State of California

The Resources Agency

Memorandum

To : Mr. Robert F. Clawson
Mr. Wayne S. Gentry
Mr. Gordon W. Dukleth

Date : December 11, 1970

File No.:

Subject : Arsenic in Wells in Northeastern California

From : Bruce Wormald
Department of Water Resources

During field investigations made throughout Northeastern California for Bulletin No. 98, "Northeastern Counties Ground Water Investigation", February 1963, occurrence of arsenic was noted in many areas.

In 1967, the presence of arsenic in the municipal water supply of Dorris was brought to the attention of the Department. The arsenic exceeded mandatory limits of 0.05 ppm established by the U. S. Public Health Service for drinking water. Also, in 1967, the Northern District's Ground Water Monitoring Program detected increasing amounts of arsenic in various wells in Honey Lake Valley. Based on this history, and because of arsenic's toxic nature, it was decided to investigate the extent and prevalence of arsenic in well water in Northeastern California. This memorandum report gives the results of that investigation.

Figure 1 shows the general area of the investigation and Figure 2 shows the extent and number of arsenic occurrences in springs and wells.

In this report the geography and geology of the area are discussed briefly. Results of the survey and the probable causes for the widespread arsenic occurrences are presented. The report concludes with recommendations for action which will mitigate the health hazards of the problem. Additional studies are recommended to identify methods to minimize or restrict the degradation of ground waters in two problem areas.

A tabulation of analyses is included at the back of this report.

Scope of Investigation

The investigation was limited to an office study. The primary source of water quality data was the District's records from the ground water monitoring ogram and water quality investigations.

Ground water quality analyses were inspected to determine the extent arsenic in wells in Northeastern California. The data and findings from two

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local investigations (Dorris-Butte Valley and Honey Lake) were reviewed, as were relevant USGS water supply papers. The geology and ground water hydrology of the area were obtained from available literature. Where indications of arsenic were found in ground waters, a more detailed examination of the geologic and hydrologic conditions was made to determine if the sources or reason for the occurrence or concentration of arsenic could be established.

Previous Reports and Investigation

In addition to the basic data records from the Department's ground water monitoring program, an office report, "Dorris-Butte Valley Water Quality Investigation", and a memorandum report, "Honey Lake Water Quality Investigation", supplied considerable background material. Information available in Bulletin No. 98, "Northeastern Counties Ground Water Investigation", February 1963; USGS Water Supply Paper 1491, "Geology and Ground Water Features of the Butte Valley Region, Siskiyou County, California" 1960; USGS Water Supply Paper 338, "Springs of California" 1915; and Bulletin No. 58, "Northeastern Counties Investigation", June 1960, also supplied valuable geologic and hydrologic information as well as supplementary water quality data.

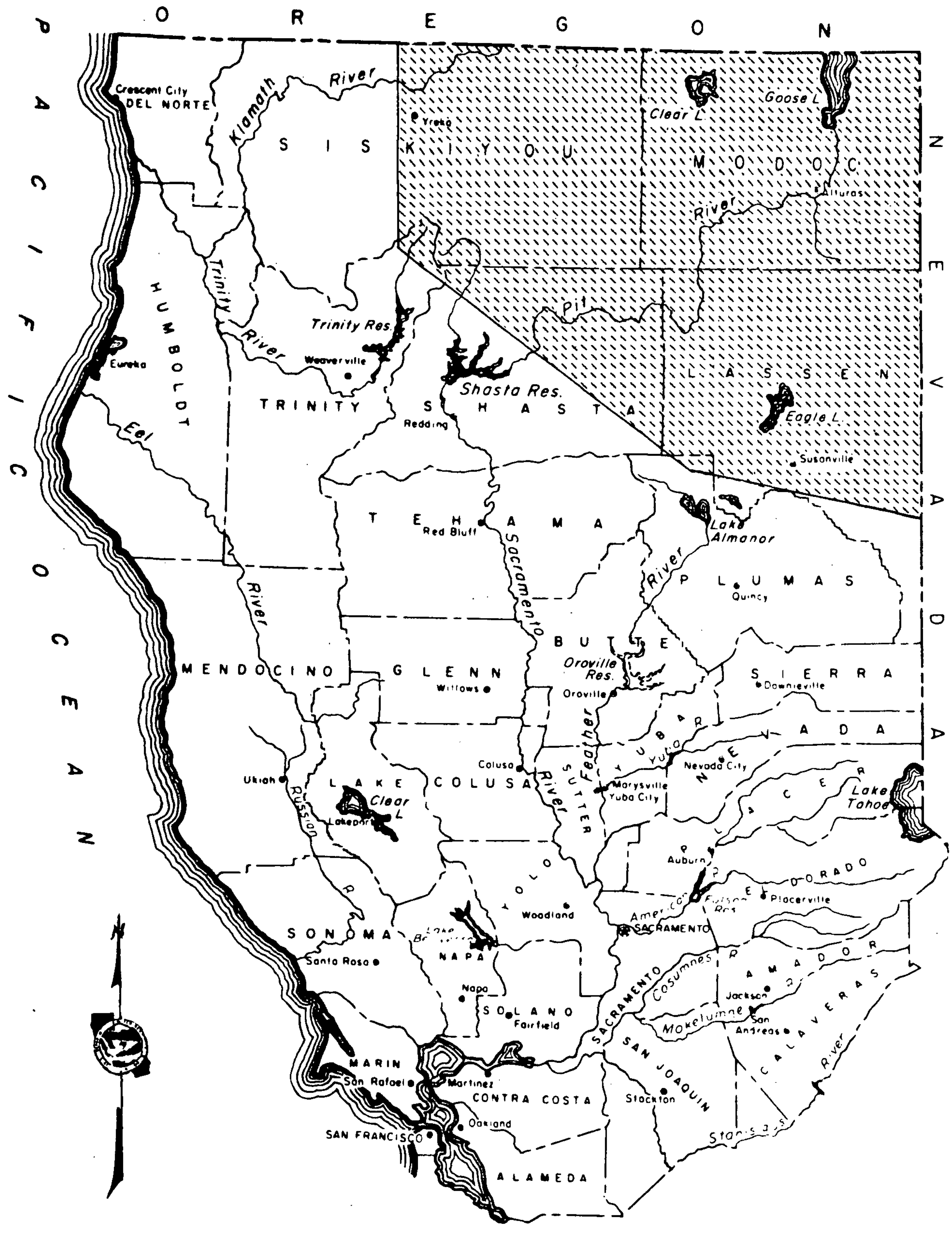
Area of Investigation

The ground water monitoring program records indicate widespread occurrences of arsenic in the ground waters of the Cascade Range, Modoc Plateau, and Basin-Range Geomorphic Provinces. The investigation extended throughout the northeast corner of the state as shown on Figure 1.

Ground waters containing arsenic were detected in Shasta Valley in the Cascade Range. They were also observed in several valleys on the Modoc Plateau extending from Butte Valley on the north to Honey Lake Valley on the south. Figure 2 shows the locations where wells with arsenic were observed.

Topography

Northeastern California is a high, rugged plateau area with numerous valleys and basins separated by mountainous areas. The Cascade Range extends along the western edge. This range is a series of extinct or quiescent volcanic peaks dominated by 10,000-foot Lassen Peak on the south and 14,000-foot Mt. Shasta on the north. High, rugged volcanic plateaus contrasted with flat alluvial valleys characterize most of the Modoc Plateau. On the eastern edge, steep escarpments forming the Warner Range and Diamond Mountains mark the western extension of the Basin-Range Geomorphic Province in California.



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

NORTHEASTERN COUNTIES ARSENIC INVESTIGATION
LOCATION MAP

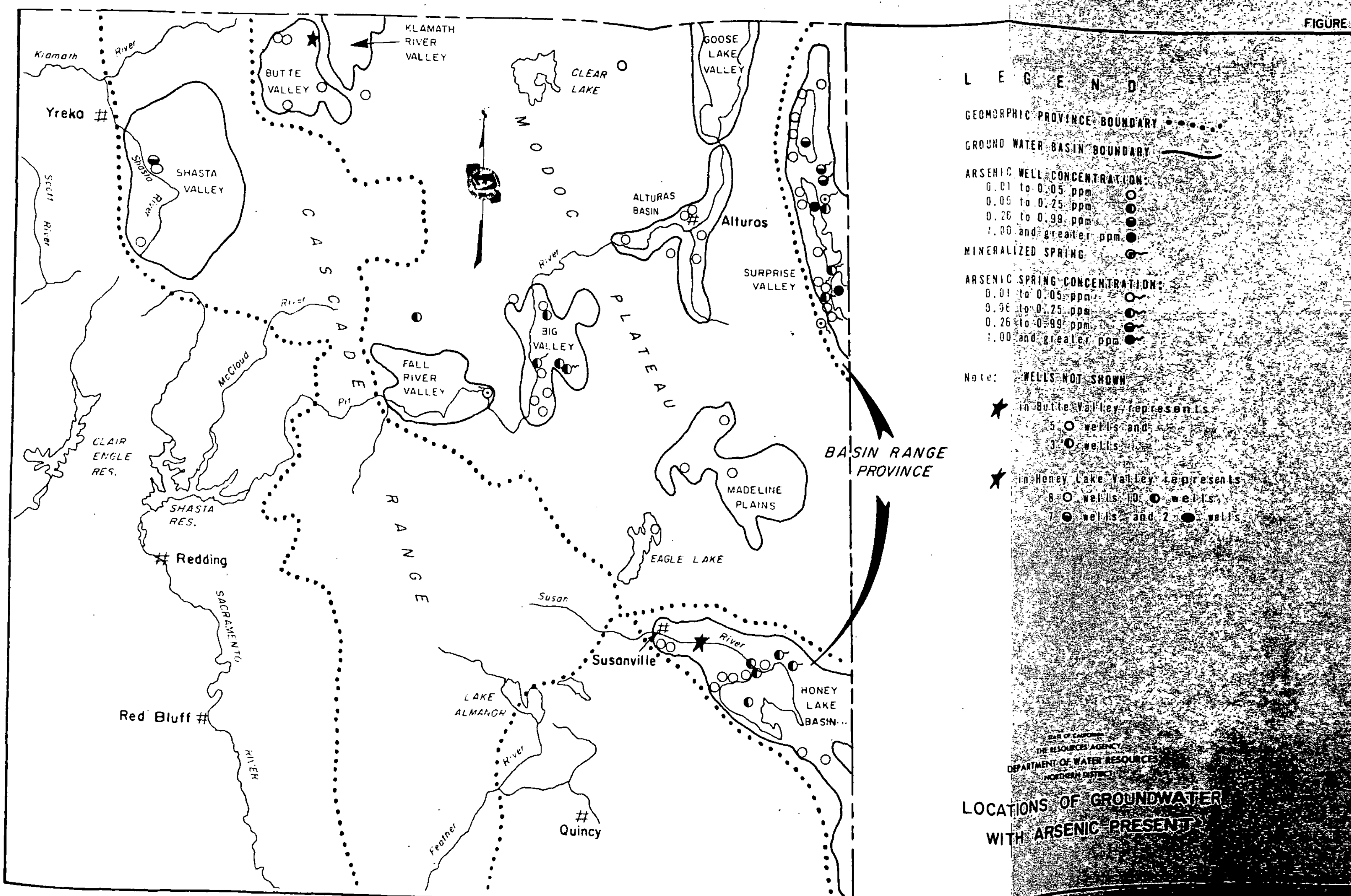


FIGURE 2

LOCATIONS OF GROUNDWATER WITH ARSENIC PRESENT

Climate

Rainfall and climate vary considerably throughout the area because of differences in elevation and variations in topography which modify regional weather patterns. Rainfall ranges from 10 to 14 inches on the valley floors to 10 to 70 inches in the mountainous areas. The rainfall is seasonal, with the major portion occurring from November through April when the large storms developing south of Alaska move in from the Pacific. Surface water is generally scarce during the summer and fall and has a limiting effect on the amount of development. This is evident by the number of streams that have been adjudicated. There is a heavy reliance on ground water for agricultural and domestic uses.

Economic Development

Agriculture and stock raising are two of the principal occupations. The beef industry has been an important segment of the economy because relatively large tracts of land have been available for the grazing of livestock. Natural pasture, range land, and timbered areas are used for grazing. Much of the irrigated agriculture within the valleys is devoted to cattle feed. In recent years there has been an increase in the acreage devoted to cash crops. Increasing acreage has been planted in potatoes, onions, and other truck and special crops.

Extensive areas of privately owned forest lands maintain a timber industry throughout the region. Many mills are found in the counties throughout the region.

Mining activity in the region today is concerned with the production of nonmetallics. Sand, gravel, and crushed rock make up a substantial portion of the total production of minerals in the area. Specialized aggregates, such as pumice, found in the volcanics are also important.

Recreation and tourism play important roles in the area. Campers, hunters, fishermen, and rock hounds find that the arid deserts, rugged mountains, and forest lands of the region contain some of the last remaining primitive areas in the state. Deer thrive on the barren plateaus, ducks abound in the marshes and lakes occupying the valley floors, and a wide array of mineralogical curiosities found in the vast assemblage of volcanic extrusions covering the area, beckon the rock collector. Sweeping vistas and magnificent panoramas summon the tourist and camper from the city.

In the last few years there has been considerable impetus toward the development of recreational subdivisions. Large acreages have been subdivided into one-, two-, and five-acre "ranchos". Many of these rely exclusively on ground water for domestic supplies.

Water Resources

The valley floor areas within the area of this investigation are located in either the North Coastal, Central Valley, or Lahontan Drainage Basins.

Goose Lake Valley, Alturas Basin, Big Valley, and Fall River Valley drain to the Pit River, a tributary of the Sacramento River. There is a low divide separating Goose Lake from the headwaters of the Pit River. Except at stages exceeding 4,716 feet elevation, Goose Lake acts as a closed basin.

Butte Valley and the Klamath River Valley discharge into the Klamath River. Butte Valley is topographically a closed basin; however, there is evidence of ground water discharge to the northwest into Klamath River Valley. A recently constructed pumping project can also divert water from Meiss Lake over a low divide to the north into the Klamath River.

Surprise Valley, Madeline Plains, and Honey Lake Valley are part of the interior drainage system of the Lahontan Basin. They have no surface outlet. Investigations by the University of Nevada indicate that ground water may be discharged from Honey Lake Basin to the east into the Smoke Creek Desert.

Bulletin No. 58 evaluated the available water supply and requirements for the area covered by this investigation. In that report it was concluded surface supplies were inadequate to meet ultimate requirements. Further evidence of this is the adjudication of most of the streams in the area.

Bulletin No. 98 reports on a detailed investigation of all the basins covered in this report except Shasta Valley, Butte Valley, and the Klamath Basin. The basins were evaluated in relation to their potential for ground water development.

Geology

The area extends over three of California's geomorphic provinces: the Cascade Range; the Modoc Plateau; and the Basin-Range. Two of the provinces are predominately volcanic in nature. Both the Cascade Range and the Modoc Plateau are characterized by thick and widespread volcanic flow and clastic deposits.

Cinder cones and lava flows give evidence of the volcanic activity which occurred within the historic past. Hot mineralized springs are scattered throughout the area.

The Basin-Range Province is characterized by a series of faulted mountain blocks with closed alluvial basins developing between successive blocks. The province is tectonically active and hot springs are frequently located along fault zones.

A number of the thermal springs containing arsenic and their locations are listed in the table below:

TABLE I

Spring	Basin	County
Amadee	Honey Lake	Lassen
Wendel	Honey Lake	Lassen
Basset	Big Valley	Lassen
Stonebreaker	Big Valley	Lassen
Kelley	Alturas	Modoc
East Border	Surprise Valley	Modoc
East Side Middle Lake	Surprise Valley	Modoc
SE Side Lower Lake	Surprise Valley	Modoc
SW Side Upper Lake	Surprise Valley	Modoc
West Side Lower Lake	Surprise Valley	Modoc
Bidwell Creek	Surprise Valley	Modoc
Mount Shasta	-	Siskiyou
Klamath Hot Springs	-	Siskiyou

The table above shows that geothermal activity is present throughout the area. The investigation in Butte Valley also illustrated that thermal waters are discharging into ground water reservoirs at depths without any visible surface evidence. Both temperature and chemical data indicated that a number of wells located in Butte Valley derived part of their water from geothermal sources.

In the elevated volcanic areas, the porous nature of the rock and the intense fissure and fracture patterns disrupt the movement of ground water, and the prediction of its behavior is difficult. The source of water for a well may not be readily apparent.

Thick accumulations of alluvial material have filled the valleys over the geologic past to form the present day basins. Clays, silts, sands, and gravels interfinger as the depositional regimen changed during the development of the basins. Generally coarser fractions are found along the periphery where fluvial sediment has been deposited, while fine-grained lacustrine deposits are more prevalent in the center. These sediments are the important aquifers in the region, and it is in these basins where the combinations of soil conditions and quantity of water make irrigated agriculture feasible with well water.

Water Quality

The office report covering Butte Valley demonstrated that some of the arsenic encountered in well water was the result of water contributed to the ground water reservoir from thermal springs. Although there was no consistent variation in character related to arsenic concentrations, there was a 5°F. higher water temperature in those wells penetrating volcanics where arsenic was prevalent.

The Butte Valley report also pointed out one zone where ground water with high concentrations of arsenic occurred at a particular level, indicating the possibility of a former playa where minerals had accumulated in the geologic past, and were now being redissolved by ground water. The mineral character of water was similar to ground water in the volcanics; however, the concentrations of minerals were higher.

There was evidence that recirculation could be the cause of some of the high concentrations of arsenic noted in Honey Lake Basin. In the vicinity of Standish, there were a number of wells with high concentrations of arsenic (0.25 to 2.6 ppm). There was an increase in the percentage of sulfate, although there was no definite correlation between the sulfate radical and the amount of arsenic. Generally, ground water throughout the region tended to be sodium bicarbonate in character.

Both Wendel and Amadee Hot Springs were sodium sulfate in character, with a high percentage of chloride. However, the results of the Butte Valley and Honey Lake studies indicated that there was no specific correlation between arsenic and any other particular mineral constituent or the total dissolved minerals. Some ground waters with 0.05 ppm arsenic or more had less than 450 ppm TDS and were good quality in all other respects.

The Hot Springs in Surprise Valley were sodium sulfate in character, with a high percentage of chloride. Several of the wells containing arsenic, while bicarbonate in character, had a higher percentage of sulfate over background levels for other wells in the area. This indicates that the thermal springs in Surprise Valley may be contributing arsenic to wells in the area.

Butte Valley, Surprise Valley, and Honey Lake Valley are closed basins with no surface outlet. Surface water is lost to the basins by evaporation. This situation also applies to ground water and therefore any minerals contributed to the ground water by hot springs or dissolved from the rocks or soils remain in the basins. It is possible that recirculation and concentration is responsible for some of the higher arsenic values encountered.

Analyses of water wells in the area are tabulated at the end of this report.

Findings and Conclusions

1. A survey of ground water analyses in Northeastern California indicated that the presence of arsenic in ground water is fairly widespread throughout this part of the State.

2. The high number of wells with significant arsenic levels in Butte and Honey Lake Valleys do not necessarily indicate that they are the only problem areas; it is just that arsenic investigations have been conducted more intensively in these valleys than elsewhere in the area.

3. In Honey Lake Valley, arsenic levels high (over 2 ppm) enough to be of public health concern were recorded.

4. Ground waters containing measurable arsenic concentrations are found distributed over much of the area rather than just in the major ground water basins. The fact that only three wells are located outside of basins is merely reflective of the lack of sampling in this region.

5. In both Butte and Honey Lake Valleys there is a definite relationship between wells containing arsenic and water from geothermal water sources containing arsenic.

6. In Surprise and Big Valleys there are hot springs containing arsenic, indicating a possible geothermal source for arsenic in well water.

7. In Shasta Valley and the Alturas Basin there are known mineralized springs, although there is no record of any arsenic in the spring water.

8. Most of the basins in the area have closed or restricted drainage patterns and recirculation and concentration has probably played some role in the amount of arsenic occurring in well water. This is further supported by the amount of arsenic in Honey Lake and the three Alkali Lakes of Surprise Valley.

9. The widespread evidence of volcanic, geothermal, and tectonic activity is further indication of a geothermal source for the arsenic.

10. In some of the basins, arsenic compounds have been used as insecticides and for other agricultural purposes. This source of arsenic may have augmented the levels encountered in some of the wells.

Recommendations

It is recommended that:

1. The Department conduct additional studies in Big Valley and Surprise Valley to delineate the areal extent and magnitude of arsenic problems. Where possible, sources should be indentified and remedial actions recommended to protect or minimize the effect on ground water supplies in these areas. Such studies could be undertaken as part of water resources planning studies or independently as water quality investigations.

2. Health Departments require arsenic analyses when certifying public water supplies.

3. The California Regional Water Quality Control Boards consider these arsenic problems in the establishment of water quality control policies and waste discharge requirements within this area.

4. Local Health Department's should encourage all ground water users in Honey Lake, Big, Surprise, and Butte Valleys to have arsenic analyses made of their water supplies.

MINERAL ANALYSES OF GROUND WATER

ARSENIC IN WELLS IN NORTHERN CALIFORNIA

Owner and use	State well number and other number	Date sampled	Temp in °F	Specific conductance (micromhos at 25° C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[a]	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Analyzed by[b] Remarks
						Mineral constituents in parts per million / equivalents per million																	
									MADELINE PLAINS														
C.C.C. Well	35N/13E-26J1	8-11-60	-	692	8.6	30	40	67	8.5	14	352	16	21	39	0.3	0.10	45	Fe(Dis) 0.00 Fe(Tot) 0.00 Al 0.03, As 0.01 Cr 0.00, Cu 0.00 Pb 0.00, Mn 0.00 Zn 0.06	454 (Sum)	37	239	0	DWR
		8- 9-61	-	697	8.3	30	37	66	8.8	0	373	18	18	37	0.3	0.14	44	As 0.01	442 (Sum)	38	227	0	DWR
State of California Dept. of Fish & Game	37N/13E-20Q1	8-11-60	-	2630	8.1	85	127	262	20	0	278	581	344	19	0.2	0.13	56	Fe(Dis) 0.00 Fe(Tot) 0.08 Al 0.02, As 0.01 Cr 0.00, Cu 0.00 Pb 0.00, Mn 0.00 Zn 0.41	1630 (Sum)	-	734	506	DWR
		8- 9-61	-	1880	8.2	95	83	188	15	0	388	362	222	12	0.3	0.15	57	As 0.01	1220 (Sum)	40	580	260	DWR
									ALTURAS BASIN														
J. Harry Michael	42N/10E-29H1	8- 5-58	84	269	8.2	0	0	63	1.4	0	146	14	1.9	0.8	0.2	0.07	41	Fe(Dis) 0.00 Fe(Tot) 0.03 Al 0.00, Mn 0.00 Cr 0.00, Cu 0.00 Pb 0.00, Zn 0.00 As 0.01	194 (Sum)	98	0	0	DWR
		7-29-60	-	260	8.1	33	0.0	58	1.3	0	143	15	1.9	0.4	0.2	0.10	38	Fe(Dis) 0.00 Fe(Tot) 0.17 Al 0.00, Mn 0.00 As 0.01, Zn 0.02 Cr 0.00, Cu 0.02 Pb 0.00	188 (Sum)	93	8	0	DWR
		8-24-61	-	260	8.2	35	0.1	59	1.4	0	141	15	2.8	0.2	0.2	0.09	37	As 0.01	188 (Sum)	92	9	0	DWR
		9-11-63	-	275	7.7	3.0	0.0	56	1.6	0	138	14	2.0	0.6	-	0.3	-	Fe(Tot) 0.01 Al 0.08, As 0.02 Cu 0.00, Pb 0.00 Mn 0.00, Zn 0.00	195 (Sum)	93	7.4	0	DWR
City of Alturas	42N/12E-11Q1	7-29-60	-	458	8.3	26	4.9	60	12	0	170	34	34	2.9	0.3	0.68	79	As 0.01	338 (Sum)	56	85	0	DWR
[illegible]	[illegible]	8-23-61	74	475	8.1	24	3.9	64	12	0	169	36	38	2.8	0.3	0.76	80	As 0.01	345 (Sum)	60	76	0	DWR

a. Determined by addition of constituents unless otherwise noted

b. Analysis by indicated laboratory:
U.S. Geological Survey, Quality of Water Branch (U.S.G.S.)
State Department of Water Resources (D.W.R.)

MINERAL ANALYSES OF GROUND WATER

ARSENIC IN WELLS IN NORTHERN CALIFORNIA

Owner and use	State well number and other number	Date sampled	Temp in °F	Specific conductance (micromhos at 25° C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total[a] dissolved solids in ppm	Percent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Analyzed by[b] Remarks
								ALTURAS BASIN (Continued)															
City of Alturas	42N/12E-11Q1	9-10-63	-	485	8.0	26	5.4	59	14	0	174	32	34	2.2	-	0.7	-	Fe(Tot) 0.00 Al 0.05, As 0.02 Cu 0.00, Pb 0.02 Mn 0.00, Zn 0.01	361 (Sum)	55	87	0	DWR
								SISKIYOU COUNTY															
Fall River Valley	39N/5E-9M1	6-25-58	165	1350	8.0	46 2.30	1.7 0.14	222 9.66	7.0 0.18	26 0.0	53 0.87	353 7.35	125 3.52	0.3 0.0	1.8 0.09	4.2	86	Al 0.09, Cu 0.02 As 0.14	873	685	122	79	USGS
Shasta Springs	39N/R4W-13A	1915	52	-	-	Tr.	349	447	23	1195	-	8.6	312	-	Tr.	9.9 (BO_2)	-	Li. tr., Fe 10, Al 2.5, Mn tr. Br. tr., I tr. As O_4 1.4, PO_4 0.8, CO_2 present	-	-	-	-	USGS
								SHASTA COUNTY															
Castle Crag Spring 5 Mi. So. Dunsmuir	39N/R4W	1915	53.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	As O_4 0.9	-	-	-	-	USGS
								SURPRISE VALLEY															
Lower Alkali Lake	39N/17E-8J	12-2-58	-	19200	9.5	10 0.50	0.2 0.02	5220 227.07	18 0.46	1110 37.00	1560 25.57	1230 25.61	4840 136.49	2.7 0.04	27 1.42	57	68	Fe 0.01, Al 0.8 As 1.1(c)	13400	99.4	26	0	DWR *
	39N/17E-9B	12-2-58	-	18100	9.5	8.4 0.42	0.2 0.02	4770 207.50	17 0.43	1090 36.33	1320 21.63	1070 22.28	4540 128.03	6.3 0.10	25 1.32	52	38	Fe 0.02, Al 0.8 As 0.7(c)	12300	99.4	22	0	DWR *
	39N/17E-19H	5-5-54	83	5800	9.1	6.9 0.34	0.9 0.07	1370 59.57	11 0.28	192 6.40	805 13.19	307 6.39	1160 32.72	0.4 0.01	10 0.53	19	63	Fe 1.3, As 0.09 Al 0.01(c)	3540	99	20	0	USGS*
	39N/17E-20H	9-17-53	70	473	8.4	37 1.85	18 1.48	37 1.61	4.4 0.11	10 0.33	234 3.83	21 0.44	14 0.39	0.6 0.01	0.5 0.03	0.19	47	Fe 0.25, Al 0.02 As 0.08	305	32	166	0	USGS*
Middle Alkali Lake	42N/16E-2L	12-2-58	36	24500	9.4	22 1.10	0.0 0.00	6850 297.98	12 0.31	1240 41.33	1790 29.34	1560 32.48	6810 192.04	2.5 0.04	14 0.74	94	18	Al 1.0, As 1.8	17500	99.[illegible]	55	0	DWR *
	42N/16E-2N	7-17-56	-	5510	8.9	3.2 0.08	6.3 0.52	1250 54.50	7.4 0.19	91 3.02	733 12.02	302 6.29	1180 33.40	45 0.73	5.9 0.31	20	41	Cu 0.5, Mg 0.04 As 0.4	3310	99	30	0	DWR *
		9-17-53	55	10100	9.2	17 0.85	6.2 0.51	2330 101.32	9.0 0.23	325 10.83	1010 16.55	510 10.62	2380 67.12	0.9 0.01	9.0 0.47	31	37	Fe 1.8, As 0.21	6150	98	68	0	USGS*
	42N/16E-3R	5-5-54	75	12900	9.1	17 0.85	8.9 0.73	3180 138.28	7.5 0.19	363 12.10	1300 21.31	576 11.99	3330 93.92	3.5 0.06	6.0 0.32	38	28	Fe 0.08, Zn 0.02 As 0.39	8160	99	79	0	USGS*
Upper Alkali Lake	44N/16E-33G	9-17-53	76	13400	9.3	5.1 0.25	0.3 0.02	3230 140.45	27 0.69	538 17.93	1210 19.89	467 9.72	3380 95.33	1.8 0.03	9.0 0.47	49	118	Fe 2.1, Zn 0.03 Al 0.08, As 0.27	8430	99	14	0	USGS*
	44N/16E-22E	12-2-58	-	15200	9.3	10 0.50	0.2 0.02	3940 171.39	22 0.56	629 20.96	1360 22.29	561 11.68	4020 113.36	2.1 0.03	7.7 0.40	48	162	Fe 0.02, Al 0.4 As 0.7	10100	99.[illegible]	26	0	DWR *
	44N/16E-23E	12-2-58	-	14900	9.3	10 0.50	0.2 0.02	3810 165.74	21 0.54	610 20.33	1350 22.13	555 11.56	3950 111.39	1.3 0.02	8.0 0.42	46	224	Fe 0.02, Al 0.4 As 0.7	9900	99.[illegible]	26	0	DWR *

a. Determined by addition of constituents unless otherwise noted

b. Analysis by indicated laboratory:
U.S. Geological Survey, Quality of Water Branch (U.S.G.S.)
State Department of Water Resources (D.W.R.)

*. - Surface Water

MINERAL ANALYSES OF GROUND WATER
ARSENIC IN WELLS IN NORTHERN CALIFORNIA

Owner and use	State well number and other number	Date sampled	Temp in °F	Specific conductance (micromhos at 25° C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[a]	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Analyzed by[b] Remarks
								SURPRISE VALLEY (Continued)															
Upper Alkali Lake	44N/16E-23G	-	-	14700	9.3	9.2 / 0.46	0.0 / 0.00	3750 / 163.12	20 / 0.51	608 / 20.26	1300 / 21.31	535 / 11.14	3880 / 109.42	1.0 / 0.02	7.8 / 0.41	50	76	Fe 0.02, Al 0.4, As 0.7	9580	99.4	23	0	DWR *
	44N/16E-31P	5- 5-54	79	9050	9.1	15 / 0.75	0.9 / 0.07	2120 / 92.19	13 / 0.33	275 / 9.17	970 / 15.90	333 / 6.93	2150 / 60.64	0.0 / 0.00	7.9 / 0.37	24	67	Fe 0.13, As 0.18	5480	99	41	0	USGS*
Menlo Resort Domestic (Abandon)	39N/17E-7A1	6-13-58	122	445	8.6	5.5 / 0.27	0.4 / 0.03	88 / 3.83	2.2 / 0.06	7 / 0.23	64 / 1.05	98 / 2.04	26 / 0.73	0.2 / 0.00	2.5 / 0.13	0.7	44	Fe 0.02, Al 0.13, As 0.04	306	91	15	0	DWR
Menlo Resort Irrigation	39N/17E-6R1	-	126	484	8.6	5.7 / 0.28	0.2 / 0.02	95 / 4.13	2.4 / 0.06	5 / 0.17	58 / 0.95	116 / 2.42	28 / 0.79	0.3 / 0.00	3.5 / 0.18	0.9	52	Fe 0.05, Al 0.02, As 0.04, Zn 0.01	337	92	15	0	DWR
	39N/17E-7A2	-	136	482	8.2	5.4 / 0.27	0.1 / 0.01	97 / 4.22	2.0 / 0.05	0 / 0.00	62 / 1.02	114 / 2.37	30 / 0.85	0.3 / 0.00	4.0 / 0.21	1.0	57	Fe 0.11, Al 0.21, As 0.06	342	93	14	0	DWR
William A. Cottrell Irrigation	39N/17E-29G1	6-13-58	106	286	8.5	2.6 / 0.13	0.2 / 0.02	59 / 2.57	1.7 / 0.04	6 / 0.20	73 / 1.20	39 / 0.81	16 / 0.45	0.8 / 0.01	2.0 / 0.11	0.4	42	Fe 0.02, Al 0.12, As 0.02	206	93	7	0	DWR
E. E. Rose Domestic	42N/17E-6L1	5- 7-59	184	1410	8.5	17 / 0.85	0.1 / 0.01	267 / 11.61	5.8 / 0.15	8 / 0.27	39 / 0.64	300 / 6.25	188 / 5.30	0.9 / 0.01	5.9 / 0.31	5.3	82	Fe 0.02, Al 0.35, As 0.22	900	92	43	0	Hot Spring DWR
Unknown Irrigation	43N/16E-12D1	5- 5-59	184	1670	8.0	30 / 1.50	1.2 / 0.10	305 / 13.27	10 / 0.26	0 / 0.00	67 / 1.10	373 / 7.76	220 / 6.20	1.6 / 0.02	4.0 / 0.21	8.0	118	Fe 0.02, Al 0.20, Mn 0.05, As 0.39	1100	88	88	25	Hot Spring DWR
Old Leonard Baths (Abandon)	43N/16E-13B1	5- 5-59	104	1840	8.1	17 / 0.85	2.6 / 0.21	370 / 16.10	5.7 / 0.14	0 / 0.00	172 / 2.82	386 / 8.04	225 / 6.34	1.4 / 0.02	4.0 / 0.21	7.3	59	Fe 0.04, Al 0.20, Mn 0.10, Zn 0.12, As 0.36	1160	93	53	0	Hot Spring DWR
G. W. Warren Stock	43N/16E-16L1	9-10-58	68	134	8.1	2.4 / 0.12	1.7 / 0.14	27 / 1.17	1.1 / 0.03	0 / 0.00	68 / 1.11	12 / 0.25	3.0 / 0.08	0.0 / 0.00	0.1 / 0.00	0.3	39	Fe 0.02, Al 0.14, As 0.02	120	80	13	0	Depth 60' Artesian DWR
Robertson Ranch Irrigation	44N/15E-24B1	5- 7-59	190	1520	8.4	30 / 1.50	2.4 / 0.20	290 / 12.62	14 / 0.36	7 / 0.23	235 / 3.85	253 / 5.27	176 / 4.96	0.8 / 0.01	5.9 / 0.31	4.8	103	Al 0.15, Mn 0.55, Pb 0.01, Cu 0.02, As 0.25	1000	86	85	0	Hot Spring DWR
Mike Quirk & Fort Bidwell Irrigation	44N/16E-6E2	9-10-58	77	640	8.0	3.2 / 0.16	0.5 / 0.04	138 / 6.00	4.0 / 0.10	0 / 0.00	278 / 4.56	1.9 / 0.04	70 / 1.97	0.1 / 0.00	0.7 / 0.04	5.2	68	Fe 0.03, Al 0.20, As 0.02	431	94	10	0	Depth 45' Flowing DWR
Max Fulcher	46N/16E-31R1	6-14-58	82	240	8.3	4.0 / 0.20	0.3 / 0.02	62 / 2.70	7.5 / 0.19	3.3 / 0.11	114 / 1.87	32 / 0.62	18 / 0.51	1.0 / 0.02	0.9 / 0.05	0.56	72	Al 0.07, As 0.02	256	87	11	0	Depth 41' Artesian DWR
									HONEY LAKE VALLEY														
State of California Dept. of Fish & Game	28N/14E-2G1	2-15-67	53	2460	8.2	-	-	-	-	-	-	-	401	-	-	-	-	As 0.03	-	-	-	-	DWR
	28N/14E-2Q1	9- 8-59	58	2160	7.7	101 / 5.04	45 / 3.68	257 / 11.18	14 / 0.36	0 / 0.00	282 / 4.62	13 / 0.27	550 / 15.51	0.9 / 0.01	0.1 / 0.01	0.20	51	Fe 0.23, Al 0.24, Mn 0.36, Cu 0.08, Zn 0.04, As 0.12	1170	55	436	205	DWR

a. Determined by addition of constituents unless otherwise noted

* - Surface Water

b. Analysis by indicated laboratory:

U.S. Geological Survey, Quality of Water Branch (U. S. G. S.)

State Department of Water Resources (D. W. R.)

MINERAL ANALYSES OF GROUND WATER

ARSENIC IN WELLS IN NORTHERN CALIFORNIA

Owner and use	State well number and other number	Date sampled	Temp in °F	Specific conductance (micromhos at 25° C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[a]	Percent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Analyzed by[b] Remarks
								HONEY LAKE VALLEY (Continued)															
Tanner Ranch Domestic	28N/15E-6K1	9-8-59	54	774	8.2	25 / 1.25	13 / 1.05	143 / 6.22	3.0 / 0.08	0 / 0.00	428 / 7.01	66 / 1.37	20 / 0.56	0.0 / 0.00	0.2 / 0.01	0.60	38	Al 0.23, Cu 0.02 Zn 0.23, As 0.02	520	72	115	0	DWR
Fruit Growers Supply Industrial	29N/12E-4G1	9-9-59	74	679	8.2	13 / 0.65	2.8 / 0.23	117 / 5.09	3.6 / 0.09	0 / 0.00	92 / 1.51	140 / 2.91	56 / 1.58	0.9 / 0.01	1.5 / 0.08	1.4	37	Al 0.10, As 0.01	418	84	44	0	DWR
		8-10-65	77	749	8.3	14	1.0	128	2.8	0	85	156	61	1.7	-	1.5	-	Al 0.02, As 0.02 Cu 0.00, Pb 0.00 Mn 0.01, Zn 0.00	482	87	39	0	DWR
		2-14-67	-	874	8.1	-	-	-	-	0	196	-	62	-	-	-	-	As 0.02	-	-	-	-	DWR
Morman Church	29N/12E-5H1	6- -67	-	297	7.7	9.5	0.6	56	0.9	0	143	20	5.9	0.3	-	0.2	-	Al 0.08, As 0.01 Cu 0.04, Pb 0.00 Mn 0.02, Zn 0.00 Fe(Tot) 0.20	231	-	26	-	DWR
Johnston Ranch	29N/13E-1N1	8-23-66	-	628	-	-	-	-	-	-	-	-	-	-	0.5	-	-	As 0.07	-	-	-	-	DWR
		2-15-67	-	553	3.1	4.5	0.7	108	3.9	0	162	78	20	25	0.5	-	-	As 0.04	387	-	14	0	DWR
California Conservation Center	29N/13E-4K1	2-15-67	-	216	8.0	7.1	0.4	34	9.8	0	109	15	5.8	0.5	-	0.0	-	As 0.01	196	-	19	0	DWR
Zenger	29N/13E-11P1	2-14-67	-	396	8.0	-	.94	-	-	0	208	-	7.4	-	-	-	-	As 0.02	-	-	47	-	DWR
George Brabham	29N/13E-14G1	8-23-66	-	-	-	-	-	-	-	-	-	-	-	72	-	-	-	As 0.03	-	-	-	-	DWR
		2-14-67	-	799	7.9	18	8.8	134	4.0	0	201	42	45	-	124	0.1	-	As 0.02	536	-	81	0	DWR
C. L. Curtis Domestic	29N/14E-4N1	2-15-67	-	712	8.3	12	3.9	141	9.5	0	333	54	22	5.3	-	0.4	-	As 0.02	461	-	46	0	DWR
Joe Ferre Domestic	29N/14E-17D1	8-18-67	66.5	1050	8.2	-	-	-	-	0	426	126	10	-	-	-	-	As 0.25	-	-	58	-	DWR
Marge Duckworth Standish Post Office	29N/14E-17Q1	8-18-67	65	1360	8.2	-	-	-	-	0	592	118	46	-	-	-	-	As 2.0	-	-	57	-	DWR
		9-27-67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	As 2.6	-	-	-	-	DWR
Domestic	29N/14E-18P1	8-18-67	61	883	8.1	-	-	-	-	0	314	139	25	-	-	-	-	As 0.05	-	-	326	-	DWR
Tom Swickard Domestic	29N/14E-18R1	8-23-66	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	-	As 0.35	-	-	-	-	DWR
		2-14-67	-	1420	8.5	9.7	1.2	309	9.0	15	560	162	23	61	-	1.2	-	As 0.32	940	-	-	-	DWR

a. Determined by addition of constituents unless otherwise noted

b. Analysis by indicated laboratory:
U.S. Geological Survey, Quality of Water Branch (U. S. G. S.)
State Department of Water Resources (D. W. R.)

MINERAL ANALYSES OF GROUND WATER

ARSENIC IN WELLS IN NORTHERN CALIFORNIA

Owner and use	State well number and other number	Date sampled	Temp in °F	Specific conductance (micromhos at 25° C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[a]	Percent sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Analyzed by[b] Remarks
								HONEY LAKE VALLEY (Continued)															
Tom Swickard Domestic	29N/14E-18R1	9-27-67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	As 0.16	-	-	-	-	DWR
		8-15-68	61	1440	8.9	8.7	2.3	330	9.0	19	537	158	24	64	5.0	1.3	--	As 0.36	925	-	31	-	DWR
Howard Grant Domestic	29N/14E-19A2	9- 8-59	59	1310	8.6	4.4	0.7	292	12	0	520	185	42	2.1	3.0	1.5	10	Fe(Dis) 0.15 Al 0.28, Mn 0.00 Cr 0.00, Cu 0.05 Pb 0.00, Zn 0.00 As 0.02	809	96	14	0	DWR
		8-23-66	-	1911	8.6	26	11	408	0.2	18	445	430	40	102	-	2.0	-	As 0.12, Mn 0.00	1280	-	112	0	DWR
		8-16-67	-	1980	8.7	-	-	-	-	25	428	439	-	133	2.1	-	-	As 0.12	-	-	64	-	DWR
M. Rigby Domestic	29N/14E-20B1	8-18-67	66	2290	8.2	-	-	-	-	0	794	332	120	-	-	-	-	As 0.97	-	-	227	-	DWR
		9-28-67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	As 2.0	-	-	-	-	DWR
Ray Merritt	29N/14E-20C2	8-18-67	54	1390	8.5	-	-	-	-	13	504	125	56	-	-	-	-	As 0.57	-	-	-	-	DWR
		9-29-67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	As 0.68	-	-	-	-	DWR
D. J. Ellige	29N/14E-20G1	8-18-67	60	1680	8.2	-	-	-	-	0	689	192	63	-	-	-	-	As 0.14	-	-	35	-	DWR
Don Eagle	29N/14E-20K1	8-18-67	54.2	1280	8.4	-	-	-	-	4	549	62	20	-	-	-	-	As 0.05	-	-	58	-	DWR
Mapes Ranch	29N/15E-18J2	7- 8-58	75	3240	8.1	51	7.3	574	22	0	227	295	651	2.8	0.3	0	79	Fe(Dis) 0.04 Fe(Tot) 0.04 Al 0.06, Mn 0.00 Cr 0.00, Cu 0.00 Pb 0.00, Zn 0.00 As 0.02	1790	87	157	0	DWR
State of California Dept. of Fish & Game	29N/15E-21N2	2-15-67	-	1250	9.0	-	-	-	-	48	481	-	61	-	-	-	-	As 0.04	-	-	76	-	DWR
Wendel Hot Springs	29N/15E-23K1	8- 8-57	200	1470	8.2	$\frac{20}{1.00}$	$\frac{0.2}{0.02}$	$\frac{276}{12.01}$	$\frac{8.1}{0.21}$	$\frac{0}{0.00}$	$\frac{51}{0.84}$	$\frac{342}{7.12}$	$\frac{192}{5.41}$	$\frac{0.0}{0.00}$	$\frac{2.2}{0.12}$	5.1	53	Fe 0.04, Al 0.06 As 0.18	924	91	51	9	Hot Springs DWR
		2-15-67	-	1490	8.5	22	0.0	285	0.0	9	35	366	182	0.3	-	4.8	-	Al 0.00, As 0.22 Cu 0.00, Pb 0.00 Mn 0.00, Zn 0.00 Fe (Tot) 0.01	1010	-	-	-	Hot Spring DWR
Spring	29N/15E-24F1	7- 8-58	88	368	8.2	17	2.1	49	7.2	0	144	29	15	2.2	0.1	0.17	40	Fe(Dis) 0.08 Fe(Tot) 0.14	233	64	51	0	DWR
Frank Dewitt Domestic	29N/15E-30A2	8-24-66	-	589	-	-	-	-	-	-	-	-	-	-	-	-	-	As 0.06, Pb 0.00 Mn 0.07	-	-	-	-	DWR
		2-16-67	-	617	8.5	12	3.2	129	4.2	9	365	11	7.0	0.5	-	0.4	-	As 0.05	377	-	43	0	DWR

a. Determined by addition of constituents unless otherwise noted

b. Analysis by indicated laboratory:
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State Department of Water Resources (D. W. R.)

MINERAL ANALYSES OF GROUND WATER

ARSENIC IN WELLS IN NORTHERN CALIFORNIA

Owner and use	State well number and other number	Date sampled	Temp in °F	Specific conductance (micromhos at 25° C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total[a] dissolved solids in ppm	Percent sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Analyzed by[b] Remarks
								HONEY LAKE VALLEY (Continued)															
Amedee Hot Springs	28N/16E-8B1	1915	200	-	-	18	Tr.	232	4.9	27	-	269	164	-	-	-	94	Al-Fe 1.8	-	-	-	-	Approx. 5600 GPM DWR
Shaffer Hot Springs	29N/15E-24E	1883	206	-	-	.6	.03	13.22	.24	-	-	7.27	5.84	-	-	-	-		-	-	-	-	Flow 175 GPM DWR
		1909	-	-	-	-	-	-	-	-	-	353	203	-	-	Tr.	120		-	-	-	-	
									BUTTE VALLEY														
Ken Holbrook Irrigation	47N/1E-32A1	5-25-66	69	200	8.1	7.1	3.5	29	7.8	0	115	1.5	5.1	1.2	-	0.0	-	Fe(Tot) 0.06 As 0.01	132	60	32	0	DWR
	-		67	198	8.2	5.0	4.2	28	7.6	0	115	0.0	4.7	1.0	-	0.0	-	Fe(tot) 0.04 Al 0.02, As 0.01 Cu 0.07, Pb 0.00 Mn 0.02, Zn 0.00	155	61	30	0	DWR
Roy Price Irrigation	48N/1W-28J1	5-24-66	61	402	8.3	33	17	24	8	0	236	12	4.5/11	1.1/2.7	-	0.000/0	-	As 0.012/30	216	-	-	-	DWR
		6-22-64	57	404	8.0	31	19	24	7.8	0	240	9	4.8/12	1.7/4.2	-	0.028/69	-	As 0.010/25	258	-	-	-	DWR
John Liskey Irrigation	48N/1W-28F1	4-28-66	53	589	8.2	42	30	41	7.8	0	363	10	4.6/7.8	9.4/16	-	0.120/204	-	As 0.007/12	348	-	-	-	DWR Depth 632
George Alderson Irrigation	48N/1W-24P1	5-25-66	73	262	8.5	12	7.3	33	6.8	5.9	145	7.9	2.6/9.9	0.0/0	-	0.000/0	-	As 0.018/69	166	-	-	-	DWR Depth 585
John Liskey Irrigation	48N/1E-30F1	6-22-64	54	343	8.2	-	-	22	-	0	204	-	2.7/7.9	-	-	-	-	As 0.009/26	-	-	-	-	DWR Depth 365
	48N/1E-31A1	5-25-66	69	485	8.6	14	8.5	84	31	11	247	27	6.5/13	1.1/2.3	-	0.249/513	-	As 0.021/43	262	-	-	-	DWR Depth 201
City of Dorris #5	48N/1E-30D3	8-12-66	61.6	450	-	-	-	-	-	-	-	-	7.6/17	-	-	-	-	As 0.006/13	-	-	-	-	DWR Depth 789
William Harp Irrigation	48N/1E-31K1	4-28-66	57	734	8.4	10	23	112	22	6	409	25	16/22	1.5/2.0	-	0.274/374	-	As 0.013/28	468	-	-	-	DWR Depth 360
American Forest Products	48N/1W-36J1	5-25-66	55	1330	8.4	43	73	154	30	12	858	23	23/17	4.8/3.6	-	0.117/88	-	As 0.021/16	787	-	-	-	DWR
		6-22-64	54	1300	7.8	37	68	160	30	0	843	27	25/19	7.3/5.6	-	0.021/16	-	As 0.023/18	818	-	-	-	DWR
City of Dorris #3	48N/1E-30P1	3-17-66	58	364	-	-	--	-	-	-	-	-	-	-	-	-	-	As 0.066/181	-	-	-	-	DWR

a. Determined by addition of constituents unless otherwise noted

b. Analysis by indicated laboratory:
U.S. Geological Survey, Quality of Water Branch (U.S.G.S.)
State Department of Water Resources (D.W.R.)

MINERAL ANALYSES OF GROUND WATER
ARSENIC IN WELLS IN NORTHERN CALIFORNIA

Owner and use	State well number and other number	Date sampled	Temp in °F	Specific conductance (micromhos at 25° C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[a]	Percent sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Analyzed by[b] Remarks
BUTTE VALLEY (Continued)																							
City of Dorris #3	48N/1E-30P1	5-25-66	-	396	8.6	21	17	37	9.4	8	218	8.2	5.0/13	1.3/3.3	-	0.1/25	-	As 0.009/23	240	-	122	0	DWR Depth 205
City of Dorris #4	48N/1E-30N1	6-22-64	-	437	8.1	18	26	28	12	0	221	21	12/27	6.7/15	-	0.060/138	-	As 0.042/96	271	-	-	-	DWR
		3-17-66	54	325	-	-	-	-	-	-	-	-	-	-	-	-	-	As 0.053/163	-	-	-	-	DWR Depth 260
		5-25-66	-	362	8.5	16	22	21	8.2	7	163	2.1	8.6/24	4.4/12	-	0.0/0.0	-	As 0.067/185	210	-	130	0	DWR Depth 260
T. S. Garner	48N/1W-25Q1	5-25-66	55	368	8.4	28	19	17	5.9	5.0	188	23	4.2/12	6.7/15	-	0.000/0	-	As 0.061/166	210	-	-	-	DWR Depth 147
American Forest Product (log pond)	48N/1W-36	8-11-66	-	426	-	-	-	-	-	-	-	-	-	-	-	-	-	As 0.076/178	-	-	-	-	DWR
Sewage Pond		-	55.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	As 75.00	-	-	-	-	DWR
SHASTA VALLEY																							
Ernest Strada	42N/5W-20J1	7-28-60	70	330	8.3	13	23	22	2.3	0	204	2.8	5.0	0.6	0.4	0.14	56	As 0.01	-	-	127	0	DWR
		9-12-63	-	339	8.2	15	22	23	3.5	0	203	1.3	6.3	1.4	-	0.1	-	As 0.01	-	-	128	0	DWR
S. D. Nelson	44N/5W-32F1	7-29-59	68	875	8.6	36	66	70	2.8	29	482	20	40	1.6	0.2	0.73	54	As 0.01	-	-	361	0	DWR
		9-11-63	-	973	8.5	41	70	74	3.8	22	490	19	60	4.6	-	0.9	-	As 0.01	-	-	391	0	DWR
Clay Stone	44N/6W-22K1	9-11-63	-	388	8.1	45	14	15	1.2	0	201	6.9	13	0.16	-	0.1	-	As 0.01	-	-	169	4	DWR
Hammond Ranch	46N/2E-15F1	8-16-60	-	161	7.6	8.4	5.8	12.0	2.1	0	60	11.0	7.3	2.1	0.1	0.20	42	As 0.01	-	-	45	0	DWR
BIG VALLEY																							
T. E. Conelly Domestic	37N/7E-13B1	8-10-60	-	193	8.0	12	6.6	18	4.2	0	111	1.6	3.2	2.6	0.1	0.03	61	Fe(Dis) 0.00 Fe(Tot) 0.02 Al 0.0, As 0.01 Cr 0.01, Cu 0.0 Pb 0.00, Mn 0.0 Zn 0.20	163	38	57	0	DWR Depth 158
		9- 6-61	62	200	8.2	12	6.1	17	4.4	0	108	1.6	2.2	2.3	0.2	0.09	62	As 0.01	161	38	55	0	DWR
G. G. Packwood Domestic	38N/7E-12K1	9-19-57	170 180	1180	8.7	31/1.55	0.1/0.01	216/9.40	5.2/0.13	13/0.43	11/0.18	362/7.54	96/2.71	0.0/0.00	2.4/0.13	2.4	72	Al 0.14, Zn 0.0 As 0.07	805	85	78	48	DWR Hot Spring

a. Determined by addition of constituents unless otherwise noted

b. Analysis by indicated laboratory:
U.S. Geological Survey, Quality of Water Branch (U.S.G.S.)
State Department of Water Resources (D.W.R.)

MINERAL ANALYSES OF GROUND WATER
ARSENIC IN WELLS IN NORTHERN CALIFORNIA

Owner and use	State well number and other number	Date sampled	Temp in °F	Specific conductance (micromhos at 25° C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[a]	Percent sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Analyzed by[b] Remarks
						BIG VALLEY (Continued)																	
A. O'Toole Domestic	38N/7E-14G5	8-10-60	-	417	8.0	36	16	22	2.5	0	93	79	32	2.0	0.3	0.03	66	Fe(Dis) 0.00 Fe(Tot) 0.15	302	23	156	80	DWR Depth 60
E. G. Babcock	38N/7E-34J1	8-10-60	58	189	8.0	11	6.4	20	4.1	0	118	1.0	2.3	0.5	0.1	0.02	59	Fe(Dis) 0.00 Fe(Tot) 0.12 Al 0.0, As 0.01 Cr 0.00, Cu 0.00 Pb 0.01, Mn 0.00 Zn 0.06	162	42	54	0	DWR Depth 60 Perf.0-80
Staine (Beiber)	38N/8E-14N1	9-19-57	186	1310	8.7	31	0.1	241	7.6	14	12	392	116	0.0	2.8	3.1	88	Fe 0.00, Al 0.17 Mn 0.00, Cu 0.01 Pb 0.00, Zn 0.02 As 0.13, Cr 0.00	902	86	78	45	DWR Hot Spring 2 GPM
	38N/8E-14N2	7-23-68	-	1325	8.4	-	-	-	-	-	-	-	-	-	-	-	-	As 0.13	-	-	-	-	DWR
H. Simer (Adin) Domestic	38N/8E-14P1	9-18-57	150 170 (Est)	1290	8.6	31	0.0	241	7.2	10	18	403	117	0.0	2.8	3.1	87	Fe 0.06, Al 0.15 Mn 0.00, Cu 0.01 Pb 0.00, Zn 0.01 As 0.12, Cr 0.00	911	86	78	47	DWR Depth 60
		8-10-60	121	1290	7.6	31	0.1	235	5.0	0	37	395	111	0.4	2.8	3.3	82	Fe(Dis) 0.00 Fe(Tot) 0.23 Al 0.0, As 0.14 Cr 0.00, Cu 0.01 Pb 0.00, Mn 0.00 Zn 0.05	884	86	78	48	DWR
Marie Walsh - Evan Gutry (tenant) Domestic (Beiber)	38N/8E-30R1	8-14-63	-	696	8.1	45	38	23	6.4	0	132	26	54	122	-	0.2	-	Al 0.04, As 0.05 Cu 0.00, Pb 0.00 Mn 0.00, Zn 0.16	460	15	267	159	DWR + 200' Drilled 1930
W. F. Lorensen	39N/5E-9M1	6-25-58	165	1350	8.0	46	1.7	222	7.0	0	53	353	125	0.3	1.8	4.2	86	Fe(Dis) 0.02 Fe(Tot) 0.04 Al 0.09, Mn 0.00 Cr 0.00, Cu 0.02 Pb 0.00, Zn 0.00 As 0.14	873	79	122	79	DWR
Ralph Holmes Domestic	39N/8E-23A2	8-10-60	62	222	7.9	12	9.0	16	4.7	0	96	19	4.7	2.3	0.2	0.02	70	Fe(Dis) 0.00 Fe(Tot) 0.46 Al 0.0, As 0.03 Cr 0.00, Cu 0.00 Pb 0.00, Mn 0.7[illegible] Zn 0.38	185	32	67	0	DWR Depth 370 Water from 2 wells working from a single pump

a. Determined by addition of constituents unless otherwise noted

b. Analysis by indicated laboratory:
U. S. Geological Survey, Quality of Water Branch (U. S. G. S.)
State Department of Water Resources (D. W. R.)

MINERAL ANALYSES OF GROUND WATER

ARSENIC IN WELLS IN NORTHERN CALIFORNIA

Owner and use	State well number and other number	Date sampled	Temp in °F	Specific conductance (micromhos at 25° C)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total[a] dissolved solids in ppm	Percent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Analyzed by[b] Remarks
									BIG VALLEY (Continued)														
Ralph Holmes Domestic	39N/8E-23A2	8-14-63	-	234	7.7	11	6.0	23	5.4	0	97	16	5.4	3.2	-	0.2	-	Fe(Tot) 0.40 Al 0.14, As 0.03 Cr 0.00, Cu 0.00 Pb 0.00, Mn 0.47 Zn 0.34	200	46	52	0	DWR
L. A. Meeks	39N/8E-26J1	8-10-60	56	639	8.2	48	19	45	5.4	0	133	44	40	112	0.4	0.00	65	Fe(Dis) 0.00 Fe(Tot) 0.07 Al 0.0, As 0.13 Cr 0.00, Cu 0.00 Pb 0.00, Mn 0.00 Zn 0.02	444	32	197	88	DWR Depth 30

a. Determined by addition of constituents unless otherwise noted

b. Analysis by indicated laboratory:
U.S. Geological Survey, Quality of Water Branch (U. S. G. S.)
State Department of Water Resources (D. W. R.)