Appendix A

Summary of Ambient Air Monitoring for Methyl Bromide

Department of Pesticide Regulation

Paul E. Helliker
Director

Gray Davis
Governor

Winston H. Hickox
Secretary, California Environmental Protection Agency

March 30, 2001

TO: Interested Parties

SUBJECT: SUMMARY OF AMBIENT AIR MONITORING FOR METHYL BROMIDE

At the request of the Department of Pesticide Regulation (DPR), the Air Resources Board (ARB) monitored for methyl bromide in two areas of the state between July and November 2000. DPR has evaluated ARB's data by comparing the measured air concentrations to target concentrations. DPR's goal is to regulate methyl bromide use so that the target concentrations are not exceeded. As described in the attached document, air concentrations for all one-day and one-week periods were below the target concentrations, but air concentrations for an eight-week period were above the target concentration.

DPR is analyzing the monitoring data as well as pesticide use patterns and weather data to determine the major factors causing the high air concentrations. Based on this analysis, DPR will develop mitigation measures to reduce air concentrations to acceptable levels. Some of the mitigation measures that DPR is investigating are limits on the amount of methyl bromide that can be applied in a given area, increasing the time or distance between methyl bromide fumigations, and increasing the size of buffer zones. We expect to discuss the options with you over the next few months. If additional mitigation measures are needed, we plan on implementing them prior to July 2001, the start of the peak use period.

DPR has requested ARB conduct additional monitoring later this year to determine the effectiveness of the mitigation measures. In addition, the monitoring will help determine if the regulations implemented in January 2001 have had any effect on methyl bromide levels in air.

For additional information concerning this monitoring or other methyl bromide issues please feel free to contact Mr. Randy Segawa, of my staff, at (916) 324-4137, rsegawa@cdpr.ca.gov, or DPR's web site, <www.cdpr.ca.gov>.

Sincerely,

Original Signed By

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Summary of Ambient Air Monitoring for Methyl Bromide
March 28, 2001

BACKGROUND

Methyl bromide is one of the most widely used pesticides in California, with approximately 15 million pounds applied annually in the state. Methyl bromide is a gaseous fumigant that kills insects, mites, rodents, nematodes, termites, weeds, and organisms that cause plant diseases. Because it is a colorless, odorless gas, methyl bromide is normally mixed with chloropicrin, a tear gas with a noticeable odor.

Farmers use methyl bromide to treat soil before planting vegetable, fruit and nut crops, and flower and forest nurseries. Depending on the crop, field applications may occur annually, or once every several years. Methyl bromide is injected into the soil with specialized application equipment. After harvest, methyl bromide fumigation protects crops from pest damage during storage and transportation. The fumigant is also used for termite eradication in homes and other structures, and to control insects in mills, ships, railroad cars and other transportation vehicles.

The Department of Pesticide Regulation (DPR) and the county agricultural commissioners have implemented extensive restrictions on the use of methyl bromide, such as buffer zones surrounding treated fields, equipment and procedures for application, worker safety requirements, and notification to people near fumigated fields.

As required by state law, DPR evaluates, identifies, and controls pesticides as toxic air contaminants. Under this program, methyl bromide was identified as a toxic air contaminant in 1996. As part of the toxic air contaminant program, the Air Resources Board (ARB) monitors for pesticides under the direction of DPR. ARB conducted ambient air monitoring for methyl bromide in 2000. DPR requested this monitoring as part of an ongoing effort to evaluate seasonal exposures to methyl bromide and determine if current restrictions provide adequate safety for people who live and work in areas where fumigations occur to multiple fields. This document summarizes the monitoring results and preliminary risk evaluation.

SAMPLING PLAN

Monitoring was conducted within the areas and periods of most use. ARB monitored six locations in Kern County from July 19 to September 1, 2000 (Figure 1). At each location, 1-day samples were collected four days per week for seven weeks. ARB monitored six locations in the Monterey and Santa Cruz area from September 11 to November 3, 2000 (Figure 2). At each location, 1-day samples were collected four days per week for eight weeks. Additional samples were collected for quality control.

RESULTS

The results are summarized in Table 1, and the complete results are given in Appendix A. All but one of the 320 samples contained a detectable and quantifiable amount of methyl bromide (detection limit 0.002 parts per billion [ppb], quantitation limit 0.01 ppb). *See Appendix B for an explanation of terminology, such as detection limit and parts per billion.* The highest 1-day concentration detected was 30.8 ppb. The highest 1-week average concentration was 15.5 ppb. The highest average concentration for the study period (7 or 8 weeks) was 7.7 ppb.

EVALUATION OF HEALTH RISKS

Methyl bromide causes a variety of health effects in experimental animals and humans. To evaluate health risks, DPR has calculated target concentrations or goals based on the toxic properties of methyl bromide, and compared the target concentrations to the monitoring data. These target concentrations are generally 100 times lower than doses that do not cause adverse effects, or the no-observed effect level (NOEL) in animal studies, adjusting for breathing rate differences between animals and humans. The 100-fold factor accounts for variation in sensitivity between individuals and assumes that people are more sensitive than experimental animals to the effects of methyl bromide. For a 1-day average exposure, the target concentration is 250 ppb for children and 210 ppb for adults (the target concentration for a child is higher than an adult in this case). For a 1-week average exposure, the target concentration is 70 ppb for children and 120 ppb for adults. For an 8-week average exposure, the target concentration is 1 ppb for children and 2 ppb for adults.

DPR's goal is to regulate methyl bromide use so that the target concentrations are not exceeded. The air concentrations for all 1-day and 1-week periods were lower than the target concentrations, but air concentrations exceeded the target concentration over a 7 to 8-week period (Table 1). For the location with the highest concentration, the 8-week exposure was almost eight times the target level.

While the 8-week target concentration was exceeded in several locations, illnesses would not be expected to occur because the target concentration incorporates a 100-fold safety factor.

PRELIMINARY CONCLUSIONS

Monitoring was conducted during the high methyl bromide use period of July 19 to September 1 in Kern county, and September 11 to November 3 in Monterey and Santa Cruz counties.

Monitoring was conducted in two areas of the highest methyl bromide use.

The 1-day air concentrations of methyl bromide met DPR's goal (i.e., lower than the 1-day target concentration) at all locations.

The 1-week air concentrations of methyl bromide met DPR's goal (i.e., lower than the 1-week target concentration) at all locations.

The average air concentrations of methyl bromide for the 7 to 8-week study period did not meet DPR's goal (i.e., greater than the 8-week target concentration) at one of the six monitoring locations in Kern County and at four of the six monitoring locations in the Monterey/Santa Cruz area.

FUTURE ACTIVITIES

DPR is currently analyzing the data to determine whether application patterns, weather, or other factors played a role in ambient air levels. DPR expects to finalize its analysis this spring, and if additional restrictions are deemed necessary, DPR intends to take action before the high-use season begins.

DPR has requested that ARB conduct additional ambient air monitoring for methyl bromide in these same areas in 2001 since it can be accomplished simultaneously with other planned monitoring. Additionally, the monitoring will show the change in air concentrations due to new methyl bromide regulations implemented in January 2001.

ADDITIONAL INFORMATION

This summary is based on the following documents.

ARB, 2000. Final Report for the 2000 Methyl Bromide and 1,3-Dichloropropene Air Monitoring in Kern County. California Air Resources Board, Sacramento, CA.

ARB, 2001. Final Report for the 2000 Methyl Bromide and 1,3-Dichloropropene Air Monitoring in Monterey and Santa Cruz Counties. California Air Resources Board, Sacramento, CA.

DPR, 1999. Methyl Bromide Risk Characterization Document for Inhalation Exposure (DRAFT RCD 99-02). California Department of Pesticide Regulation, Sacramento, CA.

Lim, 2001. Evaluation of Ambient Air Concentration of Methyl Bromide in Monterey, Santa Cruz, and Kern Counties. Memorandum from Lori Lim to Gary Patterson, Medical Toxicology Branch, February 15, 2001. California Department of Pesticide Regulation, Sacramento, CA.

Powell, 2001. Exposures to methyl bromide based on ARB 2000 monitoring in Monterey/Santa Cruz and Kern Counties. Memorandum from Sally Powell to Joe Frank, Worker Health and Safety Branch, February 9, 2001. California Department of Pesticide Regulation, Sacramento, CA.

Figure 1.

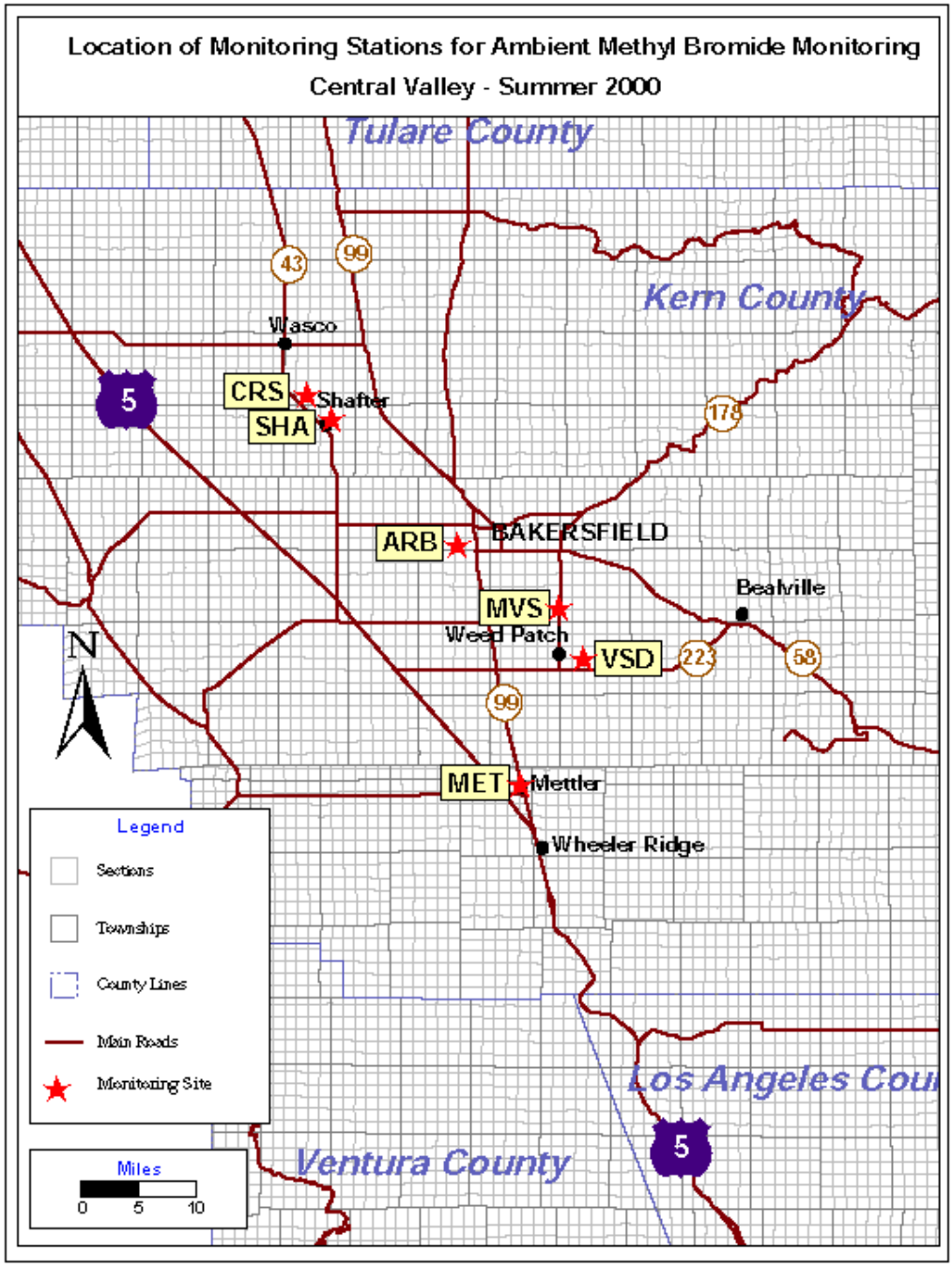
Location of Monitoring Stations for Ambient Methyl Bromide Monitoring
Central Valley - Summer 2000
Tulare County
Kern County
Wasco
CRS
Shafter
SHA
ARB
BAKERSFIELD
MVS
Weed Patch
VSD
Bealville
MET
Mettler
Wheeler Ridge
Ventura County
Los Angeles Cou
43
99
5
178
223
58
N
Legend
Sections
Townships
County Lines
Main Roads
Monitoring Site
Miles
0 5 10

Figure 2.

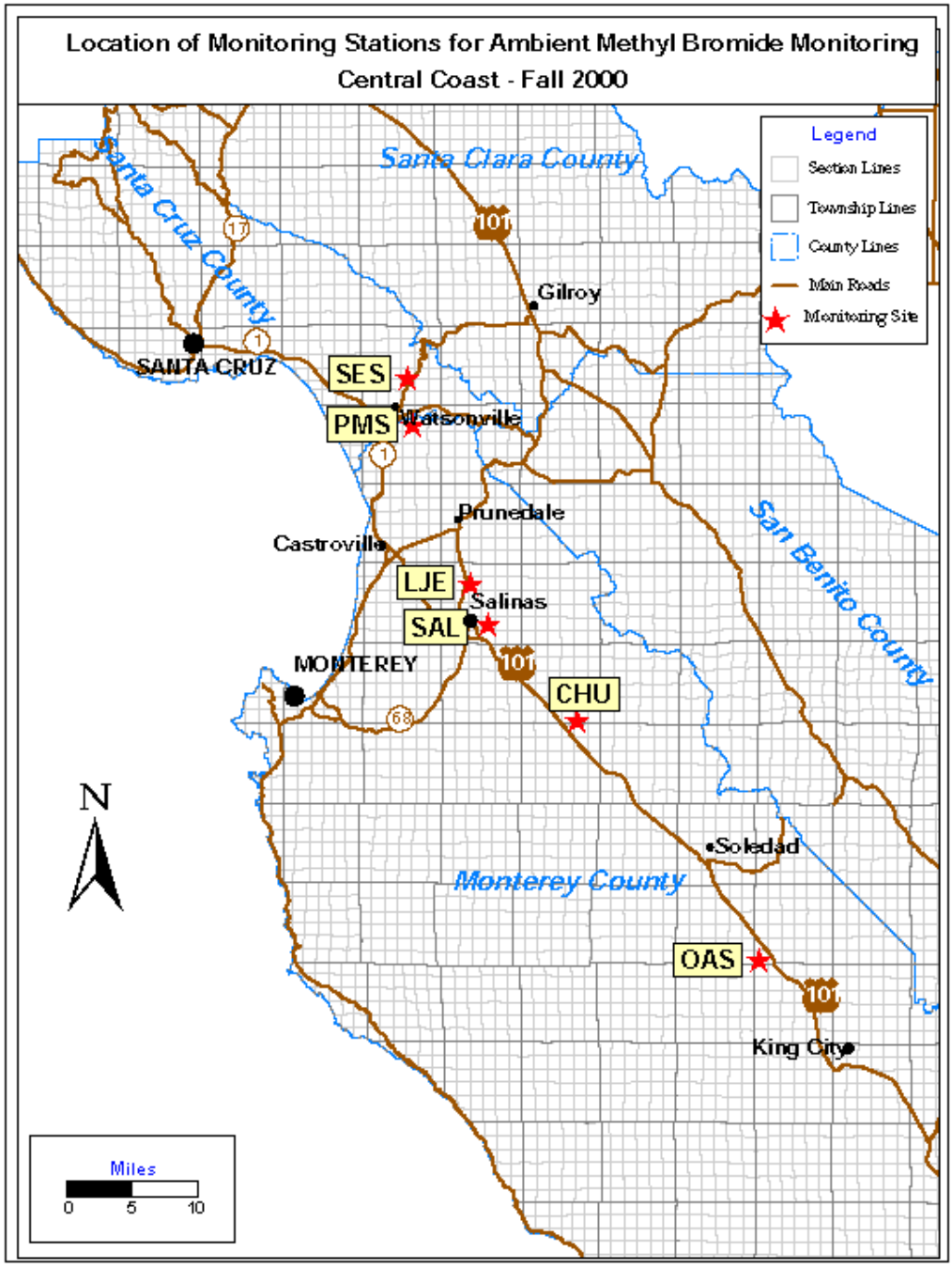
Location of Monitoring Stations for Ambient Methyl Bromide Monitoring
Central Coast - Fall 2000
Legend
Section Lines
Township Lines
County Lines
Main Roads
Monitoring Site
Santa Clara County
Santa Cruz County
San Benito County
Monterey County
Gilroy
SANTA CRUZ
SES
PMS
Watsonville
Prunedale
Castroville
LJE
Salinas
SAL
MONTEREY
CHU
Soledad
OAS
King City
N
Miles
0
5
10

Table 1. Summary of methyl bromide air monitoring results.

Location	Highest 1-Day Concentration (ppb)	Highest 1-Week Concentration (ppb)	Average Concentration for Study Period (ppb)
Monterey and Santa Cruz Counties, Sep 11 - Nov 3, 2000			
CHU Chualar School, Chualar, CA	2.4	1.6	0.6
LJE La Joya Elementary School, Salinas, CA	24.0	11.1	3.8
OAS Oak Avenue School, Greenfield, CA	1.8	1.0	0.4
PMS Pajaro Middle School, Watsonville, CA	30.8	15.5	7.7
SAL Ambient Monitoring Station, Salinas, CA	7.9	3.0	1.3
SES Salsepuedes Elementary School, Watsonville, CA	16.4	8.3	2.6
Kern County, Jul 19 - Sep 1, 2000			
ARB Ambient Monitoring Station, Bakersfield, CA	1.0	0.5	0.2
CRS Cotton Research Station, Shafter, CA	14.2	4.6	2.2
MET Mettler-Fire Station, Mettler, CA	0.2	0.1	0.08
MVS Mountain View School, Lamont, CA	0.5	0.2	0.09
SHA Shafter-Walker Ambient Monitoring Station, Shafter, CA	3.5	1.8	0.8
VSD Vineland School District, Bakersfield, CA	0.3	0.2	0.1
Target Concentrations[a]			
Child	*250*	*70*	*1*
Adult	*210*	*120*	*2*

[a] DPR uses target concentrations as benchmarks for its regulatory program. DPR establishes and modifies its restrictions so that the target concentrations should not be exceeded. Target concentrations are based on no-observed-effect levels established from animal tests of various exposure periods with a safety factor of 100x.

APPENDIX A
RESULTS OF EACH SAMPLE

Table 2. Methyl bromide results from Kern County (ppb)

Sample Start Date	Monitoring Locations[1]					
	ARB	CRS	MET	MVS	SHA	VSD
07/19/00	0.02	ND[2]	0.02	0.02	0.02	0.02
07/19/00	0.02	ND	0.11	0.02	0.03	0.02
07/20/00	1.00	5.66	0.11	0.10	3.53	0.21
07/24/00	0.18	3.11**	0.08	0.05**	0.63	0.06
07/25/00	0.34	0.89	0.03**	0.05**	0.36	0.04**
07/26/00	0.05**	1.43	0.11	0.08**	0.67	0.06
07/26/00	0.07**	1.45	0.21	0.07	0.66	0.06**
07/27/00	0.18	9.14	0.22	0.21	1.17	0.23
07/31/00	0.06**	1.61	0.19**	0.07	0.81	0.12**
08/01/00	0.93	1.72	0.12	0.08	1.15	0.12
08/02/00	0.11	0.86**	0.08**	0.06**	0.63	0.07**
08/02/00	0.11	0.85	0.08	0.06	0.62	0.07
08/03/00	0.07	14.18	0.06**	0.05	0.66	0.06
08/07/00	0.22	0.60	0.04	0.03	0.16	0.03
08/08/00	0.10	0.24	0.05	0.09	0.19**	0.09
08/09/00	0.10	0.09	0.05	0.05	0.09	0.07
08/09/00	0.10	0.09	0.05	0.05**	0.08	0.07
08/10/00	0.19	0.91	0.14	0.21	0.90	0.23
08/14/00	0.03	0.06	0.03	0.03	0.06	0.03
08/15/00	0.08	0.24**	0.04	0.05	0.06	0.05
08/16/00	0.01	NS[3]	0.01**	0.01	0.02**	0.01
08/16/00	0.02	NS	0.02	0.02**	0.02	0.01
08/17/00	0.04	NS	0.03	0.04	0.04	0.04
08/21/00	0.03	0.05	0.03	0.03	0.46	0.03
08/22/00	0.03	0.07	0.05	0.03	0.07	0.04
08/23/00	0.11	1.38	0.07	0.07	0.35	0.07
08/23/00	0.11	1.32	0.03**	0.07**	0.38	0.07
08/24/00	NA	1.07	0.09	0.24	0.49	0.19
08/28/00	0.31	2.69	0.19	0.49	2.83	0.35
08/29/00	0.10	4.88	0.09	0.09	1.02	0.10
08/30/00	0.26	2.59	0.22	0.16	1.84	0.18
08/30/00	0.25	2.66	0.22**	0.16**	1.86	0.18
08/31/00	0.09	0.94	0.07	0.07	0.42	0.06

[1] See Table 1 for description of monitoring locations
[2] None Detected, detection limit 0.002 ppb
[3] No Sample
**Sample air flow rate deviation was >25%, not used to calculate averages

Table 3. Methyl bromide results (ppb) from Monterey and Santa Cruz Counties

Sample Start Date	Monitoring Locations[1]					
	CHU	LJE	OAS	PMS	SAL	SES
09/11/00	0.67	5.57	0.31	5.08	1.98	9.46
09/12/00	0.81	24.03	0.70	10.10	2.14	16.43
09/12/00	NS[2]	NS	0.28	NS	NS	NS
09/13/00	0.94	7.32	0.68	1.11	1.50	2.62**
09/13/00	0.88	8.41	NS	1.12	1.46	NS
09/14/00	0.50	4.52	0.22	4.39	0.97	4.54
09/14/00	NS	NS	NS	NS	NS	4.86
09/18/00	0.58	11.08	0.42	11.22	1.45	3.93**
09/19/00	2.16	11.85	0.65	15.46	3.50	7.22
09/20/00	0.71	1.57	0.63	1.99	1.77	0.16
09/20/00	1.63**	2.48	0.54	1.30	1.49	0.14
09/21/00	0.84	NS	0.06	3.88	2.74	0.21
09/25/00	0.12	0.30	0.12**	1.24	0.15	1.22
09/26/00	0.32	0.60	0.15	2.73	0.26	0.82
09/26/00	0.33**	0.79**	0.16	3.57	NS	0.80
09/27/00	0.23	0.27	0.25	13.29	0.08	1.69
09/28/00	0.68	3.71	0.16	21.48	2.58	4.12
10/02/00	0.37	0.20	0.29	0.78	0.19	0.97
10/03/00	0.31	0.13	0.42	1.14	0.09	0.48
10/03/00	0.31	0.12	NS	0.91	0.09	0.48
10/04/00	0.61	4.26	0.34	1.26	1.08	0.44
10/04/00	NS	NS	0.34	NS	NS	NS
10/05/00	0.31	0.81	0.55	1.90	0.65	2.29
10/10/00	0.07	0.69	0.12**	5.45	0.06**	0.96
10/10/00	NS	NS	NS	NS	NS	1.07
10/11/00	0.38	0.62	0.33	13.12	0.38	0.52
10/11/00	0.05**	0.25**	NS	12.54**	0.39	NS
10/12/00	0.33	1.20	0.28	28.18	1.65	0.92
10/12/00	NS	1.13	0.29	NS	NS	NS
10/16/00	2.41	10.75	0.90	22.27	7.91	3.24**
10/16/00	NS	13.16	0.94	23.03**	NS	3.28
10/17/00	NA	2.13	0.70	3.94	1.21	2.95
10/17/00	1.29	NS	NS	NS	NS	NS
10/18/00	1.21	3.53	0.70	6.86	0.78	4.76
10/18/00	NS	NS	NS	NS	0.81	NS
10/19/00	1.54	3.69	1.84	4.15	2.12	3.53
10/23/00	1.14	7.04	0.62	30.77	2.38	3.28
10/24/00	0.57	1.25**	0.59	8.45	1.23	1.20
10/25/00	0.30	0.77	0.22	3.06	0.64	2.11
10/25/00	0.30	0.79	0.23	2.89	0.65	2.23
10/26/00	0.34	1.26	0.12	2.55	0.55	1.32
10/30/00	0.11	0.20	0.07	0.54	0.10	0.08
10/31/00	0.11	0.31	0.10	1.78	0.13	0.27
11/01/00	0.09	0.20	0.07	1.71	0.14	0.16
11/01/00	0.08	0.20	0.06	1.74	0.14	0.16
11/02/00	0.11	0.30	0.08	0.38	0.19	0.36

[1] See Table 1 for description of monitoring locations

[2] No Sample

**Sample air flow rate deviation was >25%, not used to calculate averages

APPENDIX B
EXPLANATION OF TERMINOLOGY

Concentration: The amount of a chemical in air is normally expressed as a concentration, the amount of the chemical in a given amount of air. Concentrations in air can be expressed in many different units, the same way that distance can be expressed as inches, feet, meters, or miles. Concentrations in air can be expressed in units of volume or weight. One common unit is percent volume. For example, air contains 21 percent oxygen. This means in 100 cubic meters of air, 21 cubic meters is comprised of oxygen.

Concentration Units and Conversion Factors: DPR often expresses methyl bromide air concentrations in parts per billion (ppb). Similar units are parts per million (ppm) and percent (percent is synonymous with parts per hundred). These units are all ratios or proportions and refer to the volume of a chemical in a volume of air. For example, 1,000 ppb means that 1,000 cubic meters of methyl bromide is contained in 1 billion cubic meters of air. While it may seem counterintuitive because a billion is more than a million, 1 ppm is a concentration 1000 times greater than 1 ppb.

ARB's report expresses the methyl bromide air concentrations as nanograms per cubic meter (ng/m³). This refers to the amount (weight) of methyl bromide in a volume of air. For example, 1,000 ng/m³ means 1,000 nanograms of methyl bromide is contained in one cubic meter of air.

The conversion factor from nanograms per cubic meter to parts per billion is not straightforward because it is usually different from chemical to chemical. For methyl bromide, the concentration in nanograms per cubic meter should be divided by 3,880 to convert to parts per billion. For example, 388,000 ng/m³ divided by 3,880 equals 100 ppb. The following table summarizes these conversion factors.

Change From	To	
ng/m^3	ppb	divide by 3,880
ppb	ng/m^3	multiply by 3,880
ppb	ppm	divide by 1,000
ppm	ppb	multiply by 1,000

Detection Limit: The detection limit is the smallest amount of the chemical that can be identified in a sample with the method employed. For example, a detection limit of 0.002 ppb for methyl bromide means that a sample can be identified as containing methyl bromide if the concentration is at least 0.002 ppb. If the sample contains no methyl bromide, or methyl bromide at a concentration less than 0.002 ppb, the sample is designated as containing no detectable amount. When calculating average concentrations or other statistics, samples with no detectable amount are normally assumed to have a concentration of one-half the detection limit. For example, if the detection limit is 0.002 ppb, samples with no detectable amount are assumed to have 0.001 ppb. The detection limit is a characteristic of both the method and the chemical. Different methods can have different detection limits for the same chemical. The same method can have different detection limits for different chemicals. See also quantitation limit.

No-Observed-Effect Level, NOEL: The NOEL is the lowest experimental concentration for which no adverse health effects were documented in a toxicology test. For example, a NOEL of 2000 ppb means that test subjects (usually animals) exposed to 2000 ppb had no adverse health effects for the duration of the test. Adverse effects occurred at the next highest dose of the test. The health or toxic effects of a chemical are related to the amount of chemical absorbed by the body. The more chemical absorbed by the body the greater the toxic effects. Scientists often say that the dose makes the poison, or stated another way, there are no poisons only poisonous doses. The NOEL is usually different for each chemical. Also, the NOEL is usually different for different exposure periods. Normally, the longer the exposure period, the lower the NOEL. In other words, it takes less chemical to produce an adverse effect if exposure occurs for one year, than if exposure occurs for one day.

Parts Per Billion, ppb: See Concentration Units and Conversion Factors.

Quantitation Limit: Similar to detection limit, the quantitation limit is the smallest amount of the chemical that can be measured. For example, a quantitation limit of 0.01 ppb for methyl bromide means that the concentration can be measured if the sample contains at least 0.01 ppb of methyl bromide. Samples with concentrations less than the quantitation limit, but more than detection limit can be identified as containing methyl bromide, but the concentration cannot be measured reliably with the method employed. For example, if the detection limit is 0.002 ppb and the quantitation limit is 0.01 ppb, samples with concentrations at least 0.01 ppb can be measured, samples with concentrations between 0.002 and 0.01 ppb contain an unmeasurable concentration between 0.002 and 0.01 ppb, and samples with concentrations less than 0.002 ppb are designated as containing no detectable amount. When calculating average concentrations or other statistics, samples with an unmeasurable concentration are normally assumed to have a concentration of the midpoint between the detection limit and the quantitation limit. For example, if the detection limit is 0.002 ppb and the quantitation limit is 0.01 ppb, samples with an unmeasurable amount are assumed to have 0.006 ppb. As with the detection limit, the quantitation limit is a characteristic of both the method and the chemical. Different methods can have different quantitation limits for the same chemical. The same method can have different quantitation limits for different chemicals.

Target Concentration: The target concentration is the benchmark or goal that DPR does not want to exceed. The target concentration is not a legal standard, but a goal for DPR's regulatory program. For example, if the target concentration for methyl bromide is 2 ppb, DPR implements restrictions on the use of methyl bromide (examples: buffer zones or acreage limitations) so that people's exposure should not exceed 2 ppb. The target concentration is based on the no-observed effect level and incorporates a safety factor. Scientists often refer to this target concentration as the reference concentration.