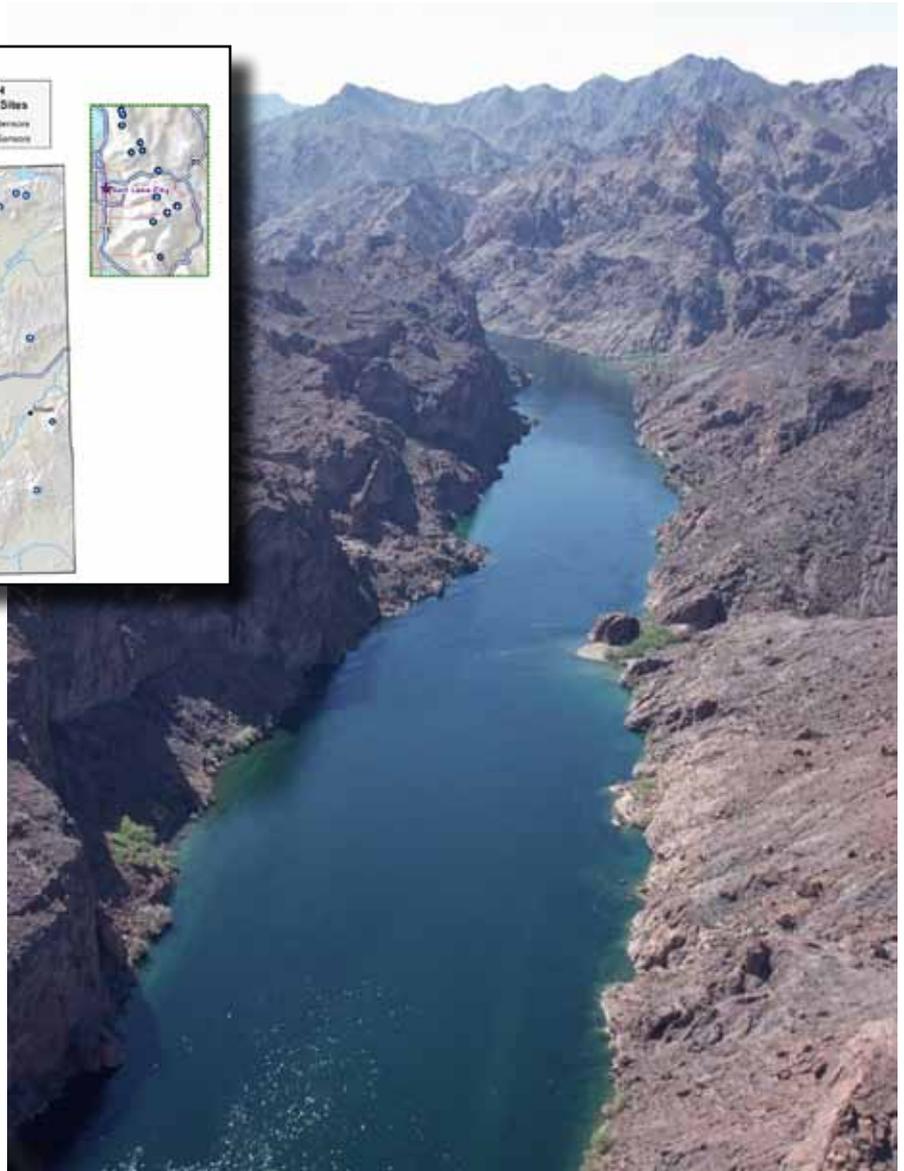
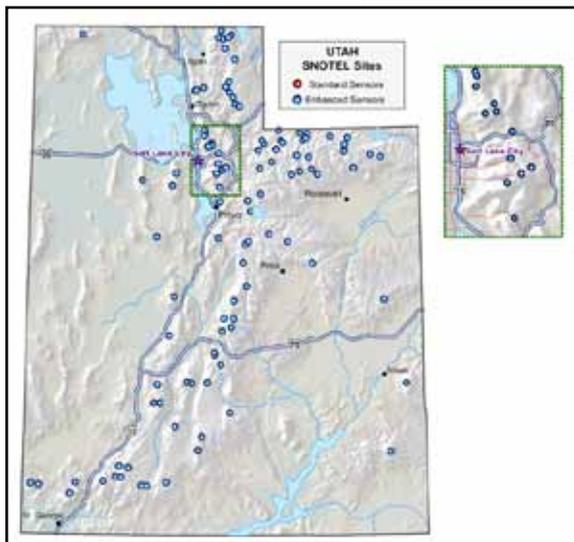


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# Chapter 1 Snow Survey and Water Supply Forecasting Program Activities



Issued April 2012

*Top left: Interactive map showing SNOTEL data collection sites in Utah.  
Bottom right: Colorado River below Hoover Dam, Clark County, Nevada.  
All photos courtesy of USDA NRCS.*

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# Chapter 1

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# Snow Survey and Water Supply Forecasting Program Activities

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## Chapter 1

# Snow Survey and Water Supply Forecasting Program Activities

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### 622.0100 Purpose and scope

Title 210, National Engineering Handbook (NEH), Part 622, Snow Survey and Water Supply Forecasting (NEH 622) provides guidelines, procedures, and practices for Natural Resources Conservation Service (NRCS) employees and partners, cooperators, and volunteers to carry out the cooperative Snow Survey and Water Supply Forecasting (SSWSF) Program. The SSWSF Program provides hydrologic and climatologic data and analyses for natural resource management in 12 Western States: Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. All data and products are freely available to the public and the scientific community.

Technology has improved dramatically since the last release of USDA Soil Conservation Service NEH Section 22 in 1972. Establishment of the automated SNOwpack TELEmetry (SNOTEL) system in the late 1970s changed the accepted methods of collection of snowpack and related climatic data. Computer technology advancements have provided new and faster tools for data analysis providing the opportunity to increase forecast accuracy. The Internet has changed data dissemination by allowing easy access to data and products by customers.

This handbook covers procedures currently used by the NRCS in collecting data, quality control and analysis of data, development of a wide spectrum of products for natural resource management decisions, and timely data and product dissemination to meet customer needs. This updated version is important for establishing guidelines and consistency in the Program as it continues to evolve and change with technology advancements.

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### 622.0101 Forecasting

Snowpack in the Western United States serves as nature's reservoir system for water delivery to the basins and valleys. It has been estimated that as much as 80 percent of the water supply in the West occurs as high-altitude snow and/or rain during the winter and spring. Forecasting the amount of water in the snowpack and the timing on the delivery of the water to streams and reservoirs is critical for managing this resource. A wide variety of users, including agriculture, hydroelectric power generation, reservoir management, recreation industry, flood control, and agencies that oversee environmental compliance, rely on accurate estimates of snow water equivalent and forecasts of quantity and timing of snowmelt as streamflow.

Forecasting techniques utilize a statistical approach that compares present conditions to 30-year normals (averages or medians) and provides probabilities for expected streamflow conditions. Water supply forecasts have improved in accuracy and delivery due to advances in forecast modeling techniques and data generation. The availability of hourly snowpack and climate data from SNOTEL sites has improved accuracy. Many forecast points are realizing daily water supply guidance due to timely delivery of products.

Increased understanding of global and regional climatic factors, such as the El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO), has allowed forecasters to consider factors beyond just the snow survey databases. Increases in climate variability, as evident in trends of temperature, precipitation, and other climatic factors, as well as more prolonged and extreme drought and flood events, have provided challenges for water supply forecasters that may require a stronger reliance on simulation modeling in the future.

Forecasting activities are covered in more detail in NEH 622, Chapter 7, Water Supply Forecasting.

## 622.0102 Data collection

Hydrologic and climatic data are valuable in many forms to different sectors of the public, government agencies, and the scientific community. One entity may require data at a specific time and place, while another may require the entire climatic dataset for a specific location or area to perform complex data analyses. Others may not want only the data but also historical data analyses on a site.

### (a) High-elevation snowpack data

High-elevation mountain snowpack data collection is the first step in providing data and products to customers.

NRCS field staff and partners collect and analyze data on snow depth, snow water equivalent, and other climate parameters at high-elevation mountain sites manually and using automated SNOTEL sites. Data types from manually surveyed sites (snow courses and aerial markers) and remote surveyed sites (SNOTEL) are described in NEH 622, Chapter 2, Data Parameters, and NEH 622, Chapter 6, Data Management.

Each data collection site should be geographically representative of the watershed area attributed to it. Therefore, appropriate location of each site becomes extremely important. Other factors, such as slope, aspect, vegetation, access to the site for installation, ongoing operations and maintenance, and environmental effects of the site, must be considered. Procedures for data site selection are provided in NEH 622, Chapter 3, Site Selection. Procedures for installing new sites are provided in NEH 622, Chapter 4, Installation. Procedures for maintaining sites and calibrating equipment are in NEH 622, Chapter 5, Maintenance and Calibration. Detailed standards and specifications related to data collection, site selection, equipment, sensors, and data management are in NEH 622, Chapter 8, Standards and Specifications.

### (b) Climatologic data

The SSWSF Program provides climate data for use in water supply forecasting and resource management

through the NWCC Web site. Climate maps, reports for soil regions in the United States, wetlands climate tables, Parameter-elevation Regressions on Independent Slopes Model (PRISM) data, weather generator technology, wind data, and other information are readily available and can be downloaded utilizing the NRCS electronic Field Office Technical Guide (eFOTG). Access and links to other climate tables, such as in the Agricultural Applied Climate Information System (AgACIS), are available through eFOTG. These data are essential for water supply forecasting as well as in conservation planning throughout the agency.

### (c) Reservoir data

The SSWSF Program collects and manages data for a significant number of reservoirs in the Western United States. These data are critical for producing streamflow data that are used in water supply forecast models and for determining water availability over the regional watersheds. These data are accessible through the NWCC Web site.

## 622.0103 Remote data communications

The value and usefulness of climatic data are increased when data and products are made available to customers in a timely manner. The SNOTEL network uses meteor burst communications to provide near real-time data. Meteor burst technology allows communication between sites located 1,200 miles from each other. The meteor burst communication system uses five master stations to collect radio transmission of SNOTEL data and then forwards all data to the NWCC for quality control and storage. Polling of the SNOTEL sites is performed at least once a day, but the sites can be polled as frequently as 24 times a day.

## 622.0104 Data dissemination

It is essential that data and forecasts are provided to users in a timely and readily accessible way. In the previous version of the Snow Survey and Water Supply Forecasting Handbook (NEH Section 22), published reports, news releases, and data files were the accepted methods of acquiring data and products. Today, the Internet provides the tool for timely release of information to anyone seeking snow data and forecasts. Customers have continuous access to program data, forecasts, and other products.

### (a) Hydrologic data

SNOTEL data are transmitted to the NWCC directly from SNOTEL master stations. Manual snow measurements are input directly into the database. Water supply forecasts are developed by hydrologists at the NWCC and posted online. All data are made publicly available on the NWCC Web site and on each of the Western States snow survey Web pages. In addition, many other products, including geographic information system (GIS) maps of snow conditions and streamflow-runoff forecasts, hydrographs, reservoir storage conditions, and other graphics, are available through various snow survey Web pages.

### (b) Water supply forecasts

The NWCC produces water supply forecasts from January through June in partnership with the National Weather Service and other partners. The SSWSF Program issues seasonal water supply forecasts, both monthly and bimonthly, at streamflow forecast points on the snow survey Web sites.

### (c) Daily water supply forecasts

SSWSF hydrologists develop daily water supply forecast models that run automatically using daily SNOTEL data to track weather trends throughout the forecast season. These forecast models augment the monthly and bimonthly forecasts, producing additional trend forecasts to aid water resource users and managers. Forecasts are also posted to the snow survey Web sites.

## (d) Media coverage

Media coverage during the snow survey season raises the awareness of the public to the conditions of the water supply, flooding, drought, or other related issues. Publishing of snow survey data and products on the Internet is an effective method of data dissemination; however, it doesn't necessarily reach all customers. A broader base of customers is reached when the information is communicated on the radio or television.

## 622.0105 Program customers and uses

Major customers of the SSWSF Program include the National Oceanic and Atmospheric Administration, National Weather Service; U.S. Department of Interior, Bureau of Reclamation; U.S. Army Corps of Engineers; U.S. Department of Energy, Bonneville Power Administration; U.S. Forest Service; State and local agencies; power utilities; soil and water conservation districts; irrigation districts; Tribal nations; Canada; Mexico; and the public.

Uses of the data include:

- water supply forecasting
- snow cover analysis
- cloud-seeding analysis
- recreation planning and management
- streamflow and flood forecasting
- flood control and prevention
- power generation
- planning for agricultural water exchanges
- academic research
- snow removal and avalanche hazard analysis
- managing intrastate streams and interstate water compacts
- municipal and industrial water supply analysis
- cross-basin water exchanges
- lake and reservoir management
- fish and wildlife management
- provision of high-altitude snowpack and general precipitation data

The customers and the uses are ever expanding as the value of the data is realized and used by new customers or a new use is determined by an existing customer. The SNOTEL network is flexible and able to add additional sensors as new needs are recognized. The network will continue to evolve as increasing and often conflicting demands for water in the West heighten the public's awareness of the need for data and analyses to make sound water management decisions.

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## 622.0106 References

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