DATA FOR SELECTED PESTICIDES AND VOLATILE ORGANIC COMPOUNDS FOR WELLS IN THE WESTERN SAN JOAQUIN VALLEY, CALIFORNIA, FEBRUARY TO JULY 1985

By John M. Neil

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This report was prepared by the U.S. Geological Survey in cooperation with the San Joaquin Valley Drainage Program and as part of the Regional Aquifer System Analysis Program of the U.S. Geological Survey.

The San Joaquin Valley Drainage Program was established in mid-1984 and is a cooperative effort of the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, U.S. Geological Survey, California Department of Fish and Game, and California Department of Water Resources. The purposes of the Program are to investigate the problems associated with the drainage of agricultural lands in the San Joaquin Valley and to develop solutions to those problems. Consistent with these purposes, program objectives address the following key areas: (1) Public health, (2) surface- and ground-water resources, (3) agricultural productivity, and (4) fish and wildlife resources.

Inquiries concerning the San Joaquin Valley Drainage Program may be directed to:

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The Regional Aquifer System Analysis (RASA) Program of the U.S. Geological Survey was started in 1978 following a congressional mandate to develop quantitative appraisals of the major ground-water systems of the United States. The RASA Program represents a systematic effort to study a number of the Nation's most important aquifer systems, which in aggregate underlie much of the country and which represent an important component of the Nation's total water supply. In general, the boundaries of these studies are identified by the hydrologic extent of each system, and accordingly transcend the political subdivisions to which investigations have often arbitrarily been limited in the past. The broad objective for each study is to assemble geologic, hydrologic, and geochemical information, to analyze and develop an understanding of the system, and to develop predictive capabilities that will contribute to an effective management of the system, The Central Valley RASA study, which focused on studying the hydrology and geochemistry of ground water in the Central Valley of California, began in 1979. Phase II of the Central Valley RASA began in 1984 and is in progress. The focus during this second phase is on more detailed study of the hydrology and geochemistry of ground water in the San Joaquin Valley, which is the southern half of the Central Valley.

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CONVERSION FACTORS

The inch-pound system of units is used in this report. For readers who prefer metric (SI) units, the conversion factors for the terms used are listed below:

Multiply	By	To obtain
acre	4,047	square meter
foot (ft)	0.3048	meter

Pesticide and volatile-organic-compound data are given in micrograms per liter (µg/L). One thousand micrograms per liter is equivalent to 1 milligram per liter. Micrograms per liter is the equivalent of "parts per billion."

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level.

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ABSTRACT

During February to July 1985, water samples were collected from 55 wells in the western San Joaquin Valley, California, for chemical analysis of concentrations of 20 selected pesticides and 26 volatile organic compounds. Twenty-six of the sampled wells are completed in the shallow unconfined regional aquifer and 29 wells are completed in the deep confined regional aquifer. Water from six of the sampled wells, four of which are completed in the shallow unconfined aquifer, contained detectable levels of the pesticides or volatile organic compounds. Four samples contained a single pesticide, one sample contained two pesticides, and one sample contained 5.9 micrograms per liter of toluene, a volatile organic compound. Five of the six pesticides detected were triazine herbicides; the maximum concentration was 0.2 microgram per liter. Four samples with detectable concentrations of triazine herbicides are from wells used for domestic water supply; however, drinking-water standards have not been established for triazine herbicides.

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INTRODUCTION

Pesticide use in the San Joaquin Valley is amongst the most intense in the United States and represents a potential threat to the quality of surface and ground water of the area. To assess the degree to which ground water has been affected by pesticides and related organic compounds, data are being collected throughout the valley as part of a comprehensive study of ground water in the San Joaquin Valley by the U.S. Geological Survey. The study is being done as part of the Regional Aquifer Analysis Program and in cooperation with the San Joaquin Valley Drainage Program.

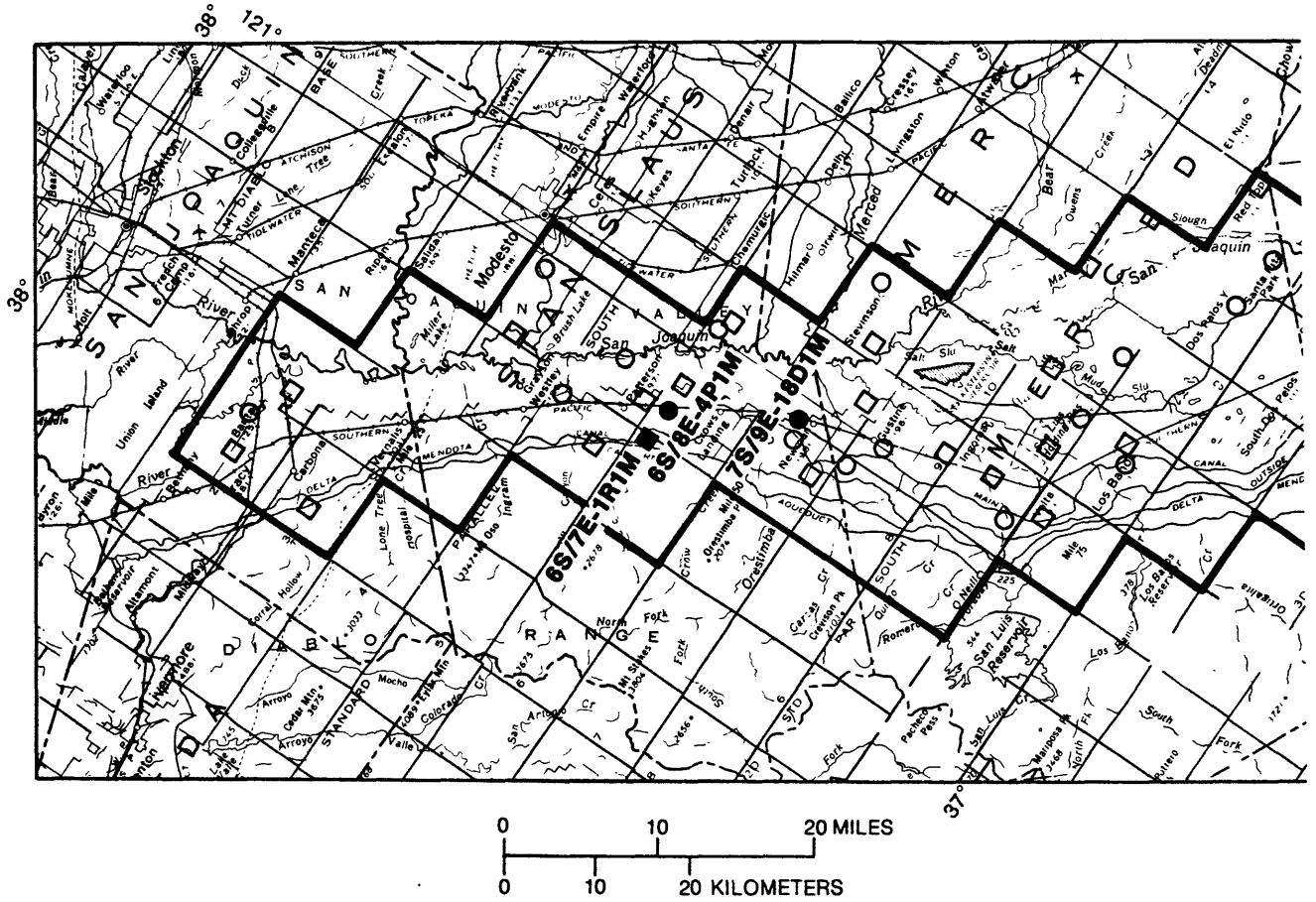
This report focuses on the western part of the San Joaquin Valley and is the second in a series of reports prepared to provide water-quality data for regional aquifers of the valley. The first report presented data on the distribution of selenium for the same area (Neil, 1986). Interpretive reports providing detailed evaluation of these data and of data collected on numerous other chemical constituents are in progress and will be published as they are completed.

DESCRIPTION OF DATA

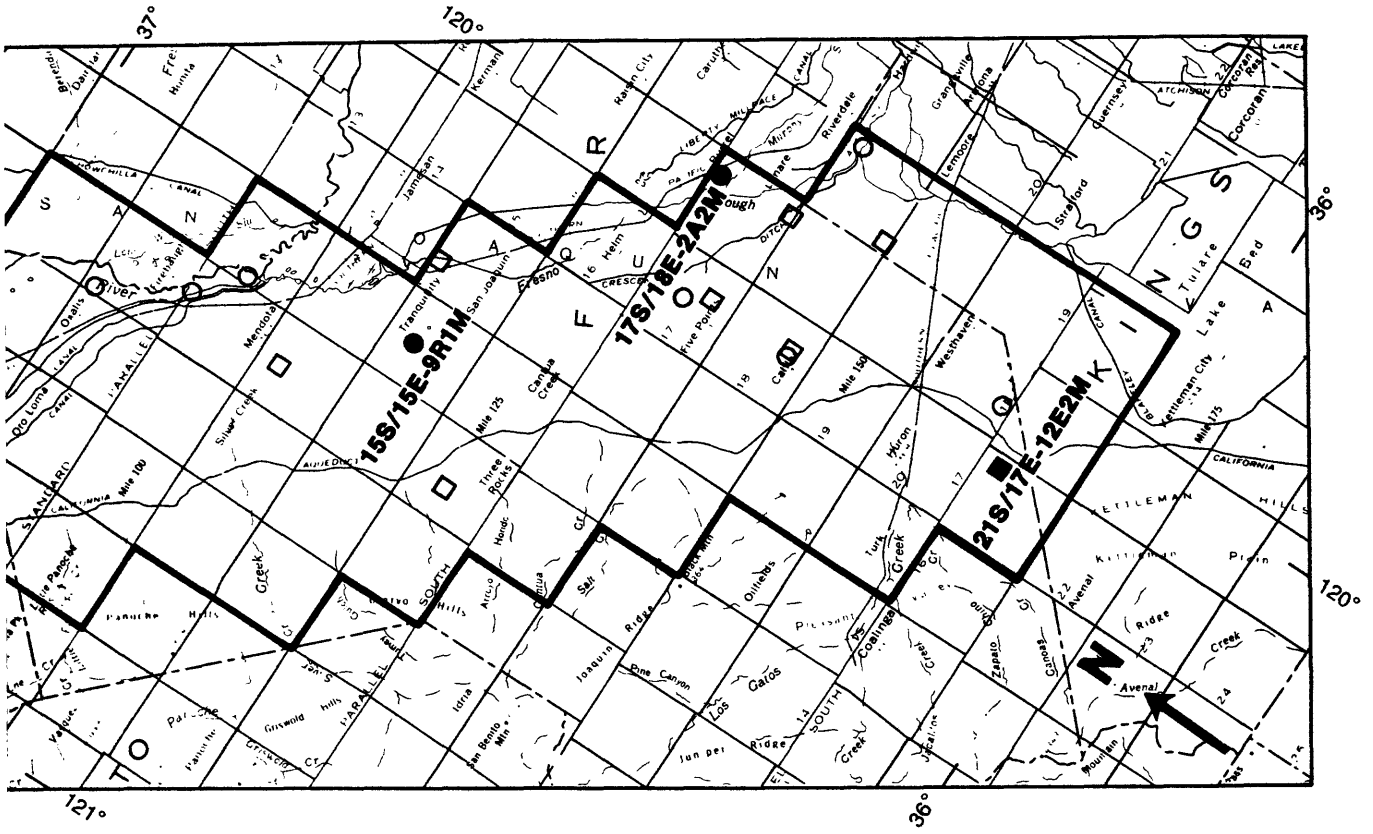
Water samples were collected during February to July 1985 for analyses of selected pesticides and volatile organic compounds from 55 existing wells completed in either the unconfined or confined aquifer. These regional aquifers underlie the entire western San Joaquin Valley and are separated by a confining layer known as the E clay that ranges in thickness from 40 to 140 feet (Hotchkiss and Balding, 1971). Sampled wells completed in the unconfined aquifer range in depth from about 50 to 500 feet; sampled wells completed in the confined aquifer range in depth from about 200 to 1,900 feet.

For the 79 townships comprising the study area, water was sampled from 26 wells completed in the unconfined aquifer in 26 townships and from 29 wells completed in the confined aquifer in 29 townships. Most of the sampled wells were in the northern part of the study area (fig. 1). A well was considered suitable for sampling if construction data identified (1) which aquifer the well was completed in, and (2) whether an operational pump was installed on the well.

Water samples were analyzed to measure concentrations of the pesticides and volatile organic compounds listed, along with their analytical detection limits, in table 1. Analyses of pesticides and volatile organic compounds are given in table 2 for wells in the unconfined aquifer and in table 3 for the confined aquifer. The areal distribution of sampled wells and the locations of wells with a detectable concentration of one or more of the compounds determined are shown in figure 1.



MAP OF CALIFORNIA



EXPLANATION

WELL – Symbol shows location of well completed in the unconfined and confined aquifers and whether any of the selected pesticides and volatile organic compounds were detected. Wells completed in the unconfined aquifer are shown as circles. Wells completed in the confined aquifer are shown as squares. Pesticide and compound data are given in tables 2 and 3

□ ○ NOT DETECTED

■ ● DETECTED – Number is well number given in tables 2 and 3

6S/7E-1R1M

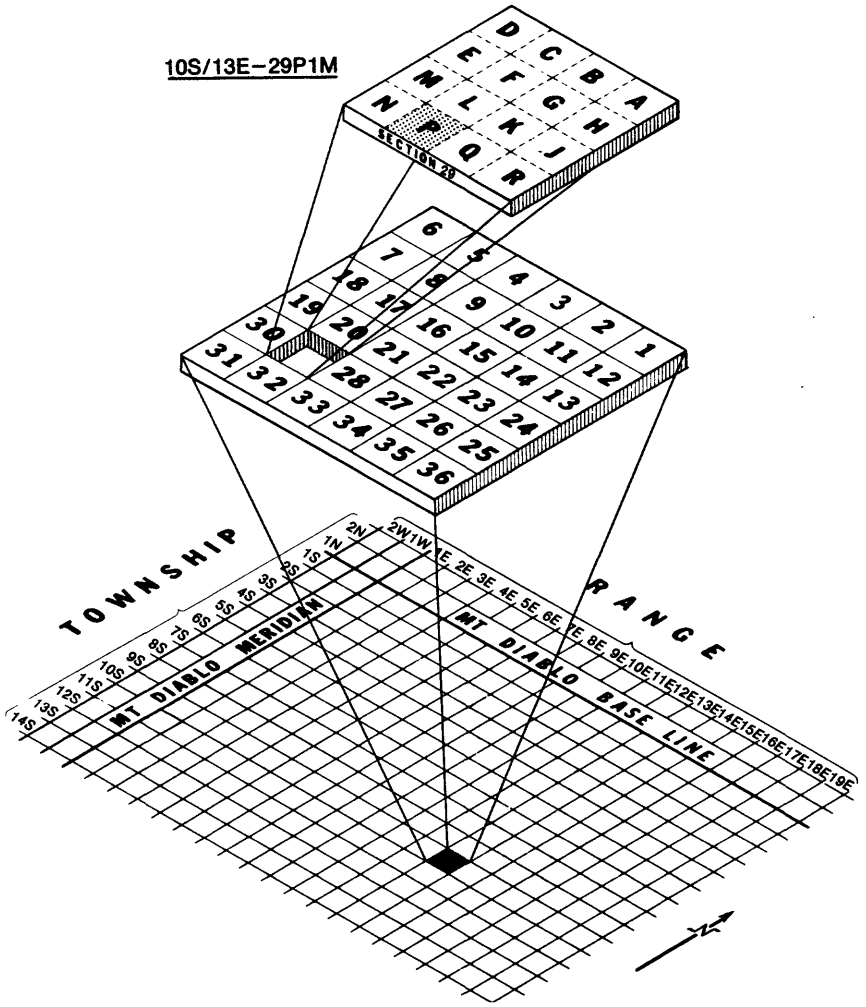
FIGURE 1. – Areal distribution of wells sampled, and locations of wells with detectable concentrations.

METHODS

Water samples from all wells were collected using the existing pump and piping system. The samples were collected after a period of pumping in which the general chemical character of the water, as measured in the field by specific conductance and pH, had stabilized. Standard field methods (U.S. Geological Survey, 1980) were used to collect samples. Laboratory methods described in Wershaw and others (1983) were used for the analyses.

WELL-NUMBERING SYSTEM

The well-numbering system used in California by the U.S. Geological Survey and the State of California indicates the location of wells according to the rectangular system for the subdivision of public lands. Their identification consists of the township number, north or south; the range number, east or west; and the section numbers. Each section is further divided into sixteen 40-acre tracts lettered consecutively (except I and O), beginning with A in the northeast corner of the section and progressing in a sinusoidal manner to R in the southwest corner. Within each 40-acre tract, wells are sequentially numbered in the order they are inventoried. The final letter in a well identification number refers to the base line and meridian. All wells in the study area are referenced to the Mount Diablo base line and meridian (M). The illustration below shows how the well number 10S/13E-29P1M is derived.



RESULTS

Water from 6 of the 55 wells sampled contained detectable levels of pesticides or volatile organic compounds. Four of these wells draw water from the shallow unconfined aquifer, and two wells draw water from the deep confined aquifer; the detections were scattered throughout the study area.

Water from one well contained two pesticides; water from the other five wells contained one pesticide or volatile compound each. Of the six pesticide detections, five were the triazine herbicides, atrazine and simazine. Their maximum concentration was 0.2 microgram per liter. Four of the five detections of pesticides were for water from wells used for domestic water supplies; however, drinking-water standards have not been established for triazine herbicides. The other pesticide detected was the organophosphorus insecticide, diazinon, at the detection limit of 0.01 microgram per liter. The only volatile organic compound detected was toluene at 5.9 micrograms per liter. The samples containing diazinon and toluene were from wells used for irrigation.

REFERENCES CITED

Hotchkiss, W.R., and Balding, G.O., 1971, Geology, hydrology, and water quality of the Tracy-Dos Palos area, San Joaquin Valley, California: U.S. Geological Survey Open-File Report 72-169, 107 p.

Neil, J.M., 1986, Dissolved-selenium data for wells in the western San Joaquin Valley, California, February to July 1985: U.S. Geological Survey Open-File Report 86-73, 10 p.

U.S. Geological Survey, 1980, Ground water, chapter 2 *of* National Handbook of Recommended Methods for Water-Data Acquisition: U.S. Geological Survey, Office of Water-Data Coordination, 149 p.

Wershaw, R.L., Fishman, M.J., Grabbe, R.R., and Lowe, L.E., eds., 1983, Methods for the determination of organic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A3, 173 p.

TABLE 1.--Pesticides and volatile organic compounds analyzed for in each sample

[Detection limits, in micrograms per liter, are given in parentheses]

Pesticides		
Triazine herbicides (0.1)	Organophosphorus insecticides (0.01)	Volatile organic compounds (3.0)
Alachlor	Diazinon	Benzene
Ametryn	Ethion	Bromoform
Atratone	Malathion	Carbon tetrachloride
Atrazine	Methyl parathion	Chlorobenzene
Cyanazine	Methyl trithion	Chloroethane
Cyprazine	Parathion	2-Chloroethyl vinyl ether
Prometon	Trithion	Chloroform
Prometryn		Chloromethane
Propazine		Dibromochloromethane
Simazine		Dichlorobromomethane
Simetone		1,1-Dichloroethane
Simetryn		1,2-Dichloroethane
Trifluralin		1,1-Dichloroethylene
		1,2-trans-Dichloroethylene
		1,2-Dichloropropane
		1,3-Dichloropropane
		Ethylbenzene
		Methyl bromide
		Methylene chloride
		1,1,2,2,-Tetrachloroethane
		Tetrachloroethylene
		Toluene
		1,1,1-Trichloroethane
		1,1,2-Trichloroethane
		Trichloroethylene
		Vinyl chloride

TABLE 2.--Well, pesticide, and volatile-organic-compound data for wells completed in the unconfined aquifer

[Station No.: Unique number for each site based on the latitude and longitude of the site. First six digits are latitude, next seven digits are longitude, and final two digits are a sequence number to uniquely identify each site. State well No.: See Well-Numbering System in text. Altitude of land surface: Altitude refers to distance above NGVD of 1929. Casing: Top and bottom of the open interval was measured from the top of the casing. Primary use of water: D, dewatering; H, domestic; I, irrigation. ND, not detected; --, not analyzed]

Station No.	State well No.	Altitude of land surface (ft)	Casing (ft)		Primary use of water	Date of sample	Triazine herbicides (µg/L)	Organo-phosphorus insecticides (µg/L)	Volatile organic compounds (µg/L)
			Top of open interval	Bottom of open interval					
374528121221801	2S/5E-13P1M	15	68	80	H	3-28-85	ND	ND	ND
						3-28-85	ND	ND	ND
373616121025001	4S/8E-12E1M	60	91	106	H	5- 1-85	ND	ND	ND
373137121092701	5S/7E-1M2M	91	90	120	H	5- 1-85	ND	ND	ND
372927121044401	5S/8E-22C1M	50	62	72	H	4-30-85	ND	ND	ND
372608121054401	6S/8E-4P1M	105	88	108	H	5-16-85	Simazine(0.2)	ND	ND
372619120593001	6S/9E-4M1M	60	71	81	D	5-15-85	ND	ND	--
371912121025001	7S/8E-13N1M	108	36	46	H	3-26-85	ND	ND	ND
371953121013701	7S/9E-18D1M	95	110	120	H	3-26-85	Atrazine(0.2)	ND	--
372004120501301	7S/10E-11Q1M	88	47	65	H	5-14-85	ND	ND	ND
371613121015201	8S/8E-1H1M	110	63	78	H	3-27-85	ND	ND	ND
371433120595601	8S/9E-17B1M	105	56	76	H	3-27-85	ND	ND	ND
370644120591601	9S/9E-33C1M	125	40	60	H	3-28-85	ND	ND	ND
370600120503501	9S/10E-35Q1M	95	120	140	H	4- 9-85	ND	ND	ND
370557120453901	9S/11E-34N2M	95	90	110	H	4-10-85	ND	ND	ND
370259120511201	10S/10E-22H4M	123	open bottom at 75 ft		H	4-30-85	ND	ND	ND
370248120380701	10S/12E-22J1M	105	120	160	H	4-29-85	ND	ND	ND
370145120341701	10S/13E-29P1M	115	115	130	H	4-30-85	ND	ND	ND
365423120291401	12S/14E-7D1M	135	45	145	H	5-13-85	ND	ND	ND
365000120253801	13S/14E-3B1M	150	open bottom at 240 ft		H	5-15-85	ND	ND	--
364747120223402	13S/15E-18Q2M	160	180	220	H	5-13-85	ND	ND	ND
363801120195901	15S/15E-9R1M	168	100	200	I	3-26-85	Atrazine(0.1)	Diazinon(0.01)	ND
362630120073901	17S/17E-16Q2M	218	270	480	I	5-16-85	ND	ND	--
362907119584901	17S/18E-2A2M	203	216	336	H	5-16-85	Simazine(0.1)	ND	ND
362019120064201	18S/17E-27F2M	283	40	60	I	3-27-85	ND	ND	ND
						5-15-85	ND	ND	ND
362317119522201	18S/19E- 2R1M	220	200	240	H	5-15-85	ND	ND	ND
360852120014601	20S/18E-33E3M	305	380	500	H	5-15-85	ND	ND	ND

TABLE 3.--Well, pesticide, and volatile-organic-compound data for wells completed in the confined aquifer

[Station No.: Unique number for each site based on the latitude and longitude of the site. First six digits are latitude, next seven digits are longitude, and final two digits are a sequence number to uniquely identify each site. State well No.: See Well-Numbering System in text. Altitude of land surface: Altitude refers to distance above NGVD of 1929. Casing: Top and bottom of the open interval was measured from the top of the casing. Primary use of water: A, general agriculture; C, commercial; H, domestic; I, irrigation; N, industrial; P, public supply; S, stock; U, unused. ND, not detected; --, not analyzed]

Station No.	State well No.	Altitude of land surface (ft)	Casing (ft)		Primary use of water	Date of sample	Triazine herbicides (µg/L)	Organo-phosphorus insecticides (µg/L)	Volatile organic compounds (µg/L)
			Top of open interval	Bottom of open interval					
374509121260001	2S/5E-21D1M	28	[1]337	1,130	P	3-27-85	ND	ND	ND
374445121200001	2S/6E-20L2M	15	592	652	U	5-21-85	ND	ND	ND
373957121260101	3S/5E-20A2M	230	340	400	H	3-28-85	ND	ND	ND
373548121075701	4S/8E-7P1M	40	280	300	H	7- 2-85	ND	ND	ND
372843121110401	5S/7E-27B1M	180	189	229	H	5-16-85	ND	ND	--
372722121063301	5S/8E-32K3M	97	255	275	H	4-30-85	ND	ND	ND
372610121083101	6S/7E-1R1M	195	[1]205	685	H	5-16-85	Simazine(0.1)	ND	--
372608121041201	6S/8E-3R2M	77	243	273	H	5-16-85	ND	ND	ND
372603120584701	6S/9E-9A2M	58	340	400	C	5-21-85	ND	ND	ND
371723121042901	7S/8E-27Q1M	155	147	247	H	5-13-85	ND	ND	--
371631120574401	7S/9E-34Q1M	72	450	658	H	3-28-85	ND	ND	ND
371833120534701	7S/10E-20L2M	70	270	360	S	5-13-85	ND	ND	ND
371125120575701	8S/9E-34Q1M	87	410	470	H	3-27-85	ND	ND	ND
370843120572301	9S/9E-14N2M	99	400	620	N	3-28-85	ND	ND	ND
370650120534101	9S/10E-32B1M	94	440	500	S	4- 9-85	ND	ND	ND
370936120484701	9S/11E-7N4M	85	320	420	H	4-10-85	ND	ND	ND
371109120411401	9S/12E-5D1M	100	[1]240	738	I	4-10-85	ND	ND	ND
370355120564901	10S/9E-14H2M	140	260	300	H	4-10-85	ND	ND	ND
370322120501901	10S/10E-23A2M	115	93	250	N	4-11-85	ND	ND	ND
						4-11-85	ND	ND	ND
370515120332401	10S/13E-1J1M	135	290	450	S	5-14-85	ND	ND	ND
365327120441301	12S/11E-14C1M	182	406	706	H	5-14-85	ND	ND	ND
364313120265701	14S/14E-9Q1M	230	[1]612	1,250	I	2-28-85	ND	ND	ND
363907120144401	15S/16E-5J1M	162	[1]663	930	H	3-25-85	ND	ND	ND
						5-14-85	ND	ND	ND
363153120272201	16S/14E-16N1M	495	904	1,900	A	3-26-85	ND	ND	--
362533120060603	17S/17E-26E3M	223	1,040	1,100	C	5-16-85	ND	ND	--
362403119583501	17S/18E-35R2M	212	310	350	H	5-16-85	ND	ND	ND
362009120064201	18S/17E-27F1M	285	[1]603	1,700	I	3-27-85	ND	ND	ND
361924119564801	18S/19E-31G1M	232	766	1,010	P	7- 2-85	ND	ND	ND
360659120053101	21S/17E-12E2M	368	568	1,290	I	7- 1-85	ND	ND	Toluene(5.9)

[1] Upper and lower depth of multiperforated well casing.