SAMPLING FOR PESTICIDE RESIDUES IN CALIFORNIA WELL WATER

1989 UPDATE
WELL INVENTORY DATA BASE

FOURTH ANNUAL REPORT TO THE LEGISLATURE,
STATE DEPARTMENT OF HEALTH SERVICES, AND
STATE WATER RESOURCES CONTROL BOARD

PURSUANT TO
THE PESTICIDE CONTAMINATION PREVENTION ACT

December 1, 1989

Environmental Hazards Assessment Program

STATE OF CALIFORNIA
Department of Food and Agriculture
Division of Pest Management, Environmental Protection and Worker Safety
Environmental Monitoring and Pest Management Branch
1220 N Street, Sacramento, California 95814

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by

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SWRCB PORTION: Staff

December 1, 1989

ENVIRONMENTAL HAZARDS ASSESSMENT PROGRAM

EXECUTIVE SUMMARY

The Pesticide Contamination Prevention Act (PCPA), Assembly Bill 2021, became effective January 1, 1986 (Food & Agr. Code, div. 7, ch. 2, art. 15, § 13141 et seq.). Section 13152, subdivision (c) requires that the California Department of Food and Agriculture (CDFA) maintain a statewide data base of wells sampled for pesticide active ingredients, and that agencies that sample wells for pesticides submit their sampling results to the CDFA. Subdivision (e) requires the CDFA, in consultation with the California Department of Health Services (CDHS) and the State Water Resources Control Board (SWRCB), to annually report the data base information to the Legislature, the CDHS, and the SWRCB.

This year's report is the third update to the first (1986) report. It summarizes ten agencies' well sampling results submitted to the CDFA between July 1, 1988 and June 30, 1989. Most results are from sampling conducted in 1987 and 1988; the rest reflect sampling conducted in 1981, 1986, or 1989. The data submitted included reports of agricultural, non-agricultural, point (well-defined areas where pollutants are concentrated) and non-point sources of pesticide active ingredients or their breakdown products in ground water.

Pesticide residues were detected in 180 wells (24%) in 20 counties, out of 748 wells sampled in 33 counties. Of those 180 wells, 38 (21%) were positive for pesticides no longer registered for use in California.

The results of 8,092 analyses run for 98 pesticide active ingredients and related chemicals (breakdown products and isomers) were reported to the CDFA; fourteen of these compounds were detected. The CDFA has determined that seven of the 14 were present in ground water as a result of agricultural use.

Presented in the following table are the compounds detected, their probable sources, and current status.

Status summary of the 14 detected pesticides or breakdown products reported by various agencies from July 1988 through June 1989.

Pesticide Detected	Source(s)	Status of Detection(s)
aldicarb sulfone	agricultural use	use (of parent compound) no longer allowed in counties where detected
aldicarb sulfoxide	agricultural use	use (of parent compound) no longer allowed in counties where detected
atrazine	agricultural use	sections of detection will become no-use PMZs[a]
bentazon	agricultural use	use suspended; Department hearing pending
bromacil	agricultural use	sections of detection will become regulated-use PMZs
1,2-D	not applicable[b]	use as active ingredient discontinued as of 1984
DBCP	not applicable	exempt from the PCPA; use was suspended in 1979
diuron	agricultural use	sections of detection will become regulated-use PMZs
EDB	not applicable	exempt from the PCPA; use was cancelled in 1985
monuron	potential point	CDFA investigation determined not due to agricultural use
prometon	point; others are under investigation	if source is determined to be from agricultural use, then sections of detection will become no-use PMZs
simazine	agricultural use	sections of detection will become regulated-use PMZs
2,4,5-T	not applicable	exempt from the PCPA
tebuthiuron	potential point	CDFA investigation determined not due to agricultural use

a A Pesticide Management Zone (PMZ) is a geographical area of about 1-square-mile which is sensitive to ground water pollution.

b "Not applicable" means that a source investigation was not conducted because the chemical is no longer registered for agricultural use.

As shown in the table, the presence in wells of aldicarb sulfone and aldicarb sulfoxide (breakdown products of aldicarb), atrazine, bentazon, bromacil, diuron and simazine was determined to be the result of agricultural use. Bentazon was detected the most frequently, being found in 36% of all wells with residues; this pesticide has been suspended from use in California. Aldicarb sulfone and sulfoxide were detected in Del Norte and Humboldt Counties; the parent compound, aldicarb, is no longer registered for use in these two counties. The use of atrazine, bromacil, diuron and simazine will be restricted in the areas where they were detected.

Of the remaining seven detected pesticides, four (1,2-D, DBCP, EDB and 2,4,5-T) are no longer registered for agricultural use in California, so no action was taken in response to these detections. However, investigations were conducted to determine the source of the other three detected pesticides. As a result, it was determined that:

a) Monuron residues were determined not to be due to agricultural use.
b) Prometon residues in one well were the result of a point source; the source for six other wells is still under investigation.
c) No tebuthiuron was found in subsequent sampling, so no further action was taken on this find.

The information in this report is presented in three parts; Parts I and II were written by the CDFA, Part III by the SWRCB.

Part I: This section presents the number of wells sampled, the number of wells with detectable levels of pesticide residues for each county, and an analysis of the well sampling results to determine the probable source of the residues. Factors that contribute to the leaching of pesticides used in agriculture - the physical and chemical characteristics of pesticide active ingredients, volume of use, method of application, irrigation practices, and types of soil and climate in areas where pesticide active ingredients are applied, are also discussed in Part I.

Part II: This section presents the actions the CDFA has recently taken to prevent pesticide contamination of ground water. Briefly, these were:

1) adopting regulations to implement the PCPA;
2) proposing additional regulations to implement the PCPA;
3) issuing the Director's decision to further restrict the use of aldicarb after a hearing and review by the Pesticide Registration and Evaluation Committee (PREC) subcommittee; further restrictions on aldicarb use in California will be proposed in regulation in 1990;
4) conducting investigations for three newly-detected chemicals: monuron, tebuthiuron, and bentazon; and determining that the monuron and tebuthiuron detections were not the result of agricultural use;
5) suspending the use of bentazon;
6) investigating new detections of chemicals previously reviewed under the PCPA (atrazine, bromacil, diuron, prometon, simazine) and recommending the adoption of additional Pesticide Management Zones (geographical areas of approximately one square mile which are sensitive to ground water contamination by pesticide leaching);
7) continuing activities of the Environmental Hazards Assessment Program (EHAP), such as conducting field research on pesticide movement, investigating contaminated wells, conducting well monitoring, working with computer modeling, and compiling pertinent data bases.

Part III: This section presents the actions taken by the SWRCB to prevent pesticides from migrating to ground water. The SWRCB has implemented or participates in several programs to identify, mitigate or prevent pesticide contamination of California ground water. These include:

1) approving amendments to incorporate its Sources of Drinking Water Policy in the Basin Plans of the Regional Boards;
2) the SWRCB representative of the PREC subcommittee recommending cancellation of aldicarb to prevent its future use from threatening ground water quality;
3) supporting DWR investigations in ways to reduce pollution from subsurface agricultural drains;
4) working with the Association of Monterey Bay Area Governments to reduce potential leaching of pesticides from the Elkhorn Slough into ground water;
5) funding research to be conducted by the Stockton East Water District to determine the long-term impact on the Stockton East ground water basin

from agricultural chemicals present in soil, and to help develop the water quality component of a water management plan for that District;

6) contracting with the University of California Sustainable Agricultural Research and Education Program to conduct demonstrations on the use of cover crops as a means to reduce the use of pesticides on agricultural crops and thereby reduce potential for ground water contamination by these pesticides;
7) Regional Boards routine responses to spills, complaints and enforcements that relate to preventing pesticide pollution of ground water.

Numerical highlights from the last three well inventory reports (Brown, et al., 1986, Ames, et al., 1987, and Cardozo, et al., 1988) and this 1989 report are presented on page vi.

Data Limitations:

1. Only data submitted to the CDFA between July 1, 1988 and June 30, 1989 are included and discussed in this report - the third update of the first annual report (Brown, et al., 1987).
2. The data included in this report are not the results of a single study. Rather, they are results of 39 studies, designed and conducted by ten agencies for varying purposes between 1981 and 1989, which has resulted in a variable amount of sampling data among the 58 counties.
3. Well sampling for pesticides is not always restricted to investigations of suspected agricultural non-point sources of contamination. Therefore, it should not be assumed that all results in the data base reflect the leaching potential of pesticides used in agriculture.
4. The data base does not contain the kinds of information necessary to determine the exact conditions and mechanisms which cause the contamination of ground water by pesticides. Therefore, the results in the data base only show where contamination has or has not occurred, among those wells and areas sampled. Conclusions about the sensitivity to pesticide leaching in areas where sampling for pesticides is done infrequently, or not at all, will require additional information not included in the data base.

Numerical highlights contained in the well inventory data base, by year of report.

NUMERICAL HIGHLIGHTS	REPORT YEAR 1986[a]	1987[b]	1988[b]	1989[b]	CUMULATIVE TOTAL
Total Analyses	71,110	4,134	39,500	8,092	122,836
Positive Analyses	5,110	1,013	334	617	7,074
Wells sampled	8,359	526	2,956	748	11,462 [c]
Wells with positive analyses	2,297	181	116	180	2,658 [c]
Counties sampled	53	19	41	33	55 [c]
Counties with positive analyses	23	13	14	20	25 [c]
Pesticides and related compounds sampled	162	77	168	98	227 [c]
Pesticides and related compounds detected	15	14	10	14	29 [c]
Pesticides residues resulting from non-point source agricultural use	9	8	1	7	12 [c]

a The 1986 report was comprehensive, i.e., it included all sampling data in the well inventory data base at that time (sampling from 1975 to August 31, 1986), which included both confirmed and non-confirmed detections.

b Numbers included are either confirmed positives (i.e., two or more positive samples per chemical and well) or negatives. Non-confirmed positives (i.e., single detections not confirmed by subsequent analyses) are not included.

c The cumulative total is not additive; e.g., a well with positive analyses reported in the 1986 report with additional analyses reported in the 1989 report will only be counted once.

PREFACE

This report fulfills the requirement in Section 13152, subdivision (e) of the Food and Agricultural Code, that the California Department of Food and Agriculture (CDFA) prepare an annual report on sampling for pesticide residues in California ground water, and to submit the report by December 1 to the Legislature, the California Department of Health Services (CDHS), and the State Water Resources Control Board (SWRCB).

This report is the third update of the first annual report (Brown, et al., 1986), which summarized results of well water sampling for agricultural pesticide residues from 1975 to 1986. The first update (Ames et al., 1987), included data submitted between September 1, 1986 and August 31, 1987. The second update (Cardozo et al., 1988), included data submitted between September 1, 1987 and June 30, 1988. This year's report summarizes the results of 8,092 well water analyses submitted to the CDFA between July 1, 1988 and June 30, 1989.

The locations of wells sampled and the sampling results are summarized in this report by county and pesticide because a listing of all records for the 748 wells sampled is not practicable. Results in the data base are identified individually by state well numbers (township, range, section, tract and sequence number), locating each well to within a 40 acre tract.

Parts I and II of this report were written by the CDFA staff; the SWRCB and Regional Water Quality Control Boards (RWQCB) staff contributed Part III.

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In addition, we acknowledge the contributions made by staff of cooperating federal, state, and local agencies. In particular, we thank Earl Hansen of the California Department of Water Resources, and staff from the Regional Water Quality Control Boards for their regional reports of ground water contamination and mitigation measures.

Finally, we thank the many individuals who, by contributing their data, time and effort, made this data base and report possible.

DISCLAIMER

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I. WELL INVENTORY DATA BASE

A. INTRODUCTION

The Pesticide Contamination Prevention Act (PCPA) (Food & Agri. Code, div. 7, ch. 2, art. 15, § 13141 et seq.) requires the California Department of Food and Agriculture (CDFA) to maintain a statewide data base of results of well sampling for pesticide active ingredients. The PCPA also requires all government agencies to submit results of all such well sampling to the CDFA, which in turn annually reports the number and locations of wells sampled and the number of wells with detectable levels of pesticides to the Legislature, the State Water Resources Control Board (SWRCB), and the California Department of Health Services (CDHS).

This is the fourth annual report and third update of the 1986 report entitled Sampling for Pesticide Residues in California Well Water, 1986 Well Inventory Data Base (Brown, et al., 1986). Results are presented in this 1989 report for the number of wells sampled and the number of wells in which pesticide residues were detected for each county. Although the data were submitted between July 1, 1988 and June 30, 1989, the results are mostly from sampling studies conducted in 1986, 1987, 1988 or 1989.

The CDFA began developing the well inventory data base in late 1983, prior to enactment of the PCPA. The purposes of the data base were to help the CDFA in: (1) centralizing reliable information on the occurrence of non-point source contamination of ground water by the agricultural use of pesticides; and (2) numerically, graphically, and spatially analyzing the data. Prior to the PCPA, only agricultural non-point source-related data were included. The scope of the data base has since expanded and now includes whatever pesticide-related well sampling results are submitted to the CDFA.

B. MATERIALS AND METHODS

Data Collection:

Section 13152, subdivision (c) of the PCPA requires all agencies that sample wells for pesticides to submit their sampling data and analytical results to the CDFA for inclusion in the well inventory data base. In August, 1986, the CDFA notified appropriate agencies of this new state law, and requested them to submit required data either on a suggested reporting form, on a form of their own, or on magnetic tape.

The PCPA also requires that the CDFA, SWRCB, and CDHS jointly agree on minimum well sampling requirements for all results submitted to the CDFA. The three agencies agreed upon minimum well sampling reporting requirements, in an effort to standardize at least the types of well sampling information reported, instead of setting standard sampling requirements which could possibly limit the amount of data received. The following minimum reporting requirements were effective as of December 1, 1986, and are applicable only to samples taken after that date:

1. state well number (township/range/section/tract/sequence number/ base and meridian)
2. county
3. date of sample (month/day/year)
4. chemical analyzed
5. individual sample concentration, in parts per billion
6. minimum detectable limit, in parts per billion
7. sampling agency
8. analyzing laboratory
9. street name and number of well location
10. well type
11. sample type (e.g., initial or confirmation)

Optional information to be included when available:

1. method of analysis
2. well depth (in feet)
3. depths of top and bottom perforations of the well (in feet)
4. depth of standing water in the well at time of sampling (in feet)
5. year the well was drilled
6. whether a driller's log was located
7. known or suspected source of contamination

Data collection required a significant amount of interagency cooperation. Agencies supplied the data as either published reports, raw laboratory results, or retrievals of information from other data bases transferred on flopppy disks or magnetic tape. CDFA staff have also traveled to other agency offices to obtain photocopies of data, or to transcribe information directly onto computer coding sheets.

The purpose of the data base prior to the enactment of the PCPA was to determine where sampling for pesticides used in agriculture had occurred and where pesticide residues in ground water due to agricultural use were present. The objective was enlarged with the PCPA to provide an absolute count of the number of contaminated versus non-contaminated wells. This new requirement introduced the need for identifying individual wells from which samples were taken, as opposed to a simple recording of all sampling results. To meet this need, complete state well numbers have since been required. The California Department of Water Resources (DWR) is responsible for assigning these numbers.

<u>Data Evaluation</u>:

Sample results were first evaluated to determine if they met the following criteria for inclusion in the well inventory data base:

a. Sample results had to be for analyses of pesticides and related compounds ("related compounds" means breakdown products such as aldicarb sulfone or isomers, such as alpha BHC).

b. Samples had to be associated with ground water, i.e., taken from a well.

c. Samples had to be taken as close to the well head as possible.

d. Samples had to be obtained from an untreated and unfiltered system, because filtration or treatment could reduce or eliminate a chemical residue and, therefore, mask the possible presence of the chemical in the supplying aquifer or ground water.

e. Location of each well sampled had to be identified at least by township/range/section according to the U. S. Geological Survey's Public Lands Survey Coordinate system. This requirement was necessary to count the number of individual wells in the data base, as well as to evaluate ground water contamination by pesticides using other spatially-distributed data sets.

f. The data must not have been entered previously.

Published reports were evaluated to determine if the data met these criteria, or, in the case of unpublished laboratory results, verbal confirmation was requested from appropriate agency staff. Data that met the criteria were then coded and keypunched; in the case of data received on floppy disks or magnetic tape, the information was transferred directly into the computer.

In order to increase the integrity and usefulness of the data, "confirmed" positive analyses were distinguished from "unconfirmed" positive analyses. The minimum reporting requirement that a sample be identified as either an initial or confirmation sample helped make this distinction possible. The document entitled "Analytical Methods for Verification of Ground Water Contamination by Pesticides" (Appendix A, p. 77), served as the basis for coding an analysis as confirmed or not.

Data Entry:

The data were coded onto appropriate forms and keypunched into files on either a PDP 11/23+ minicomputer or a PC microcomputer. They were proofread against the coding sheets and edited as necessary. Next, the data files were transferred to a PRIME computer (9750 model) for conversion to a uniform format. The data were then transferred to a SUN computer (3/280 model), checked with computer verification programs, and entered into the permanent Well Inventory Data Base, where the summary tables were generated. Codes used in the data base are listed in Appendix B (p. 82).

Data Verification:

The following computer-driven verification programs have been developed by the CDFA staff to test the accuracy of the data. All new data are verified by these two programs before inclusion in the permanent data base:

(1) Township/range/section (T/R/S) verification:
The townships, ranges, and sections in each county were coded and entered into a computer file. A program was written that compares this file to well sampling records to be included in the data base. Errors, such as an incorrect township for a county, were noted and corrected.

(2) Column verification:
A computer program was written that tests the validity of the data by comparing allowed values for each column to the actual values entered. For example, chemical codes must be acceptable to the program or they will be rejected as errors. Codes rejected by the program were inspected and corrected.

Format of The Data Base:

Each chemical analysis for a pesticide residue or related chemical in a well water sample constitutes one record in the data base. Each record may contain up to 149 columns of data. The data base format is explained in Appendix C (p. 92).

C. RESULTS AND DISCUSSION

The following agencies submitted well sampling results from 39 studies to the CDFA between July 1, 1988 and June 30, 1989:

State: CDFA, CDHS, DWR, SWRCB, and North Coast (NCRWQCB) and Central Valley (CVRWQCB) Regional Water Quality Control Boards;

County: the Department of Agriculture for the counties of Lake and San Diego, the Kern County Health Department, and the Modoc County Agricultural Commissioner;

Others: the California Water Service Company (CWSC).

The results submitted by the agencies listed above are presented in two sections: (1) confirmed detections and negative results; and (2) unconfirmed detections. For the purposes of the Well Inventory Data Base, confirmed detections are detections of a particular pesticide residue in two or more discrete samples taken from the same well, during the time period of a single monitoring study; negative results are the analyses of well water samples in which pesticide residues were not detected. Unconfirmed detections include results for which a particular pesticide was detected in only one sample from a particular well, either because no other samples were taken or because no other subsequent samples contained detectable residues. Confirmed detections are distinguished from unconfirmed detections to increase the integrity of the data presented. Only those detections that are verified according to the standards set by the CDFA (Appendix A, p. 77) will be subject to regulatory action by the Director to prevent further ground water contamination by those pesticides (Food and Agr. Code, § 13149). Appendix D (p. 97) is a summary of well studies with results included in this 1989 update report.

The results are summarized by pesticide active ingredient, showing which pesticides were analyzed for and which were detected; and by county, indicating where sampling and detections occurred.

SECTION I. CONFIRMED DETECTIONS AND NEGATIVE RESULTS

Information on 98 pesticide active ingredients and related chemicals analyzed in 8,092 samples taken from 748 wells is included in this 1989 update. Information about each pesticide detected is presented in the Status of Detected Pesticides section (pp. 13 to 22). Tables of the sampling results by county and pesticide are presented in Appendix E (pp. 101 to 121). The twelve active ingredients and two breakdown products detected, their sources and status, are summarized in Table 1 (p. 102). A summary of the numerical highlights from each of the previous well inventory reports, plus cumulative totals, is presented in Table 2 (p. 103).

RESULTS BY PESTICIDE ACTIVE INGREDIENT:

Sampling Distribution

There was great variability in the number of counties in which sampling occurred among the 98 chemicals. For example, bentazon was sampled for in 15 counties, while 2,4,5-T was sampled for in only one county. The following matrix summarizes the distribution of pesticide sampling by number of counties.

	Number of Counties Sampled			
	1-5	6-9	10-13	14-16
Number of Pesticides Analyzed	71	10	2	4

As shown in the matrix, the majority of pesticides (71) were tested for in five or fewer counties. The number of counties with positive results and the total number of counties with wells sampled for each of the 98 pesticides are summarized in Table 3 (p. 104).

There was also great variability in the number of wells sampled for each pesticide. For example, simazine was sampled for in the greatest number of wells (339), while glyphosate was sampled for in only one well.

The following matrix is a brief summary of the number of pesticides analyzed, by number of wells sampled.

	Number of Wells Sampled			
	1-49	50-99	100-199	200-300
Number of Pesticides Analyzed	24	57	3	5

As shown in the matrix, the majority of pesticides (57) were analyzed in samples taken from 50 to 99 wells, while 24, or 25% of all pesticides were analyzed for in fewer than 49 wells each. The number of positive, negative and total results per well and number of analyses for each pesticide are displayed in Table 4 (p. 109).

Because of the variation in sampling distribution and extent of sampling conducted for each pesticide, this report does not present a complete picture of the impact of agricultural use of pesticides on California's ground water quality.

Detections

Fourteen (14%) of the 98 active ingredients and related chemicals (breakdown products and isomers) analyzed for were detected in well water, while 84 (86%) were not detected. The fourteen compounds found were: 1,2-Dichloropropane (1,2-D), 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), 1,2-Dibromo-3-chloropropane (DBCP), ethylene dibromide (EDB), aldicarb sulfone, aldicarb sulfoxide, atrazine, bentazon, bromacil, diuron, monuron, prometon, simazine, and tebuthiuron. Of these, aldicarb sulfone and aldicarb sulfoxide (breakdown products of aldicarb), atrazine, bentazon, bromacil, diuron, and simazine were determined to be present in wells as a result of their agricultural use; all but bentazon have been reviewed through the Pesticide Detection Response Process (PDRP) as required by the PCPA. Bentazon is currently being reviewed through this process. An explanation of the PDRP is presented in Monk _et_ _al_., 1987.

Four of the active ingredients detected (1,2-D, 2,4,5-T, DBCP, and EDB) are no longer registered for agricultural use in California, and are therefore exempt from the reviewing requirements of the PCPA. However, the CVRWQCB is still investigating the detection of 2,4,5-T in a monitoring well that they have determined to be from a point-source contamination.

Of the remaining three detected active ingredients, only the source of the prometon contamination is still being investigated by the CDFA. Monuron is currently registered for home use only (to control algae in aquariums); it no longer has any agricultural use registrations. Nevertheless, an investigation was conducted in response to the detection, but no agricultural use sources were found. Therefore, monuron was removed from the PDRP. No detections of tebuthiuron were found in a CDFA follow-up investigation of that reported find; therefore, it also was removed from the PDRP.

Pesticide residues were detected in a total of 618 analyses of well water samples taken from 180 wells. Bentazon, the most frequently detected pesticide, accounted for 36% of the positive wells and 22% of the positive analyses. Simazine, the second most frequently detected pesticide, accounted for 29% of the positive wells and 18% of the positive analyses. As a group, DBCP, bentazon, diuron, and simazine accounted for 95% of the total positive wells and 70% of the total positive analyses. The statewide distribution of detected pesticides is shown in Figure 1 (p. 11).

The numbers of positive and total wells, analyses, and counties for each detected pesticide are shown in Table 5 (p. 116). As shown in the table, there was no relationship between the number of analyses and the frequency of detection of a particular pesticide in wells or counties.

<u>RESULTS BY COUNTY</u>:

<u>Total Number of Analyses</u>

Well sampling results from 748 wells in 33 counties are included in the 1989 additions to the data base. The results of sampling in those counties,

LEGEND

Order	Chemical	Number of Positive Wells
1	Bentazon	64
2	Simazine	53
3	DBCP	28
4	Diuron	26
5	Atrazine	20
6	Bromacil	19
7	Aldicarb Sulfone	10
8	Aldicarb Sulfoxide	8
9	Prometon	7
10	1,2-D	5
11	EDB	4
12	2,4-5-T	1
13	Monuron	1
14	Tebuthiuron	1

Figure 1. California counties where pesticides were detected in well water. Results are from sampling reported between July 1988 and June 1989.

including the number of positive, negative, and total analyses taken and wells sampled are presented in Table 6 (p. 117). As shown in the table, Kern County had the largest number of wells sampled (147 or 20% of all wells sampled), followed by Tulare County (123 wells), and Glenn County (100 wells). Tulare County had the largest number of analyses (2,349, or 29% of all analyses) followed by Fresno, Glenn, and Madera Counties, with 1,733, 670 and 599 analyses, respectively. Sampling in ten counties (Contra Costa, Del Norte, Fresno, Glenn, Kern, Kings, Los Angeles, Madera, San Joaquin and Tulare) accounted for 90% of all analyses and 74% of all wells sampled.

The number of pesticides sampled for and the number of analyses run for each pesticide also varied among counties. For example, wells in four counties (Fresno, Kings, Madera and Tulare) were sampled for the largest number of pesticides (68, 64, 66, and 69, respectively), while wells in 22 counties were sampled for five or fewer pesticides. This variation is attributable not only to differences in pesticide use among counties, but also to differences in the design of the well sampling programs. A tabular summary of pesticides sampled in each county appears in Appendix F (p. 122).

Detections

Pesticide residues were detected in wells in 20 (61%) of the 33 counties where wells were sampled. Bentazon was detected in ten of the 20 counties, and was the only pesticide detected in seven of the ten counties. The next most widely found pesticide in wells was simazine, detected in eight counties. Diuron and atrazine were each detected in wells in four counties. The remaining ten detected pesticides were each found in three or fewer counties. The number of pesticides detected and the total number of pesticides tested for in each county is listed in Table 7 (p. 119).

The number of pesticides detected in any one county ranged from one to seven. Tulare County had the largest number of pesticides detected (seven), followed by Glenn County, with five. Fresno and Yolo Counties each had four pesticides detected. The remaining 16 counties with pesticide detections each had one to three pesticides detected in wells, ranging from one pesticide in one well (Placer County) to three pesticides in 27 wells, in Kern County.

The number of wells with pesticide residues in each county ranged from one to 33. Glenn and Tulare Counties had the largest number of wells with pesticide residues (33 and 32, respectively); for Glenn County, 29 of these were bentazon detections. The counties with the next largest numbers of wells with pesticide detections were Fresno, Kern, and Los Angeles Counties (15, 27, and 16, respectively). The remaining fifteen counties had one to eight wells containing residues from one to four pesticides. A summary of the number of wells with detected pesticide residues by county and pesticide is shown in Table 8 (p. 120). Figure 2 (p. 14) is a map of California indicating the townships within each county where at least one pesticide was detected in well water.

STATUS OF DETECTED PESTICIDES:

The following section describes the status of each detected pesticide in the 1989 update to the data base:

(1) **bentazon:**

The detection of the herbicide bentazon was confirmed in 64 wells in ten counties, out of a total of 196 wells sampled by the CDFA in 15 counties. Bentazon is used in California primarily to control weeds in rice paddies. All of the detections were found in domestic wells. Concentrations of residues ranged from 0.10-13.7 ppb; the CDHS-established Maximum Contaminant Level (MCL) for bentazon is 18 ppb.

The CDFA sampled the first six wells in four 1-square-mile sections of Glenn County, in response to a detection of bentazon in that area reported to the CDFA by the CVRWQCB. Four of the wells sampled by the CDFA, including the originally reported well, were found to contain bentazon residues. To determine if these residues were due to agricultural use, 24 additional wells in Glenn County were sampled in square-mile sections surrounding the original 4-square-mile area. Nine wells from this phase of the sampling were confirmed positive for the presence of bentazon. The CDFA then sampled 48 additional wells in areas south and west of the original sampling area. Of the 48 wells in this sampling phase, 20 contained bentazon residues:

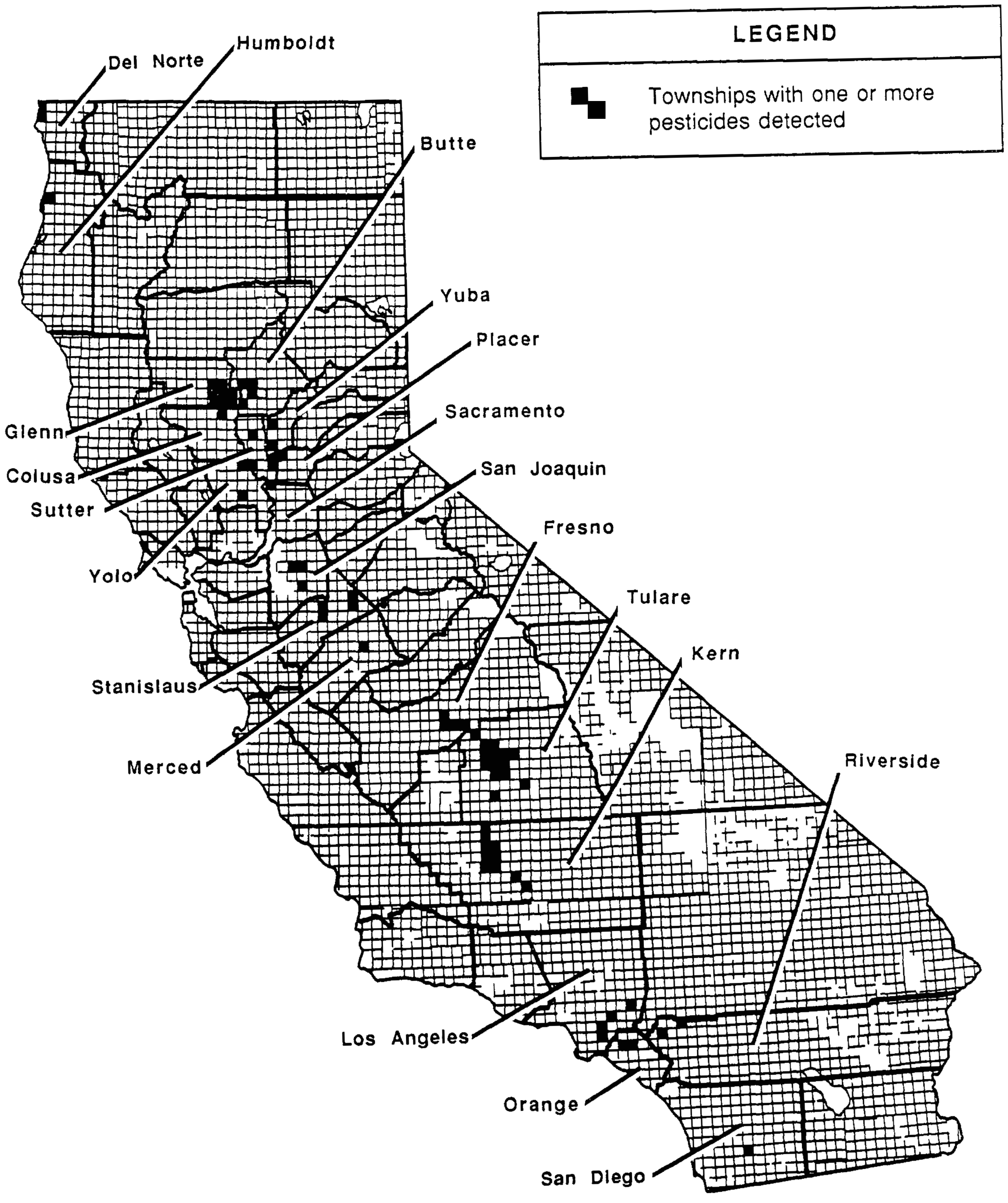

Figure 2. California townships with one or more pesticides detected in well water. Results are from sampling reported between July 1988 and June 1989.

13 in Glenn County and seven in Colusa County. Additional wells were also sampled in high-use areas of 12 other counties where rice is grown, and in Santa Barbara County, where bentazon is used in the production of crops other than rice. Positive wells were found in Butte, Merced, Placer, Sacramento, Stanislaus, Sutter, Yolo, and Yuba Counties. However, none of the samples from the Santa Barbara wells contained bentazon (minimum detectable limit [MDL] = 0.10 ppb).

As a result of the investigation, the CDFA determined that the well contamination was due to legal agricultural use and suspended the use of bentazon on all crops in California as of April 3, 1989. Bentazon is currently being reviewed through the PDRP.

(2,3) **aldicarb sulfone, aldicarb sulfoxide:**

Aldicarb sulfone and aldicarb sulfoxide are breakdown products of aldicarb - an acaricide, insecticide, and nematicide. Each was detected in six of 13 wells sampled in Del Norte County, and, of six wells analyzed in Humboldt County, aldicarb sulfone was detected in four wells and aldicarb sulfoxide in two wells. Concentrations of the sulfone residues ranged from 0.20 to 4.6 ppb, while the sulfoxide residues ranged from 0.2 to 13.2 ppb. The CDHS has not yet established an MCL for aldicarb or its breakdown products, although they have set an Action Level (AL) at 10 ppb. Current aldicarb use in California is primarily for insect and mite control in cotton, and mite and aphid control in sugar beets; it was once used to control nematodes in lily bulbs in Del Norte and Humboldt Counties.

The positive wells were sampled in 1987 and 1988 by the NCRWQCB in areas of Del Norte and Humboldt Counties where lily bulbs were grown. Aldicarb is no longer registered for use in either county.

Aldicarb was reviewed in the PDRP in 1989. As a result, the Director of the CDFA determined that currently-registered uses of aldicarb in counties other than Del Norte and Humboldt do not pose a threat to the state's ground water. Nevertheless, the CDFA will further restrict the use of aldicarb by reducing the amount allowed per acre by 50% on all crops, and will not allow fall application of aldicarb on any crop.

4) **bromacil:**

The detection of the herbicide bromacil was confirmed in 19 wells in two counties out of 253 wells sampled in ten counties. Bromacil is used in California primarily for weed control in citrus orchards and on right-of-ways. Concentrations of residues ranged from 0.19 to 12.0 ppb; an MCL or AL for bromacil has not yet been established by the CDHS. However, the Lifetime Health Advisory Level (Lifetime HAL) established by the U.S. Environmental Protection Agency (EPA) is 90 ppb.

Three of the positive wells were sampled by the CDFA as part of an investigative study. The remaining 16 positive wells were sampled by the CDFA as part of monitoring programs for Pesticide Management Zones (PMZs) (geographical areas of approximately 1-square-mile which are sensitive to ground water contamination by particular pesticides). One well was positive for bromacil in Fresno County; the remaining 13 wells were positive for bromacil in Tulare County.

Bromacil has been previously reviewed under the PDRP and its use will be restricted within bromacil PMZs. Following the investigations of the 19 detections, the CDFA determined that 16 wells were contaminated as a result of legal agricultural use and recommended that nine sections with bromacil-contaminated wells be declared PMZs for bromacil. The other three wells contaminated with bromacil are still under investigation by the CDFA.

5) **simazine:**

The detection of the herbicide simazine was confirmed in 53 wells in eight counties, out of 339 wells sampled in 16 counties. Simazine is used in California primarily for the control of weeds in citrus orchards and on right-of-ways. Concentrations of residues ranged from 0.10 to 19 ppb; the CDHS's MCL for simazine is 10 ppb. Forty-nine of the 53 wells contained simazine residues at levels below 1.0 ppb; three were between 1.1 to 5 ppb, and one was at 19 ppb.

Thirteen wells were positive for simazine in Fresno County; these wells were sampled by the CDFA in monitoring programs for PMZs. Three wells were positive for simazine in Glenn County; these wells were also sampled by the CDFA in response to previous detections. One well in Humboldt County contained simazine residues; this well was sampled by the Humboldt County Environmental Health Department, and later by the NCRWQCB during their follow-up sampling to the CDHS's AB 1803 sampling. The CDFA took additional samples from this well and surrounding wells, but only the originally-sampled well contained detectable levels of simazine. Nine wells in Los Angeles County were positive for simazine; these wells were all sampled by the CDFA in response to previous simazine detections in this county. Orange, Riverside, Stanislaus, and Tulare Counties also had wells with simazine residues, (2,3,1,and 21, respectively); these wells were all sampled by the CDFA in response to previous simazine detections in those counties.

Simazine has been previously reviewed under the PDRP, and its use will be restricted within simazine PMZs. Following the investigations of the 53 detections, the CDFA determined that the contamination was due to legal agricultural use and recommended that 39 sections with simazine-contaminated wells be declared PMZs for simazine.

6) **diuron:**

The detection of the herbicide diuron was confirmed in 26 wells in four counties out of 275 wells sampled in ten counties. Weed control on right-of-ways accounted for one-half of its reported 1987 use in California. Concentrations of residues ranged from 0.10 to 3.01 ppb; a CDHS MCL or AL for diuron has not been established. However, the EPA has set a Lifetime HAL of 10 ppb for diuron.

Tulare County accounted for 89% of the diuron detections, with residues confirmed in 20 domestic wells, one small-system well, one irrigation well, and one well of undetermined use. Confirmed finds of diuron were also made in one large-system well in Riverside County, one domestic well in Fresno County, and one domestic well in Glenn County. Two of the wells in Tulare County were sampled by the CDFA in response to a previous detection of diuron by the CDHS during AB 1803 sampling. The remaining wells were sampled by the CDFA as part of monitoring programs for PMZs.

Diuron has been previously reviewed under the PDRP, and its use will be restricted within diuron PMZs. The CDFA determined that 22 of the positive wells were contaminated with diuron due to legal agricultural use. Therefore, the CDFA recommended that 15 sections containing diuron-contaminated wells be declared PMZs for diuron.

7) **DBCP:**

Although the nematicide DBCP was officially suspended from use in 1979, DBCP residues are still being detected in wells. DBCP was formerly used in California to control nematodes in soil for many crops, but was used especially in grape and other perennial fruit crop production. The detection of DBCP was confirmed in 28 wells located in three counties, out of 196 wells sampled in six counties. Concentrations of residues ranged from 0.05 to 7.0 ppb; the CDHS's AL for DBCP is 1.0 ppb.

Fresno and Tulare Counties each had one well with a confirmed DBCP detection, with concentrations ranging from 0.5 to 2.10 ppb. These wells were sampled by the DWR in a four-county survey conducted in 1988. Kern County had 26 confirmed detections of DBCP, with concentrations ranging from 0.05 to 7.0 ppb. These wells were sampled by the Kern County Environmental Health Department, as part of their ongoing sampling for that chemical.

The CDHS is continually monitoring in limited amounts for DBCP. Also, regulations recently adopted by the CDHS make it the responsibility of large water system purveyors to routinely monitor a percentage of their wells for DBCP at specified time intervals (CCR, ch. 15, 64401-64473). DBCP has not been reviewed under the PDRP because its use has already been suspended.

8) **prometon:**

The detection of the herbicide prometon was confirmed in seven wells in three counties out of 317 wells sampled in 14 counties. Prometon is used in California primarily to control weeds in non-crop areas. Five of the positive wells are for domestic use, one is an irrigation well, and one is a monitoring well. Concentrations of residues ranged from 0.12 to 1.12 ppb; the CDHS has not set an MCL or AL for prometon. However, the EPA Lifetime HAL is 100.0 ppb.

Six of the positive wells were sampled by the CDFA as part of monitoring programs in areas adjacent to PMZs. These wells are still under investigation by the CDFA. The CVRWQCB sampled the one monitoring well, and determined that the prometon residues were due to point-source contamination.

Prometon has been previously reviewed under the PDRP and most uses will be prohibited within prometon PMZs.

9) **Atrazine:**

The detection of the herbicide atrazine was confirmed in 20 wells in four counties, out of 333 wells sampled in 15 counties. Atrazine is used in California primarily to control weeds in non-crop areas. The CDHS's MCL for atrazine is 3.0 ppb; concentrations of residues ranged from 0.10 to 1.10 ppb. The CDFA sampled 19 of the wells in response to previous detections of pesticides in Glenn, Los Angeles, and Orange Counties. The CDFA determined that 18 of the 19 positive wells they had sampled were contaminated with atrazine because of agricultural use; the 19th well (in Glenn County) was determined to be the result of point-source contamination. The CVRWQCB investigated the remaining well (in Yolo County) and determined that the atrazine residues there were also the result of point-source contamination.

Atrazine has been previously reviewed under the PDRP, and most uses will be prohibited within atrazine PMZs. Following investigations of these detections, it was recommended that 11 sections with atrazine-contaminated wells be declared PMZs for atrazine.

10) **EDB:**

Until September 1984, when the U.S. EPA suspended all ethylene dibromide (EDB) registrations for use in the U.S., EDB was used as a fumigant to control insects and nematodes in soil. Nevertheless, it continues to be detected in wells. EDB contamination was confirmed in four wells in Kern County out of 207 wells sampled in six counties. Concentrations ranged from 0.05 to 1.60 ppb; the CDHS has established an MCL of 0.02 ppb for EDB. The positive wells were sampled by the Kern County Health Department as part of their routine monitoring of the San Joaquin Basin of Kern County. Two of the wells are for community use; the other two are small water system wells.

EDB has not been reviewed under the PDRP because it is no longer registered.

11) **1,2-D:**

The detection of the nematicide 1,2-dichloropropane (1,2-D), or propylene dichloride, was confirmed in five wells in three counties, out of 73 wells sampled in seven counties. 1,2-D was formerly an active ingredient in soil fumigants used to control nematodes in soil for a wide range of crops. Concentrations of residues ranged from 0.6 to 6.2 ppb; there is no CDHS-established MCL for 1,2-D. However, the CDHS's AL for 1,2-D is set at 5.0 ppb.

One of the positive wells was in Kern County, and another was in Tulare County. Both of these wells were sampled under the CDHS's AB 1803 statewide monitoring program. The remaining three positive wells were in San Joaquin County; these wells were sampled by the CVRWQCB, as part of their follow-up monitoring of AB 1803 detections.

Use of 1,2-D as an active ingredient has not been allowed since 1984. Therefore, 1,2-D has not been reviewed under the PDRP.

12) **tebuthiuron:**

A positive find of the herbicide tebuthiuron in a San Diego County domestic well was reported by the San Diego County Department of Health Services to the CDHS, who in turn notified the CDFA of the detection. Tebuthiuron is an herbicide used for weed control in non-cropland areas. The reported concentrations of residues were 22.1 and 20.7 ppb. The CDHS has not set an AL or MCL for tebuthiuron; however, the EPA Lifetime HAL is 500 ppb.
In response to the reported find, the CDFA resampled the well and five other domestic wells in the surrounding area. None of the samples, including those from the originally positive well, contained residues of tebuthiuron. Consequently, tebuthiuron was removed from the PDRP.

13) **monuron:**

The detection of the herbicide monuron was confirmed in one domestic well in Tulare County, out of 64 wells sampled in five counties. Monuron is currently only registered in California for home use, for the control of algae in aquariums, although it was formerly used as a soil sterilant on right-of-ways. Concentrations of monuron residues detected by the CDFA were all at the minimum detectable limit of 0.50 ppb. Neither a CDHS-established AL or MCL, or an EPA Lifetime HAL has been established for monuron.

The contaminated well was originally sampled by the San Joaquin District of the DWR. The reported unconfirmed detection triggered subsequent sampling of this well and five surrounding-area wells by the CDFA. Only the original well contained detectable residues of monuron. Monuron was removed from the PDRP because it has no currently registered agricultural uses.

14) **2,4,5-T:**

The herbicide 2,4,5-T was detected in a monitoring well in Yolo County by the CVRWQCB. This herbicide is no longer registered for use in California, although it was formerly used to control woody weeds or brush in grasslands and non-crop areas, and weeds in rice and other grains. Concentrations detected were 0.14 and 0.21 ppb; the CDHS has not established an AL or MCL for 2,4,5-T. However, the EPA has set a Lifetime HAL for 2,4,5-T at 70.0 ppb. The CVRWQCB determined that the 2,4,5-T residues were the result of point-source contamination.

2,4,5-T was not reviewed under the PDRP because it is no longer registered for use in California.

SECTION 2. UNCONFIRMED DETECTIONS

An unconfirmed detection (UD) is the detection of a particular pesticide in only one sample from a particular well, either because no other samples were taken or because subsequent samples contained no detectable residues. UDs may represent either valid detections of pesticide residues or sample contamination, so they cannot be presented with the same confidence as detections with subsequent, discrete samples validating the presence of a pesticide. Therefore, the UDs are presented separately from the confirmed detections.

Twenty-one (44%) of the 48 UDs included in the 1989 data base were classified as unconfirmed detections because no residues were detected in subsequent samples. The remaining 27 (56%) UDs were from wells where only one sample was taken during the time period of a single monitoring study. Twenty of these were not investigated by the CDFA because the detected pesticide is no longer registered for use. Of the remaining seven, six are still under investigation by the CDFA and one, a bentazon sample, was not able to be investigated because the owner refused permission to resample the well. UDs of pesticides registered for use at the time they were reported were investigated by the CDFA. These follow-up studies resulted in confirmed detections of the pesticides bentazon and simazine, reported in Section 1 (pp. 13 to 17).

RESULTS BY PESTICIDE ACTIVE INGREDIENT:

A total of 48 UDs were included in the 1989 additions to the data base. These data represent sampling conducted for nine pesticides and two breakdown products (aldicarb sulfoxide and aldicarb sulfone) in a total of 41 wells. A county summary by pesticide and number of wells with UDs is presented in Table 9 (p. 121).

DBCP, 1,2-D, and simazine accounted for 73% of all wells with UDs: twelve for DBCP, nine for 1,2-D, and nine for simazine. The presence of the remaining six pesticides and two breakdown products were unconfirmed in four or fewer wells each.

All nine pesticides and both breakdown products presented as UDs in this section also had confirmed detections presented in Section 1 of the Results except for 2,4-D, which was reported only as a negative analysis.

RESULTS BY COUNTY:

UDs were reported in a total of 41 wells in ten counties. Four counties account for 78% of the total wells reported with UDs: Del Norte County with six wells (15%), Kern County with ten wells (24%), and Fresno and Tulare Counties with eight wells each (20% per county). The remaining six counties each had UDs in three or fewer wells.

LIMITATIONS ON INTERPRETING THE DATA

The well inventory data base is a compilation of results from various studies and monitoring activities designed by federal, state and local agencies to investigate possible well water contamination by pesticides. Because these studies were conducted for varying purposes, some agencies have sampled hundreds of wells for a few pesticides, while others have sampled only a few wells for many pesticides. There has never been one central agency to coordinate the sampling or monitoring efforts of all agencies in an attempt to randomly sample wells for a particular pesticide in all areas of the state where that pesticide is used. Therefore, the amount of sampling data available varies among California's 58 counties and for all pesticides used in the state. This precludes use of the data base alone for identifying areas of the state that are sensitive to pesticide leaching and pesticides that have the potential to leach. Below are additional interpretive limitations to the data.

1. The results presented in this 1989 update include only those sampling results for pesticide residues in wells submitted to the CDFA between July 1, 1988 and June 30, 1989. Most of the sampling was conducted in 1987 and 1988; some was conducted in 1981, 1986 or 1989. Discussion of this year's data relative to data presented in previous well inventory reports is limited to the cumulative summary presented in Table 2 (p. 103). Any further comparison with data submitted over the past six years is beyond the scope of this report.

2. All detections of pesticide residues in wells reported to the CDFA are included in the data base, regardless of the source of contamination. Residues could result from many sources, including the normal use of pesticides, improper handling of pesticides, or from spills at manufacturing/formulation facilities. Therefore, the number of pesticides reported as detected does not always equal the number determined to be the result of agricultural non-point sources of contamination.

3. The well inventory data base is only an inventory of wells that have been sampled for pesticides. It does not contain information on conditions

which can lead to or prevent the contamination of ground water by pesticides. Factors that can influence a pesticide's mobility in soil and an area's vulnerability to pesticide leaching, such as pesticide use patterns, cultural practices, climate and soil type, all vary between the geographical areas of the state. Therefore, the database alone cannot be used to characterize the sensitivity of a given area to ground water contamination by pesticide leaching.

4. Well sampling for pesticide residues has not occurred uniformly throughout the state where pesticides are used. Because of the high cost of sampling and analyzing for pesticide residues, agencies usually only sample for a limited number of pesticides in a designated study area. As a result, sampling is not conducted for all pesticides used in the state nor is it conducted in all areas where a given pesticide is used. Therefore, interpretation of the significance of the results included in the data base must be limited to those pesticides sampled for and those areas sampled.

Despite these limitations, the information on sampling for pesticide residues in California wells contained in the well inventory data base can be used in the following applications:

1) displaying the geographic distribution of well sampling;
2) identifying which pesticides have been sampled for;
3) displaying the known geographic distribution of pesticide contamination in wells among those wells sampled;
4) identifying areas known to be sensitive to pesticide leaching (i.e., areas with wells determined to be contaminated as a result of non-point source, agricultural use);
5) designing studies for future sampling.

D. FACTORS CONTRIBUTING TO PESTICIDE MOVEMENT TO GROUND WATER AS A RESULT OF AGRICULTURAL USE

BACKGROUND:

Effective regulation of pesticide use to prevent contamination of California's ground water requires (a) an understanding of the processes by which contamination occurs, and (b) reliable methods for preventing or mitigating contamination.

Contamination and subsequent mitigation methods vary depending on the nature of the contamination source. Contamination can result from either point or non-point sources. Pollutants from point sources, such as storage or waste sites, are initially deposited and concentrated in small, well-defined areas. Residues eventually leach from the upper to lower soil layers, encounter ground water and then follow the movement of ground water from that location. The movement can be traced back to its source by locating a plume of residue. In contrast, pollution from a non-point source, such as applications of agricultural chemicals to crops, cannot be traced to a single, definable location. Instead, the pollutants are dispersed over a large, poorly defined area. When a non-point source results in soil leaching, locating a distinct residue plume is not possible, and pollutant movement is very difficult to predict or trace back to its source.

Pesticide residues in ground water can result from industrial or agricultural activities. Pollution from the industrial sector is usually attributed to point sources such as leaks at manufacturing, storage or waste sites. Industrial point sources have been the subject of considerable scientific research, and state and federal agencies have developed techniques to identify contamination sites and to designate mitigation methods (California Department of Health Services, 1985; California Assembly Resources Subcommittee on Status and Trends, 1983). Because the land mass affected by point source contamination is usually small, clean-up can be accomplished by removal and treatment of soil or by containment and treatment of the plume of polluted ground water (Hunt, et al., 1986). In addition, future contamination may be prevented by proper design and placement of storage or waste sites.

Residues of pesticides registered for agricultural use can reach ground water from both point and non-point sources. Point sources include pesticide storage or disposal sites and applicator wash-off sites. Most of the pesticide residue detections in wells cited in the reports Water Quality and Pesticides: a California Risk Assessment Program (Cohen and Bowes, 1984) and The Leaching Fields (Price, *et al*., 1985) were associated with point sources.

Agricultural non-point source problems are more difficult to identify and mitigate because of the large land masses involved, the lower concentration of chemicals in the soil, and the lack of well-defined contamination plumes. Much less research has been done to understand the processes involved in leaching of agricultural pesticides, compared to the amount that has been done on point sources of contamination. However, what information there is, and any generated in the future, will be used to identify new agricultural practices that minimize the possibility of ground water pollution from pesticides.

The agricultural scientist is at a disadvantage in finding solutions to the problem of agricultural pesticide residues in ground water for a number of reasons:

1) Pesticides are intentionally and repeatedly applied to the soil to avert crop loss by pests. Point source problems may be mitigated by stopping exposure to the soil, but use of this option with non-point sources from agricultural applications would result in crop loss.

2) To date, agricultural research on application of pesticides has sought to find low but effective rates of application so that costs of production are kept low. Can these rates be lowered further and still provide cost-effective protection? More research is needed to examine this question, but where rates are already at their lowest effective level, new pest control methods will have to be devised.

3) Some procedures for mitigating contamination from point sources are not appropriate for agricultural non-point sources because of the large land masses involved. Removal of soil to appropriate waste sites is not a viable clean-up option. Relocation of farms and communities established

around crops that grow well in areas sensitive to leaching is out of the question.

For these reasons, research is needed on new effective pest control methods specifically designed to prevent future ground water contamination. Examples of such research currently being conducted are research efforts in sustainable agricultural techniques and ways of modifying traditional irrigation methods to prevent pesticide leaching.

DISCUSSION:

The PCPA requires the CDFA to provide the Legislature with a discussion of the factors that contribute to the movement of pesticides to ground water. These factors include the amount of pesticide used, method of application, physical and chemical characteristics of pesticides, irrigation practices, and soil type.

Pesticide residues in soil may disappear from the initial site of deposition in a number of ways: (1) through microbial action (microbes detoxify or break down the pesticide to nontoxic compounds); (2) through chemical degradation processes, such as hydrolysis, which produces breakdown products; (3) through volatilization (the chemical diffuses from the soil surface); (4) through leaching (the pesticide is transported from the upper to lower layers of soil); or (5) through runoff of water from agricultural land. A ground water problem arises when leaching occurs at a faster rate than other processes. Previously, researchers thought that under non-point source conditions, leaching occurred at such a low rate that pesticides would not move from the upper to the lower layers of soil. However, since 1979, detections of pesticides in ground water have provided strong evidence for the importance of leaching as a source of ground water contamination.

Since there are no known economically feasible methods to remove pesticide residues found in ground water due to agricultural non-point sources, the best available way to mitigate the problem lies in the regulation of pesticides before or at their point of use. However, for non-point source leaching problems, much less information exists on which to base regulatory decisions than for point source problems. The CDFA is conducting studies that will provide this kind of information, i.e., information on the factors that contribute to pesticide mobility in soil. A discussion of current findings on each of these factors follows.

USE AND METHOD OF APPLICATION:

Known non-point source pesticide pollutants are almost exclusively active ingredients that are applied to the soil. Pesticides that are applied to foliage, such as protective foliar fungicides and many insecticides, may not be important leachers for two reasons: (1) exposure to sun enhances the rate of degradation; and (2) concentrations that eventually reach the soil are low enough to allow for rapid degradation before leaching. Thus, soil surface application, soil incorporation, or both are important factors contributing to ground water contamination.

Also, there are no known differences in the leaching abilities of different pesticide formulations, such as wettable powder, granular or emulsifiable concentrate. There has been some research on the use of slow-release formulations as a method to prevent pesticide movement through the soil; however, the results to date are still preliminary, so the exact use of these formulations under agricultural conditions has yet to be determined.

One aspect of pesticide use that may be critical to leaching may be the timing of pesticide applications in relation to irrigation events. A recent theory of soil adsorption (Di Toro, 1985) proposes that the longer a pesticide remains in contact with the soil, the more resistant it becomes to leaching because the pesticide becomes more tightly bound to soil over time. To date, label recommendations for application of several of the herbicides detected in California ground water indicate that the compound should be watered into soil with a small amount of water (e.g., 0.25 to 0.5 inches). If more water is used to water-in the pesticide, much of the pesticide could leach past the root zone away from its intended zone of activity. This same result could occur from small, but multiple applications of water too close in succession. Therefore, once the pesticide is watered into the root zone, the timing of the next irrigation may be of importance in whether or not the pesticide leaches.

The CDFA conducted a study (in progress) in the summer of 1989 to provide evidence for the concept that leaching may be reduced by increasing the time between application of a pesticide and watering it in with a large amount of water, and also to provide further support for the training of Pest Control Advisors (PCAs). Three pesticides (atrazine, simazine and bromacil) were applied to soil and watered-in with a 0.5 inch sprinkler irrigation. Directly following the pesticide application, 7 inches of water was flooded onto the plots at 1, 7, or 14 days after the pesticides were watered into the soil. Soil cores are currently being analyzed and the report should be available March 1, 1990.

IRRIGATION PRACTICES:

An irrigation study conducted by the CDFA compared the movement of water and pesticide in soil under four different methods of irrigation. (In progress). The amount of water added was based on a water budgeting method that used measures of evapotranspiration (ETo), an estimate of the amount of water required to replenish that lost from evaporation and transpiration. The DWR maintains weather stations that record daily ETo values under the project "California Irrigation Management Information Systems" (CIMIS) (Snyder et al., 1985). The Office of Conservation - DWR, under contract with the University of California, has developed methods to incorporate ETo into water budgeting methods for agricultural use. Water budgeting appears to have potential for regulating the amount of water used for growing crops, but the application of this concept to different irrigation methods needs validation. The current irrigation studies are part of this process.

The CDFA study was conducted in two consecutive years, in the summers of 1987 and 1988. Results were similar between years and indicated that at similar amounts of water applied, different irrigation methods affected water movement and its distribution in soil. For example, sprinkler applications were made based on weekly cumulative ETo, whereas basin irrigations were made when a critical accumulated ETo value had been attained. Application of water in basin irrigation was much less frequent but of greater volume per irrigation. The movement of bromide, a tracer that mimicked water movement, was deeper in the basin treatments than in the sprinkler treatments. Theoretically, movement should have been similar between different irrigation methods applying the same amount of water. It appears that differences in the efficiency of irrigation methods will have to be considered in the development of an effective water budget method that prevents pesticide movement in soil.

Differences in pesticide movement were also measured between irrigation methods. Water was applied at levels of 0.75 ETo, 1.25 ETo and 1.75 ETo. For sprinkler irrigations, pesticide moved past the 10-foot depth, the deepest sample, only at the highest amount of water application (1.75 ETo). For basin irrigation, pesticide moved past the 10-foot depth at the 1.25 and 1.75 ETo treatments. Because pesticide movement was retarded compared to the bromide water tracer, water movement itself is not a clear indicator of pesticide movement. More refined descriptors relating pesticide movement to water movement will have to be derived.

In summary, the use of available measures of ETo in conjunction with water budgeting methods could be an effective technique for controlling water and, subsequently, pesticide movement in soil. However, the use of ETo values in limiting pesticide movement will require further refinement when applied to different methods of irrigation. Models could aid in defining the requirements specific to each irrigation method for achieving the goal of preventing leaching. With this in mind, the CDFA is sponsoring research to assess the fit of irrigation data to currently developed soil water and pesticide movement models. If a model proves satisfactory, it will be used as such an aid.

PHYSICAL AND CHEMICAL CHARACTERISTICS OF PESTICIDES:

The physical and chemical characteristics of pesticides thought to be important in movement through soil are: soil adsorption (usually denoted by the coefficient of soil versus water partitioning, Kd or Koc), hydrolysis half-life due to microbial or chemical activity, vapor pressure, and water solubility. These factors are used in models of pesticide transport through soils (Rao, 1985). Cohen, et al. (1984) estimated values to act as indicators of leaching potential. In addition, the PCPA requires the

Department to set specific numerical values for these factors that are used to identify pesticides with the potential to leach to ground water. The Department has updated the established Specific Numerical Values described by Wilkerson and Kim (1986) in two reports entitled: Setting Revised Specific Numerical Values (Johnson, 1988 and 1989).

SOIL TYPE:

The CDFA recognizes soil type as a very important factor in determining leaching of pesticides. Teso *et al*. (CDFA, 1988) have described the occurrence of DBCP residues in California ground water in relation to soil type. The CDFA has been developing a data base of the occurrence of soil types in mapped portions of California on a section basis; it is nearly 80% complete. Evaluation of these data for regulatory use is ongoing.

Results from the CDFA soil-coring studies indicate that organic carbon content of soil may be critical in determining the vulnerability of soils to leaching. Soils high in organic carbon tend to bond more with pesticides, a phenomenon which could result in increased rates of degradation, and thus, reduced rates of leaching. To test this possibility, the CDFA is creating a data base of soil-coring data from in-house studies, as well as from other pertinent sources, such as reports from pesticide registrants who have conducted soil-coring studies. This data base could be used to spatially relate soil-coring data with results of environmental sampling over broad areas. For example, an initial comparison was made between soil cores collected in Ventura County, an area with no positive results from non-point source contamination, and soil cores in Tulare County, an area that contains numerous PMZs. Soil in Ventura County contained greater organic carbon down to greater depths than soil in Tulare County (Welling *et al*., 1986). The distribution of organic carbon in Tulare County may be described as being a thin layer compared to that in Ventura County.

More comparisons of a similar nature are needed to support the use of organic carbon content of soils as a predictive tool for determining future locations of PMZs. Such a tool could reduce reliance on the detection of pesticides in wells as the sole indicator of vulnerable areas.

RAINFALL:

Climatic factors, such as precipitation, may override all of the previously mentioned factors in causing ground water contamination. One example of the influence of climate is the experience with residues of aldicarb detected in well water in Del Norte County (Lee, 1983). Because soils in that area are high in organic matter, they may be expected to retard pesticide movement. However, annual rainfall may be over 80 inches, and as much as 50 inches may occur primarily during the winter months (November - March). Aldicarb was applied in the fall to lily bulb fields to control nematode problems in the soil. The amount of winter rainfall was apparently sufficient to drive pesticide residues to the shallow ground water located at about 10 feet, in spite of the high soil organic matter.

A different result was observed in a study recently completed by the CDFA (Troiano and Garretson, 1988.) The effect of winter rain on movement of pesticides in the central San Joaquin Valley was investigated in the Fresno area. Because soils there are sandy, the area might be expected to be vulnerable to pesticide leaching. However, winter rainfall is usually much less there than in the Northern Coastal areas (e.g., 10 inches in the San Joaquin Valley compared to 50 inches on the North Coast). For the study, an inorganic ion tracer was added to the soil to track the movement of water. Most of the tracer was detected at about the 5.5 feet depth in the soil, with some detected down to 10 feet, the lowest depth sampled. In contrast, most of the pesticide (known to leach through soils) was recovered in the first 6-inches of soil, with some residues detected down to 6 feet. At this site there was some retardation in movement of the pesticide compared to water flow. In this situation, the amount of winter rainfall was insufficient to move pesticide residues to significant depths.

Thus, climatic conditions, such as rainfall, must not be overlooked as important factors in the leaching of pesticides through soils, and they may be important considerations in timing applications of pesticides.

E. SUMMARY AND CONCLUSIONS

This report presented results from well sampling studies conducted by ten federal, state, and local agencies received by the CDFA between July 1, 1988 and June 30, 1989. The results are from studies conducted in 1981 or sometime during 1986 to 1989, although the majority of results are from sampling that occurred in 1987 and 1988. Most of the studies were "one time" sampling studies, i.e., the wells were sampled only during the study period, and not repeatedly over time.

Included in the results received were data from 8,092 analyses taken from 748 wells located in 33 counties. Nearly 8% of the analyses, and 24% of the wells contained pesticide residues; 14 of the 98 pesticides and related compounds analyzed for were detected. Of those detected pesticides, seven were determined to be the result of non-point source, agricultural use contamination. Many of the sections where these pesticides were detected will be declared PMZs and regulated accordingly.

Regulation of pesticides to prevent residues from entering well water as a result of agricultural use depends on scientific knowledge of how pesticides move to ground water. Factors that contribute to ground water contamination by pesticides used in agriculture include amounts used, method of application, irrigation practices, pesticide physical and chemical characteristics, soil type, and climate. The role each factor plays in the contamination process is not fully understood. The CDFA Environmental Hazards Scientists are continuing their work to understand these factors by conducting field research on pesticide movement, investigating contaminated wells, conducting well monitoring, working with computer modeling, and compiling extensive data bases. The knowledge gained from these activities will be used to develop recommendations for pesticide use practices that will prevent ground water contamination by pesticides.

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II. ACTIONS TAKEN BY THE
CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
TO PREVENT PESTICIDES
FROM ENTERING GROUND WATER
AS A RESULT OF AGRICULTURAL USE

II. ACTIONS TAKEN BY THE CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE TO PREVENT PESTICIDES FROM ENTERING GROUND WATER AS A RESULT OF AGRICULTURAL USE

The CDFA has responsibility for regulating the sales and use of pesticides in California. This responsibility includes providing for the proper, safe and efficient use of pesticides for protection of the public health and safety, and protecting the environment from environmentally harmful pesticides. To achieve the specific goal of ground water protection, the CDFA actions have focused on: (1) identifying which pesticides present a threat to ground water quality as a result of agricultural use and (2) taking appropriate regulatory action to prevent or mitigate ground water contamination. The specific actions taken are described below.

PESTICIDE CONTAMINATION PREVENTION ACT:

In addition to compiling the statewide inventory of wells sampled for pesticides described in this report, the CDFA has taken the following steps between July 1, 1988 and June 30, 1989 to implement the PCPA:

Adopted Regulations (January, 1989)

The Director adopted regulations in Titles 3 and 26 of the California Code of Regulations (CCR) pertaining to ground water protection. These regulations do the following:

(1) Establish specific numerical values that the Department uses to identify pesticides with the potential to pollute ground water (Title 3, CCR [3CCR] Section 6804).

(2) Establish the Ground Water Protection List which is made up of pesticides that have polluted, and those that have the potential to pollute ground water, and specifically, to add atrazine to that list (3CCR Section 6800).

(3) Implement the sales and use reporting requirements for pesticides on the Ground Water Protection List by specifying who must report, what pesticides must be reported, and what information must be reported (3CCR Sections 6572 and 6806).

(4) Establish a new category of restricted materials that contains pesticides that have been found in ground water or soil, as specified (3CCR Section 6400).

(5) Define a Pesticide Management Zone (PMZ) as a geographical area of approximately one square mile which is sensitive to ground water pollution and establish PMZs for atrazine (3CCR Section 6802).

(6) Establish ground water protection restrictions which require a permit for use of a leaching pesticide in its PMZs. To obtain such a permit, users must submit a ground water protection advisory written by a licensed pest control adviser who has completed the Department-approved Ground Water Protection Training Program within the previous two years (3CCR Section 6416).

(7) Establish use requirements that prohibit all agricultural, outdoor institutional, and outdoor industrial uses of atrazine in its PMZs (3CCR Section 6486).

Proposed Regulations

- December, 1988. The Director proposed regulations to revise the specific numerical values for water solubility, soil adsorption coefficient, and hydrolysis which are used to identify pesticides with the potential to leach to ground water. These values may be revised as additional chemical and environmental fate information becomes available.

- February, 1989. The Director proposed regulations to do the following:

  (1) Add fifteen pesticides to the Ground Water Protection List on the basis of their detection in ground water (simazine, bromacil, diuron, and prometon), or their chemical and environmental fate

characteristics and use patterns (cyanazine, fenamiphos, fluometuron, linuron, methiocarb, methomyl, metolachlor, metribuzin, naptalam, pebulate, and vernolate).

(2) Establish PMZs for simazine, bromacil, diuron, and prometon.

(3) Change the ground water protection restrictions to require users to submit a written ground water protection advisory in order to obtain a permit to use a leaching pesticide in its PMZs.

(4) Define "ground water protection advisory"; specify what information it shall include; and describe the requirements of licensed pest control advisers when writing such an advisory.

(5) Establish use requirements for simazine, bromacil, diuron, and prometon that specify what uses are prohibited in PMZs.

(6) Provide for research authorizations that would allow application of leaching pesticides in PMZs for research and experimental purposes.

Agricultural Use Determinations

Positive finds of new pesticide residues in well water or soil under certain conditions may be the result of monitoring studies conducted by the CDFA, or may be reported to the CDFA by local, state, or federal agencies that conduct monitoring. Once a positive find of a new pesticide residue has been reported and verified, the PCPA requires the Department to determine if the residue resulted from legal agricultural use. If the residue was a result of such use, the Department notifies the appropriate registrants of their opportunity to request a hearing. If requested, such a hearing of the Pesticide Registration and Evaluation Committee (PREC) subcommittee is held pursuant to Sections 13149 and 13150 of the PCPA.

The agricultural use investigation includes a determination of whether:

(1) the residue detected, be it active ingredient, breakdown product, or any other specified ingredient, is from an economic poison that is registerd for agricultural use in California;
(2) the application of such an economic poison in the vicinity of the detection was reasonably likely;
(3) a point source was a likely cause; or
(4) a non-agricultural use of the economic poison was a likely source.

The CDFA responds to pesticide detections in wells by conducting two types of surveys. First, a survey is conducted to locate a second positive well (i.e., a well with a confirmed detection of a pesticide) in the same area as the initial positive well. This helps in determining that the residue did not result from a point source. The well survey consists of collecting water samples from a minimum of five wells that are in the same section as the reported positive well and/or in one or more of the three adjacent sections located closest to the positive well. Well selection is based on proximity to the positive well and availability. Second, a land use survey is conducted to identify potential sources for the contamination. Locations and sizes of crop and non-crop areas (such as natural vegetation, residential or industrial) are identifed on a map, and the area immediately surrounding the positive well is carefully investigated.

Seven agricultural use investigations were conducted in six different counties between July 1, 1988 and June 30, 1989. Following those investigations, it was determined that detections of aldicarb in Humboldt County and detections of bentazon in Glenn County (and ultimately in several other counties) were attributable to legal agricultural use. As a result, those two pesticides were entered into the AB 2021 review process. Conversely, the remaining five finds of pesticides in ground water were not attributable to agricultural use. These included: xylene and chlorthal-dimethyl in Monterey County, ethylene thiourea (ETU) in San Joaquin County, monuron in Tulare County, and tebuthiuron in San Diego County. [Note: The xylene, chlorthal-dimethyl, and ETU detections were presented in the 1988 well inventory report (Cardozo et al., 1988), so were not presented again in this report.]

New PMZs

A total of eight detections of pesticides previously reviewed under the PCPA were investigated between July 1, 1988 and June 30, 1989. The following list presents each pesticide detection, the county in which it was made, and the final recommendation.

Pesticide	County	Recommendation
Atrazine	Los Angeles	New PMZ Recommended
Bromacil/Diuron	Tulare	New PMZ Recommended
Atrazine/Prometon	Yolo	PMZ Not Recommended
Simazine	Humboldt	PMZ Not Recommended
Simazine	Napa	PMZ Not Recommended
Simazine	Tulare	PMZ Not Recommended
Simazine	Tulare	PMZ Not Recommended
Simazine	Stanislaus	PMZ Not Recommended *

* (Investigation continuing)

Adjacent Section Monitoring

PMZs are established by regulation when a pesticide is detected in ground water or soil under certain conditions and there is evidence that the detection resulted from legal agricultural use. Sections adjacent to a PMZ may not have been sampled previously, so they may lack adequate well sampling information on which to base a determination that they should also be designated as PMZs. Consequently, the Department conducts adjacent section monitoring to determine if these adjacent areas are also sensitive to ground water pollution by pesticides.

During the period July 1, 1988 through June 30, 1989, well sampling was conducted in sections adjacent to each established or proposed PMZ. From 25-100% of the adjacent sections in each county were monitored depending upon the total number of adjacent sections. Well samples were screened for atrazine, bromacil, diuron, prometon and simazine. In many adjacent sections, no wells were sampled because there were none, existing wells were not operating, or permission to sample could not be obtained from well owners.

Detection results for wells sampled in each of seven counties are presented in the following table (Table 10).

Table 10. Sampling results from 1988 - 1989 adjacent section monitoring, by number of wells.

County	Number of wells containing: atrazine	simazine	prometon	bromacil	diuron	Total wells positive	Total wells sampled
Contra Costa	0	0	0	0	0	0	14
Fresno	0	14	0	1	1	15	32
Glenn	2	3	1	0	1	4	42
Los Angeles	13	9	0	0	0	13	31
Orange	1	2	0	0	0	2	6
Riverside	1	4	0	0	2	4	7
Tulare	0	19	5	15	21	25	72
Totals	17	51	6	16	25	63	204

As shown in Table 10, simazine was detected most frequently (in 51 wells [25% of those sampled] in 6 counties), followed by diuron (25 in 4), atrazine (17 in 4), bromacil (16 in 2) and prometon (6 in 2). No positive wells were found in Contra Costa County. Thirty-one percent of the 204 wells sampled contained residues of at least one pesticide.

Table 11 shows the number of sections with detections by county and pesticide. As would be expected, the distribution of section detections echoes that of wells (i.e., simazine - most, to prometon - fewest). Tulare County had the highest number of sections with detections; Contra Costa had none. Forty-three percent of the 109 sections sampled had at least one chemical detected in at least one well. Simazine, the most frequently detected pesticide, was found in 39 (36%) of the 109 sections sampled.

Table 11. Sampling results from 1988 - 1989 adjacent section monitoring, by number of sections.

County	Number of sections containing:					Total Sections	
	atrazine	simazine	prometon	bromacil	diuron	Detected	Sampled
Contra Costa	0	0	0	0	0	0	5
Fresno	0	10	0	1	1	11	16
Glenn	2	3	1	0	1	4	25
Los Angeles	10	7	0	0	0	10	18
Orange	1	2	0	0	0	2	4
Riverside	1	3	0	0	1	3	5
Tulare	0	14	5	10	15	17	36
Totals	14	39	6	11	18	47	109

A land use survey was conducted in each adjacent section to characterize cropping and other land use features present. That information along with the results of well sampling will be used to determine which of the adjacent sections with detections should be made PMZs.

ENVIRONMENTAL MONITORING ACTIVITIES:

Since 1979, the CDFA has been working to gain a clearer understanding of the movement of pesticides in soil in order to prevent ground water contamination through effective regulation of pesticide sales and use. The CDFA's Environmental Hazards Assessment Program (EHAP), in the Environmental Monitoring and Pest Management Branch, forms the core of this effort. The EHAP conducts monitoring in soil and ground water, gathers environmental fate data on registered pesticides, and tests mathematical models predicting the behavior of pesticides in soils. Information gained from this work guides the CDFA in the regulatory decision-making process.

The EHAP first began monitoring soils and ground water for pesticide residues in 1979 in response to the discovery of aldicarb and DBCP in ground water in several states. At that time, very little ground water sampling had been done, and most soil sampling did not test for pesticide residues at depths below 100 centimeters (about 3 feet). A complete list of EHAP's published reports is available from the Environmental Monitoring and Pest Management Branch of the CDFA. A list follows of the EHAP's recently published reports and studies in progress which examine aspects of pesticide movement to ground water.

Published Reports

1. Final Report for Contract #8680, CDFA: Simulation of Pesticide Fate in Some California Soils. J. Hutson and J. Wagenet, Cornell University, N.Y. and J. Biggar, University of California, Davis. Nov, 1989.
   Data from EHAP field studies were used as a validation for pesticide models. Models studied were: PRZM, a model developed with funding from EPA that predicts the soil distribution of pesticides; LEACHM, a model developed for leaching of salts in California soils and then modified for pesticide movement; BAM, a model developed as a screening model with steady-state assumptions; and CMLS, a model that tracks peak solute position only. The most significant comparison was the use of models to simulate pesticide movement under different irrigation methods. Since models simulate only vertical flow (called one-dimensional flow), they

could not be used for data developed from furrow or drip irrigations where horizontal movement from wet to dry soil occurred. In simulations of data obtained from sprinkler and basin irrigations where the whole soil surface was wetted and flow was predominantly vertical, the models did not usually predict the pronounced bimodal pesticide soil distributions that were observed in the data. The differences may have been caused by slower desorption of pesticides in the field or by non-attainment of equilibrium due to swift downward movement of water. Further refinement of pesticide-soil reactions will be needed in order to produce reliable simulation models.

2. Report in Partial Fulfillment of Contract #3944, CDFA. Sorption-Desorption of the Nematicide Fenamiphos Sulfoxide in Relation to Residence Time in Soil. Dissertation submitted by Sun Kwan Kima, Dec. 1989.
   Pesticide-soil sorption processes for fenamiphos's breakdown product fenamiphos sulfoxide were compared between surface and subsurface soil obtained from Hawaii and Salinas, California. A mass balance method was found to be more reliable than the batch method to measure the amount of pesticide adsorbed to soil. The measure of soil adsorption, Kd, was found to increase with time. The increase in adsorption was ascribed to a conversion from a labile to nonlabile form. However, results from dynamic column leaching studies indicated that a greater amount of sulfoxide leached than would have been predicted by the measured adsorption-desorption rate. Although sorption partitioning increased with time, actual leaching may be faster than that predicted when the pesticide is applied to initially dry field soil.

Studies in progress

1. Effect of increases in the interval between pesticide application and irrigation treatment on soil movement of pesticide.

2. Monitoring the movement of non-fumigant nematicides through the soil profile after application through drip irrigation.

3. Effects of seasonal winter rainfall on pesticide leaching in Riverside County.

4. Effects of type and amount of irrigation on pesticide movement.

5. Contracted research to compare the amount of recharge water resulting from different methods of irrigation.

6. Movement through soil: comparison of alachlor, aldicarb, atrazine, carbofuran, diazinon, malathion, oxamyl, simazine.

7. Coastal subsoil characteristics.

8. Monitoring persistence and movement through soil of nematicides registered for use on flower bulbs.

9. Determination of soil adsorption of pesticides.

10. Sampling for alachlor, atrazine, metolachlor, and nitrate in well water in Merced County.

III. ACTIONS TAKEN BY THE
STATE WATER RESOURCES CONTROL BOARD
TO PREVENT PESTICIDES
FROM ENTERING GROUND WATER

INTRODUCTION

In compliance with section 13152(e)[4] of the Food and Agricultural Code, the State Water Resources Control Board provides to the State Legislature actions taken by the agency to prevent pesticides from migrating to the ground waters of the State.

State of California

Memorandum

To : Ron Oshima, Chief
Environmental Monitoring and Pest Management Branch
Department of Food and Agriculture
1220 N Street, Room A-149
Sacramento, CA 95814

Date : OCT 23 1989

Edward C. Anton, Chief
Planning and Standards Development Branch
Division of Water Quality

From : **STATE WATER RESOURCES CONTROL BOARD**

Subject: AB 2021 (PESTICIDE CONTAMINATION PREVENTION ACT)

The Pesticides Contamination Prevention Act (the Act) requires that actions by the State Water Resources Control Board to prevent economic poisons from migrating to the ground waters of the State be reported to the Legislature annually. The attached report is a summary of actions during the past year, and pursuant to Section 13152(e)(4) of the Act, this information is hereby submitted to your department for inclusion in the report to the Legislature.

Attachment

cc: Regional Board Executive Officers

Regional Board Branch Offices
Fresno, Redding, and Victorville

Dale Claypoole, Chief
Program Control Unit

PESTICIDE CONTAMINATION PREVENTION ACT (AB 2021)
ANNUAL REPORT TO THE LEGISLATURE
STATE WATER RESOURCES CONTROL BOARD
DECEMBER 1989

Actions taken by the State Water Resources Control Board (State Board) and the nine Regional Water Quality Control Boards (Regional Boards) (Figure 1) to prevent pesticides from entering groundwater are reported as required by Section 13152(e)(4) of the Pesticide Contamination Prevention Act (the Act).

A. STATE WATER RESOURCES CONTROL BOARD

- The State Board approved amendments incorporating its Sources of Drinking Water Policy (State Board Resolution No. 88-63) in the Basin Plans of each Regional Board.

  The amendments declare that, with certain exceptions that may be designated by the Regional Boards, all groundwaters (as well as surface waters) of the State are considered to be suitable, or potentially suitable, as municipal or domestic water supply. This action provides additional protection for groundwaters of the State.

- The subcommittee established by the Act and representing the State Board, the Department of Health Services (DHS), and the Department of Food and Agriculture (DFA) evaluated the pesticide aldicarb because of its detection in groundwater as a result of legal agricultural use. The subcommittee found that continued use of aldicarb would threaten groundwater quality. Cancellation of aldicarb products in California should follow this action.

- The State Board approved a $400,000 State Assistance Program grant to the Department of Water Resources. The grant will support investigations to reduce pollution from subsurface agricultural drainage. The studies will focus on more efficient irrigation techniques and management of shallow groundwater to improve subsurface drainage quality and to reduce subsurface drainage quantity, and the relationship of pollutant load to drainage volume. The two year studies will begin prior to or during the 1989 growing season.

- The State Board is developing a contract with the Association of Monterey Bay Area Governments to produce a management plan and outreach program to reduce the erosion created by upland strawberry agriculture and produce best management practices to reduce pesticide runoff into Elkhorn Slough. These practices will also reduce potential leaching of pesticides from the slough into groundwater.

- The State Board funded the Stockton East Water District to determine the long-term impact upon the Stockton East groundwater basin of agricultural chemicals present in the soil, and to develop the water quality component of a water management plan for the District which outlines alternatives for managing potential groundwater degradation.

STATE WATER RESOURCES CONTROL BOARD
P. O. Box 100, Sacramento, CA 95801

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARDS

NORTH COAST REGION (1)

1440 Guerneville Road
Santa Rosa, CA 95403
(707) 576-2220

SAN FRANCISCO BAY REGION (2)

1111 Jackson Street, Rm. 6040
Oakland, CA 94607
(415) 464-1255

CENTRAL COAST REGION (3)

1102-A Laurel Lane
San Luis Obispo, CA 93401
(805) 549-3147

LOS ANGELES REGION (4)

101 Centre Plaza Drive
Monterey Park, CA 91754
(213) 266-7500

CENTRAL VALLEY REGION (5)

3443 Routier Road
Sacramento, CA 95827-3098
(916) 361-5600

Fresno Branch Office

3614 East Ashlan Ave.
Fresno, CA 93726
(209) 445-5116

Redding Branch Office

100 East Cypress Avenue
Redding, CA 96002
(916) 225-2045

LAHONTAN REGION (6)

2092 Lake Tahoe Boulevard
P. O. Box 9428
South Lake Tahoe, CA 95731
(916) 544-3481

Victorville Branch Office

15428 Civic Drive, Suite 100
Victorville, CA 92392-2359
(619) 241-6583

COLORADO RIVER BASIN REGION (7)

73-271 Highway 111, Ste. 21
Palm Desert, CA 92260
(619) 346-7491

SANTA ANA REGION (8)

6809 Indiana Avenue, Ste. 200
Riverside, CA 92506
(714) 782-4130

SAN DIEGO REGION (9)

9771 Clairemont Mesa Blvd. Ste. B
San Diego, CA 92124
(619) 265-5114

8-89

- The State Board contracted with the University of California Sustainable Agriculture Research and Education Program to develop a cover crop manual and to conduct demonstrations to evaluate the effectiveness of the use of cover crops to reduce the use of pesticides on agricultural crops. Reduced use of certain pesticides is expected to reduce the potential for groundwater contamination by these pesticides.

B. REGIONAL WATER QUALITY CONTROL BOARDS

The Regional Boards engage in routine activities, such as responses to spills, complaints, and enforcements, relating to preventing pesticide pollution of groundwater. Information on prevention of pesticide pollution of groundwater by specific Regional Boards is listed in Tables 1 through 9.

Table 1. Actions taken by the North Coast Regional Board to prevent economic poisons from migrating to groundwater.

The Regional Board, in conjunction with the State Board, completed a project on groundwater pollution by pesticides in Del Norte County. The project consisted of sampling a designed monitoring well network in several areas, evaluating the hydrology in each area, developing a computer model to predict pollutant movement and fate, and developing a plan to implement recommendations resulting from the study.

The final report for the project is entitled Groundwater Pollution by Pesticides on the Smith River Plains, Del Norte County (Final Report).

Table 2. Actions taken by the San Francisco Bay Regional Board to prevent economic poisons from migrating to groundwater.

County	Site	Pesticide	Prevention Action
Alameda	Parker & Amchem	2,4-D 2,4,5-T	Soil Removal in Sept. 1988 (Work completed).
Contra Costa	Witco Chemical	xylene	Source from Koppers
Contra Costa	Kopper	xylene	Cease and Desist Order issued in Aug. 1987 (87-098) based on reported illegal discharge from xylene waste tank.
Contra Costa	Chevron Chemical	arsenic pesticides (endrin, lindane, dieldrin, DDT)	Have submitted closure plan for Class 1 impoundment. Ongoing groundwater assessment program.
Alameda	Jones-Hamilton	pentachlorophenol	Regional Board Order 89-110 specifies time schedule for investigation/cleanup.
Alameda	Port of Oakland (Embarcadero Cove)	chlordane pentachlorophenol	DHS lead enforcement.

Table 3. Actions taken by the Central Coast Regional Board to prevent economic poisons from migrating to groundwater.

County	Site	Pesticide	Prevention Action
Monterey	Soilserv King City	1,2-dichloropropane (1,2-D) & ethylene dibromide (EDB)	Investigation and cleanup underway.
Monterey	Soilserv Salinas	chlorthal-dimethyl (Dacthal)	Recent well sampling failed to confirm previous detections of dacthal. Additional sampling will be performed.
Monterey	Salinas	Dacthal	Sampling of 9 agricultural subsurface drains, jointly with State Board. Dacthal detected in all drains. Follow-up sampling in area wells being planned.
Santa Clara	Castle Vegtech, Inc. Morgan Hill	1,2-D & EDB	Investigation and cleanup underway.

Table 4. Actions taken by the Los Angeles Regional Board to prevent economic poisons from migrating to groundwater.

County	Site	Pesticide	Prevention Action
Los Angeles	Cooper Drum Co. S. El Monte	toxaphene, chlordane, DDE, DDD, & dieldrin	Cleanup referred to DHS in Dec. 1988.
	U.S. Post Office (formerly Challenger Cook Brothers, Inc.) City of Industry	lindane (gamma-BHC)	Monitoring.

Table 5. Actions taken by the Central Valley Region Board to prevent economic poisons from migrating to groundwater.

The Regional Board is managing a 205(j) project investigating the potential of on-site biological degradation of pesticides in contaminated soils (research being conducted at University of California, Davis).

Staff reviewed county agricultural commissioners' programs for disposal of empty pesticide containers.

During the past year, 166 pesticide applicator sites and dealers were inspected. In addition, information on over 300 pesticide applicator sites is available in the Regional Board's files. Many of these sites probably have pesticide contaminated soils and could pose a threat to groundwater. Due to budgetary limitations, there has been no recent regulatory activity related to most these facilities.

County	Site	Pesticide	Prevention Action
Fresno	Thompson Hayward Agriculture & Nutrition Co.	alpha-BHC, beta-BHC, gamma-BHC, dieldrin, DBCP, diphenamid, heptachlor, heptachlor epoxide	Site on State Superfund. Contamination assessment underway.
	FMC Corp.	aldrin, dieldrin, DDT, DDD, DDE, heptachlor, lindane, toxaphene, ethyl parathion, malathion, ethion, endosulfan, dimethoate, furadan, DNOC, DNBP	Site on State Superfund. Remedial investigation/ feasibility study in progress.
	Agro-West, Inc.	BHC, dicofol, endosulfan, dacthal, 2,4-D, diuron, methomyl, neburon, propham	Site on State Superfund. Hydrogeologic assessment report submitted pursuant to the Toxic Pits Cleanup Act.
	Britz, Inc. Five Points	toxaphene, DDT, dinoseb	Site on State Superfund. Partial contamination assessment submitted. Additional contamination assessment reported. Closure Plans requested.

Table 5 (continued)

County	Site	Pesticide	Prevention Action
Fresno (contd.)	Chevron Chem. Co.	unspecified	Assessment began June 1984.
	Fresno Co. Wells*	DBCP; EDB; 1,2-D	Pesticides detected in 146 wells (AB 1803 sampling). Assessment began 1988.
	Central Valley Aviation	unspecified	Assessment began April 1985.
	Wilbur-Ellis	unspecified	Assessment began June 1981.
	Union Carbide Test Plot	aldicarb	Additional contamination assessment ongoing.
	Central Valley Fertilizers	dieldrin	Bankrupt not currently operating.
	Coalinga Airport	DDT, chlorpyifos DEF, ethion, disyston	Contamination assessment requested.
	UC Ag. Field Station Westside AFS (Five Points)	simazine, diuron, prometon, MCPA	Both field stations are currently undergoing contamination assessment and installation of monitoring wells.
	UC Ag. Field Station Kearney Ag. Center (Parlier)	DDD, DDE, simazine chloroprophan, surflan	
	Occidental Chem./ J.R. Simplot	dieldrin	Surface impoundment excavated and closed continued monitoring of ground water.
	Paramount Farming	glyphosphate, diuron napropamide, bromacil, simazine	Assessing contamination beneath a dry well and and developing a closure plan.
	Selma Ag. Supply	DDT, DDE, dieldrin, chlordane, endosulfan	Soil and ground water contamination assessment ongoing.

Table 5 (continued)

County	Site	Pesticide	Prevention Action
Kern	Brown & Bryant, Inc. Arvin	1,2-D; 1,3-D; DBCP; EDB; dinoseb	Site on State Superfund. Contamination assessment report requested.
	Puregro Co. Bakersfield	DBCP	Site on State Superfund. Revised remedial action plan requested.
	Guimarra Vineyard	DBCP	Contamination Assessment and pond closure plan requested (J.R. Simplot-Edison).
	WASCO Airport	aldrin, lindane, endrin, chlordane, methoxychlor, DDT, DDD, DDE, thimet, malathion, methyl parathion, paraoxon, di-syston, omite, paraquat	Site on State Superfund. Submitted hydrogeologic assessment report pursuant to Toxic Pits Cleanup Act.
	Kern Co. Wells*	DBCP; 1,2-D, EDB	Pesticides detected in 57 wells (AB 1803 sampling).
	U.S.D.A., Shafter	dichlobenil, EPTC, prometryn	U.S.D.A. is obtaining funding for investigation and clean up.
Madera	Western Farm Service, Inc.	dinoseb, DBCP, dieldrin	Partial hydrogeological assessment report submitted. Additional contaminated assessment requested. Closure Plan requested.
	Chowchilla Muni. Airport	dieldrin, alpha-BHC, endosulfan, PCNB, DDT, DDE, lindane	Contamination assessment requested.
	Madera Co. Wells*	DBCP	DBCP detected in 2 wells (AB 1803 sampling).
Tulare	Mefford Field City of Tulare	p,p'-DDT; p,p'-DDE; 2,4,5-TP; dicamba; DNBP; diuron	Contamination Assessment and mitigation reports requested.

Table 5 (continued)

County	Site	Pesticide	Prevention Action
	Tulare Airport	Unspecified	Assessment began Jan. 1985.
	SCE Poleyard Visalia	Unspecified	Assessment began Sept. 1972.
	Kaweah Crop Dusters	DDT; 2,4-D; 2,4,5-T; methoxychlor	DHS Remedial Action Order issued January 1984; cleanup of surface impoundment in progress.
	Western Air	aldrin, DDE, heptachlor	Hydrogeologic assessment and closure plan underway pursuant to Toxic Pits Cleanup Act.
	Bixby Ranch	none	Investigation of pesticide containers disposed into open pits and trenches revealed no detectable pesticides in soil or ground water.
	Tulare Co. Wells*	1,2-D	1,2-D detected in 2 wells (AB 1803 sampling).
Merced	City of Turlock Airport	dieldrin, propham, neburon	Contaminated soil removed. Groundwater being monitored.
	Merced Co. wells*	DBCP, atrazine, simazine	Pesticides detected in 25 wells (AB 1803 sampling).
San Joaquin	Occidental Chem. Lathrop	2,4-D; 2,4,5-T; DEF; toxaphene; lindane; EDB; DBCP; dieldrin; delnav; dimethoate; disulfoton; sevin; heptachlor; DDT; DDE; DDD; aldrin; methyl parathion; ethyl parathion	Site remediation occurring pursuant to stipulation and judgement approving settlement (1981).
	Defense Depot Tracy	bromacil	Assessment began Jan. 1982.

Table 5 (continued)

County	Site	Pesticide	Prevention Action
	San Joaquin Co. Wells*	DBCP	Pesticides detected in 18 wells (AB 1803 sampling). Assessment began Feb. 1987.
	Sharpe Army Depot Stockton	bromacil	Assessment began 1982.
	Trinkle & Boys Flying Service	2,4-D; carbofuran; chlorpyrifos; diazinon; disyston; diuron; endosulfan; fenthion; malathion; methomyl; prometon; prometryn; simazine; toluene; xylene	Assessment ongoing. Cease and Desist Order issued.
	Marley Cooling	arsenic, copper, chromium	Toxic Pits Cleanup Act site.
	McCormick & Baxter	pentachlorophenols, creosote	Toxic Pits Cleanup Act site.
	Naval Communications Station	DDD	Assessment ongoing.
	Triple "E" Produce	chloroform	Assessment ongoing.
Stanislaus	Chemurgic (manufacturing site; highly contaminated soil, and moderate levels in groundwater).	BHC, DDT	Ongoing monitoring. groundwater treatment alternatives being evaluated. Field inspection and sampling.
	Geer Road Landfill	unspecified	Assessment began March 1985.
	Stanislaus Co. Wells*	DBCP	DBCP detected in 42 wells (AB 1803 sampling). Assessment began Feb. 1987. Ten Modesto City wells are included in a State State Superfund Study.
	Union Carbide Test Plots	aldicarb	Additional assessment work ongoing.

Table 5 (continued)

County	Site	Pesticide	Prevention Action
Stanislaus (contd.)	Shell Ag. (Research facility; pesticide in groundwater probably the result of use on test plots).	Bladex	Working with Shell on site evalaution. Bladex pollution contained on-site.
	Thunderbolt Riverbank (wood treatment facility).	chromium	Evalaution of site for contamination and secondary containment of treatment solutions. Groundwater extration appears successful.
	Hawke Dusters (pesticides and possible breakdown products in groundwater under rinse water storage pond).	dicofol; methomyl; PCNB; copper breakdown products(?) 1,2-DCE; chloroform; 1,2-DCA; 1,1,1-TCA; carbon tetrachloride; bromodichloromethane	Enforcement action against site owners in order to obtain site assessment and cleanup.
	Valley Wood	copper, chromium, arsenic	Referred to Attorney General and now in court. Under consideration for federal Superfund program.
Sacramento	Sacramento Army Depot	diazinon, Dursban, lindane	Assessment Report requested. Federal Superfund work in progress.
	McClellan AFB	aldrin; alpha-BHC; beta-BHC; delta-BHC; gamma-BHC (lindane); 4,4-DDD; 4,4,DDE; 4,4,DDT; dieldrin; alpha-endosulfan; endosulfan sulfate; heptachlor; heptachlor epoxide; 2,4-D; 2,4,5-T; & 2,4,5-TP	Groundwater cleanup underway.

Table 5 (continued)

County	Site	Pesticide	Prevention Action
Sutter	Bowles Flying Service	2,4-D; bolero; diuron; methayl; Ordram; & simazine	Assessment ongoing. Toxic Pits Cleanup Act site. Cease and Desist Order issued.
Yolo	Frontier Fertilizer Co., Davis	EDB	Cleanup and Abatement Order issued. State Superfund initiated.
	DOW Chemical Davis Agricultural Research Station	picloram; dinoseb; 1,2-D; 1,2-dichloroethane	Assessment ongoing.
	Yolo Co. Wells*	1,2-D; EDB	Pesticides detected in 2 wells (AB 1803 sampling).
Modoc	I'SOT, Inc. Canby	pentachlorophenol	Cleanup and Abatement Order issued to investigate extent of contamination and develop cleanup plans.
Siskiyou	Roseburg Forest Products Mt. Shasta	pentachlorophenol	Staff enforcement to determine extent of contamination and develop appropriate action.
Shasta	Calaran Lumber Co. Redding	pentachlorophenol	Staff enforcement to determine extent of contamination and develop appropriate action.
	Fibreboard Corp. Burney Operations	pentachlorophenol	Staff enforcement to verify cleanup and removal of system and contaminated soil.
	Roseburg Forest Products, Anderson	pentachlorophenol	System removed; no contamination remaining.

Table 5 (continued)

County	Site	Pesticide	Prevention Action
Shasta (contd.)	Roseburg Forest Products, Paul Bunyan Facility	pentachlorophenol	Staff enforcement to determine extent of contamiantion and develop appropriate action.
	Sierra Pacific Industries, Central Valley	pentachlorophenol	Staff enforcement to determine extent of contamination and develop appropriate action.
	Sierra Pacific Industries, Old Champion Facility	pentachlorophenol	Staff enforcement to verify cleanup and removal of system and contaminated soil.
Tehama	Crane Mills Paskenta	pentachlorophenol	Staff enforcement to determine extent of contamiantion and develop appropriate action.
	Louisiana-Pacific Red Bluff Operations	pentachlorophenol	Staff enforcement to determine extent of contamiantion and develop appropriate action.
	Waulevo, Inc. Corning	pentachlorophenol	Staff enforcement to determine extent of contamination and develop appropriate action.
Plumas	Siskiyou-Plumas Lumber Company Quincy Operations	pentachlorophenol	Staff enforcement to determine extent of contamination and develop appropriate action.
Solano	Wickes Forest Industries	chrome	Groundwater cleanup underway.

Table 5 (continued)

County	Site	Pesticide	Prevention Action
Colusa	Moore Aviation (pesticides in groundwater under rinse water disposal site)	2,4-D; MCPA	Site cleanup and groundwater remediation.
Glenn	Willows Airport (pesticides at low levels in shallow ground-water under disposal pond site).	toxaphene; endosulfan; diuron; 2,4-D; dinoseb; dicamba	Pond closed, contaminated soil removed, groundwater monitoring ongoing.
Kings	Calarco, Inc.	propargite, pendimethalin	Excavating pit for closure, ongoing monitoring of ground water.
	Lemoore N.A.S.	unspecified	Investigation ongoing.
	Blair Field	2,4-D, dicofol, diazinon, propargite	Investigating rinse water discharge to to earthen ditch.
	Blair Aviation	trifluralin, mevinphos, phorate	Contamination assessment requested.
	Lakeland Dusters	DDT, toxaphene	Toxic Pits Cleanup Act site, hydrogeologic assessment report is late; appropriate enforcement action is being considered.
Tuolumne	Tuolumne Co. Wells*	methylene chloride	Methylene chloride detected in 1 well (AB 1803 sampling).

* Number of wells under investigation from AB 1803 sampling.

Fresno County - 30
Kern County - 2
Tulare County - 2
Merced County - 24
Stanislaus County - 1
Yolo County - 2
Tuolumne County - 1

Table 5a. Rice seed soaking facilities being evaluated for pesticide residues in waste water in Central Valley region (Region 5).

County	Facility	Town
Butte	Butte County Rice Grower's Association	Richvale
Colusa	DePue Warehouse	Delevan
	DePue Warehouse, Spooner Facility	Williams
	Farmers Rice Cooperative	Princeton
	Myers & Charter	Arbuckle
	Rice Growers Association	Williams
Glenn	Glenn Growers	Glenn
Sutter	El Centro Storage	Pleasant Grove
	Hi & Dry Warehouse	Sutter
	Van Dyke Rice Dryers	Pleasant Grove

Table 6. Actions taken by the Lahontan Regional Board to prevent economic poisons from migrating to groundwater.

No pesticides detected in groundwater or subsoil in the past year.

The Regional Board, jointly with the State Board, monitored riverbed sediment, ground and surface waters following applications of the piscicide rotenone to some Sierra streams by California Department of Fish and Game. All samples were analyzed for the presence of the active ingredient rotenone and for additional formulation ingredients. No residues were detected in sediment or groundwater.

Table 7. Actions taken by the Colorado River Basin Regional Board to prevent economic poisons from migrating to groundwater.

County	Site	Pesticide	Prevention Action
* Imperial	Central Brave Ag. Service	4,4'-DDE, endosulfan	Closure of impoundment.
* Imperial	City of Brawley	4,4'-DDE, dieldrin	Closure of impoundment.
Riverside	Farmers Aerial Service	4,4'-DDE, endosulfan I	Closure of disposal area.
Imperial	Ross Flying Service	4,4'-DDD; 4,4'-DDE 4,4'-DDT; dieldrin	Closure of impoundment.
* Imperial	Visco Flying Service	4,4'-DDD; 4,4'-DDE 4,4'-DDT; endosulfan I & II	Closure of impoundment.
* Riverside	West Coast Flying	endosulfan I & II disulfoton, dimethoate	Closure of impoundment.
Riverside	Woten Aviation	disyston, DEF, ethyl parathion, methyl parathion.	Cleanup and Abatement order.
* Imperial	U.C. Davis Ag. Field Station	dacthal, diuron	Closure of disposal area.
* Imperial	Stoker Company	4,4'-DDE, endosulfan II	Closure of disposal area.

* Site subject to the Toxic Pits Cleanup Act.

Table 8. Actions taken by the Santa Ana Regional Board to prevent economic poisons from migrating to groundwater.

In the Santa Ana region, there are currently 81 confirmed detections of pesticides in groundwater. Only one of these has been attributed to a point source discharge. Groundwater extraction and treatment at this site is being performed under an order issued by the Regional Board. The remaining detections are from domestic and agricultural production wells. Seventy-eight of these wells contain dibromochloropropane (DBCP), four contain simazine, and one contains 1,2-dichloropropane (two wells contain both DBCP and simazine).

The presence of DBCP in the region's groundwater has resulted in both an actual and threatened impact on the beneficial use of water as a drinking water supply, as 56 of the 78 wells containing DBCP are drinking water wells. As a result, several activities are being undertaken by the Regional Board and local agencies to address this problem.

The Regional Board participated in a study concerning groundwater contamination in the Redlands area of the Bunker Hill Basin where 30 wells have been found to contain DBCP. The study was intended to determine if groundwater containing low concentrations of TCE and DBCP could be used for agricultural irrigation after minimal treatment, thereby mitigating the migration of a TCE plume and reducing groundwater concentrations of TCE and DBCP. Laboratory studies were performed to determine whether DBCP would be introduced back into the groundwater under such a scheme. Findings of this study indicate that application of contaminated water would be an effective method of removal of TCE and DBCP from the Bunker Hill Ground Water Basin in the vicinity of Redlands.

A follow-up field study has been proposed by the Santa Ana Watershed Project Authority. The objective of this field study is to verify whether the laboratory soil column results reflect field conditions. Although this study is intended to be specific to conditions in the Bunker Hill Basin, it should also have positive statewide implications.

In 1987 and 1989, the Regional Board approved three projects to be included in the Agricultural Drainage Loan Program. One project is the Arlington Desalter proposed by the Santa Ana Watershed Project Authority. This project involves extracting groundwater in the Arlington Basin and providing reverse osmosis and activated carbon treatment to remove nitrates and DBCP. This facility should be in operation in 1990. The other two projects involve both the City of Redlands and the City of Riverside to provide treatment to remove DBCP from the drinking water wells of these cities. The City of Riverside will install granular activated carbon units on their gage system wells. The City of Redlands will also install units on two drinking water well.

Table 8 (continued)

County	Site	Pesticide	Prevention Action
Orange	Great Western Savings Irvine	1,2-D; EDB; 1,2-DCA	NPDES permit issued November 1986. Groundwater extraction and treatment continuing.
Riverside	Sunnymead MWC (well 03, mun)	DBCP	Well has been abandoned by water purveyor.
	Arlington Basin	DBCP	Contract has been awarded to local agency under the State Board Agricultural Drainage Loan Program for the construction of a 7 MGD reverse osmosis plant with partial flow through a GAC unit for treatment of TDS, NO_3 and DBCP. Plant startup scheduled for May 1990.
	City of Corona (well 8, mun)	simazine	Chemical use questionnaires have been sent to nearby potential sources to determine if solely nonpoint source related. Chlorinated solvents have also been found. Site investigations in progress.
	Home Gardens, CWD (wells 2&3, mun)	DBCP, simazine	Water purveyor has closed wells and is now purchasing water from City of Riverside.
Riverside	Victoria Farm, MWC (well 01, mun)	DBCP	Well is being blended with better quality water.
	City of Riverside (Twin Spring, mun)	DBCP	Well is planned to be out of operation with adoption of new MCL for DBCP.

Table 8 (continued)

County	Site	Pesticide	Prevention Action
Riverside (contd.)	City of Riverside (Moor-Griff, mun)	DBCP	Well is currently inactive.
	City of Riverside (Russell "B", mun)	simazine	Water is being used for domestic purposes.
San Bernardino	Gage System Wells (11 wells, Mun)	DBCP	The City of Riverside operates the Gage Systems which consists of 13 wells located along the Santa Ana River. These wells are being blended for domestic use. The City of Riverside is currently in the process of obtaining $14,000,000 from the State Board Agricultural Drainage Loan Program for the construction of DBCP treatment facilities.
Riverside	City of Riverside (1st St., mun)	DBCP	Well is not being used due to high concentrations of DBCP.
	City of Riverside (3 wells, mun)	DBCP	Water from Hunt wells No. 6, 10, and 11 is being blended with other wells in the area.
	City of Riverside (4 wells, emergency, Downtown Riverside)	DBCP	These 4 wells are also contaminated with industrial organic solvents. Investigation is underway to determine the source of solvents.
	Riverside County Hall Record, (pr)	DBCP	TCE and PCE have also been found. Well will be used for emergency purposes only.

Table 8 (continued)

County	Site	Pesticide	Prevention Action
Riverside (contd.)	Loma Linda Univ., Arlington, (mun)	DBCP	Currently testing water to determine whether to continue using well or switch to City water.
San Bernardino	Bunker Hill II Basin: Crafton/ Redlands area (30 wells)	DBCP	Regional Board heads Technical Advisory Committee of local agencies. Under the direction of the Committee, the University of California, Irvine, explored lab-scale models of soil columns to determine if groundwater contaminated with DBCP can safely be used for irrigation without introducing the contaminants back into the aquifer. A field demonstration study is being considered. The City of Redlands has been approved to received a DHS grant and a $2.7 million State Board Agricultural Drainage Loan to construct TCE and DBCP wellhead treatment facilities at a well field.
	So. San Berdo. Co. Water Dist. (3 wells, mun)	DBCP	Currently, the Water District is using two of their wells for production. A third well is being tested to determine if it is feasible to use.
Riverside	Home Gardens School (mun)	DBCP	Well was abandoned 18 months ago. Now using water from Home Gardens Water District.

Table 8 (continued)

County	Site	Pesticide	Prevention Action
Riverside	Buschlen, Dwight (mun)	DBCP	Well was abandoned about 3 years ago. A second well on the property with no traces of DBCP is being used for drinking water and irrigation.
San Bernardino	Cucamonga CWD (4 wells, mun)	DBCP	Two wells with DBCP concentrations less than 0.5 ppb are being blended. Two wells are out of operation due to a drop in the water table.
	Monte Vista CWD (3 wells, mun)	DBCP	One well was used last year for a short period. The remaining two wells have been off line. These wells are stand-by wells and, under emergency cases, will be blended with other clean sources.
	City of Upland (6 wells, mun)	DBCP	Two wells are out of operation. Four wells are used in emergency cases during high demand periods and are blended with other sources.
	City of Loma Linda (4 wells, mun)	DBCP	Two wells are off line. The other two wells are being used due to a drop in DBCP concentration. The City performed a test on one well using a Rotor Strip unit test results indicated some DBCP removal, but the removal efficiency was not satisfactory for DBCP. The City also purchases some water from the City of San Bernardino.

Table 9. Actions taken by the San Diego Regional Board to prevent economic poisons from migrating to groundwater.

County	Site	Pesticide	Prevention Action
San Diego	City of Oceanside Water Utility Dist. (well no. 12 - 11S/4W-18L1 S)	1,2-Dichloropropane	This backup drinking water well is located in the San Luis Rey River Valley. 1,2-dichloropropane of up to 2.3 ppm has been detected in this well. No preventive action has been initiated to date. The City of Oceanside is continuing monitoring of this well and reports to the county.
	Truly Nolen Exterminating, Inc.	aldrin, dieldrin, chlordane	This is an on-site abandoned well which allegedly received pesticide wastes several years ago. The pesticide constituents in the soil and groundwater include aldrin, dieldrin, and chlordane. Based on Title 22 definition, the near surface soils have hazardous and extremely hazardous levels of these constitutents. This site is subject to the Toxic Pits Cleanup Act of 1984 and a technical cleanup plan has been submitted for approval. Cleanup of this site should begin in the near future.

APPENDIX A

ANALYTICAL METHODS FOR VERIFICATION OF GROUND WATER CONTAMINATION BY PESTICIDES

Verification

All reports of pesticide residues in ground water are considered verified after the following has occurred:

(1) Two discrete samples from the same site have been taken by the Department, no longer than 30 days apart, and have been analyzed by a method approved by the Department and found to contain the substance under investigation. If only a degradation product of the substance under investigation is subsequently detected, then the degradation product itself must be detected in a second discrete sample. This first step of the verification process provides evidence that the well was contaminated and the residue was not due to contamination during sampling and transport or during lab processing and analysis.

(2) The residue has been detected by one laboratory using different analytical methods approved by the Department or by two different laboratories using an analytical method approved by the Department. This second step provides evidence that the residue was precisely identified and could not be due to lab contamination or chemist error.

Definition of Different Analytical Methods

Confirmation of a residue by a second analytical method is intended to increase the confidence in the positive detection of a chemical by the first analytical method. If the measurement procedures of the second method vary only slightly from the first method, it is likely that an erroneous identification in the first determination would also occur in the second. Therefore, the second method should be based on separation and/or detection processes as different from the first method as feasible.

The minimum changes needed in the first method to qualify it to be considered a second method depend on the specificity of both methods. The following matrix lists the possible combinations where "detection and separation" is defined as a significant change in both detector and separation procedure, "detection" is a significant change in the detector only, and "detection or separation" is a significant change in the detector or separation procedure.

Minimum requirements for procedural changes in a first method to qualify it as a second method:

First Method	Second Method	
	nonspecific	specific
nonspecific	detection & separation	detection only
specific	detection only	detection or separation

Specific Methods

A specific method provides positive identification of the measured chemical. This unequivocal identification implies that the detection system can distinguish the target compound from all other compounds in a given mixture, with or without the need for an additional separation procedure. A method is also considered to be specific if all known interferences yield insignificant responses, i.e., the sensitivity for the interfering compound is less than 0.1% of the sensitivity for the target compound.

Examples for specific methods are spectroscopic techniques like mass spectroscopy (MS) and Fourier transform infrared (FTIR) spectroscopy, generally used together with separation techniques like gas chromatography (GC) or high performance liquid chromatography (HPLC).

Nonspecific Methods

All methods that respond to more than one chemical and which use detectors that cannot distinguish between these different chemicals are considered to be nonspecific. Analytical methods that incorporate nonspecific detectors rely completely on separation procedures for identification. The problem with nonspecific detectors is that they can only prove the absence of a chemical when no signal is registered at the proper conditions for the chemical in question. When a signal is measured, however, one can only say that it is likely that the signal is caused by that chemical. But it is not a proven fact, as another component of the unknown mixture might interfere and the detector cannot distinguish between the two.

This definition of nonspecific includes the majority of gas chromatographic techniques. For example, nitrogen-phosphorus specific detectors used in GC analysis are specific only on the atomic level; they can distinguish nitrogen and phosphorus atoms from other atoms, but they cannot distinguish between one nitrogen-containing chemical and another.

Significant Change

A significant change in detector means a change in detection principle (for GC, a change from a flame photometric detector [FPD] to a conductivity detector, for example). A significant change in the separation procedure is either a change in separation principle (from GC to HPLC, for example) or a change in the separation condition (i.e., using a different type of column), as long as this change will alter the sequence in which the compounds are registered.

Following are examples for the three types of minimum changes (detection and separation, detection only, and detection or separation), given in the previous matrix, that qualify as significant changes:

Case 1

When both the first and the second method are nonspecific, both the detector and the separation procedure have to be changed significantly. For example, a first method using GC separation and a flame photometric detector could use as a second method either a GC with a significantly different column and a nitrogen-phosphorus detector (changing separation conditions and detector) or an HPLC separation with a UV-detector (changing separation principle and detector).

Case 2

When only one of the methods is specific, just the detection principle has to be changed; the separation procedure may be kept the same (GC/FPD and GC/MS using the same column, for example).

Case 3

When both methods are specific, either the detector or the separation procedure may be changed. Examples for these cases are GC/MS and HPLC/MS (keeping the same detector) or GC/MS and GC/FTIR (keeping the same separation conditions).

In the cases (2 and 3) where only a change in detector is needed, it is acceptable to use an integrated system where the effluent of the separation step is split and routed to two detectors. An example for this is GC/MS/FTIR, where the effluent of the GC is analyzed by MS and FTIR simultaneously. As this integrated analytical instrument uses two specific detectors, it counts as both first and second method.

Screening Methods

Special consideration has to be given to qualitative or semi-quantitative methods typically used for screening. Qualitative methods yield only detected/not detected results; semi-quantitative methods indicate the order of magnitude for the concentration of the identified chemical. Samples identified as positive will be forwarded for analysis by a quantitative method.

In this case, the qualitative screen is considered to be the first method. The quantitative method is then selected based on the above criteria for a second method. A second quantitative method (i.e, a third analysis method) is required only when verification is needed not only for the identity of the compound but also for its concentration. Analogously, a qualitative method may be used as a second method if verification of the concentration level is not required. A qualitative method cannot be used as a second method when the first method is qualitative also.

For example: a specific enzyme-linked immunosorbent assay (ELISA) may be used as a first method, even if it is used just as a detected/not detected screen. Or, a nonspecific ELISA qualifies as a second detector for the effluent from an HPLC. Note, however, that any ELISA which shows significant cross-reactivity to other compounds is considered to be nonspecific and would also require a change in the separation procedure.

APPENDIX B

EXPLANATION OF CODES

I. County Code*

Code	County	Code	County	Code	County
01	Alameda	21	Marin	41	San Mateo
02	Alpine	22	Mariposa	42*	Santa Barbara
03	Amador	23	Mendocino	43	Santa Clara
04*	Butte	24*	Merced	44	Santa Cruz
05	Calaveras	25*	Modoc	45	Shasta
06*	Colusa	26*	Mono	46	Sierra
07*	Contra Costa	27*	Monterey	47	Siskiyou
08*	Del Norte	28*	Napa	48*	Solano
09*	El Dorado	29	Nevada	49	Sonoma
10*	Fresno	30*	Orange	50*	Stanislaus
11*	Glenn	31*	Placer	51*	Sutter
12*	Humboldt	32	Plumas	52*	Tehama
13	Imperial	33*	Riverside	53*	Trinity
14	Inyo	34*	Sacramento	54*	Tulare
15*	Kern	35	San Benito	55	Tuolumne
16*	Kings	36	San Bernardino	56	Ventura
17*	Lake	37*	San Diego	57*	Yolo
18	Lassen	38	San Francisco	58*	Yuba
19*	Los Angeles	39*	San Joaquin		
20*	Madera	40	San Luis Obispo		

* Counties included in the 1989 data base.

II. Base Meridian Code

H = Humboldt
M = Mt. Diablo
S = San Bernardino

III. Well Study Code

Code	Agency	Pesticide(s) Analyzed
23	CDHS	1,2-D
72	KCEHD	(Kern Co. Env. Health Dept.); DBCP and EDB
95	CDFA	aldicarb, aldicarb sulfone, and aldicarb sulfoxide
99	RWQCB	2,4,5-T, atrazine, and prometon
100	CDFA	atrazine
101	CDFA	xylene
102	CDFA	rotenolone, rotenone, and others
103	CDFA	bromacil and diuron
104	CDFA	xylene
105	CDFA	dacthal
106	CDFA	ethylene thiourea
107	CDFA	atrazine and prometon
108	RWQCB	simazine
109	CDFA	simazine
110	CDFA	MCPA, bentazon, prometon, and thiobencarb
111	LCDA	(Lake County Dept. of Ag.); carbofuran, organophosphate screen, and simazine
112	CDFA	xylene
113	CDFA	atrazine, bromacil, diuron, prometon, and simazine
115	CDFA & MCAC	(Modoc Co. Ag. Comm.); 2,4-D, MCPA, dicamba, metribuzin, and picloram
117	CDFA	simazine
118	DWR	various chemicals: 26 inorganic and 83 organic
119	RWQCB	nitrate and simazine
120	CWSC	(Calif. Water Service Co.); 1,2-D
121	RWQCB	1,2-D
122	RWQCB	1,2-D, aldicarb, fenamiphos, and phorate
123	CDFA	rotenone
124	CDFA	monuron
125	CDFA	simazine
126	CDFA	simazine
127	CDFA	simazine
128	RWQCB	1,2-D
131	RWQCB	DBCP and EDB
132	CDFA	phosmet
133	CDFA	atrazine, bromacil, prometon, and simazine
134	SWRCB	atrazine, fenamiphos, and simazine
135	SDCHD	(San Diego Co. Health Dept.); tebuthiuron
136	CDFA	tebuthiuron
137	SWRCB	oxamyl
138	RWQCB	aldicarb, fenamiphos, and phorate

IV. Sampling Agency Code

Code	Agency Name
1401	San Diego County (Department of Agriculture)
2894	California Regional Water Quality Control Board (RWQCB), Region 1 (North Coast)
4323	California Dept. of Food and Agriculture (CDFA - Environmental Hazards Assessment Program)
5050	California Dept. of Water Resources (DWR)
5055	California Regional Water Quality Control Board (RWQCB), Region 5 (Central Valley)
5056	California State Water Resources Control Board (SWRCB)
5060	California Dept. of Health Services (CDHS; Sanitary Engineering Branch
5111	Lake County (Department of Agriculture)
5119	Kern County (Health Department)
5701	California Water Service Co. (CWSC)
9067	Modoc County Agricultural Commissioner

V. Chemical Codes

Code	Common Name
00506	1,2-D
00573	1,3-D
00639	2,4,5-T
00640	2,4,6-trichlorophenol
00636	2,4-D
00838	4(2,4-DB),dimethylamine salt
90359	BHC (not gamma isomer)
00183	DBCP
02092	DDE
00186	DDT
00632	DMPA
00271	EDB
00788	MCPA (sodium salt)
00786	MCPA, dimethylamine salt
00464	PCNB
00678	alachlor
00575	aldicarb
$0575	aldicarb sulfoxide
*0575	aldicarb sulfone
00009	aldrin
00018	ametryn
****1	aminocarb
00045	atrazine
00055	barban
00053	benefin
01552	benomyl
01944	bentazon
00083	bromacil
00104	captan
00105	carbaryl
00106	carbofuran
00110	carbophenothion
00130	chlordane
00576	chloroxuron
00141	chlorpropham
00179	chlorthal-dimethyl
01640	cyanazine
00185	d-d mix
00200	dicamba
00346	dicofol
00210	dieldrin
00238	dinoseb
00231	diuron
00259	endosulfan
00262	endrin

Code	Common Name
----1	ethylene thiourea (breakdown product)
01857	fenamiphos
*1857	fenamiphos sulfone
$1857	fenamiphos sulfoxide
***12	fenuron
00166	fluometuron
01855	glyphosate
00317	heptachlor
00359	lindane (gamma-BHC)
00361	linuron
00375	methiocarb
00383	methomyl
00384	methoxychlor
00385	methyl bromide
00623	mexacarbate
00449	molinate
00408	monuron
00421	naphthalene
00424	neburon
00592	nitrofen
00578	orthodichlorobenzene
01910	oxamyl
00478	phorate
$0478	phorate sulfone
*0478	phorate sulfoxide
00335	phosmet
*0335	phosmet-oa
00593	picloram
01875	pirimicarb
$1875	pirimicarb sulfoxide
*1875	pirimicarb sulfone
00499	prometon
00502	prometryn
00511	propachlor
00504	propazine
00339	propham
00062	propoxur
00518	rotenone
*0518	rotenolone
90518	rotenone, other related
***CB	screen (carbamate)
***OP	screen (organophosphate)
00603	siduron
00530	silvex
00531	simazine
****5	simetryn
01810	tebuthiuron
****6	terbuthylazine
01691	terbutryn
01933	thiobencarb
00594	toxaphene
00622	xylene

VI. Sample-Type Code

Sample-type codes are used to give additional information about chemical analyses CDFA has received. Definitions of terms used, e.g., initial detection sample, are included.

Definitions:

Initial detection sample:
For a single study and one particular well, the initial detection sample for a chemical will be the positive sample with the earliest sampling date and/or time. Split samples and replicate samples are coded in relation to the initial detection sample.

Replicate sample:
A discrete sample taken from the same well as the initial detection sample. In reference to a single chemical, discrete samples taken during a single study will be recorded as replicates of the initial detection sample.

Split sample:
A discrete sample which is divided into subsamples.

Codes:

(I) INITIAL DETECTION SAMPLE, NOT CONFIRMED
- -only one positive analysis
- -method and laboratory may or may not be known
- -no further sampling

(B) INITIAL DETECTION SAMPLE, w/FURTHER QUALITATIVE OR QUANTITATIVE ANALYSES HAVING ALL NEGATIVE RESULTS
- -initial detection with negative subsequent analyses
- -subsequent analyses are assigned the appropriate sample type codes "D" through "L", or "-"

(Q) INITIAL DETECTION SAMPLE, w/ FURTHER ANALYSES
- -initial detection with at least one positive subsequent analysis
- -no qualitative analyses
- -subsequent analyses are assigned the appropriate sample type codes "D" through "L", or "-"

(P) INITIAL DETECTION, w/FURTHER QUANTITATIVE AND QUALITATIVE ANALYSES
- -indicates that beyond the quantitative values recorded for the initial and subsequent analyses, some qualitative analyses were also performed
- -qualitative analyses can be either for the initial or for the subsequent analyses
- -at least one positive subsequent analysis
- -subsequent analyses are coded with the appropriate sample type codes "D" through "L", or "-"

(H) REPLICATE SAMPLE, METHOD- Different, LAB- Same
-a replicate sample analyzed with a different analytical method(s) but by the same laboratory as the initial detection sample

(J) REPLICATE SAMPLE, METHOD- Different, LAB- Different
-a replicate sample analyzed with a different analytical method(s) and by a different laboratory as the initial detection sample

(K) REPLICATE SAMPLE, METHOD- Same, LAB- Different
-a replicate sample analyzed with the same analytical method(s) but by a different laboratory as the initial detection sample

(L) REPLICATE SAMPLE, METHOD- Same, LAB-Same
-a replicate sample analyzed with the same analytical method(s) and by the same laboratory as the initial detection sample

(-) NOT SPECIFIED
-used when laboratory or analytical methods are unknown for analyses subsequent to initial detection sample
-used when all discrete samples are negative

VII. Analyzing Laboratory Code

Code	Laboratory Name
1050	California State University Lab (Fresno)
2371	Appl, Inc., Lab
3102	Eureka Lab Inc.
3334	North Coast, LTD, Lab
4323	California Dept. Food and Agriculture Lab (Sacramento)
5060	Cal. Dept. Health Services Lab (Berkeley)
5073	Cal. Dept. Fish and Game Lab (Nimbus)
5080	Cal. Dept. Food and Agriculture Lab (Berkeley)
5112	Fresno Co. Health Dept. Lab
5119	Kern Co. Health Dept. Lab
5497	Quality Assurance Lab
5701	Cal. Water Service Co. Lab
5806	B C Lab
9527	California Analytical Lab

VIII. Method of Analysis Code

E = EPA approved Method
I = In-house
P = P.A.M. (Pesticide Analytical Method)
O = Other

IX. Road Code

AV = Avenue
BL = Boulevard
CR = Circle
CT = Court
DR = Drive
HY = Highway
LN = Lane
PL = Place
RD = Road
RT = Route
ST = Street
WY = Way

X. Well (Type) Code

USGS Code	CDFA Code	
	B =	Both I and D
	C =	Community well
	D =	Domestic (private) well (residences)
	F =	Both D and Y
	G =	Both D and R
	H =	D, I, and R
	I =	Irrigation (agricultural) well
	L =	Large Water System well (more than 200 service connections)
	N =	Non-community well (schools, hospitals, restaurants, filling stations, parks, campgrounds (see Title 22 of the Health and safety code for more detailed definitions)
	S =	State Small Water System well (less than 200 service connections)
	T =	Test, monitoring, or observation well
	U =	Unknown type of well
	X =	Irrigation and industrial well
	Y =	Industrial well
(D)	W =	Dewatering well (see USGS definition below)
(C)	( )=	Commercial well (we will include this category in whichever CDFA category it bests fits, for example, industrial or non-community, depending on the described use of the well; see USGS definition below).)
(S)	R =	Stock (see USGS definition below)
(U)	A =	Unused well (see USGS definition below)

(D) Dewatering means the water is pumped for dewatering a construction or mining site, or to lower the water table for agricultural purposes. In this respect, it differs from a drainage well that is used to drain surface water underground. If the main purpose for which the water is withdrawn is to provide drainage, dewatering should be indicated even though the water may be discharged into an irrigation ditch and subsequently used to irrigate land.

(C) Commercial use refers to use by a business establishment that does not fabricate or produce a product. Filling stations and motels are examples of commercial establishments. If some product is manufactured, assembled, remodeled, or otherwise fabricated, use of water for that plant should be considered industrial, even though the water is not used directly in the product or in the manufacturing of the product.

(S) Stock supply refers to the watering of livestock.

(U) Unused means water is not being removed from the site for one of the purposes described above. A test hole*, oil or gas well, recharge, drainage, observation*, or waste-disposal well will be in this category. * = this type of well will be given the CDFA code of "T"; the others will get a CDFA code of "A".

APPENDIX C

FORMAT OF DATA ENTRY SHEETS

Format of Data Entry Sheets:

The format of the Well Inventory Data Entry Sheets has changed since the 1988 update report. The study number columns have been expanded from two to four and columns 16, 17, 70, and 112, previously blank spaces, have been incorporated into various data fields on the entry sheets.

Each chemical analysis for a pesticide residue or related chemical in a well water sample constitutes one record in the data base. Each record may contain up to 149 columns of data, although the majority of records contain 132 columns. The following is an explanation of the format. Definitions for the codes used on the data sheets can be found in Appendix B.

Column Number	Explanation
1-2	County code: a minimum reporting requirement. This code is consistent with the CDFA Pesticide Use Report format.
3-14	State well number (township/range/section/tract/sequence number): a minimum reporting requirement. This is the U.S. Geological Survey's Public Lands Survey Coordinate System (Davis and Foote, 1966) used by the DWR to numerically identify individual wells. Township lines (T, cols. 3-5) are oriented from north to south and are 6 miles long. Range lines (R, cols. 6-8) are oriented east to west and are 6 miles wide. A 6 X 6 mile township is divided into 36, 1 mile by 1 mile sections (S, cols. 9-10), numbered consecutively from 1 to 36. Each section is again divided into 16 individual 40 acre tracts (Tr, col. 11) that are identified by letters (A through R, excluding I and O). Wells in a tract are further identified with a sequential number (cols. 12-14) in the order of identification by the DWR.
15	Base line and meridian: this minimum reporting requirement is included in the state well number. These lines divide the state into three areas: Humboldt, Mount Diablo, and San Bernardino, forming the basic structure for the Township/Range/Section numbering system.
16	In-house code.
17-20	Study number: numbers were assigned consecutively as studies were obtained. (See Appendix D for summary of each study).
21-24	Sampling agency code: a minimum reporting requirement.

Column Number	Explanation
25-30	Date of sample: a minimum reporting requirement. Day, month, and year of each sampling record is included. The middle month of an indicated period is used when only a season is designated as the sampling date, e.g., "all samples were taken in spring of 1982." However, the precise sampling date is recorded for most studies.
31-35	Chemical code: a minimum reporting requirement. Each chemical is assigned a 5-digit chemical code which corresponds to the chemical codes used in the Pesticide Use Reporting System maintained by the Information Services Branch, CDFA. Breakdown products of pesticides are marked with a single asterisk or dollar sign to distinguish them from the parent compound, e.g., 01857 = fenamiphos, *1857 = fenamiphos sulfone, $1857 = fenamiphos sulfoxide. Pesticides sampled for that have not been registered for use in California are assigned sequential numbers preceded by multiple asterisks, e.g., ***12 = fenuron.
36	Sample type: a minimum reporting requirement.
37-42	Chemical concentration: a minimum reporting requirement. Analytical results are recorded in parts per billion (ppb) in scientific notation. Columns 37-40 are the significant figures, column 41 is the sign of the exponent (+ or -), and column 42 is the exponent (power of 10). Trace amounts, non-detected, or less than the minimum detectable limit values are all recorded as non-detected (0.00+0).
43-48	Minimum detectable limit (MDL): a minimum reporting requirement. The MDL for the chemical assay is recorded in ppb, in the same format as chemical concentration. The MDL for a given compound may vary by laboratory, date, or year, reflecting differences in analytical techniques.
49-52	Analyzing laboratory: a minimum reporting requirement.
53	Method of analysis: general type of analytical method is designated (e.g., I = In-house).
54-59	Date of analysis: a minimum reporting requirement. Month/day/year.
60-63	File name: internal file designation.
64-65	Summary year: indicates the year of the Well Inventory Summary Report in which each record appears. This is used for extracting from the main file only that data to be included in yearly updates.

Column Number	Explanation
66-114	Well location information: a minimum reporting requirement. Designates the street name and number or descriptive address of the well.
	Well-construction information - obtained from water well drillers' reports or well logs (confidential):
115-118	Well depth (in feet): the completed well depth, as recorded on the well log.
119-121	Depth to top of perforation (in feet): as recorded on the well log.
122-125	Depth to bottom of perforation (in feet): as recorded on the well log; often corresponds to depth of completed well.
126-129	Water depth: the depth of standing water in the well at time of sampling.
130-131	Log year: year the well was drilled; information obtained from well log, raw data, or verbally from a well owner.
132	Well code: a minimum reporting requirement. This code indicates well use, e.g., private domestic, irrigation, or both.
	Latitude/Longitude:
133-140	Latitude: the latitude is expressed in degrees (DD), minutes (MM) and seconds (SS.S). Seconds may be specified to the nearest tenth of a second. The format is DDMMSS.S. (The decimal point is implied and not included in a column.)
141-149	Longitude: the longitude is expressed in degrees (DDD), minutes (MM) and seconds (SS.S). Seconds may be specified to the nearest tenth of a second. The format is DDDMMSS.S. (The decimal point is implied and not included in a column.)

WELL INVENTORY FORMAT

STATE OF CALIFORNIA
DEPARTMENT OF FOOD
AND AGRICULTURE

ENVIRON. MONITOR. & PEST MGMT
ENVIRON. HAZARDS ASSESSMENT
1220 N STREET ROOM A-149

LINE NO	TEMPORARY NUMBER	COUNTY	STATE WELL NUMBER: TOWN-SHIP	STATE WELL NUMBER: RANGE	STATE WELL NUMBER: SECTION	STATE WELL NUMBER: TRACT	STATE WELL NUMBER: SEQUENCE NUMBER	BASE MERIDIAN	D OR ?	STUDY #	SAMPLING AGENCY	SAMPLE DATE: MONTH	SAMPLE DATE: DAY	SAMPLE DATE: YR	CHEMICAL CODE	SAMPLE TYPE	CHEMICAL CONCEN-TRATION (ppb)	MINIMUM DETECTABLE LEVEL (ppb)	ANALYZING LAB	ANAL. METH.	DATE OF ANALYSIS: MONTH	DATE OF ANALYSIS: DAY	DATE OF ANALYSIS: YR	FILE NAME	SUMMARY YEAR
	1 2 3 4	5 6	7 8 9	1 1 2	3 4	5	6 7 8	9	2	1 2 3 4	5 6 7 8	9 3	1 2	3 4	5 6 7 8 9	4	1 2 3 4 5 6	7 8 9 5 1 2	3 4 5 6	7	8 9	6 1	2 3	4 5 6 7	8 9
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									

96

WELL LOCATION ADDRESS

WELL CONSTRUCTION INFORMATION

LINE NO	STREET NUMBER	RD. DIR	STREET NAME	P or N	ROAD CODE	WELL DEPTH	TOP PERF	BOTTOM PERF	WATER DEPTH	LOGYEAR	WELLCODE
	7 1 2 3 4	5	6 7 8 9 8 1 2 3 4 5 6 7 8 9 9 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 1 1 2 3 4 5	6	7 8	9 2 1 2	3 4 5	6 7 8 9	3 1 2 3	4 5	6
1											
2											
3											
4											
5											
6											
7											
8											

APPENDIX D

SUMMARY OF WELL STUDIES IN THE 1989 UPDATE OF THE WELL INVENTORY DATA BASE

I. CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE (CDFA)

Agency No. 4323: [Environmental Hazards Assessment Program (EHAP)]

Study No. 95	aldicarb, aldicarb sulfone, aldicarb sulfoxide; Humboldt County; May 1988. 5 wells sampled.
Study No. 100	atrazine; Los Angeles County; March 1988. 7 wells sampled.
Study No. 101	xylene; Fresno County; April 1988. 6 wells sampled.
Study No. 102	rotenolone, rotenone, and others; Tulare County; September-December 1987. 9 wells sampled.
Study No. 103	bromacil and diuron; Tulare County; May 1988. 6 wells sampled.
Study No. 104	xylene; Monterey County; June 1988. 5 wells sampled.
Study No. 105	chlorthal-dimethyl; Monterey County; June 1988. 5 wells sampled.
Study No. 106	ethylene thiourea; San Joaquin County; August 1988. 6 wells sampled.
Study No. 107	atrazine and prometon; Sacramento and Yolo Counties; August 1988. 5 wells sampled: 2 in Sacramento County and 3 in Yolo County.
Study No. 109	simazine; Napa County; November 1988. 6 wells sampled.
Study No. 110	MCPA, bentazon, prometon, and thiobencarb; Butte, Colusa, Glenn, Kern, Madera, Merced, Placer, Sacramento, San Joaquin, Santa Barbara, Stanislaus, Sutter, Tehama, Yolo, and Yuba Counties; September 1988. 188 wells sampled.
Study No. 112	xylene; Tulare County; April 1988. 1 well sampled.
Study No. 113	atrazine, bromacil, diuron, prometon, and simazine sampling in sections adjacent to PMZs; Contra Costa, Fresno, Glenn, Los Angeles, Orange and Riverside Counties; October, November, December, 1988, January, February, and April 1989. 210 wells sampled.
Study No. 115	Joint study with Modoc Co. Ag. Commissioner; 2,4-D, MCPA, dicamba, metribuzin, and picloram; Modoc County; June-August 1987. 2 wells sampled.
Study No. 117	simazine; Humboldt County; September 1988. 5 wells sampled.
Study No. 123	rotenone; El Dorado and Mono Counties; August-November 1988. 5 wells sampled.
Study No. 124	monuron; Tulare County; January 1989. 7 wells sampled.
Study No. 125	simazine; Tulare County; February 1989. 6 wells sampled.
Study No. 126	simazine; Tulare County; January 1989. 6 wells sampled.
Study No. 127	simazine; Stanislaus County; February 1989. 5 wells sampled.
Study No. 132	phosmet; Trinity County; June-August 1987. 1 well sampled.

Study No. 133 atrazine, bromacil, prometon, and simazine; Glenn, Placer, Sacramento, San Joaquin, and Yuba Counties; February 1988. 71 wells sampled.

Study No. 136 tebuthiuron; San Diego County; April 1989. 6 wells sampled.

II. CALIFORNIA DEPARTMENT OF HEALTH SERVICES (CDHS)

Agency No. 5060: [Sanitary Engineering Branch (SEB)]

Study No. 23 1,2-D; AB 1803 data (5 records, hand-coded); Kern and Tulare Counties; July 1986-March 1987. 2 large system wells sampled.

III. CALIFORNIA DEPARTMENT OF WATER RESOURCES (DWR)

Agency No. 5050:

Study No. 118 Groundwater Resources Evaluation Project: analyzed for 26 inorganics and 83 organics; Fresno, Kings, Madera and Tulare Counties; April and May 1988. 58 wells sampled.

IV. CALIFORNIA STATE WATER RESOURCES CONTROL BOARD (SWRCB)

Agency No. 5056:

Study No. 134 atrazine, fenamiphos, and simazine; Fresno County; March 1988. 5 wells.

Study No. 137 oxamyl; Monterey County; November 1986. 7 wells sampled.

V. REGIONAL WATER QUALITY CONTROL BOARD (RWQCB)

Agency No. 2894: Region 1 (North Coast)

Study No. 108 simazine; Humboldt County; June 1988. 1 well sampled.

Study No. 122 1,2-D, aldicarb, fenamiphos, and phorate; Del Norte County; November 1987 and May 1988. 10 wells sampled.

Study No. 128 1,2-D; Del Norte County; December 1988. 8 wells sampled.

Study No. 138 aldicarb, fenamiphos, and phorate; Del Norte County; December 1988. 8 wells sampled.

Agency No. 5055: Region 5 (Central Valley)

Study No. 99 2,4,5-T, atrazine, and prometon; Yolo County; February 1988. 1 well sampled.

Study No. 119 nitrate and simazine; Stanislaus County; December 1988. 1 well sampled.

Study No. 121 1,2-D; AB 1803 update; San Joaquin County; September 1986 and April 1987. 14 wells sampled.

Study No. 131 DBCP and EDB; Solano County; March 1981. 5 wells sampled.

VI. LAKE COUNTY DEPARTMENT OF AGRICULTURE

Agency No. 5111:

Study No. 111 carbofuran, organophosphate screen, and simazine; Lake County; November 1988. 4 wells sampled.

VII. KERN COUNTY HEALTH DEPARTMENT

Agency No. 5119:

Study No. 72 DBCP and EDB; Kern County; January-December 1987. 147 wells sampled.

VIII. MODOC COUNTY AGRICULTURAL COMMISSIONER

Agency No. 9067:

Study No. 115 Joint study with CDFA; 2,4-D, MCPA, dicamba, metribuzin, and picloram; Modoc County; June-August 1987. 2 wells sampled.

IX. SAN DIEGO COUNTY HEALTH DEPARTMENT

Agency No. 1401:

Study No. 135 tebuthiuron; San Diego County; January and February 1989. 1 well sampled.

X. CALIFORNIA WATER SERVICE COMPANY

Agency No. 5701:

Study No. 120 1,2-D; San Joaquin County; May 1988. 16 wells sampled.

APPENDIX E

PART 1: TABLES ONE THROUGH NINE

Table 1. Status summary of the 14 detected pesticides or breakdown products reported by various agencies from July 1988 through June 1989.

Pesticide Detected	Source(s)	Status of Detection(s)
aldicarb sulfone	agricultural use	use (of parent compound) no longer allowed in counties where detected
aldicarb sulfoxide	agricultural use	use (of parent compound) no longer allowed in counties where detected
atrazine	agricultural use	sections of detection will become no-use PMZs[a]
bentazon	agricultural use	use suspended; Department hearing pending
bromacil	agricultural use	sections of detection will become regulated-use PMZs
1,2-D	not applicable[b]	use as active ingredient discontinued as of 1984
DBCP	not applicable	exempt from the PCPA; use was suspended in 1979
diuron	agricultural use	sections of detection will become regulated-use PMZs
EDB	not applicable	exempt from the PCPA; use was cancelled in 1985
monuron	potential point	CDFA investigation determined not due to agricultural use
prometon	point; others are under investigation	if source is determined to be from agricultural use, then sections of detection will become no-use PMZs
simazine	agricultural use	sections of detection will become regulated-use PMZs
2,4,5-T	not applicable	exempt from the PCPA
tebuthiuron	potential point	CDFA investigation determined not due to agricultural use

a A Pesticide Management Zone (PMZ) is a geographical area of about 1-square-mile which is sensitive to ground water pollution.

b "Not applicable" means that a source investigation was not conducted because the chemical is no longer registered for agricultural use.

Table 2. Numerical highlights contained in the well inventory data base, by year of report.

NUMERICAL HIGHLIGHTS	REPORT YEAR 1986[a]	1987[b]	1988[b]	1989[b]	CUMULATIVE TOTAL
Total Analyses	71,110	4,134	39,500	8,092	122,836
Positive Analyses	5,110	1,013	334	617	7,074
Wells sampled	8,359	526	2,956	748	11,462[c]
Wells with positive analyses	2,297	181	116	180	2,658[c]
Counties sampled	53	19	41	33	55[c]
Counties with positive analyses	23	13	14	20	25[c]
Pesticides and related compounds sampled	162	77	168	98	227[c]
Pesticides and related compounds detected	15	14	10	14	29[c]
Pesticides residues resulting from non-point source agricultural use	9	8	1	7	12[c]

a The 1986 report was comprehensive, i.e., it included all sampling data in the well inventory data base at that time (sampling from 1975 to August 31, 1986), which included both confirmed and non-confirmed detections.

b Numbers included are either confirmed positives (i.e., two or more positive samples per chemical and well) or negatives. Non-confirmed positives (i.e., single detections not confirmed by subsequent analyses) are not included.

c The cumulative total is not additive; e.g., a well with positive analyses reported in the 1986 report with additional analyses reported in the 1989 report will only be counted once.

Table 3. The number of counties with positive results and the number of counties in which samples were taken, for each pesticide and related chemical. Results are from sampling reported between July 1988 and June 1989.

PESTICIDE	NUMBER OF COUNTIES WITH POSITIVE RESULTS	NUMBER OF COUNTIES SAMPLED
1,2-D	3	7
1,3-D	0	6
2,4,5-T	1	1
2,4,6-trichlorophenol	0	4
2,4-D	0	6
2-(2,4-dichlorophenoxy) propionic acid	0	4
4(2,4-DB), dimethylamine salt	0	4
BHC (not gamma isomer)	0	4
DBCP	3	6
DDE	0	4
DDT	0	4
DMPA	0	4
EDB	1	6
MCPA (sodium salt)	0	3
MCPA, dimethylamine salt	0	1
PCNB	0	4
alachlor	0	4
aldicarb	0	6
aldicarb sulfone	2	2
aldicarb sulfoxide	2	2
aldrin	0	4

Table 3. (continued)

PESTICIDE	NUMBER OF COUNTIES WITH POSITIVE RESULTS	NUMBER OF COUNTIES SAMPLED
ametryn	0	4
aminocarb	0	4
atrazine	4	15
barban	0	4
benefin	0	4
benomyl	0	4
bentazon	10	15
bromacil	2	10
captan	0	4
carbaryl	0	5
carbofuran	0	6
carbophenothion	0	4
chloramben (NH4 salt)	0	1
chlordane	0	4
chloroxuron	0	1
chlorpropham	0	1
chlorthal-dimethyl	0	5
cyanazine	0	1
d-d mix	0	1
dicamba	0	5
dicofol	0	4
dieldrin	0	4
dinoseb	0	4
diuron	4	10

Table 3. (continued)

PESTICIDE	NUMBER OF COUNTIES WITH POSITIVE RESULTS	NUMBER OF COUNTIES SAMPLED
endosulfan	0	4
endrin	0	4
ethylene thiourea	0	1
fenamiphos	0	2
fenamiphos sulfone	0	2
fenamiphos sulfoxide	0	2
fenuron	0	4
fluometuron	0	1
glyphosate	0	1
heptachlor	0	4
lindane (gamma-bhc)	0	4
linuron	0	5
methiocarb	0	5
methomyl	0	5
methoxychlor	0	4
methyl bromide	0	6
mexacarbate	0	4
molinate	0	2
monuron	1	5
naphthalene	0	1
neburon	0	5
nitrofen	0	4
orthodichlorobenzene	0	5
orthodichlorobenzene, other related	0	5

Table 3. (continued)

PESTICIDE	NUMBER OF COUNTIES WITH POSITIVE RESULTS	NUMBER OF COUNTIES SAMPLED
oxamyl	0	6
phorate	0	1
phorate sulfone	0	1
phorate sulfoxide	0	1
phosmet	0	1
phosmet-oa	0	1
picloram	0	1
pirimicarb sulfone	0	1
prometon	3	14
prometryn	0	5
propachlor	0	4
propazine	0	5
propham	0	5
propoxur	0	5
rotenolone	0	2
rotenone	0	3
rotenone, other related	0	1
screen (carbamate)	0	1
screen (organophosphate)	0	1
siduron	0	4
silvex	0	5
simazine	8	16
simetryn	0	4
tebuthiuron	1	1

Table 3. (continued)

PESTICIDE	NUMBER OF COUNTIES WITH POSITIVE RESULTS	NUMBER OF COUNTIES SAMPLED
terbuthylazine	0	4
terbutryn	0	4
thiobencarb	0	2
toxaphene	0	4
xylene	0	6

Table 4. Number of wells sampled and analyses taken for each chemical. Results are from sampling reported between July 1988 and June 1989.

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
1,2-D	5	13	68	72	73	85
1,3-D	0	0	85	104	85	104
2,4,5-T	1	2	0	1	1	3
2,4,6-trichlorophenol	0	0	58	58	58	58
2,4-D	0	0	63	68	63	68
2-(2,4-dichlorophenoxy) propionic acid	0	0	58	58	58	58
4(2,4-DB), dimethylamine salt	0	0	58	58	58	58
BHC (not gamma isomer)	0	0	58	58	58	58
DBCP	28	90	168	211	196	301
DDE	0	0	58	58	58	58
DDT	0	0	58	58	58	58
DMPA	0	0	58	58	58	58
EDB	4	11	203	297	207	308
MCPA (sodium salt)	0	0	34	34	34	34

Table 4. (continued)

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
MCPA, dimethylamine salt	0	0	3	3	3	3
PCNB	0	0	58	58	58	58
alachlor	0	0	58	58	58	58
aldicarb	0	0	77	116	77	116
aldicarb sulfone	10	29	9	35	19	64
aldicarb sulfoxide	8	29	11	30	19	59
aldrin	0	0	58	58	58	58
ametryn	0	0	58	58	58	58
aminocarb	0	0	58	58	58	58
atrazine	20	41	313	536	333	577
barban	0	0	58	58	58	58
benefin	0	0	58	58	58	58
benomyl	0	0	58	58	58	58
bentazon	64	138	132	225	196	363
bromacil	19	39	234	433	253	472

Table 4. (continued)

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
captan	0	0	58	58	58	58
carbaryl	0	0	59	62	59	62
carbofuran	0	0	60	63	60	63
carbophenothion	0	0	58	58	58	58
chloramben (NH4 salt)	0	0	1	2	1	2
chlordane	0	0	58	58	58	58
chloroxuron	0	0	1	1	1	1
chlorpropham	0	0	1	4	1	4
chlorthal-dimethyl	0	0	63	63	63	63
cyanazine	0	0	1	4	1	4
d-d mix	0	0	9	21	9	21
dicamba	0	0	60	61	60	61
dicofol	0	0	58	59	58	59
dieldrin	0	0	58	58	58	58
dinoseb	0	0	58	58	58	58

Table 4. (continued)

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
diuron	26	97	249	448	275	545
endosulfan	0	0	58	58	58	58
endrin	0	0	58	58	58	58
ethylene thiourea	0	0	6	24	6	24
fenamiphos	0	0	18	33	18	33
fenamiphos sulfone	0	0	18	32	18	32
fenamiphos sulfoxide	0	0	18	33	18	33
fenuron	0	0	58	58	58	58
fluometuron	0	0	1	4	1	4
glyphosate	0	0	1	1	1	1
heptachlor	0	0	58	58	58	58
lindane (gamma-bhc)	0	0	58	58	58	58
linuron	0	0	59	62	59	62
methiocarb	0	0	58	61	58	61
methomyl	0	0	59	62	59	62

Table 4. (continued)

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
methoxychlor	0	0	58	58	58	58
methyl bromide	0	0	84	103	84	103
mexacarbate	0	0	58	58	58	58
molinate	0	0	19	19	19	19
monuron	1	4	63	71	64	75
naphthalene	0	0	9	21	9	21
neburon	0	0	59	62	59	62
nitrofen	0	0	58	58	58	58
orthodichlorobenzene	0	0	77	96	77	96
orthodichlorobenzene, other related	0	0	77	96	77	96
oxamyl	0	0	66	69	66	69
phorate	0	0	13	28	13	28
phorate sulfone	0	0	13	29	13	29
phorate sulfoxide	0	0	13	27	13	27
phosmet	0	0	1	5	1	5

Table 4. (continued)

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
phosmet-oa	0	0	1	5	1	5
picloram	0	0	3	3	3	3
pirimicarb sulfone	0	0	1	1	1	1
prometon	7	14	310	541	317	555
prometryn	0	0	59	62	59	62
propachlor	0	0	58	58	58	58
propazine	0	0	59	62	59	62
propham	0	0	59	62	59	62
propoxur	0	0	59	62	59	62
rotenolone	0	0	5	15	5	15
rotenone	0	0	14	48	14	48
rotenone, other related	0	0	9	33	9	33
screen (carbamate)	0	0	7	7	7	7
screen (organophosphate)	0	0	4	4	4	4
siduron	0	0	58	58	58	58

Table 4. (continued)

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
silvex	0	0	59	61	59	61
simazine	53	109	286	535	339	644
simetryn	0	0	58	58	58	58
tebuthiuron	1	2	5	14	6	16
terbuthylazine	0	0	58	58	58	58
terbutryn	0	0	58	58	58	58
thiobencarb	0	0	19	19	19	19
toxaphene	0	0	58	58	58	58
xylene	0	0	69	77	69	77
TOTAL RESULTS		618		7474		8092

Table 5. Detection and frequency of analysis of the fourteen detected pesticides by number of positive and total wells, analyses, and counties. Results are from sampling reported between July 1988 and June 1989.

PESTICIDE DETECTED	POSITIVE			TOTAL		
	WELLS	ANALYSES	COUNTIES	WELLS	ANALYSES	COUNTIES
1,2-D	5	13	3	73	85	7
2,4,5-T	1	2	1	1	3	1
DBCP	28	90	3	196	301	6
EDB	4	11	1	207	308	6
aldicarb sulfone	10	29	2	19	64	2
aldicarb sulfoxide	8	29	2	19	59	2
atrazine	20	41	4	333	577	15
bentazon	64	138	10	196	363	15
bromacil	19	39	2	253	472	10
diuron	26	97	4	275	545	10
monuron	1	4	1	64	75	5
prometon	7	14	3	317	555	14
simazine	53	109	8	339	644	16
tebuthiuron	1	2	1	6	16	1

Table 6. Positive, negative and total results for counties in which sampling was reported. Results are from sampling reported between July 1988 and June 1989.

COUNTY	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
BUTTE	8	16	2	4	10	20
COLUSA	7	14	12	76	19	90
CONTRA COSTA	0	0	21	213	21	213
DEL NORTE	6	38	7	267	13	305
EL DORADO	0	0	2	12	2	12
FRESNO	15	35	49	1698	64	1733
GLENN	33	81	67	589	100	670
HUMBOLDT	5	24	7	77	12	101
KERN	27	99	120	397	147	496
KINGS	0	0	7	455	7	455
LAKE	0	0	4	9	4	9
LOS ANGELES	16	52	22	289	38	341
MADERA	0	0	12	599	12	599
MERCED	1	2	6	36	7	38
MODOC	0	0	4	16	4	16
MONO	0	0	3	18	3	18
MONTEREY	0	0	17	29	17	29
NAPA	0	0	5	10	5	10
ORANGE	2	6	4	54	6	60
PLACER	1	2	9	11	10	13
RIVERSIDE	3	10	3	52	6	62
SACRAMENTO	1	2	11	36	12	38

Table 6. (continued)

COUNTY	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
SAN DIEGO	1	2	5	14	6	16
SAN JOAQUIN	3	8	25	123	28	131
SANTA BARBARA	0	0	10	10	10	10
SOLANO	0	0	5	10	5	10
STANISLAUS	4	8	11	32	15	40
SUTTER	7	16	3	15	10	31
TEHAMA	0	0	8	16	8	16
TRINITY	0	0	1	10	1	10
TULARE	32	182	91	2167	123	2349
YOLO	4	13	9	108	13	121
YUBA	4	8	6	22	10	30
TOTALS	180	618	568	7474	748	8092

Table 7. The number of pesticides detected in well water and the total number of pesticides sampled for in each county. Results are from sampling reported between July 1988 and June 1989.

COUNTY	NUMBER OF PESTICIDES DETECTED	NUMBER OF PESTICIDES ANALYSED FOR
BUTTE	1	1
COLUSA	1	7
CONTRA COSTA	0	6
DEL NORTE	2	14
EL DORADO	0	2
FRESNO	4	68
GLENN	5	9
HUMBOLDT	3	7
KERN	3	4
KINGS	0	64
LAKE	0	3
LOS ANGELES	2	5
MADERA	0	66
MERCED	1	5
MODOC	0	4
MONO	0	2
MONTEREY	0	4
NAPA	0	1
ORANGE	2	5
PLACER	1	1
RIVERSIDE	2	5
SACRAMENTO	1	3
SAN DIEGO	1	1
SAN JOAQUIN	1	7
SANTA BARBARA	0	1
SOLANO	0	2
STANISLAUS	2	3
SUTTER	1	2
TEHAMA	0	1
TRINITY	0	2
TULARE	7	69
YOLO	4	24
YUBA	1	2

Table 8. Summary of the number of wells with detected residues by county and pesticide. Results are from sampling reported between July 1988 and June 1989.

COUNTY	1,2-D	2,4,5-T	DBCP	EDB	aldicarb sulfone	aldicarb sulfoxide	atrazine	bentazon	bromacil	diuron	monuron	prometon	simazine	tebu-thiuron	**Total Discrete Wells**
Butte								8							8
Colusa								7							7
Del Norte					6	6									6
Fresno			1						1	1			13		15
Glenn							2	29		1		1	3		33
Humboldt					4	2							1		5
Kern	1		26	4											27
Los Angeles							16						9		16
Merced								1							1
Orange							1						2		2
Placer								1							1
Riverside										1			3		3
Sacramento								1							1
San Diego														1	1
San Joaquin	3														3
Stanislaus								3					1		4
Sutter								7							7
Tulare	1		1						18	23	1	5	21		32
Yolo		1					1	3				1			4
															180
Total per Chemical	5	1	28	4	10	8	20	64	19	26	1	7	53	1	

Table 9. Summary of the number of wells with single sample detections by county and pesticide. Results are from sampling reported between July 1988 and June 1989.

COUNTY	1,2-D	2,4-D	DBCP	EDB	aldicarb sulfone	aldicarb sulfoxide	atrazine	bentazon	monuron	prometon	simazine	**Total Discrete Wells**
Contra Costa							1			1	1	1
Del Norte	6				1	2						6
Fresno			2							2	5	8
Glenn								2				2
Humboldt						1						1
Kern			5	4				1				10
Modoc		1										1
San Joaquin	3											3
Stanislaus											1	1
Tulare			5						1	1	2	8
Total # Wells	9	1	12	4	1	3	1	3	1	4	9	

APPENDIX F

RESULTS BY COUNTY AND PESTICIDE

COUNTY: BUTTE

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
bentazon	8	16	2	4	10	20

TOTAL NUMBER OF ANALYSES 16 4 20

COUNTY: COLUSA

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
atrazine	0	0	10	10	10	10
bentazon	7	14	12	22	19	36
bromacil	0	0	10	10	10	10
molinate	0	0	7	7	7	7
prometon	0	0	10	10	10	10
simazine	0	0	10	10	10	10
thiobencarb	0	0	7	7	7	7

TOTAL NUMBER OF ANALYSES 14 76 90

COUNTY: CONTRA COSTA

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
atrazine	0	0	21	43	21	43
bromacil	0	0	20	40	20	40
chloramben (NH4 salt)	0	0	1	2	1	2
diuron	0	0	21	42	21	42
prometon	0	0	21	43	21	43
simazine	0	0	21	43	21	43

TOTAL NUMBER OF ANALYSES 0 213 213

COUNTY: DEL NORTE

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
1,2-D	0	0	2	2	2	2
1,3-D	0	0	8	8	8	8
aldicarb	0	0	13	40	13	40
aldicarb sulfone	6	15	7	23	13	38
aldicarb sulfoxide	6	23	7	18	13	41
chloroxuron	0	0	1	1	1	1
fenamiphos	0	0	13	28	13	28
fenamiphos sulfone	0	0	13	27	13	27
fenamiphos sulfoxide	0	0	13	28	13	28
methyl bromide	0	0	7	7	7	7
phorate	0	0	13	28	13	28
phorate sulfone	0	0	13	29	13	29
phorate sulfoxide	0	0	13	27	13	27
pirimicarb sulfone	0	0	1	1	1	1

TOTAL NUMBER OF ANALYSES 38 267 305

COUNTY: EL DORADO

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
rotenolone	0	0	2	6	2	6
rotenone	0	0	2	6	2	6

TOTAL NUMBER OF ANALYSES 0 12 12

COUNTY: FRESNO

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
1,2-D	0	0	21	21	21	21
1,3-D	0	0	21	21	21	21
2,4,6-trichlorophenol	0	0	21	21	21	21
2,4-D	0	0	21	21	21	21
2-(2,4-dichlorophenoxy) propionic acid	0	0	21	21	21	21
4(2,4-DB), dimethylamine salt	0	0	21	21	21	21
BHC (not gamma isomer)	0	0	21	21	21	21
DBCP	1	2	18	18	19	20
DDE	0	0	21	21	21	21
DDT	0	0	21	21	21	21
DMPA	0	0	21	21	21	21
EDB	0	0	21	21	21	21
PCNB	0	0	21	21	21	21
alachlor	0	0	21	21	21	21
aldicarb	0	0	21	21	21	21
aldrin	0	0	21	21	21	21
ametryn	0	0	21	21	21	21
aminocarb	0	0	21	21	21	21
atrazine	0	0	59	92	59	92
barban	0	0	21	21	21	21
benefin	0	0	21	21	21	21
benomyl	0	0	21	21	21	21
bromacil	1	3	33	67	34	70
captan	0	0	21	21	21	21
carbaryl	0	0	21	21	21	21
carbofuran	0	0	21	21	21	21
carbophenothion	0	0	21	21	21	21

COUNTY: FRESNO

PESTICIDE	POSITIVE NO. OF WELLS	POSITIVE NO. OF ANALYSES	NEGATIVE NO. OF WELLS	NEGATIVE NO. OF ANALYSES	TOTAL NO. OF WELLS	TOTAL NO. OF ANALYSES
chlordane	0	0	21	21	21	21
chlorthal-dimethyl	0	0	21	21	21	21
dicamba	0	0	21	21	21	21
dicofol	0	0	21	21	21	21
dieldrin	0	0	21	21	21	21
dinoseb	0	0	21	21	21	21
diuron	1	4	54	87	55	91
endosulfan	0	0	21	21	21	21
endrin	0	0	21	21	21	21
fenamiphos	0	0	5	5	5	5
fenamiphos sulfone	0	0	5	5	5	5
fenamiphos sulfoxide	0	0	5	5	5	5
fenuron	0	0	21	21	21	21
heptachlor	0	0	21	21	21	21
lindane (gamma-bhc)	0	0	21	21	21	21
linuron	0	0	21	21	21	21
methiocarb	0	0	20	20	20	20
methomyl	0	0	21	21	21	21
methoxychlor	0	0	21	21	21	21
methyl bromide	0	0	21	21	21	21
mexacarbate	0	0	21	21	21	21
monuron	0	0	21	21	21	21
neburon	0	0	21	21	21	21
nitrofen	0	0	21	21	21	21
orthodichlorobenzene	0	0	21	21	21	21
orthodichlorobenzene, other related	0	0	21	21	21	21
oxamyl	0	0	21	21	21	21
prometon	0	0	55	91	55	91
prometryn	0	0	21	21	21	21

COUNTY: FRESNO

PESTICIDE	POSITIVE NO. OF WELLS	POSITIVE NO. OF ANALYSES	NEGATIVE NO. OF WELLS	NEGATIVE NO. OF ANALYSES	TOTAL NO. OF WELLS	TOTAL NO. OF ANALYSES
propachlor	0	0	21	21	21	21
propazine	0	0	21	21	21	21
propham	0	0	21	21	21	21
propoxur	0	0	21	21	21	21
siduron	0	0	21	21	21	21
silvex	0	0	21	21	21	21
simazine	13	26	44	86	57	112
simetryn	0	0	21	21	21	21
terbuthylazine	0	0	21	21	21	21
terbutryn	0	0	21	21	21	21
toxaphene	0	0	21	21	21	21
xylene	0	0	25	25	25	25

TOTAL NUMBER OF ANALYSES 35 1698 1733

COUNTY: GLENN

PESTICIDE	POSITIVE NO. OF WELLS	POSITIVE NO. OF ANALYSES	NEGATIVE NO. OF WELLS	NEGATIVE NO. OF ANALYSES	TOTAL NO. OF WELLS	TOTAL NO. OF ANALYSES
MCPA (sodium salt)	0	0	15	15	15	15
atrazine	2	4	60	101	62	105
bentazon	29	65	38	59	67	124
bromacil	0	0	62	105	62	105
diuron	1	4	41	83	42	87
molinate	0	0	12	12	12	12
prometon	1	2	61	103	62	105
simazine	3	6	59	99	62	105
thiobencarb	0	0	12	12	12	12

TOTAL NUMBER OF ANALYSES 81 589 670

COUNTY: HUMBOLDT

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
aldicarb	0	0	6	18	6	18
aldicarb sulfone	4	14	2	12	6	26
aldicarb sulfoxide	2	6	4	12	6	18
atrazine	0	0	6	12	6	12
glyphosate	0	0	1	1	1	1
prometon	0	0	6	12	6	12
simazine	1	4	5	10	6	14

TOTAL NUMBER OF ANALYSES 24 77 101

COUNTY: KERN

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
1,2-D	1	2	0	0	1	2
DBCP	26	86	115	158	141	244
EDB	4	11	140	234	144	245
bentazon	0	0	2	5	2	5

TOTAL NUMBER OF ANALYSES 99 397 496

COUNTY: KINGS

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
1,2-D	0	0	7	7	7	7
1,3-D	0	0	7	7	7	7
2,4,6-trichlorophenol	0	0	7	7	7	7
2,4-D	0	0	7	7	7	7
2-(2,4-dichlorophenoxy) propionic acid	0	0	7	7	7	7
4(2,4-DB), dimethylamine salt	0	0	7	7	7	7
BHC (not gamma isomer)	0	0	7	7	7	7
DBCP	0	0	7	7	7	7
DDE	0	0	7	7	7	7
DDT	0	0	7	7	7	7
DMPA	0	0	7	7	7	7
EDB	0	0	7	7	7	7
PCNB	0	0	7	7	7	7
alachlor	0	0	7	7	7	7
aldicarb	0	0	7	7	7	7
aldrin	0	0	7	7	7	7
ametryn	0	0	7	7	7	7
aminocarb	0	0	7	7	7	7
atrazine	0	0	7	7	7	7
barban	0	0	7	7	7	7
benefin	0	0	7	7	7	7
benomyl	0	0	7	7	7	7
captan	0	0	7	7	7	7
carbaryl	0	0	7	7	7	7
carbofuran	0	0	7	7	7	7
carbophenothion	0	0	7	7	7	7
chlordane	0	0	7	7	7	7

COUNTY: KINGS

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
chlorthal dimethyl	0	0	7	7	7	7
dicamba	0	0	7	7	7	7
dicofol	0	0	7	7	7	7
dieldrin	0	0	7	7	7	7
dinoseb	0	0	7	7	7	7
diuron	0	0	7	7	7	7
endosulfan	0	0	7	7	7	7
endrin	0	0	7	7	7	7
fenuron	0	0	7	7	7	7
heptachlor	0	0	7	7	7	7
lindane (gamma-bhc)	0	0	7	7	7	7
linuron	0	0	7	7	7	7
methiocarb	0	0	7	7	7	7
methomyl	0	0	7	7	7	7
methoxychlor	0	0	7	7	7	7
methyl bromide	0	0	7	7	7	7
mexacarbate	0	0	7	7	7	7
monuron	0	0	7	7	7	7
neburon	0	0	7	7	7	7
nitrofen	0	0	7	7	7	7
orthodichlorobenzene	0	0	7	7	7	7
orthodichlorobenzene, other related	0	0	7	7	7	7
oxamyl	0	0	7	7	7	7
prometon	0	0	7	7	7	7
prometryn	0	0	7	7	7	7
propachlor	0	0	7	7	7	7
propazine	0	0	7	7	7	7
propham	0	0	7	7	7	7
propoxur	0	0	7	7	7	7

COUNTY: KINGS

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
siduron	0	0	7	7	7	7
silvex	0	0	7	7	7	7
simazine	0	0	7	14	7	14
simetryn	0	0	7	7	7	7
terbuthylazine	0	0	7	7	7	7
terbutryn	0	0	7	7	7	7
toxaphene	0	0	7	7	7	7
xylene	0	0	7	7	7	7

TOTAL NUMBER OF ANALYSES 0 455 455

COUNTY: LAKE

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
carbofuran	0	0	1	1	1	1
screen (organophosphate)	0	0	4	4	4	4
simazine	0	0	4	4	4	4

TOTAL NUMBER OF ANALYSES 0 9 9

COUNTY: LOS ANGELES

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
atrazine	16	33	22	43	38	76
bromacil	0	0	31	66	31	66
diuron	0	0	31	67	31	67
prometon	0	0	31	66	31	66
simazine	9	19	22	47	31	66
TOTAL NUMBER OF ANALYSES		52		289		341

COUNTY: MADERA

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
1,2-D	0	0	9	9	9	9
1,3-D	0	0	9	9	9	9
2,4,6-trichlorophenol	0	0	9	9	9	9
2,4-D	0	0	9	9	9	9
2-(2,4-dichlorophenoxy) propionic acid	0	0	9	9	9	9
4(2,4-DB), dimethylamine salt	0	0	9	9	9	9
BHC (not gamma isomer)	0	0	9	9	9	9
DBCP	0	0	9	9	9	9
DDE	0	0	9	9	9	9
DDT	0	0	9	9	9	9
DMPA	0	0	9	9	9	9
EDB	0	0	9	9	9	9
PCNB	0	0	9	9	9	9
alachlor	0	0	9	9	9	9

COUNTY: MADERA

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
aldicarb	0	0	9	9	9	9
aldrin	0	0	9	9	9	9
ametryn	0	0	9	9	9	9
aminocarb	0	0	9	9	9	9
atrazine	0	0	11	11	11	11
barban	0	0	9	9	9	9
benefin	0	0	9	9	9	9
benomyl	0	0	9	9	9	9
bentazon	0	0	3	6	3	6
bromacil	0	0	2	2	2	2
captan	0	0	9	9	9	9
carbaryl	0	0	9	9	9	9
carbofuran	0	0	9	9	9	9
carbophenothion	0	0	9	9	9	9
chlordane	0	0	9	9	9	9
chlorthal-dimethyl	0	0	9	9	9	9
dicamba	0	0	9	9	9	9
dicofol	0	0	9	9	9	9
dieldrin	0	0	9	9	9	9
dinoseb	0	0	9	9	9	9
diuron	0	0	9	9	9	9
endosulfan	0	0	9	9	9	9
endrin	0	0	9	9	9	9
fenuron	0	0	9	9	9	9
heptachlor	0	0	9	9	9	9
lindane (gamma-bhc)	0	0	9	9	9	9
linuron	0	0	9	9	9	9

COUNTY: MADERA

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
methiocarb	0	0	9	9	9	9
methomyl	0	0	9	9	9	9
methoxychlor	0	0	9	9	9	9
methyl bromide	0	0	9	9	9	9
mexacarbate	0	0	9	9	9	9
monuron	0	0	9	9	9	9
neburon	0	0	9	9	9	9
nitrofen	0	0	9	9	9	9
orthodichlorobenzene	0	0	9	9	9	9
orthodichlorobenzene, other related	0	0	9	9	9	9
oxamyl	0	0	9	9	9	9
prometon	0	0	11	11	11	11
prometryn	0	0	9	9	9	9
propachlor	0	0	9	9	9	9
propazine	0	0	9	9	9	9
propham	0	0	9	9	9	9
propoxur	0	0	9	9	9	9
siduron	0	0	9	9	9	9
silvex	0	0	9	9	9	9
simazine	0	0	11	20	11	20
simetryn	0	0	9	9	9	9
terbuthylazine	0	0	9	9	9	9
terbutryn	0	0	9	9	9	9
toxaphene	0	0	9	9	9	9
xylene	0	0	9	9	9	9

TOTAL NUMBER OF ANALYSES 0 599 599

COUNTY: MERCED

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
atrazine	0	0	6	6	6	6
bentazon	1	2	6	12	7	14
bromacil	0	0	6	6	6	6
prometon	0	0	6	6	6	6
simazine	0	0	6	6	6	6

TOTAL NUMBER OF ANALYSES 2 36 38

COUNTY: MODOC

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
2,4-D	0	0	4	7	4	7
MCPA, dimethylamine salt	0	0	3	3	3	3
dicamba	0	0	2	3	2	3
picloram	0	0	3	3	3	3

TOTAL NUMBER OF ANALYSES 0 16 16

COUNTY: MONO

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
rotenolone	0	0	3	9	3	9
rotenone	0	0	3	9	3	9

TOTAL NUMBER OF ANALYSES 0 18 18

COUNTY: MONTEREY

PESTICIDE	POSITIVE NO. OF WELLS	POSITIVE NO. OF ANALYSES	NEGATIVE NO. OF WELLS	NEGATIVE NO. OF ANALYSES	TOTAL NO. OF WELLS	TOTAL NO. OF ANALYSES
chlorthal-dimethyl	0	0	5	5	5	5
oxamyl	0	0	7	7	7	7
screen (carbamate)	0	0	7	7	7	7
xylene	0	0	5	10	5	10
TOTAL NUMBER OF ANALYSES		0		29		29

COUNTY: NAPA

PESTICIDE	POSITIVE NO. OF WELLS	POSITIVE NO. OF ANALYSES	NEGATIVE NO. OF WELLS	NEGATIVE NO. OF ANALYSES	TOTAL NO. OF WELLS	TOTAL NO. OF ANALYSES
simazine	0	0	5	10	5	10
TOTAL NUMBER OF ANALYSES		0		10		10

COUNTY: ORANGE

PESTICIDE	POSITIVE NO. OF WELLS	POSITIVE NO. OF ANALYSES	NEGATIVE NO. OF WELLS	NEGATIVE NO. OF ANALYSES	TOTAL NO. OF WELLS	TOTAL NO. OF ANALYSES
atrazine	1	2	5	10	6	12
bromacil	0	0	6	12	6	12
diuron	0	0	6	12	6	12
prometon	0	0	6	12	6	12
simazine	2	4	4	8	6	12
TOTAL NUMBER OF ANALYSES		6		54		60

COUNTY: PLACER

PESTICIDE	POSITIVE NO. OF WELLS	POSITIVE NO. OF ANALYSES	NEGATIVE NO. OF WELLS	NEGATIVE NO. OF ANALYSES	TOTAL NO. OF WELLS	TOTAL NO. OF ANALYSES
bentazon	1	2	9	11	10	13
TOTAL NUMBER OF ANALYSES		2		11		13

COUNTY: RIVERSIDE

PESTICIDE	POSITIVE NO. OF WELLS	POSITIVE NO. OF ANALYSES	NEGATIVE NO. OF WELLS	NEGATIVE NO. OF ANALYSES	TOTAL NO. OF WELLS	TOTAL NO. OF ANALYSES
atrazine	0	0	6	12	6	12
bromacil	0	0	6	12	6	12
diuron	1	4	5	10	6	14
prometon	0	0	6	12	6	12
simazine	3	6	3	6	6	12
TOTAL NUMBER OF ANALYSES		10		52		62

COUNTY: SACRAMENTO

PESTICIDE	POSITIVE NO. OF WELLS	POSITIVE NO. OF ANALYSES	NEGATIVE NO. OF WELLS	NEGATIVE NO. OF ANALYSES	TOTAL NO. OF WELLS	TOTAL NO. OF ANALYSES
atrazine	0	0	2	8	2	8
bentazon	1	2	9	20	10	22
prometon	0	0	2	8	2	8
TOTAL NUMBER OF ANALYSES		2		36		38

COUNTY: SAN DIEGO

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
tebuthiuron	1	2	5	14	6	16

TOTAL NUMBER OF ANALYSES 2 14 16

COUNTY: SAN JOAQUIN

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
1,2-D	3	8	8	12	11	20
1,3-D	0	0	10	17	10	17
bentazon	0	0	10	19	10	19
ethylene thiourea	0	0	6	24	6	24
methyl bromide	0	0	10	17	10	17
orthodichlorobenzene	0	0	10	17	10	17
orthodichlorobenzene, other related	0	0	10	17	10	17

TOTAL NUMBER OF ANALYSES 8 123 131

COUNTY: SANTA BARBARA

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
bentazon	0	0	10	10	10	10

TOTAL NUMBER OF ANALYSES 0 10 10

COUNTY: SOLANO

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
DBCP	0	0	5	5	5	5
EDB	0	0	5	5	5	5

TOTAL NUMBER OF ANALYSES 0 10 10

COUNTY: STANISLAUS

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
atrazine	0	0	5	10	5	10
bentazon	3	6	7	14	10	20
simazine	1	2	4	8	5	10

TOTAL NUMBER OF ANALYSES 8 32 40

COUNTY: SUTTER

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
MCPA (sodium salt)	0	0	9	9	9	9
bentazon	7	16	3	6	10	22

TOTAL NUMBER OF ANALYSES 16 15 31

COUNTY: TEHAMA

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
bentazon	0	0	8	16	8	16

TOTAL NUMBER OF ANALYSES 0 16 16

COUNTY: TRINITY

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
phosmet	0	0	1	5	1	5
phosmet-oa	0	0	1	5	1	5

TOTAL NUMBER OF ANALYSES 0 10 10

COUNTY: TULARE

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
1,2-D	1	3	21	21	22	24
1,3-D	0	0	30	42	30	42
2,4,6-trichlorophenol	0	0	21	21	21	21
2,4-D	0	0	21	21	21	21
2-(2,4-dichlorophenoxy) propionic acid	0	0	21	21	21	21
4(2,4-DB), dimethylamine salt	0	0	21	21	21	21
BHC (not gamma isomer)	0	0	21	21	21	21
DBCP	1	2	14	14	15	16
DDE	0	0	21	21	21	21
DDT	0	0	21	21	21	21
DMPA	0	0	21	21	21	21
EDB	0	0	21	21	21	21
PCNB	0	0	21	21	21	21
alachlor	0	0	21	21	21	21
aldicarb	0	0	21	21	21	21
aldrin	0	0	21	21	21	21
ametryn	0	0	21	21	21	21
aminocarb	0	0	21	21	21	21
atrazine	0	0	91	161	91	161
barban	0	0	21	21	21	21
benefin	0	0	21	21	21	21
benomyl	0	0	21	21	21	21
bromacil	18	36	58	113	76	149
captan	0	0	21	21	21	21
carbaryl	0	0	21	21	21	21
carbofuran	0	0	21	21	21	21
carbophenothion	0	0	21	21	21	21
chlordane	0	0	21	21	21	21
chlorthal-dimethyl	0	0	21	21	21	21
d-d mix	0	0	9	21	9	21

COUNTY: TULARE

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
dicamba	0	0	21	21	21	21
dicofol	0	0	21	22	21	22
dieldrin	0	0	21	21	21	21
dinoseb	0	0	21	21	21	21
diuron	23	85	74	127	97	212
endosulfan	0	0	21	21	21	21
endrin	0	0	21	21	21	21
fenuron	0	0	21	21	21	21
heptachlor	0	0	21	21	21	21
lindane (gamma-bhc)	0	0	21	21	21	21
linuron	0	0	21	21	21	21
methiocarb	0	0	21	21	21	21
methomyl	0	0	21	21	21	21
methoxychlor	0	0	21	21	21	21
methyl bromide	0	0	30	42	30	42
mexacarbate	0	0	21	21	21	21
monuron	1	4	25	30	26	34
naphthalene	0	0	9	21	9	21
neburon	0	0	21	21	21	21
nitrofen	0	0	21	21	21	21
orthodichlorobenzene	0	0	30	42	30	42
orthodichlorobenzene, other related	0	0	30	42	30	42
oxamyl	0	0	21	21	21	21
prometon	5	10	86	150	91	160
prometryn	0	0	21	21	21	21
propachlor	0	0	21	21	21	21
propazine	0	0	21	21	21	21
propham	0	0	21	21	21	21

COUNTY: TULARE

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
propoxur	0	0	21	21	21	21
rotenone	0	0	9	33	9	33
rotenone, other related	0	0	9	33	9	33
siduron	0	0	21	21	21	21
silvex	0	0	21	21	21	21
simazine	21	42	80	160	101	202
simetryn	0	0	21	21	21	21
terbuthylazine	0	0	21	21	21	21
terbutryn	0	0	21	21	21	21
toxaphene	0	0	21	21	21	21
xylene	0	0	22	22	22	22

TOTAL NUMBER OF ANALYSES	182	2167	2349

COUNTY: YOLO

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
2,4,5-T	1	2	0	1	1	3
2,4-D	0	0	1	3	1	3
atrazine	1	2	2	10	3	12
bentazon	3	7	7	9	10	16
carbaryl	0	0	1	4	1	4
carbofuran	0	0	1	4	1	4
chlorpropham	0	0	1	4	1	4
cyanazine	0	0	1	4	1	4
diuron	0	0	1	4	1	4
fluometuron	0	0	1	4	1	4
linuron	0	0	1	4	1	4
methiocarb	0	0	1	4	1	4
methomyl	0	0	1	4	1	4
monuron	0	0	1	4	1	4
neburon	0	0	1	4	1	4
oxamyl	0	0	1	4	1	4
prometon	1	2	2	10	3	12
prometryn	0	0	1	4	1	4
propazine	0	0	1	4	1	4
propham	0	0	1	4	1	4
propoxur	0	0	1	4	1	4
silvex	0	0	1	3	1	3
simazine	0	0	1	4	1	4
xylene	0	0	1	4	1	4

TOTAL NUMBER OF ANALYSES 13 108 121

COUNTY: YUBA

PESTICIDE	POSITIVE		NEGATIVE		TOTAL	
	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES	NO. OF WELLS	NO. OF ANALYSES
MCPA (sodium salt)	0	0	10	10	10	10
bentazon	4	8	6	12	10	20

TOTAL NUMBER OF ANALYSES 8 22 30