REPORT ON PURNELL PROJECT 44

FORECASTING THE RUNOFF OF THE HUMBOLDT RIVER, NEVADA

Report by Carl Elges

Nature was very considerate during the 1939 runoff period and gave us a normal amount of precipitation. The forecast for the Humboldt River yield at Palisade during the March-July period was set at 140,000 acre feet or about 56 percent of normal provided the precipitation during the period would be normal. The actual flow was 151,600 or 59 percent of normal. Similarly the runoff of Lamoille Creek was forecast at 17,500 acre feet or 75 percent of normal and the actual attained was 18,790 or 82.4 percent of normal. These represent the accuracy that is desired and that has been the aim of the Department since the time the project was started. However, the above figures represent only those for 1939 and it remains to be seen whether forecasts will uniformly be as close in the future. The following table gives a comparison of the March 1 snow cover with the forecast and actual runoff at Palisade for the March-July period since 1932:

	Show Water Content	Forecast	Actual	Deviation of Forecast
1932	107.1	99	118	+19
33	82.9	97	46	+51
34	59.9	10	4	+ 6
35	73.7	25	57	-32
36	134.8	115	98	+17
37	78.1	51	67	-16
38	63.3	70	82	-12
39	69.4	56	59	- 3
1940	56.0	56		

All figures represent percent of normal.
These figures are uncorrected for precipitation.
They are given just as they appear in the published forecasts.

From the table it is apparent that the streamflow does not necessarily correlate with the snow cover water content. Before the forecast is made, it is therefore necessary to study several items, viz: the ground water table elevations in the tributary valleys of the Humboldt and along the valley of the main channel for the years of record; the hydrograph of similar years of snow cover; the winter flow as compared to other years; the distribution of the snow cover; the variation of winter precipitation from the snow storage on March 1; the temperature during the winter and during the runoff period; the runoff of previous years to see whether the year in question followed a dry or wet one; the variation caused by the spring and summer rains; and variations in the snowcover and precipitation from the March 1 snow survey until the actual date of the issuance of the forecast. When all these have been duly studied, it is only then possible to make up the forecast. As more data are accumulated it is expected that the forecast accuracy will be improved.

For the past few years a forecast has been made each year on Lamoille Creek, a small watershed that is receiving detailed study because of its accessibility. It is an excellent indicator basin for the Ruby Mountains and a network of five snow courses is now in use in the canyon. The results of these forecasts have been very satisfactory and it shows that there will be little trouble in forecasting the tributary streams above diversions when sufficient runoff measurements have been made to give a fair record for comparisons. This year one additional stream, the South Fork at the Bolten Ranch has been added to the forecast list of stations for which quantitative estimates are given. If the flow

of the streams in the Upper Humboldt Basin is not erratic this year, it should be possible to forecast more of the tributaries and it is hoped that eventually a forecast can be made for Palisade based upon the combined flow of the tributaries to confirm the one made by the present method.

Prior to 1936 the Supervising Water Commissioner required the commissioners working under him to take runoff measurements, which were included with the report of the distribution for that year. This method gave us some records but not always covering the same period of time or the same stations. Furthermore the stations were of a very temporary nature and cases of very poor records were discovered, thus making the value of the records as a whole rather doubtful.

In 1936 the new supervising water commissioner did away with the stream flow records entirely. As a result at the end of the season there was no way to check the accuracy of our work and it left a gap in the record that was being accumulated. A protest was made to the State Engineer who had requested our cooperation by making forecasts of available irrigation water and he finally agreed to hire a hydrographer to work under the direction of the Department of Meteorology but to be paid from State funds. A network of stations was then made up and it was decided to obtain a record over the uniform period of April through July of each year. This system has worked out very well. It is costing the State about $1500 each year to hire the hydrographer or to have the water commissioners collect the required data. The Experiment Station in cooperation with the U. S. Geological Survey has been

establishing recording stream gaging stations and has endeavored to make them more or less permanent. The Experiment Station paid the bills, which were small, for improvement of the gaging stations and the installation of small temporary gage houses. Through the Division of Irrigation, Soil Conservation Service, it was possible to borrow a number of water stage recorders and the important stations are now all equipped with them. Cables and gage carts are provided where it would be dangerous or impossible for the hydrographer to make measurements without them. The records collected now are of some real value.

Also through the cooperation of the Division of Irrigation, Soil Conservation Service, it was possible during the past two years to visit all snow courses in the Humboldt Basin. It was found that there were many that were improperly posted, some that were not posted at all, some that needed clearing, and some for which no descriptions were even written up. Accordingly the courses were posted, mapped, and cleared of brush and rocks where necessary. Directions and identification signs were added. It is planned to make regular inspections of the courses henceforth so that the basic snow data will be as accurate as possible. Frequent inspections should also be made of the snow surveying instruments. Travel expenses in connection with this work are necessarily high, for on a trip made to a portion of the courses last fall a distance of 3200 miles was covered. Since cooperation with the Division of Irrigation has been established, much of the expense has been borne by it. During the past year it furnished us with snow survey equipment valued at about $400. Furthermore it has allotted $300 toward securing the snow survey measurements, which has aided in reducing the Experiment Station's financial load.

A detailed study has been made of the snow surveys and stream flow in the Little Humboldt, particularly Martin Creek, for which good forecasts were made for a number of years. It was discovered that ever since an attempt was made in 1932 to improve the only snow survey course by lengthing it and putting a cross course in conjunction with it, the forecastshave been grossly in error. Three new courses were laid out in the basin in 1932, but despite these improvements, the forecasts have been worse. Graphs were made plotting all the individual measurements on the courses, the relationship of the separate courses and branches thereof with the runoff, and the monthly runoff of the stream. There seems to be no good combination of the courses. By field inspection on March 1 it appeared that some of the courses can be improved by eliminating their extremities.* It is planned to carry the study further and try to rebuild the forecast accuracy.

Last fall a new snow course was laid out above Midas to serve for Rock Creek and the headwaters of the East Fork of the Little Humboldt River. It will also be valuable as a western course to be used in conjunction with the Taylor Canyon course to indicate conditions for Susie and Maggie Creeks. Two new courses were also laid out near Cave Creek upon request of U.S. Biological Survey to serve for south Ruby Valley and Huntington Creek.

A 1940 Forecast is submitted herewith.

*The application of this curtailment to the first course since studied has considerably improved its harmony with the other courses and the streamflow.

Since snow survey measurements made in the northern portions of Humboldt and Elko counties are also of value to Oregon interests, $40 is now received in wages from the Owyhee Project, Bureau of Reclamation, for transmitting the records to them for its use. This allotment is paid toward the hiring of snow survey assistants to take the readings.

The State Engineer in addition to furnishing the hydrographer, pays $150 per year from the Humboldt Distribution Fund toward the expenses of obtaining the snow surveys in the main basin. During the past year, through the cooperation of the Division of Irrigation, the Bureau of Reclamation, the Forest Service, and the State Engineer, all bills for the regular surveys were paid without the financial aid of the Experiment Station.

During the past year, five trips were made in connection with the project. Of these, one was paid for by the Experiment Station; but the remainder were all paid for by the Division of Irrigation, Soil Conservation Service.

Well measurements have been continued semi-monthly in Lamoille Valley. Orval Ames of Lamoille is hired to make the measurements and is paid mileage for his car. The annual cost of obtaining these measurements is about $250.

For the past three years measurements have been secured on a series of wells along the valley of the main Humboldt semi-annually, once the latter part of October and once on April 1. These have been taken either by the Hydrographer or by the Assistant Meteorologist when on a trip through the region.

To determine the relative intensity of spring and summer precipitation on mountain slopes, three years ago a number of precipitation gages were obtained from the Division of Irrigation

for installation at various elevations in Lamoille Canyon. These were placed and the Forest Service agreed to have its warden, stationed in the canyon during the summer, visit each gage after every storm to measure the amount of rainfall. However, the warden was not put on the job until the middle of June since the Lamoille Canyon road is not opened until early that month. Moreover, foot travel over the 14 miles of soft snow and return was impracticable. Therefore the measurements during the earlier part of the March-July period desired were not obtained. Consequently, last October, through cooperation with the Forest Service and Weather Bureau, a battery of storage precipitation gages mounted on towers was installed at the Terraces (8,500 ft.). These gages charged with calcium chloride to prevent freezing and covered with a thin film of oil to stop evaporation, can be left for a considerable period of time without attention. Their chief value, as far as the project is concerned, is to give accurate precipitation data after the date of the principal snow survey during the runoff period. A new snow course was laid out in conjunction with the gages to give a monthly check reading for comparison. It is planned to obtain two more of these gages to be installed at the 7600 and at the 9000 ft. snow courses in the canyon. They can be read when the regular snow surveys are made the first of each month and should prove very satisfactory. The forest ranger at Lamoille has agreed to take the measurements and look after the gages.

In conjunction with the new gages it is planned to have the March 1 snow survey party set up the old small gages at points not covered by the newer installations. The old gages will be charged with calcium chloride so that they too can be left for a month without being read.