PART XI

PHYSICAL DESCRIPTION

Physical Regions of Washington

On the basis of surface features, Washington may be divided into eight major regions. Agricultural settlement is influenced by factors of topography, climate, soil, forest vegetation and water resources distinctive to each of the physiographic regions. Each has become a different type of farming area as settlers have learned to adapt crops and livestock to the conditions, or have improved limitations through drainage or irrigation.

Coastal Plains

A narrow, sandy plain with shallow bays, tidal flats, stream deltas and low headlands lies between the coastline and the Coast Range. It extends from the Columbia River mouth almost to Cape Flattery, being widest and lowest in the Grays Harbor and Willapa Bay districts. The climate is mild and damp with a long growing season, but it is too cool, cloudy and wet for most crops. Originally, this area was covered with heavy forests but much of it is now covered with woodlands. Lumbering and manufacture of wood products is the main industry. Farming is largely livestock and dairying using the low uplands and drained areas in the lower Chehalis River Valley. Cranberry growing is important and well-adapted to numerous, boggy areas in the Grays Harbor and Willapa Bay regions. The shallow bays are also used for oyster culture. Fishing is common in the rivers and coastal banks.

Coast Range

The Coast Range is an uplifted area of sedimentary and metamorphic rocks divided into the Olympic Mountains and the Willapa Hills. The Olympics tower to nearly 8,000 feet in a dome-like structure, carved deeply by rivers. These mountains have the heaviest precipitation in the state. Snowfields and heavy forest cover the mountains. Most of the wilderness area is within the Olympic National Forest and Olympic National Park, being managed for recreation, wild-life and timber. Farm settlement is limited to some foothill river plains and coastal terraces such as the Dungeness and Port Angeles districts along the Strait of Juan de Fuca. Here in the lee of the mountains, rainfall is moderate and irrigation is practiced by some livestock farmers. The Willapa Hill country is wet, heavily forested and carved into numerous narrow valleys. Logging is the main industry, combined with livestock farming in the upper Chehalis River Valley and along the banks of the Columbia River. Wet climate, hilly topography and the difficulty of clearing stump land retards agriculture.

Willamette-Puget Sound Lowland

A broad lowland, described as a trough or valley, lies between the Coast Range and the Cascade Mountains. The northern part is the Puget Sound Lowland which has been glaciated and is occupied by the sea in the lowest sections. The continental glacier reached slightly south of Olympia. Under a warming climate it melted and geologists believe it receded about 25,000 years ago, leaving an infertile plain of moraines and outwash gravels, sands and clays known today as the Puget Glacial Drift Plain. Its rolling surface has numerous lakes and bogs.

Most of the major cities--Seattle, Tacoma, Everett, Bellingham and Olympia--have been built on moraines bordering the Sound. Rivers such as the Nooksack, Skagit, Snoqualmie, White and Puyallup have built up deltas and floodplains over the older gravelly plains. These narrow valleys are more fertile than the older glacial plains and support numerous small dairy, vegetable and berry farms. Most of the gravelly areas are wooded with a second-growth forest and are used for pastures. In the southern part of the Willamette-Puget Sound Lowland there are two large valleys--the Cowlitz and Chehalis. They drain a low, hilly area with several flat prairies and bottomlands.

Agriculture is handicapped by poor drainage and flooding of the river deltas and plains, by heavy, winter rainfall, by cloudy but dry summers, by coarse, gravelly upland soils and by densely wooded land which is costly to clear. Advantages are mild climate and a location close to major markets for farm products such as milk, poultry and vegetables.

Cascade Mountains

The Cascades are a wide and high topographic and climatic barrier which separates western and eastern Washington. The range is made up of sedimentary, igneous and metamorphic rocks which have been carved by glaciers and streams. High, isolated volcanic cones of lava such as Mt. Adams (12,307 feet), Mt. Rainier (14,408 feet) and Mt. Baker (10,791 feet), appear upon the older Cascade rocks. The Cascade crest varies between 10,000 and 3,000 feet and is higher and more rugged in northern Washington. Roads and railroads have been built across its lower passes in central and southern Washington. The Columbia River has cut a deep gorge and the lowest pass through the barrier. The western slope is wet and heavily forested with Douglas fir; the eastern slope is drier with a less-dense pine forest. Nearly all classified as forest land, most of the area is in Federal ownership in five national forests and Mount Rainier National Park. Tree fruit farming in the eastern slope valleys of Wenatchee, Chelan, Methow, Naches and the Columbia Gorge is most important. Sheep and cattle summer grazing on alpine grasslands is another use. Deep, western slope valley bottoms such as the Skagit, Snoqualmie, Nisqually, Cowlitz and Lewis also contain livestock farms. The area is vitally important as a watershed for irrigation and city drinking water and as a source of timber. Steep terrain, wet climate, short growing seasons and heavy forest vegetation are main handicaps for agriculture.

Columbia Basin

A low plateau of old lava rocks covered with stream and wind-deposited soils extends in a series of plains, ridges, coulees and hills from the Cascades to the eastern Washington border. The area is basin-like in structure, being higher around its margins and sloping inward to low and level central plains. It has been sharply eroded by the Columbia River and its interior tributaries--the Snake, Yakima, Palouse and Spokane Rivers. The basin has several sub-areas created by crustal movements and erosion.

A. The Yakima Folds are a series of hilly ridges extending from the Cascades eastward into the lower part of the basin. The Yakima and Columbia Rivers have cut gaps through the ridges and have built up plains in the troughs between them. The rich, alluvial plain of the Yakima River is an important irrigated valley.

B. The Waterville Plateau is a tableland of thin soils overlaying basaltic rock at an elevation of 2,500 to 3,000 feet. It has gorges cut by the Columbia River and ancient glacial outwash streams once flowing in Moses and Grand Coulees. It is too high for irrigation and is used for dryland grain and livestock farming.

C. The Channelled Scablands are a belt of dry terrain carved by ice-age rivers into a series of coulees. Bare rock is exposed in the coulees. Small plateaus between the old river channels have thin soils used for dryland farming. The Grand Coulee of this region has been developed into a major irrigation reservoir.

D. The Palouse Hills consist of fertile deposits of wind-blown soil overlaying basaltic lava flows. After being deposited in large dunes, the formation was reshaped by streams into an intricate pattern of low, rounded hills. The hills receive 16 to 25 inches of rainfall annually and have deep, porous and fertile soils. It is one of the richest farming areas of the Pacific Northwest.

E. The Central Plains are low and relatively level expanses of soil, deposited by old streams crossing the Channelled Scablands and later by the flooding of the Yakima, Columbia, Snake and Walla Walla Rivers. Climate is desert-like (6-12 inches of precipitation per year). The lower lands of the area, the Quincy and Pasco Basins and the Walla Walla Valley, are irrigated. The Quincy Basin is a new irrigation area watered by Grand Coulee Dam.

Agricultural handicaps in Columbia Basin regions are mainly found in its dry, continental climate. Large irrigation systems built since 1900 have overcome much of the need for water on rich valley and basin soils. Dryland farming in higher areas is practiced widely, although occasional variations in rainfall, lack of snowfall, winterkill, water and wind erosion inflict damage to field crops and to livestock ranges.

Okanogan Highlands

A portion of the Rocky Mountains, consisting of well-eroded, old granites, lavas and sedimentary rocks extends across north-central Washington. These are the Okanogan Highlands, the state's richest mineral area. Summit levels reach 4,000 to 5,000 feet with peaks exceeding 7,000 feet. Prominent north-south valley are occupied by irrigated tree fruit and livestock farms. These are the Okanogan, Sanpoil, Kettle and Colville Valleys. The Columbia River Gorge through the Okanogan Highlands is occupied by the large man-made lake behind Grand Coulee Dam--Roosevelt Lake. Higher and wetter portions are forested with pine and larch, and are managed for timber and for livestock ranges by the United States Forest Servic and the Bureau of Indian Affairs. Cold winter temperatures, short growing seasons dry valley climates and remoteness from markets are farming handicaps.

Selkirk Mountains

The Selkirks, a range of the Rocky Mountain system, extend into the northeast corner of Washington. The rocks are old, mineralized granites and metamorphics reaching elevations of over 7,000 feet. The Pend Oreille River Valley at the base of the Selkirks is an agricultural area of narrow bottomlands settled by livestock farmers. Nearly all of the uplands are in Kaniksu National Forest. While climate

is cool and growing seasons are short, the Pend Oreille Valley has an advantage of being relatively in close proximity to the Spokane metropolitan market area.

Blue Mountains

The Blue Mountains are an uplifted and eroded plateau extending into the southeastern corner of Washington. The strata are mainly ancient crystalline rocks which contain some minerals. The highest point of the mountains in the Washington section is Diamond Peak (6,401 feet) located on the divide between the Grande Ronde, Tucannon and Touchet Rivers. These rivers, and the Walla Walla River, have cut valleys into the plateau. Extensive pine forest and grassland areas are in the highlands within Umatilla National Forest, where rainfall is 30 to 40 inches. The Snake River has cut a deep valley and gorge across the lower parts of the mountains. The area is well developed agriculturally around its northern foothills where wind-blown soils are deep and irrigation systems are used. The Walla Walla and Tucannon Valleys are rich grain, legume and livestock areas of irrigation and dry farming. Grazing is an important use of the highlands by livestock ranchers in the upper valleys.

Topography of Grant County

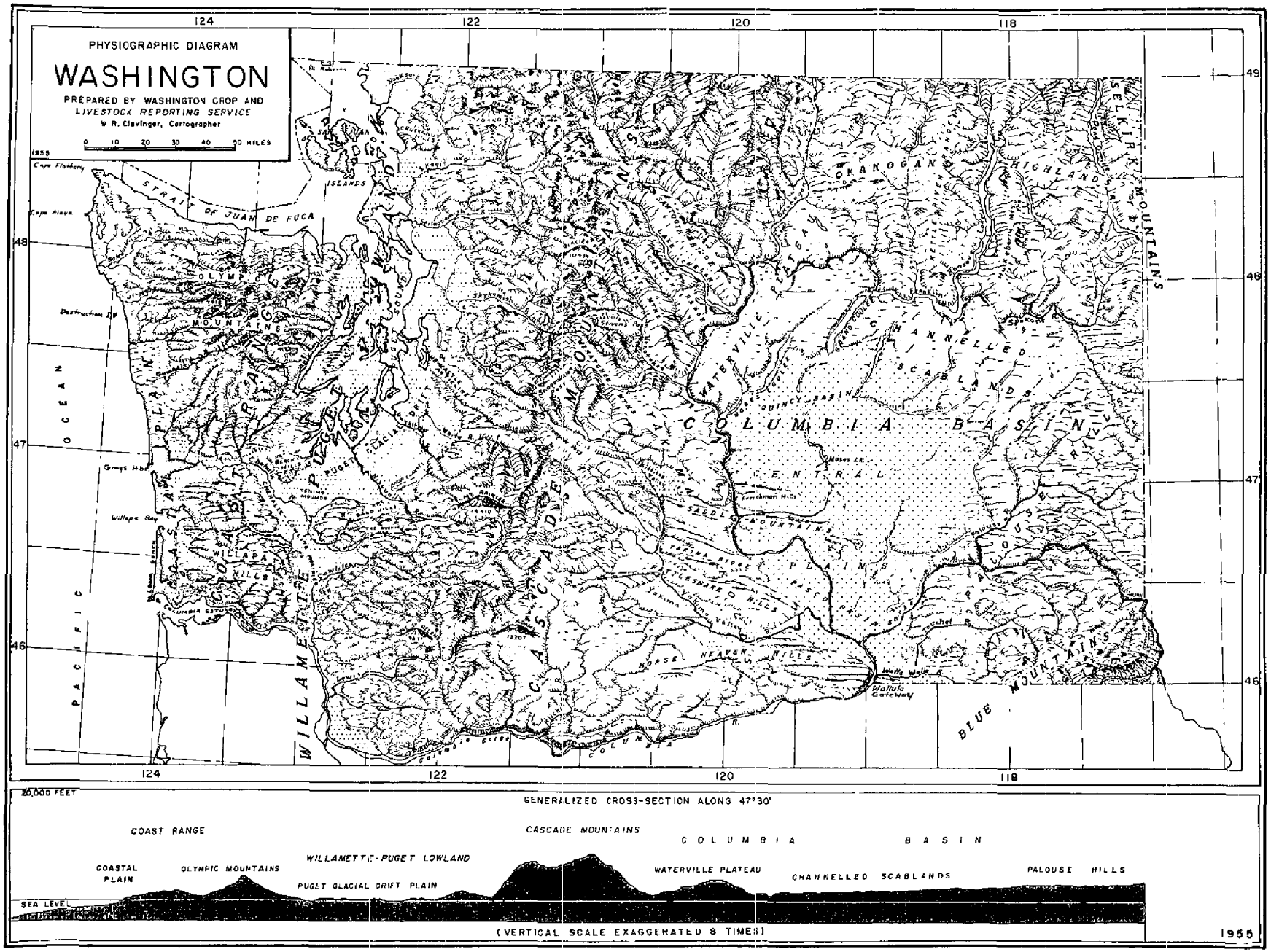
Grant County lies within the basaltic tableland of the Columbia Basin called the Columbia Plateau. It contains major parts of the Central Plains and the Channelled Scablands--geographic features resulting from glacial and glacial meltwater action, and later wind erosion, in which fairly level deposits of fine sand and silt were accumulated. Scenic local features are the deep, steeply-sided gorges and coulees cut by glacial meltwater and the Columbia River.

Elevations vary from about 400 feet along the Columbia River bars, deeply intrenched in the old lava beds, to the gentle 2,250 foot ridge crests in the Frenchman Hills and Saddle Mountains. The sandy and silty plains of the gently rolling Quincy Basin and the Moses Lake-Potholes Reservoir depression are the most habitable districts. These irrigated plains range from 1,200 to 1,500 feet in elevation. They are underlain with gravelly and sandy materials deposited in fan-like formations by ancient streams which flooded down from the north through the coulees from the continental ice sheet that filled the valleys of the Okanogan Highlands. The Potholes, a large dune area formed by recent wind erosion, lies at the base of the Frenchman Hills.

Some of the uneven and poorly drained glacial channels and depressions are occupied by lakes, such as Soap Lake, Blue Lake, Lenore Lake, Moses Lake, and Goose Lake. Two of these basins were developed for irrigation water storage by the Columbia Basin Project to form the Grand Coulee Equalizing Reservoir and the Potholes Reservoir.

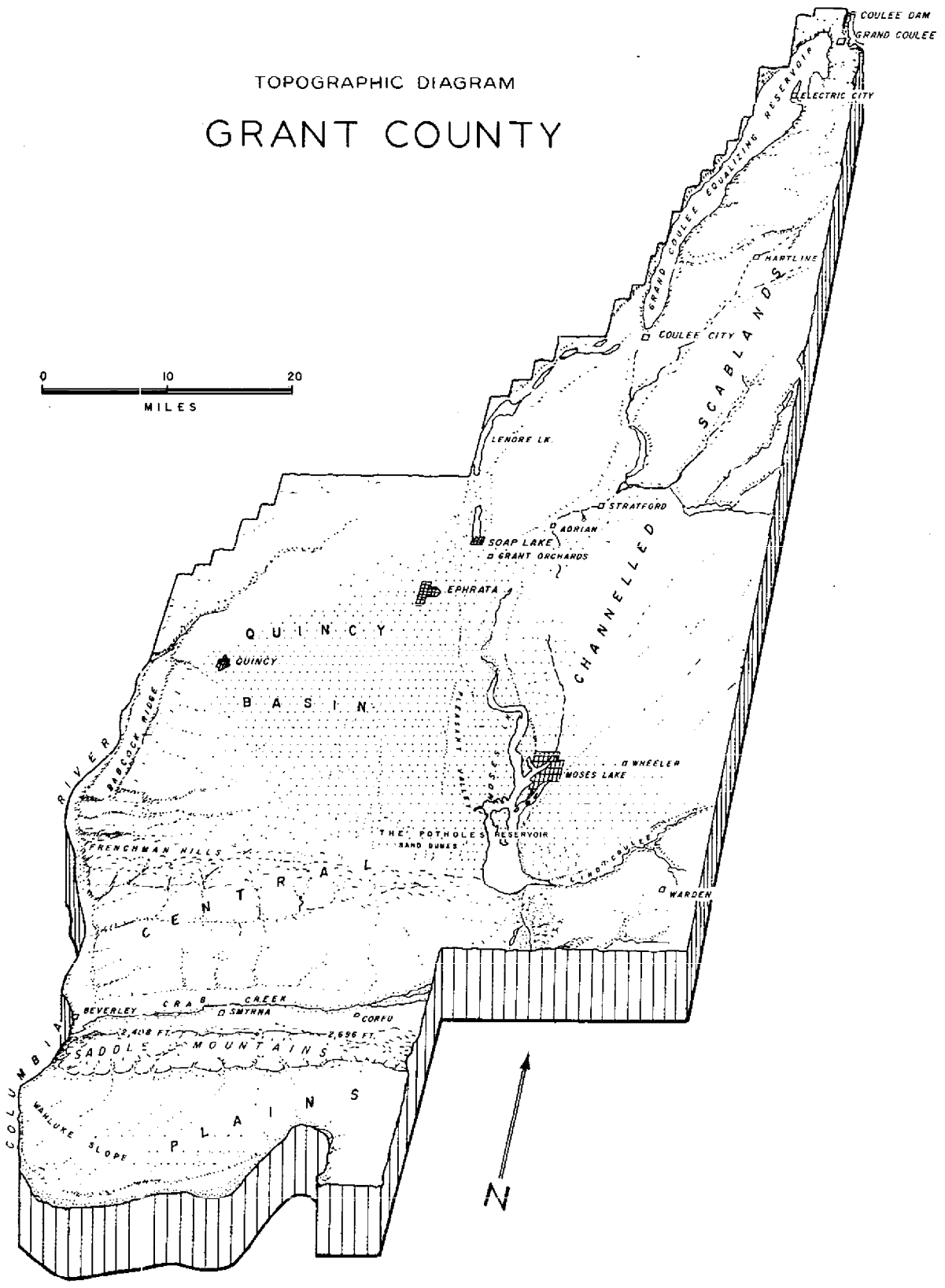
Land Classification and Soils

The U. S. Soil Conservation Service's (SCS) Capability Classification is a grouping of soils that shows, in a general way, how suitable the soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. All kinds of soils are grouped into eight major capability classes. Class I contains soils that have few limitations, the widest range of use, and the least risk of damage when they are used. Soils in the other classes have progressively


PHYSIOGRAPHIC DIAGRAM
WASHINGTON
PREPARED BY WASHINGTON CROP AND LIVESTOCK REPORTING SERVICE
W. R. Clavinger, Cartographer
0 10 20 30 40 50 MILES
1955
124
122
120
118
49
48
47
46
PACIFIC OCEAN
STRAIT OF JUAN DE FUCA
SAN JUAN ISLANDS
NORTH CASCADE MOUNTAINS
OKANOGAN HIGHLAND
SELKIRK MOUNTAINS
OLYMPIC MOUNTAINS
PUGET LOWLAND
PUGET GLACIAL DRIFT PLAIN
WILLAPA HILLS
COASTAL PLAIN
WILLAMETTE VALLEY
CASCADE MOUNTAINS
WATERVILLE PLATEAU
CHANNELLED SCABLANDS
COLUMBIA BASIN
CENTRAL
QUINCY BASIN
SADDLE MOUNTAINS
YAKIMA FOLDS
YAKIMA RIDGE
TAHOMA RIVER PLAINS
PASCO BASIN
PALOUSE HILLS
HORSE HEAVEN HILLS
BLUE MOUNTAINS
Cape Flattery
Cape Alava
Destruction Is.
Grays Hbr.
Willapa Bay
Columbia R. Estuary
Walla Walla Gateway
Spokane R.
Grand Coulee
Moses Lk.
Yakima R.
Snake R.
Columbia R.
20,000 FEET
GENERALIZED CROSS-SECTION ALONG 47°30'
COAST RANGE
CASCADE MOUNTAINS
COLUMBIA BASIN
COASTAL PLAIN
OLYMPIC MOUNTAINS
WILLAMETTE-PUGET LOWLAND
PUGET GLACIAL DRIFT PLAIN
WATERVILLE PLATEAU
CHANNELLED SCABLANDS
PALOUSE HILLS
SEA LEVEL
(VERTICAL SCALE EXAGGERATED 8 TIMES)
1955

TOPOGRAPHIC DIAGRAM

GRANT COUNTY



WASHINGTON CROP AND LIVESTOCK REPORTING SERVICE

W. R. CLEVINGER

greater natural limitations; Classes V through VIII are generally unsuited for cultivation.

The SCS 1949 land use capability map shows no Class I land in Grant County, although some of the Class II land within the Columbia Basin Project area has recently been given Class I designation by the Bureau of Reclamation for irrigation purposes. The main areas of Class II land are in the vicinity of Quincy in the western part of Quincy Basin, to the east of Moses Lake, in the vicinity of Warden, and in the Hartline area in the northern part of the county. Large Class III and IV areas, which have major limitations requiring careful management if cultivated, are found on the Central Plains north and south of Crab Creek, to the east and west of Moses Lake, and to the west, northeast, and surrounding Ephrata and Soap Lake.

A generalized soil association map was prepared by the SCS for Grant County in 1961. In addition, Washington State University published a rather detailed description of soils and physiography for land within the Columbia Basin Project. A summary appears below:

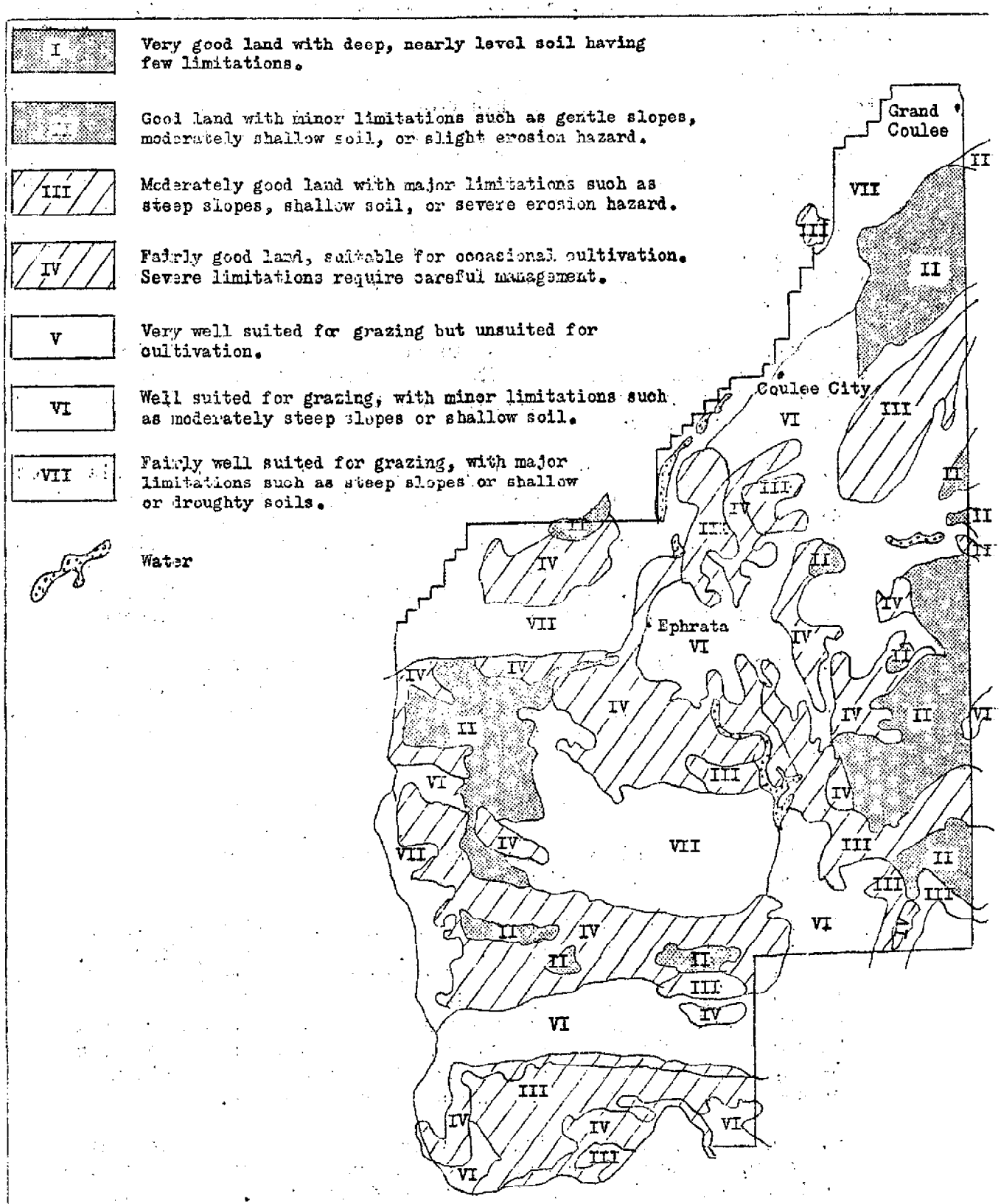
A. Soils on glacial outwash and stream terraces. Soils in this group include the Ephrata, Moses Lake, Rupert, Timmerman, Neppel, and Burbank series. This group covers more area than any other in the project. Locations include the Ephrata-Moses Lake area north of Moses Lake, western Quincy Basin, the Wahluke Slope, and smaller areas west and north of Corfu. The Ephrata soils contain the largest acreage of this group and are among the more irrigable soils of the project.

B. Loessal soils. This group exemplifies maximum soil development in the Columbia Basin and is found at higher elevations along the eastern margin of the project, the Babcock ridge area, and higher areas in the northern part of the project. Series represented are the Ritzville and Renslow.

C. Ringold formation soils. This group represented by the Ringold and Wiehl series, is made up of young, recently deposited soils that are very susceptible to wind erosion. They occur frequently in the southern part of the project.

D. Soils on wind modified glacial sediments. Series in this group are Wahluke, Royal, Warden, Corfu, Haywood, Novara, Sagehill, Arrowsmith, and Ottmar. These soils developed on water-laid sediments that were later modified by erosion and wind deposition. Parent material is basaltic or granitic with a lime layer often present. This group is widely distributed on gentle slopes around the Quincy Basin, south slopes of the Frenchman Hills and Saddle Mountains, around Quincy, and to the north and south of Wheeler.

E. Touchet formation soils. This group, which contains the Sagemoor, Ellisforde, and Hezel series, developed over a landscape that was once a glacial lake bottom or flood plain. These soils occur in a complex association along Lind and Weber Coulees north of Warden.



Source: U. S. Soil Conservation Service Map - Washington, Generalized Classification of Land According to its Capability for Use, 1949.

Figure 5. Land Use Capability Classes in Grant County.

F. Soils on wind-blown sands. Series represented are the Quincy and Winchester. Found over a large portion of the Quincy Basin west of the Potholes Reservoir, these soils show little development, are often dune-like, and are unsuitable for gravity irrigation.

G. Soils on sediments over caliche. Series are the Burke, Taunton, Koehler, and Babcock. Soils originated from a variety of sediments ranging from loess to coarse water-laid materials laid down on an older caliche formation. In Grant County they are found mostly north and east of Quincy, in the Central Plains, and in scattered areas in the eastern part of the project.

H. Soils on shallow sediments over basalt. These include the Scooteney, Eltopia, and Prosser series. Variable soil depths and drainage characteristics make irrigation difficult. The group is located mainly around Burk in the western part of the project, to the northeast and southeast of Soap Lake, and in scattered patches south of the Potholes Reservoir.

I. Soils on recent alluvial and colluvial deposits. Series represented are the Esquatzel, Red Rock, Naylor, Soap Lake, Beverly, Pasco, and Wahatis. Esquatzel soils, the only series covering an appreciable acreage, are found along coulee bottoms throughout the project. They often become saline or alkaline under irrigation, especially where poorly drained.

Climate

Grant County's climate is, generally speaking, a continental, desert type. Precipitation is low, summers are warm, and winters are cool. The climate is quite uniform over the county, due to the essentially uniform elevation.

Mountain ranges surrounding the Columbia Basin greatly influence its climate. The Rocky Mountains and ranges in southern British Columbia give protection from most severe winter storms moving southward across Canada. Some cold air flows into Washington's interior through north-south valleys near the Canadian Border. Such air drainage from the more severe storms sometimes results in several days of unusually low temperatures in mid-winter or a damaging late spring or early fall freeze.

The Cascade Mountains, west of the basin, rise to 4,000 to 7,000 feet, with peaks over 10,000 feet, and form a north-south topographic and climatic barrier. Prevailing westerly winds in the fall and winter bring a flow of relatively mild, moist air into western Washington. Cooling and condensation occur as this air rises along the slope of the Cascades, resulting in heavy precipitation along the western slope and near the summit. The air becomes warmer and drier as it descends the eastern slope and moves inland, resulting in a decrease in annual precipitation from about 100 inches near the summit of the Cascades to less than 10 inches in the lower elevations of the Columbia Basin.

Precipitation for all Grant County weather stations, except those in the northern end, averaged less than 10 inches per year over a period of several years. The annual precipitation at Moses Lake ranged from less than five to 13 inches per year for the twelve years prior to 1960. Grand Coulee and Hartline

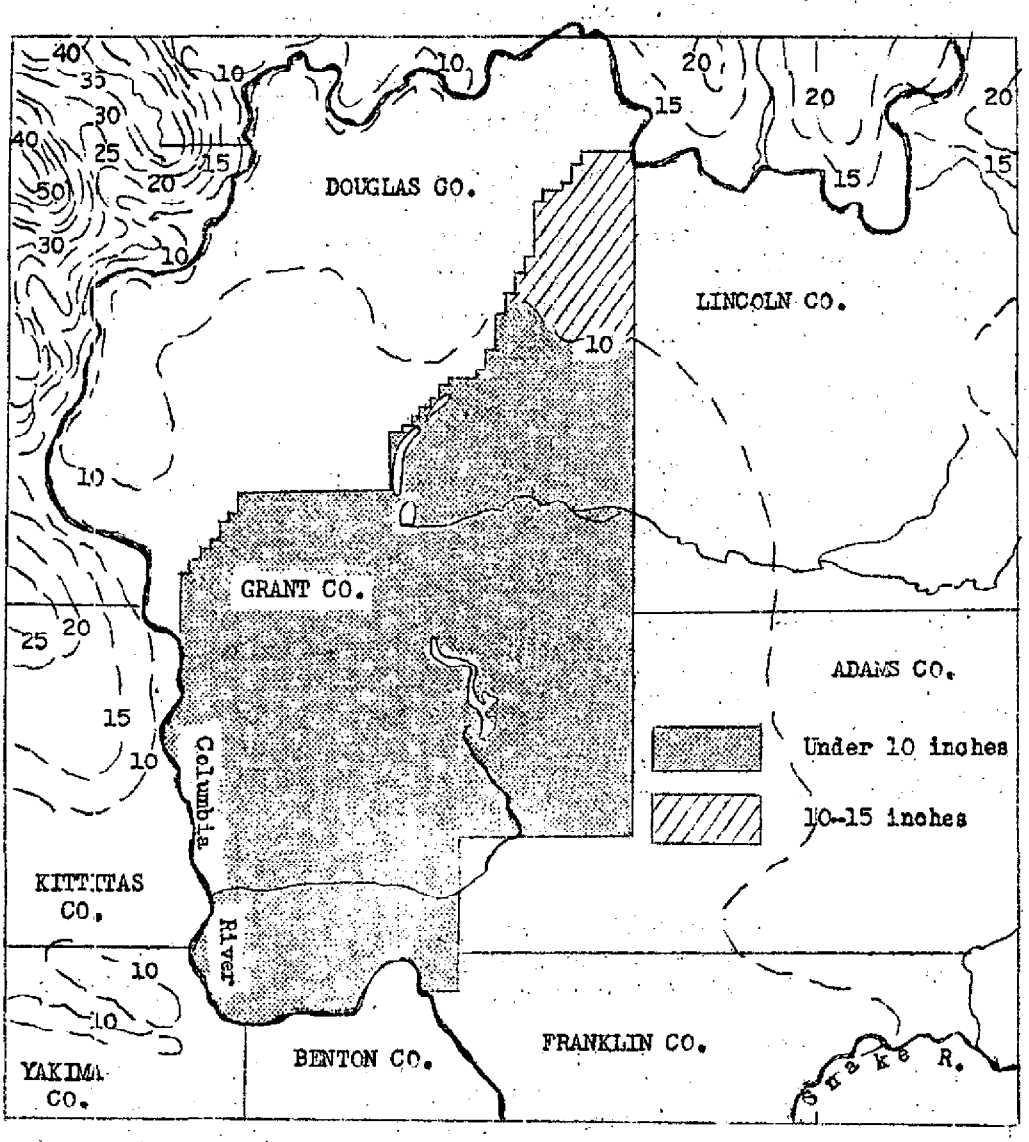


Figure 6. Distribution of Mean Annual Precipitation, 1930-1957. Dotted lines connect points of equal precipitation.

average slightly over 10 inches annually, due to their slightly higher elevation. Precipitation typically increases in the fall to a peak of about one inch per month in mid-winter, decreases in the spring, increases slightly with shower activity in May and June, and then drops off sharply in July and August. It is not unusual for a month or six weeks to pass without measurable rainfall in mid-summer. Snow may be expected any time between the latter part of November and the first of March. Snow accumulates to a depth of 4 to 8 inches in a typical Moses Lake winter, and may remain on the ground from one to six weeks or longer. Warm "chinook" winds frequently cause mid-winter thaws throughout the county, often resulting in rather severe soil erosion.

Low annual precipitation in northern Grant County's dryland wheat farming area necessitates summer fallowing to accumulate and hold moisture for grain crops. Sowing winter wheat in the fall enables plants to use moisture stored in the soil from winter and spring storms. Croplands around Quincy, Ephrata, and Moses Lake are in the county's driest area and irrigation is necessary for all crops.

Table 4. Averages and Extremes in Precipitation (Inches), Grant County

Station	Elev. (ft.)	Period of Record	Average Annual	Greatest Annual	Least Annual	Greatest Monthly	Least Monthly	Greatest Daily
Ephrata	1,275	1931-60	8.42	14.25	4.68	3.84	0	1.56
Grand Coulee	1,702	1935-60	10.66	20.37	6.02	5.52	0	1.38
Hartline	1,910	1931-60	10.96	20.18	6.79	5.73	0	1.80
Moses Lake	1,208	1948-60	8.17	13.14	4.80	2.79	0	1.08
Quincy	1,260	1941-60	8.19	12.75	4.32	3.56	0	1.40
Ruff	1,440	1931-56	9.62	21.01	4.29	4.51	0	2.20
Smyrna	560	1951-60	8.10	10.12	5.78	2.44	0	1.13
Wilson Creek	1,276	1931-60	9.17	16.91	5.71	4.55	0	2.50

Source: U. S. Weather Bureau, Climatological Office.

Table 5. Average Monthly Precipitation (Inches), Grant County

Station	Elev. (ft.)	Period of Record	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Ephrata	1,275	1931-60	1.05	0.74	0.67	0.56	0.72	0.92	0.20	0.25	0.46	0.77	0.98	1.10
Grand Coulee	1,702	1935-60	1.18	0.97	0.71	0.80	1.19	1.23	0.38	0.43	0.57	0.89	1.19	1.12
Hartline	1,910	1931-60	1.27	0.92	0.79	0.74	1.13	1.22	0.33	0.24	0.59	0.98	1.23	1.47
Moses Lake	1,208	1948-60	1.09	0.65	0.63	0.48	0.89	0.72	0.33	0.35	0.45	0.77	0.97	0.77
Quincy	1,260	1941-60	0.99	0.80	0.62	0.64	0.85	0.84	0.19	0.25	0.46	0.75	1.07	0.73
Ruff	1,440	1931-56	1.19	0.84	0.72	0.50	0.86	1.08	0.39	0.20	0.44	1.00	1.03	1.37
Smyrna	560	1951-60	1.44	0.87	0.69	0.59	0.52	0.66	0.13	0.13	0.37	0.59	0.97	1.14
Wilson Creek	1,276	1931-60	1.09	0.78	0.69	0.54	0.82	1.08	0.28	0.20	0.52	0.88	1.12	1.17

Source: U. S. Weather Bureau, Climatological Office.

Evaporation loss is rather high. Average evaporation at Moses Lake is as follows: April 5.68, May 7.33, June 8.60, July 10.21, August 8.04, September 5.36, and October 2.61 inches.

Rather strong winds associated with storms moving across the state often cause considerable erosion and blown dust. During the winter, warm moist air crossing the Cascades and mixing with colder air accumulated in the basin produces considerable cloudiness and some fog. The amount of cloudiness decreases rapidly in the spring, reaching a minimum in July and August. The amount of sunshine possible on a clear day at this latitude ranges from about 8 hours in mid-winter to 16 hours in mid-summer.

Temperatures often exceed 100° F. in the summer and dip to the minus 20's in the winter throughout the county. Ephrata and Grand Coulee have recorded highs of 113° F. in the 25 to 29 years prior to 1960. The lowest in the years from 1948 to 1960 was -33° F. at Moses Lake. Days are warm and nights cool in the summer throughout the county, and temperatures range from average minimums in the 50's to average maximums around 90° F. in July.

The growing season at the 32° F. level (the average number of days from the last 32° frost in the spring until its first occurrence in the fall) ranges from 127 days at Ruff to 180 days at Ephrata. Growing seasons are shorter and killing frosts come earlier in the higher dryland farming regions around Hartline, Wilson Creek, and Wheeler. Frost also settles in low pockets where air drainage is poor, such as at Moses Lake.

Table 6. Temperature Data: Average Daily Maximum, Average Daily Minimum, Daily Mean, and Highest and Lowest Temperature Each Month, Grant County

Station		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Ephrata	Av. Max.	33.7	40.9	53.4	65.1	74.8	81.2	90.5	88.3	79.7	64.9	46.3	37.6	63.0
(1931-60)	Av. Min.	21.2	25.7	33.4	41.2	49.3	55.7	62.4	60.7	53.2	42.7	31.2	25.6	41.9
1,275 ft.	Mean	27.5	33.3	43.4	53.2	62.1	68.5	76.5	74.5	66.5	53.8	38.8	31.6	52.5
elev.	Highest	61	68	76	92	101	104	113	105	102	90	70	64	113
	Lowest	-17	-23	3	16	28	38	42	37	29	12	0	-7	-23
Grand Coulee	Av. Max.	30.8	38.1	50.4	62.5	72.3	78.1	88.6	86.2	77.6	62.1	43.1	35.6	60.5
(1935-60)	Av. Min.	20.6	24.5	31.2	38.6	46.6	52.3	57.9	56.5	50.8	41.1	30.9	26.2	39.8
1,702 ft.	Mean	25.7	31.3	40.8	50.6	59.5	65.2	73.3	71.4	64.4	51.8	37.0	30.9	50.2
elev.	Highest	54	60	74	92	99	105	113	106	104	90	62	58	113
	Lowest	-17	-15	0	20	27	38	43	38	34	12	1	-2	-17
Moses Lake	Av. Max.	31.9	40.7	51.5	62.9	72.1	78.4	87.0	84.2	77.4	60.5	46.8	37.2	61.1
(1948-60)	Av. Min.	16.3	22.7	28.9	34.4	42.9	49.0	52.9	50.7	44.7	35.5	27.1	22.4	35.6
1,208 ft.	Mean	24.1	31.7	40.2	48.7	57.5	63.7	70.0	67.5	61.1	49.0	37.0	29.8	48.4
elev.	Highest	57	64	75	85	96	99	106	101	101	85	66	61	106
	Lowest	-30	-33	6	18	23	32	36	37	25	15	-9	-12	-33
Quincy	Av. Max.	31.4	40.9	52.4	64.1	73.2	79.1	89.6	86.8	78.7	63.5	45.2	35.7	61.7
(1941-60)	Av. Min.	14.8	22.9	28.8	36.9	45.9	52.0	58.2	56.4	48.6	37.7	27.5	21.4	37.6
1,260 ft.	Mean	23.1	31.9	40.6	50.5	59.6	65.6	73.9	71.6	63.7	50.6	36.4	28.6	49.7
elev.	Highest	63	73	78	89	97	101	109	107	100	89	75	64	109
	Lowest	-29	-25	0	7	23	36	40	37	29	16	-2	-9	-29
Wilson Creek	Av. Max.	33.7	42.4	51.2	64.3	74.1	80.4	90.2	87.4	79.3	64.1	45.6	37.1	62.5
(1940-60)	Av. Min.	17.3	24.1	29.0	34.7	42.2	48.1	52.2	50.2	44.4	35.4	27.2	23.0	35.6
1,276 ft.	Mean	25.5	33.3	40.1	49.5	58.2	64.3	71.2	68.8	61.8	49.8	36.4	30.1	49.1
elev.	Highest	56	63	77	87	97	102	111	104	102	91	69	59	111
	Lowest	-30	-30	1	18	21	29	36	33	25	14	-6	-13	-30
Hartline	Av. Max.	31.5	36.9	49.2	60.9	70.6	77.4	87.8	84.6	76.5	61.4	42.3	34.4	59.5
(1931-60)	Av. Min.	19.6	22.5	30.2	36.7	43.5	49.7	55.9	53.7	48.6	38.3	28.0	23.3	39.7
1,910 ft.	Mean	25.6	29.7	39.7	48.8	57.1	63.6	71.9	69.2	62.6	49.9	35.2	28.9	48.5
elev.	Highest	52	60	73	88	98	102	110	103	100	86	62	55	110
	Lowest	-18	-20	4	14	24	31	35	31	27	4	-4	-6	-20
Smyrna	Av. Max.	37.5	45.7	55.4	66.3	76.9	83.4	93.8	90.0	82.2	66.6	48.3	40.4	65.5
(1952-60)	Av. Min.	20.9	27.0	31.7	37.7	47.4	52.7	59.4	57.2	48.4	38.8	28.3	25.7	39.6
560 ft.	Mean	29.2	36.4	43.6	52.0	62.2	68.0	76.6	73.6	65.3	52.7	38.3	33.0	52.6
elev.	Highest	63	68	82	90	103	108	111	107	102	89	70	65	111
	Lowest	-28	-13	8	21	24	35	42	40	28	20	-1	-6	-28
Ruff	Av. Max.	34.9	41.3	53.5	65.2	73.2	80.2	90.1	88.3	79.1	64.4	46.2	37.9	62.9
(1931-56)	Av. Min.	19.7	23.6	29.6	35.4	41.8	47.7	52.9	51.2	45.6	37.4	28.2	23.8	36.4
1,440 ft.	Mean	27.3	32.4	41.6	50.3	57.5	64.0	71.5	69.8	62.4	50.9	37.2	30.8	49.6
elev.	Highest	57	64	79	95	100	108	112	106	104	92	67	60	112
	Lowest	-26	-31	1	14	20	28	34	32	18	12	-10	-8	-31

Source: U. S. Weather Bureau, Climatological Office.

Table 7. Probability of Freezing Temperatures -- Grant County 1/

STATION	TEMP. (° F.)	PROBABILITY — SPRING 90%	75%	50%	25%	10%	PROBABILITY — FALL 10%	25%	50%	75%	90%	Growing Season Mean Length (Days)
Ephrata	32	Mar 22	Apr 3	Apr 16	Apr 29	May 11	Sep 20	Oct 1	Oct 13	Oct 25	Nov 5	180
	28	Mar 4	Mar 16	Mar 30	Apr 12	Apr 24	Oct 6	Oct 17	Oct 29	Nov 10	Nov 21	213
	24	Feb 10	Feb 22	Mar 8	Mar 21	Apr 2	Oct 21	Nov 1	Nov 13	Nov 25	Dec 6	250
	20	Jan 21	Feb 4	Feb 18	Mar 3	Mar 15	Nov 1	Nov 12	Nov 25	Dec 6	Dec 19	279
	16	—	Jan 18	Feb 7	Feb 23	Mar 7	Nov 11	Nov 23	Dec 6	Dec 25	--	303
Hartline	32	Apr 12	Apr 23	May 7	May 21	Jun 1	Sep 17	Sep 27	Oct 10	Oct 22	Nov 2	156
	28	Mar 16	Mar 28	Apr 10	Apr 24	May 5	Sep 30	Oct 11	Oct 25	Nov 4	Nov 15	198
	24	Feb 23	Mar 6	Mar 20	Apr 3	Apr 15	Oct 10	Oct 21	Nov 2	Nov 14	Nov 25	227
	20	Feb 6	Feb 18	Mar 3	Mar 17	Mar 28	Oct 28	Nov 8	Nov 20	Dec 2	Dec 13	262
	16	Jan 17	Feb 3	Feb 17	Mar 3	Mar 15	Nov 7	Nov 18	Nov 30	Dec 12	Dec 22	286
Moses Lake 3E	32	Apr 15	Apr 27	May 11	May 24	Jun 5	Sep 7	Sep 18	Oct 1	Oct 13	Oct 24	143
	28	Mar 24	Apr 5	Apr 19	May 2	May 14	Sep 16	Sep 26	Oct 9	Oct 22	Nov 1	173
	24	Mar 14	Mar 26	Apr 9	Apr 23	May 4	Sep 30	Oct 11	Oct 24	Nov 5	Nov 16	198
	20	Feb 20	Mar 4	Mar 18	Apr 1	Apr 12	Oct 21	Oct 31	Nov 13	Nov 25	Dec 6	240
	16	Jan 28	Feb 9	Feb 23	Mar 8	Mar 20	Oct 26	Nov 5	Nov 18	Dec 2	Dec 20	268
Quincy 3S	32	Apr 5	Apr 17	Apr 30	May 14	May 26	Sep 14	Sep 25	Oct 7	Oct 20	Oct 30	160
	28	Mar 21	Apr 3	Apr 17	Apr 30	May 12	Sep 29	Oct 10	Oct 22	Nov 3	Nov 14	188
	24	Mar 6	Mar 18	Mar 31	Apr 13	Apr 25	Oct 5	Oct 16	Oct 28	Nov 9	Nov 20	211
	20	Feb 13	Feb 25	Mar 10	Mar 24	Apr 5	Oct 19	Oct 30	Nov 11	Nov 23	Dec 4	246
	16	Feb 3	Feb 14	Feb 28	Mar 13	Mar 25	Nov 3	Nov 14	Nov 26	Dec 9	Dec 17	271
Ruff	32	Apr 28	May 9	May 23	Jun 5	Jun 17	Sep 4	Sep 15	Sep 27	Oct 9	Oct 20	127
	28	Apr 10	Apr 23	May 6	May 19	Jun 1	Sep 17	Sep 28	Oct 10	Oct 22	Nov 2	157
	24	Mar 9	Mar 20	Apr 3	Apr 17	Apr 29	Oct 3	Oct 14	Oct 26	Nov 7	Nov 18	206
	20	Feb 12	Feb 24	Mar 9	Mar 23	Apr 4	Oct 15	Oct 26	Nov 7	Nov 19	Nov 30	243
	16	—	Feb 1	Feb 20	Mar 6	Mar 19	Nov 4	Nov 15	Nov 27	Dec 11	--	280
Wilson Creek	32	Apr 24	May 5	May 19	Jun 1	Jun 13	Sep 3	Sep 14	Sep 26	Oct 8	Oct 19	130
	28	Apr 1	Apr 13	Apr 27	May 10	May 22	Sep 17	Sep 28	Oct 10	Oct 22	Nov 1	166
	24	Mar 8	Mar 20	Apr 2	Apr 15	Apr 27	Oct 4	Oct 15	Oct 27	Nov 8	Nov 19	208
	20	Feb 13	Feb 26	Mar 11	Mar 24	Apr 6	Oct 12	Oct 25	Nov 6	Nov 19	Nov 28	240
	16	Jan 21	Feb 6	Feb 20	Mar 5	Mar 17	Oct 29	Nov 9	Nov 21	Dec 2	—	274

Source: U. S. Weather Bureau, Climatological Office.

1/ To illustrate the data in the table, we find that the 50 percent probability of a 32° spring freeze for Ephrata is April 16th. But there is also a 25 percent chance (1 year in 4) that a 32° freeze will occur as late as April 29th, and 10 percent chance as late as May 11th.

Vegetation and Wildlife

Natural vegetation has been modified or completely replaced over much of Grant County by agriculture, urban development, and other activities. The great majority of the undisturbed portions of the county are covered by sagebrush-grass vegetation. Principal shrubs and browse plants are sagebrush (Artemisia spp.), rabbitbrush (Chrysothamnus spp.), and antelope bitterbrush (Purshia tridentata) on the better sites. Major grasses include bluebunch wheatgrass (Agropyron spicatum), Idaho fescue (Festuca idahoensis), Sandberg bluegrass (Poa secunda), needle-and-thread grass (Stipa spp.), and squirreltail (Sitanion spp.).

Plant cover on the more rocky sites in the Channelled Scablands is quite sparse. Annual grasses, principally cheatgrass (Bromus tectorum), have taken over some rangeland in the western part of the county.

Grant County offers some of the best upland bird and waterfowl hunting in Washington. The 1962 pheasant and duck kills of 89,730 and 104,470 birds, respectively, were the highest in the state. The county was second in the number of geese taken that year with 6,240 birds. Expansion of open-water areas by dam construction and irrigation has flooded some waterfowl nesting sites but has also created new ones. The area is expected to become one of the most important migratory routes for waterfowl in the West. Irrigation, production of forage crops, and creation of edge cover between cultivated and noncultivated areas have generally benefited pheasant, quail, mourning dove, Hungarian partridge, cottontail, and other upland game species. Irrigation developments have also provided more forage for deer, and the small resident herds must be harvested sufficiently to prevent a population build-up to nuisance proportions. The 1962 deer kill was 270.

About 100,000 acres of land and water in the county are owned or controlled by the Washington Department of Game and are open to public hunting, fishing, and other recreational use. An additional 50,000 acres of private land have been opened to the public by farmers and ranchers participating in a cooperative "Hunting by Permission" program with the Department of Game. The Department has been active in stocking new fishing waters, improving old ones, and in habitat improvement work for game species.

Although not a major industry, some Grant County residents supplement their income by trapping fur-bearing animals. The catch reported for the 1962-1963 season was 2,311 muskrat, 28 mink, 24 marten, 8 raccoon, 2 otter, 2 skunk, 3 weasel, and 1 bobcat.

As the demand for outdoor recreation expands with increasing population, mobility, and leisure time, development of private land for hunting, fishing, camping, and other recreational pursuits should provide the Grant County farmer with an additional source of income.

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