PROPOSED TELEMETRY OF MOUNTAIN SNOWPACK AND RELATED DATA

WASHINGTON

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PROPOSED SYSTEM FOR WASHINGTON

Telemetry of Mountain Snowpack and Related Data

INTRODUCTION

Over 75 percent of the water in the West comes from snowmelt. Since 1935 the Soil Conservation Service and its predecessor agencies have been manually measuring snow and related hydroclimatological data in the western mountains. These data and various interpretations such as irrigation season water supply forecasts have been provided to a wide range of private, state and federal water users, management and regulatory agencies.

With the ever increasing demand on water, it is essential that water management techniques become more sophisticated. This in turn requires more hydroclimatological data on a real time basis. The availability of reliable remote sensors and related telemetry makes it possible to meet this demand.

Recognizing this need, the Soil Conservation Service is proposing a west-wide telemetry system which will provide water users with the information required for timely and effective planning and operational water management decisions. This report discusses the proposed system for Washington, east of the Cascades.

AUTHORITY

As a result of the 1934 drought, the Congress appropriated money to the Bureau of Agricultural Engineering in 1935, authorizing that agency to coordinate activities, develop uniform equipment and methods of snow surveying and water supply forecasting.

The key network of snow courses, as a part of the present system, was installed between 1936 and 1938. On July 1, 1939, the Division of Irrigation of the former Bureau of Agricultural Engineering was transferred

to the Soil Conservation Service, Research Division. The snow survey activity was retained in the Soil Conservation Service when research activities were transferred to the Agricultural Research Service in July, 1953.

USDA Administrative Regulations, 1 AR 180, Chapter 2, page 50, Item f, reads as follows in assigning responsibility to the Soil Conservation Service: "Responsibility for making and coordinating snow surveys in the Western States and Alaska and preparing forecasts of seasonal water supplies in affected streams, for the purpose of relating available water supply to agricultural plans and operations."

Based on PL 46 and the above authorities, the Soil Conservation Service has provided the leadership and participated in the operation and directions of the cooperative snow survey activity in the Western States since 1935.

HISTORY

The first known record of a snow survey in the United States was made in 1834 in New York. The first account of how a survey was made was 1903 in Maine. The first attempt to relate water equivalent of snow to runoff in the West was made in 1908 by Dr. J.E. Church, a Professor of Classics at the University of Nevada. An enthusiastic winter mountaineer, Dr. Church became interested in the effect of the mountains' yearly snowfall on streamflow. His early work suggested the relationship between snow water equivalent of the snowpack and subsequent runoff from a given watershed. In order to collect the needed snowpack data, Dr. Church designed the Mount Rose snow sampler, which is the forerunner of the Federal snow sampler used today.

In Washington the first snow course was established at Bumping Lake in 1915. A network of 18 snow courses was next established on the Chelan

Lake watershed by Washington Water Power in 1926-27. This basic network of snow courses has expanded to 186 snow courses and aerial markers.

OBJECTIVES

The expanding use of water and the need for greater control and foreknowledge has led to the development of remote sensors and telemetry to accomplish this purpose. The Soil Conservation Service in cooperation with federal, state and private cooperators has proposed a network of 40 remote data sites that would report through five repeaters to a computer controlled base located at Spokane. In addition to these above-mentioned data sites in Washington it is planned that 17 sites from northern Idaho and eight sites from northeastern Oregon will also be received for retransmission to their respective states. This is in addition to a number of private systems that are planned or operational on the west side of the state.

The telemetry network has been designed to permit the addition of more sites as may be required in the future. Additional data sites and/or parameters may be added at the request of others desiring to cooperate in the establishment of the network. Data will be collected and evaluated at the Spokane terminal base and will then be distributed to cooperators.

Snow water equivalent, precipitation, air temperature, solar radiation, relative humidity, wind direction and speed, soil temperature and moisture are the parameters that will be measured with the network.

Observations are planned on a daily basis with hourly and on-call interrogation capability.

Installation cost of the proposed Washington System over the next five years is estimated to be $630,000. Estimated annual costs thereafter are $41,000. These estimates are in addition to present funding and staffing.

The following tables and map provide pertinent information concerning the proposed remote data sites and base station.

Number	Name	Location Lat.	Location Long.	Elevation
Base Station				
B1	Spokane	47° 40'	117° 23'	1890
Repeater Sites				
R1	Krell Hill	47-39	117-17	3600
R2	Mission Ridge	47-15	120-25	7000
R3	Quartz Mtn.	47-04	121-05	6200
R4	Steamboat Mtn.	46-09	121-44	5425
R5	Tunk Mtn.	48-33	119-14	6055
R6	Calispell Peak	48-25	117-30	6840
R7	Alpenthatl	47-26	121-26	5800
Data Sites - Alpine 1/				
1	Quartz Mtn.	47-04	121-05	6200
2	Steamboat Mtn.	46-09	121-44	5425
3	Tunk Mtn.	48-33	119-12	6055
Data Sites - Meteorological 2/				
4	Trough No. 2	47-14	120-19	5310
5	Harts Pass	48-43	120-39	6500
6	Rainy Pass	48-34	120-43	4780
7	Surprise Lakes	46-06	121-45	4250
8	Upper Wheeler	47-17	120-22	4400
Data Sites - Snow 3/				
9	Beehive Springs	47-20	120-24	4400
10	Grouse Camp	47-16	120-29	5385
11	Walters Flat	47-12	120-27	3360
12	Jump Off	47-17	120-17	4450
13	Bumping Ridge	46-47	121-20	4440
14	Plains of Abraham	46-13	122-09	4400
15	Spencer Meadow	46-11	121-56	3400
16	Lone Pine Shelter	46-16	121-58	3800
17	Table Mountain	46-15	121-42	4200
18	Pigtail Peak	46-37	121-23	5900
19	Corral Pass	47-01	121-28	6000
20	Snowshoe Butte	47-14	121-22	5000
21	Stampede Pass	47-17	121-20	3860

Number

Data Sit

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23
24
25
26
27
28
29
30
31
32
33
34

1/ Wind

2/ Snowp
humid

3/ Snowp

ncerning

Elevation

23' 1890

17 3600
25 7000
05 6200
44 5425
14 6055
30 6840
26 5800

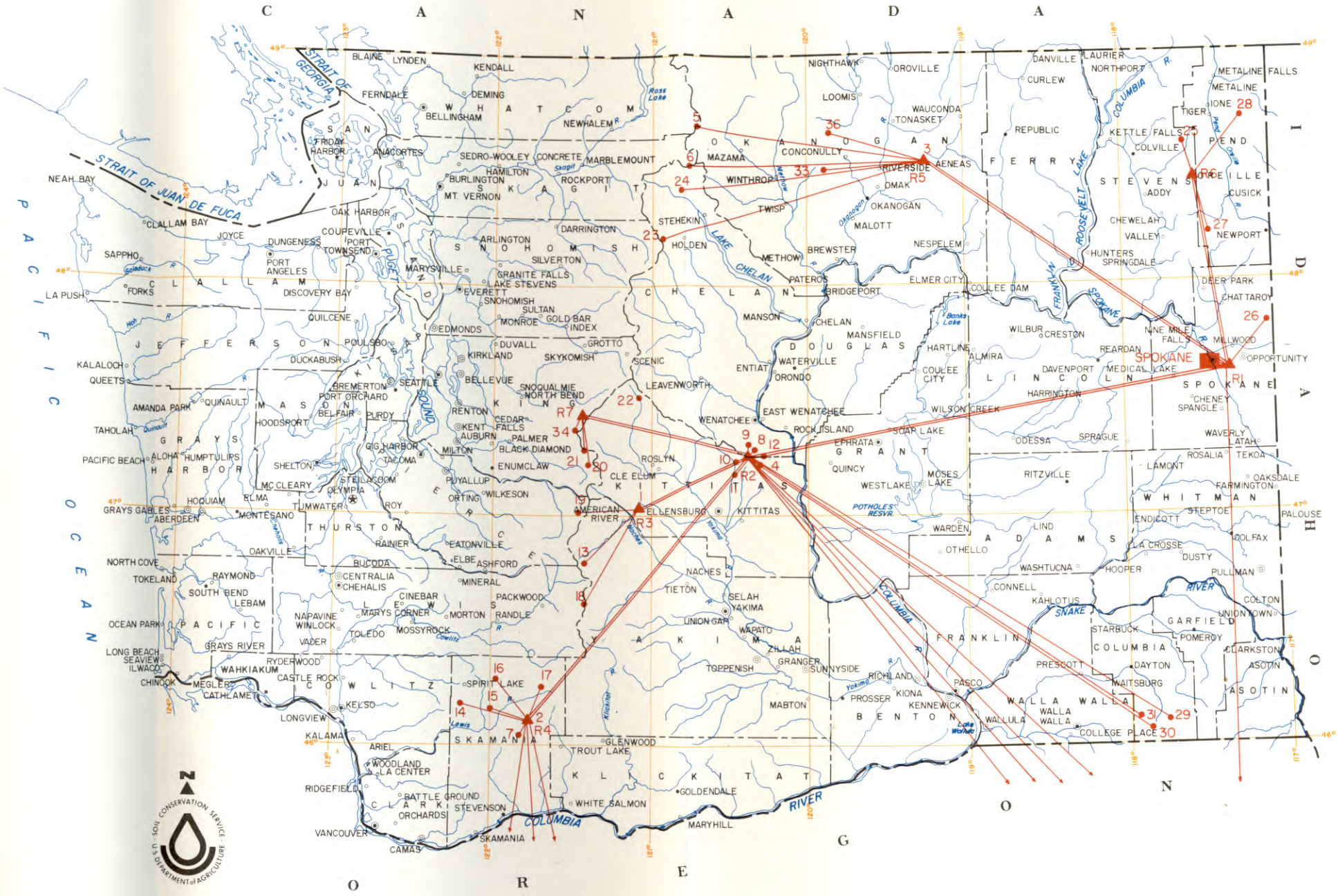
05 6200
44 5425
12 6055

19 5310
39 6500
43 4780
45 4250
22 4400

24 4400
29 5385
27 3360
17 4450
20 4440
09 4400
56 3400
58 3800
42 4200
23 5900
28 6000
22 5000
20 3860

Number	Name	Location Lat.	Location Long.	Elevation
Data Sites - Snow 3/ (Cont.)				
22	Fish Lake	47-13	121-04	3371
23	Lyman Lake	48-12	120-55	5900
24	Park Creek Ridge	48-27	120-55	4600
25	Baird	48-37	117-34	3215
26	Bunchgrass Meadow	48-41	117-10	5000
27	Boyer Mountain	48-12	117-26	5250
28	Newman	47-41	117-01	4500
29	Touchet No. 1	46-09	117-46	5120
30	Touchet No. 2	46-05	117-52	5400
31	Touchet No. 3	46-08	117-56	5000
32	Salmon Meadows	48-40	119-50	4500
33	Rusty Creek	48-32	119-52	4000
34	Olallie Meadows	47-23	121-27	3625

1/ Wind speed and direction, temperature, solar radiation, relative humidity.
2/ Snowpack sensor, precipitation, temperature, soil moisture, relative humidity, wind speed and direction.
3/ Snowpack sensor, precipitation, temperature, and soil moisture.


CANADA
PACIFIC OCEAN
STRAIT OF GEORGIA
STRAIT OF JUAN DE FUCA
WHATCOM
SKAGIT
SNOHOMISH
KING
PIERCE
THURSTON
LEWIS
SKAMANIA
CLARK
KLICKITAT
YAKIMA
BENTON
FRANKLIN
WALLA WALLA
COLUMBIA
GARFIELD
ASOTIN
OKANOGAN
CHELAN
DOUGLAS
GRANT
ADAMS
LINCOLN
SPOKANE
WHITMAN
PEND OREILLE
STEVENS
FERRY
JEFFERSON
CLALLAM
KITSAP
MASON
GRAYS HARBOR
PACIFIC
LEWIS
COWLITZ
WAHKIAKUM
OREGON
IDAHO
BLAINE
LYNDEN
KENDALL
FERNDALE
DEMING
BELLINGHAM
NEWHALEM
NIGHTHAWK
OROVILLE
LOOMIS
DANVILLE
LAURIER
NORTHPORT
CURLEW
METALINE FALLS
METALINE
IONE
TIGER
KETTLE FALLS
COLVILLE
REPUBLIC
WAUCONDA
TONASKET
OMAK
OKANOGAN
RIVERSIDE
AENEAS
CONCONULLY
MAZAMA
WINTHROP
MARBLEMOUNT
CONCRETE
SEDRO-WOOLEY
ANACORTES
FRIDAY HARBOR
NEAH BAY
CLALLAM BAY
SAPPHO
FORKS
LA PUSH
JOYCE
COUPEVILLE
PORT TOWNSEND
DUNGENESS
PORT ANGELES
DISCOVERY BAY
QUILCENE
SEQUIM
DUNGENESS
DARRINGTON
ARLINGTON
MARYSVILLE
EVERETT
SNOHOMISH
SULTAN
MONROE
GOLD BAR
INDEX
GRANITE FALLS
LAKE STEVENS
SILVERTON
STEHEKIN
HOLDEN
METHOW
BREWSTER
PATEROS
ELMER CITY
COULEE DAM
NESPELEM
MALOTT
TWISP
CHEWELAH
VALLEY
HUNTERS
SPRINGDALE
NEWPORT
DEER PARK
CHATTAROY
MANSON
CHELAN
MANSFIELD
WILBUR
CRESTON
NINE MILE FALLS
MILLWOOD
REARDAN
SPOKANE
OPPORTUNITY
HARTLINE
ALMIRA
COULEE CITY
DAVENPORT
MEDICAL LAKE
CHENEY
SPANGLE
HARRINGTON
WATERVILLE
ORONDO
ENTIAT
WENATCHEE
EAST WENATCHEE
LEAVENWORTH
SCENIC
SKYKOMISH
GROTTO
DUVALL
KIRKLAND
BELLEVUE
SEATTLE
SNOQUALMIE
NORTH BEND
BREMERTON
PORT ORCHARD
BELFAIR
PURDY
RENTON
CEDAR FALLS
KENT
AUBURN
PALMER
BLACK DIAMOND
MILTON
TACOMA
GIG HARBOR
SHELTON
ENUMCLAW
ROSLYN
CLE ELUM
KITTITAS
ELLENSBURG
AMERICAN RIVER
PUYALLUP
ORTING
WILKESON
OLYMPIA
STEILACOOM
LAKEWOOD
TUMWATER
ROY
MC CLEARY
ELMA
HOQUIAM
GRAYS HARBOR
ABERDEEN
MONTESANO
QUINAULT
AMANDA PARK
TAHOLAH
KALALOCH
QUEETS
HUMPTULIPS
ALOHA
PACIFIC BEACH
RAINIER
EATONVILLE
ELBE
ASHFORD
OAKVILLE
NORTH COVE
TOKELAND
RAYMOND
SOUTH BEND
LEBAM
OCEAN PARK
LONG BEACH
SEAVIEW
ILWACO
CHINOOK
GRAYS RIVER
WAHKIAKUM
RYDERWOOD
CASTLE ROCK
MEGLER
CATHLAMET
LONGVIEW
KELSO
KALAMA
ARIEL
WOODLAND
LA CENTER
RIDGEFIELD
BATTLE GROUND
ORCHARDS
VANCOUVER
CAMAS
STEVENSON
SPIRIT LAKE
TROUT LAKE
GLENWOOD
GOLDENDALE
WHITE SALMON
MARYHILL
SKAMANIA
BUCODA
CENTRALIA
CHEHALIS
MINERAL
CINEBAR
MARYS CORNER
MORTON
RANDLE
PACKWOOD
NAPAVINE
WINLOCK
TOLEDO
MOSSYROCK
VADER
CHEHALIS
NACHES
TIETON
SELAH
YAKIMA
UNION GAP
WAPATO
ZILLAH
TOPPENISH
GRANGER
SUNNYSIDE
MABTON
PROSSER
KIONA
RICHLAND
PASCO
KENNEWICK
WALLULA
WALLA WALLA
COLLEGE PLACE
WAITSBURG
PRESCOTT
DAYTON
STARBUCK
POMEROY
CLARKSTON
ASOTIN
UNIONTOWN
COLTON
PULLMAN
HOOPER
CONNELL
KAHLOTUS
WARDEN
LIND
OTHELLO
ADAMS
LA CROSSE
DUSTY
ENDICOTT
STEPTOE
PALOUSE
COLFAX
FARMINGTON
OAKSDALE
LAMONT
ROSALIA
TEKOA
LATAH
WAVERLY
RITZVILLE
WESTLAKE
MOSES LAKE
QUINCY
EPHRATA
SOAP LAKE
ODESSA
SPRAGUE
ROCK ISLAND
WILSON CREEK
GRANT
POTHOLES RESVR.
Ross Lake
Skagit
Methow
Okanogan
Chelan
Lake Chelan
Banks Lake
Roosevelt Lake
Franklin
Spokane
Columbia
Snake
Yakima
Cowlitz
Lewis
Klickitat
Wallula
Pend Oreille
Nooksack
Samish
Stillaguamish
Snoqualmie
Skykomish
Green
Puyallup
Nisqually
Chehalis
Quinault
Queets
Hoh
Quillayute
Soleduck
Dungeness
Elwha
Pysht
Lake Quinault
Lake Wenatchee
Potholes Reservoir
Moses Lake
Banks Lake
Lake Roosevelt
Lake Wallula
Columbia River
Snake River
Yakima River
Pend Oreille River
Okanogan River
Methow River
Chelan River
Skagit River
Nooksack River
Samish River
Stillaguamish River
Snoqualmie River
Skykomish River
Green River
Puyallup River
Nisqually River
Chehalis River
Quinault River
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Quillayute River
Soleduck River
Dungeness River
Elwha River
Pysht River

FEDERAL - STATE - PRIVATE

COOPERATIVE SNOW SURVEYS

Furnishes the basic data necessary for forecasting water supply for irrigation, domestic and municipal water supply, hydro-electric power generation , navigation , mining and industry

"The Conservation of Water begins with the Snow Survey"