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WHITE SANDS MISSILE RANGE

1970

A BASIC-DATA REPORT

. UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Albuquerque, New Mexico



Annual water-resources review

White Sands Missile Range

1970

- a basic-data report -

Ву

J. A. Basler

Open file-report

70-49

Prepared by the U.S. Geological Survey, Water Resources Division, in cooperation with White Sands Missile Range

March 1971.

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Introduction

This report presents information on the water resources of the White Sands Missile Range that was collected during the period January 1970 to January 1971 by personnel of the U.S. Geological Survey, Water Resources Division. Data on ground-water pumpage and resulting water-level fluctuation, chemical quality, precipitation, and surface-water runoff are summarized in the report. The data were obtained as a result of the continuing water-resources basic-data collection program sponsored by the Facilities Engineering Division, White Sands Missile Range.

Continuing observations

The program to collect basic data on the water resources of White Sands Missile Range has been continuous since 1953. It has expanded from the original program of water-level observations in five test wells in the Post Headquarters area to the present program of periodic measurements in 15 supply wells and 27 test and observation wells, semi-annual water sampling in 8 test wells, and operation and monitoring of 23 rain gages and 2 runoff stations in widely-scattered areas on the missile range (fig. 1).

This report is the fourth annual water-resources review prepared for White Sands Missile Range. Reports prior to 1967 were in letter form.

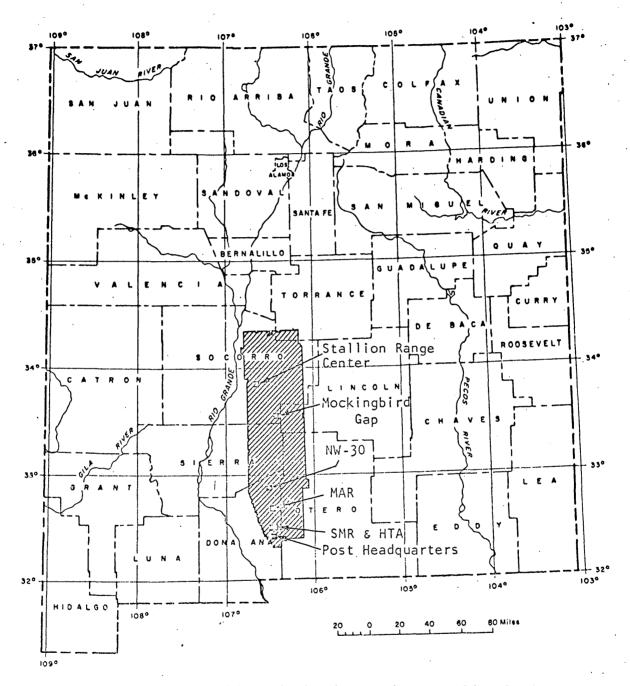


Figure 1.--Areas of hydrologic observations on White Sands
Missile Range, New Mexico.

Pumpage and water-level fluctuations

Total ground-water pumpage at White Sands Missile Range in 1970, according to records furnished by the Facilities Engineering Division, was 923,059,000 gallons. The Post Headquarters well field produced 899,869,000 gallons; MAR-1 and 2, 3,562,000 gallons; SMR-1, 1,336,000 gallons; and SRC-1 and 2, 18,292,000 gallons.

Figure 2 shows pumpage by month and total gallons pumped per year 1961-70 in the Post Headquarters well field. The fluctuation of water level in the Main Gate well (fig. 8) is also illustrated by a hydrograph plotted above the pumpage graph.

Figure 3 shows the combined monthly pumpage of supply wells 17, 18, 19, and 20 in the Post Headquarters well field and water-level fluctuation in test well T-7 (fig. 8). These supply wells are the northernmost wells in the well field (fig. 5), and in 1970 supplied more than half of the total monthly pumpage from the well field.

Test well T-7 is located about 0.7 mile east of the supply wells.

Water-level fluctuations in test well T-7 (fig. 3) are principally the result of withdrawals from the northern part of the well field.

Graphs on figure 4 show water-level fluctuations in test wells T-8,

T-10, and T-11. Hourly water-level fluctuations are recorded in the Main Gate well and in wells T-7, T-8, T-10, and T-11.



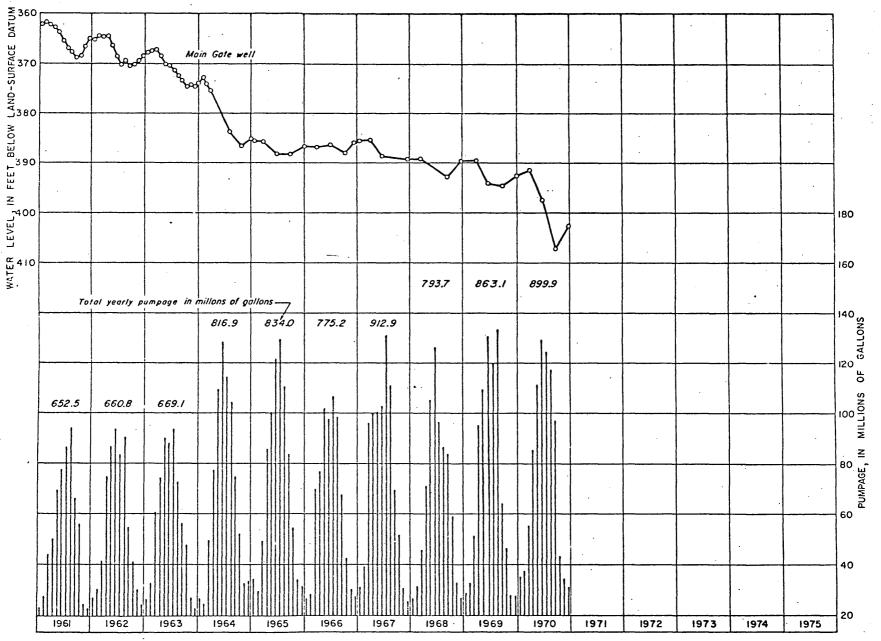


Figure 2.--Monthly and yearly pumpage in the Post Headquarters well field, and water-level fluctuation in the Main Gate well, 1961-70.

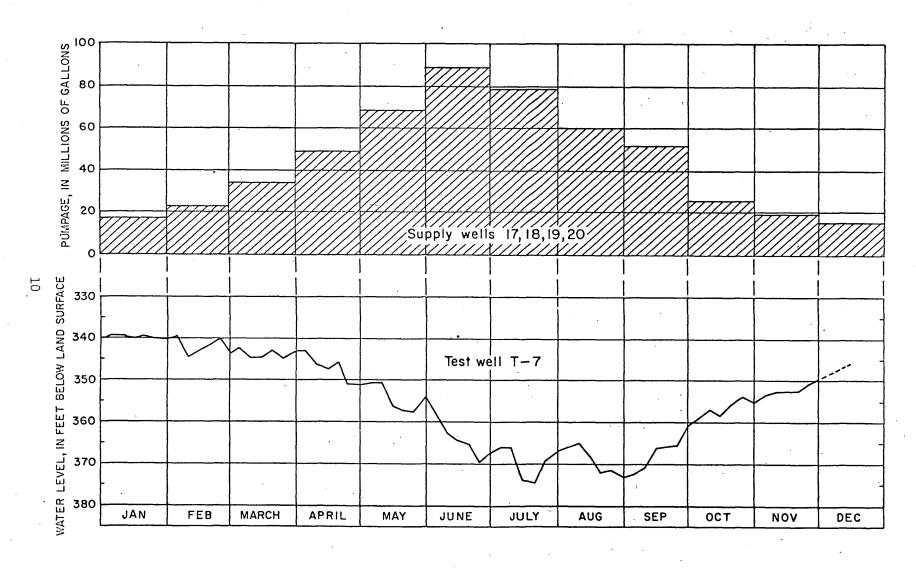


Figure 3.--Combined monthly pumpage of supply wells 17, 18, 19, and 20, and water-level fluctuation in test well T-7, 1970.

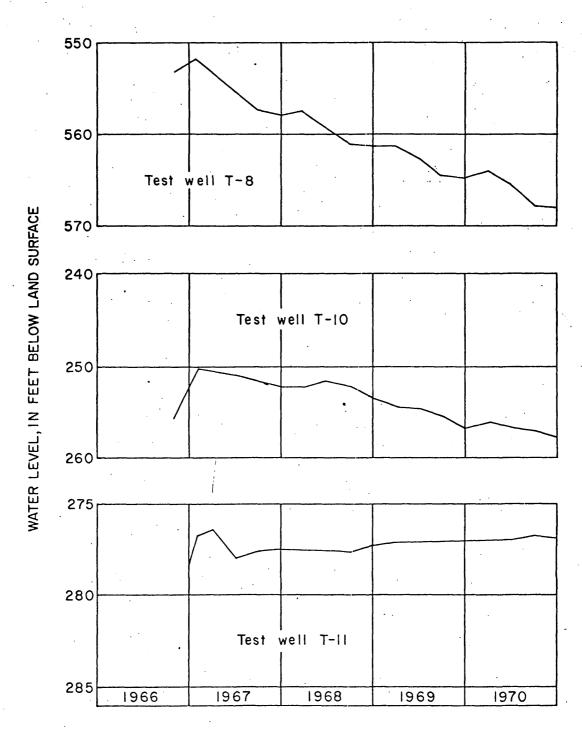


Figure 4.--Water-level fluctuations in test wells
T-8, T-10, and T-11 for period of
available record.

Water-level measurements in supply wells

Annual depth-to-water measurements are made in 9 supply wells in the Post Headquarters well field (fig. 5), 2 supply wells in the MAR area (fig. 6), 1 supply well in the SMR area (fig. 6), and 2 supply wells at Stallion Range Center (fig. 7). The measurements usually are made during January and the change in ground-water storage that has occurred as the result of pumping the supply wells is reflected in table 1 as net change in the depth to water in the wells. The wells were not measured during January 1970; the depths to water and net changes listed in the table are based on measurements made during January 1969 and January 1971.

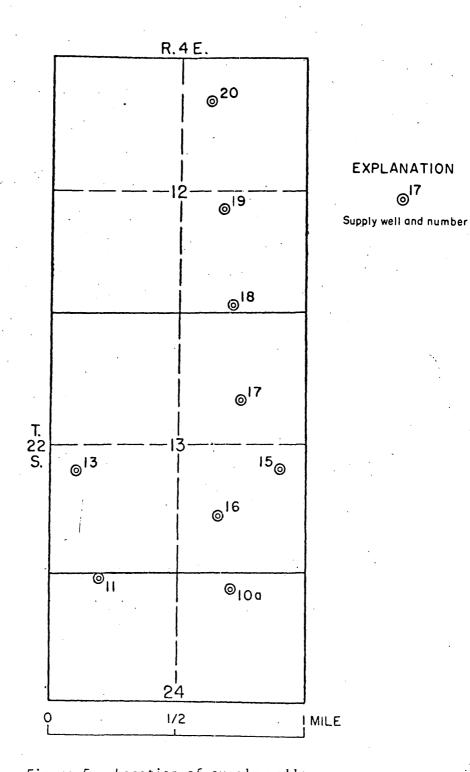
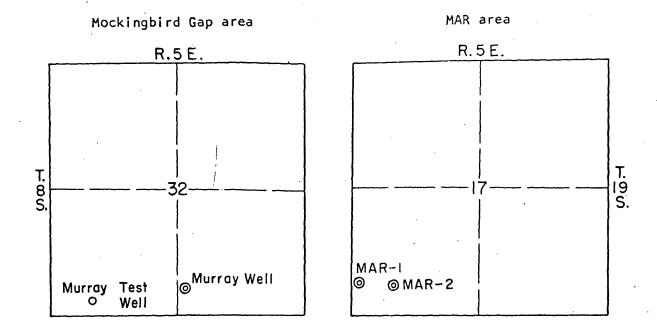
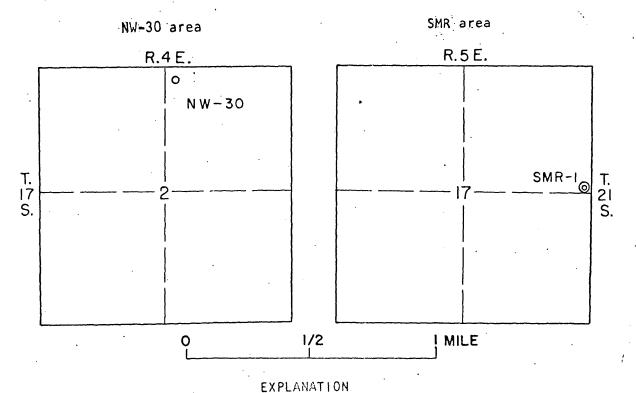


Figure 5.--Location of supply wells,

Post Headquarters well field.





ONW-30
Test well and name
⊚SMR-1
Supply well and name

Figure 6.--Location of test wells and supply wells in Mockingbird Gap, MAR; NW-30, and SMR areas

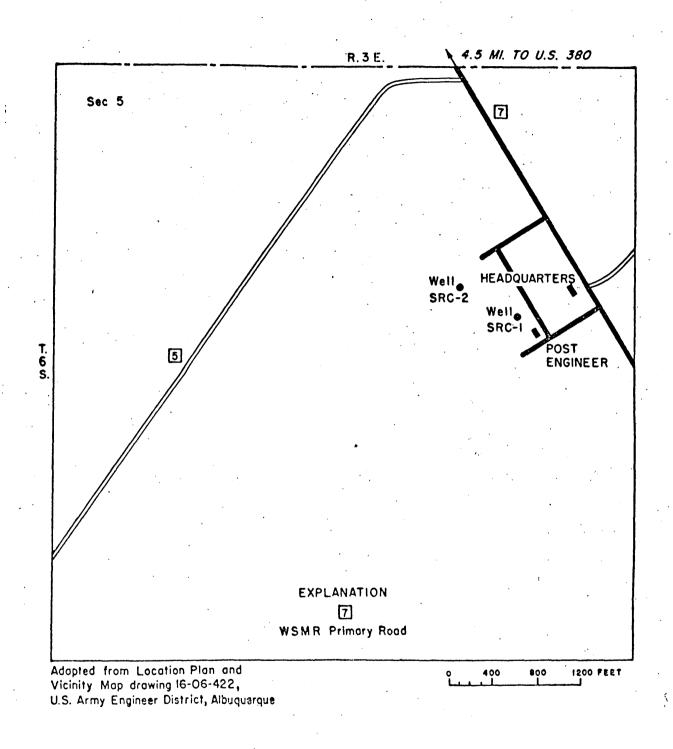


Figure 7.--Location of supply wells, Stallion Range Center.

Table 1.--Depth to water in supply wells, and change of
water level from January 1969 to January 1971

Well no.	Depth to was January 1969	ter, in feet January 1971	Change in water level a/
10a	<u>b</u> /410.0	416.28	- 6.3
11	$\frac{b}{330.0}$	341.54	-11.5
13	$\frac{b}{317.0}$	321.91	- 4.9
15	$\frac{b}{420.0}$	$\frac{b}{420.0}$.0
16	$\frac{b}{430.0}$	$\frac{b}{430.0}$.0
17	$\frac{b}{418.0}$	424.77	- 6.8
18 .	$\frac{b}{405.0}$	411.26	- 6.3
19	$\frac{b}{428.0}$	434.60	- 6.6
20	$\frac{b}{488.0}$	495.14	- 7.1
MAR-1	213.90	214.16	26
MAR-2	213.60	219.96	- 6.36
SMR-1	287.84	<u>c</u> / _{291.95}	- 4.11
Murray wel	1	203.84	
SRC-1		$\frac{d}{205.51}$.·
SRC-2		$\frac{d}{213.07}$	'

 $[\]frac{a}{b}$ /Water-level rise (+) or decline (-), in feet $\frac{c}{a}$ /Air-line gage reading September 1970 February 1971

Water-level measurements in test and observation wells

Quarterly measurements were made in 18 wells at Post Headquarters and adjacent areas, 2 wells in HTA area, 3 wells in the SMR area, 2 wells in the MAR area (fig. 8), 1 well in the NW-30 area, and 1 well in the Mockingbird Gap area (fig. 6). Depth-to-water measurements made at quarterly intervals during 1970 in the Post Headquarters area are given in table 2. Four of the test wells in the Post Headquarters area were equipped with continuous recording gages. Hydrographs prepared from measurements and recording gages on the Main Gate well and test well T-7 are shown on figures 2 and 3 respectively. The change in water level between measurements made at comparable dates in 1969 and in 1970 is shown in table 2.

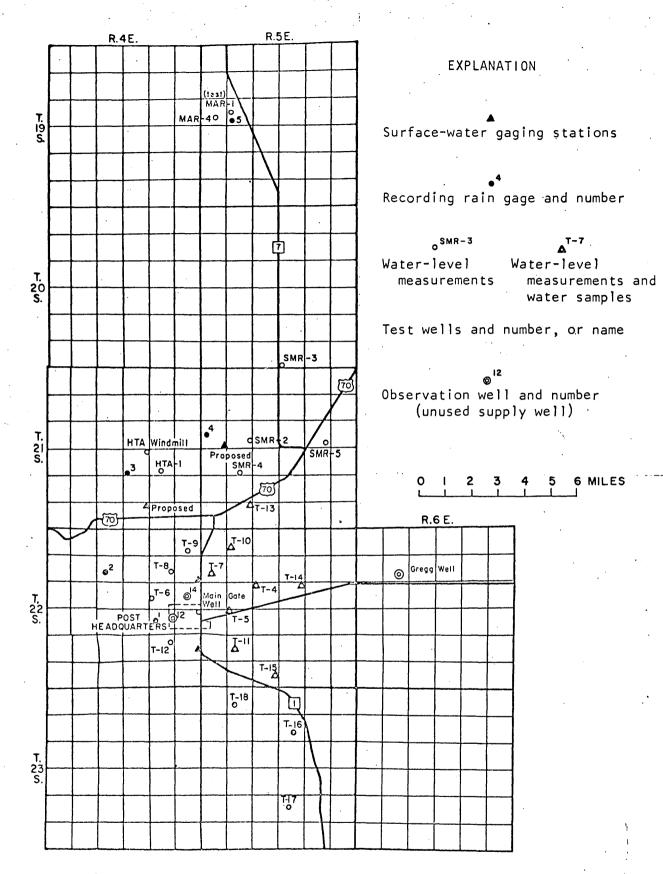


Figure 8.--Location of gaging stations, recording rain gages, test wells, and observation wells at Post Headquarters and adjacent areas.

Table 2.--Depth to water in test and observation wells,

and change of water level in 1970

Well no.	Date of measurement (1970)	Depth to water, in feet below land surface	Change in a/ water level 1969-70	Remarks
T-4	March 25	224.97	- 0.07	
	June 24	225.03	10	
• *	Sept. 24	225.04	29	
	Dec. 15	224.97	+ .06	
T-5	March 25	273.45	68	
	June 25	273.55	80	
	Sept. 24	273.53	93	4
	Dec. 15	273.54	12	
T-6	March 25	206.97	+ .07	
	June 25	207.71	54	
	Sept. 25	207.97	- 1.57	
	Dec. 16	209.08	- 2.04	
T-7	March 23	344.40	- 2.79	Equipped with
	June 23	368.37	54	recorder
	Sept. 24	365.07	-10.38	•
	Dec. 15	345.82	- 4.42	
T-8.	March 24	564.21	- 2.87	Equipped with recorder
	June 23	565.99	- 3.16	
	Sept. 24	568.16	- 3.44	
	Dec. 16	568.22	- 3.66	

a/ -Water-level rise (+) or decline (-), in feet

Table 2.--Depth to water in test and observation wells,

and change of water level in 1970 - Continued

	•			
Well	Date of measurement (1970)	Depth to water, in feet below land surface	Change in <u>a/</u> water level— 1969-70	
T-9	March 24	385.32	- 2.13	
	June 23	385.85	- 2.40	
	Sept. 24	386.25	+ .03	•
	Dec. 16	386.77	- 1.89	
T-10	March 23	256.14	- 1.59	Equipped with recorder
	June 23	256.67	- 1.81	10001 001
	Sept. 24	257.17	- 1.67	
	Dec. 15	257.75	- 1.88	
T-11	March 24	276.96	+ .34	Equipped with recorder
	June 23	276.98	+ .18	20001001
·	Sept. 24	276.76	+ .41	
	Dec. 15	276.90	+ .20	
T-13	March 23	208.73	11	•
	June 23	208.78	+ .22	٠.
	Sept. 24	208,90	+ 1.70	
	Dec. 15	208.78	- 2.04	
T-14	March 24	131.56	0	
	June 23	131.60	10	
	Sept. 24	131.56	+ .04	
	Dec. 15	131.55	+ .05	

 $[\]frac{a}{W}$ ater-level rise (+) or decline (-), in feet

Table 2.--Depth to water in test and observation wells,

and change of water level in 1970 - Continued

Well no.	Date of measurement (1970)	Depth to water, in feet below land surface	Change in <u>a/</u> water level Remarks 1969-70	
T-15	March 24	179.20	+ 0.10	
	June 23	180.20	+ .05	
	Sept. 23	179.22	07	
	Dec. 15	179.07	+ .17	
T-16	March 24	186.75		
	June 23	186.60	+ .25	
·	Sept. 23	190.05	- 3.15	
	Dec. 15	192.44	- 5.76	
T-17	March 24	241.80	· ·	
	June 23	242.15	+ .01	
	Sept. 23	244.83	- 2.84	
	Dec. 15	242.23	18	
T-18	March 24	246.53	· 	
•	June 23	246.37		
	Sept. 23	245.84	+ 1.13	
	Dec. 15	250.02	- 3.27	
01d	March 25	263.71	+ 4.27	
supply	June 24	263.74	+ 4.01	
well 12	Sept. 24	261.21	+ 4.26	
	Dec. 16	261.30	+ 2.35	

a/ Water-level rise (+) or decline (-), in feet

Table 2.--Depth to water in test and observation wells,
and change of water level in 1970 - Continued

Well no.	Date of measurement (1970)	Depth to water, in feet below land surface	Change in water level—/ 1969-70	Remarks
01d	March 25	399.55	. 	Quarterly water level measurements
supply	June 25	407.92		began March 1970
well 14	Sept. 24	395.48		
	Dec. 16	397.50	450 450	
Main	March 24	391.45	- 1.66	
Gate	June 25	397.44	- 3.09	
well	Sept. 24	407.04	-12.64	N _i
	Dec. 16	402.68	-10.22	
Gregg well	Jan. 27	. 20 214 <i>-</i> 55	 ·	Quarterly water level measurements began January 1971
HTA 1				Well equipped with
		-		submersible pump; no access for measurements
НΓА	Dec. 16	46.55	+ 1.40	
windmill				
SMR-2	March 25	309.22	12	
	June 25	309.65	55	
	Sept. 25	310.19	- 1.69	
	Dec. 16	310.57	- 1.24	
SMR-3	March 25	297.68	36	Well equipped with
	June 25	298.40	- 1.07	submersible pump

a/Water-level rise (+) or decline (-), in feet

Table 2.--Depth to water in test and observation wells, and change of water level in 1970 - Concluded

Well	Date of measurement (1970)	Depth to water, in feet below land surface	Change in water level a/ 1969-70	Remarks
SMR-4	March 25	276.22	- 0.70	
	June 25	276.59	- 1.09	
	Sept. 25	277.05	+ 1.95	•
	Dec. 16	277.19	- 1.02	
MAR-1 (Test)	Jan. 7	221.65		
	March 25	221.25	0	
	June 25	221.09	+ .21	
	Sept. 25	221.21	+ .69	
	Dec. 16	221.02		
MAR-4	Jan. 7	304.05	: 	•
	March 25	304.13	28	
	June 25	304.00	+ 3.80	
-	Sept. 25	304.10	28	
	Dec. 16	303.96	-	
NW-30	Jan. 7	211.14		
	March 23	211.05	+ .90	
	June 25	211.13	18	
	Sept. 25	211.30	12	
	Dec. 16	211.21		
Murray test well	Feb. 2 <u>b</u> /	176.40	<u>c/</u> 95	

 $[\]frac{a}{b}$ /Water-level rise (+) or decline (-), in feet $\frac{b}{c}$ /February 2, 1971 Change in water level March 1969 to February 1971

Chemical quality

The water-sampling program was expanded in 1970 to monitor any changes in chemical quality of ground water that may occur in the area east of the Post Headquarters well field (fig. 8). Test well T-15 was added to the eight test wells (T-4, T-5, T-7, T-10, T-11, T-13, T-14, and T-15) sampled in 1969. Chemical analyses of water samples collected during 1970 are given in table 3.

Table 3.--Chemical analyses of water from test wells,

Post Headquarters area, 1970

U.S. DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

Analyses by Geological Survey, United States Department of the Interior

9-268 q (milli	lgrams pe	r liter))			
Test well	T-4	T-4	T-5	T-5	T-7	T-7
Laboratory No	667932	710932	667933	710933	667934	710930
Date of collection Depth sampled (feet) Sounded depth of well (feet)	6-24-70 250 	12-15-70 300 336	6-24-70 325 350	12-15-70 330 352	6-24-70 600 	12-15-70 812 968
Silica (SiO ₂)	19	21	36	35	28	30
Iron (Fe)				 .	 ·	
Manganese (Mn)						
Calcium (Ca)	19 3.5 26	20 4.4 26	36 6.8 30	36 9.2 27	34 3.6 74	27 5.5 34
Bicarbonate (HCO ₃) Carbonate (CO ₃) Sulfate (SO ₄) Chloride (Cl) Fluoride (F) Nitrate (NO ₃)	71 0 42 12 .4 .0	70 0 42 15 .4 2.2	111 0 57 16 .3	110 0 59 20 .4 7.0	124 0 103 30 .5 9.0	112 0 44 14 .5 6.8
Dissolved solids Calculated	157 62 4 	165 68 10 	249 118 27 	248 128 38 	343 100 0 	217 90 0
Specific conductance (micromhos at 25°C) pH Color SAR Temperature (°C)	247 8.0' 48 	262 8.1 46 23	370 8.0 36 	373 8.1 31 24	527 7.9 62 	324 8.1 45 26

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Table 3.-- Chemical analyses of water from test wells,

Post Headquarters area, 1970 - Continued

U.S. DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

Analyses by Geological Survey, United States Department of the Interior

22.1.0.1, 202 2, 200108-0	- , o , , , , , , , , , , , , , , , , , , ,				410 21001	
9-268 q (mill	igrams p	er liter	·)·	·	· · ·	•
7-268 q (mill	T-10	T-10	T-11,	T-11	T-13	T-13
Laboratory No	667936	710929	667935	710934	667937	710935
Date of collection Depth sampled (feet) Sounded depth of well (feet)		12-15-70 530 544	6-24-70, 400 	12-15-70 550 577	6-24-70 400 	12-15-70 500 521
Silica (SiO ₂)	1	34	38	29	35	36
Iron (Fe)					`	
Manganese (Mn)			v			
Calcium (Ca)	7.8	33 8.6 24	34 5.1 24	28 6.3 27	52 12 34	50 5.6 50
Bicarbonate (HCO ₃) Carbonate (CO ₃) Sulfate (SO ₄) Chloride (Cl) Fluoride (F) Nitrate (NO ₃)	0 43	126 0 43 12 .3 4.5	117 0 44 8.5 .3 4.6	110 0 44 12 .3 1.0	149 0 80 28 1.0 8.0	148 0 80 29 .9 9.0
Dissolved solids Calculated	228 122 10 	221 118 14 	216 106 10	202 96 6 	323 179 57 	334 148 26
Specific conductance (micromhos at 25°C) pH Color SAR Temperature (°C)	343 8.0 31 	331 8.2 31 25	317 7.6 33 	292 8.0 38 23	499 7.7 30 	485 8.1 42 24.5
					į	

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Table 3.--Chemical analyses of water from test wells,

Post Headquarters area, 1970 - Concluded

U.S. DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

Analyses by Geological Survey, United States Department of the Interior

9-268 q (mill	ligrams p			·	the Inter	101
Test well	T-14	T-14	T-15			
Laboratory No	667938	710931	710936		,	
Date of collection Depth sampled (feet) Sounded depth of well (feet)	6-24-70 300 312	12-15-70 300 316	12-15-70 400 445			,
Silica (SiO ₂)	1.7	2.3	5.1			
Iron (Fe)	1		<u></u>			
Manganese (Mn)						
Calcium (Ca)	:6.0	8 2.4 583	51 2.2 133			
Bicarbonate (HCO ₃) Carbonate (CO ₃) Sulfate (SO ₄) Chloride (Cl) Fluoride (F) Nitrate (NO ₃)	78 8 374 565 .6 .0	50 20 380 585 .6	.0 16 137 179 1.0			
Dissolved solids Calculated	 57	1,610 30 0 	525 136 108 			
Specific conductance (micromhos at 25°C) pH Color SAR Temperature (°C)	2,730 9.0 95 	2,780 9.4 98 23	921 10.0 68 23			

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Precipitation

Measurements of precipitation were made in 18 non-recording and 5 recording rain gages in the Post Headquarters and MAR areas (fig. 8) during 1970. Locations of non-recording gages are not shown because these gages are subject to relocation owing to construction activities on the missile range, or for the purpose of obtaining more complete coverage. Monthly measurements and yearly totals of precipitation recorded by these gages are listed in table 4.

Non-recording gages 8, 9, 10, 11, and 21 were repeatedly molested and destroyed during 1970 to the extent that monitoring at these sites was discontinued. New locations for these gages are being considered and monitoring is expected to resume by March 1971.

Table 4.--Precipitation record, 1970, White Sands Missile Range

No.	Location	T					Non-rec	ordina	90000					1
		Jan.	Feb.	Mar.	Apr.	May	June	July		Sept.		Nov.	Dec.	Total
17	T. 21 S., R. 4 E. SE'NE'SE' Sec. 10	0	0	0.84	0	0	0.10	2.00	0.35	0.31	0	0	0.34	3.94
18	NEWNWWSEK Sec. 14	0	0	.70	0	0	0	1.80	.22	. 24	0.20	0	.40	3.56
15	SWkSWkNEk Sec. 21	0	0	.90	0	0	0	1.80	.46	.36	.24	*	*	3.76
16	NEWNEWNEW Sec. 22	0	0	.80	0	0	0	2.00	.40	.05	.21	0	.15	3.61
14	NEWNEWSEW Sec. 25	0	0	.48	0	0	0	2.80	.30	.19	.20	0 "	.36	4.33
13	NEKNEKSWK Sec. 27	0	0	.70	0	0	0	2.00	0	.22	.13	*	.22	3.27
11	NWkNWkNWk Sec. 32	0	0	*	*	*	*	*	*	*	*	*	*	
12	NEKNWASWA Sec. 32	0	0	.75	0	0	0	1.65	.31	.34	.22	0	.16	3.43
10	SE'sSE'sSW's Sec. 32	0	0	*	*	*	0	*	*	* .	*	*	*	
9	NEWNEWSWW Sec. 33	0	0	0	0	0	0	*	*	.17	0	0	:31	.489
	T. 21 S., R. 5 E.								_			Ì		
21	SEKSEKNEK Sec. 17	*	*	*	*	*	*	*	*	0	*	*	*	
8	T. 22 S., R. 4 E. SEKNWKNWK Sec. 2	. 0	0	0	0	0	0	*	*	*	*	0	.26	ر <u>ه</u> 26.
7	NEWNEWNWW Sec. 10	*	*.	*	*	0	.15	3.05	.38	0.	.17	0	.20	3.954
6	NW4NW4SW4 Sec. 11	0	0	.40	0	0	.15	3.00	.41	0	0	0	.35	4.31
1	SEKSEKSEK Sec. 11	0	0	.50	0	0	0	2.90	.56	σ	.04	0	.36	4.36
4	NEWNEWNEW Sec. 22	. 0	0	.65	0	0	0	3.40	.15	0	.10	0	.34	4.64
3	T. 22 S., R. 5 E. NE\sw\4SW\4 Sec. 25	0	0	.66	0	0	0	2.95	.11	0	0	0	.50	4.22
2	T. 23 S., R. 5 E.	0	0 .	.86	0	0	0	4.65	.70	.37	.30	0	.58	7.29
*Gage destroyed during months indicated. *Partial record Recording gages														
5	T. 19 S., R. 5 E. SW\2SW\2SW\2 Sec. 17	0	0	0.44	0	0	0	4.:	12	0.48	Ó	o	0.62	5.66
3	T. 21 S., R. 4 E. NEWNEWSEW Sec. 22	0	0	.84	0	0	0	3.04	0.19	.21	0	.02	.36	4.66
4	T. 21 S., R. 5 E. SELSELNWL Sec. 18	0	0	.85	0	0	0	4.0	I 04 I		0	0.06	.50	5.45
2	T. 22 S., R. 4 E. NELNELSW4 Sec. 9	0	.0	.66	0	0	0	1.51	.88	.25	.74	.03	.61	4.68
1	SEKNWKNWK Sec. 23	0	0	.82	0	0	0	.76		1.62		.02	.56	3.78

Surface-water runoff

Measurements of runoff made at the two gaging stations in the Post Headquarters area during 1970 are given below:

Location	USGS Station no.		ge events (cfs-days)
One mile north of Main	8-4862.5	10-21	0.70
Gate on WSMR Primary Route No. 1		10-22	.40
		7-25	1.10
		7–27	4.5
		7-28	.31
	Total discharg	e cfs-days	7.01
	Total acre-fee	t	14.00
One and a half miles	8-4862.6	10-21	.22
south of Main Gate on WSMR Primary		10-22	.11
Route No. 1		6-30	.23
		7–23	1.00
		7-25	9.50
		7-27	4.40
		7-28	.05
		8.5	15.0
	Total discharge	e cfs-days	30.51
	Total acre-fee	t	61.00

Summary

Ground-water pumpage at the Post Headquarters well field was 36,718,000 gallons more in 1970 than in 1969. Pumpage decreased 812,400 gallons at SMR-1, and 1,784,100 gallons at MAR-1 and 2. Total pumpage from these three well fields was 904,767,000 gallons, or 34,121,500 gallons more than in 1969.

Water-level declines, ranging from 4.9 feet in well 13 to 11.5 feet in well 11, occurred in 7 of the 9 supply wells in the Post Headquarters well field during the period January 1969 to January 1971. No decline was observed in supply wells 15 and 16; measurements in these wells were obtained from air-line gage readings. Probably the gage-line readings were inaccurate, as water-level decline similar to those measured in nearby wells should have occurred in wells 15 and 16.

Declines of water level were observed in the MAR and SMR wells. The water level in MAR-1 was 0.26 feet lower in January 1971 than in January 1969; the water level in MAR-2 was 6.8 feet lower. The water level in SMR-1 was 4.11 feet lower in January 1971 than in January 1969.

Depth-to-water measurements made at quarterly intervals in test and observation wells during 1969 and 1970 indicate that declines of water level occurred in all wells located within a radius of about 1 mile from the approximate center of sec. 13, (see fig. 5) which is near the middle of the Post Headquarters well field. The magnitude of observed water-level changes was the greatest in test well T-7, and in the Main Gate well. The water level in the Main Gate well was 10.22 feet lower in December 1970 than in December 1969, and was 4.42 feet lower in test well T-7.

The water Level in test wells more than 1 mile from the Post Headquarters well field fluctuated seasonally, but, with the exception of test wells T-16 and T-18, remained about the same in 1970 as in 1969. The reason for the declines in T-16 and T-18 is not clear as both test wells are several miles from the well field.

Water-level declines of slightly more than 1 foot occurred during 1970 in the three test wells in SMR area.

The chemical quality of water samples collected during 1970 was similar to that of samples collected from the same sources during 1969. The specific conductance of samples collected in December 1969 and 1970 is compared in the following table.

	Specific	conductance
Test well	1969	1970
T-4	242	262
T-5	373	373
T-7	341	324
T-10	348	331
T-11	316	292
T-13	522	485
T-14	2,580	2,780

Recorded precipitation in the Post Headquarters area in 1970 varied from a low of 4.22 inches to a high of 7.29 inches, as compared with a low of 6.78 inches, and a high of 10.57 inches in 1969 (totals shown are for gages with a recorded reading for each month of the year). Precipitation amounts were recorded in nearly all gages during March, July, August, and December.

Surface-water runoff amounts of 14 acre-feet, and 61 acre-feet were recorded in 1970 at the gage 1 mile north of the Main Gate, and 1.5 miles south of the Main Gate, respectively. During 1969 the runoff at the north gate totaled 132 acre-feet; 96 acre-feet were recorded at the south gage.