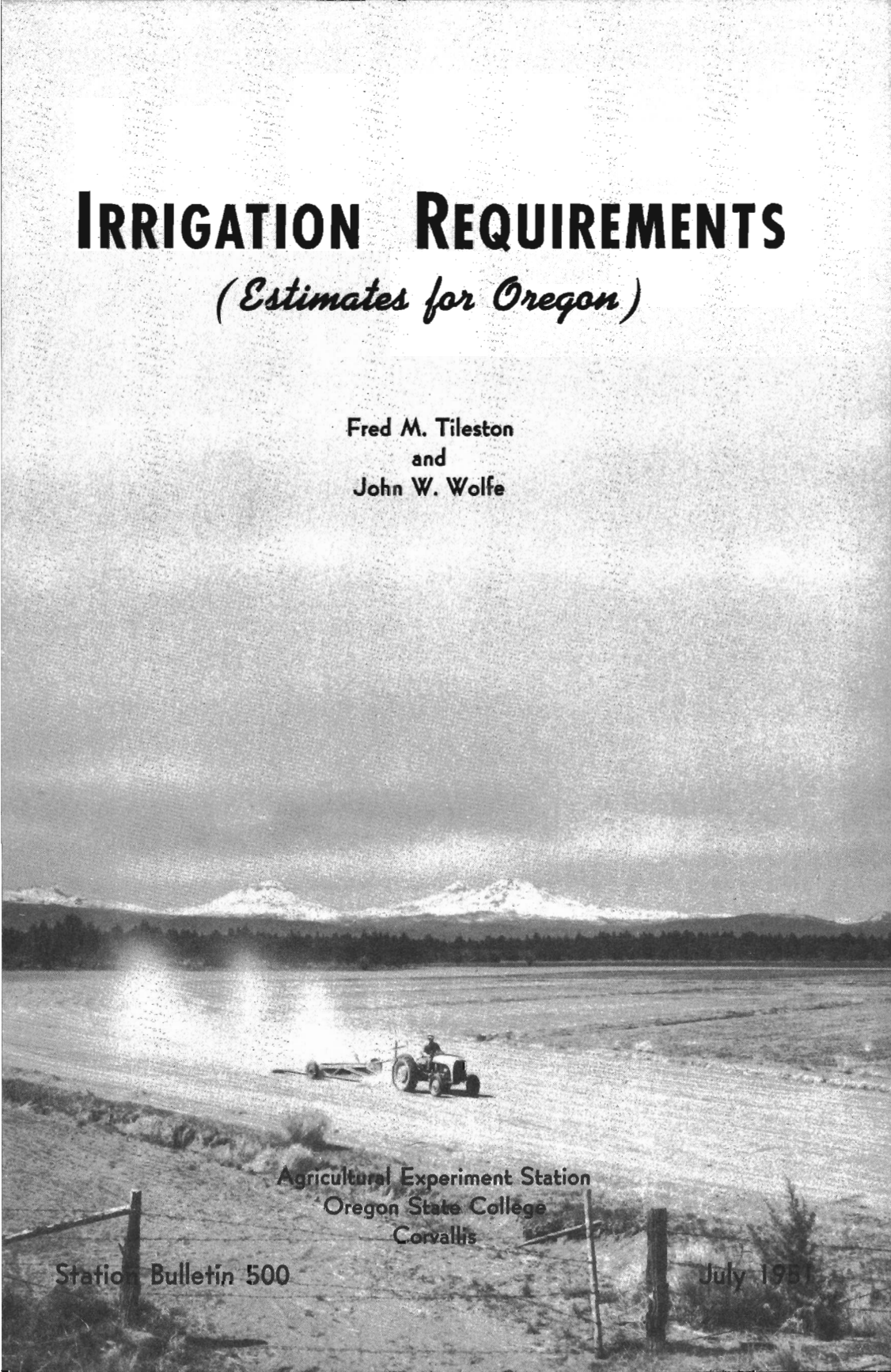
IRRIGATION REQUIREMENTS

(Estimates for Oregon)

Fred M. Tileston
and
John W. Wolfe



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Foreword

THE first settlers arrived in Oregon more than 100 years ago and from that time on the practice of irrigating to raise crops has been steadily increasing. At first there was plenty of water and plenty of land, but it soon became evident that there was more land than water to serve it adequately.

In recent years, it has become more and more apparent that when all of the feasible reservoirs have been built, there will still be a shortage of irrigation water in some areas. For this reason, considerable emphasis is now being placed on the efficient use of water. In order to use water efficiently, it is necessary to know how much water plants need.

This bulletin contains estimates of consumptive use and irrigation water requirements for most of the important crops in Oregon. The values of consumptive use were obtained from an empirical formula using climatological data from most of the weather stations in Oregon. Results obtained by the use of this formula have been checked against experimental data for many areas of the United States and have been found to agree quite well with the measured values.

The authors found it necessary to make several simplifying assumptions for Oregon conditions. As more irrigation research is conducted in the future, these computed figures can be verified or replaced by more accurate figures. Until such information is available, however, these figures can be useful for estimating water requirements of irrigated crops in Oregon.

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Summary

Water requirements, calculated empirically for 23 major crops grown in irrigated areas of Oregon, are presented in this bulletin. The total amounts of water consumed by the crops, the amounts supplied by precipitation, and the net amounts that must be supplied by irrigation have been computed for years of normal temperature and rainfall conditions.

Irrigation water cannot be applied under field conditions without some losses. Practical attainable irrigation efficiencies are suggested for several conditions found in Oregon. Through the use of these efficiency figures and the calculated net irrigation requirements, it is possible to compute how much water must be delivered to a farmer's headgate for good crop production.

The capacity of an irrigation system should be adequate to satisfy peak demands. This report suggests peak rates of water use by crops.

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Definition of Terms

Consumptive use (evapo-transpiration)—The sum of the volumes of water used by the vegetative growth of a given area in transpiration or building of plant tissue and that evaporated from adjacent soil, snow, or intercepted precipitation on the area in any specified time, divided by the given area. If the unit of time is small, such as a day or week, the consumptive use is expressed in acre-inches per acre or depth in inches, whereas, if the unit of time is large, such as a crop-growing season or a 12-month period, the consumptive use is expressed as acre-feet per acre or depth in feet. (S.C.S.)

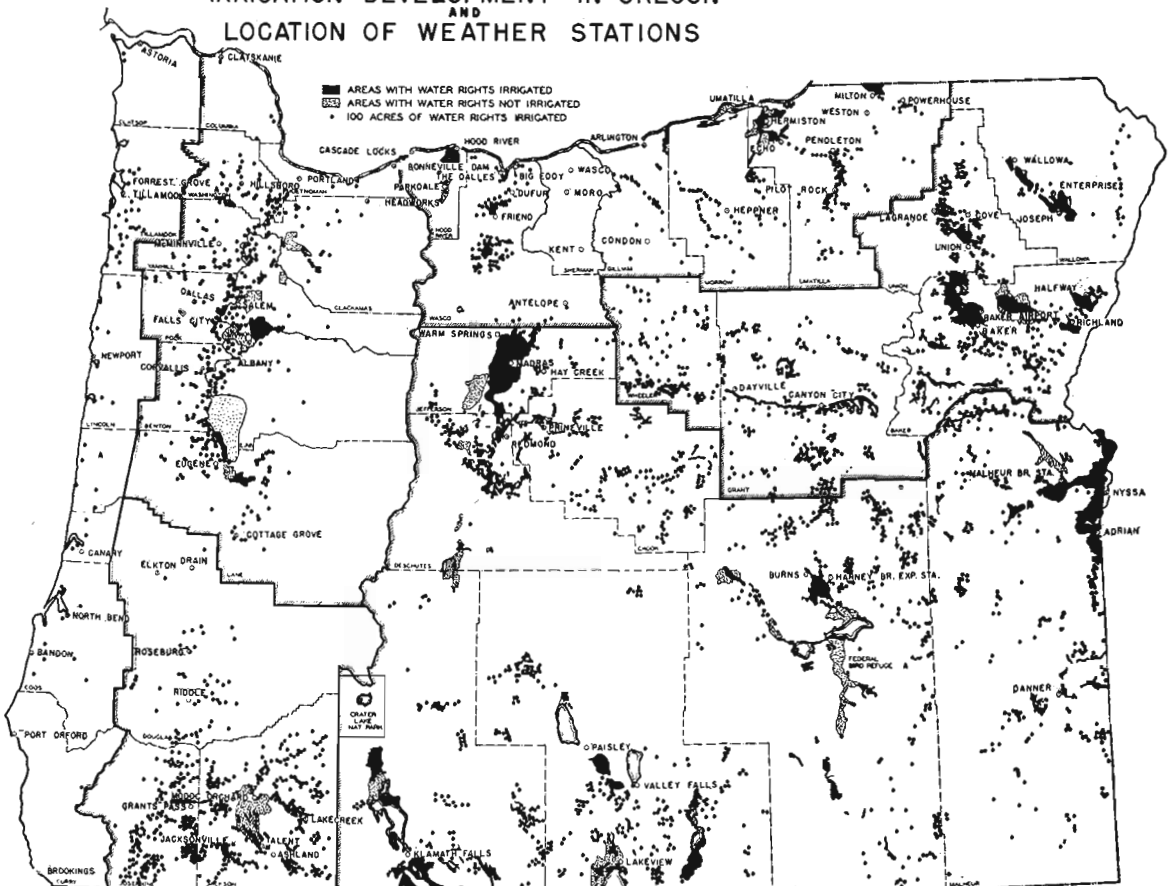
Net irrigation requirement—In this bulletin, the figure obtained by subtracting the precipitation which falls during the growing period from the consumptive use. Except that it may include winter precipitation stored in the soil for use by the crops early in the growing season, this value would represent the total irrigation water requirement if it could be applied without loss.

Farm irrigation efficiency—The percentage of irrigation water delivered to the farm headgate that is available for consumptive use by the crops. (S.C.S.)

Field irrigation efficiency—The percentage of irrigation water delivered to the field that is available for consumptive use by the crops. It does not include ditch losses. (S.C.S.)

Irrigation requirement—The quantity of water, exclusive of precipitation, that is required for crop production. It includes surface evaporation and other economically unavoidable wastes. Usually expressed in depth for a given time (volume per unit area for given time). (A.S.A.E.) (A.S.C.E.) In this bulletin it is found by dividing the net irrigation requirement by the field irrigation efficiency.

IRRIGATION DEVELOPMENT IN OREGON AND LOCATION OF WEATHER STATIONS



ORIGINAL MAP
PREPARED BY E.B. HURD, BUREAU OF AGRI ECONOMICS, U.S.D.A., H.D. SCUDDER, OREGON AGRI EXPERIMENT STATION, AND CARL D. MERRYMAN, RESETTLEMENT ADMINISTRATION,
IN COOPERATION WITH CHAS E. STRICKLIN, STATE ENGINEER. WATER RIGHT TRANSCRIPTION BY RUTH HUBBARD, OREGON AGRI. EXPERIMENT STATION.
ACREAGE INCREASE FROM 1935 TO 1951 HAS BEEN ESTIMATED BY THE AUTHORS AND ADDED TO THE 1935 MAP.

IRRIGATION REQUIREMENTS

(Estimates for Oregon)

By FRED M. TILESTON and JOHN W. WOLFE*

CONSUMPTIVE use and net irrigation requirements for nearly all of the important crops in the irrigated areas in Oregon are presented in this bulletin. It is hoped that this information will be helpful as a guide to more efficient use of irrigation water. The difference between the net irrigation requirement and the actual water applied represents the amount of water lost insofar as that crop is concerned. This loss includes evaporation and seepage from ditches, deep percolation, and run-off from the end of the field. In many instances waste of water means that fewer acres of land can be irrigated. Frequently water losses through percolation, together with canal losses, may raise the water table high enough to require the installation of an expensive drainage system and/or cause a reduction in crop yield. It is responsible, occasionally, for developing a serious alkali problem.

Irrigation efficiencies may be improved through the use of better irrigation methods, practices, and better system designs. This bulletin does not discuss water application problems. It does give figures for the average quantity of water required each season, however, based on an irrigation efficiency of 100 per cent.

The State of Oregon was divided into 25 agricultural areas and the consumptive use and net irrigation requirements were computed for each major crop known to be irrigated in each area. In arriving at the results, an attempt was made to take into account temperatures, growing season, daytime hours, and precipitation. For areas along the lower Columbia River and the Coast, special adjustments in the calculations were necessary to arrive at proper net irrigation requirements. For arid conditions, all rain that falls during the growing season may be considered as meeting a part of the requirement for consumptive use. Under coastal conditions of Oregon, however, the growing season is so long that it includes part of the rainy season in early spring and late fall. During those months where rainfall exceeds normal consumptive use, therefore, the excess monthly rainfall is considered wasted.

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Courtesy Robert Branstead, U.S.D.A. Soil Conservation Service

Contour irrigation of potatoes near Redmond simplifies water control.

As more information is gathered concerning the use of water by crops and the amount of precipitation that is effective, further refinements can be made. Some of the assumptions made may not fit every local situation. Figures for some areas will not be as accurate as for other areas. It is hoped that future research will help to point out the discrepancies and fill in the gaps in the existing information.

Procedure for Calculating Consumptive Use and Net Irrigation Requirement

General

This procedure used to calculate consumptive use and water requirement was developed by H. F. Blaney and W. D. Criddle, of the Division of Irrigation and Water Conservation, Soil Conservation Service. Their studies indicate that consumptive use of water by crops varies with temperature, length of the growing season, and monthly per cent of daytime hours. It is agreed generally that these factors have considerable influence on plant growth. After the consumptive use is determined, the net amount of irrigation water required is found by subtracting the effective precipitation from the calculated consumptive use. The net irrigation requirement divided by the field irrigation efficiency gives the seasonal irrigation requirements of the crop.

Consumptive use varies with temperature and length of day. It has been found that this relationship may be expressed by the formula $u = Kf$, in which:

u = Monthly consumptive use in inches.
K = An experimentally determined empirical coefficient.
f = Monthly consumptive use factor.

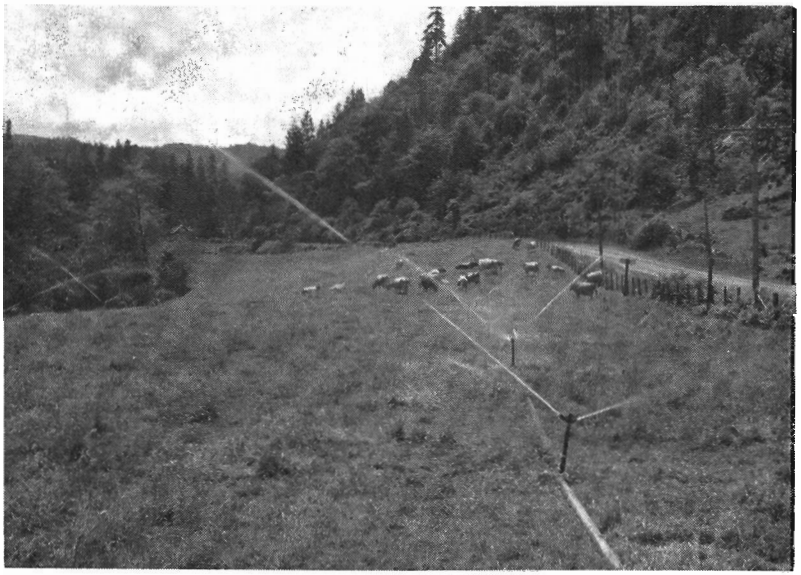
This factor is computed by multiplying the mean temperature in degrees Farenheit for the month by the per cent that the number of daylight hours (sunrise to sunset) during the same month is of the total number of daylight hours in a year, and dividing by 100.

The consumptive use for the growing season or other period is then found by the formula $U = KF$ in which:

U = Growing season consumptive use in inches.
K = The same empirical coefficient used in the monthly formula.
F = Growing season consumptive use factor = the sum of the factors (f) for the individual months of the season.

By knowing the consumptive use of water of a particular crop in one locality, an estimate of use by the same crop in some other

locality may be made by the application of the formula. As a result of analyses of tank, plot, field, and valley experiments in several western states, Blaney and Criddle[1] found that even among many different locations and growing conditions there is a fairly consistent value for K for each crop when ample water is available for plant growth. It has been shown, for example, that over a wide range of conditions alfalfa has a K of about 0.85. Other crops have been



Sprinkler irrigation maintains good pasture growth in western Oregon.

studied and the K value has been found to be quite consistent. Values of K and the growing season or period used for crops grown in Oregon are listed in Table 2. For some of the crops shown, the K values were entirely estimated, but are the best estimates available. As research is extended, these figures may be refined.

Irrigated areas in Oregon

The state has been divided into 25 agricultural areas in each of which the climatic characteristics were generally uniform and for which climatological data are available. These areas are shown in Table 1. The locations of the areas are shown in the map on page 4. Climatological data from the various weather stations in each area were averaged to compute net irrigation requirements.

[1]See Bibliography.

Table 1. IRRIGATED AREAS, WEATHER BUREAU STATIONS, AND GROWING SEASONS USED IN COMPUTING CONSUMPTIVE USE OF IRRIGATION WATER.

Agricultural section and Weather Bureau station	Elevation	Growing season		Period of record used
		Frost-free dates[1]	Length[2]	
	Feet	*Month/day*	*Days*	*Year*
Coastal area				
Astoria	220	3/8 to 12/6	273	1899-1938
Bandon	248	4/2 to 11/24	236	1942-1949
Brookings	162	3/15 to 12/9	269	1932-1949
Canary	100	4/6 to 11/3	211	1932-1949
Newport	155	3/23 to 11/26	248	1900-1938
North Bend	11	3/1 to 12/1	276	1931-1949
Port Orford	64	2/25 to 12/8	286	1909-1938
Tillamook	40	5/5 to 11/3	182	1911-1938
Average	125	3/22 to 11/24	247	
Columbia River below Hood River				
Bonneville Dam	85	3/18 to 11/24	251	1938-1949
Cascade Locks	100	4/7 to 11/10	217	1899-1938
Clatskanie	80	4/3 to 11/8	219	1935-1949
Headworks	747	4/11 to 11/1	204	1899-1938
Portland	30	3/6 to 11/24	263	1899-1938
Average	208	3/28 to 11/14	231	
Tualatin Valley				
Forest Grove	180	4/28 to 10/20	175	1917-1949
Hillsboro	203	4/17 to 11/7	204	1930-1949
Average	192	4/23 to 10/30	190	
Willamette Valley				
Albany	212	4/4 to 11/2	212	1914-1938
Corvallis—State College	260	4/12 to 10/25	195	1901-1938
Cottage Grove	650	5/13 to 10/26	166	1925-1938
Dallas	325	4/28 to 10/27	182	1936-1949
Eugene Airport	364	4/11 to 11/6	209	1942-1949
Falls City	550	5/6 to 10/18	165	1911-1938
McMinnville	150	4/23 to 10/20	179	1907-1949
Portland	30	3/6 to 11/24	263	1899-1938
Salem	195	4/1 to 10/31	213	1908-1938
Average	304	4/15 to 10/30	198	
Umpqua River area				
Drain	302	4/20 to 10/24	187	1912-1938
Elkton	125	3/25 to 11/18	238	1937-1949
Riddle	700	3/31 to 10/17	200	1921-1938
Roseburg	479	3/30 to 11/19	234	1899-1938
Average	401	4/3 to 11/4	215	
Medford-Grants Pass area				
Ashland	2,050	4/23 to 10/22	182	1907-1938
Grants Pass	926	4/23 to 10/22	182	1914-1949
Jacksonville	1,640	4/20 to 10/27	190	1907-1938
Talent	1,575	4/28 to 10/15	170	1921-1938
Average	1,548	4/23 to 10/21	181	
Lakecreek-Little Butte Creek area				
Lakecreek	2,000	5/2 to 10/14	165	1918-1949
Modoc Orchard	1,270	5/3 to 10/13	163	1925-1938
Average	1,635	5/3 to 10/14	164	

See footnotes at end of table.

Table 1—*Continued.* IRRIGATED AREAS, WEATHER BUREAU STATIONS, AND GROWING SEASONS USED IN COMPUTING CONSUMPTIVE USE OF IRRIGATION WATER.

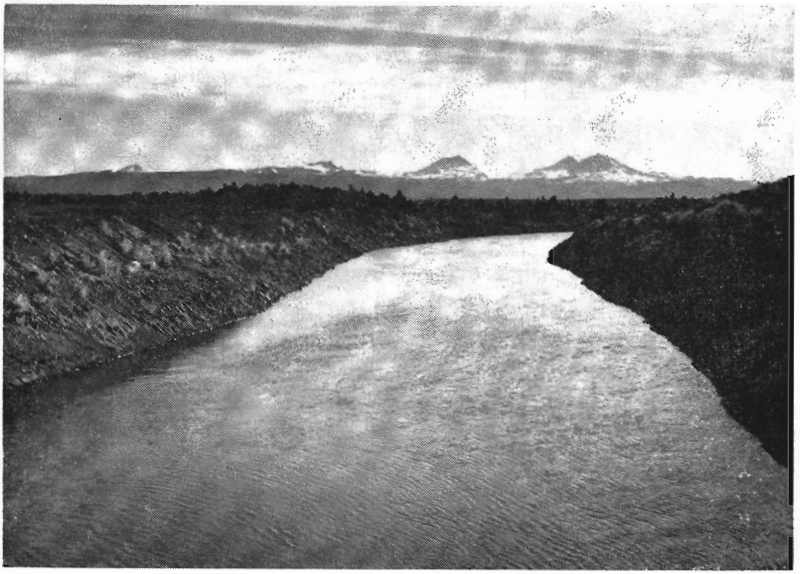
Agricultural section and Weather Bureau station	Elevation	Growing season		Period of record used
		Frost-free dates[1]	Length[2]	
	Feet	*Month/day*	*Days*	*Year*
Hood River Valley				
Hood River Exp. Sta.	500	4/21 to 10/21	183	1908-1949
Parkdale	1,740	5/17 to 10/7	143	1921-1938
Average	1,120	5/4 to 10/14	163	
Columbia River above Hood River				
Arlington	350	4/7 to 10/29	205	1927-1938
Big Eddy	138	4/11 to 10/25	197	1929-1938
The Dalles	98	4/11 to 10/24	196	1907-1938
Umatilla	285	4/9 to 10/23	197	1907-1938
Average	218	4/9 to 10/25	199	
East Slope of Mt. Hood				
Dufur	1,335	5/10 to 10/14	157	1918-1949
Friend	2,400	6/3 to 9/24	113	1926*-1949
Average	1,868	5/22 to 10/4	135	
Madras-Redmond area				
Hay Creek	2,938	5/23 to 9/23	123	1925-1949
Madras	2,265	6/7 to 9/16	101	1925-1938
Prineville	2,868	5/29 to 9/18	112	1911-1938
Redmond	2,994	5/22 to 9/29	130	1929-1938
Warm Springs	1,500	5/17 to 10/1	137	1914-1949
Average	2,513	5/26 to 9/23	120	
Klamath area				
Klamath Falls	4,190	5/18 to 9/26	131	1901-1938
Malin	4,050	5/24 to 9/16	113	1926-1949
Average	4,120	5/21 to 9/21	123	
Lakeview area				
Lakeview	4,756	5/27 to 9/25	121	1914-1938
Paisley	4,371	6/7 to 9/7	92	1925-1949
Valley Falls	4,326	5/28 to 9/18	113	1922-1949
Average	4,484	5/31 to 9/17	109	
Columbia Basin wheat land				
Antelope	2,690	5/25 to 9/23	121	1925-1949
Condon	2,900	5/27 to 9/24	120	1916-1938
Kent	2,707	5/17 to 10/8	144	1924-1938
Moro	1,838	5/3 to 10/15	165	1925-1949
Wasco	1,270	4/25 to 10/15	173	1918-1938
Average	2,281	5/14 to 10/5	144	
Pendleton-Heppner area				
Heppner	1,950	4/29 to 10/14	168	1909-1938
Pendleton	1,489	5/3 to 10/5	155	1907-1938
Pilot Rock	1,800	4/29 to 10/13	167	1918-1938
Average	1,746	4/30 to 10/10	163	
Hermiston area				
Echo	601	4/20 to 10/11	174	1913-1938
Hermiston	624	4/29 to 10/9	163	1914-1938
Average	612	4/24 to 10/10	169	

Table 1—*Continued.* IRRIGATED AREAS, WEATHER BUREAU STATIONS, AND GROWING SEASONS USED IN COMPUTING CONSUMPTIVE USE OF IRRIGATION WATER.

Agricultural section and Weather Bureau station	Elevation	Growing season		Period of record used
		Frost-free dates[1]	Length[2]	
	Feet	*Month/day*	*Days*	*Year*
Milton-Freewater area				
Milton	1,100	4/6 to 10/23	200	1916-1949
Powerhouse	1,315	4/5 to 10/19	197	1923*-1949
Weston	1,800	5/5 to 10/10	158	1909-1938
Average	1,405	4/15 to 10/17	185	
Dayville-Canyon City				
Canyon City	3,194	5/4 to 10/12	161	1939-1949
Dayville	2,434	5/19 to 9/28	132	1907-1938
Average	2,814	5/11 to 10/5	147	
Harney Valley				
Burns	4,143	5/27 to 9/19	116	1930-1949
Harney Br. Exp. Sta.	4,139	6/7 to 9/2	87	1923-1949
Average	4,141	6/1 to 9/10	101	
Wallowa Valley				
Enterprise	3,700	6/4 to 9/1	89	1932-1949
Joseph	4,175	5/20 to 9/27	130	1907-1949
Wallowa	2,950	5/22 to 9/7	108	1911-1938
Average	3,608	5/26 to 9/12	109	
Grand Ronde Valley				
Cove	3,100	5/8 to 10/2	147	1917-1949
La Grande	2,784	4/26 to 10/3	160	1907-1938
Union	2,787	5/24 to 9/20	120	1915-1949
Average	2,890	5/9 to 9/27	142	
Baker Valley				
Baker Airport	3,372	6/2 to 9/9	100	1943-1949
Baker	3,446	5/13 to 10/1	141	1900-1949
Average	3,409	5/25 to 9/20	120	
Pine and Eagle Valleys				
Halfway	2,675	5/22 to 9/20	129	1937-1949
Richland	2,315	5/21 to 9/28	130	1921-1938
Average	2,495	5/21 to 9/25	130	
Malheur area				
Adrian	2,235	4/29 to 10/9	163	1943-1949
Malheur Br. Sta.	2,251	5/1 to 10/7	159	1943-1949
Nyssa	2,185	4/22 to 10/19	180	1939-1949
Vale	2,242	5/3 to 10/6	156	1916-1949
Average	2,228	4/29 to 10/10	164	
Jordan Valley				
Danner	4,000	6/1 to 9/13	104	1930-1949

[1] [2]Length of growing season is the frost-free period as reported in the Department of Agriculture Yearbook for 1941 on all entries where last date of record included is 1938. On all others, data were calculated from 1939-1949 and averaged with the Yearbook data.

* Dates excluded:
Power House—1926; 1929-1941 (inclusive).
Friend—1928-1940; 1947; 1948.



Courtesy Robert Branstead, U.S.D.A. Soil Conservation Service

Madras canal, bringing water from the Three Sisters watershed area.

Assumptions

To apply the results of a study made in one area to some other area for which complete data are not available, usually it is necessary to make some assumptions. Actual data, if available, should be used. Such data sometimes are not known in sufficient detail for reliable use. Where necessary information is lacking the following assumptions are suggested when applying the consumptive use formula to the areas of Oregon:

1. Consumptive use varies directly with consumptive use factor (F).
2. Sufficient water is applied at the proper time to maintain good growing conditions.
3. Annual crops usually start to use water near the beginning of the frost-free period.
4. The length of growing season, to a large extent, determines or is an index of the production and consumptive use of continuously growing crops such as alfalfa and pasture.
5. Normal precipitation during the nongrowing season usually takes care of the consumptive use of perennials during this period.

6. Precipitation which occurs during the growing season is consumptively used and decreases the irrigation requirement by this amount. During the growing season in areas where the monthly precipitation exceeds the monthly consumptive use of that crop, however, excess precipitation is assumed to be wasted.
7. The fertility and producing power of soils are similar.

Consumptive use coefficient

A summary of consumptive use coefficients (K) for the important crops in various localities of Oregon is presented in Table 2. If the water supply is limited during the latter part of the irrigation season, some corrections must be made. Further studies may verify or modify these coefficients.

Table 2. ESTIMATED LENGTH OF GROWING SEASON AND CONSUMPTIVE USE COEFFICIENTS.

Crop	Length of growing season	Consumptive use coefficients (K)[1]		
		Coastal area	Willamette Valley	Eastern Oregon
Alfalfa	Between frosts	0.75	0.80	0.85
Beans, pole	4 months	.....	0.75	.....
Beans, bush	3 months	.....	.....	0.70
Corn	4 months	0.75	0.80	0.85
Grains, small, and fiber flax	3 months	0.75	0.80	0.85
Grains, sorghums	4 months	.....	.....	0.70
Grass seed	3 months	0.50	0.50	0.50
Hay, grass	Between frosts	0.70	0.75	0.75
Hops	5 months	0.60	0.65	0.70
Legume seed	Between frosts	.....	0.75	0.80
Mint	5 months	0.70	0.70	.....
Onions	4 months	0.65	0.70	0.75
Orchards, deciduous	Between frosts	0.60	0.65	0.70
Orchards with permanent cover	Between frosts	0.75	0.80	0.85
Pasture, grass	Between frosts	0.70	0.75	0.80
Pasture, Ladino clover	Between frosts	0.75	0.80	0.85
Peas	2 months[2]	.....	0.75	0.80
Potatoes	4 months	.....	0.70	0.75
Strawberries	Between frosts	.....	0.60	0.60
Sugar beets	6 months or between frosts	.....	.....	0.75
Tomatoes	4 months	.....	0.70	0.70
Truck, small; and cane berries	3 months	.....	0.65	0.70
Vegetable seed	3 months	.....	0.65	0.70

[1]K = U ÷ F = Consumptive use ÷ Consumptive use factor = Consumptive use coefficient.
[2]Green peas are usually planted well before the end of the frost-free period and harvested within 45 to 60 days following the last frost in the spring.

Estimates of consumptive use

The consumptive use factor (F) for the irrigation, growing, or frost-free period for each area was computed from the monthly temperature records and monthly per cent of annual daytime hours for the locations shown in Table 1. Precipitation and frost-free dates were obtained from published records of the U. S. Weather Bureau.

The monthly consumptive use factors and the average monthly precipitation for each weather bureau station in the area are presented in Table A, Appendix. Computed total consumptive use of water for the principal crops of Oregon is listed in Table 3. This includes all of the water consumed by the plants and that evaporated from adjacent soil. This water may be supplied from various sources such as precipitation, soil moisture, ground water, and irrigation.

Net irrigation requirement

The amount of irrigation water required depends upon how much is available from other sources. It is assumed that:

1. Ground water is below the reach of the plant and is not a contributing factor.
2. All precipitation falling during the growing season is effective except under Oregon coastal conditions.
3. The soil moisture conditions at the end of the growing season are the same as at the beginning of the growing season. This assumption is not strictly true, and in areas of heavy winter precipitation, adjustments may be necessary for moisture stored in the soil.

The net amount of water required for irrigation is the total consumptive use minus the rainfall and is presented in Table 3. Application losses are not shown.

Irrigation Requirements

General

The gross irrigation requirements of crops is that quantity of water needed exclusive of rainfall to satisfy consumptive use, plus the quantity required to take care of losses which occur in transportation and application. The losses include seepage and evaporation from canals and ditches, deep percolation, and surface run-off from the fields being irrigated.

Distribution and transportation losses are dependent mainly upon the soils and topography through which the canals and ditches pass, and upon management practices. Losses through leaky canal structures and by seepage may account for a large percentage of the water diverted into the canals.

Irrigation efficiency

In many cases, large portions of water that arrive at the farm are still lost insofar as plant use is concerned. Some of the loss is unavoidable in distributing water over the land. Unnecessary losses may occur because of poor land preparation, inadequate control

Table 3. CONSUMPTIVE USE[1] AND NET IRRIGATION REQUIREMENTS[2] FOR THE IMPORTANT CROPS IN IRRIGATED AREAS OF OREGON.[1]

Agricultural Section	Alfalfa		Beans, pole		Beans, bush		Corn		Small grains and fiber flax		Grains, sorghums		Grass seed	
	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Coastal area[3]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Columbia River below Hood River[3]	33.2	14.5	17.8	7.4	.....	.....	19.0	8.4	13.5	3.8	.....	.....	.....	.....
Tualatin Valley	28.6	19.2	18.8	14.4	.....	.....	20.1	15.6	14.8	10.8	.....	.....	.....	.....
Willamette Valley	29.5	18.6	18.4	12.8	.....	.....	19.6	14.0	14.2	9.1	.....	.....	8.9	3.7
Umpqua River area	31.8	20.6	18.0	12.1	.....	.....	19.2	13.3	13.7	8.0	.....	.....	8.5	2.9
Medford-Grants Pass area	30.1	24.8	.....	.....	.....	.....	21.8	18.6	16.0	13.0	.....	.....	.....	.....
Lake Creek-Little Butte Creek area	27.4	22.3	.....	.....	.....	.....	21.9	18.7	16.4	13.5	.....	.....	.....	.....
Hood River Valley	24.9	20.0	.....	.....	.....	.....	20.1	17.4	15.2	12.9	.....	.....	.....	.....
Columbia River above Hood River	34.7	31.8	.....	.....	13.5	12.0	22.9	21.3	16.4	14.9	18.8	17.2	.....	.....
East slope of Mt. Hood	22.0	19.9	.....	.....	.....	.....	.....	.....	16.0	14.7	.....	.....	.....	.....
Madras-Redmond area	20.4	18.3	.....	.....	.....	.....	.....	.....	16.3	14.9	.....	.....	.....	.....
Klamath area	20.4	18.5	.....	.....	.....	.....	.....	.....	15.9	14.4	.....	.....	9.3	7.9
Lakeview area	18.7	16.9	.....	.....	.....	.....	.....	.....	16.4	14.9	.....	.....	.....	.....
Columbia Basin wheat land	24.6	21.9	.....	.....	.....	.....	.....	.....	16.8	15.1	.....	.....	.....	.....
Pendleton-Heppner area	28.3	23.9	.....	.....	.....	.....	.....	.....	16.9	14.1	.....	.....	.....	.....
Hermiston area	30.8	28.3	.....	.....	14.5	13.0	23.8	22.0	17.6	16.1	19.6	17.9	.....	.....
Milton-Freewater area	31.6	25.1	.....	.....	13.2	9.1	22.3	17.8	16.1	11.9	.....	.....	.....	.....
Dayville-Canyon City	25.3	21.0	.....	.....	.....	.....	.....	.....	16.8	13.9	.....	.....	.....	.....
Harney Valley	17.5	15.9	.....	.....	.....	.....	.....	.....	16.3	14.9	.....	.....	.....	.....
Wallowa Valley	18.3	14.3	.....	.....	.....	.....	.....	.....	18.3	14.3	.....	.....	.....	.....
Grand Ronde Valley	24.1	18.9	.....	.....	.....	.....	.....	.....	16.3	12.6	.....	.....	9.6	5.9
Baker Valley	20.0	16.7	.....	.....	.....	.....	.....	.....	16.0	13.3	.....	.....	.....	.....
Pine and Eagle Valleys	23.2	20.4	.....	.....	.....	.....	22.1	19.4	17.4	15.2	.....	.....	.....	.....
Malheur area	29.2	26.5	.....	.....	14.3	12.3	23.3	21.1	17.3	15.3	.....	.....	.....	.....
Jordan Valley	18.7	17.0	.....	.....	.....	.....	.....	.....	17.0	15.6	.....	.....	.....	.....

See footnotes at end of table.

Table 3.—*Continued.* CONSUMPTIVE USE[1] AND NET IRRIGATION REQUIREMENTS[2] FOR THE IMPORTANT CROPS IN IRRIGATED AREAS OF OREGON.[1]

Agricultural section	Hay		Hops		Legume seed		Mint		Onions		Orchards, deciduous		Orchards with permanent cover		Pasture, grass	
	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Coastal area[3]	28.3	9.1	.....	.....	.....	.....	19.0	7.1	.....	.....	.....	.....	.....	.....	28.3	9.1
Columbia River below Hood River[3]	31.1	12.9	19.7	8.9	.....	.....	21.2	10.2	16.6	6.5	27.0	9.7	33.2	14.5	31.1	12.9
Tualatin Valley	26.8	17.4	20.0	14.1	.....	.....	21.5	15.7	17.6	13.1	23.3	13.8	28.6	19.2	26.8	17.4
Willamette Valley	27.6	16.8	19.7	13.0	27.6	16.8	21.2	14.5	17.1	11.6	23.9	13.1	29.5	18.6	27.6	16.8
Umpqua River area	29.8	18.6	.....	.....	29.8	18.6	.....	.....	16.8	10.9	25.8	14.6	31.8	20.6	29.8	18.6
Medford-Grants Pass area	26.6	21.3	22.0	18.0	28.4	23.0	.....	.....	19.3	16.0	24.8	19.5	30.1	24.8	28.4	23.0
Lake Creek-Little Butte Creek area	24.1	19.1	21.5	17.2	25.8	20.7	.....	.....	19.3	16.1	22.5	17.5	27.4	22.3	25.8	20.7
Hood River Valley	23.3	18.5	.....	.....	.....	.....	.....	.....	.....	.....	20.2	15.4	24.9	20.0	23.3	18.5
Columbia River above Hood River	30.6	27.7	.....	.....	32.7	29.7	.....	.....	20.2	18.6	28.6	25.6	34.7	31.8	32.7	29.7
East slope of Mt. Hood	19.4	17.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20.7	18.6
Madras-Redmond area	18.0	16.0	.....	.....	19.2	17.1	.....	.....	.....	.....	.....	.....	.....	.....	19.2	17.1
Klamath area	18.0	16.1	.....	.....	19.2	17.3	.....	.....	.....	.....	.....	.....	.....	.....	19.2	17.3
Lakeview area	16.5	14.7	.....	.....	17.6	15.8	.....	.....	.....	.....	.....	.....	.....	.....	17.6	15.8
Columbia Basin wheat land	21.7	19.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	23.2	20.5
Pendleton-Heppner area	25.0	20.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26.7	22.2
Hermiston area	27.2	24.7	23.7	21.5	29.0	26.5	.....	.....	21.0	19.2	25.4	22.9	30.8	28.3	29.0	26.5
Milton-Freewater area	27.9	21.3	.....	.....	.....	.....	.....	.....	19.6	15.1	26.0	19.5	31.6	25.1	29.7	23.2
Dayville-Canyon City	22.3	18.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	23.8	19.5
Harney Valley	15.4	13.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16.5	14.9
Wallowa Valley	16.2	12.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17.2	13.2
Grand Ronde Valley	21.3	16.0	.....	.....	.....	.....	.....	.....	.....	.....	19.8	14.6	24.1	18.9	22.7	17.4
Baker Valley	17.7	14.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18.8	15.5
Pine and Eagle Valleys	20.5	17.6	.....	.....	.....	.....	.....	.....	.....	.....	19.1	16.3	23.2	20.4	21.9	19.0
Malheur area	25.8	23.0	23.1	20.6	.....	.....	.....	.....	20.6	18.4	24.1	21.3	.....	.....	27.5	24.8
Jordan Valley	16.5	14.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17.6	15.9

Table 3.—*Continued.* CONSUMPTIVE USE[1] AND NET IRRIGATION REQUIREMENTS[2] FOR THE IMPORTANT CROPS IN IRRIGATED AREAS OF OREGON.[1]

Agricultural section	Pasture, ladino clover		Potatoes		Strawberries		Sugar beets		Tomatoes		Truck and cane berries		Vegetable seed	
	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.	U	Net irrig. req.
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Coastal area[3]	30.3	10.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Columbia River below Hood River[3]	33.2	14.5	16.6	6.5	24.9	8.3	.....	.....	16.6	6.5	11.0	2.0	.....	.....
Tualatin Valley	28.6	19.2	17.6	13.1	21.5	12.0	.....	.....	17.6	13.1	12.0	8.0	12.0	8.0
Willamette Valley	29.5	18.6	17.1	11.6	22.1	11.3	.....	.....	17.1	11.6	11.6	6.4	11.6	6.4
Umpqua River area	31.8	20.6	16.8	10.9	23.8	12.6	.....	.....	16.8	10.9	11.1	5.4	.....	.....
Medford-Grants Pass area	30.1	24.8	.....	.....	21.3	15.9	.....	.....	18.0	14.7	13.2	10.2	13.2	10.2
Lake Creek-Little Butte Creek area	27.4	22.3	.....	.....	19.3	14.2	.....	.....	18.0	14.8	13.5	10.6	13.5	10.6
Hood River Valley	24.9	20.0	17.6	14.9	18.6	13.8	.....	.....	17.6	14.9	12.3	10.1	.....	.....
Columbia River above Hood River	34.7	31.8	20.2	18.6	.....	.....	.....	.....	18.8	17.2	13.5	12.0	.....	.....
East slope of Mt. Hood	22.0	20.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Madras-Redmond area	20.4	18.3	18.0	16.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Klamath area	20.4	18.5	18.0	16.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lakeview area	18.7	16.9	16.6	14.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Columbia Basin wheat land	24.6	21.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pendleton-Heppner area	28.3	23.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hermiston area	30.8	28.3	21.0	19.2	.....	.....	.....	.....	19.6	17.9	14.5	13.0	.....	.....
Milton-Freewater area	31.6	25.1	19.6	15.1	22.3	15.8	27.9	21.3	18.3	13.8	13.2	9.1	.....	.....
Dayville-Canyon City	25.3	21.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Harney Valley	17.5	15.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wallowa Valley	18.3	14.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Grand Ronde Valley	24.1	18.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Baker Valley	20.0	16.7	17.7	14.4	.....	.....	17.7	14.4	.....	.....	.....	.....	.....	.....
Pine and Eagle Valleys	23.2	20.4	.....	.....	.....	.....	.....	.....	18.2	15.5	14.3	12.1	.....	.....
Malheur Area	29.2	26.5	20.6	18.4	.....	.....	25.8	23.0	.....	.....	14.3	12.3	.....	.....
Jordan Valley	18.7	17.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

[1]Consumptive use figures include water from all sources (precipitation, soil moisture, ground water, and irrigation). They represent the water actually used by the plants and the amount evaporated from the surface of the ground.

[2]Net irrigation requirement figures are consumptive use minus effective precipitation. Do not include application losses.

[3]For those months of the growing season that the rainfall exceeded the consumptive use, the excess rainfall was considered wasted and was not subtracted from the seasonal consumptive use figure to obtain water requirement.

structures, and poor farm irrigation system design. Poor irrigation practices and lack of attention by the irrigator frequently cause low application efficiency. An adequate irrigation water supply, properly distributed throughout the irrigation season (together with its cost) also is an important factor affecting the efficient use of water.

Where only natural stream flow is available, there may be a tendency to put as much water on the land as possible during periods of high spring flow. Heavy applications sometimes are made for the purpose of storing the maximum amount of moisture in the soil for later use by the crop. It should be realized, however, that only a limited amount of water can be stored in the soil. If excess water is applied in the spring, it contributes only to high evapo-transpiration and run-off losses, seepage, and leaching of plant nutrients. If adequate reservoir storage can be obtained, the tendency is to apply more nearly the proper amounts of water needed by the plants during the early months and to hold as much water as possible in the reservoirs for later use.

Because of the wide variation in water supply and climatic conditions in Oregon, and differences in types of crops and intensity of farming, wide variations in irrigation efficiencies are found. For example, in high cool valleys the growing season is quite short and only pasture, hay, and small grains can be grown successfully. Irri-

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Constructing contour corrugations in a seeded alfalfa field, Keating.

gation efficiencies in these areas often are low because the spring runoff is permitted to flood the land continuously for long periods of time, sometimes creating drainage problems on the lower lying lands. When water is thus diverted over the high meadows it is questionable whether 20 per cent of the amount diverted is actually consumed by the crop.

In some of the regions of Oregon, such as the Malheur area, irrigation water is retained in reservoirs and conditions are conducive to more efficient irrigation practices. Higher irrigation efficiencies usually may be found in these regions where more expensive stored water is available. Even here, however, higher efficiencies can be obtained and should be a prime objective of all irrigators.

Irrigation efficiency is widely variable, and few data on irrigation efficiency are available for the various crops and soils of Oregon. Losses shown in Table 4 can be used as a guide in determining farm headgate requirements under various conditions. These values might be used in estimating farm irrigation requirements for local areas where other data are not available. The practical, attainable irrigation efficiencies should be established for each area in which irrigation requirements are desired. Irrigation efficiencies thus established should be representative of good irrigation practices. Methods of determining irrigation efficiencies have been fully described in the other reports which are listed. See 2, 5, and 9.

Table 4. TYPICAL WATER-APPLICATION LOSSES AND IRRIGATION EFFICIENCIES FOR DIFFERENT SOIL CONDITIONS.

Item	General soil type	
	Medium loam	Heavy clay
	Per cent	*Per cent*
Farm-lateral loss	10	5
Surface-runoff loss	15	30
Deep percolation loss	15	5
Field-irrigation efficiency	70	65
Farm-irrigation efficiency	60	60
Sprinkler irrigation efficiency	75	75

Consumptive use rates for irrigation system design

The frequency of irrigation, and therefore, the needed capacity of a system, sprinkler or surface, depends largely on how long the available water stored in the root zone will last when consumptive use is at a maximum. Normal consumptive use rates for the peak month can be determined from data shown in Table A, Appendix. Data for determining consumptive use rates for periods of less than a month, however, are not readily available.

Since daily rates would be higher for shorter periods, it is suggested that for design purposes, peak daily consumptive use rates be assumed to be about 1.5 times the average daily rates during the peak month. The consumptive use for various crops in the 25 selected agricultural areas of Oregon for the month of maximum use are shown in Table C, Appendix. This table also shows the suggested design values for peak daily consumptive use, computed by multiplying monthly consumptive use by 1.5/31.

For the benefit of sprinkler system designers, the suggested design rates have been converted to gallons per minute per acre at 75 per cent irrigation efficiency. These rates may be hardly adequate for sandy soils that require very frequent irrigations. Conversely, they may be as much as 10 or 15 per cent higher than necessary for medium and heavy soils with a deep root zone. If 60 per cent irrigation efficiency is expected instead of 75 per cent, the suggested system capacity should be multiplied by 75/60.

Procedure example

The state is zoned according to similar climatological data and the data are averaged for the several stations within any given area.

Consumptive use requirements are calculated for the Klamath Falls area from temperature, precipitation, daytime hours, and length

Table 5. OBSERVED AVERAGE MONTHLY TEMPERATURES AND PRECIPITATION WITH CALCULATED CONSUMPTIVE-USE FACTORS, FOR THE KLAMATH FALLS AREA.

Month	Mean monthly temperature (t)	Daytime hours (p)	Consumptive-use factor (f)	Average precipitation (r)	Growing season and crop: Alfalfa, hay, pasture, Ladino clover, legume seed 5/21 to 9/21 (f)	(r)	Potatoes 5/21 to 9/21 (f)	(r)	Grain 5/21 to 8/21 (f)	(r)
	Degrees F.	*Per cent*		*Inches*		*Inches*		*Inches*		*Inches*
January	28.6	6.62	1.89	1.69	.....	.....	.....	.....	.....	.....
February	32.8	6.64	2.18	1.44	.....	.....	.....	.....	.....	.....
March	39.6	8.31	3.29	1.12	.....	.....	.....	.....	.....	.....
April	45.8	9.00	4.12	1.06	.....	.....	.....	.....	.....	.....
May	52.6	10.14	5.33	1.04	1.72	0.34	1.72	0.34	1.72	0.34
June	59.5	10.22	6.08	0.74	6.08	0.74	6.08	0.74	6.08	0.74
July	66.8	10.36	6.92	0.22	6.92	0.22	6.92	0.22	6.92	0.22
August	64.6	9.63	6.22	0.18	6.22	0.18	6.22	0.18	4.22	0.12
September	56.5	8.40	4.75	0.53	3.32	0.37	3.32	0.37	.....	.....
October	47.9	7.70	3.69	0.98	.....	.....	.....	.....	.....	.....
November	37.7	6.61	2.49	1.59	.....	.....	.....	.....	.....	.....
December	31.0	6.37	1.97	1.68	.....	.....	.....	.....	.....	.....
Total	.....	100.00	48.93	12.27	24.26	1.85	24.26	1.85	18.94	1.42

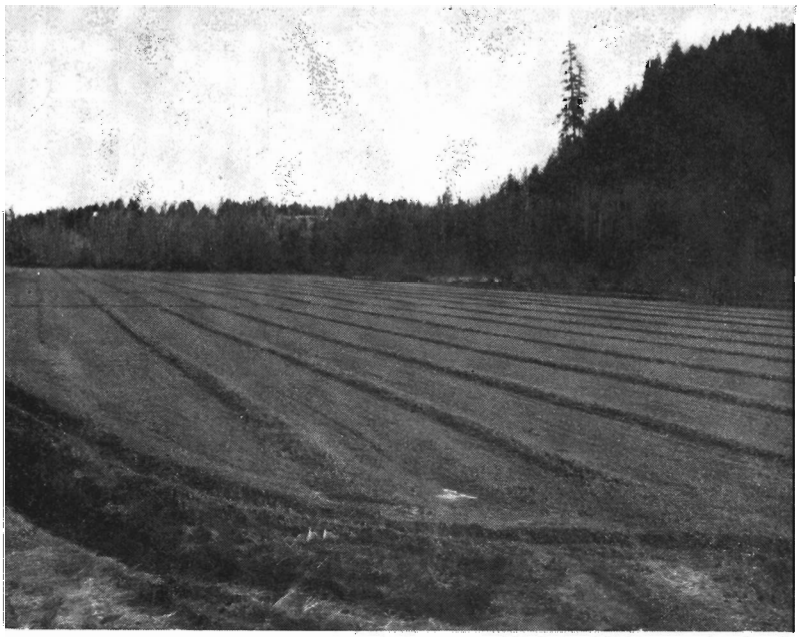
t = Mean monthly temperatures.
p = Per cent of daytime hours of year for month.
f = t × p ÷ 100 = monthly consumptive use factor.
r = Mean monthly precipitation.

of growing period and is presented in Table 5. Data from Table A, Appendix, are presented in columns (f) and (r). The monthly per cent of annual daytime hours (p) was obtained from Table B, Appendix. Monthly consumptive use factor (f) was obtained by multiplying (t) $\times$ (p).

The calculated (f) and (r) respectively for full season, 4 months, and 3 months lengths of growing period are shown. It is assumed that all crops start using water at the beginning of the frost-free period.

Lengths of growing season for crops are shown in Table 2. If crops in some areas are found to have different growing periods than those shown in the table, some adjustments in the calculations may be necessary.

The following sample calculations for alfalfa illustrate the method of determining (F) and (R) for the entire growing season after they have been computed for each month. Alfalfa is assumed to start its seasonal growth on May 21 because that is the average beginning of the frost-free period. Since only 10 days of May remain for growth, the (f) factor for May is 10/31 of 5.33, or 1.72.



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Well constructed borders in an irrigated pasture near Scappoose.

Similarly the rainfall (r) for May is 10/31 of 1.04, or 0.34 inches. In June, July, and August, alfalfa is considered to be growing full time so the full monthly factors are used for those three months. Likewise all of the averaged monthly rainfall is used. The end of the average frost-free period is September 21, so the (f) factor for September is 21/30 of 4.75, or 3.32. Similarly (r) for September is 21/30 of 0.53, or 0.37 inches.

For crops with shorter growing seasons such as grain, the growth period is assumed to be shortened respectively. The monthly consumptive use factors (f) are then summed up for the various lengths of the growing seasons and designated as (F).

The crops irrigated in the area were assembled as shown in

Table 6. EXAMPLE OF COMPUTATIONS OF SEASONAL CONSUMPTIVE USE AND NET IRRIGATION REQUIREMENTS FOR CROPS IN THE KLAMATH FALLS AREA.

Crop	Growing season	Consumptive use coefficient (K)	Consumptive use factor (F)	Consumptive use (U)	Average precipitation (R)	Net irrigation requirement (U minus R)
				Inches	*Inches*	*Inches* *Feet*
Alfalfa	5/21 to 9/21	0.85	24.26	20.62	1.85	18.77 = 1.56
Grains, small	5/21 to 8/21	0.85	18.94	16.10	1.42	14.68 = 1.22
Hay	5/21 to 9/21	0.75	24.26	18.19	1.85	16.34 = 1.36
Pasture, grass, legume seed	5/21 to 9/21	0.80	24.26	19.40	1.85	17.55 = 1.46
Pasture, Ladino clover	5/21 to 9/21	0.85	24.26	20.62	1.85	18.77 = 1.56
Potatoes	5/21 to 9/21	0.75	24.26	18.19	1.85	16.34 = 1.36

U = KF = Consumptive use for growing or irrigation season.
K = Consumptive use coefficient. Determined experimentally. (See Table 2.)
F = Sum of monthly consumptive-use factors (*f*) for the growing season.
R = Sum of monthly precipitation (r) for growing season.

Table 6. The length of growing season and consumptive use coefficients (K) were obtained from Table 2. Season consumptive use factors (F) and rainfall (R) were obtained from Table 5. Consumptive use (U) is then calculated by multiplying (K) $\times$ (F). The net irrigation water requirements were then determined by subtracting growing period rainfall (R) from (U). These steps are illustrated in Table 6.

In any irrigation planning procedure, it is necessary to know the amount of water required at the farm headgate. An example of the calculations required for determining the irrigation requirement for a typical farm in the Klamath Falls area is shown in Table 7. It was assumed that the soil on this farm is a deep loamy soil of medium texture. The net irrigation requirement was obtained from Table 6. The estimated field irrigation efficiency was selected from Table 4. The irrigation requirement was computed

by dividing the net irrigation requirement by the estimated field irrigation efficiency. For alfalfa 1.54 acre feet per acre was divided by the estimated efficiency of 70 per cent or $(1.54 \div 70) \times 100 = 2.20$ acre feet per acre required at the field. The total acre feet required for each crop and the total for the farm is shown in Table 7.

Table 7. ILLUSTRATION OF THE METHOD USED TO COMPUTE THE ANNUAL AMOUNT OF WATER REQUIRED AT HEADGATE OR PUMP OF A TYPICAL FARM—KLAMATH FALLS AREA.

Classification	Area of each crop	Net irrigation water requirement[1]	Field irrigation efficiency[2]	Water required at farm headgate	
				Unit	Total
	Acres	*Acre-feet/acre*	*Per cent*	*Acre-feet/acre*	*Acre-feet*
Irrigated					
Alfalfa	15	1.56	70	2.23	33.4
Pasture	20	1.46	60	2.44	48.7
Potatoes	5	1.36	60	2.27	11.3
Miscellaneous					
Roads and farmstead	3	0.00	....	0.00	0.00
Ditch losses	....	10% loss	....	.....	10.4
Total water delivery required at the farm headgate or pump for normal season					103.8

[1]Consumptive use (U) minus precipitation (R) for growing season. (See Table 6.)
[2]Assumed reasonable for this area. (See Table 4.)

Appendix

Table A. Summary of Calculated Normal Monthly Consumptive Use Factors (f) and Average Monthly Precipitation (r), in Inches, for Weather Bureau Stations in Oregon.

Month	Weather Bureau station									
	Adrion		Albany		Antelope		Arlington		Ashland	
	f	r	f	r	f	r	f	r	f	r
January	1.78	1.17	2.54	6.43	1.93	1.32	2.08	1.50	2.52	2.80
February	2.25	0.93	2.79	5.18	2.26	1.08	2.46	1.10	2.74	2.25
March	3.57	0.70	3.90	4.14	3.37	0.99	3.88	0.71	3.81	1.97
April	4.66	0.81	4.70	2.78	4.27	1.00	4.92	0.60	4.55	1.55
May	6.11	0.77	5.87	2.23	5.47	1.20	6.38	0.52	5.76	1.59
June	6.97	0.76	6.45	1.34	6.20	0.98	7.21	0.49	6.40	1.05
July	8.02	0.23	7.05	0.43	7.17	0.15	8.00	0.09	7.20	0.40
August	7.13	0.29	6.47	0.55	6.48	0.38	7.25	0.16	6.63	0.28
September	5.30	0.50	5.11	1.76	4.92	0.67	5.52	0.35	5.20	0.90
October	3.97	0.73	4.05	3.13	3.80	0.89	4.16	0.76	4.12	1.46
November	2.57	0.87	2.92	6.15	2.53	1.46	2.71	1.38	2.95	2.60
December	1.92	0.96	2.52	7.01	2.03	1.51	2.20	1.39	2.46	3.13
Total	54.25	8.72	54.37	41.13	50.43	11.63	56.77	9.05	54.34	19.98
	Astoria		Baker		Baker Airport		Bandon		Big Eddy	
	f	r	f	r	f	r	f	r	f	r
January	2.55	11.86	1.60	1.39	1.50	1.39	2.98	11.06	2.16	1.96
February	2.77	9.05	1.90	1.23	1.83	1.23	3.03	8.17	2.55	1.52
March	3.78	8.60	3.12	1.10	3.02	1.10	3.93	7.33	3.92	1.07
April	4.51	5.23	4.10	1.09	4.03	1.09	4.50	5.13	4.94	0.53
May	5.57	3.72	5.34	1.55	5.25	1.55	5.46	3.57	6.28	0.41
June	6.09	2.92	6.12	1.34	5.97	1.34	5.87	1.68	7.08	0.43
July	6.50	1.16	6.93	0.58	6.72	0.58	6.08	0.48	7.85	0.11
August	6.04	1.28	6.29	0.49	6.12	0.49	5.65	0.50	7.15	0.17
September	4.97	3.30	3.87	0.74	4.58	0.74	4.72	2.47	5.52	0.54
October	4.10	5.87	3.54	0.91	3.40	0.91	4.06	5.54	4.22	0.88
November	3.00	10.84	2.31	1.05	2.21	1.05	3.23	8.11	2.74	2.03
December	2.56	12.50	1.68	1.70	1.57	1.70	2.99	11.84	2.24	2.37
Total	52.44	76.33	46.80	13.17	46.20	13.17	52.50	65.88	56.65	12.02
	Bonneville Dam		Brookings		Burns		Canary		Canyon City	
	f	r	f	r	f	r	f	r	f	r
January	2.36	7.96	3.08	11.83	1.60	1.55	2.82	11.14	2.14	1.96
February	2.70	8.88	3.19	9.19	1.88	1.23	2.97	9.29	2.38	1.42
March	3.85	7.49	4.07	8.78	3.01	0.93	3.90	9.23	3.49	1.49
April	4.80	4.45	4.61	5.83	4.00	0.73	4.49	5.04	4.42	1.66
May	6.04	3.54	5.45	3.58	5.21	0.76	5.46	3.55	5.74	2.05
June	6.51	2.63	5.80	2.60	6.05	0.95	5.93	2.58	6.27	1.32
July	7.32	0.75	6.05	0.53	6.97	0.44	6.29	0.94	7.32	0.48
August	6.64	0.68	5.66	0.51	6.26	0.25	5.88	0.69	6.72	0.45
September	5.38	2.54	4.94	2.57	4.68	0.87	4.98	2.35	5.18	1.11
October	4.20	7.01	4.28	5.71	3.51	0.62	4.19	6.94	4.00	1.15
November	2.83	11.30	3.40	11.13	2.29	1.30	3.14	11.14	2.67	1.65
December	2.45	11.38	3.04	12.38	1.64	1.37	2.82	12.77	2.19	1.68
Total	55.08	68.61	53.57	74.64	47.10	11.00	52.87	75.67	52.51	16.42
	Cascade Locks		Clatskanie		Condon		Corvallis, Oregon State College		Cottage Grove	
	f	r	f	r	f	r	f	r	f	r
January	2.27	11.54	2.40	7.71	1.83	1.40	2.53	6.47	2.58	6.25
February	2.56	9.30	2.68	7.83	2.15	1.01	2.77	5.15	2.80	5.22
March	3.81	8.15	3.78	5.72	3.33	0.94	3.83	4.13	3.83	4.65
April	4.75	5.57	4.60	3.57	4.18	1.05	4.62	2.56	4.53	3.57
May	5.95	3.54	5.79	2.31	5.39	1.18	5.74	1.88	5.60	2.28
June	6.58	2.33	6.27	2.17	6.22	1.07	6.35	1.14	6.21	1.54
July	7.23	0.71	6.77	0.65	7.11	0.39	6.98	0.28	6.79	0.18
August	6.66	0.92	6.22	0.78	6.45	0.35	6.48	0.43	6.28	0.48
September	5.20	3.19	5.09	1.92	4.85	0.87	5.14	1.57	5.02	1.90
October	4.12	6.33	4.01	4.50	3.69	0.99	4.08	2.88	4.07	3.34
November	2.85	11.68	2.76	7.33	2.49	1.58	2.93	6.43	2.55	6.46
December	2.32	13.14	2.44	9.34	1.92	1.32	2.48	6.14	2.54	6.98
Total	54.30	76.40	52.81	53.83	49.61	12.15	53.93	39.06	52.80	42.85

Table A—*Continued.* SUMMARY OF CALCULATED NORMAL MONTHLY CONSUMPTIVE USE FACTORS (f) AND AVERAGE MONTHLY PRECIPITATION (r), IN INCHES, FOR WEATHER BUREAU STATIONS IN OREGON.

Month	Weather Bureau station									
	Cove		Dallas		Danner		Dayville		Drain	
	f	r	f	r	f	r	f	r	f	r
January	1.88	2.30	2.43	7.20	1.61	1.09	2.18	1.26	2.66	7.22
February	2.17	1.90	2.71	6.99	1.99	1.13	2.50	1.16	2.93	5.39
March	3.28	2.29	3.79	5.28	3.17	1.00	3.62	0.96	3.97	4.63
April	4.22	2.42	4.52	2.80	4.15	1.10	4.49	1.07	4.70	2.99
May	5.50	1.97	5.74	2.08	5.40	1.07	5.66	1.21	5.71	2.25
June	6.25	2.19	6.22	1.43	6.15	1.08	6.47	1.15	6.32	1.34
July	7.17	0.46	6.89	0.39	7.23	0.25	7.30	0.45	6.93	0.32
August	6.42	0.80	6.27	0.50	6.48	0.11	6.54	0.43	6.37	0.37
September	4.86	1.47	5.14	1.24	4.85	0.58	4.99	0.65	5.11	0.66
October	3.72	2.01	4.04	3.62	3.66	0.90	3.87	0.80	4.19	3.28
November	2.50	2.42	2.82	7.15	2.32	1.15	2.70	1.14	3.07	7.00
December	1.96	2.35	2.51	8.18	1.87	1.11	2.18	1.25	2.58	7.07
Total	49.93	22.58	53.08	46.86	48.88	10.57	52.50	11.53	54.54	42.52
	Dufer		Echo		Elkton		Enterprise		Eugene Airport	
	f	r	f	r	f	r	f	r	f	r
January	1.88	1.89	2.04	1.36	2.68	6.39	1.55	0.82	2.45	4.56
February	2.22	1.48	2.47	1.12	2.98	6.70	1.84	0.83	2.85	5.03
March	3.46	0.88	3.89	0.87	4.06	5.32	3.00	1.10	3.87	4.06
April	4.32	0.70	4.93	0.76	4.73	3.26	4.02	1.33	4.62	2.26
May	5.56	0.71	6.35	0.65	5.89	2.15	5.24	1.42	5.82	2.34
June	6.29	0.72	7.23	0.69	6.38	1.74	5.86	2.24	6.34	1.24
July	7.06	0.25	8.08	0.20	7.05	0.42	6.70	0.53	7.00	0.43
August	6.42	0.16	7.16	0.28	6.46	0.40	5.91	0.44	6.41	0.43
September	4.93	0.79	5.43	0.51	5.32	1.34	4.55	1.21	5.18	1.47
October	3.78	0.84	4.13	0.78	4.30	4.11	3.51	1.28	4.05	3.72
November	2.47	1.97	2.68	1.28	3.07	7.46	2.18	1.04	2.94	6.73
December	1.96	2.13	2.15	1.25	2.72	7.84	1.67	0.96	2.52	6.51
Total	50.35	12.52	56.54	9.75	55.64	47.13	46.03	13.20	54.05	38.78
	Falls City		Forest Grove		Friend		Grants Pass		Halfway	
	f	r	f	r	f	r	f	r	f	r
January	2.44	11.26	2.38	7.29	1.45	2.34	2.59	5.39	1.57	1.22
February	2.72	9.98	2.65	6.06	2.10	1.78	2.86	4.47	1.98	2.00
March	3.77	7.52	3.75	4.68	3.09	1.17	3.97	2.97	3.19	2.00
April	4.56	3.88	4.57	2.71	3.95	0.74	4.71	1.84	4.36	1.97
May	5.61	2.72	5.78	1.92	5.10	0.80	5.87	1.44	5.77	1.57
June	6.18	1.40	6.42	1.28	5.61	0.76	6.50	0.80	6.46	1.86
July	6.78	0.28	7.03	0.39	6.67	0.08	7.28	0.14	7.40	0.33
August	6.25	0.51	6.51	0.56	6.04	0.20	6.67	0.20	6.68	0.18
September	5.04	2.02	5.13	1.76	4.78	0.62	5.26	0.88	5.09	0.75
October	4.00	4.71	3.98	3.45	3.55	1.01	4.15	2.11	3.80	1.59
November	2.87	12.09	2.82	7.53	2.27	2.30	2.76	4.28	2.33	2.92
December	2.46	13.16	2.39	8.52	1.83	2.96	2.51	5.23	1.91	3.03
Total	52.68	69.53	53.41	46.15	46.44	14.76	55.13	29.75	50.54	19.42
	Harney Br. Exp. Sta.		Hay Creek		Headworks		Heppner		Hermiston	
	f	r	f	r	f	r	f	r	f	r
January	1.41	1.22	1.99	1.43	2.36	10.49	2.01	0.36	1.97	1.14
February	1.79	1.04	2.31	0.98	2.62	8.42	2.36	1.26	2.39	0.94
March	3.08	0.73	3.37	0.90	3.71	8.58	3.58	1.25	3.83	0.65
April	4.04	0.88	4.16	0.78	4.55	5.98	4.44	1.33	4.90	0.61
May	5.30	0.64	5.36	1.49	5.67	5.21	5.69	1.30	6.29	0.53
June	6.01	0.75	6.05	0.81	6.26	3.89	6.42	1.17	7.15	0.55
July	6.99	0.20	6.88	0.51	6.91	1.24	7.29	0.44	7.91	0.16
August	6.17	0.23	6.17	0.31	6.34	1.52	6.59	0.37	7.02	0.27
September	4.58	0.37	4.73	0.84	4.98	4.00	5.04	0.89	5.29	0.43
October	3.45	0.74	3.66	0.74	4.04	6.34	3.90	1.12	3.99	0.67
November	2.23	1.00	2.49	1.66	2.85	11.10	2.68	1.37	2.59	1.16
December	1.62	1.11	2.06	1.30	2.39	11.34	2.14	1.37	2.05	1.13
Total	46.67	8.91	49.23	11.75	52.68	78.11	52.14	12.23	55.38	8.24

Table A—*Continued.* SUMMARY OF CALCULATED NORMAL MONTHLY CONSUMPTIVE USE FACTORS (f) AND AVERAGE MONTHLY PRECIPITATION (r), IN INCHES, FOR WEATHER BUREAU STATIONS IN OREGON.

Month	Weather Bureau station									
	Hillsboro		Hood River Exp. Sta.		Jacksonville		Joseph		Kent	
	f	r	f	r	f	r	f	r	f	r
January	2.40	5.09	2.09	5.18	2.42	4.04	1.49	1.64	1.83	1.28
February	2.72	4.23	2.40	3.98	2.72	3.39	1.74	1.53	2.18	1.00
March	3.84	3.96	3.61	3.24	3.82	2.20	2.81	1.74	3.39	0.91
April	4.72	1.96	4.57	1.69	4.61	1.56	3.84	1.73	4.27	0.86
May	5.87	1.74	5.83	1.10	5.80	1.49	5.10	2.06	5.57	0.86
June	6.39	1.35	6.47	0.77	6.50	1.04	5.83	2.02	6.62	0.91
July	7.00	0.39	7.16	0.18	7.35	0.27	6.75	0.76	7.28	0.20
August	6.39	0.42	6.50	0.26	6.78	0.30	6.10	0.77	6.57	0.27
September	5.14	1.55	5.04	1.18	5.27	0.81	4.56	1.26	5.03	0.63
October	4.02	3.14	3.92	2.17	3.72	1.68	3.46	1.40	3.85	0.82
November	2.77	5.24	2.65	5.32	3.56	3.66	2.21	1.66	2.51	1.32
December	2.46	7.43	2.15	6.23	2.36	4.23	1.58	1.56	2.00	1.27
Total	53.72	36.50	52.39	31.30	51.71	24.67	45.47	18.13	51.10	10.33
	Klamath Falls		La Grande		Lakecreek		Lakeview		Madras	
	f	r	f	r	f	r	f	r	f	r
January	1.92	2.05	1.93	2.14	2.44	3.24	1.82	1.93	1.91	1.09
February	2.21	1.50	2.18	1.90	2.71	5.82	2.01	1.85	2.27	0.69
March	3.29	1.17	3.36	2.05	3.85	5.90	2.99	1.43	3.39	0.64
April	4.19	0.91	4.36	1.71	4.46	2.59	3.86	1.18	4.21	0.63
May	5.42	0.91	5.67	1.93	5.48	2.30	5.15	1.25	5.42	0.86
June	6.15	0.72	6.45	1.53	6.16	1.44	5.96	0.92	6.23	0.70
July	7.07	0.27	7.41	0.59	6.90	0.18	6.90	0.31	7.01	0.20
August	6.47	0.25	6.71	0.63	8.36	0.25	6.33	0.25	6.25	0.28
September	4.95	0.55	5.01	1.12	5.03	1.33	4.78	0.64	4.78	0.66
October	3.81	0.99	3.80	1.57	3.98	2.64	3.70	0.96	3.65	0.65
November	2.55	1.71	2.57	2.12	2.86	3.43	2.49	1.62	2.46	1.30
December	1.99	1.86	2.02	2.06	2.38	2.59	1.90	1.79	1.94	1.10
Total	50.02	12.89	51.47	19.35	54.61	31.71	47.89	14.13	49.52	8.80
	Malheur Br. Exp. Sta.		Malin		McMinnville		Milton		Modoc Orchard	
	f	r	f	r	f	r	f	r	f	r
January	1.62	0.81	1.87	1.32	2.47	6.96	2.02	1.54	2.47	3.06
February	2.30	0.81	2.14	1.37	2.76	5.29	2.44	1.41	2.80	2.76
March	3.54	0.85	3.29	1.06	3.84	4.37	3.77	1.34	3.90	1.80
April	4.69	0.62	4.06	1.22	4.63	2.65	4.88	1.27	4.71	1.39
May	6.14	1.14	5.25	1.17	5.78	1.87	6.24	1.19	5.88	1.09
June	6.75	0.93	6.01	0.75	6.36	1.31	7.07	1.24	6.59	0.83
July	7.78	0.12	6.76	0.17	7.01	0.38	7.93	0.29	7.35	0.18
August	7.00	0.05	5.97	0.12	6.47	0.48	7.10	0.35	6.78	0.23
September	5.26	0.24	4.54	0.51	5.11	1.83	5.37	0.80	5.29	0.69
October	3.90	0.93	3.57	0.96	4.09	2.98	4.10	1.08	4.11	1.64
November	2.50	1.23	2.43	1.47	2.90	7.35	2.62	1.73	2.87	3.30
December	1.90	0.88	1.95	1.49	2.48	7.43	2.11	1.76	2.42	3.65
Total	53.38	8.61	47.84	11.61	53.86	42.90	55.65	14.00	55.17	20.62
	Moro		Newport		North Bend Airport		Nyssa		Paisley	
	f	r	f	r	f	r	f	r	f	r
January	1.89	1.58	2.82	9.70	2.89	10.90	1.92	1.23	2.00	1.97
February	2.23	1.22	2.96	8.06	3.02	8.89	2.42	1.28	2.36	0.82
March	3.50	0.87	3.84	7.45	3.95	7.54	3.64	1.07	3.39	0.76
April	4.79	0.78	4.44	4.60	4.49	4.86	4.79	0.78	4.23	0.82
May	5.68	0.78	5.35	3.50	5.41	3.22	6.23	0.94	5.42	0.79
June	6.48	0.65	5.77	2.55	5.83	1.68	6.80	0.97	6.07	0.86
July	7.34	0.18	6.01	0.78	6.21	0.43	7.77	0.12	7.08	0.44
August	6.64	0.21	5.59	0.91	5.82	0.39	7.12	0.30	6.43	0.17
September	5.02	0.67	4.74	2.77	4.89	2.40	5.51	0.01	4.91	0.47
October	3.81	0.93	4.08	4.87	4.14	4.08	3.62	0.66	3.80	0.60
November	2.48	1.70	3.16	9.98	3.23	9.95	2.65	1.36	2.53	0.85
December	1.95	1.67	2.80	10.64	2.81	9.79	2.13	1.24	2.08	1.05
Total	51.81	11.24	51.56	65.81	52.69	64.13	54.60	9.96	50.30	8.60

Table A—*Continued.* SUMMARY OF CALCULATED NORMAL MONTHLY CONSUMPTIVE USE FACTORS (f) AND AVERAGE MONTHLY PRECIPITATION (r), IN INCHES, FOR WEATHER BUREAU STATIONS IN OREGON.

Month	Weather Bureau station									
	Parkdale		Pendleton Airport		Pilot Rock		Portland		Port Orford	
	f	r	f	r	f	r	f	r	f	r
January	1.92	6.90	2.01	1.78	2.08	1.43	2.51	6.60	3.06	11.55
February	2.22	4.86	2.33	1.61	2.39	1.30	2.74	5.36	3.11	8.73
March	3.39	4.22	3.68	1.38	3.72	1.21	3.89	3.91	4.01	7.93
April	4.26	2.17	4.63	1.05	4.67	1.37	4.71	2.87	4.53	5.24
May	5.42	1.54	5.92	1.29	6.04	1.23	5.89	2.19	5.37	3.52
June	6.11	0.99	6.72	0.98	6.87	1.31	6.55	1.52	5.78	2.25
July	6.74	0.22	7.58	0.41	7.73	0.30	7.08	0.61	6.17	0.50
August	6.14	0.32	6.89	0.52	6.97	0.42	6.52	0.64	5.76	0.47
September	4.76	1.25	5.20	0.89	5.26	0.76	5.20	1.98	4.96	2.65
October	3.67	2.72	3.92	1.12	4.00	1.02	4.11	3.12	4.21	5.31
November	2.47	6.57	2.64	1.65	2.65	1.46	2.99	6.10	3.29	9.32
December	2.00	7.74	2.08	1.62	2.12	1.48	2.51	6.72	3.01	11.62
Total	49.10	39.50	53.60	14.30	54.50	13.29	54.70	41.62	53.26	69.09
	Power House		Prineville		Redmond		Richland		Riddle	
	f	r	f	r	f	r	f	r	f	r
January	2.07	2.26	2.03	0.95	2.08	1.00	1.79	1.15	2.72	4.75
February	2.51	2.36	2.32	0.83	2.38	0.69	2.22	1.05	2.96	3.74
March	3.70	2.25	3.37	0.65	3.47	0.56	3.42	0.77	4.01	2.70
April	4.76	2.00	4.21	0.76	4.33	0.70	4.44	0.74	4.69	2.11
May	6.06	1.70	5.40	0.94	5.44	0.84	5.74	1.12	5.77	1.41
June	6.68	1.76	6.03	0.33	6.09	1.02	6.64	0.67	6.46	1.01
July	7.70	0.42	6.16	0.33	6.92	0.48	7.51	0.28	7.10	0.22
August	6.86	0.38	6.15	0.30	6.24	0.30	6.82	0.34	6.55	0.30
September	5.22	1.08	4.72	0.61	4.83	0.45	5.02	0.54	5.20	1.03
October	3.99	1.77	3.69	0.74	3.74	0.57	3.75	0.72	4.20	2.24
November	2.62	2.25	2.59	1.08	2.56	0.87	2.54	1.11	3.10	4.42
December	2.15	2.40	2.04	0.97	2.11	0.86	1.87	1.28	2.63	5.09
Total	54.32	20.63	45.71	8.49	50.19	8.34	49.76	9.77	55.39	29.02
	Roseburg		Salem Airport		Talent		The Dalles		Tillamook	
	f	r	f	r	f	r	f	r	f	r
January	2.69	5.31	2.54	5.43	2.48	2.16	2.07	2.86	2.71	13.48
February	2.87	4.49	2.79	4.89	2.77	1.82	2.48	2.01	2.89	11.59
March	3.91	3.28	3.85	3.88	3.86	1.51	3.83	1.36	3.79	10.74
April	4.61	2.27	4.66	2.44	4.67	1.43	4.88	0.65	4.40	6.36
May	5.72	1.93	5.81	2.02	5.86	1.31	6.26	0.61	5.39	5.17
June	6.45	1.09	6.45	1.21	6.61	0.97	6.99	0.53	5.83	3.60
July	7.04	0.32	7.08	0.39	7.38	0.34	7.70	0.20	6.23	1.33
August	6.58	0.34	6.51	0.47	6.77	0.17	6.99	0.18	5.75	1.48
September	5.28	1.27	5.17	1.63	5.26	0.86	5.32	0.73	4.75	4.18
October	4.13	2.61	4.12	2.91	4.06	1.55	4.08	1.04	4.02	7.28
November	3.00	4.66	2.93	6.11	2.87	2.38	2.71	2.43	3.06	13.51
December	2.62	5.34	2.52	6.56	2.42	2.69	2.17	2.89	2.69	15.22
Total	54.90	32.91	54.43	37.94	55.01	17.19	55.48	15.49	51.51	93.94
	Umatilla		Union		Vale		Valley Falls		Wallowa	
	f	r	f	r	f	r	f	r	f	r
January	2.08	1.11	1.86	1.15	1.71	1.28	2.01	1.20	1.56	1.75
February	2.47	0.86	2.18	1.00	2.11	0.91	2.28	1.24	1.86	1.56
March	3.91	0.64	3.32	1.22	3.48	0.81	3.29	0.98	3.16	1.49
April	4.99	0.57	4.28	1.38	4.54	0.71	4.11	1.14	4.18	1.41
May	6.43	0.56	5.50	1.40	5.91	0.86	5.28	1.31	5.38	1.56
June	7.30	0.47	6.22	1.50	6.72	0.76	6.02	0.96	6.17	1.68
July	8.10	0.14	7.05	0.50	7.63	0.24	6.92	0.40	6.96	0.63
August	7.27	0.29	6.34	0.59	6.78	0.23	6.29	0.33	6.22	0.66
September	5.46	0.46	4.77	0.92	5.04	0.42	4.76	0.63	4.72	1.11
October	4.09	0.64	3.66	1.14	3.76	0.69	3.70	0.91	3.57	1.51
November	2.68	1.09	2.51	1.12	2.42	0.92	2.53	1.17	2.28	1.97
December	2.11	1.03	1.95	1.13	1.78	1.07	2.02	1.27	1.68	1.66
Total	56.89	7.86	49.64	13.05	51.88	8.90	49.21	11.54	47.74	16.99

Table A—*Continued.* Summary of Calculated Normal Monthly Consumptive Use Factors (f) and Average Monthly Precipitation (r), in Inches, for Weather Bureau Stations in Oregon.

Month	Weather Bureau station					
	Warm Springs Agency		Wasco		Weston	
	f	r	f	r	f	r
January	2.11	1.33	1.93	1.86	1.99	2.37
February	2.44	0.98	2.31	1.33	2.27	2.19
March	3.61	0.87	3.62	0.95	3.54	2.36
April	4.50	0.49	4.56	0.71	4.54	1.98
May	5.70	0.78	5.83	0.74	5.82	1.87
June	6.54	0.60	6.65	0.59	6.53	1.35
July	7.44	0.31	7.49	0.17	7.45	0.45
August	6.64	0.33	6.81	0.21	6.78	0.51
September	5.08	0.62	5.16	0.60	5.12	1.13
October	3.88	0.62	3.91	0.95	3.89	1.69
November	2.66	1.42	2.55	1.83	2.57	2.57
December	2.02	1.39	2.04	1.86	2.06	2.43
Total	52.62	9.74	52.86	11.80	52.56	20.90

Table B. Monthly Per Cent of Annual Daytime Hours for Latitudes Including Oregon.[1]

Month	Latitude				
	42°	43°	44°	45°	46°
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
January	6.62	6.56	6.49	6.41	6.33
February	6.65	6.62	6.58	6.54	6.50
March	8.31	8.31	8.30	8.29	8.29
April	9.00	9.02	9.05	9.08	9.12
May	10.14	10.20	10.26	10.33	10.39
June	10.21	10.30	10.38	10.45	10.54
July	10.35	10.42	10.49	10.57	10.64
August	9.62	9.66	9.70	9.75	9.79
September	8.40	8.40	8.41	8.42	8.42
October	7.70	7.67	7.63	7.60	7.58
November	6.62	6.55	6.49	6.42	6.36
December	6.38	6.29	6.22	6.14	6.04
Annual	100.00	100.00	100.00	100.00	100.00

[1]Computed from "Sunshine Tables," U. S. Weather Bulletin 805, 1905 Edition.

Table C. Peak Monthly and Daily Rates of Consumptive Use and Suggested Rates for Irrigation System Design.[2]

Agricultural section	Alfalfa, corn, ladino clover pasture, small grains, orchards with permanent cover			Grass hay, pole beans			Grass pasture, legume seed, peas		
		Suggested design rates			Suggested design rates			Suggested design rates	
	Peak monthly U	Peak[1] daily U	Sprinkler[2] capacity	Peak monthly U	Peak[1] daily U	Sprinkler[2] capacity	Peak monthly U	Peak[1] daily U	Sprinkler[2] capacity
	Inches	*Inches*	*Gpm/acre*	*Inches*	*Inches*	*Gpm/acre*	*Inches*	*Inches*	*Gpm/acre*
Coastal area	.....	.....	.....	4.33	0.210	5.28	4.33	0.210	5.28
Columbia River below Hood River	5.65	0.273	6.86	5.30	0.256	6.44	5.30	0.256	6.44
Tualatin Valley	5.62	0.272	6.84	5.26	0.255	6.41	5.26	0.255	6.41
Willamette Valley	5.57	0.270	6.79	5.22	0.253	6.36	5.22	0.253	6.36
Umpqua River area	5.62	0.272	6.84	5.27	0.255	6.41	5.27	0.255	6.41
Medford-Grants Pass	6.20	0.300	7.54	5.48	0.265	6.66	5.84	0.283	7.12
Lake Creek-Little Butte Creek area	6.05	0.293	7.37	5.34	0.258	6.49	5.70	0.276	6.94
Hood River Valley	5.56	0.269	6.76	5.21	0.252	6.34	5.21	0.252	6.34
Columbia River above Hood River	6.72	0.325	8.17	5.93	0.287	7.22	6.33	0.306	7.69
East slope of Mt. Hood	5.84	0.283	7.12	5.15	0.249	6.26	5.50	0.266	6.69
Madras-Redmond Area	5.85	0.283	7.12	5.16	0.250	6.29	5.50	0.266	6.69
Klamath area	5.90	0.286	7.18	5.20	0.252	6.32	5.54	0.268	6.74
Lakeview area	5.92	0.286	7.19	5.22	0.253	6.36	5.57	0.270	6.79
Columbia Basin wheat land	6.19	0.300	7.54	5.46	0.264	6.64	5.82	0.282	7.09
Pendleton-Heppner area	6.40	0.310	7.79	5.65	0.273	6.86	6.02	0.291	7.32
Hermiston area	6.79	0.329	8.27	5.99	0.290	7.29	6.39	0.309	7.77
Milton-Freewater area	6.54	0.316	7.94	5.77	0.279	7.01	6.15	0.298	7.49
Dayville-Canyon City	6.21	0.301	7.57	5.48	0.265	6.66	5.84	0.283	7.12
Harney Valley	5.93	0.287	7.22	5.24	0.254	6.39	5.58	0.270	6.79
Wallowa Valley	5.79	0.280	7.04	5.11	0.247	6.21	5.45	0.264	6.64
Grand Ronde Valley	6.13	0.297	7.47	5.41	0.262	6.59	5.77	0.279	7.01
Baker Valley	5.80	0.281	7.06	5.12	0.248	6.23	5.46	0.264	6.64
Pine and Eagle Valleys	6.34	0.307	7.72	5.60	0.271	6.81	5.97	0.289	7.27
Malheur area	6.63	0.321	8.07	5.85	0.283	7.12	6.24	0.302	7.59
Jordan Valley	6.15	0.298	7.49	5.42	0.262	6.59	5.78	0.280	7.04

Table C—*Continued.* PEAK MONTHLY AND DAILY RATES OF CONSUMPTIVE USE AND SUGGESTED RATES FOR IRRIGATION SYSTEM DESIGN.[2]

Agricultural section	Mint, onions, sugar beets, potatoes			Hops, deciduous orchards, vegetable seed, small truck, bush beans, sorghum			Strawberries			Tomatoes		
		Suggested design rates			Suggested design rates			Suggested design rates			Suggested design rates	
	Peak monthly U	Peak[1] daily U	Sprinkler[2] capacity	Peak monthly U	Peak[1] daily U	Sprinkler[2] capacity	Peak monthly U	Peak[1] daily U	Sprinkler[2] capacity	Peak monthly U	Peak[1] daily U	Sprinkler[2] capacity
	Inches	*Inches*	*Gpm/acre*	*Inches*	*Inches*	*Gpm/acre*	*Inches*	*Inches*	*Gpm/acre*	*Inches*	*Inches*	*Gpm/acre*
Coastal area	4.33	0.210	5.28	.....	.....	.....						
Columbia River below Hood River	4.94	0.239	6.01	4.59	0.222	5.58	4.24	0.205	5.15	4.94	0.239	6.01
Tualatin Valley	4.91	0.238	5.98	4.56	0.221	5.56	4.21	0.204	5.13	4.91	0.238	5.98
Willamette Valley	4.87	0.236	5.93	4.52	0.219	5.51	4.18	0.202	5.08	4.87	0.236	5.93
Umpqua River area	4.92	0.238	5.98	4.57	0.221	5.56	4.22	0.204	5.13	4.92	0.238	5.98
Medford-Grants Pass	5.48	0.265	6.66	5.11	0.247	6.21	4.38	0.212	5.33	5.11	0.247	6.21
Lake Creek-Little Butte Creek area	5.34	0.258	6.49	4.98	0.241	6.06	4.27	0.207	5.20	4.98	0.241	6.06
Hood River Valley	4.86	0.235	5.91	4.52	0.219	5.51	4.17	0.202	5.08	4.86	0.235	5.91
Columbia River above Hood River	5.93	0.287	7.22	5.54	0.268	6.74	.....	.....	.....	5.54	0.268	6.74
East slope of Mt. Hood	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Madras-Redmond area	5.16	0.250	6.29	.....	.....	.....	.....	.....	.....	.....	.....	.....
Klamath area	5.20	0.252	6.32	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lakeview area	5.22	0.253	6.36	.....	.....	.....	.....	.....	.....	.....	.....	.....
Columbia Basin wheat land	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pendleton-Heppner area	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hermiston area	5.99	0.290	7.29	5.59	0.271	6.81	.....	.....	.....	5.59	0.271	6.81
Milton-Freewater area	5.77	0.229	7.01	5.38	0.260	6.54	4.61	0.223	5.61	5.38	0.260	6.54
Dayville-Canyon City	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Harney Valley	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wallowa Valley	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Grand Ronde Valley	.....	.....	.....	5.05	0.244	6.13	.....	.....	.....	.....	.....	.....
Baker Valley	5.12	0.248	6.23	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pine and Eagle Valleys	.....	.....	.....	5.22	0.253	6.36	.....	.....	.....	5.22	0.253	6.36
Malheur area	5.85	0.283	7.12	5.46	0.264	6.64	.....	.....	.....	.....	.....	.....
Jordan Valley	.....	.....	.....	.....	.....	.....						

[1]Peak daily consumptive use = Peak monthly use ÷ 31 × 1.5.

[2]Suggested design rates are based on 75 per cent irrigation efficiency and apply to sandy soils. For medium or heavy soils, these rates could probably be multiplied by 0.90 and 0.85 respectively.

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