II. Regional Assessments

C. Region C - Arid/Semiarid West Assessment

1. Executive Summary

Region C. Arid/Semiarid West

This module of the Organophosphate (OP) cumulative risk assessment focuses on risks from OP uses in the Arid/Semiarid West (area shown to right). Information is included in this module only if it is specific to the Arid/Semiarid West, or is necessary for clarifying the results of the Arid/Semiarid West assessment. A comprehensive description of the OP cumulative assessment comprises the body of the main document; background and other supporting information for this regional assessment can be found there.

This module focuses on the two components of the OP cumulative assessment which are likely to have the greatest regional variability: drinking water and residential exposures. Dietary food exposures are likely to have significantly less regional variability, and are assumed to be nationally uniform. An extensive discussion of food exposure is included in the main document. Pesticides and uses which were considered in the drinking water and residential assessments are summarized in Table II.C.1 below. The OP uses included in the drinking water assessment generally accounted for 95% or more of the total OPs applied in that selected area. Various uses that account for a relatively low percent of the total amount applied in that area were not included in the assessment.

Table II.C.1. Pesticides and Use Sites/Scenarios Considered in Arid/Semiarid West Residential/Non-Occupational and Drinking Water Assessment

Pesticide	OP Residential Use Scenarios	OP Drinking Water Scenario Uses
Acephate	Ornamental Gardens	Beans, Tomatoes
Azinphos-methyl	None	Almonds/Walnuts, Apples/ Pears
Bensulide	Golf Courses	None
Chlorpyrifos	None	Alfalfa, Almonds/Walnuts, Apples/Pears, Asparagus, Field Corn, Grapes, Peaches/ Apricots/Nectarines, Sugarbeets, Tomatoes
DDVP	Pest Strips	None
Diazinon	None	Almonds/Walnuts, Apples/Pears, Melons (Cantaloupe), Grapes, Peaches/Apricots/ Nectarines, Tomatoes, Broccoli

Pesticide	OP Residential Use Scenarios	OP Drinking Water Scenario Uses
Dimethoate	None	Alfalfa, Apples/Pears, Broccoli, Melons (Cantaloupe), Beans, Field Corn, Grapes, Peaches/Apricots/Nectarines, Tomatoes
Disulfoton	Ornamental Gardens	Asparagus
Fenamiphos	Golf Courses	None
Malathion	Home Fruit & Vegetable Gardens, Ornamental Gardens	Alfalfa, Asparagus, Beans, Field Corn, Grapes, Tomatoes
Methamidophos	None	Broccoli, Sugarbeets, Tomatoes
Methidathion	None	Apples/Pears, Peaches/Apricots/Nectarines, Almonds/Walnuts
Methyl-parathion	None	Alfalfa
Naled	None	Almonds/Walnuts, Beans, Grapes, Peaches/Apricots/Nectarines, Sugarbeets
Oxydemeton-methyl	None	Broccoli, Melon (Cantaloupe), Sugarbeets
Phorate	None	Field Corn, Sugarbeets
Phosmet	None	Almonds/Walnuts, Apples/Pears, Peaches/Apricots/Nectarines, Alfalfa
TCVP	Pet Uses	None
Trichlorfon	Golf Courses, Lawn applications	None

This module will first address residential exposures. The residential section describes the reasons for selecting or excluding various use scenarios from the assessment, followed by a description of region-specific inputs. Detailed information regarding the selection of generic data inputs common to all the residential assessments (e.g., contact rates, transfer coefficients, and breathing rate distributions, etc.) are included in the main document.

Drinking water exposures are discussed next. This will include criteria for the selection of a sub-region within the Arid/Semiarid West for modeling drinking water residues, followed by modeling results, and finally characterization of the available monitoring data which support use of the modeling results will be discussed. This characterization of monitoring data includes a justification for assuming surface water sources of drinking water for the entire population within the region rather than ground water sources, since surface water sources represent a high-end of potential residues. While some OP crop uses were not included in the model estimates, the estimates are still considered high-end. This is discussed in more detail in the drinking water section below.

Finally, a characterization of the overall risks for the Arid/Semiarid West region is presented, focusing on aspects which are specific to this region.

In general, the risks estimated for the Arid/Semiarid West show a similar pattern to those observed for other regions. Drinking water does not contribute to the risk picture in any significant way at the upper percentiles of exposure. At these higher percentiles of exposure, residential exposures are the major source of risk - in particular, inhalation exposure from use of DDVP pest strips. These patterns occur for all population sub-groups, although potential risks appear to be higher for children than for adults regardless of the percentile considered.

2. Development of Residential Exposure Aspects of Arid/Semiarid West Region C

In developing this aspect of the assessment, the residential exposure component of Calendex was used to evaluate predicted exposures from residential uses. Except for golf course uses, this assessment is limited to the home, as are most current single chemical assessments. The residential component of the assessment incorporates dermal, inhalation, and non-dietary ingestion exposure routes which result from applications made to residential lawns (dermal and non-dietary ingestion), golf courses, ornamental gardens, home fruit and vegetable gardens, pest strip, and pet uses. These scenarios were selected because they are expected to be the most prominent contributors to exposure in this region. Public health uses were not expected to be a significant contributor to cumulative risk in this region, and were therefore not included in this assessment. Additional details regarding the selection of the scenario-pesticide pairs can be found in Part I of this document. OPP believes that the majority of exposures (and all significant exposures) in this region have been addressed by the scenarios selected.

The data inputs to the residential exposure assessment come from a variety of sources including the published, peer reviewed literature and data submitted to the Agency to support registration and re-registration of pesticides. Generic scenario issues and data sources are discussed in Part I of this report. However, a variety of additional region-specific ancillary data was required for this assessment of the Arid/Semiarid West. This information includes region-specific data on pesticide application rates and timing, pesticide use practices, and seasonal applications patterns, among others. The Gaant chart shown in Figure II.C.1 displays and summarizes the various region-specific residential applications and their timing (including repeated applications) over the course of a year which were used in this assessment. Specific information and further details regarding these scenarios, the Calendex input parameters, and the pesticides for which these scenarios were used are presented in Table II.C.2 which summarizes all relevant region-specific scenarios.

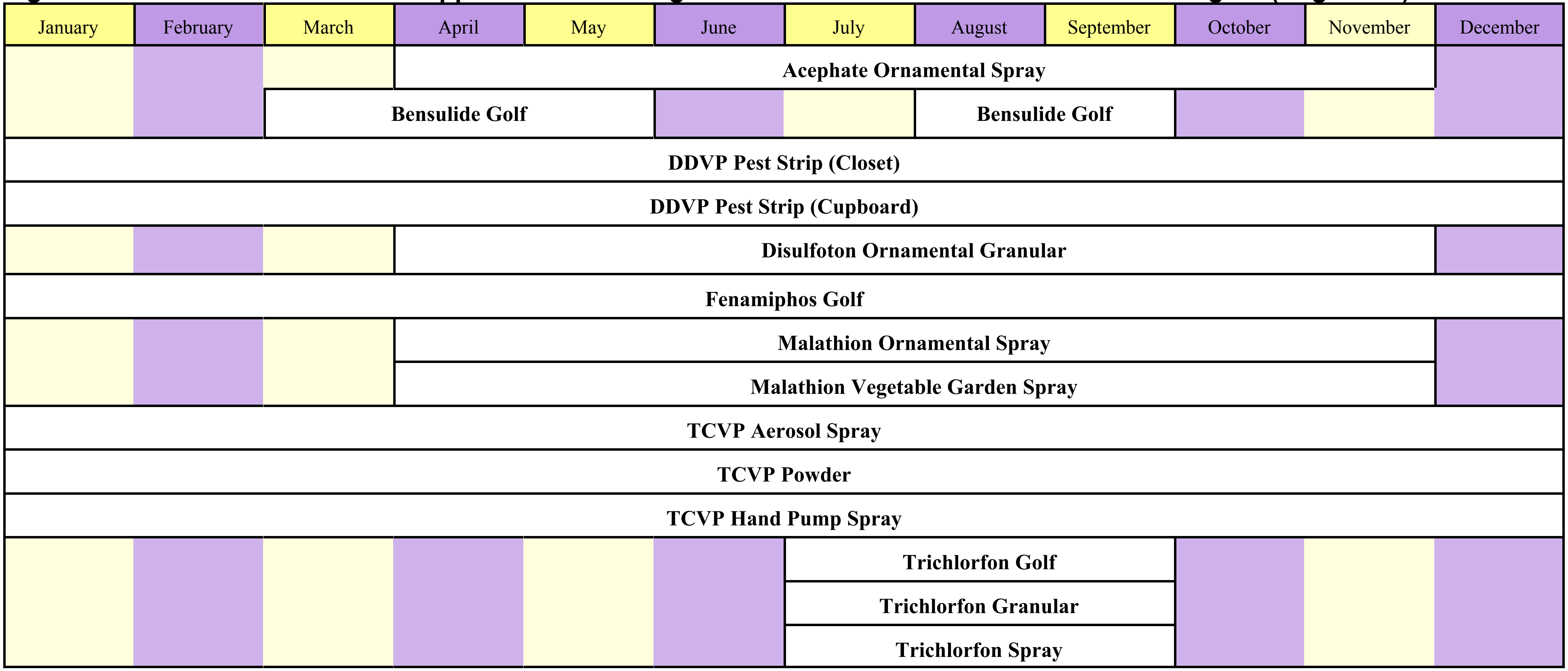
Table II.C.2. Use Scenarios and Calendex Input Parameters for Arid/Semiarid West Residential Exposure Assessment

Chemical	Use Scenario	Application Method	Amt. Applied lb ai/A	Max. No./ Frequency Of Apps.	App. Schedule	% Use LCO	% Use HO	% Users	Residue Persistence (Days)	Routes of Exposure
Acephate	Ornamental	hand pump sprayer	0.9-2	4/yr, 2 wks. Between Apps.	Apr.-Nov. 13-45 wks.	--	100	4	1	inhalation(a), dermal(a)
Bensulide	Golf Course	NA	12.5	2/yr, 27 wks. Between Apps.	Mar.-May and Aug.-Sept.	100	--	2	14	dermal(p)
DDVP	Pest Strip	closet strip	NA	16 wks., Regular App. Schedule	Jan.-Dec. 1-52 wks.	--	100	2	120	inhalation(p)
		cupboard strip	NA	16 wks., Regular App. Schedule	Jan.-Dec. 1-52 wks.	--	100	2	120	inhalation(p)
Disulfoton	Ornamental	granular	8.7	3/yr, 6 wks. Between Apps.	Apr.-Nov. 14-46 wks.	--	100	7	1	inhalation(a), dermal(a)
Fenamiphos	Golf Course	NA	10	1/yr	Jan.-Dec. 1-52 wks.	100	--	1	2	dermal(p)
Malathion	Ornamental	hand pump spray	0.9-2	2/yr, 2 wks. Between Apps.	Apr.-Nov. 14-48 wks.	--	100	6	1	inhalation(a), dermal(a)
	Vegetable Garden	hand pump sprayer	1.5	5/yr, 2 wks. Between Apps.	Apr.-Nov. 14-48 wks.	--	100	2	1 14	inhalation(a), dermal(a)(p)
TCVP	Pet Aerosol	aerosol spray	2.4×10^{-5}- 3.3×10^{-5} lb ai/lb dog	1/8 wks., Regular App. Schedule	Jan.-Dec. 1-52 wks.	--	100	5	1 32	inhalation(a), oral(p), dermal(a)(p)
	Pet Powder	shaker can	4.6×10^{-5}- 5.5×10^{-5} lb ai/lb dog	1/8 wks., Regular App. Schedule	Jan.-Dec. 1-52 wks.	--	100	5	1 32	inhalation(a), oral(p), dermal(a)(p)
	Pet Spray	hand pump sprayer	2.0×10^{-5}- 2.2×10^{-5} lb ai/lb dog	1/8 wks., Regular App. Schedule	Jan.-Dec. 1-52 wks.	--	100	5	1 32	inhalation(a), oral(p), dermal(a)(p)

Chemical	Use Scenario	Application Method	Amt. Applied lb ai/A	Max. No./ Frequency Of Apps.	App. Schedule	% Use LCO	% Use HO	% Users	Residue Persistence (Days)	Routes of Exposure
Trichlorfon	Golf Course	NA	8	1/yr	Jul.-Sept. 27-35 wks.	100	--	5	2	dermal(p)
	Lawn Granular	rotary spreader	8	1/yr	Jul.-Sept. 27-35 wks.	19	81	1	1 2	inhalation(a), oral(p), dermal(a)(p)
	Lawn Spray	NA	8	1/yr	Jul.-Sept. 27-35 wks.	100	--	2	2	oral(p), dermal(p)

(a) = applicator exposure
(p) = post application exposure
Note: For applicator dermal exposure, the residue persistence is 1 day.

Figure II.C.1 Residential Scenario Application and Usage Schedules for the Arid/Semiarid West Region (Region 7a)



<table>
<tr><th>January</th><th>February</th><th>March</th><th>April</th><th>May</th><th>June</th><th>July</th><th>August</th><th>September</th><th>October</th><th>November</th><th>December</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td></td><td colspan="8">Acephate Ornamental Spray</td><td rowspan="2"></td></tr>
<tr><td colspan="3">Bensulide Golf</td><td></td><td></td><td colspan="2">Bensulide Golf</td><td></td><td></td></tr>
<tr><td colspan="12">DDVP Pest Strip (Closet)</td></tr>
<tr><td colspan="12">DDVP Pest Strip (Cupboard)</td></tr>
<tr><td></td><td></td><td></td><td colspan="8">Disulfoton Ornamental Granular</td><td></td></tr>
<tr><td colspan="12">Fenamiphos Golf</td></tr>
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<tr><td colspan="8">Malathion Vegetable Garden Spray</td></tr>
<tr><td colspan="12">TCVP Aerosol Spray</td></tr>
<tr><td colspan="12">TCVP Powder</td></tr>
<tr><td colspan="12">TCVP Hand Pump Spray</td></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td colspan="3">Trichlorfon Golf</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td colspan="3">Trichlorfon Granular</td></tr>
<tr><td colspan="3">Trichlorfon Spray</td></tr>
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a. Dissipation Data Sources and Assumptions

i. Bensulide

A residue dissipation study was conducted with multiple residue measurements collected for up to 14 days after treatment. For each day following application, a residue value from a uniform distribution bounded by the low and high measurements was selected (the day zero distribution consisted of measurements collected immediately after application and 0.42 day after treatment). No half-life value or other degradation parameter was used, with the current assessment based instead on the time-series distribution of actual measurements. Residues measured at day 7 were assumed to be available and to persist to day 10 and day 10 measurements to persist to day 14.

ii. Malathion

For western regions a residue degradation study was based on a 3 day study conducted in California (application rate of 5 lb ai/acre). These measured residue values were entered into the Calendex software as a time series distribution of 4 values (Days 0, 1, 2, and 3).

For the vegetable gardening scenario in Region C, a residue dissipation study was conducted in California with multiple residue measurements collected up to 14 days after treatment. A uniform distribution bounded by the low and high residue measurements was used for each day after the application. The study was conducted at one pound ai per acre. The residues were adjusted upwards to account for the 1.5 pound ai per acre rate for vegetables.

iii. Fenamiphos

Snyder et al., 1999 collected residue dissipation data on the day of and day after application following the application of fenamiphos on a golf course. Only mean measurements were collected and used in the assessment.

iv. Trichlorfon

Residue values from a residue degradation study for the granular and sprayable formulations were collected for the “day of” and “day following” the application. A uniform distribution bounded by the low and high residue measurements was used, with these residue values adjusted proportionately upwards to simulate the higher active ingredient concentrations in use (i.e., adjusted to 0.5% and 1% for granular and sprayable formulations respectively). These distributions reflect actual measurements including those based on directions to water in the product. For use on home lawns for assessing non-dietary ingestion for children, these values were multiplied by a value selected from a uniform distribution bounded by 1.5 and 3 to account for wet hand transfer.

3. Development of Water Exposure Aspects of Arid/Semiarid West Region

Because of the localized nature of drinking water exposure, the water exposure component of this assessment focused on a specific geographic area within the Arid/Semiarid West Region. This region combines the Southwest Fruitful Rim and Basin and Range regions from the preliminary assessment. The selection process considers OP use and the relative potencies of those OP pesticides and the location, nature, and vulnerability of the drinking water sources. The methods used to identify a specific location within the region are described in the main document (Section I.E). The following discussion provides the details specific to the Arid/Semiarid West regional assessment for OP cumulative drinking water exposure. The discussion centers on four main aspects of the assessment: (1) the selection of counties in the Central Valley of California for the drinking water assessment for the region, (2) predicted cumulative concentrations of OPs in surface water for those OP-crop uses included in this regional assessment, (3) a comparison of the predicted concentrations used in the regional assessment with monitoring data for the region, and (4) a summary of water monitoring data used for site selection and evaluation of the estimated drinking water concentrations for the region.

a. Selection of Central Valley of California for Drinking Water Assessment

An evaluation of OP usage, drinking water sources, vulnerability of those sources to OP pesticide contamination, and available monitoring data indicates that (1) surface water sources of drinking water are likely to be more vulnerable than ground water sources, and (2) a surface water assessment based in the Central Valley will represent one of the more vulnerable sources of drinking water in the region.

In the preliminary OP cumulative risk assessment, OPP split the Central Valley into southern (Fresno County and south) and north-central (Merced, San Joaquin, and Stanislaus counties) segments based on use and rainfall. Total OP use is an order of magnitude greater in the southern portion of the valley while the central and northern portions are potentially more vulnerable to runoff. A comparison of the resulting OP cumulative distributions for each section showed that cumulative concentrations estimated for the north-central distribution were roughly two to three times greater than those for the southern section at the higher percentiles. Thus, OPP focused on the northern counties in the Central Valley for the revised assessment.

Total OP usage in the West region is greater than in any other region, with the vast majority of usage concentrated in the Central Valley and in southern

California/south-central Arizona. In 1997, approximately 10.5 million pounds (ai) of OPs were applied on agricultural crops in this region, with 90 percent of that occurring in the CA-AZ use areas. High OP-use crops in the region are cotton, alfalfa, nut trees, citrus, fruit orchards, and vegetables (Table II.C.3).

Table II.C.3. General overview of OP use in the CA-AZ area of the West Region.

Crops	Primary Production Areas	Total Pounds Applied	Percent of Total OP Use
Cotton	Southern CA, south-central AZ	3,311,000	35
Alfalfa	CA	1,319,000	14
Nut Trees	Central Valley	1,263,000	13
Citrus	Southern Central Valley	882,000	9
Orchard (fruit)	Central Valley	734,000	8
Lettuce	CA Coastal Valleys	366,000	4
Brassicas	CA Coastal Valleys	384,000	4
Sugar beets	Central Valley	175,000	2
Other vegetables	CA	415,000	4
Grapes	Central Valley	215,000	2
		9,404,000	96

(1) Source: NCFAP, 1997.

High OP-use areas are concentrated in the Central and Coastal Valleys of California and in southern California extending into south-central Arizona (Figure II.C.2). Little OP usage occurs in the Basin and Range. Cotton is the dominant OP use crop in southern California (little or no OP use on cotton is reported north of Fresno County) and in south-central Arizona. OP use on vegetables is dominant in the coastal valleys of California. In the drier southern portion of the Central Valley, the dominant OP use crops are cotton, nut trees, citrus, alfalfa, and grapes. OP use on cotton and citrus drops out north of Fresno County, where the dominant use crops are nut and fruit orchards, several vegetables (in particular, legumes, tomatoes, and asparagus), alfalfa, and field corn.

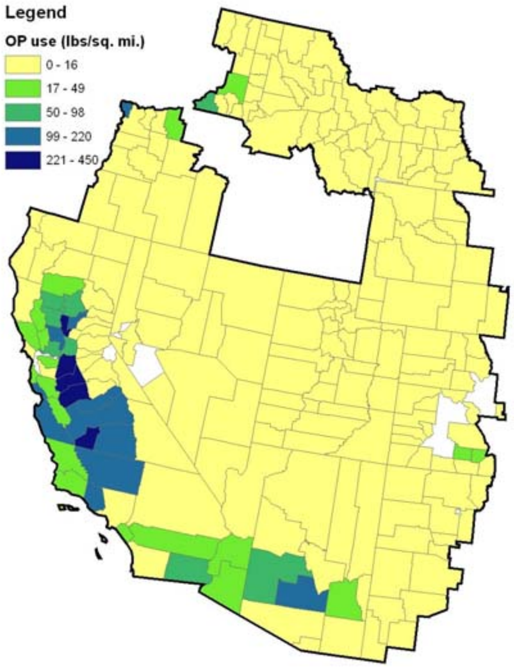

Figure II.C.2. Total OP usage (pounds per area) in the Arid/Semiarid West (source: NCFAP, 1997)

Surface water sources of drinking water are scattered throughout the region, with clusters in the northern and southern ends of California (Figure II.C.3). While many of the surface water intakes for the Central Valley are located in the mountainous regions outside of the agricultural areas, a few intakes occur within the valley. Runoff vulnerability in the region is generally low, although some areas within the region have a moderate runoff potential. In the Central Valley, runoff tends to be greater to the north, where more rainfall occurs. Timing of application is particularly critical in this region. Pesticide applications during the rainy season will potentially have a greater impact on water resources than applications during drier times of the year.

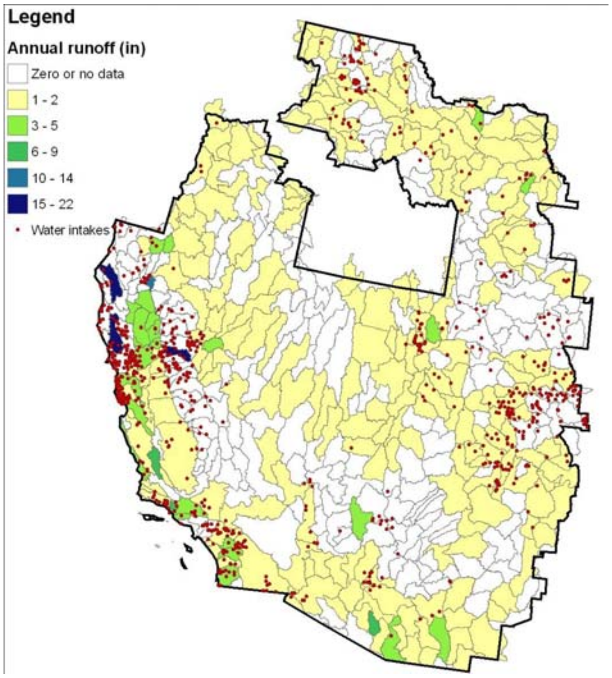

Figure II.C.3. Locations of surface water intakes of drinking water in relation to average annual runoff in the West Region.

Water in the Central Valley rivers is highly regulated, including a series of canals that bring water to and from irrigated fields. Surface water is the main source of drinking water in the northern part of the Central Valley, but ground water is the more important source in the southern San Joaquin river basin and in the high OP-use areas of Arizona.

The amount of pesticide usage in the Central Valley contributes to the vulnerability of surface water to pesticide contamination, even though this area has a lower runoff potential. Thus, drinking water sources in the Central Valley are among most vulnerable to pesticide runoff in the U.S. (Kellogg et al, 1999).

Similarly, the vulnerability of ground water to pesticide leaching is strongly impacted by the amount of pesticide used in the area and irrigation practices in the region. Figure II.C.4 indicates that ground water in the Central Valley may be potentially vulnerable to pesticide leaching. While portions of the Columbia Plateau have a moderate to low vulnerability to pesticide leaching, characteristics of the ground-water aquifer and monitoring indicate that OP contamination is not expected to be substantial.

The Central Valley aquifer is unconfined to a few hundred feet in depth, becoming confined in the south of the valley under “numerous overlapping lens-shaped clay beds”(USGS Hydrologic Investigations Atlas 730-B). The installation of thousands of wells in the San Joaquin Valley over time, some of which are screened throughout their length, has compromised the ability of the clay lenses to confine deeper aquifers, making them vulnerable to contamination through these wells. Overdevelopment of the ground-water resource has led in part to land subsidence in portions of the Central valley.

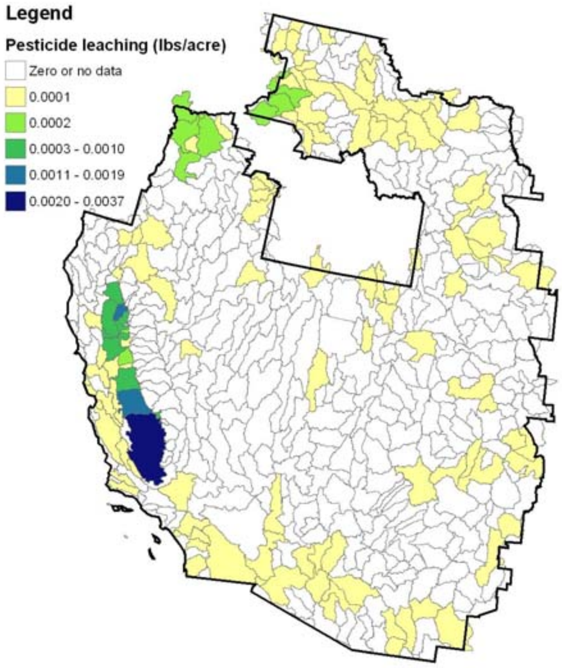

Figure II.C.4. Vulnerability of ground water resources to pesticide leaching in the West Region, adapted from USDA (Kellogg, 1998).

An evaluation of OP usage, drinking water sources, vulnerability of those sources to OP pesticide contamination, and available monitoring data indicates that (1) surface water sources of drinking water are likely to be more vulnerable than ground water sources in the West Region, and (2) a surface water assessment based in the Central Valley is representative of the more vulnerable areas within the region. The surface-water exposure assessment should be considered a conservative surrogate for the portion of the population deriving its drinking water from ground water. While surface water sources north of Fresno County are likely to be more vulnerable to runoff contamination, monitoring suggests that surface water sources in the southern Central Valley may also be vulnerable because of the greater magnitude of OP use in this region.

In the north/central counties in the Central Valley, OP use on nut trees, vegetables, alfalfa, and field corn accounted for more than 80 percent of total agricultural use (Table II.C.4).

Table II.C.4. OP use on agricultural crops in the Central Valley of California (Merced, San Joaquin, and Stanislaus Counties), West Region.

OP Usage/ Agricultural Crops				Cropland Acreage, Assessment Area	
Crop Group	**Crops**	**OP Usage x 1000 lb**	**Percent of Total OP Use**	**Acres x 1000**	**Pct of total Cropland**
Nut trees	Almond, walnut, pistachio	322	54	277	19
Fruit orchard	Apple, peach, pear, apricot, nectarine	78	13	39	3
Alfalfa	Alfalfa, hay	76	13	157	11
Vegetables: Legumes	Beans	33	6	35	2
Vegetables: Tomato	Tomato	14	2	73	5
Vegetables: Other	Asparagus, brassicas, melons	37	6	39	3
Corn	Field corn	21	3	68	4
Sugarbeet	Sugarbeet	8.5	1	15	1
Grapes	Grapes	7	1	109	7
				813	55

Pesticide use based latest data collected by USDA National Agricultural Statistics Service (NASS). For crops not included in the NASS survey, usage information comes from CA DPR Pesticide Use Reports. Acreage estimates based on USDA 1997 Census of Agriculture. Details on the sources of usage information are found in Appendix III.E.8.

b. Cumulative OP Concentration Distribution in Surface Water

The Agency estimated drinking water concentrations in the West region cumulative assessment using PRZM-EXAMS with input parameters specific to the Central Valley of California. Table II.C.5 summarizes pesticide use information from California Department of Pesticide Regulations (CDPR) used in the regional assessment. Chemical-, application-, and site-specific inputs into the assessments are found in Appendices III.E.5-7.

Table II.C.5. OP-Crop combinations and application information for the West Region assessment.

Chemical	Crop/Use	Pct Acres Treated	Rate, lb/A	Application Method	Application Dates
AzinphosMethyl	Almonds, walnuts	3	1.54	Airblast	Jul 12, Jul 19, Jul 20, Jul 26, Jul 27
Chlorpyrifos	Almonds, walnuts	23	1.69	Foliar/ airblast	May 10, May 17, Jun 07, Jul 26, Aug 02
Diazinon	Almonds, walnuts	10	1.86	Foliar/ airblast	Jan 11, Jan 18, Feb 01, Feb 02, Feb 08
Methidathion	Almonds, walnuts	10	0.96	Foliar/ airblast	Jan 11, Jan 18, Jan 19, Jan 25, Feb 01
Naled	Almonds, walnuts	1	1.59	Foliar/ airblast	Jan 18, Jan 24, Jan 25, Jan 26, Feb 01
Phosmet	Almonds, walnuts	4	2.83	Foliar/ airblast	Mar 22, Jul 19, Jul 26, Aug 02, Aug 09
Chlorpyrifos	Alfalfa	65	0.56	Aerial	Mar 08, Mar 15, Mar 22, Apr 26, Aug 30

Chemical	Crop/Use	Pct Acres Treated	Rate, lb/A	Application Method	Application Dates
Dimethoate	Alfalfa	3	0.35	Aerial/broadcast	Mar 08, Mar 15, Mar 22, Mar 29, May 17
Malathion	Alfalfa	2	1.13	Aerial/broadcast	Mar 22, Mar 29, Apr 05, Apr 12, Apr 19
MethylParathion	Alfalfa	1	0.83	Aerial/broadcast	Mar 07, Mar 08, Mar 09, Mar 15, Mar 22
Phosmet	Alfalfa	10	0.71	Aerial/broadcast	Mar 08, Mar 15, Mar 16, Mar 22, Mar 29
AzinphosMethyl	Apples, pears	30	1.04	Airblast	May 24, Jun 14, Jun 21, Jul 19, Aug 23
Chlorpyrifos	Apples, pears	46	1.30	Airblast	Mar 08, Apr 26, May 03, May 24, Jun 21
Diazinon	Apples, pears	16	1.49	Airblast	Jan 25, Mar 08, Mar 09, Mar 15, Aug 16
Dimethoate	Apples, pears	2	0.57	Airblast	Apr 18, Apr 19, Apr 20, May 10, Jun 07
Methidathion	Apples, pears	30	1.14	Airblast	Jan 18, Jan 25, Feb 22, Mar 01, Mar 08
Phosmet	Apples, pears	76	2.99	Airblast	May 17, May 31, Jul 05, Jul 26, Aug 23
Chlorpyrifos	Peaches, apricots, nectarines	4	1.81	Airblast	Jan 25, Jan 26, Feb 01, Dec 16, Dec 17
Diazinon	Peaches, apricots, nectarines	17	2.09	Airblast	Nov 22, Nov 23, Dec 07, Dec 21, Dec 28
Dimethoate	Peaches, apricots, nectarines	0.1	3.58	Airblast	Jun 05, Jun 06, Jun 07, Jun 08, Jun 09
Methidathion	Peaches, apricots, nectarines	19	1.16	Airblast	Jan 18, Mar 01, Dec 06, Dec 20, Dec 21
Naled	Peaches, apricots, nectarines	2	1.63	Airblast	Jan 04, Jan 05, Jan 17, Jan 18, Jan 19
Phosmet	Peaches, apricots, nectarines	32	2.76	Airblast	May 31, Jun 07, Jun 14, Jul 05, Jul 19
Acephate	Legume (dry/ succulent beans)	109	0.86	Aerial broadcast	Aug 02, Aug 09, Aug 16, Aug 30, Sep 06
Dimethoate	Legume (dry/ succulent beans)	102	0.40	Aerial broadcast	Jul 19, Aug 02, Aug 09, Aug 30, Sep 13
Malathion	Legume (dry/ succulent beans)	5	1.06	Aerial broadcast	Jun 28, Aug 02, Aug 09, Aug 10, Aug 16
Naled	Legume (dry/ succulent beans)	10	0.87	Aerial broadcast	Aug 30, Sep 06, Sep 13, Sep 14, Sep 27
Acephate	Tomato	1	0.81	Aerial broadcast	Aug 09, Aug 10, Aug 30, Aug 31, Sep 06
Chlorpyrifos	Tomato	0	0.60	Foliar broadcast; unincorp.	Jul 12, Aug 02, Aug 03, Aug 23, Aug 24
Diazinon	Tomato	2	1.10	Ground broadcast; no incorp	Mar 08, May 03, May 17, May 24, Jul 12
Dimethoate	Tomato	68	0.44	Aerial broadcast	Jul 05, Jul 19, Jul 26, Aug 02, Aug 23
Malathion	Tomato	0.2	1.18	Aerial broadcast	Jul 26, Jul 27, Aug 02, Aug 03, Aug 16
Methamidophos	Tomato	11	0.85	Aerial broadcast	Jul 12, Jul 26, Aug 16, Sep 06, Sep 27
Diazinon	Broccoli, brassicas	1	1.00	Ground broadcast; no incorp	Aug 16, Aug 17, Aug 18, Aug 19, Aug 20
Dimethoate	Broccoli, brassicas	39	0.36	Aerial broadcast	Aug 16, Aug 30, Sep 06, Sep 13, Oct 11

Chemical	Crop/Use	Pct Acres Treated	Rate, lb/A	Application Method	Application Dates
Methamidophos	Broccoli, brassicas	14	1.49	Aerial broadcast	Sep 06, Sep 26, Sep 27, Sep 28, Oct 18
ODM	Broccoli, brassicas	12	0.50	Aerial broadcast	Jan 11, Feb 15, Oct 17, Oct 18, Oct 19
Chlorpyrifos	Asparagus	19	0.64	Aerial broadcast	Jul 05, Jul 26, Aug 02, Sep 13, Oct 18
Disulfoton	Asparagus	71	1.05	Aerial broadcast	Aug 09, Sep 06, Sep 20, Oct 04, Oct 11
Malathion	Asparagus	8	0.99	Aerial broadcast	Jun 06, Jun 07, Jun 08, Jun 21, Jun 28
Chlorpyrifos	Sugarbeet	47	0.62	Aerial broadcast	Mar 17, May 26, Jun 16, Jul 07, Jul 14
Methamidophos	Sugarbeet	11	0.73	Aerial broadcast	May 10, Aug 02, Aug 09, Aug 16, Oct 04
Naled	Sugarbeet	1	1.01	Aerial broadcast	Sep 18, Sep 19, Sep 20, Sep 21, Sep 22
ODM	Sugarbeet	6	0.44	Aerial broadcast	Apr 19, Apr 20, Apr 26, Sep 06, Sep 20
Phorate	Sugarbeet	2	0.24	Incorporation	Apr 10, Apr 11, Apr 12, Apr 13, Apr 14
Diazinon	Cantaloupe	28	0.34	Aerial broadcast	May 17, May 24, Aug 01, Aug 02, Aug 03
Dimethoate	Cantaloupe	15	0.48	Aerial broadcast	Aug 02, Aug 03, Aug 09, Aug 10, Aug 17
ODM	Cantaloupe	4	0.38	Aerial broadcast	Jul 24, Jul 25, Jul 26, Jul 27, Jul 28
Chlorpyrifos	Field Corn	8	1.13	Ground	May 17, Jun 07, Jun 14, Jun 28, Jul 12
Dimethoate	Field Corn	0.1	0.32	Aerial broadcast	Mar 13, Mar 14, Mar 15, Mar 16, Jun 14
Malathion	FieldCorn	0.1	0.50	Aerial broadcast	Mar 22, Mar 23, Apr 05, Aug 16, Aug 23
Phorate	Field Corn	18	1.17	Ground; incorporation	May 03, May 17, May 31, Jun 07, Jun 14
Chlorpyrifos	Grapes	0.4	1.86	Airblast/ vineyard	Mar 07, Mar 08, Mar 09, Mar 15, Mar 16
Diazinon	Grapes	1	0.34	Airblast/ vineyard	May 17, Aug 08, Aug 09, Aug 10, Aug 11
Dimethoate	Grapes	1	0.29	Airblast/ vineyard	Jul 17, Jul 18, Jul 19, Jul 20, Jul 21
Malathion	Grapes	1	1.50	Airblast/ vineyard	Jun 19, Jun 20, Jun 21, Jun 22, Jun 23
Naled	Grapes	1	0.67	Airblast/ vineyard	Jun 21, Jul 19, Aug 02, Aug 09, Sep 06

Application information comes from CA DPR Pesticide Use Reports. Application dates are split into quintiles so that each application represents 20% of the total OP applied to that crop.

The Agency used CDPR's Pesticide Use Reporting (PUR) data in this regional assessment. The PUR data contains detailed information on all commercial pesticide applications made on each date to every field within the State of California. The Agency used this data to obtain actual application dates reported by applicators rather than indirect estimates of dates from pesticide use windows. After plotting the temporal distribution for each particular use to represent all acre treatments that were made throughout the calendar year, the Agency selected the midpoints of each 20th percentile (quintiles). Thus, total pesticide application for each crop was split into 5 increments. A comparison of estimated OP cumulative distributions using the quintile applications described here with single applications applied at the beginning of the application window (as done in the other regions) found that the single applications resulted in estimated concentrations that were less than a factor of 2 greater than estimated by the split applications (Appendix III.E.11).

The temporal distribution for each OP use generated with the PUR data eliminated the need to know the base acres treated and the average number of applications. In the PRZM-EXAMS approach used here, the number of times a base acre is treated does not affect the environmental fate of these OPs. The pesticide use statistics of primary concern are the application date, the total area treated relative to total area in the watershed, and the average application rate. While it is possible to 'chop' up such a temporal distribution into smaller pieces (e.g., 35 application dates), the Agency determined that it could adequately capture the majority of the temporal variability in pesticide usage reported among growers (users) in the region by approximating these distributions with five application dates.

Figures II.C.5 and II.C.6 depict total usage of OPs in the north-central Central Valley in 1998, by crop and by active ingredient, respectively. Most of the OP use in this area occurred between weeks 19 and 40; with over 42,000 lbs ai applied during week 30. Some early applications (dormant season use of diazinon) occur on almonds during January, followed by some spring applications (chlorpyrifos) on alfalfa (first cuttings). Various OP-crop uses contributed to overall use during this period, including applications to walnuts, almonds, corn, and tomatoes.

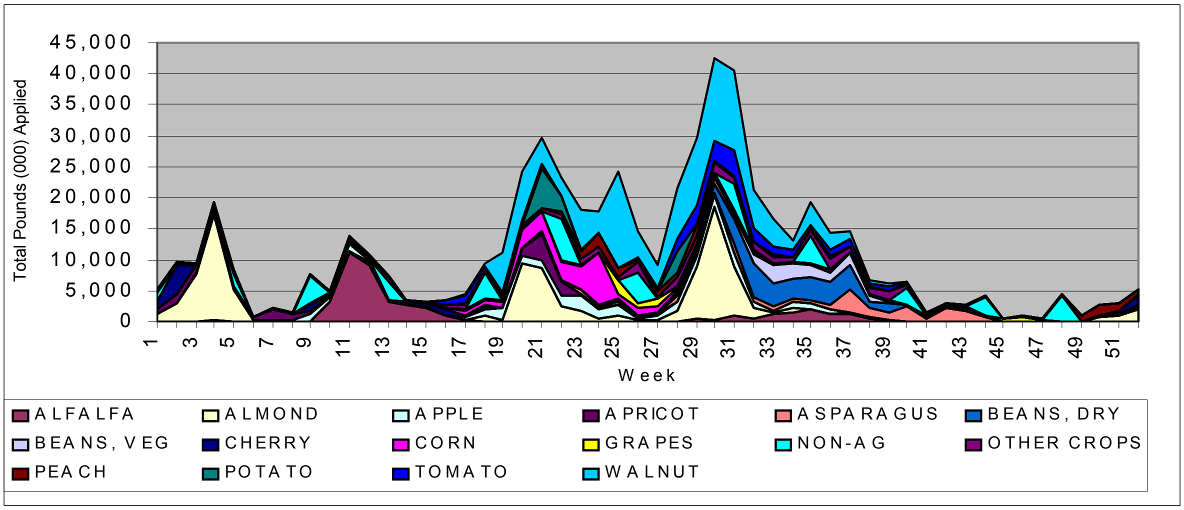

Figure II.C.5. Total OP use for north Central Valley, by crop, 1998.

Chlorpyrifos accounted for the greatest usage among OPs (Figure II.C.6), with 180,000 lbs ai applied. Some chlorpyrifos was applied to alfalfa during the early season, but most was applied to almonds and walnuts during the summer months. There was also a considerable amount of phosmet (96,000 lbs ai), diazinon (58,000 lbs ai) and acephate (33,000 lbs ai) applied.

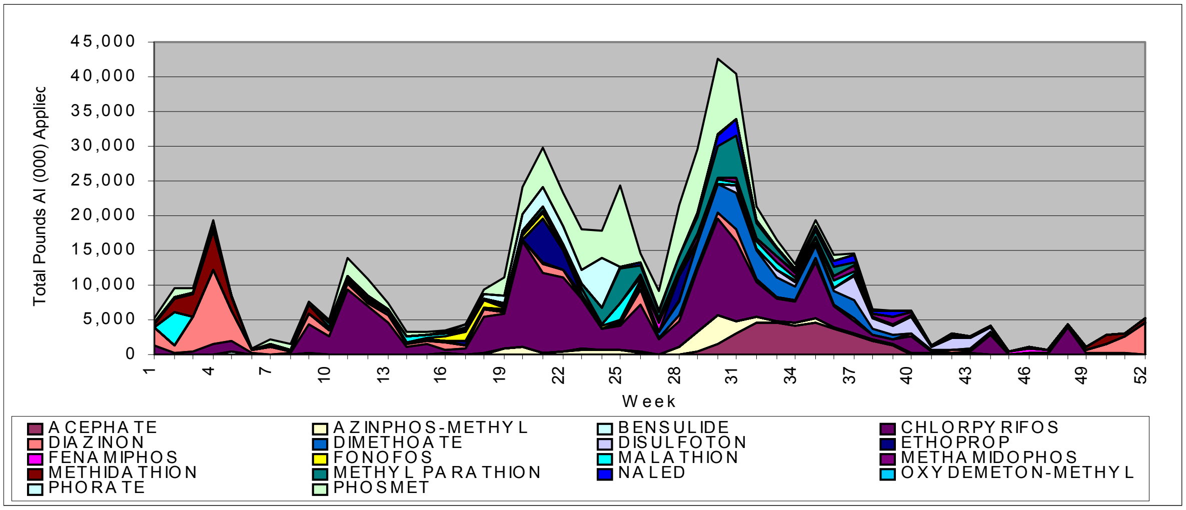

Figure II.C.6. Total OP use for north Central Valley, by active ingredient, 1998.

OPP compared estimated OP cumulative distributions for the West region derived from both CDPR PURs and NASS use surveys (Appendix III.E.11). OP cumulative concentrations estimated using the more complete CDPR use information were approximately 3 times greater than concentrations estimated using the NASS survey information.

Estimated cumulative OP concentrations as well as estimated concentrations for individual OP pesticides in the region were in the sub-part per billion range (Table II.C.6). Several OPs – chlorpyrifos, diazinon, disulfoton, methidathion, and phorate had estimated maximum concentrations of 0.1 to 0.3 ppb. At the 99th percentile level, only diazinon had an estimated concentration greater than 0.1 ppb.

Table II.C.6. Estimated percentile concentrations of individual OP pesticides and of the cumulative OP distribution in the Arid/Semiarid West Region.

Chemical	Crop/Use	Concentration in ug/L (ppb)						
		Max	99th	95th	90th	80th	75th	50th
Acephate	Legume vegetables, tomato	1.6e-02	1.3e-02	8.5e-03	5.0e-03	3.7e-04	1.0e-04	3.7e-06
Azinphos Methyl	Apples, pears; nuts (almonds, walnuts)	3.8e-02	5.7e-03	2.5e-03	1.8e-03	1.3e-03	1.1e-03	4.7e-04
Chlorpyrifos	Nuts; fruit trees; alfalfa; sugarbeets; corn; grapes; tomato; asparagus	1.3e-01	5.4e-02	3.7e-02	3.0e-02	2.3e-02	2.0e-02	1.2e-02
Diazinon	nuts; fruit trees; grapes; brassicas; tomato; melons	2.3e-01	1.4e-01	8.1e-02	5.6e-02	3.2e-02	2.5e-02	9.9e-03
DDVP	Naled degradate	1.3e-03	1.9e-04	9.4e-06	6.3e-07	2.6e-09	1.4e-10	8.2e-13
Dimethoate	Fruit trees; alfalfa; corn; grapes; legumes; tomatoes; brassicas; melons	8.4e-02	2.2e-02	1.6e-02	1.3e-02	8.0e-03	5.4e-03	1.4e-03
Disulfoton	Asparagus	1.2e-01	4.9e-02	3.7e-02	3.3e-02	2.8e-02	2.6e-02	1.7e-02
Malathion	Alfalfa; corn; grapes, legumes; tomatoes; asparagus	8.3e-03	1.9e-03	1.2e-03	7.9e-04	3.0e-04	1.2e-04	2.8e-08
Methamidophos	Acephate degradate; tomato; sugarbeet; legume; brassicas	1.3e-02	3.0e-03	1.6e-03	9.6e-04	3.6e-04	2.3e-04	4.6e-06
Methyl Parathion	Alfalfa	5.3e-03	2.6e-03	1.4e-03	8.6e-04	1.4e-04	4.7e-05	4.3e-08
Methidathion	Nut trees; fruit trees	1.5e-01	6.5e-02	3.5e-02	2.0e-02	8.4e-03	5.8e-03	7.6e-04
Naled	Nut trees; fruit trees; sugarbeets; grapes; legumes	4.4e-03	9.0e-04	5.3e-05	1.0e-05	2.3e-07	1.2e-08	2.1e-12
ODM	Sugarbeet; brassicas; melons	3.8e-03	2.2e-03	1.1e-03	6.7e-04	3.9e-04	3.2e-04	1.4e-04
Phorate	Sugarbeet; corn	2.6e-01	1.0e-02	5.1e-04	4.2e-05	3.5e-07	3.2e-08	3.5e-12
Phosmet	nut trees; fruit trees; alfalfa	3.2e-02	3.0e-03	6.1e-04	6.3e-05	1.4e-06	2.3e-07	1.2e-11
OP cumulative concentration in methamidophos equivalents		7.6e-01	2.2e-01	1.6e-01	1.4e-01	1.2e-01	1.1e-01	7.6e-02

Figure II.C.7 displays 35 years of predicted OP cumulative concentrations for the central/northern counties of the Central Valley of California. Estimated peaks generally remained below 0.2 ppb, exceeding 0.3 ppb in only 3 of 35 simulated years.

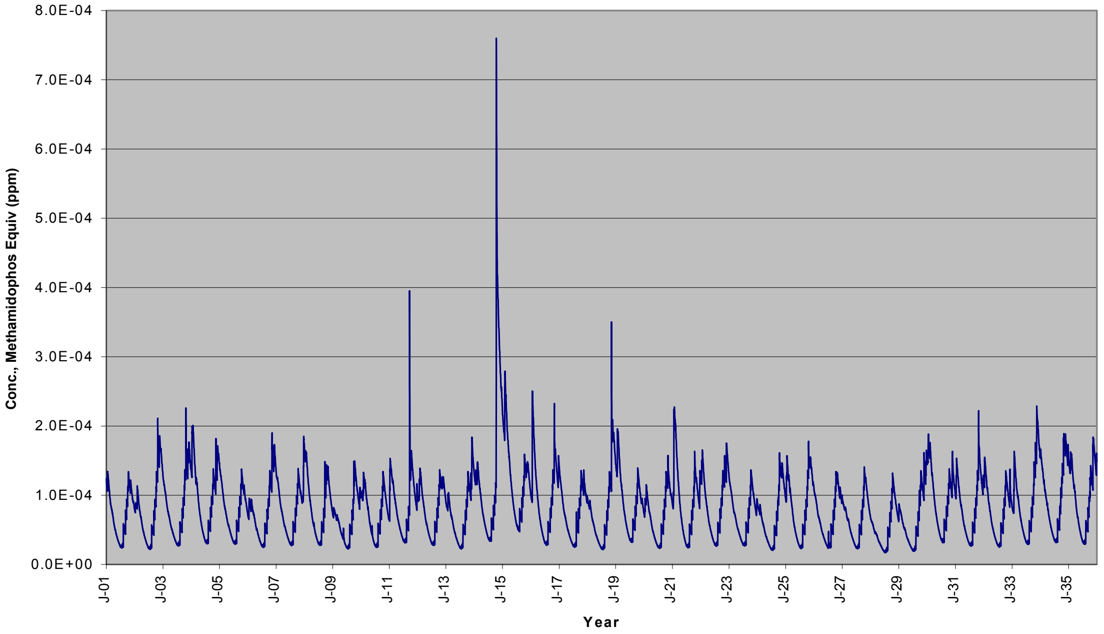

Figure II.C.7. Cumulative OP distribution in water in the West Region, 35 years of weather patterns.

An overlay of all 35 years of predicted values in the same year span shows that pulse OP concentrations generally occurred during the late season, on or after week 40, and extending into the beginning of the following year (Figure II.C.8).

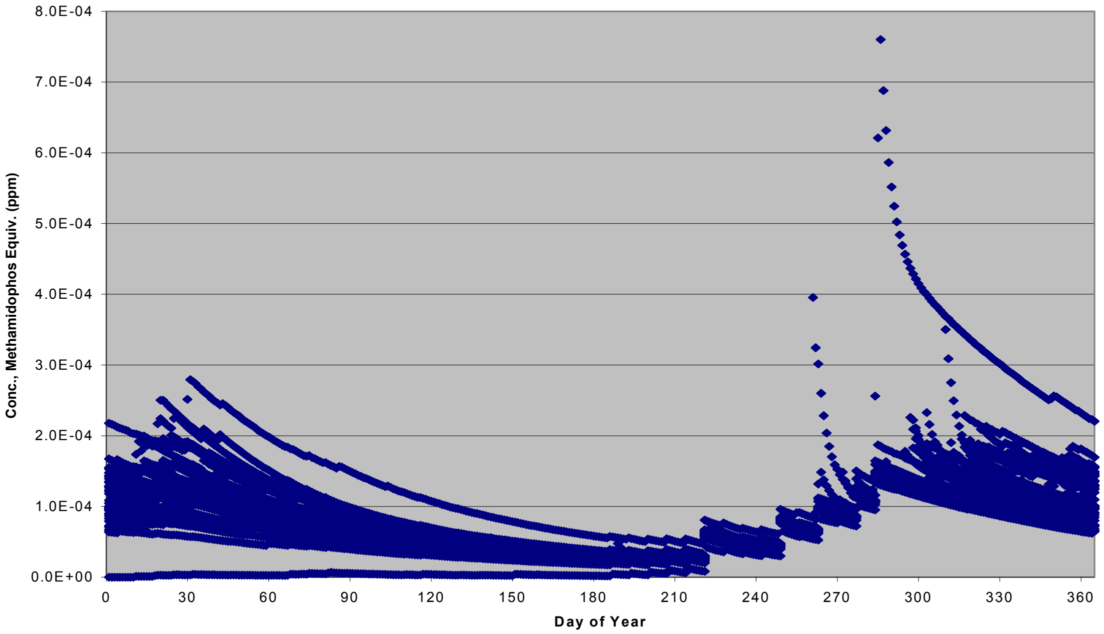

Figure II.C.8. Variations in yearly pattern of cumulative OP concentrations in water in the West Region (35 years of varying weather patterns).

Disulfoton use on asparagus and phorate use on corn were the two contributors to the highest OP peak concentration found in the late season peak of Year 14 (Figure II.C.9).

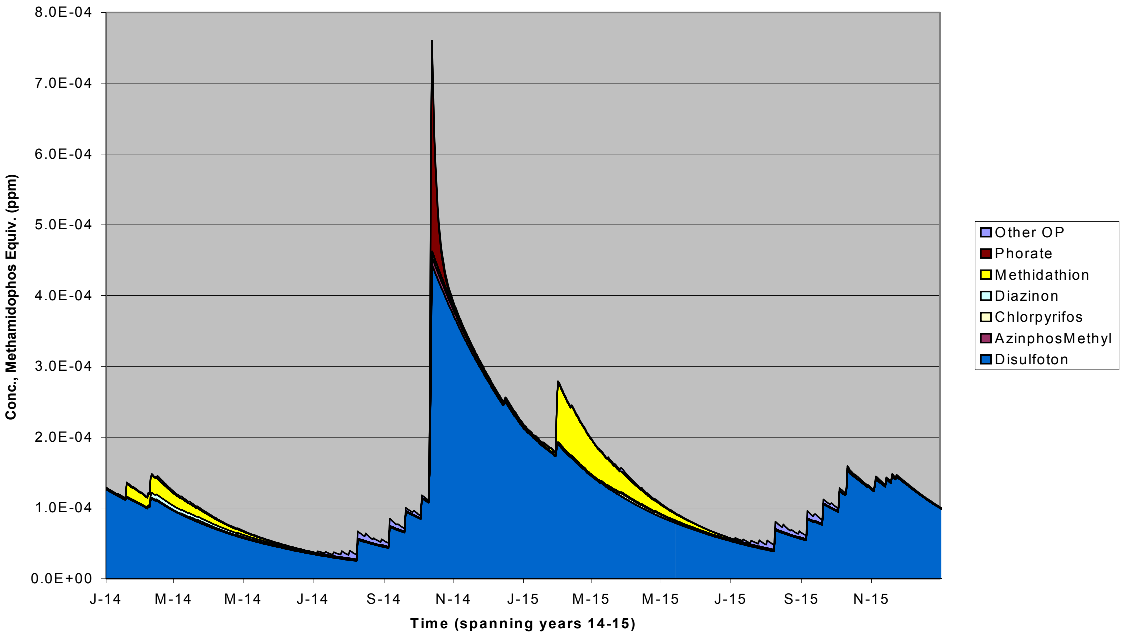

Figure II.C.9. Cumulative OP distribution spanning 2 years (14-15) showing relative contributions of individual OPs in the West Region.

It is important to note that these relative contributions reflect both individual chemical concentrations in water and the relative potency factor (RPF) of each of the OP chemicals found in the water. This can be seen by comparing the cumulative OP distribution in methamidophos equivalents (Figure II.C.9) with the distribution of individual OP pesticides over the same time span (Figure II.C.10). The high diazinon pulse seen in year 14 translates into only a modest contribution to the cumulative OP load for that year because of the low RPF for diazinon (0.01). In contrast, disulfoton, with an RPF of 1.26, dominates the cumulative OP load, despite lower concentrations in water.

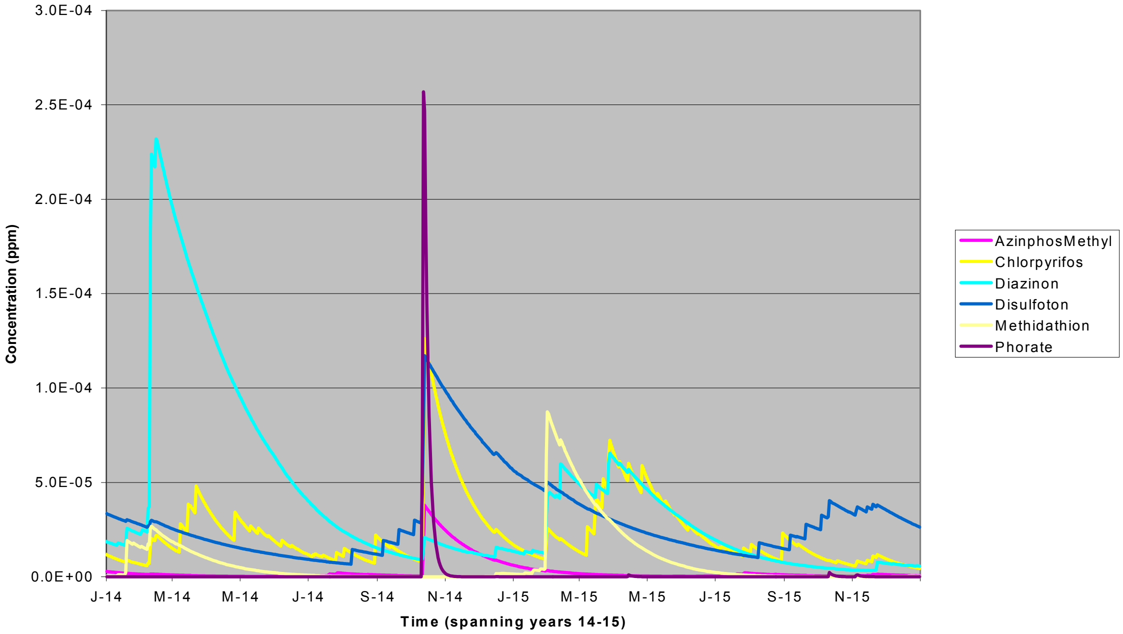

Figure II.C.10. Concentrations of selected OPs spanning 2 years (14-15) in the West Region. Contrast with Figure II.C.9 for effect of relative potency on cumulative OP concentration.

c. A Comparison of Monitoring Data versus Modeling Results

In comparison to NAWQA monitoring from agricultural sites in the San Joaquin-Tulare Basin (summarized below and in Appendix III.E.1), estimated concentrations for individual OP pesticides (Table II.C.6) tended to be similar to or less than reported detections in the NAWQA study unit. Reported detections of azinphos methyl, malathion, and methyl parathion were an order of magnitude greater than the estimated concentrations for the 75th to 90th percentiles and greater. The 99th percentile of monitoring detections for diazinon was an order of magnitude greater than estimated concentrations. Estimated chlorpyrifos distributions through the median and diazinon distributions below the 99th percentile were similar to the distributions of monitoring concentrations in the agricultural streams. Neither phorate nor disulfoton were detected in the NAWQA study. Approximately 99 percent of the estimated concentrations for phorate fell below the USGS analytical limit of detection (LOD). The estimated maximum concentration for disulfoton was 7 times greater than the LOD; 99th and 95th percentile estimates were roughly 2 times greater than the LOD.

In evaluating these comparisons, it is important to realize that the estimated cumulative OP concentrations used in the exposure assessment represent concentrations that would occur in a reservoir, and not in the streams and rivers represented by the NAWQA sampling. The sampling frequency of the NAWQA study (sample intervals of 1 to 2 weeks apart or less frequent) was not designed to capture peak concentrations, so it is unlikely that the monitoring data will include true peak concentrations. As noted earlier, the surface-water hydrology in this region is complicated by irrigation and by a system of canals. The main document provides a characterization of what the water exposure estimates represent and includes an analysis of the factors that most influence these estimated concentrations.

One reservoir (Canyon Reservoir near Elsinore, CA) in the USGS-EPA reservoir monitoring study is located in the Arid/Semiarid West Region. However, this reservoir is located outside of the high OP-use area of the Central Valley of California or the moderate OP use areas in southern California and was selected to represent urban/residential pesticide runoff. Thus, no relevant comparison can be made between the estimated OP concentrations made for the West Region and monitoring results from this reservoir.

d. Summary of Available Monitoring Data for the West Region

The **Sacramento River Basin (SACR) NAWQA** study site includes the Sacramento Valley in the Fruitful Rim, SW. The Sacramento River is the largest river in the State of California, and is a highly managed water body which meets the needs of the more than one million people in the Sacramento area. The USGS indicates that while the concentrations of OP insecticides in agricultural and urban streams in this region “sometimes exceed amounts that are toxic to zooplankton in laboratory tests, the toxicity is greatly reduced or eliminated when concentrations of these pesticides are diluted by the Sacramento River” (USGS Water Resources Circular 1215).

Surface-water monitoring included 3 intensive sampling sites, including the Colusa Basin Drain, which in the late 1980s had elevated concentrations of methyl parathion and malathion. Since that time, a program to reduce spray drift and increase paddy-water holding time has reduced detected concentrations dramatically. A description of this program is included in the State Monitoring Appendix. An urban intensive study site was also sampled.

In the SACR study, chlorpyrifos, diazinon, malathion, and azinphos-methyl were detected in surface water. Diazinon was detected in 71% of agricultural samples and 35% of mixed land-use samples, with a maximum concentration of slightly over 0.1 ug/l. Chlorpyrifos was detected in 29% of agricultural samples with a maximum concentration detected of about 0.05 ug/l. Malathion was detected in 53% of urban samples and 33% of agricultural samples, with a maximum detection of nearly 1 ug/l.

An aquifer study in the SACR included single samples of 31 domestic wells in the southeastern Sacramento Valley, where the Sacramento Valley aquifer is an important domestic and irrigation water source. Ground water in some other parts of the Sacramento Valley are not potable, due to elevated levels of fluoride and boron. A rice land-use study included single samples from 28 monitoring wells installed near the water table beneath or near rice fields. Finally, 19 urban monitoring wells were sampled once each from the surficial, unconfined aquifer. No OPs were detected in ground water from any of these studies.

The **San Joaquin-Tulare Basins (SANJ) NAWQA** study site includes the southern Central Valley of California. Surface water accounts for more overall water use than ground water, but ground water is the predominant source of drinking water in this region (USGS Water Resources Circular 1159). Irrigation accounts for the greatest amount of water use, and is also the greatest source of aquifer recharge, which can lead to contamination of ground water with agricultural chemicals.

Ground-water monitoring in the SANJ included single samples from 30 domestic wells around the eastern portion of the valley. Monitoring also included in single samples from 20 domestic wells and 10 monitoring wells each in almond, vineyard and row crop land-use ground-water studies. More than 50% of the monitoring wells in each of these studies were within a quarter-mile of cropped fields. Chlorpyrifos, malathion and diazinon were detected in one, two, and three ground water samples, respectively. One detection of malathion at 0.1 ug/l was the highest OP concentration detected in ground water.

The SANJ report specifically mentions that “high concentrations of organophosphate insecticides, resulting from application to some orchards during the winter, are of particular concern” (USGS Water Resources Circular 1159). Surface-water monitoring included biweekly to monthly sampling at intensive agricultural, rangeland and urban sites in 1993. Another 23 sites were sampled once at low flow in urban and agricultural areas.

Diazinon was detected in 71% of samples taken, with a maximum concentration of 3.8 ug/l. Chlorpyrifos was detected in 52% of samples, with a maximum concentration of about 0.5 ug/l. Azinphos methyl was also extensively (12%) detected, with a maximum concentration of about 1.0 ug/l. Malathion was detected in 8% of samples, with a maximum concentration between 0.5 and 1.0 ug/l. Ethoprop, disulfoton, methyl parathion and terbufos were detected in fewer than 1% of samples analyzed. The maximum concentrations of chlorpyrifos were detected in samples taken around the winter application season.

The USGS San Joaquin River Basin study included a study designed to determine sampling frequency needed to characterize the occurrence and distribution of pesticides in surface water in a semiarid agricultural region such as the SJRB. Results indicated that sampling three times per week is more likely to detect higher concentrations than once per week, as indicated by the larger variance about the median for the more frequent sampling. Sampling once per week is sufficient if only the median concentration is important.

The **Central Arizona Basins (CAZB) NAWQA** study unit is located in southern and central Arizona. The dominant sources of drinking water in central Arizona are deep basin aquifers, some of which may have been recharged thousands of years ago. At the very least, 55% of wells tested in the Central Arizona Basins NAWQA study area (CAZB) were recharged before 1953 (USGS Water Resources Circular 1213) .

The main aquifers in the Central Arizona region were formed by the sedimentary infilling of structural depressions typical of the Basin and Range physiographic province. These sediments, which range in thickness from a few thousand to as much as 10,000 feet, have led to a topography of broad, sloping plains interrupted by sharply rising mountains (USGS Professional Paper 1406-A). Natural recharge to these aquifers occurs mainly in the foothills of the mountain ranges, where rainfall is greater, and through infiltration from larger rivers. The USGS Regional Aquifer-System Analysis program identified 72 separate basin aquifers that are “virtually independent hydrologic entities that share common geologic and hydrologic characteristics.”

Alluvial deposits in the vicinity of major streams in Arizona range in thickness up to about 300 feet, and where locally saturated serve as aquifers. Chlorpyrifos was detected in a single sample from a shallow monitoring well in the CAZB study unit, but no OP was detected in samples from wells installed in the deeper aquifers. Although a single sampling of a well network is not definitive in determining the likelihood of pesticide contamination, the depth of the aquifers, combined with the very low rainfall for the region, result in very slow recharge rates which may delay contamination by OP residues for a long time.

In the CAZB report, the USGS notes that domestic wells drawing from below confining clay beds are protected to a large extent from surface contamination. However, the older water from below this layer could be contaminated in the future if large-scale water induces downward flow through the clay layer, or through breaches through the clay layer by well-drilling. For the present, however, the Arizona portion of the Fruitful Rim NCV should be conservatively represented by monitoring and modeling assessments for California.

Increased water withdrawal in Arizona that occurred with population growth from the middle 20th century has greatly exceeded recharge, and has led to depletion of aquifers. In addition to the loss of water that had been stored in the aquifer for hundreds of years, the withdrawal has led to compaction of pore spaces in some depleted portions of the aquifer. This has led to land subsidence in some places, and even to crevassing at the land surface.

In order to avoid permanent damage to the storage capacity of the aquifer, and to meet water needs for the long term, city and state water authorities have put in place plans to replace water taken from aquifer storage through artificial recharge.

Surface-water monitoring in this region included two intensive sampling sites from agricultural streams, and three other fixed sites which were sampled quarterly. Diazinon was detected in 97% of samples, and chlorpyrifos in 94%, all below 0.5 ug/l. malathion was detected in 26% of samples at similar concentrations. Disulfoton was detected once at nearly 1 ug/l. Azinphos methyl, methyl parathion, and phorate are also reported to have been detected in surface water.

However, while these mixed agricultural/urban streams may be effected ecologically by this contamination, they are not used as drinking water sources. The two streams (Buckeye Canal and Hassayampa River) are typical of most in the region, in that flow is maintained through addition of treated wastewater effluent and irrigation return water.

The California Environmental Protection Agency Department of Pesticide Regulation (CDPR) performed a 10-year study of **rice pesticides in surface water**, which included methyl parathion and malathion. CDPR samples the Colusa Basin Drain, an agricultural discharge channel that collects outflow from rice fields from about 20 to 100 miles north of Sacramento, and west of the Sacramento River. This area is used for many continuous miles of rice monoculture on heavy clay soils.

According to the CDPR, methyl parathion was detected at concentrations of up to 6 ppb in 1989. CDPR was concerned with surface water contamination by a suite of rice pesticides. By the late 1980s, CDPR had instituted a control program to reduce the surface water impacts of rice herbicides. In the early 1990s, the CDPR expanded the program to include rice insecticides.

The program includes both irrigation and application controls to reduce direct input of pesticides to the Colusa Basin Drain, which drains to the Sacramento River. Rice farmers are required to hold water on flooded rice fields for prescribed periods of time before releasing it to the drainage system, periods which depend on the pesticides applied. The holding time for methyl parathion is 24 days, but it is held longer if applied concurrently with another pesticide that must be held longer. A voluntary holding time of 4 days is suggested for malathion. Application controls include requirements such as positive shutoff systems for aircraft nozzles, use of drift control agents, and a 300-foot buffer from water bodies for aerial applications.

CDPR has seen measurable improvements in the samples they have taken each year from early or mid-April to mid-June. For instance, the peak concentration of methyl parathion detected in 1996 was 0.12 ppb. A maximum concentration of 0.107 ppb of methyl parathion was detected in 32 samples taken in 1997. A single detection of <0.1 ug/l of malathion was detected in 1997. These data reflect successful mitigation, and also a reduction in methyl parathion use in the area over 15 years.

The CDPR and the USGS have ongoing studies investigating OP contamination from winter use as a **dormant spray to tree fruits and tree nuts**. Since the series of CDPR dormant spray studies focus sampling on pesticides used in the area, coinciding with when they were applied, the frequency and concentrations of OP detections have both been relatively high. For instance, in sampling in the winters of 1991-1992 and 1992-1993, diazinon, methidathion, and chlorpyrifos were detected in 72, 18 and 10% of 108 samples collected in the San Joaquin River Basin, respectively. Dimethoate was detected in 60% of samples taken in the watershed in the summer of 1992, at concentrations up to 2.4 ug/l. Azinphos-methyl, chlorpyrifos, diazinon, and methidathion were also detected in summer sampling.

Sampling in the Sacramento River watershed has also led to detections of OPs from dormant spray use. Diazinon and methidathion, the two most important tree fruit and tree nut dormant spray insecticides in the watershed, were detected at levels toxic to some aquatic invertebrates. Concentrations and frequency of detection of diazinon was greater than that of methidathion. Details of the detection of diazinon in studies performed by the State of California can be found in the diazinon Reregistration Eligibility Document, which is available on the internet at http://www.epa.gov/pesticides/op/status.htm.

Frank Spurlock of the CDEP has written a paper on the findings of chlorpyrifos and diazinon in surface water. This paper, which has not yet been published, is a summary of about 30 monitoring studies, including samples from the Sacramento and San Joaquin Rivers and their tributaries, as well as agricultural drains. The monitoring was predominantly from streams affected by agricultural runoff. Urban data is limited, but urban concentrations were much higher.

Agricultural loading was the most significant load of these chemicals in the Sacramento River. Small streams in the Sacramento basin had the highest agricultural detections. Of approximately 3900 individual samples for diazinon a very small percentage exceeded the lifetime Health Advisory of 0.6 ppb in rivers and tributaries. None of the 3700 samples for chlorpyrifos had concentrations that exceeded the lifetime Heath Advisory of 20 ppb. Overall, concentrations of chlorpyrifos were lower than those of diazinon. In general, based on analysis which will be available when the paper is published, overall concentrations in the winter application months have declined since a decade ago, corresponding with reductions in use (Frank Spurlock, personal communication).

Preliminary reports from a prospective ground-water monitoring study for fenamiphos use on grapes in California, begun in October, 1997, report detections of fenamiphos and its sulfone and sulfoxide degradates in soil-pore water and ground water after one application of 6 lb A.I./acre. Fenamiphos and fenamiphos sulfone were detected in one ground-water sample, at concentrations of 0.05 and 0.53 ppb respectively, 216 days after treatment (DAT). Fenamiphos sulfoxide was detected in ground water samples from four of eight well clusters, at concentrations up to 2.13 ppb. These concentrations can be considered as a lower bound measure of the peak concentrations of total fenamiphos residues in ground water resulting from use of fenamiphos on HSG A soils. It is likely that application to similar soils in areas with higher rainfall or at higher applications rates will result in higher groundwater concentrations. A similar study on more vulnerable soils in the Florida Central Ridge resulted in significantly higher ground-water detections.

The CDPR is currently sampling “about 40 domestic wells for fenamiphos in high use areas” (Robert Matzner, CDPR, written communication to EPA). Twenty-eight wells sampled in 2001 did not have detections of fenamiphos, fenamiphos sulfoxide, or fenamiphos sulfone. This sampling program is ongoing. These OPs were also not detected in 803 wells sampled in California from 1985 to 1994.

4. Results of Cumulative Assessment

Analyses and interpretation of the outputs of a cumulative distribution rely heavily upon examination of the results for changing patterns of exposure. Briefly, the cumulative assessment generates multiple potential exposures (i.e., distribution of exposures for each of the 365 days of the year) for each hypothetical individual in the assessment for each of the 365 days in a year. Because multiple calculations for each individual in the CSFII population panel are conducted for each day of the year, a distribution of daily exposures is available for each route and source of exposure throughout the entire year. Each of these generated exposures is internally consistent – that is, each generated exposure appropriately considers temporal, spatial, and demographic factors such that “mismatching” (such as combining a winter drinking water exposure with an exposure that would occur through a spring lawn application) is precluded. In addition, a simultaneous calculation of MOEs for the combined risk from all routes is performed, permitting the estimation of distributions of the various percentiles of total risk across the year. Results are displayed as MOEs with the various pathways, routes, and the total exposures arrayed across the year as a time series (or time profile). Any given percentile of these (daily) exposures can be selected and evaluated as a function of time. That is, for example, a 365-day series of 95th percentile values can be arrayed, with 95th percentile exposures for each day of the year (January 1, January 2, etc) shown. The result can be regarded as a “time-based exposure profile” in which periods of higher exposures (evidenced by low ‘Margins of Exposure’) and lower exposures (evidenced by high ‘Margins of Exposure’) can be discerned. Patterns can be observed and interpreted and exposures by different routes and pathways (e.g., dermal route through lawn application) observed and compared. Abrupt changes in the slope or levels of such a profile may indicate some combination of exposure conditions resulting in an altered risk profile due to a variety of factors. Factors may include increased pest pressure and subsequent home pesticide use, or increased use in an agricultural setting that may result in increased concentrations in water. Alternatively, a relatively stable exposure profile indicates that exposure from a given source or combination of sources is stable across time and the sources of risk may be less obvious. Different percentiles can be compared to ascertain which routes or pathways tend to be more significant contributors to total exposure at various total exposure levels for different subgroups of the Arid/Semi-Arid West output distribution (e.g, those at the 95th percentile vs. 99th percentiles of exposure).

Figures III.L.2-1 through III.L.2-8 in Appendix L present the results of this cumulative risk analysis for Children, 1-2 years for a variety of percentiles (95, 99, 99.5, and 99.9) and two time averaging periods (one- and seven-day) of the Arid/Semi-Arid West output distribution. Figure III.L.2-9 through Figure III.L.2-16 present these same figures for Children 3-5. Appendix III.L.3 present the ungraphed data/output for Adults 20-49 and Adults 50+, respectively. The following paragraphs describe, in additional detail, the exposure profiles for each of these age groups for the 99.9th and 95th percentiles. Briefly, these figures present a series of time courses of exposure (expressed as MOEs) for various age groups at various percentiles of exposure. For example, for the 95th percentile MOEs for children 1-2 years old, the 95th percentile (total) exposure for children 1-2 is estimated for each of the 365 days of the year, with each of these (total) exposures – expressed in terms of MOEs – and arrayed as a function of time. The result is a “time course” (or “profile”) of exposures representing that portion of the Arid/Semi-Arid West output distribution at the 95th percentile exposures throughout the year. In addition, the MOEs are shown for each pathway or route (e.g., oral ingestion through food, oral ingestion through hand-to-mouth activity, inhalation, dermal, etc.) for each of a variety of percentiles. This discussion represents the unmitigated exposures (i.e., exposures which have not been attempted to be reduced by discontinuing specific uses of pesticides) and no attempt is made in this assessment to evaluate potential mitigation options. The following paragraphs describe the findings and conclusions from each of the assessments performed.

a. Children 1-2 years old

Single Day Analysis (Figure III.L.2-1 through Figure III.L.2-4): At the 99.9th percentile, total MOEs range from ~ 10 to 60. Residential exposures through inhalation are responsible for MOEs of ~ 10 to 90. At the 95th percentile, total MOEs are well above 100, and no exposure through the use of DDVP pest strips occurs. It is important to express these exposures as a *range* of MOEs because there may be variability across seasons. For all the percentiles examined (95th through 99.9th), drinking water exposures do not contribute to substantial exposure and are responsible for MOEs of generally greater than 1000 throughout the year. Similarly, dermal and/or hand-to-mouth exposures are apparent in the overall risk picture, but remain a small fraction of total exposure with MOEs generally remaining above 1000.

Seven Day Rolling Average Analysis (Figure III.L.2-5 through Figure III.L.2-8): At the 99.9th percentile, total MOEs range from ~ 30 to 70. Residential exposures through inhalation are responsible for the majority of this exposure. At the 95th percentile, total MOEs are well above 100, and no exposure through the use of DDVP pest strips occurs. It is important to express these exposures as a *range* of MOEs because there may be variability across seasons. For all the percentiles examined (95th through 99.9th), Drinking water exposures do not contribute to substantial exposure and are responsible for MOEs generally greater than 1000 throughout the year. For the dermal and/or hand-to-mouth pathways, exposures remain a small fraction of total exposure with MOEs of greater than 1000 throughout the year.

b. Children 3-5 years old

Single Day Analysis (Figure III.L.2-9 through Figure III.L.2-12): At the 99.9th percentile, total MOEs for children 3-5 range from ~ 15 to 60. Residential exposures through inhalation are responsible for MOEs of ~ 15 to 100. At the 95th percentile, total MOEs are well above 100, and no exposure through the use of DDVP pest strips occurs. It is important to express these exposures as a *range* of MOEs because there may be variability across seasons. For all the percentiles examined (95th through 99.9th), the drinking water, dermal, and oral hand-to-mouth pathways do not contribute to substantial exposure and are responsible for MOEs generally greater than 1000 throughout the year.

Seven Day Rolling Average Analysis (Figure III.L.2-12 through Figure III.L.2-16): At the 99.9th percentile, total MOEs for children 3-5 range from ~ 30 to 70. Residential exposures through inhalation are responsible for the majority of this exposure. At the 95th percentile, total MOEs are well above 100, and no exposure through the use of DDVP pest strips occurs. It is important to express these exposures as a *range* of MOEs because there may be variability across seasons. For all the percentiles examined (95th through 99.9th), Drinking water exposures do not contribute to substantial exposure and are responsible for MOEs generally greater than 1000 throughout the year. Dermal and/or hand-to-mouth exposures are apparent in the overall risk picture, but are small with MOEs of greater than 1000 throughout the year.

c. Adults, 20-49 and Adults 50+ years old

Single Day Analysis (Appendix III.L.3) At the 99.9th percentile, total MOEs are in the ~ 40 to 170 range with inhalation exposures from DDVP pest strips responsible for MOEs of ~ 50 to 270. At the 95th percentile, total MOEs are all substantially above 100, and exposure through residential pest strips does not occur. It is important to express these exposures as a *range* of MOEs because there may be variability across seasons. For all percentiles examined (95th through 99.9th), drinking water exposures continue to remain reasonably low for most of the year with MOEs generally exceeding 1000 throughout the year. This is also true for residential exposures by the dermal routes which also continue to be a small fraction of total exposure and are responsible for MOEs of >1000.

Seven Day Rolling Average Analysis (Appendix III.L.3) At the 99.9th percentile, total MOEs are in the ~ 90 to 200 range with inhalation exposures from DDVP pest strips responsible for MOEs of ~ 95 to 210. At the 95th percentile, total MOEs are all substantially above 100, and exposure through residential pest strips does not occur. It is important to express these exposures as a *range* of MOEs because there may be variability across seasons. Throughout the range of percentiles examined (95th through 99.9th), drinking water exposures continue to remain reasonably low for most of the year and yield MOEs that are in a large part greater than 1000. This is also true for residential exposures by the dermal routes which also continue to be a small fraction of total exposure and remain greater than 1000 throughout the year.