DRAFT

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AIR MONITORING NETWORK RESULTS FOR 2013

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By

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SUMMARY

In February 2011, DPR implemented a multi-year statewide air monitoring network for measuring pesticides in various agricultural communities. This pesticide Air Monitoring Network (AMN) is the first multi-year air monitoring study conducted by DPR. The goals of the AMN are to provide data that assists in assessing potential health risks, developing measures to mitigate risks, and measuring the effectiveness of regulatory requirements. This report is the 3rd volume of this study and contains AMN results from January 1, 2013 to December 31, 2013.

DPR monitored a total of 32 pesticides and 5 pesticide breakdown products in three communities. Pesticides monitored in the AMN were selected based primarily on potential health risk. Higher-risk pesticides were prioritized and targeted for monitoring. Higher-risk pesticides were identified based on higher use, higher volatility, and higher toxicity. DPR evaluated 226 communities in California as candidates for inclusion in the network. DPR selected one site each in Salinas (Monterey County), Shafter (Kern County), and Ripon (San Joaquin County) for the AMN based on pesticide use, demographic data, and availability of other exposure and health data.

One 24-hour sample was collected each week at each of the three sites. The starting day varied each week with the actual dates being randomly selected. Sampling start times were left to the discretion of the field sampling personnel, but they always started anywhere from 9:00 a.m. to 2:00 pm. No state or federal agency has established health standards for pesticides in air. Therefore, DPR developed health screening levels for the monitored pesticides to place the results in a health-based context. The health screening level is the calculated air concentration based on a chemical's toxicity that is used to evaluate the possible health effects of exposure to the chemical. Although screening levels are not regulatory standards, they can be used to evaluate air monitoring results and determine if a more detailed assessment is warranted.

Overall, 92.9 % of the 6,033 analyses (number of samples times the number of chemicals analyzed) resulted in no detectable concentrations. Only 426 (7.1%) of the analyses had detectable (trace or quantifiable) concentrations, and 2.6% of the analyses had quantifiable concentrations. Quantifiable detections refer to concentrations above the limit of quantitation (LOQ) for their respective pesticide. Thirteen of the 32 pesticides and 5 pesticide breakdown products monitored by DPR were not detected.

Of the 32 pesticide and 5 breakdown products included in the AMN, 24 were detected in at least one sample. However, nearly all air concentrations were low relative to the screening levels. Of the 32 pesticide and 5 breakdown products included in the AMN, chloropicrin and 1,3-dichloropropene were the only pesticides that exceeded any of its screening levels for any of the exposure periods, indicating low health risk of most pesticides to the people in these communities. The maximum 4-week air concentration for chloropicrin was 3,200 ng/m^3 at the Salinas site, or 1.4x of the 2,300 ng/m^3 subchronic screening level. The maximum annual average air concentration for 1,3-dichloropropene was 2,600 ng/m^3 at the Shafter site, or 3.47x of the 650 ng/m^3 regulatory goal for cancer risk, assuming the 2013 average concentration represents the average concentration for a 70-year lifetime. DPR is conducting more detailed evaluations of chloropicrin and 1,3-dichloropropene, including analyzing the applications and weather conditions during the time high concentrations were detected. DPR has also taken actions to reduce exposures to chloropicrin and 1,3-dichloropropene.

Of the 24 pesticides detected, 10 were detected at trace levels, and 14 had quantifiable concentrations. Eleven of the fourteen pesticides (including three breakdown products) detected at quantifiable concentrations in the AMN were either fumigants (1,3-dichloropropene, carbon disulfide, methyl bromide, chloropicrin, and MITC) or organophosphate insecticides (chlorpyrifos + OA, DDVP, diazinon + OA, and malathion). Oxyfluorfen, chlorothalonil, and EPTC were also detected at quantifiable concentrations. The chemicals with the highest number of detections were chlorothalonil (35%), chlorpyrifos (33%), and MITC (30%).

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GLOSSARY

Acute exposure: Short-term exposure. Acute toxicity can be defined as the toxicity manifested within a relatively short time interval. Acute exposure can be as short as a few minutes or as long as a few days, but is generally not longer than one day. In animal toxicity studies, exposure is usually for 24 hours or less.

ARB: California Air Resources Board, part of Cal/EPA

Cal/EPA: California Environmental Protection Agency. The Department of Pesticide Regulation is one of five boards and departments within Cal/EPA.

Chronic exposure: Long-term exposure. Chronic exposure is generally for a significant portion of an animal or human lifetime. Exposure may be through repeated single doses or may be continuous.

Co-located sampler: A second sampler located within 1 meter of the primary sampler.

Concentration: The amount of a chemical (by weight) in a given volume of air. Concentrations in air can be expressed in units of volume or weight. In this report, pesticide concentrations are expressed as nanograms per cubic meter (ng/m³).

Detected: Pertains to a chemical that is found in a sample above the method detection limit (see MDL).

Detection limit: see MDL (method detection limit)

DPR: California Department of Pesticide Regulation

Duplicate sample: Same as a primary sample, but it is obtained on a co-located sampler as a replicate.

Exposure: Contact with a chemical. Common routes of exposure are dermal (skin), oral (by mouth) and inhalation (breathing).

Field spiked sample: A sample with a known amount of chemical spiked onto the sample media which is placed next to primary sample and undergoes the same air flow and run time conditions. The field spiked sample, compared to the primary sample, provides some information about any change in the ability to recover the analyte during air sampling.

FQPA: U.S. Food Quality Protection Act

Health screening level: The calculated air concentration based on a chemical's toxicity that is used to evaluate the possible health effects of exposure to the chemical. Although not a regulatory standard, screening levels can be used in the process of evaluating the air monitoring results. A measured air concentration that is below the screening level for a given pesticide generally would not undergo further evaluation but should not automatically be considered “safe” and could undergo further evaluation. A measured concentration that is above the screening level would not necessarily indicate a health concern but would indicate the need for a further and more refined evaluation. Different screening levels are determined for different exposure periods, i.e., acute, subchronic, and chronic.

HI: Hazard index. The sum of all hazard quotients (HQs). It is used to estimate the potential health risk for non-cancer effects from exposure to several chemicals for a given time period (acute, subchronic, chronic). That is,

$$HI = HQ_1 + HQ_2 + HQ_{3+\ldots}$$

HQ: Hazard quotient. The HQ is the ratio of an exposure level for a chemical (measured air concentration of a pesticide) to a reference concentration for the chemical (screening level for that pesticide) over the same time period. An HQ less than 1 is generally considered to be health protective.

$$\text{Hazard Quotient} = \frac{\text{Air Concentration Detected (ng/m}^3\text{)}}{\text{Screening Level (ng/m}^3\text{)}}$$

LOQ: Limit of Quantitation. Similar to method detection limit (MDL), the LOQ is the smallest amount of the chemical that can be reliably measured. Samples with concentrations above the minimum detection limit but below the LOQ can be identified as containing a *trace* amount but the concentration cannot be measured reliably. When calculating average concentrations or other statistics, DPR assumes that samples with a trace concentration have a concentration at the midpoint between the MDL and the LOQ. As with the MDL, the LOQ is a characteristic of both the method and the chemical. Different methods can have different LOQs limits for the same chemical. The same method can have different LOQs for different chemicals.

Matrix: the substance in the sampling tubes, such as XAD resin or charcoal which traps and removes organic compounds from the atmosphere during sampling

MDL: Method detection limit. The MDL is the smallest amount of the chemical that can be identified (although not necessarily quantified) in a sample with the method employed. If nothing is detected, the sample may contain none of the chemical or may have a concentration less than the MDL. In either instance, the sample is designated as containing no detectable amount. When calculating average concentrations or other statistics, DPR assumes that samples with no detectable amount have a concentration of one-half the MDL. The MDL is a characteristic of both the method and the chemical. That is, different methods can have different MDLs for the same chemical. Similarly, one method can have different MDLs for different chemicals. (See also *LOQ, limit of quantitation*)

MLD: Monitoring and Laboratory Division. The MLD is the monitoring and laboratory division of the California Air Resources Board. Staff from MLD audited the Air Monitoring Network at the petition of the California Department of Pesticide Regulation.

Monitored chemical: Refers to a chemical that was sampled for in the air and analyzed for to determine its possible air concentrations. Air sampling apparatus can consist of pumps and sampling tubes or vacuum canisters. Pumps draw air over sampling tubes containing absorptive media which trap chemicals from the air. The media is then chemically analyzed in the laboratory to determine if the monitored chemical was in the air. Vacuum canisters are air-tight metal containers which utilize a starting vacuum to draw air inside during the monitoring period. The air in the canisters is then subjected to chemical analysis in the laboratory to determine if the monitored chemical was in the air. In this study, air sampling periods were 24 hours long.

ND: None detected. This is the concentration below the method detection limit (MDL).

OA: Oxygen analog, also known as oxon. This is the breakdown product from certain organophosphate pesticides. Oxygen analogs usually are more toxic than the parent compound.

QA: Quality assurance team

QAS: Quality Assurance Section of ARB

QC: quality control

Primary sample: Sample collected in the field to measure pesticide air concentrations.

PUR: Pesticide use report. All agricultural pesticide use in California is required to be reported to the County Agricultural Commissioners. DPR collects these pesticide use reports; it evaluates and annually publishes the data.

RCD: Risk characterization document. DPR's human health risk assessment for a pesticide is presented in the RCD. The RCD explains the results of the risk assessment and assembles, critiques, and interprets all pertinent scientific data on a chemical's toxicology, human experience, and exposure.

RED: Reregistration eligibility document. Reregistration is U.S. EPA's reevaluation and relicensing of existing pesticides originally registered prior to current scientific and regulatory standards. U.S. EPA's human health risk assessment for a pesticide is presented as part of its RED.

Risk: Risk is the probability that a toxic effect (adverse health effect) will result from a given exposure to a chemical. It is a function of both the inherent toxicity of the chemical as well as the exposure to the chemical.

SOP: Standard operating procedure. It is a document describing the materials and methods used for various monitoring tasks.

Sorbent cartridge: A Teflon® cartridge filled with a measured amount of trapping media and sealed. The tube is attached to an air pump and ambient air is drawn through the trapping media in the tube.

Subchronic exposure: A medium time interval of exposure to a chemical. Subchronic exposure is longer than acute exposure, but shorter than chronic exposure. Subchronic exposure may be through repeated single doses or may be continuous. See *acute exposure*, *chronic exposure*.

Trace: see *Limit of Quantitation* (LOQ)

Trip blank sample: A clean sample cartridge capped and stored on dry ice with the rest of the samples collected from the monitoring site. The purpose is to determine if handling conditions in the field, sample transporting, or storage procedures may have contaminated the samples.

U.S. EPA: U.S. Environmental Protection Agency

VOC: volatile organic compound

INTRODUCTION

Background

The Department of Pesticide Regulation (DPR) is the public agency responsible for protecting California and its residents from adverse health effects caused by the use of pesticides. On February 2011, as part of DPR's mandate for "continuous evaluation" of currently registered pesticides, DPR implemented a multi-year statewide air monitoring network for measuring pesticides in various agricultural communities. This pesticide Air Monitoring Network (AMN) is the first long-term air monitoring study conducted by DPR. Past and current studies by the Air Resources Board (ARB) and DPR for the toxic air contaminant program usually consist of monitoring for a few weeks for individual pesticides. This produced data that was used to estimate seasonal pesticide exposures and local concentrations. However, since long-term data was not previously available, to estimate concentrations associated with annual and lifetime exposures, DPR would extrapolate the short-term concentrations detected. AMN results provide the needed results to more accurately estimate chronic pesticide exposures. The goals of the AMN are to provide data that assists in assessing potential health risks, developing measures to mitigate risks, and measuring the effectiveness of regulatory requirements.

The AMN includes these scientific objectives:

- Identify common pesticides in air and determine seasonal, annual, and multiple-year concentrations.
- Compare concentrations to subchronic and chronic health screening levels.
- Track trends in air concentrations over time.
- Estimate cumulative exposure to multiple pesticides with common physiological modes of action in humans (e.g., cholinesterase inhibitors).
- Attempt to correlate concentrations with use and weather patterns.

As part of the monitoring station selection process for the AMN, DPR evaluated and prioritized 226 communities in California as candidates for inclusion in the network. The 226 communities were prioritized based on pesticide use (both local and regional), demographic data (including: communities with higher populations of children, persons over 65, and number of persons living in close proximity to farms and agricultural areas with high pesticide use), and availability of other exposure and health data. DPR also considered other factors, including air sampling feasibility, weather patterns, and the potential for collaboration with other projects focused on environmental health (Segawa, 2010). Salinas (Monterey County), Shafter (Kern County), and Ripon (San Joaquin County) were selected as the sampling locations for the air network.

As described in AMN's Volume 1 report (DPR, 2013), it was previously determined that representative sampling could be obtained from one 24-hour air sample each week from each community selected. The air samples collected were analyzed for 32 pesticides and 5 pesticide breakdown products.

This is the 3rd volume of AMN result data. The report contains AMN results from all three sites starting from January 1, 2013 to December 31, 2013.

Site Locations

<u>Ripon</u>
Ripon is a small city (4.2 square miles in area) located approximately 20 miles south of Stockton in San Joaquin County. The elevation is 69 feet, with approximately 13.8 inches of precipitation annually. Average temperatures during summer range from 60º to 94º and 47º to 62º F during winter. Based on US Census data, the estimated population in 2010 was 14,297, of which 28.8% was below 18 years of age and 11.8% was 65 years or older. Almond orchards, grapes and field crops are the major crops

surrounding the community. The monitoring site is located in an open area behind the Police Station on N. Wilma Ave near the western side of the middle of the city.

Shafter

Shafter is a small city (18 square miles in area) located approximately located 18 miles west-northwest of Bakersfield in Kern County. The elevation is 351 feet, with approximately 7 inches of precipitation annually. Average temperatures range from 59º to 99º F in the summer and 35º to 64º F in winter. In 2010, the population was 16,988 of which 36.0% was below 18 years of age and 6.6% was above 65 years of age. The major crops in the immediate area around Shafter are almonds, grapes, and alfalfa some field crops. The monitoring site is located near a city well adjacent to Shafter High School in the northeastern edge of the city.

Salinas

Salinas is located in Monterey County approximately 15 miles north-east of Monterey and encompasses a total area of 19 square miles. In 2010, Salinas had a population of 150,441 of which 31.4% was below 18 years of age and 7.4% was above 65. The average rainfall is approximately 14.5 inches. Average temperatures range from 51º to 72º F in the summer and 40º to 52º F in winter. Heavy morning fog often occurs during summer months. Salinas is surrounded mainly by strawberries, lettuce and other field crops. The monitoring site is located at the Salinas Airport in the south-eastern section of the City.

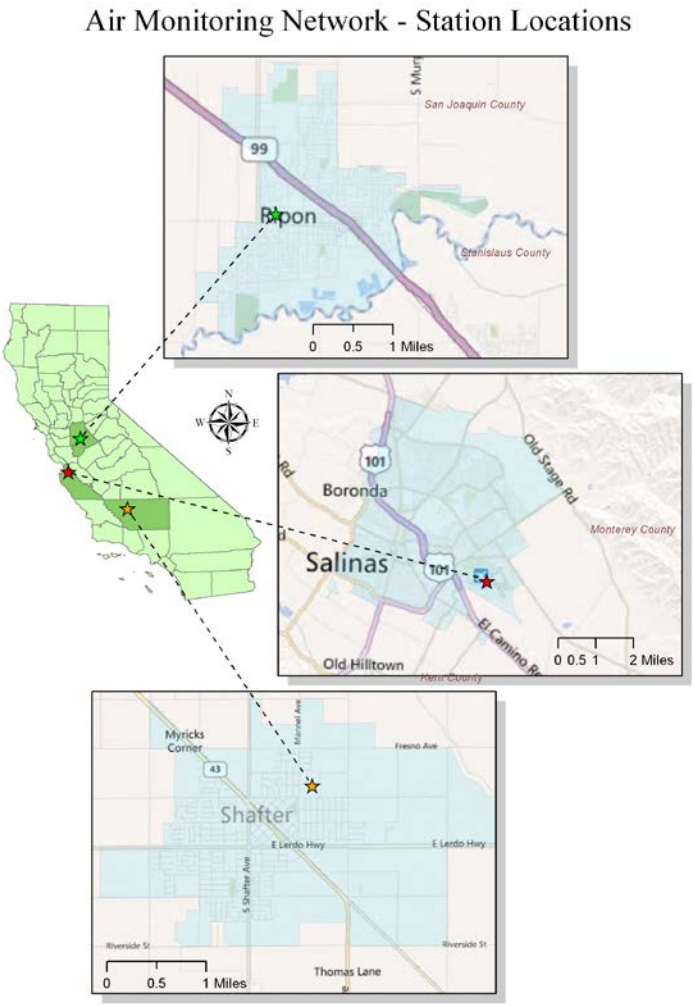


Figure 1. Map of the three sampling station locations.

Pesticides Monitored

DPR monitored a total of 32 and 5 pesticide breakdown products. Pesticides included in AMN monitoring were selected based primarily on potential health risk. Higher-risk pesticides have higher priority for monitoring. Pesticides were selected based on criteria described on the AMN's Volume 1 report (DPR, 2013)

Multi-Pesticide Residue Analysis

Multi-pesticide residue analysis using XAD-4 resin as the solid phase trapping medium were performed by CDFA laboratory using GC-MS and LC-MS methods as described in method EMON-SM-05-002 (CDFA, 2008). Analysis includes a variety of fungicides, insecticides, herbicides, and defoliants. The breakdown products of chlorpyrifos, diazinon, dimethoate, endosulfan and malathion were also included in the multi-residue analysis method. Table 1 lists the target analytes in multi-pesticide residue analysis with XAD-4 resin.

Table 1. Target analytes in multi-pesticide residue analysis with XAD-4 resin.

Pesticide	Product Name	Pesticide Group	Chemical Class
Acephate	Orthene	Insecticide	Organophosphate
Bensulide	Prefar	Herbicide	Organophosphate
Chlorothalonil	Bravo	Fungicide	Chloronitrile
Chlorpyrifos	Dursban	Insecticide	Organophosphate
Chlorpyrifos Oxygen Analog	-		
Chlorthal-dimethyl	Dacthal	Herbicide	Phthalate
Cypermethrin	Demon	Insecticide	Pyrethroid
Diazinon	Various names	Insecticide	Organophosphate
Diazinon Oxygen Analog	-		
Dicofol	Kelthan	Insecticide	Organochlorine
Dimethoate	Cygon	Insecticide	Organophosphate
Dimethoate Oxygen Analog	-		
Diuron	Karmex	Herbicide	Urea
Endosulfan	Thiodan	Insecticide	Organochlorine
Endosulfan Sulfate	-		
EPTC	Eptam	Herbicide	Carbamate
Iprodione	Rovral	Fungicide	Dicarboximide
Malathion	Various names	Insecticide	Organophosphate
Malathion Oxygen Analog	-		
Methidathion	Supracide	Insecticide	Organophosphate
Metolachlor (S-metolachlor)	Dual	Herbicide	Chloracetanilide
Naled as dichlorvos (DDVP)	Dibrom, Vapona	Insecticide	Organophosphate
Norflurazon	Solicam	Herbicide	Pyridazinone
Oryzalin	Surflan	Herbicide	Dinitroaniline
Oxydemeton-methyl	Metasystox-R	Insecticide	Organophosphate
Oxyfluorfen	Goal	Herbicide	Diphenyl ether
Permethrin	Ambush	Insecticide	Pyrethroid
Phosmet	Imidan	Insecticide	Organophosphate
Propargite	Omite	Insecticide	Organosulfite
Simazine	Princep	Herbicide	Triazine
SSS-tributylphosphorotrithioate	DEF	Defoliant	Organophosphate
Trifluralin	Treflan	Herbicide	Dinitroaniline

Volatile Organic Compound Analysis
Air canisters were analyzed for the analytes listed in Table 2 using a volatile organic compound (VOC) using GC-MS in a method similar to U.S. EPA's Method TO-15. The SOP describing the details of the procedure is EMON-SM-05-002 (CDFA, 2008).

MITC
Samples collected on SKC Inc® coconut charcoal sample tubes were analyzed for residues of MITC by GC-MS as described in analytical method EMON-SM41.9 (CDFA, 2004). MITC extraction from the sorbent medium involves using carbon disulfide in ethyl acetate with subsequent analysis using Gas Chromatography-Nitrogen Phosphorous Detector (GC-NPD).

Chloropicrin
SKC Inc® XAD-4 sample tubes were analyzed for residues of chloropicrin by Gas Chromatography-Electron Capture Detector (GC-ECD) as described in CDFA Method: EM16.0 (CDFA, 1999). Each tube was desorbed in hexane and analyzed by gas chromatograph equipped with GC-ECD.

Table 2. Target analytes in canister residue analysis.

Pesticide	Product Name	Pesticide Group	Chemical Class
1,3-dichloropropene	Telone, Inline	Fumigant	Halogenated organic
Methyl Bromide		Fumigant	Halogenated organic
carbon disulfide	Enzone	Fumigant	Inorganic
MITC*	Vapam, K-Pam, Dazomet	Fumigant	
Chloropicrin*		Fumigant	Halogenated organic

*are collected on individual sample tubes until CDFA is able to include in canister method.

MATERIALS AND METHODS

Air Sampling Equipment and Methods

A protective shelter was placed at each air sampling location. The shelter housed Airchek HV30 pumps, SKC Inc® personal sample pumps, and SilcoCan® canisters. Air samples were collected via three different sampling methods: a multi-pesticide method, individual chemical method (MITC and chloropicrin), and volatile organic compound method (Segawa, 2010). For multi-pesticide monitoring, an AirChek® pump pulling air at a rate of 15 L/min was attached to a hand-packed Teflon® cartridge containing 30 mL of XAD-4 sorbent resin material. For MITC and chloropicrin monitoring, manufactured pre-packed 200/1800 mg coconut charcoal tubes (MITC) or manufactured pre-packed 400/200 mg XAD-4 tubes (chloropicrin) with sealed glass end tips were attached to a SKC Inc® personal sample pump set to a flow rate of 1.5 L/min for MITC or 50 mL/min for chloropicrin. Lastly, for VOC monitoring, a vacuumed 6-liter SilcoCan® canister with an attached flow controller to maintain a constant air flow for a 24-hour period was utilized.

Once samples were collected, open tube and cartridge ends were tightly capped with appropriate end caps and the air canister's valve was tightly closed. Sample tubes and cartridges were placed in an insulated storage container containing dry ice and remained frozen until transported to the West Sacramento facility where they were checked-in and placed into a freezer until delivered to the CDFA laboratory for analysis. SilcoCan® canister were transported and stored at ambient conditions. Sample handling-shipping and tracking procedures were followed as defined in DPR's SOP QAQC004.1 and SOP QAQC003.02 (DPR, 1999; DPR, 2005). The samples were sent to a chemical laboratory for extraction and analysis.

Personnel from CDFA's Center for Analytical Chemistry washed, rinsed, and packed XAD-4 sorbent material into Teflon® sample cartridges and pre-evacuated SilcoCan® canisters to a pressure of -30"Hg. Chain of custody forms (COC), sample analysis request forms, and sample labels including the study number and sample identification numbers were supplied to field sampling personnel to be

attached to sampling tubes, cartridges, and canisters prior to sampling. As the air sampling commenced at each monitoring site, the sample tracking number, date, time, staff initials, weather conditions, and air sampler flow rate were documented on the COC form as presented in SOP ADMN006.01 (DPR, 2004). All pumps used for air sampling were previously calibrated to their respective flow rate by DPR personnel. The use, operation, calibration and maintenance of air sampling pumps are described in DPR's SOP EQAI001.00 (DPR, 2001). Air sampler flow rates were measured using a DryCal ® flow meter at the beginning and the end of sampling period. All sample pumps were checked and initially calibrated in the laboratory.

Sampling Procedure

AMN samples included in this report were collected from 1/1/2013 to 12/31/2013. One 24-hour sample was collected each week at each of the three sites. The starting day varied each week with the actual dates being randomly selected. Actual sampling start times were left to the discretion of the field sampling personnel, but they always started anywhere from 9:00 a.m. to 2:00 pm.

Quality Control Methods

Besides collecting field samples during monitoring, DPR collected additional quality control samples consisting of trip blank samples, field spikes and co-located duplicate samples.

A trip blank sample provides information on possible contamination of samples. For the manufactured pre-packed XAD-4 and charcoal sample tubes, the ends were broken open, capped and placed on dry ice with the field samples. The multi-pesticide XAD tubes were opened in the field, capped, and placed on dry ice to be stored and shipped with the field samples. Due to method development issues, no air canister trip blanks were taken. Trip blanks collected from each sampling site were randomly selected and collected at least once every month of sampling. Trip blank samples containing detectable amounts of any of the pesticides would mean a problem with contamination during field and laboratory procedures.

A field spike is a laboratory spike sent to the field and placed on an air sampler with air flowing through the sorbent tube. Shipped on dry ice to the field, it is treated just like a field sample, including storage and shipping conditions. The field spike, in comparison with the respective field sample, gives information about any change in the ability to recover the analyte during air sampling. DPR collected one field spike sample per month for each sample type with the exception of VOC samples. VOC field spikes were not collected since the CDFA laboratory does not currently have the proper equipment to create field spikes using canisters. The multi-pesticide XAD cartridge was spiked with two different analytes every month. While chloropicrin and MITC spiked samples varied the spiked concentrations every month. Spike samples outside the control limits established from the validation data for each pesticide would trigger a reassessment of the field and laboratory procedures.

A duplicate sample is a sample that is co-located with a field sample. These samples evaluate overall precision in sample measurement and analysis. DPR collected one duplicate sample for each sample type once per month of sampling.

Laboratory Methods

<u>Method calibration</u>
The laboratory verified calibration by analyzing a series of standard samples (samples containing known amounts of analyte dissolved in a solvent). The linear range of calibration was determined by analyzing standards of increasing concentration. Within the linear range, the calibration was determined by regressing the standard concentration on the response of the instrument (peak height or peak area of the chromatogram) using at least five concentrations. The minimum acceptable correlation coefficient of the calibration was given in the SOP for each method, but in general was at least 0.95.

Method detection limits and limits of quantitation

The method detection limit (MDL) is the lowest concentration of a pesticide (analyte) that a chemical method can reliably detect. The laboratory determined the method detection limit for each analyte by analyzing a standard at a concentration with a signal to noise ratio of 2.5 to 5. This standard is analyzed at least 7 times, and the MDL is determined by calculating the 99 percent confidence interval of the mean.

The limit of quantitation (LOQ) is the level at which concentrations may be reliably measured and is set at a certain factor above the method detection limit. The level of interference determines the magnitude of this factor; the more interference, the higher the factor. Table 3 lists all of quantitation limits for Air Monitoring Network samples.

Table 3. Quantitation limits for Air Monitoring Network samples.

Pesticide	Detection limit (MDL) (ng/m^3)	Quantitation limit (LOQ) (ng/m^3)
Acephate	1.0	9.2
Bensulide	1.4	9.3
Chloropicrin	222	2,778
Chlorothalonil	13.7	23.1
Chlorpyrifos	5.0	23.1
Chlorpyrifos OA	2.9	9.3
Cypermethrin	4.7	23.1
Dacthal	9.3	9.3
DDVP	3.2	23.1
Diazinon	1.2	9.3
Diazinon OA	2.1	9.3
Dicofol	2.2	23.1
Dimethoate	2.3	9.3
Dimethoate OA	1.9	9.3
Diuron	5.1	9.3
Endosulfan	3.2	23.1
Endosulfan Sulfate	4.6	23.1
EPTC	1.7	9.3
Iprodione	1.1	9.6
Malathion	2.2	9.3
Malathion OA	1.3	9.3
Methidathion	1.4	9.3
Metolachlor	2.7	9.3
MITC	5.6	23.1
Norflurazon	3.7	9.3
Oryzalin	1.4	23.1
Oxydemeton methyl	2.3	9.3
Oxyfluorfen	6.4	23.1
Permethrin	7.2	23.1
Phosmet	8.0	9.3
Propargite	3.8	23.1
Simazine	1.2	9.3
SSS-tributyltriphosphorotrithioate (DEF)	1.8	9.3
Trifluralin	1.7	23.1
VOC Samples*		
Carbon Disulfide	--	311 (0.1 ppb); (31.1 (0.01 ppb)**
1,3-Dichloropropene	--	454 (0.1 ppb); (45.4 (0.01 ppb)**
Methyl Bromide	--	396 (0.1 ppb); (39.6 (0.01 ppb)**

*For VOC samples the detection limit is the LOQ, the level that can be reliably quantified

**On 10/15/2013, the quantification limit was lowered to 0.01 ppbv.

Calculations of air concentrations

For the sorbent tube samples, air concentrations were calculated as an amount of pesticide captured from a volume of air moving through the sampling media. Analytical results are presented in micrograms per sample (ug/sample). The concentrations are converted from ug/sample to nanograms (ng) per cubic meter (m^3) of sample air using the following calculations:

$$\frac{sample\,results\,(ug) \times 1000\,L/m^3}{flow\,rate\,of\;sampler\,(L/\min) \times run\,time\,(\min)} \text{ x 1000 ng/ug = ng/m}^3$$

The VOC concentrations were reported as ppb and converted to ng/m3 using the following calculations:

$$\frac{sample\,results\,(ppb)\;\times\;molecular\,weight}{24.45} \text{ x 1000 = ng/m}^3$$

The calculation above assumes 1 atmosphere of pressure at 25 °C

When calculating average concentrations from multiple samples, samples with no detectable amount were assumed to contain one-half the MDL, and samples with trace amounts were assumed to contain the value halfway between the MDL and the LOQ.

Health Evaluation Methods

Pesticides can cause a variety of health effects at high concentrations. The pesticides included in the AMN were selected in part because risk assessments indicate the potential for high exposure or they are high priority for risk assessment due to toxicity and/or exposure concerns. The AMN pesticides can cause a variety of adverse effects, including respiratory illnesses, damage to the nervous system, cancer, and birth defects. The potential health effects of each pesticide have been summarized on AMN's Volume 1 report (DPR, 2013).

No state or federal agency has established health standards for pesticides in air. Therefore, DPR developed health screening levels for the monitored pesticides to place the results in a health-based context. Health screening levels are calculated air concentrations based on a chemical's toxicity that is used to evaluate the possible health effects of exposure to the chemical. Although screening levels are not regulatory standards, they can be used to evaluate air monitoring results. A measured air concentration below the screening level for a given pesticide would not be considered a significant health concern and would not generally undergo further evaluation at this time. A measured concentration that is above the screening level would not necessarily indicate a significant health concern, but would indicate the need for a further, more refined evaluation. Significant exceedances of the screening levels could be a health concern and may indicate the need to explore the imposition of mitigation measures. More information on DPR determined screening levels including information on deriving screening levels for each individual pesticide have been summarized on AMN's Volume 1 report (DPR, 2013).

The cumulative exposure and risk were estimated using a hazard quotient and hazard index approach for pesticides that have a common mode of action. The potential risk of the measured concentrations of a pesticide in air was evaluated by comparing the air concentration measured over a specified time (e.g., 24 hours, 4 weeks, 1 year) with the screening level derived for a similar exposure (i.e., acute, subchronic, chronic). The ratio of measured air concentration of a pesticide to a reference concentration or screening level for that pesticide is called the hazard quotient (HQ). In this case,

$$\text{Hazard Quotient} = \frac{\text{Air Concentration Detected (ng/m}^3\text{)}}{\text{Screening Level (ng/m}^3\text{)}}$$

If the HQ is greater than 1, then the air concentration exceeds the screening level and would indicate the need for further and more refined evaluation. Similarly, the risk from multiple pesticides (cumulative risk) is evaluated using the hazard index (HI) approach, which sums all of the HQs for the pesticides monitored.

$$HI = HQ_1\ (pesticide\ 1) + HQ_2\ (pesticide\ 2) + HQ_3\ (pesticide\ 3)_{+\ldots}\ \text{(and so forth)}$$

If the HI is greater than 1, this indicates that the cumulative toxicity of the multiple pesticides should be further evaluated and that potential health impacts may have been missed by only considering the pesticides individually.

The AMN samples for nine pesticides that may cause cancer, as designated by the Proposition 65, the Safe Drinking Water and Toxic Enforcement Act of 1986, or the Environmental Protection Agency's (EPA) B2 list. Proposition 65 protects California citizens and the State's drinking water sources from chemicals known to cause cancer, birth defects or other reproductive harm, and to inform citizens about exposures to such chemicals while EPA's B2 list "probable human carcinogen" chemicals. Chemicals on the Proposition 65 list for cancer are: carbon disulfide, oxydemeton methyl, and propargite while chemicals on EPA's B2 list are: 1,3-dichloropropene, chlorothalonil, DDVP, diuron, iprodione, and propargite. Cancer risk is expressed as a probability for the occurrence of cancer (e.g., 1 in 1,000,000 or 10^{-6}, 1 in 100,000 or 10^{-5}, etc.), and was estimated based on the following calculation for each pesticide.

Risk of single pesticide = (cancer potency) X (exposure)

Exposure for single pesticide = (air concentration) X (respiratory rate)

Risk for single pesticide = (cancer potency) X (air concentration) X (respiratory rate)

Total risk for AMN pesticides = (risk of pesticide 1) + (risk of pesticide 2)…

It is a standard default assumption that exposure to a carcinogen takes place over a lifetime, so DPR uses a default respiratory rate for an adult of 0.28 m^3/kg-day. Risk in the range of 10^{-5} to 10^{-6} or less is generally considered to be at the limit of what is considered to be negligible.

DPR has issued risk management directives for some pesticides that specify air concentration levels as regulatory goals, and these goals have been footnoted in the appropriate tables. The data from this monitoring will be used in part to determine the effectiveness of its mitigation measures in meeting these goals.

AIR MONITORING RESULTS

Results for All Pesticides and Communities Combined

DPR collected 159 sets of samples, with each set consisting of four samples analyzed for 32 pesticides and 5 breakdown products. Of the 159 sets of samples, 131 (82.4%) contained at least one detectable chemical. A total of 6,033 analyses were conducted on the air samples collected from all three sampling locations from January 1, 2013 to December 31, 2013. Of the 6,033 analyses, 426 (7.1%) showed detectable concentrations, which included quantifiable and trace detections. Samples with quantifiable concentrations accounted for 2.6% (159) of all analyses conducted. Quantifiable detections refer to concentrations above the LOQ for their respective pesticide. Ten of the 32 pesticides and 5 pesticide breakdown products monitored by DPR were only detected at Trace levels. Thirteen of the 32 pesticides and 5 pesticide breakdown products monitored by DPR were not

detected. Table 4 lists the number of detections for each pesticide and pesticide breakdown products included in the AMN. The chemicals with the highest number of detections were chlorothalonil (35%), chlorpyrifos (33%), and MITC (30%).

Table 4. Percentage of positive samples per chemical.

Pesticide	Number of possible detections	Total number of detections*	Number of quantified detections	Percent of possible detections	Percent of quantifiable detections
EPTC	159	5	5	3%	3%
DDVP	159	14	2	9%	1%
Trifluralin	159	8	0	5%	0%
Chlorothalonil	159	56	4	35%	3%
Dacthal	159	30	0	19%	0%
Chlorpyrifos	159	52	5	33%	3%
pp-Dicofol	159	0	0	0%	0%
Malathion	159	11	1	7%	1%
Endosulfan	159	1	0	1%	0%
Endosulfan Sulfate	159	0	0	0%	0%
Oxyfluorfen	159	1	1	1%	1%
Propargite	159	8	0	5%	0%
Iprodione	159	7	0	4%	0%
Permethrin	159	2	0	1%	0%
Cypermethrin	159	0	0	0%	0%
Acephate	159	0	0	0%	0%
Bensulide	159	0	0	0%	0%
Chlorpyrifos OA	159	41	4	26%	3%
SSS-tributyl...(DEF)	159	0	0	0%	0%
Diazinon	159	6	3	4%	2%
Diazinon OA	159	6	1	4%	1%
Dimethoate	159	0	0	1%	0%
Dimethoate OA	159	1	0	8%	0%
Diuron	159	12	0	8%	0%
Malathion OA	159	19	0	12%	0%
Methidathion	159	0	0	0%	0%
Metolachlor	159	0	0	0%	0%
Norflurazon	159	0	0	0%	0%
Oryzalin	159	1	0	1%	0%
Oxydemeton methyl	159	0	0	0%	0%
Phosmet	159	0	0	0%	0%
Simazine	159	0	0	0%	0%
MITC	158	48	40	30%	25%
Chloropicrin	159	10	6	6%	4%
Methyl Bromide	157	12	12	8%	8%
Carbon Disulfide	157	21	21	13%	13%
cis-1,3-Dichloropropene	157	31	31	20%	20%
t-1,3-Dichloropropene	157	23	23	15%	15%
Total	**6033**	**426**	**159**	**7.1%**	**2.6%**

***Includes both quantified and trace detections**

Tables 5-8 list the number of detections for each pesticide and pesticide breakdown products per sampling location. Dacthal (26), Chlorpyrifos (40), and Chlorothalonil (22) were the chemicals with the most detections in Salinas, Shafter, and Ripon, respectively.

Table 5. Percentage of positive samples per chemical in Salinas, California.

Pesticide	Number of possible detections	Total number of detections*	Number of quantified detections	Percent of possible detections	Percent of quantifiable detections
EPTC	53	0	0	0%	0%
DDVP	53	7	2	13%	4%
Trifluralin	53	0	0	0%	0%
Chlorothalonil	53	2	0	4%	0%
Dacthal	53	26	0	49%	0%
Chlorpyrifos	53	1	0	2%	0%
pp-Dicofol	53	0	0	0%	0%
Malathion	53	8	1	15%	2%
Endosulfan	53	0	0	0%	0%
Endosulfan Sulfate	53	0	0	0%	0%
Oxyfluorfen	53	1	1	2%	2%
Propargite	53	0	0	0%	0%
Iprodione	53	0	0	0%	0%
Permethrin	53	0	0	0%	0%
Cypermethrin	53	0	0	0%	0%
Acephate	53	0	0	0%	0%
Bensulide	53	0	0	0%	0%
Chlorpyrifos OA	53	0	0	0%	0%
SSS-tributyl...(DEF)	53	0	0	0%	0%
Diazinon	53	1	1	2%	2%
Diazinon OA	53	1	1	2%	2%
Dimethoate	53	0	0	0%	0%
Dimethoate OA	53	0	0	19%	0%
Diuron	53	10	0	19%	0%
Malathion OA	53	7	0	13%	0%
Methidathion	53	0	0	0%	0%
Metolachlor	53	0	0	0%	0%
Norflurazon	53	0	0	0%	0%
Oryzalin	53	0	0	0%	0%
Oxydemeton methyl	53	0	0	0%	0%
Phosmet	53	0	0	0%	0%
Simazine	53	0	0	0%	0%
MITC	53	8	5	15%	9%
Chloropicrin	53	7	6	13%	11%
Methyl Bromide	51	5	5	10%	10%
Carbon Disulfide	51	7	7	14%	14%
cis-1,3-Dichloropropene	51	8	8	16%	16%
t-1,3-Dichloropropene	51	0	0	0%	0%
Total	**2006**	**99**	**37**	**4.9%**	**1.8%**

***Includes both quantified and trace detections**

Table 6. Percentage of positive samples per chemical in Shafter, California.

Pesticide	Number of possible detections	Total number of detections*	Number of quantified detections	Percent of possible detections	Percent of quantifiable detections
EPTC	53	5	5	9%	9%
DDVP	53	3	0	6%	0%
Trifluralin	53	2	0	4%	0%
Chlorothalonil	53	32	4	60%	8%
Dacthal	53	4	0	8%	0%
Chlorpyrifos	53	40	5	75%	9%
pp-Dicofol	53	0	0	0%	0%
Malathion	53	2	0	4%	0%
Endosulfan	53	0	0	0%	0%
Endosulfan Sulfate	53	0	0	0%	0%
Oxyfluorfen	53	0	0	0%	0%
Propargite	53	6	0	11%	0%
Iprodione	53	2	0	4%	0%
Permethrin	53	1	0	2%	0%
Cypermethrin	53	0	0	0%	0%
Acephate	53	0	0	0%	0%
Bensulide	53	0	0	0%	0%
Chlorpyrifos OA	53	29	4	55%	8%
SSS-tributyl...(DEF)	53	0	0	0%	0%
Diazinon	53	3	1	6%	2%
Diazinon OA	53	4	0	8%	0%
Dimethoate	53	0	0	0%	0%
Dimethoate OA	53	0	0	2%	0%
Diuron	53	1	0	2%	0%
Malathion OA	53	5	0	9%	0%
Methidathion	53	0	0	0%	0%
Metolachlor	53	0	0	0%	0%
Norflurazon	53	0	0	0%	0%
Oryzalin	53	1	0	2%	0%
Oxydemeton methyl	53	0	0	0%	0%
Phosmet	53	0	0	0%	0%
Simazine	53	0	0	0%	0%
MITC	53	30	26	57%	49%
Chloropicrin	53	0	0	0%	0%
Methyl Bromide	53	2	2	4%	4%
Carbon Disulfide	53	8	8	15%	15%
cis-1,3-Dichloropropene	53	14	14	26%	26%
t-1,3-Dichloropropene	53	14	14	26%	26%
Total	**2014**	**208**	**83**	**10.3%**	**4.1%**

***Includes both quantified and trace detections**

Table 7. Percentage of positive samples per chemical in Ripon, California.

Pesticide	Number of possible detections	Total number of detections*	Number of quantified detections	Percent of possible detections	Percent of quantifiable detections
EPTC	53	0	0	0%	0%
DDVP	53	4	0	8%	0%
Trifluralin	53	6	0	11%	0%
Chlorothalonil	53	22	0	42%	0%
Dacthal	53	0	0	0%	0%
Chlorpyrifos	53	11	0	21%	0%
pp-Dicofol	53	0	0	0%	0%
Malathion	53	1	0	2%	0%
Endosulfan	53	1	0	2%	0%
Endosulfan Sulfate	53	0	0	0%	0%
Oxyfluorfen	53	0	0	0%	0%
Propargite	53	2	0	4%	0%
Iprodione	53	5	0	9%	0%
Permethrin	53	1	0	2%	0%
Cypermethrin	53	0	0	0%	0%
Acephate	53	0	0	0%	0%
Bensulide	53	0	0	0%	0%
Chlorpyrifos OA	53	12	0	23%	0%
SSS-tributyl...(DEF)	53	0	0	0%	0%
Diazinon	53	2	1	4%	2%
Diazinon OA	53	1	0	2%	0%
Dimethoate	53	0	0	2%	0%
Dimethoate OA	53	1	0	2%	0%
Diuron	53	1	0	2%	0%
Malathion OA	53	7	0	13%	0%
Methidathion	53	0	0	0%	0%
Metolachlor	53	0	0	0%	0%
Norflurazon	53	0	0	0%	0%
Oryzalin	53	0	0	0%	0%
Oxydemeton methyl	53	0	0	0%	0%
Phosmet	53	0	0	0%	0%
Simazine	53	0	0	0%	0%
MITC	52	10	9	19%	17%
Chloropicrin	53	3	0	6%	0%
Methyl Bromide	53	5	5	9%	9%
Carbon Disulfide	53	6	6	11%	11%
cis-1,3-Dichloropropene	53	9	9	17%	17%
t-1,3-Dichloropropene	53	9	9	17%	17%
Total	**2013**	**119**	**39**	**5.9%**	**1.9%**

***Includes both quantified and trace detections**

Table 8 lists the total number of detections of the monitored chemicals segregated by the sampling location. Detection percentages for the monitored chemicals ranged from 4.9% to 10.7% of all collected samples from all three sampling sites. These detections included both quantifiable (above LOQ) and trace detections (above MDL but below LOQ). Shafter had the highest percentage of samples with detections at 10.3%, it also contained the highest percent of quantifiable samples at 4.1%. A total of 159 sample sets were taken from all three sampling locations (53 sample sets from each sampling location), 131 (82.4%) sample sets contained at least one detection. Percentage of sample sets with at least one detection ranged from 64.2% to 100% depending on sampling location.

Table 8. Detections of monitored chemicals by location.

Location	Number of possible detections	Total number of detections*	Number of quantified detections	Percent of possible detections	Percent of quantifiable detections		Number of sampling sets	Number of sets with at least one detection	Percent of sample sets with at least one detection
Salinas	2006	99	37	4.9	1.8		53	34	64.2
Shafter	2014	208	83	10.3	4.1		53	53	100.0
Ripon	2013	119	39	5.9	1.9		53	44	83.0
Total	**6033**	**426**	**159**	**7.1**	**2.6**		**159**	**131**	**82.4**

*Includes quantified detections and trace detections

Table 9 presents the highest 1-day concentration at any site for each pesticide monitored. None of the pesticides monitored exceeded their screening level. Diazinon was the highest pesticide relative to its screening level with a maximum concentration of 48.7 ng/m^3 or 37.5% of its acute screening level. Chlorpyrifos was the next highest pesticide relative to its screening level with a concentration of 422.5 ng/m^3 or 35.2% of its acute screening level. Figures 2- 5 illustrate the highest one-day concentrations detections in all three sampling sites for selected pesticides due to pesticidal use.

Table 9. Highest one-day concentration for chemicals monitored.

Pesticide	Highest 1-day concentration (ng/m3)	24-hour acute screening level (ng/m3)	% of screening level
Acephate	Not Detected (0.5)	12,000	0.004%
Bensulide	Not Detected (0.7)	259,000	0.000%
Carbon Disulfide	896.5	1,550,000	0.058%
Chloropicrin	6383.9	491,000	1.300%
Chlorothalonil	79.7	34,000	0.234%
Chlorpyrifos	422.5	1,200	35.211%
Chlorpyrifos OA	143.1	1,200	11.923%
Cypermethrin	Not Detected (2.3)	113,000	0.002%
Dacthal	Trace (16.3)	23,500	0.069%
DDVP	52.1	11,000	0.473%
Diazinon	48.7	130	37.487%
Diazinon OA	25.8	130	19.879%
cis-1,3-Dichloropropene	19281.4	160,000	12.051%
trans-1,3-Dichloropropene	20687.8	160,000	12.930%
pp-Dicofol	Not Detected (1.1)	68,000	0.002%
Dimethoate	Not Detected (1.2)	4,300	0.027%
Dimethoate OA	Trace (5.6)	4,300	0.131%
Diuron	Trace (7.2)	170,000	0.004%
Endosulfan	Trace (13.2)	3,300	0.399%
Endosulfan Sulfate	Not Detected (2.3)	3,300	0.070%
EPTC	250.3	230,000	0.109%
Iprodione	Trace (12.1)	939,000	0.001%
Malathion	Trace (12.6)	112,500	0.011%
Malathion OA	Not Detected (5.3)	112,500	0.005%
Methidathion	Not Detected (0.7)	3,100	0.023%
Methyl Bromide	4424.8	820,000	0.540%
Metolachlor	Not Detected (1.4)	85,000	0.002%
MITC	852.2	66,000	1.291%
Norflurazon	Not Detected (1.9)	170,000	0.001%
Oryzalin	Trace (12.2)	420,000	0.003%
Oxydemeton methyl	Not Detected (1.2)	39,200	0.003%
Oxyfluorfen	52.7	510,000	0.010%
Permethrin	Trace (15.2)	168,000	0.009%
Phosmet	Not Detected (4.0)	77,000	0.005%
Propargite	Trace (13.2)	14,000	0.096%
Simazine	Not Detected (0.6)	110,000	0.001%
SSS-tributyl...(DEF)	Not Detected (0.9)	8,800	0.010%
Trifluralin	Trace (12.4)	1,200,000	0.001%

* DPR regulatory target level for 1-day or shorter exposure.
† Number in parentheses is one-half the MDL for samples with no detectable amount, and a value halfway between the MDL and the LOQ for trace samples.
‡ A concentration greater than 100% of the screening level suggests the need for further evaluation.

Figure 2. Highest one-day (acute) concentrations detected in all three sampling locations.

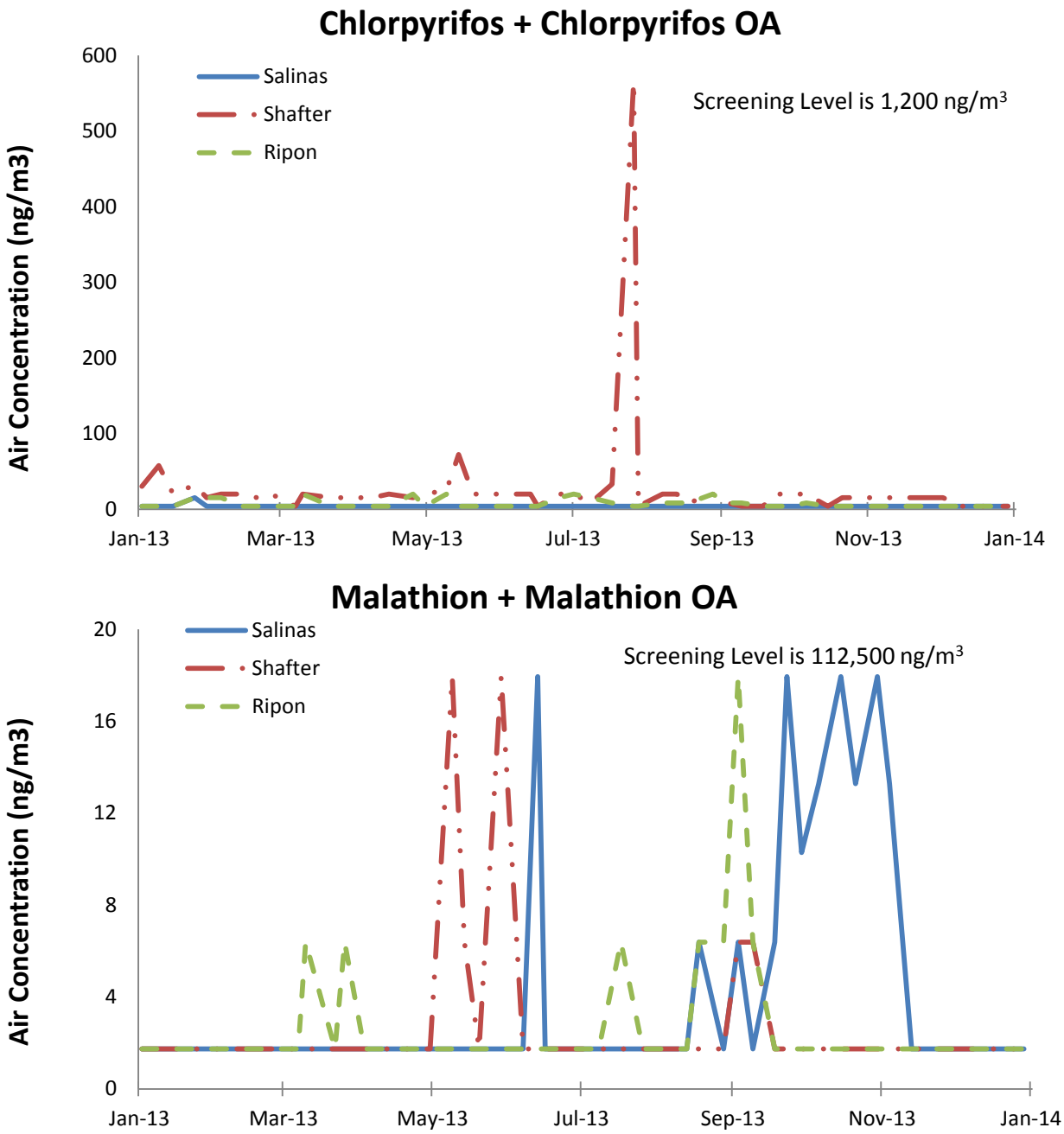
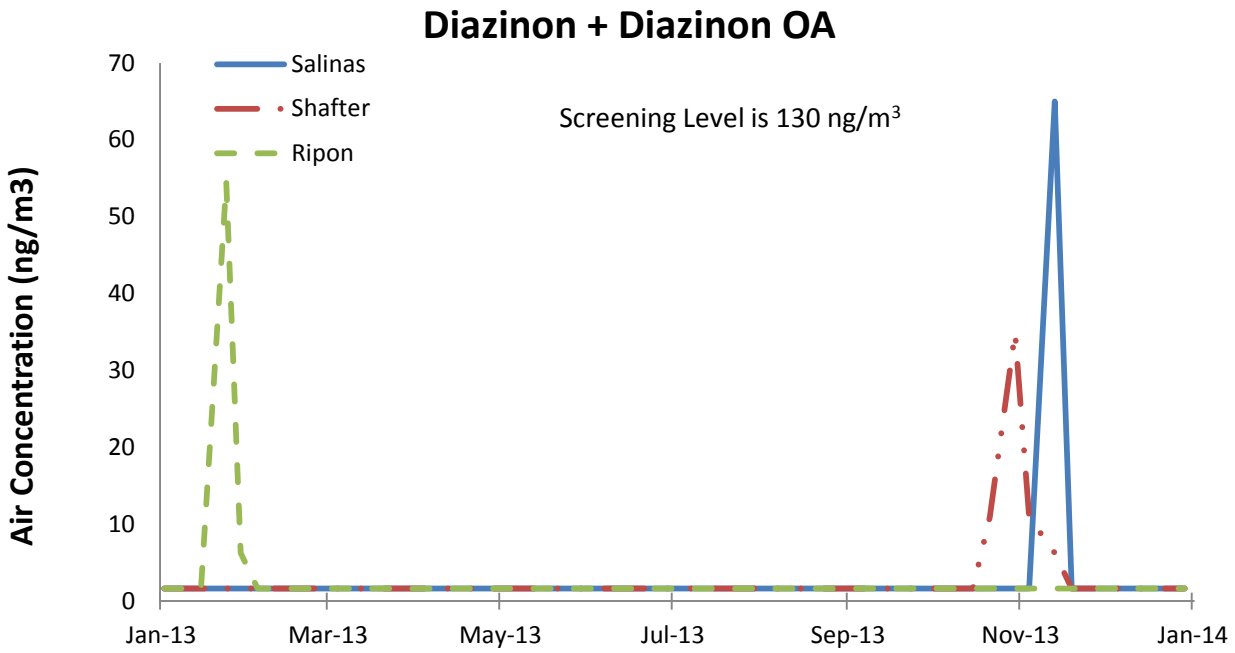


Figure 3. Highest one-day (acute) concentrations detected in all three sampling locations (continued).



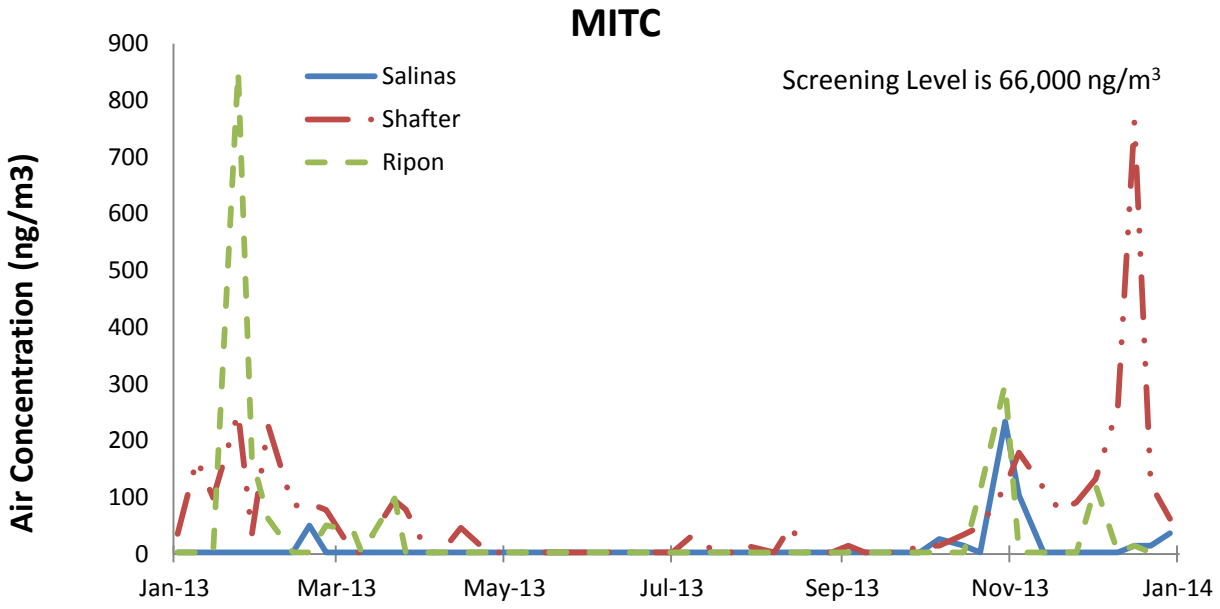


Figure 4. Highest one-day (acute) concentrations detected in all three sampling locations (continued).

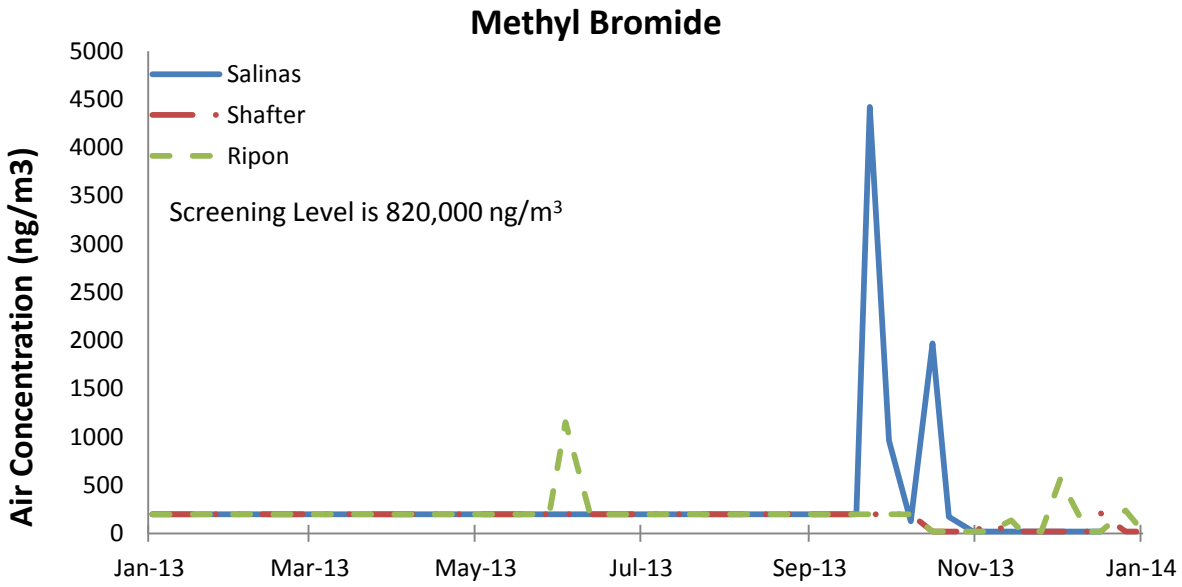


Figure 5. Highest one-day (acute) concentrations detected for the aggregate of *cis*- and *trans*-1,3-dichloropropene in all three sampling locations.

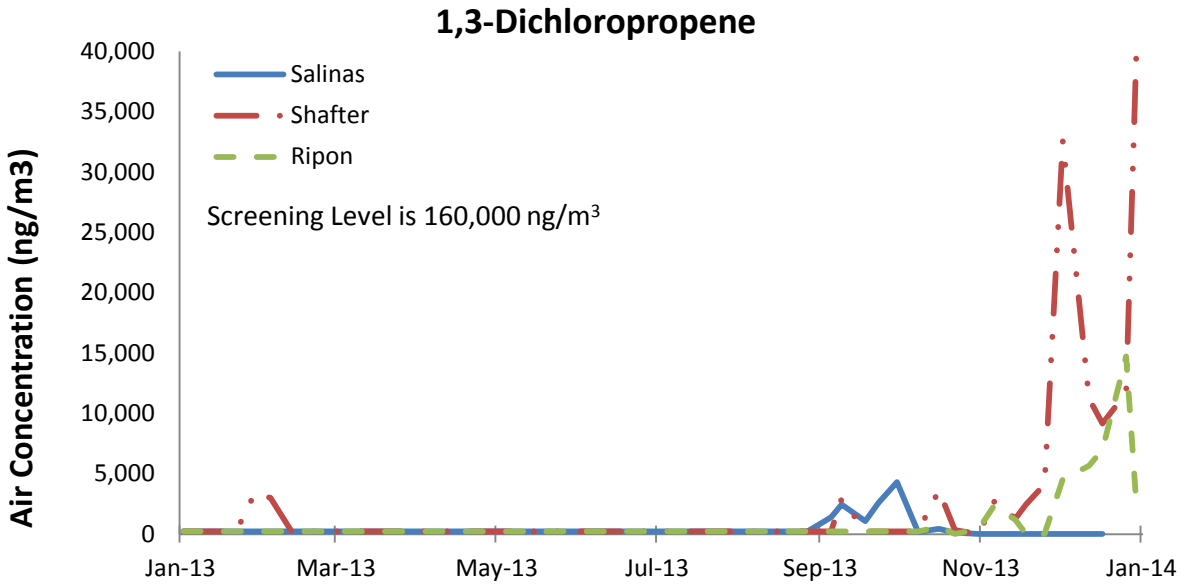


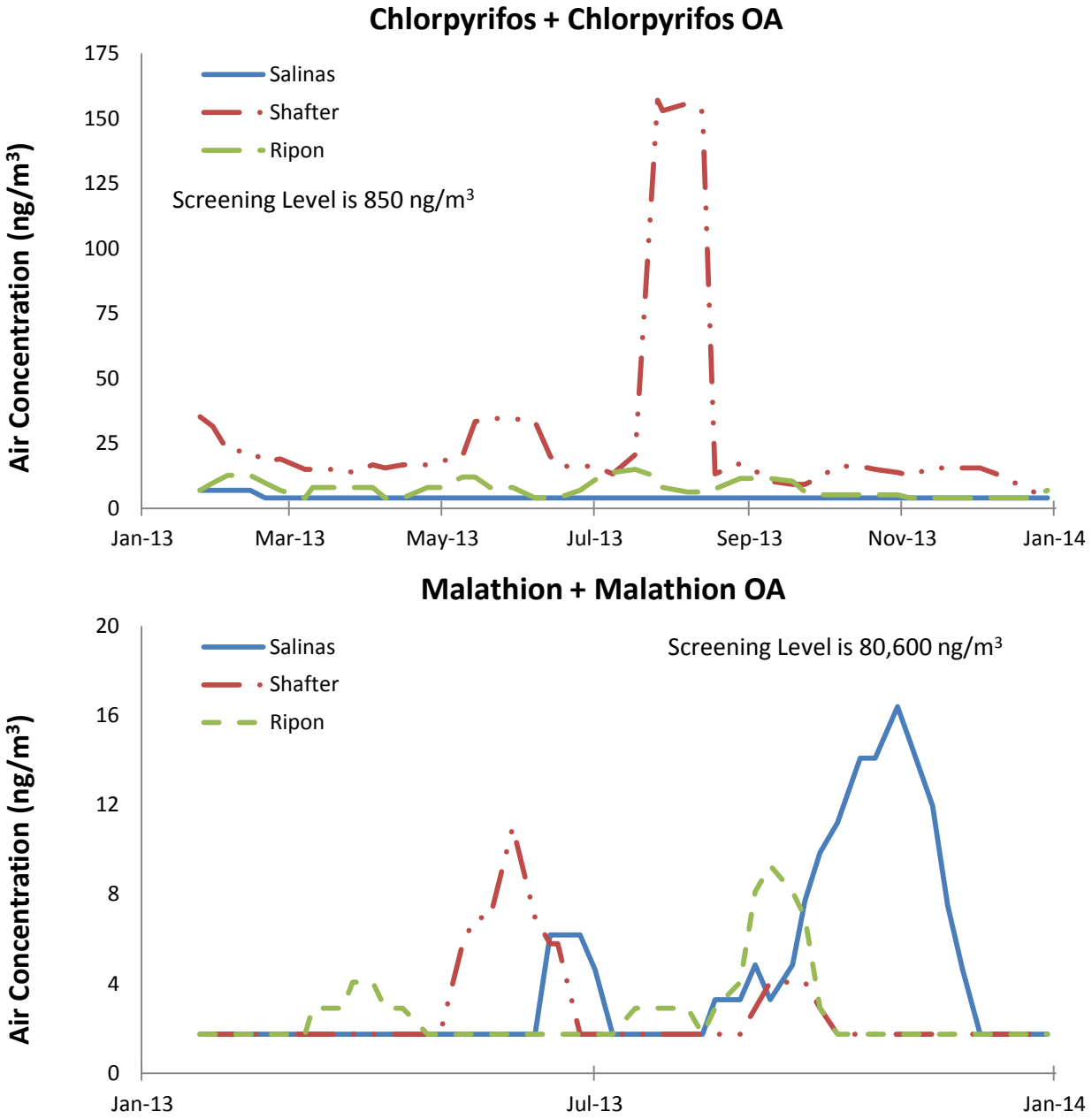
Table 10 shows the highest 4-week average concentrations. The pesticide with the highest subchronic exposure was chloropicrin, with a maximum 4-week concentration equivalent to 140% of its screening level. Chlorpyrifos and MITC were the next highest, with maximum 4-week concentrations equivalent to 13.3% and 10.6% of their screening levels, respectively trans-1,3-dichloropropene had the highest absolute 4-week concentration of 9,034 ng/m^3. Figures 6-8 present the highest 4-week concentrations measured in any sample for each of the pesticides with a quantifiable detection that was from pesticidal use, compared with the subchronic screening level for the pesticide. Figure 9 presents the rolling 4-week concentrations measured for the sum of *cis*-1,3-dichloropropene and *trans*-1,3-dichloropropene from all three sampling locations. The 4-week concentrations were calculated using one-half the MDL for samples with no detectable amount, and a value halfway between the MDL and the LOQ for samples with trace (unquantifiable) concentrations.

Table 10. The highest of rolling 4-week air concentrations, subchronic screening levels, and % of the subchronic screening level.

Pesticide	Highest 4-wk rolling concentration (ng/m3)	Subchronic Screening Level (ng/m3)	% of screening level
Acephate	0.5	8,500	0.006%
Bensulide	0.7	24,000	0.003%
Carbon Disulfide	340.7	800,000	0.043%
Chloropicrin	3224.4	2,300	140.193%
Chlorothalonil	38.0	34,000	0.112%
Chlorpyrifos	113.3	850	13.330%
Chlorpyrifos OA	43.7	850	5.137%
Cypermethrin	2.3	81,000	0.003%
Dacthal	16.3	470	3.457%
DDVP	27.9	2,200	1.270%
Diazinon	13.8	130	10.601%
Diazinon OA	7.2	130	5.570%
cis-1,3-Dichloropropene	8988.5	120,000	7.490%
trans-1,3-Dichloropropene	9033.6	120,000	7.528%
pp-Dicofol	1.1	49,000	0.002%
Dimethoate	1.2	3,000	0.039%
Dimethoate OA	2.1	3,000	0.071%
Diuron	6.1	17,000	0.036%
Endosulfan	4.5	3,300	0.137%
Endosulfan Sulfate	2.3	3,300	0.070%
EPTC	139.4	24,000	0.581%
Iprodione	12.1	286,000	0.004%
Malathion	12.6	80,600	0.016%
Malathion OA	5.3	80,600	0.007%
Methidathion	0.7	3,100	0.023%
Methyl Bromide	1870.9	19,400	9.644%
Metolachlor	1.4	15,000	0.009%
MITC	318.9	3,000	10.631%
Norflurazon	1.9	26,000	0.007%
Oryzalin	3.6	230,000	0.002%
Oxydemeton methyl	1.2	610	0.189%
Oxyfluorfen	15.6	180,000	0.009%
Permethrin	6.5	90,000	0.007%
Phosmet	4.0	26,000	0.015%
Propargite	13.5	14,000	0.096%
Simazine	0.6	31,000	0.002%
SSS-tributyl...(DEF)	0.9	8,800	0.010%
Trifluralin	6.6	170,000	0.004%

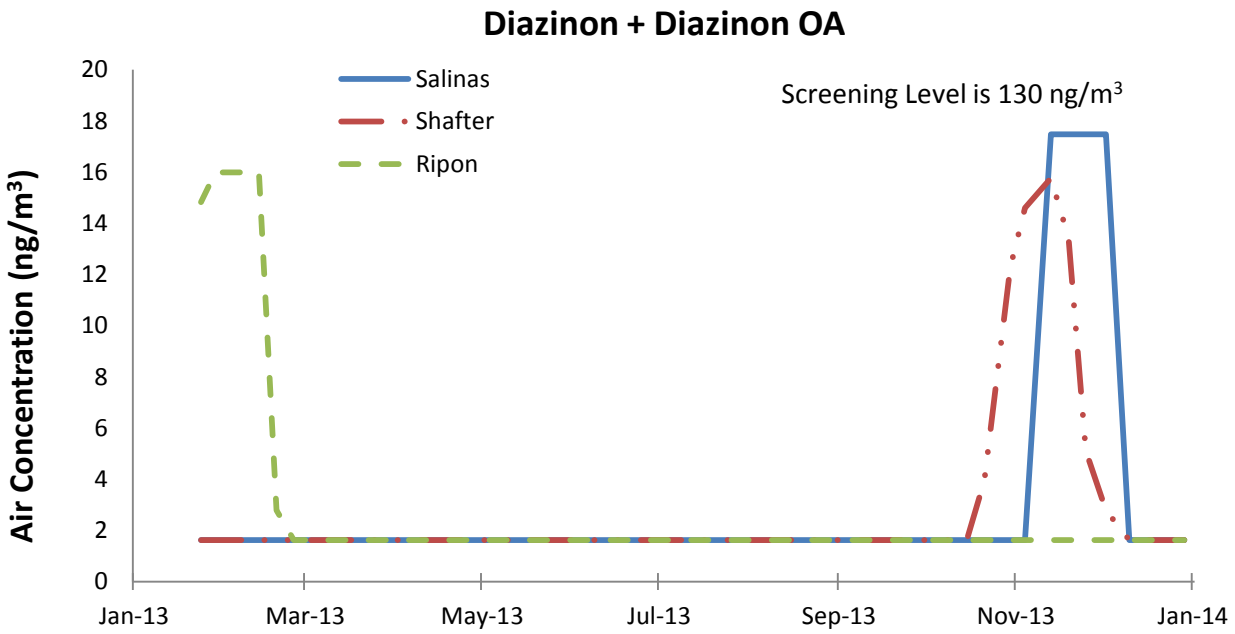
* DPR regulatory target level for 4-week exposure.
† Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).
‡ A concentration greater than 100% of the screening level suggests the need for further evaluation

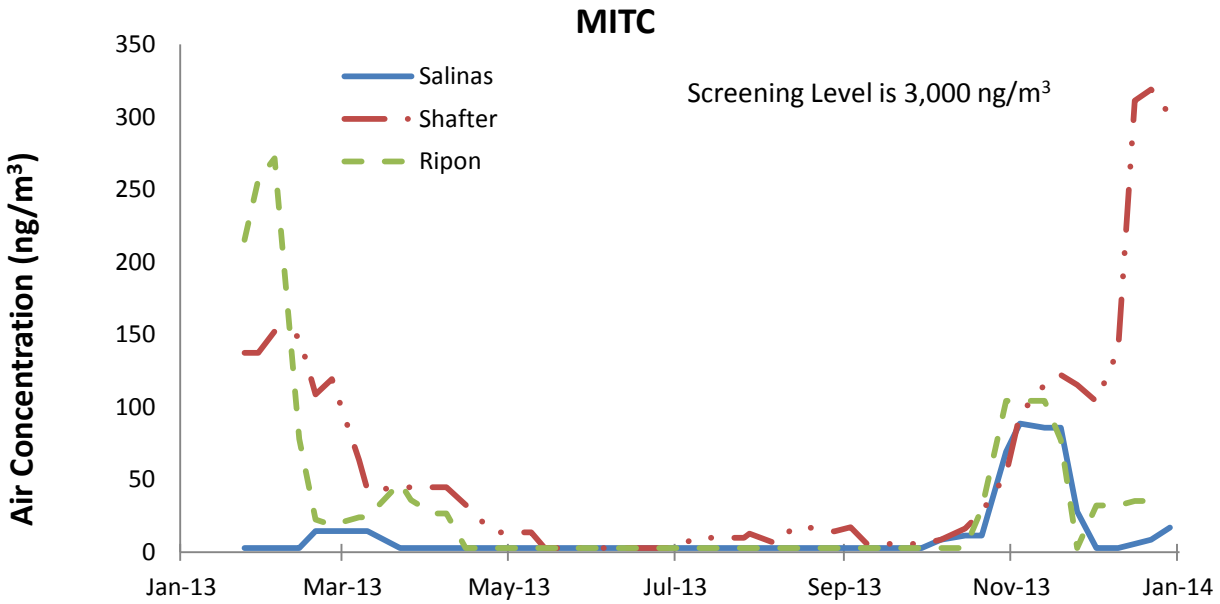
Figure 6. Rolling 4-week average (subchronic) concentrations detected for the three monitoring locations.



*Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).

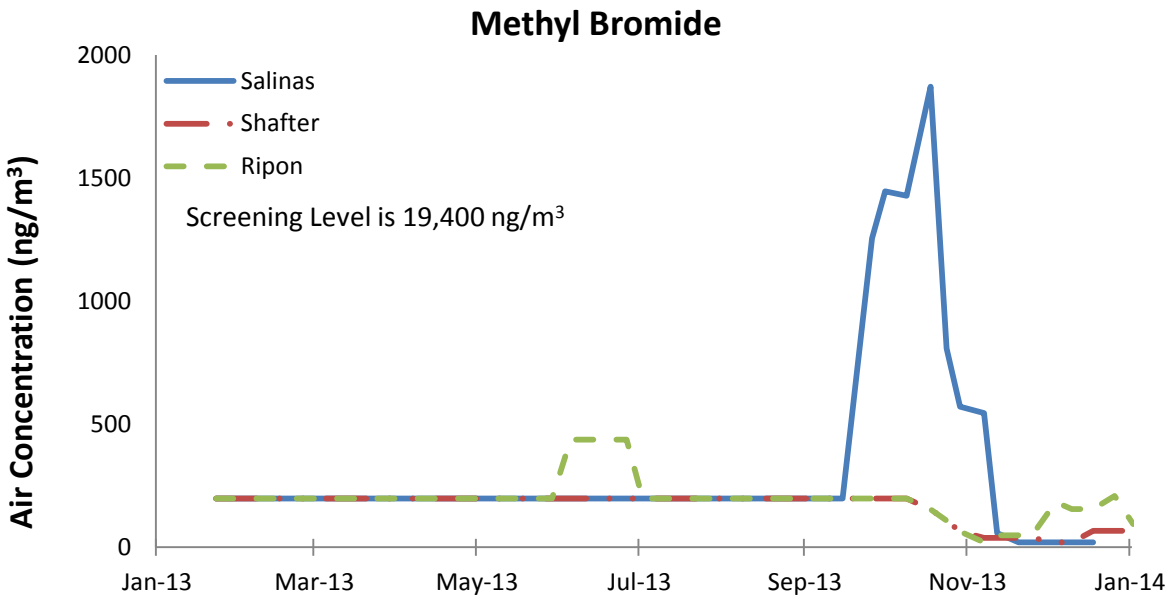
Figure 7. Rolling 4-week average (subchronic) concentrations detected for the three monitoring locations (continued).

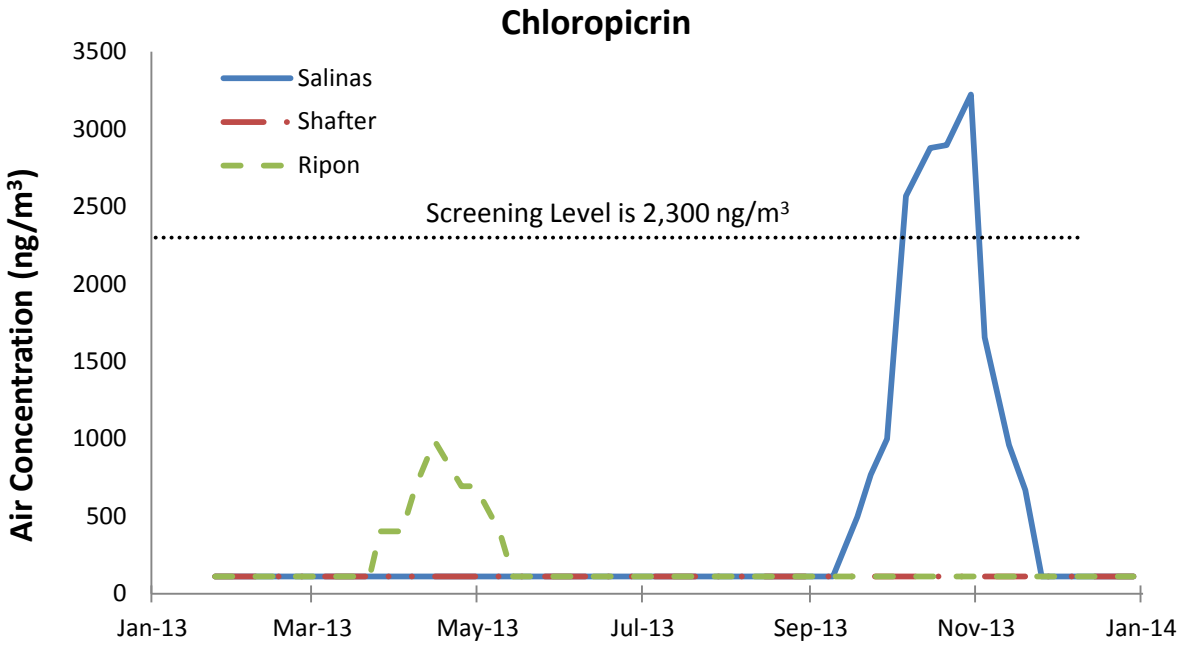




*Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).

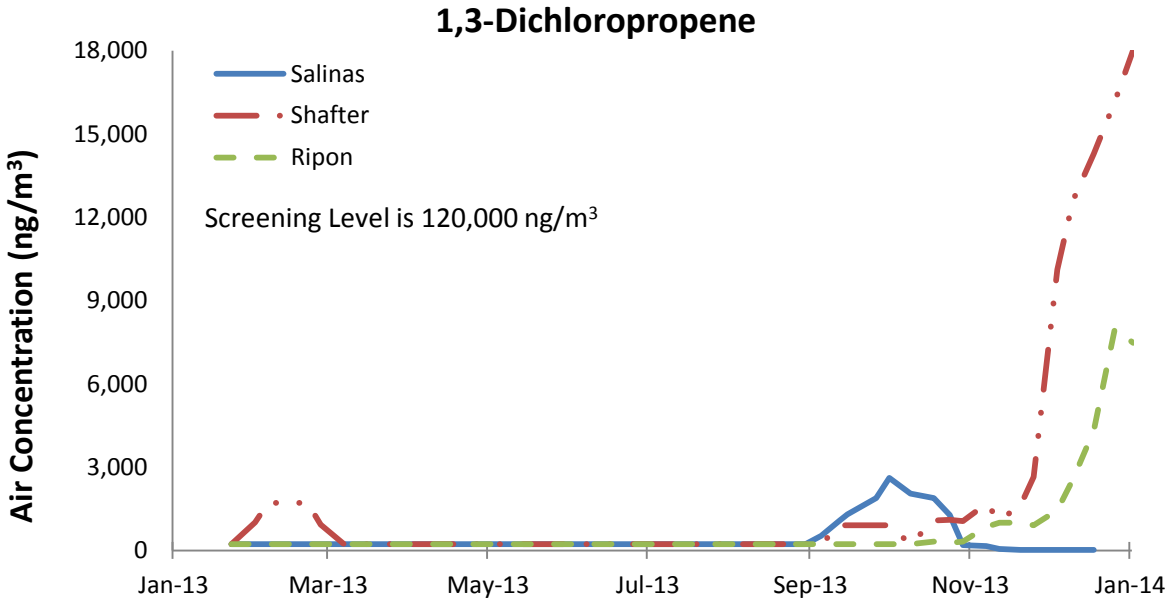
Figure 8. Rolling 4-week average (subchronic) concentrations detected for the three monitoring locations (continued).





*Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).

Figure 9. Rolling 4-week average (subchronic) concentrations detected for the aggregate of *cis*- and *trans*-1,3-dichloropropene in all three sampling locations.



*Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).

Table 11 shows the overall average concentrations for all samples collected from January 1, 2013 to December 31, 2013. Average concentrations were calculated using one-half the MDL for samples with no detectable amount, and a value halfway between the MDL and the LOQ for samples with trace (unquantifiable) concentrations. No pesticide average concentrations exceeded the screening levels for the chronic exposure period. However, the 2013 average concentration for 1,3-dichloropropene exceeded DPR's cancer risk goal for a 70-year lifetime exposure at the Ripon and Shafter sites, assuming the 1-year average represents an average lifetime exposure (see cancer risk section for more information). The pesticide with the highest chronic exposures was Dacthal, with concentration of 6.9 ng/m^3 or 15% of its chronic screening level, followed by chloropicrin with an overall concentration of 234 ng/m^3 or 13% of its screening level. The highest overall average concentration measured for pesticide was 819 ng/m^3 for *cis*-1,3-dichloropropene.

Table 11. The average concentration for all chemicals from samples collected from January 1, 2013 through December 31, 2013.

Pesticide	Overall average concentration (ng/m3)	Chronic screening level (ng/m3)	% of screening level
Acephate	0.5	8,500	0.006%
Bensulide	0.7	24,000	0.003%
Carbon Disulfide	141.8	800,000	0.018%
Chloropicrin	233.7	1,800	12.985%
Chlorothalonil	11.6	34,000	0.034%
Chlorpyrifos	9.4	510	1.836%
Chlorpyrifos OA	3.9	510	0.755%
Cypermethrin	2.3	27,000	0.009%
Dacthal	6.9	47	14.637%
DDVP	3.0	770	0.391%
Diazinon	1.4	130	1.072%
Diazinon OA	1.3	130	1.032%
cis-1,3-Dichloropropene	818.8	120,000	0.682%
trans-1,3-Dichloropropene	669.9	120,000	0.558%
pp-Dicofol	1.1	20,000	0.005%
Dimethoate	1.2	300	0.385%
Dimethoate OA	1.0	300	0.333%
Diuron	2.9	5,700	0.051%
Endosulfan	1.7	330	0.513%
Endosulfan Sulfate	2.3	330	0.702%
EPTC	4.5	8,500	0.053%
Iprodione	1.0	286,000	0.000%
Malathion	1.9	8,100	0.023%
Malathion OA	1.2	8,100	0.015%
Methidathion	0.7	2,500	0.029%
Methyl Bromide	218.0	3,900	5.588%
Metolachlor	1.4	15,000	0.009%
MITC	38.2	300	12.739%
Norflurazon	1.9	26,000	0.007%
Oryzalin	0.8	232,000	0.000%
Oxydemeton methyl	1.2	610	0.189%
Oxyfluorfen	3.5	51,000	0.007%
Permethrin	3.8	90,000	0.004%
Phosmet	4.0	18,000	0.022%
Propargite	2.5	14,000	0.018%
Simazine	0.6	31,000	0.002%
SSS-tributyl...(DEF)	0.9	NA - Seasonal	NA
Trifluralin	1.4	41,000	0.003%

†A concentration greater than 100% of the screening level suggests the need for further evaluation.

Table 12 summarizes the magnitude of the air concentrations relative to the screening levels for the 14 pesticides and breakdown products that had quantifiable concentrations in at least one sample. Chloropicrin was the only pesticide that exceeded any of its screening levels for any of the exposure periods. Diazinon (plus its OA) had the highest acute risk, with a maximum 1-day concentration that was 50% of its acute screening level. Chloropicrin had the highest subchronic risk, with a maximum 4-week concentration that was 140% of its subchronic screening level. Chloropicrin also had the highest chronic risk, with a 1-year concentration that was 13% of its screening level.

Table 12. Overall air concentrations relative to the screening levels for chemicals with quantifiable concentrations.

Pesticide	% of acute screening level	% of subchronic screening level	% of chronic screening level
1,3-Dichloropropene	24.981%	15.018%	1.095%
Carbon Disulfide	0.058%	0.043%	0.018%
Chloropicrin	1.300%	140.193%	12.985%
Chlorothalonil	0.234%	0.112%	0.034%
Chlorpyrifos + OA	47.134%	18.467%	2.036%
DDVP	0.473%	1.270%	0.391%
Diazinon + OA	50.010%	13.437%	1.872%
EPTC	0.109%	0.581%	0.053%
Malathion	0.011%	0.016%	0.023%
Methyl Bromide	0.540%	9.644%	5.588%
MITC	1.291%	10.631%	12.739%
Oxyfluorfen	0.010%	0.009%	0.007%

†A concentration greater than 100% of the screening level suggests the need for further evaluation.

Results for Salinas

Tables 13-15 show the highest 1-day, 4-week, and overall average concentrations for pesticides monitored in Salinas, respectively. Chloropicrin was the only pesticide that exceeded any of its screening levels. The maximum 4-week air concentration for chloropicrin was 3,200 ng/m^3 at the Salinas site, or 140% of the 2,300 ng/m^3 subchronic screening level. DPR is conducting a more detailed evaluation of chloropicrin, including analyzing the applications and weather conditions during the time high concentrations were detected. Nine pesticides were detected at quantifiable concentrations in Salinas: 1,3-dichloropropene, carbon disulfide, chloropicrin, DDVP, diazinon + OA, methyl bromide, MITC and oxyfluorfen. Six additional pesticides (or breakdown products) were detected at trace levels only. Twenty-two pesticides (or breakdown products) were not detected. Chloropicrin had the highest 1-day concentration of 6,384 ng/m^3 or 1.3% of its screening level. Chloropicrin also had the highest 4-week average concentration relative to its screening level (140% of its screening level, 3,224 ng/m^3). Chloropicrin was also the pesticide with the highest overall average concentration relative to its screening level with a value of 23% (413 ng/m^3). Cumulative exposure to organophosphate is discussed in a later section.

Table 13. Highest 1-day concentrations for pesticides monitored in Salinas, California.

Pesticide	Highest 1-day concentration (ng/m3)	1-day acute screening level (ng/m3)	% of screening level
Acephate	Not Detected (0.5)	12,000	0.004%
Bensulide	Not Detected (0.7)	259,000	0.000%
Carbon Disulfide	152.5**	1,550,000	0.010%
Chloropicrin	6383.9	491,000	1.300%
Chlorothalonil	Trace (18.4)	34,000	0.054%
Chlorpyrifos	Trace (14.1)	1,200	1.173%
Chlorpyrifos OA	Not Detected (1.5)	1,200	0.122%
Cypermethrin	Not Detected (2.3)	113,000	0.002%
Dacthal	Trace (16.3)	23,500	0.069%
DDVP	52.1	11,000	0.473%
Diazinon	39.2	130	30.131%
Diazinon OA	25.8	130	19.879%
1,3-Dichloropropene	4319.0	160,000	2.699%
pp-Dicofol	Not Detected (1.1)	68,000	0.002%
Dimethoate	Not Detected (1.2)	4,300	0.027%
Dimethoate OA	Not Detected (1.0)	4,300	0.023%
Diuron	Trace (7.2)	170,000	0.004%
Endosulfan	Not Detected (1.6)	3,300	0.049%
Endosulfan Sulfate	Not Detected (2.3)	3,300	0.070%
EPTC	Not Detected (0.8)	230,000	0.000%
Iprodione	Not Detected (0.5)	939,000	0.000%
Malathion	Trace (12.6)	112,500	0.011%
Malathion OA	Trace (5.3)	112,500	0.005%
Methidathion	Not Detected (0.7)	3,100	0.023%
Methyl Bromide	4424.8	820,000	0.540%
Metolachlor	Not Detected (1.4)	85,000	0.002%
MITC	233.8	66,000	0.354%
Norflurazon	Not Detected (1.9)	170,000	0.001%
Oryzalin	Not Detected (0.7)	420,000	0.000%
Oxydemeton methyl	Not Detected (1.2)	39,200	0.003%
Oxyfluorfen	52.7	510,000	0.010%
Permethrin	Not Detected (3.6)	168,000	0.002%
Phosmet	Not Detected (4.0)	77,000	0.005%
Propargite	Not Detected (1.9)	14,000	0.014%
Simazine	Not Detected (0.6)	110,000	0.001%
SSS-tributyl...(DEF)	Not Detected (0.9)	8,800	0.010%
Trifluralin	Not Detected (0.8)	1,200,000	0.000%

**Highest 1-day concentration detected after detection limit was lowered from 156 ng/m3 to 15.6 ng/m3 on October 15, 2013.
†A concentration greater than 100% of the screening level suggests the need for further evaluation.
‡Number in parentheses is one-half the MDL for samples with no detectable amount, and a value halfway between the MDL and the LOQ for trace samples.

Table 14. Highest 4-week rolling concentrations for pesticides monitored in Salinas, California.

Pesticide	Highest 4-wk rolling concentration (ng/m3)	Subchronic Screening Level (ng/m3)	% of screening level
Acephate	0.5	8,500	0.006%
Bensulide	0.7	24,000	0.003%
Carbon Disulfide	155.5	800,000	0.019%
Chloropicrin	3224.4	2,300	140.193%
Chlorothalonil	9.7	34,000	0.029%
Chlorpyrifos	5.4	850	0.637%
Chlorpyrifos OA	1.5	850	0.172%
Cypermethrin	2.3	81,000	0.003%
Dacthal	16.3	470	3.457%
DDVP	27.9	2,200	1.270%
Diazinon	10.2	130	7.867%
Diazinon OA	7.2	130	5.570%
1,3-Dichloropropene	2610.9	120,000	2.176%
pp-Dicofol	1.1	49,000	0.002%
Dimethoate	1.2	3,000	0.039%
Dimethoate OA	1.0	3,000	0.032%
Diuron	6.1	17,000	0.036%
Endosulfan	1.6	3,300	0.049%
Endosulfan Sulfate	2.3	3,300	0.070%
EPTC	0.8	24,000	0.003%
Iprodione	0.5	286,000	0.000%
Malathion	12.6	80,600	0.016%
Malathion OA	3.8	80,600	0.005%
Methidathion	0.7	3,100	0.023%
Methyl Bromide	1870.9	19,400	9.644%
Metolachlor	1.4	15,000	0.009%
MITC	88.7	3,000	2.957%
Norflurazon	1.9	26,000	0.007%
Oryzalin	0.7	230,000	0.000%
Oxydemeton methyl	1.2	610	0.189%
Oxyfluorfen	15.6	180,000	0.009%
Permethrin	3.6	90,000	0.004%
Phosmet	4.0	26,000	0.015%
Propargite	1.9	14,000	0.014%
Simazine	0.6	31,000	0.002%
SSS-tributyl...(DEF)	0.9	8,800	0.010%
Trifluralin	0.8	170,000	0.000%

† Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).
‡ A concentration greater than 100% of the screening level suggests the need for further evaluation

Table 15. Overall average concentrations for pesticides monitored in Salinas, California.

Pesticide	Overall average concentration (ng/m3)	Chronic Screening Level (ng/m3)	% of screening level
Acephate	0.5	8,500	0.006%
Bensulide	0.7	24,000	0.003%
Carbon Disulfide	136.4	800,000	0.017%
Chloropicrin	413.1	1,800	22.948%
Chlorothalonil	7.3	34,000	0.021%
Chlorpyrifos	2.7	510	0.538%
Chlorpyrifos OA	1.5	510	0.286%
Cypermethrin	2.3	27,000	0.009%
Dacthal	10.4	47	22.055%
DDVP	4.3	770	0.553%
Diazinon	1.3	130	1.006%
Diazinon OA	1.5	130	1.160%
1,3-Dichloropropene	406.7	120,000	0.339%
pp-Dicofol	1.1	20,000	0.005%
Dimethoate	1.2	300	0.385%
Dimethoate OA	1.0	300	0.323%
Diuron	3.4	5,700	0.060%
Endosulfan	1.6	330	0.491%
Endosulfan Sulfate	2.3	330	0.702%
EPTC	0.8	8,500	0.010%
Iprodione	0.5	286,000	0.000%
Malathion	2.8	8,100	0.034%
Malathion OA	1.3	8,100	0.016%
Methidathion	0.7	2,500	0.029%
Methyl Bromide	300.7	3,900	7.711%
Metolachlor	1.4	15,000	0.009%
MITC	11.7	300	3.892%
Norflurazon	1.9	26,000	0.007%
Oryzalin	0.7	232,000	0.000%
Oxydemeton methyl	1.2	610	0.189%
Oxyfluorfen	4.1	51,000	0.008%
Permethrin	3.6	90,000	0.004%
Phosmet	4.0	18,000	0.022%
Propargite	1.9	14,000	0.014%
Simazine	0.6	31,000	0.002%
SSS-tributyl...(DEF)	0.9	NA - Seasonal	
Trifluralin	0.8	41,000	0.002%

† A concentration greater than 100% of the screening level suggests the need for further evaluation.

Results for Shafter

Tables 16-18 show the highest 1-day, 4-week, and overall average concentrations for pesticides monitored in Shafter, respectively. No pesticides exceeded any of the screening levels. However, the 2013 average concentration for 1,3-dichloropropene (2,589 ng/m^3) was 3.47x (347%) of DPR's cancer risk goal for a 70-year lifetime exposure (see cancer risk section for more information). Nine pesticides were detected at quantifiable concentrations in Shafter: 1,3-dichloropropene, carbon disulfide, chlorothalonil, chlorpyrifos + OA, diazinon, EPTC, methyl bromide, and MITC. Eleven additional pesticides were detected at trace levels. Seventeen pesticides (or breakdown products) were not detected. 1,3-dichloropropene had the highest 1-day and highest 4-week rolling average concentration relative to its screening level with values of 25% and 15% of its screening level, respectively. MITC was pesticide with the highest overall average concentration relative to its screening level with a value of 22% (65.7 ng/m^3). Cumulative exposure to organophosphates is discussed in a later section.

Table 16. Highest 1-day concentrations for pesticides monitored in Shafter, California.

Pesticide	Highest 1-day concentration (ng/m3)	1-day acute screening level (ng/m3)	% of screening level
Acephate	Not Detected (0.5)	12,000	0.004%
Bensulide	Not Detected (0.7)	259,000	0.000%
Carbon Disulfide	896.5	1,550,000	0.058%
Chloropicrin	Not Detected (111.0)	491,000	0.023%
Chlorothalonil	79.7	34,000	0.234%
Chlorpyrifos	422.5	1,200	35.211%
Chlorpyrifos OA	143.1	1,200	11.923%
Cypermethrin	Not Detected (2.3)	113,000	0.002%
Dacthal	Trace (16.3)	23,500	0.069%
DDVP	Trace (13.2)	11,000	0.120%
Diazinon	29.3	130	22.502%
Diazinon OA	Trace (5.7)	130	4.377%
1,3-Dichloropropene	39969.2	160,000	24.981%
pp-Dicofol	Not Detected (1.1)	68,000	0.002%
Dimethoate	Not Detected (1.2)	4,300	0.027%
Dimethoate OA	Not Detected (1.0)	4,300	0.023%
Diuron	Trace (7.2)	170,000	0.004%
Endosulfan	Not Detected (1.6)	3,300	0.049%
Endosulfan Sulfate	Not Detected (2.3)	3,300	0.070%
EPTC	250.3	230,000	0.109%
Iprodione	Trace (12.1)	939,000	0.001%
Malathion	Trace (12.6)	112,500	0.011%
Malathion OA	Trace (5.3)	112,500	0.005%
Methidathion	Not Detected (0.7)	3,100	0.023%
Methyl Bromide	208.8	820,000	0.025%
Metolachlor	Not Detected (1.4)	85,000	0.002%
MITC	762.4	66,000	1.155%
Norflurazon	Not Detected (1.9)	170,000	0.001%
Oryzalin	Trace (12.2)	420,000	0.003%
Oxydemeton methyl	Not Detected (1.2)	39,200	0.003%
Oxyfluorfen	Not Detected (3.2)	510,000	0.001%
Permethrin	Trace (15.2)	168,000	0.009%
Phosmet	Not Detected (4.0)	77,000	0.005%
Propargite	Trace (13.5)	14,000	0.096%
Simazine	Not Detected (0.6)	110,000	0.001%
SSS-tributyl...(DEF)	Not Detected (0.9)	8,800	0.010%
Trifluralin	Trace (12.4)	1,200,000	0.001%

† A concentration greater than 100% of the screening level suggests the need for further evaluation.
‡Number in parentheses is one-half the MDL for samples with no detectable amount, and a value halfway between the MDL and the LOQ for trace samples.

Table 17. Highest 4-week rolling concentrations for pesticides monitored in Shafter, California.

Pesticide	Highest 4-wk rolling concentration (ng/m3)	Subchronic Screening Level (ng/m3)	% of screening level
Acephate	0.5	8,500	0.006%
Bensulide	0.7	24,000	0.003%
Carbon Disulfide	340.7	800,000	0.043%
Chloropicrin	111.0	2,300	4.826%
Chlorothalonil	38.0	34,000	0.112%
Chlorpyrifos	113.3	850	13.330%
Chlorpyrifos OA	43.7	850	5.137%
Cypermethrin	2.3	81,000	0.003%
Dacthal	16.3	470	3.457%
DDVP	7.4	2,200	0.336%
Diazinon	10.1	130	7.749%
Diazinon OA	5.7	130	4.377%
1,3-Dichloropropene	18022.1	120,000	15.018%
pp-Dicofol	1.1	49,000	0.002%
Dimethoate	1.2	3,000	0.039%
Dimethoate OA	1.0	3,000	0.032%
Diuron	3.7	17,000	0.022%
Endosulfan	1.6	3,300	0.049%
Endosulfan Sulfate	2.3	3,300	0.070%
EPTC	139.4	24,000	0.581%
Iprodione	6.3	286,000	0.002%
Malathion	6.9	80,600	0.009%
Malathion OA	4.1	80,600	0.005%
Methidathion	0.7	3,100	0.023%
Methyl Bromide	198.0	19,400	1.021%
Metolachlor	1.4	15,000	0.009%
MITC	318.9	3,000	10.631%
Norflurazon	1.9	26,000	0.007%
Oryzalin	3.6	230,000	0.002%
Oxydemeton methyl	1.2	610	0.189%
Oxyfluorfen	3.2	180,000	0.002%
Permethrin	6.5	90,000	0.007%
Phosmet	4.0	26,000	0.015%
Propargite	13.5	14,000	0.096%
Simazine	0.6	31,000	0.002%
SSS-tributyl...(DEF)	0.9	8,800	0.010%
Trifluralin	6.6	170,000	0.004%

† Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).
‡ A concentration greater than 100% of the screening level suggests the need for further evaluation

Table 18. Overall average concentrations for pesticides monitored in Shafter, California.

Pesticide	Overall average concentration (ng/m3)	Chronic Screening Level (ng/m3)	% of screening level
Acephate	0.5	8,500	0.006%
Bensulide	0.7	24,000	0.003%
Carbon Disulfide	149.1	800,000	0.019%
Chloropicrin	111.0	1,800	6.167%
Chlorothalonil	16.0	34,000	0.047%
Chlorpyrifos	20.4	510	4.005%
Chlorpyrifos OA	7.6	510	1.487%
Cypermethrin	2.3	27,000	0.009%
Dacthal	5.6	47	11.855%
DDVP	2.3	770	0.295%
Diazinon	1.3	130	0.997%
Diazinon OA	1.4	130	1.070%
1,3-Dichloropropene	2588.8	120,000	2.157%
pp-Dicofol	1.1	20,000	0.005%
Dimethoate	1.2	300	0.385%
Dimethoate OA	1.0	300	0.323%
Diuron	2.7	5,700	0.047%
Endosulfan	1.6	330	0.491%
Endosulfan Sulfate	2.3	330	0.702%
EPTC	11.8	8,500	0.138%
Iprodione	1.0	286,000	0.000%
Malathion	1.5	8,100	0.019%
Malathion OA	1.1	8,100	0.013%
Methidathion	0.7	2,500	0.029%
Methyl Bromide	162.6	3,900	4.169%
Metolachlor	1.4	15,000	0.009%
MITC	65.7	300	21.909%
Norflurazon	1.9	26,000	0.007%
Oryzalin	0.9	232,000	0.000%
Oxydemeton methyl	1.2	610	0.189%
Oxyfluorfen	3.2	51,000	0.006%
Permethrin	3.8	90,000	0.004%
Phosmet	4.0	18,000	0.022%
Propargite	3.2	14,000	0.023%
Simazine	0.6	31,000	0.002%
SSS-tributyl...(DEF)	0.9	NA - Seasonal	
Trifluralin	1.3	41,000	0.003%

† A concentration greater than 100% of the screening level suggests the need for further evaluation

Results for Ripon

Tables 19-21 show the highest 1-day, 4-week, and overall average concentrations for pesticides monitored in Ripon, respectively. None of the pesticides exceeded the screening levels. However, the 2013 average concentration for 1,3-dichloropropene (914 ng/m^3) was 1.38x (138%) of DPR's cancer risk goal for a 70-year lifetime exposure (see cancer risk section for more information). Six pesticides were detected at quantifiable concentrations in Ripon: 1,3-dichloropropene, carbon disulfide, chloropicrin, diazinon, methyl bromide, and MITC. Fourteen additional pesticides were detected at trace levels. Seventeen pesticides were not detected. Diazinon had the highest 1-day concentration relative to its screening level (37.5% or 49 ng/m^3). Chloropicrin had the highest 4-week average concentration relative to its screening level (43% or 987 ng/m^3). MITC was the pesticide with the highest overall average concentration relative to its screening level with a value of 12.4% (37 ng/m^3).

Table 19. Highest 1-day concentrations for pesticides monitored in Ripon, California.

Pesticide	Highest 1-day concentration (ng/m3)	1-day acute screening level (ng/m3)	% of screening level
Acephate	Not Detected (0.5)	12,000	0.004%
Bensulide	Not Detected (0.7)	259,000	0.000%
Carbon Disulfide	463.8	1,550,000	0.030%
Chloropicrin	1279.0	491,000	0.260%
Chlorothalonil	Trace (18.4)	34,000	0.054%
Chlorpyrifos	Trace (14.1)	1,200	1.173%
Chlorpyrifos OA	Trace (6.1)	1,200	0.509%
Cypermethrin	Not Detected (2.3)	113,000	0.002%
Dacthal	Not Detected (4.7)	23,500	0.020%
DDVP	Trace (13.2)	11,000	0.120%
Diazinon	48.7	130	37.487%
Diazinon OA	Trace (5.7)	130	4.377%
1,3-Dichloropropene	14744.6	160,000	9.215%
pp-Dicofol	Not Detected (1.1)	68,000	0.002%
Dimethoate	Not Detected (1.2)	4,300	0.027%
Dimethoate OA	Trace (5.6)	4,300	0.131%
Diuron	Trace (7.2)	170,000	0.004%
Endosulfan	Trace (13.2)	3,300	0.399%
Endosulfan Sulfate	Not Detected (2.3)	3,300	0.070%
EPTC	Not Detected (0.8)	230,000	0.000%
Iprodione	Trace (12.1)	939,000	0.001%
Malathion	Trace (12.6)	112,500	0.011%
Malathion OA	Trace (5.3)	112,500	0.005%
Methidathion	Not Detected (0.7)	3,100	0.023%
Methyl Bromide	1152.8	820,000	0.141%
Metolachlor	Not Detected (1.4)	85,000	0.002%
MITC	852.2	66,000	1.291%
Norflurazon	Not Detected (1.9)	170,000	0.001%
Oryzalin	Not Detected (0.7)	420,000	0.000%
Oxydemeton methyl	Not Detected (1.2)	39,200	0.003%
Oxyfluorfen	Not Detected (3.2)	510,000	0.001%
Permethrin	Trace (15.2)	168,000	0.009%
Phosmet	Not Detected (4.0)	77,000	0.005%
Propargite	Trace (13.5)	14,000	0.096%
Simazine	Not Detected (0.6)	110,000	0.001%
SSS-tributyl...(DEF)	Not Detected (0.9)	8,800	0.010%
Trifluralin	Trace (12.4)	1,200,000	0.001%

†A concentration greater than 100% of the screening level suggests the need for further evaluation
‡Number in parentheses is one-half the MDL for samples with no detectable amount, and a value halfway between the MDL and the LOQ for trace samples.

Table 20. Highest 4-week rolling concentrations for pesticides monitored in Ripon, California.

Pesticide	Highest 4-wk rolling concentration (ng/m3)	Subchronic Screening Level (ng/m3)	% of screening level
Acephate	0.5	8,500	0.006%
Bensulide	0.7	24,000	0.003%
Carbon Disulfide	169.6	800,000	0.021%
Chloropicrin	987.0	2,300	42.913%
Chlorothalonil	18.4	34,000	0.054%
Chlorpyrifos	11.2	850	1.316%
Chlorpyrifos OA	6.1	850	0.719%
Cypermethrin	2.3	81,000	0.003%
Dacthal	4.7	470	1.000%
DDVP	10.3	2,200	0.467%
Diazinon	13.8	130	10.601%
Diazinon OA	2.2	130	1.694%
1,3-Dichloropropene	7992.7	120,000	6.661%
pp-Dicofol	1.1	49,000	0.002%
Dimethoate	1.2	3,000	0.039%
Dimethoate OA	2.1	3,000	0.071%
Diuron	3.7	17,000	0.022%
Endosulfan	4.5	3,300	0.137%
Endosulfan Sulfate	2.3	3,300	0.070%
EPTC	0.8	24,000	0.003%
Iprodione	12.1	286,000	0.004%
Malathion	4.0	80,600	0.005%
Malathion OA	5.3	80,600	0.007%
Methidathion	0.7	3,100	0.023%
Methyl Bromide	436.7	19,400	2.251%
Metolachlor	1.4	15,000	0.009%
MITC	271.6	3,000	9.052%
Norflurazon	1.9	26,000	0.007%
Oryzalin	0.7	230,000	0.000%
Oxydemeton methyl	1.2	610	0.189%
Oxyfluorfen	3.2	180,000	0.002%
Permethrin	6.5	90,000	0.007%
Phosmet	4.0	26,000	0.015%
Propargite	7.7	14,000	0.055%
Simazine	0.6	31,000	0.002%
SSS-tributyl...(DEF)	0.9	8,800	0.010%
Trifluralin	6.6	170,000	0.004%

† Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).
‡ A concentration greater than 100% of the screening level suggests the need for further evaluation

Table 21. Overall average concentrations for pesticides monitored in Ripon, California.

Pesticide	Overall average concentration (ng/m3)	Chronic Screening Level (ng/m3)	% of screening level
Acephate	0.5	8,500	0.006%
Bensulide	0.7	24,000	0.003%
Carbon Disulfide	139.7	800,000	0.017%
Chloropicrin	177.1	1,800	9.840%
Chlorothalonil	11.6	34,000	0.034%
Chlorpyrifos	4.9	510	0.965%
Chlorpyrifos OA	2.5	510	0.493%
Cypermethrin	2.3	27,000	0.009%
Dacthal	4.7	47	10.000%
DDVP	2.5	770	0.324%
Diazinon	1.6	130	1.213%
Diazinon OA	1.1	130	0.867%
1,3-Dichloropropene	913.6	120,000	0.761%
pp-Dicofol	1.1	20,000	0.005%
Dimethoate	1.2	300	0.385%
Dimethoate OA	1.1	300	0.353%
Diuron	2.7	5,700	0.047%
Endosulfan	1.8	330	0.557%
Endosulfan Sulfate	2.3	330	0.702%
EPTC	0.8	8,500	0.010%
Iprodione	1.6	286,000	0.001%
Malathion	1.3	8,100	0.016%
Malathion OA	1.3	8,100	0.016%
Methidathion	0.7	2,500	0.029%
Methyl Bromide	193.7	3,900	4.965%
Metolachlor	1.4	15,000	0.009%
MITC	37.2	300	12.410%
Norflurazon	1.9	26,000	0.007%
Oryzalin	0.7	232,000	0.000%
Oxydemeton methyl	1.2	610	0.189%
Oxyfluorfen	3.2	51,000	0.006%
Permethrin	3.8	90,000	0.004%
Phosmet	4.0	18,000	0.022%
Propargite	2.3	14,000	0.017%
Simazine	0.6	31,000	0.002%
SSS-tributyl...(DEF)	0.9	NA - Seasonal	
Trifluralin	2.1	41,000	0.005%

† A concentration greater than 100% of the screening level suggests the need for further evaluation

Cumulative Exposure Estimates

Cumulative exposures were only calculated for organophosphate pesticides. These were the only pesticides that have a common mode of action and were detected at quantifiable concentrations. While organophosphates can have additional potential health effects, they all inhibit cholinesterase, an enzyme in the nervous system. Although EPTC, an N-methyl carbamate herbicide, inhibits cholinesterase, it has a different mechanism of toxicity and toxicity profile than the organophosphate insecticides; therefore, it would not be appropriate to group it with the organophosphates in a cumulative exposure calculation. As described in the Materials and Methods section, the cumulative exposure was estimated using a hazard quotient and hazard index approach that relies on the ratio between detected air concentration and the screening level. The organophosphate cumulative exposures were estimated for each community and exposure period.

As shown in Table 22, none of the hazard indices exceeded one, indicating that the screening levels were not exceeded for all organophosphates combined. Shafter had a higher hazard index than Salinas and Ripon for all exposure periods. The acute hazard indices were higher for all three communities, in comparison to the subchronic and chronic hazard indices.

Table 22. Summary of organophosphate cumulative exposure.

Community	Acute hazard index	Subchronic hazard index	Chronic hazard index
Salinas	0.519	0.158	0.040
Shafter	0.742	0.273	0.085
Ripon	0.439	0.151	0.045

† A hazard quotient or hazard index greater than one suggests the need for further evaluation.

As shown in Tables 23 - 31, all three sampling locations had at least one quantifiable concentration of organophosphates detected. A total of 3 organophosphates were detected at quantifiable concentration in Salinas (DDVP, Diazinon, and Diazinon OA), another 3 organophosphates were detected at quantifiable concentration in Shafter (Chlorpyrifos, Chlorpyrifos OA, and Diazinon), and one organophosphate was detected at quantifiable concentration in Ripon (Diazinon). All three communities had trace levels for several organophosphates. Eight of the 14 organophosphates or OAs were detected in at least one sample; Acephate, Bensulide, Dimethoate, Oxydemeton-methyl, Phosmet, and DEF were not detected. Diazinon and chlorpyrifos (plus their OAs) accounted for most of the organophosphate cumulative exposure for all exposure periods. These two pesticides accounted for 75.0% – 99.7% of the organophosphate cumulative exposure, depending on the community and exposure period.

Table 23. Highest one-day concentration of organophosphates monitored in Salinas, California

Pesticide	Highest 1-day adjusted concentration (ng/m3)	24-Hour acute Screening Level (ng/m3)	Acute Hazard quotient
Acephate	Not Detected (0.5)	12,000	0.000043
Bensulide	Not Detected (0.7)	259,000	0.000003
Chlorpyrifos	Trace (14.1)	1,200	0.011729
Chlorpyrifos OA	Not Detected (1.5)	1,200	0.001217
DDVP	52.1	11,000	0.004734
Diazinon	39.2	130	0.301306
Diazinon OA	25.8	130	0.198793
Dimethoate	Not Detected (1.2)	4,300	0.000269
Dimethoate OA	Not Detected (1.0)	4,300	0.000226
Malathion	Trace (12.6)	112,500	0.000112
Malathion OA	Trace (5.3)	112,500	0.000047
Oxydemeton methyl	Not Detected (1.2)	39,200	0.000029
Phosmet	Not Detected (4.0)	77,000	0.000052
SSS-tributyl...(DEF)	Not Detected (0.9)	8,800	0.000100
Hazard Index			**0.518659**

† A hazard quotient or hazard index greater than one suggests the need for further evaluation.
‡Number in parentheses is one-half the MDL for samples with no detectable amount, and a value halfway between the MDL and the LOQ for trace samples.

Table 24. Highest 4-week rolling concentration of organophosphates monitored in Salinas, California.

Pesticide	Highest 4-wk rolling concentration (ng/m3)	Subchronic Screening Level (ng/m3)	Subchronic Hazard quotient
Acephate	0.5	8,500	0.000060
Bensulide	0.7	24,000	0.000029
Chlorpyrifos	5.4	850	0.006368
Chlorpyrifos OA	1.5	850	0.001718
DDVP	27.9	2,200	0.012697
Diazinon	10.2	130	0.078673
Diazinon OA	7.2	130	0.055698
Dimethoate	1.2	3,000	0.000385
Dimethoate OA	1.0	3,000	0.000323
Malathion	12.6	80,600	0.000157
Malathion OA	3.8	80,600	0.000047
Oxydemeton methyl	1.2	610	0.001893
Phosmet	4.0	18,000	0.000221
SSS-tributyl...(DEF)	0.9	8,800	0.000100
Hazard Index			**0.158368**

† A hazard quotient or hazard index greater than one suggests the need for further evaluation.
‡Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).

Table 25. Overall average concentration of organophosphates monitored in Salinas, California.

Pesticide	Overall average concentration (ng/m3)	Chronic screening level (ng/m3)	Chronic Hazard quotient
Acephate	0.5	8,500	0.000060
Bensulide	0.7	24,000	0.000029
Chlorpyrifos	2.7	510	0.005378
Chlorpyrifos OA	1.5	510	0.002863
DDVP	4.3	27,000	0.000158
Diazinon	1.3	130	0.010062
Diazinon OA	1.5	130	0.011600
Dimethoate	1.2	300	0.003850
Dimethoate OA	1.0	300	0.003233
Malathion	2.8	8,100	0.000343
Malathion OA	1.3	8,100	0.000156
Oxydemeton methyl	1.2	610	0.001893
Phosmet	4.0	18,000	0.000221
SSS-tributyl...(DEF)	0.9	NA - Seasonal	NA
Hazard Index			**0.039847**

† A hazard quotient or hazard index greater than one suggests the need for further evaluation.

Table 26. Highest one-day concentration of organophosphates monitored in Shafter, California.

Pesticide	Highest 1-day adjusted concentration (ng/m3)	24-Hour acute Screening Level (ng/m3)	Acute Hazard quotient
Acephate	Not Detected (0.5)	12,000	0.000043
Bensulide	Not Detected (0.7)	259,000	0.000003
Chlorpyrifos	422.5	1,200	0.352111
Chlorpyrifos OA	143.1	1,200	0.119225
DDVP	Trace (13.2)	11,000	0.001197
Diazinon	29.3	130	0.225023
Diazinon OA	Trace (5.7)	130	0.043769
Dimethoate	Not Detected (1.2)	4,300	0.000269
Dimethoate OA	Not Detected (1.0)	4,300	0.000226
Malathion	Trace (12.6)	112,500	0.000112
Malathion OA	Trace (5.3)	112,500	0.000047
Oxydemeton methyl	Not Detected (1.2)	39,200	0.000029
Phosmet	Not Detected (4.0)	77,000	0.000052
SSS-tributyl...(DEF)	Not Detected (0.9)	8,800	0.000100
Hazard Index			**0.742206**

† A hazard quotient or hazard index greater than one suggests the need for further evaluation.
‡Number in parentheses is one-half the MDL for samples with no detectable amount, and a value halfway between the MDL and the LOQ for trace samples.

Table 27. Highest 4-week rolling concentration of organophosphates monitored in Shafter, California.

Pesticide	Highest 4-wk rolling concentration (ng/m3)	Subchronic Screening Level (ng/m3)	Subchronic Hazard quotient
Acephate	0.5	8,500	0.000060
Bensulide	0.7	24,000	0.000029
Chlorpyrifos	113.3	850	0.133297
Chlorpyrifos OA	43.7	850	0.051371
DDVP	7.4	2,200	0.003361
Diazinon	10.1	130	0.077486
Diazinon OA	5.7	3,000	0.001897
Dimethoate	1.2	3,000	0.000385
Dimethoate OA	1.0	300	0.003233
Malathion	6.9	80,600	0.000085
Malathion OA	4.1	80,600	0.000051
Oxydemeton methyl	1.2	610	0.001893
Phosmet	4.0	18,000	0.000221
SSS-tributyl...(DEF)	0.9	8,800	0.000100
Hazard Index			**0.273470**

† A hazard quotient or hazard index greater than one suggests the need for further evaluation.
‡Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).

Table 28. Overall average concentration of organophosphates monitored in Shafter, California.

Pesticide	Overall average concentration (ng/m3)	Chronic screening level (ng/m3)	Chronic Hazard quotient
Acephate	0.5	8,500	0.000060
Bensulide	0.7	24,000	0.000029
Chlorpyrifos	20.4	510	0.040050
Chlorpyrifos OA	7.6	510	0.014866
DDVP	2.3	27,000	0.000084
Diazinon	1.3	130	0.009973
Diazinon OA	1.4	130	0.010700
Dimethoate	1.2	300	0.003850
Dimethoate OA	1.0	300	0.003233
Malathion	1.5	8,100	0.000188
Malathion OA	1.1	8,100	0.000134
Oxydemeton methyl	1.2	610	0.001893
Phosmet	4.0	18,000	0.000221
SSS-tributyl...(DEF)	0.9	NA - Seasonal	NA
Hazard Index			**0.085282**

† A hazard quotient or hazard index greater than one suggests the need for further evaluation.

Table 29. Highest one-day concentration of organophosphates monitored in Ripon, California.

Pesticide	Highest 1-day adjusted concentration (ng/m3)	24-Hour acute Screening Level (ng/m3)	Acute Hazard quotient
Acephate	Not Detected (0.5)	12,000	0.000043
Bensulide	Not Detected (0.7)	259,000	0.000003
Chlorpyrifos	Trace (14.1)	1,200	0.011729
Chlorpyrifos OA	Trace (6.1)	1,200	0.005092
DDVP	Trace (13.2)	11,000	0.001197
Diazinon	48.7	130	0.374869
Diazinon OA	Trace (5.7)	130	0.043769
Dimethoate	Not Detected (1.2)	4,300	0.000269
Dimethoate OA	Trace (5.6)	4,300	0.001307
Malathion	Trace (12.6)	112,500	0.000112
Malathion OA	Trace (5.3)	112,500	0.000047
Oxydemeton methyl	Not Detected (1.2)	39,200	0.000029
Phosmet	Not Detected (4.0)	77,000	0.000052
SSS-tributyl...(DEF)	Not Detected (0.9)	8,800	0.000100
Hazard Index			**0.438618**

† A hazard quotient or hazard index greater than one suggests the need for further evaluation.
‡Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).

Table 30. Highest 4-week rolling concentration of organophosphates monitored in Ripon, California.

Pesticide	Highest 4-wk rolling concentration (ng/m3)	Subchronic Screening Level (ng/m3)	Subchronic Hazard quotient
Acephate	0.5	8,500	0.000060
Bensulide	0.7	24,000	0.000029
Chlorpyrifos	11.2	850	0.013162
Chlorpyrifos OA	6.1	850	0.007188
DDVP	10.3	2,200	0.004674
Diazinon	13.8	130	0.106006
Diazinon OA	2.2	130	0.016942
Dimethoate	1.2	3,000	0.000385
Dimethoate OA	2.1	3,000	0.000711
Malathion	4.0	80,600	0.000049
Malathion OA	5.3	80,600	0.000066
Oxydemeton methyl	1.2	610	0.001893
Phosmet	4.0	18,000	0.000221
SSS-tributyl...(DEF)	0.9	8,800	0.000100
Hazard Index			**0.151486**

† A hazard quotient or hazard index greater than one suggests the need for further evaluation.
‡Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).

Table 31. Overall average concentration of organophosphates monitored in Ripon, California.

Pesticide	Overall average concentration (ng/m3)	Chronic screening level (ng/m3)	Chronic Hazard quotient
Acephate	0.5	8,500	0.000060
Bensulide	0.7	24,000	0.000029
Chlorpyrifos	4.9	510	0.009651
Chlorpyrifos OA	2.5	510	0.004927
DDVP	2.5	27,000	0.000092
Diazinon	1.6	130	0.012125
Diazinon OA	1.1	130	0.008675
Dimethoate	1.2	300	0.003850
Dimethoate OA	1.1	300	0.003526
Malathion	1.3	8,100	0.000161
Malathion OA	1.3	8,100	0.000156
Oxydemeton methyl	1.2	610	0.001893
Phosmet	4.0	18,000	0.000221
SSS-tributyl...(DEF)	0.9	NA - Seasonal	NA
Hazard Index			**0.045368**

† A hazard quotient or hazard index greater than one suggests the need for further evaluation.

Cancer Risk Estimates

Only one of the chemicals measured at a quantifiable concentration is considered a human carcinogen. 1,3-D is classified as a probable human carcinogen by U.S.EPA and is listed as a carcinogen under Proposition 65. The risk of cancer from exposure to a chemical is determined from the cancer potency of the chemical and the human exposure to the chemical. Cancer potency is expressed in the units of $(mg/kg\text{-}day)^{-1}$. Cancer risk is expressed as a probability for the occurrence of cancer (e.g., 1 in 1,000,000 or 10^{-6}, 1 in 100,000 or 10^{-5}, etc). It is a standard default assumption that exposure to a carcinogen takes place over a lifetime, so the default respiratory rate for an adult is used (0.28 m^3/kg/day) over 70 years. DPR has calculated a cancer potency of 0.055 $(mg/kg\text{-}day)^{-1}$. The risk is then calculated as (cancer potency) X (chronic air concentration) X (respiratory rate).

The yearly concentration is calculated as an average of the monthly averages of the measured concentrations over the year of sampling. Since most of the samples resulted in non-detectable concentrations, the method of handling the non-detectable concentrations can have a large effect on the estimated cancer risk. Because the detection limit for 1,3-dichloropropene has such a significant effect on the cancer risk estimates, three different estimates were calculated (Table 32). In addition to uncertainty in the data, the estimate assumes that the chronic exposure occurs every single day for a lifetime (70 years). However, this assumption is consistent with standard risk assessment procedures.

As described in the next section, the cancer risk estimates for 1,3-D were calculated by treating samples with no detectable concentrations as having concentrations of 0 (Minimum), 1/2MDL (Standard), or MDL(Maximum):

Table 32. Minimum, standard, and maximum cancer risk estimates for 1,3-D in 2013.

Sampling Location	Minimum (ND = 0*MDL)	Standard (ND = 1/2 MDL)	Maximum (ND = MDL)
Salinas	3.54E-06	6.07E-06	8.61E-06
Shafter	3.22E-05	3.47E-05	3.72E-05
Ripon	1.10E-05	1.38E-05	1.66E-05

The method of calculation determines whether the risk is considered negligible or above that. Risk in the range of 10^{-5} to 10^{-6} or less is generally considered to be at the limit of what is considered to be negligible. DPR has set a cancer risk regulatory goal of 10^{-5} for 1,3-D. Using DPR's standard assumption for no detectable samples, the air concentrations at the Shafter and Ripon sites exceeded DPR's cancer risk goal by 347% and 138%, respectively. Although the results of the air monitoring cannot be ignored, there are several factors that create uncertainty about their use as an indicator of cancer risk.

- The air concentrations discussed in this report are one-year averages, while the regulatory goal is an average for a 70-year lifetime.
- Monitoring did not occur continuously, so the air concentrations during the unmonitored periods are unknown. DPR's yearly concentrations are based on one day of sampling each week.
- The detection limit impacts the estimate of average concentrations. A risk of 1.00E-05 (1 excess cancer per 100,000 people) equates to an average concentration of 650 ng/m^3 (0.14 ppb). DPR's detection limit for most of the monitoring was 454 ng/m^3 (0.1 ppb). In October 2013, the laboratory was able to lower the 1,3-D detection limit to 45.4 ng/m^3 (0.01 ppb). Table 32 shows the possible range of cancer risk for 2013.

Using DPR's standard method (1/2 MDL) to estimate average air concentrations, Table 33 shows the estimated cancer risk for each year of the AMN, as well as the overall average risk for all years combined. The 3-year average concentrations at the Shafter and Ripon sites exceeded DPR's regulatory goal of 1.00E-05 for a 70-year lifetime.

Table 33. 1,3-D Cancer risk estimate comparisons for all three AMN sampling locations for sampling years 2011, 2012, and 2013.

Sampling Location	2011	2012	2013	Average
Salinas	1.37E-05	5.27E-06	6.07E-06	8.35E-06
Shafter	----	7.65E-06	3.47E-05	2.12E-05
Ripon	1.13E-05	----	1.38E-05	1.26E-05

† Cancer risk estimates were calculated using 1/2MDL for samples with no detectable concentrations (standard method)
---- No quantifiable detections were measured at location during the sampling year.

Uncertainty of Air Concentrations - Treatment of ND and Trace Samples

To determine the impact of DPR's practice of substituting a value of one-half of the Method Detection Limit (MDL) for samples with no detectable amount and substituting the midpoint between the MDL and the Limit of Quantitation (LOQ) for trace samples, various highest 4-week rolling average concentrations and overall average concentrations were calculated for pesticides with at least one detectable concentration using two alternative methods of treating samples with no detectable and trace concentrations. Table 34 shows various highest 4-week rolling average concentrations and overall average concentrations determined by using a "minimum", a "standard", and a "maximum" method. Minimum average concentrations are calculated using a value of 0 ng/m^3 for samples with no detectable amount and by using the Method Detection Limit (MDL) for trace samples. Standard

average concentrations are calculated by using a value of one-half of the MDL for samples with no detectable amount and substituting the midpoint between the MDL and the Limit of Quantitation (LOQ) for trace samples. Maximum average concentrations were calculated using the MDL for samples with no detectable amount and substituting the LOQ for all trace detections.

The difference between maximum and minimum values for 4-week rolling averages varied from 0% to 104% depending on the pesticide in question, while the difference in the overall average concentrations contained more variance for some pesticides ranging from 0% to 1,147%. Overall compared to the screening level, employing the DPR's standard method versus a minimum or maximum alternative method does not change the fact that the concentrations observed are greatly below the screening levels for all pesticides monitored, with chloropicrin's subchronic screening level and 1,3-dichloropropene's cancer risk being exceptions, and thus the standard method provides more of an accurate midpoint representation of the actual environmental concentrations for the target pesticides.

Table 34. Minimum, standard, and maximum highest 4-week rolling average concentrations and overall average concentrations for pesticides with at least one quantifiable detection.

Pesticide	Minimum Highest 4-wk rolling concentration (ng/m^3)	Standard Highest 4-wk rolling concentration (ng/m^3)	Maximum Highest 4-wk rolling concentration (ng/m^3)	Percent Difference between maximum and minimum	Minimum overall average concentration (ng/m^3)	Standard overall average concentration (ng/m^3)	Maximum overall average (ng/m^3)	Percent Difference between maximum and minimum
1,3-D	18,022	18,022	18,022	0%	1,148	1,315	1,481	29%
Carbon Disulfide	224	341	457	104%	21	142	262	1,147%
Chloropicrin	3,224	3,224	3,224	0%	130	234	338	160%
Chlorothalonil	38	38	38	0%	7	12	16	129%
Chlorpyrifos	108	113	118	9%	5	9	14	180%
Chlorpyrifos OA	42	44	45	7%	2	4	6	200%
DDVP	28	28	28	0%	2	3	5	150%
Diazinon	13	14	15	15%	1	1	2	100%
Diazinon OA	7	7	9	29%	0	1	3	---
EPTC	4	5	5	25%	139	139	139	0%
Methyl Bromide	1,871	1,871	1,871	0%	65	218	371	471%
MITC	319	319	319	0%	36	38	40	11%
Oxyfluorfen	0	4	7	---	13	16	18	39%

AIR MONITORING NETWORK TREND ANALYSIS

This is the 3rd volume of AMN result data. Volume 1 of the AMN included results from February 1, 2011 to December 31, 2011. Volume 2 of the AMN included results from January 1, 2012 to December 31, 2012. Of the 34 pesticides and 5 pesticide breakdown products monitored by DPR in 2011, 29 were detected in at least one sample. All concentrations were low relative to the screening levels. Overall, 92.5 % of the 5,676 analyses (number of samples times the number of chemicals analyzed) resulted in no detectable concentrations. Only 7.5% of the analyses had detectable (trace or quantifiable) concentrations, and 3% of the analyses had quantifiable concentrations. None of the pesticides exceeded their screening levels for exposure periods of one year or less, indicating low health risk to the people in these communities. Seven of the nine pesticides (plus two breakdown products) detected at quantifiable concentrations in the AMN were either fumigants (1,3-

dichloropropene, chloropicrin, methyl bromide, MITC) or organophosphate insecticides (chlorpyrifos, diazinon, malathion).

Of the 33 pesticides and 5 pesticide breakdown products monitored by DPR in 2012, 24 were detected in at least one sample. All concentrations were low relative to the screening levels. A total of 6,002 analyses were conducted on the air samples collected from all three sampling locations from January 1, 2012 to December 31, 2012. Of the 6,002 analyses, 331 (5.5%) showed detectable concentrations, which included quantifiable and trace detections. Samples with quantifiable concentrations accounted for 1.3% (81) of all analyses conducted. Quantifiable detections refer to concentrations above the LOQ for their respective pesticide. Fourteen of the 33 pesticides and 5 pesticide breakdown products monitored by DPR were not detected.

Of the 32 pesticides and 5 pesticide breakdown products monitored by DPR in 2013, 24 were detected in at least one sample. Chloropicrin exceeded its subchronic screening level, and 1,3-dichloropropene exceeded DPR's regulatory goal for cancer risk. All other concentrations were low relative to the screening levels. A total of 6,033 analyses were conducted on the air samples collected from all three sampling locations from January 1, 2013 to December 31, 2013. Of the 6,033 analyses, 426 (7.1%) showed detectable concentrations, which included quantifiable and trace detections. Samples with quantifiable concentrations accounted for 2.6% (159) of all analyses conducted. Quantifiable detections refer to concentrations above the LOQ for their respective pesticide. Thirteen of the 33 pesticides and 5 pesticide breakdown products monitored by DPR were not detected.

Table 35 shows the highest 24-hour concentrations from all three AMN sampling locations from 2011, 2012, and 2013. Concentrations measured in 2012 were relatively lower than the concentrations measured in 2011 for most pesticides monitored with the exception of Chlorpyrifos, Chlorpyrifos OA, and Carbon Disulfide both of which were not detected in 2011 but had quantifiable concentrations in 2012. Similarly, concentrations measured in 2013 were both lower and higher than concentrations measured in 2011 or 2012, depending on the pesticide monitored. Each of the previously detected pesticides (either in 2011 or 2012) were also detected in 2013 at quantifiable or at trace concentrations in at least one sampling location.

Table 35. Comparison of the highest 24-hour concentrations for pesticides with at least one detectable concentration in either 2011, 2012, or 2013 for all three AMN sampling locations.

Chemical	Highest 24-hour concentration (ng/m^3)										
	2011				2012				2013		
	Salinas	Shafter	Ripon		Salinas	Shafter	Ripon		Salinas	Shafter	Ripon
1,3-D	10,072 (6%)	ND	12,250 (4%)		3,430 (2%)	3,643 (6%)	ND		4,319 (16%)	39,969 (26%)	14,745 (17%)
Carbon Disulfide	ND	ND	ND		616 (2%)	ND	ND		153 (14%)	897 (15%)	464 (11%)
Chloropicrin	3,926 (6%)	ND	ND		ND	ND	ND		6,384 (13%)	ND	1,279 (6%)
Chlorothalonil	ND	Trace (13%)	Trace (38%)		ND	Trace (23%)	Trace (21%)		Trace (4%)	80 (60%)	Trace (42%)
Chlorpyrifos	Trace (23%)	27 (53%)	Trace (19%)		Trace (23%)	131 (48%)	Trace (13%)		Trace (2%)	423 (75%)	Trace (21%)
Chlorpyrifos OA	Trace (11%)	9 (45%)	Trace (25%)		Trace (8%)	17 (48%)	13 (19%)		ND	143 (55%)	Trace (23%)
DDVP	Trace (6%)	Trace (2%)	ND		Trace (10%)	ND	69 (2%)		52 (13%)	Trace (6%)	Trace (8%)
Diazinon	Trace (23%)	60 (11%)	Trace (4%)		Trace (2%)	Trace (4%)	Trace (4%)		39 (2%)	29 (6%)	49 (4%)
Diazinon OA	Trace (17%)	36 (4%)	Trace (2%)		ND	10 (8%)	Trace (2%)		26 (2%)	Trace (8%)	Trace (2%)
Diuron	Trace (4%)	Trace (6%)	ND		32 (40%)	Trace (12%)	Trace (10%)		Trace (19%)	Trace (2%)	Trace (2%)
EPTC	ND	187 (17%)	ND		ND	18 (4%)	ND		ND	250 (9%)	ND
Malathion	13 (9%)	ND	Trace (2%)		Trace (13%)	Trace (2%)	ND		Trace (15%)	Trace (4%)	Trace (2%)
Malathion OA	Trace (30%)	Trace (6.4%)	Trace (13%)		Trace (31%)	11 (10%)	Trace (10%)		Trace (13%)	Trace (9%)	Trace (13%)
Methyl bromide	6,055 (19%)	2,934 (9%)	2,934 (20%)		2,527 (10%)	2,135 (4%)	2,667 (4%)		4,425 (10%)	209 (4%)	1,153 (9%)
MITC	51 (10%)	930 (40%)	308 (42%)		182 (6%)	347 (56%)	90 (23%)		234 (15%)	762 (57%)	852 (19%)
Oxyfluorfen	ND	ND	Trace (4%)		ND	ND	Trace (6%)		53 (2%)	ND	ND

†Values in parentheses refer to the percentage of samples with detections.
‡ND = Not Detected.

Table 36 shows the highest 4-week rolling concentrations from all three AMN sampling locations from 2011, 2012, and 2013. Concentrations are presented as rolling or moving averages (i.e., average of weeks 1, 2, 3, and 4; average of weeks 2, 3, 4, and 5, etc.). Although, most concentrations measured in 2012 were relatively lower than the concentrations measured in 2011 for most pesticides monitored, the highest 4-week rolling concentrations for Chlorpyrifos, Chlorpyrifos OA, DDVP, and Diuron all were higher in 2012 compared to the 4-week rolling concentrations from 2011. Compared to highest 4-week rolling concentrations from 2011 and 2012, 2013 concentrations provided mixed results: seven pesticides were generally higher than previously measured concentrations in 2011 or 2012 (1,3-D, CS_2, chloropicrin, chlorpyrifos, chlorpyrifos OA, DDVP, and EPTC), seven pesticides were generally lower than previously measured concentrations in 2011 or 2012 (diazinon, diazinon OA, diuron, malathion, malathion OA, methyl bromide, and MITC), and two pesticides were detected in 2013 that were previously never been measured above trace levels in either 2011 or 2012 as part of the AMN monitoring (chlorothalonil and oxyfluorfen).

Table 36. Comparison of the highest 4-week rolling concentrations for pesticides with at least one detectable concentration in either 2011, 2012, or 2013 for all three AMN sampling locations.

Chemical	Highest 4-week rolling concentration (ng/m^3)									
	2011				2012				2013	
	Salinas	Shafter	Ripon		Salinas	Shafter	Ripon		Salinas	Shafter	Ripon
1,3-D	2,743	ND	4,022		1,082	1,135	ND		2,611	18,022	7,993
Carbon Disulfide	ND	ND	ND		271	ND	ND		156	341	170
Chloropicrin	1,809	ND	ND		ND	ND	ND		3,224	ND	987
Chlorothalonil	ND	Trace	Trace		ND	Trace	Trace		Trace	38	Trace
Chlorpyrifos	Trace	11	Trace		Trace	46	Trace		Trace	113	Trace
Chlorpyrifos OA	Trace	5	Trace		Trace	13	8		ND	44	Trace
DDVP	Trace	Trace	ND		Trace	ND	18		28	Trace	Trace
Diazinon	Trace	17	Trace		Trace	Trace	Trace		10	10	14
Diazinon OA	Trace	10	Trace		ND	6	Trace		7	ND	ND
Diuron	Trace	Trace	ND		20	6	5		Trace	Trace	Trace
EPTC	ND	75	ND		ND	7	ND		ND	139	ND
Malathion	6	ND	Trace		Trace	Trace	ND		Trace	Trace	Trace
Malathion OA	Trace	Trace	Trace		Trace	4	Trace		Trace	Trace	Trace
Methyl bromide	4,124	1,403	1,659		1,098	683	1,119		1,871	198	437
MITC	15	564	144		71	177	50		89	319	272
Oxyfluorfen	ND	ND	Trace		ND	ND	Trace		16	ND	ND

† ND = Not Detected.
‡Concentrations are presented as rolling or moving averages (i.e., average of weeks 1,2,3, and 4; average of weeks 2,3,4, and 5, etc.).

As listed on Table 37, the overall average concentrations from the pesticides with at least one detectable concentration in 2012 were generally lower than the average concentrations from 2011. With the exception of diuron, malathion, and malathion OA; pesticides detected in 2013 had a higher overall average concentration than the same pesticides in 2011 and 2012.

Table 37. Comparison of the overall average concentrations for pesticides with at least one detectable concentration in either 2011, 2012, or 2013 for all three AMN sampling locations.

Chemical	Overall average concentration (ng/m^3)									
	2011				2012				2013	
	Salinas	Shafter	Ripon		Salinas	Shafter	Ripon		Salinas	Shafter	Ripon
1,3-D	760	ND	851		360	453	ND		407	2,589	914
Carbon Disulfide	ND	ND	ND		270	ND	ND		136	149	140
Chloropicrin	325	ND	ND		ND	ND	ND		413	ND	177
Chlorothalonil	ND	Trace	Trace		ND	Trace	Trace		Trace	16	Trace
Chlorpyrifos	5	7	5		5	11	4		Trace	20	Trace
Chlorpyrifos OA	2	2	3		2	4	3		ND	8	Trace
DDVP	2	2	ND		3	ND	3		4	Trace	Trace
Diazinon	2	2	1		1	1	1		1	1	3
Diazinon OA	2	2	1		ND	2	1		2	ND	ND
Diuron	3	3	ND		5	3	3		Trace	Trace	Trace
EPTC	ND	8	ND		ND	1	ND		ND	12	ND
Malathion	2	ND	1		3	1	ND		Trace	Trace	Trace
Malathion OA	2	1	1		2	1	1		Trace	Trace	Trace
Methyl bromide	1,020	425	656		355	247	315		301	163	194
MITC	6	73	34		8	51	14		12	66	37
Oxyfluorfen	ND	ND	Trace		ND	ND	Trace		4	ND	ND

† ND = Not Detected.

Comparison to Other Monitoring

The ARB, in support of DPR's toxic air contaminant monitoring program, monitors ambient air for a variety of pesticides. The ARB monitors air concentrations of a pesticide in counties with the highest reported use for that particular pesticide and during the season of its highest reported use. The ambient air sampling conducted under this program includes results for 15 of the pesticides in the AMN: 1,3-dichloropropene, chlorpyrifos, chlorothalonil, diazinon, endosulfan, EPTC, malathion, MITC, methyl bromide, permethrin, propargite, simazine and S,S,S-tributylphosphorotrithioate (DEF).

Pesticide Action Network North America (PANNA) monitored for chlorpyrifos and its oxon analog in Lindsay (Tulare County) as part of its Drift Catcher program (Mills and Kegley, 2006). The program collected 104 24-hour samples between July 13 and August 2, 2004, and 108 samples between June 13 and July 22, 2005. In 2004, 76 percent of the samples were above the quantitation limit of 30 ng/sample (equivalent to 6 ng/m^3 for a 24-hour sample). The highest concentration measured was 1,340 ng/m^3 for a 24-hour period (Table 38).

Concentrations measured at Salinas and Ripon in 2013 were much lower than concentrations measured in other parts of the state by ARB, PANNA, or those measured by DPR in Parlier, with the exception of EPTC, which was detected at a higher 24-hour concentration than in other previous studies included in this report. Similarly, concentrations measured in Shafter for 1,3-D, chlorothalonil, chlorpyrifos, and chlorpyrifos OA were higher than 24-hour maximum concentrations measured in Parlier, but lower than concentrations measured in other parts of the state by ARB, PANNA (Table 38).

Table 38. Highest 24-hour concentrations of the pesticides monitored in Salinas, Shafter, and Ripon from 2011 to 2013 compared to previous DPR/ARB and PANNA monitoring studies in California.

Chemical	Year	County			2011			2012			2013		
			Other Studies	Parlier	Salinas	Shafter	Ripon	Salinas	Shafter	Ripon	Salinas	Shafter	Ripon
			Max. 24-hr conc. (ng/m^3)										
1,3-D	2000	Kern	135,000	23,080	10,072	ND	12,249	3,430	3,643	ND	4,319	39,969	14,745
Chlorothalonil	2002	Fresno	14	Trace	ND	Trace	Trace	ND	18	Trace	Trace	80	Trace
Chlorpyrifos	2004	Tulare	1,340	150	Trace	27	Trace	Trace	131	Trace	Trace	423	Trace
Chlorpyrifos OA	1996	Tulare	230	28	Trace	9.2	Trace	Trace	17	13	ND	143	Trace
Diazinon	1997	Fresno	290	172	Trace	60	Trace	Trace	Trace	Trace	39	29	49
Endosulfan	1996	Fresno	166	ND	ND	ND	ND	ND	ND	Trace	ND	ND	Trace
EPTC	1996	Imperial	240	ND	ND	187	ND	ND	18	ND	ND	**250**	ND
Malathion	1998	Imperial	90	21	13	ND	Trace	Trace	Trace	ND	Trace	Trace	Trace
Malathion OA	1998	Imperial	28	16	Trace	Trace	Trace	Trace	11	Trace	Trace	Trace	Trace
Methyl bromide	2001	Santa Cruz	142,000	2,468	6,055	2,934	2,934	2,527	2,135	2,667	4,425	209	1,153
MITC	1993	Kern	18,000	5,010	51	930	308	182	347	90	234	762	852
Permethrin	1997	Monterey	Trace	Trace	ND	Trace	Trace	ND	ND	ND	ND	Trace	Trace
Propargite	1999	Fresno	1300	Trace	ND	Trace	Trace	ND	ND	Trace	ND	Trace	Trace
Simazine	1998	Fresno	18	Trace	Trace	Trace	Trace	Trace	Trace	Trace	ND	ND	ND
DEF	1987	Fresno	330	ND	ND	ND	ND	ND	ND	Trace	ND	ND	ND

† ND = Not Detected.

DATA VALIDATION/QUALITY ASSURANCE

Data Review

Before any statistical or other evaluation of the data, the entire set of sample chains of custody and laboratory quality assurance data were reviewed to determine the strength of the data for final assessment. The sample chains of custody were checked for any notations of flow faults or stoppage in sample collection, or any changes greater than 20 percent in the flow over the sampling interval. A grand total of three air samples were invalid: an MITC air sample taken from Ripon, and two air canister samples taken from Salinas. The MITC sample was lost due to CDFA laboratory staff utilized an incorrect solvent for sample extraction. The air canister samples were lost due to CDFA laboratory power failure while analyzing the samples. The invalid samples were not replaced and were not included in any of the average calculations.

Quality Control Results

Laboratory matrix spikes and matrix blanks were included with every set of samples extracted and analyzed at the lab and are part of the laboratory quality control (QC) program. The matrix spikes are conducted to assess accuracy and precision; the blanks are to check for contamination at the laboratory or contamination of the resin packed in the sorption tubes. The blank matrix materials were not fortified, but were extracted and analyzed along with the matrix spikes and field samples. Table 39 lists the averages for the quality control samples that were extracted and analyzed with the air samples for the entire monitoring period. Laboratory matrix spike recovery averages ranged from 77 percent to 98 percent for all chemicals analyzed. None of the laboratory matrix spike samples were outside the control limits established from the validation data.

The matrix blind spikes were fortified by a CDFA chemist not associated with the analysis. The blind spikes were given to DPR staff, relabeled, and then intermingled and delivered with field samples. The average percent recovery results are listed on Table 39 and ranged from 0 to 195 percent. The trip blanks were blank matrix samples that were transported to and from the field locations, but were not placed on air pumps. These samples were a control to check for contamination during transportation.

Field blanks, blind spikes and duplicate samples are part of DPR's field and laboratory QC program. A duplicate sample is a sample that is co-located with another sample in the field. These samples serve to evaluate overall precision in sample measurement and analysis. Duplicate samples (Table 40) with quantifiable concentrations had a maximum relative difference of 3.1 percent for the XAD multiple pesticide samples, 11.6 percent for the MITC samples, 0 percent for chloropicrin samples, and 24.3 percent for VOC samples.

Table 39. Average results for quality control/quality assurance samples.

Chemical	Lab spikes (% recovery)	Field spikes (% recovery)	Lab blanks (ng/m^3)	Trip blanks (ng/m^3)
Acephate	89.1	82.9	ND	ND
Bensulide	86.3	81.7	ND	ND
Carbon Disulfide	95.8	NS	ND	ND
Chloropicrin	91.0	79.8	ND	ND
Chlorothalonil	90.4	56.1	ND	ND
Chlorpyrifos	92.3	86.2	ND	ND
Chlorpyrifos OA	85.9	92.5	ND	ND
Cypermethrin	89.5	80.0	ND	ND
Dacthal	91.5	97.8	ND	ND
DDVP	87.3	NS	ND	ND
Diazinon	89.1	NS	ND	ND
Diazinon OA	87.3	NS	ND	ND
cis-1,3-Dichloropropene	98.3	131.7	ND	ND
trans-1,3-Dichloropropene	97.3	129.3	ND	ND
Dicofol	93.3	120.8	ND	ND
Dimethoate	89.3	NS	ND	ND
Dimethoate OA	89.2	NS	ND	ND
Diuron	87.0	64.8	ND	ND
Endosulfan	91.5	NS	ND	ND
Endosulfan Sulfate	91.9	NS	ND	ND
EPTC	85.3	NS	ND	ND
Iprodione	88.9	52.3	ND	ND
Malathion	94.3	82.7	ND	ND
Malathion OA	91.8	95.5	ND	ND
Methidathion	90.8	195.0	ND	ND
Methyl Bromide	96.4	45.8	ND	ND
Metolachlor	87.3	82.2	ND	ND
MITC	77.3	57.5	ND	ND
Norflurazon	87.3	64.0	ND	ND
Oryzalin	87.2	0.0	ND	ND
Oxydemeton methyl	92.1	NS	ND	ND
Oxyfluorfen	93.6	0.0	ND	ND
Permethrin	89.1	NS	ND	ND
Phosmet	87.0	81.7	ND	ND
Propargite	89.1	70.3	ND	ND
Simazine	86.0	NS	ND	ND
SSS-tributyl… (DEF)	91.1	103.8	ND	ND
Trifluralin	91.6	49.4	ND	ND

†ND = Not detected.
‡NS = Field sample not spiked with the chemical.

Table 40. Results for duplicate sample pairs.

	Number of matches			
Primary/duplicate results	**Multiple chemical samples**	**MITC samples**	**Chloropicrin samples**	**VOC samples**
ND†/ND	445	11	17	18
Trace‡/trace	21	1	0	0
ND/trace	8	0	0	0
ND/>LOQ	4	4	0	3
trace/>LOQ	0	0	0	0
>LOQ/>LOQ	2	3	0	6
Relative Difference[ŧ]	3.1%	11.6%	0%	24.3%

†ND = Not detected.
‡trace = Pesticide detection confirmed, but less than the quantitation limit.
[ŧ]For pairs with both concentrations >LOQ.

Validation and Control Limits

The MITC and the multi-pesticide analysis method in sorption tubes were validated according to the DPR SOP QAQC001.00 (DPR, 1995). The laboratory conducted validations by spiking three to five matrix blanks at three to five different spike levels, and then analyzing them. This procedure was repeated three to five times. From the validation data, DPR created control limits by multiplying the standard deviation of the data by ± 3 times and adding it to the mean.

DISCUSSION

Overall, 92.9 % of the 6,033 analyses (number of samples times the number of chemicals analyzed) resulted in no detectable concentrations. Only 426 (7.1%) of the analyses had detectable (trace or quantifiable) concentrations, and 2.6% of the analyses had quantifiable concentrations. Quantifiable detections refer to concentrations above the LOQ for their respective pesticide. Thirteen of the 32 pesticides and 5 pesticide breakdown products monitored by DPR were not detected.

Of the 33 pesticide and 5 breakdown products included in the AMN, 24 were detected in at least one sample. However, air concentrations were low relative to the screening levels. Of the 32 pesticide and 5 breakdown products included in the AMN, chloropicrin and 1,3-dichloropropene were the only pesticides that exceeded any of its screening levels for any of the exposure periods. The maximum 4-week air concentration for chloropicrin was 3,200 ng/m^3 at the Salinas site, or 140 percent of the 2,300 ng/m^3 subchronic screening level. The maximum annual average air concentration for 1,3-dichloropropene was 2,600 ng/m^3 at the Shafter site, or 347 percent of the 650 ng/m^3 regulatory goal for cancer risk, assuming the 2013 average concentration represents the average concentration for a 70-year lifetime.

Eleven of the fourteen detected at quantifiable concentrations in the AMN were either fumigants (1,3-dichloropropene, carbon disulfide, methyl bromide, chloropicrin, and MITC) or organophosphate insecticides (chlorpyrifos + OA, DDVP, diazinon + OA, and malathion). Oxyfluorfen, chlorothalonil, and EPTC were also detected at quantifiable concentrations.

The primary need for the AMN is to supplement data from the toxic air contaminant program, particularly to estimate subchronic and chronic exposure to individual as well as cumulative exposure to multiple pesticides. Organophosphates were the only pesticides that were detected at quantifiable concentrations and have a common mode of action (cholinesterase inhibition). The hazard index (combined screening level) for organophosphates was less than one for all exposure periods, indicating a low risk from cumulative exposure.

Relative to the screening levels, air concentrations representing chronic exposure were less than the acute or subchronic exposures for most pesticides. While the subchronic exposure was greater than

the acute exposure for several pesticides, the AMN and other community ambient air monitoring usually underestimates acute exposure. Ambient air monitoring in communities is the standard method DPR uses to estimate subchronic and chronic exposures. Application-site monitoring in the immediate vicinity of a treated field is normally used to estimate acute exposure, and these air concentrations are typically several times higher than acute exposures measured from ambient air monitoring since they are collected 100 feet or less from the application, whereas ambient samples may be collected a mile or more away. It's likely that the maximum acute exposure is higher than indicated by these data.

DPR has established regional use limits (township caps) for methyl bromide to control subchronic exposure. Townships are 6 x 6 mile areas designated by the Public Lands Survey System. The township cap for methyl bromide is a monthly cap, with the goal of limiting the subchronic exposure to no more than the screening level of 19,400 ng/m^3 (5 ppb). All measured air concentrations were less than ten percent of DPR's regulatory target, indicating that the methyl bromide township caps are keeping air concentrations below the health protective targets set by DPR.

Higher pesticide air concentrations have been detected in other studies. This is likely due to greater amounts of pesticides applied near the monitoring sites for the other studies, as well as mitigation measures implemented since some of the studies were conducted. Ambient air monitoring for the toxic air contaminant program focuses on the highest use areas and highest use periods for individual pesticides.

Since chloropicrin exceeded its subchronic screening level, DPR is conducting a more detailed evaluation. This evaluation includes analysis of pesticide use data, such as amount, date, and location of applications, as well as analysis of wind speed, wind direction and other weather conditions during the time high concentrations were detected. In 2013, DPR proposed additional restrictions to reduce acute exposure, including larger buffer zones for some applications. Once finalized, the additional restrictions are likely to reduce subchronic as well as acute exposures.

Since 1,3-dichloropropene exceeded the regulatory goal for cancer risk, DPR is also conducting a more detailed evaluation for this pesticide. Similar to chloropicrin, the evaluation includes analysis of pesticide use data, such as amount, date, and location of applications, as well analysis of wind speed, wind direction and other weather conditions during the time high concentrations were detected. DPR is also updating its risk assessment for 1,3-dichloropropene, which should be complete in approximately one year. In the meantime, DPR has taken action to reduce 1,3-dichloropropene exposure. DPR implemented a township cap for 1,3-dichloropropene in 1999 to control cancer risk. However, DPR approved waivers to the cap for several townships each year. The high concentrations detected at the AMN sites, as well as sites from other monitoring, occurred in townships or adjacent to townships where DPR granted waivers to the township cap. Based on the monitoring results, DPR suspended approval of the township cap waivers in February 2014.

DPR plans to continue monitoring at the same AMN sites through at least 2014, in part to determine the effectiveness of the actions to reduce exposure to chloropicrin and 1,3-dichloropropene.

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