California Environmental Protection Agency
Department of Pesticide Regulation

PESTICIDE AIR MONITORING IN PARLIER, CA

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By

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DISCLAIMER

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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.

SJVAPCD: San Joaquin Valley Air Pollution Control District

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

Breakthrough: The desorption and loss of an analyte trapped on sampling media due to too large a volume of air moving over the sampling media.

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

Cholinesterase: Short for acetylcholinesterase (AChE), an enzyme that breaks down the neurotransmitter acetylcholine. It is found in the nervous system and in other tissues. When this enzyme is inhibited, acetylcholine can build up, often leading to overstimulation of nerves and subsequent toxicity. Several of the pesticides monitored inhibit this enzyme.

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.

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/m^3).

Confirmation sample: Same as a duplicate sample, but a confirmation sample is sent to a different lab for confirmation.

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

DQO: Data quality objectives

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

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

Field blank: A sample cartridge that is capped and left beside sampler for a single sampling interval, and then stored on dry ice with the rest of the samples. The purpose is to determine if the procedures used in the field or in transporting samples may have contaminated the sample

FFDCA: Federal Food, Drug, and Cosmetic Act

FIFRA: Federal Insecticide, Fungicide, and Rodenticide Act

Fortified sample: A sample with a known amount of analyte spiked onto the sample media which is placed next to primary sample and treated to same flow and run time. The fortified spike, in comparison with trip spikes and the respective field sample, provides some information about any change in the ability to recover the analyte during air sampling.

FQPA: U.S. Food Quality Protection Act

Hazard index (HI): 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. It 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.

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

LAG: Local advisory group

LOAEL: Lowest observed adverse effect level. In an animal toxicity study, the LOAEL is the lowest dose level used in that study that produces an observable adverse effect.

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.

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*)

Monitored: Pertains to a chemical that was sampled and analyzed for to determine possible air concentrations.

NOAEL: No-observed-adverse-effect-level. In an animal toxicity study, the NOAEL is the highest dose level used in the study that did not produce an observable adverse effect.

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.

OEHHA: Office of Environmental Health Hazard Assessment, part of Cal/EPA.

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

Public land survey system (PLSS): The PLSS is a method used in the United States to survey and identify land parcels, particularly for titles and deeds. Major elements are:

> Section - Basic unit of the system, a square tract of land 1 mile by 1 mile, containing 640 acres.
>
> Township – A parcel of land with 6-mile sides, containing 36 square-mile sections arranged 6 across and 6 down. Numbering begins in the northeast (NE) corner section (1) and ends in the southeast (SE) corner section (36). The numbers run in an s-shape, alternate lines east to west and then west to east.
>
> Range - Assigned to a township by measuring east or west of a meridian. The range number identifies how many cells the property is to the east or west of a starting point.

Range lines - A boundary of a township surveyed in a north-south direction.

Township Lines - East to west lines that mark township boundaries.

Meridian - Reference or beginning point for measuring east or west ranges. All townships in Parlier use the Mount Diablo Meridian.

Baseline - Reference or beginning point for measuring north or south townships. All townships in Parlier use the Mount Diablo Baseline.

A specific township and section are identified as being north or south of a particular baseline and east or west of a particular principal meridian. For example, township 14S22E is the fourteenth township south of the Mount Diablo baseline in the twenty-second range east of the Mount Diablo meridian. This particular 36 square-mile area is located north of Parlier. 14S22E23 is section 23 in this township, a 1-by-1 mile area in the SE corner of the township.

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.

Range: see *Public land survey system.*

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.

RfD: Reference dose. The RfD is an estimate of the daily exposure of the human population to a chemical, usually by the oral route, that is likely to be without adverse effects. Initially the term was used only to address chronic exposures but is now often used for other exposure durations. When it is used for other than chronic exposure, that exposure is specified (e.g., "subchronic RfD").

RfC: Reference concentration. The RfC is an estimate of the daily air concentration of a chemical that is likely to be without adverse effects to the exposed human population. Initially the term was used only to address chronic exposures but is now often used for other exposure durations. When it is used for exposure durations other than chronic, that exposure is specified (e.g., "subchronic RfC").

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.

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.

Section: see *Public land survey system.*

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: Exposure may be through repeated single doses or may be continuous.

TAG: Technical advisory group.

Township: see *Public land survey system.*

Trace: see *Limit of Quantitation* (LOQ)

Trip blank sample: A 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 the field, sample transporting, or storage procedures may have contaminated the sample.

Trip spike sample: A sample with a known amount of the target chemical spiked onto the sample media. It is sent with the field technician but is stored on dry ice for the duration of the monitoring period. The trip spikes provide information about any loss or change in the ability to recover the analyte during sample transport or storage.

UCD: University of California at Davis

Units of measurement:

g: Gram. 1 g = 1,000 mg
Kg: Kilogram. 1 Kg = 1,000 grams
L: Liter
lbs: Pounds
m: Meter
m^3: Cubic meter. 1 m^3 = 1,000 L
mg: Milligram. 1 mg = 1,000 ug
ng: Nanogram. 1 ug = 1000 ng
ppb: Parts per billion
ppm: Parts per million
ug: Microgram. 1 ug = 1,000 ng
%: Percent

Units of measurement of air 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/m^3).

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

INTRODUCTION

Background

In 2004, the California Environmental Protection Agency (Cal/EPA) released its Environmental Justice Action Plan (CalEPA, 2004). Under the plan, Cal/EPA charged its six boards, departments and offices (BDOs) with developing and conducting pilot projects that “focus on environmental risk factors (including emissions/discharge, exposure, and health risk) that impact children’s health.” Because rural, agricultural communities may have higher concentrations of pesticides in ambient air compared with their urban counterparts, Cal/EPA asked DPR to postpone its air monitoring network project and instead conduct focused air monitoring for one year in a single Central Valley farming community.

The Parlier study also met DPR’s mandate for “continuous evaluation.” Under California law, DPR is required to “eliminate from use” any pesticide that “endangers the agricultural or nonagricultural environment….” To perform this function, the law requires DPR to conduct “continuous evaluation” of currently registered pesticides. Several DPR programs evaluate use practices to detect possible problems and to determine if further regulatory measures are necessary. For example, DPR conducts field studies to monitor exposure to workers, and to measure how pesticides move and break down in air, soil and water.

Past air monitoring by the Department of Pesticide Regulation (DPR) provided limited data to estimate human exposure as these earlier studies focused on short-term monitoring for a single chemical in each study. To generate better data on long-term exposures, in the early part of this decade DPR began planning a network to sample ambient air for multiple pesticides in several communities over several years.

Elements common to all of Cal/EPA pilot projects included reducing environmental risk to children, public participation, and addressing, to the degree possible, cumulative impacts and precautionary approaches.

The Department of Pesticide Regulation (DPR) conducted a project to assess human exposure to ambient air sources of pesticides in a rural community in California. In addition, drinking water sources were monitored for known ground-water contaminant pesticides to evaluate other potential routes of exposure for addressing cumulative risk. It is thought that rural communities may have higher concentrations of pesticides in air and water than urban communities because they are close to agricultural activities. In this project, air and water were identified as the major potential sources of pesticides. The department’s yearlong project measured pesticide air concentrations at multiple sites; it also collected data about pesticide concentrations in the water supply.

The project goals were to evaluate multiple pesticides in air and water and identify opportunities to reduce health risk, particularly to children. Initial project objectives were to answer the following questions:

- Are residents of the community exposed to pesticides in the air and in the water supply?
- Which pesticides are people exposed to and in what amounts?
- Do measured pesticide air levels exceed levels of concern to human health, particularly children?

DPR evaluated 83 communities in Fresno, Kern, Kings, Madera, Merced, Stanislaus, and Tulare Counties as candidates for this project. The communities were prioritized based on demographic data, availability of other exposure and health data, and pesticide use (both local and regional). DPR also considered other factors, including air sampling feasibility, weather patterns, and the potential for collaboration with other projects focused on environmental health. The evaluation process included public participation and comment on the selection parameters and final determination of the study site. Based on these factors, DPR selected Parlier in Fresno County (DPR, 2005). (See Appendix A for more information about the evaluation process.)

Once the decision was made to monitor in Parlier, DPR formed a local workgroup to assist in study design. At the suggestion of the city manager, DPR asked members of the Parlier Coordinating Responsibility Authority Committee to serve on a local advisory group (LAG), and sent out requests for participation and applications to other interested local community members. Priority for membership on the committee was given to persons living or working in or near Parlier. The LAG was key to ensuring meaningful public participation in this environmental justice project. The LAG included representatives of the California Rural Legal Assistance Foundation; Californians for Pesticide Reform; Fresno County Agricultural Commissioner’s office; Fresno Metro Ministry; Latino Issues Forum; Parlier City government; Parlier HEAL Asthma Project; and the Parlier Unified School District. The LAG also included the following: a local realtor, businessman, health care provider, vintner, and three farmers, including an organic farmer.

At the recommendation of the LAG, DPR added the following project objectives:
--Inform the community on the project, including public forums.
--Reduce pesticide risk.
--Conduct follow-up actions, such as education or regulatory actions or both.
--Put risk in perspective. To the extent feasible (considering resources and available data), put pesticide risk in perspective compared to other pollutants.

In addition, DPR formed a technical advisory group (TAG) to provide guidance on the scientific elements of the project. The TAG included staff from federal, state, and county agencies, and the University of California, as well as technical specialists from farm organizations.

Site Description

Parlier is a small city (approximately 1.6 square miles in area) in the San Joaquin Valley, about 20 miles southeast of Fresno (Figure 1). Parlier has an elevation of approximately

340 feet, with about 13 inches of average annual precipitation. Summer temperatures typically range from 60 – 96 °F, and 35 – 50 °F in winter. Average prevailing winds are from the northwest at 5 – 8 miles an hour. During winter and spring, predominant winds are from the southeast; in summer and fall, the winds are predominantly from the northwest.

According to the 2000 U.S. Census, Parlier's total population is 11,088. About 38 percent of the population is less than 18 years old, 97 percent are Hispanic, and the median family income is $24,275 per year.

Parlier is a rural community surrounded by agriculture. Major crops in the area are grapes and tree fruit. More than 200 chemicals are used for agricultural production within 5 miles of Parlier, with over 2 million pounds used per year. Insecticides and fungicides are the most heavily used pesticides in the area (DPR, 2007).

PESTICIDES AND AREA MONITORED

Pesticides Monitored

This project monitored ambient air concentrations of 40 pesticides and pesticide breakdown products. Working with the LAG and TAG, DPR selected the pesticides for monitoring based on: (1) toxicity, (2) vapor pressure (volatility), (3) use, (4) availability of sampling and laboratory methods, and ability to include a pesticide in a multiple analysis method. The LAG chose to add MITC to the list as a separate sample. (Details of the pesticide selection process are given in Appendix A.) DPR monitored 31 pesticides and pesticide breakdown products, and the California Air Resources Board (ARB) the remaining 9 pesticides. The ARB monitored air concentrations of 23 volatile organic compounds (VOCs), 6 of which have pesticidal uses; 28 metals, 3 of which have pesticidal uses; hexavalent chromium; and particulate matter (PM2.5). In addition, the San Joaquin Valley Air Pollution Control District (SJVAPCD) monitored ozone and nitrogen oxide.

A method to measure multiple chemicals in a single sample was developed by the University of California Davis (UCD) Trace Analytical Laboratory for a study that DPR conducted in Lompoc in 2000 (DPR, 2003). The method involved analysis for 22 pesticides and 5 breakdown products. The California Department of Food and Agriculture (CDFA), Center for Analytical Chemistry Laboratory, modified the method to analyze for the pesticides selected as chemicals of concern in Parlier.

Table 1 lists the 40 pesticides and pesticide breakdown products monitored in Parlier. Table 2 presents the physical and chemical properties of the pesticides monitored by DPR. Table 3 lists the use and chemical class of each of the pesticides monitored.

Table 1. List of 35 pesticides and 5 breakdown products monitored in Parlier, CA, 2006

Pesticide	Breakdown product	Monitoring agency
1,3-Dichloropropene		ARB
Acrolein		ARB
Arsenic		ARB
Azinphos-methyl		DPR
Carbon disulfide		ARB
Chlorothalonil		DPR
Chlorpyrifos	Chlorpyrifos oxygen analog (OA)	DPR
Copper		ARB
Cypermethrin		DPR
Diazinon	Diazinon OA	DPR
Dicofol		DPR
Dimethoate	Dimethoate OA	DPR
Diuron		DPR
Endosulfan	Endosulfan sulfate	DPR
EPTC		DPR
Formaldehyde		ARB
Malathion	Malathion OA	DPR
Metam sodium/metam potassium/dazomet[a] Monitored as MITC		DPR
Methyl bromide		ARB
Metolachlor		DPR
Molinate		DPR
Naled[a] Monitored as DDVP		DPR
Norflurazon		DPR
Oryzalin		DPR
Oxyfluorfen		DPR
Permethrin		DPR
Phosmet		DPR
Propanil		DPR
Propargite		DPR
Simazine		DPR
SSS-tributylphosphorotrithioate (DEF)		DPR
Sulfur		DPR
Thiobencarb		DPR
Trifluralin		DPR
Xylene		ARB

[a] Parent compound not monitored.

Table 2. Selected physical and chemical properties of the pesticides monitored by DPR and ARB in Parlier, 2006. Source: DPR Pesticide Chemistry Database (DPR, 2008a)

Analyte	Molecular weight (g/mole)	Water solubility[a] (ppm)	Vapor pressure[b] (mmHg)	Hydrolysis half-life[c] (days)	Aerobic soil half-life[d] (days)	Soil photolysis half-life[d] (days)
1,3-Dichloropropene	110.97	2250	26.65	10.4	32.7	NA[e]
Acrolein	56.06	23,200	240	1.40	0.16	NA
Arsenic	74.92	NA	NA	NA	NA	NA
Azinphos-methyl	317.33	28	1.6E-6	10	44	9
Carbon disulfide	76.14	1,185[f]	358 [f]	NA	NA	NA
Chlorothalonil	265.9	1.2	2.0E-06	49	42	>74
Chlorpyrifos	350.6	1.39	1.4E-05	72.1	194	10
Copper	63.55	NA	NA	NA	NA	NA
Cypermethrin	416.30	0.01	1.3E-09	>29	1103	<8-42
Diazinon	304.3	6	9.1E-05	138	49.7	2.55
Dichlorvos	221.0	1570	1.7E-02	5.77	NA	NA
Dicofol	370.5	0.83	3.9E-07	2.75	66.4	200
Dimethoate	229.2	39,800	1.9E-06	68	2	7.33-66.7
Diuron	233.10	36.4	6.9E-08	1285	372	173
Endosulfan	406.96	0.03	1.3E-05	14.8	31.6	238
EPTC	189.3	345	2.6E-02	>30	42	NA
Formaldehyde	30.03 [f]	550000 [f]	5.2E+03 [f]	NA	NA	NA
Malathion	330.3	125	2.3E-05	6	2	174
Methyl bromide	94.94	15,223 [f]	1.62E+03 [f]	20	9.8	NA
MITC	73.12	8420	16	20.4	0.34	NA
Metolachlor	283.8	492	3.1E-05	>200 [g]	26	37
Molinate	187.30	970	5.0E-03	1560	41	2210
Norflurazon	303.67	33.7	1.8E-08	2650	123-240	21.2
Oryzalin	346.36	2.6	1E-08	>28	63.3	3.95
Oxyfluorfen	361.70	0.12	NA	114	435	199
Permethrin	391.3	0.07	2.2E-08	42	10.5	254-324
Phosmet	317.33	20	4.9E-07	<0.38	7.2	1660
Propanil	218.08	152	7.8E-07	5000	2.43	75-84.3
Propargite	350.47	1.93	4.2E-08	63	46.9	272-280
Simazine	201.7	6	2.2E-08	>28	110	107
SSS-tributylphos… (DEF)	314.52	2.3	1.7E-06	>30	745	>30
Sulfur	32.06	NA	NA	NA	NA	NA
Thiobencarb	257.8	27.5	2.2E-05	>160	37	419
Trifluralin	335.3	0.3	1.0E-04	30	169	41
Xylene	106.17	NA	6.8	NA	NA	NA

[a] 9 - 25 °C

[b] 20 - 25 °C

[c] 9 - 25 °C; pH 6 - 7.5

[d] Averaged over different soil types

[e] NA = Not Available

[f] Source: SRC chemical properties database http://www.srcinc.com/what-we-do/databaseforms.aspx?id=381 (accessed 1/1/09)

[g] 30° C

Table 3. The common trade name, use (action), and chemical class for each pesticide monitored.

Pesticide (active ingredient)	Common trade names	Use	Chemical class
1,3-Dichloropropene	Telone, Inline	Fumigant	Halogenated organic
Acrolein	Magnacide	Algaecide	Aldehyde
Arsenic			Elemental metal
Azinphos-methyl	Guthion	Insecticide	Organophosphate
Carbon disulfide	Enzone	Fumigant	
Chlorothalonil	Bravo, Daconil	Fungicide	Chloronitrile
Chlorpyrifos	Dursban, Lorsban	Insecticide	Organophosphate
Copper		Fungicide	Elemental metal
Cypermethrin	Demon	Insecticide	Pyrethroid
Diazinon	Diazinon-various brands	Insecticide	Organophosphate
Dichlorvos	Vapona, DDVP	Insecticide	Organophosphate
Dicofol	Kelthane	Insecticide	Organochlorine
Dimethoate	Cygon	Insecticide	Organophosphate
Diuron	Karmex	Herbicide	Urea
Endosulfan	Thiodan	Insecticide	Organochlorine
EPTC	Eptam	Herbicide	Carbamate
Formaldehyde		Microbiocide	Aldehyde
Malathion	Malathion-various brands	Insecticide	Organophosphate
MITC generating	Vapam, K-pam, Basamid	Fumigant	Dithiocarbamate
Methyl bromide	Brom-O-Gas, Pic-Brom	Fumigant	Halogenated organic
Metolachlor	Dual	Herbicide	Chloracetanilide
Molinate	Ordram	Herbicide	Thiocarbamate
Naled (dichlorvos)	Dibrom	Insecticide	Organophosphate
Norflurazon	Solicam	Herbicide	Pyridazinone
Oryzalin	Surflan	Herbicide	Dinitroaniline
Oxyfluorfen	Goal	Herbicide	Diphenyl ether
Permethrin	Ambush, Pounce	Insecticide	Pyrethroid
Phosmet	Imidan	Insecticide	Organophosphate
Propanil	Duet, Wham	Herbicide	Anilide
Propargite	Omite, Comite	Insecticide	Organosulfite
Simazine	Princep	Herbicide	Triazine
SSS-tributylphosphorotrithioate	DEF, Folex, Tribufos	Defoliant	Organophosphate
Sulfur		Fungicide	Elemental mineral
Thiobencarb	Bolero, Abolish	Herbicide	Thiocarbamate
Trifluralin	Treflan	Herbicide	Dinitroaniline
Xylene		Solvent	Petroleum derivative

Study Area

The study area for the Parlier project encompassed the City of Parlier and the surrounding agricultural areas. For the purposes of this study, the pesticide use report (PUR) data reflects applications made within five miles of the city boundary (Figure 1).

As a result of consultation with the LAG, air-sampling stations were set up at three elementary schools in Parlier (Figure 2): John C. Martinez (northwest part of town), S. Ben Benavidez (central), and Cesar E. Chavez (southeast). The ARB co-located a station at the Benavidez Elementary School to monitor volatile organic compounds (VOCs), criteria pollutants and metals. In addition, the SJVAPCD routinely monitors for other air pollutants at the University of California Kearney Agricultural Center, approximately one mile southeast of town.

MATERIALS AND METHODS

The design for sample collection is a product of the objectives of the project, the input of the community, and technical input from the LAG and TAG. This section describes the types of samples DPR collected, sample measurement, sampling materials used, and methods of sampling and analysis.

Air Sampling Methods

Department of Pesticide Regulation

The method uses sampling and chemical analytical methods that have been established for all pesticides. The most widely used procedure for atmospheric measurement of pesticides is to pass 2 to 100 liters of air per minute (L/min) through a solid sorbent material onto which the pesticide is adsorbed (Keith, 1988). Sorbent media typically used to trap pesticides include XAD resins and carbon sorbents such as charcoal (Majewski and Capel, 1995; Keith, 1988; Baker et al, 1996). For this study, staff collected two types of samples. (See Appendix B for the field sampling protocol.) Sorbent tube samples were collected according to procedures listed in DPR'S SOP EQAI001.00 (Appendix C). The multi-pesticide air monitoring was conducted with air sampling pumps equipped with a sampling tube containing 30 mL of XAD-4 adsorbent set at an air flow rate of 15 L/min. MITC samples were collected using personal sample pumps equipped with coconut charcoal tubes (SKC Inc., #226-16-02) set at an air-flow rate of 1.5 L/min. 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 the sample containers. Before monitoring, sample labels with the study number and sample identification numbers were attached to both types of tubes. Chain of custody forms, log book forms, and sample analysis request forms were supplied to field sampling personnel. The sampling equipment was calibrated to a flow rate of 15 L/min in the laboratory before delivery to the field. The samples were collected with Andersen Series 110 Constant Flow Air Sampler Model 114 pumps. The coconut charcoal tubes were placed on SKC Inc. personal sample pumps (SKC Inc., #224-PCRX).

The use, operation, calibration and maintenance of air sampling pumps are described in DPR's SOP EQAI001.00 and SOP EQAI002.00 (Appendix C).

The flow rate for each sampler was measured and recorded before and after each sampling period. Flows were measured with a DryCal® primary flowmeter, which had been calibrated by SKC West, Inc. on February 27, 2006. All sample pumps were checked and initially calibrated in the laboratory.

The sampling equipment was located in plastic storage boxes that were altered to allow protection of the equipment and electrical supply and proper siting of the sample tubes (Figure 3). The boxes were set on the roofs of the three elementary schools (Figure 2). Sorbent tubes were set at a height of 1 m above the equipment box and protected from sunlight and rain with PVC covers.

Samples were collected and immediately placed on dry ice. Samples were kept on dry ice until they were delivered to the CDFA laboratory in Sacramento at the end of the week. A temperature data-logger was placed in the dry ice container from sample collection to sample delivery. A chain of custody record, signed by field and laboratory personnel handling the sample, accompanied each sample. All samples followed sample receipt log-in and verification procedures described in DPR's SOP QAQC003.02 and QAQC004.01 (Appendix C).

Air Resource Board

The ARB set up a meteorological station and monitoring trailer at the Benavidez Elementary School in central Parlier for measuring ambient concentrations of VOCs, including the fumigants 1,3-dichloropropene and methyl bromide, and particle-bound metals and elements, including hexavalent chromium. Continuous monitoring for particulate matter less than 2.5 microns in aerodynamic diameter (PM2.5) and meteorological parameters were also conducted. The methods used to perform the monitoring can be found in ARB's Air Monitoring Plan for Benavidez Elementary School and Quality Assurance Report on the Parlier Community Air Monitoring Project (Appendix D).

San Joaquin Valley Air Pollution Control District.

The SJVAPCD routinely monitors for hydrocarbons and aldehydes at the Kearney Agricultural Center as part of the Photochemical Assessment Monitoring System (PAMS). The station is part of a network of air monitoring sites operated by the ARB and local air districts. The station continuously monitors for nitrogen dioxide and ozone.

Figure 1. Township, range and sections that define the agricultural boundary for the Parlier air monitoring study.

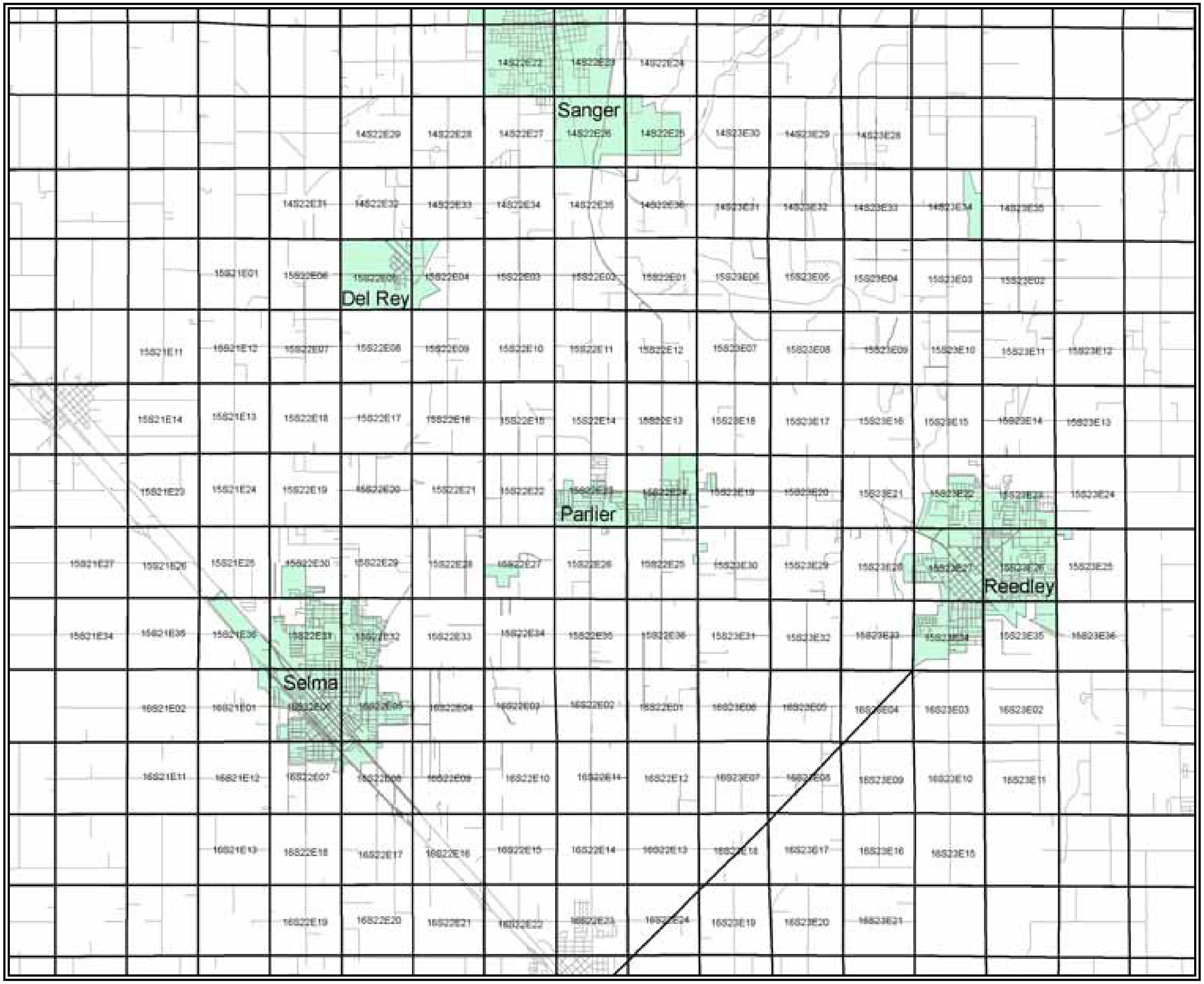


Figure 2. Sampling locations at three Parlier elementary schools and the San Joaquin Valley Air Pollution Control District (SJVAPCD) monitoring site.

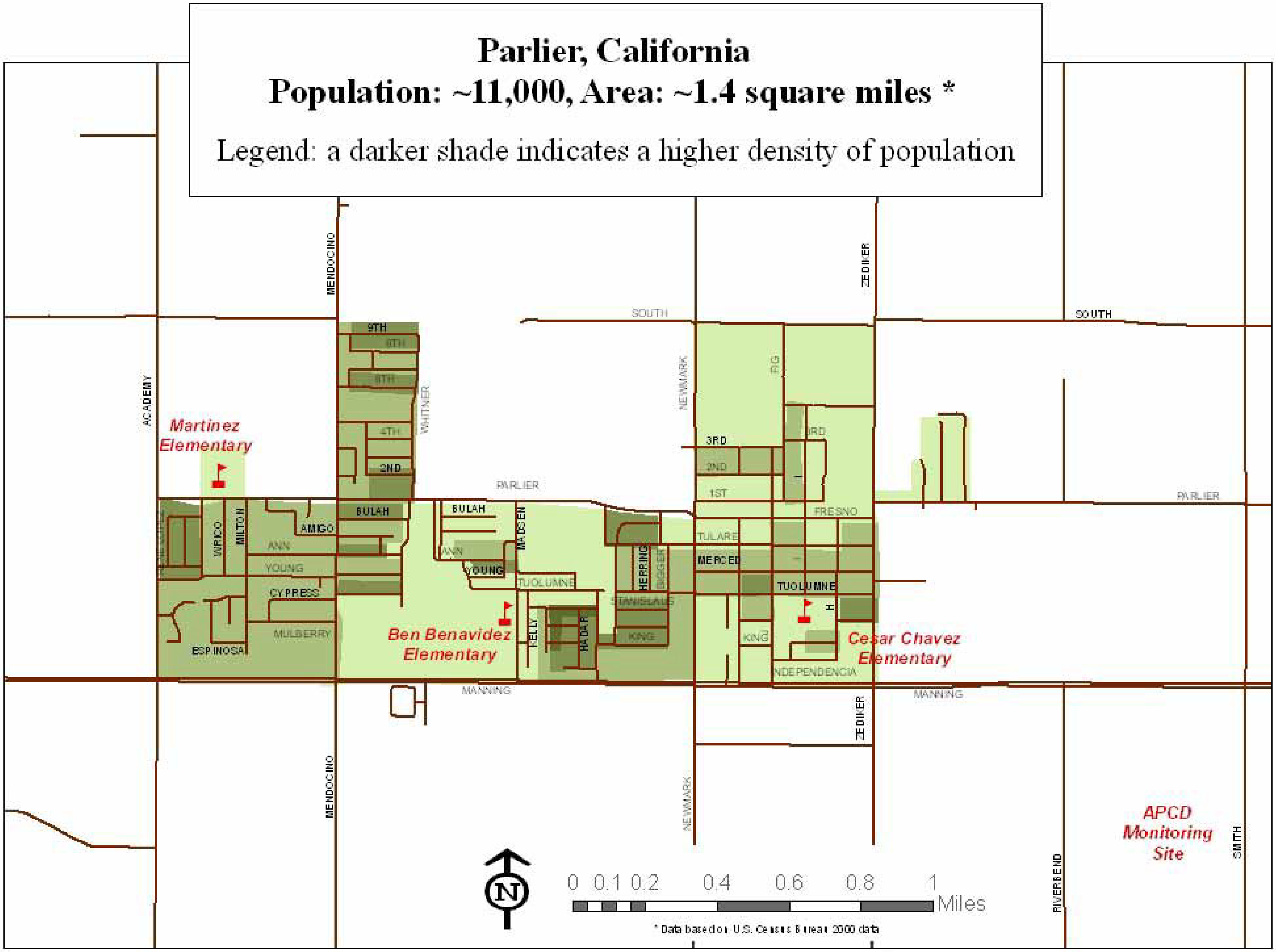


Figure 3. Air sampling equipment on a Chavez Elementary School rooftop.

Methods for Collecting Weather Data

The ARB meteorological station at Benavidez Elementary School measured wind speed and direction, and temperature. The SJVAPCD station at the Kearney Agricultural Center measures wind speed and direction, air temperature, barometric pressure, relative humidity, and solar radiation.

Methods for Collecting Pesticide Use Data

Under California law, all agricultural pesticide use must be reported. DPR maintains a database of all reported agricultural pesticide applications in California. The pesticide use report (PUR) database contains information on all production agricultural pesticide use and some nonagricultural use in California. The database includes information on the pesticide product used, the application date, the application amount, and application location to a square-mile section. During the study, data were collected to specifically locate the fields where each application occurred. A DPR report (DPR, 1995) gives a complete description of the PUR database.

Additional Sampling by DPR

In addition to collecting air samples, DPR collected ground water samples from municipal wells that supply drinking water to Parlier for additional data for cumulative exposure risk assessment. Samples were collected from all wells in use in 2006. The well-water samples were analyzed for currently registered, known ground water contaminants: atrazine, bromacil, diuron, hexazinone, metribuzin, norflurazon, prometon, simazine, and the breakdown products desmethyl norflurazon, deethyl atrazine (DEA), deisopropyl atrazine (ACET), and diamino chlorotriazine (DACT). The CDFA Center for Analytical Chemistry analyzed the samples. Well monitoring followed the procedure described in DPR's SOP FSWA001.00 (Appendix C).

Sampling Procedure

DPR's sampling began January 3, 2006, and ended December 28, 2006. Samples were collected for 24 hours 3 consecutive days a week at each of the 3 schools. The starting day varied each week, with the criterion that 1 of DPR's sample days each week would correspond with ARB's scheduled 24-hour air toxics samples. Sampling usually started around 8:00 a.m.

The ARB sample collection and monitoring began in mid-January for PM2.5, VOCs, elements and metals. The ARB monitored PM2.5 and weather data on a continuous basis. The ARB's air monitoring network for VOCs and metals throughout California usually collects one 24-hour sample every 12 days. For this study, however, the ARB collected 24-hour VOC samples every 6 days at Benavidez School from January 17, 2006, through January 6, 2007. The sampling frequency increased to every three days during peak high-use periods for sulfur and 1,3-dichloropropene.

The SJVAPCD monitors ozone and nitrogen dioxide on a continuous hourly basis, and hydrocarbons seasonally at the Kearney Agricultural Center. The SJVAPCD collects 4 sequential 3-hour samples (12 consecutive hours during the day), every 3 days between July and September for hydrocarbons.

Quality Control Methods

In addition to collecting field samples during monitoring, DPR collected trip blank samples, fortified field spikes and co-located duplicate samples.

A trip blank sample provides information on possible contamination of samples. For the charcoal sample tubes, the ends were broken open, capped and placed on dry ice with the field samples. The multi-pesticide XAD tubes were left capped and also placed on dry ice to be stored and shipped with the field samples. A trip blank was collected for each sample type during one of every three weeks of sampling. Blank samples containing detectable amounts of any of the pesticides would mean a problem with contamination during field and laboratory procedures.

A fortified 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 fortified 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 fortified field spike for both the multi-pesticide XAD and charcoal sample tubes during one of every three weeks of sampling. The multi-pesticide XAD tube was spiked with three to four analytes that use reports for previous years indicated would be in use at the time. 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 during one of every three weeks of sampling. Duplicate samples that are greater than 50 percent different would trigger a reassessment of the field and laboratory procedures.

A quality assurance team conducted a system audit of the CDFA and ARB laboratories in conjunction with the analysis of the samples in March. The team returned in September to conduct a follow-up audit of the laboratories. An equipment quality assurance team conducted a field audit of the sampler air-flow rates in January and a follow-up audit in September. (For audit results see Appendix D.)

Laboratory Methods

The CDFA's Center for Analytical Chemistry analyzed all samples that DPR collected. The ARB's Monitoring and Laboratory Division analyzed ARB's samples.

Method calibration

Each laboratory used certified analytical standards. 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.

Holding times

See Table 4 (and Appendix E) for storage stability data for the chemicals monitored.

Method detection limits and limits of quantitation

Each laboratory determined the method detection limit (MDL) 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. This procedure is described in detail in U.S. EPA (1990). The MDL for each analyte and method is given in the SOPs (Appendix E).

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. See Table 5 for the LOQ for each analyte along with a summary of chemical analytical and air sampling methods.

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:

$$\frac{sample\ results\,(ug) \times 1000\,L/m^3}{flowrate of\ \ sampler\,(L/\min) \times runtime\,(\min)} \text{ x 1000 ng/ug = ng/m}^3$$

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

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

Assuming 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.

Multiple Pesticide Samples

Table 4 references chemical extraction methods for multiple pesticides from sorbent tubes. Extraction of the multiple pesticides from sorbent tubes was performed in accordance with DPR's SOP (see Appendix E).

MITC Samples

Table 4 references chemical extraction methods for MITC from sorbent tubes. Extraction of MITC from sorbent tubes was performed in accordance with DPR's SOP (see Appendix E).

Table 4. Summary of laboratory analytical parameters for pesticides monitored in Parlier, 2006.

	Air samples		Water samples
	Multiple Pesticide	**MITC**	**Ground Water**
Sorbent Tube Adsorbent	XAD-4	Coconut charcoal	NA[a]
Analytical Method	Liquid chromatography (LC) (19 analytes) gas chromatography (GC) (11 analytes)	Gas chromatography	Liquid chromatography (LC)
Extraction Solvent	Ethyl acetate	0.1% CS2 in Ethyl acetate	2 solid-phase extraction cartridges, eluted with 5% ammonium hydroxide in methanol
Detector	Tandem Mass spectrometer (LC/MS/MS) Mass selective detector (GC/MSD)	Thermospray detector (GC/TSD)	Tandem Mass spectrometer (LC/MS/MS)
Trapping Efficiency	Appendix E	Appendix E	NA
Desorption Efficiency	Appendix E	Appendix E	Validation in analytical method (Appendix E)
Storage Stability	28 days	14 days	50 days
Flow Rate (L/min)	15	1.5	NA

[a] NA = Not applicable to this analysis type.

Table 5. Quantitation limits for CDFA and ARB analytical laboratories for 24-hour samples.

Pesticide	Detection limit (ng/m^3)	Quantitation limit (ng/m^3)
CDFA		
Azinphos-methyl	7.59	23.2
Chlorothalonil	13.7	46.3[a]
Chlorpyrifos	5.05	46.3
Chlorpyrifos oxygen analog	2.92	11.6
Cypermethrin	4.68	46.3
Diazinon	1.16	4.63[b]
Diazinon oxygen analog	2.08	4.63 [b]
Dichlorvos (Naled)	3.24	46.3
Dicofol	2.13	46.3
Dimethoate	2.31	4.63[b]
Dimethoate oxygen analog	1.94	4.63[b]
Diuron	5.14	23.2
Endosulfan	3.24	46.3
Endosulfan sulfate	4.63	46.3
EPTC	1.67	4.63[b]
Malathion	2.18	11.6
Malathion oxygen analog	1.30	4.63[b]
Metolachlor	2.73	11.6
MITC	5.56	23.2
Molinate	1.81	4.63[b]
Norflurazon	3.75	11.6
Oryzalin	1.39	4.63[b]
Oxyfluorfen	6.39	46.3
Permethrin	7.22	46.3
Phosmet	7.96	23.2
Propanil	2.31	11.6
Propargite	3.8	46.3
Simazine	1.20	4.63[b]
SSS-tributylphos… (DEF)	1.76	4.63[b]
Thiobencarb	5.60	11.6
Trifluralin	1.67	23.2
ARB[c]		
1,3-dichloropropene		454
Acrolein		688
Arsenic		1
Carbon disulfide		311
Copper		1
Formaldehyde		123
Methyl bromide		116
Sulfur		2
Xylene		868

[a] Quantitation limit higher during July – mid September.

[b] Had slightly higher quantitation limit January – February.

[c] For ARB samples, the detection limit is the LOQ, the level that can be reliably quantified.

DATA ANALYSIS METHODS

Health Evaluation Methods

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 (Table 6, Appendix F). Although they are not regulatory standards, these screening levels 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, but also 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 significant health concern, but would indicate the need for a further, more refined evaluation. Significant exceedances of the screening levels could be of health concern and would indicate the need to explore the imposition of mitigation measures.

To the extent possible, health screening levels are based on identified critical toxicology values or exposure levels taken from existing documents that have already been subject to peer review and, in some cases, public comment. The three primary sources are: risk assessments in the form of risk characterization documents (RCDs) conducted by DPR; re-registration eligibility documents (REDs) completed by U.S. EPA; and reference exposure levels (RELs) established by California's Office of Environmental Health Hazards Assessment (OEHHA) and peer-reviewed by the California's Toxic Air Contaminant (TAC) Scientific Review Panel. In some cases, information from the U.S. EPA Integrated Risk Information System (IRIS) is used for cancer potency values. (See Appendix F for the basis of deriving screening levels for each individual pesticide.)

In 1996, Congress passed major food safety legislation, the Food Quality Protection Act of 1996 (FQPA). It made significant changes to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA). Among other provisions, the FQPA requires U.S. EPA to review existing pesticide food tolerances (legal limits for pesticide residues in food) and to include an additional "safety factor" of up to 10-fold to account for uncertainty in data relative to children and/or for increased sensitivity of children. U.S. EPA generally sets the factor at 1-fold, 3-fold, or 10-fold, depending on the completeness and reliability of the data available to assess pre- or post-natal toxicity and depending on the potential for pre- or post-natal effects of concern. This additional factor has become known as the "FQPA factor" or "FQPA safety factor." In some cases, additional data may lead to a decrease in uncertainty and a concomitant decrease in the FQPA factor. On the other hand, if the FQPA factor is based on evidence of increased sensitivity of children, the safety factor may remain unchanged. Although U.S. EPA initially used this factor for evaluating pesticide food tolerances and dietary risk, the factor was applied to the aggregate exposure (all potential sources and routes of exposure) of children (food, skin contact, inhalation of ambient air, etc.). DPR evaluated the results of this project by considering the "FQPA factor" in addition to the screening levels following discussions with the LAG and TAG. The original charge to DPR (from Cal/EPA under the Environmental Justice Action Plan), to focus on environmental risk to children, supports consideration of the

FQPA factor. This consideration is further supported by the December 9, 2009, U.S. EPA announcement of a draft policy: “To provide comprehensive and consistent evaluation of potential risks of food use pesticides, non-food use pesticides, and related occupational exposures, EPA intends to apply risk assessment techniques developed in implementing the Food Quality Protection Act of 1996 to any pesticide risk assessment, whether it falls under FQPA or not, as long as applying the risk assessment technique is consistent with good scientific practice and is not otherwise prohibited by law. Specifically, this will include using an additional safety/uncertainty factor to protect children, considering aggregate exposure to pesticides from multiple sources. . .”

To avoid confusion in evaluating multiple pesticide/chemical exposure, the screening levels derived for this project (Table 6) did not incorporate the FQPA safety factor initially; however, the factors are presented and were considered when DPR later evaluated the measured air concentrations of the individual pesticides from the Parlier project. The measured air levels were compared to the screening levels with and without the FQPA factors and all values are clearly identified.

Acute toxicity can be defined as the toxicity manifested within a relatively short time interval, generally not longer than one day. In this document, unless specifically noted, acute screening levels are for 24 hours. Subchronic toxicity can be defined as the toxicity manifested within a more extended interval, but not one that constitutes a significant portion of the lifespan of the species in question. In subchronic toxicity testing using mammalian test species, the period of exposure is generally 30 to 90 days. Chronic toxicity is manifested over a long-term period, generally for a significant portion of a lifetime.

One quantitative descriptor of the results of a toxicity study is the no-observed-adverse-effect level (NOAEL). The NOAEL can be defined as the highest level of a chemical (in this case, a pesticide) that causes no observable adverse or toxic effect in the animal test species in the study. A related term, the lowest-observed-adverse-effect level (LOAEL), can be defined as the lowest dose of a chemical that still causes an observable adverse or toxic effect. In some cases, a study will demonstrate adverse effects at all dose levels and a NOAEL will not be readily apparent. In these situations, applying an uncertainty factor (generally 10-fold or less) to the LOAEL can generate an estimated no-adverse-effect level.

Two other terms that need to be defined are reference dose (RfD) and reference concentration (RfC). The RfD is an estimate of the daily exposure of the human population to a chemical, usually by the oral route, that is likely to be without adverse effects. The RfC is an estimate of the daily air concentration of a chemical that is likely to be without adverse effects to the exposed human population. The RfCs and RfDs are derived by applying the appropriate uncertainty factors to the appropriate NOAEL. In deriving an RfD or RfC from a NOAEL from an animal study, the standard practice is to apply a default uncertainty factor of 100 (to extrapolate from the results of an animal study to an estimated safe level for humans). This factor of 100 is derived from a factor of 10 to account for the uncertainty in extrapolating from animals to humans and an uncertainty factor of 10 to account for variability in the human population. The presence of additional data or information may support the use of alternate factors.

Children have the highest inhalation rate relative to body weight; therefore, they would inhale the highest amount of airborne material relative to their body weight. Since the screening levels are being used to evaluate ambient air concentrations, it is appropriate that health-protective values are used, and the screening levels were based on children less than one year of age. Unless otherwise stated, this document uses a default inhalation rate for a child less than 1 year of age of 4.5 m^3/day and a default body weight of 7.6 kg.

The respiratory rate is then calculated as:

$(4.5\ m^3/day)/(7.6kg) = 0.59\ m^3/kg/day$

DPR's toxicology database for a pesticide contains a series of toxicity studies. The particular study and corresponding NOAEL that are selected as the basis for the risk calculations or screening level derivations can be described as the "critical" study or NOAEL. Inhalation NOAELs are generally derived from studies using laboratory animals, frequently the rat, and are usually expressed in terms of an air concentration. Since the experimental animals have different respiratory rates than humans, it is DPR's practice to convert an inhalation NOAEL from an animal study to a human equivalent level to account for the differences in respiratory rates. It should be noted that this adjustment does not factor in differences in toxicological sensitivity. This potential differential sensitivity is taken into account in the application of uncertainty factors.

To convert an inhalation NOAEL to the human equivalent NOAEL, DPR uses the equation:

Animal NOAEL x (animal resp. rate/human resp. rate) = human equivalent NOAEL

For the rat, DPR's default respiratory rate is 0.96 m^3/kg/day, and the above equation becomes:

$Rat\ NOAEL \times (0.96\ m^3/kg/day)/(0.59\ m^3/kg/day) = human\ equivalent\ NOAEL$

Rat NOAEL x 1.6 = human equivalent NOAEL

For logistical reasons, if the period of exposure in the animal study is less than a full 24 hours, the resulting NOAEL is usually normalized to a 24-hour period. In general, rat inhalation NOAELs are derived from studies of either 4 or 6 hours out of 24 hours. In cases where an inhalation NOAEL is derived from such a study, it is the accepted practice to normalize the NOAEL to 24 hours by multiplying the experimental NOAEL by either (4/24) or (6/24) to calculate an equivalent 24-hour NOAEL. Subchronic or chronic inhalation studies are often conducted for five days per week, and the results are normalized to a seven-day week by multiplying the NOAEL by (5/7) to calculate an equivalent NOAEL for exposure throughout the seven-day week.

Often, inhalation studies are not available for a particular chemical. In these cases, the results from oral studies are used. However, the oral NOAEL (or the RfD) must be converted to an inhalation NOAEL (or RfC). This conversion calculates the air concentration that would result in the subject taking in the same amount of chemical as would be taken in orally. To convert an oral NOAEL or RfD to an inhalation NOAEL or RfC, DPR uses the equation:

RfC (or screening level) = RfD x body weight of subject/ inhalation rate

For the child less than one year of age, the RfC is calculated as:

$RfC \text{ or screening level } (mg/m^3) = RfD\ (mg/kg/day) \times (7.6kg)/(4.5\ m^3/day) = 1.7\ RfD$

Carcinogenic effects

The uncertainty factor approach used in generating the screening levels implicitly assumes that there is a threshold below which the toxic effect will not occur. This approach is not appropriate for carcinogenic chemicals that have a non-threshold mechanism of action. For these chemicals, the chronic screening level does not include carcinogenic effects, and a cancer potency value is derived for that chemical (see Appendix F).

Table 6. Screening levels for the pesticides monitored.

Chemical	Acute[a]			Subchronic			Chronic			FQPA safety factor	Cancer potency (Q_1^*) (mg/kg-day)$^{-1}$
	NOAEL (ug/m^3)[b,c]	Uncertainty Factor (UF)	Screening level (ug/m^3)	NOAEL (ug/m^3)[b,c]	UF	Screening level (ug/m^3)	NOAEL (ug/m^3)[b,c]	UF	Screening level (ug/m^3)		
1,3-Dichloropropene	11000 (rat)	100	160	7400(rat)	100	120	3700(mouse)	100	120		0.055
Acrolein	10(man,1 hr)[d]	60	0.19	160 (rat)	9	0.18	160(rat)	27	0.06		
Arsenic	190(rat,4hr) [d]	1000	0.03	190(rat,4hr) [d]	1000	0.03	190(rat,4 hr) [d]	1000	0.03		12
Azinphos-methyl	0.75mg/kg(man)	10	101	0.25mg/kg(man)	30	11	0.15 mg/kg (dog)	30	6.8	1	
Carbon disulfide	6.2x10^5(rat,6hr)	100	1,550	2.4x10^4(man)	10	800	2.4x10^4(man)	10	800		
Chlorothalonil	2.0mg/kg(rat)	100	34	2.0mg/kg(rat)	100	34	2.0mg/kg(rat)	100	34	1	0.011
Chlorpyrifos	74 (rat)	100	1.2	53 (rat)	100	0.85	0.03mg/kg(dog)	100	0.51	10	
Copper	1000 (man)	10	100	1000(man)	100	10	1000(man)	100	10		
Cypermethrin	2500(rat)	100	40	1800(rat)	100	29	600(rat)	100	9.6	1	
Diazinon	8.33(rat)	100	0.13	8.33(rat)	100	0.13	8.33(rat)	100	0.13	1	
Dicofol	4mg/kg(rabbit)	100	68	0.29mg/kg(dog)	100	49	0.12mg/kg(dog)	100	20	3	
Dichlorvos	1200(rabbit)	100	11	240(rabbit)	100	2.2	48(rat)	100	0.77	3	0.35
Dimethoate	2.0 mg/kg (rat)	100	34	1.07mg/kg(rat)	100	17	0.05mg/kg(rat)	100	0.85	1	
Diuron	10mg/kg(rat)	100	170	1.0mg/kg(rat)	100	17	0.33mg/kg(rat)	100	5.7	1	0.0191
Endosulfan	400(rat)	100	4	290(rat)	100	2.9	290(rat)	100	2.9	10	
EPTC	14500(rat)	100	230	1500(rat)	100	24	0.5mg/kg(rat)	100	8.5	10	
Formaldehyde	190(man)	10	19	32(man)	10	3	32(man)	10	3		0.021
Malathion	2500(rat)	100	40	1800(rat)	100	29	1800(rat)	100	29	10	
MITC	660(man)	10	66	300(rat)	100	3	300(rat)	1000	0.3		
Methyl bromide	40ppm(rabbit)	100	820	5 ppm (dog)	100	35	1 ppm (rat)	100	3.9	1	
Metolachlor	50mg/kg(rat)	100	85	8.8mg/kg(rat)	100	15	9.7mg/kg(rat)	100	16	1	
Molinate	11.5mg/kg(rat)	100	200	0.48mg/kg(rat)	100	8.2				10	
Naled (Dichlorvos)	58 (rat)	100	0.92	41(rat)	100	0.65	41(rat)	100	0.65	1	
Norflurazon	10mg/kg(rabbit)	100	170	1.5mg/kg(dog)	100	26	1.5mg/kg(dog)	100	26	3[e]	
Oryzalin	25mg/kg(rabbit)	100	420	14mg/kg(rat)	100	230	14mg/kg(rat)	100	232	1	0.00779
Oxyfluorfen	30mg/kg(rabbit)	100	510	11mg/kg	100	180	3.0mg/kg(dog)	100	51	1	0.0732
Permethrin	10500(rat)	100	168	5600(rat)	100	90	5600(rat)	100	90	1	0.00957
Phosmet	4.5mg/kg(rat)	100	77	1.5mg/kg(rat)	100	26	1.1mg/kg(rat)	100	18	1	
Propanil	3mg/kg(rat)	100	51	3mg/kg(rat)	100	51	3mg/kg(rat)	100	51	1	
Propargite	2mg/kg(rat)	100	14	2mg/kg(rat)	100	14	2mg/kg(rat)	100	14	1	0.0059-0.026
SSS-tributylphos.. (DEF)	600(rat)	100	8.8	600(rat)	100	8.8				10	0.084
Simazine	6.25mg/kg(rat)	100	110	1.8mg/kg(rat)	100	31	1.8mg/kg(rat)	3		3	
Sulfur	Insufficient data to drive screening levels										
Thiobencarb	25mg/kg(rat)	100	425	2mg/kg(rat)	100	34	1mg/kg(rat)	100	17	1	
Trifluralin	75000(rat)	100	1200	10mg/kg(rat)	100	170	2.4mg/kg(dog)	100	41	1	0.0058
Xylene	9000(man)	10	900	22000(man)[d]	30	700	22000(man)[d]	30	700		

[a] Normalized to 24 hours unless otherwise noted; subchronic and chronic also normalized to 7 days a week.

[b] ug/m^3 unless otherwise noted.

[c] NOAEL unless otherwise noted; NOAEL may have been derived from a LOAEL.

[d] LOAEL.

[e] 3X only for acute exposure of females 13-50, 1X for all other exposures.

RESULTS

Air Monitoring Results

Monitoring Results from DPR and ARB for Pesticides

DPR collected 468 samples that were analyzed for 30 pesticides and another 468 that were analyzed for the fumigant pesticide MITC. The ARB analyzed 71 samples for VOCs and 64 samples for metals and elements. The SJVAPCD collected continuous samples for the criteria pollutants, nitrogen dioxide and ozone. Appendix G shows all sample raw data; none have been adjusted for quality control sample recovery results.

Seventeen of the 31 pesticides and pesticide breakdown products monitored by DPR were not detected at concentrations above the detection limit, 6 were detected but at a concentration between the detection limit and the quantitation limit, and 8 were detected at quantifiable concentrations. The ARB detected nine pesticides at quantifiable concentrations. Table 7 lists the detection status for each of the pesticides monitored.

Table 7. Detection status of each of the pesticides monitored. Pesticides shown in **bold** were monitored by DPR. Pesticides shown in *italics* were monitored by ARB.

Not detected	Trace detection only	Quantifiable detection
Azinphos-methyl	**Chlorothalonil**	**Chlorpyrifos**
Cypermethrin	**Dichlorvos**	**Chlorpyrifos OA**
Dicofol	**Permethrin**	**Diazinon**
Dimethoate	**Propargite**	**Diazinon OA**
Dimethoate oxygen analog	**Simazine**	**Malathion**
Diuron	**Trifluralin**	**Malathion OA**
Endosulfan		**MITC**
Endosulfan sulfate		**Phosmet**
EPTC		*1,3-Dichloropropene*
Metolachlor		*Acrolein*[a]
Molinate		*Arsenic*[a]
Norflurazon		*Carbon disulfide*[a]
Oryzalin		*Copper*
Oxyfluorfen		*Formaldehyde*[a]
Propanil		*Methyl bromide*
SSS-tributylphos… (DEF)		*Sulfur*
Thiobencarb		*Xylene*

[a] Detections of these compounds are likely due to non-pesticidal sources only.

Acute exposure: Table 8 presents the highest one-day concentration at any site for each pesticide monitored. The highest 1-day concentration detected for any pesticide monitored was 23,601 ng/m^3 for 1,3-dichloropropene. The second highest concentration that was most likely due to pesticidal use was 5,010 ng MITC/m^3. Diazinon was the only pesticide monitored whose concentration exceeded the screening level for the acute period. The highest concentration measured for diazinon was 170 ng/m^3, which is above the screening level of 130 ng/m^3. Acrolein concentrations exceeded the screening level because of non-pesticidal use. Figures 4a-d present the highest one-day concentrations measured in any sample for each of the pesticides monitored with a quantifiable detection that was because of pesticidal use. The acute screening level for each of the pesticides is included.

Table 8. Highest one-day concentration for chemicals with detectable concentrations. Pesticides shown in **bold** were monitored by DPR. Pesticides shown in *italics* were monitored by ARB.

Pesticide	**Highest 1-day concentration (ng/m^3)**	**Acute screening level (ng/m^3)**
1,3-dichloropropene	23,601	160,000
Acrolein[a]	4,586	190
Arsenic[a]	5	30
Carbon disulfide[a]	3,114	1,550,000
Chlorothalonil	Trace (30-238)[b]	34,000
Chlorpyrifos	150	1,200
Chlorpyrifos OA	28	1,200
Copper[b]	550	100,000
Diazinon	172	130
Diazinon OA	71	130
Dichlorvos	Trace (24.8)	11,000
Formaldehyde[a]	9,457	19,000
Malathion	21	40,000
Malathion OA	16	40,000
Methyl bromide	2,524	820,000
MITC	5,010	66,000
Permethrin	Trace (26.8)	168,000
Phosmet	42	77,000
Propargite	Trace (25.1)	14,000
Simazine	Trace (2.9-6.4)[b]	110,000
Sulfur[c]	1,800	NA[d]
Trifluralin	Trace (23.2)	1,200,000
Xylene[c]	5,905	900,000

[a] Detections of these compounds are likely due to non-pesticidal sources only.
[b] The LOQ varied during the study.
[c] Detections of these compounds are likely due to pesticidal and non-pesticidal sources.
[d] NA = Not available.

Figure 4a. Highest one-day (acute) concentrations detected among the three monitoring locations of pesticides with quantifiable concentrations.

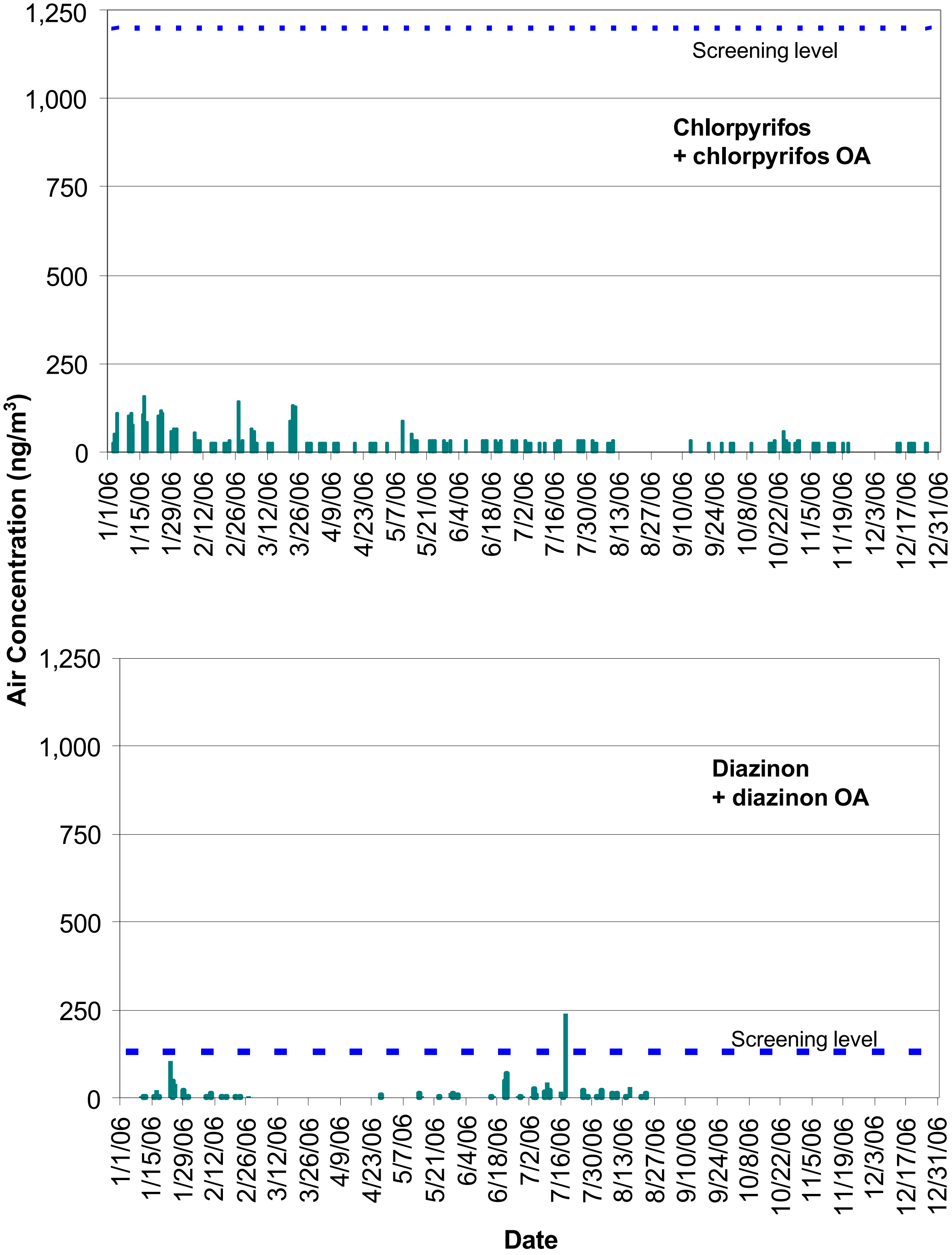


Figure 4b. Highest one-day (acute) concentrations detected among the three monitoring locations of pesticides with quantifiable concentrations (continued).

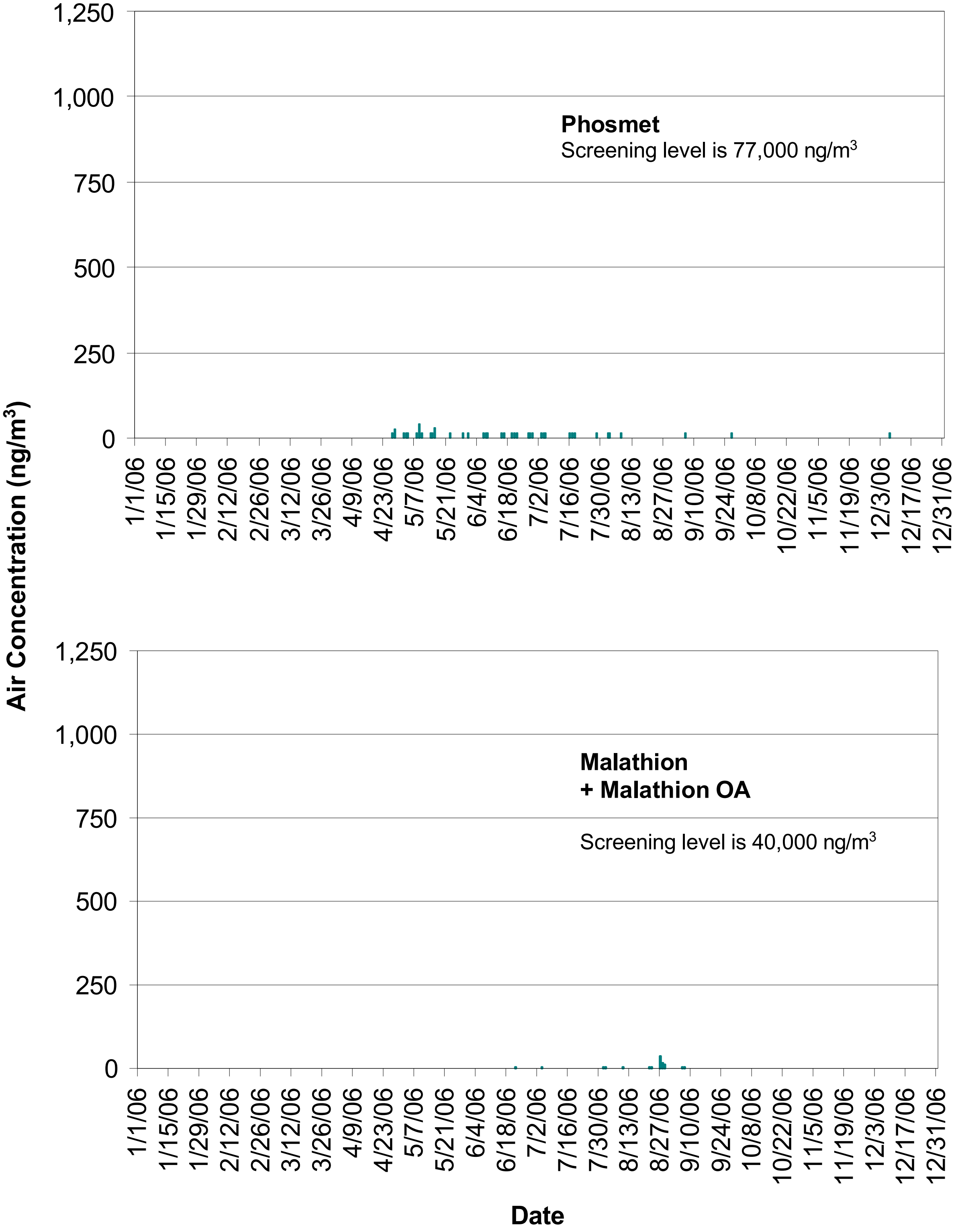


Figure 4c. Highest one-day (acute) concentrations detected among the three monitoring locations of pesticides with quantifiable concentrations (continued). Note: Concentration scale for MITC and methyl bromide is higher than in the previous graphs.

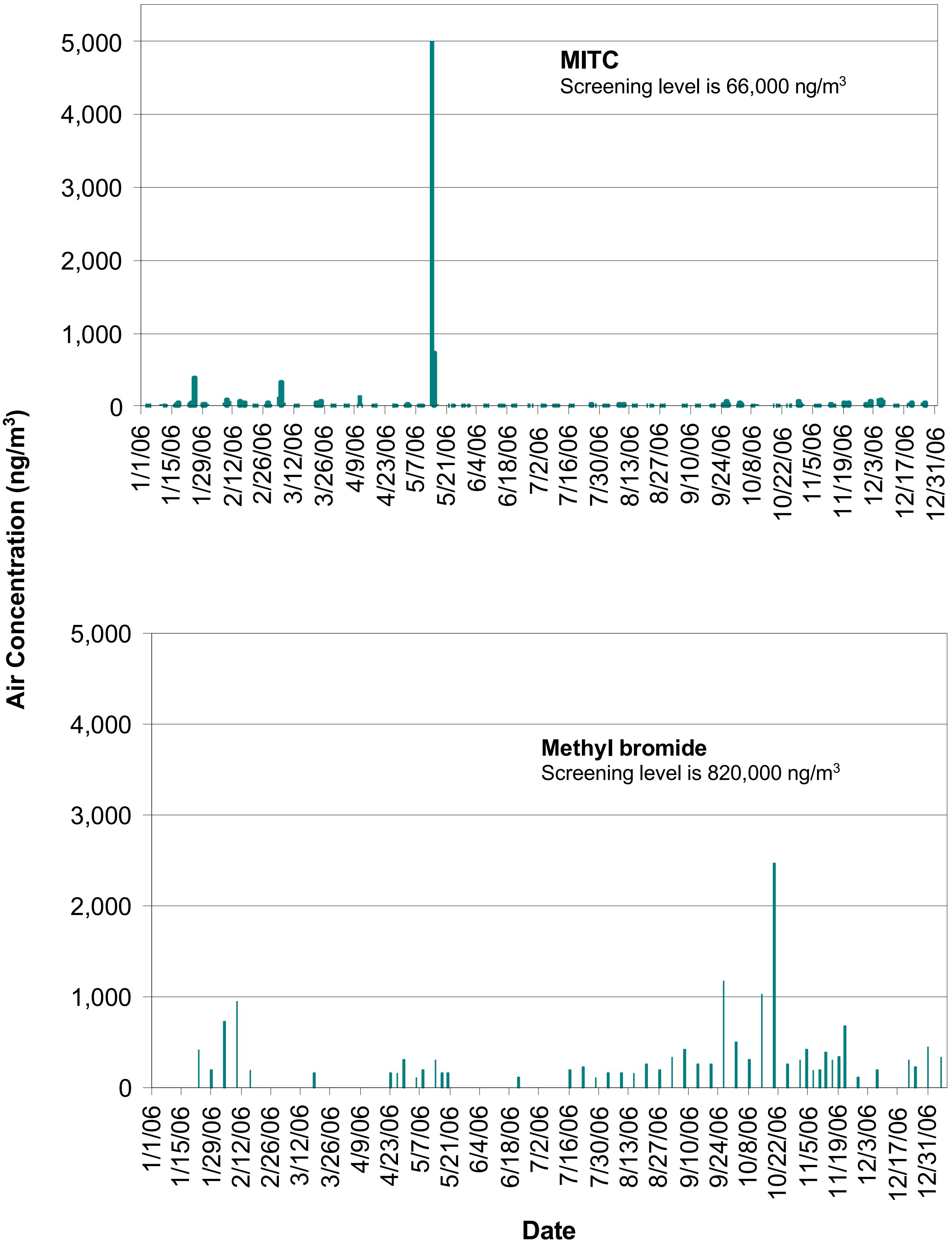
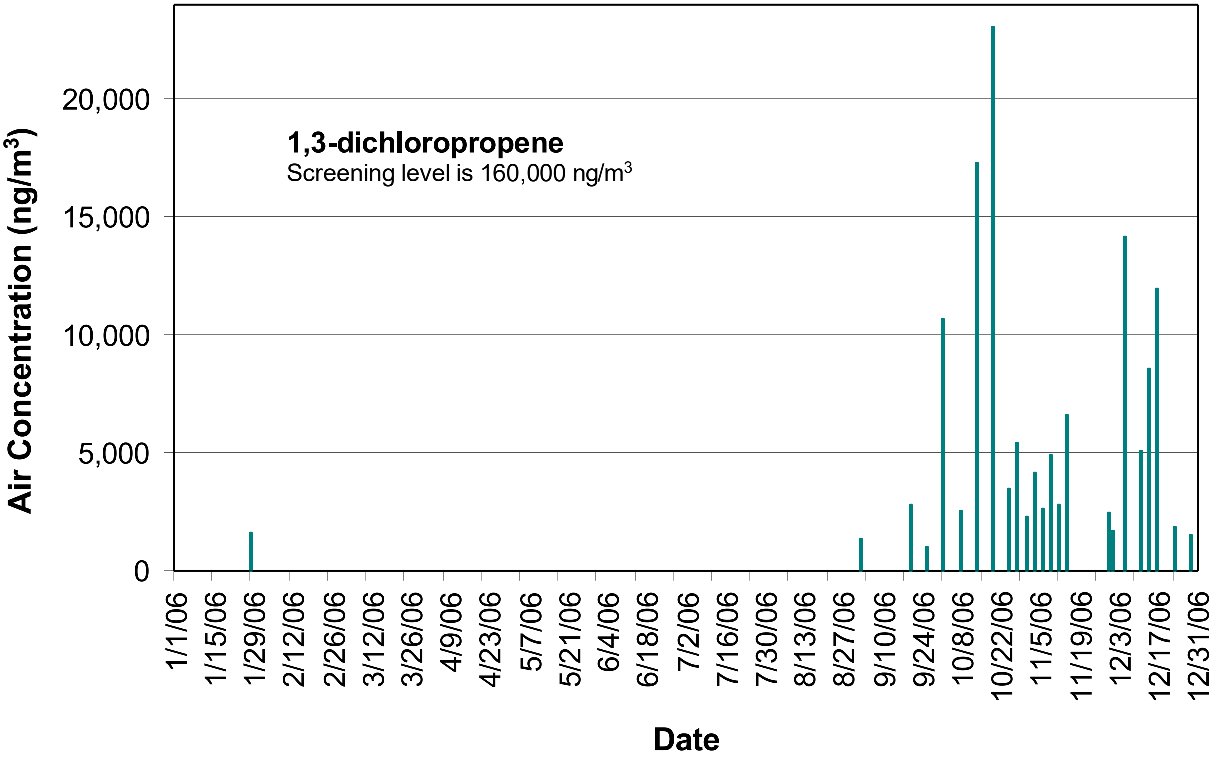


Figure 4d. Highest one-day (acute) concentrations detected among the three monitoring locations of pesticides with quantifiable concentrations (continued).
Note: Concentration scale for 1,3-dichloropropene is higher than Figures 4a, 4b, and 4c.



Subchronic exposure: Table 9 shows the highest 14-day average concentrations. Only concentrations measured by DPR are presented since ARB conducted its sampling only one out of six days, which is insufficient for subchronic analysis. The highest 14-day average concentration measured for any site was 377 ng/m^3 for MITC. The second highest was 96.1 ng/m^3 for chlorpyrifos. No pesticide concentrations exceeded the screening levels for the subchronic exposure (two-week) periods. Figures 5a-c present the highest 14-day 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. The 14-day 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 9. The highest 14-day average concentration for chemicals with detectable concentrations. Only pesticides monitored by DPR are included.

Note: For most of the year, ARB took only 2 samples in any 14-day period, which is not sufficient to generate data to use for subchronic analysis.

Chemical	Highest 14-day average concentration (ng/m^3)	Subchronic screening level (ng/m^3)
Chlorothalonil	30.0	24,000
Chlorpyrifos	96.1	850
Chlorpyrifos OA	6.81	850
Diazinon	20.4	130
Diazinon OA	13.4	130
Dichlorvos	9.34	2,200
Malathion	3.14	15,000
Malathion OA	3.6	15,000
MITC	377	3,000
Permethrin	7.47	90,000
Phosmet	18.3	26,000
Propargite	25.1	14,000
Simazine	3.5	31,000
Trifluralin	11.15	170,000

Figure 5a. Highest two-week average (subchronic) concentrations detected among the three monitoring locations. Concentrations are presented as rolling or moving averages (i.e., average of weeks 1 and 2, average of weeks 2 and 3, etc.).

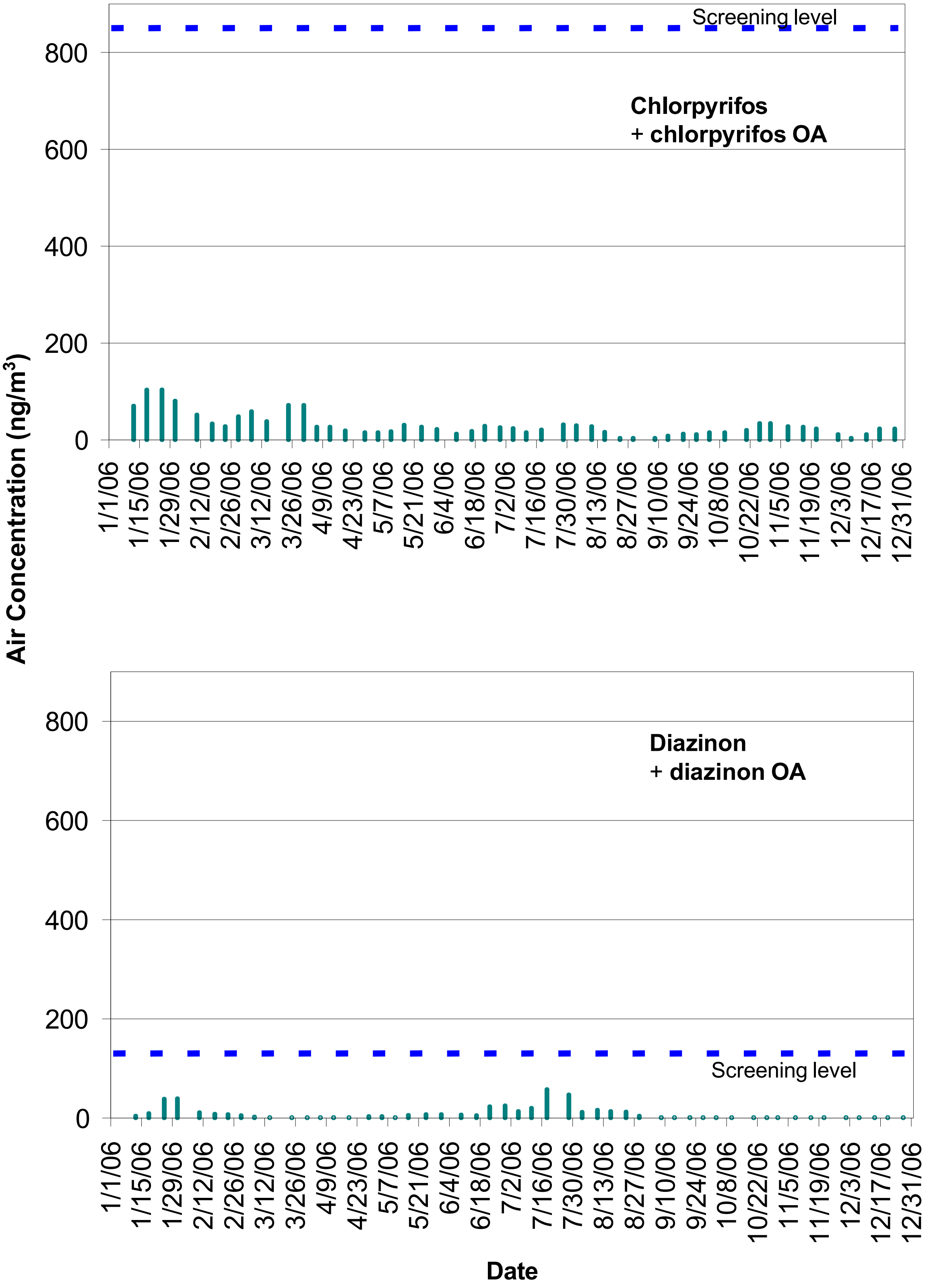


Figure 5b. Highest two-week average (subchronic) concentrations detected among the three monitoring locations. Concentrations are presented as rolling or moving averages (i.e., average of weeks 1 and 2, average of weeks 2 and 3, etc.). (continued).

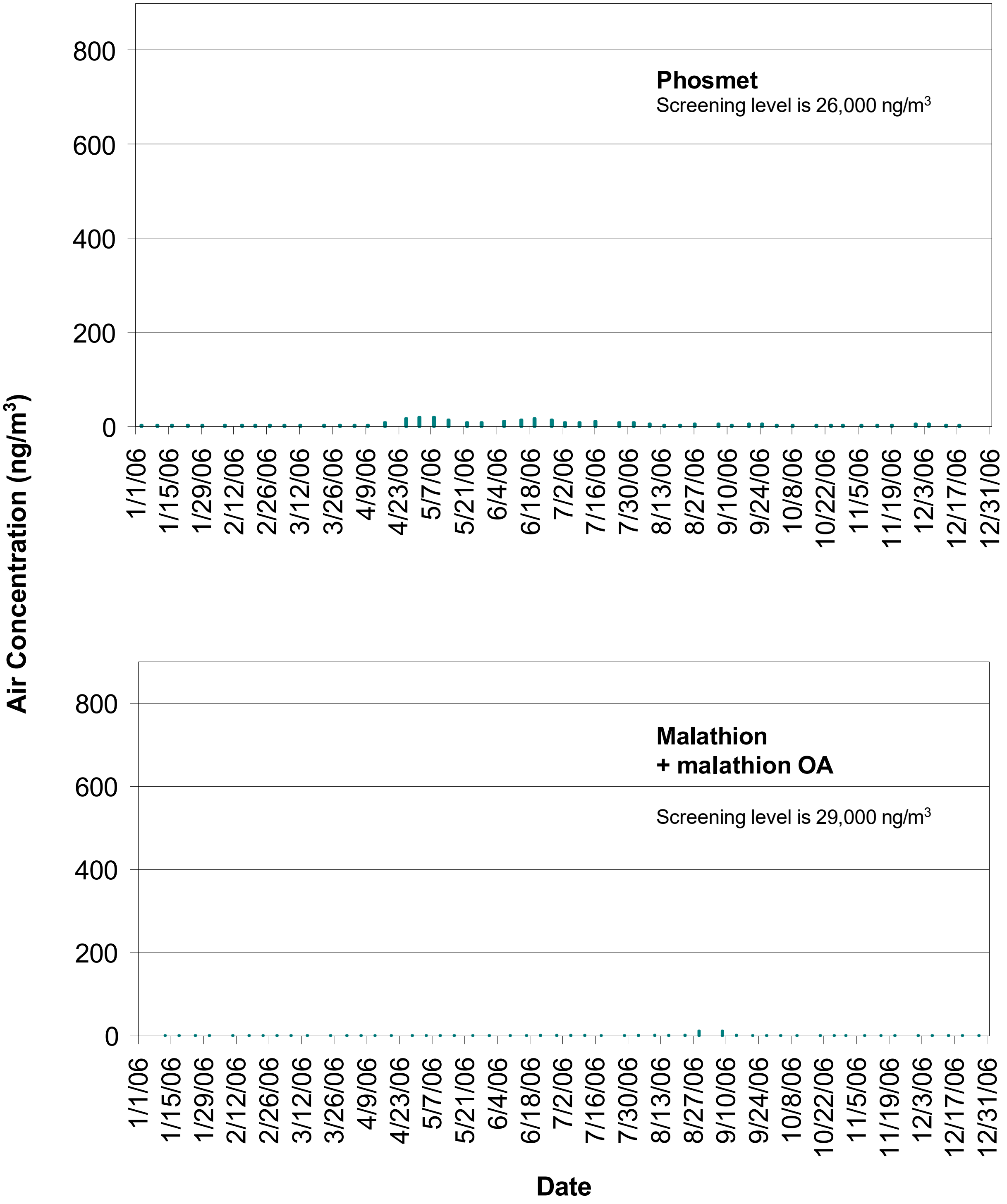


Figure 5c. Highest two-week average (subchronic) concentrations detected among the three monitoring locations. Concentrations are presented as rolling or moving averages (i.e., average of weeks 1 and 2, average of weeks 2 and 3, etc.). (continued).
Note: Concentration scale for MITC is higher than Figures 5a and 5b.

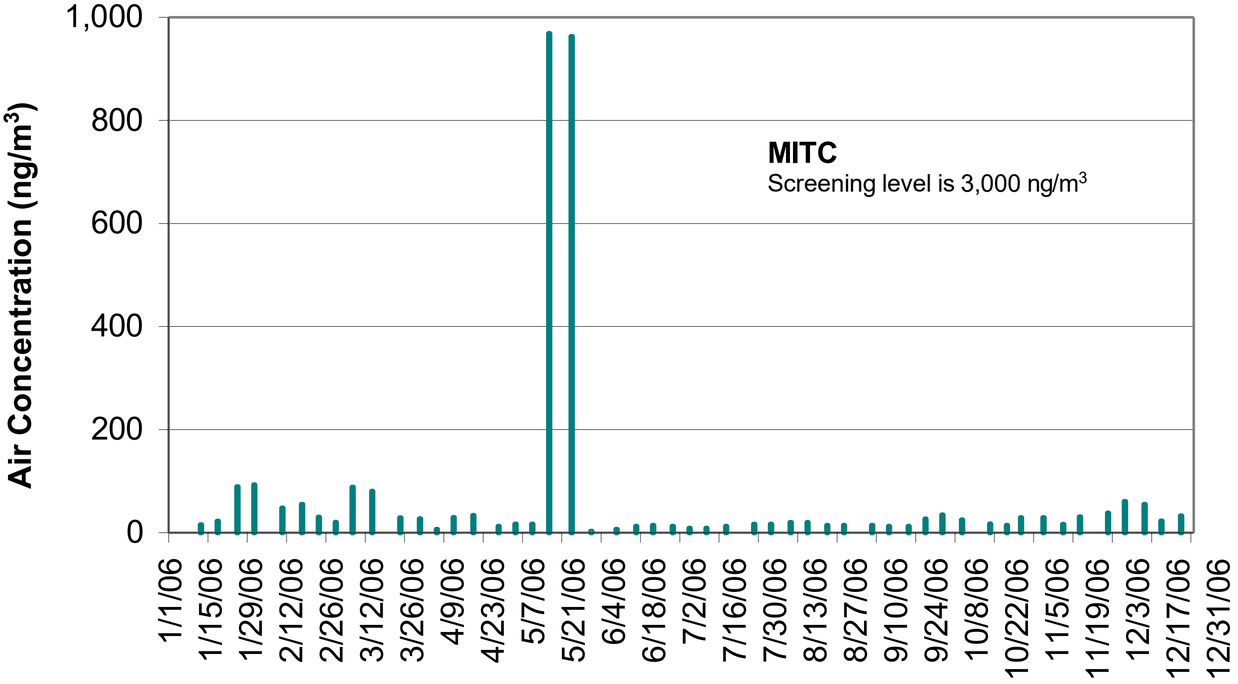


Table 10 presents the one-year average concentrations for all of the chemicals monitored with detectable concentrations. Concentrations were calculated using one-half the MDL for samples with no detectable amount, and a value halfway between the MDL and the LOQ for samples with trace concentrations. The ARB sample concentrations were calculated as a total average of all of the monthly averages. Acrolein and formaldehyde both exceeded the chronic screening level. Formaldehyde had the highest 1-year average concentration of 3,256 ng/m^3; however this was likely because of vehicle exhaust. The pesticide with the highest 1-year concentration was 1,3-dichloropropene (1,970 ng/m^3).

Table 10. The one-year average concentration for chemicals with detectable concentrations.

Note: Chemicals with concentrations above the screening level are shown in **bold**.

Chemical	1-year average concentration (ng/m^3)	Chronic screening level (ng/m^3)
1,3-Dichloropropene	1,970	120,000
Acrolein[a]	**1,412**	**60**
Arsenic[a]	1.33	30
Chlorothalonil	10.7	34,000
Chlorpyrifos	23.1	510
Chlorpyrifos OA	2.82	510
Copper[b]	43.7	10,000
Diazinon	3.16	130
Diazinon OA	2.33	130
Dichlorvos	1.92	770
Formaldehyde[a]	**3,256**	**3,000**
Malathion	1.17	29,000
Malathion OA	0.81	29,000
Methyl bromide	281	3,900
MITC	38.1	300
Permethrin	3.76	90,000
Phosmet	6.27	18,000
Propargite	5.36	14,000
Simazine	0.84	8,500
Sulfur[b]	692	NA[c]
Trifluralin	3.64	41,000
Xylene[b]	1,498	700,000

[a] Detections of these compounds are likely due to non-pesticidal sources only.

[b] Detections of these compounds are likely due to pesticidal and non-pesticidal sources.

[c] NA = Not available

Detections of individual pesticides: Table 11 lists the percentages of samples that had detections for each separate chemical. Carbon disulfide, copper, formaldehyde, and sulfur were detected in 100 percent of the samples collected by ARB. There was no reported agricultural pesticidal use of carbon disulfide and formaldehyde in the Parlier area. Although formaldehyde is used in poultry and dairy facilities, there were no such facilities within five miles of Parlier. Of the pesticides monitored by DPR, MITC was most frequently detected (84 percent). Although azinphos-methyl, dicofol, dimethoate, diuron, endosulfan, norflurazon, oryzalin, and oxyfluorfen were used in the Parlier area, none were detected in any samples. There was no use and no detections of cypermethrin, EPTC, metolachlor, molinate, propanil, SSS-tributyltriphosphorotrithioate, and thiobencarb. The number of pesticides detected in individual samples varied from 0 to 9, with 2 pesticides being the most common number detected (Figure 6). One sample had positive detections for 9 different chemicals while 12 percent of the samples had positive detections of 5 different chemicals. Each of the 156 days DPR monitored had at least one detection.

Table 11. Percent of samples with detectable pesticide concentrations and reported use within five miles of Parlier. Pesticides shown in **bold** were monitored by DPR. Pesticides shown in *italics* were monitored by ARB.

Detected with quantifiable concentrations

Pesticide	Number of samples collected	Percent of samples with detections	Reported use 2006 (pounds a.i.)	Number of reported applications 2006
Carbon disulfide[a]	33	100	0	0
Copper[b]	64	100	109,750	2,159
Formaldehyde[a]	65	100	0	0
Sulfur[b]	64	100	801,340	6,197
Acrolein[a]	71	85	0	0
MITC	468	84	36,483	16
Methyl Bromide	71	66	12,481[c]	68[c]
Chlorpyrifos	468	64	31,420	1217
Arsenic[a]	64	64	0	0
Xylene[b]	71	49	0[d]	0
1,3-dichloropropene	71	34	302,075	122
Diazinon	468	32	3,450	222
Chlorpyrifos oxygen analog	468	22	Not applicable	Not applicable
Diazinon oxygen analog	468	19	Not applicable	Not applicable
Phosmet	468	19	31,862	1235
Malathion oxygen analog	468	5	Not applicable	Not applicable
Malathion	468	1	665	14

Detected but concentration not quantifiable (trace)

Trifluralin	468	24	79	16
Chlorothalonil	468	17	5,230	153
Propargite	468	15	7,080	330
Simazine	468	7	13,120	1063
Dichlorvos	468	1	0	0
Permethrin	468	1	222	43

Not detected

Azinphos-methyl	468	0	83	7
Cypermethrin	468	0	0	0
Dicofol	468	0	151	6
Dimethoate	468	0	374	15
Dimethoate oxygen analog	468	0	Not applicable	Not applicable
Diuron	468	0	2,310	125
Endosulfan	468	0	7	1
Endosulfan sulfate	468	0	Not applicable	Not applicable
Norflurazon	468	0	1,249	204
EPTC	468	0	0	0
Metolachlor	468	0	5	1
Molinate	468	0	0	0
Oryzalin	468	0	12,970	708
Oxyfluorfen	468	0	8,502	2,369
Propanil	468	0	0	0
SSS-tributylphos… (DEF)	468	0	0	0
Thiobencarb	468	0	0	0

[a] Detections of these compounds are likely due to non-pesticidal sources only.

[b] Detections of these compounds are likely due to pesticidal and non-pesticidal sources.

[c] Includes some chamber fumigations.

[d] Previous reports listed use, but use was determined to be an error in PUR database.

Figure 6. The percentage of samples collected by DPR with multiple detections for pesticides.

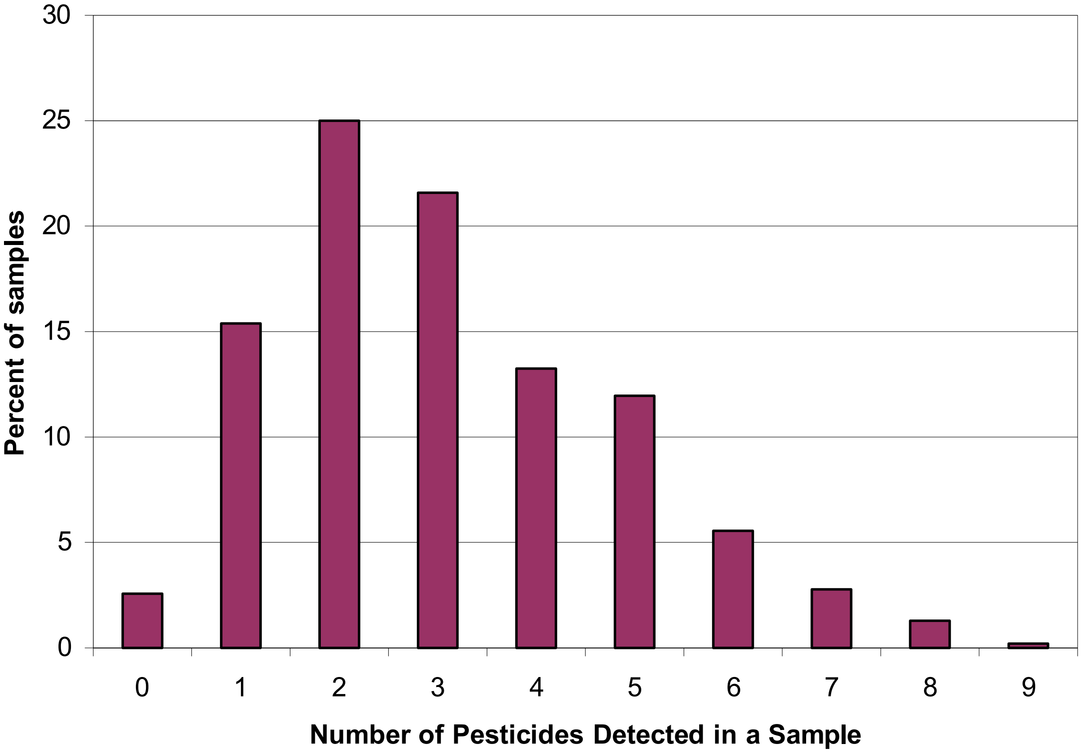


Table 12 indicates the number of detections of any chemical at each individual site. Martinez Elementary School had the highest number of detections with 10.1 percent of the possible detections above the MDL, but all of the schools had similar results. Table 13 indicates the number of detections of each individual chemical at each individual site. The number of detections above the LOQ (quantifiable) is listed in parentheses. Figure 7 compares the air concentrations measured for the pesticides with quantifiable concentrations of each sampling site. Not included in the figure are the results for 1,3-dichloropropene monitoring at Benavidez by ARB. The maximum and average concentrations for 1,3-dichloropropene were 23,601 ng/m^3 and 1,970 ng/m^3, respectively.

Table 12. Pesticide detections of DPR monitored chemicals by location.

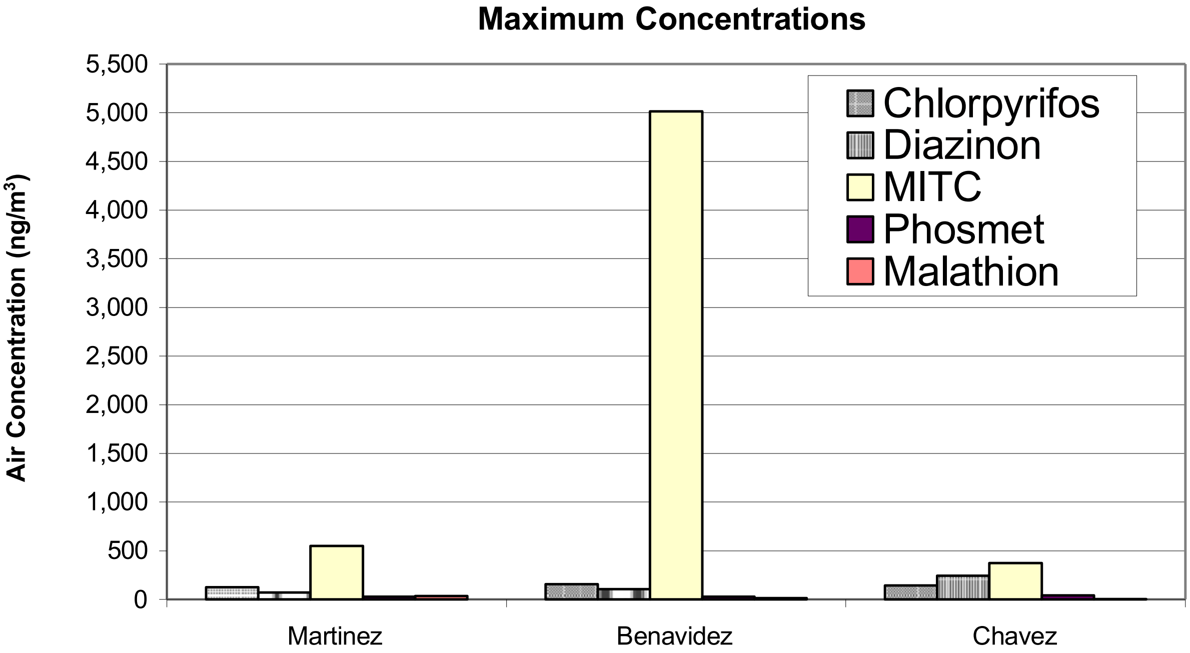
Location	Number of possible detections	Number of detections[a]	Percent of possible detections	Percent quantifiable detections
Martinez	4833	489	10.1	1.8
Benavidez	4833	480	9.9	2.1
Chavez	4833	476	9.8	1.9
Total	14499	1445	10.0	1.9

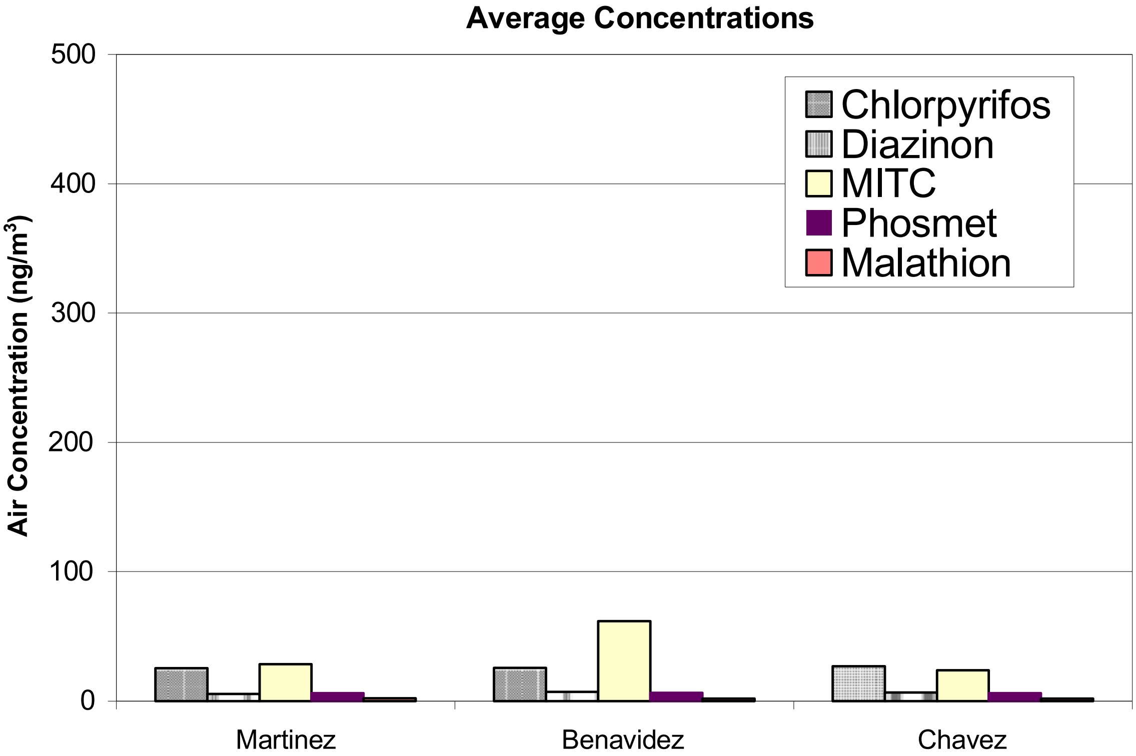
[a] Includes quantified detections and trace detections.

Table 13. Total number of confirmed DPR pesticide detections at each monitoring site. (Numbers in parenthesis are detections above LOQ.)

Chemical	Sampling location		
	Martinez	Benavidez	Chavez
Azinphos-methyl	0	0	0
Chlorothalonil	29(0)	23(0)	25(0)
Chlorpyrifos	103(14)	96(18)	100(17)
Chlorpyrifos OA	33(1)	35(1)	35(0)
Cypermethrin	0	0	0
Dichlorvos (naled)	2(0)	2(0)	2(0)
DEF	0	0	0
Diazinon	51(12)	50(14)	48(16)
Diazinon OA	27(11)	32(14)	29(17)
Dicofol	0	0	0
Dimethoate	0	0	0
Dimethoate OA	0	0	0
Diuron	0	0	0
Endosulfan	0	0	0
Endosulfan Sulfate	0	0	0
EPTC	0	0	0
Malathion	3(1)	1(0)	0
Malathion OA	9(3)	6(1)	8(0)
Metolachlor	0	0	0
MITC	131(45)	133(50)	128(43)
Molinate	0	0	0
Norflurazon	0	0	0
Oryzalin	0	0	0
Oxyfluorfen	0	0	0
Permethrin	1(0)	1(0)	1(0)
Phosmet	28(1)	31(2)	28(1)
Propanil	0	0	0
Propargite	25(0)	21(0)	24(0)
Simazine	11(0)	10(0)	10(0)
Thiobencarb	0	0	0
Trifluralin	36(0)	39(0)	38(0)
Total	**489(88)**	**480(100)**	**476(94)**

Figure 7. Air concentrations of DPR monitored pesticides with quantifiable concentrations by location.





Results from Monitoring by ARB and SJVAPCD for VOCs, Metals, Hexavalent Chromium and Criteria Pollutants

For this project, ARB analyzed approximately 70 samples for VOCs and 65 samples for metals and elements. The ARB collected its last VOC and metals/elements samples on January 6, 2007, and PM2.5 samples on January 14, 2007. The SJVAPCD collected continuous samples for the criteria pollutants, nitrogen dioxide and ozone. The ARB also monitors VOCs in Fresno, which is an urban area approximately 20 miles northwest of Parlier.

Twenty-one of 23 VOCs monitored by ARB were detected in Parlier (Table 14). Acetone had the highest concentration (47,509 ng/m^3), which compares with levels measured in Fresno. Acrolein was the only pesticide monitored by ARB that exceeded the acute screening level (highest concentration detected was 4,586 ng/m^3, screening level was 190 ng/m^3). No reported agricultural use of acrolein occurred in the Parlier area in 2006. Major sources of acrolein include engine exhaust and tobacco smoke. Carbon disulfide and formaldehyde also have some pesticidal uses, but detected concentrations in Parlier were likely due to non-pesticidal sources. Carbon disulfide is a naturally occurring product and is used in industrial processes. Formaldehyde is found in pressed wood (e.g., plywood and particleboard), tobacco smoke and other combustion processes, textiles (e.g., clothing and drapes), and adhesives/glues.

All 27 metals monitored by ARB were detected (Table 15). The highest concentration detected was silicon at 19,000 ng/m^3. Copper and sulfur were the only metals monitored which had pesticidal use in Parlier. Arsenic was also detected but there was no reported use of arsenic in the Parlier area.

Table 16 presents the results for the hexavalent chromium concentrations measured at the ARB monitoring station in Parlier. Concentrations are for a composite sample averaged over a three-month period.

The PM2.5 state and federal 24-hour average standard of 35,000 ng/m^3 was exceeded in January, February, September, October, November, and December 2006, and January 2007 (Figure 9). The standard was exceeded 12 percent of the time during the one-year monitoring period.

Figure 8 shows concentrations of the criteria air pollutants ozone and nitrogen dioxide at the SJVAPCD Kearney Agricultural Center monitoring station. The highest 1-hour concentration for ozone was 257,070 ng/m^3 (131 ppb) and nitrogen dioxide was 116,773 ng/m^3 (62 ppb). Ozone exceeded the 8-hour average concentration air quality standard of 137,000 ng/m^3 (70 ppb) multiple times from April through October, and was close in November 2006. Nitrogen dioxide did not exceed the 1-hour average concentration standard of 339,000 ng/m^3 (180 ppb). Table 17 shows other results for chemicals monitored by SJVAPCD for 2006.

Table 14. Highest volatile organic compound (VOC) concentrations measured by ARB. The VOCs that were detected because of likely pesticide use in the Parlier area are shown in **bold**. The VOCs shown in *italics* have some pesticidal use, but not in the Parlier area. Concentrations detected at ARB's monitoring station in Fresno are shown for comparison.

Volatile organic compound	**Quantitation limit (ng/m^3)**	**Parlier: Highest 1-day concentration (ng/m^3)**	**Fresno: Highest 1-day concentration (ng/m^3)**	**Acute screening level (ng/m^3)[a]**
1,3-Butadiene	88	509	664	NA [b]
1,3-Dichloropropene	454	23,601	5,991	160,000
Acetaldehyde	180	10,630	7,207	NA
Acetone	713	47,509	35,632	NA
Acetonitrile	504	8,059	6,380	NA
Acrolein	688	4,586	5,044	190
Acrylonitrile	651	2,604	1,910	NA
Benzene	160	3,195	4,473	13,000,000
Carbon disulfide	311	3,114	2,118	1,550,000
Carbon tetrachloride[c]	126	881	Did not sample	19,000,000
Chloroform	98	146	244	1,500,000
Dichlorobenzene	1,804	Not detected	Not detected	NA
Ethyl benzene	868	1,216	2,041	NA
Formaldehyde	123	9,457	10,808	19,000
Methyl bromide	116	2,524	427	820,000
Methyl chloroform	55	109	109	NA
Methyl ethyl ketone	295	1,769	1,474	130,000,000
Methylene chloride	347	1,424	1,181	140,000,000
Perchloroethylene	68	339	339	200,000,000
Styrene	426	Not detected	1,108	210,000,000
Toluene	754	6,406	12,059	370,000,000
Trichloroethylene	107	107	Not detected	NA
Xylene[d]	434	5,906	10,074	900,000

[a] Reference exposure levels determined by OEHHA are the acute screening levels used for VOCs.

[b] NA = Not available.

[c] Measured during January – February 2006 only.

[d] Non-pesticidal sources may contribute to the detection of xylene.

Table 15. Highest metal and element concentrations detected by ARB. Metals or elements that were detected because of likely pesticide use in the Parlier area are shown in **bold**. Metals shown in *italics* have some pesticidal use, but not in the Parlier area.

Metal	**Quantitation limit (ng/m^3)**	**Highest concentration in Parlier (ng/m^3)**	**Acute screening level (ng/m^3)**
Aluminum	3[a]	6,600	NA[b]
Antimony	5 [a]	27	NA
Arsenic	1[a]	*5*	*190*
Barium	4[a]	390	NA
Bromine	1	28	NA
Calcium	2[a]	3,800	NA
Chlorine	1[a]	1,000	210,000
Chromium	1[a]	22	NA
Cobalt	1[a]	13	NA
Copper	1	550	100,000
Iron	1	8,300	NA
Lead	1[a]	15	NA
Manganese	1	170	NA
Mercury	1[a]	2	1,800
Molybdenum	2	52	NA
Nickel	1	2	6,000
Phosphorus	1[a]	1,200	NA
Potassium	2[a]	5,000	NA
Rubidium	1	23	NA
Selenium	1[a]	5	NA
Silicon	2	19,000	NA
Strontium	1	94	NA
Sulfur	1[a]	1800	NA
Tin	4[a]	9	NA
Titanium	1[a]	790	NA
Vanadium	1[a]	10	NA
Yttrium	1[a]	3	NA
Zinc	1	200	NA

[a] The quantitation limit has changed over the study duration. All have decreased.

[b] NA = Not available.

Table 16. Average quarterly hexavalent chromium concentrations measured at the ARB monitoring station in Parlier. Concentrations detected at ARB's monitoring station in Fresno are shown for comparison.

Date	**Hexavalent chromium (ng/m^3)**	
	Parlier	**Fresno**
1/1/06 – 3/30/06	0.06	0.08
4/1/2006 – 6/30/06	<MDL[a]	0.06
7/1/06 – 9/30/06	<MDL	<MDL
10/1/06 – 12/31/06	0.07	0.06

[a] MDL = Minimum detection limit = 0.06

Table 17. Air concentrations measured by SJVAPCD at the UC Kearney Agricultural Station for 2006. (continued on next page)

Chemical	Time of sampling	Maximum concentration (ppb)	Average concentrations (ppb)	Duration of sample (hours)
Ozone	Year round	131	61.5	1
Nitric oxide	Year round	101	6.00	1
Nitrogen dioxide	Year round	620	11.5	1
Oxides of Nitrogen	Year round	128	13.2	1
Total NMOC[1]	Year round	1090	73.3	1
Sum of PAMS[2] target compounds	July – Sept.	218	35.9	3
n-Dodecane	July – Sept.	5.5	0.18	3
Ethane	July – Sept.	7.4	0.17	3
Ethylene	July – Sept.	3.1	0.07	3
Propane	July – Sept.	48.3	12.8	3
Propylene	July – Sept.	3.8	0.50	3
Acetylene	July – Sept.	9.2	0.13	3
n-Butane	July – Sept.	5.8	1.21	3
Isobutane	July – Sept.	10.4	1.11	3
trans-2-Butene	July – Sept.	0.1	0.05	3
cis-2-Butene	July – Sept.	0.1	0.05	3
n-Pentane	July – Sept.	17.1	1.30	3
Isopentane	July – Sept.	37.7	3.65	3
1-Pentene	July – Sept.	0.1	0.05	3
trans-2-Pentene	July – Sept.	0.1	0.05	3
cis-2-Pentene	July – Sept.	0.1	0.05	3
3-Methylpentane	July – Sept.	7.2	1.08	3
n-Hexane	July – Sept.	6	0.72	3
n-Heptane	July – Sept.	5.6	0.28	3
n-Octane	July – Sept.	3.5	0.08	3
n-Nonane	July – Sept.	1.7	0.07	3
n-Decane	July – Sept.	28	0.40	3
Cyclopentane	July – Sept.	0.1	0.05	3
Isoprene	July – Sept.	3	0.09	3
2,2-Dimethylbutane	July – Sept.	1.1	0.06	3
1-Hexene	July – Sept.	1.3	0.06	3
2,4-Dimethylpentane	July – Sept.	1.6	0.06	3
Cyclohexane	July – Sept.	3.6	0.36	3
3-Methylhexane	July – Sept.	5.3	0.42	3
2,2,4-Trimethylpentane	July – Sept.	3.2	0.83	3
2,3,4-Trimethylpentane	July – Sept.	1.1	0.06	3
3-Methylheptane	July – Sept.	0.1	0.05	3
Methylcyclohexane	July – Sept.	3.6	0.15	3
Methylcyclopentane	July – Sept.	2.7	0.52	3
2-Methylhexane	July – Sept.	2.2	0.36	3
1-Butene	July – Sept.	2.2	0.07	3

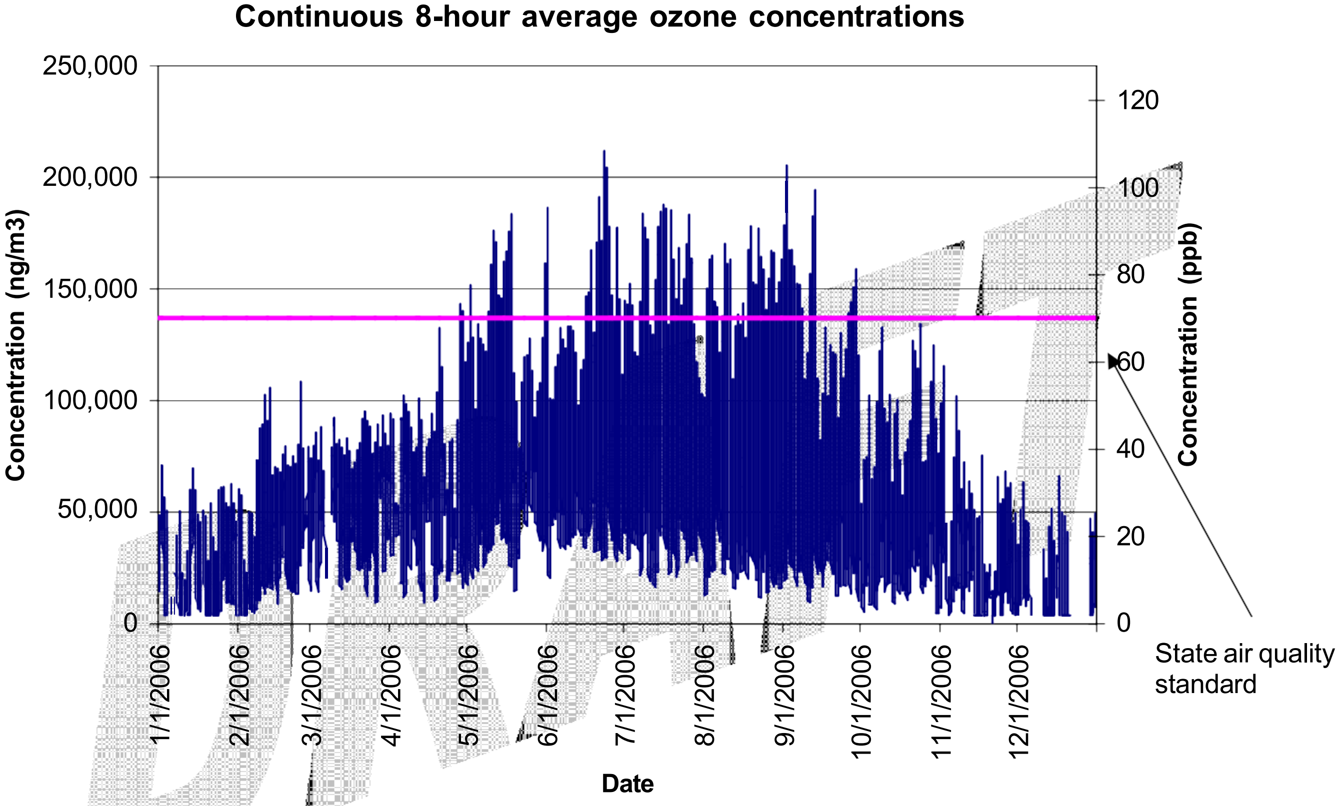
Table 17. Air concentrations measured by SJVAPCD at the Kearney Agricultural Station for 2006 (continued).

Chemical	Time of sampling	Maximum concentration (ppb)	Average concentrations (ppb)	Duration of sample (hours)
2,3-Dimethylbutane	July – Sept.	2	0.15	3
2-Methylpentane	July – Sept.	8.7	0.98	3
2,3-Dimethylpentane	July – Sept.	1.5	0.24	3
n-Undecane	July – Sept.	11.3	0.46	3
2-Methylheptane	July – Sept.	1.3	0.06	3
m/p Xylene	July – Sept.	6.2	1.57	3
Benzene	July – Sept.	2.6	0.81	3
Toluene	July – Sept.	68.6	4.36	3
Ethylbenzene	July – Sept.	2.5	0.36	3
o-Xylene	July – Sept.	2.6	0.45	3
1,3,5-Trimethylbenzene	July – Sept.	1	0.06	3
1,2,4-Trimethylbenzene	July – Sept.	4.2	0.64	3
n-Propylbenzene	July – Sept.	0.1	0.05	3
Isopropylbenzene	July – Sept.	0.1	0.05	3
o-Ethyltoluene	July – Sept.	1.4	0.07	3
m-Ethyltoluene	July – Sept.	2.4	0.21	3
p-Ethyltoluene	July – Sept.	1.4	0.07	3
m-Diethylbenzene	July – Sept.	0.1	0.05	3
p-Diethylbenzene	July – Sept.	0.1	0.05	3
Styrene	July – Sept.	5.6	0.10	3
1,2,3-Trimethylbenzene	July – Sept.	1.5	0.08	3

[1] Non-methane organic compounds.

[2] Photochemical assessment monitoring.

Figure 8. Concentrations of criteria air pollutants at the Parlier monitoring station, 2006.



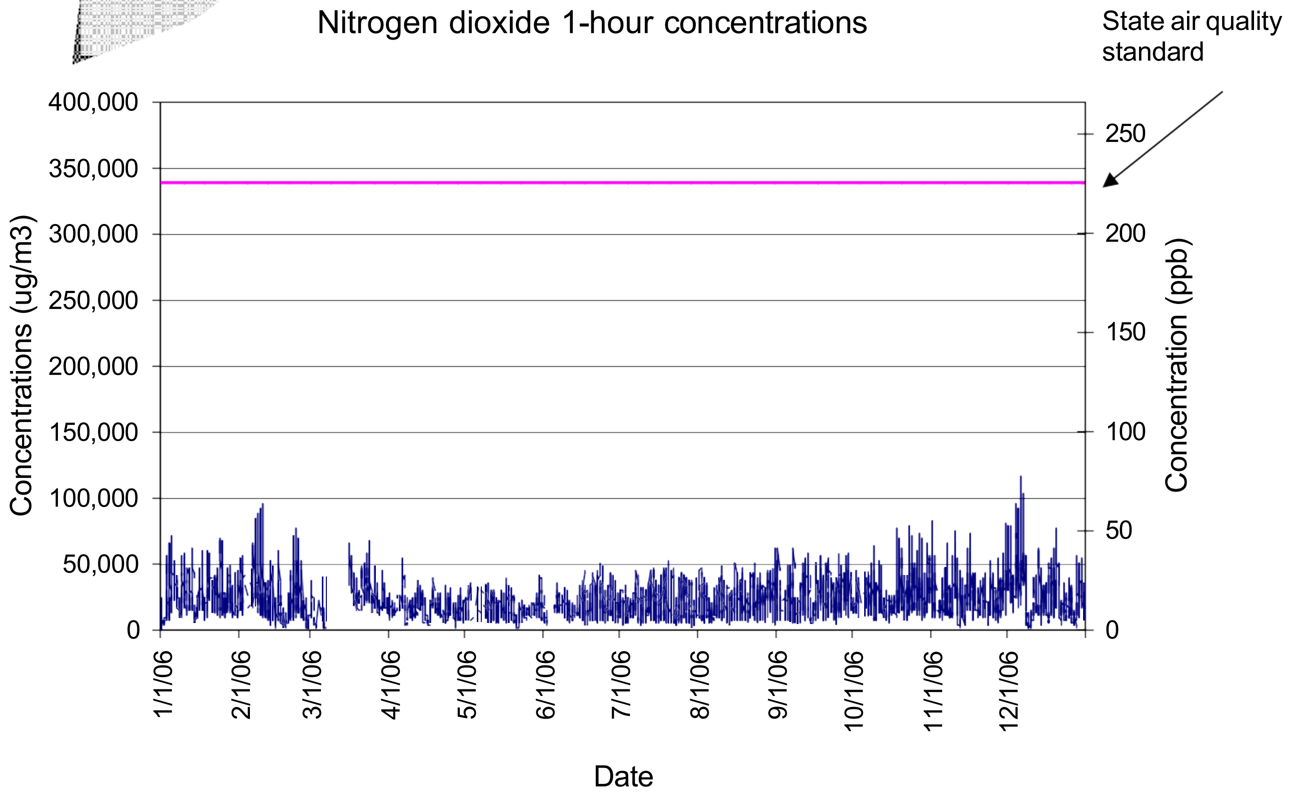
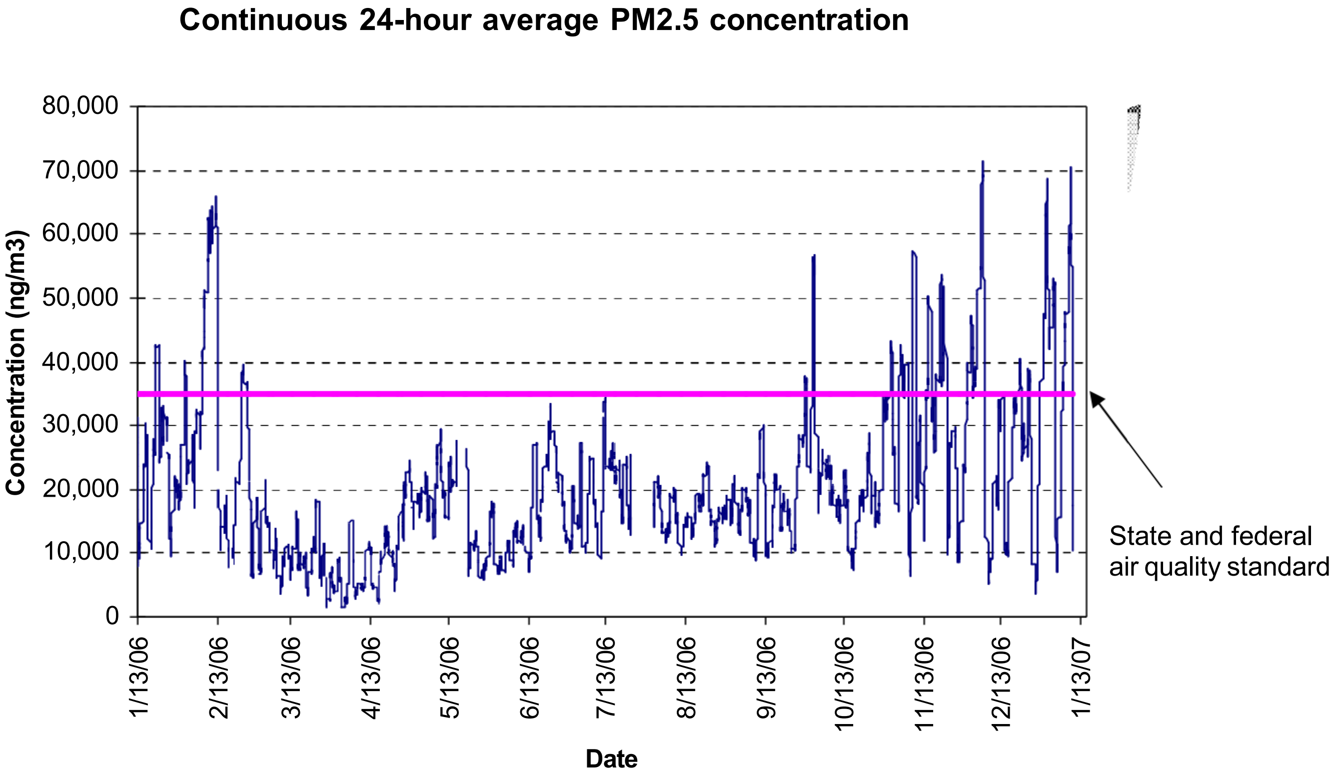


Figure 9. Concentrations of fine particulate matter (PM2.5) at the Parlier monitoring station, 2006.



Additional Sampling

Ground Water Sampling

In addition to collecting air samples, DPR collected ground water samples from the three municipal wells that supplied drinking water for the city of Parlier in 2006. The samples from these wells contained no detectable concentrations of eight pesticides and four breakdown products found in ground water in other areas of California: atrazine, bromacil, diuron, hexazinone, metribuzin, norflurazon, prometon, simazine, desmethyl norflurazon, deethyl atrazine, deisopropyl atrazine, and diamino chlorotriazine. The CDFA Center for Analytical Chemistry analyzed the samples.

The City of Parlier Public Works Department routinely monitors for other ground water contaminants according to Federal and State laws and reports the results in their City of Parlier Annual Water Quality Report. The 2006 Consumer Confidence Report stated that the drinking water met all federal and state requirements. The report did not list any pesticides as detected.

Particulate Sampling

University of California Davis's (UCD) Center for Health and the Environment conducted a study at the UC Kearney Agricultural Station in Parlier to analyze the effect of exposure to real-world particles under conditions that might mimic a bad air pollution day. In collaboration with engineers at UCD and the University of Southern California, UCD's Center for Health and the Environment has acquired a special mobile system that allows them to concentrate, in real time, airborne particles to levels 20- to 40-fold above ambient concentrations. The system is designed to uniformly capture and concentrate particles that range in size from ultrafine (20 nm) to coarse (10 µ). Small laboratory animals are exposed to these concentrated particles in real time while the particles are passing through this system.

DPR assisted UCD with finding a suitable location for this system at the Kearney station. In addition, DPR collected samples to measure pesticide concentration in the air during the time the UCD system was collecting and concentrating particles. The Department collected air samples with quartz and glass filters attached to the intake of XAD-4 air sample tubes. The samples were analyzed using the multiple pesticide screen. None of the samples contained detectable concentrations of any of the multiple chemicals analyzed, although difficulties with the sampling method and various problems with the laboratory analysis may have been a factor in the results. Results of UCD's Center for Health and the Environment study are scheduled to be published in early 2010 (Ngo, M. et al., in print).

Weather Data

Parlier is in the San Joaquin Valley, a generally flat valley with mountain ranges to the east, west and south. Most of the valley is below 1,000 feet in elevation, with Parlier at approximately 340 feet. The valley has cool winters and hot dry summers. The Parlier area receives approximately 13 inches of precipitation annually, on average.

Weather data were measured at the ARB station at Benavidez Elementary School in Parlier. The meteorological data collected included wind speed, wind direction, and outside temperature at a height of approximately 7 meters. In addition, a SJVAPCD station at the Kearney Agricultural Center collects hourly data on wind speed, wind direction, air temperature, and relative humidity at a height of 10 meters. Table 18 summarizes the meteorological data.

In addition, a California Irrigation Management Information Systems (CIMIS) station is located at the Kearney Agricultural Center. The CIMIS station provides hourly data for precipitation, solar radiation, vapor pressure, air temperature, relative humidity, dew point, wind speed, wind direction, and soil temperature.

Data for January through March were collected from the SJVAPCD and CIMIS meteorological stations because of a lack of data for that period at the ARB site. All other data are from the ARB monitoring site.

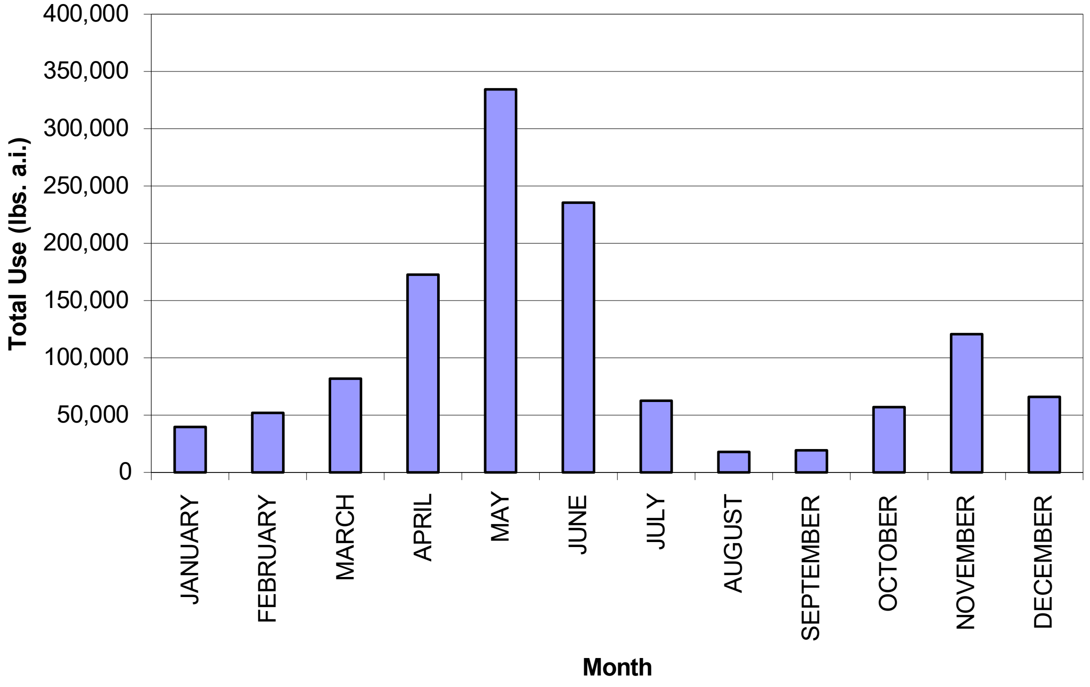
Table 18. Summary of 2006 weather data for Parlier, CA.

	Minimum	Maximum	Average
Wind Speed (m/s)	<0.5	19	2.1
Wind Speed (mph)	<1	43	4.6

Temperature (ºF)	28	109	64
Temperature (ºC)	-2	43	18

Figure 10 presents the total reported use of pesticides in the Parlier area by month. The figure shows a general seasonal use pattern that can be split into three-month periods (January – March, April – June, July – Septmeber, October - December). Wind roses were created to show the seasonal weather pattern for these three-month periods from the ARB and SJVAPCD meteorological data (Figure 11). Wind roses are a graphic tool to view how wind speed and direction are distributed at a location for a particular duration. The wind roses show the frequency of winds blowing *from* a direction. The length of each spoke relates to the percentage of time that the wind blows from that direction. Each spoke is broken in segments to show wind speed ranges.

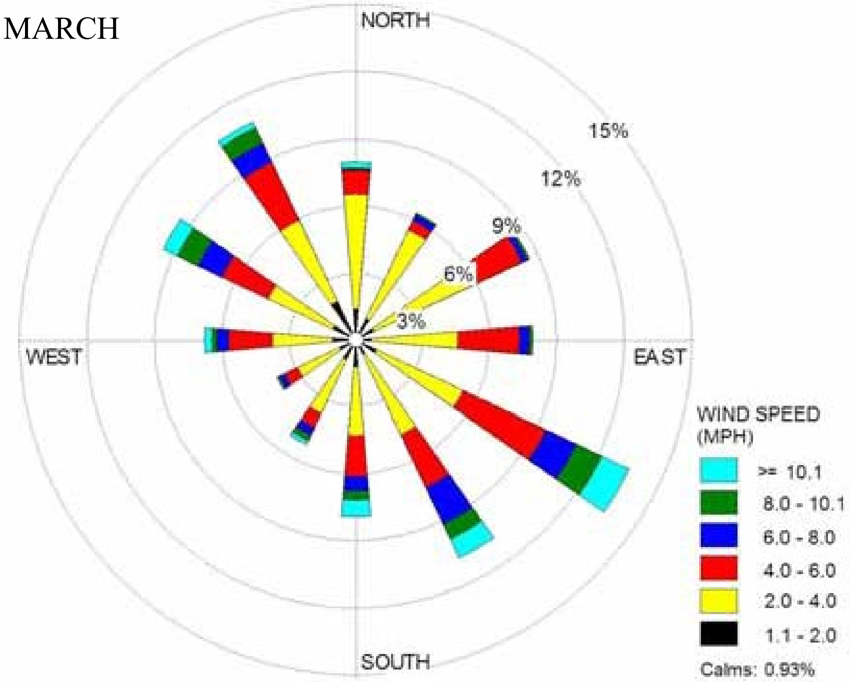
Figure 10. Reported use by month for monitored pesticides to demonstrate seasonal relationship.



As Figure 11 shows, from January through March, the winds tend to be higher and blow from all directions with a slight predominance from the southeast. From April through September, the winds change to a dominant northwest direction with slower speeds, especially July to September. The wind speeds from October through December are slower and the wind direction is more variable but still predominantly from the northwest. The wind roses were produced with Lakes Environmental WRPLOT view version 5.9 (Lakes Environmental, 2008).

Figure 11. Wind roses showing percentage of time for each direction the wind is coming from, and wind speed at the Parlier monitoring station, 2006.

JANUARY - MARCH



APRIL - JUNE

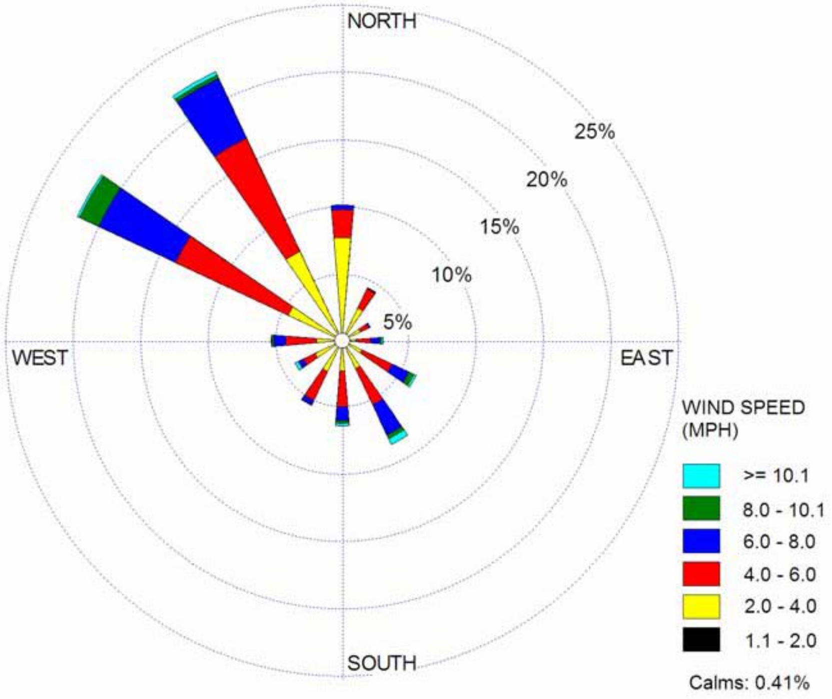
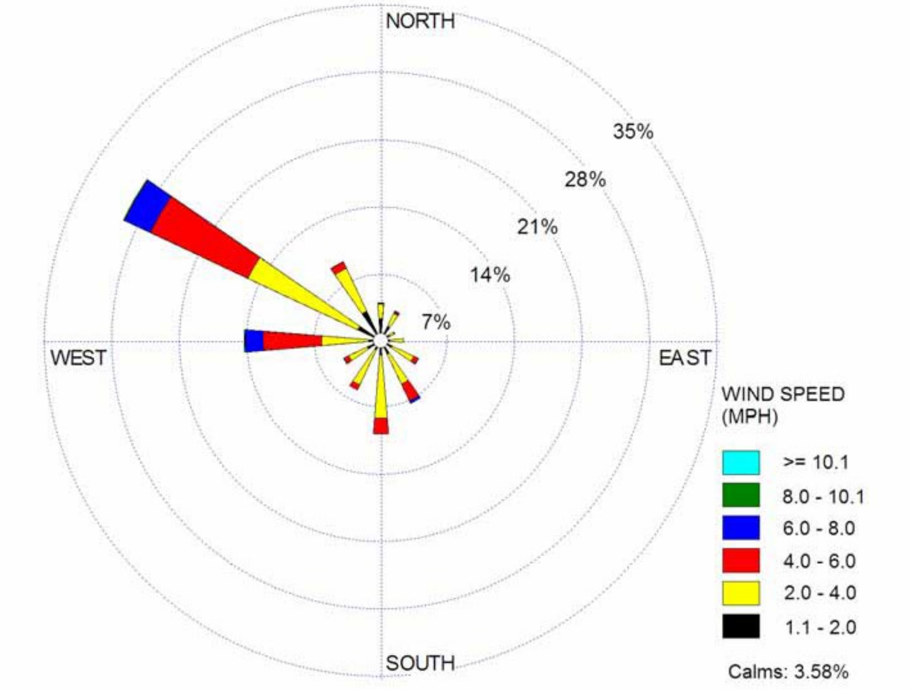
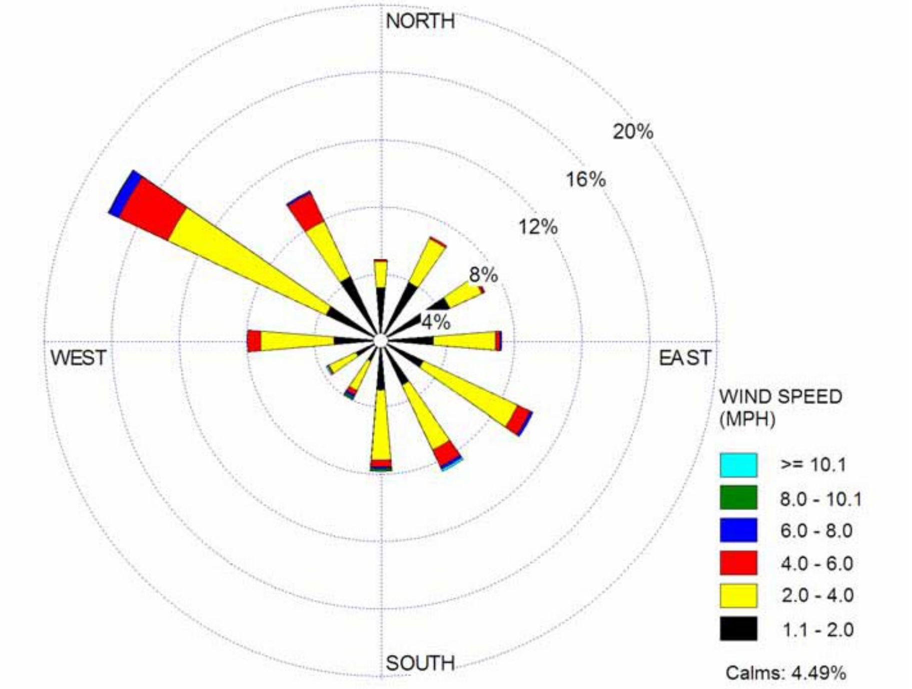


Figure 11. Wind roses showing percentage of time for each direction the wind is coming from, and wind speed at the Parlier monitoring station, 2006 (continued).

JULY – SEPTEMBER



OCTOBER – DECEMBER



Health Evaluation of Measured Air Concentrations

As discussed earlier in this report, the potential health risk of a chemical(s) in air is a function of both the inherent toxicity of the chemical(s) as well as the level of exposure to the chemical(s). The potential risk of the measured concentrations of pesticides in Parlier air can be evaluated by comparing the air concentration measured over a specified time (e.g., 24 hours, 14 days, 1 year) with the screening level derived for a similar exposure (i.e., acute, subchronic, chronic). The screening levels were previously set for the study (as described in the protocol and Appendices A and E), and underwent public discussion and comment. Those levels were used for this evaluation.

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. Again, these are screening levels, not action levels or regulatory standards. While a measured air concentration above a screening level does not necessarily indicate a significant health concern, it does indicate the need for further and more refined evaluation.

Chemicals may exhibit toxic effects independently, or they may interact in an additive, synergistic, or antagonistic manner. The risk from multiple pesticides (cumulative risk) was evaluated using the hazard index (HI) approach, by adding the HQs for the pesticides that can be appropriately grouped according to mechanism or site of toxicity.

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

This approach assumes that toxicity and risk of monitored pesticides that are grouped according to similar mechanism or site of toxicity are additive, although only a subset of the monitored pesticides are known to act in an additive manner (including organophosphate insecticides and oxygen analog breakdown products toxic to the nervous system). As with the HQ, an HI greater than 1 indicates the need for further evaluation. If an HQ for one pesticide is greater than 1, the HI for the same period will be greater than 1, since the HQs are added together. The HI is most useful when individual HQs are less than 1. However, 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. For some organophosphate pesticides monitored, both the parent pesticide as well as the oxon breakdown product were listed in tables and figures separately. In these cases, the parent and the breakdown product are considered together to evaluate risk.

DPR evaluated potential health effects for acute, subchronic and chronic exposure, and for carcinogenic potential. These evaluations are presented below.

Acute Exposure

To evaluate the potential health risk of exposure to the individual monitored pesticide, the highest 24-hour concentration at any site was used. The relative acute health risk of all the chemicals monitored likely to be present because of pesticidal use was dominated by chlorpyrifos and diazinon (Figure 12).

Chlorpyrifos: The insecticide chlorpyrifos or its breakdown product were detected in 64 percent of the samples. No sample was above the screening level. For comparison, if the federal Food Quality Protection Act (FQPA) 10-fold chlorpyrifos safety factor were applied to the acute screening level, it would have lowered it by a factor of 10 (see Health Evaluation Section). If that were done, as can be seen from the "FQPA-Adjusted HQ" column in Table 19, the acute HQ for chlorpyrifos and its oxon would be greater than 1. In this latter case, 6 samples out of 468 would be above the screening level. In addition to the measured concentrations, the frequency of chlorpyrifos detections is also of interest, since it was found in 64 percent of the samples.

Diazinon: As can be seen from the "Acute HQ" column in Table 19, the acute HQ for diazinon is greater than 1, making diazinon the only monitored pesticide that exceeded its acute screening level due to pesticidal use. One sample (out of 468) had a concentration of diazinon above the acute screening level. [Note: the screening level for diazinon is especially health-protective. The U.S. EPA recommended (in its diazinon RED) that the results of a 21-day animal inhalation study be used to assess human inhalation exposures for all time periods (i.e., for short-term, medium-term, and long-term exposures), since this was the only available inhalation study. Typically, acceptable exposure levels for one day are higher than acceptable exposure levels over longer periods.]

Chlorpyrifos and diazinon: These compounds are in the same chemical family (organophosphates) and have the same mechanism of toxicity in the nervous system—they both inhibit the enzyme acetylcholinesterase (an enzyme necessary for proper nerve function) and are appropriately added together to calculate cumulative risk. The FQPA 10-fold safety factor for chlorpyrifos is based on the potential for chlorpyrifos to cause abnormal nerve development. It has been postulated (U.S. EPA, 2007) that this effect is due to a mechanism that is not directly related to the inhibition of the acetylcholinesterase enzyme and therefore different than EPA's proposed mechanism of action for diazinon. If this were the case, the HQ for chlorpyrifos incorporating the 10-fold factor would not be used in calculations of cumulative risk for effects resulting from the inhibition of acetylcholinesterase. In this evaluation, the HI is calculated both with and without the 10-fold factor. Other cholinesterase pesticides were detected; however, they were found at levels so low as to be inconsequential when considered either singly or cumulatively, compared to chlorpyrifos and diazinon. Figure 13 illustrates the HIs. In one instance, the HI was greater than 1 due to the diazinon peak that was above the screening level. In addition, another HI was close to 1 because of a high diazinon concentration. When the 10-fold FQPA factor for chlorpyrifos was applied to the chlorpyrifos screening level, 13

HIs equal or are greater than 1. Again, one of these is because of the single diazinon level above the screening level. Six of the HIs were greater than 1 due to the chlorpyrifos concentrations exceeding the FQPA safety factor adjusted screening level. Six of the HIs were greater than 1 due to the combined impacts of the diazinon and chlorpyrifos concentrations. In addition, a number of HIs were less than 1, but still of some significance.

Acrolein: Acrolein was detected frequently; however, there were no reported pesticidal uses. Its presence was almost certainly due to non-pesticidal sources such as vehicle emissions, since acrolein is a byproduct of combustion. The acrolein concentrations measured were similar to those typically found in other areas of the state and country. Regardless, the acute acrolein concentrations were as much as 23-fold greater than the screening levels. These screening levels were set based on RELs (acute 1 hour – 190 ng/m^3; subchronic - 180 ug/m^3; chronic – 60 ng/m^3) set by OEHHA as part of the Air Toxics Hotspots Program. Amended RELs (acute 8 hour – 700 ng/m^3; chronic – 350 ng/m^3) for acrolein were proposed by OEHHA in 2008. While these RELs result in higher screening levels, the acute acrolein air concentrations still significantly exceeded the screening levels by as much as 6.4-fold and are of concern. The acrolein air concentrations would dominate any cumulative risk calculation.

Formaldehyde: Formaldehyde was detected in all samples; however, like acrolein, it is a byproduct of combustion and natural processes and has a number of industrial uses and sources. Since there were no reported pesticidal uses and no nearby dairy or poultry farms, its presence in air was clearly because of non-pesticidal sources. While the measured formaldehyde concentrations did not exceed the acute screening level, they did approach one-half of the screening level (HQ = 0.49).

Fumigants: The fumigants MITC, methyl bromide, and 1,3-dichloropropene were frequently detected; however, all the detections were well below the acute screening levels and not of acute health concern. All three of the fumigants have different mechanisms of toxicity; therefore, grouping them together for the calculation of a cumulative risk value is not appropriate.

Subchronic Exposure

To calculate the subchronic HQ of exposure for individual pesticides, a rolling average concentration for every two-week period was calculated for all of the sampling sites and days. Table 20 lists the highest two-week average. As a result, only pesticides monitored by DPR (three times per week three sites) are included in these calculations. The relative subchronic health risk was dominated by chlorpyrifos (Figure 12).

Chlorpyrifos: No two-week average concentrations for chlorpyrifos and its oxon were above the subchronic screening levels (i.e., no HQs were greater than 1). However, if the FQPA 10-fold safety factor were applied to the subchronic screening level for chlorpyrifos, it would be lowered by a factor of 10 (see Health Evaluation Section). If that were done, as can be seen from the "FQPA-Adjusted HQ" column in Table 20, a subchronic HQ for chlorpyrifos and its oxon would be greater than 1 (measured concentrations greater than the screening level). Hazard quotients would be greater than 1 for 2 overlapping 2-week periods in January. In addition, another 4 HQs would approach 1.

Diazinon: As can be seen from the "Subchronic HQ" column in Table 20, the subchronic HQs for diazinon and for diazinon plus its oxon are less than 1, in contrast to the acute HQs. However, the values are still of concern (highest HQ value is approximately 0.26), giving the largest HQ of all the measured pesticides, with the exception of the previously described FQPA-adjusted HQs for chlorpyrifos.

Chlorpyrifos and diazinon: As was done in the evaluation of acute exposure, the cumulative risk of chlorpyrifos and diazinon is evaluated using a HI approach. The HI is calculated both with and without the FQPA 10-fold factor for chlorpyrifos. While other cholinesterase pesticides were detected, they were found at concentrations so low as to be inconsequential when considered either singly or cumulatively, compared to chlorpyrifos and diazinon. Figure 13 illustrates the HIs. None of the HIs for diazinon plus chlorpyrifos are greater than 1. However, when the 10-fold FQPA factor for chlorpyrifos is applied to the chlorpyrifos screening level, 1 of the resulting HIs is above 1, and several others approach 1.

MITC: While the subchronic HQs for MITC are all well below 1 (Table 20), they are still worthy of note since its HQ is higher than many of the others and MITC was found in 84 percent of the samples.

Chronic Exposure

The one-year average of all the sampling sites and days was used to calculate the chronic air concentrations (and resulting HQs) for individual pesticides. The one-per-week samples collected by ARB result in sufficient data points for the calculation of chronic air concentrations and are included in this evaluation of chronic exposure. Figure 12 shows the relative chronic health risk of all the chemicals monitored that were likely because of pesticidal use.

Compounds present because of pesticidal uses: As can be seen from Table 21, all of the one-year average concentrations of pesticides were below the corresponding chronic screening levels. Thus, all of the chronic HQs for these pesticides were less than 1. In fact, almost all of the chronic HQs were substantially less than one—10 times less than 1. Exceptions were the HQ for MITC, which was 0.13 (slightly less than 10-fold below the screening level) and the HQ for chlorpyrifos plus chlorpyrifos oxon, calculated using the additional FQPA safety factor for chlorpyrifos. In this latter case, the chronic average air level for chlorpyrifos plus chlorpyrifos oxon is about one-half of the screening level (HQ = 0.51).

Acrolein and formaldehyde: As previously discussed, both of these compounds are byproducts of combustion and natural processes and have a number of industrial uses and sources. Their presence in the air is because of activities that do not involve pesticidal use; their concentrations are similar to those found in ambient air elsewhere in the state.

The 1-year chronic exposure level of formaldehyde slightly exceeds the chronic screening level, resulting in an HQ of 1.1. The chronic average air level of acrolein significantly exceeds the screening level (HQ of 23.5). If the amended OEHHA acrolein chronic REL (see discussion in section on acute levels of acrolein) of 350 ng/m^3 is used as the chronic screening level, the air concentrations would still exceed the screening level by a factor of 4.0 (HQ = 4.0). These two compounds would dominate any consideration of chronic risk from multiple chemical exposures.

Carcinogenicity

Only two of the chemicals with concentrations measured in any meaningful chronic amounts are carcinogens: 1,3-dichloropropene and formaldehyde. The carcinogenic risk of both of these compounds is evaluated using a low-dose extrapolation (non-threshold mechanism). In such an approach, 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 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). 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.

Risk = (cancer potency) X (exposure)

Exposure = (air concentration) X (respiratory rate)

Risk = (cancer potency) X (air concentration) X (respiratory rate)

Cancer potency is expressed in the units of (mg/kg-day)$^{-1}$. The air concentration for this calculation, then, has to be in units of mg/m^3. In this report, the air concentrations were expressed in units of ng/m^3, so they were converted for these calculations. 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).

1,3-dichloropropene:

Potency = 0.055 (mg/kg-day)$^{-1}$, air concentration = 0.001970 mg/m^3; therefore, Risk = 3.0 x 10^{-5}.

The concentration reported for 1,3-dichloropropene was calculated by adding the amount measured for the cis and trans isomer of 1,3-dichloropropene. For sample dates with no detectable amounts, a value of one-half the detection limit was assigned. The detection limit for both the cis- and trans- 1,3-dichloropropene was 454 ng/m^3; therefore, a sample with no detectable amount was given a value of 227 ng/m^3. As noted, the total average of the monthly averages for the year was 1,970 ng/m^3 or 0.001970 mg/m^3. If the values of the nondetections were assigned a value of 0, the average for the year would be 1,823 ng/m^3 or 0.001823 mg/m^3, resulting in a risk level of 2.8 x 10^{-5}. Therefore, regardless of how the chronic average air concentration is calculated, the resulting risk level is greater than the range of what would normally be considered negligible and merits further evaluation.

Formaldehyde:

> Potency = 0.021 $(\text{mg/kg-day})^{-1}$, air concentration = 0.003256 mg/m^3; therefore, Risk = 1.9×10^{-5}.

This risk level is also greater than the range of what normally would be considered negligible. One approach to evaluating the cumulative risk from exposure to non-threshold carcinogens is to add the respective cancer risks. If this were done for formaldehyde and 1,3-dichloropropropene, the resulting risk would be:

> $3.0 \text{ x } 10^{-5} + 1.9 \text{ x } 10^{-5} = 4.9 \text{ X } 10^{-5}$.

Table 19. Highest one-day air concentrations, acute screening levels, and acute hazard quotients. The FQPA-adjusted hazard quotient adds an uncertainty factor for some pesticides to address children's sensitivity. Chemicals with the highest risk are shown in **bold**.

Pesticide	24-hour acute screening level (ng/m^3)	Highest 1-day concentration (ng/m^3)	Acute hazard quotient	FQPA-adjusted hazard quotient
1,3-dichloropropene	**160,000**	**23,601**	**0.1475063**	**0.1475063**
Acrolein[a]	**190**	**4,586**	**24.1368421**	**24.1368421**
Arsenic[a]	**30**	**5**	**0.1666667**	**0.1666667**
Azinphos-methyl	101,000	ND (3.80)	0.0000376	0.0000376
Carbon disulfide[a]	1,550,000	3,114	0.0020090	0.0020090
Chlorothalonil	34,000	Trace (30-238)[c]	0.0008824	0.0008824
Chlorpyrifos	**1,200**	**150**	**0.1250000**	**1.2500000**
Chlorpyrifos OA		**28**	**0.0233333**	**0.2333333**
Copper[b]	100,000	550	0.0055000	0.0055000
Cypermethrin	40,000	ND (2.34)	0.0000585	0.0000585
Diazinon	**130**	**172**	**1.3230769**	**1.3230769**
Diazinon OA	**130**	**71**	**0.5461538**	**0.5461538**
Dichlorvos	11,000	Trace (24.8)	0.0022545	0.0067636
Dicofol	68,000	ND (1.07)	0.0000157	0.0000472
Dimethoate	34,000	ND (1.16)	0.0000341	0.0000341
Dimethoate OA	34,000	ND (0.97)	0.0000285	0.0000285
Diuron	170,000	ND (2.57)	0.0000151	0.0000151
Endosulfan	4,000	ND (1.62)	0.0004050	0.0040500
Endosulfan sulfate	4,000	ND (2.32)	0.0005800	0.0058000
EPTC	230,000	ND (0.84)	0.0000037	0.0000365
Formaldehyde[a]	**19,000**	**9,457**	**0.4977368**	**0.4977368**
Malathion	40,000	21	0.0005250	0.0052500
Malathion OA	40,000	16	0.0004000	0.0040000
Methyl bromide	820,000	2,524	0.0030078	0.0030078
Metolachlor	85,000	ND (1.37)	0.0000161	0.0000161
MITC	66,000	5,010	0.0759091	0.0759091
Molinate	200,000	ND (0.91)	0.0000046	0.0000455
Norflurazon	170,000	ND (1.88)	0.0000111	0.0000332
Oryzalin	420,000	ND (0.70)	0.0000017	0.0000017
Oxyfluorfen	510,000	ND (3.20)	0.0000063	0.0000063
Permethrin	168,000	Trace (26.8)	0.0001593	0.0001593
Phosmet	77,000	42	0.0005455	0.0005455
Propanil	51,000	ND (1.16)	0.0000227	0.0000227
Propargite	14,000	Trace (25.1)	0.0017893	0.0017893
Simazine	110,000	Trace (2.9-6.4)[d]	0.0000423	0.0001268
SSS-tributylphos.. (DEF)	8,800	ND (0.88)	0.0001000	0.0010000
Sulfur[b]		1,800	NA	NA
Thiobencarb	425,000	ND (2.80)	0.0000066	0.0000066
Trifluralin	1,200,000	Trace (23.2)	0.0000193	0.0000193
Xylene[b]	900,000	5,906	0.0065622	0.0065622
TOTAL (Hazard Index)			**27.07** [e]	**28.43** [e]

[a] Detections of these compounds are likely due to non-pesticidal sources only.

[b] Detections of these compounds are likely due to pesticidal and non-pesticidal sources.

[c] All "traces" were detected when LOQ was 30 ng/m^3.

[d] Used average of LOQ since "trace" detections occurred with both LOQs.

[e] A hazard quotient greater than 1 suggests the need for further evaluation.

Table 20. The highest 14-day average concentration for detected chemicals. The ARB samples were collected only one out of every six days and were not used to determine subchronic concentrations.

Chemical	Subchronic screening level (ng/m^3)	Highest 14-day average concentration (ng/m^3)	Subchronic hazard quotient	FQPA-adjusted hazard quotient
Chlorothalonil	24,000	30.0	0.0012500	0.0012500
Chlorpyrifos	850	96.1	0.1130588	1.1305882
Chlorpyrifos OA	850	6.81	0.0080118	0.0801176
Diazinon	130	20.44	0.1572308	0.1572308
Diazinon OA	130	13.37	0.1028462	0.1028462
Dichlorvos	2,200	9.34	0.0042455	0.0127364
Malathion	15,000	3.14	0.0002093	0.0020933
Malathion OA	15,000	3.6	0.0002400	0.0024000
MITC	3,000	377	0.1256667	0.1256667
Permethrin	90,000	7.47	0.0000830	0.0000830
Phosmet	26,000	18.3	0.0007038	0.0007038
Propargite	14,000	25.1	0.0017929	0.0017929
Simazine	31,000	3.5	0.0001129	0.0003387
Trifluralin	170,000	11.15	0.0000656	0.0000656
TOTAL (Hazard Index)			**0.51**	**1.62**[a]

[a] A hazard quotient greater than 1 suggests the need for further evaluation.

Table 21. The one-year average concentration for detected chemicals.

Chemical	**Chronic screening level (ng/m^3)**	**1-year average concentration (ng/m^3)**	**Chronic hazard quotient**	**FQPA-adjusted hazard quotient**
1,3-Dichloropropene	120,000	1,970	0.0164167	0.0164167
Acrolein[a]	60	1,412	23.5333333	23.5333333
Arsenic[a]	30	1.33	0.0443333	0.0443333
Chlorothalonil	34,000	10.7	0.0003147	0.0003147
Chlorpyrifos	510	23.1	0.0452941	0.4529412
Chlorpyrifos OA	510	2.82	0.0055294	0.0552941
Copper[b]	10,000	43.7	0.0043700	0.0043700
Diazinon	130	3.16	0.0243077	0.0243077
Diazinon OA	130	2.33	0.0179231	0.0179231
Dichlorvos	770	1.92	0.0024935	0.0074805
Formaldehyde[a]	3,000	3,256	1.0853333	1.0853333
Malathion	29,000	1.17	0.0000403	0.0004034
Malathion OA	29,000	0.81	0.0000279	0.0002793
Methyl bromide	3,900	281	0.0720513	0.0720513
MITC	300	38.1	0.1270000	0.1270000
Permethrin	90,000	3.76	0.0000418	0.0000418
Phosmet	18,000	6.27	0.0003483	0.0003483
Propargite	14,000	5.36	0.0003829	0.0003829
Simazine	8,500	0.84	0.0000988	0.0002965
Sulfur[b]	NA[c]	692	NA	NA
Trifluralin	41,000	3.64	0.0000888	0.0000888
Xylene[b]	700,000	1,498	0.0021400	0.0021400
TOTAL (Hazard Index)			**24.98[d]**	**25.45[d]**

[a] Detections of these compounds are likely due to non-pesticidal sources only.

[b] Detections of these compounds are likely due to pesticidal and non-pesticidal sources.

[c] NA = Not available.

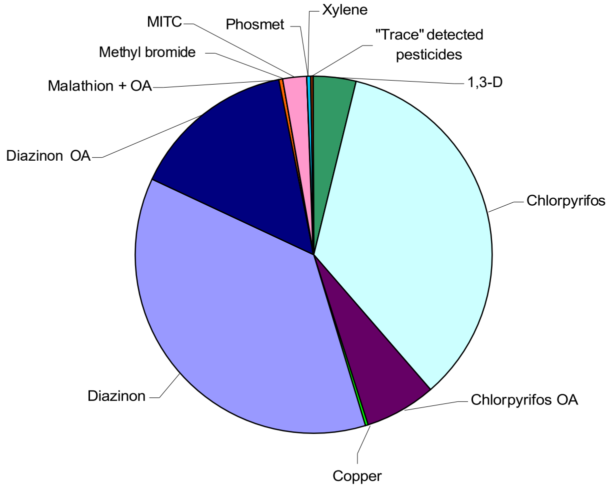
[d] A hazard quotient greater than 1 suggests the need for further evaluation.

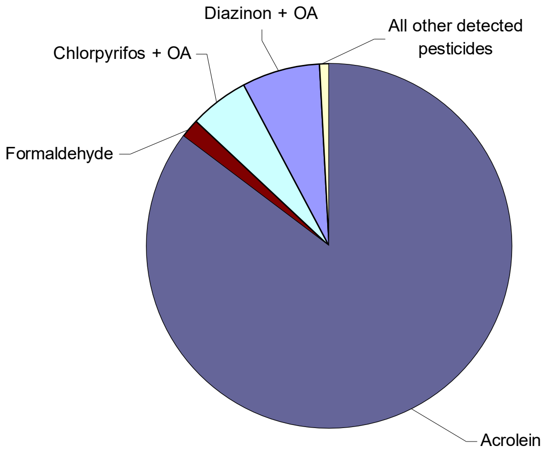
Figure 12a. Relative health risk of all detected chemicals likely due to pesticidal use.

Figure 12b. Relative health risk of pesticides compared to two major VOC air contaminants, acrolein and formaldehyde.

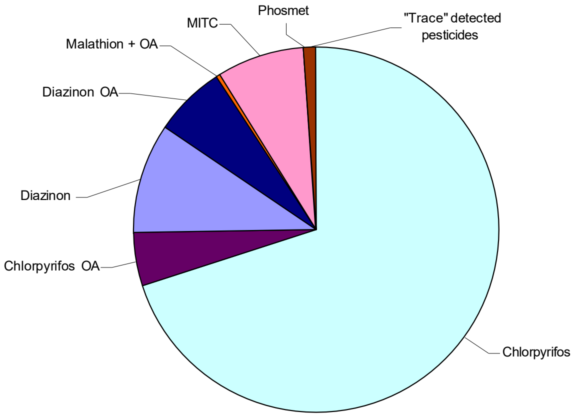
Note: HQ and FQPA quotients used in figure are located in Tables 19 – 21.

Acute HQ x FQPA



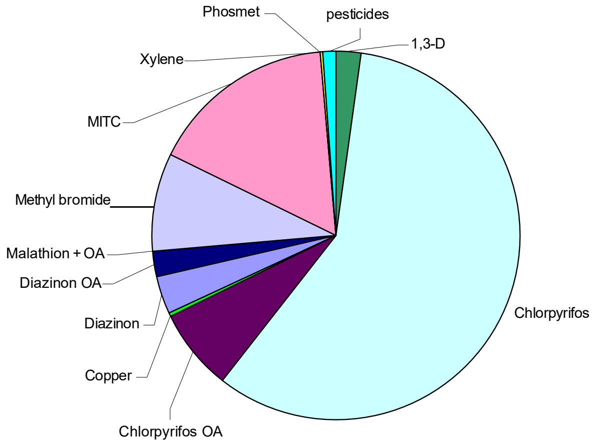


Subchronic HQ x FQPA



(ARB sampled once every 6 days. This is insufficient to estimate a 2-week subchronic exposure.)

Chronic HQ x FQPA



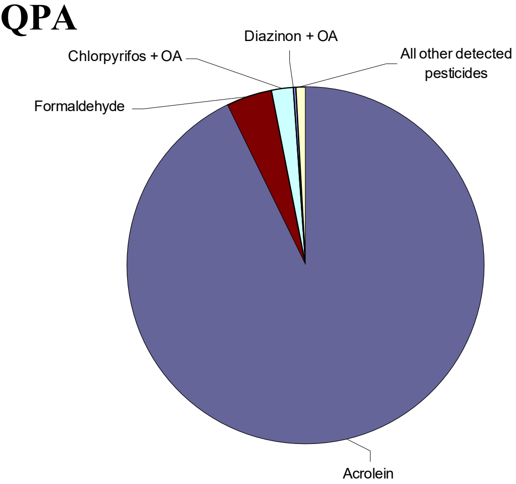
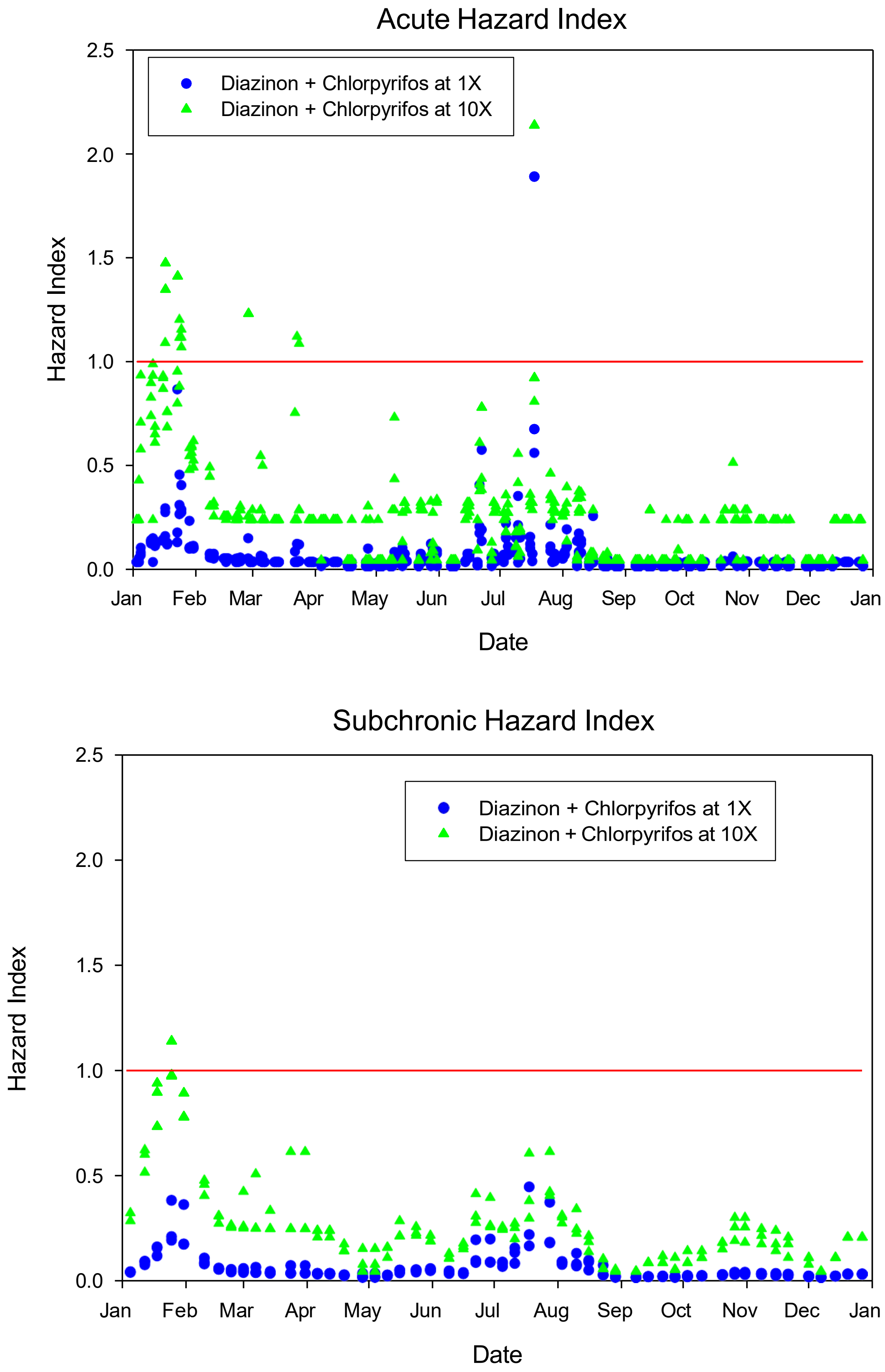


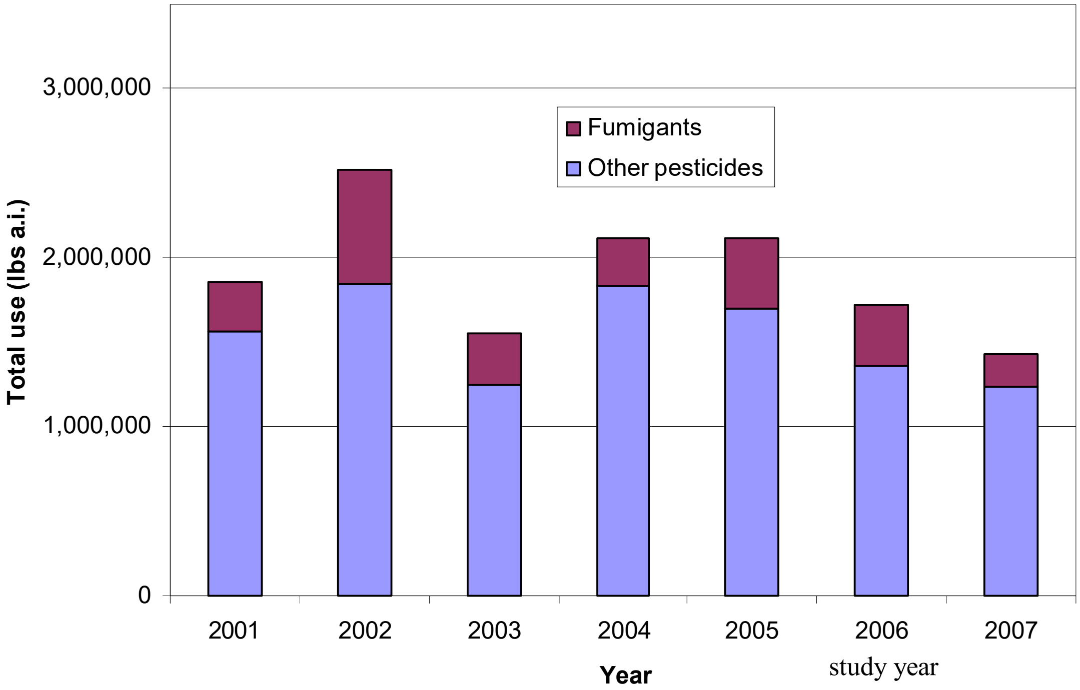
Figure 13. The hazard indices for diazinon and chlorpyrifos. *Note: includes oxygen analog concentrations.*



Reported Pesticide Use in the Parlier Area

As with other areas of the state, reported pesticide use in the Parlier area varies year to year depending on factors such as weather and pest pressure. Figure 14 shows the variation from 2001 through 2007 of total reported pesticide use within five miles of Parlier (Figure 1) (DPR, 2007). The use of all pesticides in the Parlier area in 2006 was slightly less than the average of the five years before plus the year after the study. During study year 2006, fumigants accounted for 21 percent of the total reported pesticide use in the Parlier area. In the other years, fumigant use ranged from 13 to 27 percent of total reported pesticide use.

Figure 14. Total reported pesticide use in the Parlier area for 2001 through 2007.



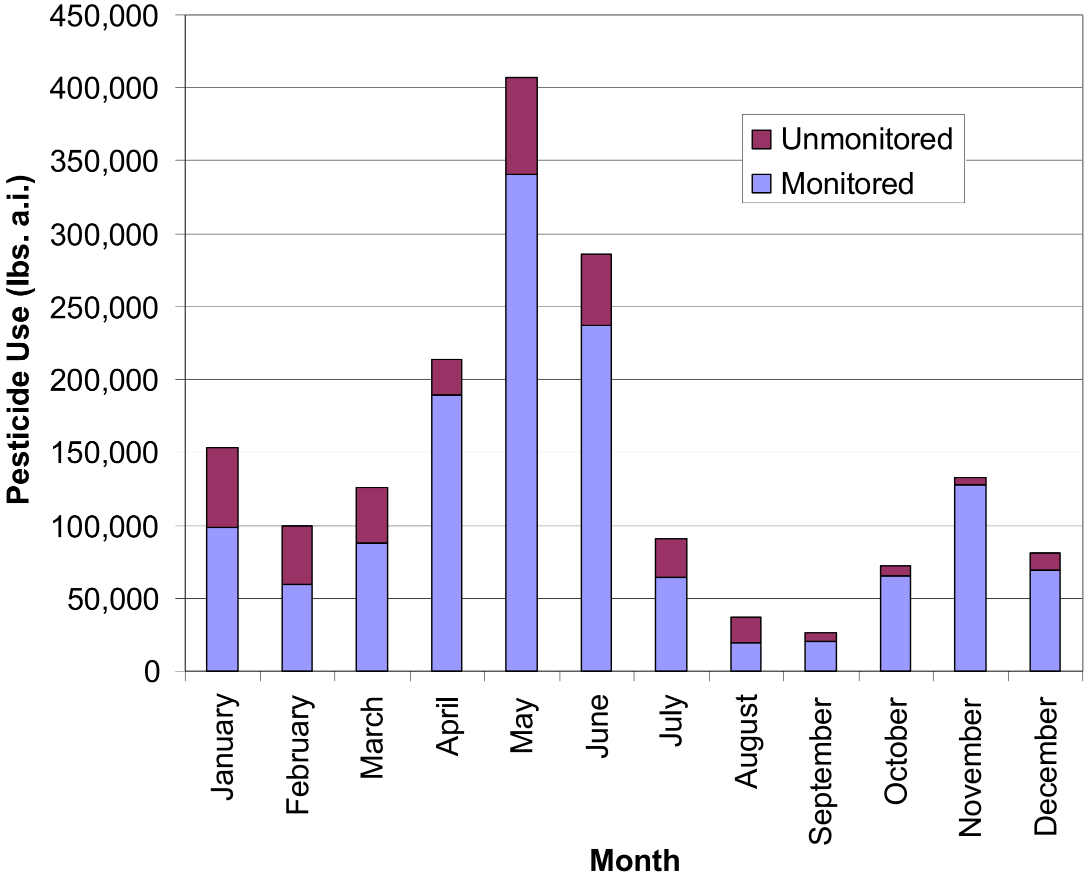
Tables 11 and 22 present reported use data for the pesticides monitored. Of the 36 pesticides monitored, 12 had no reported use in the Parlier area. A total of 1,725,250 pounds of pesticides (not including oils, such as mineral oil) were applied to the Parlier area in 2006. Of this, 801,343 pounds were sulfur, 302,075 pounds were 1,3-dichloropropene, and 109,753 pounds were copper. Of the total pounds of pesticides applied during 2006, 80 percent was of pesticides monitored (Figure 15). Previous progress reports had listed use of xylene. The active ingredient for the two reported applications in question were inaccurately identified as xylene; the product reported was actually a diazinon product. It is still possible that xylene may be present from pesticidal use because it is an inert ingredient commonly used in pesticide formulations. In 2000, xylene-range solvents (xylene and other hydrocarbons with similar boiling temperatures) made up 5 percent of the statewide VOC emissions from agricultural and structural pesticide products, the seventh highest active or inert ingredient in the state.

Table 22. Reported pounds used and number of acres treated for pesticides monitored in Parlier.

	2003		2004		2005		2006	
Pesticide	**Use (lbs)**	**No. of acres**	**Use (lbs)**	**No. of acres**	**Use (lbs)**	**No. of acres**	**Use (lbs)**	**No. of acres**
Fumigants								
1,3-Dichloropropene	248,547	1,257	224,603	1,025	364,524	1,174	302,075	934
Dazomet	0	0	0	0	0	0	0	0
Metam-sodium	15,468	98	26,670	84	22,985	129	25,358	134
Methyl bromide	36,742	150	23,753	83	16,959	77	11,692	51
Potassium N-methyldithiocarbamate	0	0	0	0	0	0	11,125	66
Fumigant Total	300,756	1,505	275,026	1,192	404,468	1,380	339,125	1,119
Organophosphates								
Azinphos-methyl	504	318	337	227	668	678	83	52
Chlorpyrifos	25,132	12,909	26,620	13,253	28,309	13,687	31,418	2,034
Diazinon	2,334	1,539	3,922	2,266	4,083	3,341	3,446	2,787
Dichlorvos (DDVP)	0	0	0	0	0	0	0	0
Dimethoate	208	190	128	154	33	20	374	240
Malathion	621	98	1	3	134	17	665	157
Naled	0	0	0	0	5	19	0	0
Phosmet	32,118	13,552	36,965	15,283	23,573	9,897	31,863	13,440
SSS-Tributylphos.. (DEF)	0	0	0	0	0	0	0	0
Organophosphate Total	60,917	28,606	67,973	31,186	56,805	27,659	67,849	18,710
Carbamates								
EPTC	0	0	0	0	0	0	0	0
Molinate	0	0	0	0	0	0	0	0
Thiobencarb	0	0	0	0	0	0	0	0
Carbamate Total	0	0	0	0	0	0	0	0
Other								
Acrolein	0	0	0	0	0	0	0	0
Chlorothalonil	2,212	855	1,274	489	3,144	1,483	5,230	2,034
Cypermethrin	1	18	0	0	0	0	0	0
Dicofol	713	704	28	40	20	80	151	89
Diuron	2,477	3,255	2,165	3,103	1,872	3,526	2,310	3,974
Endosulfan	0	0	336	231	66	87	7	9
Metolachlor	0	0	0	0	0	0	5	4
Norflurazon	1,735	2,368	1,694	2,634	1,165	1,865	1,249	2,087
Oryzalin	2,615	2,269	5,253	3,956	7,890	6,346	12,970	8,890
Oxyfluorfen	3,973	17,580	5,087	19,902	6,254	21,008	8,502	22,792
Permethrin	10	61	64	364	75	354	222	723
Propanil	0	0	0	0	0	0	0	0
Propargite	9,212	5,217	6,481	3,557	9,830	5,005	7,077	3,966
Simazine	12,026	15,956	13,196	15,638	11,867	13,124	13,117	17,352
Sodium tetrathiocarbonate (CS2)	0	0	0	0	0	0	0	0
Trifluralin	174	257	127	231	32	65	79	108
Xylene	299	179	194	144	135	103	0	0
Other Total	35,447	48,719	35,899	50,289	42,350	53,046	50,930	62,042
Metals								
Arsenic	0	0	0	0	0	0	0	0
Copper	99,558	27,238	90,333	23,989	99,612	33,903	109,753	36,447
Sulfur	849,451	114,344	933,120	122,762	1,208,805	162,963	801,343	128,608

Sulfur-Copper Total	949,009	141,549	1,023,453	146,751	1,308,417	196,866	911,096	165,055

Figure 15. Monthly reported use of both monitored and unmonitored pesticides in 2006.



Figures 16 through 20 present the weekly average concentrations of the five pesticides detected at quantifiable amounts, overlaid with the weekly sum of the reported use of the pesticide. All of the pesticide detections corresponded with times of reported use except for MITC. Several detections of MITC (Figure 19) did not correspond with reported use of field applications of any MITC-producing pesticides. This could indicate that applications made outside of the five-mile boundary of Parlier may have influenced the concentrations of MITC detected.

Figure 16. Chlorpyrifos + oxygen analog: comparison of weekly reported use and detections in the Parlier area.

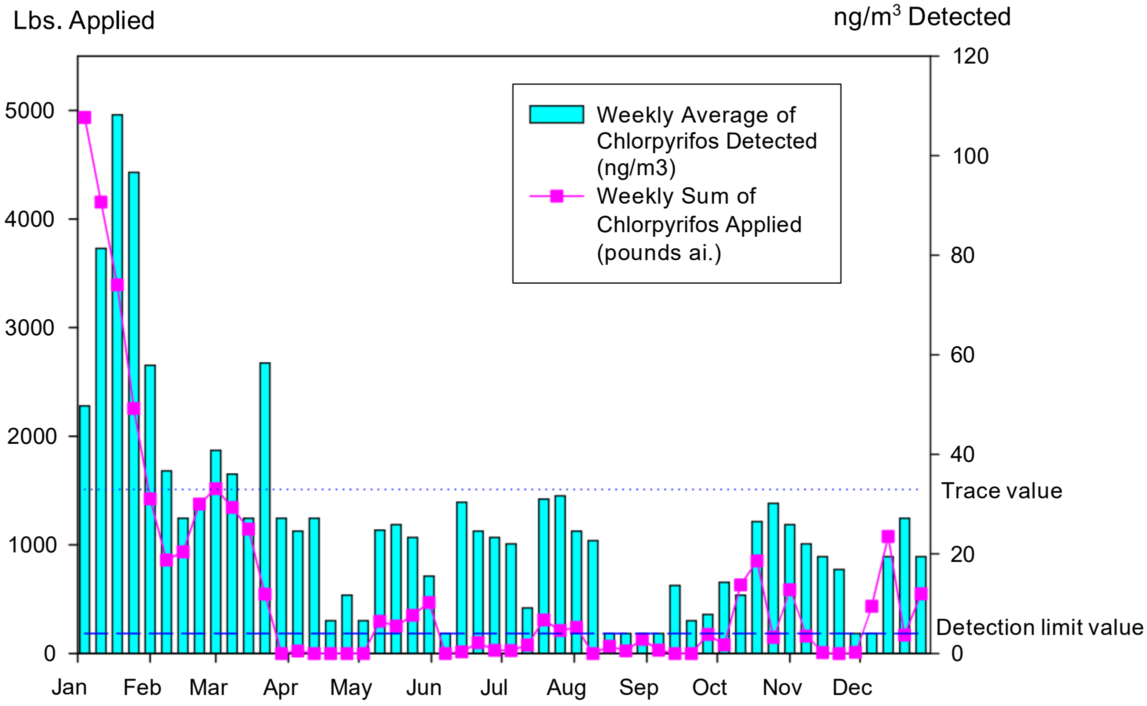


Figure 17. Diazinon + oxygen analog: comparison of weekly reported use and detections in the Parlier area.

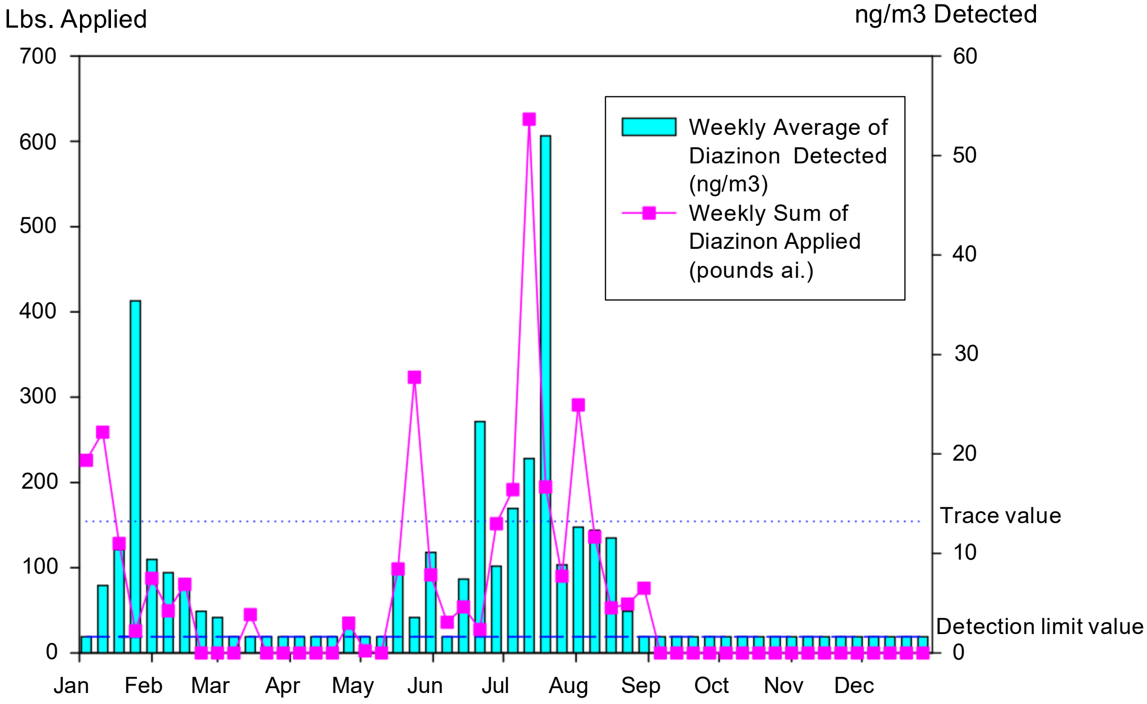


Figure 18. Malathion + oxygen analog: comparison of weekly reported use and detections in the Parlier area. Note: Malathion products are also registered for home use, which is not subject to use reporting requirements.

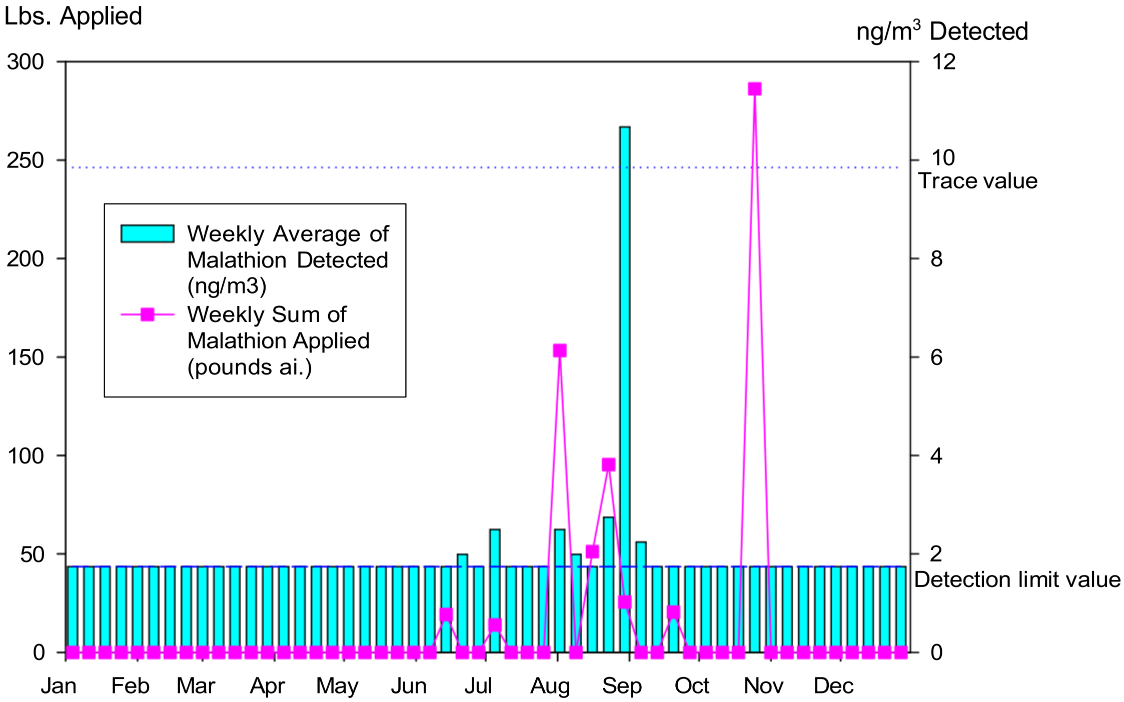


Figure 19. MITC: comparison of weekly reported use and detections in the Parlier area. Note: This figure includes reported use of all MITC-generating products.

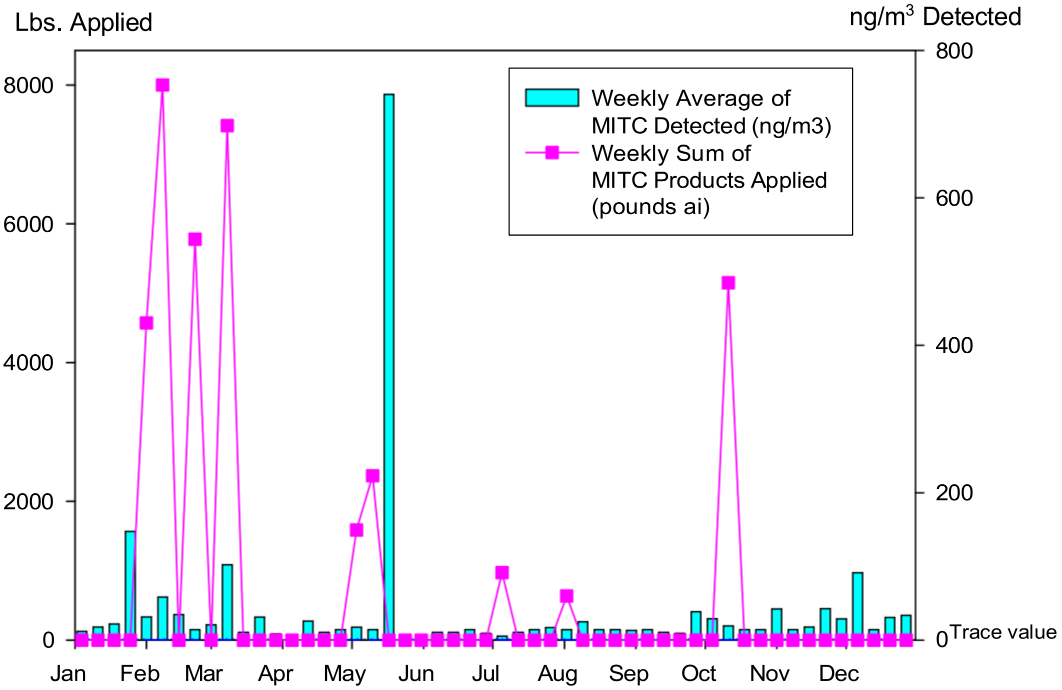
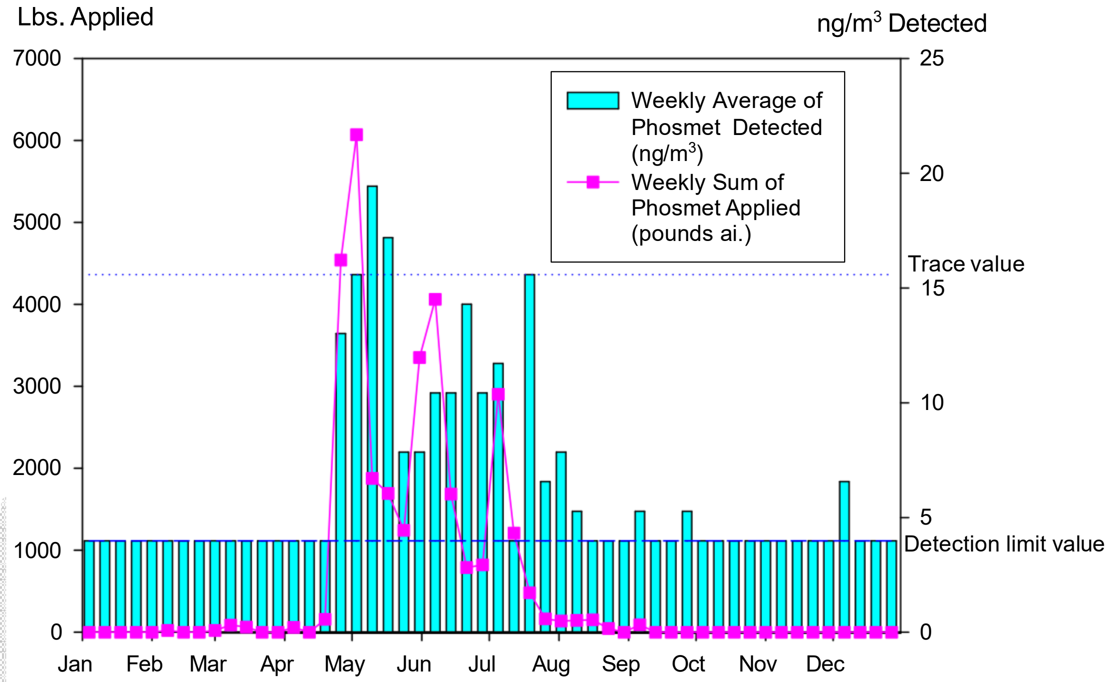


Figure 20. Phosmet: comparison of weekly reported use and detections in the Parlier area.



Figures 21 through 23 map the locations of the applications of chlorpyrifos, diazinon, and phosmet made in 2006. Additional maps for other pesticides with detectable concentrations and reported use are in Appendix I. The maps show the total pounds of active ingredient used for each agricultural field during 2006. Maps were created with ArcInfo 9.2 (ESRI, 2008).

Figure 21. Chlorpyrifos: locations of all reported applications in 2006.

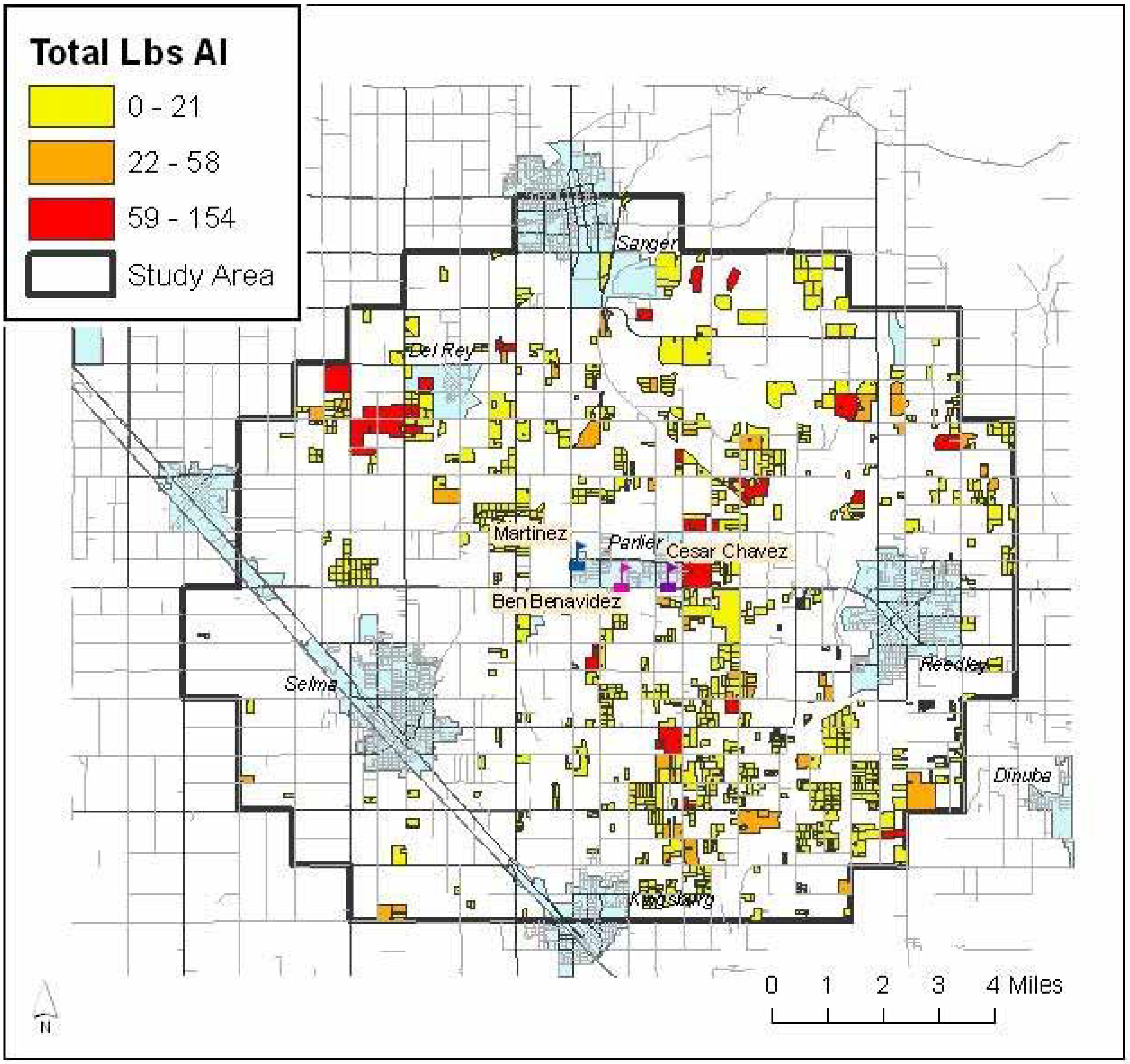


Figure 22. Diazinon: locations of all reported applications in 2006.

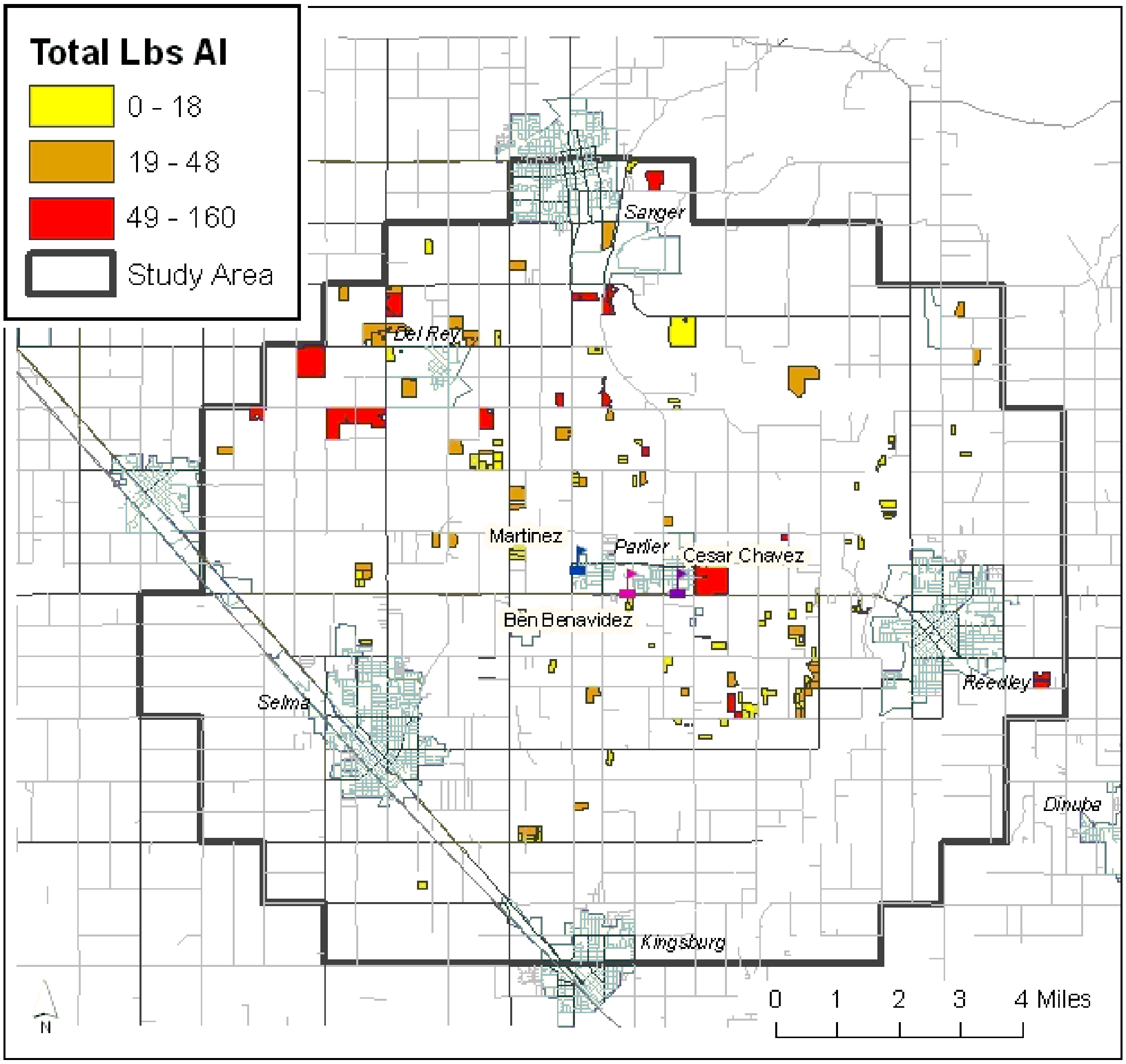


Figure 23. Phosmet: locations of all reported applications in 2006.

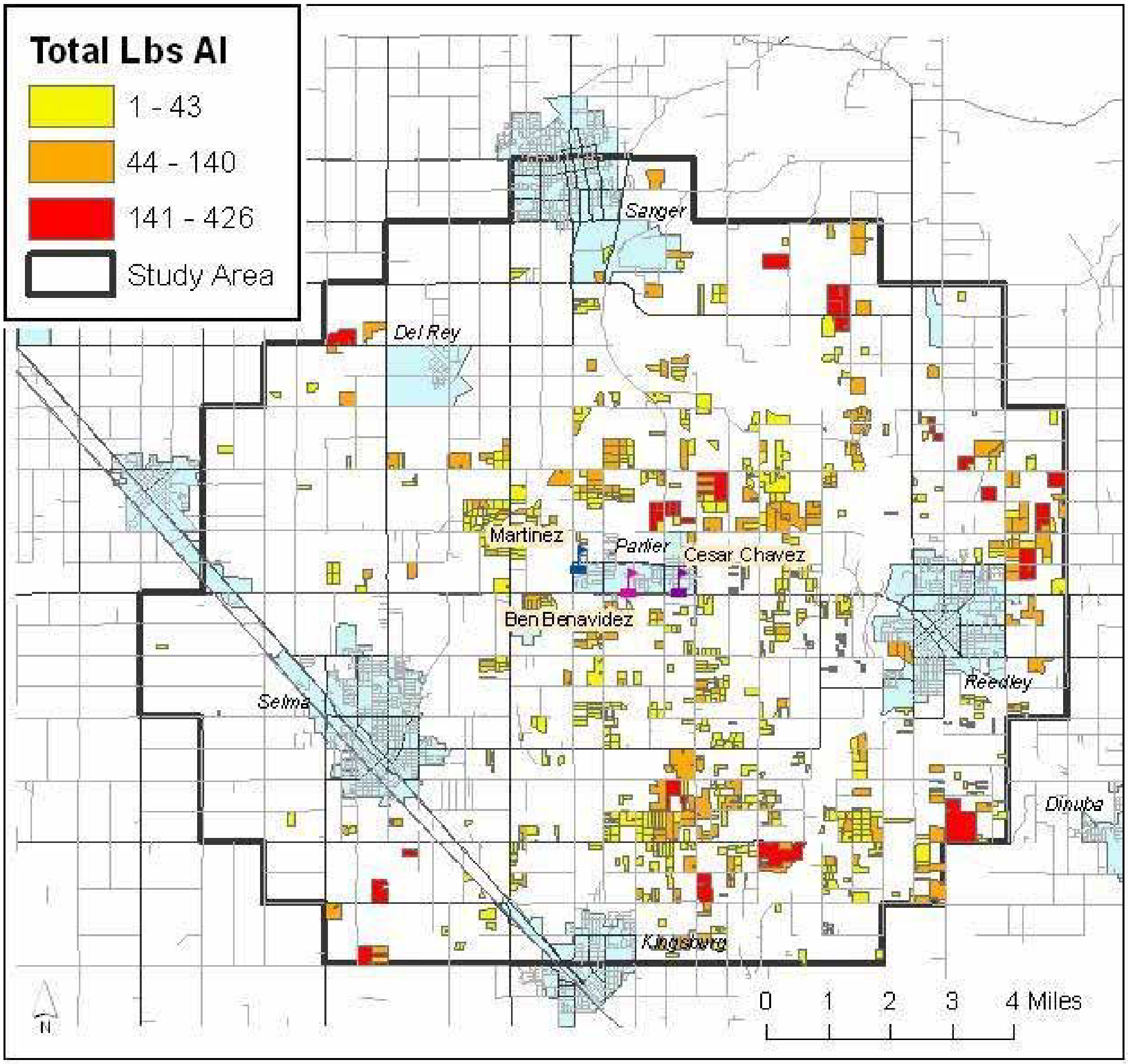
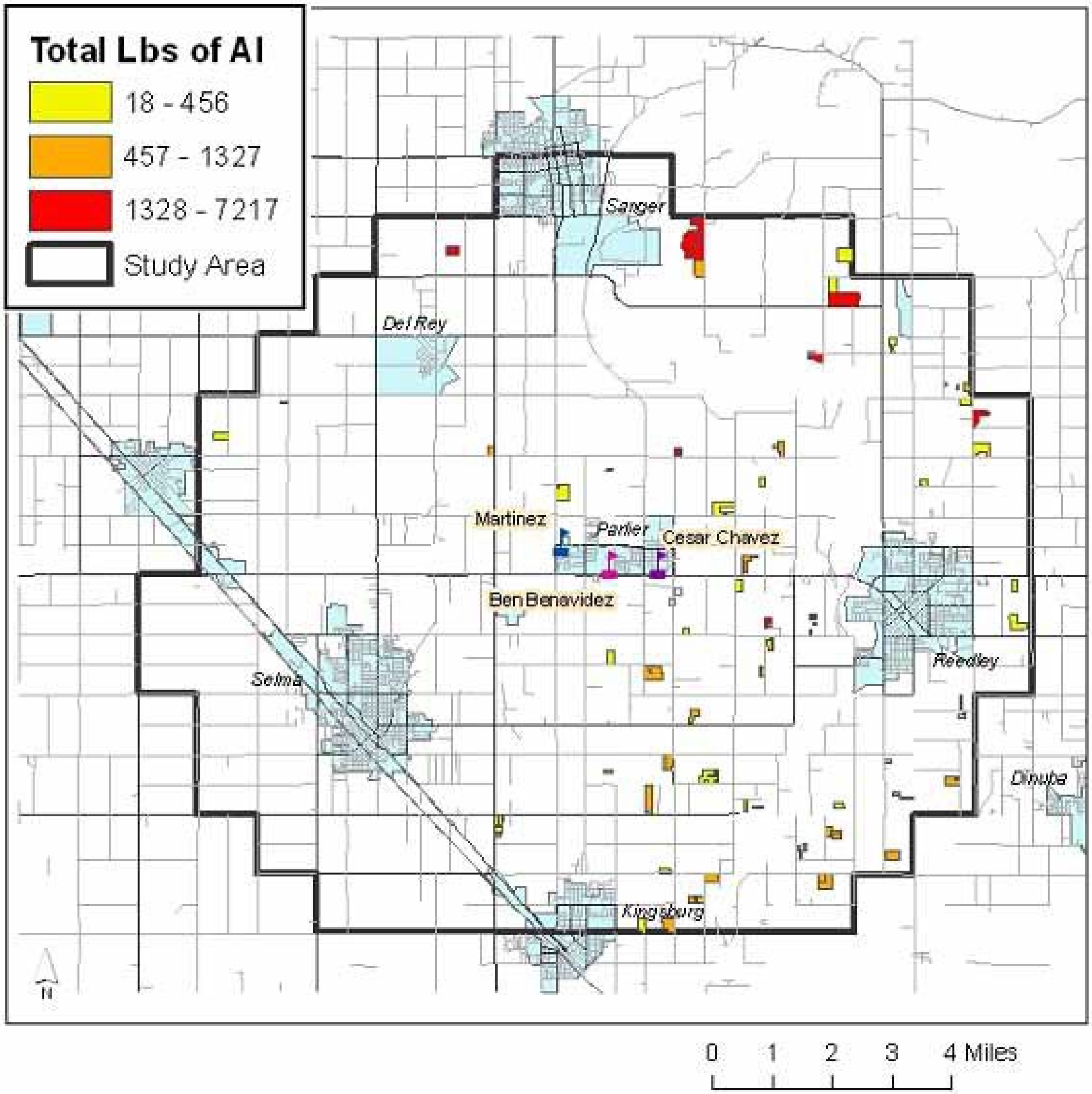


Figure 24. 1,3-dichloropropene: locations of all reported applications in 2006.



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 25 percent in the flow over the sampling interval. Two primary samples collected on January 10 at Chavez Elementary and Martinez Elementary had a 123 percent increase and a 65 percent decrease, respectively, in flow during the sampling period. The samples were retained in the analysis after comparison with the primary at Benavidez Elementary. In addition, a sample collected on April 17 at Benavidez Elementary had a 74 percent decrease in flow during the sampling interval but was also retained after comparison with samples from the other sample sites.

Sample Shipment Quality Assurance

Measurements collected by temperature recorders in the sample shipment containers were reviewed for any temperature changes during shipment that would adversely affect the samples. All samples arrived as expected with dry ice in sample shipment and measured temperatures in an acceptable range.

Pesticide Use Report Validation

The methods used in the validation of DPR's pesticide use reporting database are in DPR report PM 01-02, entitled "Final Report to the California Department of Food and Agriculture for Contract Agreement No. 98-0241 Data Quality of California's Pesticide Use Report" (Wilhoit et al., 2001).

Audit Results

Sampler Flow Audits

The Quality Assurance Section (QAS) of the ARB performed a sampler flow rate audit on January 26, 2006, at three schools. All samplers were operating within the QAS ± 10 percent control limit. It was noted that the mass flow meter used by the field team had not been certified since June 21, 2004, and the sample intake for the co-located multiple pesticide samplers were less than 1 meter apart. The QAS also audited the ARB's Beta Attenuation Monitor (BAM) for PM2.5, and toxics samplers located at the Benavidez Elementary School. (See Appendix D for the results.)

A follow-up sampler flow audit was conducted on March 30 at the three sample sites. It was noted that the mass flow meters used by the field team had been recertified on February 27, 2006. It was also noted that the co-located multiple pesticide samplers were still less than 1 meter apart. Since only one of the co-located samplers was run at a time, the project leader did not feel it was necessary to relocate the sample intakes further apart.

Laboratory Audits

The Quality Assurance (QA) team evaluated the CDFA Center for Analytical Chemistry laboratory, the ARB's Organic Laboratory Section, and ARB's Inorganic Laboratory Section in March 2006. The QA team found that all the laboratories were following accepted and agreed-upon procedures for analysis and quality assurance, including sample handling, instrument calibration, method validation, and documentation. The QA team noted that all three laboratories had good QA practices and produced good quality data. The QA team had several comments and recommendations (see Appendix D).

A follow-up audit was conducted in September 2006 since insufficient data were generated at the time of the first audit to review the required 5 percent of the data generated. Once again, the QA team found that the three laboratories had good QA practices and produced good quality data. Appendix D contains comments and recommendations.

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. Matrix spikes and blanks were conducted for all matrices: XAD4 resin tubes, SKC coconut charcoal tubes, ground water, and quartz and glass fiber filters. Laboratory matrix spikes were fortified with the same analytes that were part of the analytical screens for the field samples. The blank matrix materials were not fortified, but were extracted and analyzed along with the matrix spikes and field samples. Table 23 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 78 percent to 110 percent for all chemicals analyzed. None of the spike samples were outside the control limits established from the validation data. Glass filters showed a greater range in recoveries than quartz filters, none detected to 115 percent and 46.3 percent to 126 percent respectively, which was possibly because of our request that the lab quickly develop a method for this analysis (Table 24). Furthermore, problems with the filters contaminating the GC column occurred. One ground water lab matrix QC sample was fortified and analyzed with the three well samples collected for this study. The herbicide percent recoveries ranged from 93.5 percent to 100 percent, which were within the control limits (Table 25). The surrogate propazine was added to each of the samples and the QC sample. The propazine recovery was within control limits for all 3 samples and ranged from 81.5 to 87.5 percent. None of the laboratory blanks contained detectable concentrations of any chemical analyzed. (See Appendix J for additional results of CDFA's laboratory quality control and quality assurance data.)

Trip blanks, blind spikes and duplicate samples are part of DPR's field and laboratory QC program (Tables 23 and 26). 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 26) with quantifiable concentrations had a maximum relative difference of 21 percent for the XAD multiple pesticide samples and 9 percent for the MITC samples, indicating proper field and laboratory procedures. The matrix blind spikes were fortified by a CDFA chemist not associated with the analysis (Table 23). The blind spikes were given to DPR staff, relabeled, and then intermingled and delivered with field samples. Blind spikes were only submitted for the air sample analyses. The average percent recovery results of the blind spikes ranged from 65.2 to 112 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. The trip blanks contained no detectable concentrations.

Problems with the Chlorothalonil Analysis

Following the analysis of the quartz and glass fiber filters for the particulate sampling associated with UCD Center for Health and the Environment's study, the LOQ for chlorothalonil was raised because of contamination of the GC column. The chlorothalonil LOQ varied for samples collected from June 26, 2006, to September 9, 2006, and the results should be considered questionable and may not be valid. The problem was corrected and all following samples had a LOQ of 1 ug/sample (46.3 ng/m^3) for chlorothalonil. The contamination of the GC column also affected the recoveries from the glass filters for chlorothalonil, cypermethrin, and phosmet (Table 24).

Validation and Control Limits

The MITC and the multi-pesticide analysis method in sorption tubes and the herbicide in ground water analysis method were validated according to the DPR SOP QAQC001.00 (Appendix C). 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. For the sorption tube validations, the validations give an idea of the desorption efficiency of the extraction method. Once the study began, DPR staff discovered that the validation of the MITC method was very precise and the spike levels were much higher than staff requested for QC spikes analyzed with the samples. Therefore, DPR staff chose to use the first seven QC spikes to develop the control limits (Appendix E). Validation was conducted for the ground water screen for DPR's ground water program previous to this study. The data are part of the laboratory method SOP (Appendix E).

Storage Stability

Storage stability studies were conducted for the sorption tube and ground water analyses. MITC was spiked on 3 separate coconut charcoal tubes and analyzed on days 0, 1, 7, 14, 29, 46, and 60. Each day had 3 replicates. MITC recovery at day 60 was 4.8 percent less than the QC sample; thus, the frozen samples were adequately stable. The field samples were analyzed on average within five days. The average included 4 back-up samples that were held up to 43 days before analysis. Likewise the multi-pesticide screen analytes were spiked on 3 replicates for each day, and then analyzed on days 0, 7, 14, and 28. Most of the analytes were stable, but 4 analytes had some recovery loss by day 28. The multi-pesticide XAD4 samples were stored an average of 5 days including a few back-up samples that were analyzed at up to 22 days after sampling because of breakage or analysis problems with the initial samples.

Ground water storage stability for the herbicides followed the same procedure and was analyzed on multiple days to day 50. The ground water samples were sampled and extracted within five days.

Trapping Efficiency

To determine the effectiveness of resin and charcoal trapping and retention of the analytes while air is drawn through the tubes, two trapping efficiency tests were conducted according to SOP FSAI003.00 (Appendix C). For the multi-pesticide analytes, 3 tubes were spiked with 10 µg, 3 more with 5 µg and 3 with 2 µg of all the analytes, and were placed on pumps for 24 hours at a rate of 15 L/min. After laboratory analysis, mean recoveries of the repetitions were calculated to determine the XAD4 resin trapping efficiency for each analyte. The trapping efficiency was good for most analytes except for oryzalin and oxyfluorfen, which had variable and low recoveries. For the organophosphates (OPs) dimethoate, malathion, diazinon and chlorpyrifos, the lab analyzed for the OA to determine the percent conversion of the parent compound to the OA. The OP parent analytes converted less than six percent to their OAs (Appendix E).

MITC was spiked at 1.0 and 100 µg and run with 2 reps of each spike amount at either 1.5 L/min or 1.0 L/min for 24 hours. The average recovery of the 2 1.0- and 100- µg spikes at 1.5 L/min was 82.3 percent and the same combination at 1L/min was 75.8 percent (Appendix E).

Table 23. 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)**
Azinphos-methyl	91.9	112	ND[a]	ND
Chlorothalonil	110	83.3	ND	ND
Chlorpyrifos	95.5	102	ND	ND
Chlorpyrifos OA	94.2	78.5	ND	ND
Cypermethrin	102	NS[b]	ND	ND
Diazinon	90.6	97.1	ND	ND
Diazinon OA	96.3	86.0	ND	ND
Dichlorvos	92.6	80.1	ND	ND
Dicofol	91.2	NS	ND	ND
Dimethoate	94.1	79.0	ND	ND
Dimethoate OA	96.6	NS	ND	ND
Diuron	95.6	95.3	ND	ND
Endosulfan	96.1	NS	ND	ND
Endosulfan sulfate	103	NS	ND	ND
EPTC	77.7	NS	ND	ND
Malathion	93.3	89.3	ND	ND
Malathion OA	98.0	81.7	ND	ND
Metolachlor	97.3	NS	ND	ND
MITC	85.4	65.2	ND	ND
Molinate	80.2	NS	ND	ND
Norflurazon	95.5	NS	ND	ND
Oryzalin	93.1	88.7	ND	ND
Oxyfluorfen	101	92.0	ND	ND
Permethrin	93.4	73.8	ND	ND
Phosmet	106	92.4	ND	ND
Propanil	91.2	NS	ND	ND
Propargite	98.1	89.8	ND	ND
Simazine	96.2	96.5	ND	ND
SSS-tributylphos… (DEF)	94.0	NS	ND	ND
Thiobencarb	88.9	NS	ND	ND
Trifluralin	91.7	87.0	ND	ND

[a] ND = None detected.

[b] NS = Field sample not spiked with the chemical.

Table 24. Results for quality control samples for glass and quartz fiber filters.
Note: All blank glass and quartz fiber filters run as a control with samples were none detected.
All chemicals were spiked at 3 ug/filter each.

	Percent recovery of lab spiked filters			
Chemical	**Glass filter extracted 6/27/06**	**Quartz filter extracted 6/27/06**	**Glass filter extracted 1/18/07**	**Quartz filter extracted 1/18/07**
Azinphos-methyl	86.0	108	81.7	88.3
Chlorothalonil	ND[a]	ND	79.0	114
Chlorpyrifos	69.7	93.0	83.3	89.0
Chlorpyrifos OA	82.3	91.3	92.0	100
Cypermethrin	38.3	46.3	45.3	78.7
Diazinon	97.0	106	95.3	95.0
Diazinon OA	95.0	103	115	126
Dichlorvos	49.3	83.0	79.0	93.7
Dicofol	67.3	90.0	90.3	90.7
Dimethoate	85.7	111	88.0	91.3
Dimethoate OA	89.7	98.3	93.3	92.0
Diuron	111	93.7	102	115
Endosulfan	72.3	97.0	72.7	81.0
Endosulfan sulfate	59.0	70.3	71.3	91.0
EPTC	31.7	69.7	76.7	95.0
Malathion	87.0	96.0	82.7	96.3
Malathion OA	95.3	103	94.7	102
Metolachlor	88.7	98.3	89.3	105
Molinate	68.7	91.0	88.0	99.3
Norflurazon	98.0	101	90.3	88.0
Oryzalin	81.7	92.7	92.3	92.3
Oxyfluorfen	78.3	102	81.3	88.3
Permethrin	72.3	90.0	74.3	79.3
Phosmet	15.7	109	2.13	92.7
Propanil	99.3	102	105	109
Propargite	90.7	109	107	116
Simazine	97.0	107	82.0	90.0
SSS-tributylphos… (DEF)	94.3	103	84.0	88.3
Thiobencarb	88.7	99.3	88.7	93.7
Trifluralin	75.0	98.0	86.0	94.7

[a] ND = None detected

Table 25. Results for quality control samples for ground water samples.

Note: The laboratory matrix blank was none detected.

Chemical	**Lab spikes (% recovery)**
Atrazine	95.5
Simazine	94.5
Diuron	95.5
Prometon	98.5
Bromacil	98.0
Hexazinone	93.5
Norflurazon	100
Desmethyl Norflurazon	93.5
DEA (2-amino-4-chloro-6-isopropylamino-s-triazine)	99.5
ACET (2,4-diamino-6-chloro-s-triazine)	99.5
DACT (2,4-diamino-6-chloro-s-triazine)	99.0
Propazine surrogate	89.0

Table 26. Results for duplicate sample pairs.

	Number of matches	
Primary/duplicate results	**Multiple chemical samples**	**MITC samples**
ND[a]/ND	474[b]	2
trace[c]/trace	22	10
ND/trace	8	1
ND/>LOQ	0	0
trace/>LOQ	2	1
>LOQ/>LOQ	4	5
Relative Difference[d]	0.9% - 21%	5% - 9%

[a] ND = None detected.

[b] Includes 289 possible pairs from nondetected chemicals.

[c] trace = Pesticide detection confirmed, but less than the quantitation limit.

[d] For pairs with both concentrations >LOQ.

DISCUSSION

How do these results compare with other air monitoring results for pesticides in California? DPR, ARB, and the Pesticide Action Network North America (PANNA) have monitored ambient air for pesticides in different parts of California. (See Appendix H for detailed results.)

DPR conducted a two-phase study in Lompoc (Santa Barbara County). Phase One, a 1998 pilot project, was designed to develop and test a method to analyze multiple pesticides from a single air sample. In Phase Two, in 2002, DPR measured ambient air concentrations of 15 pesticides, many of the same ones analyzed in the Parlier study (Table 27).

Table 27. Summary of the highest 24-hour concentrations measured in Lompoc in Phase One and Phase Two, and in Parlier.

	Phase One		Phase Two		Parlier	
	Highest concentration (ng/m^3)	**Percent of samples with detection[a]**	**Highest concentration (ng/m^3)**	**Percent of samples with detection[a]**	**Highest concentration (ng/m^3)**	**Percent of samples with detection[a]**
Chlorothalonil	Trace	23.5	Trace	17	Trace	17
Chlorpyrifos	83	97	15.1	34	150	64
Chlorpyrifos OA	8.5	3.4	Trace	11	28	22
Diazinon	18	2.5	Trace	7.5	172	32
Diazinon OA	5.3	0.8	Trace	2.5	71	19
Dichlorvos (naled)	Not Sampled	Not Sampled	Trace	20	Trace	1
Dicofol	Not Sampled	Not Sampled	Trace	5.7	Not Detected	0
Dimethoate	Not Detected	0	Trace	1.9	Not Detected	0
Dimethoate OA	Not Detected	0	Trace	7.5	Not Detected	0
EPTC	Not Sampled	Not Sampled	6.5	5.0	Not Detected	0
Malathion	Not Sampled	Not Sampled	7.6	23	21	1
Malathion OA	Not Sampled	Not Sampled	2.2	20	16	5
Methyl bromide	Not Sampled	Not Sampled	Not detected (Trace)[b]	2	2,524	66
MITC	Not Sampled	Not Sampled	920 (1885)[b]	58	5,010	84
Permethrin	Trace	0.8	Trace	4.4	Trace	1
Simazine	Not Sampled	Not Sampled	Not Detected	0	Trace	7
Trifluralin	Not Sampled	Not Sampled	Trace	24	Trace	24

[a] Includes quantified and trace detections.

[b] Concentration in parenthesis is from canister sample.

Chlorpyrifos, diazinon, methyl bromide and MITC concentrations measured in Parlier were many times higher than those measured in Lompoc. There was a much higher reported use of the pesticides during the monitoring period in Parlier than in Lompoc.

The ARB, in support of DPR's Toxics Air Contaminant (TAC) 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 the TAC program includes results for 14 of the pesticides in the Parlier study: 1,3-dichloropropene, chlorpyrifos, chlorothalonil, diazinon, endosulfan, EPTC, malathion, MITC, methyl bromide, molinate, permethrin, propargite, simazine and S,S,S-tributyl phosphorotrithioate. See Table 28 (and Appendix H) for detailed results of the individual pesticides monitored.

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 28). In 2005, 80 percent of the samples were above the quantitation limit; the maximum concentration measured was 1,120 ng/m^3.

Concentrations measured in Parlier were lower than concentrations measured in other parts of the state by the ARB (under DPR's TAC program which samples in areas of highest use) or PANNA.

Table 28. Highest 24-hour concentrations of the pesticides monitored in Parlier, compared to previous DPR/ARB and PANNA monitoring studies in California.

	Other Studies					**Parlier**		
Chemical	**Year**	**County**	**Maximum 24-hour concentration (ng/m^3)**	**Percent of samples with quantifiable concentrations**	**LOQ[a] (ng/m^3)**	**Parlier maximum 24-hour concentration (ng/m^3)**	**Percent of samples with quantifiable concentrations**	**LOQ (ng/m^3)**
1,3-Dichloropropene	2000	Kern	135,000[b]	32	50	23,080	34	444
Chlorothalonil	2002	Fresno	14	60	2.3	Trace	0	92.6
Chlorpyrifos	2004	Tulare[c]	1,340	76	6	150	10	46.3
Chlorpyrifos OA	1996	Tulare	230	70	9.4	28	0.4	11.6
Diazinon	1997	Fresno	290	22	75	172	9	11.6
Dichlorvos/Naled	1991	Tulare	65	14	40	Trace	0	46.3
Endosulfan	1996	Fresno	166[d]	100	11	Not detected	0	46.3
EPTC	1996	Imperial	240	23	72	Not detected	0	11.6
Malathion	1998	Imperial	90	78	4	21	0.2	11.6
Malathion OA	1998	Imperial	28	37	7.9	16	1	11.6
Methyl bromide	2001	Santa Cruz	142,000	100	36	2,468	66	116
MITC	1993	Kern	18,000	88	10	5,010	29	23.2
Permethrin	1997	Monterey	Trace	5	15	Trace	0	46.3
Propargite	1999	Fresno	1300	40	23	Trace	0	46.3
Simazine	1998	Fresno	18	18	4.2	Trace	0	11.6
S,S,S-tributyl… (DEF)	1987	Fresno	330	78	1.1	Not detected	0	11.6

[a] LOQ = Limit of Quantitation.
[b] After development of mitigation measures.
[c] Monitoring conducted by PANNA.
[d] Total of endosulfan I and II.

CONCLUSIONS, ACTIONS AND RECOMMENDATIONS

The monitoring was designed to answer these questions:

- **Are residents exposed to pesticides in the air? Which pesticides are people exposed to? In what amounts?** Yes, of the 40 pesticides or breakdown products that were monitored for, 23 were detected (See Table 8). Measured amounts varied, depending on the pesticide and, for the most part, were comparable to levels measured in other Central Valley communities.
- **Are the amounts of pesticides found in air of concern to human health, particularly for children?** Diazinon was the only pesticide monitored that exceeded the acute screening levels. Chlorpyrifos air concentrations did not exceed the acute screening level but, if the federal FQPA 10-fold safety factor were applied, the measured air concentrations would have approached or exceeded the screening level in several instances. The 1,3-dichloropropene chronic average air level results in a calculated cancer risk that is above the range of what would normally be considered negligible (that is, above the acceptable risk level).

Chlorpyrifos and diazinon accounted for most of the relative health risk of the monitored chemicals that were likely because of pesticidal use. Because of these results, DPR moved diazinon to the top of the high priority list for risk assessment. DPR initiated a comprehensive diazinon risk assessment in 2008 to consider all routes of exposure, including inhalation of ambient air. In addition, U.S. EPA's Reregistration Eligibility Decision for diazinon places additional restrictions on the agricultural uses of the pesticide. While DPR had already initiated a risk assessment on chlorpyrifos, it will complete the assessment sooner than originally planned, based on these findings. The air concentrations measured in Parlier are an integral part of the assessment.

The 1,3-dichloropropene chronic average air concentration results in a calculated cancer risk that is above the range of what would normally be considered negligible. These results indicate a need for further evaluation; the results will be considered along with the Department's air modeling results as part of its continuing evaluation of management plans and permitted uses and application restrictions for 1,3-dichloropropene. Additionally, DPR has reopened the risk assessment of 1,3-dichloropropene and is evaluating current uses in various regions in the state.

Acrolein and formaldehyde were frequently detected, often at concentrations well above the acute and chronic screening levels. In addition, the air concentrations of formaldehyde indicated concern was warranted for carcinogenic effects. However, acrolein and formaldehyde concentrations were not because of activities involving pesticidal use (including dairy or poultry farms) and their concentrations were similar to those found in the ambient air elsewhere in the state. Since these air concentrations are not due to pesticidal uses, their mitigation and regulation fall outside DPR's regulatory mandate and its ability to mitigate. Nonetheless, DPR had already initiated a risk assessment on the pesticidal uses of acrolein and will include these acrolein air concentrations in the assessment. The Department will work with ARB and OEHHA to conduct the assessment.

The detection of pesticides corresponded with reported use during the study, except for MITC. MITC was frequently detected when use of its parent compounds metam sodium, potassium N-methyldithio-carbamate (K-Pam), or dazomet was not reported. Perhaps applications made outside of the five-mile boundary of the study area influenced the concentrations of MITC detected.

After discussion with the LAG, DPR added the following objectives unrelated to the monitoring:

- **Inform the community of project, including public forums.** DPR held eight public meetings with the LAG from 2005 through 2007. Several hundred people attended DPR's community forum in January 2006 to "kick off" the monitoring. In addition to a discussion of the monitoring, the forum included more than a dozen other organizations that provided immunizations, as well as information on lead exposure prevention, crime prevention, vehicle safety, gardening, and jobs. DPR made a presentation at a public meeting of the joint powers authority that included elected officials from Parlier and surrounding communities. DPR also made presentations to the staff and students of the monitored schools, discussing the study and other monitoring the Department conducts.
- **Reduce pesticide risk.** This report focuses on the results of the monitoring conducted in Parlier; actions on the precautionary approach to reduce pesticide risk is beyond the scope of this report. For further information on actions to address the precautionary approach, please see DPR's report on *Soil Fumigant and Organophosphate Insecticide Use and Alternatives—Parlier, Fresno County, California* (DPR, 2007). This document identified research needs and outreach priorities for reduced-risk pest management in the Parlier area. It includes significant changes that growers have made to pesticide practices that will reduce exposure and risk. Growers and others can use this document to apply the precautionary approach to protect public health and the environment by promoting and supporting the development and voluntary adoption of reduced-risk pest management systems.
- **Conduct follow-up actions, such as education or regulatory actions or both.** See the previous section describing actions taken in response to detections of chlorpyrifos, diazinon, and 1,3-dichlorpropene.
- **Put risk in perspective.** The risks from acrolein and formaldehyde were higher than any of the pesticides detected in Parlier. OEHHA is developing methods to comprehensively evaluate cumulative and relative risk.

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