UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

THE GROUND-WATER RESOURCES OF COW VALLEY NEAR IRONSIDE, MALHEUR COUNTY, OREGON

By

S. G. Brown
and
R. C. Newcomb

PART I - COMPILATION OF DATA

PART II - INTERPRETATION AND CONCLUSIONS

Prepared in cooperation with the Oregon State Engineer

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PART I

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COMPILATION OF DATA ON THE GROUND-WATER RESOURCES OF COW VALLEY NEAR IRONSIDE, MALHEUR COUNTY, OREGON

INTRODUCTION

Scope and Purpose of This Compilation

Since 1950 the Portland office of the Ground Water Branch, as a part of its data-collection project in cooperation with the Oregon State Engineer, has maintained observations on water levels in wells and has collected current data on wells in Cow Valley. Upon request from the State Engineer, a more extensive net of wells was used for measurements of water levels in 1954 and 1955; a barometric traverse was run to determine the altitudes of the wells, a geologic reconnaissance was made, data were collected from short-term pump-capacity tests in 1955, and a planimetric map of the area (pl. 1) was prepared.

The purpose of this report is to put the collected data together in one place.

Location and Size of the Area Concerned

Cow Valley is the name commonly applied to the upper part of the valley of Cow Creek, a tributary of Willow Creek. The valley is a saucer-shaped upland basin about 50 square miles in area (pl. 1). It has a maximum length of about 12 miles in a general west-east direction and a maximum width of about 8 miles. It lies about midway between the towns of Ironside and Brogan in the northern part of Malheur County. The plain of Cow Valley lies in 2 main compartments whose surfaces are continuous one to the other. The western and higher section is commonly referred to as the upper part and the long rectangular extension to the east is called the lower part of the Cow Valley plain.

Physiographic Characteristics of the Valley

Cow Valley is a part of the upper Cow Creek basin which is typical of mountain basins that owe their shape to folding and faulting of the bedrock followed by erosion and the accumulation of alluvium to create a sloping plain in the central down-warped part of the basin. The alluvial plain of Cow Valley slopes from the west, south, and north. It descends about 50 to 200 feet to a central west-east axis. The central axis of the plain ranges in altitude from about 3,900 feet near the west end to 3,850 feet at the east end.

The valley floor consists of a central plain, a general smooth and gentle surface underlain by fine-grained soils, and the adjoining alluvial slopes. The alluvial slopes are characterised by steeper gradient, stony soils, and arroyo-marked surfaces and extend up to the bedrock exposures of the hill lands (pl. 1). The alluvial valley floor lies to the north side of the drainage basin, being in most places within a mile of the northern dibide but lying mostly from 2 to 4 miles from the southern ~~divide. The drainage divide stands~~ 50 to 100 feet above the valley floor on the east and west, 100 to 400 feet on the north, and 300 to 900 feet on the south. Above the alluvial plain the eroded bedrock slopes extend to the drainage divide.

On the north and west the bedrock uplands consist mostly of a single slope which continues up to the drainage divide, but on the south the uplands are more extensive and include several small fault-block mountains which lie entirely within the drainage basin. Some of these mountains are steep and pointed, but most are flat-topped, plateau-like uplands. The highest reach an altitude estimated to be about 5,000 feet.

Only during periods of unusually heavy runoff does Cow Creek flow entirely through the valley. During the winter and spring periods upper Cow Creek discharges water onto the alluvial slope near old Bonita. Its distributary channels seldom carry water as far down valley as secs. 10 and 11, T. 15 S., R. 40 E. During the drier parts of most years upper Cow Creek carries less than 50 gallons of water per minute and does not flow beyond old Bonita. Numerous other intermittent creeks in the arroyos (not shown on pl. 1) in the southwest and south parts of the basin discharge spring runoff to the alluvial slope but in most years do not reach Cow Creek in the valley plain. Below the highway crossing in secs. 5 and 8, T. 15 S., R. 41 E., lower Cow Creek carries some water throughout most years. It drains along the north edge of the narrow eastern segment of the valley floor, passes through a gap in an old earthen dam at a bedrock constriction in sec. 5, and a mile farther north at an altitude of about 3,840 feet, flows into a narrow bedrock coulee toward Willow Creek. At times in the summers of recent years the writers have observed the creek below the highway bridge carrying several cubic feet of water per second from wastage by the Crow and Holloway irrigation operations. Unpublished records in the office of the State Engineer, for a gaging station near the mouth of Cow Creek, show that the discharge totaled about 390 acre-feet of water in calendar 1912 and about 372 acre-feet in calendar 1913.

Climatic Information

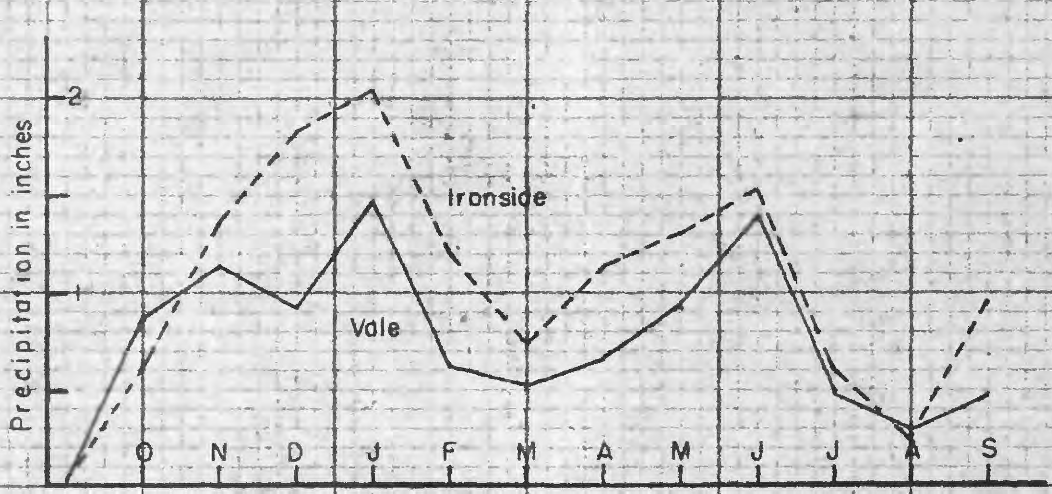
The valley lies in an arid region whose climate is characterized by dry, warm summers, more humid cool winters, and a precipitation that increases with greater altitude.

Cow Valley itself has had no weather observation station. Some short-term records were kept at Ironside about 7 miles northwest of the valley. For the period July 1909 to December 1915 the average annual precipitation at Ironside was 13.49 inches. Such an amount may be indicative of the precipitation received on the floor of Cow Valley during that period. Plate 2 gives the observed precipitation at Vale 37 miles southeast of, and 1,640 feet lower in altitude than, Cow Valley. The average annual precipitation for the years 1891 to 1954 inclusive at Vale is 8.42 inches. Plate 3 compares the monthly average precipitation at Vale with that at Ironside for the period July 1909 to December 1915. Plate 3 also shows the monthly average precipitation at Vale for the period 1891 to 1954 and shows that 77.4 percent of the total falls in the period October 1 to April 30. Of the 22.6 percent falling in the growing season, only 0.08 inch comes during the period July 1 to September 30.

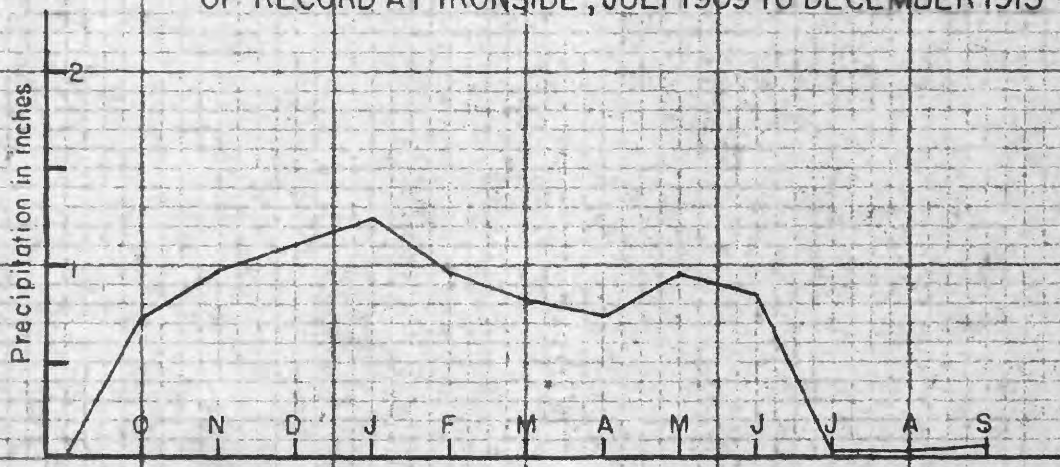
Well-Numbering Systems

In this paper use is made of both the local system of identifying the wells by the name of the owner in consecutive order of their construction (as Crow No. 8, Holloway No. 3, and Davis No. 4) and the Geological Survey system based on the location in township, range, section, 40-acre tract and the order of description within the 40-acre tract.

PLATE 3



MONTHLY AVERAGE PRECIPITATION AT IRONSIDE
AND VALE, OREGON COMPARED FOR THE PERIOD
OF RECORD AT IRONSIDE, JULY 1909 TO DECEMBER 1915



MONTHLY AVERAGE PRECIPITATION AT VALE, OREGON
FOR THE PERIOD OF RECORD, DECEMBER 1891 TO
SEPTEMBER 1954

In the Geological Survey system, each well is designated by a symbol which indicates its location according to the official rectangular survey of public lands. For example, the symbol 15/40-2Q1 refers to a well in sec. 2, T. 15 S., R. 40 E. The letter after the section number refers to a 40-acre subdivision of the section according to the following diagram, and the number 1 to the first well visited in that particular 40-acre tract.

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

General Nature of the Data Collected

The information consists of records of the levels of water in wells, in both static and dynamic conditions, barometric altitudes of the land surface at the wells, capacities of the pumps on some of the wells, drillers' logs of the wells, and geologic observations of the earth materials that crop out and are penetrated by the wells.

DATA COMPILATION

Well Data

The information on the wells is annotated in table 1. The columns give the well number, barometer altitude, diameter and depth of casing, depth to and thickness of the aquifers, the first recorded water level, type of pump and use of the water, and pertinent references to further data.

Subsurface Strata

The available drilling logs are given in table 2. Stratigraphic headings have been inserted by the Geological Survey to indicate the main grouping of the earth formations. Data on well casing, water levels, and pumping tests are copied from the drillers' records on file with the State Engineer.

Geologic Character of the Valley

The region in which the valley is located is largely formed by partly metamorphosed rocks of sedimentary and igneous origin and of Triassic and Jurassic age. Those rocks are shown at Triassic and Jurassic rocks of Blue Mountains, Oregon on the U. S. Geological Survey map of the United States, scale 1:2,500,000, 1932. They crop out in the hill slopes and road cuts on all sides of Cow Valley. The older rocks contain many older sets of shear planes, faults and displacements that are not present in the overlying lava rocks. The base of the older rocks is not exposed near Cow Valley. Overlying those older rocks is a generally prevalent stratum of lava rocks and volcanic-sedimentary materials (tuffs and agglomerates). The lava rock and volcanic fragmentary materials are visible in thicknesses up to a maximum of about 300 feet and are present over the older rock on all sides of Cow Valley. The volcanic rocks originally formed in a cap rock position over the older rocks. The older bedrocks and the lava rock were folded and faulted during the tectonic epoch that gave the skeletal structure of Cow Valley. On the north, south, east, and west sides of the valley plain the volcanic stratum dips toward the valley plain and disappears beneath the valley alluvium, the surface of which forms the plain. Plate 1 shows some of the places where the easily accessible outcroppings of the older rocks and the lava rock can be examined.

The unconsolidated alluvium underlies the lower slopes of the valley and extends to several hundred feet in depth at places beneath the valley plain. Where visible in the ravines of the valley slopes the alluvium consists of rock rubble, rubbly sand and gravel, and silt. In the valley-floor area the exposed material is largely silt and poorly rounded sand and gravel. Below the highway crossing over Cow Creek (in secs. 5 and 6, T. 15 S., R. 41 E.) the alluvium immediately below the surface is a silt and clay that is of relatively low permeability compared to the alluvium higher in the valley.

The older bedrocks of Triassic and Jurassic age are shale, argillite, slaty shale, shaley sandstone, quartzite, and other relatively impermeable material. In the one well (Crow No. 9) whose record shows that it was drilled a substantial depth into these older bedrocks, only a little water-bearing material was encountered in the older bedrock and the water was much warmer than the water in the overlying lava rocks and valley alluvium.

The lava rock and its associated volcanic-sedimentary materials contain pervious zones. Of the wells that have penetrated this material beneath the valley alluvium, most of them have obtained large yields of water from permeable zones in the lava rock.

The drillers' logs show that the alluvium beneath the valley plain contains layers of sand and rubbly gravel that are water-bearing where they occur below the level of the water table.

Levels of the Ground Water

The upper surface of unconfined ground water is called the water table. The variations in altitude of the top of the saturated zone can indicate many significant factors of the natural ground-water regimen and many significant features induced by diversions from its natural conditions.

The records of the levels of water in the wells of Cow Valley are shown on the drillers' logs, in table 4, and the graphs (pls. 4 and 5). The drillers' records do not show any changes in the static water level during the time of drilling in wells that penetrate the valley alluvium and the lava rock--they likewise show no changes during drilling in the well that penetrates deeply into the older bedrock (Crow No. 9).

Observations made on water levels to date in Cow Valley are listed in table 4.

Water Yields of the Wells

The yields of 9 wells are shown on plate 9 for short-term tests. The yields of Holloway Nos. 1 and 2, Locey No. 1, and Davis Nos. 1 and 2 were approximated from the estimated rates of water discharge from the pumps. Only these 14 wells were equipped with large pumps in July of 1955.

The discharge of each of the Crow wells 1 through 9 was determined by measuring the head on a Cipoletti-type weir plate constructed of sheet metal and bolted to a concrete headwall. The head on the weirs was measured by means of a staff gage set back from the upstream face of the weir a distance of at least 5 times the depth of the head on the weir. The drawdown in the wells was measured by the wetted-tape method and was read to the nearest one hundredth of a foot below the measuring point. Where, due to water returning down the casing, it was not feasible to use the wetted-tape method, an electric tape or the owner's air-line gage was used. The electric tape was read to the nearest hundredth of a foot and the air-line gage to the nearest foot or the least division on the face of the gage.

Some of the wells could not be entered for measurement of water level and only the rate of water discharge was measured.

Pumpage of Water From Wells

Table 6 shows the yearly and the total pumpage of the wells in Cow Valley. The pumpage for the Rankin Crow wells in Cow Valley was calculated by using the discharge rate of each well as obtained during the capacity tests of May 1955. The total duration of pumping during the first part of the 1955 irrigation season was obtained from reports of the operators. The power consumption in kilowatt hours was taken from the meter for each pump. Thus the number of acre-feet pumped per kilowatt hour by each well was established. Using the calculated value for the acre-feet of water per kilowatt hour of electricity, the pumpage for previous years was calculated with the assumption that the discharge rate as established by the capacity tests of the Crow wells and the rough measurement of the discharge rate of the other wells was the average discharge for the period of time considered.

Quality of the Ground Water

Table 3 gives the results of chemical analyses and the temperature of the water from some irrigation wells in Cow Valley.

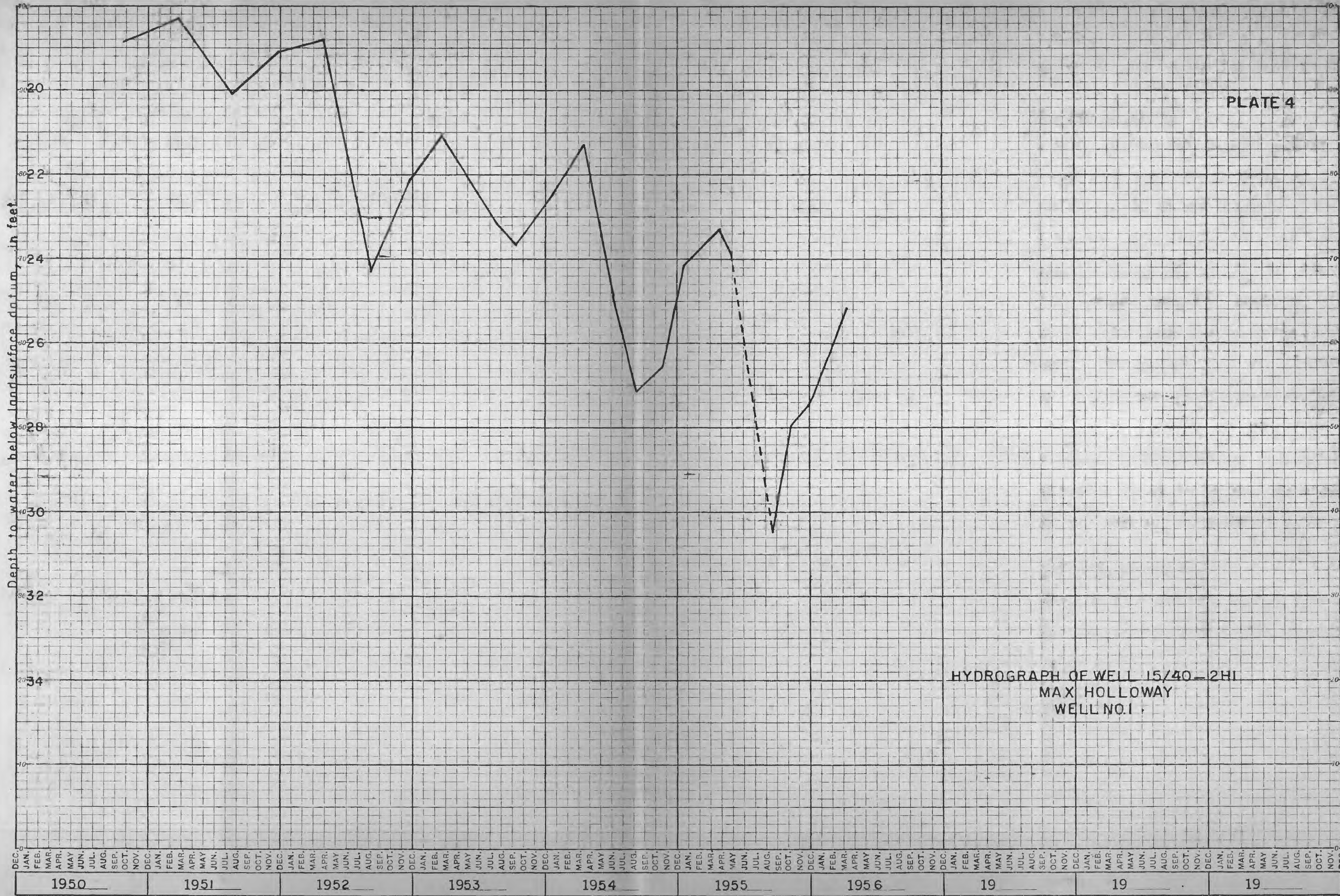


PLATE 4
HYDROGRAPH OF WELL 15/40-2H1
MAX HOLLOWAY
WELL NO. 1
Depth to water, below landsurface datum, in feet
20
22
24
26
28
30
32
34
DEC. JAN. FEB. MAR. APR. MAY JUN. JUL. AUG. SEP. OCT. NOV. DEC.
1950
1951
1952
1953
1954
1955
1956
19
19
19

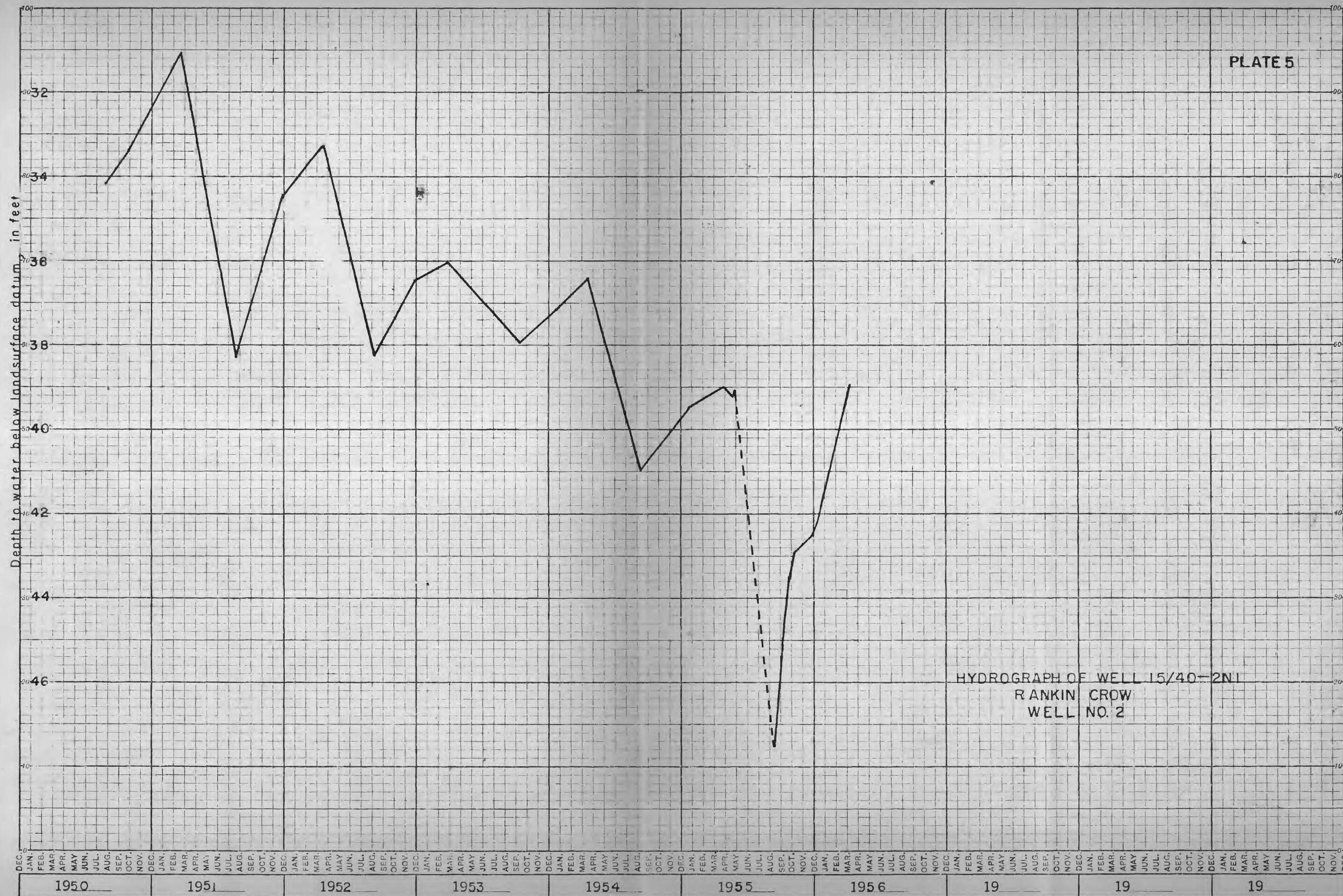
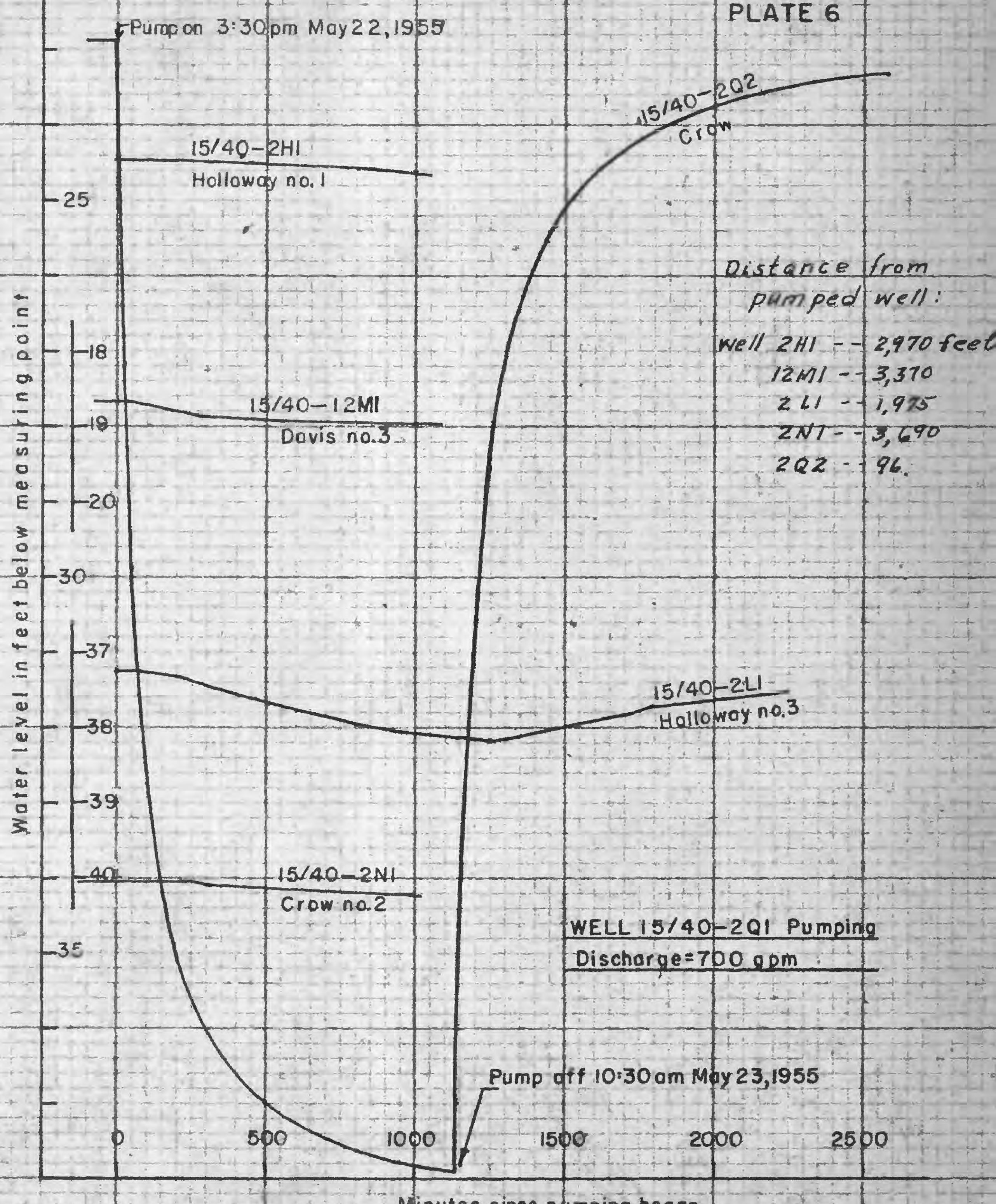


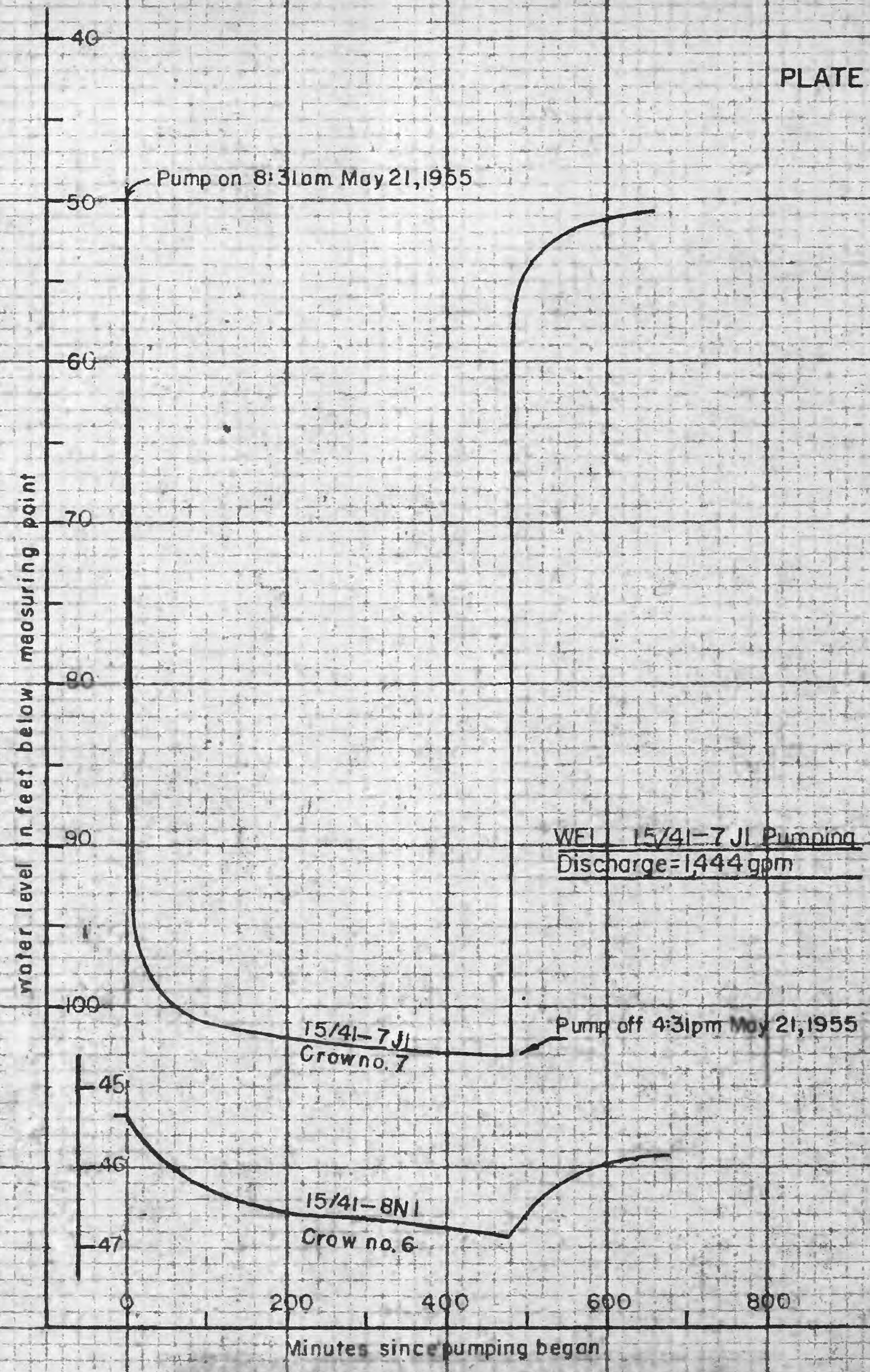
PLATE 5
Depth to water below landsurface datum, in feet
32
34
36
38
40
42
44
46
1950
1951
1952
1953
1954
1955
1956
19
19
19
HYDROGRAPH OF WELL 15/40-2N1
RANKIN CROW
WELL NO. 2

PLATE 6



WATER LEVELS IN OBSERVATION WELLS DURING AQUIFER TEST ON MAY 22 & 23, 1955 IN COW VALLEY, OREGON

PLATE 7



WATER LEVELS IN OBSERVATION WELLS
DURING AQUIFER TEST ON MAY 21, 1955
IN COW VALLEY, OREGON

Table 1.- Wells in

Topography: v, valley; Vs, valley slope.
Type of well: Dr, drilled.
Type of pump: J, jet pump; N, none; T, turbine.

Well no	Owner	Topography and altitude (approx.) (feet above sea level)	Type	Depth (feet)	Diameter (inches)	Depth of casing (ft)	Water-bearing zone or		
							Depth to top (feet)	Thickness (feet)	Character of material
(1)	(2)	)3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	T. 15 S., R. 40 E.								
1C1	E. and F. Locey	Vs 3,986	Dr	330	14	300	120	95	Sand and gravel
							245	55	do.
							312	18	Lava rock
2H1	Max Holloway	Vs 3,905	Dr	421	12	55	97	3	Sand and gravel
							180	3	Lava rock
							320	6	do.
							421	6	do.
2L1	do.	Vs 3,908	Dr						
2M1	do.	Vs 3,908	Dr	535	12	250	83	17	Sand and gravel
							393	535	Lava rock
2N1	Rankin Crow	V 3,896	Dr	310	10	170	48	2	Sand and gravel
							140	25	do.
							285	20	do.
							305	10	Gravel
2Q1	do.	V 3,885	Dr	362	10	131	114	4	Gravel
							305	3	Sand, cindery
2Q2	do.	V 3,881	Dr	74	6	62	62	12	Sand

Cow Valley Near Ironside

Use of water: D, domestic; Irr, irrigation; S, stock.
Ground-water occurrence: U, unconfined.

zones	Water level		Type of pump and yield (gallons per minute)	Use	Remarks
Ground-water occurrence	Feet below land surface	Date			
(11)	(12)	(13)	(14)	(15)	(16)
	90	1953	T, 1,400	Irr	Locey no. 1; see table 2 for log.
	19	1949	T, 1,000	Irr	Holloway no. 1; see table 2 for log.
	35.64	5/18/55			Holloway no. 3.
	40	1952 (?)	T	Irr	Holloway no. 2; see table 2 for log.
	37.5	1949-50	T, 310	Irr	Crow no. 2; now filled to 128 ft by quicksand; see table to for log.
	17	5/ /49	T, 700	Irr	Crow no. 1; see table 2 for log.
U	22.52	5/18/55	J, 20	S	Located 95 ft south of well -2Q1.

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Well no.	Owner	Topography and altitude (approx.) (feet above sea level)	Type	Depth (feet)	Diameter (inches)	(Depth of casing(ft)	Water-bearing zone or		
							Depth to top (feet)	Thickness (feet)	Character of materials
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	T. 15 S., R. 10 E. - Continued								
10B1	Rankin Crow	V 3,903	Dr	255	12	130	50	4	Sand and gravel
							94	10	do.
							204	2	Gravel
							250	5	do.
10Q1	do.	V 3,926	Dr	1000	14	100	60	5	do.
							80	5	do.
							170	45	Lava rock(?)
11P1	do.	V 3,920	Dr	200	12	128	54	4	Sand and gravel
							98	8	do.
							140	50	Lava rock
12M1	Gus Davis	V 3,902	Dr	280	14				
12Q1	do.	V 3,916	Dr	100	14				
13D1	do.	V 3,916	Dr	500	14				Lava rock
13G1	do.	V 3,928	Dr	173	14				
14L1	Rankin Crow	V 3,930	Dr	285	12	160	170	15	Sand and gravel
							245	40	Lava rock
14Q1	do.	V 3,946	Dr	248	14	157	223	25	do.

Valley Near Ironside - Continued

zones Ground-water occurrence	Water level Feet below land surface	 Date	Type of pump and yield (gallons per minute)	Use	Remarks
(11)	(12)	(13)	(14)	(15)	(16)
	42	7/ /50	T, 1,004	Irr	Crow no. 3; see table 2 for log.
	55	1953	T, 596	Irr	Crow no. 9; see table 2 for log.
	42	8/ /50	T, 882	Irr	Crow no. 4; see table 2 for log.
	18.55	4/29/55	N		Davis no. 3.
U	37.83	11/ 6/54	N		Davis no. 4; well not completed.
	38.86	4/29/55	N		Davis no. 1.
	57.69	5/18/55	T	Irr	Davis no. 2.
	68	11/ /50	T, 1,617	Irr	Crow no. 5; see table 2 for log.
	90	9/ /51	T, 1,157	Irr	Crow no. 8; see table 2 for log.

Table 1.- Wells in Cow

Well no.	Owner	Topography and altitude (approx.) (feet above sea level	Type	Depth (feet)	Diameter (inches)	Depth of casing (feet)	Water-bearing zone or		
							Depth to top (feet)	Thickness (feet)	Character of material
(1)	(2)	(3)	4)	5)	6)	(7)	(8)	(9)	(10)
	T. 15 S., R. 41 E.								
7J1	Rankin Crow	V 3,917	Dr	338	12	150	95 314	45 24	Sand and gravel Lava rock
8A1	do.	V 3,890	Dr	128	6	128			Sand
8K1	do.	V 3,900	Dr		6				
.8N1	do.	V 3,920	Dr	360	12	100	160 320	5 40	Gravel Gravel or lava rock
11M1	Esther Davis	V 3,908	Dr		8				

Valley Near Ironside - Continued

zones	Water level				
Ground-water occurrence	Feet below land surface	Date	Type of pump and yeild (gallons per minute)	Use	Remarks
(11)	(12)	(14)	(14)	(15)	(16)
	46	1951	T, 1,582	Irr	Crow no. 7; see table 2 for log.
	19.14	5/18/55	J	S	
U				D	
	50±	1951	T, 1,880	Irr	Crow no. 6; see table 2 for log.
U	43.80	11/ 5/54	J	S	

Table 2.- Materials Penetrated by Wells
[Tentative stratigraphic headings inserted in drillers' logs by R. C. Newcomb]

15/40-1C1. E. and F. Locey. Locey no. 1. Drilled by Max Holloway, 1953

Materials	Thickness (feet)	Depth (feet)
Alluvium:		
Soil	30	30
Sand and gravel	90	120
Sand and gravel, water-bearing	55	175
Boulders, 6 inches in diameter	5	180
Sand and gravel, water-bearing	35	215
Sand, fine	30	245
Sand and gravel, water-bearing	55	300
Sand rock	12	312
Lava rock:		
Boulder, lava, large, with lots of water	18	330

Casing, 14-inch, set to 300 ft and perforated 180 to 245 ft and 275 to 290 ft. Static level of water when well was drilled was 90± ft below the land surface. After being drilled, well was test pumped for short period at 1,400 gpm with 70 ft of drawdown.

15/40-2H1. Max Holloway. Holloway no. 1. Drilled by owner, 1949

Alluvium:		
Soil	10	10
Hardpan	3	13
Clay, yellow	4	17
Gravel, water-bearing	6	23
Clay, hard, yellow	74	97
Gravel, water-bearing	3	100
Clay, brown, mixed with gravel	80	180
Lava rock and associated volcanic sedimentary rocks:		
Lava cinders, red, water-bearing	3	183
Clay, hard, gray	57	240
Clay, hard, red	80	320
Lava boulders, water-bearing	6	326
Clay, hard, dark-brown	89	415
Boulders, large, water-bearing	6	421

Casing, 12-inch, set to 55 ft. Static level of water when well was drilled was 19 ft below land surface. After being drilled, well was test pumped for 8 hours at 1,000 gpm with 31 ft of drawdown.

Table 2.--Materials penetrated by wells - Continued

15/40-2M1. Max Holloway. Holloway No. 2. Drilled by owner, 1952(?)

Materials	Thickness (feet)	Depth (feet)
Alluvium:		
Soil	65	65
Gravel, water-bearing	3	68
Clay	15	83
Sand, coarse, and gravel	17	100
Sand, fine, quick	140	240
Clay, hard	81	321
Lava rock:		
Basalt, hard, black	72	393
Lava, porous	137	530
Lava, broken	5	535

Casing, 12-inch, set to 250 ft. and perforated 40 to 100 ft. Static level of water when well was drilled was 40 ft.

15/40-2N1. Rankin Crow. Crow No. 2. Drilled by Max Holloway, 1949-50

Materials	Thickness (feet)	Depth (feet)
Alluvium:		
Soil	4	4
Hardpan	4	8
Clay, yellow	40	48
Sand and gravel, fine	2	50
Clay	10	60
Sand, fine, and mud, mixed	18	78
Sand, rock, hard	2	80
Clay, yellow	60	140
Sand and gravel	25	165
Sand rock	20	185
Clay, yellow	60	245
Sand rock, red	40	285
Sand and gravel, fine, mixed	20	305
Gravel, coarse	5	310

Casing, 10-inch, set to 170 ft. and perforated 80 to 170 ft. Filled with sand to 128 ft. in August 1950. Static level of water when well was drilled was $37\frac{1}{2}$ ft. below land surface. After being drilled, well was test pumped for a short time at 650 gpm with 50 ft. of drawdown.

Table 2.- Materials Penetrated By Wells - continued

15/40-2Q1. Rankin Crow. Crow no. 1. Drilled by Max Holloway 1949

Materials	Thickness (feet)	Depth (feet)
Alluvium:		
Soil	17	17
Gravel	4	21
Clay and sand, mixed	93	114
Gravel	4	118
Clay and sand, mixed	187	305
Sand, cindery	3	308
Clay, hard, sticky	54	362

Casing, 10-inch, set to 121 ft and perforated from the top to 121 ft. Static level of the water when well was drilled was 17 ft below land surface. After being drilled, well was test pumped a short period at 1,000 gpm with 18 ft of drawdown.

15/40-10B1. Rankin Crow. Crow no. 3. Drilled by Max Holloway, 1950

Materials	Thickness (feet)	Depth (feet)
Alluvium:		
Soil	4	4
Hardpan	4	8
Clay, yellow	42	50
Sand and gravel	4	54
Clay, hard, yellow	40	94
Sand and gravel	10	104
Clay, hard, yellow	100	204
Gravel	2	206
Clay, hard, yellow	44	250
Gravel, coarse	5	255

Casing, 12-inch, set to 110 ft and perforated from 6 to 130 ft. Static level of water when well was drilled was 42 ft below land surface. After being drilled, well was test pumped a short time at 840 gpm with 38 ft of drawdown.

Table 2.--Materials penetrated by wells - Continued

15/40-10Q1. Rankin Crow. Crow No. 9. Drilled by Max Holloway, 1953

Materials	Thickness (feet)	Depth (feet)
Alluvium:		
Soil	20	20
Clay	40	60
Gravel, water-bearing	5	65
Clay	15	80
Gravel, water-bearing	5	85
Clay	85	170
Lava rock:		
Rock, small amount of water	45	215
Older rocks:		
Clay (soil and weathering zone?)	75	290
Shale, blue	280	570
Rock, with a little water	50	620
Sandstone, black	70	690
Sandstone rock, black, some water	30	720
Shale, blue	80	800
Sandstone, blue and gray	70	870
Shale, blue, and soapstone	15	885
Shale, hard, blue, and hot	15	900
Sandstone and gravel	50	950
Sand and gravel, with warm water	35	985
Shale, sticky, blue	15	1,000

Casing, 14-inch, set to 100 ft. and perforated from 60 ft. to bottom. Static level of water when well was drilled was 55 ft. below land surface. After being drilled, well was test pumped 1 hour at 580 gpm with 121 ft. of drawdown. Reportedly was test pumped at 400 to 500 gpm before being deepened into the older rocks.

Table 2.- Materials Penetrated by Wells - Continued

15/40-11P1. Rankin Crow. Crow no. 4. Drilled by Max Holloway, 1950

Materials	Thickness (feet)	Depth (feet)
Alluvium:		
Soil	2	2
Hardpan	4	6
Loam	8	14
Clay, yellow	40	54
Sand and gravel, mixed	4	58
Clay, yellow	40	98
Sand and gravel, mixed	8	106
Clay, hard, yellow	34	140
Lava rock:		
Lava rock, porous, creviced	50	190
Basalt, hard, black	10	200

Casing, 12-inch, set to 128 ft and perforated 40 to 128 ft. Static level of water when well was drilled was 42 ft below land surface. After being drilled, well was test pumped 2½ hours at 800 gpm with drawdown of 120 ft.

15/40-14L1. Rankin Crow. Crow no. 5. Drilled by Max Holloway, 1950

Materials	Thickness (feet)	Depth (feet)
Alluvium:		
Soil	4	4
Gravel, cemented	16	20
Clay, red	50	70
Sand and gravel	4	74
Clay, yellow	35	109
Sand, fine, with mud intermixed	40	149
Sand rock	21	170
Sand and gravel, fine, mixed	15	185
Clay, hard, yellow	60	245
Lava rock:		
Lava, porous	35	280
Lava rock, loose, caving	5	285

Casing, 12-inch, set to 160 ft with no perforations. Static level of water when well was drilled was 60 ft below land surface. After being drilled, well was test pumped for 2 hours at progressively greater rates up to 1,300 gpm for 30 minutes with a final drawdown of 24 ft.

Table 2.—Materials penetrated by wells - Continued

15/40-14Q1. Rankin Crow. Crow No. 8. Drilled by Max Holloway, 1951

Materials	Thickness (feet)	Depth (feet)
Alluvium:		
Soil with rocks	41½	41½
Gravel, cemented	28	69½
Clay, brown, with gravel	3	72½
Gravel, cemented; water at 94 feet	22½	95
Sandstone	2	97
Clay, brown, with little gravel	125	222
Sand and gravel	1	223
Lava rock(?):		
Cinders	25	248

Casing, 14-inch, set to 157½ ft. with no record of perforations. Static level of water when well was drilled was 90 ft. below land surface. After being drilled, well was test pumped at progressively greater rates for 1¾ hours, the last 30 minutes at 2,500 gpm with a drawdown of 45 ft.

15/41-7J1. Rankin Crow. Crow no. 7. Drilled by Max Holloway, 1951

Materials	Thickness (feet)	Depth (feet)
Alluvium:		
Soil	15	15
Gravel and boulders	25	40
Clay	10	50
Sand and clay	25	75
Quicksand	15	90
Clay, hard	70	160
Gravel, water-bearing	5	165
Clay and sand	35	200
Clay, hard	50	250
Clay and small gravel	50	300
Gravel and clay, warm	20	320
Talus material(?):		
Gravel, large, and boulders, water-bearing . .	40	360

Casing, 12-inch, set to 100 ft with no record of perforations. Static level of water when well was drilled was 52± ft. After being drilled, well was test pumped at 1,900 gpm with no record of duration or drawdown.

15/41-8N1. Rankin Crow. Crow no. 6. Drilled by Max Holloway, 1951

Materials	Thickness (feet)	Depth (feet)
Alluvium:		
Soil	75	75
Gravel, water-bearing	5	80
Clay	15	95
Sand and gravel, water-bearing	45	140
Clay, hard	174	314
Lava rock:		
Rock, hard	20	334
Rock, loose, water-bearing	4	338

Casing, 12-inch, set to 150 ft with no record of perforations. Static level of water when well was drilled was 46 ft below land surface. After being drilled, well was test pumped at 2,000 gpm without record of duration or drawdown.

[illegible]

Table 3.- Analyses of Water
(Chemical constituents in
[Analyses by

Well number Date of collection	15/40-2N1 5/24/55	15/40-2Q1 5/23/55	15/40-10Q1 5/24/55
Temperature (°F.)	54	54	76
Silica (SiO_2)	55	53	87
Calcium (Ca)	26	46	13
Magnesium (Mg)	10	23	8.9
Sodium (Na)	19	25	54
Potassium (K)	3.3	4.1	12
Bicarbonate (HCO_3)	143	165	195
Carbonate (CO_3)	8	15	18
Chloride (Cl)	8	40	7
Fluoride (F)			
Nitrate (NO_3)	1.4	2.5	.3
Hardness as $CaCO_3$			
(Calcium, magnesium)	106	210	69
(Noncarbonate)	0	50	0
Sodium-adsorption ratio (SAR)	.8	.8	1.1
Percent sodium	27	20	65
Specific conductance (micromhos at 25° C)	293	533	382
pH	8.7	8.6	8.8

from Wells in Cow Valley
parts per million)
Geological Survey7

15/40-11P1 5/25/55	15/40-14L1 5/25/55	15/40-14Q1 5/25/55	15/41-7J1 5/21/55	15/41-8N1 5/25/55
57	54	59½	65	67
54	48	48	63	52
37	39	29	25	25
14	15	9.3	6.2	5.5
42	19	21	22	21
5.[illegible]	2.9	3.6	4.1	4.1
284	228	181	138	139
0	0	0	9	6
7	8	4	4	4
.6	1.4	1.9	2.3	2.1
150	159	111	88	85
0	0	0	0	0
2.1	1.5	1.9	1.5	1.9
39	22	31	37	37
465	399	304	288	264
8.2	8.2	8.2	8.7	8.6

Unpublished records subject to revision

Table 3.- Analyses of Water From Wells in Cow Valley, Continued

Well number Date of collection	15/40-2H1 7/21/55	15/40-13D1 7/22/55
Temperature (°F)	54	54
Silica (SiO_2)	46	49
Calcium (Ca)		
Magnesium (Mg)		
Sodium (Na)	25	19
Potassium (K)		
Bicarbonate (HCO_3)	153	197
Carbonate (CO_3)		
Chloride (Cl)	9	6
Fluoride (F)		
Nitrate (NO_3)		
Hardness as $CaCO_3$		
(Calcium, magnesium)	108	138
(Noncarbonate)	0	0
Sodium-adsorption ratio (SAR)		
Percent sodium		
Specific conductance (Micromhos at 25° C)	318	328
pH	8.6	8.7

Table 4.- Measurements of Depth to Water in Wells

The following symbols are used for special notations throughout this table:

a - Depth to water reported by driller.
b - Pumping.
c - Pumped recently
d - Nearby well pumping.
e - Nearby well pumped recently.

15/40-1C1. E. Locey. Measuring point is $1\frac{1}{2}$-inch pipe on east side of pump 2.0 ft above land surface

Date	Depth to water (ft below land-surface datum)	Date	Depth to water (ft below land-surface datum)
1953	a 90±	May 22, 1955	c 101.08
Nov. 6, 1954	99.81	23	100.93
May 18, 1955	100.35	Nov. 12	102.75
		Jan. 12, 1956	101.60
		Apr. 11	100.32

15/40-2H1. Max Holloway. Holloway no. 1. Measuring point is top of well casing 0.6 ft above original land surface. See also plates 4 and 6

1949	a 19	Apr. 15, 1954	21.30
Oct. 27, 1950	18.86	July 8	24.83
Mar. 18, 1951	18.28	Sept.12	27.12
Aug. 14	20.77	Jan. 20, 1955	24.15
Dec. 29	19.06	Apr. 29	23.26
Apr. 18, 1952	18.80	May 18	23.74
June 23	b 40.75	22	23.86
Sept. 9	24.30	July 21	b 50.50
Dec. 29	22.05	Sept.18	30.56
Mar. 27, 1953	21.05	Nov. 12	27.95
Aug. 4	23.16	Dec. 28	27.45
Oct. 13,	23.64	Jan. 13, 1956	27.21
Jan. 22, 1954	22.43	Apr. 11	25.17

Table 4.- Measurements of Depth to Water in Wells - Continued

15/40-2L1. Max Holloway. Holloway no. 3. Measuring point is top of casing on east side, 1.7 ft above land surface. See also plates 6 and 8

Date	Depth to water (ft below land-surface datum)	Date	Depth to water (ft below land-surface datum)
May 18, 1955	35.64	Oct. 8, 1955	36.99
19	35.61	9	36.99
20	35.58	10	36.96
21	35.57	11	37.10
22	35.54	12	37.12
23	d 36.44	13	37.18
24	d 37.62	14	37.10
25	e 35.84	15	37.05
26	e 35.86	16	37.08
June 15	d 42.33	17	37.07
17	d 42.48	18	37.03
July 21	d 42.91	19	37.08
22	d 42.13	20	37.13
22	42.43	21	37.13
23	42.43	22	37.10
24	40.97	23	37.16
25	42.52	24	37.13
26	42.75	25	37.06
27	42.95	26	37.08
28	43.06	27	37.22
29	43.10	28	37.16
30	43.01	29	37.15
31	43.05	30	37.06
Aug. 1	43.16	31	37.06
2	43.13	Nov. 1	37.12
3	43.00	2	37.20
4	43.10	3	37.17
5	43.06	4	37.12
6	42.91	5	37.22
11	42.41	6	37.23
12	42.27	7	37.28
13	42.23	8	37.26
14	42.14	9	37.24
15	42.12	10	37.22
16	42.15	11	37.15
17	42.05	12	37.26
18	42.10	13	37.23
19	42.04	14	37.27
20	42.04	15	37.37
21	42.02	16	37.32
22	42.88	17	37.32
23	42.86	18	37.33
24	41.73	19	37.34
25	41.74	20	37.33

Table 4.- Measurements of Depth to Water in Wells - Continued

15/40-2L1. Max Holloway - Continued

Date	Depth to water (ft below land-surface datum)	Date	Depth to water (ft below land-surface datum)
Aug. 26, 1955	41.75	Nov. 21, 1955	37.35
27	41.72	22	37.43
28	40.76	23	37.36
Sept. 2	41.48	24	37.44
3	41.83	25	37.44
4	41.70	26	37.45
5	41.81	27	37.50
6	41.86	28	37.49
7	41.91	29	37.49
8	41.98	30	37.45
9	41.91	Dec. 1	37.39
10	41.98	2	37.34
11	42.04	3	37.54
12	42.05	4	37.55
13	42.11	5	37.52
14	42.17	6	37.49
15	41.01	7	37.58
16	41.79	8	37.59
17	40.69	9	37.56
18	40.35	10	37.58
19	40.11	11	37.58
20	39.97	12	37.57
21	39.93	13	37.58
22	39.62	14	37.62
23	38.27	15	37.62
24	37.91	16	37.58
25	37.74	17	37.57
26	37.57	18	37.57
27	37.45	19	37.58
28	37.40	20	37.63
29	37.36	21	37.63
30	37.32	22	37.56
Oct. 1	37.13	23	37.53
2	37.08	24	37.66
3	37.01	25	37.69
4	37.05	26	37.67
5	37.11	27	37.68
6	37.12	28	37.76
7	37.00	Jan. 13, 1956	37.63
		Apr. 11	35.40

Measurements from July 22 to Dec. 28, 1955, are noon-hour readings from automatic water-stage recorder.

15/40-2M1. Max Holloway. Holloway no. 2. Measuring point is top of 2-inch inclined pipe, 0.3 ft above land surface

Date	Depth to water (ft below land-surface datum)	Date	Depth to water (ft below land-surface datum)
1952(?)	a 40	May 22, 1955	41.83
Nov. 5, 1954	43.60	Jan. 13, 1956	45.50
May 18, 1955	44.22	Apr. 11	42.60

15/40-2N1. Rankin Crow. Crow no. 2. Measuring point is top of $1\frac{1}{2}$-inch pipe, 1 ft above land surface on east side of pump. See also plates 4 and 6

1949-50	a 37.5	Sept. 12	40.96
Aug. 24, 1950	34.19	Jan. 20, 1955	39.47
Oct. 27	33.39	Apr. 29	39.00
Mar. 18, 1951	31.06	May 18	39.21
Aug. 13	38.29	22	39.07
Dec. 29	34.44	July 21	b 116.80
Apr. 18, 1952	33.25	Sept. 18	47.52
Sept. 9	38.22	Oct. 4	45.10
Dec. 29	36.45	28	43.30
Mar. 27, 1953	36.07	Nov. 12	42.90
Oct. 13	37.98	Dec. 28	42.56
Jan. 22, 1954	37.14	Jan. 12, 1956	42.20
Apr. 15	36.40	Apr. 11	38.91

15/40-2Q1. Rankin Crow, Crow no. 1. Measuring point is top of casing which is at land surface

May 1949	a 17	April 11, 1956	23.49
Jan. 12, 1956	25.49		

15/40-2Q2. Rankin Crow. Domestic and stock well 95 ft south of 15/40-2Q1. Measuring point is 3/8-inch hole drilled in 2-inch-by-4-inch pump supports 0.4 ft above land surface

May 18, 1955	22.52	Oct. 4, 1955	26.80
22	22.89	28	25.20
June 15	e 39.51	Jan. 12, 1956	24.71
July 22	d 39.40	Apr. 11	22.58

15/40-10B1. Rankin Crow. Crow no. 3. Measuring point is bottom of slot on north side of pump column 1.2 ft below land surface

Date	Depth to water (ft below land-surface datum)	Date	Depth to water (ft below land-surface datum)
July 1950	a 42	Oct. 4, 1955	56.00
Sept.12, 1954	50.57	28	53.90
Nov. 5	48.50	Jan. 12, 1956	50.23
May 18, 1955	46.36	Apr. 12	47.46
22	46.29		

15/40-10Q1. Rankin Crow. Crow no. 9. Measuring point is top of casing 1.0 ft below land surface

1953	a 55	Oct. 4, 1955	65.50
Sept.12, 1954	62.30	28	65.30
May 18, 1955	58.10	Jan. 12, 1956	62.92
24	58.03	Apr. 12	61.01

15/40-11F1. Rankin Crow. Crow no. 4. Measuring point is top of casing at land surface

Aug. 1950	a 42	Oct. 4, 1955	53.90
Sept.12, 1954	49.08	28	52.50
May 18, 1955	47.14	Jan. 12, 1956	49.96
26	47.27	Apr. 11	49.43

15/40-12M1. Gus Davis. Davis no. 3. Measuring point is 0.3 ft above land surface

Apr. 4, 1955	18.53	June 15, 1955	20.97
May 18	18.55	22	23.03
22	18.37	Jan. 12, 1956	21.73
24	18.36	Apr. 11	19.94

Table 4.- Measurements of Depth to Water in Wells - Continued

15/40-12Q1. Gus Davis. Davis no. 4. Measuring point is bottom of perforation on west side of well casing at land surface

Date	Depth to water (ft below land-surface datum)	Date	Depth to water (ft below land-surface datum)
Nov. 6, 1954	37.63	June 15, 1955	38.65
Apr. 4, 1955	36.56	July 22	42.23
May 18	36.55	Jan. 11, 1956	40.30
22	36.[illegible]	Apr. 11	38.76

15/40-13D1. Gus Davis. Davis no. 1. Measuring point is 1½-inch pipe on west side of well 0.8 ft above land surface

Apr. 4, 1955	38.86	Jan. 11, 1956	39.46
May 18	34.74	Apr. 11	37.85
June 15	37.90		

15/40-13G1. Gus Davis. Davis no. 2. Measuring point is top of 1½-inch pipe 1.4 ft above land surface

May 18, 1955	57.69	Jan. 11, 1956	61.86
June 15	60.43	Apr. 11	60.47
July 22	c 6[illegible]		

15/40-14L1. Rankin Crow. Crow no. 5. Measuring point is top of 1½-inch pipe 1.5 ft above land surface

Nov. 1950	a 68	Oct. 4, 1955	82.00
May 18, 1955	74.86	Jan. 12, 1956	78.67
25	74.80	Apr. 11	76.12

15/40-14Q1. Rankin Crow. Crow no. 8. Measuring point is top of casing at land surface

Sept. 1951	a 90	Oct. 4, 1955	96.60
Sept. 12, 1954	96.98	28	99.50
May 18, 1955	93.78	Jan. 12, 1956	97.68
25	93.75	Apr. 11	96.38
26	93.83		

Table 4.- Measurements of Depth to Water - Continued

15/41-7J1. Rankin Crow. Crow no. 7. Measuring point is 1½-inch pipe on east side of well 1.15 ft above land surface. See also plate 7

Date	Depth to water (ft below land-surface datum)	Date	Depth to water (ft below land-surface datum)
1951	a 56	May 25, 1955	c 49.91
Sept.12, 1954	51.35	Jan. 11, 1956	51.25
May 18, 1955	48.55	Apr. 12	50.88
22	49.23		

15/41-8A1. Rankin Crow. Stock and domestic well. Measuring point is top of 6-inch casing 5 ft below land surface in concrete pit

May 18, 1955	19.14	Jan. 12, 1956	22.64
July 22	18.70	Apr. 12	19.27

15/41-8N1. Rankin Crow. Crow no. 6. Measuring point is top of 1½-inch pipe on east side of well 0.70 ft above land surface. See also plate 7

1951	a 46	May 24, 1955	c 45.41
Aug. 4, 1953	52.20	Oct. 4	42.60
Sept.12, 1954	52.50	28	44.90
May 18, 1955	45.58	Jan. 11, 1956	48.99
22	45.56	Apr. 12	46.69

15/41-11M1. Esther Davis. Stock well. Measuring point is top of casing 1.0 ft above land surface

Nov. 5, 1954	43.80	Jan. 12, 1956	43.10
May 26, 1955	42.89	Apr. 12	41.96

Table 5.- Capacity Tests

USGS well no.	Owner's no.	Discharge (gpm) at Start	Discharge (gpm) at End	Water level (feet) Start	Water level (feet) End
15/40-2Q1	Crow no. 1	700	700		
15/40-2N1	Crow no. 2	310	251	40.29	89.08
15/40-10B1	Crow no. 3		1,004	46.40	53
15/40-11P1	Crow no. 4	882	852	47.27	
15/40-14L1	Crow no. 5		1,617	76.30	
15/41-8N1	Crow no. 6	1,880	1,880	45.36	
15/41-7J1	Crow no. 7	1,582	1,546	51.06	106
15/40-14Q1	Crow no. 8		1,157	93.86	117
15/40-10Q1	Crow no. 9	596	596 574	57.03 142.5	176 195+

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Duration of test (min.)	Remarks
1,135	Pump column fits so closely inside well casing that water level cannot be measured; see also plate 6.
376	See also plate 6.
15	Ditch washed out repeatedly during test, making discharge measurements difficult.
180	Water ran down pump column; could not measure water level at end of test.
245	Pump column fits close to well casing and water level could not be measured; road culvert caused difficulty in measuring discharge at start of test.
158	Water ran down pump column; see also plate 7.
170	See plate 7.
15	At several times during test ditch overflowed above weir and weir submerged temporarily because of choked downstream channel.
10 2,052	Water level dropped below airline near end of test; could not be measured with steel tape; 195 ft reported length of airline.

PART II

CONTENTS

ILLUSTRATIONS

PART II

GROUND-WATER RESOURCES OF COW VALLEY NEAR IRONSIDE, MALHEUR COUNTY, OREGON

INTERPRETATIONS AND CONCLUSIONS

Occurrence of the Ground Water

The drillers' records show that the wells (listed in table 2 and shown on plate 1 of Part I) derive water from the saturated part of the valley alluvium and the lava rock unit which overlies the older rocks of Triassic and Jurassic age. All the wells obtain water from one or both of these materials. One well (Crow No. 9) penetrated the underlying older rocks and was not believed by the driller (personal communication to R. C. Newcomb) to have obtained any additional water below the lava rocks; however, it may have obtained a small amount of water from the older rocks.

The water encountered by the wells stands at a rather uniform level which is the water table (see pl. 1 of Part II). The water table in Cow Valley slopes generally downstream in the upper part of the valley and is commonly slightly above Cow Creek and is tributary to Cow Creek in the lower part of the valley. The level of the water in this body of permeable materials rises and falls with the precipitation cycle. The water levels in the wells have been observed to decline with pumpage withdrawals from certain other wells.

The observations on the subsurface materials and the water level phenomena indicate a body of ground water that is one-unit and hydraulically continuous below the water table in the alluvial and lava rocks materials of Cow Valley.

Source and Quantity of the Water Which Goes Underground to Recharge the Ground Water Body

The rise and fall of the level of the water table coincident with the availability and lack of precipitation, snowmelt and upland runoff indicate the natural source of the ground-water replenishment is the precipitation. The altitude of the water table in Cow Valley, where it stands at a higher altitude than in the adjacent stream valleys, and the evident lack of permeability of the older rocks (of Triassic and Jurassic age), which form the main bedrock of Cow Valley, preclude the possibility of any substantial interstream transfers underground to the ground-water body of Cow Valley. No evidence is known to indicate any water source to the ground water of the valley other than the infiltration of precipitation and its resultant runoff.

Amount of Water Annually Recharged

The recharge expresses itself by a rise, or a lessening of the rate of decline, of the water table. The pumpage withdrawals and the natural discharge are indicated by lowering of the level of the water table. At this time neither the rise nor the decline in the water table can be converted directly to a precise measure of the quantities of water added annually to the ground-water body because the average effective porosity, the effect on the natural discharge, and the lateral extent of these fluctuations are not sufficiently known. However, because the wells are distributed across the upper part of the valley below the points of known maximum recharge infiltration, the relative water levels give a rough comparison between the annual recharge and the annual pumpage diversions. Plates 4 and 5 of Part I show the records of water levels in index wells; table 4 of Part I shows measurements to water levels in the wells and table 6 of Part I shows pumpage diversions approximated from the consumption of electric power. Plate 1 (Part II) shows a graphical comparison of water levels and pumpage diversions.

The correlation of pumpage diversions with the decrease in altitude of the water table in the upper valley is clearly shown by those data. Also shown is the relation of the level of the water table to the amount of precipitation. The quantity of infiltration to recharge the ground water apparently is not entirely proportional to the precipitation in every year.

Among the interpretations evident from the relation of pumpage to the ground-water levels the following can be selected: (1) An average withdrawal of about 3,945 acre-feet of water during the irrigation season produced a progressive decline in the altitude of the March-April level of the ground water of the upper part of the valley during the 4½ years up to July 11, 1955. (2) The withdrawal of about

3,000 acre-feet in the 1953 irrigation season was just about equal to the quantity recharged during the first part of the 1954 water year. (3) the withdrawal of about 6,300 acre-feet of water in the 1954 irrigation season exceeded the recharge occurring mainly in the first part of the 1955 water year. (4) The water levels for well 15/40-2N1 (Crow No. 2) were nearly restored to the previous April levels (pl. 1, Part II) by uncommonly heavy recharge from the nearby Crow reservoir, which was filled during the 1955-56 winter for the second time in its 8-year life. Well 15/40-2H1 (Holloway No. 1) which is situated on the lower part of the valley slope did not receive recharge from the reservoir and continued to decline at approximately the same rate as during the previous years of record.

Characteristics of the Aquifer

By means of suitably regulated pumping tests, values can be derived to indicate the water storage and transmissive capacity of an aquifer. During the short-term pump-capacity tests on the Crow wells in 1955, an opportunity existed for evaluating the aquifer by short-term tests in wells 15/40-2Q1, Crow No. 1, and 15/41-7J1, Crow No. 7. By utilizing this (1935) nonequilibrium formula/

/For a good description of, and references on, the common methods by which mathematical coefficients are derived for aquifers the reader is referred to Chapter VII "Ground Water" by John Ferris in the book "Hydrology" by C. O. Wisler and E. F. Brater, John Wiley and Sons, 1951.

$$s = \frac{114.6\,Q}{T}\int_{1.87r^2S/Tt}^{\infty}\frac{e^{-u}\,du}{u}$$

where s = the drawdown in feet

Q = the amount of water pumped in gallons per minute

and $u = \frac{1.87\,r^2\,S}{Tt}$

where r = the distance from the pumped well to the observation well,

values may be derived for T and S. T is the coefficient of transmissibility and may be expressed as the number of gallons of water per day that the water-bearing material is capable of passing through a strip of the aquifer 1 foot wide extending the full thickness of the aquifer under unit hydraulic gradient. S is the coefficient of storage of an aquifer and is the volume of water it releases from or takes into storage per unit surface area of the aquifer per unit change in the component of head normal to that surface. By using the values obtained for T and S from the pumping test of a particular well, the drawdown in any hydraulically continuous and isotropic aquifer at any distance from the well can be approximated mathematically. Such theoretical projections of the expected drawdown are expressed graphically on plates 2 and 3 (Part II). These plates show the mathematically derived drawdown at points up to 5,500 feet from the pumping wells for times of 1, 10, and 100 days of steady pumping.

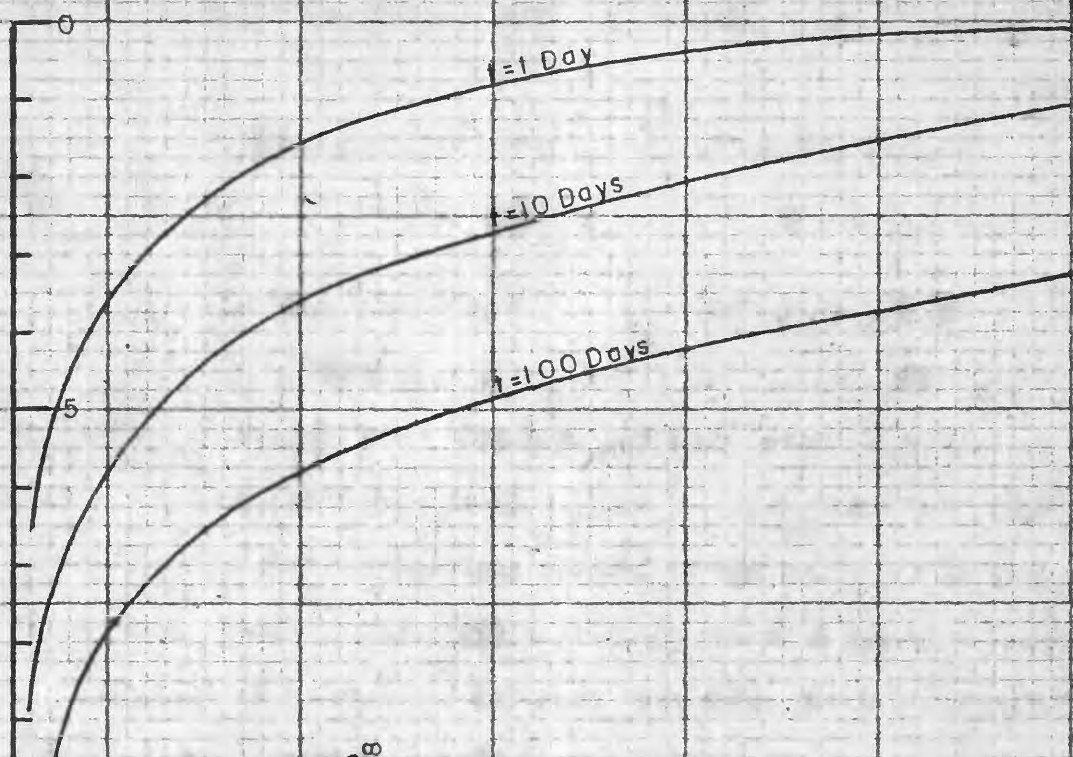
Values of T and S obtained from the pumping tests were as follows:

Pumping 15/40-2Q1	T = 85,000 gpd/ft
Crow No. 1	$S = 2.4 \times 10^{-3}$
Pumping 15/41-7J1	T = 295,000 gpd/ft
Crow No. 7	$S = 1.44 \times 10^{-3}$

Crow No. 1 obtains water from the sand and gravel layers of the valley alluvium. The coefficient of storage is of such a value as to indicate that some of the water may be locally confined and for the short-term of these tests was entering the well under pressure head. Crow No. 7 well apparently draws water only from the lava rock underlying the valley alluvium and the coefficient of storage derived from the test of this well indicates the water also is partly confined.

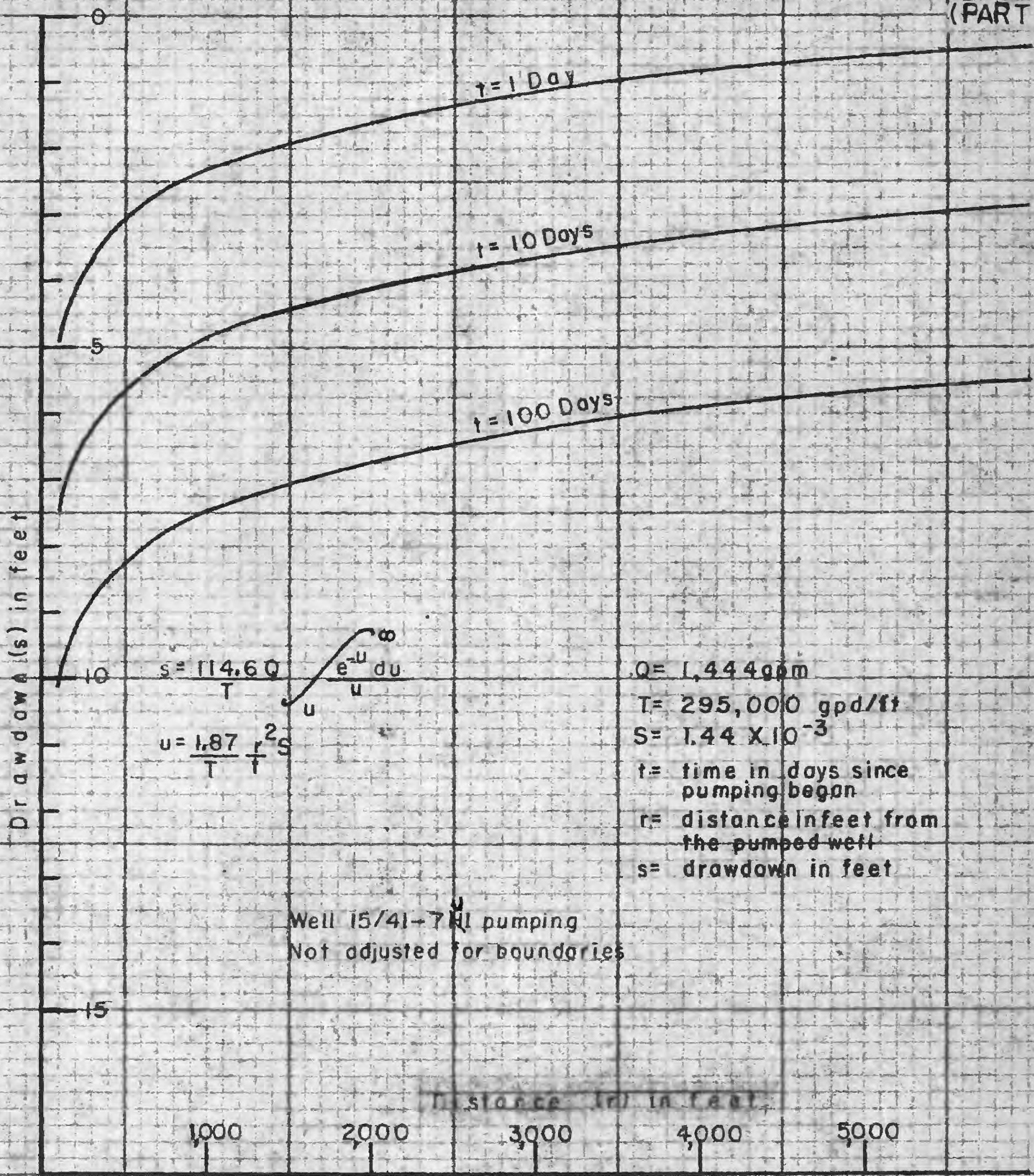
The water levels, the mutual drawdown of water level, the chemical and physical similarity of the water, and the drillers' logs all indicate that the water-bearing materials penetrated by the wells are hydraulically interconnected. In effect, these features indicate that the aquifers in Cow Valley are an over-all hydraulic unit and that any differences in well performance are due to conditions that may extend only a short distance from any one well or are due to differences in the manner of constructing, finishing, and using the wells.

PLATE 2
(PART II)



MATHEMATICAL PROJECTION OF PUMP TEST DATA SHOWING EXPECTED RELATION OF DRAWDOWN TO DISTANCE FROM THE PUMPED WELL IN THE AQUIFER UNDERLYING THE UPPER PART OF COW VALLEY, OREGON

PLATE 3
(PART II)



MATHEMATICAL PROJECTION OF PUMP TEST DATA SHOWING EXPECTED RELATION OF DRAWDOWN TO DISTANCE FROM THE PUMPED WELL IN THE AQUIFER UNDERLYING THE UPPER PART OF COW VALLEY, OREGON

CONCLUSIONS

Unity of the Ground-Water Body

The ground-water in the alluvial and lava-rock materials beneath Cow Valley has one water table and hydraulic continuity. The aquifer has an over-all cross-sectional shape that approximates that of a shallow dish partly full of water. It lies in a roughly rectangular pattern and its saturated part has a volume approximated from an average width of about 2½ miles, an average length of about 5 miles and an average thickness of approximately 250 feet.

Source and Quantity of Recharge

The ground water in Cow Valley is recharged by the infiltration of some of the precipitation and the infiltration of some of its associated ephemeral runoff.

The annual recharge to the ground-water body in the upper part of Cow Valley has been less than the average annual pumpage diversion for the period 1951 to 1955. Pumpage has averaged about 4,000 acre-feet per year for the 4½ years 1951 to July 11, 1955.

Characteristics of the Aquifer

The lava rock has a much greater capacity to pass water to a well than the sand and gravel beds of the alluvium.

A well, when pumped for even short-term tests, draws down the level of the water table sufficiently to allow measurements of that effect in other wells as much as 3,600 feet away. Those measurements allow numerical coefficients to be derived for the aquifer. When mathematically projected, those coefficients permit the calculation of the theoretical drawdown to be expected in the water table at any given distance at the end of any given period of steady pumping. Plate 2 (Part II) shows that at the end of 100 days steady pumping the cone of depression of 15/41-7J1, Grow No. 7, should draw the water table down at least 5.6 feet at a distance of 5,900 feet. Plate 3 shows that well 15/40-20l should draw the water table down 3.3 feet at a distance of 5,500 feet after pumping steadily for 100 days.

Further Collection of Data

Collection of water-level data and water-use data should be continued. The maintenance of economically feasible levels of the ground water are of such importance to the users that all possible measures should be taken to record pertinent ground-water data and to maintain the ground-water levels at the highest feasible altitudes.