 to 333 days) in anaerobic aquatic laboratory studies.

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. For a complete listing of 2,4-D degradates for each route of degradation, please see the environmental risk assessment. No degradates were considered for further analysis in water or the terrestrial ecological assessment.

Mobility

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.

Bridging Strategy

The 1988 2,4-D Registration Standard proposed an environmental fate strategy for bridging the degradation of 2,4-D esters and 2,4-D amine salts to 2,4-D acid. The bridging provides information on the dissociation of 2,4-D amine salts and hydrolysis of 2,4-D esters is included in the ecological 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 amines will degrade rapidly to form 2,4-D acid.

2,4-D Amine Salts

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.

2,4-D Esters

The conversion of 2,4-D esters to the acid and an associated alcohol moiety is more difficult to generalize. 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).

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 a granule formulation, 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 de-esterification 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.

Persistance of 2,4-D Amine Salts and 2,4-D Esters

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.

b. Aquatic Organism Exposure

For exposure to aquatic fish and invertebrates, EPA considers surface water exposure only, since most aquatic organisms are not found in ground water. Surface water models are used to estimate exposure to freshwater aquatic animals. Unlike the drinking water assessment described in the human health risk assessment section of this document, the ecological water resource assessment does not include the Index Reservoir (IR) and Percent-Crop Area (PCA) factor refinements. The IR and PCA factors represent a drinking water reservoir, not the variety of aquatic habitats, such as ponds adjacent to treated fields, relevant to a risk assessment for aquatic animals. Therefore, the EEC values used to assess exposure to aquatic animals are not the same as the values used to assess human dietary exposure from drinking water sources.

1) Exposure to 2,4-D Acid in Surface Water

The aquatic exposure assessment for 2,4-D 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 its various chemical forms in a variety of exposure scenarios. Concentrations used 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 the ecological risk assessment for 2,4-D.

2) Surface Water Modeling of 2,4-D Esters

The Agency'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, 2,4-D esters may persist under acidic aquatic conditions. In order to account for the potential impact of the spray application of 2,4-D esters to aquatic environments, and to account for runoff during the time in which 2,4-D EHE may remain in the field, the Agency conducted additional modeling with PRZM/EXAMS to assess the potential for aquatic organisms to be exposed to 2,4-D EHE through spray drift or runoff. The peak (acute) estimated environmental concentrations (EECs) for the 2,4-D esters were estimated for each scenario and range from 0.6 ug ae/L (CA citrus) to 7.4 ug ae/L (NC pasture). 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.

3) 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, the Agency developed a simple spreadsheet model that incorporates degradation based on an acceptable aerobic aquatic metabolism study for the EFED standard pond with no flow. In this model, the 21-day average and 60-day average concentrations were calculated assuming first-order dissipation from aerobic aquatic degradation, but does not assume dissipation.

The interpretation of the label for aquatic weed control is that the target rate for 2,4-D amine (2,4-D DMAS) and ester (2,4-D BEE) 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; however, this application scenario will over-predict actual concentrations because 2,4-D is not applied to more than 50% of a water body in a single treatment. Treating more than 50% of a water body will result in oxygen depletion due to decaying plant material. Typically, 2,4-D is applied to control aquatic weeds in littoral zones that make up less than 50% of the water body. Modeling the 2,4-D concentration that results when 100% of the water body is treated 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. Actual concentrations are expected to be less given the conservative treatment area assumption as described above, and the likely effects of dispersion on 2,4-D concentrations.

EFED evaluated the potential for exposure to 2,4-D BEE using a similar approach. Modeling 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.

4) 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 ae per acre. Modeling of this use rate results in an estimated acute 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. 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.

c. Terrestrial Organism Exposure

The Agency assessed exposure to terrestrial organisms by first predicting the amount of 2,4-D residues found on animal food items and then by determining the amount of pesticide consumed by using information on typical food consumption by various species of birds and mammals. The amount of residues on animal feed items are based on the Fletcher nomogram (a model developed by Fletcher, Hoerger, Kenaga, et al.)[1] and the current maximum application rate as stated in the Master Label for 2,4-D. For terrestrial uses of 2,4-D, the Master Label allows a maximum single application of 4 lbs ae/A and up to two 2 lbs ae/A applications per season for a total seasonal maximum rate of 4 lbs ae/A. Therefore, for terrestrial uses, EPA modeled the maximum and mean residues of 2,4-D in various food items immediately after the 4 lb lbs ae/A application. The Agency assumed no dilution due to the growth of the plants or degradation of 2,4-D. EPA's estimates of 2,4-D residues on various wild animal food items are summarized in Table 26. EPA used these EECs and standard food consumption values to estimate dietary exposure levels for 2,4-D to birds and mammals.

Table 26. Estimated Environmental Concentrations on Avian and Mammalian Food Items (ppm) Following a Single Application at 1 lb ae/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 ae/a application rate and are based on Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994).

1) Birds and Mammals

The Agency expects exposure to birds and mammals from residues of 2,4-D on food items. Exposure is probable because 2,4-D is applied in many different environments that provide habitats rich in food sources attractive to various avian and mammalian species.

a) Exposure to Nongranular (Liquid) Formulations

Toxicant concentrations on food items following multiple applications are predicted based on a first-order residue decline using the Agency's FATE5 model. The FATE5 model allows determination of residue dissipation over time by incorporating degradation half-life. Predicted maximum and mean EECs resulting from multiple applications are calculated by taking into account the maximum or mean initial EEC from the first application, the total number of applications, the time interval between applications, and a first-order foliar degradation rate of 8.8 days.

b) Exposure to Granular Formulations

Birds and small mammals may be exposed to granular formulations through ingestion of granules. The number of lethal doses (LD_{50}) that are available within one square foot immediately after application (LD_{50}/ft^2) is used as the risk quotient (RQ) for granular products. RQs are calculated for three separate weight classes of birds (1000 g, 180 g, and 20 g) and mammals (15 g, 35 g, and 1000 g, 35 g, and 15 g).

2) Non-target Terrestrial Plants

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 for the non-target terrestrial plant risk assessment. 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 as another group.

Terrestrial plants inhabiting dry and semi-aquatic areas may be exposed to pesticides from runoff, spray drift or volatilization. EPA's runoff exposure estimate assumes a 1-in-10 year rain event and is based on a pesticide's water solubility and the amount of pesticide present on the soil surface and its top one inch, characterized as "sheet runoff" (one treated acre to an adjacent acre) for dry areas, characterized as "channelized runoff" (10 treated acres to a distant low-lying acre) for semi-aquatic areas, and is 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. The modeled runoff exposure estimates likely over-estimate actual exposures from runoff, given the conservative 1-in-10 year rain event assumption, and also given that farming practices, intended to minimize soil loss from runoff, are not taken into account.

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 (i.e., the amount that lands on the target area) of 60%. The effects of multiple applications are addressed by summing the application rates from individual applications.

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, the Agency'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 EECs for the acid and amine salts as well as the esters to dry and semi-aquatic areas are tabulated in Appendix F of the 2,4-D ecological risk assessment for single applications to the targeted use sites. The percent runoff value based on water solubility is assumed to be 5% for the acid and amines and 1% for the esters.

2. Environmental Effects (Toxicity)

a. Toxicity to Aquatic Organisms

Freshwater and Estuarine/Marine Fish

The available acute toxicity data on 2,4-D indicate that the acid and amine salts are practically non-toxic to freshwater or marine fish. The esters are highly to slightly toxic to marine or freshwater fish. 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 larval 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.

Amphibians

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. Tests indicate that 2,4-D acid, 2,4-D DMA, and 2,4-D EHE are practically non-toxic to tadpoles.

Freshwater and Estuarine/Marine Invertebrates

Acute toxicity of 2,4-D acid and amine salts to freshwater aquatic invertebrates ranges from a LC_{50} of 25 to 642.8 mg ae/L (slightly toxic to practically non-toxic). 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 (moderately toxic to slightly toxic). Acute toxicity of 2,4-D acid and amine salts to marine invertebrates range from an LC_{50} of 49.6 for 2,4-D IPA to 830 mg ae/L for 2,4-D DMA (slightly toxic to practically non-toxic). The marine invertebrate LC_{50} s range from >0.092 to >66 mg ae/L for the 2,4-D esters (highly toxic to practically non-toxic). These toxicities indicate that the esters are more toxic than the acid and amine salts. Although 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 for freshwater and estuarine/marine invertebrates were performed on 2,4-D acid, 2,4-D DEA, 2,4-D DMAS, and 2,4-D BEE. The toxicity ranged from a NOEC of 16.05 mg ae/l for 2,4-D DEA (survival and reproduction) and 79 mg ae/L for the 2,4-D acid (number of young). The chronic freshwater NOEC is 0.20 mg ae/L for the 2,4-D BEE (survival and reproduction). There are no freshwater or marine chronic toxicity data for any of the other 2,4-D esters.

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. The data from the freshwater invertebrate studies will be bridged to the estuarine/marine invertebrates for the 2,4-D acid and amine salts. The RQs for the freshwater chronic studies were well below the levels of concern, and the chronic risk for estuarine/marine invertebrates would be expected to be low. However, there is a risk concern for for estuarine/marine invertebrates for the 2,4-D esters. A chronic study will be required for 2,4-D BEE to reduce the uncertainty to estuarine/marine invertebrates.

Aquatic Plants

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

b. Toxicity to Terrestrial Organisms

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.

Birds

Toxicity ranges for birds 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 use rates on the master label are given in pounds acid equivalent per acre.

2,4-D is classified as moderately toxic to practically non-toxic to birds on an acute oral basis, since the oral LD_{50} ranges from 500 mg ai/kg (415 mg ae/kg) for 2,4-D DMAS to >1000 mg ae/kg for the 2,4-D acid.

The chronic NOEC of 962 ppm is based on the endpoints of eggs cracked and a decreased number of 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.

Mammals

The Agency expects exposure to mammals from residues of 2,4-D on food items, since 2,4-D is used in many different mammalian habitats, including pasture and rangeland, and turf lawns. Toxicity ranges for 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 pounds acid equivalent per acre. The rat LD_{50} ranged from 579 to 1300 mg ae/kg.

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 NOAEL in the rat chronic toxicity study was 5 mg/kg/day, with a LOAEL of 75 mg/kg/day based on decreased body-weight gain and alterations in hematology. The NOAEL in the rabbit developmental toxicity study was 30 mg/kg/day, and the LOAEL was 90 mg/kg/day based on clinical signs, loss of righting reflex, and abortions.

Non-Target Insects

Available data from a honey bee acute toxicity study indicated that technical 2,4-D is practically non-toxic to the honey bee. The LD_{50} in the honey bee acute toxicity study is greater than 10 micrograms per bee; see MRID 445173-04 for 2,4-D DMA and MRID 445173-01 for 2,4-D EHE. Minimal risk is expected to non-target insects from 2,4-D use.

Terrestrial Plants

The terrestrial plant runoff exposure scenario is based on the solubility of the 2,4-D compound. The water solubilities differ greatly between 2,4-D esters and 2,4-D acid and amine salts. The terrestrial plant toxicity values for 2,4-D acid and amine salts is summarized in Table 27, 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 27. Terrestrial Plant Toxicity Summary for 2,4-D Acid and amine salts

Study Type		Most sensitive Crop / Active Ingredient	EC25 / NOEC (lb ae/A)
Seedling Emergence	Monocot	Sorghum / 2,4-D DMAS	0.026 / 0.015
	Dicot	Mustard /2,4-D DEA	0.045 / <0.045
Vegetative Vigor	Monocot	Onion / 2,4-D Acid	<0.0075 / <0.0075
	Dicot	Tomato / 2,4-D DEA	0.003 / 0.002

The terrestrial plant toxicity for the 2,4-D esters is summarized in Table 28. The sensitivity ranges for the monocot and dicot species are listed for the seedling emergence and vegetative vigor studies.

Table 28. Terrestrial Plant Toxicity Summary for 2,4-D Esters

Study Type		Most sensitive Crop / Active Ingredient	EC25 / NOEC (lb ae/A)
Seedling Emergence	Monocot	Onion / 2,4-D IPE	0.01 / 0.005628
	Dicot	Lettuce / 2,4-D IPE	0.00081 / 0.00047
Vegetative Vigor	Monocot	Corn /2,4-D IPE	0.2016 / 0.0252
	Dicot	Lettuce / 2,4-D IPE	0.00126 / 0.006132

3. Ecological Risk Estimation (RQs)

The Agency's ecological risk assessment compares toxicity endpoints from ecological toxicity studies to estimated environmental concentrations (EECs) based on environmental fate characteristics and pesticide use data. To evaluate the potential risk to non-target organisms from the use of 2,4-D products, the Agency calculates a Risk Quotient (RQ), which is the ratio of the EEC to the most sensitive toxicity endpoint values. These RQ values are then compared to the Agency's levels of concern (LOCs), given in Table 29, which indicate whether a pesticide, when used as directed, has the potential to cause adverse effects on non-target organisms. When the RQ exceeds the LOC for a particular category (e.g., endangered species), the Agency presumes a risk of concern to that category. These risks of concern may be addressed by further refinements of the risk assessment or by mitigation. Use, toxicity, fate, exposure, and incidents are considered when characterizing the risk, as well as the levels of uncertainty in the assessment.

Table 29. EPA's Levels of Concern and Associated Risk Presumptions.

Risk Presumption	LOC terrestrial animals	LOC aquatic animals	LOC Plants
Acute Risk - there is potential for acute risk; regulatory action may be warranted in addition to restricted use classification.	0.5	0.5	1
Acute Restricted Use - there is potential for acute risk, but may be mitigated through restricted use classification.	0.2	0.1	N/A
Acute Endangered Species - endangered species may be adversely affected; regulatory action may be warranted.	0.1	0.05	1
Chronic Risk - there is potential for chronic risk; regulatory action may be warranted.	1	1	N/A

For a more detailed explanation of the ecological risks posed by the use of 2,4-D, refer to Environmental Fate and Effects Division's Risk Assessment for the Reregistration Eligibility Document for 2,4- Dichlorophenoxyacetic Acid (2,4-D), dated October 28, 2004.

a. Risk to Aquatic Organisms

The RQs for aquatic organisms are presented in detail in Appendix F of the ecological risk assessment for 2,4-D.

1) Fish and Aquatic Invertebrates

There were no acute or chronic Level of Concern (LOC) exceedances for aquatic organisms through use of 2,4-D acid and amine salts due to runoff/drift from use on terrestrial sites, no acute LOC exceedances for aquatic organisms due to drift-only of 2,4-D esters to water bodies from use on terrestrial sites, and, there were no acute LOC exceedances for aquatic organisms due to the runoff/drift of 2,4-D esters to water bodies from use on terrestrial sites. Chronic concerns were not evaluated for terrestrial uses of 2,4-D esters.

Estimated risk quotients (RQs) from use of 2,4-D acid and amine salts in aquatic weed control through direct subsurface application to water bodies exceed the restricted use LOCs for freshwater invertebrates. There are no chronic LOC exceedances for this use. Estimated RQs for use of 2,4-D BEE in weed control through direct subsurface application to water bodies exceed the acute risk LOC for freshwater fish and invertebrates and chronic risk LOC for freshwater and estuarine fish and freshwater invertebrates when compared on an acid equivalent basis.

Additional characterization of the potential risk associated with the direct application of 2,4-D for aquatic weed control was completed by back-calculating the target concentration needed to reduce EECs below LOCs. This type of consideration provides context to the characterization of potential risk and indicates that for all 2,4-D chemical forms target concentration reduction of up to 10-fold still exceeds all LOCs for aquatic organisms.

While noting the potential risks identified above, it is important to note the benefits gained through the direct application of 2,4-D to aquatic bodies, for the control of invasive species. The U.S Army Corps of Engineers (USACE), among others, has identified 2,4-D as an important tool for protecting the nation's waters from the invasion and establishment of some of the world's worst species of exotic nuisance vegetation. 2,4-D has a reputation as a selective and economical means to remove invasive plants, enhance the growth and recovery of desirable native vegetation, restore water quality, reduce sedimentation rates in reservoirs, and improve fish and wildlife habitat. 2,4-D products are used to control invasive weeds, such as Eurasian watermilfoil (*Myriophyllum spicatum*) in the northern tier states and water hyacinth (*Eichhornia crassipes*) in the Gulf Coast states. Effective control of these plants can benefit public health with respect to reducing levels of mosquito habitat. In addition, according to USACE, no other product (or alternative technique) can control these plants in a more cost-effective manner (K. Getsinger, USACE, Public Comment; Docket ID# OPP-2004-0167-0053).

Estimated RQs for use of 2,4-D acid and amine salts in rice paddies exceed the acute 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 is expected to decrease away from the point of release. Additional characterization was conducted by considering average application rates (average rates are presented in the quantitative usage analysis dated August 9, 2001 prepared by the Biological and Economic Affairs Division of EPA/OPP) versus maximum label rates and assuming a proportional reduction in EECs. Consideration of average application rates results in EECs below the endangered species LOC.

2) Aquatic Plants

For non-target, aquatic plants, estimated RQs resulting from the runoff/drift of 2,4-D acid and amine salts from use on terrestrial crops exceed the aquatic vascular plant endangered species LOCs for use of 2,4-D acid and amine salts on pasture and apples. Consideration of average application rates and assuming a proportional reduction in EECs results in RQs below the endangered species LOC. Likewise, there are no LOC exceedances from the drift of the ester forms to aquatic water bodies or from the runoff of the ester forms to water bodies from use on terrestrial sites.

Estimated RQs for the scenario of direct application to water for aquatic weed control for 2,4-D acid and amine salts indicate acute and endangered species LOC exceedances for aquatic vascular plants and acute LOC exceedances for non-vascular plants, while estimated RQs for the use of 2,4-D BEE for direct application to water to control aquatic weeds exceed all LOCs for vascular and one acute LOC exceedance for non-vascular plants. Risk to endangered non-vascular plants is not evaluated because at this time there are no listed endangered nonvascular plant species. Additional characterization of potential risk for the direct application of 2,4-D for aquatic weed control was completed by back-calculating the target concentration needed to reduce the RQs below LOCs. This type of consideration provides context to the characterization of potential risk and indicates that for all 2,4-D chemical forms target concentration reduction of up to 100-fold still exceeds all LOCs for aquatic plants.

While noting the potential risks identified above, it is important to note the benefits gained through the direct application of 2,4-D to aquatic bodies, for the control of invasive species. The U.S Army Corps of Engineers (USACE), among others, has identified 2,4-D as an important tool for protecting the nation's waters from the invasion and establishment of some of the world's worst species of exotic nuisance vegetation. 2,4-D has a reputation as a selective and economical means to remove invasive plants, enhance the growth and recovery of desirable native vegetation, restore water quality, reduce sedimentation rates in reservoirs, and improve fish and wildlife habitat. 2,4-D products are used to control invasive weeds, such as Eurasian watermilfoil (*Myriophyllum spicatum*) in the northern tier states and water hyacinth (*Eichhornia crassipes*) in the Gulf Coast states. Effective control of these plants can benefit public health with respect to reducing levels of mosquito habitat. In addition, according to USACE, no other product (or alternative technique) can control these plants in a more cost-effective manner (K. Getsinger, USACE, Public Comment; Docket ID# OPP-2004-0167-0053).

Estimated RQs for use of 2,4-D acid and amine salts in rice paddies exceed the acute and endangered species LOCs for aquatic vascular plants. Consideration of average application rates results in RQs below the endangered species LOCs.

b. Risk to Non-target Terrestrial Organisms

1) Birds

The RQs for birds are presented in detail in Appendix F of the ecological risk assessment for 2,4-D. Potential risks were evaluated for non-granular and granular formulations applied both as banded and broadcast applications.

EPA has relied on risk estimates from oral gavage studies on birds (LD_{50} of 415 mg ae/kg-bw) to assess risk because no definitive endpoint was determined from dietary studies. Therefore, it is likely that the risk estimates associated with the gavage studies overestimate the actual exposure of birds in the field. For predicted maximum exposures when compared with oral gavage data there are exceedances of acute LOCs for all use sites except potatoes and citrus for most small birds and some medium birds. There are also exceedances of acute restricted use and endangered species LOCs for medium and large birds feeding on short grass, tall grass, and broadleaf forage/small insects at all use sites except potatoes and citrus. However, comparison with the lowest dietary LC_{50} of >5620 mg ae/kg-diet would result in no acute LOC exceedances. As noted previously, no definitive endpoint was available from the avian acute dietary studies and, hence, risk was not evaluated using this endpoint.

The RQs are presented below in Table 30 for the avian risk due to 2,4-D residues on various food items.

Table 30. 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,**
Fallow areas and Crop Stubble; Turf (Golf courses, Residential Lawns, Grasses Grown for Seed, and Sod); Pastures, Rangeland, Perennial Grassland; Sugarcane (2 lbs ae/A/app, 2 app., ground/aerial, 30 day interval)				
Acute RQ Exceedance	0.1* - 1.91***	0.04 - 0.88***	0.04 - 0.78***	-
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*
Fruit, Small Grains (Except Corn), Asparagus (1.4 to 2.0 lbs ae/A/app)				
Acute RQ Exceedance	0.09 - 1.75***	0.04 - 0.81***	0.03 - 0.72***	-
Corn (1.5 lbs ae/A/app, 2 app., 7 day interval, ground or aerial)				
Acute RQ Exceedance	0.1* - 2.07***	0.04 - 0.81***	0.03 - 0.72***	-

* 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.

Chronic risk calculations resulted in RQ's of 1.0 to 1.1 on birds which forage on short grass when the application rate of 2,4-D ranges from 2.0 to 4.0 lb ae/A such as seen with rights-of-way, cranberries or asparagus. The chronic risk LOC is 1.0.

Non-granular Banded Applications - According to the Master Label for 2,4-D, products that allow for banded applications of sprays to row crops require all formulators to adjust the application rates according to a formula provided. Many current labels do not advise applicators to adjust the application rates, and the resulting treatment can be interpreted to concentrate 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. EPA/OPP evaluated the banded risk by comparing the RQs from unadjusted band rates to those using the adjusted band rates to illustrate the increased risk. OPP 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 for all uses 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 31: Avian Acute Risk Quotient Calculations for Granular Broadcast Applications

	Bird Body Weight (g)	Acute RQ (LD_{50} per ft^2) [a]
Non-Cropland (4.0 lbs ae/A/app, 1 app., ground/aerial,) Aquatic areas (4.0 lb ae/A/app. 3 wks between apps) Cranberry (4.0 lbs ae/A/app, 1 app., ground)	20	5.02***
	180	0.55***
	1000	0.1*
Turf (2.0 lbs ae/A/app, 2 app., ground/aerial, 30 day interval) Aquatic areas - Ditchbank applications (2.0 lb ae/A/app., 2 app., ground)	20	2.5***
	180	0.3**
	1000	0.05
Aquatic areas - Surface application or subsurface injection (10.8 lb ae/acre-foot to an average pond depth of 5 feet)	20	13.55***
	180	1.5***
	1000	0.27**

[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 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. If banded granular applications were used at the same sites as banded spray applications, the risk would be similar.

2) Mammals

Acute LOCs for mammals feeding on plants and insects were exceeded when considering non-granular formulations, for all uses assessed for small and medium size mammals, except potatoes and citrus. There were no exceedances for granivores. Banded applications result in exceedances of acute LOCs at all use sites.

Mammalian chronic RQs range from 0.05 to 200 and chronic LOCs were exceeded in all cases with the exception of potatoes and citrus (large insects, seeds). Consideration of average application rates results in EECs below the LOCs for non-granular, granular, or banded applications. However, consideration of average application rates for non-granular, granular and banded applications did not result in exposure below the chronic LOC.

Acute Exposure from Nongranular 2,4-D Products The acute RQs for broadcast applications of nongranular products are tabulated for herbivores/insectivores and granivores in Appendix F of the ecological risk assessment for 2,4-D. When the LD_{50} of 1072 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. There are no LOC exceedances for granivorous mammals.

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 32. Again, for purposes of comparison, the unadjusted rates that appear on many of the current labels have been included. Using the mammalian LD50 of 579 mg ae/kg, 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 of the ecological risk assessment for 2,4-D.

Acute Exposure to Granular 2,4-D Products - Mammalian species also may be exposed to granular pesticides by ingesting 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, aquatic areas (ditchbanks and surface applications), or cranberries.

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 32: Mammalian Acute Risk Quotient Calculations for Granular Broadcast Applications

Animal Body Weight (g)		Acute RQ (LD_{50} per ft^2) [1]
Non-Cropland (4.0 lbs ae/A/app, 1 app., ground/aerial,) Aquatic areas (4.0 lb ae/acre/app. 3 weeks between applications) Cranberry (4.0 lbs ae/A/app, 1 app., ground)	15	4.8 ***
	35	2.1 ***
	1000	0.1 *
Turf (2.0 lbs ae/A/app, 2 app., ground/aerial, 30 day interval) Aquatic areas - Ditchbank applications (2.0 lb ae/acre/app., 2 app., ground	15	2.4 ***
	35	1.0 ***
	1000	??
Aquatic areas - Surface application or subsurface injection (10.8 lb ae/acre foot to an average pond depth of 5 feet)	15	12.9 ***
	35	5.5 ***
	1000	0.2 **

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

* 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.

Chronic Exposure to Mammals - The chronic RQs for broadcast applications of nongranular products are tabulated in Appendix F of the 2,4-D ecological risk assessment 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 that 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 rates. 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.

3) Non-Target Insects

The Agency 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 predicted to pose minimal risk to pollinators and other beneficial insects.

4) Non-target Terrestrial Plants

Acute LOCs for both non-endangered and endangered terrestrial plants were exceeded for non-granular and granular uses at many use sites. Consideration of average application rates did not result in exposure below LOCs.

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 of the ecological risk assessment.

Risk Quotient (RQ) 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.

RQs for Endangered Plants - 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 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 labeled for maximum application rate for a single application.

Table 33. 2,4-D Use Sites With Maximum Labeling for a Single Application

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

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

The detailed RQ calculations for single applications are tabulated in detail in Appendix F of the ecological assessment for 2,4-D, and a summary is presented below.

Table 34. Terrestrial Plant Risk Quotients for Single Applications

Chemical Group (acid / ester)	Plant Group (non-endangered / endangered)	Risk Quotient Range
2,4-D Acid and Amine Salt	non-endangered	0.18 - 67
	endangered	0.13 - 136
2,4-D Ester	non-endangered	<0.01 - 543.21
	endangered	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 a maximum of two applications is allowed, the RQ doubles for these applications. The detailed calculations are tabulated in detail in Appendix F of the 2,4-D ecological risk assessment, and a summary is presented below.

Table 35. Terrestrial Plant Risk Quotients for Multiple Applications

Chemical Group (acid / ester)	Plant Group (non-endangered / endangered)	Risk Quotient Range
2,4-D Acid and Amine Salt	non-endangered	0.19 - 157
	endangered	0.19 - 272

Chemical Group (acid / ester)	Plant Group (non-endangered / endangered)	Risk Quotient Range
2,4-D Ester	non-endangered	0.01 - 12
	endangered	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 others do not. For the labels which do not adjust the application rates, the treatments could be 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 affect the exposure to non-target plants when label rates are not adjusted.

The 2,4-D Task Force proposal to require all formulators to adjust the application rates for banded applications will reduce the exposure to non-target plants. If we assume use of 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 of the ecological risk assessment for 2,4-D, and summarized for multiple and single applications in the following table.

Table 36. Non-target Plant Risk Quotient Summary of Adjusted Band Applications to Selected Row Crops.

Chemical Group (acid / ester)	Plant Group (non-endangered / endangered)	Risk Quotient Range (Single Applications)	Risk Quotient Range (Multiple Applications)
2,4-D Acid and Amine Salt	non-endangered	0.02 - 60	0.04 - 120
	endangered	0.02 - 439	0.04 - 878
2,4-D Ester	non-endangered	<0.01 - 27	<0.01 - 54
	endangered	<0.01 - 47	<0.01 - 94

Granular Applications **-** The only currently approved granular applications which are currently allowed on the master label are on grass grown for seed or sod, turf, cranberries, non-crop land, and aquatic weed control sites. The non-target terrestrial plant RQ summaries for the acid and amine salts for the esters are presented below. Detailed RQs are presented in Appendix F of the ecological risk assessment for 2,4-D.

Table 37. Non-target Plant Risk Quotient Summary of Granular Applications to Selected Uses.

Chemical Group (acid / ester)	Plant Group (non-endangered / endangered)	Risk Quotient Range (Single Applications)	Risk Quotient Range (Multiple Applications)[1]
2,4-D Acid and Amine Salt	non-endangered	2.2 - 77	4.4 - 154
	endangered	2.2 - 133	4.4 - 266
2,4-D Ester	non-endangered	2.0- 494	4.0 - 987.62
	endangered	3.57 - 851	7.14 - 1702.12

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

4. Ecological Incidents

Aquatic Incidents

The EFED Ecological Incident Information System (EIIS) database reports pesticide incidents that have been voluntarily submitted to 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 were 227 incidents reported for 2,4-D, and 24 of these incidents were reported as aquatic incidents under the 2,4-D acid only.

The two "highly probable" registered use incidents occurred when 2,4-D was applied to corn and a railroad right-of-way. 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.

The corn incident affected bluegill, catfish, crappie, fox squirrel, greengill, largemouth bass, silver minnow, smallmouth bass, sunfish and watersnake. This incident was determined to be "highly probable" and was not listed as a misuse, however, no residue analysis was obtained. Another 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.

Terrestrial Incidents

There were 227 terrestrial incidents reported for 2,4-D, and 155 of these incidents were reported as plant incidents under the acid form only. Two incidents were reported as both terrestrial and aquatic.

Eighty-four incidents to plants were listed as registered uses and most were considered "probable." Crop damage was reported to have occurred on numerous crops, but most common non-target plant damages occurred on grass and corn. However, most of these incidents resulted from applications to lawns/turf and corn, respectively.

Results from the incident reports 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.

5. Endangered Species Concerns

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:

- Estimated risk quotients (RQs) from use of 2,4-D DMAS in weed control through direct subsurface application to water bodies exceed the endangered species LOC for freshwater and estuarine fish, and estuarine invertebrates. However, there are currently no endangered estuarine/marine invertebrates.
- Estimated RQs from use of 2,4-D BEE in weed control through direct subsurface application to water bodies exceed the endangered species LOC for freshwater fish and invertebrates and estuarine fish.
- Estimated RQs from use of 2,4-D acid and amine salts in rice paddies exceed 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, 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. Estimated RQs from use of 2,4-D BEE for direct application to water for weed control exceed 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 non-vascular plant species.
- Target 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.
- Target acute LOCs for both non-endangered and endangered plants were exceeded for non-granular and granular for multiple uses, based on predicted EECs.

In December 2004, EPA completed a refined assessment for 2,4-D's potential effects to 26 environmentally significant units (ESUs) of Pacific Salmonids (salmon and steelhead). That refined assessment concluded that 2,4-D has "no effect" on these species when used according to label directions on terrestrial sites. Further, that assessment concluded that use of 2,4-D on rice "may affect but is not likely to adversely affect" 4 ESU's and will have "no effect" on 22 ESU's. That same analysis concluded that use of 2,4-D "may affect" each of the 26 ESU's when used for aquatic weed control purposes. As a result of that assessment, EPA is currently engaged in consultation with the National Marine Fisheries Service regarding those scenarios that resulted in a determination that 2,4-D "may affect but is not likely to adversely affect" the species, or "may affect" the species.

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.

6. Risk Characterization

The Agency 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, the Agency concludes use of 2,4-D for aquatic weed control presents risk to aquatic organisms, while 2,4-D use on terrestrial sites presents the greatest potential risks to small mammals, birds, and non-target terrestrial plants.

a. Characterization of risk to aquatic organisms from direct aquatic application

Whereas the maximum labeled target concentration for control of aquatic weeds is 4 ppm, the typical target concentration is 2 ppm. Moreover, the risks to aquatic organisms were estimated based on a 2,4-D application that resulted in a whole-reservoir concentration of 4 ppm. Treating 100% of the water body would result in a large amount of decaying plant life, thereby creating an oxygen-depleted environment that would most likely result in fish kills. To avoid that scenario, the 2,4-D label advises the applicator to avoid treating more than 50% of a water body in a single application. In actual practice, aquatic weeds that 2,4-D controls tend to grow in littoral zones. As a result, generally a maximum of 20-30% of a water body is treated in a single application. Applying the typical rate of 2 ppm, and taking into account a typical maximum treated area of 30% would decrease calculated RQs by approximately 6-fold.

While noting the potential risks to aquatic organisms from the direct application of 2,4-D for the control of aquatic weeds identified above, it is important to note the benefits gained through the direct application of 2,4-D to aquatic bodies, for the control of invasive species. The U.S Army Corps of

Engineers (USACE), among others, has identified 2,4-D as an important tool for protecting the nation's waters from the invasion and establishment of some of the world's worst species of exotic nuisance vegetation. 2,4-D has a reputation as a selective and economical means to remove invasive plants, enhance the growth and recovery of desirable native vegetation, restore water quality, reduce sedimentation rates in reservoirs, and improve fish and wildlife habitat. 2,4-D products are used to control invasive weeds, such as Eurasian watermilfoil (*Myriophyllum spicatum*) in the northern tier states and water hyacinth (*Eichhornia crassipes*) in the Gulf Coast states. Effective control of these plants can benefit public health with respect to reducing levels of mosquito habitat. In addition, according to USACE, no other product (or alternative technique) can control these plants in a more cost-effective manner (K. Getsinger, USACE, Public Comment; Docket ID# OPP-2004-0167-0053).

b. Characterization of risk to mammals from terrestrial use

All of 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 (Quantitative Usage Analysis for 2,4-D, Case Number: 0073, Date: 8-9-01, A. Halvorson) 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. However, asparagus is representative of a minor 2,4-D use, and risk to mammals from use of 2,4-D on asparagus would be minimal, given that fact.

To add context to the acute mammalian assessment, the effect of assuming an average application rate was determined. 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, the resulting RQ is 0.31 which is below the acute LOC, but above the restricted use LOC of 0.2. Similar trends are noted for other major use sites.

Calculated chronic risks to mammals were greatest for small herbivores/insectivores. For 15 g mammalian herbivores/insectivores, chronic RQs based on maximum residues and mean residues ranged from <1 to 200 and <1 to 70, respectively. For major use sites, including rangeland/pasture, RQs were approximately 100. These chronic risk estimates are likely conservative as described below.

<u>Exposure</u>

The chronic RQs calculated for mammalian herbivores/insectivores are based on conservative estimates of exposure that are not likely to occur in nature. In the example of pasture/rangeland, the chronic RQ of approximately 100 for maximum residues (35 for mean residues) was calculated based on an application rate of 4 lbs ae/A. This maximum application rate was determined based on the knowledge that the maximum rate of 2 lbs ae/A may be applied twice per year, at a 30 day interval. However, the Biological and Economic Analysis Division within OPP has determined that the average application rate on pasture/rangeland is only 0.62 lbs ae/acre (BEAD QUA). Moreover, information from several state contacts indicate that a once per year application of less than 1 lb ae/A is typical (personal communications). As the typical rate is approximately 25% of the assessed rate, use of the typical rate would be expected to decrease the RQ for the pasture/rangeland scenario to approximately 25 for maximum residues and 9 for mean residues.

A second example of the conservative assumptions included in the assessment of exposure to mammalian herbivores/insectivores is the assumption that 100% of the long term diet is limited 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. Moreover, currently Agency 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 so that the current approach may overestimate the amount of 2,4-D available for exposure in terrestrial systems. Therefore, the percent of diet 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.

Hazard

The mammalian chronic risk assessment utilized a toxicity endpoint from a rat two-generation reproduction test. This endpoint was the NOAEL of 5 mg/kg-bw/day 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 exposures 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, a 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-bw/day for increased rate of fetal abortions, with a LOAEL 90 mg/kg-day. Similar NOAEL and LOAEL thresholds were observed in studies in 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.

c. Characterization of risk to birds from terrestrial use

The assessment of risk to birds from exposure to 2,4-D is likely conservative as follows. Currently, Agency 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.

For non-granular spray application, the highest acute avian RQ (3.50) was from the cranberry scenario, for birds feeding on short grass. That assessment was based on a maximum application rate of 4 lbs ae/acre; however, the average application rate is 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 an assumption made that the resulting EEC will be reduced linearly, the RQ would be 1.60.

To determine the hazard associated with acute exposures to birds, the assessment has considered 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. The Agency 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.

Given the conservative assumptions in both exposure scenarios and hazard determinations, the Agency finds that the acute risk to birds from 2,4-D exposure does not exceed the Agency's level of concern.

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.

d. Characterization of risk to non-target plants from terrestrial use

Acute LOCs for both non-endangered and endangered terrestrial plants were exceeded for non-granular and granular uses at many use sites. Consideration of average application rates did not result in exposure below LOCs. However, the exposure estimates used to develop the RQs were likely conservative, as follows.

In the exposure calculation for non-target plants, the major contributor is run-off from the application site. The runoff and leaching vulnerability schemes used in this assessment were adapted from a vulnerability scheme developed by the USDA (Kellogg et al, 1998), and incorporate several conservative assumptions. For example, a 1-in-10 year rain event is modeled, resulting in 3 cm of runoff water. 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, however, there is a low probability that a 1-in-10 year rain event will coincide with the first few days following a 2,4-D application at the maximum application rate. Also, it is likely that farm management practices would be in place to limit run-off, as run-off events are detrimental to the farm as a whole for reasons other than pesticide damage.

Currently Agency 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.

IV. Risk Management, Reregistration, and Tolerance Reassessment Decision

A. Determination of Reregistration Eligibility

Section 4(g)(2)(A) of FIFRA calls for the Agency to determine, after submission of relevant data concerning an active ingredient, whether or not products containing the active ingredient are eligible for reregistration. The Agency has previously identified and required the submission of the generic (i.e., active ingredient-specific) data to support reregistration of products containing 2,4-D as an active ingredient. The Agency has completed its review of these generic data, and has determined that the data are sufficient to support reregistration of all products containing 2,4-D .

The Agency has completed its assessment of the dietary, occupational, residential, and ecological risk associated with the use of pesticide products containing the active ingredient 2,4-D . Based on a review of these data and on public comments on the Agency's assessments for the active ingredient 2,4-D , the Agency has sufficient information on the human health and ecological effects of 2,4-D to make decisions as part of the tolerance reassessment process under FFDCA and reregistration process under FIFRA, as amended by FQPA. The Agency has determined that 2,4-D containing products are eligible for reregistration provided that: (i) current data gaps and confirmatory data needs are addressed; (ii) the risk mitigation measures outlined in this document are adopted; and (iii) label amendments are made to implement these measures. Label changes are described in Section V. Appendix A summarizes the uses of 2,4-D that are eligible for reregistration. Appendix B identifies the generic data requirements that the Agency reviewed as part of its determination of reregistration eligibility of 2,4-D, and lists the submitted studies that the Agency found acceptable. Data gaps are identified as generic data requirements that have not been satisfied with acceptable data.

Based on its evaluation of 2,4-D, the Agency has determined that 2,4-D products, unless labeled and used as specified in this document, would present risks inconsistent with FIFRA. Accordingly, should a registrant fail to implement any of the risk mitigation measures identified in this document, the Agency may take regulatory action to address the risk concerns from the use of 2,4-D . If all changes outlined in this document are incorporated into the product labels, then all current risks for 2,4-D will be adequately mitigated for the purposes of this determination.

B. Public Comments and Responses

Through the Agency's public participation process, EPA worked extensively with stakeholders and the public to reach the regulatory decisions for 2,4-D . During the public comment period on the revised risk assessments, which closed on March 14, 2005, the Agency received comments from numerous parties. These comments in their entirety are available in the public docket (OPP-2004-0167) at http://www.epa.gov/edockets. Individual responses to these comments are also available in the public docket (OPP-2004-0167).

The RED and technical supporting documents for 2,4-D are available to the public through EPA's electronic public docket and comment system, EPA Dockets, under docket identification number OPP-2004-0167. The public may access EPA Dockets at http://www.epa.gov/edockets. In addition, the 2,4-D RED may be downloaded or viewed through the Agency's website at http://www.epa.gov/pesticides/reregistration/status.htm.

C. Regulatory Position

1. Food Quality Protection Act Findings

a. "Risk Cup" Determination

As part of the FQPA tolerance reassessment process, EPA assessed the risks associated with this pesticide. EPA has determined that risk from dietary (food sources only) exposure to 2,4-D is within its own "risk cup." An aggregate assessment was conducted for exposures through food, drinking water, and residential uses. The Agency has determined that the aggregate human health risks from these combined exposures are within the risk cup. In other words, EPA has concluded that the tolerances for 2,4-D meet FQPA safety standards. In reaching this determination, EPA has considered the available information on the special sensitivity of infants and children, as well as aggregate exposure from food, water, and residential uses.

b. Determination of Safety to U.S. Population

The Agency has determined that the established tolerances for 2,4-D , with amendments and changes as specified in this document, meet the safety standards under the FQPA amendments to section 408(b)(2)(D) of the FFDCA, and that there is a reasonable certainty no harm will result to the general population or any subgroup from the use of 2,4-D. In reaching this conclusion, the Agency has considered all available information on the toxicity, use practices and exposure scenarios, and the environmental behavior of 2,4-D . Both the acute dietary (food alone) and chronic dietary risk from 2,4-D are not of concern.

Acute and chronic risks from drinking water exposures are not of concern. Models have been used to estimate surface water concentrations. The surface water EECs are below the DWLOCs for all population subgroups. Drinking water monitoring data from the USGS NAWQA Program confirm that concentrations of 2,4-D are less than modeled estimates for surface water. The maximum concentration detected in ground water monitoring (from USGS NAWQA) has been used as the ground water EEC. The ground water EEC is below the DWLOCs for all populations subgroups.

EPA has determined that the established tolerances for 2,4-D, with amendments and changes as specified in this document, meet the safety standards under the FQPA amendments to section 408(b)(2)(C) of the FFDCA, that there is a reasonable certainty of no harm for infants and children. The safety determination for infants and children considers the factors noted above for the general population, but also takes into account the possibility of increased dietary exposure due to the specific consumption patterns of infants and children, as well as the possibility of increased susceptibility to the toxic effects of 2,4-D residues in this population subgroup. FQPA directs EPA, in setting pesticide tolerances, to use an additional tenfold margin of safety to protect infants and children, taking into account the potential for pre- and postnatal toxicity and the completeness of the toxicology and exposure databases. The statute authorizes EPA to replace this tenfold FQPA safety factor with a different FQPA factor only if reliable data demonstrate that the resulting level of exposure would be safe for infants and children.

FQPA Special Safety Factor

EPA concludes that the toxicology database for 2,4-D is substantially complete since all required studies have been submitted. After evaluating hazard and exposure data for 2,4-D, EPA removed the default 10X FQPA special safety factor. The toxicity database for 2,4-D includes acceptable developmental and reproductive toxicity studies. Developmental toxicity studies were conducted in both rats and rabbits for most 2,4-D forms. There is qualitative evidence of susceptibility in the rat developmental toxicity study with 2,4-D acid and DEA salt where fetal effects (skeletal abnormalities) were observed at a dose level that produced less severe maternal toxicity (decreased body-weight gain and food consumption). There is no evidence of increased (quantitative or qualitative) susceptibility in the prenatal developmental toxicity study in rabbits or in the 2-generation reproduction study in rats on 2,4-D. Regarding the 2,4-D amine salt and ester forms, no evidence of increased susceptibility (quantitative or qualitative) was observed in the prenatal developmental toxicity study in rat and rabbits (except for 2,4-D DEA) dosed with any of the amine salts or esters of 2,4-D. There is evidence of increased susceptibility (qualitative) in the prenatal developmental study in rabbits for 2,4-D DEA salt.

After establishing developmental toxicity endpoints to be used in the risk assessment with traditional uncertainty factors (10x for interspecies variability and 10x for intraspecies variability), the Agency has no residual concerns for the effects seen in the developmental toxicity studies. Therefore, the 10X FQPA special safety factor was reduced to 1X.

Database Uncertainty Factor

The EPA has concluded that there is a concern for developmental neurotoxicity resulting from exposure to 2,4-D, and that a developmental neurotoxicity (DNT) study in rats is required for 2,4-D. The Agency has also concluded that a 2-generation reproduction study is required to address both the concern for thyroid effects and immunotoxicity, as well as a more thorough assessment of the gonads and reproductive/developmental endpoints. EPA has determined that a 10X database uncertainty factor (UF_{DB}) is needed to account for the lack of these studies. This Uncertainty Factor is applied only to exposure scenarios that are expected for children or pregnant women, and thus is not applied to occupational exposure scenarios.

2. Endocrine Disruptor Effects

EPA is required under the FFDCA, as amended by 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 endocrine effects as the Administrator may designate." When the appropriate screening and/or testing protocols being considered under the EDSP have been developed, 2,4-D may be subject to additional screening and/or testing to better characterize effects related to endocrine disruption.

3. Cumulative Risks

The Food Quality Protection Act (FQPA) requires EPA to consider "available information" concerning the cumulative effects of a particular pesticide's residues and "other substances that have a common mechanism of toxicity" when considering whether to establish, modify, or revoke a tolerance. Potential cumulative effects of chemicals with a common mechanism of toxicity are considered because low-level exposures to multiple chemicals causing a common toxic effect by a common mechanism could lead to the same adverse health effect as would a higher level of exposure to any one of these individual chemicals. 2,4-D is a member of the alkylphenoxy herbicide class of pesticides. A cumulative risk assessment has not been performed as part of this human health risk assessment because the Agency has not yet made a determination of whether 2,4-D and other alkylphenoxy compounds have a common mechanism of toxicity. For information regarding EPA's efforts to determine which chemicals have a common mechanism of toxicity and to evaluate the cumulative effects of such chemicals, see the policy statements by the EPA's Office of Pesticide Programs concerning common mechanism determinations and procedures for cumulating effects from substances found to have a common mechanism on EPA's website at http://epa.gov/pesticides/cumulative/.]

4. Special Review Disposition

2,4-D has been in pre-Special Review status since September 22, 1986, because of carcinogenicity concerns. In 1994 a Science Advisory Panel/Scientific Advisory Board classified 2,4-D as a Group D carcinogen (not classifiable to human carcinogenicity). The Agency requested further histopathological examinations of rat brain tissues and mouse spleen tissues in question. These exams were submitted and reviewed, and on March 16, 1999, The Agency notified the 2,4-D Task Force that the Agency would continue to classify 2,4-D as a Group D carcinogen. Also, in a 1994 review of all relevant epidemiological studies, EPA found that none of the more recent epidemiological studies definitively linked human cancer cases to 2,4-D. A final notice of the Agency's intent not to initiate Special Review will be published in concert with the release of this RED document.

5. Dioxin Contaminants

Exposure

In 1987, a DCI titled "Data Call-In Notice for Product Chemistry Relating to Potential Formation of Halogenated Dibenzo-p-dioxin or Dibenzofuran Contaminants in Certain Active Ingredients," was issued to identify pesticides that may contain halogenated dibenzo-p-dioxin and dibenzofuran contaminants. A second DCI in 1987, "Data Call-In for Analytical Chemistry Data on Polyhalogenated Dibenzo-p-Dioxins/Dibenzofurans (HDDs and HDFs)," was issued, under which registrants whose products did not qualify for an exemption or waiver were required to generate and submit analytical methods and certification limits of dioxins and furans.

The specific results of analysis of multiple 2,4-D technical products, submitted to EPA in response to both DCIs, are considered confidential business information (CBI) and cannot be released by EPA to the public. In summary, two of eight technical products had concentrations of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD; dioxin) greater than the limit of quantitation (LOQ; LOQ = 0.1 ppb) and three of eight had concentrations of 1,2,3,7,8-pentachlorodibenzo-p-dioxin (PCDD) greater than the LOQ (LOQ = 0.5 ppb).

In 1991, the EPA's Office of Research and Development (EPA/ORD) began an assessment of the health risks of exposure to dioxins. The most recent revision of that assessment has recently been submitted to the National Academies of Science (NAS) for review. In that document and elsewhere, a source inventory of dioxin was published. As a result of the 1987 DCI data, and the amount of 2,4-D applied to agricultural and residential settings (approximately 50 million pounds per year), the current draft dioxin source inventory (see The Inventory of Sources and Environmental Releases of Dioxin-Like Compounds in the United States: The Year 2000 Update, EPA/600/P-03/002A, External Review Draft, March 2005) identifies 2,4-D as a source of dioxin emissions (28.9 g TEQDF-WHO98; TEQ = Toxic EQuivalent amount, or an amount of total dioxin equivalent to 28.9 g of the most toxic dioxin congener, 2,3,7,8-TCDD). It should be noted that this estimate of dioxin release assumes all products are contaminated and does not take into account manufacturing changes since the DCI. Moreover, that estimate is specific for the year 1995, and therefore should not be considered the current estimate of dioxin release.

The 1995 estimate for dioxin emissions from 2,4-D, taken together with NAS estimates for 2002/2004 releases from other sources of dioxin in the U.S., suggest that 2,4-D applications to land ranks seventh (2.6% of all dioxin sources) behind backyard burning (57%), sewage sludge application (6.9%), residential wood burning (5.7%), coal-fired utilities (5.4%), diesel trucks (3.2%), and secondary aluminum smelting (2.6%) in terms of dioxin emissions (see The Inventory of Sources and Environmental Releases of Dioxin-Like Compounds in the United States: The Year 2000 Update, EPA/600/P-03/002A, External Review Draft, March 2005). According to 2,4-D registrants, since the 1990's, the manufacturing processes for 2,4-D and its chemical intermediate, dichlorophenol, have been modified, and those modifications decrease the chance that TCDD and PCDD are formed during the manufacturing process. The following description of the current 2,4-D manufacturing process summarizes information submitted by the 2,4-D Task Force II.

A key chemical intermediate in the manufacture of 2,4-D is 2,4-dichlorophenol (2,4-DCP) and the purity of this intermediate has a strong correlation to the purity of 2,4-D acid produced from it. In the manufacture of 2,4-DCP, multiple positions around the phenyl ring structure may be chlorinated. The desired positions for chlorination are carbons two and four of the phenyl ring, but the reaction may yield small quantities of compounds chlorinated at different positions. Certain combinations of these chlorinated structures may form precursors to the dioxin 2,3,7,8-TCDD.

Manufacture of the 2,4-DCP intermediate has been optimized by controlling processing conditions necessary to drive the chlorination reaction to the preferred two and four carbon positions, thereby limiting the formation of impurities that can lead to dioxin formation. Controlled temperature and residence time during the chlorination reaction, programmed addition of the chlorinating agent, and efficient agitation in the reaction vessel are processing factors that contribute to the purity of 2,4-DCP. Additionally, distillation of 2,4-DCP is a technique that may be employed post-chlorination to increase purity. Moreover, quality control sampling and analytical procedures are also utilized to verify product quality at various steps of the 2,4-DCP process. According to Results of testing of 2,4-DCP, performed in response to the Toxic Substances Control Act (TSCA) Dioxin/Furan Test Rule, showed no detectable concentrations of 2,3,7,8-substituted tetra- through hepta-CDD/CDFs.

In the manufacture of 2,4-D acid *per se*, there are additional process conditions and procedures that must be controlled to maximize yield and purity. Details regarding these measures are dependent on specific manufacturing methodologies and, as such, are protected under FIFRA Section 10 as Confidential Business Information.

Anticipated Residues

The Agency's most recent evaluations of anticipated dioxin and furan residues resulting from 2,4-D applications are based on the concentrations of dioxins and furans present in technical grade 2,4-D as determined by review of analytical data submitted in response to the 1987 DCI. In those evaluations, completed in the early 1990's, the ratios of individual chlorodibenzo-p-dioxin (CDD; dioxin) or chlorodibenzo-p-furan (CDF; furan) contaminant concentrations to 2,4-D acid concentrations were calculated, and those ratios were used with 2,4-D tolerance expressions to calculate an anticipated residue in eggs, fruits, grains, kidney (hogs), meat (hogs), milk, nuts, poultry, and sugarcane, for each detected dioxin or furan. For each technical 2,4-D formulation for which the Agency received data, calculation of an anticipated dietary exposure was based on a worst-case scenario in which the highest anticipated residue was used, and an assumption was made that 100% of the diet consisted of the food item with the highest anticipated residue.

Toxicological Significance

Based on the calculation of dietary exposures, using the worst-case scenario described above, both the cancer and non-cancer risks from dietary exposure to dioxins and furans as contaminants of 2,4-D acid were considered to be of no toxicological concern at the time of the assessment.

Risk Management

Members of the 2,4-D Task Force II have submitted information about the current manufacturing process for the 2,4-D intermediate, 2,4-DCP, as well as for 2,4-D acid itself, and have included in their submissions explanatory text on how current manufacturing processes minimize the chance of dioxin and furan formation. To confirm that the changes to the manufacturing processes since the time of the 1987 DCI have resulted in lower concentrations of dioxin congeners in technical 2,4-D products, the Agency is requiring that five recent batches of all technical products be analyzed for 2,3,7,8-TCDD, 2,3,7,8-TCDF and their respective higher substituted chlorinated congeners using validated analytical methods. The Agency is specifying that the manufacturers use the most current state-of-the art laboratory methods for measuring 2,3,7,8-TCDD and TCDF at levels less than 1 part per trillion (EPA Method 1613, Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS). Because 1,2,3,7,8-PeCDD is equi-potent to 2,3,7,8-TCDD in the TEF scheme, the Agency is adding this compound to our testing requirements. The pentachloro-congener was reported as present in 2,4-D in the 1987 Data Call-in. Registrants are encouraged to submit their analytical methods and sampling plans to the Agency for review prior to commencing these studies.

D. Tolerance Reassessment Summary

1. Tolerances Currently Listed Under 40 CFR §180.142

Tolerances for residues of 2,4-D in/on plant RACs and processed commodities, fish, and potable water are currently expressed in terms of 2,4-D *per se* [40 CFR §180.142(a)(1-6 and 9-12) and (b)]. Tolerances for residues in livestock commodities are currently expressed in terms of 2,4-D and/or its metabolite 2,4-dichlorophenol (2,4-DCP) [40 CFR §180.142(a)(8)]. EPA has concluded that 2,4-D is the residue of concern and that tolerances listed in 40 CFR §180.142 are to be defined as residues of 2,4-D, both free and conjugated, determined as the acid.

The listing for 2,4-D tolerances in 40 CFR §180.142 should be recodified into parts (a), (b), (c), and (d). Part (a) should be reserved for commodities with permanent tolerances reflecting at least a preharvest (field) or postharvest use, part (b) for Section 18 emergency exemptions, part (c) for tolerances with regional use registrations, and part (d) for commodities bearing 2,4-D residues solely inadvertently, including irrigated crops. A summary of 2,4-D tolerance reassessments and recommended recodifications is presented in Table 37 along with any recommended changes in commodity definitions.

Note that some commodities currently are the subject of two or more separate tolerances depending on the use pattern, the 2,4-D form applied, timing of treatment (preharvest or postharvest), or degree of intent to deposit residues (direct treatment or inadvertent). Direct treatment involves intentional field treatment of crop sites or postharvest treatment of harvested commodities on registered labels. Inadvertent deposition involves the incidental exposure of crops when water passing through 2,4-D-treated irrigation ditchbanks or diverted from 2,4-D-treated bodies of water is used to irrigate crops. EPA is proposing to remove most such use-pattern or FIFRA-related language at 180.142. Due to the complicated nature of the routes of residue deposition, we are proposing to subsume the lower tolerances in the highest existing or reassessed tolerance established in the same commodity - even if that results in 180.142(a) containing some tolerances that reflect 2,4-D residues that could potentially result from two or more exposure routes. An example is citrus which has tolerances for 2,4-D in the RAC resulting from preharvest use + postharvest use, irrigation ditchbank treatment (inadvertent), and direct water body treatment (also inadvertent). If there are no registered uses on a given commodity and residues are likely to occur on that commodity solely inadvertently, i.e., via irrigation, then the tolerance in that commodity will be located under 180.142(d). In most cases, residues, and hence the tolerance, resulting from a direct, registered use are higher than the residues (and the tolerance) resulting inadvertently. EPA proposes these revisions because we know that an enforcement agency, having detected 2,4-D residues in a commodity, would: (i) not be able to distinguish which form of 2,4-D had been applied; (ii) rarely be able to determine who applied the pesticide, when, or for what purpose; and (iii) not know whether a sample is violative if the 2,4-D concentration falls between two tolerance levels.

Tolerances Listed Under 40 CFR §180.142(a)(1):

Adequate data are available to reassess the established tolerances for the following commodities: apple, apricot, citrus fruit, pear, potato and quince.

The available apple and pear residue data will support a crop group tolerance at 0.05 ppm for pome fruits under the redesignated section 180.142(a). The separate tolerances on apple, pear, and quince should be revoked concomitant with establishing a new pome fruit crop group tolerance.

The 5 ppm tolerance on citrus fruits should be reassessed to 3.0 ppm to reflect any combination of the preharvest use on citrus, the postharvest use of 2,4-D on lemons in the U.S., a similar postharvest use on oranges imported into the U.S., and any inadvertent (irrigation) residues that may be incurred as a result of 2,4-D use in aquatic sites. The tolerances in citrus fruit of 0.1 ppm at 180.142(a)(3) and 1.0 ppm at 180.142(a)(6), both reflecting inadvertent residues, should be revoked as they will be subsumed by the reassessed tolerance of 3.0 ppm at 180.142(a).

The tolerance for residues in/on apricots should be revoked as residues in/on apricots will be covered by the tolerance in stone fruits.

Tolerances Listed Under 40 CFR §180.142(a)(2):

Adequate data are available to reassess all the tolerances listed under 180.142(a)(2). All reassessed tolerances should be recodified under the revised section 180.142(a).

Based on the available residue data, the current tolerances on grass hay and tree nuts are adequate. However, tolerances can be lowered on the following commodities: blueberry, sweet corn (kernel plus cob with husks removed), corn forage and grain, cranberry, stone fruits, grape, grass forage, pistachio, rice straw, sorghum forage, grain and stover, and sugarcane. Tolerances should be increased on the following commodities: corn stover, rice grain, and wheat grain and forage.

The available residue data for wheat commodities will be used to reassess tolerances on similar commodities from barley, millet, oats, and rye. Tolerances should be increased accordingly on: barley grain; millet grain, forage and straw; oat forage and grain; and rye forage and grain.

The tolerance for residues in sugarcane forage should be revoked because it is no longer considered a significant livestock feed item (OPPTS GLN 860.1000).

Tolerances Listed Under 40 CFR §180.142(a)(3):

Tolerances listed in 40 CFR §180.142(a)(3) are established for negligible residues of 2,4-D in irrigated crops from application of its dimethylamine salt to irrigation ditch banks in the Western United States in programs of the Bureau of Reclamation, U.S. Department of Interior; cooperating water user organizations; the Bureau of Sport Fisheries, U.S. Department of Interior; Agricultural Research Service, U.S. Department of Agriculture; and the Corps of Engineers, U.S. Department of Defense. Where tolerances are established at higher levels resulting from other uses of 2,4-D, the higher tolerance applies also to residues in crops from the irrigation ditch bank use cited in this paragraph.

The tolerances in crops or crop groups listed under 40 CFR §180.142(a)(3) that do not have a direct treatment tolerance under 180.142(a) should be recodified as 180.142(d), i.e., inadvertent residue tolerances.

The available irrigated crop data support tolerances for inadvertent residues at 0.2 ppm in foliage of legume vegetables (group 7) and non-grass animal feed (group 18) and at 0.05 ppm in/on the following crops groups: bulb vegetables (group 3), legume vegetables (group 6), cucurbit vegetables (group 9), and fruiting vegetables (group 8).

In addition, tolerances resulting from the primary use of 2,4-D on grasses, citrus fruits, and tree nuts are high enough to cover any inadvertent residues in these crops that may result from the use of 2,4-D treated irrigation water. Therefore, separate tolerances for inadvertent residues in/on these crops are not required.

Separate tolerances for inadvertent residues are unnecessary in pome fruits, stone fruits, pistachios, grapes, blueberry, and strawberry as these crops all have tolerances resulting from the direct use of 2,4-D. However, the tolerances in all of these commodities have been reassessed at 0.05 ppm, the limit of quantitation of the enforcement method, to reflect only direct treatment at this time. It is reasonably possible that inadvertent residues resulting from irrigation with treated water could contribute concentrations of 2,4-D in the commodities necessitating tolerances higher than 0.05 ppm. Therefore, confirmatory irrigated crop residue data are required for a representative perennial crop (strawberry). Also, additional residue data on sugar beets and tops irrigated with water containing 2,4-D at 0.1 ppm are required to permit reassessment of the tolerances in the Root and Tuber Vegetables Group and the Leaves of Root and Tuber Vegetables Group resulting inadvertently due to irrigation with 2,4-D-treated water. These data may also be used to reassess inadvertent tolerances established at 180.142(d) as a result of the 2,4-D RED.

Tolerance Listed Under 40 CFR §180.142(a)(4):

The established tolerance for residues in/on asparagus is reassessed at the current level under the revised tolerance expression and is to be recodified as 40 CFR §180.142(a).

Tolerance Listed Under 40 CFR §180.142(a)(5)

The established tolerance for residues in/on strawberry is reassessed at the current level under the revised tolerance expression and is to be recodified as 40 CFR §180.142(a).

Tolerances Listed Under 40 CFR §180.142(a)(6):

Tolerances listed in 40 CFR §180.142(a)(6) are established for residues of 2,4-D from application of its dimethylamine salt for water hyacinth control in ponds, lakes, reservoirs, marshes, bayous, drainage ditches, canals, rivers, and streams that are quiescent or slow moving in programs conducted by the Army Corps of Engineers or other Federal, State, or local public agencies. Where tolerances are established at higher levels from other uses of the dimethylamine salt of 2,4-D on crops included within these commodity groups, the higher tolerances also apply to residues from the aquatic uses cited in this paragraph.

Based on the available residue data, the current tolerance in shellfish is adequate and the tolerance in fish can be reduced to 0.1 ppm. Both tolerances should be recodified under the revised section 180.142(a).

Tolerances for residues in/on the irrigated crops and crop groups at the current §180.142(a)(6) are set at 1.0 ppm whereas the tolerances in/on the identical crops/crop groups at §180.142(a)(3) are at 0.1 ppm for the irrigation ditchbank use. The recommended/reassessed tolerances from §180.142(a)(3) to be recodified under sections §180.142(a) or §180.142(d) concomitantly address the reassessments/recodifications recommended for tolerances at §180.142(a)(6), depending on whether residues are incurred directly and/or inadvertently, as explained above.

Tolerances Listed Under 40 CFR §180.142(a)(8):

Tolerances listed in 40 CFR §180.142(a)(8) are established for residues of 2,4-D and/or its metabolite 2,4-DCP in livestock commodities. As indicated by the Agency, the regulated residue in animal commodities is 2,4-D (free and conjugated). As a result of this residue definition change, all reassessed livestock tolerances should be recodified to §180.142(a).

Based upon the available livestock feeding study, the 0.1 ppm tolerance in milk is reassessed at 0.05 ppm and the tolerances in cattle, goat, horse, and sheep commodities are reassessed at: 0.3 ppm in fat, meat, and meat byproducts except kidney and 4.0 ppm in kidney.

The established tolerances for 2,4-D residues in hog commodities may be revoked. Based on the MTDB for swine (1.6 ppm) and the results of the ruminant feeding study, there is no reasonable expectation of finite 2,4-D residues occurring in hog commodities [Category 3 of 40 CFR §180.6(a)(3)].

In addition, the established tolerances for 2,4-D residues in eggs and poultry tissues may be revoked. Based on the results of the 2,4-D poultry metabolism study, there is no reasonable expectation of finite residues in poultry tissues and eggs [Category 3 of 40 CFR §180.6(a)(3)].

Tolerance Listed Under 40 CFR §180.142(a)(9):

Tolerances listed in 40 CFR §180.142(a)(9) are established for residues of 2,4-D from applications of its dimethylamine salt or its butoxyethanol ester for Eurasian water milfoil control in programs conducted by the Tennessee Valley Authority in dams and reservoirs of the TVA system.

The tolerance for 2,4-D residues in fish at 40 CFR §180.142(a)(9) should be revoked and this section deleted. There is no need for two 2,4-D tolerances in fish. It has already been recommended that the 1.0 ppm tolerance in fish currently at §180.142(a)(6) be reassessed at 0.1 ppm and that this reassessed tolerance be recodified at the new 40 CFR §180.142(a).

Tolerance Listed Under 40 CFR §180.142(a)(10):

The tolerance listed in 40 CFR §180.142(a)(10) is a regional registration as defined in Sec. 180.1(n) and is established for the residues of 2,4-D in raspberries. The tolerance includes residues from the application of 2,4-D and its N-oleyl-1,3-propylenediamine salt.

As the members of Task Force II are not supporting 2,4-D use on this commodity, the tolerance for residues in/on raspberries should be revoked unless another party wishes to support a use on this crop. 40 CFR §180.142(a)(10) should be deleted and any tolerances with regional use registration should be established under the revised section 40 CFR §180.142(c).

Tolerance Listed Under 40 CFR §180.142(a)(11):

A time-limited tolerance of 0.02 ppm has been established for residues of 2,4-D resulting from the preplant use of 2,4-D ester or amine in/on soybean seed [40 CFR §180.142(a)(11)], expired on December 31, 2004. Adequate residue data are available to support permanent tolerances on soybean commodities. Section 180.142(a)(11) should be deleted, and permanent tolerances for 2,4-D residues in/on soybean seed, forage, and hay are recommended to be established under the revised section 180.142(a).

Tolerances Listed Under 40 CFR §180.142(a)(12):

Tolerances listed at 40 CFR §180.142(a)(12) are established for residues of 2,4-D in processed feeds. Such residues may be present therein only as a result of application to the growing crop of the herbicides identified in this section. Tolerances formerly listed at 40 CFR §180.1450 were moved to 40 CFR §180.142(a)(12) (63 FR 34829, 6/26/98).

The tolerance for residues in sugarcane bagasse should be revoked because it is no longer considered a significant livestock feed item and has been deleted from Table 1 (OPPTS GLN 860.1000).

40 CFR §180.142(a)(12) should be deleted. The tolerance for 2,4-D residues in milled fractions derived from barley, oats, rye, and wheat should be revoked as the commodity definition will change and the tolerances will be increased and recodified at the revised 40 CFR §180.142(a) for residues in barley bran, rye bran, and wheat bran. No tolerances in other processed products of small grains are necessary because concentration of residues does not occur in them.

Tolerances Listed Under 40 CFR §180.142(a)(13):

Tolerances listed at CFR §180.142(a)(13) are established for residues of 2,4-D in processed foods and potable water.

40 CFR §180.142(a)(13) should be deleted. The tolerances for 2,4-D residues in sugarcane molasses and in milled fractions derived from barley, oats, rye, and wheat should be revoked as tolerances will be recodified under the revised 40 CFR §180.142(a) for residues in sugarcane molasses, barley bran, rye bran, and wheat bran.

The established tolerance for residues of 2,4-D in potable water should be revoked as EPA/OPPTS/OPP no longer establishes pesticide tolerances in potable water. Instead, the EPA Office of Water establishes Maximum Contaminant Levels (MCLs). An MCL of 0.07 ppm has been established for 2,4-D in drinking water.

Tolerances Listed Under 40 CFR §180.142(b):

The tolerance listed in 40 CFR §180.142(b) is a time-limited tolerance established for 2,4-D in/on wild rice in connection with use of 2,4-D in MN under a Section 18 emergency exemption granted by EPA. The tolerance is set to expire on December 31, 2005. As adequate residue data are available on wild rice grown in MN, a permanent tolerance for rice, wild, grain should be established at 0.05 ppm under 40 CFR §180.142(c).

2. Tolerances to Be Proposed Under 40 CFR §180.142

Tolerances Needed Under 40 CFR §180.142(a):

The revised section will include all permanent tolerances for residues of 2,4-D, defined as residues of 2,4-D, both free and conjugated, determined as the acid. The section will include all plant commodities (excluding crop commodities exposed solely inadvertently), livestock commodities, fish, and shellfish at reassessed levels.

In addition, the available residue data indicate that new tolerances should be established for 2,4-D residues in/on the following commodities: almond hulls; aspirated grain fractions; barley bran and straw; oat straw; rice hulls; rye bran and straw; soybean forage, hay, and seeds; and wheat bran and straw.

Once adequate residue data become available, new tolerances should also be established for wheat hay. Wheat hay data will be translated to barley hay, millet hay, and oat hay.

Tolerances Needed Under 40 CFR §180.142(c):

Based on the available residue data, tolerances with regional use registrations should be established for wild rice grain at 0.05 ppm, reflecting the use of 2,4-D on wild rice grown in MN.

Tolerances Needed Under 40 CFR §180.142(d):

Tolerances for inadvertent 2,4-D residues in irrigated crops that have no registered, direct uses will be moved from paragraph §180.142(a)(3) to paragraph §180.142(d) and the commodity and crop group listings will be revised to the current EPA definitions.

Table 38. Tolerance Reassessment Summary for 2,4-D.

Commodity	Tolerance Listed Under 40 CFR §180.142 (ppm)	Reassessed Tolerance (ppm)	Comment *[Corrected Commodity Definition]*
Tolerances Listed Under 40 CFR §180.142 (a) (1) [2]			

Commodity	Tolerance Listed Under 40 CFR §180.142 (ppm)	Reassessed Tolerance (ppm)	Comment *[Corrected Commodity Definition]*
Apple	5	Revoke	A single tolerance should be established at 0.05 ppm under 180.142(a) for direct and inadvertent residues in/on the *Fruit, pome, group 11*.
Apricot	5	Revoke	Residues in/on apricots will be covered by the tolerance for direct and inadvertent residues in stone fruits at 180.142(a).
Fruit, citrus	5	3.0	A tolerance should be established in Fruit, citrus, group 10, recodified as 180.142(a), that will cover the preharvest use on citrus, the postharvest use on lemons in the U.S., the postharvest use on citrus imported into the U.S., and the inadvertent residues due to irrigation with treated water.
Pear	5	Revoke	A single tolerance should be established at 0.05 ppm under 180.142(a) for direct and inadvertent residues in/on the *Fruit, pome, group 11*.
Potato	0.2	0.40	Includes direct and inadvertent (irrigation) residues. Recodify as 180.142(a).
Quince	5	Revoke	Residues in/on quince will be included under the 0.05 ppm tolerance at 180.142(a) for direct and inadvertent residues in/on the *Fruit, pome, group 11*.
Tolerances Listed Under 40 CFR §180.142 (a) (2) [2]			
Barley, grain	0.5	2.0	The submitted data for wheat grain may be translated to barley grain. Recodify as 180.142(a).
Blueberry	0.1	Revoke	To be included under the 0.2 ppm *Berries group 13* tolerance to be recodified as 180.142(a).
Corn, fodder	20	50.0	Residue data from the 7-day PHI. Recodify as 180.142(a). *Corn, stover*
Corn, forage	20	6.0	Residue data from the 7-day PHI. Recodify as 180.142(a).
Corn, fresh, sweet, kernel plus cob with husks removed	0.5	0.05	Recodify as 180.142(a).
Corn, grain	0.5	0.05	Residue data from 7-day PHI. Recodify as 180.142(a).
Cranberry	0.5	Revoke	To be included under the 0.2 ppm *Berries group 13* tolerance to be recodified as 180.142(a).
Fruit, stone	0.2	0.05	Recodify as 180.142(a). This tolerance will now cover both direct and inadvertent residues. *Fruit, stone, group 12*
Grape	0.5	0.05	Residue data on grape are available for the entire U.S. Recodify as 180.142(a).
Grass, hay	300	300	Residue data from the 7-day posttreatment interval (PTI) for *Grass, hay*. Recodify as 180.142(a).

Commodity	Tolerance Listed Under 40 CFR §180.142 (ppm)	Reassessed Tolerance (ppm)	Comment *[Corrected Commodity Definition]*
Grass, pasture	1,000	360	Recodify as 180.142(a). Residue data from the 0-day PTI. This new tolerance will now cover both direct and inadvertent residues. *Grass, forage*
Grass, rangeland	1,000		
Millet, forage	20	25	The data for wheat forage, grain, and straw may be translated to millet forage, grain, and straw. The required wheat hay data will be translated to millet hay. Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues.
Millet, grain	0.5	2.0	
Millet, straw	20	50	
Nut	0.2	0.2	Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues. *Nut, tree, group 14*
Oat, forage	20	25	The data for wheat forage may be translated to oat forage. Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues.
Oat, grain	0.5	2.0	The data for wheat grain may be translated to oat grain. Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues.
Pistachio	0.2	0.05	Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues.
Rice	0.1	0.5	Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues. *Rice, grain*
Rice, straw	20	10	Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues.
Rye, forage	20	25	Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues. The data for wheat forage may be translated to rye forage.
Rye, grain	0.5	2.0	Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues. The data for wheat grain may be translated to rye grain.
Sorghum, fodder	20	0.2	Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues. *Sorghum, stover*
Sorghum, forage	20	0.2	Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues.
Sorghum, grain	0.5	0.2	Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues.
Sugarcane	2	0.05	Recodify as 180.142(a). *Sugarcane, cane*
Sugarcane, forage	20	Revoke	Sugarcane forage is no longer considered a significant livestock feed item.

Commodity	Tolerance Listed Under 40 CFR §180.142 (ppm)	Reassessed Tolerance (ppm)	Comment *[Corrected Commodity Definition]*
Wheat, forage	20	25	Recodify as 180.142(a). This new tolerance will now cover both direct and inadvertent residues. The 14-day PHI residue data on wheat forage and grain will be used to support tolerances for residues in/on similar commodities of barley, millet, oats, and rye.
Wheat, grain	0.5	2.0	
Tolerance Listed Under 40 CFR §180.142 (a)(3) [4]			
Avocado	0.1(N)	0.05	Recodify as 180.142(d).
Cottonseed	0.1(N)	0.05	Recodify as 180.142(d). *Cotton, undelinted seed*
Cucurbits	0.1(N)	0.05	Recodify as 180.142(d). *Vegetable, cucurbit, group 9*
Fruit, citrus	0.1(N)	Revoke	Inadvertent residues will be covered by the crop group tolerance on citrus fruit at 180.142(a).
Fruit, pome	0.1(N)	Revoke	Inadvertent residues will be covered by the crop group tolerance on pome fruit at 180.142(a).
Fruit, stone	0.1(N)	Revoke	Revocation of one strone fruit tolerance is necessary to avoid duplication. Inadvertent residues will be covered by the stone fruit group tolerance at 180.142(a)(2) to be recodified as 180.142(a).
Grain, crop	0.1(N)	Revoke	Separate tolerances in RACs of each grain will be individually established and recodified as 180.142(a) in/on grain, forage, fodder, stover, or hay, as applicable, to cover both direct and inadvertent residues. Upon formal Agency approval, a small grains subgroup tolerance may be established.
Grass, forage	0.1(N)	Revoke	Inadvertent residues will be covered by the grass forage tolerance for direct residues to be recodified as 180.142(a).
Hop	0.1(N)	0.2	Inadvertent residues will be covered by the hop tolerance for direct residues upon establishment at 180.142(a) in response to PP#2E6352.
Leafy vegetables	0.1(N)	0.4	Establish separate tolerances for inadvertent residues in the *Vegetable, leafy, except brassica, group 4* and *Vegetable, brassica, leafy, group 5* at 0.4 ppm under the revised 180.142(d)
Legume, forage	0.1(N)	Group 7 - 0.2 Group 18 - 0.2	Establish separate tolerances for the *Vegetable, foliage of legume, group 7* and *Animal feed, nongrass, group 18* for inadvertent residues under 180.142(d).
Nut	0.1(N)	Revoke	Inadvertent residues will be covered by the tolerance in the tree nuts crop group at 180.142(a)

Commodity	Tolerance Listed Under 40 CFR §180.142 (ppm)	Reassessed Tolerance (ppm)	Comment *[Corrected Commodity Definition]*
Root crop vegetables	0.1(N)	Group 1 - TBD Group 2 - TBD Group 3 - 0.05	Additional data are required to determine inadvertent residues in sugar beet roots and tops to represent root and tuber vegetables. Establish separate tolerances in the *Vegetable, bulb, group 3.* When sugar beet data are received, establish separate tolerances in the *Vegetable, root and tuber, group 1* and *Vegetable, leaves of root and tuber, group 2*. Recodify as 180.142(a).
Seed and pod vegetables	0.1(N)	0.05	Establish tolerance for inadvertent residues at 180.142(d) in the *Vegetable, legume, group 6*.
Small fruit	0.1(N)	0.2	The 0.2 ppm tolerance in the *Berries group 13*, to be recodified at §180.142(a), will also cover inadvertent residues. Inadvertent residues in/on blueberry and cranberry will also be covered by this group tolerance. Inadvertent residues in/on grape and strawberry will be covered by separate tolerances for direct uses on these crops §180.142(a).
Vegetable, fruiting	0.1(N)	0.05	Establish tolerance for inadvertent residues at 0.05 ppm in the *Vegetable, fruiting, group 8* recodified under §180.142(d).
Tolerance Listed Under 40 CFR §180.142 (a)(4) [2]			
Asparagus	5	5.0	Recodify as §180.142(a).
Tolerance Listed Under 40 CFR §180.142 (a)(5) [2]			
Strawberry	0.05	0.05	Recodify as §180.142(a). This tolerance will cover direct and inadvertent residues.
Tolerance Listed Under 40 CFR §180.142 (a)(6) [2]			
Crops in paragraph (c) of this section	1.0	Revoke	The tolerances to be established under paragraphs §180.142(a) and §180.142(d) will be sufficient to cover inadvertent residues in irrigated crops under the recodified §180.142(a)(6).
Crop groupings in paragraph (c) of this section	1.0	Revoke	The tolerances to be established under paragraphs §180.142(a) and §180.142(d) will be sufficient to cover inadvertent residues in irrigated crops under the recodified §180.142(a)(6).
Fish	1.0	0.10	Residue data for fish and shellfish are from recent tests where fish and shellfish were exposed to 2,4-D under static conditions at 6.0 ppm (1.5x). Recodify to §180.142(a).
Shellfish	1.0	1.0	
Tolerance Listed Under 40 CFR §180.142 (a)(8) [2]			
Cattle, fat	0.2	0.3	Recodify as §180.142(a).
Cattle, kidney	2	4.0	Recodify as §180.142(a).
Cattle, meat	0.2	0.3	Recodify as §180.142(a).

Commodity	Tolerance Listed Under 40 CFR §180.142 (ppm)	Reassessed Tolerance (ppm)	Comment *[Corrected Commodity Definition]*
Cattle, meat byproducts, except kidney	0.2	0.3	Recodify as §180.142(a).
Egg	0.05	Revoke	Category 3 of 40 CFR §180.6(a)(3) applies.
Goat, fat	0.2	0.3	Recodify as §180.142(a).
Goat, kidney	2	4.0	Recodify as §180.142(a).
Goat, meat	0.2	0.3	Recodify as §180.142(a).
Goat, meat byproducts, except kidney	0.2	0.3	Recodify as §180.142(a).
Hog, fat	0.2	Revoke	Category 3 of 40 CFR §180.6(a)(3) applies.
Hog, kidney	2		
Hog, meat	0.2		
Hog, meat byproducts, except kidney	0.2		
Horse, fat	0.2	0.3	Recodify as §180.142(a).
Horse, kidney	2	4.0	Recodify as §180.142(a).
Horse, meat	0.2	0.3	Recodify as §180.142(a).
Horse, meat byproducts, except kidney	0.2	0.3	Recodify as §180.142(a).
Milk	0.1	0.05	Residues in milk increased linearly with dose; therefore, the 0.05 ppm tolerance will be adequate for the 1x dose level. Recodify as §180.142(a).
Poultry	0.05	Revoke	Category 3 of 40 CFR §180.6(a)(3) applies.
Sheep, fat	0.2	0.2	Recodify as §180.142(a).
Sheep, kidney	2	2.0	Recodify as §180.142(a).
Sheep, meat	0.2	0.2	Recodify as §180.142(a).
Sheep, meat byproducts, except kidney	0.2	0.2	Recodify as §180.142(a).
Tolerance Listed Under 40 CFR §180.142 (a)(9) [2]			
Fish	1.0	Revoke	The reassessed tolerance of 0.1 ppm at §180.142(a)(6) will be recodified as §180.142(a). There is no need for duplication of tolerances.
Tolerance Listed Under 40 CFR §180.142 (a)(10) [2]			
Raspberry	1.0	Revoke	Although there is no indication that IR-4 or the Task Force II is supporting a use on raspberries, it would be covered by the 0.2 ppm tolerance in the Berries group 13 at §180.142(a).

Commodity	Tolerance Listed Under 40 CFR §180.142 (ppm)	Reassessed Tolerance (ppm)	Comment *[Corrected Commodity Definition]*
Tolerance Listed Under 40 CFR §180.142 (a)(11) [3]			
Soybean, seed	0.02	0.02	Tolerance expired on 12/31/04. Residue data support a permanent tolerance. If established, recodify as §180.142(a).
Tolerance Listed Under 40 CFR §180.142 (a)(12) [2]			
Sugarcane bagasse	5	Revoke	Sugarcane bagasse is no longer considered a significant livestock feed item.
Sugarcane molasses	5	0.20	Maximum residue value is based on HAFT residues of 0.015 ppm in/on sugarcane and a 7x concentration factor for molasses. Recodify as §180.142(a). *Sugarcane, molasses*
Milled fractions derived from barley, oats, rye, and wheat to be ingested as animal feed or converted into animal feed	2	Revoke	Tolerances for direct and inadvertent residues of 2,4-D in barley, bran; rye, bran; and wheat, bran are to be established under revised 40 CFR 180.142(a). Tolerances in other small grain processed products are not necessary as residues do not concentrate upon processing.
Tolerance Listed Under 40 CFR §180.142 (a)(13) [2]			
Sugarcane molasses	5	Revoke	The sugarcane molasses reassessed tolerance at §180.142(a)(12) will be recodifed as §180.142(a). Duplication of tolerances is not necessary.
Milled fractions derived from barley, oats, rye, and wheat to be ingested as animal feed or converted into animal feed	2	Revoke	Tolerances for direct and inadvertent residues of 2,4-D in barley, bran; rye, bran; and wheat, bran are to be established under revised 40 CFR 180.142(a). Tolerances in other small grain processed products are not necessary as residues do not concentrate upon processing.
Potable water	0.1 (N)	Revoke	OPP no longer establishes tolerances in drinking water. EPA's Office of Water has established an MCL for 2,4-D at 0.07 ppm.
Tolerances Needed Under 40 CFR §180.142 (a); this list does not include recodifications, etc. from above			
Almond hulls	None	0.10	*Almond, hulls*
Aspirated grain fractions	None	40	Based on HAFT residues of 0.038 ppm for corn grain and a 39x concentration factor, maximum expected residues would be 1.48 ppm in aspirated grain fractions (AGF) derived from corn grain. Based on HAFT residues of 3.24 ppm for wheat grain and a 11.2x concentration factor, maximum expected residues would be 36.3 ppm in AGF derived from wheat grain. As sorghum and soybeans uses are early-season uses, residue data on AGF were not generated for these crops. Establish tolerance in AGF at 40 ppm.

Commodity	Tolerance Listed Under 40 CFR §180.142 (ppm)	Reassessed Tolerance (ppm)	Comment *[Corrected Commodity Definition]*
Barley, hay	None	TBD	Data for wheat straw were translated to barley straw. Required wheat wheat hay data will be translated to barley hay.
Barley, straw	None	50	
Barley, bran	None	4.0	Data for wheat bran were translated to barley bran.
Millet, hay	None	TBD	Required wheat wheat hay data will be translated to millet hay.
Oat, hay	None	TBD	Data for wheat straw were translated to oat straw. Required wheat wheat hay data will be translated to oat hay.
Oat, straw	--	50	
Rice, hulls	None	2.0	Maximum residue value is based on HAFT residues of 0.425 ppm in/on rice grain and a 3.3x concentration factor for hulls.
Rye, straw	None	50	Data for wheat straw were translated to rye straw.
Rye, bran	None	4.0	Data for wheat bran were translated to rye bran.
Soybean, forage	None	0.02	Adequate residue data are available to support permanent tolerances on soybean commodities.
Soybean, hay	None	2.0	
Soybean, seed	None	0.02	
Wheat, hay	None	TBD	Data are required on wheat hay
Wheat, straw	None	50	
Wheat, bran	None	4.0	Maximum residue value is based on HAFT residues of 1.08 ppm in/on wheat grain (14-day PHI) and a 3.6x concentration factor for bran.
Tolerance Listed Under 40 CFR §180.142 (b) [5]			
Wild rice	0.1	0.05	Tolerance expires 12/31/05. Adequate data are available to establish a permanent tolerance with a regional registration to be recodified as §180.142(c) for *Rice, wild, grain* at 0.05 ppm.
Tolerance Needed Under 40 CFR §180.142 (c) [6]			
Rice, wild, grain	None	0.05	regional tolerance with use restricted to MN
Tolerances Needed Under 40 CFR §180.142 (d) [7]			
Commodities and crop groups currently listed under paragraph (a)(3)	0.1 (N)	NA	See comments listed under §180.142(a)(3)

1 Maximum residue of treated RAC sample(s) following application of 2,4-D formulations according to use patterns the Task Force II registrants intend to support for reregistration.
2 This subparagraph will be deleted and tolerances recodified under revised paragraph (a).
3 TBD = To be determined. Reassessment of tolerances(s) cannot be made at this time because additional data are required.
4 Tolerances listed under §180.142 (a)(3) for inadvertent residues will be recodified as either §180.142(a) or §180.142(d).
5 This paragraph will be reserved for future time-limited tolerances under Section 18 Emergency Exemptions.
6 Tolerances with regional use registration.

[7] Paragraph (d) will contain tolerances for inadvertent residues (e.g., residues in irrigated crops) only, i.e., there is no registration for direct use in the U.S. If residues may result inadvertently as well as intentionally (direct, labeled treatment), the tolerance is codified at §180.142(a)

3. Codex Harmonization

The Codex Alimentarius Commission has established several maximum residue limits (MRLs) for residues of 2,4-D in/on various plant and animal commodities. The Codex MRLs are expressed in terms of 2,4-D *per se*. The expression of residues for Codex MRLs and U.S. tolerances is harmonized. A numerical comparison of the Codex MRLs and the corresponding reassessed U.S. tolerances is presented in Table 39.

Table 39. Codex MRLs and applicable U.S. tolerances for 2,4-D. Recommendations for compatibility are based on conclusions following reassessment of U.S. tolerances

Codex		Reassessed U.S. Tolerance, ppm	Recommendation And Comments
Commodity, As Defined	MRL (mg/kg)		
Barley	0.5	2.0	
Blackberries	0.1	0.20	U.S. tolerance for Berries group 13
Citrus fruits	2.0	3.0	
Eggs	0.05 (*)	Revoked	
Maize	0.05 (*)	0.05	
Meat (from mammals other than marine mammals)	0.05 (*)	0.30	Meat, fat, and mbyp except kidney
		4.0	Kidney
Milk products	0.05 (*)	0.05	
Milks	0.05 (*)	0.05	
Oats	0.5	2.0	
Potato	0.2	0.40	
Raspberries, Red, Black	0.1	0.20	U.S. tolerance for Berries group 13
Rice	0.05 (*)	0.50	
Rye	0.5	2.0	
Sorghum	0.05 (*)	0.20	Forage, grain, and stover=0.2
Vaccinium berries, including Bearberry	0.1	0.20	U.S. tolerance for Berries group 13
Wheat	0.5	2.0	

(*) = At or about the limit of detection.

4. Residue Analytical Methods - Plants and Livestock (GLN 860.1340)

For the purpose of reregistration, adequate methods are available for data collection and the enforcement of plant commodity tolerances. The Pesticide Analytical Manual (PAM) Vol. II lists three GC methods (designated as Methods A, B, and C) with microcoulometric detection and one GC method (designated as Method D) with electron capture detection (ECD). In a letter dated September 3, 1993 (CBRS No. 12270, DP Barcode D193335, 9/3/93, W. Smith), Task Force II indicated that the enforcement methods currently listed in PAM Vol. II are unsuitable for determining residues of 2,4-D in wheat and poultry commodities.

Plant Commodities: Task Force II submitted an adequate proposed GC/ECD enforcement method for plants (designated as EN-CAS Method No. ENC-2/93) which has been independently validated. Adequate radiovalidation data have been submitted and evaluated for the proposed enforcement method using samples from the wheat metabolism study. The proposed enforcement method or modifications of the enforcement method were used for data collection purposes.

Livestock Commodities: Task Force II submitted two separate (but essentially comparable) proposed enforcement methods (GC/ECD) for determination of 2,4-D in livestock commodities. Adequate radiovalidation data have been submitted for the method using samples of fat, kidney, and milk from the goat metabolism study and samples of eggs from the poultry metabolism study. The Agency concluded that the methods are adequate provided the registrants satisfy the following requests: (i) submit a revised method which combines the two methods into a single method; (ii) delete from the method all references to the use of diazomethane as a derivatizing agent; and (iii) provide complete raw data and sample calculations (including chromatograms showing peak areas, external standard linearity curves and associated data, standard calculations, etc.). Once an adequate revised method is submitted, the Agency will evaluate the tolerance method validation. Recently, it has been determined that the technology to generate diazomethane has advanced such that it is no longer considered to be a dangerous procedure; as a result, the use of diazomethane as a derivatizing agent is now considered acceptable.

E. Regulatory Rationale

The following is a summary of the rationale for managing risks associated with the use of 2,4-D. Where labeling revisions are warranted, specific language is set forth in the summary tables of Section V of this document.

1. Human Health Risk Management

a. Residential Risk

1) Residential risk summary

A Margin of Exposure (MOE) of 1000 (10x for interspecies extrapolation, 10x for intraspecies variation, and 10x database uncertainty factor) is considered adequately protective for this assessment of residential risks. Residential handler risks are not of concern. All MOEs for post-application, oral exposure to children from playing on treated lawns meet or exceed 1000; therefore, post-application exposure to children is not of concern. Likewise, all adult acute/short term MOEs meet or exceed 1000, so post-application exposure is not of concern for adults.

As discussed below, potential risks were identified to individuals who swim in water treated with 2,4-D. Although the risk assessment is likely to be conservative, mitigation measures will be required.

2) Residential Post-application Mitigation

For residential, post-application exposures, when the calculated MOE of 1000 based on modeling is considered in conjunction with biomonitoring results, it is clear that the modeled short-term risks from post-application exposure are upper bound estimates. At one day post-treatment, the MOEs for the volunteers who wore shorts and no shoes ranged from 1400 to 35000 with the lowest MOE corresponding to the volunteer who removed his shirt during the exposure period. The MOEs for the remaining volunteers ranged from 24000 to 37000. The Agency has concluded that no further mitigation is needed for residential post-application exposures.

3) Residential Swimmer Mitigation

The acute MSWC of 9.8 ppm for exposures to 2,4-D acid or amine is greater than the proposed maximum application rate of 4.0 ppm, therefore, acute exposures to acid or amine are not of concern. The MSWC of 3.6 ppm for short-term exposures to acid or amine is also not of concern because some dissipation or dispersion is likely to occur which would cause the 7-day average of 2,4-D concentrations to be less than 3.6 ppm. Dissipation studies submitted to the Agency indicated that the half lives following pond and lake liquid treatments ranged from 3.2 days to 27.8 days which yield 7 day average concentrations of 1.9 ppm when the half life equals 3.2 days, to 3.6 ppm when the half life equals 27.8 days.

The MSWCs for 2,4-D BEE are less than the master label application rate of 4 ppm, but they are unlikely to be of concern for the following reasons:

- 2,4-D BEE degrades rapidly by abiotic hydrolysis in sterile water to form 2,4-D acid particularly when the pH is 7.5 or above.

- 2,4-D BEE degrades to 2,4-D acid by microbial hydrolysis with an average half life of 2.6 ± 1.8 hours at a bacterial concentration of 5×10^{-8} organisms per liter. Therefore, degradation of 2,4-D BEE to 2,4-D under typical environmental conditions will be rapid leading to significantly lower risk estimates because the 2,4-D acid has a lower rate of dermal absorption.

- Modeling predicts direct water application of 2,4-D BEE will yield surface water concentrations of 2,4-D BEE concentrations in the Agency 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.

- The existing label rates for 2,4-D BEE products are also lower than the master label rate.

Although the risk characterization above suggests that the risk estimates are conservative, a 24 hour post-application restriction on swimming is necessary to ensure the safety of children swimming in water treated with 2,4-D BEE.

b. Aggregate Risk

The Food Quality Protection Act amendments to the Federal Food, Drug, and Cosmetic Act (FFDCA, Section 408(b)(2)(A)(ii)) require "that there is a reasonable certainty that no harm will result from aggregate exposure to pesticide chemical residue, including all anticipated dietary exposures and other exposures for which there is reliable information." Aggregate exposure will typically include exposures from food, drinking water, residential uses of a pesticide, and other non-occupational sources of exposure.

1) Aggregate Risk Summary

For 2,4-D, EPA conducted acute, short-term, and chronic aggregate risk assessments using the reduced maximum application rate for residential turf (1.5 lbs ae/A). The aggregate risk assessment compares the Drinking Water Level of Comparison (DWLOC) for each scenario with the appropriate Estimated Drinking Water Concentration (EDWC) for the pesticide. The DWLOC is the maximum concentration in drinking water which, when considered together with food, and, if appropriate, residential exposure, does not exceed EPA's level of concern. Generally, EDWCs that are less than the corresponding DWLOC are not of concern to the Agency.

It is important to note that the MCL for 2,4-D, established by EPA's Office of Water under the Safe Drinking Water Act (SDWA), is 70 ug/L. To minimize the possibility that direct aquatic applications will result in drinking water concentrations in excess of the MCL, the Agency has worked with the 2,4-D Task Force and water quality specialists to develop appropriate label requirements for 2,4-D products registered for use to control aquatic weeds.

2) Acute Aggregate Risk

<u>DWLOC Approach</u>

Acute DWLOCs were calculated based upon acute dietary exposures. Acute residential exposures from swimming in treated water bodies or playing on treated turf were not included because exposures are unlikely to co-occur with acute dietary exposures. The acute DWLOCs are range from 432 to 1932 with the most sensitive population being females 13 to 49 years old. The EDWCs of 118 ug/liter for surface water and 15 ug/liter for groundwater are substantially less than the DWLOCs which means that the risks are not of concern.

<u>Forward Calculation Approach</u>

Acute aggregate risks were assessed by directly combining acute food exposures and estimates of acute water exposures. The acute aggregate risks and are not of concern because they are less than 100 percent of the aPAD. The highest risks (58 percent of the aPAD) are for females 13-49 years old because these risks are based upon the lower NOAEL of 25 mg/kg/day from a developmental study in rats. Whereas, estimates of other population groups are based on a NOAEL of 67 mg/kg/day from an acute neurotoxicity study in rats.

3) Short-term Aggregate Risk

DWLOC Approach

Short-term aggregate risks assessments were conducted by calculating DWLOCs based upon short-term turf exposures, chronic food exposures and short-term endpoints. Short-term exposures from swimming in treated water bodies were not included because these exposures represent high-end unlikely scenarios. The short-term DWLOCs were calculated only for females 13-49 and children 1-6 because these population subgroups have the highest exposure and estimates calculated for these groups are protective of the other subgroups. The DWLOCs range from 24 to 36 ug/liter. The EDWCs range from 15 to 23 ug/liter. Since the DWLOCs are all greater than the EDWCs, the short term risks are not of concern.

Forward Calculation Approach

Short-term aggregate risks were assessed by aggregating short-term turf exposures, chronic food exposures and chronic water exposures. Short-term aggregate risk were calculated only for females 13-49 and children 1-6 because these population subgroups have the highest exposure and estimates calculated for these groups are protective of the other subgroups. The short-term aggregate MOEs indicate that the short term risks are not of concern because the MOEs equal or exceed the target MOE of 1000.

4) Chronic (Non-Cancer) Aggregate Risk

DWLOC Approach

Chronic DWLOCs were calculated based upon chronic dietary exposures. As there are no chronic residential exposures, residential exposures were not included in the chronic DWLOC calculations. The chronic DWLOCs are 46 ug/L or greater with the most sensitive populations being infants and children. The EDWCs, which range from 1.5 to 23 ug/L, are less than the DWLOCs which means that the risks are not of concern. It should be noted that the master label indicates that potable water consumption from a treated water body cannot begin until the 2,4-D concentration is 70 ug/L or below, therefore an annual average exposure at the MCL of 70 ug/L would not occur because dissipation would reduce the initial concentration of 70 ug/L to an annual average concentration of 11 ug/L.

Forward Calculation Approach

Chronic aggregate risks were assessed by aggregating chronic food exposures and chronic water exposures. The chronic aggregate risks are not of concern because they are less than 100 percent of the cPAD. The highest risks (38 percent of the cPAD) are for children 1-2 years old.

5) Aggregate Risk Mitigation

Given the reduced maximum application rate to residential lawns (1.5 lbs ae/A), the highest aggregate risks are the risks from short-term exposures, which include the turf exposure scenarios. For the most sensitive subpopulation (females 13-49) these risks meet the target MOE of 1000 and the turf exposure is the risk driver as it contributes 96 percent of the risk.

Whereas calculated risks just meet the Agency's target MOE, it is important to note that the turf exposure estimate is based upon modeling and is greater than exposure measurements obtained from biomonitoring. As described in the human health assessment, the results of a biomonitoring study were used to calculated MOEs by assuming that all of the urinary 2,4-D measured in the 96 hours after the exposure period was the result of the turf exposure. This assumption is protective because 2,4-D exposures due to inhalation and due to food and water ingestion would be counted as dermal exposure. The biomonitoring results were adjusted by a factor of two to account for the SOP assumption of two hours of daily exposure vs one hour of exposure during the study, and a factor of 1.7 to account for an application rate of 1.5 lbs ae/acre vs 0.88 lb ae/acre applied during the study. At one day post-treatment, the MOEs for the volunteers who wore shorts and no shoes ranged from 1400 to 35000 with the lowest MOE corresponding to the volunteer who removed his shirt during the exposure period. The MOEs for the remaining volunteers ranged from 24000 to 37000. If the calculated MOE of 1000 based on modeling is considered in conjunction with the MOE calculated based on biomonitoring results, it is clear that the modeled short-term risks are upper bound estimates. The Agency has concluded that aggregate risks from acute, short-term and chronic exposures are not of concern. No further mitigation beyond reducing the maximum application rate from 2.0 to 1.5 lbs/ae per acre is needed.

c. Occupational Risk Mitigation

1) Handler Risk Mitigation

With the exception of mixing/loading wettable powder, the short-term and intermediate-term Margin of Exposure estimates (MOEs) exceed 100 with baseline attire (i.e., long-sleeved shirt, long pants, shoes plus socks) or single layer attire (i.e., long-sleeved shirt, long pants, shoes plus socks, gloves) and are not of concern. The MOEs for handling wettable powder are acceptable with engineering controls (i.e. water soluble bags). Water soluble bags will be required for wettable powder formulations.

2) Post-application Risk Mitigation

All short- and intermediate-term MOEs are above 100 on day zero. All occupational postapplication risk scenarios are below EPA's level of concern. Products containing 2,4-D salt and ester forms as active ingredient with Worker Protection Standard (WPS) uses will require a re-entry interval (REI) of 12 hours. Because of acute eye irritation concerns, products containing 2,4-D acid and amine forms with WPS uses will require a REI of 48 hours and protective eyewear. The requirements for individual products will be finalized based on product-specific chemistry and acute toxicity review. The exposure reduction program implemented in 1992 will be replaced with the personal protective equipment described in section V.D. of this document.

2. Environmental Risk Mitigation

The Agency has considered available information on 2,4-D's toxicity, use areas, usage, fate properties, application methods, and formulations in calculating ecological risks. The resulting assessment suggests that the use of 2,4-D for aquatic weed control presents risk to aquatic organisms, while 2,4-D use on terrestrial sites presents greater potential risks to small mammals, birds, and non-target terrestrial plants, than to other plants and animals.

a. Birds

Acute Risk

Whereas the assessment of risk to birds from the terrestrial use of 2,4-D suggests risks of concern, the assessed exposures to 2,4-D are likely conservative in the following ways. Currently, Agency 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.

For non-granular spray application, the highest acute avian RQ (3.5) was from the cranberry use-site scenario, for birds feeding on short grass. That assessment was based on a maximum application rate of 4 lbs ae/acre; however, the average application rate is 1.83 lbs ae/acre (see the Agency's quantitative use assessment). If the modeled application rate was reduced to 1.83 lbs ae/acre for cranberries, and an assumption made that the resulting EEC will be reduced linearly, the RQ would be 1.6.

To determine the hazard associated with 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. The Agency 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.

Chronic Risk

Potential chronic risks to birds is limited to the following use sites: non-cropland, forest, asparagus, and cranberry. The RQs for these sites range from one to slightly above one. Further characterization of these use sites by evaluating average application rates versus maximum application rates lower these RQs to below the LOCs.

Given the conservative assumptions in both exposure scenarios and hazard determinations, the Agency finds that the acute and chronic risks to birds from 2,4-D exposure are not of concern.

b. Mammals

Acute risk

All of the calculated RQs for mammalian acute risk for the non-granular use of 2,4-D were based on maximum labeled application rates. The EPA's quantitative use assessment (EPA QUA) 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 2 lbs ae/A applied two times a year; however, the average application rate was only 1.10 lbs ae/A (EPA QUA). If the modeled application rate was reduced to the reported average application rate of 1.10 lbs ae/A for asparagus, the RQ would be 1.08 which is still above the acute LOC of 0.5. However, asparagus is representative of a minor 2,4-D use, and risk to mammals from use of 2,4-D on asparagus would be minimal, given that fact.

To add context to the acute mammalian assessment, the effect of assuming an average application rate was determined. 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/A. However, the average application rate was only 0.62 lbs ae/A (BEAD QUA). If the modeled application rate was reduced to 0.62 lbs ae/A for pasture/rangeland, the resulting RQ is 0.31 which is below the acute LOC, but above the restricted use LOC of 0.2. Similar trends are noted for other major use sites.

Although the calculated RQ values still exceed the Agency's level of concern when average applications rates are considered, the Agency has concluded that the benefits from 2,4-D use (including control of invasive and noxious weed species), taken together with the low toxicity of 2,4-D to humans, outweigh the concerns of toxicity to small mammals. No additional mitigation steps will be taken.

Chronic risk

Calculated chronic risks to mammals were greatest for small herbivores/insectivores. For 15 g mammalian herbivores/insectivores, chronic RQs based on maximum residues and mean residues ranged from <1 to 200 and <1 to 70, respectively. For major use sites, including rangeland/pasture, RQs were approximately 100. These chronic risk estimates are likely conservative as described below.

The chronic RQs calculated for mammalian herbivores/insectivores are based on conservative estimates of exposure that are not likely to occur in nature. In the example of pasture/rangeland, the chronic RQ of approximately 100 for maximum residues (35 for mean residues) was calculated based on an application rate of 2 lbs ae/A applied twice per year, at a 30 day interval. However, the EPA has determined that the average application rate on pasture/rangeland is only 0.62 lbs ae/A (EPA QUA). Moreover, information from several of the Agency's state contacts indicate that a once per year application of less than 1 lb ae/A is typical (personal communications). As the typical rate is approximately 25% of the assessed rate, use of the typical rate would be expected to decrease the RQ for the pasture/rangeland scenario approximately four-fold, to approximately 25 for maximum residues and 9 for mean residues.

A second example of the conservative assumptions included in the assessment of exposure to mammalian herbivores/insectivores is the assumption that 100% of the long term 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. The risk assessment assumed that 100% of the small mammals' diet consists of short grasses. Several published reports suggest that actual diets of small mammals are more varied, and would likely include invertebrates, worms, fungi, and seeds, in addition to plant matter.

Given the conservative assumptions in the exposure scenarios, the Agency finds that the risks identified in the risk assessment are likely to overestimate actual risks to mammals from 2,4-D applications. Based on information about average application rates and dietary patterns as described above, the Agency has concluded that actual 2,4-D exposures to mammals are likely to be significantly lower than those assessed but may still be above the chronic LOC for this screening level assessment. However, the Agency has concluded that the benefits from 2,4-D use (including control of invasive and noxious weed species), taken together with the low toxicity of 2,4-D to humans, outweigh the concerns of toxicity to small mammals. No additional mitigation is being required at this time.

c. Aquatic Organisms

Whereas the assessment of risk to aquatic organisms suggests risks of concern, the assessed exposures to 2,4-D are likely conservative as follows. Whereas the maximum labeled target concentration for control of aquatic weeds is 4 ppm, the typical target concentration is 2 ppm. A rate of 4 ppm is reserved for spot-treating new aquatic weed stands and hybrid weed species that tend to be less susceptible to 2,4-D. Per the product label, re-application of 2,4-D can occur after 21 days.

In the current assessment, the risks to aquatic organisms were estimated based on a 2,4-D application that resulted in a whole-reservoir concentration of 4 ppm. Treating 100% of the water body would likely result in a large amount of decaying plant life, thereby creating an oxygen-depleted environment that would most likely result in fish kills. To avoid that scenario, the current 2,4-D label advises that the applicator avoid treating more than 50% of a water body in a 21-day period. In actual practice, aquatic weeds that 2,4-D controls tend to grow near the shore of lakes, ponds, and reservoirs. As a result, generally a maximum of 20-30% of a water body is treated in a single application. Applying the typical rate of 2 ppm, and taking into account a typical maximum treated area of 30%, would decrease calculated RQs by approximately 6-fold.

While noting the potential risks to aquatic organisms from the direct application of 2,4-D for the control of aquatic weeds identified above, it is important to note the benefits gained through the direct application of 2,4-D to aquatic bodies, for the control of invasive species. The U.S Army Corps of Engineers (USACE) and state agencies have identified 2,4-D as an important tool for protecting water bodies from the invasion and establishment of some species of exotic nuisance vegetation. 2,4-D has a reputation as a selective and economical means to remove invasive plants, enhance the growth and recovery of desirable native vegetation, restore water quality, reduce sedimentation rates in reservoirs, and improve fish and wildlife habitat. 2,4-D products are used to control invasive weeds, such as Eurasian water milfoil (*Myriophyllum spicatum*) in the northern tier states and water hyacinth (*Eichhornia crassipes*) in the Gulf Coast states. Effective control of these plants can benefit public health with respect to reducing levels of mosquito habitat. In addition, according to USACE, no other product (or alternative technique) can control these plants in a more cost-effective manner (K. Getsinger, USACE, Public Comment; Docket ID# OPP-2004-0167-0053).

Given the typical application rates and treatment areas, and considering the beneficial aspects of using 2,4-D to control invasive plant species, the Agency concludes that the benefits from direct aquatic use of 2,4-D outweigh the risk concerns for aquatic organisms. No additional mitigation measures will be required at this time to address risk to aquatic organisms.

d. Non-target Insects

Risk to non-target insects do not exceed the Agency's level of concern. Available data from a honey bee acute toxicity study indicated that technical 2,4-D is practically non-toxic to the honey bee. The potential for 2,4-D and its salts and esters to pose risk to pollinators and other beneficial insects is expected to be minimal.

e. Non-target Terrestrial Plants

Estimated RQs exceeded acute LOCs for both non-endangered and endangered terrestrial plants for non-granular and granular uses at many use sites. Consideration of average application rates did not result in exposure below LOCs. However, the exposure estimates used to develop the RQs were likely conservative, as follows.

In the exposure calculation for non-target aquatic plants and terrestrial plants in intermittently flooded areas, the major contributor is run-off from the application site. The run-off and leaching vulnerability schemes used in this assessment incorporate several conservative assumptions which are fully discussed in the ecological risk assessment. Also, it is likely that farm management practices would be in place to limit run-off, as run-off events are detrimental to the farm as a whole for reasons other than pesticide damage.

Whereas the risk assessments are likely conservative as described above, the Agency is concerned about the risk to non-target terrestrial plants from drift of 2,4-D during application. To address that concern, the Agency is implementing spray drift controls that will decrease the risk that 2,4-D will drift onto non-target plants.

f. Summary of Environmental Risk Mitigation

Characterization of the risks identified in the Agency's screening level risk assessment suggests that risks from drift onto non-target plants exceeds the Agency's level of concern. The Agency is implementing spray drift controls that will decrease the risk that 2,4-D will drift onto non-target plants.

F. Other Labeling Requirements

In order to be eligible for reregistration, various use and safety information will be included in the labeling of all end-use products containing 2,4-D. For the specific labeling statements and a list of outstanding data, refer to Section V of this RED document.

1. Endangered Species Considerations

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 that may affect any particular species, EPA uses basic toxicity and exposure data and considers ecological parameters, pesticide use information, geographic relationship between specific pesticide uses and species locations, and biological requirements and behavioral aspects of the particular species. Based on EPA's screening level assessment for 2,4-D, RQs exceed levels of concern for mammals, birds, aquatic plants, and terrestrial plants. However, these findings are based solely on EPA's screening level assessment and do not constitute "may affect" findings under the ESA. The Agency is requiring additional data to further characterize and refine its ecological and endangered species risk assessments. The 2,4-D Task Force has submitted a limited endangered species assessment on several crops for the Agency's consideration. This assessment was generated using the FIFRA Endangered Species Task Force (FESTF) integrated management system (IMS).

2. Spray Drift Management

The Agency has been working closely with stakeholders to develop improved approaches for mitigating risks to human health and the environment from pesticide spray and dust drift. As part of the reregistration process, we will continue to work with all interested parties on this important issue.

From its assessment of 2,4-D, as summarized in this document, the Agency concludes that certain drift mitigation measures are needed to address the risks from off-target drift for 2,4-D. Label statements implementing these measures are listed in the "spray drift management" section of the Labeling Changes Summary Table in section V.D. of this RED document. In the future, 2,4-D product labels may need to be revised to include additional or different drift label statements.

3. Consumer Labeling Initiative

The Consumer Labeling Initiative (CLI) is an effort among federal, state, and local government agencies, industry, environmental groups, and other interested parties working to improve product labels on residential pesticides in order to improve consumer understanding and compliance of consumer labels. The CLI Work Group of the Pesticide Program Dialogue Committee (PPDC) is working to revise consumer labels. In addition to the labeling changes presented in this RED, the Agency will leave open the possibility that changes to residential product labeling may occur as the result of the PPDC CLI.

V. What Registrants Need To Do

<u>For 2,4-D technical grade active ingredient products,</u> registrants need to submit the following items.

Within 90 days from receipt of the generic data call-in (DCI):

(1) completed response forms to the generic DCI (i.e., DCI response form and requirements status and registrant's response form); and

(2) submit any time extension and/or waiver requests with a full written justification.

Within the time limit specified in the generic DCI:

(1) cite any existing generic data which address data requirements or submit new generic data responding to the DCI.

Please contact Katie Hall at (703) 308-0166 with questions regarding generic reregistration and/or the DCI. All materials submitted in response to the generic DCI should be addressed:

<u>By US mail:</u>
Document Processing Desk (DCI/SRRD)
Katie Hall
US EPA (7508C)
1200 Pennsylvania Ave., NW
Washington, DC 20460

<u>By express or courier service:</u>
Document Processing Desk (DCI/SRRD)
Katie Hall
Office of Pesticide Programs (7508C)
Room 604, Crystal Mall 2
1801 S. Bell Street
Arlington, VA 22202 -4501

<u>For products containing the active ingredient 2,4-D</u> registrants need to submit the following items for each product.

Within 90 days from the receipt of the product-specific data call-in (PDCI):

(1) completed response forms to the PDCI (i.e., PDCI response form and requirements status and registrant's response form); and

(2) submit any time extension or waiver requests with a full written justification.

Within eight months from the receipt of the PDCI:

(1) two copies of the confidential statement of formula (EPA Form 8570-4);

(2) a completed original application for reregistration (EPA Form 8570-1). Indicate on the form that it is an "application for reregistration";

(3) five copies of the draft label incorporating all label amendments outlined in Table 40 of this document;

(4) a completed form certifying compliance with data compensation requirements (EPA Form 8570-34);

(5) if applicable, a completed form certifying compliance with cost share offer requirements (EPA Form 8570-32); and

(6) the product-specific data responding to the PDCI.

Please contact Moana Appleyard at (703) 308-8175 with questions regarding product reregistration and/or the PDCI. All materials submitted in response to the PDCI should be addressed:

By US mail:
Document Processing Desk (PDCI/PRB)
Moana Appleyard
US EPA (7508C)
1200 Pennsylvania Ave., NW
Washington, DC 20460

By express or courier service only:
Document Processing Desk (PDCI/PRB)
Moana Appleyard
Office of Pesticide Programs (7508C)
Room 266A, Crystal Mall 2
1801 Bell Street
Arlington, VA 22202

A. Manufacturing Use Products

1. Additional Generic Data Requirements

The generic data base supporting the reregistration of 2,4-D for eligible uses has been reviewed and determined to be substantially complete. However the following data requirements are necessary to confirm the reregistration eligibility decision documented in this RED.

Table 40. Data Requirements for the Reregistration Eligibility Decision for 2,4-D

Guideline Study Name	New OPPTS Guideline No.	Old Guideline No.
Environmental Fate and Effects Data Requirements		
Aquatic field dissipation studies (Behavior of 2,4-D BEE under acidic to neutral aquatic conditions in a water/sediment system)	835.6200	164-2
Laboratory volatility study (2,4-D IPE)	835.1410	163-2
Terrestrial field dissipation studies (2,4-D IPA, 2,4-D TIPA, 2,4-D DEA, 2,4-D BEE)	835.6100	164-1

Guideline Study Name	New OPPTS Guideline No.	Old Guideline No.
Aquatic field dissipation studies in a rice use scenario (2,4-D IPA, 2,4-D TIPA, 2-4-D DEA)	835.6200	164-2
Aquatic field dissipation studies in an aquatic weed control scenario (2,4-D IPA, 2,4-D TIPA, 2-4-D DEA)	835.6200	164-2
Forest field dissipation studies (2,4-D IPA, 2,4-D TIPA, 2,4-D BEE, and 2,4-D DEA)	835.6300	164-3
Fish acute toxicity test, freshwater and marine with typical end-use product (TEP) (2,4-D BEE)	850.1075	72-1
Oyster acute toxicity test with TEP (2,4-D BEE)	850.1025	72-3
Mysid acute toxicity test with TEP (2,4-D BEE)	850.1035	72-3
Penaid acute toxicity test with TEP (2,4-D BEE)	850.1045	72-3
Sediment and soil adsorption/desorption (2,4-D BEE granular formulation)	835.1230	163-1
Seedling Germination/Seedling Emergence Vegetative Vigor Non-target terrestrial plants - TEP representative testing from the acid and amine salts group, and representative testing from the ester group. The test products should include the most common and most active surfactants and adjuvants which affect the toxicity of the product. The registrants should consult with the Agency before finalizing which products to test.	850.4225 850.4250	123-1(a) 123-1(b)
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. Registrants should consult with the Agency prior to fulfilling this data requirement.	-	-
Human Health Effects Data Requirements		
Developmental neurotoxicity study	870.6300	83-6
Subchronic inhalation toxicity study (28-day)	870.3465	82-4
Repeat two-generation reproduction study (using the most recent Agency protocol) addressing concerns for endocrine disruption (thyroid and immunotoxicity measures)	870.3800	83-4
Product and Residue Chemistry Data Requirements		
Crop field trials - wheat hay	860.1500	171-4k

Guideline Study Name	New OPPTS Guideline No.	Old Guideline No.
Water, fish, and irrigated crops - irrigated crop studies in strawberries and sugar beet roots and tops	860.1400	171-4f
Residue analytical method - revised enforcement method for determination of 2,4-D in livestock commodities	860.1340	171-4c
Directions for Use	860.1200	171-3
Other Data Requirements		
UV/Visible Absorption	830.7050	None
Droplet Size Spectrum	840.1100	201-1
Drift Field Evaluation	840.1200	202-1
The Agency is requiring that five recent batches of all technical products be analyzed for 2,3,7,8-TCDD, 2,3,7,8-TCDF and their respective higher substituted chlorinated congeners using validated analytical methods. The Agency specifies that the manufacturers use the most current state-of-the art laboratory methods for measuring 2,3,7,8-TCDD and TCDF at levels less than 1 part per trillion (EPA Method 1613, Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS). Because 1,2,3,7,8-PeCDD is equi-potent to 2,3,7,8-TCDD in the TEF scheme, the Agency is adding this compound to our testing requirements.	-	-

B. End-Use Products

1. Additional Product-Specific Data Requirements

Section 4(g)(2)(B) of FIFRA calls for the Agency to obtain any needed product-specific data regarding the pesticide after a determination of eligibility has been made. Registrants must review previous data submissions to ensure that they meet current EPA acceptance criteria and if not, commit to conduct new studies. If a registrant believes that previously submitted data meet current testing standards, then the study MRID numbers should be cited according to the instructions in the Requirement Status and Registrants Response Form provided for each product.

2. Labeling for End-Use Products

Labeling changes are necessary to implement the mitigation measures outlined in Section IV above. Specific language to incorporate these changes is specified in Table 40.

C. Existing Stocks

Registrants may generally distribute and sell products bearing old labels/labeling for 12 months from the date of the issuance of this Reregistration Eligibility Decision document. Persons other than the registrant may generally distribute or sell such products for 24 months from the date of the issuance of this RED. However, existing stocks time frames will be established case-by-case, depending on the number of products involved, the number of label changes, and other factors. Refer to "Existing Stocks of Pesticide Products; Statement of Policy"; *Federal Register*, Volume 56, No. 123, June 26, 1991.

D. Required Labeling Changes Summary Table

In order to be eligible for reregistration, all product labels must be amended to incorporate the risk mitigation measures outlined in Section IV. The following table describes how language on the labels should be amended.

Table 41: Summary of Labeling Changes for 2,4-D		
Description	Amended Labeling Language	Placement on Label
For all Manufacturing Use Products	"Only for formulation into an *herbicide or plant growth regulator* for the following use(s) [fill blank only with those uses that are being supported by MP registrant]." "Wettable powder formulations must be packaged in water-soluble packages."	Directions for Use
One of these statements may be added to a label to allow reformulation of the product for a specific use or all additional uses supported by a formulator or user group	"This product may be used to formulate products for specific use(s) not listed on the MP label if the formulator, user group, or grower has complied with U.S. EPA submission requirements regarding support of such use(s)." "This product may be used to formulate products for any additional use(s) not listed on the MP label if the formulator, user group, or grower has complied with U.S. EPA submission requirements regarding support of such use(s)."	Directions for Use
Environmental Hazards Statements Required by the RED and Agency Label Policies	"This chemical is toxic to fish and aquatic invertebrates. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollution Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA."	Precautionary Statements
End Use Products Intended for Occupational Use		

PPE Requirements Established by the RED[1] for liquids, wettable powders formulated in water-soluble packages, and water-dispersible granules	"Personal Protective Equipment (PPE) "Some materials that are chemical-resistant to this product are" (*registrant inserts correct chemical-resistant material*). "If you want more options, follow the instructions for category" *[registrant inserts A,B,C,D,E,F,G,or H*] "on an EPA chemical-resistance category selection chart." "All mixers, loaders, applicators, flaggers, and other handlers must wear: - long-sleeved shirt and long pants, - shoes and socks, plus - chemical resistant gloves, when applying postharvest dips or sprays to citrus, applying with any handheld nozzle or equipment, mixing or loading, cleaning up spills or equipment, or otherwise exposed to the concentrate. - chemical resistant apron when applying postharvest dips or sprays to citrus, mixing or loading, cleaning up spills or equipment, or otherwise exposed to the concentrate. See engineering controls for additional requirements."	Immediately following/below Precautionary Statements: Hazards to Humans and Domestic Animals
PPE Requirements Established by the RED[1] for granular formulations	"Personal Protective Equipment (PPE) All loaders, applicators, and other handlers must wear: - long-sleeved shirt and long pants, - shoes plus socks."	Immediately following/below Precautionary Statements: Hazards to Humans and Domestic Animals
User Safety Requirements	"Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry."	Precautionary Statements: Hazards to Humans and Domestic Animals immediately following the PPE requirements

Engineering Controls for aerial applications	Enclosed Cockpits "Engineering Controls: Pilots must use an enclosed cockpit that meets the requirements listed in the WPS for agricultural pesticides [40 CFR 170.240(d)(6)]"	Precautionary Statements: Hazards to Humans and Domestic Animals (Immediately following PPE and User Safety Requirements.)
Engineering Controls for wettable powder formulations packaged in water-soluble packages	"Engineering Controls" "Water-soluble packets when used correctly qualify as a closed loading system under the WPS. Mixers and loaders using water-soluble packets (1) must wear the PPE specified above for mixers and loaders and (2) must be provided, have immediately available for use in an emergency, such as a broken package, spill, or equipment breakdown a NIOSH-approved dust mist filtering respirator with MSHA/NIOSH approval number prefix TC-21C *or* a NIOSH-approved respirator with any N [2], R, P, or HE filter."	Precautionary Statements: Hazards to Humans and Domestic Animals (Immediately following PPE and User Safety Requirements.)
User Safety Recommendations	"User Safety Recommendations Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet. Users should remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. If pesticide gets on skin, wash immediately with soap and water. Users should remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing."	Precautionary Statements under: Hazards to Humans and Domestic Animals immediately following Engineering Controls (Must be placed in a box.)

Environmental Hazard Statement for Terrestrial Uses	"This pesticide may be toxic to fish and aquatic invertebrates. Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark except as noted on appropriate labels. Drift and runoff may be hazardous to aquatic organisms in water adjacent to treated areas. Do not contaminate water when disposing of equipment wash waters or rinsate. This chemical has properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination. Application around a cistern or well may result in contamination of drinking water or groundwater."	Precautionary Statements immediately following the User Safety Recommendations
Environmental Hazard Statement for products used for aquatic weed control	"Fish breathe dissolved oxygen in the water and decaying weeds also use oxygen. When treating continuous, dense weed masses, it may be appropriate to treat only part of the infestation at a time. For example, apply the product in lanes separated by untreated strips that can be treated after vegetation in treated lanes has disintegrated. During the growing season, weeds decompose in a 2 to 3 week period following treatment. Begin treatment along the shore and proceed outwards in bands to allow fish to move into untreated areas. Waters having limited and less dense weed infestations may not require partial treatments."	Precautionary Statements immediately following the User Safety Recommendations
Restricted-Entry Interval for products containing with directions for use within the scope of the WPS and containing 2,4-D acid or amine forms	"Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 48 hours."	Directions for Use, Under Agricultural Use Requirements Box
Restricted-Entry Interval for products containing with directions for use within the scope of the WPS and containing 2,4-D salt or ester forms	"Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 12 hours."	Directions for Use, Under Agricultural Use Requirements Box

Early Entry Personal Protective Equipment established by the RED for products containing 2,4-D acid or amine forms and with WPS uses	"PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water is: - coveralls, - chemical-resistant gloves made of any water-proof material, - shoes plus socks, - protective eyewear."	Directions for Use, Agricultural Use Requirements Box
Early Entry Personal Protective Equipment established by the RED for products containing 2,4-D salt or ester forms and with WPS uses	"PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water is: - coveralls, - chemical-resistant gloves made of any water-proof material, - shoes plus socks."	Directions for Use, Agricultural Use Requirements Box
Entry Restrictions for Granular Formulations with directions for use outside the scope of the WPS	"Do not enter or allow people (or pets) to enter the treated area until dusts have settled."	If no WPS uses on the product, place the appropriate statement in the Directions for Use Under General Precautions and Restrictions. If the product also contains WPS uses, then create a NonAgricultural Use Requirements box as directed in PR Notice 93-7 and place the appropriate statement inside that box.

Entry Restrictions for liquids, water-dispersible granules, and wettable powders formulated in water-soluble packages with directions for use outside the scope of the WPS	"Do not enter or allow people (or pets) to enter the treated area until sprays have dried."	If no WPS uses on the product, place the appropriate statement in the Directions for Use Under General Precautions and Restrictions. If the product also contains WPS uses, then create a NonAgricultural Use Requirements box as directed in PR Notice 93-7 and place the appropriate statement inside that box.
General Application Restrictions for products primarily intended for occupational (professional) use	"Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application."	Directions for Use under General Precautions and Restrictions

Use-Specific Application Restrictions (Note: The maximum allowable application rate must be listed as pounds or gallons of formulated product per surface acre, not just as pounds acid equivalent per surface acre.)	**“Aquatic weed control”** For all acids, salts, amines, and butoxyethanol ester forms used for aquatic weed control, the following statements must appear on the product label: **> “Ditchbank application** Postemergence: Limited to 2 applications per season. Maximum of 2.0 lbs ae/acre per application. Minimum of 30 days between applications. Spot treatment permitted. Do not use on small canals with a flow rate less than 10 cubic feet per second (CFS) where water will be used for drinking purposes. CFS may be estimated by using the formula below. The approximate velocity needed for the calculation can be determined by observing the length of time that it takes a floating object to travel a defined distance. Divide the distance (ft.) by the time (sec.) to estimate velocity (ft. per sec.). Repeat 3 times and use the average to calculate CFS. Average Width (ft.) x Average Depth (ft.) x Average Velocity (ft. per sec.) = CFS For ditchbank weeds: Do not allow boom spray to be directed onto water surface. Do not spray across stream to opposite bank.	Directions for Use Associated with the Specific Use Pattern

Use-Specific Application Restrictions (Note: The maximum allowable application rate must be listed as pounds or gallons of formulated product per surface acre, not just as pounds acid equivalent per surface acre.)	For shoreline weeds: Allow no more than 2 foot overspray onto water." **> "Floating and Emergent Weeds** Maximum of 4.0 lbs ae/surface acre per application. Limited to 2 applications per season. Minimum of 21 days between applications. Spot treatments are permitted. Apply to emergent aquatic weeds in ponds, lakes, reservoirs, marshes, bayous, drainage ditches, non-irrigation canals, rivers, and streams that are quiescent or slow moving. Coordination and approval of local and state authorities may be required, either by letter of agreement or issuance of special permits for aquatic applications. **<u>Water Use</u>** **1. Water for irrigation or sprays:** **A.** If treated water is intended to be used only for crops or non-crop areas that are labled for direct treatment with 2,4-D such as pastures, turf, or cereal grains, the treated water may be used to irrigate and/or mix sprays for these sites at anytime after the 2,4-D aquatic application.	Directions for Use Associated with the Specific Use Pattern

Use-Specific Application Restrictions	**B.** Due to potential phytotoxicity considerations, the following restrictions are applicable: If treated water is intended to be used to irrigate or mix sprays for plants grown in commercial nurseries and greenhouses; and other plants or crops that are not labeled for direct treatment with 2,4-D, the water must not be used unless one of the following restrictions has been observed: **i.** A setback distance from functional water intake(s) of greater than or equal to 600 ft. was used for the application, or, **ii.** A waiting period of 7 days from the time of application has elapsed, or, **iii.** An approved assay indicates that the 2,4-D concentration is 100 ppb (0.1 ppm) or less at the water intake. Wait at least 3 days after application before initial sampling at water intake. **2. Drinking water (potable water):** **A.** Consult with appropriate state or local water authorities before applying this product to public waters. State or local agencies may require permits. The potable water use restrictions on this label are to ensure that consumption of water by the public is allowed only when the concentration of 2,4-D in the water is less than the MCL (Maximum Contaminant Level) of 70 ppb. Applicators should consider the unique characteristics of the treated waters to assure that 2,4-D concentrations in potable water do not exceed 70 ppb at the time of consumption.	Directions for Use Associated with the Specific Use Pattern

Use-Specific Application Restrictions	**B.** For floating and emergent weed applications, the drinking water setback distance from functioning potable water intakes is greater than or equal to 600 ft. **C.** If no setback distance of greater than or equal to 600 ft. is used for application, applicators or the authorizing organization must provide a drinking water notification prior to a 2,4-D application to the party responsible for public water supply or to individual private water uses. Notification to the party responsible for a public water supply or to individual private water users must be done in a manner to assure that the party is aware of the water use restrictions when this product is applied to potable water. The following is an example of a notification via posting, but other methods of notification which convey the above restrictions may be used and may be required in some cases under state or local law or as a condition of a permit. **Example:** Posting notification should be located every 250 feet including the shoreline of the treated area and up to 250 feet of shoreline past the application site to include immediate public access points. Posting must include the day and time of application. Posting may be removed if analysis of a sample collected at the intake 3 or more days following application shows that the concentration in the water is less than 70 ppb (100 ppb for irrigation or sprays), or after 7 days following application, whichever occurs first.	Directions for Use Associated with the Specific Use Pattern

Use-Specific Application Restrictions	**Text of notification:** Wait 7 days before diverting functioning surface water intakes from the treated aquatic site to use as drinking water, irrigation, or sprays, unless water at functioning drinking water intakes is tested at least 3 days after application and is demonstrated by assay to contain not more than 70 ppb 2,4-D (100 ppb for irrigation or sprays). Application Date:_____ Time:______ **D.** Following each application of this product, treated water must not be used for drinking water unless one of the following restrictions has been observed: **i.** A setback distance from functional water intake(s) of greater than or equal to 600 ft. was used for the application, or, **ii.** A waiting period of at least 7 days from the time of application has elapsed, or, **iii.** An approved assay indicates that the 2,4-D concentration is 70 ppb (0.07 ppm) or less at the water intake. Sampling for drinking water analysis should occur no sooner than 3 days after 2,4-D application. Analysis of samples must be completed by a laboratory that is certified under the Safe Drinking Water Act to perform drinking water analysis using a currently approved version of analytical Method Number 515, 555, other methods for 2,4-D as may be listed in Title 40 CFR, Part 141.24, or Method Number 4015 (immunoassay of 2,4-D) from U.S. EPA Test Methods for Evaluating Solid Waste SW-846. **E.** Note: Existing potable water intakes that are no longer in use, such as those replaced by a connection to a municipal water system or a potable water well, are not considered to be functioning potable water intakes.	Directions for Use Associated with the Specific Use Pattern

Use-Specific Application Restrictions	**F.** Drinking water setback distances do not apply to terrestrial applications of 2,4-D adjacent to water bodies with potable water intakes. **3. Swimming (2,4-D butoxyethanol ester only):** **A.** Do not swim in treated water for a minimum of 24 hours after application. **B.** Users must provide notification prior to performing a 2,4-D BEE application. Notification to the party responsible for the public swimming area or to individual private users must be done in a manner to assure that the party is aware of the water use swimming restrictions when this product is applied to water. The following is an example of a notification via posting, but other methods of notification which convey the above restrictions may be used and may be required in some cases under state or local law or as a condition of a permit. **Example:** Posting notification should be located every 250 feet including the shoreline of the treated area and up to 250 feet of shoreline past the application site to include immediate public access points. **Text of Notification:** Do not swim in treated water for a minimum of 24 hours after application. Application Date: ______ Time: _____ . **4.** Except as stated above, there are no restrictions on using water from treated areas for swimming, fishing, watering livestock or domestic purposes."	Directions for Use Associated with the Specific Use Pattern

<table>
<tr>
<td rowspan="9">Use-Specific Application Restrictions

(Note: The maximum allowable application rate must be listed as pounds or gallons of formulated product per acre-foot, not just as pounds acid equivalent per acre-foot.)</td>
<td colspan="4">> “Submersed Weeds
Maximum of 10.8 lbs ae/per acre-foot per application.
Limited to 2 applications per season.
Apply to aquatic weeds in ponds, lakes, reservoirs, marshes, bayous, drainage ditches, non-irrigation canals, rivers, and streams that are quiescent or slow moving.
Do not apply within 21 days of previous application.
When treating moving bodies of water, applications must be made while traveling upstream to prevent concentration of 2,4-D downstream from the application.
Coordination and approval of local and state authorities may be required, either by letter of agreement or issuance of special permits for such use.</td>
<td rowspan="9">Directions for Use Associated with the Specific Use Pattern</td>
</tr>
<tr><td colspan="4">Table 1. Amount of 2,4-D to Apply for a Target Subsurface Concentration</td></tr>
<tr><td>Surface Area</td><td>Average Depth</td><td>For typical conditions - 2 ppm 2,4-D ae/acre-foot</td><td>For difficult conditions* - 4 ppm 2,4-D ae/acre-foot</td></tr>
<tr><td rowspan="5">1 acre</td><td>1 ft.</td><td>5.4 lbs</td><td>10.8 lbs</td></tr>
<tr><td>2 ft.</td><td>10.8 lbs</td><td>21.6 lbs</td></tr>
<tr><td>3 ft.</td><td>16.2 lbs</td><td>32.4 lbs</td></tr>
<tr><td>4 ft.</td><td>21.6 lbs</td><td>43.2 lbs</td></tr>
<tr><td>5 ft.</td><td>27.0 lbs</td><td>54.0 lbs</td></tr>
<tr><td colspan="4">* Examples include spot treatment of pioneer colonies of Eurasian Water Milfoil and certain difficult to control aquatic species.</td></tr>
</table>

Use-Specific Application Restrictions	**<u>Water Use:</u>** **1. Water for irrigation or sprays:** **A.** If treated water is intended to be used only for crops or non-crop areas that are labeled for direct treatment with 2,4-D such as pastures, turf, or cereal grains, the treated water may be used to irrigate and/or mix sprays for these sites at anytime after the 2,4-D aquatic application. **B.** Due to potential phytotoxicity and/or residue considerations, the following restrictions are applicable: If treated water is intended to be used to irrigate or mix sprays for unlabeled crops, non-crop areas or other plants not labeled for direct treatment with 2,4-D, the water must not be used unless one of the following restrictions has been observed: **i.** A setback distance described in the Drinking Water Setback Table was used for the application, or, **ii.** A waiting period of 21 days from the time of application has elapsed, or, **iii.** An approved assay indicates that the 2,4-D concentration is 100 ppb (0.1 ppm) or less at the water intake. See Table 3 for the waiting period after application but before taking the initial sampling at water intake. **2. Drinking water (potable water):** **A.** Consult with appropriate state or local water authorities before applying this product to public waters. State or local agencies may require permits.	Directions for Use Associated with the Specific Use Pattern

Use-Specific Application Restrictions	The potable water use restrictions on this label are to ensure that consumption of water by the public is allowed only when the concentration of 2,4-D in the water is less than the MCL (Maximum Contaminant Level) of 70 ppb. Applicators should consider the unique characteristics of the treated waters to assure that 2,4-D concentrations in potable water do not exceed 70 ppb at the time of consumption. **B.** For submersed weed applications, the drinking water setback distances from functioning potable water intakes are provided in Table 2. Drinking Water Setback Distance (below). **C.** If no setback distance from the Drinking Water Setback Table (Table 2) is to be used for the application, applicators or the authorizing organization must provide a drinking water notification and an advisory to shut off all potable water intakes prior to a 2,4-D application. Notification to the party responsible for a public water supply or to individual private water users must be done in a manner to assure that the party is aware of the water use restrictions when this product is applied to potable water. The following is an example of a notification via posting, but other methods of notification which convey the above restrictions may be used and may be required in some cases under state or local law or as a condition of a permit.	Directions for Use Associated with the Specific Use Pattern

Use-Specific Application Restrictions	**Example:** Posting notification should be located every 250 feet including the shoreline of the treated area and up to 250 feet of shoreline past the application site to include immediate public access points. Posting should include the day and time of application. Posting may be removed if analysis of a sample collected at the intake no sooner than stated in Table 3 (below) shows that the concentration in the water is less than 70 ppb (100 ppb for irrigation or sprays), or after 21 days following application, whichever occurs first. **Text of notification:** Wait 21 days before diverting functioning surface water intakes from the treated aquatic site to use as drinking water, irrigation, or sprays, unless water at functioning drinking water intakes is tested no sooner than (insert days from Table 3) and is demonstrated by assay to contain not more than 70 ppb 2,4-D (100 ppb for irrigation or sprays). Application Date: ______ Time: _____ . **D.** Following each application of this product, treated water must not be used for drinking water unless one of the following restrictions has been observed: **i.** A setback distance described in the Drinking Water Setback Distance Table was used for the application, or, **ii.** A waiting period of at least 21 days from the time of application has elapsed, or,	Directions for Use Associated with the Specific Use Pattern

Use-Specific Application Restrictions	**iii.** An approved assay indicates that the 2,4-D concentration is 70 ppb (0.07 ppm) or less at the water intake. Sampling for drinking water analysis should occur no sooner than stated in Table 3. Analysis of samples must be completed by a laboratory that is certified under the Safe Drinking Water Act to perform drinking water analysis using a currently approved version of analytical Method Number 515, 555, other methods for 2,4-D as may be listed in Title 40 CFR, Part 141.24, or Method Number 4015 (immunoassay of 2,4-D) from U.S. EPA Test Methods for Evaluating Solid Waste SW-846. **E.** Note: Existing potable water intakes that are no longer in use, such as those replaced by a connection to a municipal water system or a potable water well, are not considered to be functioning potable water intakes. **F.** Drinking water setback distances do not apply to terrestrial applications of 2,4-D adjacent to water bodies with potable water intakes.	Directions for Use Associated with the Specific Use Pattern

Use-Specific Application Restrictions	**3. Swimming (2,4-D butoxyethanol ester only):** **A.** Do not swim in treated water for a minimum of 24 hours after application. **B.** Users must provide the following notification prior to performing a 2,4-D BEE application. Notification to the party responsible for the public swimming area or to individual private users must be done in a manner to assure that the party is aware of the water use swimming restrictions when this product is applied to water. The following is an example of a notification via posting, but other methods of notification which convey the above restrictions may be used and may be required in some cases under state or local law or as a condition of a permit. Example: Posting notification should be located every 250 feet including the shoreline of the treated area and up to 250 feet of shoreline past the application site to include immediate public access points. **Text of Notification:** Do not swim in treated water for a minimum of 24 hours after application. Application Date: ______ Time: _____ . **4.** Except as stated above, there are no restrictions on using water from treated areas for swimming, fishing, watering livestock or domestic purposes."	Directions for Use Associated with the Specific Use Pattern
Use-Specific Application Restrictions	**Table 2. Drinking Water Setback Distance for Submersed Weed Applications** Application Rate and Minimum Setback Distance (feet) From Functioning Potable Water Intake	Directions for Use Associated with the Specific Use Pattern

	1 ppm*	2 ppm*	3 ppm*	4 ppm*	
	600	1200	1800	2400	
	* ppm acid equivalent target water concentration				
	Table 3. Sampling for Drinking Water Analysis After 2,4-D Application for Submersed Weed Applications				
	Minimum Days After Application Before Initial Water Sampling at the Functioning Potable Water Intake				
	1 ppm*	2 ppm*	3 ppm*	4 ppm*	
	5	10	10	14	
	* ppm acid equivalent target water concentration”				

Use-Specific Application Restrictions (Note: The maximum allowable application rate must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.	**“Asparagus**” Permitted forms of 2,4-D include acid, salts, and amines. “The preharvest interval (PHI) is 3 days. Limited to 2 applications per crop cycle. Maximum of 2.0 lb ae/acre per application Minimum of 30 days between applications.” **“Blueberry, low bush”** Permitted forms of 2,4-D include acid, salts, and amines. “Postemergence: Limited to one postemergence application per year. Maximum of 0.0375 lbs ae/gallons of spray solution per application. Postharvest: Limited to one postharvest application per year. Maximum of 1.0 lbs ae/gallon spray solution per application. For spot or directed wipe treatment only. Apply only in non-bearing years.”	Directions for Use Associated with the Specific Use Pattern

Use-Specific Application Restrictions (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	"**Blueberry, high bush"** Permitted forms of 2,4-D include acid, salts, and amines. "The preharvest interval (PHI) is 30 days. Postemergence and postharvest: Limited to 2 applications per year. Maximum of 1.4 lbs ae/acre per application." **"Cereal Grains (wheat, barley, millet, oats, and rye)"** Permitted forms of 2,4-D include acid, salts, amines, and esters. "The preharvest interval (PHI) is 14 days. Postemergence: Limited to one postemergence application per crop cycle. Maximum of 1.25 lbs ae/acre per application. Preharvest: Limited to one preharvest application per crop cycle. Maximum of 0.5 lbs ae/acre per application. Limited to 1.75 lbs ae/acre per crop cycle."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**"Citrus (growing fruit)** Permitted form of 2,4-D is isopropyl ester. "The preharvest interval (PHI) is 7 days. -To increase fruit size on growing Navel oranges, Valencia oranges, and grapefruit: Limited to one application per crop cycle. Maximum of 45 grams ae per acre (0.1 lbs ae/acre). -To reduce pre-harvest fruit drop on growing Navel oranges, Valencia oranges, and grapefruit: Limited to one application per crop cycle. Maximum rate of 200 ppm per application. -To prevent pre-harvest drop of mature fruit and leaves on lemons, Navel oranges, Valencia oranges, and Tangelos: Limited to one application per crop cycle. Maximum rate of 24 ppm per application."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**Postharvest Citrus Treatment** Permitted form of 2,4-D is isopropyl ester. "Permitted application methods include dip or spray. <u>Postharvest packing house application to lemons:</u> Limited to one application per crop. Maximum rate of 500 ppm per application."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**"Corn, field and pop"** Permitted forms of 2,4-D include acid, salts, amines, and esters. "Do not use treated crop as fodder for 7 days following application. The preharvest interval (PHI) is 7 days. Maximum of 3 lbs ae/acre per crop cycle. Preplant or preemergence: Limited to one preplant or preemergence application per crop cycle. Maximum of 1.0 lb ae/acre per application. Postemergence: Limited to one postemergence application per crop cycle. Maximum of 0.5 lb ae/acre per application. Preharvest: Limited to one preharvest application per crop cycle. Maximum of 1.5 lbs ae/acre per application."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**"Corn, sweet"** Permitted forms of 2,4-D include acid, salts, amines, and esters. "Do not use treated crop as fodder for 7 days following application. The preharvest interval (PHI) is 45 days. Minimum of 21 days between applications. Maximum of 1.5 lbs ae/acre per crop cycle. Preplant or preemergence: Limited to one preplant or preemergence application per crop cycle. Maximim of 1.0 lb ae/acre per application. Postemergence: Limited to one postemergence application per crop cycle. Maximum of to 0.5 lb ae/acre per application."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	"**Cranberries**" Permitted forms of 2,4-D include acid, salts, amines, and esters. "The preharvest interval (PHI) is 30 days. <u>Dormant Season</u>: Limited to one application per crop cycle. Maximum of 4.0 lbs ae/acre per dormant season <u>Postemergence</u>: Limited to 2 applications per crop cycle. Maximum of 1.2 lbs ae/acre per postemergence application." **"Filberts"** Permitted forms of 2,4-D include acid, salts, and amines. "The preharvest interval (PHI) is 45 days. Minimum of 30 days between applications. Limited to 4 applications per year. Maximum of 1.0 lbs ae per 100 gallons of spray solution per application. "**Fallowland (crop stubble on idle land, or postharvest to crops, or between crops)**" Permitted forms of 2,4-D include acid, salts, amines, and esters. "Plant only labeled crops within 29 days following application. Limited to 2 applications per year. Maximum of 2.0 lbs ae/acre per application. Minimum of 30 days between applications."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**"Forestry (forest site preparation, forest roadsides, brush control, established conifer release, Chrismas trees, reforestation areas)"** Permitted forms of 2,4-D include acid, salts, amines, and esters. Broadcast application: Limited to 1 broadcast application per year. Maximum of 4.0 lbs ae/acre per broadcast application. Basal spray, Cut Surface - Stumps, and Frill: Limit of one basal spray or cut surface application per year. Maximum of 8.0 lbs ae per 100 gallons of spray solution. Injection: Limit to one injection application per year. Maximum of 2 ml of 4.0 lbs ae formulation per injection site." **"Grapes"** Permitted forms of 2,4-D include acid, salts, and amines. "For use only in California. The preharvest interval (PHI) is 100 days. Limited to 1 application per crop cycle. Maximum of 1.36 lbs ae/acre per application."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	"**Grasses (pastures and rangeland not in agricultural production)**" Permitted forms of 2.4-D include acid, salts, amines, and esters. "The preharvest interval (PHI) is 7 days (cut forage for hay). <u>Postemergence</u>: Limited to 2 applications per year. Maximum of 2.0 lbs ae/acre per application. Minimum of 30 days between applications. If grass is to be cut for hay, Agricultural Use Requirements for the Worker Protection Standard are applicable. For program lands, such as Conservation Reserve Program, consult program rules to determine whether grass or hay may be used. The more restrictive requirements of the program rules or this label must be followed." **"Hops"** Permitted forms of 2,4-D include acid and amines. "The preharvest interval (PHI) is 28 days. Postemergence: Limited to 3 applications per crop cycle. Maximum of 0.5 lb ae/acre per application. Maximum of 1.5 lbs ae/acre per crop cycle. Minimum of 30 days between applications."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**"Non-Cropland (fencerows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, and industrial sites)"** Permitted forms of 2,4-D include acid, salts, amines, and esters. "Postemergence (annual and perennial weeds): Limited to 2 applications per year. Maximum of 2.0 lbs ae/acre per application. Minimum of 30 days between applications. Postemergence (woody plants): Limited to 1 application per year. Maximum of 4.0 lbs ae/acre per year. Applications to non-cropland areas are not applicable to treatment of commercial timber or other plants being grown for sale or other commercial use, or for commercial seed production, or for research purposes."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**"Pasture and Rangeland (established grass pastures, rangeland, and perennial grasslands not in agricultural production)"** Permitted forms of 2,4-D include acid, salt, amines, and esters. "Do not cut forage for hay within 7 days of application. <u>Postemergence</u>: For susceptible annual and biennial broadleaf weeds: Use 1.0 lbs ae/acre per application. For moderately susceptible biennial and perennial broadleaf weeds: Use 1.0 to 2.0 lbs ae/acre per application. For difficult to control weeds and woody plants: Use 2.0 lbs ae/acre per application. Spot treatment: Use 2.0 lbs ae/acre. Maximum of two applications per year. Maximum of 4.0 lbs ae/acre per year. Minimum of 30 days between applications. If grass is to be cut for hay, Agricultural Use Requirements for the Worker Protection Standard are applicable." **"Pistachios"** Permitted forms of 2,4-D include acid, salts, and amines. "Do not cut orchard floor forage for hay within 7 days of application. The preharvest interval (PHI) is 60 days. <u>Postemergence</u>: Limited to 2 applications per year. Maximum of 2.0 lbs ae/acre per application. Minimum of 30 days between applications."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**"Pome Fruits"** Permitted forms of 2,4-D include acid, salts, and amines. "The preharvest interval (PHI) is 14 days. Do not cut orchard floor forage for hay within 7 days of application. <u>Postemergence</u>: Limited to 2 applications per crop cycle. Maximum of 2.0 lbs ae/acre per application. Minimum of 75 days between applications." **"Potatoes"** Permitted forms of 2,4-D include acid, salts, amines, and esters. "Only for use on potatoes intended for fresh market. The preharvest interval (PHI) is 45 days. <u>Postemergence</u>: Limited to 2 applications per crop cycle. Maximum of 0.07 lb ae/acre per application. Minimum of 10 days between applications."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**“Rice”** Permitted forms of 2,4-D include acid, salts, and amines. “The preharvest interval (PHI) is 60 days. Maximum of 1.5 lbs ae/acre per crop cycle.” Preplant: Limited to one preplant application per crop cycle. Maximum of 1.0 lbs ae/acre per preplant application.. Postemergence: Limited to one postemergence application per crop cycle. Maximum of 1.5 lbs ae/acre per postemergence application. “**Rice, wild”** Permitted forms of 2,4-D include acid, salts, and amines. “For use in Minnesota only. The preharvest interval (PHI) is 60 days. Postemergence: Limited to 1 application per crop cycle . Maximum of 0.25 lb ae/acre per application.”	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	“**Sorghum”** Permitted forms of 2,4-D include acid, salts, amines, and esters. “The preharvest interval (PHI) is 30 days. Do not permit meat or dairy animals to consume treated crop as fodder or forage for 30 days following application. Postemergence (acid, salts, and amines): Limited to 1 application per crop cycle. Maximum of 1.0 lb ae/acre per application. Postemergence (esters): Limited to 1 application per crop cycle. Maximum of 0.5 lb ae/acre per application.”	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**"Soybeans"** Permitted forms of 2,4-D include acid, salts, amines, and esters. "The maximum rate per crop cycle is 1.0 lb ae/acre. Preplant: Limited to 2 preplant applications per crop cycle. Maximum of 0.5 lb ae/acre per preplant application. > Esters: Apply not less than 7 days prior to planting soybeans. >Amines, acid, salts: Apply not less than 15 days prior to planting soybeans." or "Preplant: Limited to 1 application per crop cycle. Maximum of 1.0 ae/acre per preplant application. >Esters: Apply not less than 15 days prior to planting soybeans. >Amines, acid, salts: Apply not less than 30 days prior to planting soybeans." **"Stone Fruits"** Permitted forms of 2,4-D include acid, salts, and amines. "The preharvest interval (PHI) is 40 days. Do not cut orchard floor forage for hay within 7 days of application. Postemergence: Limited to 2 applications per crop cycle. Maximum of 2.0 lb ae/acre per application. Minimum of 75 days between applications."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**"Strawberry"** Permitted forms of 2,4-D include acid, salts, and amines. "Do not apply in California or Florida. <u>Dormant or after last picking</u>: Limited to 1 application per crop cycle. Maximum of 1.5 lbs ae/acre per application." **"Sugarcane"** Permitted forms of 2,4-D include acid, salts, and amines. "Do not harvest cane prior to crop maturity. Do not apply more than 4 lbs ae/acre per crop cycle. <u>Preemergence</u>: Limited to one application per crop cycle. Maximum of 2.0 lbs ae/acre per application. <u>Postemergence</u>: Limited to one application per crop cycle. Maximum of 2.0 lbs ae/acre per application.."	Directions for Use Associated with the Specific Use Pattern

Other Application Restrictions (Risk Mitigation) (Note: The maximum allowable application rate and maximum allowable rate per year must be listed as pounds or gallons of formulated product per acre, not just as pounds acid equivalent per acre.)	**"Tree Nuts"** Permitted forms of 2,4-D include acid, salts, and amines. "The preharvest interval (PHI) is 60 days. Do not cut orchard floor forage for harvest within 7 days of application. <u>Postemergence</u>: Limited to 2 applications per crop cycle Maximum of 2.0 lbs ae/acre per application. Minimum of 30 days between applications." **"Turf, ornamental (golf courses, cemetaries, parks, sports fields, turfgrass, lawns and other grass areas)"** Permitted forms of 2,4-D include acid, salts, amines, and esters. "<u>Postemergence</u>: Limited to 2 applications per year. Maximum of 1.5 lbs ae/acre per application. The maximum seasonal rate is 3.0 lbs ae/acre, excluding spot treatments." **"Turf, grown for seed or sod"** Permitted forms of 2,4-d include acid, salts, amines, and esters. "Limited to 2 applications per year. Maximum of 2.0 lbs ae/acre per application. Minimum of 21 days between applications."	Directions for Use Associated with the Specific Use Pattern

Spray Drift	"SPRAY DRIFT MANAGEMENT" "A variety of factors including weather conditions (e.g., wind direction, wind speed, temperature, relative humidity) and method of application (e.g., ground, aerial, airblast, chemigation) can influence pesticide drift. The applicator must evaluate all factors and make appropriate adjustments when applying this product." **Droplet Size** "When applying sprays that contain 2,4-D as the sole active ingredient, or when applying sprays that contain 2,4-D mixed with active ingredients that require a Coarse or coarser spray, apply only as a Coarse or coarser spray (ASAE standard 572) or a volume mean diameter of 385 microns or greater for spinning atomizer nozzles." "When applying sprays that contain 2,4-D mixed with other active ingredients that require a Medium or more fine spray, apply only as a Medium or coarser spray (ASAE standard 572) or a volume mean diameter of 300 microns or greater for spinning atomizer nozzles." **Wind Speed** "Do not apply at wind speeds greater than 15 mph. Only apply this product if the wind direction favors on-target deposition and there are not sensitive areas (including, but not limited to, residential areas, bodies of water, known habitat for nontarget species, nontarget crops) within 250 feet downwind. If applying a Medium spray, leave one swath unsprayed at the downwind edge of the treated field."	*Directions for Use*

	Temperature Inversions "If applying at wind speeds less than 3 mph, the applicator must determine if: a) conditions of temperature inversion exist, or b) stable atmospheric conditions exist at or below nozzle height. Do not make applications into areas of temperature inversions or stable atmospheric conditions." **Susceptible Plants** "Do not apply under circumstances where spray drift may occur to food, forage, or other plantings that might be damaged or crops thereof rendered unfit for sale, use or consumption. Susceptible crops include, but are not limited to, cotton, okra, flowers, grapes (in growing stage), fruit trees (foliage), soybeans (vegetative stage), ornamentals, sunflowers, tomatoes, beans, and other vegetables, or tobacco. Small amounts of spray drift that might not be visible may injure susceptible broadleaf plants." **Other State and Local Requirements** "Applicators must follow all state and local pesticide drift requirements regarding application of 2,4-D herbicides. Where states have more stringent regulations, they must be observed." **Equipment** "All aerial and ground application equipment must be properly maintained and calibrated using appropriate carriers or surrogates." *Additional requirements for aerial applications:* "The boom length must not exceed 75% of the wingspan or 90% of the rotor blade diameter."	

	"Release spray at the lowest height consistent with efficacy and flight safety. Do not release spray at a height greater than 10 feet above the crop canopy unless a greater height is required for aircraft safety. This requirement does not apply to forestry or rights-of-way applications." "When applications are made with a crosswind, the swath will be displaced downwind. The applicator must compensate for this by adjusting the path of the aircraft upwind." *Additional requirements for ground boom application:* "Do not apply with a nozzle height greater than 4 feet above the crop canopy." *Additional requirements for liquid products applied as a spray and containing an ester form of 2,4-D (e.g. 2,4-D butoxyethyl ester, 2,4-D ethylhexyl ester, 2,4-D isopropyl ester):* "2,4-D esters may volatilize during conditions of low humidity and high temperatures. Do not apply during conditions of low humidity and high temperatures."	
End Use Products Intended for Residential Use		
Application Restrictions	"Do not apply this product in a way that will contact any person or pet, either directly or through drift. Keep people and pets out of the area during application."	Directions for Use under General Precautions and Restrictions
Entry Restrictions for liquids, water-dispersible granules, and wettable powders formulated in water-soluble packages	"Do not allow people or pets to enter the treated area until sprays have dried."	Directions for use under General Precautions and Restrictions

Entry Restrictions for granular formulations	"Do not allow people or pets to enter the treated area until dusts have settled."	Directions for use under General Precautions and Restrictions
Environmental Hazard Statement for Residential Use labels	"This pesticide is toxic to fish and aquatic invertebrates. Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark except as noted on appropriate labels. Drift and runoff may be hazardous to aquatic organisms in water adjacent to treated areas. Do not contaminate water when disposing of equipment wash waters or rinsate.[2] This chemical has properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination. Application around a cistern or well may result in contamination of drinking water or groundwater."	Precautionary Statements immediately following the User Safety Recommendations

[1] PPE that is established on the basis of Acute Toxicity of the end-use product must be compared to the active ingredient PPE in this document. The more protective PPE must be placed in the product labeling. For guidance on which PPE is considered more protective, see PR Notice 93-7.

[2] May be deleted for ready-to-use products.

VI. Appendicies

Appendix A. Table of 2,4-D Use Patterns Eligible for Reregistration (Case 0073)

Appendix A. Use Patterns Subject to Reregistration for 2,4-D (Case 0073)

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Aquatic weed control - Ditchbank application	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid, Granular	2.0	Lbs ae/acre	2 per season	4.0 lbs ae/acre	30	NA	NA	See Label Changes Summary Table in 2,4-D RED.
Aquatic weed control - floating and emergent weeds	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid, Granular	4.0	Lbs ae/surface acre	2 per season	8.0 lbs ae/surface acre	21	NA	NA	Apply to aquatic weeds in ponds, lakes, reservoirs, marshes, bayous, drainage ditches, non-irrigation canals, rivers, and streams that are quiescent or slow moving. Coordination and approval of local and state authorities may be required, either by letter of agreement or issuance of special permits for such use. See Label Changes Summary Table in 2,4-D RED.

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Aquatic weed control - submersed weeds	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid, Granular	10.8	Lbs ae per acre-foot	2 per season	21.6 lbs ae per acre-foot per season	21	24 hour swimming restriction for 2,4-D BEE form	NA	Apply to aquatic weeds in ponds, lakes, reservoirs, marshes, bayous, drainage ditches, non-irrigation canals, rivers, and streams that are quiescent or slow moving. When treating moving bodies of water, applications must be made while traveling upstream to prevent concentration of 2,4-D downstream of the application. Coordination and approval of local and state authorities may be required, either by letter of agreement or issuance of special permits for such use. See Label Changes Summary Table in 2,4-D RED.
Asparagus	Wettable powder, Emulsifiable concentrate, soluble concentrate - liquid, soluble concentrate - solid	2.0	Lbs ae/acre	2 per crop cycle	4.0 lbs ae/acre	30	2,4-D acid and amines -48 hours; 2,4-D salt and esters - 12 hours	NA	See Label Changes Summary Table in 2,4-D RED.

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Blueberry, low bush	Wettable powder, Emulsifiable concentrate, soluble concentrate - liquid, soluble concentrate - solid	Postemergence: 0.0375 Postharvest: 1.0	lbs ae per gallon spray solution per application	Postemergence: 1 Postharvest: 1	0.0375 lbs ae per gallon spray solution	NA	2,4-D acid and amines -48 hours; 2,4-D salt and esters - 12 hours	NA	Postharvest: For spot or directed wipe treatment only. Apply only in non-bearing years. See Label Changes Summary Table in 2,4-D RED.
Blueberry, high bush	Wettable powder, Emulsifiable concentrate, soluble concentrate - liquid, soluble concentrate - solid	1.4	Lbs ae/acre	2 per year	2.8 lbs ae/acre	NS	2,4-D acid and amines -48 hours; 2,4-D salt and esters - 12 hours	PHI - 30 days	See Label Changes Summary Table in 2,4-D RED

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Citrus, growing fruit	Emulsifiable concentrate	To increase fruit size on growing Navel oranges, Valencia oranges, and grapefruit: 0.1 To reduce pre-harvest fruit drop on growing Navel oranges, Valencia oranges, and grapefruit: 200	To increase fruit size on growing Navel oranges, Valencia oranges, and grapefruit: lbs ae/acre To reduce pre-harvest fruit drop on growing Navel oranges, Valencia oranges, and grapefruit: ppm	1 per crop cycle	same as max. single app. rate	NA	12 hours	PHI - 7 days	See Label Changes Summary Table in 2,4-D RED

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
		To prevent pre-harvest drop of mature fruit and leaves on lemons, Navel oranges, Valencia oranges, and Tangelos: 24	To prevent pre-harvest drop of mature fruit and leaves on lemons, Navel oranges, Valencia oranges, and Tangelos: ppm	1	same as max. single app. rate				
Citrus, postharvest treatement	Emulsifiable concentrate	500	ppm	1	500 ppm	NA	NA	NA	Application methods include dip or spray See Label Changes Summary Table in 2,4-D RED
Corn, field and pop	Wettable powder, Emulsifiable concentrate, Granular, Soluble concentrate - liquid, Soluble concentrate - solid	Preplant or preemergence: 1.0 Postemergence: 0.5 Preharvest: 1.5	Lbs ae/acre	Preplant or preemergence: 1 Postemergence: 1 Preharvest: 1	3.0 lbs ae/acre	NA	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	PHI - 7 days PGI - 7 days	See Label Changes Summary Table in 2,4-D RED

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Corn, sweet	Wettable powder, Emulsifiable concentrate, Granular, Soluble concentrate - liquid, Soluble concentrate - solid	Preplant or preemergence: 1.0 Postemergence: 0.5	Lbs ae/acre	Preplant or preemergence: 1 Postemergence: 1	1.5 lbs ae/acre per crop cycle	21	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	PHI - 45 days PGI - 7 days	See Label Changes Summary Table in 2,4-D RED
Cranberries	Wettable powder, Emulsifiable concentrate, Granular, Soluble concentrate - liquid, Soluble concentrate - solid	Dormant season: 4.0 Postemergence: 1.2	Dormant season: lbs ae/acre per dormant season Postemergence: lbs ae/acre per postemergence application	Dormant season: 1 Postemergence: 2	Dormant season: 4 lbs ae/acre per dormant season Postemergence: 2.4 lbs ae/acre per postemergence application	NS	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	PHI - 30 days	See Label Changes Summary Table in 2,4-D RED
Filberts	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	1.0	lbs ae per 100 gallons of spray solution	4	4.0 lbs ae per 100 gallons of spray solution per year	30	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	PHI - 45 days	See Label Changes Summary Table in 2,4-D RED

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Fallowland (crop stubble on idle land, or postharvest to crops, or between crops)	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	2.0	Lbs ae/acre	2 per year	4.0 lbs ae/acre per year	30	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	NS	Plant only label crops within 29 days following application. See Label Changes Summary Table in 2,4-D RED
Forestry (forest site preparation, forest roadsides, brush control, established conifer release, Christmas trees, reforestation areas)	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	Broadcast: 4.0 Basal spray, cut surface - stumps, frill: 8.0 Injection: 2	Broadcast: lbs ae/acre Basal spray, cut surface - stumps, frill: lbs ae per 100 gallons of spray solution Injection: ml of 4.0 lbs ae formulation per injection site	1 per year	Broadcast: 4.0 lbs ae/acre per year Basal spray, cut surface - stumps, frill: lbs ae per 100 gallons of spray solution Injection: ml of 4.0 lbs ae formulation per injection site	NA	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	NA	See Label Changes Summary Table in 2,4-D RED
Grapes	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	1.36	lbs ae/acre	1 per crop cycle	1.36 lbs ae/acre per year	NA	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	PHI - 100 days	For use in California only. Do not apply to grape foliage, shoots, or stems. See Label Changes Summary Table in 2,4-D RED

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Grasses (pastures and rangeland not in agricultural production)	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	2.0	Lbs ae/acre	2 per year	4.0 lbs ae/acre per year	30	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	PHI - 7 days	Do not cut forage for hay within 7 days of application. If grass is to be cut for hay, Agricultural Use Requirements for the Worker Protection Standard are applicable. For program lands, such as Conservation Reserve Program, consult program rules to determine whether grass or hay may be used. The more restrictive requirements of the program rules or this label must be followed. See Label Changes Summary Table in 2,4-D RED
Hops	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	0.5	Lbs ae/acre	3 per crop cycle	1.5 lbs ae/acre per crop cycle	NS	2,4-D acid and amines - 48 hours	PHI - 28 days	See Label Changes Summary Table in 2,4-D RED

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Non-Cropland (fenecrows, hedgerows, roadsides, ditches, rights-of-way, utility power lines, railroads, airports, and industrial sites)	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid, Granular	Postemergence (annual and perennial plants): 2 Postemergence (woody plants): 4	lbs ae/acre	Postemergence (annual and perennial plants): 2 Postemergence (woody plants): 1	4.0 lbs ae/acre	Postemergence (annual and perennial plants): 30 days Postemergence (woody plants): NA	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	NA	Applications to non-cropland areas are not applicable to treatment of commercial timber or other plants being grown for sale or other commercial use, or for commercial seed production, or for research purposes. See Label Changes Summary Table in 2,4-D RED.
Nut Orchards	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	2.0	Lbs ae/acre	2 per year	4.0 lbs ae/acre per year	30	2,4-D acid and amines - 48 hours; 2,4-D salt - 12 hours	NS	Do not cut forage for hay within 7 days of application. See Label Changes Summary Table in 2,4-D RED.

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Pasture and Rangeland (established grass pastures, rangeland, and perennial grasslands not in agricultural production)	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	Susceptible annual and biennial broadleaf weeds: 1.0 Moderately susceptible biennial and perennial broadleaf weeds: 1.0 to 2.0 Difficult to control weeds and woody plants: 2.0 Spot treatment: 2.0	Lbs ae/acre	2 per year	4.0 lbs ae/acre	30	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours		Do not forage for hay within 7 days of application. For program lands, such as Conservation Reserve Program, consult program rules to determine whether grass or hay may be used. The more restrictive requirements of the program rules or this label must be followed. If grass is to be cut for hay, Agricultural Use Requirements for the Worker Protection Standard are applicable. See Label Changes Summary Table in 2,4-D RED.
Pome fruits	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	2.0	Lbs ae/acre	2 per crop cycle	4.0 lbs ae/acre	75	2,4-D acid and amines - 48 hours; 2,4-D salt - 12 hours	PHI - 14 days	Do not cut orchard floor forage for hay within 7 days of application. See Label Changes Summary Table in 2,4-D RED.

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Potatoes	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	0.07	Lbs ae/acre	2 per crop cycle	0.14 per crop cycle	10	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	PHI - 45 days	Only for use on potatoes intended for fresh market. See Label Changes Summary Table in 2,4-D RED.
Rice	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	Preplant: 1.0 Postemergence: 1.5	Lbs ae/acre	Preplant: 1 per crop cycle Postemergence: 1 per crop cycle	1.5 lbs ae/acre per crop cycle	NA	2,4-D acid and amines - 48 hours; 2,4-D salt - 12 hours	PHI - 60 days	See Label Changes Summary Table in 2,4-D RED.
Rice, wild	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	0.25	Lbs ae/acre	1 per crop cycle	0.25 lbs ae/acre per crop cycle	NA	2,4-D acid and amines - 48 hours; 2,4-D salt - 12 hours	PHI - 60 days	For use in Minnesota only. See Label Changes Summary Table in 2,4-D RED.

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Sorghum	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	Postemergence (acid, salts, and amines): 1.0 Postemergence (esters): 0.5	Lbs ae/acre	1 per crop cycle	Postemergence (acid, salts, and amines): 1.0 lbs ae/acre per crop cycle Postemergence (esters): 0.5 lbs ae/acre per crop cycle	NA	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	PHI - 30 days	Do not permit meat or dairy animals to consume treated crop as fodder or forage for 30 days following application. See Label Changes Summary Table in 2,4-D RED.
Soybean	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	1.0	Lbs ae/acre	1 app. of 1.0 lbs ae/acre per crop cycle OR 2 apps. Of 0.5 lbs ae/acre per crop cycle	1.0 lbs ae/acre per crop cycle	NS	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	-	0.5 lbs ae/acre rate: >Esters: Apply not less than 7 days prior to planting soybeans. >Amines, acid, salts: Apply not less than 15 days prior to planting soybeans. 1.0 lb ae/acre rate: >Esters: Apply not less than 15 days prior to planting soybeans. >Amines, acid, salts: Apply not less than 30 days prior to planting soybeans. See Label Changes Summary Table in 2,4-D RED.

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Stone fruits	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	2.0	Lbs ae/acre	2	4.0 lbs ae/acre per crop cycle	75	2,4-D acid and amines - 48 hours; 2,4-D salt - 12 hours	PHI - 40 days	Do not cut orchard floor forage for hay within 7 days of application. See Label Changes Summary Table in 2,4-D RED.
Strawberry	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	1.5	Lbs ae/acre	1	1.5 lbs ae/acre per cop cycle	NA	2,4-D acid and amines - 48 hours; 2,4-D salt - 12 hours	-	Do not apply in California or Florida. Apply in dormant stage or after last picking. See Label Changes Summary Table in 2,4-D RED.
Sugarcane	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid	Preemergence: 2.0 Postemergence: 2.0	Lbs ae/acre	Preemergence: 1 Postemergence: 1	4 lbs ae/acre per crop cycle	NS	2,4-D acid and amines - 48 hours; 2,4-D salt - 12 hours	-	Do not harvest cane prior to crop maturity. See Label Changes Summary Table in 2,4-D RED.

Use Site	Formulation	Max. Single App. Rate	Unit	Max. # App. Per Crop Cycle/Year	Max. App. Rate Per Crop Cycle/Year	Min. Retreatment Interval (days)	Reentry Interval (REI)	Preharvest Interval (PHI) Pregrazing Interval (PGI) Preslaughtering Interval (PSI)	Restrictions/Comments
Turf, ornamental (golf courses, cemetaries, parks, sports fields, turfgrass, lawns, and other grass areas)	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid, Granular	1.5	Lbs ae/acre	2	3.0 lbs ae/acre per year, excluding spot treatments	NS	NS	-	See Label Changes Summary Table in 2,4-D RED.
Turf, grown for seed or sod	Wettable powder, Emulsifiable concentrate, Soluble concentrate - liquid, Soluble concentrate - solid, Granular	2.0	Lbs ae/acre	2	4.0 lbs ae/acre per crop cycle	21	2,4-D acid and amines - 48 hours; 2,4-D salt and esters - 12 hours	-	See Label Changes Summary Table in 2,4-D RED.

Appendix B. Data Supporting Guideline Requirements for the Reregistration of 2,4-D

Appendix B

Data Supporting Guideline Requirements for the Reregistration of 2,4-D

REQUIREMENT			Use Patterns	CITATION(S)
PRODUCT CHEMISTRY				
New Guideline Number	**Old Guideline Number**			
830.1550	**61-1**	**Product Identity and Composition**	All	41219701, 41223801, 41926201, 43516401, 43516402, 43981801, 40808301, 41219601, 41055804, 41055805, 41220101, 41973501, 41055801, 41055802, 41220101, 41973501, 41067001, 41203301, 41123601, 41055809, 41055810, 41964401, 41055815, 41055816, 41978001, 44807001, 41055818, 41055819, 41055812, 41055813, 41961301, 41055806, 41055807, 41968301, 41015001, 42188601, 42786501, 40443301, 41224201
830.1600	**61-2A**	**Description of materials used to produce the product**	All	41223801, 41637501, 41790601, 44149301, 44547901, 43516401, 40808301, 41246701, 41681901, 41796201, 41055804, 41496701, 41055801, 41496701, 41973501, 41067001, 41599401, 42537501, 44184201, 41055809, 41055815, 41055818, 41055812, 44584501, 44963803, 41055806, 44982101, 41015001, 42188601, 41376701, 40443301, 41224201
830.1620	**61-2B**	**Description of production process**		41223801, 41790601, 44149301, 44547901, 43516401, 40808301, 41246701, 41796201, 41496701, 41055801, 41973501, 41067001, 41599401, 41789901, 42537501, 44184201, 41055809, 41055815, 44727101, 44807001, 41055818, 44228301, 41055812, 44584501, 44963803, 41055806, 44982101, 41015001, 42188601, 41376701, 40443301, 41224201

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Data Supporting Guideline Requirements for the Reregistration of 2,4-D

REQUIREMENT			Use Patterns	CITATION(S)
830.1670	**61-2B**	**Formation of Impurities**	All	41223801, 41790601, 44149301, 44547901, 43516401, 40808301, 41246701, 41496701, 41055801, 41973501, 41067001, 41599401, 41789901, 41789902, 41123601, 42537501, 44184201, 41055809, 41964401, 42798101, 41055815, 41978001, 42798301, 44727101, 44807001, 41055818, 42798201, 44228301, 41055812, 41961301, 44584501, 44963803, 41055806, 41968301, 44982101, 41015001, 42188601, 42786501, 40443301
830.1700	**62-1**	**Preliminary Analysis**	All	41219701, 41926201, 41790602, 44149302, 44543502, 44543503, 44932701, 43516401, 43516402, 43981801, 40808301, 41724201, 41724202, 41349001, 41796201, 41796202, 41219601, 41796202, 41055805, 41220101, 41496701, 41973501, 43777501, 44287101, 41055802, 41220101, 41496701, 41973501, 43777502, 44228601, 41067001, 41203301, 41735701, 41123601, 41055810, 41964401, 43314701, 41055816, 41055819, 44620501, 41055813, 44963801, 41349002, 41724201, 41724203, 41055807, 45014801, 41015002, 42188601, 40443301, 41206901
830.1750	**62-2**	**Certification of limits**	All	41219701, 41223801, 41926201, 43516401, 43516402, 43981801, 40808301, 41219601, 41055804, 41055805, 41220101, 41496701, 41973501, 41055801, 41055802, 41220101, 41496701, 41973501, 41067001, 41203301, 41599401, 41123601, 41055809, 41055810, 41964401, 41055815, 41055816, 41978001, 44807001, 41055818, 41055819, 41055812, 41055813, 41961301, 44963804, 41055806, 41055807, 41968301, 41015001, 42188601, 40443301, 41206901

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REQUIREMENT			Use Patterns	CITATION(S)
830.1800	**62-3**	**Analytical Method**	All	41219701, 41223801, 41637501, 41926201, 44543502, 44543503, 43516401, 43516402, 43981801, 40808301, 41219601, 41796202, 41055802, 41220101, 41496701, 41055802, 41220101, 41496701, 41067001, 41203301, 41599401, 41789902, 41123601, 41055810, 41055816, 41055819, 41055813, 449638034, 44963804, 41055807, 44982102, 41015002, 42188601, 42786501, 40443301, 41206901
830.6302	**63-2**	**Color**	All	41223801, 44543504, 43516403, 43516404, 40808301, 41055803, 41067001, 41123601, 42857203, 41055811, 41055817, 41055820, 41055814, 44963802, 41055808, 41015003, 40443301, 41224201
830.6303	**63-3**	**Physical State**	All	41223801, 44543504, 43516403, 43516404, 40808301, 41055803, 41067001, 41123601, 42857203, 41055811, 41055817, 41055820, 41055814, 44963802, 41055808, 41015003, 40443301, 41224201
830.6304	**63-4**	**Odor**	All	41223801, 44543504, 43516403, 43516404, 40808301, 41055803, 41067001, 41123601, 42857203, 41055811, 41055817, 41055820, 41055814, 44963802, 41055808, 41015003, 40443301, 41224201
830.6313	**63-13**	**Stability to normal and elevated temperatures, metals, and metal ions**	All	41223801, 41745301, 42023601, 44543504, 41055803, 41855701, 42023601, 42795401, 43516403, 43516404, 40808301, 41055803, 41855701, 42023601, 42795401, 41055803, 42795401, 41973502, 41067001, 41855701, 42857209, 41978002, 42487901, 41968303, 44963802, 41015003, 42116702, 42786501, 40443301, 41224201
830.6314		**Oxidation/Reduction: Chemical Incompatibility**	All	42023601, 43516403, 43516404, 40808301, 41973501, 41067001, 41055811, 41055817, 41055820, 41055814, 41968303, 44963802, 41055808, 40443301, 41224201

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Data Supporting Guideline Requirements for the Reregistration of 2,4-D

REQUIREMENT			Use Patterns	CITATION(S)
830.6315		**Flammability**	All	41055811, 41055817, 41055820, 41055814, 41055808, 41015003, 40443301, 41224201
830.6316		**Explodability**	All	41745302, 43516403, 43516404, 40808301, 41973501, 41067001, 42537501, 41055811, 41055817, 41055820, 41055814, 41055808, 41015003, 40443301, 41224201
830.6317		**Storage stability**	All	41745301, 41926203, 43516403, 43516404, 40808301, 43260501, 41067001, 41123601, 42227501, 41055811, 45642701, 41055817, 43874601, 41055820, 41055814, 41055808, 41015003, 42786501, 40443301, 41224201
830.6319		**Miscibility**	All	40443301, 41224201
830.6320		**Corrosion characteristics**		42023601, 43516403, 43516404, 40808301, 43260501, 41973501, 41067001, 41123601, 42227501, 41055811, 45642701, 41055817, 41055820, 41055814, 41055808, 41015003, 40443301, 41224201
830.7000	**63-12**	**pH**	All	41926202, 44543504, 43516403, 43516404, 40808301, 41123601, 42857208, 41055811, 41055817, 41055820, 41015003, 40443301, 41224201
830.7050	**None**	**UV/Visable Absorption**	All	44543504, **Datagap**
830.7100		**Viscosity**	All	41055811, 41055817, 41055820, 41055814, 41055808, 41015003, 40443301, 41224201
830.7200	**63-5**	**Melting Point**	All	41223801, 44543504, 41055803, 41067001, 41223801, 43516403, 43516404, 40808301, 41055803, 41067001, 42537501, 42857209, 42829901, 42831001, 43325003,
830.7220	**63-6**	**Boiling Point**	All	43325001, 42830901, 43325001, 44963802, 43325002, 44963802, 42831101, 41015003, 40443301, 41224201

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Data Supporting Guideline Requirements for the Reregistration of 2,4-D

REQUIREMENT			Use Patterns	CITATION(S)
830.7300	**63-7**	**Density**	All	41223801, 44543504, 43516403, 43516404, 40808301, 41055803, 41973501, 41067001, 41855701, 41123601, 42857204, 41055811, 41055817, 41055820, 41055814, 44963802, 41055808, 41015003, 40443301, 41224201
830.7370	**63-10**	**Dissociation constants in water**	All	41223801, 41308901, 44543504, 41055803, 41067001, 41972501, 44543504, 43516403, 43516404, 40808301, 41055803, 41067001, 41332009, 41015003, 41224201
830.7550	**63-11**	**Partition coefficient, shake flask method**	All	41332004, 44543504, 41332004, 43516403, 43516404, 40808301, 41055803, 41067001, 42537501, 42857207, 41647001, 44963802, 41055808, 44963802, 41055808, 41015003, 42116702, 40443301, 41224201
830.7840	**63-8**	**Solubility**	All	41223801, 42023601, 41332002, 44543504, 45692501, 41055803, 45692501, 43516403, 43516404, 40808301, 45692501, 41055803, 41067001, 41332002, 41880601, 42537501, 42857205, 43358801, 41055811, 42021002, 41978001, 43358802, 41669501, 42830901, 42831101, 44963802, 41055808, 41968302, 41015003, 42116702 [3], 42786501, 43302001, 40443301, 41224201
830.7950	**63-9**	**Vapor Pressure**	All	41223801, 44543504, 41055803, 41067001, 44543504, 43516403, 43516404, 40808301, 41055803, 41067001, 42537501, 42857206, 42021001, 41431101, 41431301, 44963802, 41055808, 44963802, 41055808, 41015003, 40443301, 41224201
ECOLOGICAL FATE AND EFFECTS				
835.2120	**161-1**	**Hydrolysis**	A, B	410073-01, 413537-01, 414831-01, 413496-01, 434412-01, 427354-01, 427705-02, 427705-01
835.2240	**161-2**	**Photodegradation in Water**	A, B	411253-06, 414831-02, 427497-02
835.2410	**161-3**	**Photodegradation on Soil**	A, B	411253-05, 427497-02

Appendix B

Data Supporting Guideline Requirements for the Reregistration of 2,4-D

REQUIREMENT			Use Patterns	CITATION(S)
835.2370	**161-4**	**Photodegradation in Air**	A, B	414831-03
835.4100	**162-1**	**Aerobic Soil Metabolism**	A, B	431675-01, 437991-01, 431496-01, 434159-01, 436859-01, 437991-02, 438215-01
835.4200	**162-2**	**Anaerobic Soil Metabolism**	A, B	433560-01, 434159-01,
835.4400	**162-3**	**Anaerobic Aquatic Metabolism**	A, B	415579-01, 433560-01, 425747-01, 437991-03, 436063-01, 438829-01, 439083-01, 437991-05, 437991-04
835.4300	**162-4**	**Aerobic Aquatic Metabolism**	A, B	420453-01, 429792-01, 441886-01, 437991-06, 431496-01, 436910-01, 436859-02, 444394-01, 437796-01, 437991-08, 437991-07
835.1230	**163-1**	**Leaching-Adsorption/Desorption**	A, B	420253-02, 441179-01, 441585-01, 441052-01, **Datgap**
835.1410	**163-2**	**Laboratory Volatility**	A, B	417180-01, 420596-01, **Datagap**
835.8100	**163-3**	**Field Volatility**	A, B	
835.6100	**164-1**	**Terrestrial Field Dissipation**	A, B	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, 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, **Datagap**
835.6200	**164-2**	**Aquatic Field Dissipation**	A, B	445250-01, 439083-02, 439547-01, 434916-01, 458971-01, 439083-02, 439547-01, **Datagap**
835.6300	**164-3**	**Forestry Dissipation**	A, B	439083-03, 439271-01, 439547-02, **Datagap**
840.1100	**201-1**	**Droplet Size Spectrum**	A, B	**Datagap**
840.1200	**202-1**	**Drift Field Evaluation**	A, B	**Datagap**
850.2100	**71-1A**	**Avian Acute Oral Toxicity**	A, B	415462-02, 419751-01, 415462-01, 233351, 00138871, 416444-01, 414541-01, 411583-03, 72472, 226397, 439350-01

Appendix B

Data Supporting Guideline Requirements for the Reregistration of 2,4-D

REQUIREMENT			Use Patterns	CITATION(S)
850.2200	**71-2A** **71-2B**	**Avian Dietary Toxicity**	A, B	415861-01, 415462-02, 419751-02, 419751-03, 417495-01, 233351, 417495-02, 00138870, 00138872, 416444-02, 416444-03, 414484-01, 414290-07, 411583-05, 45070, 411583-04, 226397, 439349-01, 439352-01
850.2300	**71-4A** **71-4B**	**Avian Reproduction**	A, B	453364-01
850.1075	**72-1**	**Fish Toxicity Bluegill**	A, B	411583-01, 53986, 419751-05, 419751-04, 0073-091-01, 233350, 411583-11, 419751-04, 234027, 419751-04, 01338869, 413538-03, 413538-04, 413538-01, 00050674, 00053988, 417373-03, 45068, 45069, 439331-01, 439332-01, 439307-01 439103-01, **Datagap**
850.1010	**72-2A**	**Invertebrate Toxicity**	A, B	411583-01, 419751-06, 232630, 413538-03, 413538-01, 67328
850.1075	**72-3A**	**Estuarine/Marine Toxicity - Fish**	A, B	429797-01, 417373-06, 420183-02, 419751-07, 411583-10, 419734-01, 411583-11, 418252-08, 232630, 414290-03, 414290-02, 414290-06, 411583-10, 418352-04, 418352-01, 411583-11, 418352-06, 418352-03
850.1025	**72-3B**	**Estuarine/Marine Toxicity - Mollusk**	A, B	429797-01, 420183-02, 411583-11, 419734-01, 414290-03, 414290-06, 411583-10, 418352-04, 418352-01, **Datagap**
850.1035	**72-3C**	**Estuarine/Marine Toxicity - Shrimp**	A, B	417373-06, 419751-07, 411583-11, 419252-08, 232630, 414290-02, 414290-05, 418352-06, 418352-03, **Datagap**
850.1045	**72-3**	**Estuarine/Marine Toxicity - Penaid**	A, B	**Datagap**
850.1300	**72-4A**	**Fish Early Life Stage - Daphnid**	A, B	417373-04, 420183-04, 417677-01
850.1350	**72-4B**	**Estuarine/Marine Invertebrate Life Cycle**	A, B	418352-11, 420183-03, 418352-10, 413583-02
850.1400	**72-4C**	**Freshwater Fish- Acute Toxicity**	A, B	
850.1500	**72-5**	**Life Cycle Fish**	A, B	413457-01, 417373–05
850.4100	**122-1A**	**Terrestrial Plant Toxicity, Seedling Emergence**	A, B	

Appendix B

Data Supporting Guideline Requirements for the Reregistration of 2,4-D

REQUIREMENT			Use Patterns	CITATION(S)
850.5400	**122-2**	**Aquatic Plant Growth**	A, B	
850.4225	**123-1A**	**Seedling Germination and Seedling Emergence**	A, B	424168-02, 426091-1, 442756-01, 430167-02, 423895-01, 431970-03, 431970-02, 431970-01, 424492-01, 439821-01, **Datagap**
850.4250	**123-1B**	**Vegetative Vigor**	A, B	424168-01, 426091-02, 423439-02, 437882-01, 426693-04, 439821-01, **Datagap**
850.4400	**123-2**	**Aquatic Plant Growth**	A, B	442951-01, 427122-04, 427122-05, 427122-01, 427122-02, 427122-03, 415059-04, 414200-02, 415059-01, 415059-03, 415059-02, 417321-02, 434886-02, 417321-01, 434886-03, 434886-04, 434886-01, 420684-04, 417321-02, 420684-04, 420684-03, 417352-03, 417352-06, 417352-04, 417352-05, 417352-02
850.3020	**141-1**	**Honey Bee Acute Contact**	A, B	445173-04, 445173-01
<u>TOXICOLOGY</u>				
870.1100	**81-1**	**Acute Oral Toxicity-Rat**	A, B	00101605, 41920901, 00157512, 00252291, 41709901, 41413501, 40629801, 41209001
870.1200	**81-2**	**Acute Dermal Toxicity-Rabbit/Rat**	A, B	00101596, 41920911, 00157513, 00252291, 41709902, 41413502, 40629802, 41209002
870.1300	**81-3**	**Acute Inhalation Toxicity-Rat**	A, B	00161660, 41986601, 00157514, 40085501, 40352701, 41957601, 40629803, 42605202
870.2400	**81-4**	**Primary Eye Irritation-Rabbit**	A, B	41125302, 41920902, 00157515, 00252291, 40352702, 41413504, 40629804, 44725303
870.2500	**81-5**	**Primary Skin Irritation**	A, B	42232701, 41920903, 00157516, 00252291, 40352703, 41413505, 40629805, 41413505
870.2600	**81-6**	**Dermal Sensitization**	A, B	00161659, 41920904, 41642805, 41233701, 40352704, 41413506, 40629806, 41209006
870.3100	**82-1A**	**Subchronic Oral Toxicity: 90-Day Study Rodent**	A, B	41991501, 41928101, 41994001, 41896701, 41896702, 42021401, 43515901, 42021402

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REQUIREMENT			Use Patterns	CITATION(S)
870.3150	**82-1B**	**Subchronic Oral Toxicity: 90-Day Study Non-rodent**	A, B	41737301, 42780001, 42780003, 43515501, 42780002
870.3200	**82-2**	**21-Day Dermal - Rabbit/Rat**	A, B	41735304, 41735301, 41407901, 41920905, 41735303, 41735306, 41735302, 41735305, 41407903, 41407902
870.3465	**82-4**	**90-Day Inhalation-Rat**	A, B	**Datagap**
870.4100	**83-1B**	**Chronic Feeding Toxicity**	A, B	43612001, 430490001
870.3700	**83-3A**	**Developmental Toxicity - Rat**	A, B	00130407, 00130408, 41527101, 41527104, 41920906, 41986602, 41735201, 42304601, 42304602, 43523101, 43523001, 41527103; 41527106, 41527102; 41527105
870.3700	**83-3B**	**Developmental Toxicity - Rabbit**	A, B	41747601, 42158703, 42158706, 42055501, 42013501, 42224001, 42304603, 42304604, 42158702; 42158704, 42158701, 42158705
870.3800	**83-4**	**2-Generation Reproduction - Rat**	A, B	00150557, 00163996, **Repeat Study Required**
870.4300	**83-5**	**Combined Chronic Toxicity/ Carcinogenicity: Rats**	A, B	43879801, 43597201
870.4200	**83-2B**	**Carcinogenicity Mice**	A, B	43612001
870.5265	**84-2**	**Gene Mutation**	A, B	41409801, 41388204, 41797903, 41409802, 41409803, 41388203, 41797902, 42015701, 43935101, 41388202, 41797901
870.5300	**84-2**	***In vitro* Mammalian Cell Gene Mutation Test**	A, B	43394201, 43327304, 43327302
870.5375	**84-2**	***In vitro* Chromosome Aberration**	A, B	43327305, 43327303, 43327301
870.5385	**84-2B**	***In vivo* chromosome aberration**	A, B	Mustonen, *et al.*, 41478301, 42015704, 42015701, 42015707, 41409805, 41870102, 41409806, 41870103, 41478303, 42015701, 42015703, 42015706, 43930801, 41478302, 42015701, 42015702, 42015705
870.5395	**84-2**	**Micronucleus Assay**	A, B	41409804, 41870101

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REQUIREMENT			Use Patterns	CITATION(S)
870.5450	**84-2**	**Rodent Dominant Lethal Assay**	A, B	41409807, 41498101, 41409808, 41409809, 41498103, 43930501, 41498102
870.6200	**81-8, 82-7, 83-1**	**Neurotoxicity Screening Battery**	A, B	43115201, 43293901
870.6300	**83-6**	**Developmental Neurotoxicity**	A, B	**Datagap**
870.7485	**85-1**	**General Metabolism**	A, B	41737302
870.7600	**85-3**	**Dermal Penetration and Absorption**	A, B	Feldman. R. J. And Maibach, H. I. (1974)
OCCUPATIONAL/RESIDENTIAL EXPOSURE				
875.1100	**231**	**Estimation of Dermal Exposure at Outdoor Sites**	A, B	449722-01, 444598-01
875.1300	**232**	**Estimation of Inhalation Exposure at Outdoor Sites**	A, B	449722-01, 444598-01
875.2200	**132-1b**	**Soil Residue Dissipation**	A, B	446557-01, 446557-04, 446557-03, 450331-01
RESIDUE CHEMISTRY				
860.1200		**Directions for Use**	A, B	**Datagap**
860.1300	**171-4A**	**Plant Metabolism**	A, B	00004666, 00004667, 00004669, 00004675, 00004676, 00004677, 00004680, 00004681, 00004682, 00004683, 00004689, 00004693, 00004698, 00004699, 00004715, 00004723, 00004960, 00004996, 00074214, 00074215, 00074216, 00074217, 00102675, 00102676, 00102679 00102717, 00123973, Blacktop and Linscott. (1968), Feung, et al. (1972), 41991503, 42423101, 42439701 42615601, 43290501, 43496101
860.1300	**171-4B**	**Livestock Metabolism**	A, B	00004705, 00068891, 42605201, 42749701, 43160201

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Data Supporting Guideline Requirements for the Reregistration of 2,4-D

REQUIREMENT			Use Patterns	CITATION(S)
860.1340	**171-4C**	**Residue Analytical Method - Plant commodities**	A, B	00004720, 00033119, 00036171, 00037169, 00042288, 00045364, 00045365, 00046125, 00059025, 00059026, 00059027, 00059033, 00060113, 00060120, 00060870, 00060872, 00060880, 00061012, 00061014, 00061016, 00061017, 00061018, 00061645, 00074219, 00075198, 00075715, 00075716, 00075719, 00088176, 00102605, 00102710, 00102717, 00102719, 00102737, 00102815, 00102862, 00102865, 00109535, 00115499, 00115509, 00120057, 00121733, 00123269, 00126684, 00127273, 00133938, 00136845, 00138635, 00139511, 00139951, 00140092, 00156264, PP#6E2606 (1979), Aly and Faust (1964), Bontoyan (1985), Freed (1948), 43289301, 43691101, 43893701
860.1340	**171-4C**	**Residue Analytical Method - Livestock commodities**	A, B	00004701, 00004707, 00004719, 00037169, 00043759, 00055485, 00066156, 00068011, 00068892, 00068893, 00071787, 00078237, 00102713, 00102714, 00102760, 00102816, 00102821, 00115509, 00115515, 00120057 Otto et al (1982), 44016501, 44016502, **Datagap**
860.1340	**171-4C**	**Residue Analytical Method - Water**	A, B	00035913, 00115509, 00121711, 00136848, 00140032, Otto et al (1982)
860.1380	**171-4E**	**Storage Stability - Plant commodities**	A, B	00136845, 00140092, 00145248, 43809901, 43870301, 43879901, 43879902, 43879903, 43879904, 43879905, 43886401, 43886402, 43886403, 43886404, 43886405, 43886406, 43943101, 43963801, 43963802, 44211901, 45245601
860.1380	**171-4E**	**Storage Stability - Livestock commodities**	A, B	44024801, 44967401
860.1380	**171-4E**	**Storage Stability - Water**	A, B	00035913, 00139511
860.1400	**171-4F**	**Water, Fish, and Irrigated Crops - Irrigated Crops**	A, B	00052597, 00139511, **Datagap**

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REQUIREMENT			Use Patterns	CITATION(S)
860.1400	**171-4F**	**Water, Fish, and Irrigated Crops - Fish and Shellfish**	A, B	00028443, 00035913, 00043759, 00052597, 00102760, 00115741, 43378801, 44135201, 44577801
860.1400	**171-4F**	**Water, Fish, and Irrigated Crops - Water**	A, B	00035913, 00038429, 00052597, 00102788, 00115741, 00118549, 42968501, 42968502
860.1480	**171-4J**	**Meat, Milk, Poultry, Eggs - Milk and the Fat, Meat, and Meat Byproducts of Cattle, Goats, Hogs, Horses, and Sheep**	A, B	00004701, 00004707, 00004719, 00059034, 00068892, 00068893, 00102714, 44024801
860.1480	**171-4J**	**Meat, Milk, Poultry, Eggs - Eggs and the Fat, Meat, and Meat Byproducts of Poultry**	A, B	00102719
860.1500	**171-4K**	**Crop Field Trials (Root and Tuber Vegetables Group - Potatoes)**	A, B	00060876, 00102814, 00102862, 00136845, 43886401
860.1500	**171-4K**	**Crop Field Trials (Legume Vegetables (Succulent or Dried) Group - Soybean seed)**	A, B	43356301, 43356302, 43356303, 43669801
860.1500	**171-4K**	**Crop Field Trials (Foliage of Legume Vegetables Group - Soybean forage and hay)**	A, B	43356301, 43356302, 43356303, 43669801
860.1500	**171-4K**	**Crop Field Trials (Citrus - Grapefruits, Lemons, Oranges)**	A, B	00102605, 43870303, 00102879, 00115509, 43870303, 45462201, 00042526, 00102605, 00102737, 00139059, 00163903, 43870303, 45462201, 45672201
860.1500	**171-4K**	**Crop Field Trials (Pome Fruits Group - Apples, Pears, Quinces)**	A, B	00102824, 43943101, 00102824, 43886405
860.1500	**171-4K**	**Crop Field Trials (Stone Fruits Group - Cherry, Peach, Plum/Fresh Prune)**	A, B	00088176, 43879902, 43879901, 43879903
860.1500	**171-4K**	**Crop Field Trials (Berries Group - Blueberries, Raspberries)**	A, B	00061010, 00061012, 43886403, 44268501, 40881401

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REQUIREMENT			Use Patterns	CITATION(S)
860.1500	**171-4K**	**Crop Field Trials (Tree Nut Group - Almond, Filbert, Pecan, Walnut)**	A, B	00088176, 44211901, 43963801, 43963802, 00115509
860.1500	**171-4K**	**Crop Field Trials (Cereal Grains Group - Barley, grain; Corn, field, grain; Corn, sweet (K+CWHR); Millet, grain; Oats, grain; Rice, grain; Rice, wild, grain; Rye, grain; Sorghum, grain; Wheat, grain)**	A, B	00004610, 00036168, 00036169, 00036171, 00036169, 00059025, 00059027, 00059029, 00060117, 00061010, 00021755, 00022329, 00025383, 00028385, 00030697, 43676801, 43686001, 43693702, 00102865, 43886406, 00025330, 00161187, 00036169, 00059028, 00102816, 00004594, 00120057, 43747901, 43785901, 43853601, 00102719, 00102889, 00120057, 43697801, 43718001, 43718002, 00022622, 00036168, 00036170, 00036171, 00045369, 00046127, 00059029, 00060111, 00061010, 00078482, 00090361, 00127226, 00128778, 43665201, 43665202, 43676802, 43797901, 43797903, 44190301, 44190302, **Datagap**
860.1500	**171-4K**	**Crop Field Trials (Forage, Fodder, and Straw of Cereal Grains Group - Barley, haw and straw; Corn, field, forage, and stover; Corn, sweet, forage and stover; Millet, forage, hay, and straw; Oat, forage, hay, and straw; Rice, straw; Rye, forage and straw; Sorghum, forage and stover; Wheat, forage, hay, and straw)**	A, B	00036168, 00036171, 00059025, 00059027, 00021755, 00022622, 00025383, 00028385, 00030697, 00073273, 00075715, 00075724, 00102865, 00127273, 00139511, 43676801, 43686001, 43693702, 00059028, 00120057, 43747901, 43785901, 00102719, 00102889, 00120057, 43697801, 43718001, 43718002, 00004485, 00028173, 00028200, 00042288, 00061010, 00063507, 00090360, 00102712, 00120057, 00138635, 00144791, 00147047, 43665201, 43665202, 43676802, 43797901, 43797903, 44190301, 44190302, **Datagap**
860.1500	**171-4K**	**Crop Field Trials (Grass Forage, Fodder, and Hay Group - Grass (pastures and rangeland) forage and hay)**	A, B	00004485, 00028173, 00028200, 00042288, 00061010, 00063507, 00090360, 00102712, 00120057, 00138635, 00144791, 00147047, 43592101, 43610801, 43610802, 43665203, 43665204, 43665205, 43779501, 43779502, 43779503, 43779504

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REQUIREMENT			Use Patterns	CITATION(S)
860.1500	**171-4K**	**Crop Field Trials (Miscellaneous Commodities - Asparagus; Aspirated Grain Fractions; Cranberries; Grapes; Hops; Pistachios; Strawberries; Sugarcane)**	A, B	00025338, 00060870, 43879905, 43693701, 43709701, 00061010, 00061012, 43886402, 00061012, 00102833, 43947901, 45245601, 45647101, 45665801, 45512701, 43879904, 00102717, 00102812, 43886404, 00030701, 00079738, 00102640, 00102794, 00115793, 00127823, 43736101, 43736102
860.1520	**171-4L**	**Processed Food/Feed (Apples; Barley; Citrus; Corn, field; Grape; Oats; Potato; Prunes; Rice; Rye; Sorghum; Soybean; Sugarcane; Wheat)**	A, B	43943101, 43870302, 43709701, 45245601, 45647101, 43879903, 43755402, 43709702, 00030701, 00068889, 43755401, 43693701
860.1850	**165-1**	**Confined Rotational Crops**	A, B	43356002
OTHER				
840.1100	**201-1**	**Droplet Size Spectrum**	A, B	Reserved
840.1200	**202-1**	**Drift Field Deposition Evaluation**	A, B	Reserved

Appendix C. Technical Support Documents

Appendix C. TECHNICAL SUPPORT DOCUMENTS

Additional documentation in support of this RED is maintained in the OPP docket, located in Room 119, Crystal Mall #2, 1801 South Bell Street, Arlington, VA. It is open Monday through Friday, excluding legal holidays, from 8:30 am to 4 pm.

The docket initially contained preliminary risk assessments and related documents as of June 23, 2004. Sixty days later the first public comment period closed. The EPA then considered comments, revised the risk assessment, and added the response to comments documents, preliminary mitigation strategies, and the revised risk assessments to the docket on January 12, 2005. The second sixty day public comment period closed on March 14, 2005. The 2,4-D Reregistration Eligibility Decision (RED), revised risk assessments, and response to comments documents were made available in the summer of 2005.

All documents, in hard copy form, may be viewed in the OPP docket room or downloaded or viewed via the Internet at the following site:

www.epa.gov/pesticides/reregistration

These documents include:

HED Documents:

1. 2,4-D. HED's Revised Human Health Risk Assessment for the Reregistration Eligibility Decision (RED) Revised to Reflect Public Comments. PC Code 030001; DP Barcode D316597. May 12, 2005.

2. 2,4-D. Revised Acute and Chronic Dietary Exposure Assessments Including Proposed New Uses Hops and Potatoes for the Reregistration Eligibility Decision. April 18, 2005.

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Appendix D. Citations Considered to be Part of the Data Base Supporting the Reregistration Eligibility Decision (Bibliography) for 2,4-D

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Appendix E. Generic Data Call-In

Appendix E.

The generic data call-in will be posted at a later date.

Appendix F. Product Specific Data Call-In

Appendix F.

The product specific data call-in will be posted at a later date.

Appendix G. EPA's Batching of 2,4-D Products for Meeting Acute Toxicity Data Requirements for Reregistration

Appendix G.

The batching of 2,4-D products for meeting acute toxicity data requirements for reregistration will be posted at a later date.

Appendix H. List of Registrants Sent This Data Call-In

Appendix H.

A list of registrants sent this data call-in will be posted at a later date.

Appendix I. List Of Available Related Documents And Electronically Available Forms

Appendix I. LIST OF AVAILABLE RELATED DOCUMENTS AND ELECTRONICALLY AVAILABLE FORMS

Pesticide Registration Forms are available at the following EPA internet site:

http://www.epa.gov/opprd001/forms/

Pesticide Registration Forms (These forms are in PDF format and require the Acrobat reader)

Instructions

1. Print out and complete the forms. (Note: Form numbers that are bolded can be filled out on your computer then printed.)

2. The completed form(s) should be submitted in hardcopy in accord with the existing policy.

3. Mail the forms, along with any additional documents necessary to comply with EPA regulations covering your request, to the address below for the Document Processing Desk.

DO NOT fax or e-mail any form containing 'Confidential Business Information' or 'Sensitive Information.'

If you have any problems accessing these forms, please contact Nicole Williams at (703) 308-5551 or by e-mail at williams.nicole@epa.gov.

The following Agency Pesticide Registration Forms are currently available via the internet: at the following locations:

8570-1	Application for Pesticide Registration/Amendment	http://www.epa.gov/opprd001/forms/8570-1.pdf
8570-4	Confidential Statement of Formula	http://www.epa.gov/opprd001/forms/8570-4.pdf
8570-5	Notice of Supplemental Registration of Distribution of a Registered Pesticide Product_	http://www.epa.gov/opprd001/forms/8570-5.pdf
8570-17	Application for an Experimental Use Permit	http://www.epa.gov/opprd001/forms/8570-17.pdf
8570-25	Application for/Notification of State Registration of a Pesticide To Meet a Special Local Need	http://www.epa.gov/opprd001/forms/8570-25.pdf
8570-27	Formulator's Exemption Statement	http://www.epa.gov/opprd001/forms/8570-27.pdf
8570-28	Certification of Compliance with Data Gap Procedures	http://www.epa.gov/opprd001/forms/8570-28.pdf
8570-30	Pesticide Registration Maintenance Fee Filing_	http://www.epa.gov/opprd001/forms/8570-30.pdf
8570-32	Certification of Attempt to Enter into an Agreement with other Registrants for Development of Data	http://www.epa.gov/opprd001/forms/8570-32.pdf
8570-34	Certification with Respect to Citations of Data (PR Notice 98-5)	http://www.epa.gov/opppmsd1/PR_Notices/pr98-5.pdf

8570-35	Data Matrix (PR Notice 98-5)	http://www.epa.gov/opppmsd1/PR_Notices/pr98-5.pdf
8570-36	Summary of the Physical/Chemical Properties (PR Notice 98-1)	http://www.epa.gov/opppmsd1/PR_Notices/pr98-1.pdf
8570-37	Self-Certification Statement for the Physical/Chemical Properties (PR Notice 98-1)	http://www.epa.gov/opppmsd1/PR_Notices/pr98-1.pdf

Pesticide Registration Kit www.epa.gov/pesticides/registrationkit/

Dear Registrant:

For your convenience, we have assembled an online registration kit which contains the following pertinent forms and information needed to register a pesticide product with the U.S. Environmental Protection Agency's Office of Pesticide Programs (OPP):

1. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug and Cosmetic Act (FFDCA) as Amended by the Food Quality Protection Act (FQPA) of 1996.

2. Pesticide Registration (PR) Notices

   a. 83-3 Label Improvement Program--Storage and Disposal Statements
   b. 84-1 Clarification of Label Improvement Program
   c. 86-5 Standard Format for Data Submitted under FIFRA
   d. 87-1 Label Improvement Program for Pesticides Applied through Irrigation Systems (Chemigation)
   e. 87-6 Inert Ingredients in Pesticide Products Policy Statement
   f. 90-1 Inert Ingredients in Pesticide Products; Revised Policy Statement
   g. 95-2 Notifications, Non-notifications, and Minor Formulation Amendments
   h. 98-1 Self Certification of Product Chemistry Data with Attachments (This document is in PDF format and requires the Acrobat reader.)

Other PR Notices can be found at http://www.epa.gov/opppmsd1/PR_Notices

3. Pesticide Product Registration Application Forms (These forms are in PDF format and will require the Acrobat reader).

   a. EPA Form No. 8570-1, Application for Pesticide Registration/Amendment
   b. EPA Form No. 8570-4, Confidential Statement of Formula
   c. EPA Form No. 8570-27, Formulator's Exemption Statement
   d. EPA Form No. 8570-34, Certification with Respect to Citations of Data
   e. EPA Form No. 8570-35, Data Matrix

4. General Pesticide Information (Some of these forms are in PDF format and will require the Acrobat reader).

   a. Registration Division Personnel Contact List
   b. Biopesticides and Pollution Prevention Division (BPPD) Contacts
   c. Antimicrobials Division Organizational Structure/Contact List
   d. 53 F.R. 15952, Pesticide Registration Procedures; Pesticide Data Requirements (PDF format)
   e. 40 CFR Part 156, Labeling Requirements for Pesticides and Devices (PDF format)

   f. 40 CFR Part 158, Data Requirements for Registration (PDF format)
   g. 50 F.R. 48833, Disclosure of Reviews of Pesticide Data (November 27, 1985)

Before submitting your application for registration, you may wish to consult some additional sources of information. These include:

1. The Office of Pesticide Programs' website.

2. The booklet "General Information on Applying for Registration of Pesticides in the United States", PB92-221811, available through the National Technical Information Service (NTIS) at the following address:

   National Technical Information Service (NTIS)
   5285 Port Royal Road
   Springfield, VA 22161

   The telephone number for NTIS is (703) 605-6000.

3. The National Pesticide Information Retrieval System (NPIRS) of Purdue University's Center for Environmental and Regulatory Information Systems. This service does charge a fee for subscriptions and custom searches. You can contact NPIRS by telephone at (765) 494-6614 or through their website.

4. The National Pesticide Telecommunications Network (NPTN) can provide information on active ingredients, uses, toxicology, and chemistry of pesticides. You can contact NPTN by telephone at (800) 858-7378 or through their website: ace.orst.edu/info/nptn.

   The Agency will return a notice of receipt of an application for registration or amended registration, experimental use permit, or amendment to a petition if the applicant or petitioner encloses with his submission a stamped, self-addressed postcard. The postcard must contain the following entries to be completed by OPP:

   - Date of receipt;
   - EPA identifying number; and
   - Product Manager assignment.

   Other identifying information may be included by the applicant to link the acknowledgment of receipt to the specific application submitted. EPA will stamp the date of receipt and provide the EPA identifying file symbol or petition number for the new submission. The identifying number should be used whenever you contact the Agency concerning an application for registration, experimental use permit, or tolerance petition.

   To assist us in ensuring that all data you have submitted for the chemical are properly coded and assigned to your company, please include a list of all synonyms, common and trade names, company experimental codes, and other names which identify the chemical (including "blind" codes used when a sample was submitted for testing by commercial or academic facilities). Please provide a chemical abstract system (CAS) number if one has been assigned.

Documents Associated with this RED

The following documents are part of the Administrative Record for this RED document and may be included in the EPA's Office of Pesticide Programs Public Docket. Copies of these documents are not available electronically, but may be obtained by contacting the person listed on the respective Chemical Status Sheet.

1. Detailed Label Usage Information System (LUIS) Report.