

# Climate of Washington

## Introduction

This publication consists of a narrative that describes some of the principal climatic features and a number of climatological summaries for stations in various geographic regions of the State. The detailed information presented should be sufficient for general use; however, some users may require additional information.

The National Climatic Data Center (NCDC) located in Asheville, North Carolina is authorized to perform special services for other government agencies and for private clients at the expense of the requester. The amount charged in all cases is intended to solely defray the expenses incurred by the government in satisfying such specific requests to the best of its ability. It is essential that requesters furnish the NCDC with a precise statement describing the problem so that a mutual understanding of the specifications is reached.

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The Means and Extremes of meteorological variables in the Climatography of the U.S. No.20 series are recorded by observers in the cooperative network. The Normals, Means and Extremes in the Local Climatological Data, annuals are computed from observations taken primarily at airports.

The editor of this publication expresses his thanks to those State Climatologists, who, over the years, have made significant and lasting contributions toward the development of this very useful series.

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## **Climate of Washington**

**Topographic Features-** The location of the State of Washington on the windward coast in mid-latitudes is such that the climatic elements combine to produce a predominantly marine-type climate west of the Cascade Mountains, while east of the Cascades, the climate possesses both continental and marine characteristics. Considering its northerly latitude, 46 to 49° North, Washington's climate is mild.

There are several climatic controls which have a definite influence on the climate, namely: (a) terrain, (b) Pacific Ocean, and (c) semi-permanent high and low pressure regions located over the North Pacific Ocean. The effects of these various controls combine to produce entirely different conditions within short distances.

Washington's western boundary is formed by the Pacific Ocean. The seasonal change in the temperature of the ocean is less than the seasonal change in the temperature of the land, thus the ocean is warmer in winter and cooler in summer than the adjoining land surfaces. The average temperature of the water along the coast and in the Strait of Juan de Fuca ranges from 45 degrees Fahrenheit (° F) in January to 53 in July; however, during the summer, some of the shallow bays and protected coves are five to 10 degrees warmer.

There are two ranges of mountains parallel to the coast and athwart to the prevailing direction of moist air moving inland from over the ocean. The first orographic lifting and major release of moisture occurs along the western slope of the Coastal Range. The second area of heavy orographic precipitation is along the windward slopes of the Cascade Range. The Cascade Mountains, 90 to 125 miles inland and 4,000 to 10,000 feet in elevation, are a topographic and climatic barrier separating the State into eastern and western Washington. The higher, wider and more rugged sections are in the northern part of the State. Some of the highest isolated volcanic peaks are Mt. Rainier (14,410 feet), Mt. Adams (12,276 feet) and Mt. Baker (10,775 feet). These and other high peaks are snowcapped throughout the year. The only break in the Cascade Range is the narrow and scenic Columbia River gorge.

Warming and drying of air as it descends along the lee (eastern) slopes of the Cascade Range results in near desert conditions in the lowest section of the Columbia Basin. Another orographic lifting of the air occurs as it flows eastward from the lowest elevations of the Inland Basin toward the Rocky Mountains. This lifting of air results in a gradual increase in precipitation from the lowest section of the basin to the higher elevations along the eastern border of the State.

The location and intensity of the semi-permanent high and low pressure areas over the North Pacific Ocean have a definite influence on the climate. Air circulates in a clockwise direction around Northern Hemispheric high pressure systems and in a counter-clockwise direction around low pressures. During the spring and summer, the low pressure cell becomes weak and moves north of the Aleutian Islands. At the same time, the high-pressure area spreads over most of the

North Pacific Ocean. A circulation of air around the high pressure center brings a prevailing westerly and northwesterly flow of comparatively dry, cool and stable air into the Pacific Northwest. As the air moves inland, it becomes warmer and drier which results in a dry season beginning in the late spring and reaching a peak in midsummer.

In the fall and winter, the Aleutian low pressure center intensifies and moves southward reaching a maximum intensity in midwinter. At the same time, the high pressure area becomes weaker and moves southward. A circulation of air around these two pressure centers over the ocean brings a prevailing southwesterly and westerly flow of air into the Pacific Northwest. This air from over the ocean is moist and near the temperature of the water. Condensation occurs as the air moves inland over the cooler land and rises along the windward slopes of the mountains. This results in a wet season beginning in October, reaching a peak in winter, and then gradually decreasing in the spring.

Although the Cascade Range divides the State into two major climatic regions, there are several distinct climatic areas within each of these regions:

Western Washington – West of the Cascade Mountains, summers are cool and comparatively dry and winters are mild, wet and cloudy. The average number of clear or partly cloudy days each month varies from four to eight in winter, eight to 15 in spring and fall, and 15 to 20 in summer. The percent of possible sunshine received each month ranges from approximately 25 percent in winter to 60 percent in summer. In the interior valleys, measurable rainfall is recorded on 150 days each year and on 190 days in the mountains and along the coast. Thunderstorms over the lower elevations occur on four to eight days each year and over the mountains on seven to 15 days. Damaging hailstorms rarely, if ever, occur in most localities of western Washington. During July and August, the driest months, it is not unusual for two to four weeks to pass with only a few showers; however, in December and January, the wettest months, precipitation is frequently recorded on 20 to 25 days or more each month. The range in annual precipitation is from approximately 20 inches in a “rain shadow” northeast of the Olympic Mountains to 150 inches along the southwestern slopes of these mountains. Snowfall is light in the lower elevations and heavy in the mountains.

During the wet season, rainfall is usually light to moderate in intensity and continuous over a period of time rather than heavy downpours for brief periods. Maximum rainfall intensities to expect in one out of 10 years are: 0.6 to 1.0 inch in an hour; 1.0 to 2.5 inches in three hours; 1.5 to 5.0 inches in six hours; and 2.0 to 7.0 inches in 12 hours. The heavier intensities occur along the windward slopes of the mountains.

During the latter half of the summer and early fall, the lower valleys are sometimes filled with fog or low clouds until noon, while at the same time, the higher elevations are sunny. The strongest winds are generally from the south or southwest and occur during the late fall and winter. In the interior valleys, wind velocities can be expected to reach 40 to 50 mph each winter and 75 to 90 mph once in 50 years. The daily variation in relative humidity in January is from approximately 87 percent at 4:00 a.m. to 78 percent at 4:00 p.m., and in July from 85 percent at 4:00 a.m. to 47 percent at 4:00 p.m. During periods of easterly winds, the relative humidity can drop to 25 percent or lower. The highest summer and lowest winter temperatures are usually

recorded during periods of easterly winds. The total evaporation for the warm season, May through September, as measured at Seattle, is 25 inches with an average of seven inches in July.

In order to describe the climate of western Washington in more detail, the area has been divided into five regions.

West Olympic-Coastal – This area includes the coastal plains and the western slope of the Coastal Range from the Columbia River to the Strait of Juan de Fuca. The Olympic Mountains, located on the northern section of the Olympic Peninsula, tower to nearly 8,000 feet in dome-like structures, deeply carved by rivers. The Willapa Hills, elevation 1,000 to 3,000 feet, form a continuous ridge from the Chehalis River valley to the Columbia River. This area receives the full force of storms moving inland from over the ocean, thus heavy precipitation and winds of gale force occur frequently during the winter season. Wind velocities in the lower elevations can be expected to reach 90 to 100 mph once in 100 years. Wind data from a well exposed site on a ridge (2,000 feet elevation) near the ocean indicates that wind velocities in excess of 100 mph occur in the higher elevations almost every winter.

The “rainforest” area along the southwestern and western slopes of the Olympic Mountains receives the greatest amount of precipitation in the coterminous United States. Annual precipitation ranges from 70 to 100 inches over the Coastal Plains to 150 inches or more along the windward slopes of the mountains. The greatest annual precipitation recorded in this area was 185 inches at Wynoochee Oxbow, elevation 670 feet. Also, Washington’s greatest 24-hour rainfall, 14.26 inches at Mt. Mitchell # 2 elevation 3,600 feet, also occurred in this region.

On Blue Glacier, elevation 6,900 feet and near the summit of Mt. Olympus, 149 inches of precipitation were recorded between August 1957 and July 1958. The total snowfall for this period was 542 inches. During the same period, precipitation at lower elevation stations was approximately 15 percent below normal.

Annual snowfall ranges from 10 to 30 inches in the lower elevations and between 250 to 500 inches in the higher mountains. In the lower elevations, snow melts rather quickly and depths seldom exceed six to 15 inches. In mid-winter, the snowline in the Olympic Mountains and the Willapa Hills is between 1,500 and 3,000 feet above sea level. The higher ridges are covered with snow from November until June. The average maximum temperature in July is near 70 along the coast and 75° F in the foothills, and minimum temperatures are near 50. In winter, the warmer areas are near the coast. January maximum temperatures range from 43 to 48° F and minimum temperatures from 32 to 38.

Northeast Olympic-San Juan – This area includes the lower elevations along the northeastern slope of the Olympic Mountains extending eastward along the Strait of Juan de Fuca from near Port Angeles to Whidbey Island and then northward into the San Juan Islands. The Olympic Mountains and the extension of the Coastal Range on Vancouver Island shield this area from winter storms moving inland from over the ocean. This belt, in the “rain shadow” of the Olympic Mountains, is the driest area in western Washington. The average annual precipitation ranges from about 18 inches near Sequim, Port Townsend and Coupeville to between 25 and 30 inches in the vicinity of Everett on the east, Port Angeles on the west and Olga in the San Juan

Islands on the north. Measurable precipitation is recorded on three to five days each month in summer and on 17 to 22 days in winter.

Another factor which distinguishes this belt from other localities in the Puget Sound region is the rate of rainfall. This area frequently receives drizzle or light rain while other localities are experiencing light to moderate rainfall. Snowfall is light in the lower elevations adjacent to the water, increasing with distance from the water and rise in terrain.

This area is considered to receive slightly more sunshine and have less cloudiness than other localities in Puget Sound; however, the difference is not proportionate to the precipitation decrease. During the latter half of the summer and early fall, fog banks form over the ocean and Strait of Juan de Fuca resulting in considerable fog and morning cloudiness in the low elevations.

The average July maximum temperature ranges from 65 near the water up to 75° F well inland, and the minimum temperature is near 50. Maximum temperatures seldom exceed 90° F. In January, maximum temperatures are in the 40s and minima in the lower 30s. Minimum temperatures between -5 and -8° F have been recorded; however, the minimum temperature seldom drops below 15 to 20. The coldest weather is usually associated with an outbreak of cold air from the interior of Canada. The average date of the last freezing temperature in the spring ranges from the latter half of March near the water to the last of April in agricultural areas 100 to 300 feet above sea level and a few miles inland. The first freezing temperature in the fall is about the first of November.

Puget Sound-Lowlands – This area includes a narrow strip of land along the west side of Puget Sound southward from the Strait of Juan de Fuca to the vicinity of Centralia and Chehalis and a somewhat wider strip along the east side of the Sound extending northward to the Canadian Border. Variations in the temperature, length of the growing season, fog, rainfall and snowfall are due to such factors as distance from the Sound, the rolling terrain and air from over the ocean reaching this area through the Strait of Juan de Fuca and the Chehalis River valley. Occasionally in the winter season, cold air from the interior of Canada flows southward through the Fraser River canyon and over the northern Puget Sound lowlands.

The prevailing directions of the wind are south or southwest during the wet season and northwest in summer. The average wind velocity is less than 10 mph. This is the most densely populated and industrialized area in the State. Air pollution is usually most noticeable in the late fall and winter season, under conditions of clear skies, light wind and a sharp temperature inversion. These conditions prevail a few days before a weather system moves through removing the pollution by wind and rain.

Most of this area is near the eastern edge of the “rain shadow” of the Olympic Mountains. Annual precipitation ranges from 32 to 37 inches from the Canadian Border to Seattle, and then gradually increases to 47 inches in the vicinity of Centralia. Snowfall ranges from 10 to 20 inches. Both rainfall and snowfall increase with a slight increase in elevation and distance from the Sound. Snow generally melts rather quickly and depths seldom exceed six to 15 inches. The greatest snow depth recorded in Seattle is 29 inches.

The average January maximum temperature ranges from 41 to 45° F and minimum temperatures from 28 to 32. With an increase in distance from the Sound, winter temperatures decrease and summer temperatures increase. Minimum temperatures ranging from 0 to -10° F have been recorded; however, temperatures seldom drop lower than 10 to 15. In July, the average maximum temperature ranges from 73° F near the Canadian Border to 78 in the vicinity of Olympia, and the minimum temperature is near 50. Maximum temperatures of 100° F have been reached; however, in an average summer, 90° F or higher is only recorded on three to five days. The growing season is from the latter half of April until the middle of October.

East Olympic-Cascade Foothills – This area includes foothills along the eastern slope of the Coastal Range, foothills along the western slope of the Cascade Mountains and the valley separating these ridges from the vicinity of Chehalis to the Columbia River. The easterly movement of moist air from over the ocean produces downslope winds in foothills along the eastern slope of the Coastal Range and upslope winds in the foothills along the western slope of the Cascade Mountains. Precipitation is heavier along the windward slopes than in the valley or along the lee slopes. The average annual precipitation ranges from 40 inches in the lower valleys near the Columbia River to 90 inches at stations 800 to 1,000 feet above sea level and along the western slope of the Cascade Range. Annual snowfall increases from less than 10 inches in the lower valleys to 50 inches in elevations 500 to 800 feet.

The Columbia River gorge permits an exchange of air between eastern and western Washington. The direction and speed of air movement through the gorge is determined primarily by the pressure gradient between the eastern and western slopes of the mountains. In summer, the flow of air is usually from west to east, and in winter from east to west. During the winter season, easterly winds in the gorge sometimes reach gale force. Rather severe ice storms or “silver thaws” occur in a narrow area westward from the gorge to the vicinity of Vancouver. Silver thaws result from rain falling through a layer of cold air flowing westward through the gorge.

In January the average maximum temperature ranges from 38 to 45° F, and the minimum from 25 to 32. Minimum temperatures have dropped to between 0 and -15° F; however, minimum temperatures lower than 5 to 10 occur infrequently. In July the average maximum temperature ranges from 75 to 80° F and the minimum is near 50. Maximum temperatures have reached 100 to 105° F; however, it is unusual for temperatures to exceed 90° F on more than eight to 15 days. The hottest weather occurs during periods of dry easterly winds. The average date of the last freezing temperature in the spring ranges from the middle of April in the warmer valleys to the middle of May in the colder localities. In the fall, freezing temperatures can be expected after the middle of October.

Cascade Mountains -West – This area includes the western slope of the Cascade Range from an elevation of approximately 1,000 feet to the summit and extending from the Columbia River to the Canadian Border. Orographic lifting of the moisture-laden southwesterly and westerly winds results in heavy precipitation in this area. The annual precipitation ranges from 60 to more than 100 inches. The heaviest precipitation usually occurs along the slopes of east-west mountain valleys which narrow as the elevation increases. Annual precipitation in some of the wetter areas has reached 140 inches once in 10 years.

The average winter season snowfall ranges from 50 to 75 inches in the lower elevations, gradually increasing with elevation to between 400 and 600 inches at 4,000 to 5,500 feet. Some of the greatest seasonal snowfalls and snow depths in the United States have been recorded on the slopes of Mt. Rainier and Mt. Baker. The greatest seasonal snowfall recorded at Mt. Baker (elevation 4,200 ft) was 1,140 inches (95 feet) in 1998 - 1999. These and other high peaks above 7,000 or 8,000 feet remain snowcapped throughout the summer. Snowfall usually begins in the higher elevations in September, gradually working down to 3,000 feet by the last of October. The snowline in mid-winter varies from 1,500 to 2,000 feet above sea level. Although snowfall continues until late spring, the maximum depth is usually reached during the first half of March. At this season of the year, snow depths above 3,000 feet range from 10 to 25 feet. The density of the snow pack increases from approximately 30 percent water the first of December to 45 percent water in March. In elevation above 5,000 feet, snow remains on the ground until the last of June or first of July.

Average January maximum temperatures range from 40 in the lower elevations to 30° F at 5,500-foot elevation. Minimum temperatures range from 30 in the lower elevations to 20 in the higher elevations. Minimum temperatures from 0 to -17° F have been recorded in the higher elevations to the lower 60s in the higher elevations. Above 4,000 feet minimum temperatures occasionally drop below freezing in midsummer. In general, the temperature decreases approximately 3° F with each 1,000 feet increase in elevation.

Eastern Washington – This section of the State is part of the large inland basin between the Cascade and Rocky Mountains. In an easterly and northerly direction, the Rocky Mountains shield the inland basin from cold air masses traveling southward across Canada. In a westerly direction, the Cascade Range forms a barrier to the easterly movement of moist and comparatively mild air in winter and cool air in summer. Some of the air from each of these source regions reaches this section of the State and produces a climate which has some of the characteristics of both continental and marine types. Most of the air masses and weather systems crossing eastern Washington are traveling under the influence of the prevailing westerly winds. Infrequently, dry continental air masses enter the inland basin from the north or east. In summer this air from over the continent results in low relative humidity and high temperatures, while in winter, clear, cold weather prevails. Extremes temperatures generally occur when the inland basin is under the influence of air from over the continent.

East of the Cascades, summers are warmer, winters are colder and precipitation is less than in western Washington.

The average number of clear or partly cloudy days each month varies from five to 10 in winter, 12 to 18 in spring and fall, and 20 to 28 in summer. The percent of possible sunshine received each month is from 20 to 30 percent in winter, 50 to 60 percent in spring and fall and 80 to 85 percent in summer. The number of hours of sunshine possible on a clear day ranges from approximately eight in December to 16 in June. In the driest areas, measurable rainfall is recorded on 70 days each year and on more than 120 days in the higher elevations near the eastern border and along the eastern slope of the Cascades.

Annual precipitation ranges from seven to nine inches near the confluence of the Snake and Columbia Rivers, 15 to 30 inches along the eastern border and 75 to 90 inches near the summit of the Cascade Mountains. During July and August, it is not unusual for four to eight weeks to pass with only a few scattered showers. Thunderstorms can be expected on one to three days each month from April through September. Most thunderstorms in the warmest months occur as isolated cells covering only a few square miles. A few damaging hailstorms are reported each summer. Maximum rainfall intensities expected in one out of 10 years are 0.6 inch in an hour; 1.0 inch in three hours; 1.0 to 1.5 inches in six hours; and 1.2 to 2.0 inches in 12 hours.

During the coldest months, a loss of heat by radiation at night and moist air crossing the Cascades and mixing with the colder air in the inland basin results in cloudiness, fog and occasional freezing drizzle. A “chinook” wind, which produces a rapid rise in temperature, occurs a few times each winter. Frost penetration in the soil depends to some extent on the vegetative cover, snow cover and the duration of low temperatures. In an average winter, frost in the soil can be expected to reach a depth of 10 to 20 inches. During a few of the colder winters with little or no snow cover, frost has reached a depth of 25 to 35 inches.

During most of the year, the prevailing direction of the wind is from the southwest or west. The frequency of northeasterly winds is greatest in the fall and winter. Wind velocities ranging from four to 12 mph can be expected 60 to 70 percent of the time; 13 to 24 mph, 15 to 24 percent of the time; and 25 mph or higher, one to two percent of the time. The highest wind velocities are from the southwest or west and are frequently associated with rapidly moving weather systems. Extreme wind velocities at 30 feet above the ground can be expected to reach 50 mph at least once in two years; 60 to 70 mph once in 50 years and 80 mph once in 100 years.

During the growing season, April through September, the average evaporation is 35 to 52 inches. Monthly evaporation in midsummer ranges from nine to 12 inches. Annual evaporation from lakes and reservoirs is estimated at 26 inches in the mountains and 34 to 42 inches in other localities. The average relative humidity in January is approximately 85 percent at 4:00 a.m. and 75 percent humidity at 4:00 p.m. and in July, 65 percent at 4:00 a.m. and 27 percent at 4:00 p.m.

In order to describe the climate in more detail, eastern Washington has been divided into five sections:

East Slope-Cascades – This area extends from the summit of the Cascades eastward for distances varying from 25 to 75 miles and from the Canadian Border to the Columbia River. In an easterly direction, the elevation decreases from the summit of the Cascade Range to approximately 2,000 feet above sea level. One of the outstanding features of the climate is the decrease in precipitation along the eastern slope of the mountains as the distance from the summit increases and the elevation decreases. For example, within a distance of 20 miles, the average annual precipitation decreases from 84 inches at Stampede Pass (elevation 3,958 feet) to 23 inches at Cle Elum (elevation 1,920 feet).

The average winter season snowfall decreases from approximately 400 inches near the summit of the mountains to about 75 inches at 2,000 feet above sea level. In elevations above 3,000 feet snow can be expected in October; however, it generally does not accumulate on the ground until



after the first of November. In the lower elevations snow reaches a depth of two to five feet in January or February and in the higher elevations, 10 to 20 feet by the first of March. The density of the snow pack increases from approximately 30 percent water at the beginning of the winter season to 45 percent water by mid-March. In the higher elevations, snow remains on the ground until June or July. Several large irrigation reservoirs are located in valleys along the eastern slope of the Cascades. Melting of the snow provides irrigation water for orchards and other agricultural areas in the Okanogan, Wenatchee, Methow, Yakima and Columbia River valleys.

The average January maximum temperature varies from 25 to 35° F and the minimum temperature from 15 to 25. Minimum temperatures ranging from 0 to -15° F are recorded almost every winter and minimum temperatures have dropped to -30° F in the colder valleys. In July the average maximum temperature ranges from 70 to 85° F and the minimum temperature from 45 to 50. In the lower elevations maximum temperatures exceed 90° F on 15 to 20 days each summer. Temperatures 80° F or higher is usually recorded in the higher elevations. In elevations below 3,000 feet, maximum temperatures have reached 100 to 105° F. A cool mountain breeze in the late afternoon results in rapid cooling after sunset.

Okanogan-Big Bend – This area includes fruit producing valleys along the Okanogan, Methow and Columbia Rivers, grazing land along the southern Okanogan highlands, the Waterville Plateau and part of the channeled scablands. The elevation varies from approximately 1,000 feet in the lower river valleys to 3,000 feet over the Waterville Plateau and Okanogan highlands. North-south ranges of mountains extending into southern British Columbia reach elevations of 4,000 to 5,000 feet within a few miles of the Okanogan River. The annual precipitation increases from 11 inches in the valley to 16 inches over some of the Plateau. Winter season snowfall varies from 30 to 70 inches. Both rainfall and snowfall increase in the higher elevations. Snow can be expected after the first of November and to remain on the ground from the first of December until March or April. Snow accumulates to a depth of 10 to 20 inches in the valleys and over the Waterville Plateau, increasing to 40 inches in the higher grazing areas.

The average January maximum temperature is 28 to 32° F and the minimum temperature varies from 15 to 20. Minimum temperatures from 0 to -15° F are recorded on a few nights each winter and -30° F has been recorded in the colder localities. Occasional outbreaks of cold air from Canada moving southward through the valleys result in a late spring or early fall freeze. In July the average maximum temperature is 85 to 90° F, and the minimum is in the lower 50s. Maximum temperatures reach 100° F or higher on a few afternoons each summer, and 105 to 113° F have been recorded. Thunderstorms occur on 10 to 15 days each summer, and a few damaging hailstorms are reported in the fruit-producing valleys.

The average date of the last freezing temperature in the spring is the latter half of April in the warmer fruit-producing valleys along the Columbia and Okanogan Rivers, the middle of May in the colder valleys along the Wenatchee and Methow Rivers and the last of May over the Waterville Plateau and the higher rangelands. The first freezing temperature in the fall usually occurs in the latter half of September on the Waterville Plateau and by the middle of October in the warmer fruit-producing valleys.

Central Basin – The Central Basin includes the Ellensburg valley, the central plains area in the Columbia basin south from the Waterville Plateau to the Oregon border and east to near the Palouse River. The elevation increases from approximately 400 feet at the confluence of the Snake and Columbia Rivers to 1,300 feet near the Waterville Plateau and 1,800 feet along the eastern edge of the area. This is the lowest and driest section in eastern Washington. Annual precipitation ranges from seven inches in the drier localities along the southern slopes of the Saddle Mountains, Frenchman Hills and east of Rattlesnake Mountains, to 15 inches in the vicinity of the Blue Mountains. Summer precipitation is usually associated with thunderstorms. During July and August, it is not unusual for four to six weeks to pass without measurable rainfall.

The winter season snowfall is from 10 to 35 inches. Snow can be expected after the first of December and to remain on the ground for periods varying from a few days to two months between mid-December and the last of February. Other than in the Ellensburg Valley, snow depths seldom exceed eight to 15 inches. The Central Basin is subject to “chinook” winds which produce a rapid rise in temperature. A few damaging hailstorms are reported in the agricultural areas each summer.

The average January maximum temperature is near 30 in the colder localities in the Columbia Basin and 40° F in the lower Yakima valley, and minimum temperatures are 15 to 25. Minimum temperatures between 0 to -10° F are recorded almost every winter and temperatures from -15 to -30° F have been recorded. In July the average maximum temperature is in the lower 90s, and the minimum temperature is in the upper 50s. The record maximum temperature for the State, 118° F, was recorded on July 24, 1928, at Wahluke, located along the southern slope of the Saddle Mountains and again on August 5, 1961, at Ice Harbor Dam on the Snake River. Maximum temperatures reach 100 to 105° F on a few afternoons each summer. The last freezing temperature in the spring occurs during the latter half of April in the Yakima valley and the latter half of May in the colder localities of the Columbia Basin. The first freezing temperature in the fall is usually recorded between mid-September and mid-October.

Northeast – The northeastern and higher elevations of the Okanogan highlands, the Selkirk Mountains, and the lower elevations southward to the vicinity of the Spokane River are included in the northeastern area. Ranges of mountains in this section of the State are separated by narrow north-south valleys. The elevation increases from 2,000 feet in the valleys to 6,000 feet along the higher ridges. The average annual precipitation increases in a northeasterly direction from 17 inches in the Spokane area to 28 inches in the northeastern corner of the State.

Annual snowfall in the valleys varies from 40 to 80 inches. Precipitation, liquid and frozen, increases along the slopes of the mountains. Snow can be expected in the higher elevations in October and in the lower valleys by the last of November. In the lower elevations, snow reaches a depth of 15 to 30 inches and remains on the ground most of the time from the first of December until March. For elevations above 5,000 feet, six to eight feet of snow is on the ground the first of April and four to five feet remain the first of May.

Cold continental air moving southward through Canada will occasionally cross the higher mountains and follow the north-south valleys into the Columbia Basin. On clear, calm winter

nights, the loss of heat by radiation from over a snow cover produces ideal conditions for low temperatures. The lowest temperature in the State, -48° F, was recorded December 30, 1965, at Mazama and Winthrop. In January, the average maximum temperature is near 30 and the minimum temperature is 15. Minimum temperatures from -10 to -20° F are recorded almost every winter and temperatures ranging from -25 to -42° F have been recorded in the colder valleys. In July, the average maximum temperature is 85 to 90° F and the minimum temperature 45 to 50° F. Maximum temperatures reach 100° F on a few afternoons each summer and temperatures of 105 to 110° F have been recorded. The average date of the last freezing temperature can be expected in the colder valleys by the first of September and before mid-October in the warmer areas.

Palouse-Blue Mountains – This area includes counties along the eastern border of the State south from Spokane to the Oregon border and west to near Walla Walla. The elevation increases from 1,000 feet in the vicinity of Walla Walla to 3,500 feet in the Palouse Hills and to 6,000 feet in the Blue Mountains. Precipitation increases as the elevation increases in an easterly direction across this area. Annual precipitation is between 10 to 20 inches over most of the agricultural section increasing to 40 inches or more in the higher elevations of the Blue Mountains. The average winter season snowfall varies from 20 to 40 inches. Snow can be expected in November and to remain on the ground from periods ranging from a few days to two months between the first of December and March. Snowfall and the depth on the ground increase along the slopes of the mountains.

The average January maximum temperature is near 34 in the Palouse Hills and 38° F in the Snake and Walla Walla River valleys. The average minimum temperature varies from 20 to 25° F. Minimum temperatures between 0 and -15° F are recorded on a few nights each winter and temperatures ranging from -25 to -35° F have been recorded. In July, the average maximum temperature is in the upper 80s and the minimum is in the mid 50s. Maximum temperatures usually reach 100° F and temperatures from 105 to 112° F have been recorded.

The last freezing temperature in the spring is the last of April in the Walla Walla and Snake River valleys and the last of May in the Palouse Hills. The first freezing temperatures usually occur the last of September or first of October.

Rivers – The Columbia River, draining approximately 259,000 square miles in the Pacific Northwest and second only to the Mississippi River in terms of US rivers by volume flow, enters near the northeastern corner of the State and flows in a semi-circular pattern through eastern Washington. Before reaching the Pacific Ocean, it forms most of the boundary between Washington and Oregon, draining all of eastern Washington and the western slope of the Cascade Mountains between Mt. Rainier and the southern border. In addition to providing water for vast irrigation and hydroelectric projects, the Columbia River is a navigable stream for ocean vessels to ports at Vancouver and Portland and for river barges into eastern Washington. Principal tributaries of the Columbia in Washington include the Pend Oreille, Spokane, Snake and Cowlitz Rivers.

Although some overflow may be expected in Washington in most years, severe flooding is rare.

In the Columbia River basin in eastern Washington, winter floods are rare. They may occur at times, however, especially in local areas as a result of a combination of moderate snow cover, warm southerly winds and heavy rains. Annual peak flows occur in the spring and early summer as the winter snow pack melts.

In western Washington, the Snoqualmie, Skagit, Stillagumish, Chehalis and other streams drain into Puget Sound, the Strait of Juan de Fuca and the Pacific Ocean. There are two periods of high flow in the streams of western Washington, especially in the Puget Sound region and in the Cowlitz River basin. One occurs during the winter months coinciding with the periods of maximum precipitation, and the other in the spring or early summer caused by the seasonal rise in temperature with the resultant melting of snow accumulations in the higher elevations augmented at times by rainfall.

Climate and the Economy- Land utilization is determined to a large extent by the terrain, soil and the climate. The mountainous areas over the entire State and a major portion of the lowlands west of the Cascades are in timber. Forest vegetation varies from the large Douglas fir, spruce, hemlock and cedar with a dense undergrowth of fern and moss in the rainforest on the Olympic Peninsula, to the open stands of Ponderosa pine in eastern Washington. Lumbering and forestry management are major activities in many areas.

West of the Cascades, agriculture is confined to the river valleys and well-drained areas in the Puget Sound lowlands. The climate is favorable for growing berry crops, cool season vegetable crops, flower bulbs, potatoes and grass. Dairying and poultry production are important sources of income to the Puget Sound area. Reservoirs on the windward slopes of the mountains provide an abundance of water for metropolitan areas, and hydroelectric projects have been developed along several rivers.

The major agricultural areas are in eastern Washington. Agriculture is highly specialized in some localities and diversified in others. The fruit producing areas are in irrigated valleys along the Okanogan, Columbia, Wenatchee and Yakima Rivers. The Okanogan highlands, northeastern valleys and channeled scablands are devoted to grazing. The major wheat producing areas include the Big Bend, Waterville Plateau, Palouse Hills and Horse Heaven Hills. Dry land farming practices are generally followed in the small grain section. The more important crops grown in the irrigated sections include sugar beets, potatoes, alfalfa, corn, onions, beans, mint, hops and a variety of vegetable crops.

Ordinarily, drought is not a problem in Washington agriculture. The dry season begins at approximately the same time each summer and agricultural activities are planned accordingly.

Tourist business and recreational activities are an important source of income. The climate, mountains, ocean beaches, lakes, rivers, national parks and forest areas permit a vast range of recreational activities. In the mountains, the ski season begins in November and continues until late spring. The season for camping, hiking and fishing in the higher mountain lakes and streams begins as the snow melts and continues until early fall.

In the fall, hunters flock to the mountains seeking their limit of deer, elk and other game, while those looking for birds scatter over the lowlands. In summer, the numerous lakes and warm sunny days east of the Cascades are inviting to many, while to others the cooler marine air and ocean beaches in western Washington are a welcome relief from summer heat in other sections of the country.