Aerial markers

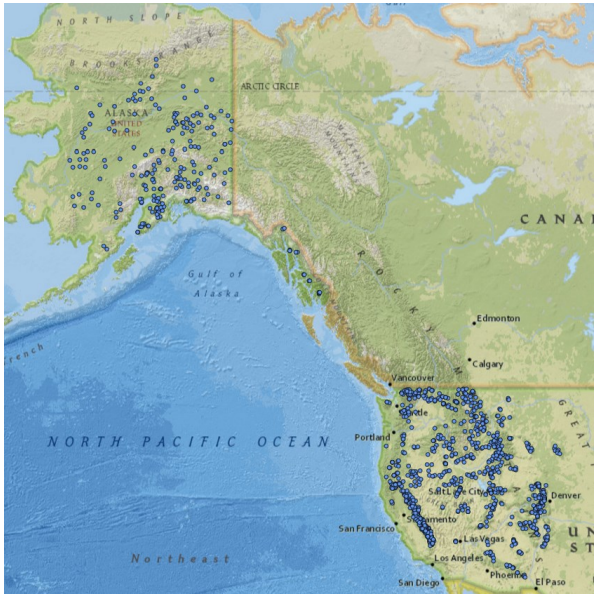
Aerial markers are used to measure the depth of snow. The markers are located in remote locations that are difficult to reach by over-snow travel. They consist of one measuring point marked by a vertical support with crossbars that can be easily observed by aircraft flyover. Surveyors then use an estimated density to calculate snow water equivalent.

Harts Pass aerial marker, Washington.

Snow courses & aerial markers in the western U.S.

The SSWSF Program's manual snow measurement network is composed of over 1,100 snow courses and aerial markers in the western U.S. and Alaska. Because many of the sites have been installed and data collected over several decades, these sites offer a long-range, historical view of the snow patterns in these regions.

All the data collected at snow courses and aerial markers are entered into the Water and Climate Information System (WCIS) database and made available to its wide variety of users via an extensive internet delivery system.



NWCC's interactive map showing snow courses and aerial markers in the western U.S. and Alaska.

The SSWSF Program and manual snowpack measurements are of critical value to water users and managers throughout the West. To learn more, visit our website at www.wcc.nrcs.usda.gov.

Contact us

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Snow course marker, Washington

Manual Snowpack Measurement: Snow Courses & Aerial Markers

USDA
National Water and Climate Center
Natural Resources Conservation Service

Dr. James Church, Mt. Rose, Lake Tahoe area, 1906.

History & program overview

Early westerners realized the ties between the size of the winter snowpack in the high mountain ranges and their summer water supply.

Some attempts to measure the snow and predict runoff had been made in the East as early as 1834, but it wasn't until the early 1900s that a systematic survey was undertaken in the West.

In 1906, Dr. James Church, a professor at the University of Nevada in Reno, laid out a **snow course** and made surveys on Mt. Rose in the Sierra Nevada. He also developed measuring equipment and sampling techniques, many of which are still being used today, that led to the first water supply forecasts.

What is a snow course?

Snow courses are locations where manual snow measurements are taken during the winter season to determine the depth and water content of the snowpack. Generally, snow courses are about 1,000 feet (300 meters) long and are situated in small meadows protected from the wind. They consist of a variable number of equally-spaced individual sample points, typically 5 to 10.

In 1935, a federal **Snow Survey and Water Supply Forecasting (SSWSF) Program** was created under the direction of the Bureau of Agricultural Engineering. In 1939, the bureau was transferred to the Soil Conservation Service (SCS); this agency, now known as the Natural Resources Conservation Service (NRCS), continues to conduct snow surveys and develop water supply forecasts for the western U.S.

Manual snowpack measurements

As part of the SSWSF Program, the National Water and Climate Center (NWCC) administers a manual snow monitoring program for the western U.S. Manual monitoring consists of monthly snow course measurements and aerial marker observations of mountain snowpack during the winter months.

Snow courses

Once onsite at a snow course, surveyors use snow samplers at each sample point to measure the depth of the snowpack and then weigh the snow to determine the **snow water equivalent**.

What is snow water equivalent?

Snow water equivalent (SWE) is a common snowpack measurement. It is the amount of water contained within the snowpack. It can be thought of as the depth of water that would theoretically result if you melted the entire snowpack.

Snow samplers

Snow samplers consist of an aluminum snow tube and a spring scale. Snow depth is measured by pushing the tube down through the snowpack to the ground surface and then extracting a core. One surveyor measures the snow depth while the other surveyor records data.

To take an accurate snow core sample, the surveyor must verify that the tube has reached ground level by examining the base of the tube and finding soil. After clearing the soil from the tube, the surveyor then determines the amount of water in the snowpack by weighing the tube with its snow core and subtracting the weight of the empty tube. An average of all samples taken is calculated and used to represent that snow course.

Extracting a core sample of the snowpack using a snow tube.

Using a snow scale to measure snow water equivalent of mountain snowpack.