

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division

GROUND-WATER INVENTORY FOR 1964,
EDWARDS AIR FORCE BASE, CALIFORNIA

By

F. W. Giessner and S. G. Robson

65-62

Prepared in cooperation with the
Department of the Air Force

OPEN-FILE REPORT

Garden Grove, California
1965

10-21-65

P.4 Follows

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SUMMARY AND CONCLUSIONS

The water supply for Edwards Air Force Base is ground water pumped from wells. Because recharge to the ground-water supply is very small, constant surveillance of the quantity and quality of the water stored in the underground basin is maintained. This report, covering the period March 1964 through March 1965, is the eighth annual inventory made at the request of the Department of the Air Force. The results of the current study are summarized below.

1. Ground-water pumpage.—Ground-water pumpage by the base for all uses during the calendar year 1964 was about 7,220 acre-feet, most of which was pumped from the Main Base, East Camp, and North Base wells.

2. Water-level fluctuations.--In the Main Base, East Camp, Rosamond, and North Muroc storage units, water levels declined about 0.2 to 9.3 feet in 1964.

3. Ground water in storage.--Ground water in storage beneath and adjacent to the base in 1952 was estimated by Dutcher (1958, p. 40) to be 1,500,000 acre-feet. Depletion of ground water in storage during the period March 1964 to March 1965 was about 15,800 acre-feet. Depletion during the period 1952-65 is about 135,300 acre-feet, an average of about 10,400 acre-feet per year.

4. Quality of water.--Chemical analyses of water, collected annually from the principal base-supply wells, indicate no appreciable deterioration of quality. However, some deterioration occurred at North Base well 10N/9W-7A2.

The chloride content in water from well 10N/9W-7A2 (NB-2), as indicated by a sample collected in 1964, was 960 ppm (parts per million). Experience has shown that the chloride content in water from this well is related to the length of time the well is idle prior to pumping for sampling. Efforts will be made in 1965 to determine the source of the water of high-chloride content.

Analyses of water samples from well 9N/10W-16C2 show that major-constituent concentrations have decreased 70 to 85 percent from the values determined in 1963.

5. New wells.—In May 1964 a new well was drilled at North Base to a depth of 500 feet; the yield was 2,200 gpm (gallons per minute).

PURPOSE AND SCOPE OF THE CONTINUING INVENTORY

This report, for the period March 1964 through March 1965, is the eighth annual inventory of ground-water conditions at Edwards Air Force Base, Los Angeles, Kern, and San Bernardino Counties, Calif. It was prepared by the U.S. Geological Survey in cooperation with the Air Force. The area of investigation is shown on figure 1.

The geology and ground-water resources of the Edwards Air Force Base area were described by Dutcher and Worts (1958). Basic data are contained in a report by Dutcher, Bader, Hiltgen, and others (1962).

The continuing inventory, submitted annually since 1958, has as its purpose the collection, analysis, and interpretation of hydrologic data necessary to keep the Air Force advised of current water-supply conditions on the base.

The scope of the program requested by the Air Force is as follows: (1) To continue periodic water-level measurements in key observation wells on the base to estimate the quantity of ground water in storage; (2) to continue to interpret chemical analyses of water from base wells to detect any changes in chemical quality of ground water and, in particular, to detect any deterioration of quality due to return of sewage effluent, downward movement of water of inferior quality from the shallow water bodies, or migration of water of poor quality from local areas near the margins of the basins toward the base wells; and, as funds permit, to collect water samples periodically from key wells to supplement the base sampling program; (3) to continue as technical adviser on water-supply problems at Edwards Air Force Base; and (4) to prepare a brief annual report incorporating the findings made during the continuing inventory, including a summary of ground-water pumpage, an estimate of ground water in storage, hydrographs of water-level measurements, chemical analyses, and other basic data.

The work was done by the U.S. Geological Survey, Water Resources Division, under the immediate supervision of L. C. Dutcher, chief of the Garden Grove subdistrict office, and under the general supervision of Walter Hofmann, district chief in charge of water-resources investigations in California.

The well-numbering system was described by Dutcher and others (1962). For convenience of reference, table 1 presents a cross index of the well numbers used by Edwards Air Force Base and those used by the Geological Survey.

Table 1.--Cross index of Edwards Air Force Base and Geological Survey

<u>well numbers</u>					
Base number or name	Abbreviated base number ¹	USGS number	Basin and ground- water storage unit	Use	
<u>Lancaster basin</u>					
Main Base well 1	MB- 1	9N/ 9W- 6L1	Main Base (adjacent)	(a)	
3	MB- 3	9N/ 9W- 6E1	Main Base (adjacent)	(b)	
5	MB- 5	9N/ 9W- 6A1	Main Base (adjacent)	(a)	
6	MB- 6	9N/10W-12R1	Main Base (adjacent)	(c)	
6A	MB- 6A	9N/10W-24F1	Main Base	(a)	
7	MB- 7	9N/ 9W-18C1	Main Base	(a)	
8	MB- 8	9N/10W-24G1	Main Base	(a)	
9	MB- 9	9N/10W-24C1	Main Base	(a)	
11	MB-11	9N/10W-24E1	Main Base	(a)	
Well C-2	C- 2	9N/10W-16C2	---	(a)	
Telemeter Station well 10	TS-10	9N/10W- 8P1	---	(b)	
South Track well A	ST-A	8N/10W- 2F1	Main Base	(b)	
D	ST-D	8N/10W- 2N2	Main Base	(b)	
E	ST-E	8N/10W- 1C1	Main Base	(a)	
East Camp well 1	EC-1	9N/ 8W- 6H2	East Camp	(a)	
2	EC-2	9N/ 8W- 6H1	East Camp	(a)	
3	EC-3	9N/ 8W- 6J1	East Camp	(a)	
NASA well 1	NASA-1	9N/ 9W-14P2	East Camp	(a)	
2	NASA-2	9N/ 9W-23B1	East Camp	(a)	
3	NASA-3	9N/ 9W-13N1	East Camp	(a)	
4	NASA-4	9N/ 9W-15J1	East Camp	(a)	
<u>North Muroc basin</u>					
North Base well 1	NB-1	10N/9W- 7A1	North Muroc	(a)	
2	NB-2	10N/9W- 7A2	North Muroc	(a)	
3	NB-3	11N/9W-32Q1	North Muroc	(a)	
4	NB-4	10N/9W- 4D2	North Muroc	(a)	
5	NB-5	10N/9W- 5B1	North Muroc	(a)	
Test well 4	TW-4	10N/9W- 4D1	North Muroc	(c)	
Graham Ranch well		9N/10W-16P1	---	(d)	
		9N/10W-34P3	---	(d)	
Red Barn well		9N/10W-34Q1	---	(d)	
		9N/10W-34Q2	---	(d)	

1. Symbol used in text.
- a. Supply well.
- b. Unused well.

- c. Recorder well.
- d. Recreational well.

GROUND-WATER PUMPAGE

The metered pumpage for the base in 1964 totaled 6,450 acre-feet (fig. 2). In addition monthly records show that pumpage ranged from a January low of 85,851,000 gallons (263 acre-feet) to an August high of 330,014,000 gallons (1,010 acre-feet). Pumpage for all uses by the base in 1964, including both metered and estimated pumpage from the several ground-water basins and storage units, is shown in table 2. Pumpage records for irrigation and other uses outside the base in 1964 are not available.

Table 2.--Pumpage from base-supply wells for calendar year 1964

Basin and well field	Pumpage ^{1/}	
	1,000 gallons	acre-feet ^{2/}
<u>Lancaster basin</u>		
Main Base wells 6A, 7, 8, 9, and 11	1,060,000	3,260
Main Base wells 1 and 5	39,800	122.3
East Camp wells 1, 2, and 3	432,000	1,320
NASA wells 1, 2, 3, and 4	65,800	202
Recreation wells ^{3/}	250,000	767
Well C-2	570	1.8
South Track well E	4,300	13.2
Subtotal	1,850,000	5,690
<u>North Muroc basin</u>		
North Base wells 1, 2, 3, 4, and 5	498,000	1,530
Total	2,350,000	7,220

1. All values rounded to three significant figures, or the nearest 0.1 acre-foot.
2. One acre-foot equals 325,851 gallons.
3. Pumpage is estimated; the water is not used for base supply, and the pumpage is not shown on figure 2.

WATER-LEVEL FLUCTUATIONS

Water levels were measured biannually in nearly 100 wells on and near the base. Recorders were operated on four wells to obtain continuous records of water-level fluctuations. Water-level records are on file in the office of the Geological Survey in Garden Grove, Calif., and are available on request.

The water-level-contour map (fig. 3) shows three principal pumping depressions near Edwards Air Force Base. The largest is centered about 10 miles east of Lancaster, a second depression is near wells 9N/10W-24E1 and 24F1 in the Main Base well field, and the third pumping depression is in the North Muroc storage unit near well 11N/9W-24Q1.

In most of the area, ground-water levels start to decline in the early spring and continue to decline until about September, when a recovery begins, as shown by the hydrographs on figure 4. For the period of record, the highest annual water level in most wells has been lower than the highest level for the previous year. Similarly, the lowest annual water level also has been lower each succeeding year.

During the period of this report, the decline of water levels in the North Muroc storage unit ranged from 0.44 to 3.73 feet, based on water levels in wells 10N/9W-24A2 and 10N/9W-4D1. In the East Camp area, the decline ranged from 1.74 to 3.60 feet, and in the Rosamond storage unit, the decline ranged from 0.20 to 6.86 feet. In the Main Base storage unit, the decline ranged from 1.78 to 9.34 feet.

GROUND WATER IN STORAGE, 1964-65

The quantity of ground water in storage in 1952 in the ground-water storage units of Edwards Air Force Base (fig. 3) was estimated by Dutcher (1958, p. 40). Table 3 shows the estimated yearly depletion for the period 1952-65, using the same assumptions and data sources.

Table 3.--Status of ground water in storage, Edwards Air Force Base, 1952-65

Basin and storage unit ^{1/}	Estimated ground-water depletion, in acre-feet ^{2/}											Total 1952-65
	Estimated :	:	:	:	:	:	:	:	:	:	:	
	:ground water:	:	:	:	:	:	:	:	:	:	:	
	: in storage :	:	:	:	:	:	:	:	:	:	:	:
	: in 1952 ^{1/} :	1952-59 ^{3/} :	1959-60 ^{4/} :	1960-61 ^{4/} :	1961-62 ^{5/} :	1962-63 ^{5/} :	1963-64 ^{5/} :	1964-65 :	:	:	:	:
	: (acre-feet):	:	:	:	:	:	:	:	:	:	:	:
<u>Lancaster basin</u>												
East Camp	310,000	15,800	4,300	4,100	3,200	5,100	4,000	4,100				40,600
Main Base	440,000	23,500	3,600	4,000	2,600	5,100	3,800	5,000				47,600
Rosamond	340,000	14,800	4,000	2,500	1,700	3,000	2,000	3,500				31,500
Subtotal	1,100,000	b54,000	11,900	10,600	7,500	13,200	9,800	12,600				b119,700
<u>North Muroc basin</u>												
North Muroc	a450,000	3,000	1,000	4,000	1,000	2,000	1,400	3,200				15,600
Total	1,500,000	57,000	12,900	14,600	8,500	15,200	11,200	15,800				135,300

1. Storage units and estimates of ground water in storage from Dutcher and Worts (1958, pl. 12 and table 10).
2. Estimates were made from water-level measurements obtained in the spring of the year.
3. Estimates of depletion from Dutcher (1958, p. 40, and 1959, p. 47) and Moyle (1960, p. 25).
4. Estimates of depletion from Moyle (1960, p. 25, and 1961, p. 38).
5. Estimates of depletion from Weir (1962, p. 18; 1963, p. 19, and 1965, p. 20).
- a. Approximately 70 percent within the Base.
- b. See points plotted on figure 5.

The estimated depletion of ground water, between March 1964 and March 1965, is about 15,800 acre-feet (table 3) in the East Camp, Main Base, Rosamond, and North Muroc storage units. This depletion is 4,600 acre-feet more than that for the 1963-64 period and is the record high.

The total depletion for 1952-65, as shown by table 3, is about 135,300 acre-feet. Depletion in all storage units, except North Muroc, for the same period was 119,700 acre-feet (table 3 and fig. 5), which represents an average water-level decline of 30 feet for the 13-year period.

QUALITY OF WATER

Water samples have been collected annually from base wells for chemical analysis. Except in the area of wells 9N/10W-16C2 (C-2), 10N/9W-7A2 (NB-2), and 9N/8W-6H2 (EC-1), the analyses indicated no significant changes in the chemical quality of the water on the base. The quality of the water from well 9N/10W-16C2 showed an improvement in 1964. The concentrations of most of the major constituents were about 70 to 85 percent less than in 1963. The quality of the water from well 10N/9W-7A2 deteriorated somewhat in 1964. The sodium and the chloride contents increased from 515 ppm and 735 ppm to 610 ppm and 960 ppm, respectively. This deterioration is also reflected by the chloride content of water from well 10N/9W-7A1 (fig. 6). The chloride content of water from well 10N/9W-7A2 usually increases when the well has not been pumped for several days prior to sampling. Efforts will be made in 1965 to determine the source of the water of high-chloride content. The nitrate content of the water from supply well 9N/8W-6H2 increased from 8.5 ppm in 1963 to 20 ppm in 1964. Additional water samples will be taken in 1965 to determine if this quality change is significant.

Records of chemical analyses made prior to 1964 are tabulated in reports by Dutcher, Bader, Hiltgen, and others (1962, table 7, p. 184-209), Dutcher and Worts (1958, table 9, p. 189), Dutcher (1959, table 8, p. 52-56), Moyle (1960, table 6, p. 29-31, and 1961, table 5, p. 40-42), and Weir (1962, table 5, p. 21-22, 1963, table 5, p. 22-23, and 1965, table 4, p. 23-24).

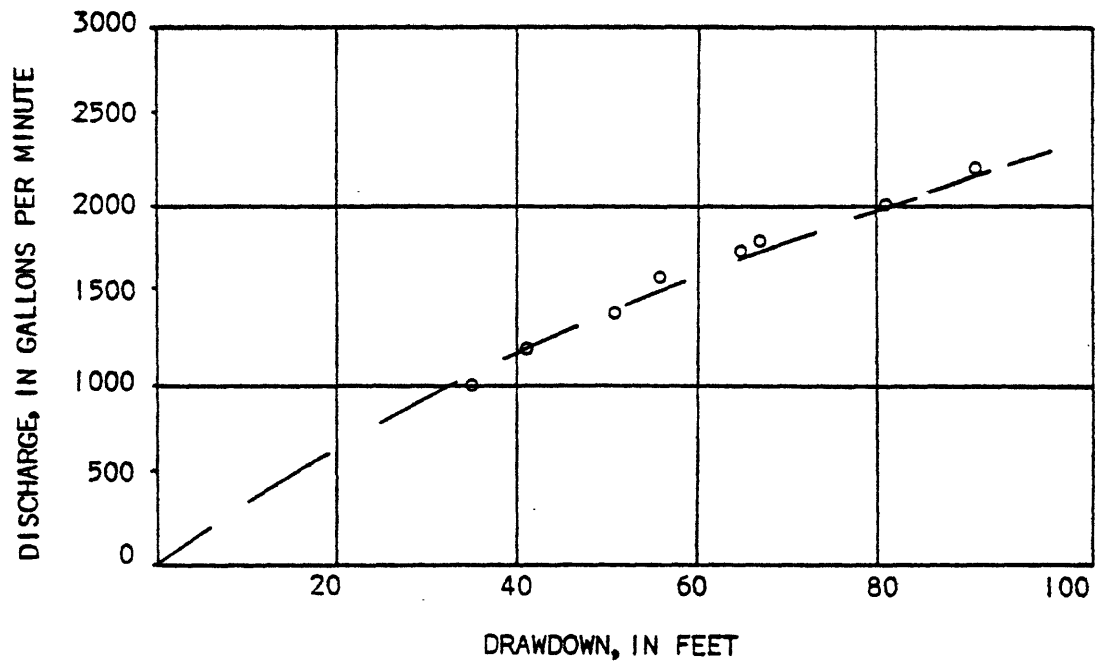
NEW WELLS

To satisfy the demand for a water supply at the base, a new well was drilled in the North Base field in May 1964. The well was drilled to a depth of 500 feet, and a 16-inch casing, perforated from 100 to 500 feet, was installed. The static water level in this area is about 75 feet below the land surface. The log of the well is shown on the following page.

10N/9W-5B1 (NB-5). Drilled by Evans Bros., Lancaster, Calif.
 Altitude about 2,290 feet above mean sea level. 16-inch casing,
 0-500 feet; perforated 100-500 feet; gravel packed.

	Thickness (feet)	Depth (feet)
Surface soil -----	8	8
Sand -----	52	60
Sand and gravel, with clay streaks -----	186	246
Sand, gravel, and boulders; very little clay -----	23	269
Sand and sandy brown clay -----	6	275
Clay, brown, with some sand -----	19	294
Sand and boulders -----	12	306
Sand, gravel, and boulders -----	14	320
Sand, gravel, and brown clay -----	28	348
Sand and gravel, with thin streaks of brown clay -	37	385
Sand, hard, with thin streaks of clay -----	73	458
Sand, with streaks of clay -----	27	485
Sand -----	15	500

The graph below shows the results of a 48-hour pumping test at the new supply well. The well yielded 2,200 gpm with 91 feet of drawdown, which is excellent in comparison with yields of other wells in the area.



GRAPH OF PUMPING TEST FOR SUPPLY WELL 10N/9W-5B1 (NB-5)

Because of prevailing drought conditions in southern California and the long history of declining water levels in the desert region, it is important that the Air Force continue the program of monitoring water levels in observation and supply wells. In some of the key observation wells on the base, the water levels have declined below the bottoms of the wells; other wells have been plugged with debris. This gradual but continuing loss of observation wells reduces the data available to appraise the adequacy of the ground-water supply in the area. Therefore, a program should be initiated to restore or reclaim the dry and plugged observation wells so that periodic measurements of water level can be continued.

As a part of the continuing program at the base in fiscal year 1966, the Geological Survey will prepare a summary of the work needed to restore, clean, or deepen some of the observation wells previously measured regularly. Cost estimates for any work which cannot be accomplished by the Survey will be included.

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FIGURE 1

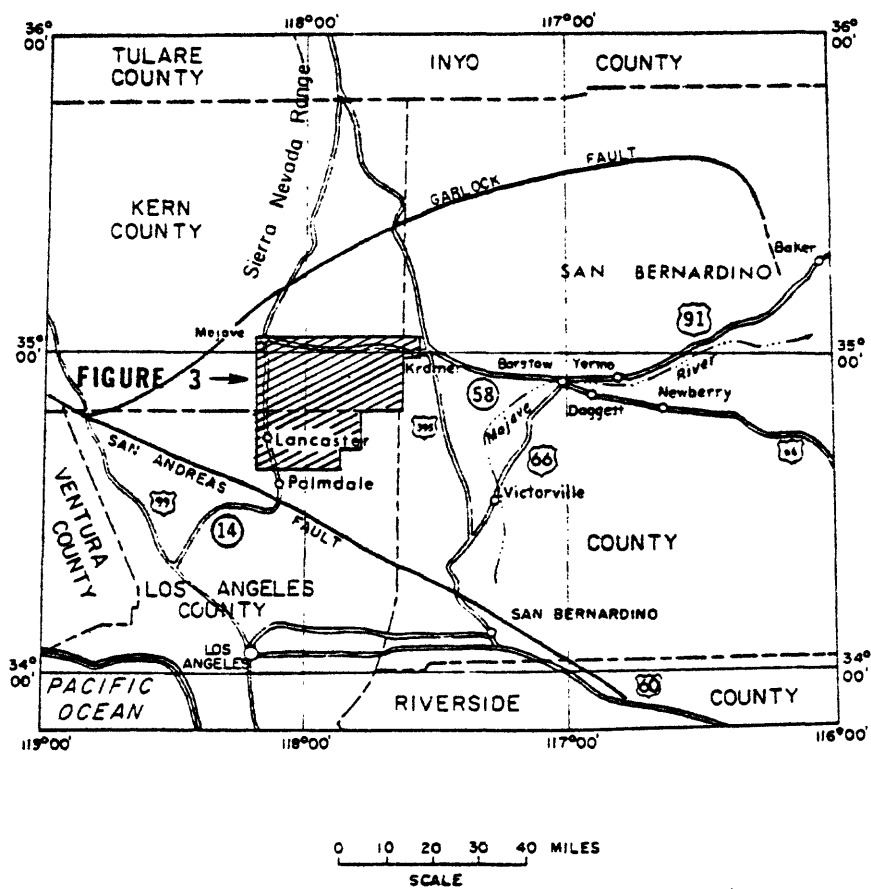
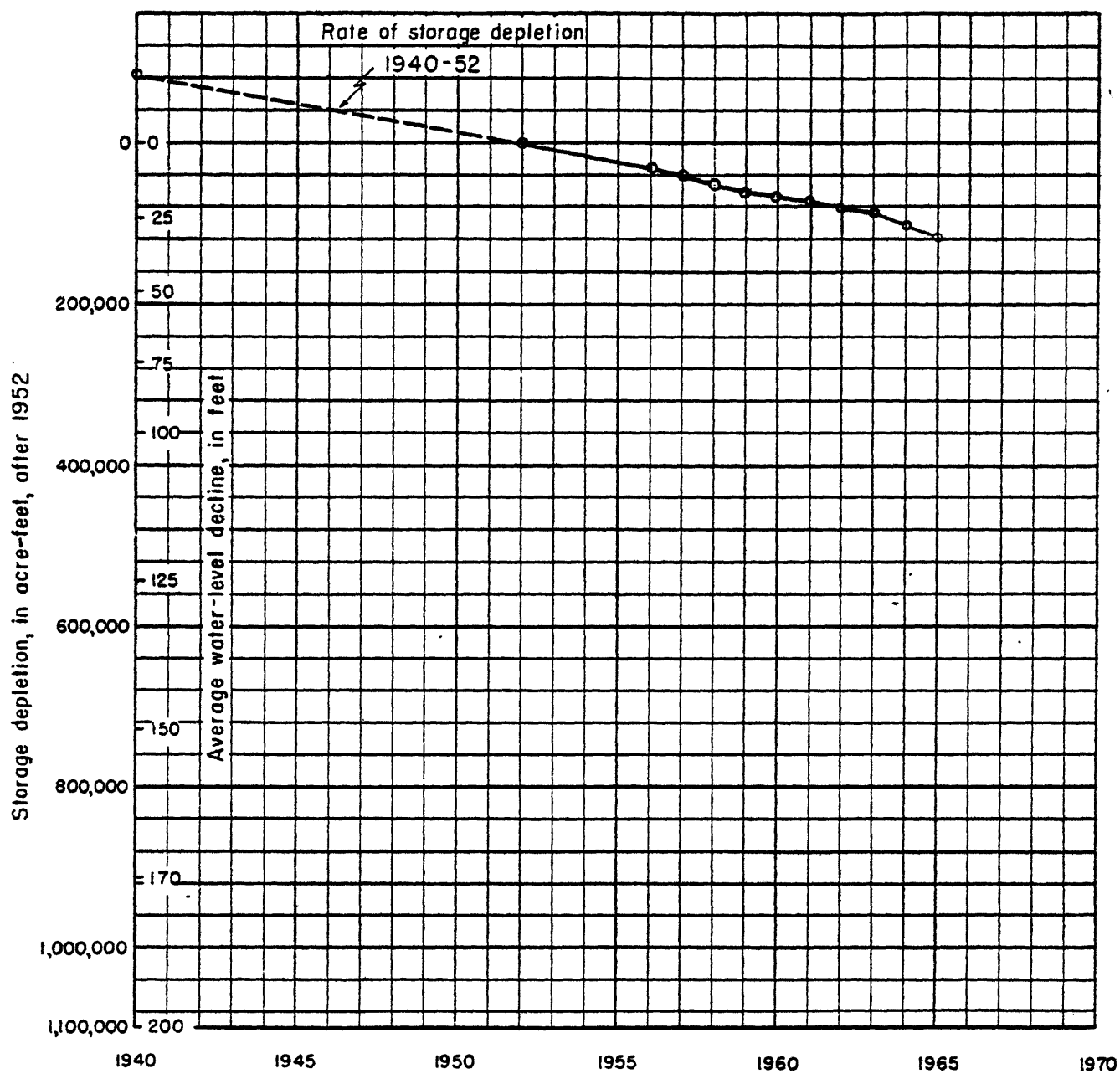


FIGURE 1.—Map of part of southern California showing area described in this report



ESTIMATED TOTAL DEPLETION OF GROUND WATER IN STORAGE IN
EAST CAMP, MAIN BASE, AND ROSAMOND STORAGE
UNITS

chemical analysis
California (WSP 1970)
After WSP 1470, P. 101
& S to A, P. 234.

Table 4. -- Chemical analyses of water

The calculated values of dissolved solids (sum of determined constituents) were computed by the U.S. Geological Survey, Water Resources Division, Garden Grove, Calif.

Analyzing laboratory: GS, U.S. Geological Survey, Water Resources Division, Sacramento, Calif.

Well number	Date of collection	Depth of well (feet)	Water temperature (°F.)	Results in parts per million (ppm)														pH	Specific conductance (micromhos at 25°C)	Percent sodium	Laboratory and Lab. number			
				Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃)	Carbonate (CO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO ₃)	Boron (B)	Dissolved solids					Hardness as CaCO ₃	Noncarbonate hardness as CaCO ₃	
																	Calculated (sum of determined constituents)							Residue on evaporation at 180°C
U.S. Public Health Service drinking-water standards 1962																								
8N/10W- 1C1	10- 9-64		73	45	0	11	0.9	79	2.2	174	0	56	1.1	1.3	0.5	0.3	287	291	31	0	83	413	7.5	GS-47742
9N/ 8W- 6H1	10-13-64	467	72	37	0	26	8.5	230	4.8	305	0	149	132	1.9	8.0	1.0	748	747	100	0	83	1,180	7.6	GS-47734
6H2	10-13-64	354	72	39	0	14	7.1	190	2.1	288	0	113	71	2.8	20	.9	602	584	64	0	86	918	7.9	GS-47728
6J1	10-13-64	363	72	37	0	28	7.3	230	2.1	280	13	151	121	1.7	9.5	1.1	743	742	100	0	83	1,170	8.5	GS-47729
9N/ 9W- 6A1	10-12-64	199	68	34	0	50	12	62	1.0	133	0	117	55	.5	1.1	.3	400	412	176	67	43	649	7.4	GS-47743
6L1	10- 9-64	147	68	35	0	56	14	80	1.6	140	0	114	95	.6	1.1	.3	471	496	196	81	47	793	7.4	GS-47745
13N1	9-23-64	555	--	37	0	20	3.4	65	1.4	120	4	74	15	.5	1.5	.2	281	287	64	0	68	421	8.3	GS-47735
14P2	9-23-64	500	--	35	0	29	4.3	44	3.1	127	0	63	10	.3	2.2	.2	254	262	90	0	50	382	7.6	GS-47732
15J1	9-23-64	534	--	34	0	31	2.6	44	3.1	133	0	62	9.0	.5	2.1	0	254	264	88	0	51	380	7.5	GS-47731
18C1	10- 9-64	360	69	30	0	29	2.3	48	2.2	139	0	58	12	.2	1.3	.2	251	252	82	0	55	379	7.5	GS-47749
23B1	9-23-64	557	--	38	0	27	3.5	50	2.7	126	0	65	15	.8	1.5	.1	264	275	82	0	56	387	8.2	GS-47730
9N/10W-16C2	10- 9-64	216	69	38	0	40	11	83	3.0	151	0	117	55	1.2	1.7	.4	425	445	145	21	55	669	7.5	GS-47733
24C1	10- 9-64	750	67	30	0	12	2.2	75	1.0	151	0	59	12	.6	.4	.4	267	275	39	0	80	414	7.4	GS-47750
24E1	10- 9-64	700	67	30	0	19	2.3	66	1.4	149	0	59	13	.5	.4	.3	265	273	57	0	71	400	7.5	GS-47748
24F1	10- 9-64	430	69	29	.01	24	2.4	46	2.2	139	0	50	5.7	.4	.6	.1	228	232	70	0	58	341	7.5	GS-47739
																		21						

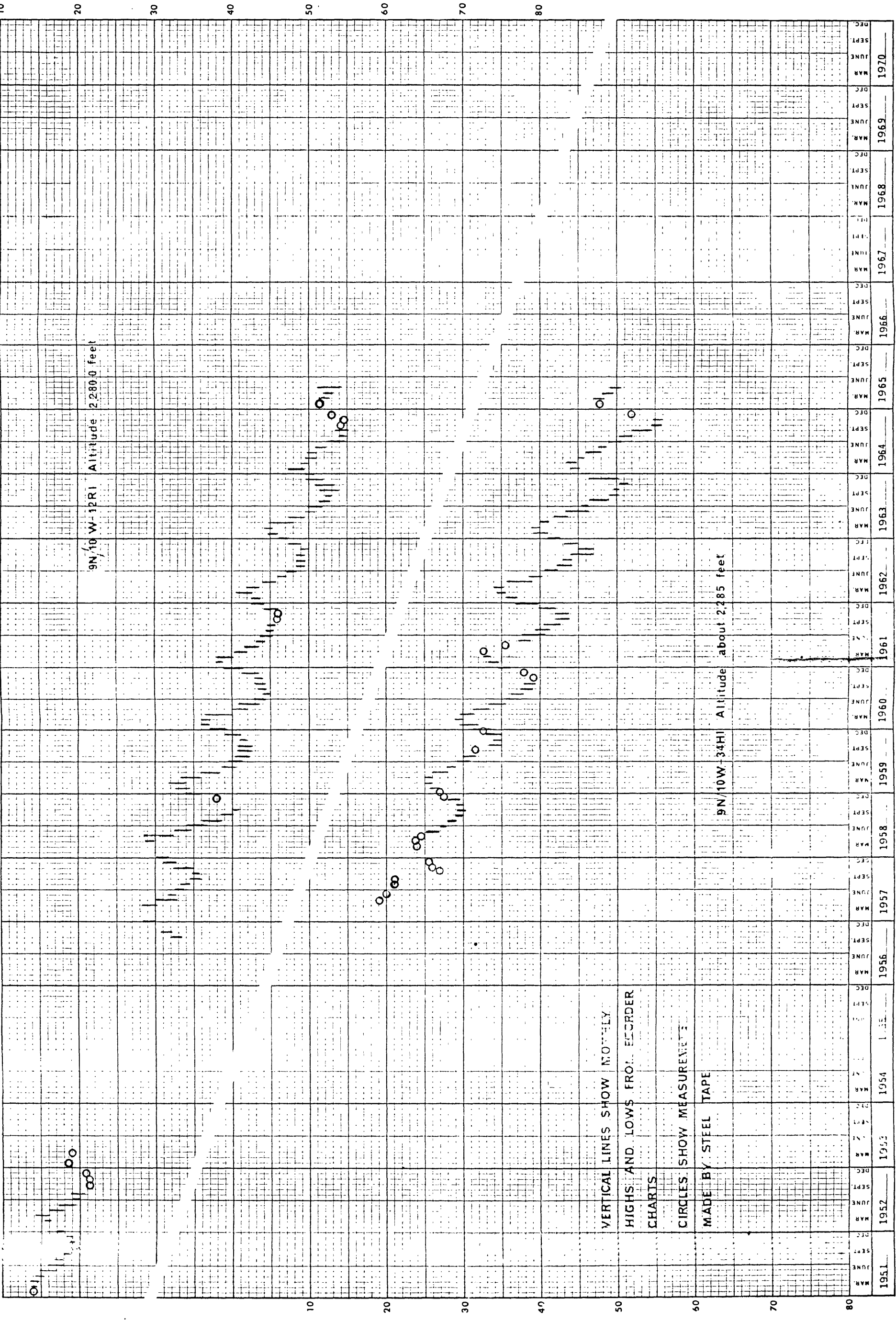
Table 4.---Chemical analyses of water--obtained

Chemical analyses
California (TW) 1964
After WSP 1473, p. 153
& S to A, p. 214

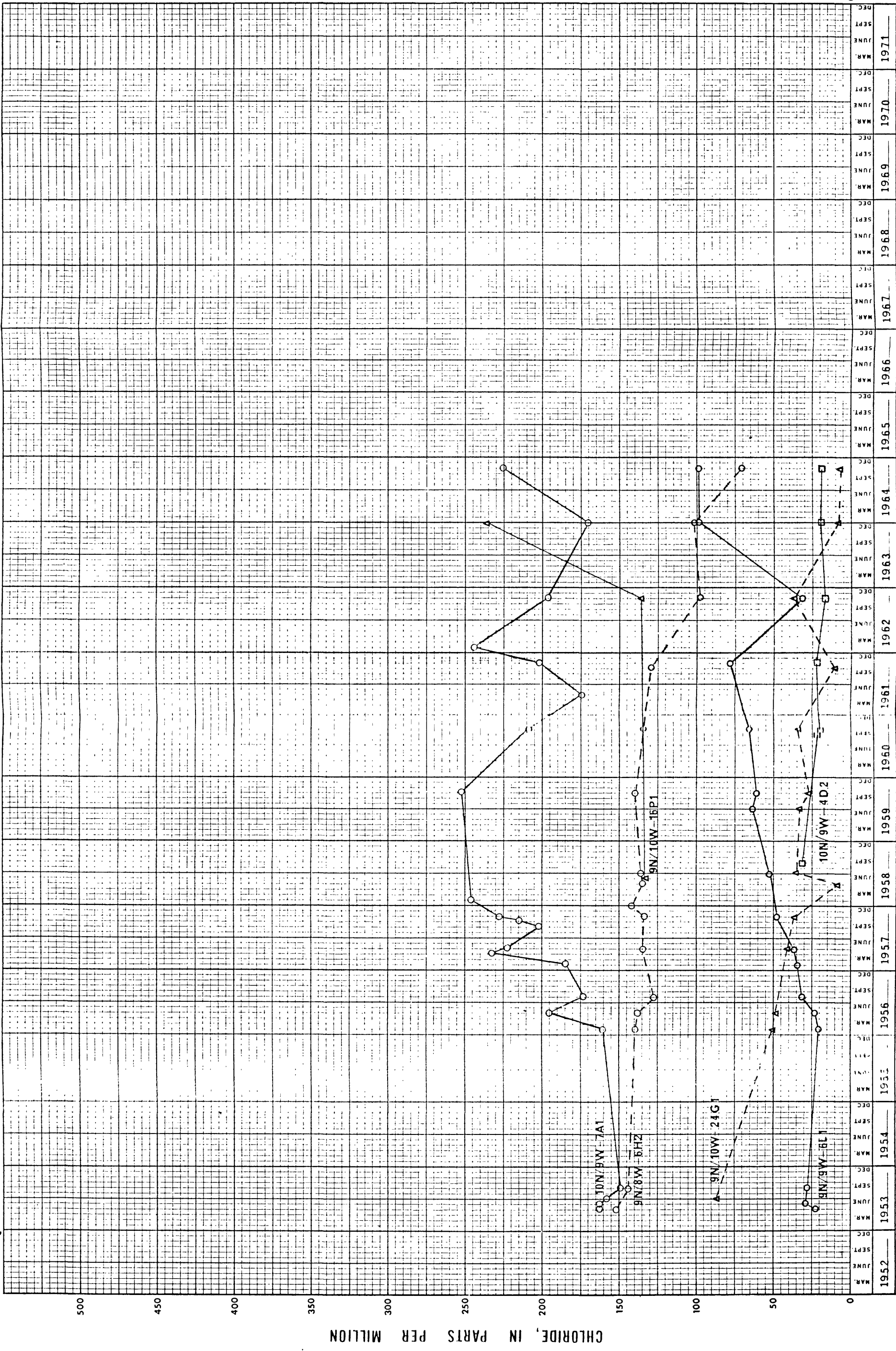
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U.S. GEOLOGICAL SURVEY

65-62 FIGURE 4



HYDROGRAPHS OF WELLS 9N/10W-12RI AND 9N/10W-34HI



CHLORIDE CONTENT OF WELL WATER, EDWARDS AIR FORCE BASE, CALIFORNIA