UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Ground Water Branch

GROUND-WATER INVENTORY FOR 1962, EDWARDS AIR FORCE BASE, CALIFORNIA

By

J. E. Weir, Jr.

Prepared in cooperation with the
Department of the Air Force

OPEN-FILE REPORT

Long Beach, California
1963

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GROUND-WATER INVENTORY FOR 1962, EDWARDS AIR FORCE BASE, CALIFORNIA

By J. E. Weir, Jr.

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, it is necessary to maintain constant surveillance of the amount and quality of the water stored in the underground basin. This report, covering the period March 1962 through March 1963, is the sixth periodic 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.--The total ground-water pumpage by the Base for all uses during 1962 was about 5,640 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 7 feet during 1962. In the irrigated areas south of the Base, water levels measured in the spring of 1963 were lower, in general, than in the spring of 1962 and nearly the same as those measured in the spring of 1961. Slight decreases in pumping locally have caused rises in water level in the North Muroc storage unit and the Rosamond storage unit.

3. Ground water in storage.--Ground water in storage beneath and adjacent to the Base in the saturated deposits to a depth of 200 feet below the 1952 water levels was estimated by Dutcher (1958, p. 40) to be 1,500,000 acre-feet. Depletion of ground water in storage during the period March 1962 to March 1963 was about 15,200 acre-feet. The total depletion of ground water in storage during the period 1952-63 is estimated to be about 108,300 acre-feet.

4. Quality of water.--Chemical analyses of water, collected annually from the principal Base supply wells, indicate no appreciable deterioration of chemical quality. However, a minor amount of deterioration occurred at two localities--North Base and the Graham Ranch area.

The chloride content in water from well 10N/9W-7A2 (NB-2) was 461 ppm after 3 hours of pumping following a nonpumping period of 223 days. Experience has shown that, at this well, chloride content is dependent largely on the length of time the well is idle prior to pumping for sampling. It is evident that contamination as a result of saline water leaking into the well is continuing at North Base, although contamination has not yet reached well 10N/9W-7A1 (NB-1).

Analyses of water samples from the Graham Ranch area show definite chloride and sulfate contamination, mainly in the vicinity of well 9N/10W-16C2, which appears to be from leakage downward around the well. Further study of the Graham Ranch area should be made to determine the source of the contamination and to seek possible means of preventing further deterioration in the quality of the water.

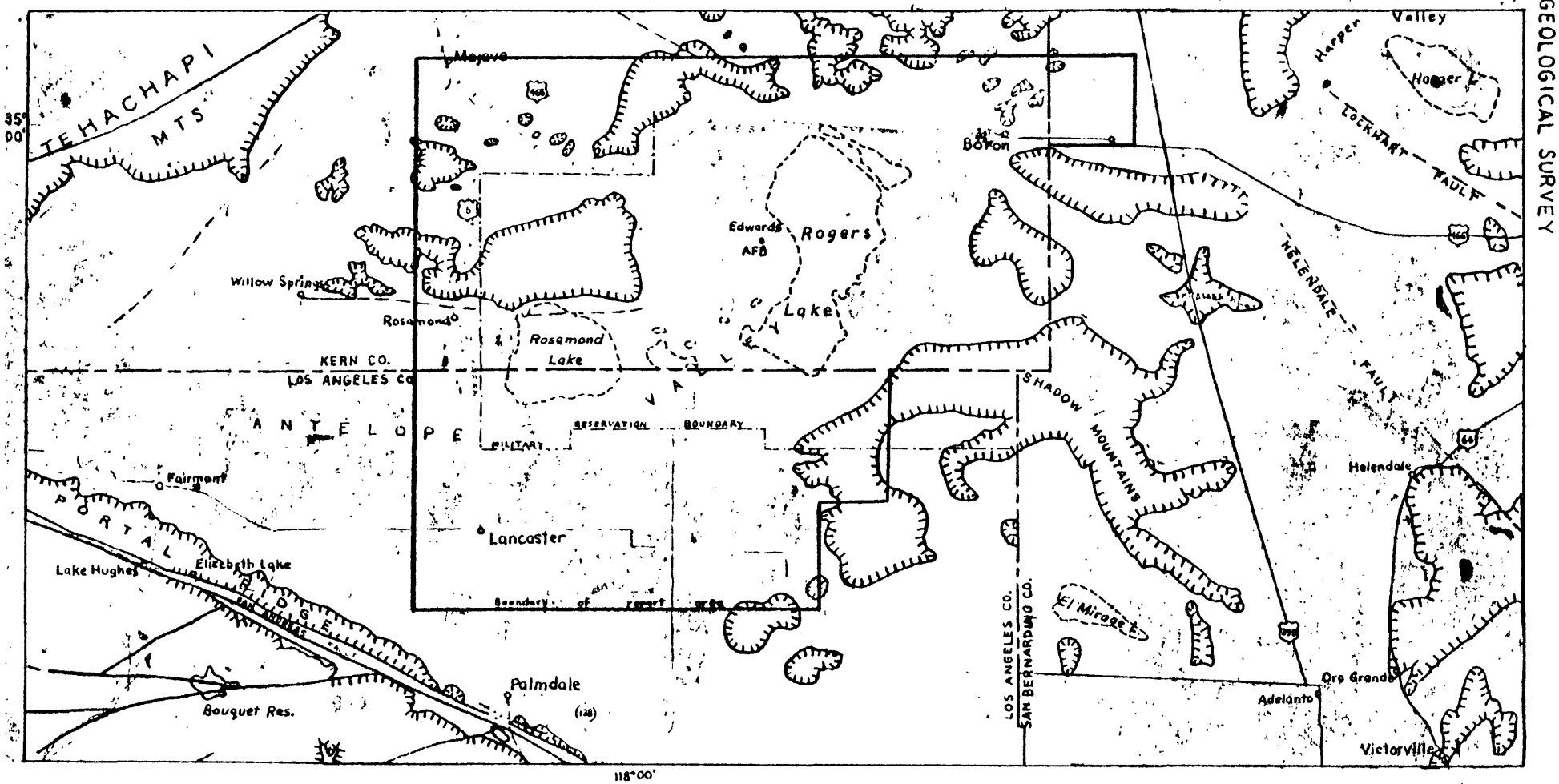
PURPOSE AND SCOPE OF THE CONTINUING INVENTORY

This report, covering the period March 1962 through March 1963, is the sixth periodic 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.

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

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

The continuing inventory, submitted annually beginning in 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.



MAP OF PART OF SOUTHERN CALIFORNIA SHOWING AREA DESCRIBED IN THIS REPORT

Base map and fault pattern largely after geologic map of California (Jenkins, 1938)

MAP LOCATION

0 8 16 Miles

Scale 1 inch = 8 miles

Valley area

Mountain area

Fault

U.S. GEOLOGICAL SURVEY

FIGURE

8a

The scope of the program requested by the Air Force is as follows: (1) Continue periodic water-level measurements in key observation wells on the Base in order to estimate the status of ground water in storage; (2) continue to interpret chemical analyses of water from Base wells to detect any changes in 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) continue as technical adviser on water-supply problems at Edwards Air Force Base, and (4) 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 and tabulations of water-level measurements, chemical analyses, and other basic data.

The work has been carried on by the Geological Survey, U.S. Department of the Interior, under the immediate supervision of G. M. Hogenson and P. M. Johnston, successive geologists in charge, Long Beach subdistrict office, and under the general supervision of Fred Kunkel, district geologist in charge of ground-water investigations in California.

A description of the well-numbering system is included in Dutcher, Bader, Hiltgen, and others (1962). For convenience of reference, table 1 presents a cross index relating the well numbers used by Edwards Air Force Base with those used by the Geological Survey.

Table 1.--Cross index of Base and Geological Survey well numbers

Base number or name	Abbreviated Base number[1]	USGS number	Basin and ground-water storage unit	Use
			Lancaster basin	
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	--	a
South Track well A	ST-A	8N/10W- 2F1	Main Base	a
D	ST-D	8N/10W- 2N2	Main Base	a
E	ST-E	8N/10W- 1C1	Main Base	b
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	b
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
			North Muroc basin	
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
Test well 4	TW-4	10N/9W- 4D1	North Muroc	b
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.

SUMMARY OF TECHNICAL ASSISTANCE TO THE BASE

The U.S. Geological Survey gave technical aid and advice to Air Force military and civilian personnel concerning water supply at Edwards Air Force Base during the period March 31, 1962, to March 31, 1963, as follows:

1. Data on water-level decline in the Main Base well field were given to the Base engineering group in September 1962. During 4 to 14 years of water-level records, 1948-62, the weighted average decline in the vicinity of the well field was about 35 feet.

2. Conferences were held at Edwards Air Force Base November 30, 1962, and February 12, 1963, to discuss the availability of water from existing wells in the northwest and south parts of the Base. Data on known yields and possible development of additional sources of water were given, and suggestions were made for testing other existing wells that might yield significant amounts of water. Estimates of water-level decline to be expected as a result of prospective pumping of several wells in the south part of the Base also were given.

3. Informal conferences were held at various times during the year regarding the quality of the water from well 9N/10W-16C2 and the fluoride content in water from well 9N/8W-6H1 (EC-2). A letter to the Base Commanding Officer, dated July 16, 1962, contained a brief discussion of chemical analyses of water from these wells.

4. Reports for the area by the Geological Survey were given to the Corps of Engineers as an aid in determining optimum locations for the new NASA well field southwest of East Camp. These four new wells, in secs. 13, 14, 15, and 23, T. 9 N., R. 9 W., yield 1,500 gpm each with drawdown ranging from 8 to 13 feet (U.S. Army Engr. Dist., 1962, p. 3).

5. Rehabilitation work on wells MB-6A, 7, 8, 9, and 11 was begun in February 1963, and occasional technical advice on this work has been given when requested. Data on pumping tests run by the contractor rehabilitating these wells will be available when the work is finished. An evaluation of these data, which should indicate the condition of these wells, will be furnished to the Base when the data are received by the Geological Survey.

GROUND-WATER PUMPAGE

The metered pumpage for the Base during 1962 totaled 4,870 acre-feet (fig. 2), and the monthly pumpage ranged from a February low of

Figure 2. Pumpage from wells at Edwards Air Force Base.

57,082,000 gallons (175 acre-feet) to a July high of 222,190,000 gallons (682 acre-feet). Pumpage for all uses by the Base during 1962, including both metered and estimated pumpage from the various ground-water basins and Base storage units, is shown in table 2. Pumpage records for irrigation and other uses outside the Base during 1962 are not available.

Table 2.--Pumpage from Base wells, 1962

Basin and Well Field	Pumpage[1]	
	1,000 gallons	acre-feet[2]
Lancaster basin		
Main Base wells 6, 7, 8, 9, & 11	961,000	2,950
Main Base wells 1 & 5	25,200	77.3
East Camp wells 1 & 2	292,000	896
Recreation wells[3]	250,000	767
Telemeter Station well 10 & well C-2[4]	494	1.5
South Track wells A & E[5]	4,580	14.1
Subtotal	1,530,000	4,710
North Muroc basin		
North Base wells 1 & 2	4,730	14.5
North Base wells 3 & 4	299,000	918
Total	1,840,000	5,640

1. All values rounded to three significant figures, or the nearest 0.1 acre-feet.

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.

4. Well C-2 replaced Telemeter Station well 10 in September 1962.

5. Well South Track E replaced well South Track A in July 1962.

WATER-LEVEL FLUCTUATIONS

The water-level contour map (fig. 3) shows two principal pumping

Figure 3. Map of Edwards Air Force Base and vicinity, California, showing geology, location wells, ground-water storage units, and water-level contours for March 1963.

depressions in the vicinity of Edwards Air Force Base. The largest is centered about 3 miles southwest of Redman, and the second depression is centered near wells 9N/10W-24E1 and 24F1 in the Main Base well field. Less pronounced pumping depressions are centered near North Base well 3 (11N/9W-32Q1) and in the vicinity of well 9N/8W-6H1 and 6H2 in the East Camp storage unit.

The water level on the Base starts to decline in the early spring and continues to decline until about September, when it begins to recover, as shown by the hydrographs on figure 4. In general, each

Figure 4. Hydrographs of wells 10N/9W-12R1 and 9N/10W-34H1.

succeeding year, for the period of record, the highest annual water level has been lower than the high for the previous year. Similarly, the lowest annual water level also has been lower each succeeding year.

The decline in water level during the period of this report in the North Muroc storage unit generally ranged between 0.2 and 2.32 feet, as indicated by water levels in wells 10N/9W-24A2 and 10N/9W-4D1 (see table 3). Water level in well 11N/9W-34A1 rose 6.1 feet during the year, probably because of decreased use of the well and a decrease in pumping from well 11N/9W-25L1. The pumping of wells 10N/9W-4D2 and 11N/9W-32Q1 caused the largest net decline in the North Muroc storage unit. In the East Camp area, net declines ranged from 1.45 to 4.75 feet; in the Main Base storage unit, the net declines ranged from 0.97 to 6.37 feet; and in and near the Rosamond storage unit, the net declines ranged from 0.96 to 7.27 feet, except well 8N/11W-14R2 where the water level rose 0.17 foot since March 1962.

GROUND WATER IN STORAGE, 1962 AND 1963

The quantity of ground water in storage in 1952 in the ground-water storage units of Edwards Air Force Base (fig. 3) was estimated in the report by Dutcher (1958, p. 40). Table 4 shows the estimate of depletion by years for the period 1952 to March 1963.

Table 4.--Status of ground water in storage, Edwards Air Force Base, 1952-63

Basin and storage unit [1]	Estimated ground water in storage in 1952 [1] (acre-feet)	Estimated ground-water depletion, in acre-feet [2]							
		1952-57 [3]	1957-58 [4]	1958-59 [5]	1959-60 [5]	1960-61 [5]	1961-62 [6]	1962-63	Total 1952-63
Lancaster basin:									
East Camp	310,000	11,000	2,600	2,200	4,300	4,100	3,200	5,100	32,500
Main Base	440,000	17,000	2,400	4,100	3,600	4,000	2,600	5,100	38,800
Rosamond	340,000	11,000	1,900	1,900	4,000	2,500	1,700	3,000	26,000
Subtotal	1,100,000	b39,000	6,900	8,200	11,900	10,600	7,500	13,200	b97,300
North Muroc basin:									
North Muroc	a450,000	1,000	1,000	1,000	1,000	4,000	1,000	2,000	11,000
Total	1,500,000	40,000	7,900	9,200	12,900	14,600	8,500	15,200	108,300

1. Storage units and estimates of ground water in storage from Dutcher and Worts (1958, pl. 12 & table 10).
2. Estimates were made from water-level measurements obtained in the spring of the year.
3. Estimate of depletion from Dutcher (1958, p. 40).
4. Estimate of depletion from Dutcher (1959, p. 47).
5. Estimates of depletion from Moyle (1961, p. 38).
6. Estimate of depletion from Weir (1962, p. 18).

a. Approximately 70 percent within Base.
b. See point plot on figure 5.

The estimated depletion of ground water, between March 1962 and March 1963, is about 15,200 acre-feet (table 4) in the East Camp, Main Base, Rosamond, and North Muroc storage units. This estimated depletion rate is larger than for any previous year for which depletion estimates have been made--exceeding the 1960-61 depletion by 4 percent, or 600 acre-feet, and the 1957-58 depletion by 92 percent, or 7,300 acre-feet.

The total depletion for 1952-63, as shown by table 4, is about 108,300 acre-feet. Depletion in all storage units, except North Muroc, for the same period was 97,300 acre-feet (fig. 5) and is attendant to

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Figure 5. Estimated total depletion of ground water in storage in East Camp, Main Base, and Rosamond storage units.

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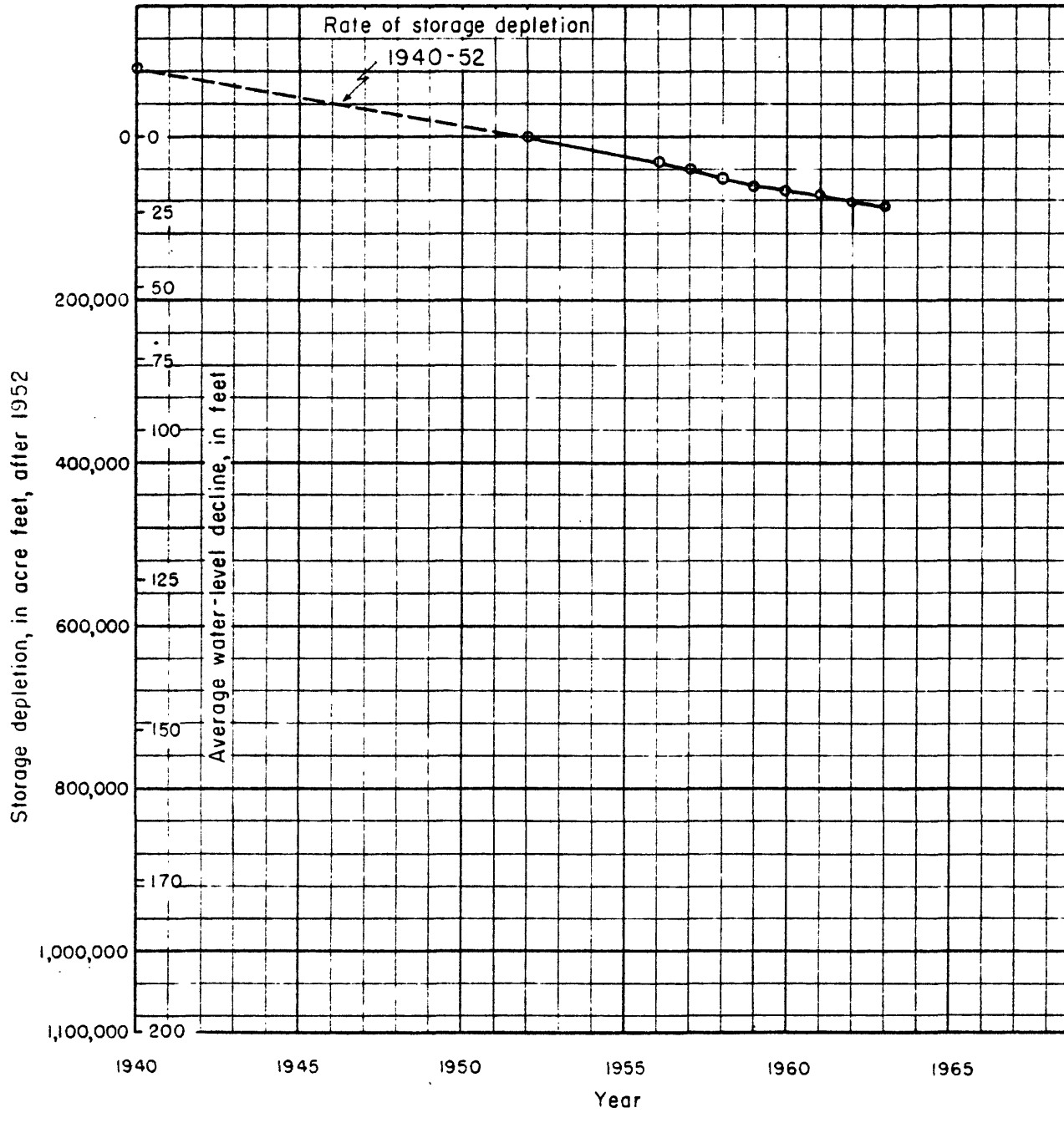
an average water-level decline of 25 feet for the 11-year period.



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

QUALITY OF WATER

Water samples have been collected annually from Base wells for chemical analysis, and results of a few analyses of water from wells off the Base also are available (table 5). Except in the vicinity of wells 10N/9W-7A2 (NB-2) and 9N/10W-16C2 (C-2), the analyses indicate no significant changes in the chemical quality of water on the Base. Potential contaminants are treated sewage effluent returning to the ground water, downward movement of water of inferior quality from shallow water bodies, or migration of water of inferior quality from adjacent local areas. The quality of the water from well 10N/9W-7A2 has deteriorated somewhat during the period of this report (fig. 6), resulting in a continued increase in chloride content. In the Graham Ranch area, the water from well C-2 (9N/10W-16C2) has increased markedly in both chloride and sulfate since 1952, apparently from downward leakage of saline water from a shallow aquifer. Moderately high chloride and sulfate in water from well 11N/9W-26R1, off the Base, indicate a locality where the water is slightly inferior to most of the water from Base supply wells.

Records of chemical analyses made prior to 1962 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).

The analysis of water from North Base well 2 (10N/9W-7A2) indicates an increase of 81 ppm (from 380 to 461 ppm) of chloride between March 15 and October 24, 1962, a period of more than 7 months during which the well was not pumped (fig. 6). A sample collected after 5 hours pumping

Figure 6. Graph showing chloride content of well water, Edwards Air Force Base, California.

March 15, 1962, had 380 ppm of chloride (Weir, 1962, p. 24), and that pumping period followed 48 days during which the well was not pumped. The amount of chloride in the water from North Base well 2 and the spread of chloride contamination in this aquifer apparently depend to some extent upon the length of time the well is idle. Chloride concentration in the aquifer will become progressively higher with continued leakage of salty water into the water body. Occasional pumping would temporarily reduce the chloride concentration, but a means of arresting contamination permanently should be sought.

Water from this well should not be used for drinking because the lowest chloride content recently determined is 461 ppm. A concentration of 250 ppm is the maximum recommended for drinking purposes by the U.S. Public Health Service (1962, p. 7). High concentrations of chloride have not yet spread to well 10N/9W-7A1 at North Base, as shown by the 196 ppm chloride in water from that well.

The fluoride concentration in East Camp well 2 (9N/8W-6H1) was 2.8 ppm on June 1 and October 25, 1962, and has averaged about 2.7 ppm for the entire period of record. Quarterly sampling for observing possible changes in fluoride content in water from this well showed no significant changes, and an annual sampling frequency was resumed as of October 1962.

No other notable changes or conditions of the chemical quality of water from Base wells were observed, except in the Graham Ranch area as discussed in the next section of this report.

SALINE[1] CONTAMINATION IN THE GRAHAM RANCH AREA

Water from well C-2 (9N/10W-16C2), which has been used since July 1962 for nonpotable purposes at the Telemeter Station, contained 465 ppm of chloride and 518 ppm of sulfate in June 1962. Water from this well was of much better chemical quality in 1952 as demonstrated by a partial analysis (Dutcher, Bader, Hiltgen, and others, 1962, p. 207) that showed the chloride content to be 139 ppm. Gradual contamination has taken place, apparently because of leakage passing down the inside or outside of the casing into the main ground-water body from a shallower aquifer containing saline water (fig. 7).

Figure 7. Diagram of selected wells in the Graham Ranch area showing probable mode of saline contamination of the main aquifer.

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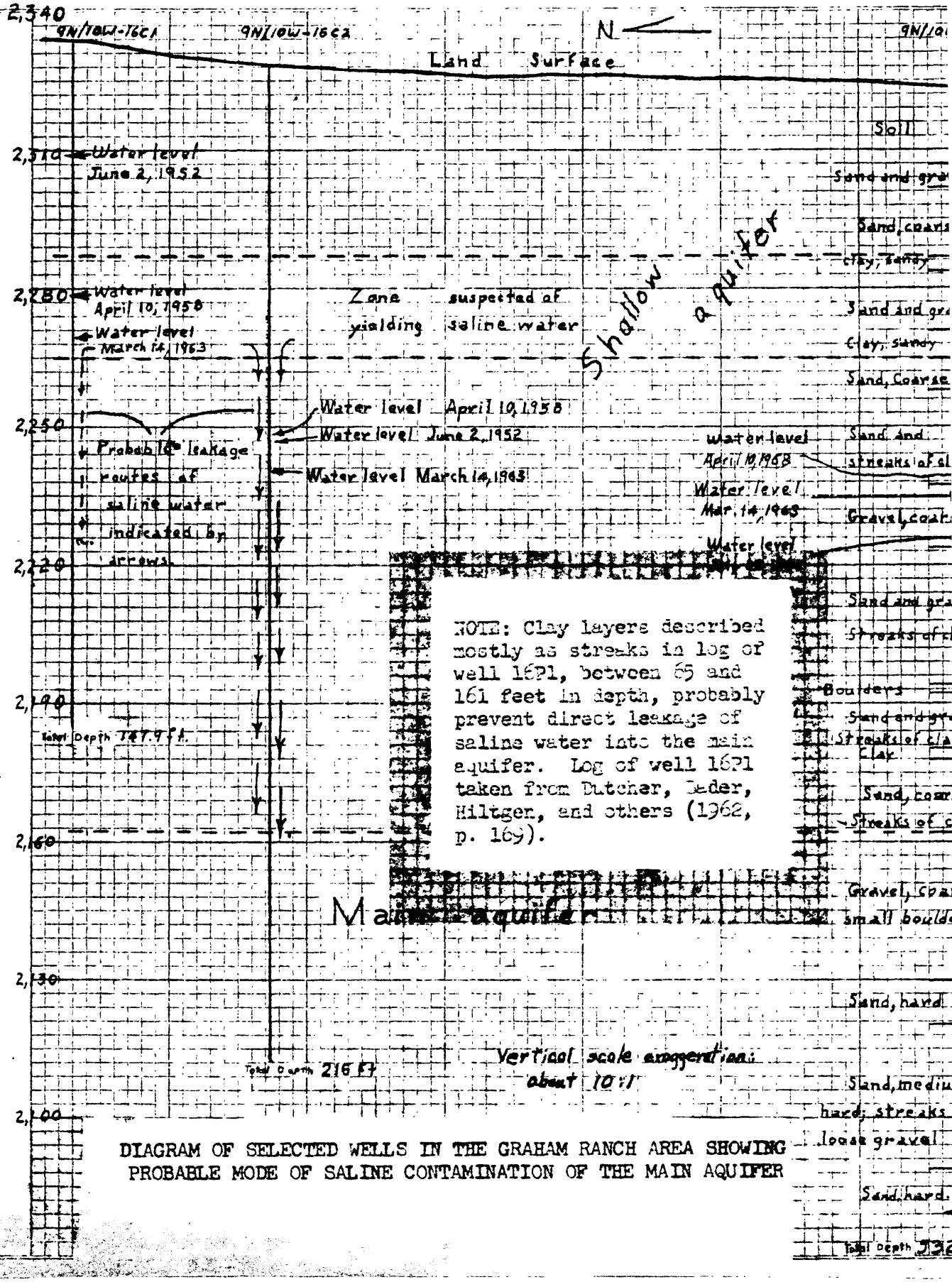
1. Saline water is defined as water containing more than 1,000 ppm of dissolved solids (Winslow and Kister, 1956). "Saline" water may include chloride, sulfate, and other constituents.

U.S. Geological Survey

Figure 7



NOTE: Clay layers described mostly as streaks in log of well 16P1, between 65 and 161 feet in depth, probably prevent direct leakage of saline water into the main aquifer. Log of well 16P1 taken from Dutcher, Leder, Hiltger, and others (1962, p. 169).

DIAGRAM OF SELECTED WELLS IN THE GRAHAM RANCH AREA SHOWING PROBABLE MODE OF SALINE CONTAMINATION OF THE MAIN AQUIFER

(DO NOT USE THIS SPACE EXCEPT FOR BINDING PURPOSES)

The chemical quality of the water from well C-2 improved markedly between samples collected in June and in October 1962 (table 5), mostly as a result of heavy pumping of the well in mid-October just prior to sampling. The contaminated water that had mixed with the better water of the main aquifer was drawn back toward the well when it was pumped, and eventually all the contaminated water might have been withdrawn by extensive pumping. However, leakage of the saline water will continue unless the upper aquifer is sealed off from the well. The depth to the shallow aquifer that yields saline water to well C-2 is estimated to be between 20 and 90 feet. The saline water probably comes from sandy clay layers such as in well 9N/10W-16P1 (fig. 7) to the south, for which a log is available. Logs for wells 9N/10W-16C1 and 16C2 are not known to be available. However, well C-2 is 216 feet deep and well 9N/10W-16C1, to the north, is 147.9 feet deep and yields water principally from the shallower saline aquifer. The shallower aquifer has a higher water level than the main aquifer, and a sample collected in 1958 from well 16C1 had 1,810 ppm of chloride and 720 ppm of sulfate (Dutcher, Bader, Hiltgen, and others, 1962, p. 195).

Chloride content in water from well 9N/10W-16P1 (fig. 6) shows no indication of contamination in this area. Evidently the beds yielding saline water, if they occur at well 16P1, are effectively cased out of this well.

Corroborating evidence can be seen in water-level fluctuations in the area from 1952 to 1958 (fig. 7). These changes show declining levels in the saline aquifer during the same period when water levels rose in the deeper fresh-water aquifer. Decline in the shallower zone is greater than the rise in the deeper zone.

Attempts should be made to learn more about the source of saline water as part of any future drilling in the Graham Ranch area. A means of abating further contamination in the area should be sought and carried out as soon as possible.

REFERENCES CITED

Dutcher, L. C., 1958, Ground-water inventory for 1954-57, Edwards Air Force Base, California: U.S. Geol. Survey open-file typewritten rept., 63 p.

_____1959, Ground-water inventory for 1958, Edwards Air Force Base, California: U.S. Geol. Survey open-file typewritten rept., 69 p.

Dutcher, L. C., Bader, J. S., Hiltgen, W. J., and others, 1962, Data on wells in the Edwards Air Force Base area, California: California Dept. Water Resources Bull. 91-6, 208 p., 2 figs.

Dutcher, L. C., and Worts, G. F., Jr., 1958, Geology and ground-water appraisal of Edwards Air Force Base and vicinity, California: U.S. Geol. Survey open-file typewritten rept., 229 p.

Jenkins, O. P., 1938, Geologic map of California: California Div. Mines.

Moyle, W. R., Jr., 1960, Ground-water inventory for 1959, Edwards Air Force Base, California: U.S. Geol. Survey open-file typewritten rept., 35 p.

_____1961, Ground-water inventory for 1960, Edwards Air Force Base, California: U.S. Geol. Survey open-file typewritten rept., 45 p.

U.S. Army Corps of Engineers, 1962, Report on water-supply investigation and development for three F-1 engine test stands(NASA), Edwards Air Force Base, California: U.S. Army Engineer District, Los Angeles, typewritten rept. Sept. 1962, 3 p., 17 illus.

Weir, J. E., Jr., 1962, Ground-water inventory for 1961, Edwards Air Force Base, California: U.S. Geol. Survey open-file rept., 54 p.

Winslow, A. G., and Kister, L. R., 1956, Saline-water resources of Texas: U.S. Geol. Survey Water-Supply Paper 1365, 105 p.