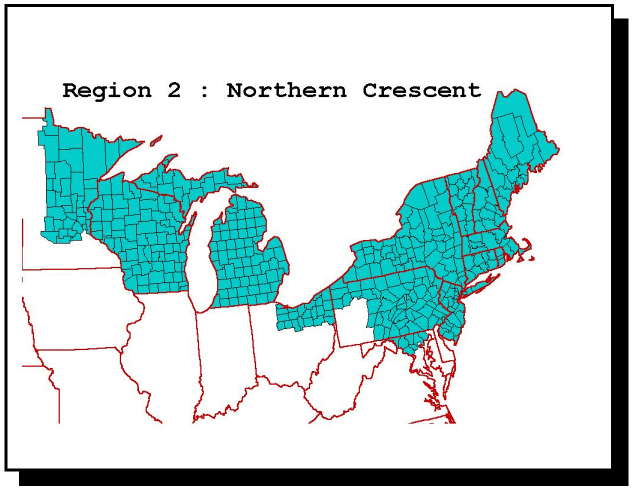
# II. Regional Assessments

## B. Region 2 - Northern Crescent

### 1. Executive Summary




This module of the Organophosphate (OP) cumulative risk assessment focuses on risks from OP uses in the Northern Crescent (area shown to the right). Information is included in this module only if it is specific to the Northern Crescent, or is necessary for clarifying the results of the Northern Crescent 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.B.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.B.1. Pesticides and Use Sites/Scenarios Considered in Northern Crescent Residential/Non-Occupational and Drinking Water Assessment**

| Pesticide | OP Residential Use Scenarios | OP Drinking Water Scenarios |
|---|---|---|
| Acephate | Ornamentals | None |
| Azinphos Methyl | None | Pears, Apples, Peaches, Pumpkins |
| Bensulide | Golf Courses | None |
| Chlorpyrifos | None | Alfalfa, Corn, Peaches, Pears |
| DDVP | Pest Strips, Crack/Crevice | None |
| Diazinon | None | Apples |

| Pesticide | OP Residential Use Scenarios | OP Drinking Water Scenarios |
|---|---|---|
| Dimethoate | None | Apples |
| Disulfoton | Ornamentals | None |
| Malathion | Lawns, Ornamentals, Vegetable Gardens, Public Health | None |
| Methidathion | None | Apples |
| Methyl Parathion | None | Apples, Peaches, Pears |
| Naled | Public Health | None |
| Phosmet | None | Apples, Peaches, Pears |
| Tebupirimphos | None | Corn |
| Terbufos | None | Corn |
| Trichlorfon | Golf Course, Lawns | 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 Northern Crescent 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 Northern Crescent region is presented, focusing on aspects which are specific to this region.

In general, the risks estimated for the Northern Crescent 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 Northern Crescent Region

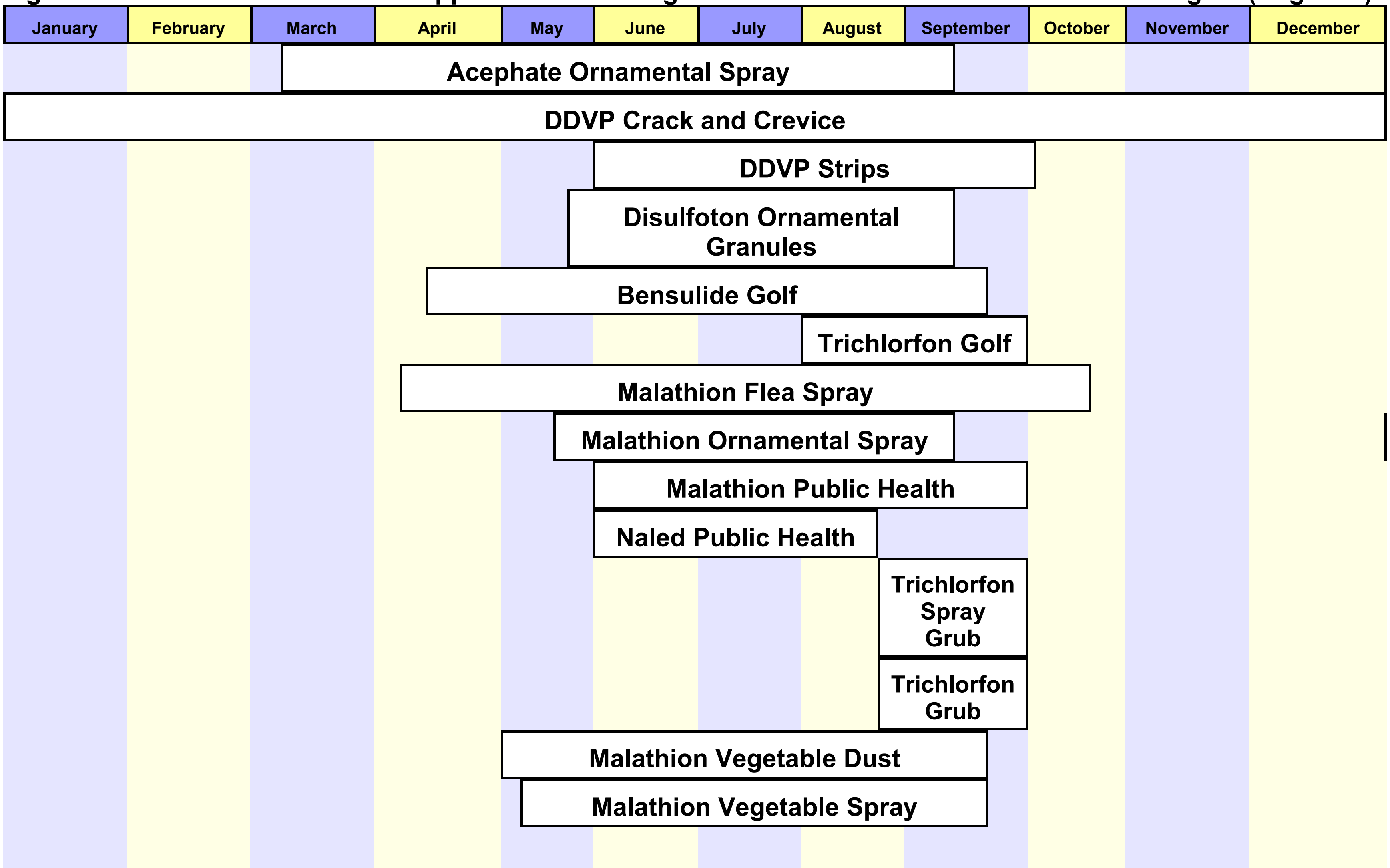
In developing this aspect of the assessment, the residential exposure component of Calendex was used to evaluate predicted exposures from residential uses. Except for golf course uses, this assessment is limited to the home as are most current single chemical assessments. The residential component of 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, public health uses, and indoor uses. These scenarios were selected because they are expected to be the most prominent contributors to exposure in this region. 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 Northern Crescent. 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.B.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.B.2 which summarizes all relevant region-specific scenarios.

**Table II.B.2. Use Scenarios and Calendex Input Parameters for Northern Crescent Residential Exposure Assessment**

| Chemical | Use Scenario and Pest | Appln. Method | Amount Applied lb ai/A or other | 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 | March-Sept. | -- | 100 | 5 | 1 | dermal, inhalation |
| Bensulide | Golf Courses | NA | 12.5 | 2/yr | April - Sept. | 100 | -- | 1 | 14 | dermal |
| DDVP | Crack/Crevice | spray can | 0.75-2.5 mg | 1/mth | Jan-Dec. | -- | 100 | 5 | 1 | inhalation |
| | Pest Strips | strip | NA | 1/yr | May-Oct. | N/A | 100 | 2.5 | 90 | inhalation |
| Disulfoton | Ornamentals | granular | 8.7 | 3/yr | May-Sept. | – | 100 | 2 | 1 | dermal, inhalation |
| Malathion | Lawns | hose end sprayer | 5 lb ai | 2/yr | April-Oct. | 19 | 81 | 2 | 4 | dermal, inhalation, oral |
| | Ornamentals | hand pump spray | 0.94-2 lb/A | 4/yr | May-Sept. | -- | 100 | 3.7 | 1 | dermal, inhalation |
| | Public Health Mosquitoes | aerial & ground | NA | 9/yr | Jun-Oct. | 100 | -- | 38 | 2 | dermal, oral |
| | Vegetable Gardens | hand duster | 1.5 lb/A | 5/yr | May-Sept. | -- | 100 | 1.04 | 7<br>1 | dermal, inhalation |
| | | hand pump sprayer | 1.5 lb/A | 5/yr | May-Sept. | -- | 100 | 1.11 | 7<br>1 | dermal, inhalation |
| Naled | Public Health | aerial & ground | NA | 5/yr | June-Aug. | 100 | -- | 20 | 1 | dermal, oral |
| Trichlorfon | Golf Courses | NA | 8 lb ai | 1/yr | Aug-Oct. | 100 | -- | 9.15 | 2 | dermal |
| | Lawns Granular | rotary spreader | 8 lb ai | 1/yr | Aug-Oct. | 19 | 81 | 2 | 7<br>1<br>10 | oral, inhalation, dermal |
| | Lawns Spray | hose end sprayer | 8 lb ai | 1/yr | Aug-Oct. | 13 | 87 | 2 | 2<br>1 | dermal, oral, inhalation |

Figure II.B.1 Residential Scenario Application and Usage Schedules for the Northern Crescent Region (Region 2)



## 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

A residue degradation study was based on a 3-day study conducted on a cool-season grass in Missouri, North Carolina, and Pennsylvania (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.

A residue dissipation study was conducted with multiple residue measurements collected up to 7 days after treatment in Pennsylvania. This was used for vegetable gardening in eastern regions 1,2,3,4,5,6,9, and 12. A value selected from a uniform distribution bounded by the low and high measurements was used for each day after the application. Since the study was conducted at a one pound ai per acre treatment rate, the residues were adjusted upwards by a 1.5 factor to account for the 1.5 pound ai per acre rate for vegetables.

### iii. 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 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 Northern Crescent 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 Northern Crescent. 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 Northern Crescent 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 south-central Pennsylvania used for the drinking water assessment for the Northern Crescent, (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 Northern Crescent 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 southeastern Pennsylvania for Drinking Water Assessment

OPP selected south-central Pennsylvania as the specific location to represent the region based on organophosphorus (OP) pesticide usage within the Northern Crescent 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 south-central Pennsylvania will represent one of the more vulnerable sources of drinking water in the region.

In 1997, approximately 3.7 million pounds (ai) of OPs were applied in on agricultural crops in this region. The dominant OP use crops in the region are corn, orchards, and alfalfa. (Table II.B.3).

**Table II.B.3. General Overview of OP Usage in the Northern Crescent**

| Crops | Primary Production Areas | Total Pounds Applied | Percent of Total OP Use |
|---|---|---|---|
| Corn (grain, sweet) | NY, PA, southern WI, southern MI | 1,518,000 | 41 |
| Orchard (apple, cherry, peach, pear) | NY, PA, MI | 1,088,000 | 29 |
| Alfalfa | PA, NY, WI | 408,000 | 11 |
| Legume vegetables (beans, peas) | WI | 99,000 | 3 |
| Cucurbits | Scattered | 67,000 | 2 |
| Other vegetables (tomatoes, peppers, onions) | Scattered pockets | 106,000 | 4 |
| | | 3,707,000 | 90 |

(1) Source: NCFAP, 1997.

Figure II.B.2 shows relatively high OP-use areas along the eastern shore of Lake Michigan, along the southern shore of Lake Ontario in northwest New York, in south-central Pennsylvania, and in southern New Jersey. Based on the vulnerability of drinking water sources, discussed below, the Agency selected south-central Pennsylvania to represent the drinking water exposure assessment for the Northern Crescent.

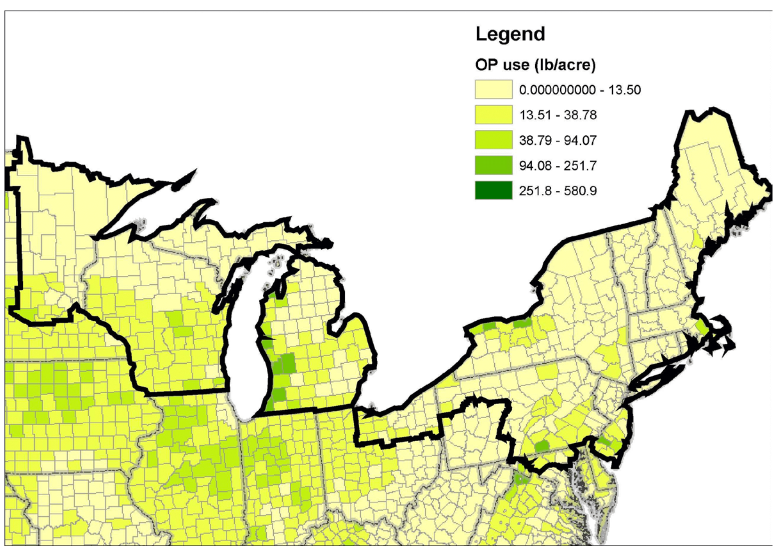



**Figure II.B.2. Total OP usage (pounds per area) in the Northern Crescent (source: NCFAP, 1997)**

In south-central Pennsylvania (Adams, Berk, Franklin, Lancaster, and York counties), OP use on orchards (apple, peach, pear), corn, and alfalfa accounted for 95 of total agricultural use(Table II.B.4). As discussed below, these uses were used to develop the drinking water assessment for this region.

**Table II.B.4. OP Usage on Agricultural Crops in South-Central Pennsylvania (Adams, Lancaster, Franklin, York, and Berk Counties)**

| 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, Peach | 85,000 | 49 | 27,000 | 3 |
| Corn | Corn, Sweet Corn | 38,000 | 22 | 459,000 | 43 |
| Alfalfa | Alfalfa for Hay | 40,000 | 24 | 118,000 | 11 |
| Vegetables: cucurbits | Pumpkin, cantaloupe | 4,000 | 2 | 1,000 | 0.1 |
| | | | 97 | 605,000 | 57 |

Pesticide use based 1997 NCFAP use data. Acreage estimates based on PA Agricultural Statistics Service. Details on the sources of usage information are found in Appendix III.E.8.

Surface water sources of drinking water are more dominant in eastern half of the region. Runoff vulnerability is generally greater in the southeastern part of the region, becoming less to the north and west. The Great Lakes are a significant source of drinking water for portions of the region. However, as noted in the discussion on water monitoring data, these water bodies are less vulnerable to pesticide contamination than the reservoirs in the east.

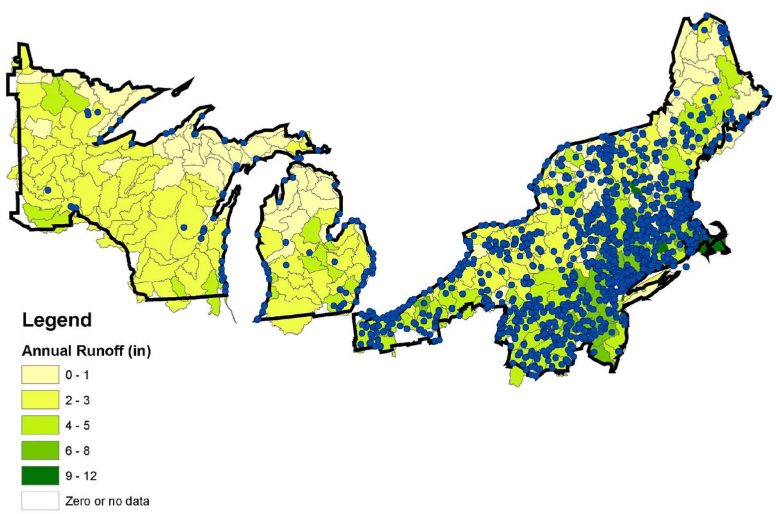



**Figure II.B.3. Locations of surface water intakes of drinking water (shown as dots) in relation to average annual runoff (color gradation) in the Northern Crescent Region**

Ground water sources in southern Michigan and central Wisconsin are potentially more vulnerable to contamination from pesticide leaching (Figure II.B.4). However, as noted in the discussion on monitoring, OP pesticides are detected less frequently and at lower concentrations in ground water in this region than in surface water.

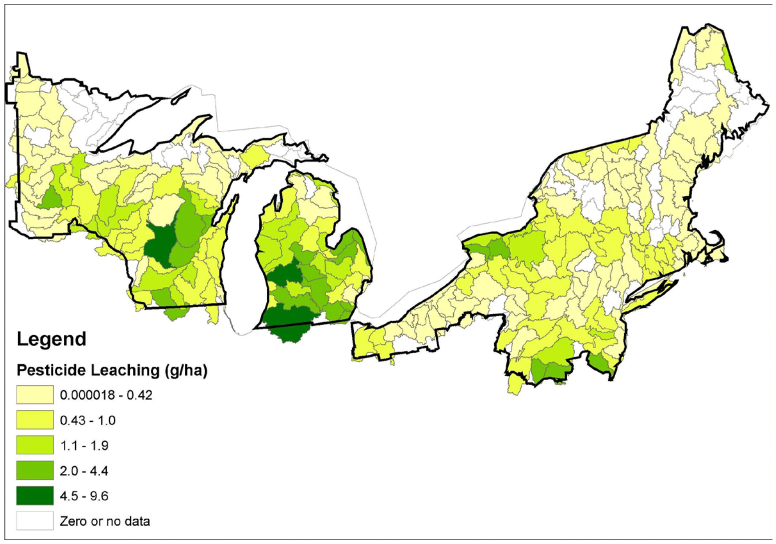



**Figure II.B.4. Vulnerability of ground water resources to pesticide leaching in the Northern Crescent, adapted from USDA (Kellogg, 1998)**

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 south-central Pennsylvania is representative of the more vulnerable areas within the Northern Crescent region. As discussed in the main document, the surface-water exposure assessment should be considered a conservative surrogate for the portion of the population deriving its drinking water from ground water.

### b. Cumulative OP Concentration Distribution in Surface Water

The Agency estimated drinking water concentrations in the Northern Crescent cumulative assessment using PRZM-EXAMS output with various input parameters that are specific, where possible, to south-central Pennsylvania. Table II.B.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. Based on the latest available USDA National Agricultural Statistics Service (NASS) usage data, these uses represent roughly 97 percent of agricultural use of OP pesticides in south-central Pennsylvania.

**Table II.B.5. OP-Crop Combinations Included in the Northern Crescent 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) |
|---|---|---|---|---|---|---|
| Chlorpyrifos | Alfalfa | 2 | 0.66 | Ground; Foliar | June 1 | May 1-Jul1 |
| Azinphos-methyl | Apple | 89 | 0.13 | Ground; Foliar | May 1, May 18, Jun 4, Jun 21, Jul 8, Jul 25, Aug 11 | May 1-Aug 31 |
| Diazinon | Apple | 34 | 0.22 | GroundDelayed; Dormant-Petal Fall | Mar 15, Apr 14 | Mar 15-May 15 |
| Dimethoate | Apple | 2 | 0.16 | Ground; Foliar | May 1, Jun 1 | May1-Jul31 |
| Methidathion | Apple | 3 | 0.41 | Ground; Green Tip-Petal Fall | Apr 1, Apr 23 | Apr1-May15 |
| Phosmet | Apple | 24 | 0.4 | Ground; Foliar | May 1, Jun18, Aug 5 | May 1-Sep 21 |
| Chlorpyrifos | Corn | 7 | 1.1 | Ground; Planting | May 17 | Apr30-Jun15 (May10-May25) |
| Tebupirimphos | Corn | 7 | 0.11 | Ground; Planting | May 17 | Apr30-Jun15 (May10-May25) |
| Terbufos | Corn | 2 | 1.07 | Ground; Planting | May 17 | Apr30-Jun15 (May10-May25) |
| Azinphos-methyl | Peach | 80 | 0.55 | Ground | Apr 15, May 9, Jun 2, Jun 26, Jul 25 | Apr15-Aug15 |
| Chlorpyrifos | Peach | 11 | 0.95 | Ground; After Harvest | Sep 30 | Sep1-Oct-30 |
| Phosmet | Peach | 37 | 0.43 | Ground | April 15, May 26, July 6 | Apr15-Aug15 |
| Azinphos-methyl | Pear | 86 | 0.32 | Ground; Foliar | April 15, May 26, July 6 | Apr15-Aug15 |
| Chlorpyrifos | Pear | 61 | 0.23 | Ground; Dormant-Delayed Dormant | March 1 | Mar1-Apr1 |
| Phosmet | Pear | 69 | 0.46 | Ground; Foliar | April 15, May 9, June 2, June 26, July 20 | Apr15-Aug15 |
| Azinphos-methyl | Pumpkin | 3 | 0.53 | Ground; Foliar | July 1, Aug. 16 | Jul1-Oct1 |

Figure II.B.4 displays 35 years of predicted OP cumulative concentrations for the Northern Crescent drinking water assessment. This chart depicts a single peak occurring each year, with some years having higher levels than others. These variations are the result of year-to-year differences in precipitation from the weather data for the region. The OP cumulative concentration levels are generally low, not exceeding 1 ppb in methamidophos equivalents.

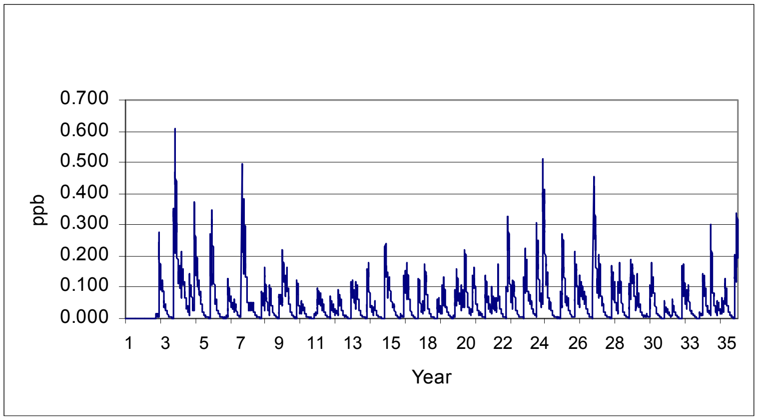



**Figure II.B.5. Cumulative OP Distribution in Water in the Northern Crescent (Methamidophos equivalents)**

Figure II.B.5 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 peaks occurring late in the year, between day 225 and day 350.

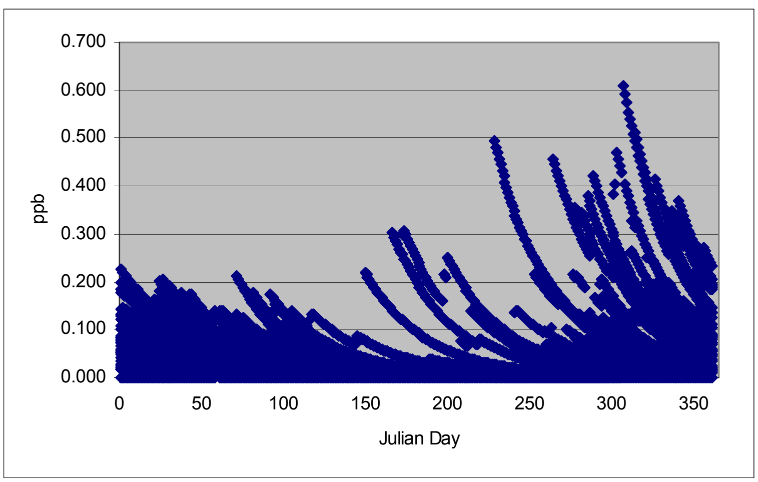



**Figure II.B.6. Cumulative OP Distribution in Water (Methamidophos Equivalents) in the Northern Crescent, summarized on a daily basis over 35 years**

Figure II.B.6 depicts the OP cumulative concentration for uses that made significant contributions to during Year 3, the year in which the highest concentration occurred. Phostebupirim use on corn was the primary use contributing to the peak that occurred during week 44. Phostebupirim was applied to corn on May 17th (week 20). 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. In the case of phostebupirim, a surrogate relative potency factor that was roughly two to three orders of magnitude greater than other OPs used on corn, greatly impacted its relative contribution to the cumulative OP load.

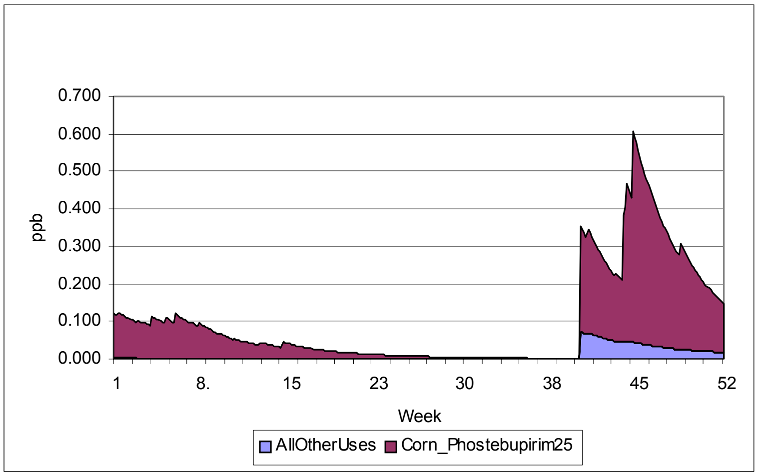



**Figure II.B.7. Cumulative OP Distribution for an Example Year (Year 3) in the Northern Crescent Region Showing Relative Contributions of the Individual OPs in Methamidophos Equivalents**

### c. A Comparison of Monitoring Data versus Modeling Results

A comparison of estimated concentrations for individual OP pesticides (Table II.B.6) with NAWQA monitoring (summarized below and in Appendix III.E.1) indicate that the predicted concentrations of OPs in surface water in south-central Pennsylvania are generally within the range of detections reported in the monitoring studies.

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

| Chemical | Crop/Use | Concentration, ug/L | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Max | 99th | 95th | 90th | 80th | 75th | 50th |
| Azinphos Methyl | Apples, Pears, Pumplins | 1.3e-01 | 4.6e-02 | 1.6e-02 | 1.1e-02 | 6.6e-03 | 5.2e-03 | 1.6e-03 |
| Chlorpyrifos | Corn, Alfalfa, Peaches, Pears | 3.0e-02 | 1.6e-02 | 8.2e-03 | 5.3e-03 | 3.5e-03 | 3.0e-03 | 1.6e-03 |
| Diazinon | Apple | 2.0e-02 | 1.5e-02 | 8.2e-03 | 5.7e-03 | 3.3e-03 | 2.6e-03 | 9.3e-04 |
| Dimethoate | Apple | 1.2e-04 | 3.5e-05 | 1.6e-05 | 1.1e-05 | 3.0e-06 | 9.9e-07 | 1.3e-08 |
| Methidathion | Apple | 8.0e-03 | 2.2e-03 | 8.4e-04 | 4.6e-04 | 1.6e-04 | 9.4e-05 | 9.1e-06 |
| Phosmet | Apples, Peaches, Pears | 4.6e-03 | 4.4e-04 | 4.1e-05 | 7.0e-06 | 1.2e-07 | 1.7e-08 | 1.0e-11 |
| Phostebupirim | Corn | 2.3e-02 | 1.2e-02 | 6.5e-03 | 4.9e-03 | 3.3e-03 | 2.7e-03 | 1.1e-03 |
| Terbufos | Corn | 1.4e-01 | 5.8e-02 | 1.7e-02 | 8.2e-03 | 3.7e-03 | 2.8e-03 | 5.8e-04 |
| OP Cumulative Concentrations (in Methamidophos Equivalents, ppb) (RPF=25) | | 6.1e-01 | 3.3e-01 | 1.8e-01 | 1.3e-01 | 8.8e-02 | 7.25-02 | 2.9e-02 |

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.

### d. Summary of Available Monitoring Data for the Northern Crescent

The Northern Crescent Farm Resource Region includes New England, New Jersey, Delaware, Michigan, Wisconsin, and parts of Pennsylvania, Maryland, Ohio and Minnesota. The topography of the Northern Crescent varies between extremes, from Mt Washington in New Hamsphire to the Atlantic coast more than 6200 feet below. Drinking water sources vary widely in their vulnerability, from shallow domestic wells in surficial, unconsolidated glacial aquifers throughout the Northern Crescent, to deep, confined bedrock aquifers in Wisconsin holding water recharged during the last Ice Age. In addition, a large population draws water from the Great Lakes, which have been more affected by past pollution than current pesticide use.

Although the topography and drinking water sources of the Northern Crescent varies throughout the region, the results of available monitoring are similar to those from other regions. Chlorpyrifos and diazinon are widely detected in urban and agricultural streams, with detections of malathion somewhat less common. However, in tree fruit areas such as central Pennsylvania, azinphos-methyl was detected as well. Other OPs,  such as ethoprop and terbufos, were infrequently detected in surface water.

Diazinon, chlorpyrifos and malathion were the only OPs detected in ground water, although rarely. This is in spite of State monitoring that concentrated on ground water, and several NAWQA monitoring studies that concentrated on shallow ground water in vulnerable agricultural areas. Ground water is an important source of drinking water in Vermont, New Hampshire and Maine, but less so in New York, Connecticut, Massachusetts, and Rhode Island, where a large majority of the population is supplied by surface water (USGS Water Atlas HA-730-M).

The Great Lakes represent a significant drinking water supply in the Northern Crescent, but water monitoring of the lakes has not concentrated on OP contamination. According to the State of Ohio's State of the Lake Report, for instance, 31 water-treatment plants on the north shore of Ohio draw water from Lake Erie http://www.epa.state.oh.us/oleo/leqi/14.pdf . These systems have not analyzed for OPs to this point, as such analysis was not required by the Safe Drinking Water Act.

These systems are likely to look for triazines once a month in the summer, and quarterly otherwise. Ohio EPA undertook a "pesticide special study" between 1995 and 1999, but also looked only for herbicides (http://www.epa.state.oh.us/ddagw/pestspst.html ). Cities like Cleveland and Toledo get their water from intakes a couple of miles into Lake Erie. Therefore, they rarely detect pesticides other than small levels of atrazine at times. Smaller communities might have their intakes somewhat closer to shore (Todd Kelleher, Ohio EPA Dept. of Drinking and Ground Waters, personal communication). Modeling results from PRZM and EXAMS for the OPs should be considered a conservative exposure estimate for populations deriving drinking water from the Great Lakes.

The EPA and Canada have identified portions of the Great Lakes that are considered "Areas of Concern" as part of the Great Lakes Water Quality Agreement. These can be seen through the EPA web page at http://www.epa.gov/glnpo/aoc/map.html . Forty-three sites (26 in the US) on the shores of the Great Lakes have been identified as AOCs for reasons such as fish tumors, bird or animal deformities or reproductive problems, restrictions on dredging and restrictions on drinking water consumption, among others (full list at http://www.ijc.org/focus/listdelist/ ). The pollutants of concern identified for the AOCs include organochlorine insecticides, but not OPs. Other concerns include heavy metals, PCBs, polynuclear aromatic hydrocarbons and sedimentation. Some of the action plans for AOCs include management practices to avoid continued non-point pollution, including pesticides in agricultural runoff.

A summary of monitoring from the Northern Crescent follows:

The **Lake Erie-Lake Saint Clair Drainages (LERI) NAWQA** study unit assessed the water quality of streams draining to these lakes in parts of Michigan, Ohio, Indiana, New York and Pennsylvania. Although historic industrial pollution on the shores of the Great Lakes has led to the identification of the AOCs mentioned above, about 75% of the area included in this study unit is dedicated to agricultural use. Insecticides were included in weekly to monthly sampling at 4 sites from 1996 to 1998. The streams sampled drain watersheds with areas from 310 to 6330 square miles.

Chlorpyrifos and diazinon were extensively detected in agricultural, mixed land-use and urban stream samples. Both were more frequently detected in urban samples than agricultural samples (36% vs 13% for chlorpyrifos, 70% vs 23% for diazinon). The maximum agricultural stream concentration of chlorpyrifos was about 0.4 ug/l. The maximum agricultural stream concentration of diazinon was 0.1 ug/l. Malathion and methyl parathion are also listed as infrequent contaminants in this study.

Ground-water monitoring in this study unit was concentrated in eastern Michigan. Thirty monitoring wells were located in agricultural areas. Some of these monitoring wells were installed alongside 18 deeper domestic wells (average 93 feet versus about 30 feet). Similar co-installation was done west of Detroit to assess mixed-use and urban ground water. Less contamination occurred in the domestic wells, one-third of which had water which according to tracers recharged before 1953. However, the single OP detection in ground water, a detection of about 0.05 ug/l of diazinon, occurred in a domestic drinking-water well. As age-dating of ground-water supply advances throughout the Nation, the Agency will better be able to assess which ground-water supplies are most likely to be affected by recent human activities.

Eighty percent of the population of the **Hudson River Basin (HDSN) NAWQA** study unit, which is located almost completely in New York, derives its drinking water from surface water supply. People drawing water from domestic wells do so mostly from unconsolidated surficial glacial and post-glacial aquifers. The region has more land devoted to forest than agriculture (62% versus 25%).

Surface-water monitoring for OPs in this study unit was limited to the 46 fixed sampling sites distributed through the basin. Diazinon was extensively detected (16%), with a maximum concentration of 0.697 ug/l. While the highest detection of diazinon was from an agricultural stream, fewer than 20% of the samples with detections of diazinon were from agricultural streams. Chlorprifos was detected in little more than 1% of agricultural streams, with a maximum detection of 0.024 ug/l. Malathion was detected in 6% of urban streams, with a maximum detection of 0.13 ug/l.

Diazinon and malathion were detected in ground water in this study unit. The monitoring program included single samples from shallow (<50 feet deep) monitoring wells (26 urban, 18 agricultural) in the unconsolidated glacial and post-glacial deposits, and domestic wells throughout the region ranging in depth from 7 to more than 100 feet deep. Diazinon was detected domestic and urban wells (2% of all wellls, max detection <0.1 ug/l). Malathion was detected in about 5% of domestic wells (1% overall, max concentration <0.05 ug/l).

The **Connecticut, Housatonic and Thames River Basins (CONN) NAWQA** study unit includes parts of Connecticut, Massachusetts, New Hampshire, New York and Vermont, and includes only 12 % agricultural land (most is forested and undeveloped). Surface water is the predominant drinking water supply, although 924 thusand of the 4.5 million people in the region had domestic wells in 1990 (USGS Circular 1155).

The fixed site surface water sampling program in this study included 12 sites around the basin sampled about 15 times per year. In addition, a single intensive urban stream site was sampled about 40 times per year in 1993 and 1994. Diazinon was frequently detected in surface water, including a 92% frequency in urban stream samples. Chlorpyrifos (max concentration <0.1 ug/l) and disulfoton (max concentration <0.01 ug/l) were detected in 1% and <1% of samples, respectively. Malathion, however, was detected in 4% of samples, with a maximum concentration of 7.5 ug/l. This detection did not occur in an agricultural stream.

Although other insecticides such as carbofuran and permethrin were detected in ground water, and although diazinon was detected extensively in surface water, no OPs were detected in ground water in this study unit. The monitoring network included 163 wells sampled once each, with 120 of these in surficial aquifers. An additional 14 wells for a flowpath

The **New Jersey-Long Island Coastal Drainages (LINJ) NAWQA** study unit includes mixed-use and urban stream samples, and agricultural, mixed use and urban ground water samples. Only seven surface water samples were collected in a stream considered to drain solely agricultural land.

An nearly equivalent number of people in the LINJ study unit derive their drinking water from surface water as from surficial aquifers. The surficial aquifers in both the southern half of New Jersey and Long Island are coarse grained soils which are susceptible to pesticide contamination.

Chlorpyrifos and diazinon were detected extensively in urban and mixed use surface water samples. Urban uses of chlorpyrifos and diazinon are currently being phased out. Only three of the urban and mixed land-use surface-water sampling sites had more than 50% agricultural land use. It is not possible to distinguish chlorpyrifos and diazinon in these samples derived from agricultural or urban/suburban use. Neither chlorpyrifos nor diazinon were detected in ground water.

The population of the **Lower Susquehanna River Basin (LSUS) NAWQA** study unit, which is located in south-central Pennsylvania and northeasternmost Maryland, derives 75% of its public water supply from surface-water sources. Public supply in this region served 1.2 million people in 1992. Another 800,000 derived their drinking water from private domestic wells. The land use in the majority of this region is equally divided between agricultural and forested land (47% each- USGS Circular 1168).

The LSUS is a study unit with relatively high frequency of OPs in surface water. Many of these correspond with tree fruit uses simulated in PRZM-EXAMS modeling for this region. Azinphos-methyl, for instance, was detected in 9% of agricultural stream samples, with a maximum concentration of 0.4 ug/l. Chlorpyrifos was detected in about 18% of agricultural streams (maximum concentration 0.09 ug/l), and diazinon was detected in little over 5% in agricultural streams (maximum concentration 0.055 ug/l). Methyl parathion, which will no longer be used on tree fruits, was detected in 2 agricultural stream samples, with a maximum concentration of 0.063 ug/l.In the LSUS, 187 sites sampled were once, 3 sites sampled intensively from 1993 to 1995.

Other OPs not included in the simulation modeling for the Northern Crescent were detected in the LSUS study. Malathion was detected in 8% of urban samples, and 3% of agricultural samples, with a maximum concentration of 0.129 ug/l. Ethoprop was detected in 1.4% of samples 8 detections), with a maximum concentration of 0.052 ug/l.

The ground-water monitoring program in the LSUS study unit included 159 wells, 152 of which were domestic supply wells, mostly <200 feet deep. The project report states that, “Samples from these wells generally contain water that has infiltrated through the ground in recent years and therefore could be used to indicate whether land-use practices have affected ground-water quality.” Many herbicides were in fact detected in these wells, as well as insecticides such as carbaryl and carbofuran. Diazinon, however, is the only OP detected in ground water. It was detected in 2 samples at concentrations <0.01 ug/l.

The **Western Lake Michigan Drainage (WMIC) NAWQA** study unit provides further data on OP contamination in the Great Lakes region, covering eastern Wisconsin and part of the Upper Peninsula of Michigan. Agriculture accounts for 37% of the land use in this region, while 50% is forested. Drinking water is predominantly derived from surface-water supplies in this area, mostly from Lakes Michigan and Winnebago.

Pesticides were included as analytes at three intensive stream sampling sites, and at 145 other sampling sites in agricultural, urban and mixed land-use areas. Diazinon was the OP most detected in this region (5%), with detections ranging to about 0.05 ug/l. Chlorpyrifos, phorate, malathion and methyl parathion were detected in no more than 3 samples each. The maximum detection among these was a phorate detection of about 0.1 ug/l.

Ground water networks included 56 shallow monitoring wells installed in unconsolidated surficial deposits, and 29 domestic, institutional or public supply wells completed in underlying bedrock. Each of these wells was sampled a single time between 1993 and 1995, and no OPs were detected in any of the ground-water samples.

The **Upper Mississippi River Basin NAWQA** study unit is located predominantly in Minnesota, with a small number of samples taken as well in Wisonsin and Iowa.

Although stream-water samples were collected from streams representing various land uses, urban streams accounted for nearly all of the OP detections in surface water in this study unit. Diazinon was detected in 9% of urban stream samples, and 48% of mixed land-use samples (maximum concentration 0.3 ug/l), but in none of the 50 agricultural stream samples collected. Similarly, chlorpyrifos was detected in 32% of urban streams, but not in any agricultural samples. Malathion was detected in 11% of urban samples (maximum concentration 0.08 ug/l), but only a single agricultural sample. Two detections of ethoprop (maximum concentration 0.02 ug/l) represent the only other OP detections in agricultural streams.

Diazinon was detected in four ground-water samples taken from wells in “major aquifers.” The maximum concentration detected was greater than 10 ug/l, which represented the highest concentration of diazinon in ground water detected in the NAWQA program.

**State Monitoring**

Connecticut

Judith Singer provided data from a USGS report which cover the Connecticut, Housatonic and Thames Rivers from 1969 to 1992. The tables she provided indicate that diazinon was detected in 3 surface water samples from 0.01 to 0.03 ppb (detection limit reported as 10 ppb). Chlorpyrifos, diazinon, and phorate were detected once each at 0.01 ppb, and a single detection of “total diazinon” occurred at 0.07 ppb.

Connecticut’s main focus is the Pesticide Management Plan.

Delaware

Scott Blaier of the Delaware Department of Agriculture indicated that chlorpyrifos was detected one year in domestic and monitoring wells. As part of the PMP program, chlorpyrifos was included in 1998. The top of the well screen of 70% of the “domestic and agricultural wells” sampled was between 16 and 35 feet. Top of screen for 80 percent of the monitoring wells was shallower than 15 feet.

Chlorpyrifos was detected in a single well (LOD = 0.22 ppb) at a concentration of 0.75 ppb. This was a domestic well screened between 33 and 38 feet. From, “The Occurrence and Distribution of Several Agricultural Pesticides in Delaware's Shallow Ground Water”, 2000: http://www.udel.edu/dgs/Publications/pubsonline/RI61.pdf

Maine

Julie Chizmas of the Maine Department of Agriculture wrote that Maine samples drinking water wells no more than 1/4-mile down-gradient of an active use site. Analytes are chosen based on local sales data. Sampling took place in 1994 and then in 1999, and included the following OPs:

- azinphos methyl
- diazinon
- chlorpyrifos
- ethoprop
- phosmet

No OPs were detected in 1999. One detection of diazinon in 1994 (7.4 ppb) was determined to be the result of a homeowner putting diazinon around her well head to get rid of ants. Ethoprop was detected in one well at 0.075 ppb. No followup to that detection was conducted.

Surface-water monitoring in Maine has included the following OPs:

- azinphos methyl
- chlorpyrifos
- diazinon
- ethoprop
- malathion
- phosmet

Most surface-water monitoring in Maine is in response to the endangered species designation for Atlantic salmon. “Blueberries are the most intensively grown commodity in the salmon watershed.” Only phosmet has been detected to date in surface water, with a maximum detection of 0.52 ppb (3 detections). In this study, surface water samples were collected less than 2 hours after a phosmet application. Sampling continues in that watershed, except for ethoprop.

Maryland

Rob Hofstedter of the Maryland Department of Agriculture reports that their agency has a current ground-water study that includes diazinon. Results of this study are not yet available. He indicated that the Maryland Geological Survey would have information on previous surface-water studies which included malathion.

David Bolton of the Maryland Geological Survey provided summary tables from the MGS Report of Investigations number 66, “Ground-Water Quality in the Piedmont Region of Baltimore County, Maryland.” Analysis in this rural region included 12 OPs, 10 of which are still registered. Seven of the 10 current OPs were not detected in ground water. Results of the monitoring are as follows, with concentrations in ug/l.

**Table II.B.7 Ground Water Quality in the Piedmont Region of Baltimore County**

| Pesticide | # Samples | MRL | >/= MRL | < MRL | Maximum Conc. |
|---|---|---|---|---|---|
| Azinphos Methyl | 112 | 0.001 | 0 | 0 | |
| Chlorpyrifos | 112 | 0.004 | 0 | 0 | |
| Diazinon | 112 | 0.002 | 1 | 0 | 0.003 |
| Dimethoate | 1 | 0.004 | 0 | 0 | |
| Disulfoton | 112 | 0.017 | 0 | 0 | |
| Ethoprop | 112 | 0.003 | 1 | 1 | 0.004 |
| Fonofos | 112 | 0.003 | 0 | 0 | |
| Malathion | 112 | 0.005 | 0 | 0 | |
| Methyl Parathion | 112 | 0.006 | 0 | 0 | |
| Parathion | 112 | 0.004 | 1 | 0 | 0.022 |
| Phorate | 112 | 0.002 | 1 | 0 | 0.010 |
| Terbufos | 112 | 0.013 | 0 | 0 | |

Surface-water sampling at 8 sites at the Pocomoke River in 1998 did not result in detections of chlorpyrifos, dimethoate, malathion or terbufos above levels of detection. One sample included a “trace” level of terbufos, reported as between 0.07 and 0.1 ppb.

Massachusetts

Kenneth Pelotiere indicated that over the last 10 years, testing of surface water and ground water has been for pesticides required under the Safe Drinking Water Act. Therefore, OPs have not been included as analytes.

Michigan

Dennis Bush from the Surface Water Quality Division will provide to OPP information on a study of tributaries of the Saginaw River, which included OPs as analytes.  This information has not yet arrived, but will be reviewed and incorporated into the final assessment in August 2002.

Mark Breithart of the MDEQ Drinking Water Division examined their database, and found that analysis was done for the following OPs in Michigan drinking water:

- ❑ azinphos methyl
- ❑ malathion
- ❑ chlorpyrifos
- ❑ methyl parathion
- ❑ diazinon
- ❑ fenamiphos
- ❑ dimethoate
- ❑ disulfoton

None of these were detected in 49 analyses of public water supplies. Of the 421 analyses from private water supplies, only dimethoate was detected. This single detection of 2 micrograms/liter occurred at an aerial spray service, and therefore it is not clear if it was the result of a point source.

Minnesota

See the Heartland region assessment.

New Hampshire

The New Hampshire Department of Environmental Services does not include the OPs in drinking water analysis. The state does not include OPs in systematic ground-water monitoring, which is focused on the Pesticide Management Plan program. Pat Bickford of the NHDES indicates that some monitoring of OPs has occurred, but only when the Department of Agriculture investigating misuse for enforcement, or rarely at the request of a homeowner.

New Jersey

Dr. Roy Meyer of the New Jersey Department of Environmental Protection (NJDEP) Pesticide Monitoring and Evaluation group indicated that NJDEP has not detected OPs in its ground-water monitoring program. The wells in this program are mostly concentrated in the agricultural areas of southern New Jersey. The wells are shallow (<30 feet), and are intended to give a sense of pesticide migration through the vadose zone.

Another program is in place for the Pesticide Management Plans.

Ohio

See the Heartland region section.

Pennsylvania

John Pari of the Pennsylvania Department of Agriculture indicated that PA has ground-water monitoring programs that are tailored to particular crops uses. This includes a program focusing on corn that has run from 1995 to the present. The wells are described as "water supply" wells, whether as sources for drinking water for humans or livestock.

Chlorpyrifos is the only OP included in this analysis. There have been about 450 analyses to date, and chlorpyrifos was detected in "4 or 5" samples. The maximum concentration detected was 0.29 ppb. Another study is just beginning in orchard areas, and may include other OPs.

Rhode Island

Eugene Pepper of the Rhode Island Department of Environmental Management reports that in addition to required Safe Drinking Water Act analyses, the Department of Health uses Method 525 to analyze ground water and surface water for chlorpyrifos, diazinon, and by special request, malathion. However, these insecticides have not been detected. Mr. Pepper pointed out that both raw and finished water are tested, but the lab does not include the transformation products in the analysis.

A nearly completed ground-water study for turf chemicals includes chlorpyrifos, but chlorpyrifos has not been detected in this study, either.

Vermont

Cary Giguere of the Vermont Department of Agriculture, Food and Markets reports that OPs are not regularly included in their monitoring, but that the State has an OP screen. This is used for enforcement cases, generally. OPs are not included in drinking-water monitoring.

Surface-water monitoring is not only for corn herbicides, but also railroad program, golf course permitting (includes some OPs). Act 250 requires a detailed pesticide management plan to protect surface and ground water. They have a list of pre-screened pesticides, and the state monitors certain courses. The courses must monitor drinking water. State monitors surface water, in order to be sure that permitting is effective in protecting water resources.

In 1999, VDAFM analyzed turf (including lawns and golf courses) pesticides in streams adjacent to a residential complex immediately following a commercial landscape application. Diazinon, chlorpyrifos and malathion were included in the analysis. Of these, only diazinon was detected (2 samples), at concentrations of 0.08 and 0.22 ppb.

## 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 (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. 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 95$^{th}$ percentile values can be plotted, with 95$^{th}$ 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 at various total exposure levels for different subgroups of the Northern Crescent population (e.g, those at the 95$^{th}$

percentile vs. 99th percentiles of exposure).

Figures III.J.2-1 through III.J.2-5 in Appendix J present the results of this cumulative risk analysis for Children, 1-2 years for a variety of percentiles of the Northern Crescent population (95 th , 97.5 th , 99 th , 99.5 th , and 99.9 th ). Figure III.J.2-6 through Figure III.J.2-10, Figure III.J.2-11 through III.J.2-15, and Figure III.J.2-16 through III.J.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., 95 th , 97.5 th , 99 th , 99.5 th , and 99.9 th ). 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 95 th 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 Northern Crescent 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**

(Figure III.J.2-1 through Figure III.J.2-5): At the 95th percentile, exposures from the residential applications of OP pesticides do not contribute to any substantial exposure to the pesticides in this region. 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. Exposure from drinking water at this percentile also 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 crack and crevice treatments . By the 99.9th percentile, residential exposures via 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. These continue to be low and do not contribute in any significant manner to the overall risk picture. Similarly, dermal and hand-to-mouth exposures begin to appear in the overall risk picture at only the 97.5th percentile, but continue to be a small fraction (<1%) of total exposure throughout all percentiles.

**b. Children 3-5 years old**

(Figure III.J.2-6 through Figure III.J.2-10): As with children 1-2, exposures from the residential applications of OP pesticides do not contribute to any substantial 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. Exposure from drinking water at this percentile also 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 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. These continue to be low and do not contribute in any significant manner to the overall risk picture. Similarly, dermal and hand-to-mouth exposures begin to routinely appear in the overall risk picture only at the 97.5th percentile, but continue to be a small fraction (<1%) of total exposure throughout all percentiles.

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

(Figure III.J.2-11 through Figure III.J.2-15 and Figure III.J.2-16 through III.J.2-20) At the 95th percentile, exposures from the residential applications of OP pesticides do not contribute to substantial exposure to the pesticides in this region. This is true for all of the routes of exposure examined: dermal exposure from lawn and garden and golf course treatment applications and inhalation exposure from lawn and gardening activities and indoor crack and crevice and pest strip treatments. Exposure from drinking water at this percentile also does not contribute to substantial exposure. At the higher percentiles the exposure profile and relative contributions begin to change. The residential inhalation exposures become an increasingly dominant portion of the total exposure profile. This corresponds to use of DDVP products and crack and crevice. By the 99.9th percentile, residential exposures via the inhalation pathway from the use of these DDVP products are consistently the most significant contributors to the overall risk picture. This is not true for drinking water exposures. These continue to be low and do not contribute in any significant manner to overall risk. While apparent at the 95th percentile, dermal exposures continue to be a small fraction (< ca. 1%) of total exposure throughout all percentiles examined.