# USE OF SNOW SURVEYS IN THE WEST

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The purpose of making snow measurements is to assist in better utilization of available water supply. A great deal of emphasis is placed on details of obtaining snow measurements. It does require a lot of skill and effort on the part of men who make the trips to the snow courses. Newspapers and magazine writers have used snow survey trips into remote areas of the mountains as a basis of glamour stories. However, it might be of more interest here to discuss the practical use of snow measurements as they affect an economy depending on water.

The Program Committee has raised a question as to the mechanics of the distribution of snow survey data. The following is a brief discussion.

Most snow measurements in the west are made within four days of the first of the month from January through May. Several federal agencies along with irrigation, power and other interests desire snow measurements as soon as they are available. (These are transmitted by telephone or telegraph as the individual measurements are received and checked for accuracy.) Immediate operating action by the agencies or interested parties may result on the receipt of snow survey information. In late season there is little time between the snow survey and the occurrence of the principle snow melt flow for action to be taken.

The mass distribution of snow survey data is usually called the advanced snow report which is published on the third or fourth of the month. About 90 percent of the snow measurements are available at that time. This report is nothing more than a mimeographed sheet showing current snow measurements. This is transmitted by ordinary mail to most recipients but airmailed to distant locations. For instance, at Fort Collins, we airmail the data to Nevada and California water users who are interested in upper Colorado River snow measurements. During this particular period we receive numerous informal inquiries as to our opinion on water supply outlook at the moment.

By about the tenth of the month following each snow survey date the formal "snow report" is mailed. This report includes, among other things, the current snow measurements compared with measurements of recent years, reservoir data, precipitation summaries and streamflow forecasts.

The snow report also presents in graphical and narrative form the estimate of water supply outlook by the Soil Conservation Service and cooperators in each state. The outlook is, in general terms, for major watersheds within a state or drainage basin. It is prepared and coordinated by the snow survey supervisors with advice and information from various sources.

The method of accomplishing this report of water supply outlook varies considerably from state to state. In some states the water supply outlook is prepared by the snow survey supervisor with the help of representatives from offices of State Engineer and Agricultural Experiment Stations and possibly a few others. The general procedures are agreed upon in advance so that only informal conferences are necessary at the time of the release of the report. Detailed procedures are usually developed by the snow survey supervisor. In other states, more or less formal forecast committees representing public agencies and local water users directly assist the snow survey supervisor. Actual meetings are held, streamflow forecasts are determined from data available, and a statement of water supply outlook and recommended action is prepared.

In the meantime, mass media communication facilities are used to spread water supply outlook information to the general public and to numerous small water users. Formal news releases are prepared for newspapers which carry them as first rate news almost universally throughout the west. They are written by the snow survey supervisors and are edited by specialists of the Soil Conservation Service or the Agricultural Extension Service in each state. Radio recordings are made for use on the farm programs of local stations. Limited use is made of TV where suitable time is available.

The users of snow survey data may be classified into three groups as follows:

1. *Organizations such as federal agencies, power companies, large municipalities, large irrigation districts and industrial water users.*

   These organizations have their own technical resources to assemble snow data and other hydrologic information and convert such information in terms of their needs. They assemble additional data on storage water available, water rights, precipitation, streamflow and other items. Problems such as scheduling the production of power, reservoir control, water restrictions, water available for irrigation, purchase or sale of water and estimates of crop production are involved. A snow survey supervisor cannot know all of the intricate planning necessary for the operation of any one of these types of enterprises. These users just want the basic data. The snow survey supervisors are called upon for opinions on certain phases of water problems, but the organizations maintain all responsibility for their own procedures and forecast results. Some of these procedures have been reported by Western Snow Conference.[1]

   Numerous instances could be cited in recent years where Federal agencies and others have used snow surveys for operational purposes to minimize damage from floods and to conserve water in reservoirs. Their estimates and action requires a full and detailed knowledge of all of the hydrologic factors affecting the problem in question.

2. *Organizations whose business is indirectly related to water supply.*

   These organizations include transportation companies, agricultural processors, electric power distributors, banks, crop insurance organizations, sales organizations and others of the same general nature. These groups are not interested in details of snow measurements, soil moisture and groundwater conditions, water in storage and other factors that are used in appraising the water supply outlook. The estimate of water supply is accepted by them as being reasonably accurate. Their problem is to convert the estimates into such information as car loadings, acreage in specialized crops, pumping requirements, credit policies and sales probabilities.

3. *Farmers and small water using organizations.*

   The principal group of water users which we try to serve directly are farmers and small water using organi-

zations within Soil Conservation Districts. The job of the Soil Conservation Service to assist districts is prescribed by law. As a general statement these districts do not have other technical assistance available to help the irrigation interests. Much of our effort is directly concerned with the water supply outlook for agricultural use.

In the southern half of Western United States we have experienced a series of years of short water supply. With increasing population this situation will probably not change. It may be relieved temporarily by a wet cycle but the long term pressure is on. In talking with individual farmers it is found that an increasing number are seriously concerned with water supply outlook and use whatever information they can get in planning their operations. They may not have as technical an approach to the problem as a large hydro-electric company but their thinking follows a similar pattern. Conversation on water supply outlook is like the weather. Everyone likes to talk about the subject. It is rather easy to get a farmer's opinion.

An attempt is being made to provide more and more detail on water supply outlook to personnel assigned to assist Soil Conservation Districts, to the officers of the districts, and to members of the boards of irrigation organizations. In irrigated areas which are in Soil Conservation Districts, there is usually at least one member of the board serving both organizations. A plan and program are slowly developing to inform our local personnel to be well informed on water operations in their district.

In older irrigated areas of the west, through a long shake-down of water rights, distribution systems and administrative arrangements, individuals served by a certain stream are similarly affected by water supply outlook. In other words, in a year when streamflow is low, almost all distribution systems are short of water. Conversely, when there is plenty of water, almost everyone has an adequate water supply. There are some exceptions for a few who have good water rights and those whose water depends only on high peak flow of the stream. New reclamation developments in the west tend to stabilize water supply, particularly if the snow melt season flow can be anticipated.

Some ditch companies are so organized that almost everyone on the ditch has an equal right to water available to the ditch. Each acre of irrigated land under the ditch has a share. The cost of the system is also pro-rated on this basis.

As an example, one company in the South Platte drainage of Colorado serves about 50,000 acres. In addition to direct flow and storage rights on the local stream it has private trans-mountain diversions from the Colorado and North Platte River basins and access to a share of water diverted from the Colorado River through the Colorado-Big Thompson project. Of the water available, a share is allotted to each 80 acres of irrigated land. Over the years, the company has provided on the average a little over 100 acre-feet per share. In individual years this has varied from about 60 to 180 acre-feet per share.

The attached chart (Figure 1) shows that there is a reasonable relationship between an index of snow measurements and other hydrologic conditions in recent years and the acre-feet per share delivered by the company. We need a longer record but measurements and records in earlier years are incomplete. Without going into statistics you can see that in about 8 out of 10 years we could have estimated water supply delivered within about 10 percent or 10 acre-feet per share.

Let us assume a year that the estimate is that the most probable amount of water to be delivered during the next irrigation season is 90 acre-feet per share or about 85 percent of normal. Also that the farmer is an average gambler and is willing to take the estimate for purposes of planning. He has 320 acres of irrigated land and therefore can expect to have 360 acre-feet of water. He also has a pump to serve 80 acres of land which we can eliminate from consideration. This is not enough for full plantings of alfalfa, sugar beets, corn or potatoes, the heavy water using crops grown in the area. He must have some grain which requires less water. He has 50 acres of alfalfa which must be maintained and a 50 acre beet allotment which he desires to utilize. The market for potatoes looks good this year and he would like to plant 80 acres of potatoes. The remaining 60 acres will be planted to small grains.

The table of water requirements is as follows:

**TABLE I**

| Crop | Acreage | Water Requirements* Acre-Feet/Acre (Approx.) | Total Acre-Feet |
|---|---|---|---|
| Alfalfa | 50 | 3.0 | 150 |
| Sugar Beets | 50 | 3.0 | 150 |
| Potatoes | 80 | 2.5 | 200 |
| Small grain | 60 | 0.8 | 48 |
| | 240 | | 548 |

*Based on 50 percent irrigation efficiency

This example shows that he has a requirement of 548 acre-feet with 360 acre-feet available. If the water supply was expected to be 10 to 20 percent above normal, his program would be reasonable. This year he would be faced with a choice of complete abandonment of a substantial acreage or under irrigation of all his crops resulting in low yields. A considerable investment would be lost.

After thinking the matter over, the farmer would want to maintain his sugar beet allotment because of cash values involved. He could reduce his alfalfa irrigation to 2.5 acre-feet per acre and still maintain the stand in good condition with reduced yield. Unless he can rent, buy, or pump more water he will have to give up his idea of planting potatoes. The 140 acres of small grain will be short of water but it will produce a crop.

Now his water supply adds up as follows:

**TABLE II**

| Crop | Acreage | Water Requirement Acre-Feet/Acre | Total Acre-Feet |
|---|---|---|---|
| Alfalfa | 50 | 2.5 | 125 |
| Sugar Beets | 50 | 3.0 | 150 |
| Small grain | 140 | 0.6 | 84 |
| | 240 | | 359 |

His water demands are now in reasonable balance with expected supply of 360 acre-feet. If summer rainfall is deficient and the actual delivered water supply is 10 acre-feet per share short, his small grain yield will be reduced but not a complete loss. If summer rainfall is above normal or estimates are exceeded, he can improve his alfalfa and small grain yields. Even if summer weather conditions were favorable he would have been faced with a water shortage with his original plans.

This is a simplified but typical example of the problem of balancing water requirements to water available. It is far from an exact science but within reasonable limits it can save a lot of over-planting and under-planting losses.

Another stumbling block is that it cannot be applied to all irrigation organizations with such a degree of accuracy. The system can serve a substantial number.

Through personnel assigned to Soil Conservation Districts it is planned to initiate and expand this type of planning to serve farmer-cooperators in the districts. It will require the cooperation and advice of the irrigation organizations.

The field personnel cannot hope to advise each cooperator on this matter since in many cases one Work Unit Conservationist must serve several hundred farmers over the whole field of conservation needs. However, the above procedure lends itself to mass information methods. Under the above system there are probably 200-300 farmers sharing in the same water supply. If they can be informed of water supply in acre-feet per share, or any term they understand, along with approximate requirements in acre-feet per acre for each crop, the farmer can do the arithmetic. Some statement as to accuracy of the forecast will have to be worked out. It will be an improvement over general news information or even the more or less technical snow report. Too often he is misled by reports of snow measurements in percent of normal without interpretation in terms of water supply outlook.

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