Air Resources Board

Barbara Riordan, Chairman
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ıston H. Hickox
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Protection

Gray Davis
Governor

MEMORANDUM

TO: Douglas Y. Okumura, Acting Assistant Director
Division of Enforcement, Environmental Monitoring
And Data Management
Department of Pesticide Regulation

FROM: George Lew, Chief
Engineering and Laboratory Branch
Monitoring and Laboratory Division

DATE: February 8, 1999

SUBJECT: FINAL REPORT FOR THE 1998 MALATHION AIR MONITORING

Attached is the "Report for the Application and Ambient Air Monitoring of Malathion in Imperial County." The separate volume of appendices for the report has been forwarded to Pam Wales of your staff and is available upon request. Your December 29, 1998 memorandum indicated that your staff had no comments on the draft report.

These results are intended for identifying the presence of malathion in ambient air. Additional air monitoring near the use of malathion may be necessary to determine if there is a need for mitigation. The locations of the ambient monitoring sites and the monitoring period should be evaluated when the 1998 malathion use data becomes available.

If you or your staff have questions or need further information, please contact me at (916) 263-1630 or Mr. Kevin Mongar at (916) 263-2063.

Attachment

cc: Ray Menebroker, SSD (w/Attachment and Appendices)
Pam Wales, DPR (w/Attachment and Appendices)
Sharon Seidel, DHS (w/Attachment)
Stephen L. Birdsall, Imperial County Agricultural Commissioner (w/Attachment)
George Alexeeff, Ph.D., OEHHA (w/ Attachment)

State of California
California Environmental Protection Agency
AIR RESOURCES BOARD

Report for the Application and Ambient Air Monitoring of Malathion in Imperial County

Engineering and Laboratory Branch

Monitoring and Laboratory Division

Project No. C98-003 (Application)
C98-002 (Ambient)

Date: January 28, 1999

Kevin Mongar, Project Engineer

Cynthia L. Castronovo, Manager
Testing Section

George Lew, Chief
Engineering and Laboratory Branch

Summary

Report for the Application and Ambient Air Monitoring of Malathion in Imperial County

This report presents the results of application and ambient air monitoring for the insecticide malathion in Imperial County. Application monitoring was conducted around the use of malathion on 50 acres of alfalfa from February 23 to March 1, 1998 and ambient monitoring was conducted to coincide with the use of malathion on alfalfa from February 23 to March 13, 1998. Tables 4 and 7 present the results of application and ambient air monitoring for malathion respectively. Summaries of the application and ambient results are presented in Tables 5 and 8 respectively. Laboratory results, in units of ng/sample, equal to or above the estimated quantitation limit (EQL) are reported to 3 significant figures. Air concentration results (in units of ng/m^3 and pptv) are reported to 2 significant figures. Results equal to or above the method detection limit (MDL) but below the EQL are reported as detected (Det). The analytical MDL and EQL for malathion were 3.48 and 17.3 ng/sample respectively and for malaoxon were 6.80 ng/sample and 34.0 ng/sample respectively. The air concentration, expressed in units of ng/m^3 (or pptv), associated with the EQL is dependent on the volume of air sampled which varies from sample to sample. For a 24-hour sampling period at 3 Lpm the air concentration would be 4.0 ng/m^3 (0.30 pptv) and 7.9 ng/sample (0.60 pptv) for malathion and malaoxon as associated with the EQL.

All four of the application background samples had results above the EQL for malathion. The average of the four background samples was 9.7 ng/m^3. Of the twenty-eight application samples collected (spikes, blanks, collocated and background samples excluded) twenty-seven were found to be above the EQL for malathion and the remaining sample was detected. The highest malathion concentration, 2400 ng/m^3 (180 pptv), was observed at the south sampling site during the 2nd sampling period. All four of the application background samples had results of "detected" for malaoxon. Of the twenty-eight application samples collected for malaoxon (spikes, blanks, collocated and background samples excluded) twelve were found to be above the EQL, three were found to be detected, and thirteen were below the MDL. The highest malaoxon concentration, 440 ng/m^3 (33 pptv), was observed at the south sampling site during the 5th sampling period.

For malathion, of the 60 ambient samples collected (spikes, blanks and collocated samples excluded), forty-seven were found to be above the EQL, twelve were found to be "detected" and one was below the MDL. The highest malathion concentration, 90 ng/m^3 (6.6 pptv), was observed at the Calipatria School District (bus barn) sampling site on February 26, 1998. For malaoxon, of the 60 ambient samples collected (spikes, blanks and collocated samples excluded), twenty-two were found to be above the EQL, thirty-two were found to be "detected" and six were below the MDL. The highest malaoxon concentration, 28 ng/m^3 (2.1 pptv), was observed at the Brawley High School sampling site on March 10, 1998.

Acknowledgments

Staff of the ARB Testing Section collected the application samples and staff of the Air Quality Surveillance Branch collected the ambient samples. Assistance was provided by the Imperial County Agricultural Commissioner's Office. Chemical analyses were performed by the ARB Testing Section Laboratory.

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Report for the Application and Ambient Air Monitoring of Malathion in Imperial County

I. Introduction

At the request of the California Department of Pesticide Regulation (DPR) (January 27, 1998 Draft Monitoring Recommendations, Kelly to Castronovo, Faxed), the Air Resources Board (ARB) staff determined airborne concentrations of the pesticide malathion and it's breakdown product malaoxon over a three week ambient monitoring program in populated areas of Imperial County, conducted to coincide with the use of malathion on alfalfa. Application monitoring was also conducted in Imperial County around the use of malathion on 50 acres of alfalfa. This monitoring was done to fulfill the requirements of AB 1807/3219 (Food and Agricultural Code, Division 7, Chapter 3, Article 1.5) which requires the ARB "to document the level of airborne emissions .... of pesticides which may be determined to pose a present or potential hazard..." when requested by the DPR. Method development and sample analyses were conducted by the ARB Testing Section Laboratory. Sample collection for the ambient study was conducted by staff of the Air Quality Surveillance Branch.

The "Protocol for the Application and Ambient Air Monitoring of Malathion and Malaoxon in Imperial County During Spring, 1998" is enclosed separately as Appendix I (page 1 of a separate volume of appendices to this report).

The laboratory report, "Malathion and Malaoxon Method Development Analytical Results for Ambient Monitoring Samples," is enclosed separately as Appendix II (page 10 of the separate volume of appendices to this report). The sampling/analysis Standard Operating Procedures (SOP) are also enclosed in Appendix II (page 42 of the separate volume of appendices to this report).

The pesticide use recommendation for the application study is enclosed separately as Appendix III (page 51 of the separate volume of appendices to this report).

The DPR's January 27, 1998 draft memorandum, "Use Information and Air Monitoring Recommendation for the Pesticide Active Ingredient Malathion and its Breakdown Product Malaoxon" is enclosed separately as Appendix IV (page 53 of the separate volume of appendices to this report).

The application and ambient field log sheets are enclosed separately as Appendix V (page 62 of the separate volume of appendices to this report.

The application meteorological monitoring results are enclosed separately as Appendix VI (page 71 of the separate volume of appendices to this report).

II. Chemical Properties of Malathion

The following information regarding the chemical properties of malathion was obtained from the DPR's January 27, 1998 draft memorandum,"Use Information and Air Monitoring Recommendation for the Pesticide Active Ingredient Malathion and its Breakdown Product Malaoxon" (page 53 of appendices).

Malathion (CAS:121-75-5) exists as yellowish or dark-brown liquid. Technical formulations have a garlic-like odor and formulated products have a mercaptan-like odor. Malathion has a molecular formula of $C_{10}H_{19}O_6PS_2$, a formula weight of 330.36 g/mole, and a specific density of 1.23 at 25 °C. Malathion is miscible in alcohols, chloroform, DMSO, ketones, vegetable oils, and aromatic and alkylated aromatic hydrocarbons. It's solubility in water ranges from 140 - 165 mg/L (10-30 °C). Malathion has a Henry's Constant of 4.89×10^{-9} atm-m^3/mol at 25 °C, and a vapor pressure of 1.25×10^{-6} mm Hg at 20 °C. Malathion's photolysis half life is 51 hours (absorbance $\lambda = 210$ nm) on glass plates, but only 15 hours in Suwannee River (FL) water (pH 4.8, September). Physical/chemical properties for malaoxon are not available, although they are expected to be similar to those of malathion.

Malathion is transformed in all environmental compartments. In soil, malathion has been shown to degrade to malathion monoacid, malathion dicarboxylic acid, potassium dimethylphosphoro thioate, and potassium dimethylphosphorodithioate. In air, when exposed to Ultra Violet light, malathion decomposes to malathion monoacid, malathion diacid, O,O-diethyl phosphorothioic acid, dimethylphosphate and phosphoric acid. In water, malathion decomposes to a variety of compounds depending on pH, with reaction half-life inversely proportional to temperature.

Exposure limits for malathion are: ACGIH TLV: TWA 10 mg/m^3, NIOSH REL: 10 hour TWA 15 mg/m^3, and OSHA PEL: TWA 10 mg/m^3 (total dust) and 5 mg/m^3 (respirable fraction). Symptoms of exposure are excess salivation, headache, nausea, vomiting, abdominal cramps, diarrhea, ataxia, and lastly, death. Malathion is relatively non-toxic with an acute oral LD_{50} for male and female rats of 2,800 mg/kg. Its LC_{50} (24 hour) is 100 ppb for rainbow trout, and 120 ppb for bluegill sunfish. Malathion entered the SB950 Risk Assessment process because of the potential human exposure during Mediterranean Fruit Fly eradication efforts, and because there was some concern of possible oncogenic effects.

III. Sampling

A sketch of the sampling apparatus is shown in Figure 1 of Appendix I (appendices pg. 9). Samples were collected by passing a measured volume of ambient air through XAD-2 resin. The XAD-2 resin tubes were obtained from SKC (#226-30-06). Calibrated rotameters were used to set and measure sample flow rates. The flow rate, 3 Lpm, was accurately measured and the sampling system operated continuously with the exact operating interval noted. Samplers were leak checked prior to and after each sampling period with the sampling cartridges installed. Any change in the flow rates was recorded in the field log book (see appendices pg. 62). The resin tubes were

protected from direct sunlight and supported about 1.5 meters above the ground (or roof) during the sampling period. At the end of each sampling period the tubes were capped and placed in culture tubes with an identification label affixed. The field log book was used to record start and stop times, sample identifications and any other significant comments. Subsequent to sampling, the samples were transported on dry ice, as soon as reasonably possible, to the Testing Section Laboratory in Sacramento. The samples were then stored in the freezer or extracted/analyzed immediately.

A. Application Monitoring

A 50 acre field of alfalfa was chosen for the application monitoring site. Refer to Figure 2 for a diagram of the application site. Refer to Appendix III (page 51 of appendices) for a copy of the pesticide use recommendation. A 140 acre field of alfalfa directly to the west was also treated with malathion at the same time and at the same application rate. ARB staff was not aware that this application to the adjacent 140 acres was going to occur and so had assembled samplers only around the 50 acre field. Samplers were not moved after the application started. Refer to Figure 3 for a diagram of the 50 (South Alamo 48) and 140 (South Alamo 51) acre fields.

Information collected regarding the application included: 1) the elevation of each sampling station with respect to the field, 2) the orientation of the field with respect to North (identified as either true or magnetic), 3) an accurate record of the positions of the monitoring equipment with respect to the field, including the distance each monitor is positioned away from the edge of the field and an accurate drawing of the monitoring site showing the precise location of the monitoring equipment and any wind obstacles with respect to the field, 4) the field size, 5) the application rate, 6) formulation and 7) method and length of application. Details regarding the site and application are summarized below in Table 1.

Table 1.
Application Information

Range/Township/Section:	R15E/T16S/S25 N1/2
Product Applied:	Malathion 8
Type of Application:	Aerial (by airplane)
Application Rate:	1.5 pints product per acre (1.5 lbs. malathion A.I. per acre)
Applicator:	Stoker Company

A three day monitoring period was recommended in the DPR's January 28, 1998 draft memorandum "Use Information and Air Monitoring Recommendation for the Pesticide Active Ingredient Malathion and its Breakdown Product Malaoxon" with intended sampling times as follows: (where the first sample is started at the start of application) application + 1 hour, followed by one 2-hour sample, one 4-hour sample, two 8-hour samples and two 24-hour samples.

Background samples were taken at each position to establish if any malathion was detectable in the

air before the application (i.e., from nearby applications). The background samples were collected from 2000 on February 23 to 1930 on February 24, 1998 (23.5 hours). The application was scheduled for the morning of February 24 but was delayed to February 25, 1998 due to bad weather. The February 25 application started at 1320 and ended at 1420. Referring to Figure 2, the application started at the northeast corner and generally proceeded in east/west passes (except around the houses). Table 2 lists the approximate sampling periods.

Table 2.
Application Sampling Periods

Period		Date	Time
Background		2/23-24/98	2000 to 1930
1	Application plus 1 hour	2/25/98	1330 to 1530
2	2 hours	2/25/98	1530 to 1730
3	4 hours	2/25/98	1730 to 2130
4	7 3/4 hours	2/25-26/98	2130 to 0515
5	7 1/4 hours	2/26/98	0515 to 1230
6	24 hours	2/26-27/98	1230 to 1230
7	21 ½ hours	2/27-28/98	1230 to 1000

Four samplers were positioned, one on each side of the field. A fifth sampler was collocated at the east position. The west, north, east and south samplers were positioned approximately 10 yards, 8 yards, 27 yards and 12 yards from the field respectively. All samplers were at the same elevation as the field. The meteorological station was positioned at the northwest corner of the field (oriented toward geographic north).

The meteorological station was set up to determine wind speed and direction, barometric pressure, relative humidity and air temperature. This station continued to operate continuously throughout the sampling period collecting data at 1 minute intervals using a data logger. The raw meteorological station data is available on a 1.44 MB diskette (comma delimited format). Appendix VI (page 71 of the appendices) lists the meteorological station data for the wind direction and speed, barometric pressure, relative humidity and air temperature in 15 minute averages for the test period. The data listed for the wind direction is the arithmetic average and is not valid when the wind direction varies around 0 degrees. An appropriate direction averaging program is necessary if 15 minute averages are required for wind direction. ARB staff noted the degree of cloud cover, on the sample log sheet, whenever sample cartridges were changed. The skies were partly cloudy with intermittent showers during the background period and were clear for the remainder of the study period.

B. Ambient Monitoring

Ambient monitoring took place during a three week period from February 23 to March 13, 1998. Four sampling sites were selected by ARB personnel from the areas of Imperial County where

alfalfa farming is predominant and in populated areas or in areas frequented by people. Sites were selected with considerations for both accessibility and security of the sampling equipment. Background samples were collected at the ARB ambient air monitoring station in Calexico. The five sites are listed in Table 3. Twenty-four hour (approximately) samples were taken Monday through Friday (4 samples/week) at a flow rate of 3 Lpm. Twelve discreet sampling-days were monitored at each site for a total of 60 samples (plus 15 collocated samples, 3 trip blanks and 15 quality assurance spikes).

Table 3.
Ambient Sampling Sites

HHS	Holtville Union School District Bus Barn 621 E 6th St. Holtville, CA 92250 Range/Township/Section: R.15E/T.15S/S.26-SW1/4	(760) 356-2974 Robert Duran Superintendent
PIN	Pine Elementary School 3295 Holt Road Holtville, CA 92250 Range/Township/Section: R.15E/T.14S/S.36-NW1/4	(760) 356-2615 John Kirchenbauer Principal
CAL	Calipatria School District Bus Barn 601 W. Main Calpatria, CA 92233 Range/Township/Section: R.14E/T.12S/S.16-NE1/4	(760) 348-5656 Jim Spellings, Maint. Supervisor
BRA	Brawley High School 480 N. Imperial Ave. Brawley, CA 92227 Range/Township/Section: R.13E/T.13S/S.32-NE1/4	(760) 344-3560 Garth Isom, Principal
ARB	ARB Air Monitoring Station 1029 Ethel Calexico, CA92231 Range/Township/Section: R.14E/T.16S/S.14-NE1/4	(530) 667-2282 Curt Shreiber

The Holtville Union School District Bus Barn is in a residential area in the small town of Holtville. There are alfalfa fields to the north, south and west at a distance of approximately 1 mile and to the east at a distance of approximately 2 miles. The sampling unit was placed on the roof of the barn building at a height of approximately 26 feet. The sampling cartridges were positioned approximately 4 feet above the roof. Thus, air was sampled through the cartridges at a height of approximately 30 feet.

The Pine Elementary School is situated in the rural outskirts of Holtville. There are alfalfa fields to

the north, south, east and west at a distance of approximately 50 yards. The sampling unit was placed on the roof of a pumphouse building at a height of approximately 10 feet. The sampling cartridges were positioned approximately 4 feet above the roof. Thus, air was sampled through the cartridges at a height of approximately 14 feet.

The Calipatria School District Transportation Yard is located on the west side of the small town of Calipatria. There are alfalfa fields to the south, north and east at a distance of approximately 3/4, 2 and 3 miles respectively and directly to the west at a distance of 50 yards was sudan grass. The sampling unit was placed on the top of a single story shed/building at a height of approximately 11 feet. The sampling cartridges were positioned approximately 4 feet above the roof. Thus, air was sampled through the cartridges at a height of approximately 15 feet.

The Brawley High School is situated in a residential area in the small town of Brawley. There are alfalfa fields to the north, south, east and west at a distance of approximately 1 to 2 miles. The sampling unit was placed on the roof of a single story building at a height of approximately 14 feet. The sampling cartridges were positioned approximately 4 feet above the roof. Thus, air was sampled through the cartridges at a height of approximately 18 feet.

The background monitoring was conducted at the ARB air monitoring site in a residential area in Calexico. The sampler was placed on the roof of the trailer near other monitoring equipment at a height of approximately 12 feet. Thus, air was sampled through the cartridges at a height of approximately 16 feet.

IV. Analytical Methodology

"The Standard Operating Procedures for Sampling and Analysis of Malathion in Ambient Air" are enclosed as Appendix III (page 42 of appendices). The procedures specify that the exposed XAD-2 resin tubes are stored in an ice chest on dry ice or in a freezer until desorbed with 2.5 mL of ethyl acetate. The sorbent is spiked with 250 ng of malathion D_8 prior to extraction. The splitless injection volume is 4 uL. A gas chromatograph with a DB-17 capillary column and a quadrapole mass spectrometer (MS) is used for analysis. The MS detector is operated in selected ion monitoring mode.

V. Application and Ambient Results

Tables 4 and 7 present the results of application and ambient air monitoring, respectively, for malathion and malaoxon. Summaries of the application and ambient results are presented in Tables 5 and 8 respectively. Laboratory results, in units of ng/sample, equal to or above the estimated quantitation limit (EQL) are reported to 3 significant figures. Air concentration results (in units of ng/m^3 and pptv) are reported to 2 significant figures. Results equal to or above the method detection limit (MDL) but below the EQL are reported as detected (Det).

The equation used to convert malathion air concentration from units of ug/m^3 to pptv units at 1 atmosphere and 25 °C is shown below. The equation for malaoxon would use a formula weight of 322.36 gram/mole.

$$\text{pptv} = (\text{ng/m}^3) \times \frac{(0.0820575 \text{ liter-atm/mole-°K})(298 \text{°K})}{(1 \text{ atm})(330.36 \text{ gram/mole})} = (0.0740196) \times (\text{ng/m}^3)$$

The Testing Section Laboratory determined the analytical MDL as (3.14)(s); where s is the standard deviation of the concentration (ng/mL) calculated for seven replicate resin spikes (near the estimated detection limit). Multiplying by the 2.5 mL extraction volume, the MDL was 3.48 and 6.8 ng/sample for malathion and malaoxon respectively. The EQL, calculated as 5 times the MDL, was 17.3 and 34.0 ng/sample for malathion and malaoxon respectively. The air concentration, expressed in units of ng/m^3 (or pptv), associated with the EQL is dependent on the volume of air sampled which varies from sample to sample. For a 24-hour sampling period at 3 Lpm the air concentration would be 4.0 ng/m^3 (0.30 pptv) and 7.9 ng/sample (0.60 pptv) as associated with the EQL for malathion and malaoxon respectively.

A. Application Monitoring Results

The application sample results have also been summarized as associated with sampling period wind roses in Figure 4. The spokes of the wind roses correspond to the compass direction of origin of the wind. For example, the wind was predominantly from the west during the background sampling period. The segments of each spoke correspond to incremental increases in wind speed of 2 mph each. The length of the spoke (and each segment) corresponds to the portion of the sampling time that the wind was from that direction (at that velocity).

All four of the application background samples had results above the EQL for malathion. The average of the four background samples was 9.7 ng/m^3. Of the twenty-eight application samples collected (spikes, blanks, collocated and background samples excluded) twenty-seven were found to be above the EQL for malathion and the remaining sample was detected. The highest malathion concentration, 2400 ng/m^3 (180 pptv), was observed at the south sampling site during the 2nd sampling period.

All four of the application background samples had results of "detected" for malaoxon. Of the twenty-eight application samples collected for malaoxon (spikes, blanks, collocated and background samples excluded) twelve were found to be above the EQL, three were found to be detected, and thirteen were below the MDL. The highest malaoxon concentration, 440 ng/m^3 (33 pptv), was observed at the south sampling site during the 5th sampling period.

B. Ambient Monitoring Results

For malathion, of the 60 ambient samples collected (spikes, blanks and collocated samples excluded), forty-seven were found to be above the EQL, twelve were found to be "detected" and one was below the MDL. The highest malathion concentration, 90 ng/m^3 (6.6 pptv), was observed at the

Calipatria School District (bus barn) sampling site on February 26, 1998.

For malaoxon, of the 60 ambient samples collected (spikes, blanks and collocated samples excluded), twenty-two were found to be above the EQL, thirty-two were found to be "detected" and six were below the MDL. The highest malaoxon concentration, 28 ng/m^3 (2.1 pptv), was observed at the Brawley High School sampling site on March 10, 1998.

VI. Quality Assurance

Field quality control (QC) for the application monitoring included the following:

1) Four field spikes (same environmental and experimental conditions as those occurring at the time of ambient sampling) prepared by the Testing Section staff. The field spikes were obtained by sampling ambient air at 3 Lpm for the same duration as the background samples (collocated with a background sample);
2) four trip spikes;
3) replicate samples (collocated) collected at one of the four sampling sites;
4) a trip blank; and
5) background samples at each side of the field.

The DPR's January 27, 1998 draft memorandum, "Use Information and Air Monitoring Recommendation for the Pesticide Active Ingredient Malathion and its Breakdown Product Malaoxon", stated that "Trip blank and field spike samples should be collected at the same environmental (e.g., temperature, humidity, exposure to sunlight) and experimental conditions (e.g., air flow rates) as those occurring at the time of sampling." The background samples were collected at the same environmental and experimental conditions as those occurring at the time of sampling (except for total sample volume). However, no field blanks were collected. Collection of true field blanks "same flow rate" with clean air) would involve rather complicated procedures and is not practical under field conditions. The trip blank was collected at the time of the sampling but did not experience the same environmental and experimental conditions except for transport and storage.

Field QC for the ambient monitoring included the following:

1) Five field spikes (same environmental and experimental conditions as those occurring at the time of ambient sampling) prepared by the Testing Section staff; the field spikes were obtained by sampling ambient air at the background monitoring site for 24 hour periods at 3 Lpm (collocated with an ambient sample);
2) five trip spikes;
3) replicate (collocated) samples taken for three dates at each sampling location; and
4) trip blanks collected once per week (see comment above regarding field blanks).

The instrument dependent parameters (reproducibility, linearity and EQL) are discussed in the SOP (page 48 of the appendices.) A chain of custody sheet accompanied all samples. Rotameters were

calibrated before the monitoring using a calibrated digital bubblemeter. The rotameter calibrations were also checked at the end of the study and were found to be unchanged.

VII. Quality Assurance Results

A. Method Development

Refer to Appendix II (page 42 of the appendices), "Standard Operating Procedure for the Sampling and Analysis of Malathion", for discussion and results of method development studies. Collection, extraction efficiency, storage stability and breakthrough were previously studied by the Organics Laboratory of the Air Resources Board and the results of the studies are outlined in NLB003 SOP. The freezer storage study showed that malathion was stable for at least 4 weeks. All of the application samples were initially analyzed on either March 4, 1998 or March 25, 1998 (less than 4 weeks from sampling). Samples exceeding the highest calibration standard level were reanalyzed on July 30, 1998 along with the laboratory control spikes and blank that were extracted with the batch of samples. The control samples were still within performance parameters and thus the samples that were extracted at the same time as the laboratory controls are considered valid as well.

B. Trip Blanks

The application and ambient trip blank results were all less than the MDL for malathion and malaoxon.

C. Application Background Sample Results

All four of the application background samples had results above the EQL for malathion. The average of the four background samples was 9.7 ng/m^3.

D. Collocated Sample Results

The results of the application collocated samples are listed in Table 6. The relative differences for malathion for the collocated pairs collected during periods 1 and 5 were relatively high, 136% and 81% respectively. The relative difference for the malaoxon results for period 5 were also high, 106%.

The results of the ambient collocated samples are listed in Table 9. Twelve pairs had both results above the EQL for malathion. The relative differences for three of those pairs were above 40% (53%, 51%, 44%). Four pairs had both results above the EQL for malaoxon. The relative differences for one of those pairs was above 40% (69%).

E. Laboratory Spikes

Laboratory spikes are prepared at the same time and at the same level as the trip spike and field

spike sets. The laboratory spikes are kept in a freezer until extraction and analysis. The extraction and analysis of laboratory, trip and field spikes normally occurs at the same time. Laboratory spikes for the application and ambient studies were prepared by Testing Section staff.

The laboratory spike results for the application and ambient studies are listed in Tables 10 and 13 respectively. Each of the spike cartridges was spiked with 75 ng each of malathion and malaoxon. The average recoveries for malathion for the application lab spikes was 76% and for the ambient lab spikes was 93%. The average recoveries for malaoxon for the application lab spikes was 95% and for the ambient lab spikes was 121%.

F. Trip Spikes

Trip spikes are prepared at the same time and at the same level as the laboratory spike and field spike sets. The trip spikes are kept in a freezer until transported to the field. The trip spike samples are kept on dry ice in an ice chest (the same one used for samples) during transport to and from the field and at all times while in the field except for trip spike sample log-in and labeling. Trip spikes for the application and ambient studies were prepared by Testing Section staff.

The trip spike results for the application and ambient studies are listed in Tables 11 and 14 respectively. Each of the spike cartridges was spiked with 75 ng each of malathion and malaoxon. The average recoveries for malathion for the application trip spikes was 78% and for the ambient trip spikes was 91%. The average recoveries for malaoxon for the application trip spikes was 92% and for the ambient trip spikes was 114%. These results are consistent with the lab spike results and indicate that the sample transport, storage and analytical procedures used in this study produce acceptable results for malathion and malaoxon.

G. Field Spikes

Field spikes are prepared at the same time and at the same level as the laboratory spike and trip spike sets. The field spikes are kept in a freezer until transported to the field. The field spike samples are kept on dry ice in an ice chest (the same one used for samples) during transport to and from the field and at all times while in the field except for the sampling period. Field spikes were collected at the same environmental and experimental conditions as those occurring at the time of ambient sampling. The field spikes were obtained by sampling ambient air through a previously spiked cartridge. (i.e., collocated with an ambient or background sample). Field spike sets for the application and ambient studies were prepared by Testing Section staff.

The field spike results for the application and ambient studies are listed in Tables 12 and 15 respectively. Each of the spike cartridges was spiked with 75 ng each of malathion and malaoxon. The average recovery for malathion for the application and ambient field spikes was 71% and 93% respectively. The average recovery for malaoxon for the application and ambient field spikes was 122% and 125% respectively. These results are consistent with the lab and trip spike results and indicate that the sampling, sample transport, storage and analytical procedures used in this study produce acceptable results for malathion and malaoxon.

FIGURE 1. MALATHION AMBIENT MONITORING AREA

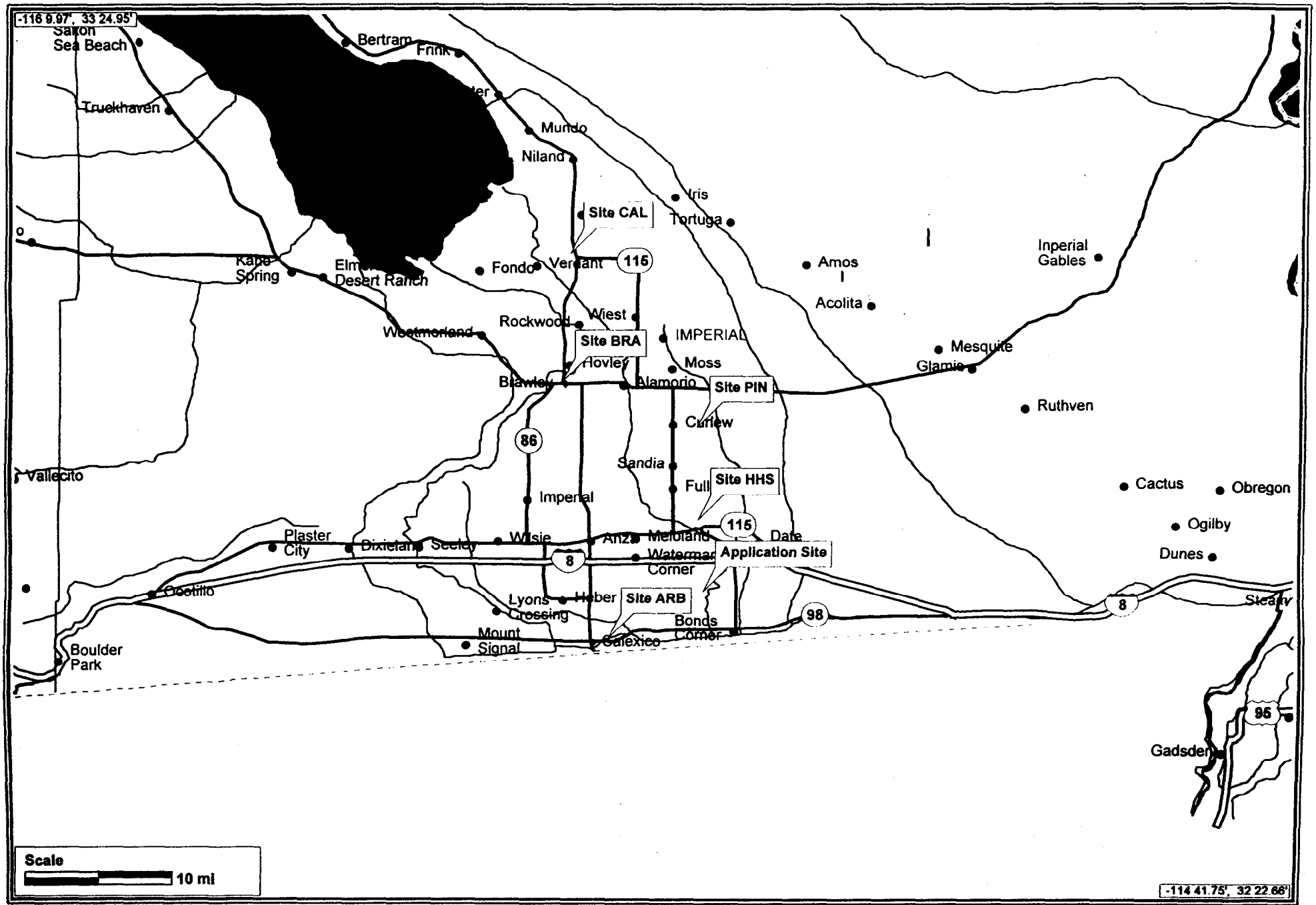
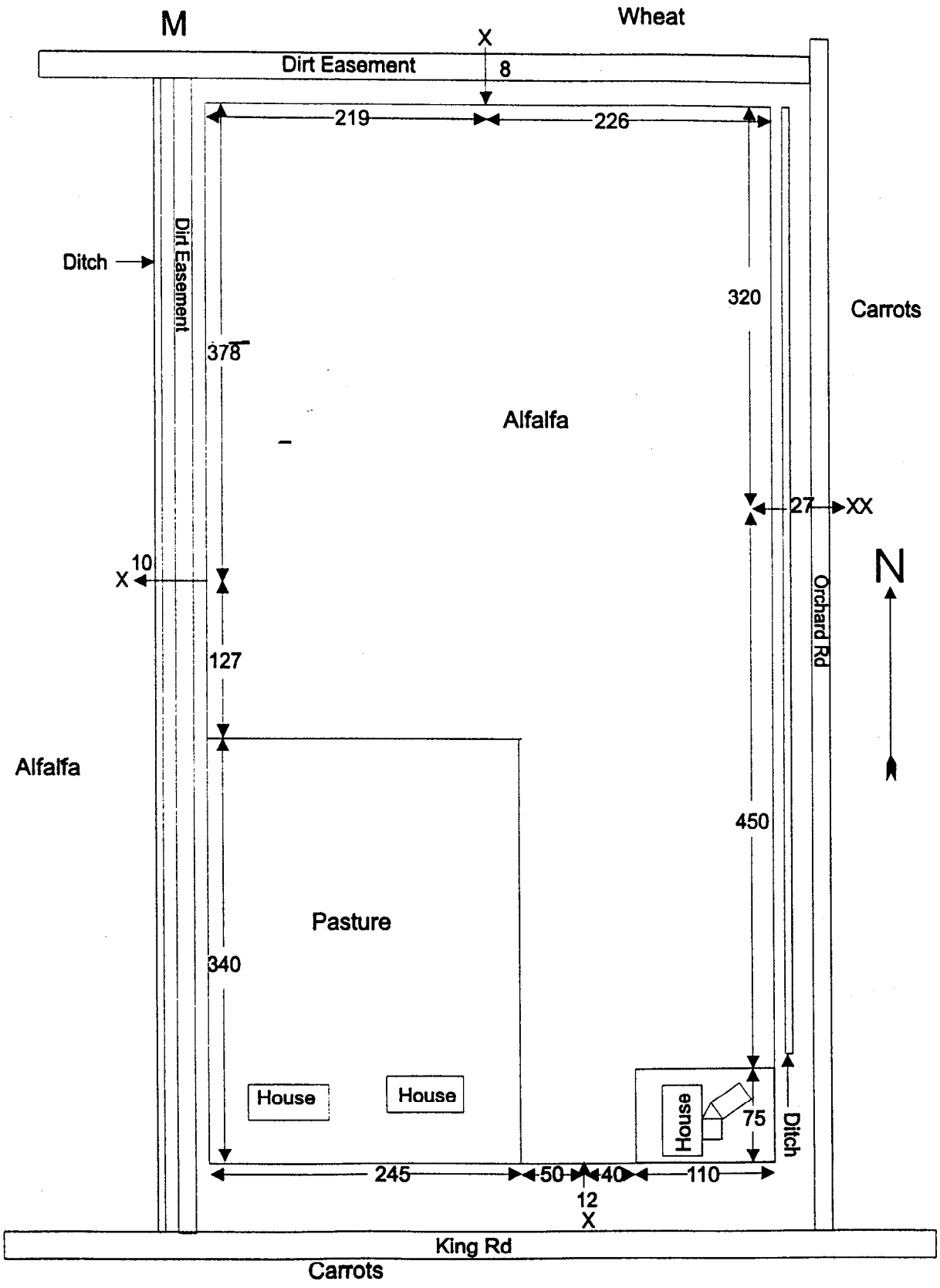
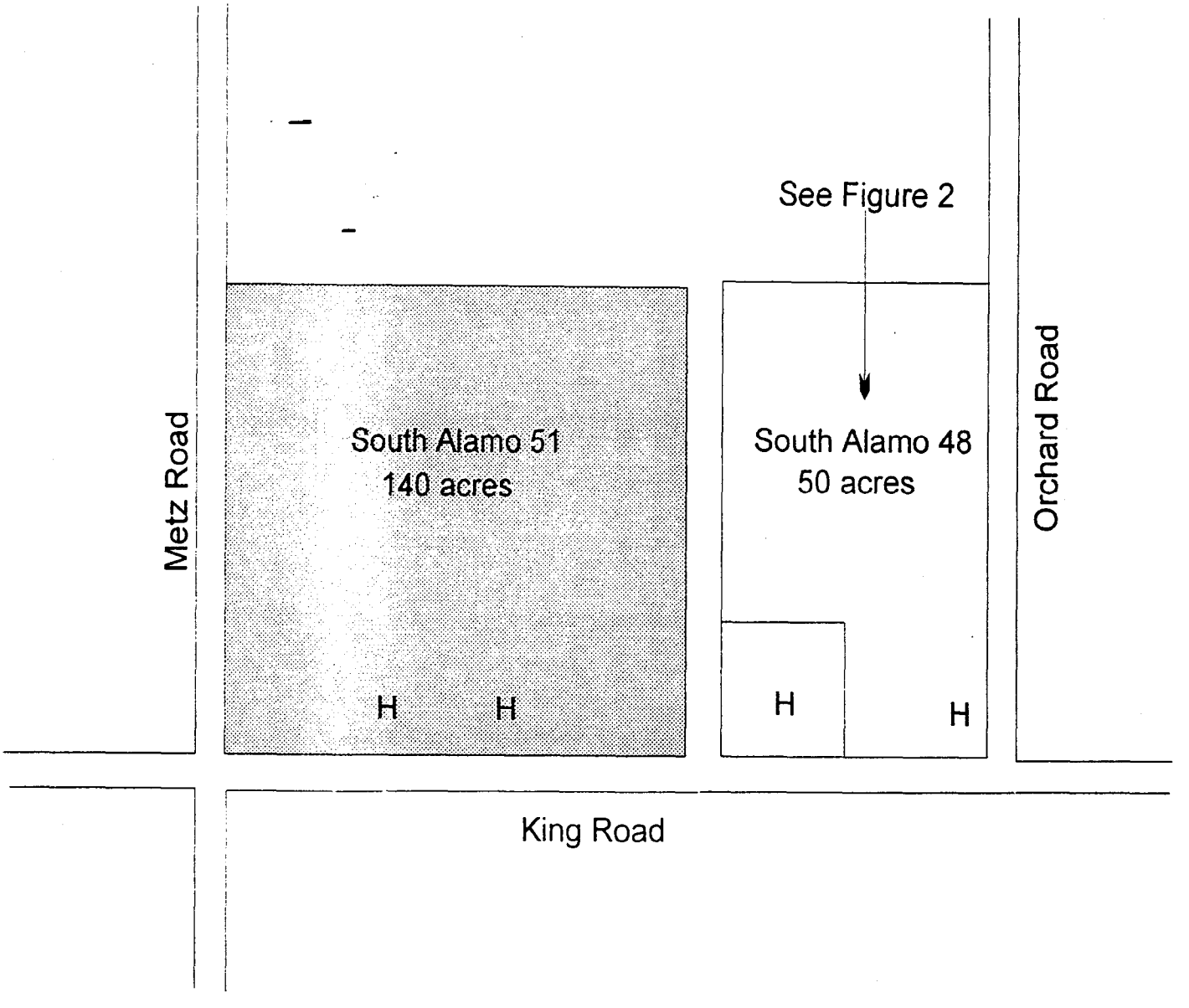


Figure 2
Malathion Application Site



M = Meteorological Station
N = Geographic North
*Distances in yards

Figure 3
Malathion Application Area



H = Homes

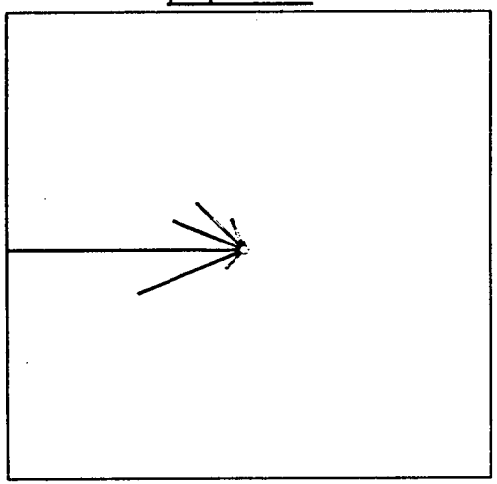
▨ = Adjacent field treated at the same time and at the same application rate.

FIGURE 4. MALATHION APPLICATION DATA (ng/m3)

BACKGROUND
23.5 Hours

[N] 11

[W] 9



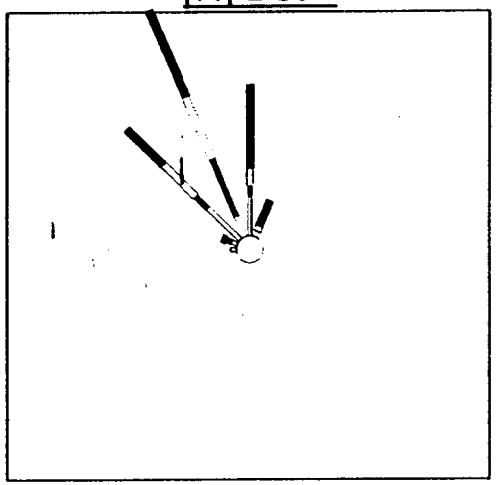
[E] 10

[S] 9

PERIOD 1
2.0 Hours

[N] Det

[W] 2200



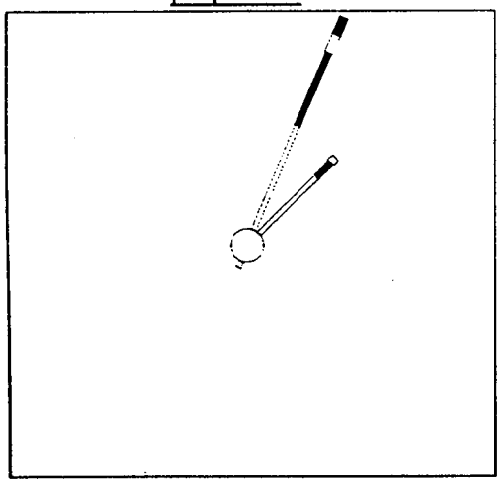
[E] 680
[ED] 130

[S] 720

PERIOD 2
2.0 Hours

[N] Det

[W] 2300



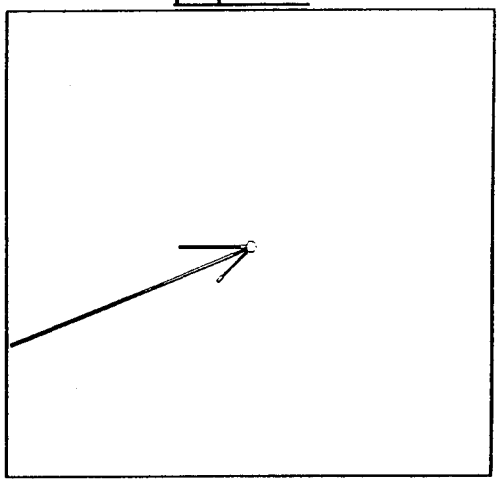
[E] 1600
[ED] 1200

[S] 2400

PERIOD 3
4.0 Hours

[N] 360

[W] 98



[E] 550
[ED] 770

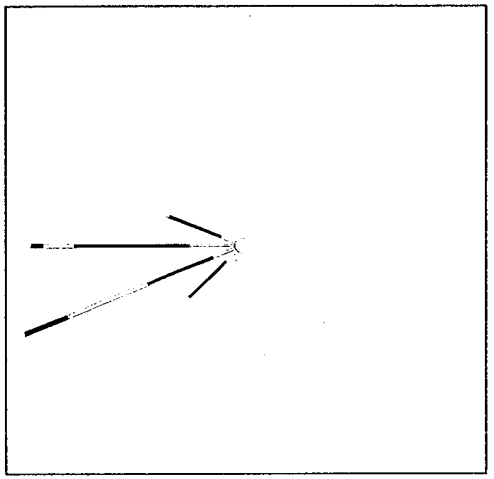
[S] 440

FIGURE 4. MALATHION APPLICATION DATA (ng/m3)

PERIOD 4
7.75 Hours

[N] 220

[W] 570



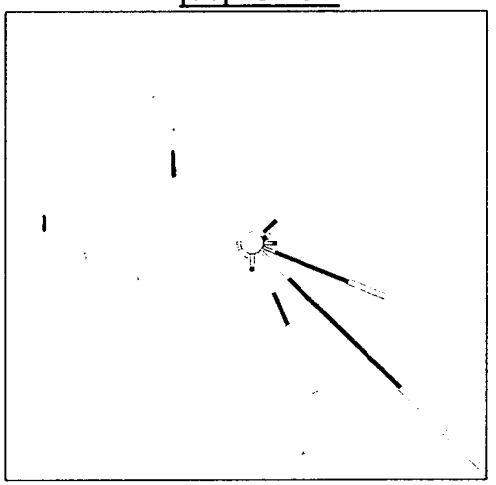
[E] 390
[ED] 390

[S] 250

PERIOD 5
7.25 Hours

[N] 570

[W] 920



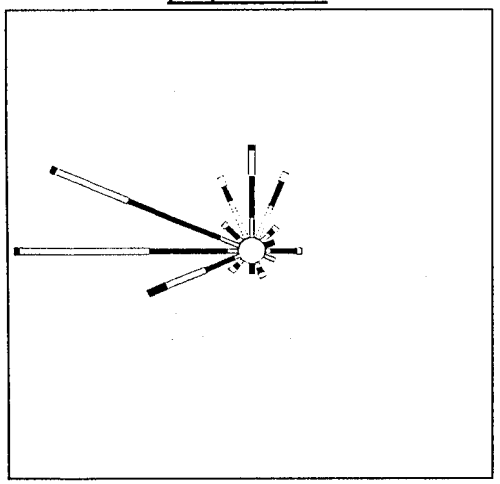
[E] 280
[ED] 660

[S] 740

PERIOD 6
24.0 Hours

[N] 240

[W] 16



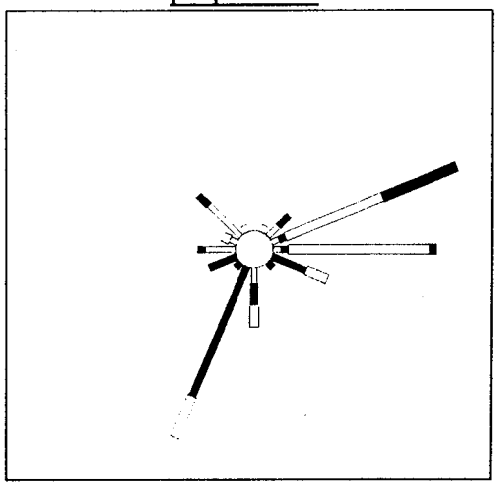
[E] 820
[ED] 760

[S] 600

PERIOD 7
21.5 Hours

[N] 190

[W] 1500



[E] 390
[ED] 350

[S] 340

Table 4. Malathion and Malaoxon Application Monitoring Results

Log #	Sample ID	Start Date/Time	End Date/Time	Time (min)	Time (hours)	Volume (m3)	Malathion (ng/sample)	(ng/m3)	*(pptv)	Malaoxon (ng/sample)	(ng/m3)	*(pptv)
1	SB	02/23/98 19:55	02/24/98 19:20	1405	23.4	4.2	3.86E+1	9.2E+00	6.8E-01	Det	Det	Det
3	WB	02/23/98 20:00	02/24/98 19:25	1405	23.4	4.2	3.89E+1	9.2E+00	6.8E-01	Det	Det	Det
5	NB	02/23/98 20:10	02/24/98 19:30	1400	23.3	4.2	4.46E+1	1.1E+01	7.9E-01	Det	Det	Det
7	EB	02/23/98 20:15	02/24/98 19:35	1400	23.3	4.2	4.31E+1	1.0E+01	7.6E-01	Det	Det	Det
9	N1	02/25/98 13:20	02/25/98 15:20	120	2.0	0.4	Det	Det	Det	<MDL	<MDL	<MDL
10	W1	02/25/98 13:20	02/25/98 15:25	125	2.1	0.4	8.30E+2	2.2E+03	1.6E+02	<MDL	<MDL	<MDL
11	S1	02/25/98 13:20	02/25/98 15:30	130	2.2	0.4	2.79E+2	7.2E+02	5.3E+01	<MDL	<MDL	<MDL
12	E1	02/25/98 13:20	02/25/98 15:35	135	2.3	0.4	2.77E+2	6.8E+02	5.1E+01	<MDL	<MDL	<MDL
13	E1D	02/25/98 13:20	02/25/98 15:35	135	2.3	0.4	5.13E+1	1.3E+02	9.4E+00	<MDL	<MDL	<MDL
14	N2	02/25/98 15:20	02/25/98 17:25	125	2.1	0.4	Det	Det	Det	<MDL	<MDL	<MDL
15	W2	02/25/98 15:25	02/25/98 17:40	135	2.3	0.4	9.26E+2	2.3E+03	1.7E+02	<MDL	<MDL	<MDL
16	S2	02/25/98 15:30	02/25/98 17:40	130	2.2	0.4	9.43E+2	2.4E+03	1.8E+02	<MDL	<MDL	<MDL
17	E2	02/25/98 15:35	02/25/98 17:45	130	2.2	0.4	6.18E+2	1.6E+03	1.2E+02	<MDL	<MDL	<MDL
18	E2D	02/25/98 15:35	02/25/98 17:45	130	2.2	0.4	4.77E+2	1.2E+03	9.1E+01	<MDL	<MDL	<MDL
19	N3	02/25/98 17:25	02/25/98 21:25	240	4.0	0.7	2.59E+2	3.6E+02	2.7E+01	<MDL	<MDL	<MDL
20	W3	02/25/98 17:35	02/25/98 21:30	235	3.9	0.7	6.88E+1	9.8E+01	7.2E+00	<MDL	<MDL	<MDL
21	S3	02/25/98 17:40	02/25/98 21:35	235	3.9	0.7	3.13E+2	4.4E+02	3.3E+01	<MDL	<MDL	<MDL
22	E3	02/25/98 17:45	02/25/98 21:40	235	3.9	0.7	3.87E+2	5.5E+02	4.1E+01	<MDL	<MDL	<MDL
23	E3D	02/25/98 17:45	02/25/98 21:40	235	3.9	0.7	5.45E+2	7.7E+02	5.7E+01	<MDL	<MDL	<MDL
24	N4	02/25/98 21:25	02/26/98 05:10	465	7.8	1.4	3.14E+2	2.2E+02	1.7E+01	<MDL	<MDL	<MDL
25	W4	02/25/98 21:30	02/26/98 05:15	465	7.7	1.4	7.98E+2	5.7E+02	4.2E+01	Det	Det	Det
26	S4	02/25/98 21:35	02/26/98 05:20	465	7.7	1.4	3.46E+2	2.5E+02	1.8E+01	3.43E+1	2.5E+01	1.9E+00
27	E4	02/25/98 21:40	02/26/98 05:25	465	7.7	1.4	5.50E+2	3.9E+02	2.9E+01	Det	Det	Det
28	E4D	02/25/98 21:40	02/26/98 05:25	465	7.7	1.4	5.39E+2	3.9E+02	2.9E+01	3.57E+1	2.6E+01	1.9E+00
29	N5	02/26/98 05:10	02/26/98 12:20	430	7.2	1.3	7.33E+2	5.7E+02	4.2E+01	4.05E+1	3.1E+01	2.4E+00
30	W5	02/26/98 05:15	02/26/98 12:30	435	7.3	1.3	1.20E+3	9.2E+02	6.8E+01	1.36E+2	1.0E+02	7.9E+00
31	S5	02/26/98 05:20	02/26/98 12:35	435	7.3	1.3	9.65E+2	7.4E+02	5.5E+01	5.78E+2	4.4E+02	3.3E+01
32	E5	02/26/98 05:25	02/26/98 12:40	435	7.3	1.3	3.68E+2	2.8E+02	2.1E+01	1.53E+2	1.2E+02	8.8E+00
33	E5D	02/26/98 05:25	02/26/98 12:40	435	7.3	1.3	8.67E+2	6.6E+02	4.9E+01	4.78E+1	3.7E+01	2.8E+00
34	N6	02/26/98 12:20	02/27/98 12:25	1445	24.1	4.3	1.05E+3	2.4E+02	1.8E+01	8.30E+1	1.9E+01	1.4E+00
35	W6	02/26/98 12:30	02/27/98 12:30	1440	24.0	4.3	6.84E+1	1.6E+01	1.2E+00	2.58E+2	6.0E+01	4.5E+00
36	S6	02/26/98 12:35	02/27/98 12:35	1440	24.0	4.3	2.61E+3	6.0E+02	4.5E+01	2.60E+2	6.0E+01	4.5E+00
37	E6	02/26/98 12:40	02/27/98 12:40	1440	24.0	4.3	3.52E+3	8.2E+02	6.0E+01	2.61E+2	6.0E+01	4.5E+00

MDL = 3.48 ng/sample for malathion and 6.80 ng/sample for malaoxon
EQL = 17.3 ng/sample for malathion and 34.0 ng/sample for malaoxon
Det = <EQL but ≥MDL
* pptv at 25 C and 1 atm
NA = Not Applicable

Table 4. Malathion and Malaoxon Application Monitoring Results

Log #	Sample ID	Start Date/Time	End Date/Time	Time (min)	Time (hours)	Volume (m3)	Malathion (ng/sample)	(ng/m3)	*(pptv)	Malaoxon (ng/sample)	(ng/m3)	*(pptv)
38	E6D	02/26/98 12:40	02/27/98 12:40	1440	24.0	4.3	3.28E+3	7.6E+02	5.6E+01	2.21E+2	5.1E+01	3.9E+00
39	N7	02/27/98 12:25	02/28/98 09:55	1290	21.5	3.9	7.47E+2	1.9E+02	1.4E+01	Det	Det	Det
40	W7	02/27/98 12:30	02/28/98 10:00	1290	21.5	3.9	5.72E+3	1.5E+03	1.1E+02	2.10E+2	5.4E+01	4.1E+00
41	S7	02/27/98 12:35	02/28/98 10:05	1290	21.5	3.9	1.30E+3	3.4E+02	2.5E+01	1.42E+2	3.7E+01	2.8E+00
42	E7	02/27/98 12:40	02/28/98 10:10	1290	21.5	3.9	1.50E+3	3.9E+02	2.9E+01	1.23E+2	3.2E+01	2.4E+00
43	E7D	02/27/98 12:40	02/28/98 10:10	1290	21.5	3.9	1.36E+3	3.5E+02	2.6E+01	8.65E+1	2.2E+01	1.7E+00
48	TB8	03/01/98 10:00	03/01/98 10:00	0	0.0	0.0	<MDL	NA	NA	<MDL	NA	NA

MDL = 3.48 ng/sample for malathion and 6.80 ng/sample for malaoxon
EQL = 17.3 ng/sample for malathion and 34.0 ng/sample for malaoxon
Det = <EQL but ≥MDL
* pptv at 25 C and 1 atm
NA = Not Applicable

Table 5. Summary of Malathion and Maloxon Application Results (ng/m3)

Sampling Period	East (-thion)	(-oxon)	East Collocated (-thion)	(-oxon)	North (-thion)	(-oxon)	South (-thion)	(-oxon)	West (-thion)	(-oxon)
Background	10	Det			11	Det	9	Det	9	Det
Period 1	680	<MDL	130	<MDL	Det	<MDL	720	<MDL	2200	<MDL
Period 2	1600	<MDL	1200	<MDL	Det	<MDL	2400	<MDL	2300	<MDL
Period 3	550	<MDL	770	<MDL	360	<MDL	440	<MDL	98	<MDL
Period 4	390	Det	390	26	220	<MDL	250	25	570	Det
Period 5	280	120	660	37	570	31	740	440	920	100
Period 6	820	60	760	51	240	19	600	60	16	60
Period 7	390	32	350	22	190	Det	340	37	1500	54

MDL = 3.48 ng/sample for malathion and 6.80 ng/sample for malaoxon
EQL = 17.3 ng/sample for malathion and 34.0 ng/sample for malaoxon
Det = <EQL but ≥MDL
* pptv at 25 C and 1 atm
NA = Not Applicable

Table 6. Malathion and Maloxon Application Collocated Results (ng/m3)

Sampling Period	East (-thion)	East Collocated (-thion)	Average	Relative Difference	East (-oxon)	East Collocated (-oxon)	Average	Relative Difference
Period 1	680	130	405	136%	<MDL	<MDL	<MDL	NA
Period 2	1600	1200	1400	29%	<MDL	<MDL	<MDL	NA
Period 3	550	770	660	33%	<MDL	<MDL	<MDL	NA
Period 4	390	390	390	0%	Det	26	NA	NA
Period 5	280	660	470	81%	120	37	79	106%
Period 6	820	760	790	8%	60	51	56	16%
Period 7	390	350	370	11%	32	22	27	37%

MDL = 3.48 ng/sample for malathion and 6.8 ng/sample for malaoxon
EQL = 17.3 ng/sample for malathion and 34.0 ng/sample for malaoxon
Det = <EQL but ≥MDL
NA = Not Applicable

Table 7. Malathion and Malaoxon Ambient Monitoring Results

Log #	Sample ID	Start Date/Time	End Date/Time	Time (min)	Time (hours)	Volume (m3)	Malathion (ng/sample)	(ng/m3)	*(pptv)	Malaoxon (ng/sample)	(ng/m3)	*(pptv)
1	HHS01	02/23/98 19:55	02/24/98 19:20	1405	23.4	4.2	3.54E+1	8.4E+00	6.2E-01	<MDL	<MDL	<MDL
2	PIN01	02/23/98 08:45	02/24/98 08:45	1440	24.0	4.3	1.38E+2	3.2E+01	2.4E+00	3.84E+1	8.9E+00	6.7E-01
3	CAL01	02/23/98 09:25	02/24/98 09:25	1440	24.0	4.3	8.77E+1	2.0E+01	1.5E+00	Det	Det	Det
4	BRA01	02/23/98 09:50	02/24/98 09:50	1440	24.0	4.3	9.04E+1	2.1E+01	1.5E+00	Det	Det	Det
5	ARB01	02/23/98 10:30	02/24/98 10:30	1440	24.0	4.3	Det	Det	Det	<MDL	<MDL	<MDL
6	HHS02	02/24/98 08:20	02/25/98 08:20	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
7	PIN02	02/24/98 08:45	02/25/98 08:45	1440	24.0	4.3	3.72E+1	8.6E+00	6.4E-01	Det	Det	Det
8	CAL02	02/24/98 09:25	02/25/98 09:25	1440	24.0	4.3	3.17E+1	7.3E+00	5.4E-01	Det	Det	Det
9	BRA02	02/24/98 09:50	02/25/98 09:50	1440	24.0	4.3	4.05E+1	9.4E+00	6.9E-01	<MDL	<MDL	<MDL
10	ARB02	02/24/98 10:30	02/25/98 10:30	1440	24.0	4.3	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
11	HHS03	02/25/98 08:20	02/26/98 08:20	1440	24.0	4.3	3.50E+1	8.1E+00	6.0E-01	Det	Det	Det
12	HHS03D	02/25/98 08:20	02/26/98 08:20	1440	24.0	4.3	4.25E+1	9.8E+00	7.3E-01	6.06E+1	1.4E+01	1.1E+00
13	PIN03	02/25/98 08:45	02/26/98 08:45	1440	24.0	4.3	8.91E+1	2.1E+01	1.5E+00	3.57E+1	8.3E+00	6.2E-01
14	PIN03D	02/25/98 08:45	02/26/98 08:45	1440	24.0	4.3	1.39E+2	3.2E+01	2.4E+00	7.25E+1	1.7E+01	1.3E+00
15	CAL03	02/25/98 09:25	02/26/98 09:25	1440	24.0	4.3	9.61E+1	2.2E+01	1.6E+00	Det	Det	Det
16	CAL03D	02/25/98 09:25	02/26/98 09:25	1440	24.0	4.3	9.71E+1	2.2E+01	1.7E+00	<MDL	<MDL	<MDL
17	BRA03	02/25/98 09:50	02/26/98 09:50	1440	24.0	4.3	5.13E+1	1.2E+01	8.8E-01	Det	Det	Det
18	BRA03D	02/25/98 09:50	02/26/98 09:50	1440	24.0	4.3	5.45E+1	1.3E+01	9.3E-01	Det	Det	Det
19	ARB03	02/25/98 10:30	02/26/98 10:30	1440	24.0	4.3	6.24E+1	1.4E+01	1.1E+00	6.25E+1	1.4E+01	1.1E+00
20	ARB03D	02/25/98 10:30	02/26/98 10:30	1440	24.0	4.3	1.07E+2	2.5E+01	1.8E+00	7.66E+1	1.8E+01	1.3E+00
21	HHS04	02/26/98 08:20	02/27/98 08:20	1440	24.0	4.3	6.72E+1	1.6E+01	1.2E+00	5.79E+1	1.3E+01	1.0E+00
22	PIN04	02/26/98 08:45	02/27/98 08:45	1440	24.0	4.3	1.18E+2	2.7E+01	2.0E+00	7.35E+1	1.7E+01	1.3E+00
23	CAL04	02/26/98 09:25	02/27/98 09:25	1440	24.0	4.3	3.87E+2	9.0E+01	6.6E+00	Det	Det	Det
24	BRA04	02/26/98 09:50	02/27/98 09:50	1440	24.0	4.3	4.24E+1	9.8E+00	7.3E-01	4.15E+1	9.6E+00	7.2E-01
25	ARB04	02/26/98 10:30	02/27/98 10:30	1440	24.0	4.3	3.08E+1	7.1E+00	5.3E-01	Det	Det	Det
26	TB4	02/27/98 10:30	02/27/98 10:30	0	0.0	0.0	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
32	HHS05	03/02/98 08:20	03/03/98 08:20	1440	24.0	4.3	4.06E+1	9.4E+00	7.0E-01	Det	Det	Det
33	PIN05	03/02/98 08:45	03/03/98 08:45	1440	24.0	4.3	1.34E+2	3.1E+01	2.3E+00	4.95E+1	1.1E+01	8.6E-01
34	CAL05	03/02/98 09:20	03/03/98 09:50	1470	24.5	4.4	1.08E+2	2.4E+01	1.8E+00	6.07E+1	1.4E+01	1.0E+00
35	BRA05	03/02/98 09:45	03/03/98 09:45	1440	24.0	4.3	2.97E+1	6.9E+00	5.1E-01	<MDL	<MDL	<MDL

MDL = 3.48 ng/sample for malathion and 6.80 ng/sample for malaoxon
EQL = 17.3 ng/sample for malathion and 34.0 ng/sample for malaoxon
Det = <EQL but ≥MDL
*pptv at 25 C and 1 atm
NA = Not Applicable

Table 7. Malathion and Malaoxon Ambient Monitoring Results

Log #	Sample ID	Start Date/Time	End Date/Time	Time (min)	Time (hours)	Volume (m3)	Malathion (ng/sample)	(ng/m3)	*(pptv)	Malaoxon (ng/sample)	(ng/m3)	*(pptv)
36	ARB05	03/02/98 10:30	03/03/98 10:30	1440	24.0	4.3	1.79E+1	4.1E+00	3.1E-01	<MDL	<MDL	<MDL
37	HHS06	03/03/98 08:20	03/04/98 08:20	1440	24.0	4.3	5.47E+1	1.3E+01	9.4E-01	4.24E+1	9.8E+00	7.4E-01
38	PIN06	03/03/98 08:45	03/04/98 08:45	1440	24.0	4.3	5.15E+1	1.2E+01	8.8E-01	6.29E+1	1.5E+01	1.1E+00
39	CAL06	03/03/98 09:20	03/04/98 09:20	1440	24.0	4.3	7.76E+1	1.8E+01	1.3E+00	3.50E+1	8.1E+00	6.1E-01
40	BRA06	03/03/98 09:45	03/04/98 09:45	1440	24.0	4.3	2.42E+1	5.6E+00	4.2E-01	4.01E+1	9.3E+00	7.0E-01
41	ARB06	03/03/98 10:30	03/04/98 10:30	1440	24.0	4.3	1.95E+1	4.5E+00	3.3E-01	Det	Det	Det
42	HHS07	03/04/98 08:20	03/05/98 08:20	1440	24.0	4.3	3.20E+1	7.4E+00	5.5E-01	Det	Det	Det
43	HHS07D	03/04/98 08:20	03/05/98 08:20	1440	24.0	4.3	3.56E+1	8.2E+00	6.1E-01	Det	Det	Det
44	PIN07	03/04/98 08:45	03/05/98 08:45	1440	24.0	4.3	9.75E+1	2.3E+01	1.7E+00	5.17E+1	1.2E+01	9.0E-01
45	PIN07D	03/04/98 08:45	03/05/98 08:45	1440	24.0	4.3	9.81E+1	2.3E+01	1.7E+00	4.52E+1	1.0E+01	7.9E-01
46	CAL07	03/04/98 09:20	03/05/98 09:20	1440	24.0	4.3	7.03E+1	1.6E+01	1.2E+00	3.77E+1	8.7E+00	6.6E-01
47	CAL07D	03/04/98 09:20	03/05/98 09:20	1440	24.0	4.3	4.20E+1	9.7E+00	7.2E-01	Det	Det	Det
48	BRA07	03/04/98 09:45	03/05/98 09:45	1440	24.0	4.3	2.29E+1	5.3E+00	3.9E-01	<MDL	<MDL	<MDL
49	BRA07D	03/04/98 09:45	03/05/98 09:45	1440	24.0	4.3	2.09E+1	4.8E+00	3.6E-01	Det	Det	Det
50	ARB07	03/04/98 10:30	03/05/98 10:30	1440	24.0	4.3	1.90E+1	4.4E+00	3.3E-01	Det	Det	Det
51	ARB07D	03/04/98 10:30	03/05/98 10:30	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
52	HHS08	03/05/98 08:20	03/06/98 08:20	1440	24.0	4.3	2.63E+1	6.1E+00	4.5E-01	Det	Det	Det
53	PIN08	03/05/98 08:45	03/06/98 08:45	1440	24.0	4.3	4.39E+1	1.0E+01	7.5E-01	3.58E+1	8.3E+00	6.2E-01
54	CAL08	03/05/98 09:20	03/06/98 09:20	1440	24.0	4.3	6.13E+1	1.4E+01	1.0E+00	3.64E+1	8.4E+00	6.3E-01
55	BRA08	03/05/98 09:45	03/06/98 09:45	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
56	ARB08	03/05/98 10:30	03/06/98 10:30	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
57	TB8	03/06/98 10:30	03/06/98 10:30	0	0.0	0.0	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
58	HHS09	03/09/98 08:20	03/10/98 08:20	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
59	PIN09	03/09/98 08:45	03/10/98 08:45	1440	24.0	4.3	9.26E+1	2.1E+01	1.6E+00	4.89E+1	1.1E+01	8.5E-01
60	CAL09	03/09/98 09:20	03/10/98 09:20	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
61	BRA09	03/09/98 09:45	03/10/98 09:45	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
62	ARB09	03/09/98 10:30	03/10/98 10:30	1440	24.0	4.3	2.38E+1	5.5E+00	4.1E-01	Det	Det	Det
63	HHS10	03/10/98 08:20	03/11/98 08:20	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
64	PIN10	03/10/98 08:45	03/11/98 08:45	1440	24.0	4.3	1.57E+2	3.6E+01	2.7E+00	1.19E+2	2.8E+01	2.1E+00
65	CAL10	03/10/98 09:20	03/11/98 09:20	1440	24.0	4.3	Det	Det	Det	Det	Det	Det

MDL = 3.48 ng/sample for malathion and 6.80 ng/sample for malaoxon
EQL = 17.3 ng/sample for malathion and 34.0 ng/sample for malaoxon
Det = <EQL but ≥MDL
*pptv at 25 C and 1 atm
NA = Not Applicable

Table 7. Malathion and Malaoxon Ambient Monitoring Results

Log #	Sample ID	Start Date/Time	End Date/Time	Time (min)	Time (hours)	Volume (m3)	Malathion (ng/sample)	(ng/m3)	*(pptv)	Malaoxon (ng/sample)	(ng/m3)	*(pptv)
66	BRA10	03/10/98 09:45	03/11/98 09:45	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
67	ARB10	03/10/98 10:30	03/11/98 10:30	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
68	HHS11	03/11/98 08:20	03/12/98 08:20	1440	24.0	4.3	1.73E+1	4.0E+00	3.0E-01	<MDL	<MDL	<MDL
69	HS11D	03/11/98 08:20	03/12/98 08:20	1440	24.0	4.3	1.87E+1	4.3E+00	3.2E-01	Det	Det	Det
70	PIN11	03/11/98 08:45	03/12/98 08:45	1440	24.0	4.3	6.54E+1	1.5E+01	1.1E+00	4.21E+1	9.7E+00	7.3E-01
71	PIN11D	03/11/98 08:45	03/12/98 08:45	1440	24.0	4.3	7.62E+1	1.8E+01	1.3E+00	4.81E+1	1.1E+01	8.4E-01
72	CAL11	03/11/98 09:20	03/12/98 09:20	1440	24.0	4.3	1.80E+1	4.2E+00	3.1E-01	Det	Det	Det
73	CAL11D	03/11/98 09:20	03/12/98 09:20	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
74	BRA11	03/11/98 09:45	03/12/98 09:45	1440	24.0	4.3	1.98E+1	4.6E+00	3.4E-01	Det	Det	Det
75	BRA11D	03/11/98 09:45	03/12/98 09:45	1440	24.0	4.3	1.85E+1	4.3E+00	3.2E-01	Det	Det	Det
76	ARB11	03/11/98 10:30	03/12/98 10:30	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
77	ARB11D	03/11/98 10:30	03/12/98 10:30	1440	24.0	4.3	Det	Det	Det	Det	Det	Det
78	HHS12	03/12/98 08:20	03/13/98 08:20	1440	24.0	4.3	7.29E+1	1.7E+01	1.2E+00	6.29E+1	1.5E+01	1.1E+00
79	PIN12	03/12/98 08:45	03/13/98 08:45	1440	24.0	4.3	8.25E+1	1.9E+01	1.4E+00	4.83E+1	1.1E+01	8.4E-01
80	CAL12	03/12/98 09:20	03/13/98 09:20	1440	24.0	4.3	4.89E+1	1.1E+01	8.4E-01	Det	Det	Det
81	BRA12	03/12/98 09:45	03/13/98 09:45	1440	24.0	4.3	3.04E+1	7.0E+00	5.2E-01	Det	Det	Det
82	ARB12	03/12/98 10:30	03/13/98 10:30	1440	24.0	4.3	3.11E+1	7.2E+00	5.3E-01	Det	Det	Det
83	TB12	03/13/98 10:30	03/13/98 10:30	0	0.0	0.0	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL

MDL = 3.48 ng/sample for malathion and 6.80 ng/sample for malaoxon
EQL = 17.3 ng/sample for malathion and 34.0 ng/sample for malaoxon
Det = <EQL but ≥MDL
*pptv at 25 C and 1 atm
NA = Not Applicable

Table 8. Summary of Malathion and Malaoxon Ambient Monitoring Results (ng/m3)

Start Date/Time	ARB Malathion	ARB oxon	BRA Malathion	BRA oxon	CAL Malathion	CAL oxon	HHS Malathion	HHS oxon	PIN Malathion	PIN oxon
02/23/98	Det	<MDL	21	Det	20	Det	8.4	<MDL	32	8.9
02/24/98	<MDL	<MDL	9.4	<MDL	7.3	Det	Det	Det	8.6	Det
02/25/98	14	14	12	Det	22	Det	8.1	Det	21	8.3
02/25/98	25	18	13	Det	22	<MDL	9.8	14	32	17
02/26/98	7.1	Det	9.8	9.6	90	Det	16	13	27	17
03/02/98	4.1	<MDL	6.9	<MDL	24	14	9.4	Det	31	11
03/03/98	4.5	Det	5.6	9.3	18	8.1	15	9.8	12	15
03/04/98	4.4	Det	5.3	<MDL	16	8.7	7.4	Det	23	12
03/04/98	Det	Det	4.8	Det	9.7	Det	8.2	Det	23	10
03/05/98	Det	Det	Det	Det	14	8.4	6.1	Det	10	8.3
03/09/98	5.5	Det	Det	Det	Det	Det	Det	Det	21	11
03/10/98	Det	Det	Det	Det	Det	Det	Det	Det	36	28
03/11/98	Det	Det	4.6	Det	4.2	Det	4.0	<MDL	15	9.7
03/11/98	Det	Det	4.3	Det	Det	Det	4.3	Det	18	11
03/12/98	7.2	Det	7.0	Det	11	Det	17	15	19	11

	ARB Malathion	ARB oxon	BRA Malathion	BRA oxon	CAL Malathion	CAL oxon	HHS Malathion	HHS oxon	PIN Malathion	PIN oxon
Maximum	25	18	21	9.6	90	14	17	15	36	28
Average	5.7	4.8	7.5	4.8	19	6.4	8.3	7.1	22	13
# Samples	12	12	12	12	12	12	12	12	12	12
# >EQL	7	1	9	2	10	4	9	4	12	11
# Det	4	8	3	8	2	8	3	7	0	1
# <MDL	1	3	0	2	0	0	0	1	0	0

Only the higher value of each collocated pair was used to calculate the above statistics.
Det results were factored into the average as (MDL+EQL)/2 = 2.4 ng/m3 for malathion and 4.7 ng/m3 for malaoxon.
<MDL results were factored into the average as MDL/2 = 0.40 ng/m3 for malathion and 0.80 ng/m3 for malaoxon.
Assume a 4.32 m3 sample volume for the above MDL and EQL.

MDL = 3.48 ng/sample for malathion and 6.80 ng/sample for malaoxon
EQL = 17.3 ng/sample for malathion and 34.0 ng/sample for malaoxon
Det = <EQL but ≥MDL

Table 9. Malathion and Malaoxon Ambient Collocated Results

Log #	Sample ID	Malathion (ng/m3)	Average	RD	Malaoxon (ng/m3)	Average	RD
19	ARB03	1.4E+01			1.4E+01		
20	ARB03D	2.5E+01	1.96E+1	53%	1.8E+01	1.60E+1	25%
50	ARB07	4.4E+00			Det		
51	ARB07D	Det	NA	NA	Det	Det	NA
76	ARB11	Det			Det		
77	ARB11D	Det	Det	NA	Det	Det	NA
17	BRA03	1.2E+01			Det		
18	BRA03D	1.3E+01	1.23E+1	6%	Det	Det	NA
48	BRA07	5.3E+00			<MDL		
49	BRA07D	4.8E+00	5.06E+0	9%	Det	Det	NA
74	BRA11	4.6E+00			Det		
75	BRA11D	4.3E+00	4.43E+0	7%	Det	Det	NA
15	CAL03	2.2E+01			Det		
16	CAL03D	2.2E+01	2.24E+1	1%	<MDL	NA	NA
46	CAL07	1.6E+01			8.7E+00		
47	CAL07D	9.7E+00	1.30E+1	51%	Det	NA	NA
72	CAL11	4.2E+00			Det		
73	CAL11D	Det	NA	NA	Det	Det	NA
11	HHS03	8.1E+00			Det		
12	HHS03D	9.8E+00	8.97E+0	19%	1.4E+01	NA	NA
42	HHS07	7.4E+00			Det		
43	HHS07D	8.2E+00	7.82E+0	11%	Det	Det	NA
68	HHS11	4.0E+00			<MDL		
69	HHS11D	4.3E+00	4.16E+0	7%	Det	NA	NA
13	PIN03	2.1E+01			8.3E+00		
14	PIN03D	3.2E+01	2.64E+1	44%	1.7E+01	1.27E+1	69%
44	PIN07	2.3E+01			1.2E+01		
45	PIN07D	2.3E+01	2.26E+1	1%	1.0E+01	1.10E+1	18%
70	PIN11	1.5E+01			9.7E+00		
71	PIN11D	1.8E+01	1.64E+1	15%	1.1E+01	1.04E+1	13%

MDL = 3.48 ng/sample for malathion and 6.80 ng/sample for malaoxon
EQL = 17.3 ng/sample for malathion and 34.0 ng/sample for malaoxon
Det = <EQL but ≥MDL
RD = Relative Difference; (Difference/Average)100
NA = Not Applicable

Table 10. Malathion and Malaoxon *Application Lab* Spike Results

Sample ID	Malathion Amount (ng)	Expected Amount (ng)	Percent Recovery	Malaoxon Amount (ng)	Expected Amount (ng)	Percent Recovery
LS1	54.2	75	72%	Coel*	75	NA
LS2	57.4	75	77%	70.3	75	94%
LS3	57.6	75	77%	68.8	75	92%
LS4	58.6	75	78%	73.8	75	98%

Coel* = coeluting compound prevented quantitation.

Table 11. Malathion and Malaoxon *Application Trip* Spike Results

Sample ID	Malathion Amount (ng)	Expected Amount (ng)	Percent Recovery	Malaoxon Amount (ng)	Expected Amount (ng)	Percent Recovery
TS1	58.6	75	78%	69.40	75	93%
TS2	60.9	75	81%	71.30	75	95%
TS3	54.2	75	72%	65.30	75	87%
TS4	60.0	75	80%	Coel*	75	NA

Coel* = coeluting compound prevented quantitation.

Table 12. Malathion and Malaoxon *Application Field* Spike Results

Sample ID	Malathion Amount (ng)	Background* Mass (ng)	Corrected Mass (ug)	Expected Amount (ng)	Percent Recovery	Malaoxon Amount (ng)	Background* Mass (ng)	Corrected Mass (ng)	Expected Amount (ng)	Percent Recovery
WFS1	96.6	38.6	58.0	75	77%	116	Det	96	75	128%
SFS2	91.2	38.8	52.4	75	70%	110	Det	90	75	120%
NFS3	98.1	44.6	53.5	75	71%	115	Det	95	75	127%
EFS4	91.0	43.1	47.9	75	64%	104	Det	84	75	112%

*The mass of malathion and malaoxon found in the collocated sample.

Det values were factored in as (EQL+MDL)/2 = 20 ng/sample.

Table 13. Malathion and Malaoxon *Ambient Lab* Spike Results

Sample ID	Malathion Amount (ng)	Expected Amount (ng)	Percent Recovery	Malaoxon Amount (ng)	Expected Amount (ng)	Percent Recovery
LS1	69.0	75	92%	79.50	75	106%
LS2	67.2	75	90%	87.6	75	117%
LS3	69.5	75	93%	88.3	75	118%
LS4	70.2	75	94%	91.1	75	121%
LS5	72.8	75	97%	107.0	75	143%

Table 14. Malathion and Malaoxon *Ambient Trip* Spike Results

Sample ID	Malathion Amount (ng)	Expected Amount (ng)	Percent Recovery	Malaoxon Amount (ng)	Expected Amount (ng)	Percent Recovery
TS1	64.7	75	86%	78.20	75	104%
TS2	68.4	75	91%	92.00	75	123%
TS3	72.8	75	97%	98.80	75	132%
TS4	68.3	75	91%	84.20	75	112%
TS5	68.2	75	91%	74.90	75	100%

Table 15. Malathion and Malaoxon *Ambient Field* Spike Results

Sample ID	Malathion Amount (ng)	Background* Mass (ng)	Corrected Mass (ug)	Expected Amount (ng)	Percent Recovery	Malaoxon Amount (ng)	Background* Mass (ng)	Corrected Mass (ng)	Expected Amount (ng)	Percent Recovery
FS1	62.0	<MDL	62.0	75	83%	96	<MDL	96	75	128%
FS2	62.4	<MDL	62.4	75	83%	95	<MDL	95	75	127%
FS3	61.0	<MDL	61.0	75	81%	91	<MDL	91	75	122%
FS4	137.0	62.5	74.5	75	99%	153	62.5	91	75	121%
FS5	150.0	62.5	87.5	75	117%	156	62.5	94	75	125%

*The mass of malathion and malaoxon found in the collocated sample.