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TEST OF THE STROEBEL SPRING

A Supplementary Study of the Fort Carson Expansion Project

Civil Action No. 8920, Tract No. 202,

El Paso County, Colorado

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ABSTRACT

The Stroebel Spring sump is a 40- by 60-foot excavation in the alluvium of Turkey Creek. The sump yielded 2 gallons per minute as overflow in October 1970 when it was not pumped and would have yielded about 90 gallons per minute if the pumping water level had been lowered 7½ feet, or to within 1 foot of the bottom. The rate of ground-water inflow to the sump will vary from slightly more to much less than 90 gallons per minute, depending upon the amount of recharge available to the ground-water reservoir from precipitation. The Stroebel Spring sump will not sustain a yield of 90 gallons per minute during periods of deficient precipitation and runoff.

INTRODUCTION

In 1968, the office of the U.S. Attorney General requested that Edward D. Jenkins be authorized to investigate the water resources of Tract 202 of the Fort Carson, Colorado, Expansion Project of the U.S. Department of the Army. A hydrologic investigation of this tract was made in the fall of 1968, and an open-file report was released in 1969 entitled "Hydrologic Investigation, Fort Carson, Colorado Expansion Project, Civil No. 8920 - Tract 202, El Paso County, Colorado" by Edward D. Jenkins and R. Theodore Hurr. The investigation showed that an excavated spring (not Stroebel Spring) in the alluvium was the best source of water in the tract.

In August 1970, Edward D. Jenkins was requested by the U.S. Attorney, Denver, Colo., to return to Tract 202 and test the flow from Stroebel Spring, which is mentioned on pages 17 and 21 of the 1969 report. An investigation was made in October 1970. Information obtained during this investigation indicates that the Strobel Spring described by Jenkins and Hurr (1969) should be called Stroebel Spring. An old windmill near the location of the Stroebel Spring has the name "Stroebel Ranch" painted on the direction-control vane.

DESCRIPTION OF SPRING

Location

Stroebel Spring issues from a small area 250 feet northeast of Turkey Creek and about a third of a mile upstream from the headquarters of Turkey Creek Ranch. The location was surveyed (plane table) as 1,330

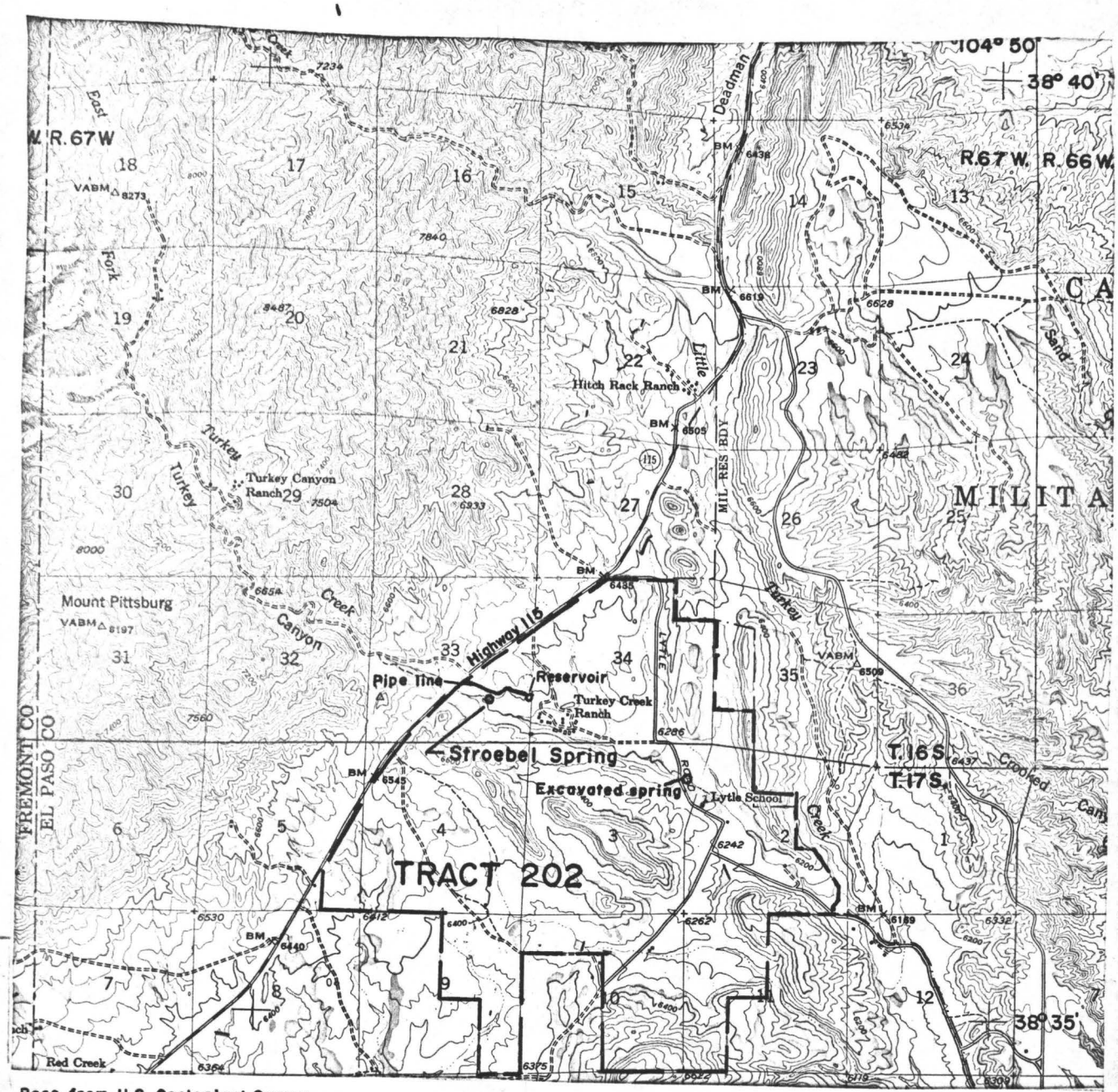
feet west and 1,400 feet north of the southeast corner of sec.33, or the SE¼NW¼SE¼ sec.33, T.16 S., R.67 W. Figure 1 shows the approximate boundaries of Tract 202 and the location of Stroebel Spring, an excavated spring, and a pipeline and reservoir.

History of development

Records of diversion ditches and decrees, as shown in table 4 of the report by Jenkins and Hurr (1969), show that a filing was made for diversion of water from a Strobel (Stroebel) Spring on October 1, 1913. The approximate point of diversion was described as being at the present spring site.

The area of the Stroebel Spring was reported as having been wet and boggy at times since 1913, but in November 1968 it was a shallow depression having no surface flow. During either the last week of December 1968 or the first week of January 1969, the Post Engineer excavated a sump about 20 feet by 30 feet by 12½ feet deep. Mr. J. A. (Jack) Gaylor, manager of the stables of the Army Recreation Club on Tract 202, who has been familiar with the area for many years, selected the site for the excavation because he understood that it was the site of the old Stroebel Spring. In this report, the excavated sump is called the Stroebel Spring sump.

The Stroebel Spring sump was excavated in the alluvium along Turkey Creek; thus, the sump and the alluvium are hydraulically connected. The alluvium consists of cobbles, gravel, sand, and silt and some large boulders more than 2 feet in diameter. A portable gasoline-powered centrifugal pump was installed in 1969, and water was pumped uphill from



Approximate boundary of Tract 202, Fort Carson Expansion Project

Figure 1.--Location of the area of investigation.

the sump to a pipeline through which the water flowed by gravity to a reservoir behind an earthen dam. Water from the reservoir was used to irrigate hay fields and as drinking water for horses.

Water level and yield in 1969

Mr. R. T. Hurr visited the Stroebel Spring sump on July 26, 1969. In conversation with Sergeant Jerry Williams, Mr. Hurr found that water had been pumped intermittently from January through March 1969 and steadily 10 hours per day from April through June 1969. The pumping rate during the 6 months was reportedly only 40 gpm (gallons per minute) because of the limited capacity of the pump. A total of about 24,000 gallons was pumped during each 10-hour period, of which about 9,000 gallons came from storage in the 20- by 30-foot sump and about 15,000 gallons or about 25 gpm came from ground-water inflow from the alluvium along Turkey Creek. The drawdown of the water level in the sump during pumping was reportedly 2 feet; therefore, the sump was yielding about 12½ gpm per foot of drawdown. At the time of the visit by Mr. Hurr, the sump had not been pumped for 2 weeks because of a worn pump. The static water level in the sump was 2½ feet below land surface.

On August 19, 1969, E. D. Jenkins visited the Stroebel Spring sump and found that it was nearly dry owing to previous pumping. The pump had not been operated for 2 hours. The bottom of the sump was covered with muck and about 1 foot of water. The pump was started, but after 10 minutes of pumping at 50 gpm, it began to surge because the pumping rate exceeded ground-water inflow. After the discharge of the pump was reduced to 11 gpm, inflow to the sump equaled the discharge.

Enlargement of sump

The Stroebel Spring sump was cleaned and enlarged by use of a dragline before the 1970 pumping season in an attempt to increase its yield. It is an elliptical excavation about 40 feet wide and 60 feet long (fig. 2). The sump is 9 feet deep below land surface at the south side and 16 feet deep below land surface at the north side. The sides slope inward, because of sloughing, to a relatively flat bottom of about 15 feet by 40 feet. Before pumping began on October 20, 1970, the area of the water surface was about 2,000 square feet. Greatest depths of water in the sump before pumping ranged from 7 feet in the west part to about 8½ feet in the east part.

Mr. Gaylor and Sergeant Williams reported that a centrifugal pump, capable of pumping 250 gpm, was used during the 1970 pumping season. Operation of the pump was cyclic. Pumping was maintained for 10 to 12 hours and then discontinued so that the Stroebel Spring sump could recover for 12 to 14 hours. The rate of pumping was about 200 gpm for about 6 hours or until storage of the sump was depleted, after which the discharge was reduced to the rate of ground-water inflow. The rate of inflow was reportedly 80 to 85 gpm in July and August as measured with a barrel and watch. The average daily pumpage, therefore, was about 100,000 gallons. Turkey Creek flowed intermittently during July and August 1970. The total precipitation recorded during this period at the Ruxten Park weather station, about 18 miles northwest of Tract 202, was 8.72 inches.

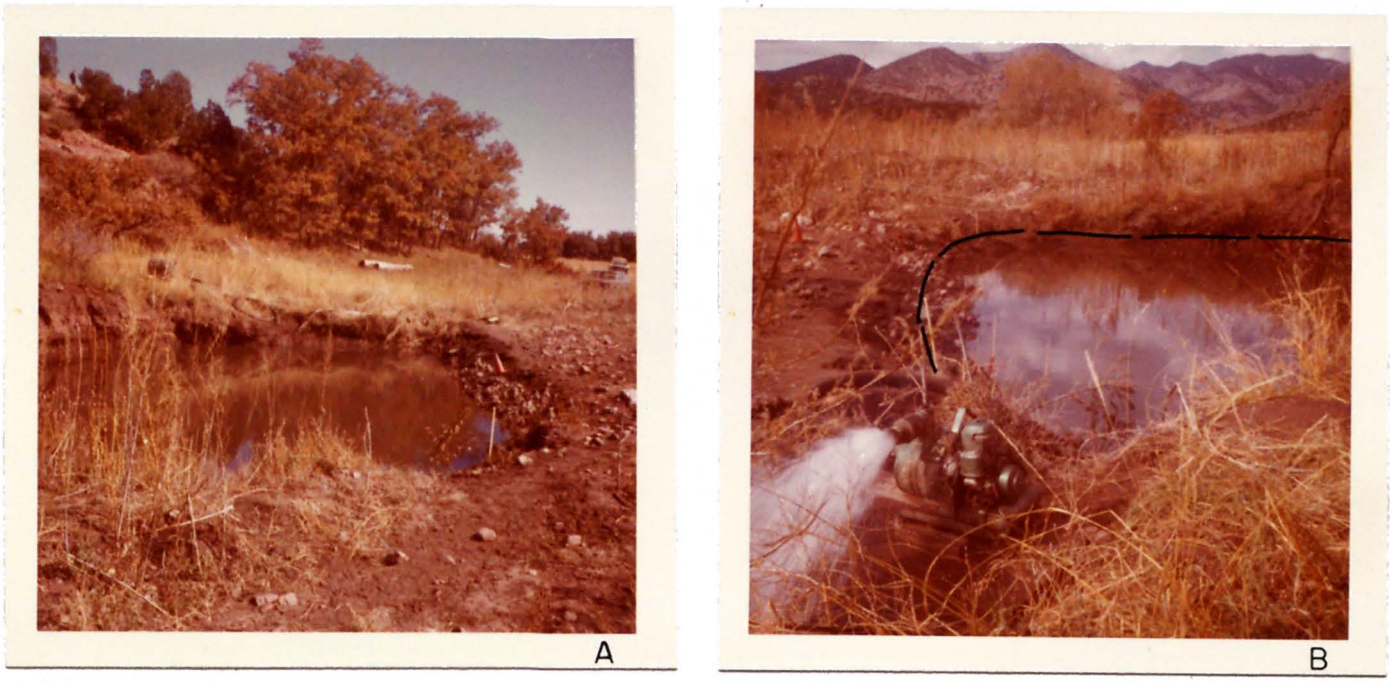


Figure 2.--Stroebel Spring sump: A, View looking east and downstream. Note the greater height of the excavation on the left. B, View looking west and upstream. Portable pump is discharging 237 gpm. Dashed line shows approximate altitude of water surface before pumping on October 20, 1970.

TESTS OF STROEBEL SPRING SUMP

Arrangements were made with the Post Engineer of Fort Carson on October 19, 1970, to test the inflow or yield of the Stroebel Spring sump located on Tract 202. The sump was surveyed and tested with the help of Mr. Philip A. Emery, Hydrologist with the Colorado District of the U.S. Geological Survey.

Pumpage was computed to determine the rate of inflow of ground water to the Stroebel Spring sump and the amount pumped from storage of the sump (table 1). The volume of water in the sump before the test was computed to be about 71,900 gallons; storage capacities at different altitudes are shown in column 10 of table 1 and in figure 3. Altitudes of the water surface and the dimensions of the sump were determined by plane table from a temporary bench mark, which was established from the topographic contours on figure 1. The temporary bench mark, about 6,400 feet above mean sea level, was the top of a nail in the most northern post of a corral 60 feet south of the sump. All discharge measurements were made with Parshall flumes.

October 20, 1970

Before pumping began at 1000 hours, the water level in the sump was 0.7 foot below land surface on the south side, and water flowed from the sump southeastward through a ditch at the rate of 2 gpm. The sump had not been pumped for a month. Attempts to test the sump were unsuccessful because of pump failures; however, pumping rates of 120 gpm were maintained from 1000 to 1213 hours and averaged 133 gpm from 1430 to 1713 hours. Results of these short-duration tests are given in table 1.

Table 1.--Results of tests of the Stroebel Spring sump.

Date	Hour	Time (minutes) Cumulative	Time (minutes) Interval	Altitude of water surface in sump (feet above mean sea level)	Drawdown (feet)	Recovery (feet)	Pumpage (gallons)	Rate of pumping (gpm) (Col.8÷ Col.4)	Storage (gallons) Cumulative	Storage (gallons) Change	Ground-water inflow Gallons	Ground-water inflow gpm (Col.12 ÷Col.4)	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14
10/20/70	1000	0	0	6,398.50	0	-	0	0	71,900	0	-	2	Outflow, 2 gpm Pump on
	1213	133	133	6,397.48	1.02	-	15,990	120	58,400	-13,500	2,490	19	Pump off
	1240	160	27	6,397.55	-	.07	-	-	59,300	+900	900	33	Recovery
	1430	270	110	6,397.68	-	.20	-	-	60,900	+1,600	1,600	15	Recovery
	1430	0	0	6,397.68	0	-	0	0	60,900	0	-	-	Pump on
	1530	60	60	6,397.16	0.52	-	8,480	141	54,000	-6,900	1,580	26	
	1640	130	70	6,396.55	1.13	-	9,310	133	47,100	-6,900	2,410	34	
	1710	160	30	6,396.37	1.31	-	3,640	121	45,000	-2,100	1,540	51	
	1713	163	3	6,396.36	1.32	-	310	103	44,850	-150	160	53	Pump off
10/21/70	0745	1,035	872	6,397.84	-	1.48	-	-	63,100	+18,250	18,250	21	Recovery
	1100	1,230	195	6,398.02	-	1.66	-	-	65,300	+2,200	2,200	11	Recovery
	1100	0	0	6,398.02	0	-	0	0	65,300	0	-	-	Pump on
	1130	30	30	6,397.50	0.52	-	7,140	238	58,600	-6,700	440	15	
	1200	60	30	6,397.05	0.97	-	7,110	237	52,700	-5,900	1,210	40	
	1230	90	30	6,396.53	1.49	-	7,110	237	46,900	-5,800	1,310	44	
	1345	165	75	6,395.25	2.77	-	17,780	237	33,000	-13,900	3,880	52	
	1520	260	95	6,393.55	4.47	-	21,960	231	16,700	-16,300	5,660	60	Pump off
10/22/70	1000	1,380	1,120	6,395.83	-	2.28	-	-	39,100	+22,400	22,400	20	Recovery
10/23/70	1400	3,060	1,680	6,397.04	-	3.49	-	-	52,400	+13,300	13,300	8	Recovery
10/24/70	1000	4,260	1,200	6,397.04	-	3.49	-	-	52,400	0	0	0	Recovery

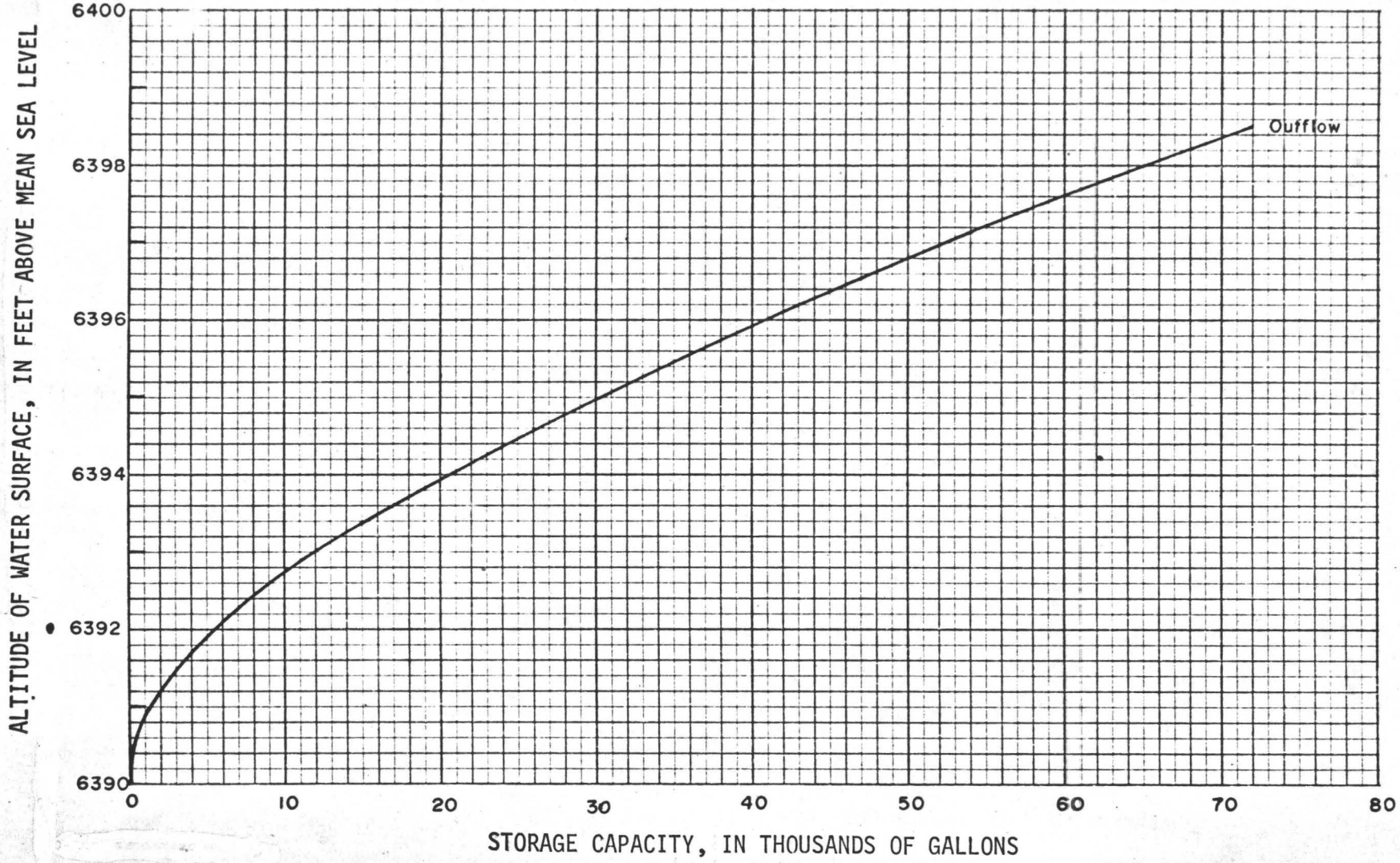


Figure 3.--Storage capacity of the Stroebel Spring sump

October 21, 1970

The water level in the sump, before pumping began at 1100 hours, lacked about 0.5 foot of recovering to the static water level on October 20 (table 1). Therefore, no water was flowing from the sump.

A portable 3-inch centrifugal pump was obtained from the Post Engineer with the agreement that the pump would be returned to the post by 1600 hours. This pump proved satisfactory and is shown discharging 237 gpm in figure 2. The test began at 1100 hours with an initial pumping rate of 238 gpm. When the test ended at 1520 hours, the pumping rate was 231 gpm. The average pumping rate for the duration of the test was 235 gpm. The water level in the sump at the end of the test was 4.47 feet below the static level on this date, and about 5 feet below the original static level of October 20.

Results of tests

A total of nearly 100,000 gallons of water (table 1) was pumped during the 2 days of testing, of which about 78,000 gallons came from storage and about 21,000 gallons came from ground-water inflow from the alluvium along Turkey Creek. The rate of ground-water inflow ranged from 0 to 60 gpm (column 13) and was dependent upon the differential head between water level in the sump and in the surrounding alluvium along Turkey Creek. An increase in drawdown in the sump increases the gradient of the water level between the alluvium and the sump and thus increases inflow. The inflow of zero occurred at the end of the recovery part of the test when the water level in the sump had recovered to within 1.5 feet of the original static level. The inflow of 60 gpm occurred near the end of

the drawdown part of the test when the water level in the sump was lowered 5 feet below the original static level. Although the specific capacity of the sump varied with time, it was computed to be 12 gpm per foot of drawdown at the end of the test, which compares closely with observations of Hurr and Jenkins in July and August 1969. If the pumping water level had been lowered to within 1 foot of the bottom of the east part of the sump (altitude 6,391 feet), resulting in a drawdown of 7½ feet, and the specific capacity had remained constant, the inflow or yield to the sump would have been about 90 gpm after about 6 hours of pumping. This compares favorably with the inflow of 80 to 85 gpm reported by Gaylor and Williams for the summer of 1970.

Data from the test show that, on the date tested, the Stroebel Spring sump could have been pumped at the tested rate of 235 gpm for about 6 hours or until storage of the sump was depleted, after which the discharge would have to have been reduced to the rate of inflow, which was about 90 gpm (130,000 gallons per day). With continuous pumping, the rate of inflow would have decreased slowly as more of the aquifer was dewatered until the cone of depression extended to and beneath the stream to intercept surface-water flow. At the time of the test, Turkey Creek was flowing about 30 gpm (less than 0.1 cubic foot per second) at a point 250 feet northwest of the sump and, at that location, the altitude of the stream was the same as the altitude of the static water level of the sump. At a point about 250 feet southwest of the sump the stream ceased to flow, which provides evidence that the alluvium, into which the sump is excavated, was being recharged by streamflow. Because of the relatively short duration of the test, no change in rate of streamflow or point of no flow could be noted.

The water level in the sump did not fully recover during measurements following the test; it was 1.5 feet below the original static level after 2 3/4 days of recovery. Therefore, after several days of continuous or intermittent pumping, the rate of ground-water inflow would be reduced because of the water-level decline in the alluvium and the Stroebel Spring sump would not sustain the yield computed from the test. However, the sump will sustain a yield longer when Turkey Creek is flowing than when it is not flowing.

RECHARGE AND DISCHARGE

Recharge to the alluvium of Turkey Creek is derived from precipitation and by seepage from Turkey Creek, which flows only during times of rainfall or snowmelt. In addition, the alluvium is recharged by seepage from canals and applied irrigation water. Natural discharge from the alluvium may occur as seepage to a stream, spring, or sump, loss to another aquifer, evapotranspiration, or ground-water outflow.

Inflow to the Stroebel Spring sump will vary from slightly more to much less than 90 gpm, depending primarily on the amount of recharge to the alluvium from precipitation. Precipitation at the Ruxten Park weather station was 21.73 inches for the first 9 months of 1970 and 18.06 inches in 1968. During periods of heavy precipitation and runoff, the water level in the alluvium and the sump could rise 0.7 foot above the static water level of October 20, 1970, before overflowing the south side of the sump. A greater temporary inflow or yield would be possible from such a rise. On the other hand, during a period of lesser precipitation, such as in October and November of 1968, the water level in the

alluvium of Turkey Creek could drop to as much as 9 feet below the channel of the creek (Jenkins and Hurr, 1969, fig. 2). During periods of deficient precipitation, there would be little water in the Stroebel Spring sump and, therefore, little if any inflow to the sump.

CONCLUSIONS

The Stroebel Spring sump will yield about 90 gpm during periods when it is possible to lower the pumping water level in the sump as much as 7½ feet below the static water level. The rate of ground-water inflow to the sump will vary from slightly more to much less than 90 gpm, depending upon the amount of recharge available to the ground-water reservoir. During periods of deficient precipitation, the water level in the alluvium could drop to as much as 9 feet below the channel of Turkey Creek, which would result in little if any inflow to the sump.

REFERENCE

Jenkins, E. D., and Hurr, R. T., 1969, Hydrologic investigation, Fort Carson, Colorado Expansion Project, Civil No. 8920 - Tract 202, El Paso County, Colorado: U.S. Geol. Survey open-file report, 38 p.