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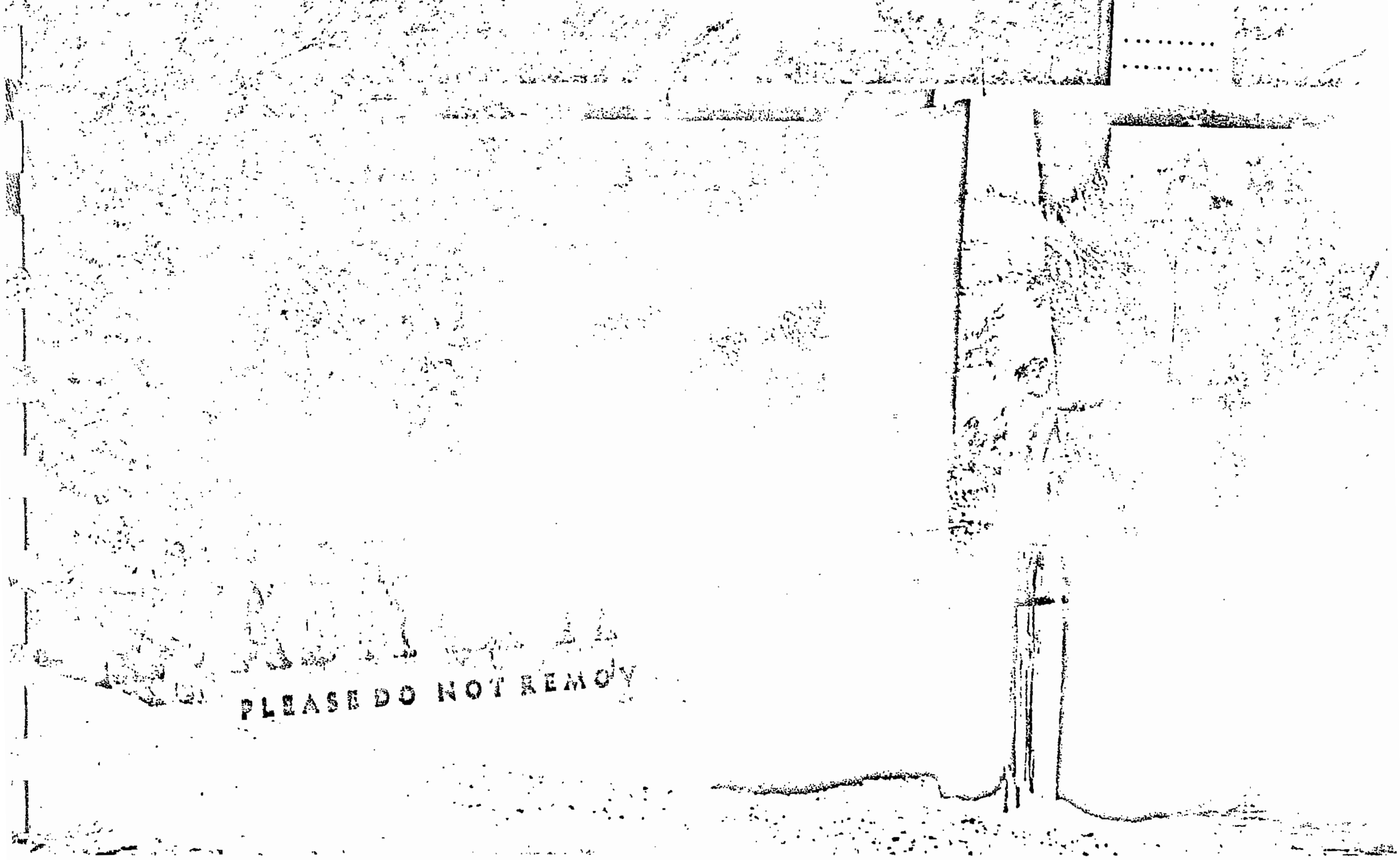

View of Muddy River at gaging station

GROUND-WATER RESOURCES – RECONNAISSANCE SERIES

REPORT 25

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GROUND–WATER APPRAISAL OF COYOTE SPRING AND KANE SPRING VALLEYS AND MUDDY RIVER SPRINGS AREA, LINCOLN AND CLARK COUNTIES, NEVADA

233

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Spring Valley and in the Muddy River Springs area. The storage and transmission of ground water in carbonate rocks beneath the valleys is inferred from the fact that the Sheep Range is an area where carbonate rocks are exposed extensively and also that the Sheep Range is a favorable area for receiving recharge from precipitation. Additionally, the relatively deep water level of the main ground-water body in the valley fill, in the vicinity of well 13S/63-25a1, is suggestive that some ground water moves downward from the valley fill into the Paleozoic carbonate rocks. Well 13S/63-25a1, which is a short distance northwest of the Arrow Canyon, is in an area where a shallow depth to water would be expected because of a decrease of transmissibility in the valley fill due to a substantial reduction in cross section of the valley fill in the gap.

Ground water occurs in the younger valley fill beneath the flood plain in the Muddy River Springs area. For most of the area the depth to water in the younger valley fill is within a few feet of land surface. However, it increases in depth to 25 to 35 feet in the northwestern part of the area beyond the springs. The thickness of the younger valley fill in this part of the area has not been determined, but based on the late geologic history of the region, its maximum thickness probably is not more than several tens of feet. Most of the ground water developed by wells in the area apparently comes from water in the younger valley fill.

Ground water also occurs in the older valley fill in this area. The depth to water varies considerably, largely due to variations in altitude of the land surface. The water surface in the older valley fill probably is consistent with that in the younger valley fill and has a general southeastward slope.

Although some recharge to the ground-water reservoir in the valley fill is derived from local precipitation, most is derived from surface and subsurface discharge of the Muddy River Springs. The water supplying the springs is derived from ground water that largely moves through Paleozoic carbonate rocks, which in turn is supplied by recharge derived from precipitation in favorable areas generally north and west of the springs.

<u>Muddy River Springs:</u> The Muddy River Springs are the dominant hydrologic feature of this area. The average annual discharge is 46.5 cfs for 25 complete years of records as measured at the Muddy River gaging station near Moapa. Monthly and annual mean discharge is given in table 3. Annual mean discharge has ranged from 43.5 cfs in 1930 to 49.6 cfs in 1958. The least monthly mean discharge is 43.2 cfs in June and the greatest monthly mean discharge is 49.6 cfs in January, according to the record. Thus the range in annual fluctuation is small with the minimum annual mean discharge being nearly 88 percent of the maximum annual mean discharge. The minimum monthly mean discharge is nearly 87 percent of the maximum monthly mean discharge. It should be noted that a small part of the measured streamflow is contributed by runoff from local precipitation. Most of this is contributed by high-intensity storms which occur most frequently in July and August.

The fact that local storms contribute only a small part of the total flow past the gaging station is shown by making a simple adjustment of the detailed gaging-station records for storm runoff, which only reduces the mean annual discharge from about 46.5 cfs to about 46.4 cfs. This adjustment, however, does shift the low monthly flow from June to July. The remaining flow measured at this gaging station represents discharge from springs.

Table 3.--Monthly and annual mean discharge, in cubic feet per second, of Muddy River, near Moapa, for 25 years during the period 1914-62

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
1914	47.6	48.9	49.7	50.3	58.7	46.8	45.4	44.0	44.3	43.9	43.5	43.9	47.2
1915	44.8	47.1	48.8	50.5	54.3	50.2	48.7	46.8	42.5	45.3	44.3	48.0	47.6
1917	46.7	49.7	49.1	48.2	49.2	48.3	46.7	44.5	44.9	44.3	44.8	44.5	46.7
1918	47.1	48.2	49.2	49.0	50.0	49.5	47.0	46.0	44.3	44.9	43.5	46.1	47.0
1929	42.4	44.1	46.7	47.5	47.0	45.7	44.7	42.7	42.0	42.9	42.5	43.2	44.3
1930	43.9	44.1	44.8	47.0	46.6	46.2	44.7	43.0	40.3	40.7	41.2	39.8	43.5
1931	43.7	44.3	45.8	46.8	46.8	45.5	42.8	42.5	40.7	41.7	40.7	45.6	43.9
1945	45.9	47.0	48.8	47.4	47.2	46.1	43.7	42.0	41.7	44.5	47.7	45.8	45.6
1946	49.7	49.4	50.1	50.8	49.7	49.2	46.6	42.7	40.6	42.5	46.0	45.9	46.9
1947	49.6	51.2	50.6	50.1	49.6	48.3	48.6	46.9	44.7	44.4	44.6	45.2	47.8
1948	46.5	48.2	50.4	48.2	48.3	47.3	46.5	45.4	44.6	42.6	43.2	44.1	46.3
1949	47.0	47.0	49.5	53.5	50.9	47.6	46.9	45.7	45.5	43.1	43.7	44.6	47.1
1950	47.2	46.8	49.8	49.0	47.5	47.8	45.9	45.0	42.8	44.5	43.1	45.2	46.2
1951	46.5	47.2	47.5	48.8	48.1	48.0	48.4	48.3	44.6	44.8	45.1	45.0	46.9
1952	46.6	48.0	49.3	49.3	47.5	50.1	47.5	45.6	45.1	44.7	42.2	43.4	46.6
1953	44.4	50.5	52.1	49.6	47.6	45.2	44.7	43.5	42.6	45.9	42.9	43.4	46.0
1954	46.6	49.0	50.3	48.9	48.5	46.5	46.1	45.6	42.4	41.7	42.4	44.4	46.0
1955	45.1	50.3	48.7	52.5	52.1	47.6	45.6	45.8	43.7	42.7	48.5	44.3	47.2
1956	46.1	46.3	48.0	49.5	50.9	47.2	46.0	44.8	43.7	41.8	41.7	43.3	45.8
1957	43.7	47.1	48.8	49.5	50.9	47.3	46.8	47.7	46.1	43.4	54.5	46.5	47.7
1958	52.9	54.2	53.6	52.5	56.2	53.5	50.6	48.5	42.8	44.0	43.3	43.8	49.6
1959	44.7	47.9	52.1	52.7	52.3	52.1	48.8	47.1	44.6	45.2	52.3	46.9	48.9
1960	47.3	53.0	54.9	55.4	51.7	51.5	47.7	45.7	41.2	40.2	41.1	43.4	47.8
1961	45.2	61.6	51.4	48.6	44.2	44.5	44.6	42.1	41.9	45.1	43.3	42.5	46.3
1962	42.8	46.2	48.3	48.2	46.3	49.9	44.0	42.7	43.5	40.6	39.0	42.4	44.5

To analyze further the gaging-station record as a means of evaluating the characteristics of the actual discharge of the springs, a set of measurements and estimates of discharge were made at 40 points in September 1963. These measurements are listed in table 4. The locations of springs and measuring points are shown in figure 3. The springs rise within a distance of two miles north of the gaging station. When the measurements were made, all except 1.4 cfs of the flow was passing the gaging station. The flow at stations 2 and 3 was the only water from the springs that did not pass the gaging station in the main channel. It is noted that the flow of 1.35 cfs past station 3 actually resulted from pumping of well 14S/65-15bb1, which is in a spring area. A special study of the discharge of the springs has been started and involves periodic measurements at selected stations. These will form the basis for a more detailed analysis of the spring flow.

Preliminary information indicates that the spring discharge has less variation than shown by the record for the gaging station on Muddy River near Moapa. Inspection of the continuous gage height record indicates that a slight daily fluctuation, on the order of a few thousandths of a foot, occurs in the summer season but not in the coldest part of December and January. This fluctuation apparently is due to evapotranspiration along the channel and ditches between the gaging station and the springs.

Inspection of the monthly mean discharge indicates that the lowest flow occurs in the summer months and the highest flow occurs about in January. This reflects the seasonal variation due to evapotranspiration in the area upgradient from the gaging station. This effect also reflects some diversion for irrigation in the area upgradient from the gaging station where most of the water diverted for irrigation is dissipated by evapotranspiration. If this effect is adjusted out of the gaging station record, the average annual discharge of the springs might closely approach the average discharge of nearly 50 cfs for January recorded at the gaging station.

Several simple preliminary adjustments of the gaging record result in the removal of local effects of evapotranspiration and surface runoff from high-intensity storms. The resultant adjusted discharge indicates a long-time variation in annual mean discharge. The inference may be made that such long-time variation in annual mean discharge is a response to the effects of long-time variations in precipitation. To examine this thesis, a comparison was made by plotting the cumulative departure from average discharge of the gaging record with the cumulative departure from average annual precipitation at Adaven about 100 miles north-northwest of the Muddy River Springs (fig. 4). This precipitation station was used because it is within the drainage area believed to supply water to the Muddy River Springs and because it has a relatively long period of record. There are considerable minor variations between the two graphs. However, the two curves seemingly fit best by matching the sharp rise in the precipitation graph during the period 1935-41 with the sharp rise in the discharge graph during the period 1956-60. The substantially above-average precipitation shown for the reference period also was in part a period of above average precipitation regionally in eastern Nevada and western Utah. Accordingly, it is inferred that throughout the drainage area that may supply Muddy River Springs, precipitation was substantially above average. If this was the case, then above-average recharge during the reference period probably was well distributed throughout the area and should be reflected, in time, in the discharge from the system. The tentative interpretation that the above-average discharge of Muddy River Springs during the period 1956-60 was in response to above average recharge during the period of 1935-41 obviously cannot be proven conclusively with the data at hand. Positive correlation with less than major conditions of precipitation--that is, excessively wet or dry periods--undoubtedly will be difficult and will require much additional information. Besides the need for a more vigorous analyses, substantially more data are required over a considerable period of time to determine if the response and lag-time is repetitive. At present the tentative interpretation only suggest that the lag-time response is on the order of a number of years which is consistent with the general concept of the dimension and character of the carbonate system.

<u>Ground-water system supplying Muddy River Springs.</u>--Under long-term conditions and prior to development, the average annual recharge to the ground-water reservoir in a hydrologically-closed ground-water system equals the average annual discharge. However, if a ground-water system in a topographically-closed valley is hydrologically open, recharge derived from

It may be noted that the relatively close values between the means and medians are indicative of the relatively uniform flow of the springs.

A partial adjustment to correct out the effects of streamflow from surface runoff due to local rainfall was made for the period 1945-62 in which records were conveniently available. The adjustment was made by reducing the high flow shown for short intervals to values consistent with the immediately preceding and succeeding periods for daily streamflow. During the 18-year period, adjustments were made for a total of 24 intervals. These were distributed by months as follows: one in October, three in November, two in December, two in February, one in March, one in May, two in June, six inJuly, and six in August.

If the 25-year mean discharge, 46.5 cfs, of Muddy River at the gaging station near Moapa is used for convenience to represent the discharge of the springs, the indicated mean discharge of the springs is about 33,700 acre-feet a year. The actual spring discharge is greater, due to some losses by irrigation diversion and evapotranspiration, and may approach a mean of 50 cfs or about 36,000 acre-feet a year. The annual mean discharge, however, has ranged from a low of 43.5 cfs in 1930 to a high of 49.6 cfs in 1958 for the period of record at the gaging station.

In addition to the spring discharge in the Muddy River Springs area several wells pump water for irrigation from the valley fill. These wells irrigate 400 to 500 acres of land. If about 5 feet of water per year is applied to this acreage, the yearly pumpage would be 2,000 to 3,000 acre-feet. Actual pumpage was not evaluated for the current year, and it is believed that acreage irrigated and acreage in various crops varies somewhat from year to year. Therefore the 2,000 to 3,000 acre-feet a year is considered to be a reasonable estimate for the "average" year.

Natural discharge of ground water by evapotranspiration in Coyote Spring and Kane Spring Valleys is relatively minor. In the vicinity of Coyote Spring, ground-water discharge probably is not more than a few hundred acre-feet a year, including that used for irrigation at the ranch. The flow of the springs in Kane Spring Valley is discharged finally by evapotranspiration from the valleys. The magnitude of this discharge is smaller than that in Coyote Spring Valley, probably less than 100 acre-feet a year.

In summary, it is estimated that ground water discharged naturally from the area of this report amounts to roughly 36,000 acre-feet a year from the springs that supply Muddy River. Of this, an average of 33,700 acre-feet, or 46.5 cfs, leave the area as streamflow past the Muddy River gaging station near Moapa. Most of the remainder apparently is used by irrigated crops or native vegetation upstream from the gaging station, and a very small amount may leave the area as underflow.

Whether part of the ground water discharged by irrigation wells subsequently leaves the area as streamflow in the Muddy River has not been