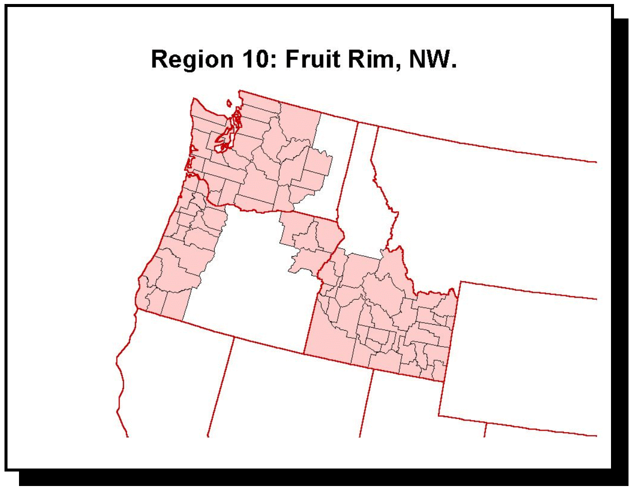
II. Regional Assessments

K. Region 10 - Fruitful Rim NW Assessment

1. Executive Summary

This module of the Organophosphate (OP) cumulative risk assessment focuses on risks from OP uses in the Fruitful Rim NW (area shown to right). Information is included in this module only if it is specific to the Fruitful Rim NW, or is necessary for clarifying the results of the Fruitful Rim NW 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 exposure is likely to have significantly less regional variability, and is 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.K.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.K.1. Pesticides and Use Sites/Scenarios Considered in Fruitful Rim NW Residential/Non-Occupational and Drinking Water Assessment

Pesticide	OP Residential Use Scenarios	OP Drinking Water Scenario Uses
Acephate	Ornamental Gardens	Mint, Cauliflower, Nursery Trees and Shrubs
Azinphos-methyl	None	Blackberries, Pears, Apples, Sweet Cherries
Bensulide	None	Cabbage, Broccoli, Cucumbers

Pesticide	OP Residential Use Scenarios	OP Drinking Water Scenario Uses
Chlorpyrifos	None	Apples, Sweet Cherries, Pears, Cabbage, Sweet Corn, Dry Onions, Hazelnut, Broccoli, Mint, Christmas Trees, Nursery Trees and Shrubs, Orchard Grass
DDVP	Indoor uses	None
Diazinon	None	Apples, Blackberries, Blueberries, Raspberries, Sweet and Tart Cherries, Green Peas, Pears, Snap Beans, Broccoli, Dry Onions, Cauliflower, Nursery Trees and Shrubs, Hops
Dimethoate	None	Sweet and Tart Cherries, Apples, Green Peas, Cabbage, Cauliflower, Christmas Trees
Disulfoton	Ornamental Gardens	Broccoli
Ethoprop	None	Snap Beans
Malathion	Lawn Applications, Home Fruit & Vegetable Gardens, Ornamental Gardens	Apples, Blueberries, Sweet Cherries, Dry Onion, Squash, Raspberries
Methidathion	None	Pears
Methyl-parathion	None	Dry Onions
Naled	None	Cauliflower, Broccoli
Oxydemeton-methyl	None	Cabbage, Christmas Trees
Phosmet	None	Pears, Apples, Tart Cherries
Trichlorfon	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 Fruitful Rim NW to model drinking water residues, followed by modeling results, and finally characterization of the available monitoring data which support use of the modeling results. This assessment accounted for all OP uses within the selected location that are anticipated to contribute significantly to drinking water exposure.

Finally a characterization of the overall risks for the Fruitful Rim NW region is presented, focusing on aspects which are specific to this region.

In general, the risks estimated for the Fruitful Rim NW 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 population exposure, residential exposures are the major source of risk - in particular inhalation exposure. These patterns occur for all population sub-groups, although potential risks appear to be higher for children than for adults regardless of the population percentile considered.

2. Development of Residential Exposure Aspects of Fruitful Rim NW Region 10

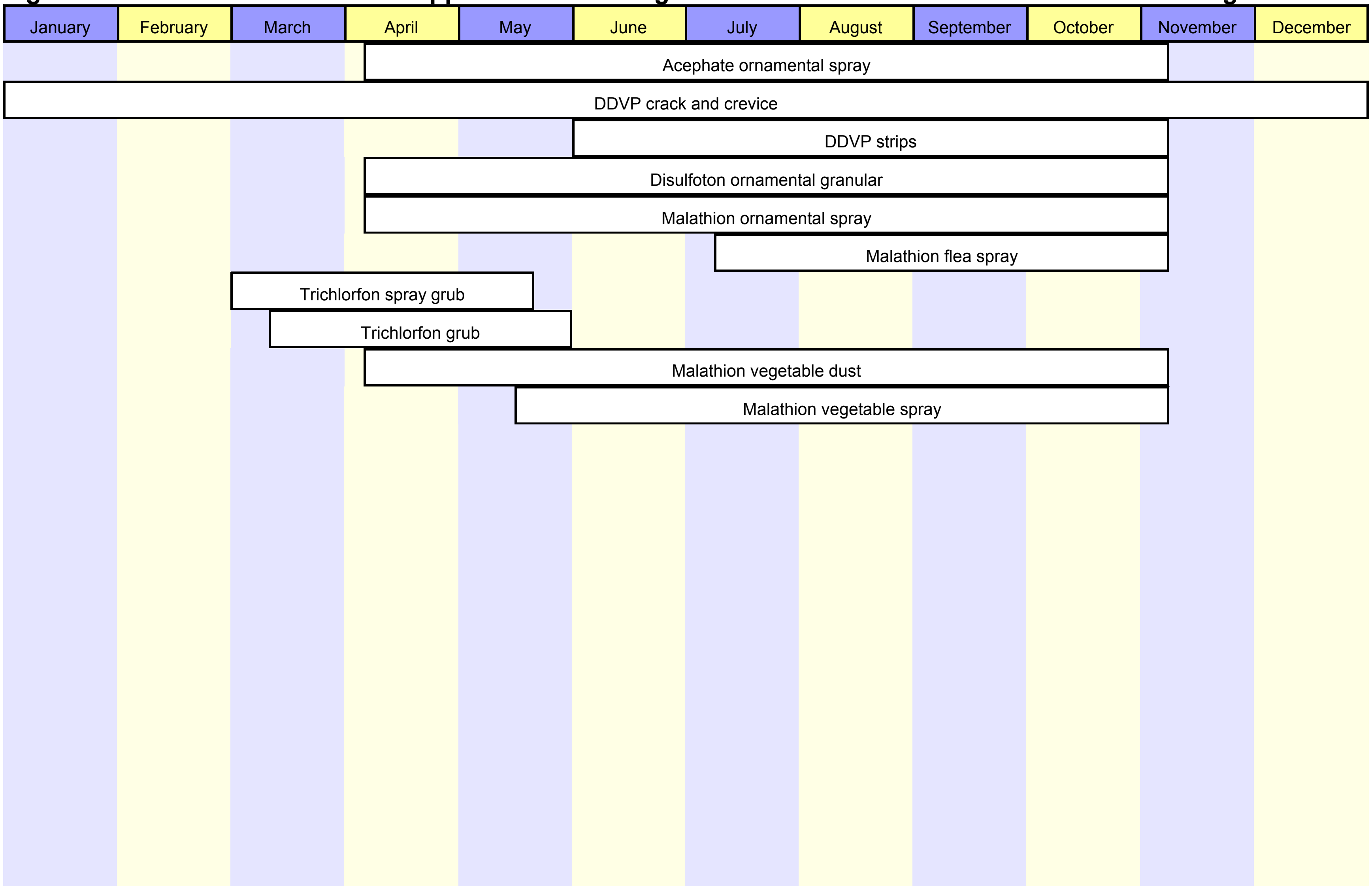
In developing this component of the assessment, the residential exposure module of Calendex was used to evaluate predicted exposures from residential uses. This assessment is limited to the home as are most current single chemical assessments. The residential component of the assessment incorporates dermal, inhalation, and non-dietary ingestion exposure routes which result from applications made to residential lawns (dermal and non-dietary ingestion), ornamental gardens, home fruit and vegetable gardens, and indoor uses. These scenarios were selected because they are expected to be the most prominent contributors to exposure in this region. Public health uses and golf course 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 Fruitful Rim NW. 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.K.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.K.2 which summarizes all relevant region-specific scenarios.

Table II.K.2. Use Scenarios and Calendex Input Parameters for Fruitful Rim NW Residential Exposure Assessment

Chemical	Use Scenario and Pest	Appln. Method	Amount Applied lb ai/A	Maximum Number and Frequency of Applns.	Seasonal Use	% use LCO	% use HO	% users	Active Exposure Period (days)	Exposure Routes
Acephate	Ornamentals	hand pump sprayer	0.934-2	4/yr	April-Nov.	--	100	7	1	dermal, inhalation
DDVP	Crack/Crevice	spray can	0.72-2.5 mg	1/mth	Jan-Dec.	--	100	6	1	inhalation
	Pest Strips	strip	NA	1/yr	June-Nov.	NA	100	2.5	90	inhalation
Disulfoton	Ornamentals	granular	8.7	3/yr	April-Nov.	NA	100	2.2	1	dermal, inhalation
Malathion	Lawns	hose end spray	5 lb ai	2/yr	July-Nov.	19	81	4	4 1	dermal, oral inhalation
	Ornamentals	hand pump spray	0.94-2 lb/A	4/yr	April-Nov.	--	100	7	1	dermal, inhalation
	Vegetable Gardens	hand duster	1.5 lb/A	5/yr	April-Nov.	--	100	1.1	14 1	dermal, inhalation
		hand pump sprayer	1.5 lb/A	5/yr	April-Nov.	--	100	1.1	14 1	dermal inhalation
Trichlorfon	Lawns Granular	rotary spreader	8 lb ai	1/yr	Feb-May	19	81	1	1 2	inhalation dermal, oral
	Lawns Spray	hose end sprayer	8 lb ai	1/yr	March-May	19	81	1	1 2	inhalation dermal, oral

Figure II.K.1 Residential Scenario Application and Usage Schedules for the Northwest Fruitful Rim Region



a. Dissipation Data Sources and Assumptions

i. Malathion

A residue degradation study was based on a 3-day study conducted on a cool-season grass 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 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.

For vegetables in western regions 7,8, and 10, a residue dissipation study was conducted with multiple residue measurements collected up to 14 days after treatment in California. A uniform distribution was used for each day after the application. The study was conducted a one pound ai per acre. The residues were adjusted upwards to account for the 1.5 pound ai per acre rate for vegetables.

ii . 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 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 also 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 Northwest Fruitful Rim 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 Northwest Fruitful Rim. The selection process considers OP usage, the locations and nature of the drinking water sources, and the vulnerability of those sources to pesticide contamination. An extensive discussion of the methods used to identify a specific location within the region is included in the main document. The following discussion provides the details specific to the

Northwest Fruitful Rim regional assessment for drinking water exposure with respect to cumulative exposure to the OP pesticides. The discussion centers on four main aspects of the assessment: (1) the selection criteria for the specific location in the Willamette River Valley of Oregon used for the drinking water assessment for the Northwest Fruitful Rim, (2) highlights of the results of the model outputs (predicted cumulative concentrations of OPs in surface water) for those OP-crop uses included in this regional assessment, (3) a summary and comparison of the predicted concentrations used in the Northwest Fruitful Rim assessment with actual surface water 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 the Willamette River Valley of Oregon for Drinking Water Assessment

OPP selected the Willamette River Valley of Oregon as the specific location to represent the region based on organophosphorus (OP) pesticide usage within the Northwest Fruitful Rim region (the region) in relation to the source, location, and vulnerability of the drinking water sources in the region, and on available monitoring data for the region. 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 Willamette River Valley will represent one of the more vulnerable sources of drinking water in the region.

OP usage in the region is dominated by orchards (primarily apples) and potatoes, which account for 80 percent of total OP use (Table II.K.3). In 1997, approximately 3.6 million pounds (ai) of OPs were applied in on agricultural crops in this region.

Table II.K.3. General Overview of OP Usage in the Northwest Fruitful Rim

Crops	Primary Production Areas	Total Pounds Applied	Percent of Total OP Use
Orchard (apple, pear, cherry)	Central Washington	1,652,000	46
Potatoes	Snake River Basin (ID), east/central OR and WA	1,244,000	34
Sugarbeets	Eastern WA, southern ID	174,000	5
Corn, sweet corn	Isolated areas in the Willamette Valley, Eastern WA, southern ID	52,000	2
Other vegetables	Willamette Valley	153,000	4
Small grains (wheat, barley)	Eastern WA, southeastern ID	121,000	3
Mint		63,000	2
		3,618,000	96

(1) Source: NCFAP, 1997.

The Northwest Fruitful Rim includes several areas of high OP use, in particular, the Willamette Valley in Oregon, the Yakima Valley and eastern Washington, and the Snake River Basin in Idaho (Figure II.K.2). The Willamette Valley is a temperate region where many major and specialty crops are grown with and without irrigation. The agricultural area of the Yakima Valley is in a more arid location east of the Cascades, and is a region of intensive irrigation. The Snake River Valley is also a semi-arid region, where irrigation withdrawals make Idaho one of the most water-consumptive states in the Nation. Yakima County and eastern Washington have the greatest total OP usage (predominantly on orchards) and highest percent crop area. The Snake River Valley in Southeast Idaho is the second highest use area (predominantly on potatoes and sugar beets). The Willamette Valley, OR, is the third high-use area, with a mix of OP uses.

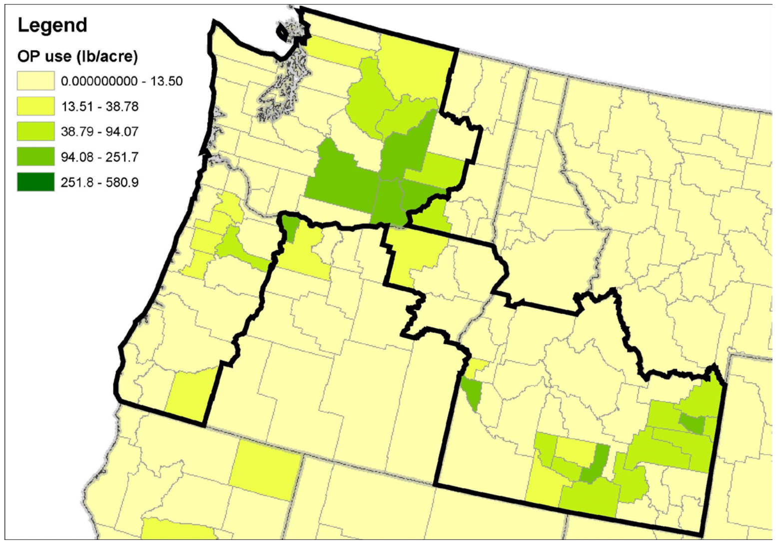


Figure II.K.2. Total OP usage (pounds per area) in the Northwest Fruitful Rim (source: NCFAP, 1997)

As described below, the Agency selected the Willamette Valley to represent the regional drinking water assessment due to its reliance on surface water as a drinking water source, the high use of a number of OPs, and its vulnerability to contamination. The Snake River Valley is an important potato-growing and OP use region, but it relies almost exclusively on ground water for drinking-water supplies. While ground water in the Snake River Valley is vulnerable to contamination, monitoring data both in the Snake River Valley and nationwide suggest that surface-water sources are more vulnerable to OP contamination than ground-water sources.

The great majority of the surface water in the Fruitful Rim NW drains to the Columbia River. The Columbia is a highly managed water body, and constitutes an important source of electricity and irrigation water. With a few exceptions, OPs were rarely detected at NASQAN sampling sites in the Columbia River Basin.

OP use is spread among a number of crops in the Willamette Valley (Table II.K.4). Usage on vegetables accounted for roughly a third of total OP usage in the area. While the list of uses in Table II.K.4 are not exhaustive, they represent more than 90 percent of total OP use in the Willamette Valley.

Table II.K.4. OP Usage on Agricultural Crops in the Willamette Valley

OP Usage/ Agricultural Crops				Cropland Acreage, Assessment Area	
Crop Group	**Crops**	**OP Usage**	**Percent of Total OP Use**	**Acres**	**Pct of total Cropland**
Orchard	Apple, Pear, Cherry	17,000	13	7,000	0.4
Nut trees	Hazelnut	7,000	5	29,000	2
Corn	Corn, Sweet Corn	13,000	10	35,000	3
Vegetables: Legumes	Beans, peas	31,000	24	26,000	2
Vegetables: Brassica	Broccoli, cauliflower, cabbage	5,000	4	13,000	0.6
Vegetables: cucurbits	Cucumber, squash	2,000	2	6,000	0.3
Vegetables: bulb	Onion	2,000	2	1,500	0.1
Mint	Mint	13,000	10	12,000	1
Hops	Hops	3,000	2	6,000	0.3
Berries	Blackberry, blueberry, raspberry	6,000	4	11,000	1
Grass for seed	Orchard grass	14,000	11	16,000	1
Christmas trees	Christmas trees	4,000	3	38,000	3
Nursery	Trees, shrubs	14,000	11	21,000	2
				214,000	17

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 USDA Crop Profiles (http://ipmwww.ncsu.edu/opmppiap/subcrp.htm). Acreage estimates based on OR Agricultural Information Network. Details on the sources of usage information are found in Appendix III.E.8.

Surface water sources of drinking water are more dominant in the western portion of the region, from the Puget Sound south through the Willamette Valley. A few surface-water intakes occur in the Yakima area of Washington and in western Idaho. However, the Willamette Valley is more vulnerable to runoff (Figure II.K.3). Available monitoring from NAWQA study units in Willamette Valley, Snake River Basin, and Puget Sound, discussed below, indicate that surface water sources in the Willamette Valley will be more vulnerable to OP contamination, with a higher potential for co-occurrence of multiple pesticides.

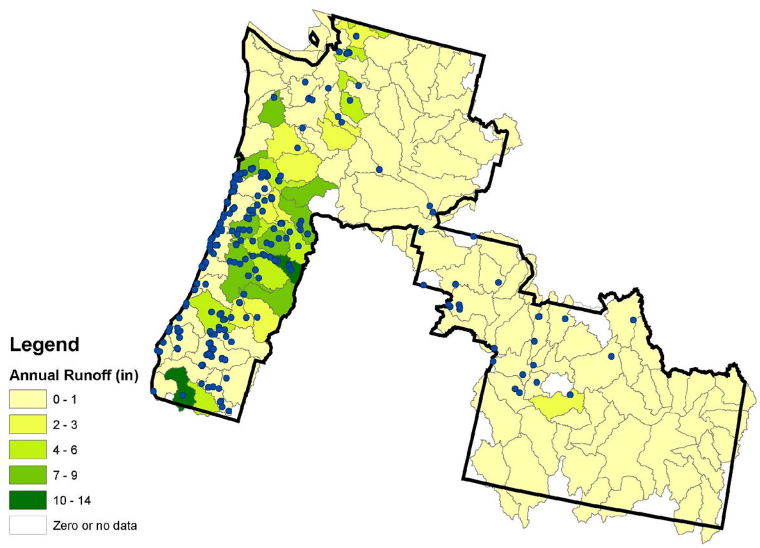


Figure II.K.3. Locations of surface water intakes of drinking water (shown as dots) in relation to average annual runoff (color gradation) in the Northwest Fruitful Rim Region

Ground-water sources of drinking water are dominant in Idaho and eastern Washington, with vulnerability to leaching potentially higher in eastern Washington (Figure II.K.4). The discussion on available monitoring in section (d) includes a detailed analysis of the ground water resources of the Snake River Valley.

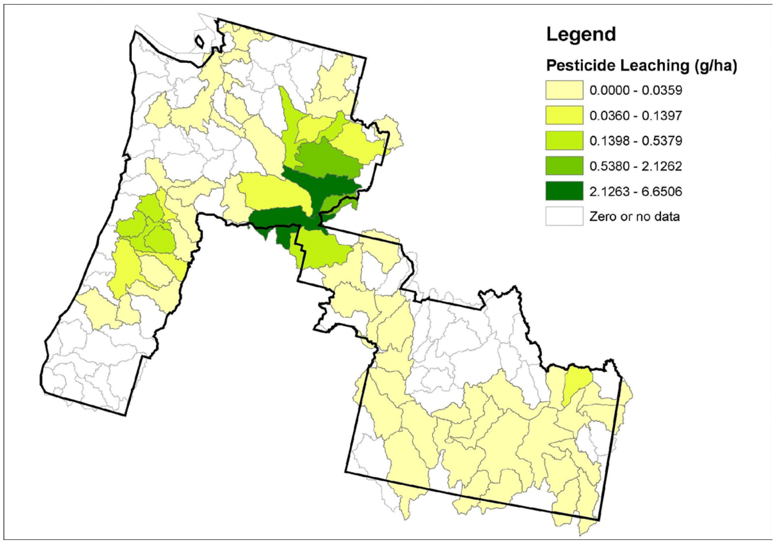


Figure II.K.4. Vulnerability of ground water resources to pesticide leaching in the Northwest Fruitful Rim, adapted from USDA (Kellogg, 1998)

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, and (2) a surface water assessment based in the Willamette Valley of Oregon is representative of the more vulnerable areas within the Northwest Fruitful Rim region. Monitoring data indicate that the surface-water exposure assessment should be considered a conservative surrogate for the portion of the population deriving its drinking water from ground water in this region.

b. Cumulative OP Concentration Distribution in Surface Water

The Agency estimated drinking water concentrations in the Northwest Fruitful Rim cumulative assessment using PRZM-EXAMS output with various input parameters that are specific, where possible, to the Willamette Valley of Oregon. Table II.K.5 presents pesticide use statistics for the OP-crop combinations which were modeled in this regional assessment. Chemical-, application- and site-specific inputs into the assessments are found in Appendices III.E.5-7. Sources of usage information can be found in Appendix III.E.8.

Table II.K.5. OP-Crop Combinations Included in the Northwest Fruitful Rim Assessment, With Application Information Used in the Assessment

Chemical	Crop/ Use	Pct. Acres Treated	App. Rate, lb ai/A	App Meth/ Timing	Application Date(s)	Range in Dates (most active dates)
Azinphos-methyl	Apples	86	0.89	Ground; Foliar	May 1, Jun 11, Jul 22	May 1 -Sep 1
Chlorpyrifos	Apples	81	1.84	Ground; Dormant-Delayed D	February 1	Feb1-Apr1
Diazinon	Apples	4	0.65	Ground; Dormant-Foliar	February 1, May 15	Feb1-Sep1
Dimethoate	Apples	29	0.77	Ground; Foliar	May 1	May1-Jul1
Malathion	Apples	6	0.94	Ground; Foliar	May 1, June 1	May1-Jul1
Phosmet	Apples	16	2.24	Ground; Foliar	May 1, July 1	May1-Sep1
Diazinon	Beans, Snap	21	0.55	Ground; Foliar	June 15	Jun 15-Aug31
Ethoprop	Beans, Snap	53	2.42	Ground; At Planting	April 30	Apr30-Jun30
Azinphos-methyl	Blackberries	11	0.41	Ground; Foliar	April 1	Apr1-June30
Diazinon	Blackberries	16	1.16	Ground; Foliar	March 15	Mar15-Mar30
Diazinon	Blueberries	28	0.8	Ground; Foliar	March 1	Mar1-Jun30
Malathion	Blueberries	9	1.62	Ground; Foliar	April 1, June 2	Apr1-Jul31
Bensulide	Broccoli	15	3.64	Ground;At Planting	May 1	May 1-Jul31
Chlorpyrifos	Broccoli	31	1.28	Ground;At Planting	May 1	May 1-Jul31
Diazinon	Broccoli	21	0.81	Foliar;Foliar	July 1	Jul1-Sep15
Disulfoton	Broccoli	6	1.02	Foliar;Foliar	July 1	Jul1-Sep15
Naled	Broccoli	6	1.4	Foliar;Foliar	July 1	Jul1-Sep15
Bensulide	Cabbage	10	3.82	Ground; At Planting	March 15	Mar15-Jul31
Chlorpyrifos	Cabbage	45	0.67	Ground; At Planting	March 15	Mar15-Jul31
Dimethoate	Cabbage	40	0.48	Ground; Foliar	July 15, August 7	Jul15-Aug30
Oxydemeton-methyl	Cabbage	48	0.57	Ground; Foliar	July 15, August 7	Jul15-Aug30
Acephate	Cauliflower	4	0.84	Ground; Foliar	August 15	Aug15-Oct15
Diazinon	Cauliflower	6	0.54	Ground; Foliar	August 15, Sept 15	Aug15-Oct15
Dimethoate	Cauliflower	32	0.47	Ground; Foliar	August 15	Aug15-Oct15
Naled	Caulifolwer	14	1.41	Ground; Foliar	August 15	Aug15-Oct15
Azinphos-methyl	Cherries, Sweet	25	0.87	Ground; Foliar	May 15	May15-Jun30
Chlorpyrifos	Cherries, Sweet	65	2.2	Ground; Dormant-Delayed D	February 1	Feb1-Mar30
Diazinon	Cherries, Sweet	10	0.97	Ground; Dormant-Foliar	February 1	Feb1-Jul15
Dimethoate	Cherries, Sweet	24	0.81	Ground; Foliar	April 15	Apr15-Jun15
Malathion	Cherries, Sweet	66	1.16	Aerial;Foliar	May 15, May 30, June 15, June 30	May15-Jul15
Dimethoate	Cherries, Tart	79	0.91	Ground; Foliar	April 15	Apr15-Jun15
Diazinon	Cherries, Tart	48	0.91	Ground; Foliar	February 1	Feb1-Jul15
Phosmet	Cherries, Tart	7	1.6	Ground; Foliar	May 15, June 7	May15-Jun30
Chlorpyrifos	Christmas Trees	6	1	Ground; Foliar	May 1	May1-Jun15
Dimethoate	Christmas Trees	7	0.5	Ground; Foliar	May 1	May1-Jun15
Oxydemeton-methyl	Christmas Trees	3	0.38	Ground; Foliar	April 15	Apr15-Jun15
Chlorpyrifos	Corn, Sweet	28	1.33	Ground; At Planting	April 15	Apr15-Jul10
Bensulide	Cucumbers	23	3.24	Ground; At Planting	May 10	May10-Jun30
Chlorpyrifos	Hazelnut	20	1.24	Ground; Foliar	April 15	Apr15-Jul30
Diazinon	Hops	50	1	Ground; Foliar	Jun 1, Jul 2, Aug 2	Jun1-Aug31
Acephate	Mint	39	0.97	Ground; Foliar	July 15	Jun15-Jul15
Chlorpyrifos	Mint	32	1.89	Ground; Foliar	August 20	Aug20-Sep30
Acephate	Nursery:Trees/ Shrubs	25	1	Ground; Foliar	April 1	Apr1-Sep1
Chlorpyrifos	Nursery:Trees/ Shrubs	25	1	Ground; Foliar	April 1	Apr1-Sep1
Diazinon	Nursery:Trees/ Shrubs	15	0.69	Ground; Foliar	April 1	Apr1-Sep1
Chlorpyrifos	Onions, Dry	89	1.02	Ground; At Planting	March 20	Mar20-Apr15
Diazinon	Onions, Dry	9	0.8	Ground; Foliar	July 1	Jul1-Aug31
Malathion	Onions, Dry	8	1.86	Ground; Foliar	July 1, August 1	Jul1-Aug31
Methyl parathion	Onions, Dry	35	0.5	Ground; Foliar	July 1, August 1	Jul1-Aug31
Chlorpyrifos	Orchardgrass for seed	88	1	Ground; Foliar	April 1	Apr1-Jun1
Azinphos-methyl	Pears	54	0.97	Ground; Foliar	April 15, June 15	Apr15-Aug15
Chlorpyrifos	Pears	59	2.02	Ground; Dormant-delayed D	February 1	Feb1-Apr1
Methidathion	Pears	2	1.31	Ground; Dormant-delayed D	February 1	Feb1-Apr1
Phosmet	Pears	66	2.86	Ground; Foliar	April 15, June 15	Apr15-Aug15
Diazinon	Pears	9	1.04	Ground; Foliar	May 15	May15-Aug15
Dimethoate	Peas, Green	67	0.18	Ground; Foliar	May 1	May1-Jun1
Diazinon	Peas, Green	3	0.5	Ground; Foliar	May 1	May1-Jun1

Chemical	Crop/ Use	Pct. Acres Treated	App. Rate, lb ai/A	App Meth/ Timing	Application Date(s)	Range in Dates (most active dates)
Diazinon	Raspberries	38	1.06	Ground; Foliar	March 1	Mar15-Mar30
Malathion	Raspberries	52	2.06	Ground; Foliar	May 1	May1-Jul30
Malathion	Squash	9	1.43	Ground; Foliar	July 1, July 16	Jul1-Aug1

Figure II.K.5 displays 35 years of predicted OP cumulative concentrations for the Northwest Fruitful Rim drinking water assessment. This chart depicts peaks during the years 1 and 15 of concentrations exceeding 0.04 ppb in methamidophos equivalents.

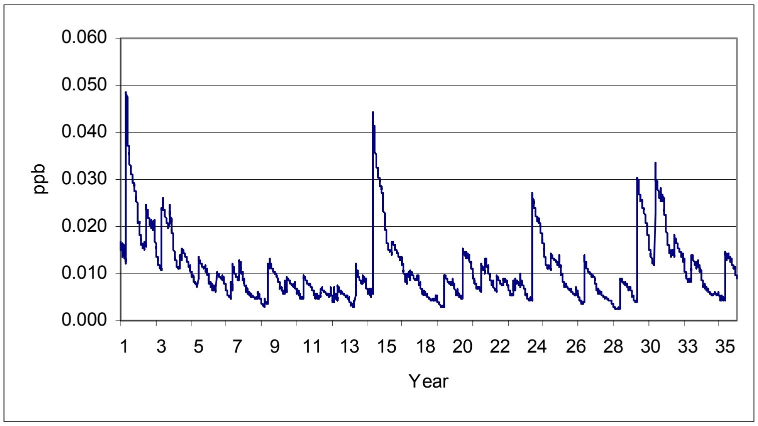


Figure II.K.5. Cumulative OP Distribution in Water in the Northwest Fruitful Rim (Methamidophos equivalents)

Figure II.K.6 overlays all 35 years of predicted values over the Julian calendar. Here, for example, each of the 35 yearly values associated with February 1st (i.e., Julian Day 32) are graphed such that the spread of concentration associated with February 1st (over all years) can readily be seen. This chart indicates that OP concentrations follow a recurring pattern each year, with a peak occurring in the late spring/early summer and dissipating over the year.

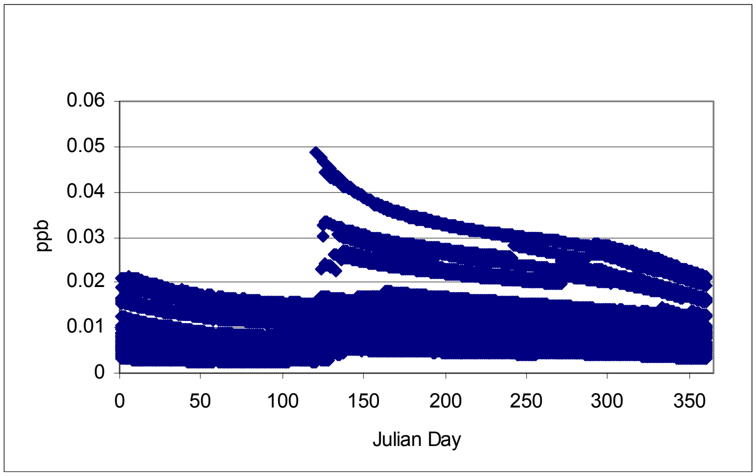


Figure II.K.6. Cumulative OP Distribution in Water (Methamidophos Equivalents) in the Northwest Fruitful Rim, summarized on a daily basis over 35 years

Figure II.K.7 depicts the predicted OP cumulative concentration for uses that made significant contributions during Year 1, the year in which the highest modeled concentration occurred. Ethoprop use on snap beans accounted for much of that OP cumulative concentration, with dimethoate use on peas and Christmas trees also contributing to that peak. Ethoprop is applied to snap beans during the last week of April (4/30). It is important to note that these concentrations are converted to methamidophos equivalents based on relative potency factors. Thus, the relative contributions are the result of both individual chemical concentrations in water and the relative potency factor of each of the OP chemicals found in the water.

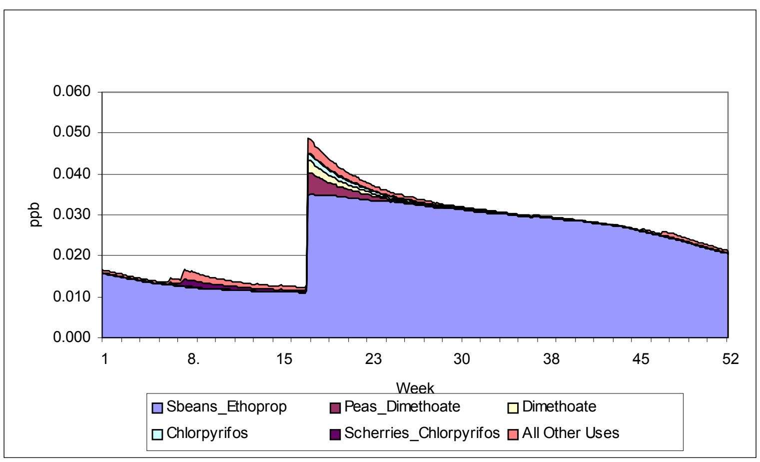


Figure II.K.7. Cumulative OP Distribution for an Example Year (Year 1) in the Northwest Fruitful Rim Region Showing Relative Contributions of the Individual OPs in Methamidophos Equivalents

c. A Comparison of Monitoring Data versus Modeling Results

The concentrations of individual OP pesticides estimated in the Willamette Valley were among the lowest of all the regional assessments. The estimated maximum concentrations for individual OP pesticides (Table II.K.6) were less than the maximum detections reported in the NAWQA monitoring for the Willamette Valley (summarized below and in Appendix III.E.1). Azinphos methyl is off by three orders of magnitude; chlorpyrifos, diazinon, and malathion are off by one to two orders of magnitude; the highest monitoring detect of ethoprop is three times the estimated maximum peak.

As described in the monitoring summary, all of the maximum monitoring detects came from the same sampling site, Zollner Creek. This stream has a watershed with 99% agricultural use. When the estimated concentrations are compared with the NAWQA monitoring for rest of the agricultural watersheds in the Willamette Valley, the estimated concentrations were similar to the monitoring concentrations, except for azinphos methyl and diazinon, which were still an order of magnitude lower than maximum monitoring detections.

Table II.K.6. Percentile Concentrations of Individual OP Pesticides and of the Cumulative OP Distribution, 35 Years of Weather

Chemical	Crop/Use	Concentration in ug/L (ppb)						
		Max	99th	95th	90th	80th	75th	50th
Acephate	Cauliflower, nursery, mint	5.0e-04	3.6e-04	1.9e-04	7.8e-05	9.8e-06	4.4e-06	1.7e-08
Azinphos Methyl	Apples, pears, cherries, blackberry	7.5e-03	2.2e-03	9.8e-04	6.7e-04	4.1e-04	3.6e-04	2.1e-04
Bensulide	Broccoli, cabbage, cucumbers	4.0e-02	3.2e-02	2.5e-02	2.2e-02	1.8e-02	1.7e-02	1.3e-02
Chlorpyrifos	Fruit/nut trees, cole crops, onions, corn, grass, trees, mint	6.0e-02	2.7e-02	1.6e-02	1.3e-02	9.8e-03	8.8e-03	5.1e-03
Diazinon	Fruit trees, legumes, cole crops, onions, nursery, hops, berries	1.4e-02	9.9e-03	7.0e-03	5.8e-03	4.3e-03	3.9e-03	2.4e-03
DDVP	Naled degradate (cole crops)	8.2e-05	2.8e-08	2.1e-12	4.9e-13	1.5e-13	9.6e-14	1.7e-14
Dimethoate	Fruit trees, legumes, cole crops, Christmas trees	2.8e-02	2.5e-03	6.8e-04	3.2e-04	1.2e-04	5.8e-05	6.5e-06
Disulfoton	Broccoli	1.1e-04	8.2e-05	6.1e-05	5.2e-05	4.1e-05	3.6e-05	2.2e-05
Ethoprop	Beans, snap	7.2e-01	6.6e-01	5.1e-01	4.1e-01	2.8e-01	2.5e-01	1.6e-01
Malathion	Apples, cherries, squash, onions, berries	1.5e-02	2.7e-03	9.2e-04	2.6e-04	3.2e-05	8.1e-06	4.5e-11
Methamidophos	Acephate degradate (cauliflower, nursery, mint)	7.3e-05	1.5e-06	6.4e-09	1.3e-10	2.0e-12	7.1e-13	8.1e-15
Methidathion	Pears	1.3e-04	5.5e-05	2.8e-05	1.6e-05	5.7e-06	3.5e-06	3.0e-07
Methyl Parathion	Onions	1.9e-04	5.0e-05	1.9e-05	1.2e-05	5.1e-06	3.5e-06	5.4e-07
Naled	Cole crops	1.4e-04	3.5e-06	2.6e-10	1.3e-12	7.2e-13	6.0e-13	3.0e-13
ODM	Cabbage, Christmas Trees	7.0e-04	1.4e-04	5.2e-05	3.1e-05	1.6e-05	1.3e-05	3.2e-06
Phosmet	Fruit trees	1.7e-03	1.1e-04	1.6e-06	1.8e-08	1.9e-11	2.2e-12	3.7e-13
OP Cumulative Concentration in Methamidophos Equivalents, ppb		4.9e-02	3.4e-02	2.6e-02	2.1e-02	1.4e-02	1.3e-02	8.7e-03

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. 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.

d. Summary of Available Monitoring Data for the Northwest Fruitful Rim

Available monitoring data from the region have been collected as part of the USGS NAWQA and NASQAN programs. These studies indicate that the highest concentrations and detection frequencies of OP pesticides occurred in the Willamette Valley. OP concentrations were greater in surface water than in ground water.

The **Willamette Basin (WILL) NAWQA** study unit is located in western Oregon. Twenty-two percent of land in this basin is devoted to agriculture, and another 70% to forestry. The cities of Portland, Salem and Eugene are located within this study unit. In 1990, 70% of Oregon's population lived in the Willamette Basin (USGS Circular 1161).

Surface water is the predominant source of drinking water in the area. The city of Portland derives its water from the pristine Bull Run Watershed, and is not even required to filter its water. However, water resources in the agricultural Willamette Valley are vulnerable to contamination from agricultural chemicals. Data from the WILL include some of the highest OP concentrations in the NAWQA program.

Four intensive stream-sampling sites were sampled monthly in urban and agricultural areas. Another 44 stream stations throughout the study unit were sampled once each in 1993 and 1994. Azinphos methyl, ethoprop, diazinon, malathion and chlorpyrifos were the active OPs detected in surface water of the WILL.

The highest OP concentrations in this study unit were detected in Zollner Creek, which drains a basin 99% devoted to agriculture. Forty-three pesticides in all were detected at this sampling station. Azinphos methyl was detected in 32% of samples at this site, with a maximum concentration of 7.35 ug/l. Ethoprop was detected in 75% of Zollner Creek samples, with a maximum detection of 1.95 ug/l. Diazinon and chlorpyrifos were detected in 72% and 65% of samples, with maximum detections of 1.28 and 0.40 ug/l, respectively. The highest concentration of malathion detected in the WILL, 0.24 ug/l, was also detected in Zollner Creek.

Zollner Creek is not a direct source of drinking water. However, it illustrates the possibility of high acute concentrations and OP co-occurrence possible if sampling is undertaken near use sites. Twenty-six of the samples taken from the Zollner Creek had detections of 4 OPs, and five samples had 5 OPs detected together. The NAWQA program does not include monitoring targeted to drinking water intakes downstream from heavy OP use areas. Zollner Creek data indicates that if such a scenario exists, exposure to multiple OPs may be possible.

Ground-water studies in the WILL were designed to assess the quality of vulnerable resources. Seventy shallow domestic wells in alluvial aquifers were sampled once each, as were 53 monitoring wells in the alluvial aquifer located in irrigated and non-irrigated farmland regions. Ten further urban wells were installed near Portland, and sampled once each. Terbufos was the only OP detected, once at <0.01 ug/l.

The **Central Columbia Plateau (CCPT) NAWQA** study unit is located almost completely in the arid region of eastern Washington, spilling over into western Idaho. It is an area with extensive dryland agriculture, with irrigation from the Columbia Basin Irrigation Project in the west, and intermittent areas of ground-water irrigation. Much of the area has few, if any, natural perennial streams. The area is much less prone to surface runoff than the Willamette Valley, which was the region for surface-water modeling scenarios for the cumulative assessment.

Eighty-four percent of drinking-water supply in this region comes from ground water. However, irrigation has changed the local hydrology over the last 50 years. In the western portion of the study unit (Quincy-Pasco subunit), water from the Columbia Basin Irrigation Project has caused a rise in the water table of 50 to 500 feet. Discharge to surface-water bodies is such that NAWQA recommends sampling of irrigation wasteways as a way to monitor trends in atrazine and nitrate concentrations in this region's ground water. Ground-water withdrawals in the North-Central subunit, by contrast, has caused up to a 150-foot decline in the water table in some places.

Ground-water studies included monitoring of ground water near irrigated row crops, orchards, and dryland grains. All three studies included both domestic wells and monitoring wells near fields (generally within 100 feet for row crops and orchards, and edge-of-field for grains). Azinphos-methyl, chlorpyrifos and methyl parathion were all detected in ground water in the CCPT. Azinphos methyl was detected four times (1%) in the orchard study, with a maximum concentration of about 0.2 ug/l. Methyl parathion was detected twice in the same study (max 0.07 ug/l), but orchard uses of methyl parathion are being phased out (Roberts and Jones, 1996).

Many more people (more than three times as many) get their drinking water from public supply wells than domestic wells. Samples from five of more than 100 public supply wells sampled in this program were contaminated by a DDT degradate, but not newer pesticides, which suggests that the wells are drawing from older water. The USGS notes, however, that "similar pesticides at similar concentrations have been detected in public supply wells," suggesting that the fractured basalt aquifer could have pathways of quicker recharge locally.

In addition to fixed sites throughout the study unit, the CCPT included four intensive sites sampling areas of potato, potato and corn, orchard,and wheat culture. **This targeted sampling resulted in greater than average agricultural detection of OPs in surface water**. Every OP included as an analyte was detected in at least one surface-water sample. For instance, azinphos methyl was detected in 16.4% of agricultural samples, with a maximum concentration of 0.5 ug/l. Ethoprop was detected in 9.2% of agricultural samples, with a maximum concentration of 0.22 ug/l. Chlorpyrifos was detected in 27% of agricultural samples, with a maximum concentration of 0.12 ug/l. Diazinon, malathion, methyl parathion, phorate and terbufos were all detected in 6% of samples or fewer, with maximum concentrations of <0.1 ug/l.

Every OP was also detected in stream samples described as "mixed use." While the frequency of detection overall was less than in agricultural streams, the maximum concentrations were higher. For instance, the maximum concentration of disulfoton in these streams was 3.8 ug/l. The rest of the OPs were detected at < 1.0 ug/l, but mostly with maximum concentrations of above 0.1 ug/l.

Therefore, higher frequencies and concentrations of OPs were found by targeted monitoring in this semi-arid area, just as they were at the Zollner Creek in the Willamette Valley.

Only 6% of land in the **Puget Sound Basin (PUGT) NAWQA** study unit is dedicated to agriculture. Drinking water in this region is drawn about equally from surface-water and ground-water sources.

No OPs were detected in three ground-water monitoring programs sampling from the Fraser aquifer in the "Puget Lowlands." The Fraser is a shallow, unconfined, glacial aquifer which underlies the main agricultural region in the study unit. The monitoring program included:

- ❏ 30 domestic wells throughout the Puget Lowlands
- ❏ 27 monitoring wells in residential areas
- ❏ 22 wells (21 domestic supply and 1 public supply) in regions of intensive row crop agriculture (such as raspberries).

In addition, 78 public supply wells throughout the entire study unit were sampled a single time. No OP was detected in these wells, either.

Surface-water studies in the PUGT included 4 intensive study sites (2 agricultural, 1 urban, 1 mixed-use) that were sampled weekly to monthly for a year (two for urban samples). In addition, 13 urban and residential sites were sampled 2 to 4 times each in response to detections of diazinon and other urban-use chemicals.

Diazinon was detected in 47% of agricultural surface-water samples , with a maximum concentration of 0.113 ug/l. Diazinon was detected in 84% of urban stream samples. Chlorpyrifos was only detected in urban or mixed-use samples. The only other OPs detected were malathion (1 of 20 detections from agricultural use, maximum concentration 0.087 ug/l) and ethoprop (3 detections, maximum 0.019 ug/l).

Data from the **Upper Snake River Basin (USNK) NAWQA** study unit are described below in the description of this high OP-use region.

Six **NASQAN** sites in the **Columbia River Basin** have been sampled for OPs since 1996. Few detections of OPs are reported in the dataset from 1996 to 1999, with the exception of the samples from the Willamette River at Portland, Oregon. The NASQAN program sampled this site in conjunction with the NAWQA program. The main sampling in the WILL NAWQA study occurred earlier, from 1991 to 1995.

Chlropyrifos and diazinon were detected in 53% and 37% of these samples, with maximum concentrations of 0.014 and 0.009 ug/l, respectively. Ethoprop was detected in 19% of samples with a maximum concentration of 0.029 ug/l. Malathion was the only other OP detected, in 3% of samples (max 0.011 ug/l).

OPs were rarely detected at the other NASQAN sites (5 on the Columbia River, one on the Snake River). Frequency of detection was <10 % for all OPs at the other sites, except for a 15% frequency of chlorpyrifos detection at the Columbia River at Quincy site in Oregon. All detections were below 0.01 ug/l, except for a detection of azinphos-methyl of 0.011 at the Columbia River at the Vernita Bridge site in Washington. Chlorpyrifos and malathion at 4 of 6sites, ethoprop and azinphos-methyl were both detected at three sites, and diazinon at two sites. While concentrations and detection frequencies were low, the presence of any concentration of OPs in these large rivers is indicative of a great amount of OP transport.

Ground-Water Assessment of Southeastern Idaho

The Snake River Valley is an important OP use area, predominantly on potatoes. However, ground-water is the predominant source of drinking water for the potato-growing region of southeastern Idaho (USGS NAWQA Circular 1208). Ground-water models which can predict potential daily exposures of pesticides in drinking water are not available. The hydrology of the Snake River Basin is such that ground water is vulnerable to contamination. However, monitoring for a limited number of OPs suggests that exposure estimates from modeling for the Willamette River Basin should be protective of drinking water in the Snake River Valley.

The Snake River Basin is a narrow area (30 to 75 miles) bounded by mountains thousands of feet high. Agricultural land is concentrated on the Snake River Plain, primarily along the Snake River and near the mouths of tributary drainage basins. Agricultural land makes up 21% of the area of the plain, while 50% is rangeland, and 23% forested (USGS Circular 1208).

Ground-water accounts for 80% of domestic and public drinking water, it is dwarfed by the use of both surface and ground water for irrigation. Non-irrigation uses of ground-water were 5% of water use in 1980 (Prof Paper 1408-F, pF21).

Local hydrology is dominated by the withdrawal and return of irrigation water, which is required to supplement the average of 8 to 12 inches of rainfall which falls each year. Irrigation is a major source of recharge to the aquifers of the Snake River Basin, and areas where the depth to ground water is shallow are vulnerable to pesticide and nutrient contamination from irrigation return water. Irrigated agriculture in the region is concentrated water table is shallowest, along the channels of the Snake River and other surface water bodies. Several OPs have been detected in ground water at low concentrations, and the potential for drinking-water contamination is significant.

Hydrology

Ground water in the Snake River Basin is derived predominantly from unconfined (water table) aquifers. The aquifers in the eastern portion of the basin consist of hundreds or thousands of feet of layered basalt (ancient lava flows). Aquifers in the western portion of the basin consist of a similar thickness of mostly unconsolidated sediment. Younger, surficial alluvium aquifers occur in the vicinity of the major rivers and streams.

Irrigated crops to which OPs are applied are concentrated in the eastern portion of the Snake River Basin. The wells in the fractured, layered basalts are among the most productive in the nation, with some yielding over one million ft^3/day (USGS Professional Paper 1408-B). Because of extensive irrigation, Idaho ranks third in the nation in total water use.

Natural recharge to the basalt aquifer was from rainfall along the margins of the plain, and seepage from streams (Prof Paper 1408-F). However, by 1980, development of the aquifer and controlled use of surface water caused an estimated 67% of recharge to be from irrigation return water. This has led in some areas to water table rises significant enough to require artificial drainage. It has also led to increased flow from large springs which empty downstream from the banks of the Snake River. These springs are the major natural discharge of ground water in the eastern portion of the basin.

Surface-water flow is also greatly altered by irrigation. The Shoshone Falls, for instance, can be reduced to a trickle during irrigation season (USGS Circular 1160). Dams in the river have created reservoirs used for irrigation water and hydroelectric power. Unlined irrigation canals further divert water from the river, then lose a significant amount of their flow to ground water.

Monitoring

The USGS NAWQA program undertook a monitoring program in the Upper Snake River Basin (USNK) between 1992 and 1995. Nine OPs were included in the analysis (diazinon, ethoprop, malathion, phorate, disulfoton, terbufos, methyl parathion and the since-cancelled fonofos and parathion). Diazinon, ethoprop, fonofos, malathion and phorate were detected at the two surface water sampling points at concentrations <0.1 ppb.

None of these insecticides were detected in ground-water samples collected once at 207 sites. Sampling was concentrated in the central reach of the Snake River, between the towns of Burley and Hagerman. The USGS sampled 105 wells (mostly domestic wells) in four “local land-use studies” located in this important potato and sugarbeet-growing region. There were another 43 domestic, irrigation, stock and public supply wells over many depths throughout the rest of the Snake river plain, and another 39 in tributary valleys.

While OPs were not detected in the NAWQA wells, some pesticides (mostly triazine herbicides) were detected extensively in ground water. Three or more pesticides were detected in 41% of domestic and irrigation wells in agricultural lands sampled in the Twin Falls and Burley areas. At least one pesticide was detected in 86% of the wells in the Minidoka local land use study area, which had the shallowest mean well depth (40 feet).

Two OPs were detected in ground-water in very limited monitoring which occurred before the NAWQA program began. (Rupert, 1994). In preparation for the NAWQA study, the USGS reviewed its "miscellaneous studies database" and found that pesticide analyses were undertaken between 1987 and 1991 in the upper Snake River Basin. Malathion was detected in 1989 above the reporting level of <0.1 ppb in three of 114 samples from 89 wells. The concentrations measured ranged from 0.01 to 0.02 ppb. Diazinon was detected in 1989 above the reporting level of <0.1 ppb in four of 114 samples from 89 wells. The concentrations measured ranged from 0.01 to 0.03 ppb. Wells in which pesticides were detected had a mean depth to water of 215 ft, and those in which pesticides were not detected had a mean depth to water of 376 feet.

Nitrate studies before and during the NAWQA USNK study have confirmed that shallower wells in the UNSK region are more likely to be contaminated with agricultural chemicals than deeper wells. The areas with the depth to water of <100 feet correspond to the most important agricultural areas, which are generally along the Snake River and its tributaries. Nitrate has been found in 10 to 25% of wells (mostly domestic and public supply) mentioned in the NAWQA study.

Conclusion

Drinking water in the Snake River plain is vulnerable to contamination from agricultural chemicals. Agricultural areas where OPs are used correspond to areas where the water table (and therefore drinking water) is shallowest (<100 feet). In addition, irrigation water is the major source of ground-water recharge in the area, bringing pesticides and nutrients to drinking-water supplies. The NAWQA USNK monitoring program has detected common contamination of ground-water with herbicides and nutrients.

However, OPs were not detected in NAWQA monitoring wells, and little other data describes OP contamination of ground water in the area. The number of OPs for which monitoring is available is limited. Although OP contamination of ground water in this region is possible, available data does not allow a detailed assessment of possible exposure.

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. To this end, graphical presentation of the data provides a useful method of examining the outputs for patterns and was selected here to be the most appropriate means of presenting the results of this cumulative assessment. Briefly, the cumulative assessment generates multiple potential exposures 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 (i.e., a distribution of exposures for *each* of the 365 days of the year) 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. As demonstrated in the graphical presentations of analytical outputs for this section, 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 plotted as a function of time. That is, for example, a 365-day series of 95th percentile values can be plotted, 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 plot" 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) seen 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 for different subgroups of the Fruitful Rim – Northwest population (e.g, those at the 95th percentile vs. 99th percentiles of exposure).

Figures III.S.2-1 through III. S.2-5 in Appendix S present the results of this cumulative risk analysis for Children, 1-2 years for a variety of percentiles of the Fruitful Rim – Northwest population (95 th, 97.5th, 99th, 99.5th, and 99.9th). Figures III.S.2-6 through III.S.2-10, Figures III.S.2-11 through III.S.2-15, and Figures III.S.2-16 through III.S.2-20 present these same figures for Children 3-5, Adults 20-49, and Adults 50+, respectively. The following paragraphs describe, in additional detail, the exposure profiles for each of these population age groups for these percentiles (i.e., 95th, 97.5th, 99th, 99.5th, and 99.9th). Briefly, these figures present a series of time course of exposure (expressed as MOEs) for various age groups at various percentiles of exposure for the population comprising that age group. For example, for the 95th percentile graphs 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 MOE's – plotted as a function of time. The result is a "time course" (or "profile") of exposures representing that portion of the Fruitful Rim – NW population at the 95th percentile exposures throughout the year. Each "component" of this 95th percentile total exposure for children 1-2 (i.e., the dermal, inhalation, non-dietary oral, food, and water, etc. "component" exposures which, together, make up the total exposure) can also be seen – each as its own individual time profile plot. 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

<u>(Figures III.S.2-1 through III.S.2-5)</u>: At the 95th percentile, exposures from the residential applications of OP pesticides do not contribute to overall exposure. This is true for all of the routes of exposure examined: dermal and hand-to-mouth exposure from lawn treatment applications and inhalation exposure from crack and crevice and pest strip treatments. We note that there are increases in drinking water concentrations beginning near Julian day 120 which corresponds to late April/early May applications of ethoprop to snap beans and, to a lesser extent, dimethoate to peas and Christmas trees. However, exposure from drinking water at this percentile does not contribute to significant exposure. At the higher percentiles, the exposure profile and relative contributions begin to change. The residential exposures (via inhalation) become an increasingly dominant portion of the total exposure profile. This corresponds to use of DDVP pest strips and crack and crevice treatments. By the 99.9th percentile, residential exposures via the inhalation pathway from the use of these DDVP products are the most significant contributors to the overall risk picture throughout the year. This is not true for drinking water exposures. Drinking water exposures continue to be low and do not contribute in any significant manner to the overall risk picture. By the 99.9th percentile, dermal and hand-to-mouth exposures from lawn uses begin to appear but continue to be a small fraction (< ca. 1%) of total exposure.

b. Children 3-5 years old

(Figures III.S.2-6 through III.S.2-10). As with children 1-2, exposures from the residential applications of OP pesticides do not contribute to the overall exposure to the pesticides in this region at the 95th percentile. This is true for all of the routes of exposure examined: dermal and hand-to-mouth exposure from lawn treatment applications and inhalation exposure from crack and crevice and pest strip treatments. Despite the increases in drinking water concentrations beginning on Julian day 120 noted above, exposure from drinking water at this percentile also does not contribute to significant exposure. The residential exposures (via inhalation) become a dominant portion of the total exposure profile at the 99.9th percentile. This corresponds to use of DDVP products. Drinking water exposures continue to remain low, and contribute little to total exposure or the overall risk picture. By the 99.9th percentile dermal and hand-to-mouth exposures from lawn uses begin to appear in the overall risk picture but continue to be a small fraction (< ca. 0.1%) of total exposure.

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

(Figures III.S.2-11 through III.S.2-15 and III.S.2.16 through III.S.2.20) At the 95th percentile, exposures from the residential applications of OP pesticides do not contribute to overall exposure to the pesticides in this region. This is true for all of the routes of exposure examined: dermal exposure from lawn and garden applications and inhalation exposure from lawn and gardening activities and indoor crack and crevice and pest strip treatments. We note that there are increases in drinking water concentrations beginning near Julian day 120 which corresponds to late April/early May applications of ethoprop to snap beans and, to a lesser extent, dimethoate to peas and Christmas trees. However, exposure from drinking water at this percentile does not contribute to substantial exposure At the higher percentiles, the exposure profile and relative contributions begin to change. The residential exposures (via inhalation) become an increasingly dominant portion of the total exposure profile. This corresponds to use of DDVP pest strips and DDVP crack and crevice treatments. By the 99.9th percentile, residential exposures via the inhalation pathway from the use of these DDVP products are the most significant contributors to the overall risk picture throughout the year. This is not true for drinking water exposures. Drinking water exposures continue to be low and do not contribute in any significant manner to the overall risk picture. By the 99.5th percentile, dermal exposures begin to appear in the overall risk picture but continue to be a small fraction (< ca. 1%) of total exposure.