Appendix B

Evaluation of Ambient Air Concentration of Methyl Bromide In Monterey, Santa Cruz, and Kern County

dpr Department of Pesticide Regulation

Paul E. Helliker
Director

Gray Davis
Governor

Winston H. Hickox
Secretary, California Environmental Protection Agency

MEMORANDUM

TO: Gary Patterson
Supervising Toxicologist, Branch Chief
Medical Toxicology Branch

FROM: Lori O. Lim
Staff Toxicologist
(916) 324-3515

DATE: February 15, 2001

SUBJECT: Evaluation of Ambient Air Concentration of Methyl Bromide in Monterey, Santa Cruz, and Kern Counties

The potential risk from exposure to ambient methyl bromide air concentrations in Monterey, Santa Cruz, and Kern Counties were evaluated. The risk was expressed as the margin of exposure (MOE) which is the ratio of the No-Observed-Effect Level (NOEL) and the estimated human exposure level. The NOELs for threshold effects were derived from animal toxicity studies as discussed in the draft Methyl Bromide Risk Characterization Document for Inhalation Exposure (DPR, 1999). The human equivalent NOELs[1] were: 21 ppm and 25 ppm, respectively, for adult and children acute exposures; 12 ppm and 7 ppm, respectively, for adult and children 1-week exposures; and 0.2 ppm and 0.1 ppm, respectively, for adult and children 6-week exposures (Table 15 of the DRAFT RCD). The exposure estimates were provided by the Worker Health and Safety Branch (Powell, 2001) and were based on studies conducted by the Air Resources Board at those counties (ARB, 2000 and 2001).

For these three counties, the highest ambient methyl bromide levels were measured at Pajaro Middle School (PMS, Watsonville, CA) for Monterey/Santa Cruz Counties and the Cotton Research Station (CRS, Shafter, CA) for Kern County. Consequently, the MOEs for all durations of exposure at these sites were lower than those for other sites.

For acute exposures, MOEs were all greater than 100 for exposure to either the maximum daily level or the 95th percentile of the daily levels (Table 1). For adults, the MOEs ranged from 682 (PMS/Monterey-Santa Cruz Counties and maximum daily level) to >93,000 (MET/Kern County site and maximum daily level). For children, the MOEs ranged from 812 (PMS site and maximum daily level) to >111,000 (MET/Kern County site and maximum daily level).

[1] Human equivalent NOELs were calculated by accounting for respiration rate differences between human (adult and child) and experimental animals and amortized for daily exposure (Appendix G of DPR, 1999). The respiration rates were: 0.46 m^3/kg/day (child), 0.26 m^3/kg/day (adult), 0.54 m^3/kg/day (rabbit), and 0.39 m^3/kg/day (dog).

$$\text{Human equivalent NOEL (ppm)} = \text{Animal NOEL (ppm)} \times \frac{\text{animal respiration rate}}{\text{human respiration rate}} \times \frac{\text{hours exposed}}{24 \text{ hours}} \times \frac{\text{days exposed per week}}{7 \text{ days}}$$

For 1-week exposures, the MOEs were also greater than 100 for exposure to either the maximum weekly means or the 95th percentile of the weekly means (Table 2). For adults, the MOEs ranged from 702 (PMS/Monterey-Santa Cruz Counties and 95th percentile weekly mean level) to >82,000 (MET/Kern County site and maximum weekly level). For children, the MOEs ranged from 409 (PMS site and 95th percentile weekly means) to >48,000 (MET/Kern County site and maximum daily level).

For 8-week exposures, the MOEs were greater than 100 only at two sites (CHU and OAS) for Monterey/Santa Cruz Counties and all but CRS for Kern county (Table 3). For Monterey/Santa Cruz Counties, sites with MOEs of less than 100 were LJE (53 and 26 for adults and children, respectively), PMS (26 and 13 for adults and children, respectively), SAL (78 for children), and SES (77 and 38 for adults and children, respectively). For Kern County, the lowest MOEs were those for CRS (93 for adults and 46 for children).

In the evaluation of these MOEs, a benchmark of 100 could be considered adequate for protection of humans against potential toxicity of methyl bromide which was determined by animal studies. This benchmark of 100 included an uncertainty factor of 10 for interspecies extrapolation and a factor of 10 for intraspecies variability. These uncertainty factors assumed that the average human is 10 times more sensitive to the effects of a chemical than the most sensitive laboratory animal, and that a sensitive individual is 10 times more susceptible than an average individual. In the review of the draft RCD (DPR, 1999), the National Research Council determined that an additional uncertainty factor for potential increased sensitivities of infants and children was not needed (National Research Council, 2000).

The MOEs should also be viewed within the context of the limitations and uncertainties in the exposure calculation and the NOEL determination. The exposure calculations were based on limited monitoring data for 6 sites for each county over a few weeks. The representativeness of the data and the relationship between use and monitored levels are not known at this time (Powell, 2001). The uncertainities associated with the selection of the NOEL have been discussed in the RCD (DPR, 1999). The NOELs were based on the most sensitive endpoints and species and there were no human studies. In the absence of data, the use of a default 10-fold factor to determine the estimated subchronic NOEL from a Lowest-Observed-Effect Level (LOEL) was considered appropriate

Conclusion:
The acute and 1-week exposures to ambient methyl bromide levels at all sites could be considered acceptable since the MOEs were greater than 100. However, the MOEs for subchronic exposures were less than 100 in LJE, PMS, SAL (children exposure only) and SES sites in Monterey/Santa Cruz Counties, and CRS in Kern County.

cc. Keith Pfeifer

Table 1: The margins of exposure for acute exposure to monitored methyl bromide concentrations in Monterey, Santa Cruz, and Kern Counties.

Sites[a]	Maximum 24-hour level			95th percentile of daily levels		
	Exposure[b] (ppb)	Adult MOE[c]	Child MOE[c]	Exposure[b] (ppb)	Adult MOE[c]	Child MOE[c]
Monterey and Santa Cruz Counties						
CHU Chualar School, Chualar, CA	2.41	8714	10373	2.26	9292	11062
LJE La Joya Elementary School, Salinas, CA	24	875	1042	18.5	1135	1351
OAS Oak Avenue School ,Greenfield, CA	1.84	11413	13587	1.21	17355	20661
PMS Pajaro Middle School, Watsonville, CA	30.8	682	812	30.2	695	828
SAL Ambient Monitoring Station, Salinas, CA	7.91	2655	3161	6.17	3404	4052
SES Salsepuedes Elementary School, Watsonville, CA	16.4	1280	1524	12.2	1721	2049
Kern County						
ARB Ambient Monitoring Station, Bakersfield, CA	0.996	21084	25100	0.556	37770	44964
CRS Cotton Research Station, Shafter, CA	14.2	1479	1761	25.4	827	984
MET Mettler-Fire Station, Mettler, CA	0.224	93750	111607	0.239	87866	104603
MVS Mountain View School, Lamont, CA	0.487	43121	51335	0.262	80153	95420
SHA Shafter-Walker Ambient Monitoring Station, Shafter, CA	3.52	5966	7102	3.98	5276	6281
VSD Vineland School District, Bakersfield, CA	0.347	60519	72046	0.292	71918	85616

a/ Details about each site are in ARB, 2000 and 2001.

b/ Acute exposure was the highest or the 95th percentile of all single-day samples for each site (Powell, 2001).

c/ The margins of exposures (MOEs) for adults were based on an acute human equivalent No-Observed-Effect Level (NOEL) of 21 ppm derived from a NOEL of 40 ppm for developmental toxicity observed in rabbits (Breslin *et al.*, 1990). The MOEs for children were based on acute human equivalent NOEL of 25 ppm derived from a NOEL of 103 ppm for neurotoxicity in dogs (Newton, 1994).

Table 3: The margins of exposure for subchronic exposure to monitored methyl bromide concentrations in Monterey, Santa Cruz, and Kern Counties.

Sites[a]	Mean of weekly means		
	Exposure[b] (ppb)	Adult MOE[c]	Child MOE[c]
Monterey and Santa Cruz Counties			
CHU Chualar School, Chualar, CA	0.644	311	155
LJE La Joya Elementary School, Salinas, CA	3.79	53	26
OAS Oak Avenue School ,Greenfield, CA	0.387	517	258
PMS Pajaro Middle School, Watsonville, CA	7.68	26	13
SAL Ambient Monitoring Station, Salinas, CA	1.29	155	78
SES Salsepuedes Elementary School, Watsonville, CA	2.6	77	38
Kern County			
ARB Ambient Monitoring Station, Bakersfield, CA	0.189	1058	529
CRS Cotton Research Station, Shafter, CA	2.16	93	46
MET Mettler-Fire Station, Mettler, CA	0.084	2381	1190
MVS Mountain View School, Lamont, CA	0.092	2174	1087
SHA Shafter-Walker Ambient Monitoring Station, Shafter, CA	0.792	253	126
VSD Vineland School District, Bakersfield, CA	0.099	2020	1010

a/ Details about each site are in ARB, 2000 and 2001.

b/ Eight-week exposure levels were the mean of the weekly means for each site (Powell, 2001).

c/ The margins of exposures (MOEs) were based on an estimated No-Observed-Effect Level (NOEL) of 0.5 ppm for neurotoxicity in dogs with a LOEL of 5 ppm (Newton, 1994). The human equivalent NOELs for this study were 0.2 ppm and 0.1 ppm for adults and children, respectively.

Table 2: The margins of exposure for 1-week exposure to monitored methyl bromide concentrations in Monterey, Santa Cruz, and Kern Counties.

Sites[a]	Maximum weekly mean level			95th percentile of weekly mean levels		
	Exposure[b] (ppb)	Adult MOE[c]	Child MOE[c]	Exposure[b] (ppb)	Adult MOE[c]	Child MOE[c]
Monterey and Santa Cruz Counties						
CHU Chualar School, Chualar, CA	1.61	7453	4348	1.63	7362	4294
LJE La Joya Elementary School, Salinas, CA	10.5	1143	667	11.1	1081	631
OAS Oak Avenue School ,Greenfield, CA	1.01	11881	6931	0.918	13072	7625
PMS Pajaro Middle School, Watsonville, CA	15.5	774	452	17.1	702	409
SAL Ambient Monitoring Station, Salinas, CA	3.01	3987	2326	3.14	3821	2229
SES Salsepuedes Elementary School, Watsonville, CA	8.3	1446	843	7.45	1611	940
Kern County						
ARB Ambient Monitoring Station, Bakersfield, CA	0.507	23669	13807	0.507	23669	13807
CRS Cotton Research Station, Shafter, CA	4.59	2614	1525	5.54	2166	1264
MET Mettler-Fire Station, Mettler, CA	0.145	82759	48276	0.163	73620	42945
MVS Mountain View School, Lamont, CA	0.201	59701	34826	0.195	61538	35897
SHA Shafter-Walker Ambient Monitoring Station, Shafter, CA	1.77	6780	3955	2.05	5854	3415
VSD Vineland School District, Bakersfield, CA	0.175	68571	40000	0.181	66298	38674

a/ Details about each site are in ARB, 2000 and 2001.

b/ One-week exposure levels were the 95th percentile of weekly means for each site (Powell, 2001).

c/ The margins of exposures (MOEs) were based on a No-Observed-Effect Level (NOEL) of 20 ppm for neurotoxicity observed in pregnant rabbits (Sikov *et al.,* 1981). The human equivalent NOELs for this study were 12 ppm and 7 ppm for adults and children, respectively.

References:

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

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

Breslin, W.J., C.L. Zablotny, G.J. Bradley, and L.G. Lomax, 1990. Methyl bromide inhalation teratology study in New Zealand white rabbits. The Toxicology Research Lab. Methyl Bromide Industry Panel. DPR Vol.123-127 #95930.

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

National Research Council, 2000. Methyl Bromide Risk Characterization in California. Subcommittee on Methyl Bromide, National Research Council. National Academy Press, Washington, D.C.

Newton, P.E., 1994. A four week inhalation toxicity study of methyl bromide in the dog. Study number 93-6068. Pharmaco LSR. DPR Vol.123-164 #132821.

Sikov, M.R., W.C. Cannon, D.B. Carr, R.A. Miller, L.F. Montgomery, and D.W. Phelps, 1981. Teratologic assessment of butylene oxide, styrene oxide and methyl bromide. Contract no. 210-78-0025. Battelle, Pacific Northwest Lab. Submitted to the Division of Biomedical and Behavioral Science, National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services. DPR Vol.123-092 #59690 (same study as in DPR Vol.123-039#26865 and 26866).

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. Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA.

dpr Department of Pesticide Regulation

Paul E. Helliker
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Gray Davis
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Winston H. Hickox
Secretary, California Environmental Protection Agency

MEMORANDUM

TO: Joe Frank, Senior Toxicologist
Worker Health and Safety Branch

FROM: Sally Powell, Senior Environmental Research Scientist
Worker Health and Safety Branch
(916) 445-4248

DATE: February 9, 2001

SUBJECT: EXPOSURES TO METHYL BROMIDE BASED ON ARB 2000 MONITORING IN MONTEREY/SANTA CRUZ AND KERN COUNTIES

Methods

Before calculating the exposures, one-half the detection limit was substituted for two Kern County samples that were below the detection limit. (No samples in Monterey/Santa Cruz were below the quantitation limit.) The detection limit for methyl bromide was 7.1 ng/m^3 (0.00182 ppb). Further, where there were pairs of colocated samples for the same day, the two values were averaged.

All exposures are expressed as air concentrations in ppb.

Acute (24-hr) exposure

For each monitoring site separately, the maximum and the 95th percentile of all daily (24-hr) monitoring samples are given. The 95th percentile is calculated using lognormal methods:

$$95^{th}\ \%ile = \exp\{\text{arithmetic mean of log concentrations} + t_{(.95;\, n-1)} * (\text{sd of logs})\}.$$

Short-term (7-day) exposure

For each monitoring site separately, the maximum and the 95th percentile of the weekly mean concentrations are given. Each weekly mean is calculated as the arithmetic mean of the 2, 3 or 4 24-hr samples taken at a site during the week (i.e., nonmonitoring days are ignored). The 95th percentile of weekly mean concentrations is calculated using normal methods:

$$95^{th}\ \%ile = \text{arithmetic mean of week means} + t_{(.95;\, n-1)} * (\text{sd of week means}).$$

Seasonal (7- or 8-week) exposure

For each monitoring site separately, seasonal exposure is the mean concentration over the monitoring period. It is calculated as the arithmetic mean of the 8 (7 in Kern Co.) weekly means calculated as above for 7-day exposure.

Results

Plots of 24-hr concentrations by day at each site are attached. Acute, short-term and seasonal concentrations are presented in Table 1.

Table1. Methyl bromide concentrations (ppb) based on ARB 2000 monitoring in Monterey/Santa Cruz and Kern Counties.

		Daily		Weekly		8-wk
Site	n days	Maximum 24-hr	95th percentile 24-hr	Maximum weekly mean	95th percentile weekly mean	Mean of weekly means
Monterey/Santa Cruz Counties (8 monitoring weeks, Sept-Oct 2000)						
		ppb				
CHU	31	2.41	2.26	1.61	1.63	0.644
LJE	30	24.0	18.5	10.5	11.1	3.79
OAS	31	1.84	1.21	1.01	0.918	0.387
PMS	31	30.8	30.2	15.5	17.1	7.68
SAL	31	7.91	6.17	3.01	3.14	1.29
SES	31	16.4	12.2	8.30	7.45	2.60
Kern County (7 monitoring weeks, July-Aug 2000)						
		ppb				
ARB	25	0.996	0.556	0.507	0.507	0.189
CRS	24	14.2	25.4	4.59	5.54	2.16
MET	26	0.224	0.239	0.145	0.163	0.084
MVS	26	0.487	0.262	0.201	0.195	0.092
SHA	26	3.52	3.98	1.77	2.05	0.792
VSD	26	0.347	0.292	0.175	0.181	0.099

Exposure appraisal

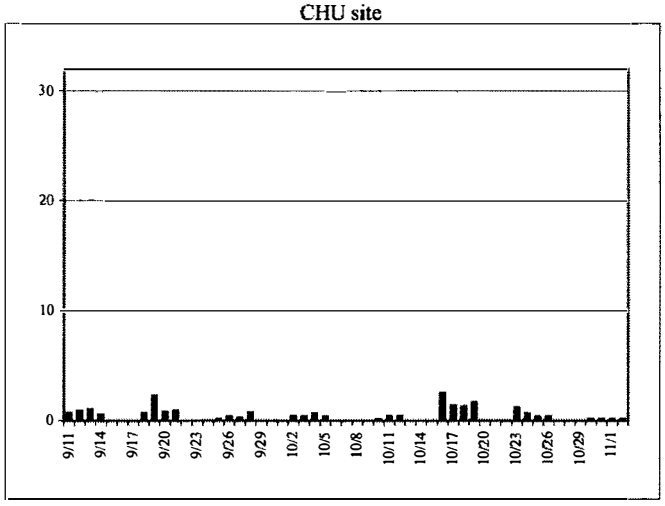
The average concentrations presented here are based on limited monitoring data and must be considered as having some degree of uncertainty. Each site is a single geographic point, monitored only 3-4 days per week for a relatively short period. The representativeness of the monitored locations and times is unknown. Further, the timing and location of nearby methyl bromide applications will influence the concentrations, and they are not yet known for the monitoring period.

cc: Tom Thongsinthusak
Lori Lim
Randy Segawa

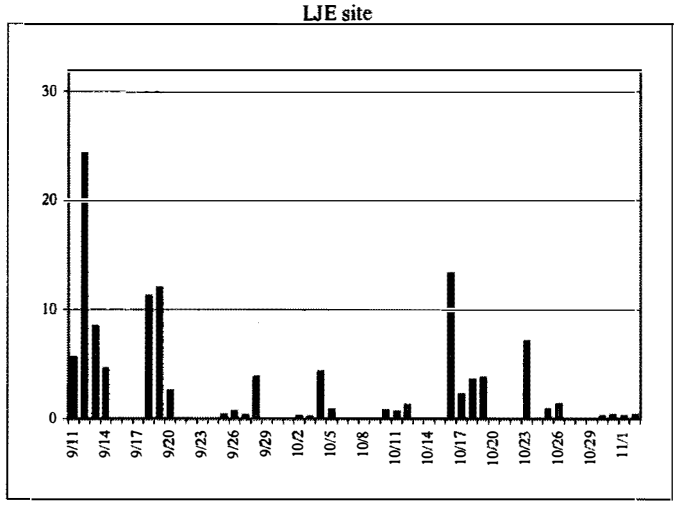
Attachments

24-hr methyl bromide concentrations (ppb) by monitoring date in Monterey/Santa Cruz Counties, Fall 2000

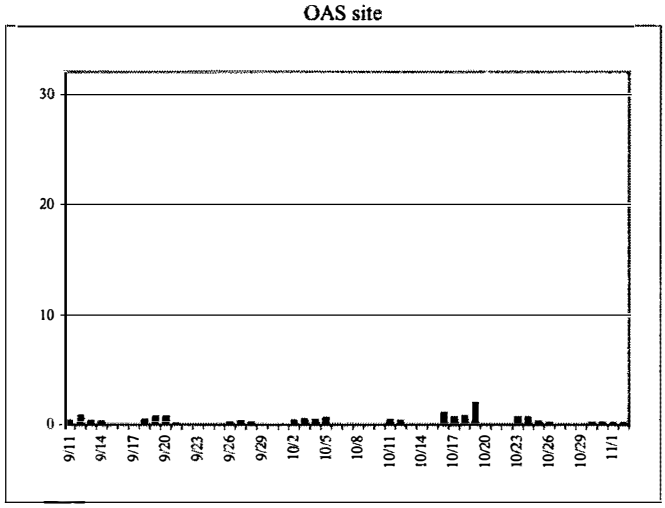
CHU site



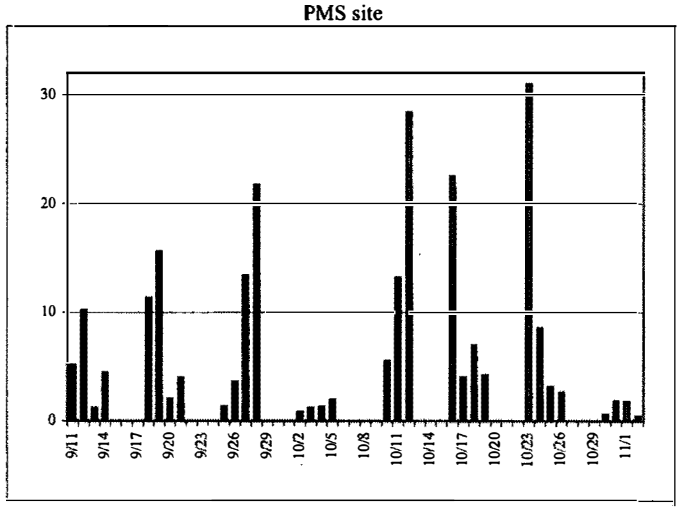
LJE site



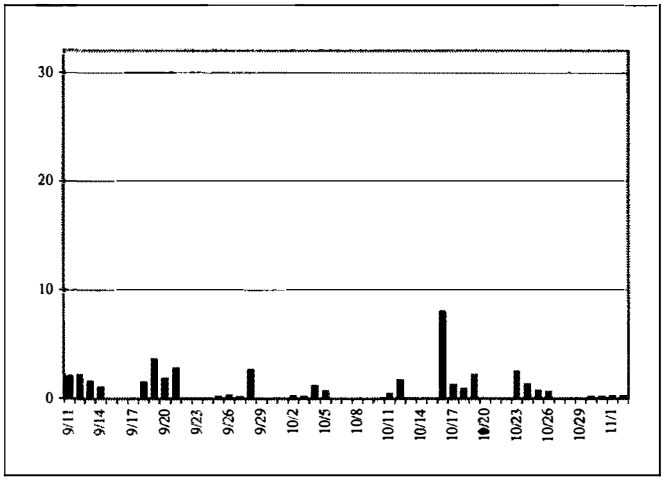
OAS site



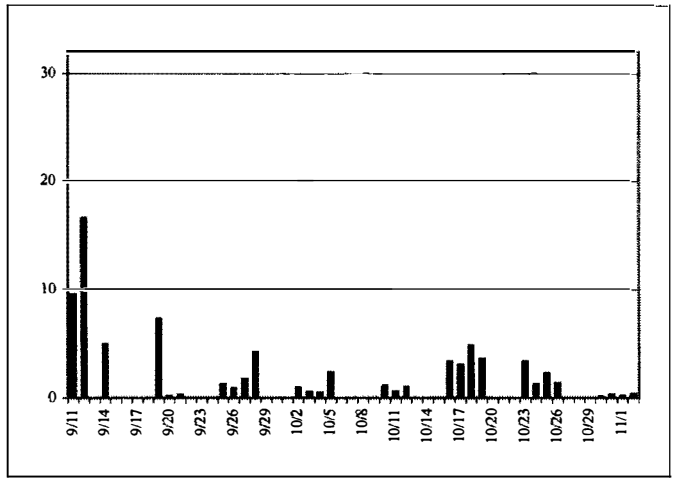
PMS site



SAL site

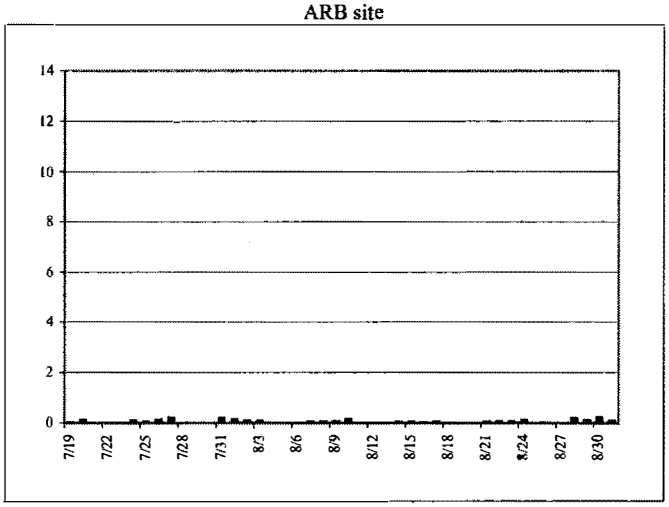


SES site

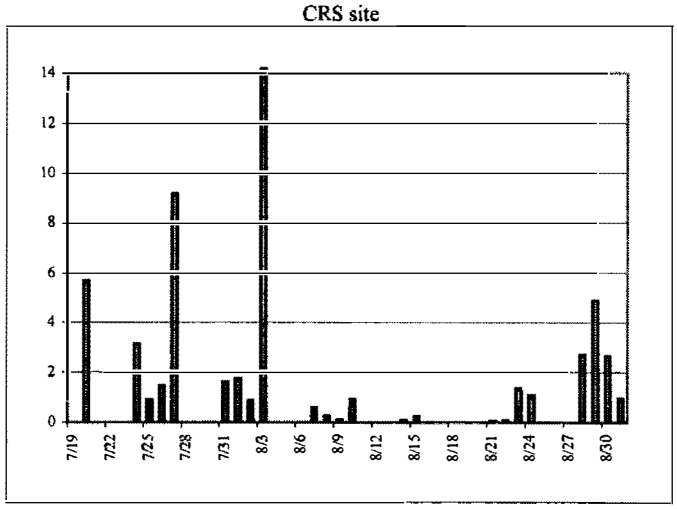


24-hr methyl bromide concentrations (ppb) by monitoring date in Kern County, Summer 2000

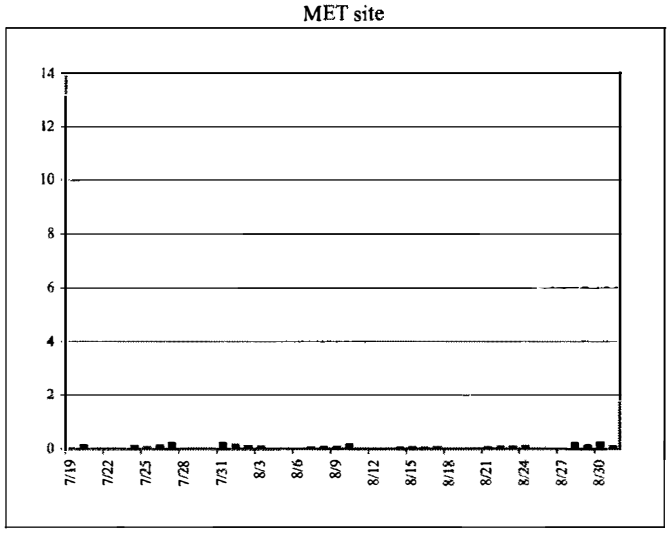
ARB site



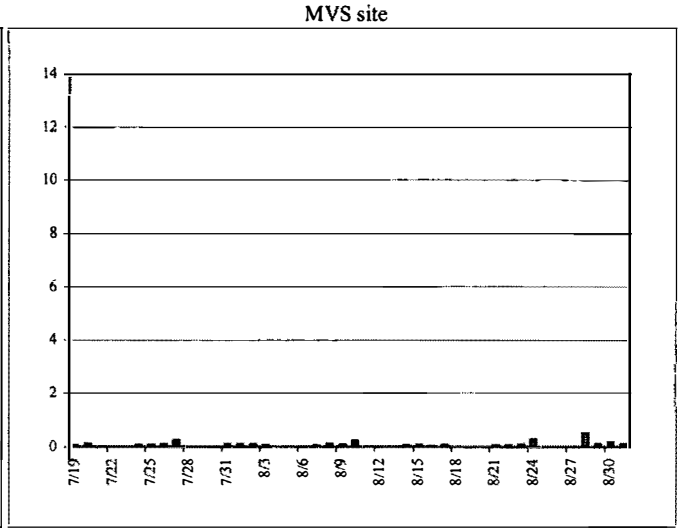
CRS site



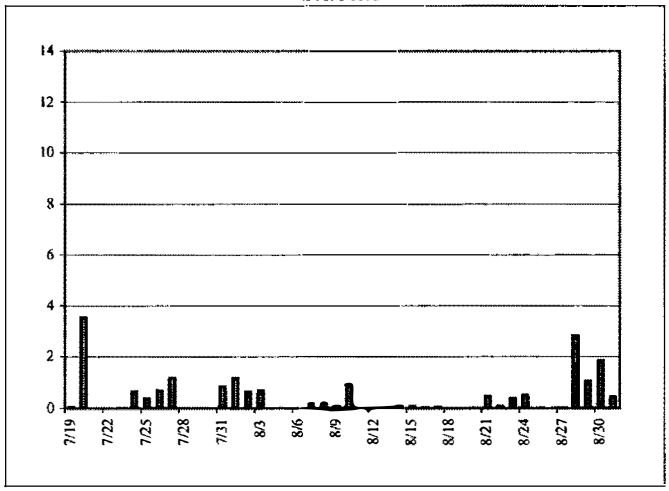
MET site



MVS site



SHA site



VSD site