HOOD BASIN

STATE WATER RESOURCES BOARD
SALEM, OREGON
April 1965

BOARD MEMBERS

JOHN D. DAVIS, CHAIRMAN - Stayton
RUTH HAGENSTEIN, VICE CHAIRMAN - Portland
EMERY N. CASTLE - Corvallis LaSELLE E. COLES - Prineville
LOUIS H. FOOTE - Forest Grove WILLIAM L. JESS - Eagle Point
KARL W. ONTHANK - Eugene

DONEL J. LANE, Executive Secretary

COVER PICTURE

View of Hood River Valley. Mt. Hood in background. Oregon State Highway Department photo.

Price $2.50

TABLE OF CONTENTS

	PAGE
LIST OF TABLES	v
LIST OF FIGURES	vi
LIST OF PLATES	viii
PURPOSE AND INTRODUCTION	ix
SUMMARY AND CONCLUSIONS	x
PART I THE BASIN	
NATURAL FEATURES	
Location and Size	1
Counties and Basin Areas	2
Stream System	2
Climate	4
CULTURAL DEVELOPMENT	
History	6
Population	7
Transportation	9
General Land Use and Management	10
ECONOMY AND RELATED NATURAL RESOURCES	
General	12
Agriculture	13
Forestry	17
Mining	20
Recreation	21
PART II WATER SUPPLY	
SURFACE WATER SUPPLY	
Introduction	23
Base Period	23
Yield	23
Seasonal Distribution	27
Extreme Discharges	29
Depletion	31
GROUND WATER SUPPLY	
General	38
Geology	39
Occurrence	41
Ground Water Rights	46

TABLE OF CONTENTS

PAGE

PART III WATER USE AND CONTROL

LEGAL RESTRICTIONS AND LIMITATIONS OF WATER USE
- Statutory 48
- State Engineer Applications Pending 48

WATER USE AND PROBLEMS
- Domestic 49
- Municipal 51
- Irrigation 54
- Power 59
- Industrial 60
- Mining 61
- Recreation 62
- Wildlife 64
- Fish Life 64
- Pollution Abatement 69

WATER CONTROL
- Flood Control 71
- Drainage 72
- Erosion 73

PART IV DEVELOPMENT POTENTIAL

- General 75
- Hood Area 77
- Wasco Area 83

APPENDIX

Authority 87
Statutory References 90
Withdrawals by State Engineer 91
Orders by State Engineer 93
Selected Bibliography 99
Table A, Hydrological Station Summary 105
Table B, Recreation Area Summary 106
Table C, Reconnaissance Data on Small Watersheds 108
Table D, Dams and Reservoir Sites 109
Table E, Water Yield and Consumptive Use 110
Table F, Average Annual Runoff 111
Table G, Recommended Minimum Flows for Fish Life 112
Abbreviations and Symbols 113
Approximate Hydraulic Equivalents 114

L I S T O F T A B L E S

TABLE		PAGE
1	Basin Areas by County	2
2	Miles of Streams	3
3	General Land Use	10
4	Land Ownership or Administration	12
5	Present and Potential Cropland and Irrigated Land	14
6	Agricultural Land Use	15
7	Gross Agricultural Income	17
8	Forest Areas by Ownership	18
9	Annual Runoff of Principal Streams	24
10	Estimated Average Annual Surface Outflow by Areas	24
11	Average Monthly Discharge of Selected Streams	27
12	Extremes of Discharge at Selected Stations	30
13	Surface Water Rights Summary	32
14	Maximum Legal Annual Depletions	33
15	Estimated Consumption	34
16	Reservoir Water Rights Summary	38
17	Representative Test Pumped High-Yield Wells	42
18	Ground Water Rights Summary	46
19	Public Water System	54
20	Irrigation Development	55
21	Hood Area, Irrigation District Data	57
22	Surface Areas of Lakes, Ponds, and Reservoirs	62
23	Sewerage Systems	70
24	Average Annual Diversion Requirements	76

LIST OF FIGURES

FIGURE		PAGE
1	Hood Basin	1
2	Long-term Average Monthly Air Temperature at Parkdale and The Dalles	5
3	Long-term Average Monthly Precipitation at Parkdale, Hood River, and The Dalles	6
4	Population Growth within Hood River and Wasco Counties	9
5	Generalized Land Use	11
6	Comparison of Basin and State Agricultural and Industrial Labor Forces	13
7	Log and Lumber Production in the Basin	19
8	Use of Parks and Recreational Areas	22
9	Annual Yield of Hood River and Tributaries	25
10	Annual Yield of Fifteenmile Creek and its Eightmile Creek Tributary	26
11	Average Monthly Discharge of Principal Hood Area Streams	28
12	Average Monthly Discharge of two Wasco Area Streams	28
13	Extreme Differences in Daily Flows	29
14	Average Annual Yield vs Consumptive Rights, Hood River	35
15	Average Annual Yield vs Consumptive Rights, Fifteenmile Creek	37
16	Generalized Ground Water Geology	40
17	Hydrographs of The Dalles and Threemile Ground Water Reservoirs	44
18	Individual Domestic Water Supplies and Study Areas	50

L I S T O F F I G U R E S

FIGURE		PAGE
19	Sources of Water Supply, Hood Area	52
20	Irrigation Districts	56
21	Distribution of Major Anadromous Fish Species .	65

L I S T O F P L A T E S

PLATE

1 Hood Drainage Basin

2 Hydrological Stations and Average Annual Precipitation

3 Recreation Areas

4 Potential Water Resource Development

Note: Plates appear at the back of the report

PURPOSE AND INTRODUCTION

The purpose of this report is to set forth in a condensed form the major items considered by the State Water Resources Board in its formulation of an integrated, coordinated program of use and control of the water resources of the Hood River Basin in Oregon.

The board's investigation activities were completed in late 1964. The study was made in conformity with ORS 536.300 (1) which states:

> "The board shall proceed as rapidly as possible to study: existing water resources of this state; means and methods of conserving and augmenting such water resources; existing and contemplated needs and uses of water for domestic, municipal, irrigation, power development, industrial, mining, recreation, wildlife, and fish life uses and for pollution abatement, all of which are declared to be beneficial uses, and all other related subjects, including drainage and reclamation."

Having completed the study necessary to formulate and implement an integrated, coordinated water resources program, the board proposes to adopt a program for the Hood River Basin. This program will fulfill the requirements of ORS 536.300 (2) which states:

> "Based upon said studies and after an opportunity to be heard has been given to all other state agencies which may be concerned, the board shall progressively formulate an integrated, coordinated program for the use and control of all the water resources of this state and issue statements thereof."

The program will be based on the standards outlined in ORS 536.310 and the data obtained in the basin investigation. A summary of basic data and factors examined in the study are contained in the report. Detailed information is available for examination in the files of the board in Salem, Oregon.

Data for study and evaluation were made available through (1) physical field activity, (2) review of available reports and data, (3) extensive personal contact, (4) formal hearings on the basin's water needs and problems (Hood River and The Dalles, January 29, 1964), (5) data supplied by the Department of Agriculture (Soil Conservation Service, Forest Service, and Economic Research Service) through a cooperative program with the State Water Resources Board, and (6) submission of data to the board, at its request, by local, state, and federal agencies and other groups.

HOOD BASIN
SUMMARY AND CONCLUSIONS

TOTAL BASIN

The Hood Basin comprises two areas widely divergent in climate, topography, and hydrology: (1) the area roughly covering the western half of the basin including practically all of that portion of Hood River County situated within the basin; and (2) the area roughly covering the eastern half of the basin including practically all of that portion of Wasco County situated within the basin. For brevity and clarity these areas are referred to as the Hood area and the Wasco area, respectively, throughout the report.

The Hood Basin average annual runoff of 1,380,000 acre-feet provides far more usable water than is needed for envisioned potential developments within the basin. Distribution problems, however, limit transporting surplus water from the Hood area to the water deficient Wasco area.

The basin's available water supply is sufficient to furnish supplemental water supplies to 25,200 acres presently irrigated, irrigate 21,500 additional acres and supply all other consumptive needs.

Because of the diverse nature of the Hood and Wasco areas, separate summaries and conclusions are presented below.

HOOD AREA

A. Water Supply

1. The average annual yield from streams and springs supplies water for 19,000 acres, supplies the other consumptive needs and allows for about 1,250,000 acre-feet of surface outflow. An unidentified ground water supply of lower quantity and quality is available.

2. There are sufficient surface water resources to increase the presently irrigated acreage by 6,200 acres and supply additional needs for domestic, municipal, industrial, fish life, and recreation users.

3. As shown in Table 24, there will be a future water shortage of 30,900 acre-feet which can be supplied by storage, systems rehabilitation, or water from other stream sources.

4. Basic hydrological data are not adequate to accurately determine the streamflows of any streams except the Hood River and its West Fork. Other streamflow must be correlated from rainfall and short-term records which results in varying degrees of accuracy.

5. Additional resources which should be investigated include ground water for domestic, municipal, and industrial use. More efficient use of presently developed supplies will extend the resource.

6. There are nine potential reservoir sites listed in Table D of the Appendix but economically feasible storage is limited by steep stream gradient in the watershed, questionable geological formations at damsites, and soil deposition problems from glaciers.

7. The first priority development potential is to supply additional irrigation, domestic, municipal, and industrial water to the Oak Grove area. The second priority development potential is to supply irrigation, recreation, and fish life water to the East Fork Hood River area. Present plans and developments on the Middle Fork Irrigation District and the Crystal Springs Water District should be facilitated.

B. Water Rights

8. The Hood area has large quantities of unappropriated water as shown in Figure 14, "Average Annual Yield vs Consumptive Rights". The lower portions of a few streams do not have water for further appropriation during much of the low flow season so storage is desirable for best use of the water.

9. Waters of upper Dog River have been withdrawn by the State Engineer for out-of-basin diversion to The Dalles for municipal purposes.

10. ORS 538.200 states that, "Streams forming waterfalls near Columbia River Highway; withdrawal from appropriation or condemnation; diversion or interruption is prohibited".

11. Application No. 5728 dated September 5, 1917 provides for withholding from general appropriation any unappropriated

waters of the Hood River, East Fork of Hood River, and their tributaries in the vicinity of Mt. Hood. This withdrawal application should be rescinded.

12. There are 476 water rights for 1,063 cubic feet per second (cfs). Two of these are ground water rights and the remainder are from surface sources. Irrigation rights account for the greatest consumptive use with 568 cfs for 42,310 acres. Surveys are underway by the State Engineer to adjust water rights downward toward actual use. Only 45 percent of the land holding water rights was irrigated in 1963.

13. Only one of the 16 power rights, which are for a total of 197 cfs, is being utilized. There are 209 domestic, 14 municipal, and 12 industrial rights for a total of 104 cfs.

C. Water Use and Control

14. Diversion and pumping requirements for increased consumptive domestic, municipal, industrial, livestock, wildlife, and recreation uses of water are estimated at 1,400 acre-feet annually.

15. Additional diversion or storage requirements for irrigation of the better Hood area lands would vary around 27,000 acre-feet, depending on sources used, efficiencies of delivery and application, and use of return flows.

16. Irrigation presently uses, and will continue to use, about 95 percent of the diverted water.

17. There are 6,200 acres of mapped irrigable land within the Hood area. Available water supplies greatly exceed available irrigable lands on all major stream systems of the Hood area.

18. Irrigation development has been restricted by the high cost of developing heavily timbered land and the difficulties encountered in controlling summer water supplies from silt-laden glacial streams. Proposals to irrigate inferior land have not received sufficient public support for project development.

19. Land quality should weigh heavily toward obtaining approval when expanding the irrigation areas within and

adjoining the seven irrigation districts and companies. The relative success of these new irrigation proposals can be forejudged by analyzing the soils, water supply, climate, and markets.

20. As shown in Table 21 which lists irrigation district data, each district manager lists a water requirement greater than the water obtained during the 1962 irrigation season. The East Fork, Mt. Hood, and Hood River Irrigation Districts have reported the most severe shortages in critically low water years.

21. Worthwhile advantages could be obtained from extensive rehabilitation programs on most irrigated land and distribution facilities. More canal lining, control structures, land leveling, drainage, and sprinkler systems are needed to save water and increase production.

22. Use of sprinklers for irrigation water distribution has increased to the point where about 90 percent of the land is now irrigated by sprinkler. Pipeline and sprinkler use have materially reduced water waste, drainage, and erosion problems.

23. Present use of water for hydroelectric power has decreased to the operation of one plant and the future potential is economically and physically limited.

24. Mining use of water is for sand and gravel production, mainly along the Columbia River.

25. Fish life will continue to be an important nonconsumptive user of water of the Hood area streams. Some of the summer flows recommended by the Oregon State Game Commission are considerably in excess of present flows. Some minimum flows can be established but further minimum flow studies are required on other streams.

26. Restrictions on further appropriations of natural streamflow on some streams would maintain a minimum perennial streamflow sufficient to support aquatic life and minimize pollution. Such streams as the Middle Fork, Lake Branch, West Fork Hood River and its tributaries of Elk and McGee Creeks have surplus unappropriated natural flows.

27. Further studies are needed as to possible means of furnishing flow requirements and passage facilities for fish

life. Most critical points are below the East Fork diversion canal, at the Dee Lumber Company dam and at the Hood River bypass channel at Powerdale.

28. A conflict exists among irrigation, recreation, industrial, pollution abatement, and fish life uses of water.

29. Pollution of ground and surface water is localized, intermittent in occurrence, and is not a critical problem except in the urban and industrial areas of Parkdale, Odell, and Indian Creek.

30. Flooding and streambank erosion are not serious problems in the Hood area. Timber lands along the Cascade summit have serious stability problems. Erosion has been reduced materially in irrigated areas by adoption of cover crops and a rapid change to sprinkler irrigation.

31. Reservoirs on Neal Creek, East Fork, Middle Fork, Ditch Creek, and Indian Creek could provide recreation benefits and late season water for irrigation, livestock, and fish life.

32. Further knowledge of surface flows is required. Reestablishment of inactive gages and establishing of stations at new sites are needed throughout the area.

33. Detailed studies of ground water location and yield capabilities are needed.

34. Mt. Hood, the Columbia Gorge, and national forest lands are major attractions for local residents and tourists.

35. A separate four-party water study was initiated in April 1964 by Hood River County, Bureau of Municipal Research, consulting engineers, and the State Water Resources Board to determine the county's future domestic, municipal, and industrial water needs and to submit a long-range development plan.

36. Physical and economic factors justify limited-purpose use of certain waters.

37. The maximum economic development and use of the waters of the Hood area will be attained through utilization of the aforementioned waters for domestic, livestock, irrigation, power development not to exceed 7½ theoretical horsepower, recreation, wildlife, fish life, and mining uses.

SUMMARY AND CONCLUSIONS

WASCO AREA

A. Water Supply

1. The average annual yield from streams and ground water supplies a partial water requirement for 6,200 irrigable acres, supplies the other consumptive needs and allows for about 130,000 acre-feet of surface outflow and an unidentified ground water outflow.

2. There are sufficient surface and ground water resources to more than treble the presently irrigated acreage, increasing it to 21,500 acres, plus supplying additional needs for domestic, municipal, industrial, and recreation users.

3. Assuming that most of the development would come from surface sources, there would be a requirement of nearly 72,000 acre-feet from storage and the Columbia River. A possible alternative source is ground water for 4,400 acre-feet in the Mosier Valley and limited supplemental supplies along Eightmile and Fifteenmile Creeks.

4. The watershed surface water supply, even with maximum justifiable control and more efficient utilization, is inadequate in most areas to provide enough water for the above goals. Therefore, the use of Columbia River water on adjacent irrigable land is needed for proper development of the Wasco area.

5. Additional detailed investigations should be made on possible storage reservoirs, ground water supplies, ground water withdrawal, ground water recharge and Columbia River usage as well as more efficient use of presently developed supplies.

6. Table D of the Appendix and Plate 4 locate 24 potential reservoir sites in the Wasco area. Economically feasible storage is generally limited by steep stream gradient in the watershed. Soil deposition problems occur when reservoirs are located adjacent to cropped area. Until very recently grain farmers showed little interest in irrigation agriculture.

7. Available data indicate that the ground water resource is very limited in quantity but represents an important source for domestic, livestock, municipal, and industrial needs, both present and future.

B. Water Rights

8. The Wasco area has practically no unappropriated water during the irrigation season. Storage is essential for best use of the water.

9. No waters have been withdrawn by the State Engineer for out-of-basin diversions. The City of The Dalles has a municipal certificate right to 5.5 cfs from Dog River of the Hood area.

10. There are 541 water rights for 296 cfs in the area. Surface rights equal 194 cfs and ground water rights equal 102 cfs. Irrigation rights account for the greatest consumptive use with 142 cfs for 11,224 acres. Summer flow irrigation rights have been over-appropriated since before 1924 according to watermaster records.

11. There is further need to review present water rights. About 45 percent of the land having water rights is not irrigated because of the water shortage. All of the 8 power rights, which are for a total of 19 cfs, have been abandoned or are not utilized for power purposes. There are 185 domestic, 15 municipal, and 17 industrial rights for a total of 33 cfs.

C. Water Use and Control

12. Diversion and pumping requirements for increased consumptive, domestic, municipal, industrial, livestock, wildlife, and recreation uses of water are estimated at 4,200 acre-feet annually.

13. Additional storage and Columbia River withdrawal requirements for irrigation of the better basin lands would be about 53,500 acre-feet, depending on sources used, efficiencies of delivery and application, and use of return flows.

14. With proposed developments, irrigation will require diversion of over 75 percent of the consumptively used water. Due to irrigation water shortage, the present diversion is only about 50 percent of the consumptively used water.

15. There are over 100,000 acres of mapped irrigable land

within the Wasco area. Suitable land areas greatly exceed water supplies.

16. Irrigation development has been restricted by the economic fact that dryland grain production has been more acceptable than irrigated agriculture even on the best irrigable lands.

17. Land quality should weigh heavily toward obtaining approval of proposed reclamation projects. The relative success of these new irrigation proposals can be forejudged by analyzing the soils, water supply, climate, and markets.

18. Only a few hundred acres of the irrigated lands receive an adequate water supply during the June to September irrigation season in an average water year and practically all irrigated areas experience severe shortages in critically low water years.

19. Worthwhile advantages could be obtained from extensive rehabilitation programs on most irrigated land and distribution facilities. More canal lining, control structures, land leveling, drainage, and sprinkler systems are needed to save water, reduce erosion and increase production.

20. Irrigation development should be concentrated on valley and smoother bench land where soils are deep and fertile. Long-range planning should include using Columbia River water on lower land so that presently available supplies can be used on higher land.

21. There is no present use of water for hydroelectric power and the future potential is economically and physically limited.

22. Mining use of water is for sand and gravel production, mainly along the Columbia River.

23. Fish life will continue to be an important nonconsumptive user of water of the Wasco area headwater streams. Summer flows recommended by the Oregon State Game Commission for anadromous fish on major streams cannot be approved because present minimum flows are zero.

24. A conflict exists among irrigation, recreation, municipal,

Other important perennial streams are Indian Creek which passes through Oak Grove and the southern portion of the city of Hood River, Lake Branch which heads at Lost Lake, Tony Creek located about midway between the West and Middle Forks flowing into the latter. Clear Branch heading in Wiyeast Basin and being the most westerly tributary to Middle Fork, and Neal Creek the principal eastern tributary to the main stem Hood River below its forks.

The Wasco area contains 226 miles of perennial and 818 miles of intermittent streams for a total of 1,044 miles. The four perennial creeks, Mosier, Mill, Eightmile, and Fifteenmile, originate in the high timbered area along the western edge of Wasco County. They have been mapped as perennial in some sections, but watermasters have reported no measurable flow on them at intervals during recorded history. Fifteenmile, with its main tributaries of Ramsey and Eightmile Creeks, originates on the 5,800-foot elevation Lookout Mountain and discharges into the Columbia River east of The Dalles. Mill Creek, which is supplemented by inter-basin diversion from Dog River (tributary to East Fork Hood River), is an important part of The Dalles municipal water supply system.

Wasco area streams generally run northeasterly through narrow, deep canyons. Natural streamflow is quite low on most perennial streams during the summer, and water users further deplete available flows. Table 9 lists minimum and maximum flows of the important streams. Fifteenmile Creek has a gradient of 40 feet per mile on the lower 37 miles and gradients of 100 to 900 feet per mile in its headwaters. The remaining stream systems have similar profile characteristics which make suitable reservoir sites hard to locate and expensive to construct.

Climate

Extreme contrasts in climate exist within the Hood Basin. The basin is in a transitional zone between the predominating influences of maritime air characteristic of western Oregon and the much drier continental climate of eastern Oregon. The growing season varies from 217 days at Cascade Locks to zero days at the higher elevations of Mt. Hood.

Prevailing winds predominantly are westerly although easterly winds often prevail along the Columbia River Gorge in December and January.

THE BASIN

Annual precipitation varies from 130 inches along the crest of the Cascade Range, the western boundary of the basin, to less than 10 inches along the eastern boundary.

In the Hood area cool summer temperatures somewhat limit the species of crops that can be grown. The climate is excellent for apple and pear production with good air drainage and a high percentage of sunshine and favorable temperature during the growing season. In the lower Hood River Valley the growing season between killing frosts is 199 days and in the upper valley 146 days.

Parkdale, located between the East and Middle Forks of Hood River at an elevation of 1,744 feet, has a mean January temperature of 30 degrees Fahrenheit (° F.), a mean July temperature of 63.5° F. and an average annual temperature of 47° F.

Figure 2 shows average maximum, mean, and minimum monthly temperatures at Parkdale. For comparative purposes temperatures for The Dalles of the Wasco area also are shown.

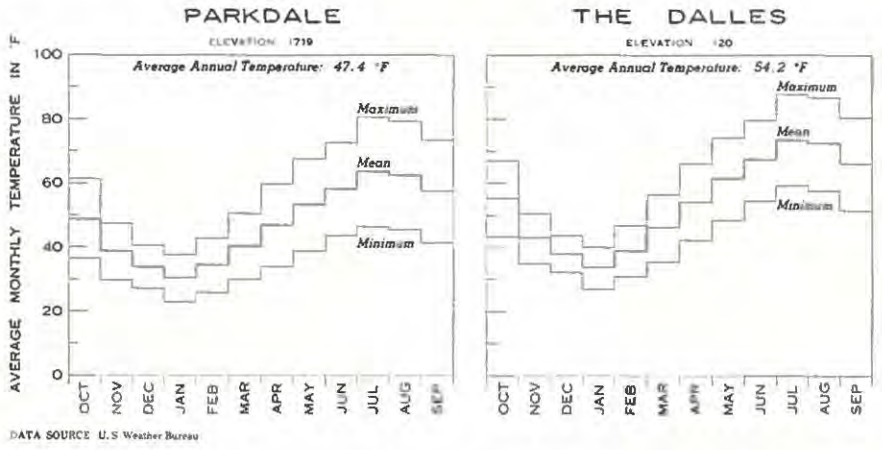


FIGURE 2. Long-term average monthly air temperature at Parkdale and The Dalles.

Base period mean annual precipitation is about 30 inches at Hood River and 45 inches at Parkdale. Thunderstorms and hailstorms are infrequent and usually not severe in the valley. Snowfall, usually light in the valley, normally is very heavy in the hill and mountain area, sometimes reaching a depth of 30 feet at timberline on Mt. Hood.

The Wasco area climate is temperate and semiarid, characterized

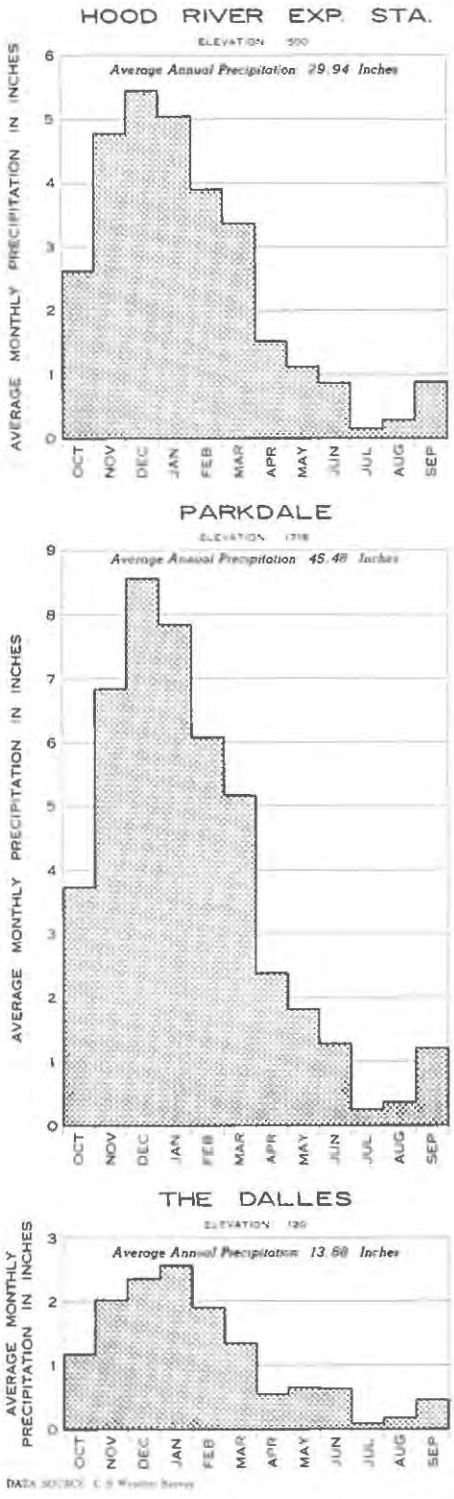


FIGURE 3. Long-term average monthly precipitation at Parkdale, Hood River, and The Dalles.

by low annual precipitation, low winter temperature, and high summer temperatures. The climate is conducive to production of hay, pasture, small grains, and stone fruit.

Base period mean annual precipitation is about 14 inches at The Dalles and 12 inches at Dufur.

Ninety-six years of temperature records for The Dalles show a mean monthly temperature of 34° F. in January, a mean maximum of 73° F. in July, and an annual mean of 54° F. at elevation 102 feet. The frost-free season for the Wasco area varies from 100 to 217 days depending upon the elevation and location.

Figure 3 shows the average monthly precipitation at Parkdale and Hood River of the Hood area and at The Dalles of the Wasco area, the three being shown together for comparative purposes. All three stations are characterized by low precipitation during June, July, August, and September, particularly at the height of the irrigation season in July and August.

CULTURAL DEVELOPMENT

History

The highest mountain peak of the basin and state, Mt. Hood, was first seen by white men in October 1792 when W. R. Broughton of the Vancouver expedition explored parts of the Columbia River. It was not until 1805 when the Lewis and Clark expedition traveled down the Columbia

River that white men first visited The Dalles and Hood River areas.

The Lewis and Clark expedition was soon followed by trappers, fur traders, and pioneer settlers who passed through this area on their way to the Willamette Valley and to coast points. Nathaniel Coe and his family were the first permanent settlers in Hood River, filing a donation land claim in 1854. Soon the sternwheeler, flat boat, and raft began supplying passenger and freight service between The Dalles and Hood River. The first road connecting these points was completed in 1867.

On January 11, 1854 the Oregon Territorial Legislature established Wasco County, its area embracing all of Oregon east of the Cascade Mountains, and parts of what are now Idaho, Montana, Wyoming, and Utah. Hood River County was created in 1908 by subdividing the northwestern portion of Wasco County.

Early river travel was interrupted by Celilo Falls requiring the establishment of portage and transshipment facilities at The Dalles. This service plus the gold rush of the 1870's helped establish The Dalles as an eastern Oregon trading center.

Since 1870 the Hood Basin has shown a fairly consistent growth rate stimulated by agricultural production, timber harvest, and transportation facilities. Except for some diversified activity along the Columbia River, the area is basically rural in nature, supported primarily by fruit, wheat, livestock, and timber production along with fruit and timber processing industries.

One of the earliest irrigation water rights in Oregon is that of Carrie Wilson with a priority date of 1850 for 6.1 acres on Mill Creek. Five additional water rights with a priority date of 1855 exist on Mill Creek for irrigation of 45 acres. Frank Davenport pioneered group irrigation development in the Hood area in 1897 with completion of the Farmers Ditch. The Hood River Irrigation District organized in 1905 was reported to be the first irrigation district formed in Oregon.

Population

Estimated total population of the Hood Basin for 1960 based on census figures, was 31,000 with over 50 percent of the population concentrated in the incorporated cities of Cascade Locks, Hood River, Mosier, The Dalles, and Dufur. The population density was 30.3 persons per square mile as compared to 19 for the

state. The basin population accounts for approximately 92 percent of the combined population of Hood River and Wasco Counties.

The rural farm population is presently estimated at 4,300 people or 14 percent of the total basin population.

Following a decline in population from 1910 to 1930 the Hood Basin experienced an increase in population starting with construction of Bonneville Dam and continuing through the subsequent construction of The Dalles Dam. Work at the Harvey Aluminum Company plant, at John Day Dam, and on the new Interstate 80 N. Freeway have helped recent growth. The basin annual growth averaged about 1.7 percent between 1950 and 1960, slightly less than the 2.1 percent growth rate for the state. The primary rural nonfarm population growth has been in suburban areas around Hood River and The Dalles.

An analysis of the development potential and census records indicates a future annual population growth of not more than 1.5 percent for the basin. Computations are based on the historically dominant role of fruit, wheat, and lumber along with their processing. Farms are becoming larger and as farms merge the displaced population is lost to towns in and out of the basin. Census records show that the 15 to 44 year age group that normally produces births has declined through out-migration over the past 20 years.

Assuming that some broadening of the Hood Basin general economy can be realized to offset job losses through mechanization, outmigration, and the decline in the birth-producing age groups, the population in the basin could reach between 37,000 and 50,000 by the year 2000.

In the Hood area a population of 13,400 is scattered throughout the Hood River Valley with principal concentrations at Hood River, Odell, Parkdale, and Cascade Locks. No recordable resident population was reported by the Census Bureau for the small mountain portion of Hood River County outside the Hood Basin.

The Wasco area has a population of 17,600, about three-fourths of which is located in The Dalles and its suburbs. The portion of Wasco County outside the Hood Basin has only an additional 2,600 population.

THE BASIN

Figure 4 shows population growth within Hood River and Wasco Counties.

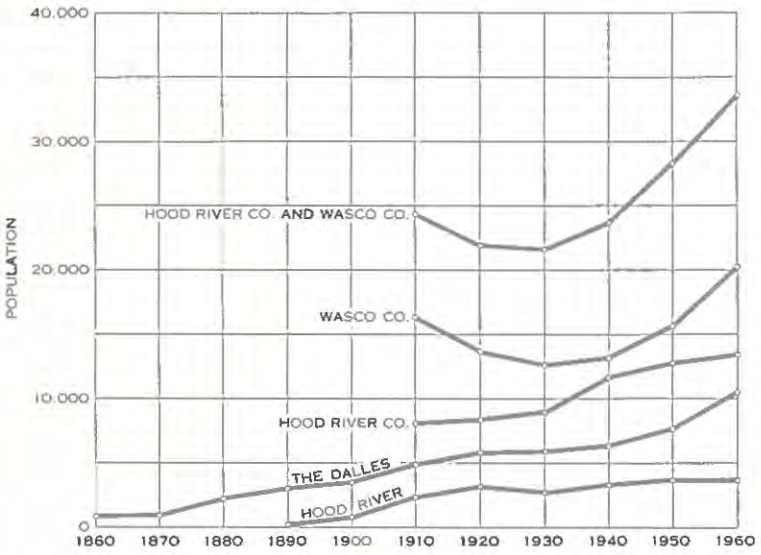


FIGURE 4. Population growth within Hood River and Wasco Counties.

Transportation

The northern, more populated parts of the Hood Basin are readily accessible by a variety of transportation facilities. The southern portion has two primary and several secondary access roads.

The basin is traversed on the northern edge by Interstate Highway 80 N. (formerly U. S. 30), connecting Cascade Locks, Hood River, Mosier, and The Dalles. U. S. Highway 197 bisects the eastern portion of the basin in a north-south direction from The Dalles through Dufur. State Highway 35 is a part of the Mt. Hood Loop Highway. Starting at Hood River it extends southward through the Hood River Valley and connects with U. S. Highway 26 on the south side of Mt. Hood just outside the basin. Access across the Columbia River to Washington points is supplied by the Bridge of The Gods at Cascade Locks, Hood River Bridge, and The Dalles Bridge.

The main line of the Union Pacific Railroad serves towns along the Columbia River, providing transcontinental passenger and freight service. The Mt. Hood spur line connects Hood River, Dee, and Parkdale, mainly for transport of fruit and timber products. The Oregon Truck Railway traverses the Deschutes River Valley immediately to the east of the basin. Regular freight and bus service is available to all larger and most smaller towns.

There are no airports within the basin used regularly by commercial airlines. The Dalles Airport is across the Columbia River in Washington. Hood River and Cascade Locks have airport facilities for smaller planes.

The ports of Hood River and The Dalles supply shallow draft vessel and barge docks; bulk handling equipment between water, rail, and highway carriers; boat basins; and moorage. In 1961 Columbia River traffic amounted to 4,000,000 tons, of which 289,000 tons was local traffic at The Dalles. Controlling channel depth for vessels and barges is 27 feet between The Dalles and Bonneville, then 29 feet to Portland.

According to the U. S. Corps of Engineers' waterways and harbors report, barge traffic on the Columbia River increased 23.6 percent for the first six months of 1963 over the same period for 1962. Large item movements include grain, animal products, wood products, petroleum, building materials, metal products, industrial chemicals, and fertilizers.

General Land Use and Management

General land use of the Hood Basin is shown in Table 3 and Figure 5. The 654,500-acre basin use is about 56 percent forest land, 14 percent rangeland, 25 percent cropland, and 5 percent towns and other public facilities.

TABLE 3

GENERAL LAND USE

USE	ACRES BY AREAS			
	Hood	Wasco	Total Basin	Percent
Forest land	226,300	142,700	369,000	56.4
Rangeland	8,400	79,600	88,000	13.4
Cropland	21,100	140,900	162,000	24.8
Other: towns, roads, etc.	27,800	7,700	35,500	5.4
TOTAL	283,600	370,900	654,500	100.0

Data Source: USDA Cooperative Report as modified by SWRB, 1964

Industrial and agricultural processing activities are concentrated along the Columbia River with specialized facilities around Dee, Parkdale, Odell, and Dufur.

The location and availability of land and water resources has determined the basic use pattern shown in Table 3.

In the Hood area, timber production is the dominant land use involving 80 percent of the land. The timbered forest lands

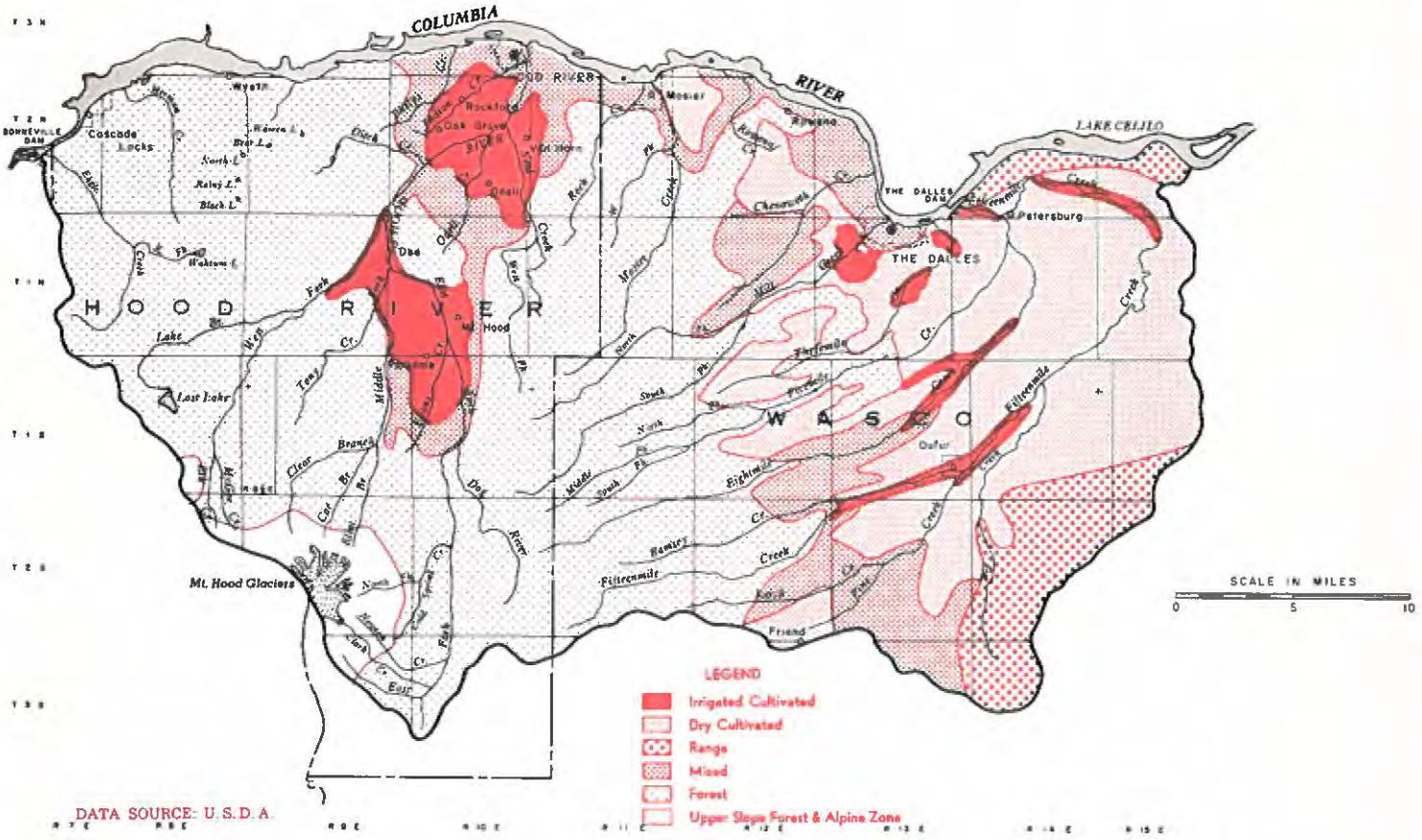


FIGURE 5. Generalized land use.

surround the valley cropland in a horseshoe pattern. Tree fruit production is the dominant land use in the valley involving 63 percent or 13,350 acres of the cropped area. Other important crops are hay and pasture.

In the Wasco area major land uses include grain, livestock, timber, and fruit production. Agriculture accounts for about 38 percent, range 21 percent, and forest 38 percent of the land use. Irrigation agriculture on 6,200 acres predominates along the larger streams and around The Dalles. The first water for the 5,400-acre Western Division, The Dalles Project is expected to be provided in 1965.

THE BASIN

Land ownership or administration of the basin is shown in Table 4. Over 60 percent is private ownership, 34 percent federal, 5 percent county, and less than 1 percent state.

TABLE 4

LAND OWNERSHIP OR ADMINISTRATION
1964

AREA	FEDERAL		STATE		COUNTY AND MUNICIPAL		PRIVATE		TOTAL
	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres
Hood	172,900	61.0	2,789	1.0	27,190	9.6	80,721	28.4	283,600
Wasco	47,700	12.9	675	0.2	7,157	1.9	315,368	85.0	370,900
BASIN	220,600	33.7	3,464	0.5	34,347	5.3	396,089	60.5	654,500

Data Source: USDA Cooperative Report, 1964, and state agencies

The 220,600 acres of federal land include 2,100 acres administered by the Bureau of Land Management and 218,500 acres by the U. S. Forest Service. Most of these lands are within the Mt. Hood National Forest.

The 3,464 acres of state land are administered by the State Land Board, Oregon Fish Commission, Board of Forestry, and the Parks Division of the State Highway Department.

Of the 34,347 acres of county and municipal land, 29,470 acres are in county and 4,877 acres are in municipal ownership. Practically all of the county lands are administered for forest production.

ECONOMY AND RELATED NATURAL RESOURCES

General

The economy of the basin has been primarily dependent upon agriculture and forest products since 1861. Increasing economic benefits are now being derived from industry and tourism. Basin economic growth is expected to be slow and steady rather than dramatic.

Analysis of the 1958 census indicates that there are approximately 80 manufacturing establishments in the Hood Basin which employed a total of about 1,600 people full time. The 1960

T H E B A S I N

Census of population reported there were about 13,500 persons in the labor force in Hood River and Wasco Counties. Of these, 1,960 were employed in agriculture, 3,480 in manufacturing, 1,830 in wholesale and retail trade, 5,180 in service industries, and 1,050 were unemployed.

The average per capita income is $3,023 in the Hood Basin while the average income in the state is $3,638. The lower income figure reflects 7.8 percent unemployment in the basin as compared to 5.9 percent average unemployment in the state during the census period.

Hood River and Wasco Counties have been designated as economically depressed areas with over 10 percent of the female and almost 7 percent of the male labor force unemployed. Contributing to this unemployment, because of their seasonal nature, are five large fruit processing plants.

Figure 6 compares the agricultural and industrial labor force of the basin with that of the state. It shows the agricultural employment of the basin to have had a greater percentage increase from 1940 to 1950 and a smaller decrease from 1950 to 1960 than did the state.

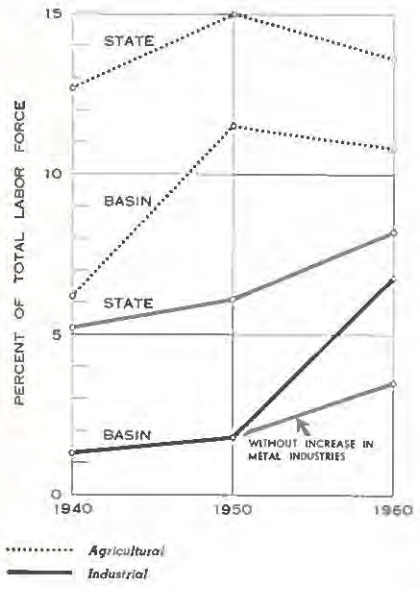


FIGURE 6. Comparison of basin and state agricultural and industrial labor forces.

The industrial types of manufacturing, which usually tend to stabilize employment, also showed a greater increase in the basin than in the state during the 1950-1960 period. This was largely due to the establishment of an aluminum reduction plant that has an annual smelting capacity of 75,000 tons per year. Smaller firms produce such diverse items as biscuits, preserved wood products, vodka, fish lures, steel boats, concrete products, boxes, and veneers.

Agriculture

Agriculture is the main source of income in the Hood Basin. Predominant agricultural activities are the production and processing of fruit, dryland grain, and livestock. Of these three, fruit production utilizes the smallest acreage and produces the greatest annual income. The Hood Basin

is one of Oregon's major commercial producers of pears, apples, and cherries.

Table 5 shows the present and potential cropland and irrigated land.

TABLE 5

PRESENT AND POTENTIAL CROPLAND AND IRRIGATED LAND

In Acres

AREA	ARABLE LAND	PRESENT CROPLAND	POTENTIAL CROPLAND	PRESENTLY IRRIGATED LAND	POTENTIALLY IRRIGABLE LAND
HOOD					
East Fork Hood River	40,600	7,500	3,500	7,000	2,000
Middle Fork Hood River	21,400	7,000	2,000	6,000	2,000
West Fork Hood River	17,200	1,100	1,000	1,000	100
Oak Grove	17,300	5,300	2,300	4,900	2,000
Columbia Gorge	12,100	200	300	100	100
SUBTOTAL	108,600	21,100	9,100	19,000	6,200
WASCO					
Fifteenmile Creek	102,800	93,200	1,000	2,500	8,000
Eightmile Creek	38,900	31,500	600	1,100	1,000
The Dalles	20,500	14,000	400	2,400	5,000
Mosier	4,900	2,200	200	200	1,300
SUBTOTAL	167,100	140,900	2,200	6,200	15,300
GRAND TOTAL	275,700	162,000	11,300	25,200	21,500

Data Source: USDA Cooperative Report, 1964

Arable land comprises all land adaptable to crop and pasture production by reason of suitable soil, topographic, and other physical qualities, i.e., all land classified I through IV by the U. S. Soil Conservation Service. The potentially irrigable acreages of Table 5 are those with physical features and location such that they can be reasonably considered for irrigation in the future.

The trend in the Hood Basin as throughout the state and nation, is toward fewer farms but farms with larger acreage, increased mechanization and thus fewer agricultural laborers, and irrigation of a higher percentage of irrigable land. Trends for land use in the basin indicate increased acreages devoted to fruit production, a decrease in hay and pasture acreage, and a fairly stable dryland grain acreage.

Table 6 shows the various acreages of agricultural land use.

TABLE 6

AGRICULTURAL LAND USE

USE	HOOD AREA Acres	WASCO AREA Acres	BASIN Acres
Grazingland			
Open rangeland	8,400	79,600	88,000
Forested land	1,400	71,000	72,400
TOTAL	9,800	150,600	160,400
Cropland			
Wheat	200	33,900	34,100
Barley	170	13,400	13,570
Other small grains	50	4,100	4,150
SUBTOTAL	420	51,400	51,820
Alfalfa hay	1,210	1,700	2,910
Other hay	1,210	1,000	2,210
SUBTOTAL	2,420	2,700	5,120
Tree fruits	13,350	6,100	19,450
Pasture	3,000	7,100	10,100
Other crops	390	300	690
SUBTOTAL	16,740	13,500	30,240
TOTAL HARVESTED AND PASTURED	19,580	67,600	87,180
NOT HARVESTED OR PASTURED	1,520	73,300	74,820
TOTAL CROPLAND	21,100	140,900	162,000

Data Source: USDA Cooperative Report, 1964

Fruit crops in the Hood area accounted for 88 percent of the $8,659,000 agricultural income in 1959 with pears and apples the chief contributors.

Most of the livestock are produced on irrigated pastures because there are only 8,400 acres of rangeland which are concentrated on the east side of the valley. The 1959 census listed livestock as producing about 10 percent of the total agricultural income.

The number of commercial farms in the Hood area decreased from 690 in 1954 to 400 in 1959, while average farm size increased. Census reports show more suburban dwellers farming small acreages than there are farm families on commercial farms.

Increases in agricultural production will come from development of the potential 6,200 irrigable acres and from more intensive utilization of the presently cultivated land. About 19,000 acres are presently irrigated in the Hood area as shown in Table 5. As will be shown in Table 9, there are sufficient surface water resources to irrigate the additional irrigable lands. Natural flows are available to irrigate 2,300 acres whereas storage would be required for 3,900 acres of the potentially irrigable land. Development requires construction of reservoirs, improvement of distribution facilities and removal of abrasive materials from glacial streams.

Although rainfall exceeds 30 inches annually, the seasonal distribution is such that irrigation is necessary to produce highest quality crops and maximum production.

The Wasco area agricultural acres are divided about as follows: grazing, 79,600; grain, 51,400; fruit, 6,100; hay and pasture, 9,800. Principal agricultural products of the area are wheat, barley, livestock products, and stone fruits, (mainly cherries). Stone fruits provide about 43 percent of farm income followed by 41 percent for small grain and 15 percent for livestock production. About 6,000 acres of cherry, peach, prune, and apricot orchards produce a gross income of about $2,800,000 annually. Orchards are located chiefly along the rolling hills south of The Dalles and in Threemile and Mill Creek Valleys.

In the Wasco area the eastern two-thirds is utilized primarily for dryland grain production. In the western one-third, vegetative cover blends from grass to shrubs to trees as the elevation increases westward into the mountainous watershed. Irrigation agriculture is concentrated around The Dalles and extends inland along the streams.

Table 7 shows the gross agricultural income from 1959.

Gross livestock income of $951,000 annually is derived chiefly from beef cattle and dairy products. Livestock producers depend heavily upon grazing the national forest lands for almost one-half the year.

The average size of Wasco County farms was 1,990 acres. No accurate records are available for the basin portion of Wasco County but the trend has been toward fewer but larger size farms.

Increase in production will come mainly from higher grain yields

due to improved cultural practices on the high plateau, and from expanded fruitland irrigation in The Dalles and Mosier

TABLE 7

GROSS AGRICULTURAL INCOME
1959

PRODUCT	HOOD AREA	WASCO AREA	BASIN TOTAL
Field crops	$ 63,000	$2,651,000	$ 2,714,000
Fruit crops	7,667,000	2,793,000	10,460,000
Other crops	36,000	100,000	136,000
TOTAL CROPS	$7,766,000	$5,544,000	$13,310,000
Beef cattle	$ 243,000	$ 500,000	$ 743,000
Dairy products	272,000	200,000	472,000
Sheep and wool	20,000	92,000	112,000
Other livestock products	358,000	159,000	517,000
TOTAL LIVESTOCK	$ 893,000	$ 951,000	$ 1,844,000
TOTAL AGRICULTURAL INCOME	$8,659,000	$6,495,000	$15,154,000

Data Source: USDA Cooperative Report, 1964

areas. Construction of storage reservoirs and wells in the Fifteenmile Creek watershed could provide supplemental water for irrigation around Dufur. Table 5 gave the present irrigated areas as 6,200 acres.

There has been little development of irrigation since the 1890's in the Fifteenmile, Eightmile, Fivemile, Threemile, and Mill Creek drainages due to low flows, inadequate storage and lack of knowledge concerning high yield wells. Shortages for presently irrigated land have been estimated as high as 85 percent on some stream systems during dry years.

The 5,400-acre West Division of The Dalles Project, an irrigation project now under construction, will utilize Columbia River water. Small quantities of well and Mill Creek water were formerly pumped to part of the lands under this project. The East Division of this project, which would also use the Columbia River source, is being considered for future development.

Forestry

National forest land is managed under the "multiple-use-sustained

yield" concept that involves producing high-level sustained yields of timber, forage, water, and wildlife, while providing for recreation. Management efforts are aimed at providing adequate facilities along with safe and aesthetically pleasing environments at parks and other outdoor recreation sites. Private forest lands in large ownerships are managed primarily for timber production with range management as their secondary objective.

The future growth and development of the Hood Basin will depend to a very great extent upon the full utilization of the forest resources obtained through product diversification and refinement by the forest industry. It is becoming quite evident that by-products which formerly were wasted during timber harvest increasingly are being processed for industrial use. A program of intensive forest management will result in greatly increased output of forest products, providing a firm basis for the forest industry to regain its former strong economic position.

Income from forestry and forest products ranks second to agriculture in the economy of the Hood Basin. No accurate basin figures are available, but in 1962 the gross value of timber products sold was estimated to be $3,700,000. Forested land in the basin occupies 56 percent of the total area, or 369,000 acres. Timber lands occupy rough mountain areas from elevations of 100 feet in the gorge to over 6,000 feet on the slopes of Mt. Hood.

Timber species and acreages are as follows: fir, pine, and associated species, 297,450 acres; hardwood, 4,000 acres; cutover land nonstocked, 3,500 acres; and noncommercial and reserved forest lands, 64,050 acres. Timber density grades from very dense along the western edge of the basin where growth is supported by 130 inches of rainfall to sparse in the 20-inch rainfall belt west of Dufur and The Dalles.

TABLE 8

FOREST AREAS BY OWNERSHIP
In Acres

AREA	FEDERAL	STATE	COUNTY AND MUNICIPAL	PRIVATE	TOTAL
Hood	158,400	2,600	28,500	36,800	226,300
Wasco	47,300	400	2,900	92,100	142,700
BASIN TOTAL	205,700	3,000	31,400	128,900	369,000

Data Source: USDA Cooperative Report, 1964

Table 8 shows the acreage of forest land in the Hood and Wasco areas by ownership.

The 205,700 acres of federal land includes 203,600 acres in the Mt. Hood National Forest

and 2,100 acres of Bureau of Land Management land. The county and private forest lands are generally located at lower elevations above the cropped land.

Figure 7 illustrates log and lumber production in board feet between 1933 and 1963. Part of the logs are imported from outside the basin.

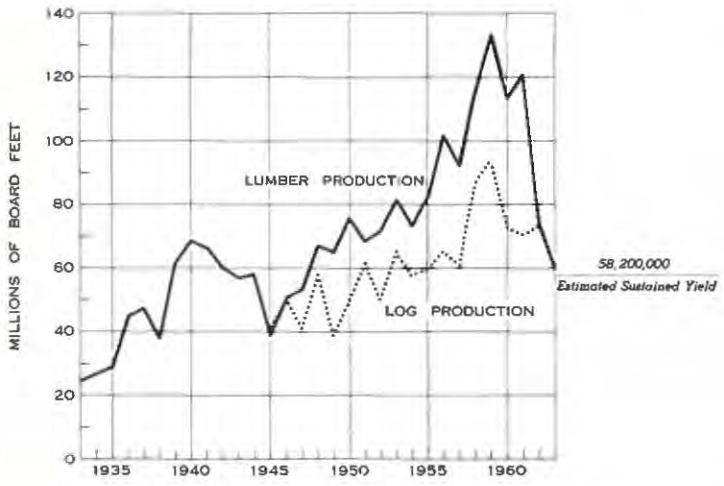


FIGURE 7. Log and lumber production in the basin.

Hood River County had an annual cut of 54 million board feet from federal and county lands in 1962. To meet a sustained yield program, the allowable cut is being reduced on federal and county lands to 32 million board feet. The cut on private land in the basin portion of the county will have to be held to 26 million board feet to maintain an estimated sustained yield program of 58 million board feet.

Further imports of logs from the State of Washington and south of Mt. Hood must be found to maintain the lumber industry's production. The lumber mill near Cascade Locks obtains practically all of its logs from the State of Washington.

Some increase in production can be expected through improved forest management and better utilization of forest products. However, the trend in timber harvest is sharply downward from the average harvest over the last 10 years. There is intense competition for available timber resources.

In the Hood area, about 226,300 acres are forested land of which 70 percent are federal, 13 percent county and municipal, 1 percent state, and 16 percent are privately owned. Both county and federal lands are supervised by the Forest Service. Private ownership comprises 36,800 acres of which about 10,000 acres are in farm wood lots. Most of the remainder is owned by logging companies. Virtually all of the milling is done by four lumber companies.

The Mill Creek watershed is managed by the U. S. Forest Service

primarily to obtain a maximum yield of potable water for the City of The Dalles.

In the Wasco area, forestry and forest products supply a relatively small portion of the income. This area's estimated sustained yield is 16.9 million board feet. Logs from 142,700 acres of timbered land move to mills in the Hood River Valley and The Dalles. Ponderosa pine is used to replant Douglas fir cutover lands because of regeneration problems on fir and associated species.

Mining

Mineral production, all from stone, sand and gravel, amounted to more than one million dollars in the Hood Basin during 1963. Most of the aggregate was excavated from near the Columbia River for use in road and building construction. No other types of mineral deposits having commercial value are known to exist in the basin.

In the Hood area, sand and gravel deposits suitable for construction purposes are being developed at two locations bordering the Columbia River east of the Cascade Locks Airport. Sand and gravel in the Hood River Valley are generally too fine or soft to meet construction specifications. Gravel from the Indian Creek pits southwest of Hood River is used by an asphalt plant. Road rock presently is quarried at four sites within the Hood River Valley and crushed by portable equipment.

The three Wasco area sand and gravel pits are located about 4 miles north of The Dalles, 5 miles east of The Dalles, and about 2.5 miles east of Mosier. Clay must be washed from aggregate taken at the latter pit. Additional sand and gravel is barged from Avery, Washington, about 6 miles upstream from The Dalles. Road rock is available in much of the area.

Semiprecious stones, particularly agates, are reportedly found in limited quantities east of The Dalles near the confluence of Threemile Creek and the Columbia River.

Four oil exploration wells, three west of Dufur and one west of The Dalles, have been drilled in the basin. The deepest, drilled in 1907, was 1,710 feet deep; the latest, drilled about 1952, was 220 feet deep. All of the wells were drilled by small independent companies and were dry.

Recreation

Recreation presently is very important to the economy of the basin and its future importance is expected to increase markedly. The Mt. Hood National Forest with approximately 200,000 acres in the basin, is the dominant potential recreational area.

The scenic Columbia River Gorge with its cliffs, spectacular waterfalls, parks, power dams, and water-based recreation facilities is a popular tourist attraction. Mt. Hood and the Columbia River Gorge are two of Oregon's many popular recreation areas. The Bonneville and The Dalles Dams, including their reservoirs which border the basin on the north, account for 1,200,000 annual visitors from counts on both sides of the river. Together these reservoirs provide 200 miles of shoreline and 28,100 surface acres of water for recreational purposes. The U. S. Corps of Engineers reports that an average of 645 pleasure boats pass through Bonneville Locks each year. The rate is increasing for larger pleasure boats.

The Mt. Hood National Forest has 23 improved campgrounds with overnight camping facilities and numerous undeveloped camp areas. In addition, five organizational groups have U. S. Forest Service special-use permits.

There are 14 state parks, 8 county parks, and numerous plans for expansion. Practically all recreation facilities are planned around water resources.

The greatest potential developments exist in the Hood area where recreation will continue to develop as an economic asset to the basin. Mt. Hood, with its extensive recreational attractions and its close proximity to Portland and other populated areas, will continue to draw increasing numbers of visitors as tourist facilities are improved. Reservoirs with resort facilities are proposed at Horsethief Meadows, on Neal Creek, and on Indian Creek.

Annual day-use accounts for the greatest increase in recreational use whereas overnight camping has shown a small increase. Winter sports could attract a sizeable share of the Mt. Hood winter recreationists if adequate facilities at Lamberson Butte, Cooper Spur, or Hood River Meadows proposed ski areas on the mountains' northern slopes were established. The U. S. Forest Service expects 1,200,000 annual ski enthusiast visits to facilities around Mt. Hood by 1975.

Lost Lake is one of the most popular resort areas with improved facilities for overnight camping, picnicking, fishing, and boating. Lost Lake records show that 62 percent of the guests come from Portland, 11 percent from out-of-state, and 27 percent from the basin and other adjacent areas.

Figure 8 shows the trends in use of the parks and recreational areas in the basin. The location and a detailed summary of the facilities available at each of these locations are shown on Plate 3 and Table B of the Appendix.

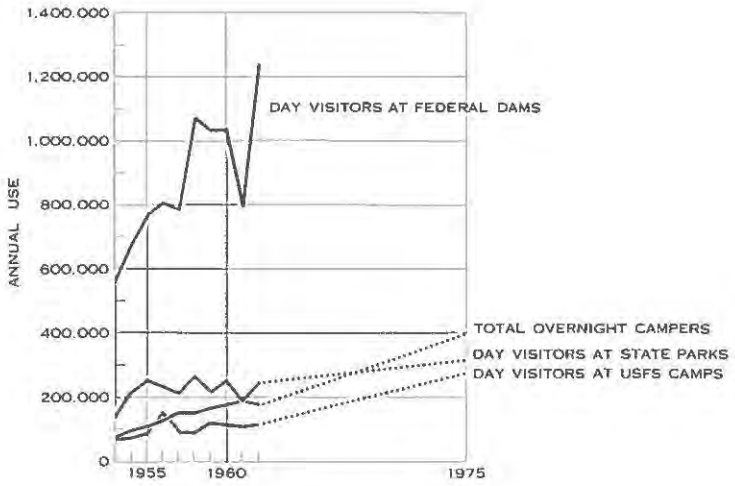
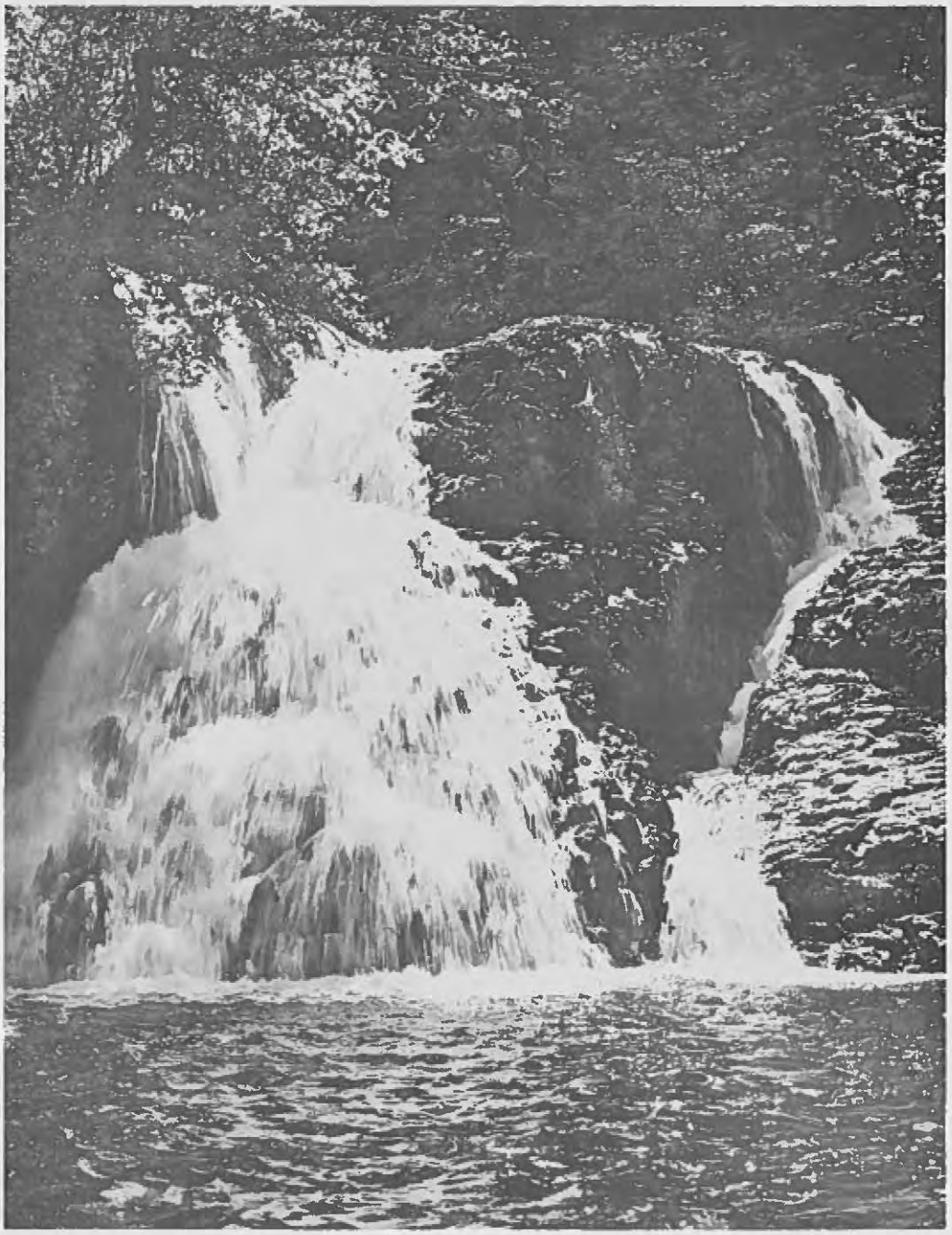


FIGURE 8. Use of parks and recreational areas.

The Wasco area has two private parks and plans for several water-based facilities along the Columbia River. The canyons and headwaters of Eight and Fifteenmile Creeks have an abundance of natural scenic, camping, hiking, and hunting features that should attract increasing numbers of visitors. Greater future multipurpose water use can be made on Mill Creek by constructing fenced storage reservoirs and pipelines from them for prevention of contamination. This would reduce the area which must be withdrawn from recreation use.

WATER SUPPLY



PART II

WATER SUPPLY

SURFACE WATER SUPPLY

Introduction

Only the Hood River has long-term gaged flow records. Determinations of stream yields, monthly distributions, and extreme discharges are based primarily on U. S. Geological Survey stream gaging records. All active and inactive hydrological stations are shown by location on Plate 2 and Table A of the Appendix by name, location, type, and period of record. Yield estimates for some ungaged streams have been made on the basis of precipitation-runoff correlations.

Water rights are based on a flow of one-eightieth cubic foot per second and not to exceed three acre-feet per acre during the irrigation season. Livestock rights are based on one-fortieth cubic foot per second per 1,000 head continuous throughout the year. Rights are contingent upon beneficial use and the priorities of rights are dates of relative appropriation.

Base Period

The base period used in this report for computation of long-term mean streamflows is 30 years, from 1932 to 1961 inclusive. This period includes a proportionate share of wet and dry years based on 80 years of precipitation records at Hood River and The Dalles, and 50 years of stream runoff records at Hood River near its mouth. The minimum discharge year for the Hood River drainage was 1941.

Yield

Maximum, minimum, and average annual yield of most principal or economically important streams of the basin are listed in Table 9.

Runoff decreases rapidly moving from the western to the eastern portions of the basin due to rapidly decreasing rainfall. The Hood Basin precipitation pattern is illustrated on the isohyetal map, Plate 2.

TABLE 9

ACTUAL AND ESTIMATED MINIMUM, MAXIMUM, AND AVERAGE ANNUAL RUNOFF OF PRINCIPAL STREAMS 1932-1961

NAME OF STREAM	USGS GAGE NO.	DRAINAGE AREA IN Sq. Mi.	COMPLETE WATER YEARS OF RECORD	ANNUAL YIELD IN ACRE-FEET			
				Minimum	Maximum	Average	Inches
*Hood River and PP&L conduit near Hood River	1205	329	48	421,100	1,222,000	814,100	46.4
Hood River at Dee	1160	155	2	216,000	500,000	356,000	43.1
East Fork Hood River above intake near Mt. Hood	1135	77.2	3	132,200	262,900	196,200	47.6
West Fork Hood River near Dee	1185	96	29	220,800	584,900	404,300	79.0
Middle Fork Hood River at mouth	-	-	-	-	-	158,000	63.5
Dog River at mouth	-	-	-	-	-	14,000	19.8
Eightmile Creek near Boyd	1050	56	?	2,000	28,000	12,800	4.3
Fifteenmile Creek near Dufur	1040	19.6	?	4,000	44,500	20,900	18.2
Fifteenmile Creek near Wrentham	1045	171	?	18,000	70,600	39,800	4.4

*Actual records. Other discharge values are by correlation extended to the base period.

Data Source: USGS

Table 10 shows the average annual outflow from the Hood and Wasco areas. Figures include estimates of small streams flowing directly into the Columbia River.

TABLE 10

ESTIMATED AVERAGE ANNUAL SURFACE OUTFLOW BY AREAS 1932-1961

AREA	AVERAGE ANNUAL OUTFLOW		
	Sq. Mi.	Acre-feet	Inches Per Acre
Hood	482	1,250,000	48.6
Wasco	540	130,000	4.6
TOTAL OR AVERAGE	1,022	1,380,000	26.6

Data Source: USGS records and SWRB correlations

The average annual outflow from Hood River is 863,000 acre-feet of the 1,250,000 acre-feet listed for the Hood area.

Due to lack of sufficient stream-flow recording stations on most of the smaller streams, average annual water yields cannot be determined from direct-flow records except by correlation. Estimates of average annual runoff on certain streams not shown in subsequent graphs are as follows:

Herman Creek	81,000 acre-feet
Tony Creek	22,000 acre-feet

Clear Branch	104,000 acre-feet
Neal Creek	28,000 acre-feet
Mosier Creek	16,000 acre-feet
Mill Creek	20,000 acre-feet
Threemile Creek	3,000 acre-feet
Fivemile Creek	12,000 acre-feet

These and other selected stream runoff records are presented in Table F of the Appendix.

Figure 9 shows gaged and/or correlated annual base period flows for the Hood River main stem, West Fork, and East Fork. The yield pattern for the Hood River and its West Fork are considerably more uniform than those of semiarid regions. The East Fork shows a much greater variation in yield by years.

Each graph shows 1941 as being the low water yield year. The lowest water yield years in sequence were between 1936 and 1945.

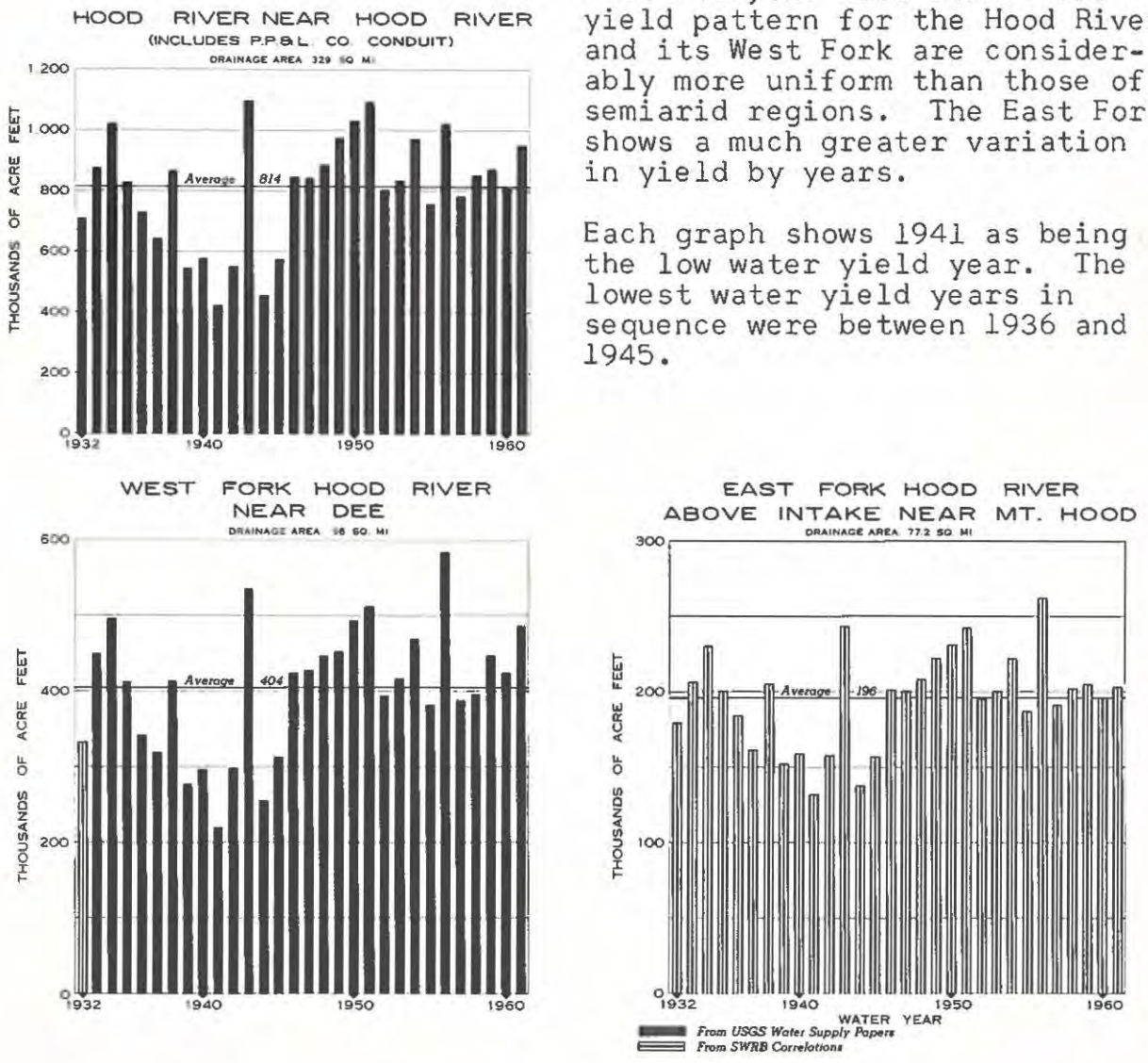


FIGURE 9. Annual yield of Hood River and tributaries.

W A T E R S U P P L Y

Rapid snowmelt on the Mt. Hood glaciers during hot weather helps to increase base streamflows during the summer heavy use period.

Figure 10 illustrates the correlated average annual yields of Fifteenmile and Eightmile Creeks. The yield patterns of these streams are typical of those in semiarid regions with great annual and seasonal variations in flow.

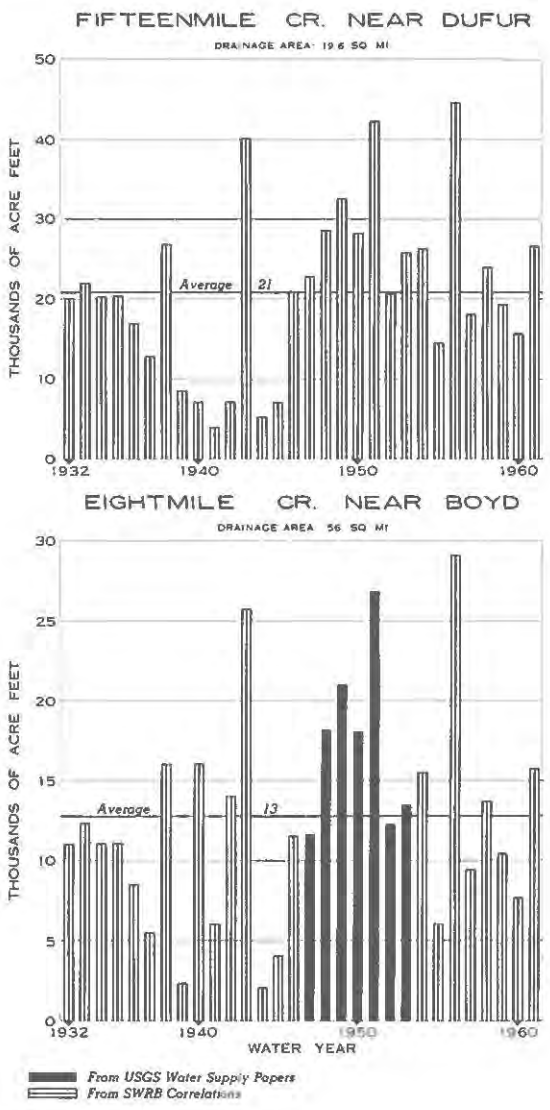


FIGURE 10. Annual yield of Fifteenmile Creek and its Eightmile Creek tributary.

The average annual runoff of Fifteenmile Creek is 70,000 acre-feet of the 130,000 acre-feet listed in Figure 10 for the Wasco area.

Streamflow on Fifteenmile and Eightmile Creeks was very low in 1941.

Farmers have reported zero flows at various times over the years which have not been officially recorded.

These graphs reflect the need for storage reservoirs with excess carryover capacity to serve domestic and irrigation needs during low water yield years.

Further ground water development on the high plateau around Dufur offers limited alternative source for additional water.

The base map on Plate 1 locates 433 springs distributed throughout the basin. Many of these springs have flows of one to several cubic feet per second and are excellent sources for domestic, livestock, municipal, industrial, irrigation, wildlife, and fish life water supplies. Some subsurface barriers cause ground water to flow to the surface as springs.

W A T E R S U P P L Y

Seasonal Distribution

The seasonal runoff distribution pattern for the Hood Basin varies greatly. The distribution pattern of this transitional zone between humid and arid climate reflects the great divergence resulting from extremes of rainfall and elevation. All conditions between humid to arid are represented. Entirely different runoff patterns are herein described for the Hood and Wasco areas.

In the Hood area the West, Middle, and East Forks, Hood River seasonal runoff distribution is more uniform than for most state streams. Heavy snow and rainfall in the watershed's high timbered areas and on the glaciers of Mt. Hood supply an abundance of summer water. Glacial flows are unique in that yield is high when the irrigation water needs are greatest during hot summers.

Yield diagrams of the Hood River and its Forks illustrate high base flows with subdued discharge peaks. Comparatively few storage and regulatory reservoirs will be needed here to supplement irrigation shortages and supply more uniform flows for fish life and recreation purposes. Highest flows are normally during December and January while the lowest flows occur in August and September.

Table 11 shows the average monthly discharge rates of Hood River, East and West Forks Hood River, and Fifteenmile Creek.

TABLE 11

AVERAGE MONTHLY DISCHARGE OF SELECTED STREAMS IN CFS
1932-1961

NAME OF STREAM	COMPLETE YEARS OF RECORD	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	ANNUAL
Hood River near Hood River	1914-61	637	1,171	1,638	1,536	1,548	1,477	1,543	1,416	1,075	632	413	416	1,123
East Fork Hood River near Mt. Hood	1916-18	190	283	353	337	338	327	341	317	264	190	155	160	271
West Fork Hood River near Dee	1914 and 1933-61	302	653	893	777	747	704	798	723	498	269	175	170	558
Fifteenmile Creek near Wrentham	1947-53	6	16	42	88	220	96	66	63	50	14	4	6	55

Data Source: USGS

Figures 11 and 12 illustrate the seasonal distribution of annual yield on the two major stream systems in the Hood and Wasco areas.

The yield diagrams clearly show the advantage of storing winter and spring floodwaters on Eight and Fifteenmile Creeks for summer usage. Over 70 percent of the outflow occurs during the December through April non-growing season. Other beneficial use requirements are also low during the winter period.

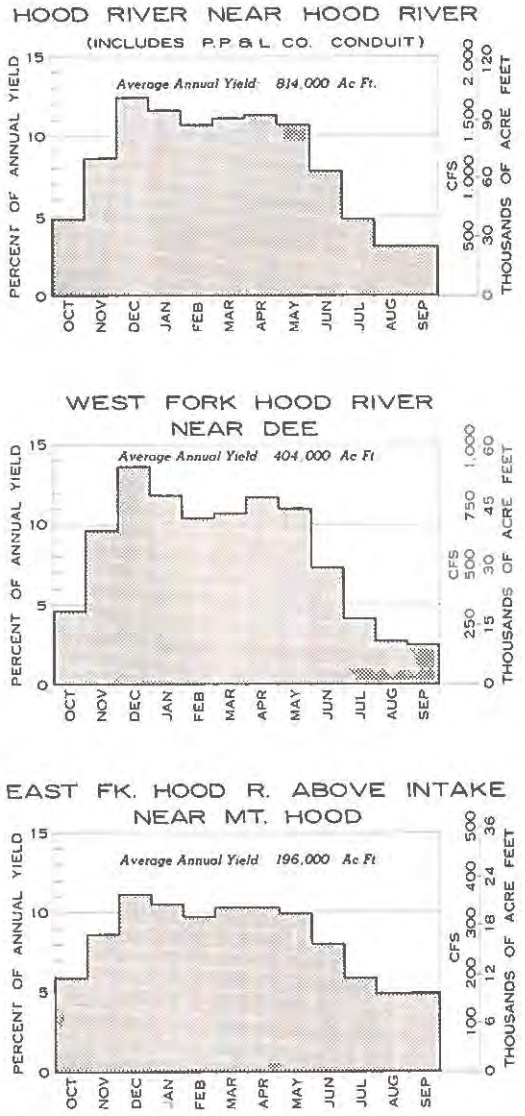


FIGURE 11. Average monthly discharge of principal Hood area streams.

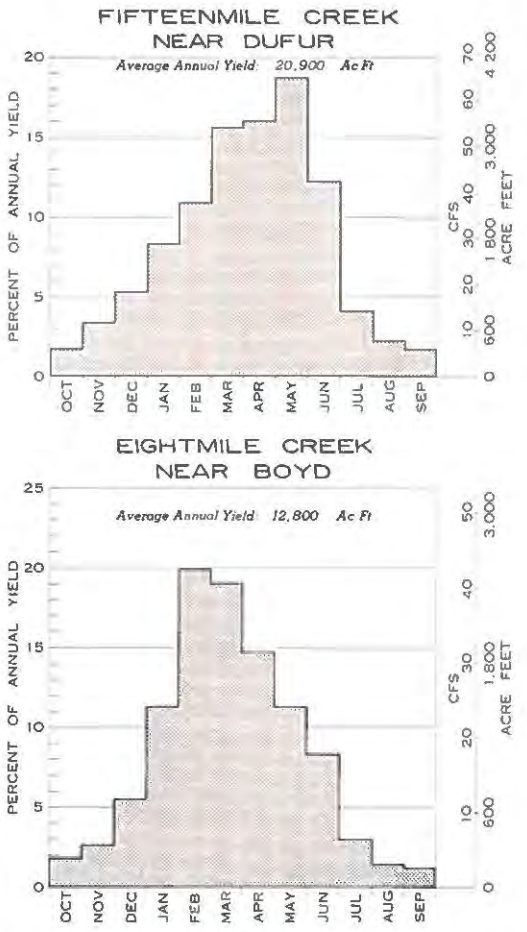


FIGURE 12. Average monthly discharge of two Wasco area streams.

W A T E R S U P P L Y

On the high plateau of the Wasco area water supplies have long been short and seasonally over-appropriated. Importation of water from adjoining watersheds (except Dog River) has not been found practical to date due to high water lifts involved. Consideration is presently being given to small storage and ground water development under Public Law 566.

Seasonal distribution of runoff is typical of semiarid regions. With relatively light snowpack and rainfall in the watershed, July through September stream yields are low.

Extreme Discharges

Figure 13 illustrates the extreme differences in daily flows for Hood River main stem and Hood River West Fork during 1941,

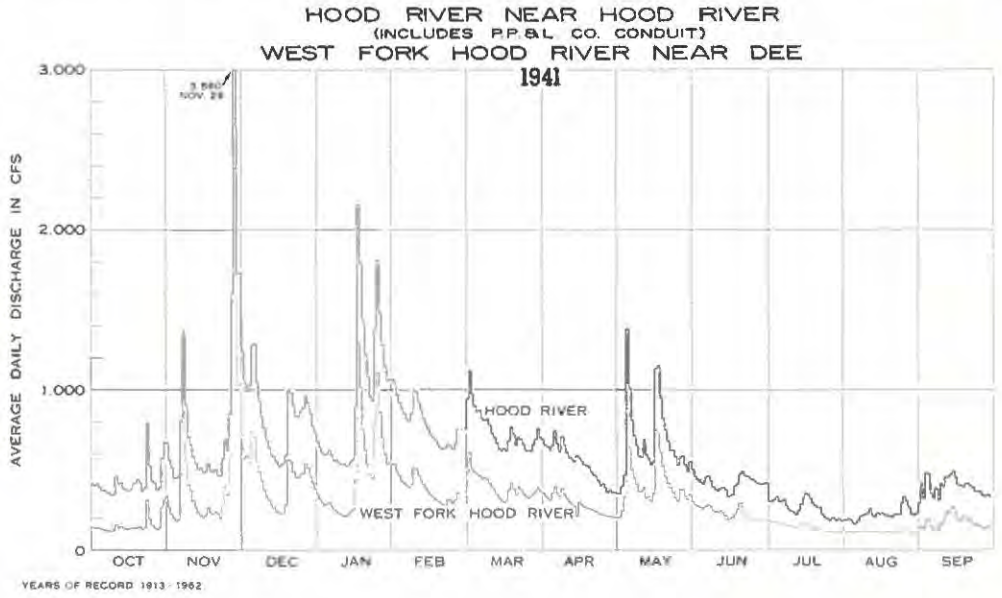


FIGURE 13. Extreme differences in daily flows.

the lowest water year of record. As shown on the lower line of the graph, the West Fork supplies over one-half the total streamflow and has runoff characteristics similar to the Hood River main stem near its mouth.

Table 12 lists available minimum and maximum instantaneous recorded discharges at twenty stream locations within the basin.

TABLE 12

EXTREMES OF DISCHARGE AT SELECTED STATIONS

MAP INDEX NO.	GAGING STATION	COMPLETE WATER YEARS OF RECORD	MINIMUM INSTANTANEOUS DISCHARGE		MAXIMUM INSTANTANEOUS DISCHARGE	
			Cfs	Month and Year	Cfs	Month and Year
	HOOD RIVER AREA					
1	Cold Springs Creek south of Parkdale	1930	10	May 1930	207	Nov. 1930
2	Dog River near Parkdale	1960-61	1.3	Nov. 1960	28	Feb. 1960
4	East Fork Hood River near Dee	0	93	Aug. 1917	560	July 1917
5	East Fork Hood River near Mt. Hood	1914	66	Sept. 1914	NR	
6	East Fork Hood River above intake near Mt. Hood	1916-18	114	Oct. 1919	2,420	Dec. 1917
10	Gorton Creek near Wyeth	1919	1.5	Sept. 1918, Oct. 1919	NR	
11	Green Point Creek below North Fork near Dee	1950-54	12	Sept. 1951, Oct. Nov. 1962	1,670	Jan. 1953
12	Green Point Creek near Dee	0	5.4	Sept. 1920	15	July 1919, July 1921
13	Hood River at Dee	1914-15	60	Aug. 1914	2,600	Dec. 1915
14	Hood River at Tucker Bridge	1898-1914, 1916-17	136	Sept. 1915	15,200	Jan. 1899
15	Hood River at Winans	1911	395	Mar. 1911	9,650	Nov. 1906, Jan. 1912
16	Hood River near Hood	1914-15, 1917-61	3*	Aug. 1926	34,000	Jan. 1923
17	Lost Lake Creek at Lost Lake	0	NR		NR	
18	North Fork Green Point Creek near Dee	0	6	Aug. 1920, Sept. 1921	29	Sept. 1921
20	West Fork Hood River near Dee	1914, 1933-61	93	Aug. 1941	12,900	Dec. 1933
	WASCO AREA					
3	Eightmile Creek near Boyd	1947-53	0.8	Sept. 1947	385	Feb. 1949
7	Fifteenmile Creek near Dufur	1919	4	Aug., Sept. 1918	113	Jan. 1918
8	Fifteenmile Creek near Wrentham	1947-53	0.8	Aug. 1947	3,540	Jan. 1953
9	Fivemile Creek near The Dalles	1949-53	0	Often	315	Feb. 1949
19	South Fork Mill Creek near The Dalles	1960-61	1.7	Dec. 1961	436	Feb. 1961

Note: *Regulated by PP&L conduit - minimum daily flow was 165 cfs in August 1941.
Map index numbers refer to Plate 3.
NR - No record.

Data Source: Oregon State Engineer and USGS

It should be noted that the column "complete water years of record" includes many intermittent periods.

The locations of the gaging stations listed in Table 12 together with their map index numbers are shown on Plate 2.

Outflow is rapid during early winter rainstorms before the heavy snowfall and freezing conditions in mountain areas hold back flows. Flood peaks are of short duration, reflecting the existing relatively short, steep, watershed characteristics. Recorded extreme discharges on Hood River show a minimum of 165 cfs in August 1941 and a maximum of 34,000 cfs in January 1923.

All streams mapped in the Hood area are perennial except four minor ones. The most striking minimum flow was 3 cfs on Hood River near Hood River, during August of 1926 due to power plant diversions of 162 cfs. Floods on Hood River were the highest of record in December 1964, causing extensive damage to the road and irrigation structures. During the 1964 flood, West Fork Hood River recorded a maximum flood flow of 50,000 cfs compared with the previous maximum recorded flow of 12,900 cfs in December 1933.

Flood damage is common on glacier fed headwater streams when glacier dikes break, releasing large quantities of rock, soil, and water.

Similar daily discharge records are not available for Wasco area streams but available data on Fifteenmile Creek indicates much wider fluctuations, with flows of from zero to 3,540 cfs over the gaged period. Fivemile Creek had a maximum recorded flow of 315 cfs in February 1949 and zero flow occurs frequently during July, August, and September.

Wasco area streamflows are much more erratic with a greater range between minimum and maximum flows. Although a zero minimum flow was recorded only at the Fivemile Creek gage, streams with low gage readings frequently have zero summer flows in portions of their channels.

Depletion

The State Water Resources Board has prepared and has on file a separate Hood Basin Water Rights Compilation booklet which lists all rights by stream, diversion point, priority date, and use. Table 13 summarizes this compilation by basin areas.

Total surface water rights equal 1,256.42 cfs of which 847.49 cfs are consumptive and 408.93 cfs are nonconsumptive.

TABLE 13

SURFACE WATER RIGHTS SUMMARY
As of January 1, 1964

AREA AND STREAM	CONSUMPTIVE						NONCONSUMPTIVE				TOTAL RIGHTS Cfs
	DOMESTIC Cfs	MUNICIPAL Cfs	IRRIGATION Cfs	IRRIGATION Acres	INDUSTRIAL Cfs	TOTAL Cfs	POWER Cfs	FISH Cfs	RECREATION Cfs	TOTAL Cfs	
HOOD AREA											
East Fork Hood Area											
East Fork Hood River	2.77	6.50	218.49	17,964		227.76	25.00	1.00		26.00	253.76
Neal Creek	0.76		8.25	661		9.01	5.10		0.05	5.15	14.16
Odell Creek	0.22	1.35	3.06	243	1.00	5.63	1.10			1.10	6.73
Hood River and Misc.	1.74	2.75	4.65	377	33.05	42.19	150.25	13.00		163.25	205.44
Middle Fork Hood Area											
Middle Fork Hood River	0.49		165.55	11,448		166.04					166.04
West Fork Hood Area											
West Fork Hood River	0.26	24.50	87.66	5,340	5.00	117.42		7.02	0.01	7.03	124.45
Oak Grove Area											
Hood River and Misc.			71.90	5,613		71.90					71.90
Phelps Creek	0.83		1.08	82		1.91	0.13			0.13	2.04
Indian Creek	0.45		4.34	337		4.79	15.00	0.30		15.30	20.09
Columbia Gorge Area											
Dry Creek	0.06	12.00	0.04	3		12.10					12.10
Herman Creek	0.22		0.25	20		0.47		118.65		118.65	119.12
Columbia River Misc.	2.66	1.00	3.14	222	6.73	13.53	0.37	53.08		53.45	66.93
TOTAL	10.46	48.10	568.41	42,310	45.78	672.75	196.95	193.05	0.06	390.06	1,062.81
WASCO AREA											
Fifteenmile Area											
Fifteenmile Creek	2.09	1.58	47.32	3,813		50.99	16.69			16.69	67.68
Ramsey Creek	0.01		2.76	220		2.77					2.77
Eightmile Area											
Eightmile Creek	1.45		13.95	1,112	0.28	15.68			0.10	0.10	15.78
Fivemile Creek	0.19		2.47	205	0.50	3.16					3.16
The Dalles Area											
Threemile Creek and Misc.	1.04		11.29	854		12.33	0.10			0.10	12.43
Mill Creek and Misc.	3.78	2.00**	13.47	1,074		19.25**					19.25**
Chenoweth Creek and Misc.	1.37		2.72	170		4.09					4.09
Columbia River Misc.	0.43		42.49	3,393	13.50	56.42					56.42
Mosier Area											
Mosier Creek and Misc.	4.43	*	5.62	383		10.05	1.88	0.10		1.98	12.03
TOTAL	14.79	3.58*	142.09	11,224	14.28	174.24**	18.67	0.10	0.10	18.87	193.61**
GRAND TOTAL	25.25	51.68*	710.50	53,534	60.08	847.49**	215.62	193.15	0.16	408.93	1,256.42**

Note: *Excludes two springs for municipal to the City of Mosier with no amount given.
**Excludes 4.55 cfs for ground water recharge of The Dalles Ground Water Pool.

Data Source: Oregon State Engineer and USGS

W A T E R S U P P L Y

Consumptive water rights for the basin would permit an annual maximum legal depletion of 255,000 acre-feet and nonconsumptive depletion of 296,300 acre-feet. The consumptive water right data is summaried in Table 14.

TABLE 14

MAXIMUM LEGAL ANNUAL DEPLETIONS
As of January 1, 1964

AREA AND STREAM	CONSUMPTIVE				
	DOMESTIC Ac.-ft.	MUNICIPAL Ac.-ft.	IRRIGATION Ac.-ft.	INDUSTRIAL Ac.-ft.	TOTAL Ac.-ft.
HOOD AREA					
East Fork Hood River	2,007	4,709	53,892		60,608
Neal Creek	551		1,983		2,534
Odell Creek	159	978	729	724	2,590
Hood River and Misc.	1,261	1,992	1,131	23,943	28,327
Middle Fork Hood River	355		34,344		34,699
West Fork Hood River	188	17,749	16,020	3,622	37,579
Oak Grove					
Hood River and Misc.			16,839		16,839
Phelps Creek	601		246		847
Indian Creek	326		1,011		1,337
Columbia Gorge					
Dry Creek	43	8,694	9		8,746
Herman Creek	159		60		219
Columbia River Misc.	1,927	724	666	4,876	8,193
TOTAL	7,577	34,846	126,930	33,165	202,518
WASCO AREA					
Fifteenmile					
Fifteenmile Creek	880	1,145	11,439		13,761
Ramsey Creek	7		660		667
Eightmile					
Eightmile Creek	839		3,336	203	4,378
Fivemile Creek	85		615	362	1,045
The Dalles					
Threemile Creek	316		2,562		3,018
Mill Creek	1,391	1,449**	3,222		6,070**
Chenoweth Creek	443		510		995
Columbia River Misc.	312		10,179	9,780	20,271
Mosier					
Mosier Creek	1,857	*	1,149		3,260
TOTAL	6,130	2,594*	33,672	10,345	52,741**
GRAND TOTAL	13,707	37,440*	106,602	43,510	255,259**

Note: *Excludes two springs for municipal to the City of Mosier with no amount given.
**Excludes 3,296 acre-feet for ground water recharge of The Dalles Ground Water Pool.

Data Source: Oregon State Engineer

W A T E R S U P P L Y

Water rights have been obtained for irrigation of 53,500 acres but only about 25,200 acres were irrigated in 1963.

Table 15 provides an estimate of water consumed by beneficial users with consumptive water rights.

TABLE 15

ESTIMATED CONSUMPTION

AREA	SURFACE WATER Ac.-ft.	GROUND WATER Ac.-ft.	TOTAL CONSUMED Ac.-ft.
Hood	46,000	0	46,000
Wasco	10,000	8,000	18,000
TOTAL	56,000	8,000	64,000

Source: SWRB estimates

The above figures reflect "net consumptive use" or water that is actually consumed by people and vegetation. The irrigation portion of this table was developed by multiplying a consumptive use factor of 2 acre-feet per acre by 25,200 acres presently irrigated. In the Hood area a conservative 10 percent of all other diversions was used as the portion which is consumed.

A different formula was required where ground water is pumped from The Dalles Pool. Computations indicated that 3,600 acre-feet of municipal-industrial water were consumed or diverted from the basin annually. These estimates were made to help determine ground water recharge requirements.

The calculated basin surface water consumption of 56,000 acre-feet contrasts with 255,259 acre-feet of legal consumptive rights and a 1,380,000 acre-feet annual average surface outflow.

The Hood area estimated surface water consumption was 46,000 acre-feet, consumptive water rights were for 202,518 acre-feet and the annual outflow average 1,250,000 acre-feet.

Hood area consumptive rights are in excess of water actually used. However, allowances must also be made for transportation losses through percolation, surface evaporation, and water distribution.

Figure 14 graphically presents the annual yield and the legal annual consumptive rights for Hood River.

No extensive analysis of present rights would be appropriate because the State Engineer is in the process of conducting final proof surveys to determine actual quantities of water beneficially used in perfection of permit and inchoate rights. These quantities are frequently less than the amount for which applications were made and permits issued. A large number of power rights are not presently being beneficially used.

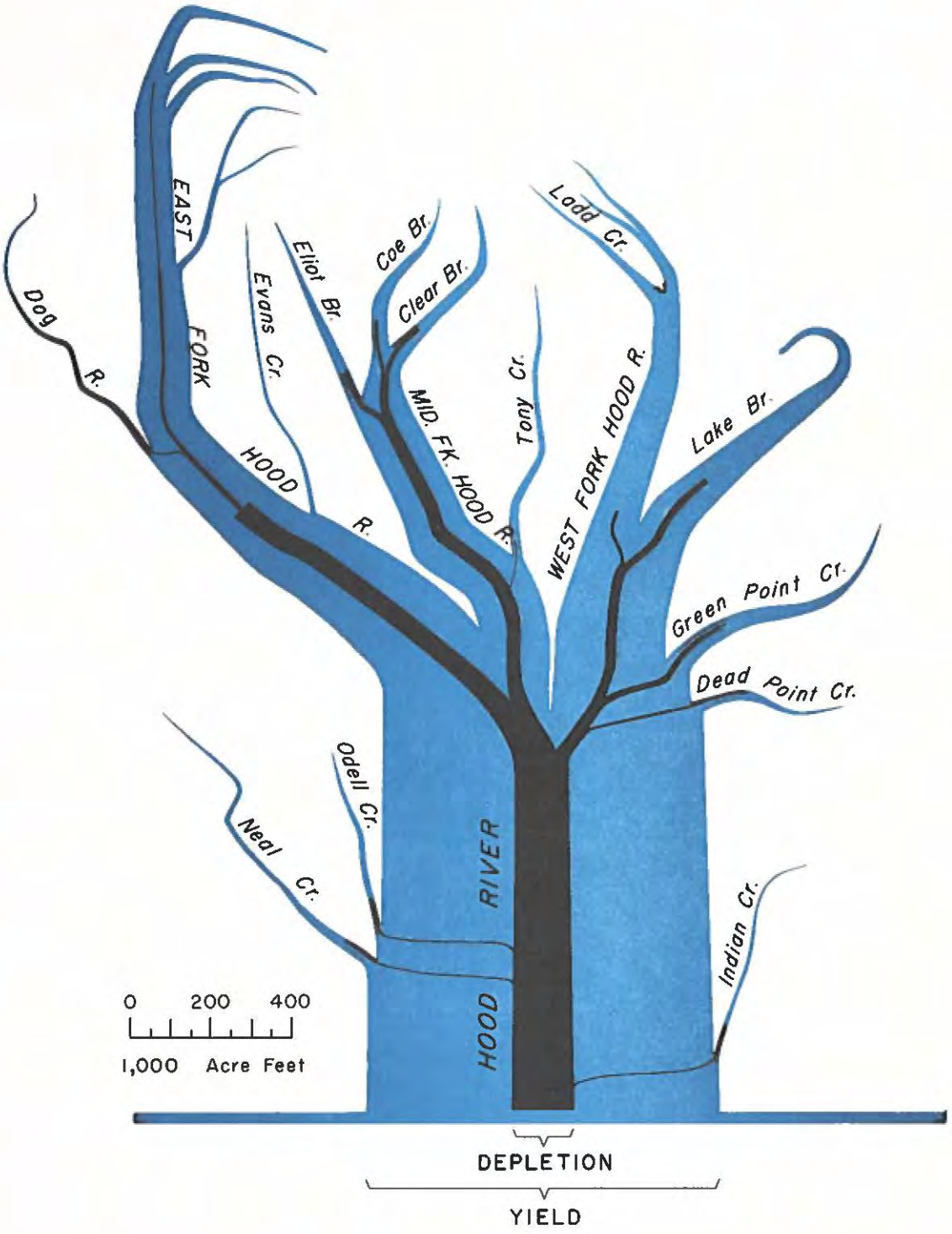


FIGURE 14. Average annual yield vs consumptive rights, Hood River.

W A T E R S U P P L Y

The large nonconsumptive rights for fish life will probably not be affected by the State Engineer's study. The largest of these rights is 118.65 cfs on Herman Creek. Rights total 53.08 cfs on other miscellaneous streams flowing directly into the Columbia River.

The Hood area has substantial quantities of unappropriated surface water subject to the jurisdiction of the State Water Resources Board. Many of the west-side streams have surplus natural flows. East-side streams have surplus winter flows, storable water, and, in the headwaters, have possibilities for such nonconsumptive uses as recreation and fish life.

Records list 25 power rights for 215.62 cfs of water but the county industrial committee survey in 1963 located only one large commercial power user. Some of these rights are being used for other purposes.

Wasco area consumption was 10,000 acre-feet, consumptive water rights were for 52,741 acre-feet and the average annual outflow was 130,000 acre-feet.

Many Wasco area municipal, industrial, and irrigation users draw water from streams while flows are available, then shift to well sources during dry summer periods to supplement their surface water sources.

In the Wasco area, the largest consumptive surface water rights are for irrigation in the amount of 142.09 cfs. All main interior streams are seasonally over-appropriated to the point that storage of unappropriated winter and spring flows is the only practical source of additional surface supplies.

Not included in the municipal summary is a permit for The Dalles to utilize 4.55 cfs of Mill Creek water for recharging The Dalles Pool which underlies the city and environs. This right is specifically for ground water recharge purposes in which the water could eventually be used for several consumptive uses. Also omitted is the right to divert all Dog River waters above the diversion headworks to Mill Creek for municipal use by The Dalles. The amount of water to be diverted was not definitely designated.

In the Wasco area, there are limited quantities of unappropriated surface water subject to the jurisdiction of the State

Water Resources Board. Most of this water can be made available only by the construction of storage reservoirs. Unregulated streamflows are generally inadequate to satisfy water rights during heavy use summer periods.

Figure 15 graphically presents the annual yield and the legal annual consumptive rights for Fifteenmile Creek.

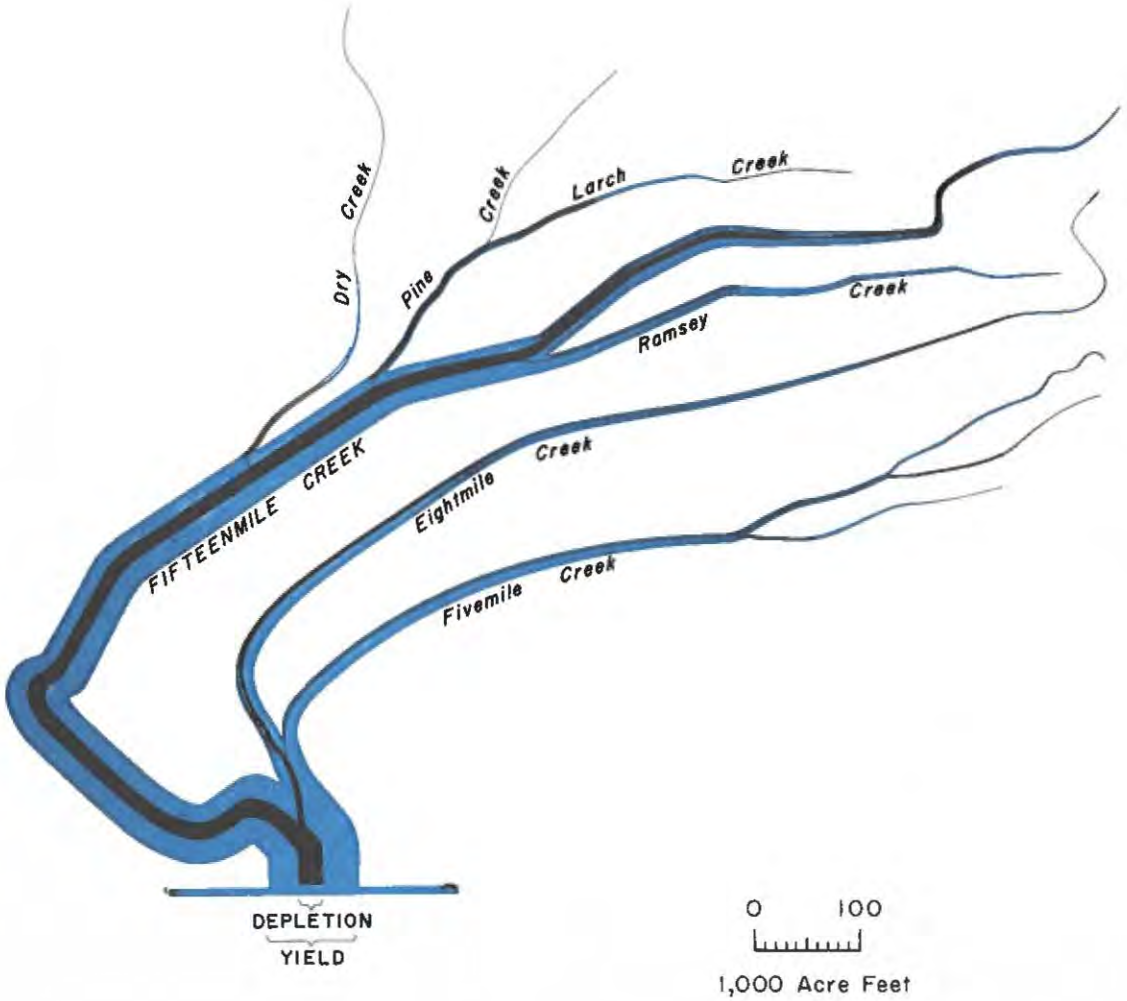


FIGURE 15. Average annual yield vs consumptive rights, Fifteenmile Creek.

W A T E R S U P P L Y

Table 16 lists existing reservoir water rights.

TABLE 16

RESERVOIR WATER RIGHTS SUMMARY

AREA	NUMBER OF RIGHTS	STORAGE CAPACITY IN ACRE-FEET						SURFACE AREA Acres
		Domestic	Irrigation	Industrial	Recreation	Fish	Total	
HOOD								
East Fork Hood	2		4.75		0.50		5.25	1.05
Middle Fork Hood	1		2,650.00				2,650.00	104.00
West Fork Hood	4		1,300.00	132.50		1.30	1,433.80	60.40
Oak Grove	1		0.40				0.40	0.05
Columbia Gorge	2					4.50	4.50	1.25
TOTAL	10		3,955.15	132.50	0.50	5.80	4,093.95	166.76
WASCO								
Fifteenmile	7	10.27	24.90				35.17	9.51
Eightmile	9	13.02	10.00	1.00	37.50		61.52	10.92
The Dalles	10	38.85	162.00				200.85	42.49
Mosier	3	7.30				125.00	132.30	16.10
TOTAL	29	69.44	196.90	1.00	37.50	125.00	429.84	79.02
GRAND TOTAL	39	69.44	4,152.05	133.50	38.00	130.80	4,523.79	245.77

Data Source: USGS

GROUND WATER

General

Available information on the geology and recharge potential of the Hood River Valley indicates that it may contain large ground water resources. Until a comprehensive ground water study is made, however, the occurrence as well as the availability of the ground water will remain conjecture. Such a study should include geologic mapping, a test-well drilling program, and the collection of precipitation, surface runoff, and water table fluctuation records for a period of several years. No such study has been made in the Hood area because of generally ample supplies of surface water.

Detailed ground water studies in the basin are limited to the Wasco area. Reports based on investigations conducted by the U. S. Geological Survey in The Dalles region and in an area near Mosier were published in 1932 and 1963, respectively. The results of ground water recharge tests made at The Dalles during the winter of 1960-61 are described in an unpublished Geological Survey report. Titles of these and other geologic references used in this report are listed in the bibliography.

W A T E R S U P P L Y

The water level in The Dalles Ground Water Reservoir, a high-yield aquifer underlying The Dalles and environs, began to decline so rapidly that the State Engineer conducted a study which led in December 1959 to declaring it a critical ground water area. The order includes the overlying Threemile Ground Water Reservoir and prohibits drilling of all but domestic wells in the area.

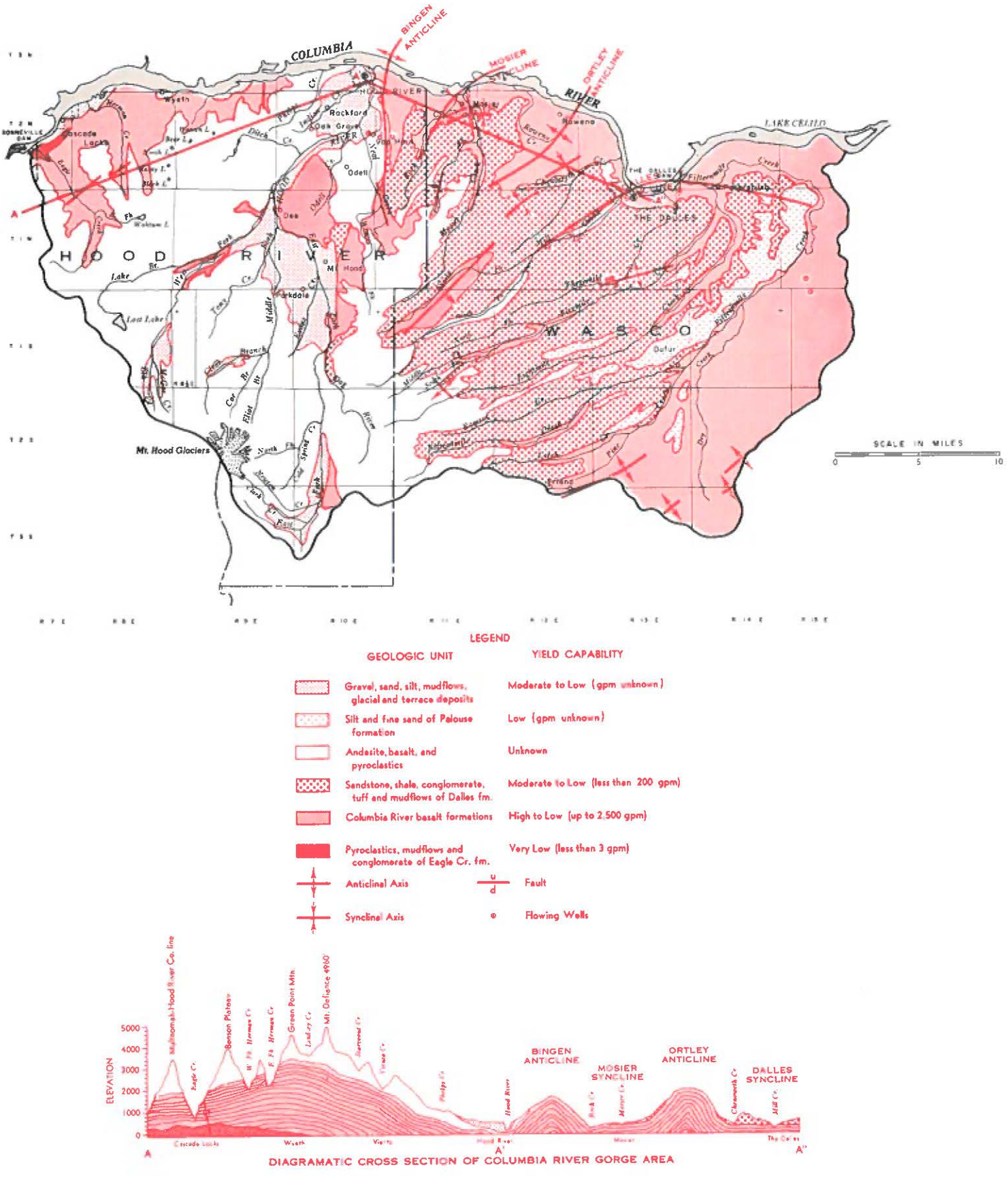
Recharge tests at The Dalles demonstrated the economic and technical feasibility of recharging the ground water reservoir by artificial means. Surplus water from the South Fork of Mill Creek was directed into the aquifer via The Dalles water distribution system and the Jordan Street municipal well. The recharging was terminated upon completion of the tests.

The water level in The Dalles aquifer has since continued to decline except for the rise caused by the abnormally high winter runoff of 1964-65. The decline is expected to continue until the withdrawals or losses are balanced by sustained recharge. The activation of the Western Division of The Dalles Project, scheduled for August 1965, will supply Columbia River water to irrigators in the area and thereby relieve the aquifer of this considerable withdrawal. Use of this source and the resulting seepage is expected to materially raise the water level in The Dalles aquifer.

Geology

Much of the Hood Basin is underlain by successive flows of Columbia River basalt as shown in Figure 16. Economically important ground water is found where incomplete closures of one flow over another, where porous and permeable tops of some flows, or where fractured zones within the flows provide an aquifer.

Geologic structures and fault barriers in the basin further play an important part in creating ground water reservoirs and in making ground water economically available. These structures, called anticlines or arches and synclines or troughs, are undulations caused by the compression of the earth's crust during the uplift of the Cascade Range. The major structures in the basin trend northeasterly and, in eastward progression, are the Hood River syncline, the Bingen anticline, the Mosier syncline, the Ortley anticline, and The Dalles syncline. Faults known to affect ground water movement and accumulation occur in the Hood River, Mosier, The Dalles, and other areas.



DIAGRAMATIC CROSS SECTION OF COLUMBIA RIVER GORGE AREA

DATA SOURCE: U. S. Geological Survey
Oregon State Engineer
Oregon State Dept. of Geology and Mineral Ind.

FIGURE 16. Generalized ground water geology.

W A T E R S U P P L Y

Figure 16 shows the geologic structures, the major known faults, and the rock types described below.

The rocks underlying the basin are predominantly volcanic, of which the widespread Columbia River basalt formation is the most productive of ground water. Rock types of considerable extent in the Hood area are the younger basaltic and andesitic flows, and younger andesite and pyroclastics forming Mt. Hood and surroundings. Their ground water potentials are generally unknown. Stream and lake deposits in the upper and lower Hood River Valley basins may contain considerable ground water. The Columbia and Hood Rivers, as well as the larger creeks in the basin, are bordered by alluvial deposits which contain ground water in varying amounts.

Overlying the Columbia River basalt flows in the Wasco area, and generally limited to the Mosier and The Dalles snyclinal troughs, is The Dalles formation of discontinuous beds or lenses of interfingering sedimentary and volcanic rocks. Its ground water potential is generally low. The Palouse formation, a relatively thin deposit of silt and fine sand overlying the eastern part of the area, yields little ground water.

Occurrence

The Hood area is believed to have considerable ground water potential in the Hood River Valley where coarse gravels, sands, mudflow breccia, and porous, permeable younger lavas make up much of the valley. Large quantities of surface irrigation water drain into these deposits and rocks, as well as rainfall and snowmelt from the extensive high areas bordering the valley. It is known that ground water in the lower valley occurs in the basalt flows at about the level of the Columbia River.

Figure 16 shows the generalized yield capability of the various geologic formations underlying the basin.

From a rock-type consideration, there should be sufficient ground water in the gravels and underlying basalts in the lower valley to justify drilling several exploratory wells to locate additional water sources for expanding needs. Before test wells are located it is recommended that geologic mapping be done to select proper drilling sites. Subsurface geologic structural barriers may be present that block or direct ground water movements. Such barriers may explain why some wells in the area have been abandoned for lack of good yields.

W A T E R S U P P L Y

In the Hood River Valley, except for iron and associated odor being reported in a well at Odell and in several wells north of Oak Grove, no ground water quality problems are known to exist.

The largest producing well is an industrial well at Odell that yields 200 gpm. Representative high-yield wells in the Hood and Wasco areas are shown in Table 17.

TABLE 17

REPRESENTATIVE TEST PUMPED HIGH-YIELD WELLS

YIELD Gpm	DRAW-DOWN Feet	SPECIFIC CAPACITY Gpm per foot of drawdown	DEPTH TO STATIC WATER LEVEL Feet	DEPTH OF WELL Feet	AQUIFER	WATER USE
The Dalles Ground Water Reservoir						
2,500	5.5	455	22	200	Basalt	Municipal
2,500	30	83	118	291	Basalt	Municipal
2,160	4.4	491	86	314	Basalt	Industrial
1,500	Little	-	52	335	Basalt	Irrigation
1,200	2	600	76	275	Basalt	Irrigation
Threemile Ground Water Reservoir						
400	66	6	?	301	Basalt	Irrigation
360	37	10	124	230	Basalt	Irrigation
215	107	2	248	494	Basalt	Irrigation
180	2.5	72	334	433	Basalt	Irrigation
Mosier Area						
400	49	8	41	250	Basalt	Municipal
200	None	200	197	401	Basalt	Irrigation
180	2	90	155	431	Basalt	Irrigation
Odell Area						
200	205	-1	?	264	Gravel	Industrial
125	150	-1	35	262	Gravel	Industrial
Parkdale Area						
22	30	-1	8	90	Gravel	Domestic
15	None	15	10	26	Basalt	Domestic

Data Source: Oregon State Engineer

In the Wasco area the outstanding source of ground water is The Dalles Ground Water Reservoir, locally known as "The Dalles Pool", which occurs in the Columbia River basalt formation underlying The Dalles and environs. This zone is exceptionally permeable and has for many years yielded abundant quantities of ground water to wells. Some wells produce as much as 2,500 gpm. The zone generally ranges from 20 to 40 feet in thickness and occurs between 350 and 400 feet below the top of the basalt formation. This reservoir forms the major part of The Dalles critical ground water area of approximately 20 square miles.

W A T E R S U P P L Y

Water level measurements in The Dalles City Hall well, representative of the generally uniform water level throughout The Dalles Ground Water Reservoir, show a 42-foot decline during the 36-year period 1928 to 1964. A small decline occurred from 1930 to 1951, followed by a large decline sometime during 1952 to 1958 when records were not kept. It is known, however, that one series of increasing declines occurred coincident with the 1957 installation of four large industrial wells north of The Dalles. Records of their production are not available.

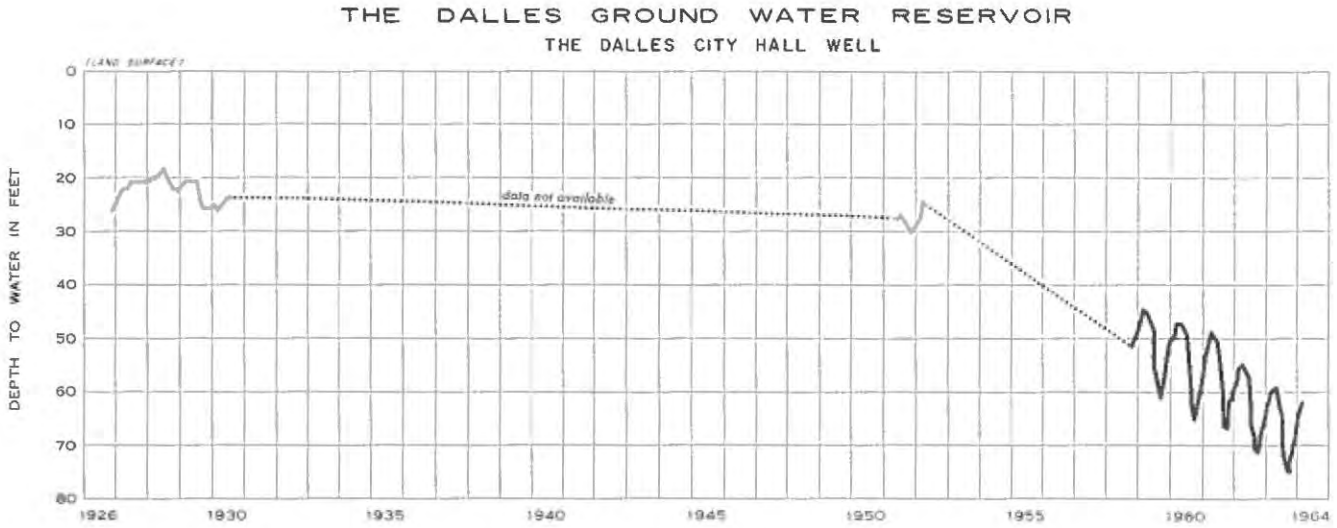
Significant recent changes in The Dalles Reservoir have been 5-foot declines during each of the one-year periods 1961-62 and 1962-63, and the 6-inch rise during the winter of 1964-65 over that of the previous winter. This rise was due to the unusually high winter runoff and is believed to be temporary. A hydrograph showing the decline of the water level in the reservoir is shown in Figure 17.

It is possible, due to the layered character and great thickness of the Columbia River basalt formation underlying The Dalles area, that additional ground water reservoirs may eventually be found below and separate from The Dalles Ground Water Reservoir. Deep wells, properly cased and sealed, would have little or no affect on the overlying water supply.

The Threemile Ground Water Reservoir, located in the southeast part of The Dalles critical ground water area, has a surface area of about six square miles. The reservoir has limited transmission capacity in several interconnected water-bearing layers that occur 35 to 100 feet below the top of the basalt underlying the lower Threemile Creek Valley. The largest producing well yields 400 gpm. The water level in this reservoir in March 1962 was about 300 feet above the underlying water level of The Dalles Ground Water Reservoir. The two reservoirs are hydraulically separate.

The water level decline in The Threemile Ground Water Reservoir is shown by records of the Cherry Hill District Improvement Company well, representative of the decline throughout the reservoir. The well record shows a decline of approximately 120 feet for the 36-year period 1926 to 1962, and an almost continuous decline since 1930. The decline has been so excessive that the ground water supply in the reservoir is near exhaustion. Water-level measurements were discontinued in 1962. A hydrograph illustrating the decline is shown in Figure 17.

The Rocky Prairie anticline southeast of Mosier was recently



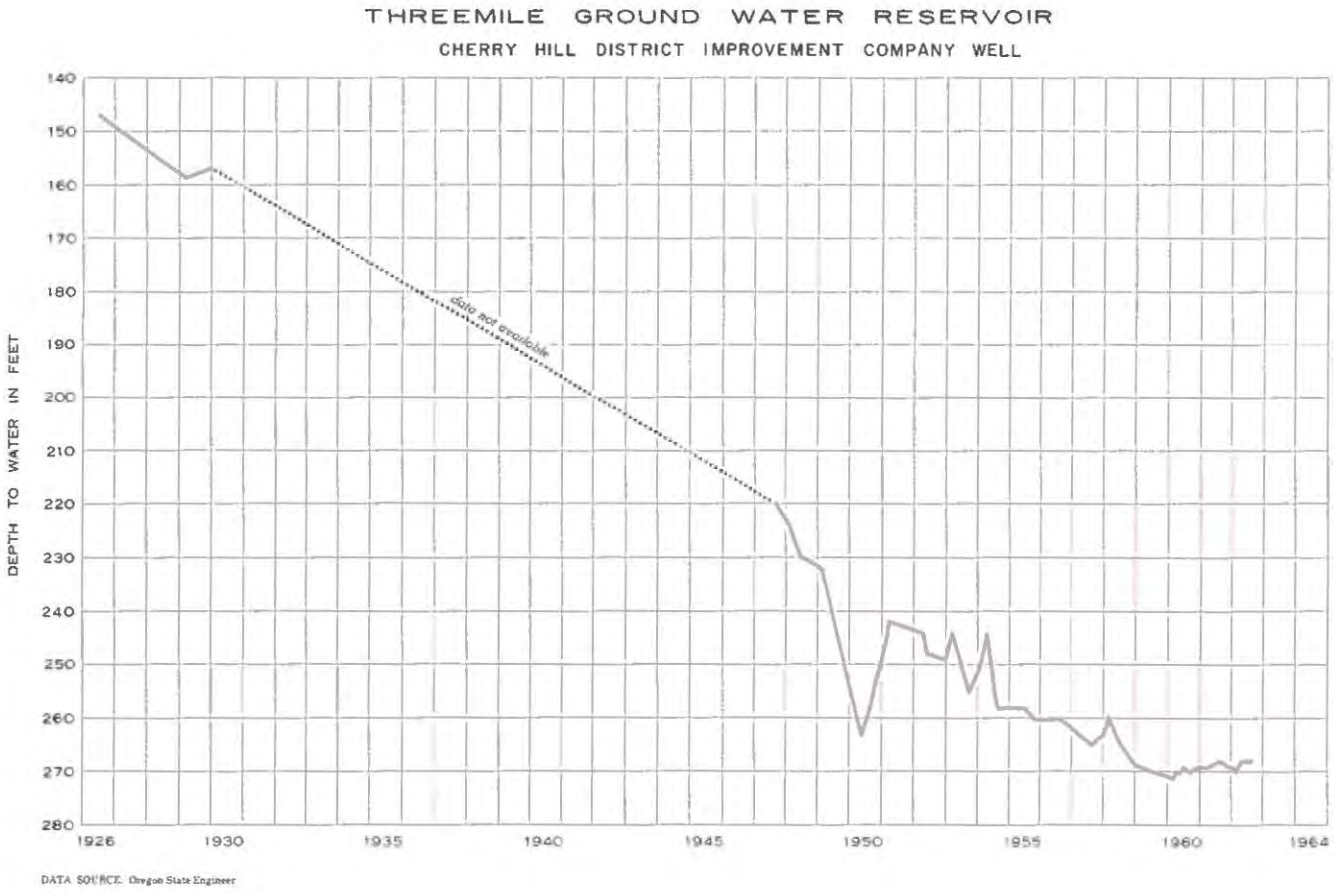


FIGURE 17. Hydrographs of The Dalles and Threemile ground water reservoirs.

found by the U. S. Geological Survey to be a barrier to the movement of ground water in the adjacent upslope Orchard syncline, thereby causing the water to accumulate to a height where it is economically available for irrigation. The agency estimates that this ground water reservoir, located in Columbia River basalt flows, could provide 3,000 acre-feet of irrigation water annually for 1,500 acres of orchard and farm land overlying the Orchard syncline. Hydrologic factors indicate that the annual recharge supplies are both adequate and dependable.

At least one-fault-impounded ground water reservoir, also in basalt, is known to occur farther up Mosier Creek Valley about five miles beyond the Orchard syncline. A like reservoir in the area occurs along the North Fork of Mill Creek.

One of the principal ground water problems in the Wasco area is that much of the plateau land lies above the regional water table and necessitates high pumping lifts. In the upper areas of Threemile, Fivemile, and Eightmile Creeks, however, geologic fault barriers in the basalt cause ground water to accumulate at higher elevations than it would otherwise. These high water levels not only make ground water economically available for pumping but also cause the flowing wells at 1,200 feet altitude on Threemile Creek and other high places. Irrigation in some of the upland areas is therefore feasible from wells. Some flowing wells, however, have stopped or are declining due to loss of hydrostatic pressure where outflow has exceeded recharge or transmissibility.

Ground water is also used in varying amounts to supplement surface irrigation supplies along parts of Mosier, Chenoweth, Mill, Threemile, Fivemile, and Fifteenmile Creeks. A number of additional wells are being constructed along Fifteenmile Creek for this purpose. A relatively high water table in some parts of the area around Dufur makes irrigation possible there. About 2,100 acres in the Wasco area are irrigated annually from ground water sources.

The small community of Friend is situated near the crest of an anticline where ground water is insufficient to supply even domestic needs. Most wells drilled in this area are dry.

The Dalles formation, overlying much of the basin east of the Hood River Valley, generally has low permeability and consequently is a source primarily of domestic water. Moderate supplies of ground water are furnished along Chenoweth Creek, west of The Dalles, by permeable gravel zones near the base of the

formation. Wells show no indication that water levels in the formation are declining. The impermeability of the formation has caused ponds to form on the upland surfaces, particularly on Mt. Hood Flat and Government Flat southwest of The Dalles. Wells tapping this formation usually have poor yields.

No ground water quality problems are known to exist in the Wasco area. The major wells in the basin, yielding up to 2,500 gpm, are located in The Dalles area. For comparative purposes, a number of these test pumped wells and several from the Threemile, Mosier, Odell, and Parkdale areas are shown in Table 17.

Ground Water Rights

The ground water rights for the basin as of January 1, 1964, summarized in Table 18, total 102.78 cfs; of which 0.49 cfs are

TABLE 18

GROUND WATER RIGHTS SUMMARY
As of January 1, 1964

AREA	USE	CLAIMED Cfs	INCHOATE Cfs	PERFECTED Cfs	AREA TOTAL Cfs
HOOD					
	Industrial	0	0	0.49	0.49
SUBTOTAL				0.49	0.49
WASCO					
	Domestic	1.77	0.28	0	2.05
	Municipal	5.10	34.41	2.68	42.19
	Industrial	0.37	14.38	0.53	15.28
	Irrigation	1.89	15.58	25.30	42.77
	(acres)	(170)	(1277)	(2350)	(3797)
SUBTOTAL		9.13	64.65	28.51	102.29
BASIN TOTAL		9.13	64.65	29.00	102.78

Note: Cfs for irrigation is based on a rate of 1/80 cfs per acre and 3 acre-feet per acre per irrigation season.

Data Source: Oregon State Engineer

for two industrial wells in the Hood area, and 102.29 cfs are for 109 wells in the Wasco area. Irrigation rights, for use on 3,797 acres of land, amount to 42.77 cfs or 42 percent of the total basin ground water rights. The other rights for the basin are 42.19 cfs or 41 percent for municipal use, 15.77 cfs or 15

percent for industrial use, and 2.05 cfs or 2 percent for domestic use.

Rights listed in Table 18 do not include small domestic, livestock, or industrial users who are exempt from having to acquire rights.

In Table 18, the Hood area has water rights for only two wells, both near Odell. These are perfected rights allowing the use of 0.22 and 0.27 cfs for industrial purposes.

A maximum legal annual irrigation ground water withdrawal of approximately 11,390 acre-feet is estimated by assuming an average duty of water of 3 acre-feet per acre for irrigated land.

The legal annual withdrawal, if all ground water rights were used to their maximum extent, amounts to 54,866 acre-feet. This figure, however, does not represent the actual withdrawal which is unknown in most instances.

WATER USE & CONTROL



WATER USE & CONTROL

HOOD AREA

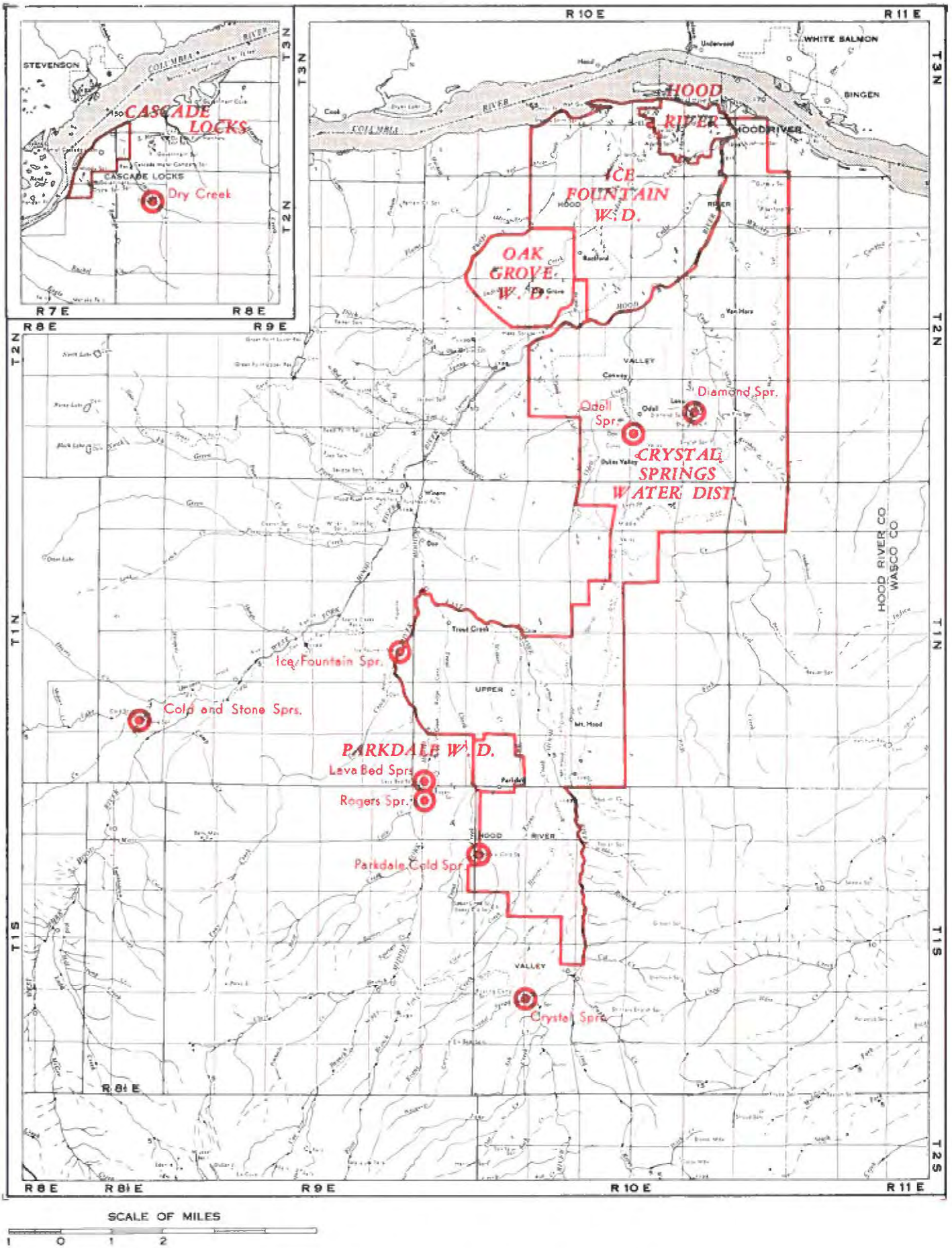


FIGURE 19. Sources of water supply - Hood area.

or a maximum annual legal depletion of 34,800 acre-feet. Municipal surface water rights on Dry Creek for the Cascade Locks water system amount to 12 cfs of the above rights. The City of Hood River, the other large municipal user, has a right for about 25 cfs from Cold and Stone Springs in the Lake Branch Hood River watershed. There are no municipal ground water rights in the Hood area.

In the Wasco area The Dalles and Dufur are expanding their municipal water systems according to plans supplied by engineering consultants. The Chenowith and Mosier Water Districts are in need of additional sources of supply.

Municipal surface water rights in the Wasco area amount to 1.58 cfs on Fifteenmile Creek for Dufur and 2.0 cfs on Mill Creek for The Dalles. This amounts to a maximum annual legal depletion of 2,594 acre-feet.

In addition, The Dalles has obtained a right for 4.55 cfs from Mill Creek to recharge The Dalles Ground Water Pool. They also have a right to all the flows of Dog River at their inter-basin diversion intake which is estimated at up to 5.5 cfs.

Municipal ground water rights in the Wasco area amount to 42.19 cfs or a maximum annual legal depletion of about 30,565 acre-feet. Most of these wells draw from The Dalles Pool which has been designated a critical ground water area.

The Dalles is partially supplied by four wells, 200 to 1,000 feet deep, that furnish approximately 300 million gallons (921 acre-feet) of water annually. The primary municipal water source is Mill Creek, with an inter-basin diversion from Dog River, tributary of Hood River East Fork. Wicks Reservoir in the Mill Creek watershed and the distribution system have a total capacity of 15 million gallons per day. The summer yield drops to about 3 million gallons per day so additional needs are obtained from ground water sources.

Storage will be required to supply 7 million gallons per day or about 2,600 acre-feet each summer within the next 20 years according to a consulting engineer's study. The Dalles Ground Water Pool has receded to a critical point so experimental recharge has successfully been tried from Mill Creek winter flow. Other water sources being considered are storage on Mill Creek, additional wells, and use of Columbia River water. Needs in the next 20 years have been estimated at 25 million gallons per day for the city. The Dalles and surrounding suburban area

present annual water usage is estimated at 4,700 acre-feet.

The Dalles Municipal Water System serves a population of 11,069 people plus 412 commercial and 13 industrial facilities. Average daily per capita consumption if 330 gallons.

The two other group water systems in this area are the Chenowith Irrigation Cooperative with three wells and the Lower Chenowith with two wells. Together they serve 2,780 people and two high water using industries.

Table 19 lists the municipal and group water systems in the basin that supplied records of their operations. Group systems supply

TABLE 19

PUBLIC WATER SYSTEMS

AREA AND WATER SYSTEM	POPULATION SERVED	SOURCE	WATER RIGHTS Cfs	WATER RIGHTS Mgd	PROBLEM
HOOD					
Cascade Locks	600	Dry Creek	12.0	7.8	Quantity
Crystal Springs	3,050	Crystal Springs	1.00	0.65	Reorganization
Hood River	7,000	Cold and Stone Springs	27.0	17.6	Reorganization
Oak Grove	(280)	Ditch Creek and Spring	0.25	0.16	
Odell	400	Odell Spring	1.35	0.88	Quantity
Parkdale	500	Trout Creek Spring	0	0	No municipal right
SUBTOTAL	14,670				
WASCO					
Dufur	555	Fifteenmile Creek	1.58	1.03	Turbidity and system rehabilitation
Mosier	260	1 well	0.33*	0.21	Quantity and quality
The Dalles	11,975	Mill Creek, Dog River, and 4 wells	29.62	19.25	Turbidity and quantity
Chenowith Irr. Coop.	2,500	3 wells	5.78	3.76	Quality and quantity
Lower Chenowith	280	2 wells	1.37	0.89	Quantity
SUBTOTAL	11,830				
TOTAL	26,500				

*Not including flow from two springs and a well for which no amount is given.

Data Source: Oregon State Engineer's records

water to approximately 26,500 persons or about 85 percent of the basin's population.

Irrigation

The annual irrigated area in the Hood Basin averages about 25,200

acres. Fruit production is the predominant irrigated crop, followed in order of importance by pasture, hay, and small grain. Irrigation is utilized wherever practicable because normal precipitation is inadequate to sustain maximum plant growth, except for small grains, throughout the growing season. Irrigation utilizes 82 percent of the consumptively used water in the basin.

Table 20 lists acreages for which water rights are held and those actually irrigated.

TABLE 20

IRRIGATION DEVELOPMENT
1963

AREA	LAND WITH IRRIGATION WATER RIGHTS			LAND UNDER IRRIGATION Acres
	SURFACE WATER Acres	GROUND WATER Acres	TOTAL RIGHTS Acres	
Hood	42,270	0	42,270	19,000
Wasco	11,224	4,406	15,630	6,200
TOTAL	53,494	4,406		25,200

Data Source: Oregon State Engineer's records

In the Hood area, surface water rights for about 42,300 acres of land total 568.41 cfs for a legal annual depletion of about 126,800 acre-feet. There are no ground water rights for irrigation. A State Engineer's survey, when completed, and the determination of the inchoate rights will permit the County Court to adjust these rights downward toward the 19,000 acres actually irrigated in the Hood River Valley during 1963.

A recently completed land classification in the Hood River Valley indicates 6,200 acres of additional available irrigable land. The Public Law 566 Middle Fork Project, recently approved for construction involves development of 2,000 acres for irrigation. Other presently proposed developments involving the remaining 4,200 acres are in the Oak Grove, Mt. Hood, East Fork, and Neal Creek areas.

With storage, available surface water supplies are adequate for proposed developments and for supplemental water needs of present irrigators who experience seasonal shortages. Shortages experienced by the Hood River Irrigation District on the west side are mainly due to seepage losses in the High and Low Line Canals. Other district shortages are due to distribution difficulties. Total diversions are only about 10 percent of the annual yield, nevertheless natural streamflow is depleted during irrigation season in dry years. Storage sites on Clear Branch, Horsethief Meadow, Neal Creek, and Indian Creek have been considered. Each of these sites, shown on Plate 4, show sufficient potential to

justify detailed study in conjunction with development proposals. Figure 20 locates irrigation districts in the basin.

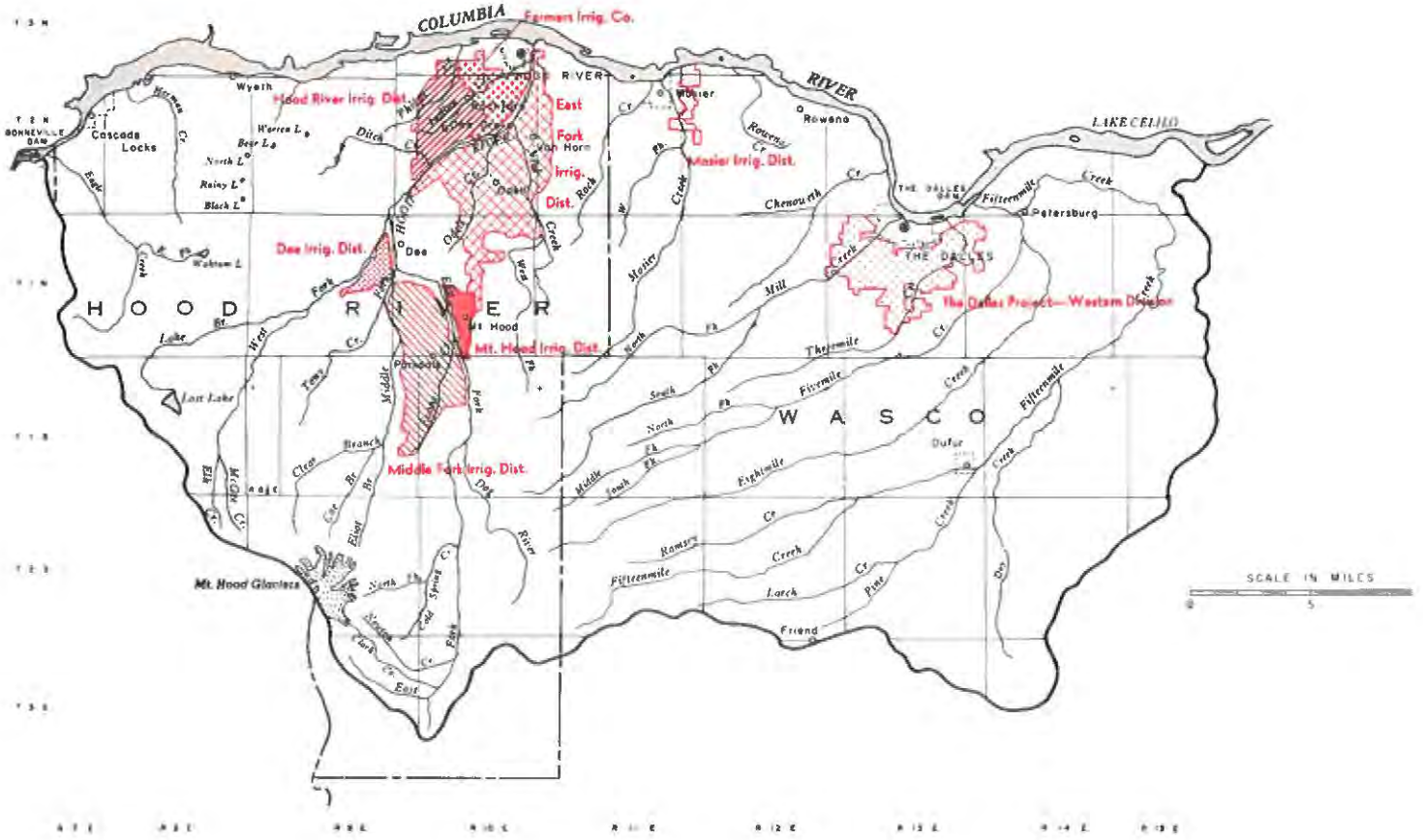


FIGURE 20. Irrigation districts.

Managers of the Hood area irrigation districts supplied the following data for their districts. The gross irrigated area within the six irrigation districts during 1962 was about 25,900 acres. Lands served from 30 private sources and the Aldrich Ditch Company during the same period equalled 660 acres. Irrigable lands not yet developed within the districts amounted to 4,700 acres.

The above are gross district figures and do not agree exactly with net irrigated acres used generally in this report.

The number of irrigation accounts where operators obtained over

one-half of their income from farming operations totaled 1,050. There were 800 additional irrigation accounts which covered mainly suburban users with small acreages. The average farm size in predominantly fruit areas was 25 acres.

The East Fork Irrigation District has had to restrict water use during several recent years and sustained a 30 percent shortage in critical years. Due to seepage losses in the Hood River District's High and Low Line Canals, this district has sustained water shortages of 2,000 to 3,000 acre-feet during most years. More serious losses were avoided by treating the more porous sections of the long intake canals with hardboard waste and bentonite.

Table 21, Irrigation District Data, includes reported average

TABLE 21

HOOD AREA

IRRIGATION DISTRICT DATA

DATA	FARMERS	DEE	EAST FORK	MIDDLE FORK	MT. HOOD	HOOD RIVER	TOTAL
Acres irrigable	5,400	1,200	10,400	9,000	1,372	3,300	30,672
Acres with water rights	5,000	1,200	11,803	6,415	1,331	4,169	29,918
Acres irrigated in 1962 (gross)	5,150	840	9,950	5,864	1,083	3,040	25,927
% of application by sprinklers	90	99	90	94	90	70	90
Acres of irrigated crops grown							
Tree fruit	4,120	800	8,000	4,574	83	1,900	19,470
Pasture	515	15	1,050	440	540	600	3,160
Forage	515	-	820	440	430	400	2,605
Berries and other	-	25	80	410	30	140	692
Maximum canal capacity in cfs	30	16	140	75	8	25	294
Water use in 1962 in ac.-ft.	12,400*	1,020*	28,590*	10,630	2,780*	4,250*	59,670
Average monthly water need in ac.-ft.							
April	1,150	20	2,020	40	-	70	3,300
May	3,320	360	4,510	960	530	780	10,460
June	4,000	840	6,770	2,820	790	1,430	16,650
July	4,390	1,050	7,680	3,650	840	1,500	19,110
August	4,310	990	7,360	3,510	680	1,340	18,190
September	2,930	430	4,980	1,780	390	620	11,130
October	1,850	-	2,740	120	-	30	4,740
Miles: main canal	12	7	40	9	0	32	100
laterals	13	3.5	45	37	4	11	113.5

Note: *Indicates incomplete gaging records.
Above figures are for comparison and do not necessarily agree with other figures in the report.

Data Source: Irrigation district managers and Oregon State Engineer's records

and monthly April through October irrigation water needs by

districts. July and August were normally the high water use months.

Over one-half of the farm irrigation distribution systems consist of pipelines and the trend is toward pressure systems for sprinklers. The East Fork, Mt. Hood, Middle Fork, and Farmers Irrigation Districts reported high maintenance costs due to abrasive action of glacial silt. They further sited silt deposition, flood damage to intake structures, and clogging of fish screens by moss as causing major operation problems. All but the Dee District reported that small, scattered, drainage needs are developing in suburban areas. The greatest problem areas are in heavy soils of the Wy'east, Odell, Parkdale, and Hood River suburban areas.

All districts reported a rapid increase in sprinkler irrigation which has improved irrigation efficiency and decreased water requirements. Analysis of the data listed in Table 21 shows the district water needs to vary from 2.0 to 5.6 acre-feet per acre annually. Two trends noted in land use are increased planting to orchards and expansion of suburban homes into irrigated areas with a net acreage loss to agriculture.

In the Wasco area, surface water rights to irrigate 11,224 acres total 142.09 cfs for a legal annual depletion of 33,672 acre-feet. Ground water rights to irrigate 3,797 acres total 42.77 cfs for a legal annual depletion of about 11,390 acre-feet. There were about 6,200 acres actually irrigated in the Wasco area during 1963. About 4,060 acres were irrigated from surface water sources and 2,140 acres from ground water sources.

Reports from the Fifteenmile Creek area indicate that in dry years only a few senior rights obtain sufficient irrigation water from surface sources. Throughout the irrigated valleys, many of the rights receive only spring floodwaters. Several wells have been drilled to supplement surface water supplies.

The West Division of The Dalles Project will obtain its water from the Columbia River for 5,420 acres when construction is completed in 1965. Due to shortages of both surface and ground water within the Wasco area studies indicate that possible future irrigation development of 700 acres or more on the East Division would also be from the Columbia River water source.

Several storage sites exist but available data from studies indicate very expensive storage costs and great variations in annual yield for the streams that would be involved. Storage sites

studied showed stream gradients of 2 to 3 percent or greater which would result in high dams, high cost, and little storage. Reservoir sites which have been studied for multipurpose uses include: Fifteenmile Creek above Ramsey Creek junction, 15,000 acre-feet; Jap Hollow between Fivemile and Eightmile, 25,000 acre-feet; Crow Creek, South Fork Mill Creek, 1,000 acre-feet; and Mosier Creek, 2,800 acre-feet. Other damsites mentioned in the Fifteenmile Creek drainage include Ramsey Creek above mouth, Dry Creek near mouth, and Fifteenmile Creek near Boyd, Rice, and Emerson. Storage on Dog River with an enlarged inter-basin diversion to Mill Creek has been proposed. These damsites are shown on Plate 4. Numerous stock water ponds exist and more are proposed on the headwaters of Fivemile, Eightmile, and Fifteenmile Creeks.

Power

The basin has 25 power rights for water totaling 215.62 cfs. Most of these rights have not been used for power production in recent years. A survey by the county industrial committee showed only one right being presently used for hydroelectric power.

The basin is located between two large hydroelectric projects, Bonneville Dam on the west boundary and The Dalles Dam immediately upstream of the City of The Dalles. Distribution of power from Bonneville Power Administration in the basin for fiscal year 1961-62 was as follows:

Customer	1000 kwh
Cascade Locks Municipal Power Company	14,018
Hood River Electric Cooperative	26,586
Pacific Power and Light Company	720,120
Wasco Electric Cooperative	36,408
Harvey Aluminum Company	1,429,930
Northern Wasco County PUD	36,354

The power right referred to above is held by the Pacific Power and Light Company which has a plant at Powerdale on the Hood River with an installed capacity of 6,000 kilowatts (kw).

State Engineer's records show a perfected Pacific Power and Light Company water right for 140 cfs with additional rights in litigation. The plant, with a 440 cfs capacity installed in 1925, diverts water three miles upstream into a 10-foot diameter wood stave and steel pipe that reduces to 8 feet.

The Edward Hines Lumber Company at Dee has a 3,500 kw thermal plant which burns sawdust as the power source. Their power right on the East Fork Hood River has not been utilized for power production during the last several years.

Although some basin sites for power production were surveyed, none of these sites presently is being considered for hydroelectric power production. Power will come from out-of-basin sources.

Industrial

Water rights for industrial uses in the basin amount to 15.28 cfs from ground water and 60.06 cfs from surface sources. The largest water users are the agricultural, forestry, and aluminum processing industries.

Excellent railroad, highway, and water transportation facilities favor further expansion of small industrial water users along the Columbia River.

Increasing irrigated acreages and intensification of fruit production in the Hood River Valley, Mosier Valley, and around The Dalles, should support a moderate increase in fruit processing increasing the present water demand for these uses.

With the industrial growth potential located along the Columbia River and in the Hood River Valley, water requirements will be more a problem of quality and distribution rather than available yield.

Transport of agricultural and industrial products on the Columbia River increased 20 percent between 1962 and 1963 to 2,229,000 tons at Bonneville Dam. Major products moved were wheat, petroleum products, and rafted logs.

Hood area industrial water rights amount to 46.27 cfs all of which are surface rights except 0.49 cfs for two wells at Odell. These rights allow a maximum annual legal depletion of 33,500 acre-feet, mainly from the West Fork Hood River and main stem adjudications.

The fruit industry is a moderate industrial user of water. The 14 packing houses and 16 cold storage plants process about 3,500,000 boxes of fruit annually and use in excess of 340 acre-feet of water. Water is used in washing fruit for fresh packing,

in canning of fruits and juices, and in the cold storage operation for condensor cooling. Fruit processing plants are located at Parkdale, Odell, Rockford, and Hood River.

Another water use is fruit spraying which uses about 40,000,000 gallons (123 acre-feet) annually, based on five sprayings per season and 600 gallons for each spraying per acre. Fruit is produced on 13,550 acres in the Hood River Valley and is expected to increase about 500 acres in the next ten years.

Wasco area industrial water rights amount to 14.28 cfs from surface and 15.28 from ground water sources. These rights allow a surface water depletion of 10,345 acre-feet and a ground water depletion of about 11,070 acre-feet. Most of the industrial water use is in The Dalles area. The three major sources of water for future needs are the Columbia River, storage in the Mill Creek-Dog River watersheds, and recharging of The Dalles Ground Water Pool. Engineering studies indicate that where water must meet high quality standards the Columbia River is the least desirable source because of treatment costs.

Water use for timber products processing should hold relatively stable. No increased water use is expected for grain or livestock processing on the high plateau of the Fifteenmile drainage.

Mining

Little water is required by the stone, sand and gravel mining operations from basin sources. No water rights, either ground or surface, have been granted for mining purposes. No quantity or quality problems are known to exist and none are anticipated in the future.

Water used to wash sand and gravel aggregate and for ready-mix concrete operations in the Hood area approximates 3.4 million gallons annually, all from basin sources. A ready-mix concrete plant near Hood River is supplied about one million gallons annually by the Crystal Springs Water District. An asphalt paving plant, also in the Hood River area, is supplied 2.4 million gallons of water annually by the Hood River Irrigation District and the Hood River municipal system. The district supplies water during the summer heavy-use period; the municipal system supplies it during the remainder of the year. Most future expansion water needs of these plants will be supplied by the Columbia River which now supplies the ready-mix concrete plant and sand and gravel operations east of Cascade Locks.

Water from basin sources used for similar purposes in the Wasco area amounts to about 8.6 million gallons annually. Two ready-mix concrete plants west of The Dalles respectively use 1.5 million gallons from a well and nearly 7.1 million gallons from a spring and the Columbia River. Maximum use from the spring is 200 gallons per minute (gpm) or about 2 million gallons per year; from the river, 500 gpm or about 5 million gallons per year. Neither plant plans to expand operations.

Recreation

Water rights for recreation total only 0.16 cfs in the Hood Basin. These rights were filed on Neal Creek, West Fork Hood River, and Eightmile Creek. Water is generally associated with, if not the prime attraction for, recreational development whether on the slopes of Mt. Hood, along the lakes and streams of the basin, or along the scenic Columbia River Gorge. Principal activities include fishing, boating, skiing, camping, swimming, and sightseeing.

Since the basin is not a major flyway or used extensively as a nesting area, waterfowl uses are small. Furbearing animals include beaver, mink, muskrat, otter, and racoon. Upland game includes quail, pheasant, and turkey. Big game includes deer, elk, and bear.

Table 22 lists the major lakes and reservoirs and indicates their maximum surface areas.

TABLE 22

SURFACE AREAS OF LAKES, PONDS, AND RESERVOIRS EXCEEDING THREE ACRES

AREA	SURFACE AREA Acres
HOOD	
Black Lake	4
Clear Branch Reservoir*	104
Green Point Reservoir	60
Lost Lake	240
North Lake	6
Rainy Lake	10
Wahtum Lake	57
Warren Lake	5
SUBTOTAL	486
WASCO	
Evans Reservoir	25
Foley Reservoir	14
Ketchum Reservoir	14
Lake Camp Baldwin	4
McClure	60
Salisbury	120
Tooley	35
SUBTOTAL	332
TOTAL	818

Note: *Approved, not constructed.

Data Source: Oregon State Engineer
Hood River County Water Resources Committee
Wasco County Water Resources Committee

There are 16 lakes and ponds in the basin having a total surface area of 818 acres. Five of the lakes have established

camping facilities. The best known of these lakes locally and nationally is Lost Lake with its scenic setting northwest of Mt. Hood supported by extensive tourist and recreation facilities.

On the West Fork Hood River where water is abundant and recreation opportunities are the greatest, it is recommended that West Fork and Lake Branch waters be withdrawn from appropriation for such nonconsumptive uses as recreation and fish life. The average annual yield of West Fork Hood River is over 400,000 acre-feet or about ten times the present legal annual depletions from water rights.

One of the greatest economic potentials of the Hood area is its year around tourist attraction. Mt. Hood, situated near the highly populated areas will increasingly attract tourists and recreationists who like to fish, camp, mountain climb, and ski. People from the extensive arid and semi-arid lands to the east and south are also attracted by the lakes and mountain scenery. Bonneville and The Dalles Dams attract over one million visitors annually, on the Oregon and Washington sides.

The major Wasco area recreation potential lies in expanding its Columbia River marina, park, and water sport facilities. Additional potential exists in its canyon and mountainous areas.

The gorge area has limited water sport potential because of high wind and waves that often make the Columbia River dangerous to boating recreationist use. As of October 1963 there were 570 registered boats of eight horsepower or more in the basin.

Problems most frequently mentioned which affect the recreation potential include:

1. A continuing controversy exists between the Game Commission and certain sports groups over closure of West Fork Hood River for steelhead rearing in an effort to protect and build up the species. The stream is reported by the Game Commission as having the Hood River system's best spawning potential, resting pools, and summer flows.

2. Many sportsmen feel that the Mill Creek watershed, which is closed to use by The Dalles for protecting municipal water supplies, should be opened to recreation usage.

There are a great many species of fish to be found in the Columbia River tributaries, the reservoirs behind Bonneville and The Dalles Dams, and the sloughs and lakes adjacent to U. S. Freeway 80 N. Carp, chubs, lampreys, shiners, suckers, and squaw fish are the most common rough fish.

Resident game fish of the basin can be separated into two categories, those whose habitat is predominately warm water and those which are more commonly found in high lakes and cool swift streams. The more frequently observed warm water game fish are black crappie, white crappie, bluegill, sunfish, pumpkinseed sunfish, yellow perch, bullhead catfish, channel catfish, largemouth bass, and sturgeon. The other resident game fish whose usual habitat is cooler waters are rainbow trout, cutthroat trout, brown trout, Dolly Varden trout, eastern brook trout, whitefish, and kokanee salmon.

As commercial fishing is not allowed above a point five miles below Bonneville Dam, this phase of fishing is only covered in the report to the extent that the basin does provide some of the spawning areas for anadromous fish production.

Due to the necessity of inundating Celilo Falls and Cascade Rapids in Lake Celilo and Bonneville Pool, the Indian tribes with historical fishing rights had to be reimbursed for the loss of this fishing area. Although the legality of their right to fish with nets is in question, some Indians continue to use nets.

Sport fishing pressure on warm and cold water resident game fish and on anadromous fish can be expected to increase. Shad fishing on the Columbia River is receiving additional attention. The maintenance of conditions conducive to the propagation of resident and anadromous fish in the basin will make the area more attractive to recreational fishermen.

Surface water temperatures on the Columbia River approach 70 degrees Fahrenheit (° F.) frequently during summer months. This temperature is above the optimum recommended for anadromous fish. With the increasing number of storage projects in the Columbia system and the possibility of additional atomic reduction plants being built, these water temperatures may increase.

The Oregon State Game Commission has suggested minimum spawning and rearing flows which appear in Table G in the Appendix. Inadequate fish passage facilities at Powerdale and Dee Dams as well as low flows have contributed to reducing the number of

anadromous fish which spawn in the Hood River system, according to the Game Commission.

Because of the large fish life enhancement potential in the Hood area, any storage or water quality improvement proposal should include full consideration of fish life benefits. Neither East Fork Hood River nor its tributaries have unappropriated waters. The same is true for Neal and Odell Creeks but recent study by the Oregon State Engineer could result in a future release of part of these flows. The Hood River West Fork and Lake Branch jointly have sufficient summer flows to establish a minimum flow at USGS gage 14-1185. Adequate arrangements for establishing minimum rearing flows at the proposed storage site on the Clear Branch Middle Fork have been made by the Middle Fork Irrigation District and the Oregon State Game Commission. Surplus flows do exist on down the Middle Fork Hood River.

Eagle, Herman, and Lindsay Creeks have a good run of chinook and silver salmon and steelhead in the lower reaches of the streams. The upper portions support a resident population of cutthroat, rainbow, and eastern brook trout. These streams are protected by statutory withdrawal under ORS 538.200 as explained in the Legal Restrictions section of the report.

Eighty-eight percent of the fish counted over the Powerdale diversion dam in 1963 were steelhead. Only 13 percent of these steelhead were counted in the Punchbowl fish ladder on the West Fork Hood River. Therefore, 87 percent of the steelhead utilizing the Hood River system spawn in the main stem and tributaries of the Hood River Middle and East Forks.

Historically the number of anadromous fish that spawned in the Hood River system were much more numerous than they are today. This has been due to the consumptive use depletions on the streams during the annual low flow period. Depletions, at times, reduce the flow to a trickle below the East Side Irrigation Company's diversion on the East Fork Hood River. Summer flow for a distance of 3.2 miles below the Powerdale diversion dam on the main stem Hood River has been reduced to a point where anadromous fish passage is impaired. Since this portion of the river is wide, boulder strewn, and has a flat cross section, low flows make fish passage difficult. Water rights covering these flows are in litigation so no minimum flows can be established at this time.

According to the Oregon State Game Commission, "Flows which would be required for fish passage through the river bypass at Powerdale

on Hood River have not been definitely determined owing to limited study time available. After additional investigations have defined these volumes, effort should be made to provide minimum flows for fish passage at all times of the year".

The Pacific Power and Light Company is assigning a fish biologist to help determine the minimum flows necessary for fish life passage, In the past several years an effort has been made to improve the downstream passage of young migrants. The irrigation companies and Pacific Power and Light Company have installed expensive fish screens on their diversions.

Fifteenmile and Eightmile Creeks have a small run of steelhead. Silver salmon are suspected to be in the lower section of Fifteenmile Creek. Rainbow trout are the most prominent of the resident game fish, and usually inhabit the upper portion of the stream.

Low flows and diversion dams on the main stem of Fifteenmile and Eightmile Creeks, during the irrigation season, annually impair passage of anadromous species to upstream spawning areas. The loss of young steelhead who utilize the stream for several months before returning to the ocean, has been reduced by the installation of seven fish screens on irrigation diversions above Dufur on Fifteenmile Creek.

Any storage proposal in the Wasco area should include consideration of minimum streamflows for fish life. No serious problem is anticipated in maintaining the present resident trout habitat at above presently cropped land.

The problem of maintaining anadromous fish passage, spawning, and rearing flows in the lower sections of the streams are similar to those in other semiarid areas where streams are small and consumptive needs are great.

The Fifteenmile Creek is an example of Wasco area streams where maintaining the status for fish life culture is difficult. After early July, there is sufficient water to care for only 15 percent of the present irrigation needs on 2,500 acres. Numerous individual farm diversion dams and warm water temperatures in the summer limit the improvement potential. Furthermore, there are no minimum flows in the Wasco area streams subject to control by the State Water Resources Board.

WATER USE AND CONTROL

Pollution Abatement

Serious pollution problems occur in only a few limited areas within the basin. These problems have developed around population concentrations and processing plants mainly on heavy soils where septic tanks, drain fields, lagoons, and other disposal facilities have failed to operate efficiently. With most of the population concentrated along the Columbia River, only limited agricultural area pollution problems have developed.

Practically all of the Hood area municipal-industrial water supplies are piped from high mountain springs above areas of serious bacterial or chemical contamination. In 1963 the Oregon State Sanitary Authority ran chemical analyses on 24 group water systems in the Hood River Valley and reported that simple treatment undertaken was adequate. A few shallow wells and springs in agricultural areas used by individuals for domestic use, upon analysis, have shown dangerous bacterial contamination. Two wells near Odell and five near the golf course have undesirable iron compound and odor characteristics.

Streams heading in glaciers carry large quantities of glacial silt which has been quite harmful to water distribution facilities and fish life. Watershed soil erosion is not generally serious due to the heavy forest cover. Some serious erosion has occurred where glacial dikes have broken and where improper logging methods have been practiced. More stream pollution problems will develop as access roads are opened to watershed recreational areas.

Urban area land and stream pollution is approaching critical conditions in only a few reported areas. Immediately north of Parkdale, Emil Creek and irrigation ditches carry objectionable quantities of human and packing plant wastes. Odell area septic tank and drainfield facilities inadequately handle town, school, and processing plant sewage thereby causing pollution problems in the area and down Odell Creek.

The milling and hardboard plant at Dee dumps objectionable quantities of wood product waste into the Hood River. These wood sugar, pulp, and bark wastes that escape settling ponds encourage excessive algae growth, decrease aesthetic appearance of the river for recreation use and contribute to headgate diversion problems for the Farmers Irrigation District. Minor pollution problems were reported in the areas along Indian Creek, around the western edge of Hood River, and from fruit processing plants in Hood River.

These problems are well known to people of the affected areas and sporadic studies have been undertaken to find solutions. Before the problems can be solved, the people who have to pay the bill must be supplied with sound development plans then they must be sufficiently motivated to take action. The County Sanitarian has suggested formation of sanitary districts for the Odell and Parkdale problem areas. The county water resource committee has discussed diverting wastes from the Dee mill to irrigable lands downstream.

Table 23 lists the sewerage systems in the Hood Basin.

TABLE 23

SEWERAGE SYSTEMS

AREA AND SYSTEM	DEGREE OF TREATMENT	DESIGN POPULATION	POPULATION SERVED	RECEIVING STREAM	ADDITIONS NEEDED
IN OPERATION					
Hood River	Primary	5,200	3,500	Columbia River	Extension to annexed area
The Dalles	Primary	20,000	10,400	Columbia River	Include fringe areas
NEEDED					
Dee* (Mill)	Ponding			Hood River	Off-stream settling
Dufur (under construc.)	Secondary	600	488	Fifteenmile Creek	Entire sewer system
Mosier	None	600		Columbia River	Improve septic tanks
Odell*	None			Odell Creek	Drain field sewers
Parkdale*	None			East Fork Hood River	Drain field sewers
Chenowith area	None	2,400		Columbia River	Partial sewer system

*Indicates there is no published reference to the need for treatment in these areas. However, the population in these areas are served by public water systems which would tend to lessen the immediate need for a sewerage system. The population density is such that a few years there will be a definite need for a sewage treatment plant.

Data Source: Oregon State Sanitary Authority, 1960 Biennial Report on Water Pollution Control
Report from Noel P. McKeehan, City-County Sanitarian, Hood River

The County Sanitarian has reported that there are no serious sewerage or pollution problems in the Wasco area. The primary treatment plant at The Dalles plus septic tanks and lagoons handle most of the present sewage wastes. On Chenowith Flat there is one small area east of Hostetler Road where the high water table may be polluted from septic tank effluent, and lower Mill Creek reportedly carries pollutants which are harmful to fish life.

In Mosier, sewage disposal is a porblem in some places but mainly due to poor installation of septic tanks. Dufur has voted bonds for a city sewer system and oxidation pond.

WATER USE AND CONTROL

Streams bisecting the high plateau wheat area often carry heavy silt loads following storms. This problem has been detrimental to agriculture and to fish life in the Fifteenmile Creek drainage system. Chemical analyses of municipal-industrial water supplies have not indicated serious pollution problems to date from either surface or well water sources.

The Oregon State Board of Health is studying methods for eliminating the industrial wastes that are presently being discharged into the Columbia River.

WATER CONTROL

Flood Control

Extensive damage occurred throughout the Hood Basin as a result of the December 1964 and January 1965 floods. Complete flood damage data is not yet available, thus analysis of these floods cannot be included in this report.

Within the Hood area the formation of terminal moraine lakes at the foot of receding glaciers, high in the watershed, creates a potential flood hazard. From time to time the natural dams created by the terminal moraines break. The result is severe washing, flooding, and gullying from the glacier to the foot of Mt. Hood. Periodic flooding has occurred on Ladd, Coe, Polallie, Eliot, Clark, and Newton Creeks which originate in Mt. Hood glaciers.

The latest serious washout, on Ladd Creek, occurred on September 1, 1961. Mud flowed down five distinct channels, carrying boulders up to 130 tons in weight, uprooting virgin timber in a swath up to 150-250 feet wide, damaging the Bonneville power line and washing out U. S. Forest Service roads. Middle Fork Irrigation District intake facilities on Eliot and Coe Creeks have been washed out so often that a more dependable water supply is being developed from Clear Branch of the Middle Fork.

Less than 1,000 acres of agricultural land is flooded annually. About 600 acres on Middle Fork and 200 acres on West Fork Hood River sustain flood damage to stream channels, irrigation structures, roads, and bridges. Other small areas damaged by annual flooding are along the East Fork, around Oak Grove, and along Indian, Herman, and Eagle Creeks. Much of the damage can be alleviated by construction of proposed multipurpose reservoirs.

W A T E R U S E A N D C O N T R O L

Hood area streams usually have subdued peak floods and high summer flows as compared to other eastern Oregon streams. Most of the streams travel in deep, rock-walled canyons where there is little development subject to damage.

In the Wasco area most of the flood damage occurs on the high plateau wheat land. A combination of warm chinook winds on frozen fields overlain by winter snow causes rapid, widespread, flood runoff. This water rushes down steep canyons, gullying stream channels, spreading debris in flatter areas, and damaging structural facilities. Heavy spring rains and summer thunder showers also cause flood problems.

Flood damage also occurs to some forest areas and pasture lands. Such damage, however, generally is minor except in a few specific areas. The total acreage affected by annual flood damage is under 2,500 acres.

Greatest flood damage is to about 1,500 acres annually on Fifteenmile Creek and its tributaries. The upstream reaches above Boyd experience severe channel and streambank erosion. Flooding damages farm facilities, roads, and bridges requiring expensive cleanup of debris and sediment. The City of Dufur has experienced flood damage during some years. A few large multipurpose and several small limited purpose reservoir developments have been proposed on the Fifteenmile Creek stream system to alleviate flooding problems, supplement irrigation supplies, and serve other beneficial uses.

Annual flood damage to about 800 acres occurs on the Eightmile Creek stream system. Floodwaters cause serious maintenance problems to irrigation systems and transportation facilities and damage cropland. Minor flood damage has been reported along Mill and Mosier Creeks. Multipurpose reservoirs have been proposed at Jap Hollow off Eightmile Creek, in the headwaters of Mill Creek and on Mosier Creek which would help alleviate flooding problems.

Drainage

Drainage is a serious problem in only a few limited locations in the Hood area of the basin. As pointed out in the prior Pollution Abatement section most of the drainage problems have developed around industrial and urban areas. The problems are most critical on heavy soils where septic tanks, drain fields, lagoons, and other disposal facilities have failed to operate efficiently.

WATER USE AND CONTROL

The U. S. Department of Agriculture has reported that about 3,300 acres of arable land need drainage, involving 500 acres along the Middle Fork, 1,000 acres along the East Fork, and 1,800 acres in the Oak Grove area.

Drainage problems occur on Van Horn, Wy'east, Ruthton, Bassler, Dee, and Winans soil types due to their hardpans, impervious texture, or depressional position.

Drainage problems largely can be corrected through establishment and operation of sewerage districts in urban areas and by providing tile drainage for the farmed areas having excessive wetness.

Poorly drained lands have not created salinity problems.

Erosion

In the Hood area extensive timber lands along the Cascade summit have serious stability problems. Steep slopes, unstable soil characteristics, and high rainfall provide conditions conducive to severe erosion and soil movement when the existing balance is disturbed. Thin, rocky soils on south and west slopes erode rapidly following timber harvest and make reforestation difficult.

With a change to sprinkler irrigation and the adoption of cover crops for barren land, erosion in the irrigated areas has been reduced materially. Minor problems of silt and debris deposition have been reported in cropped areas.

In the Wasco area erosion problems exist to varying degrees throughout the 50,000 acres of grain land. Timber, range, and irrigated land, generally, have only minor erosion problems.

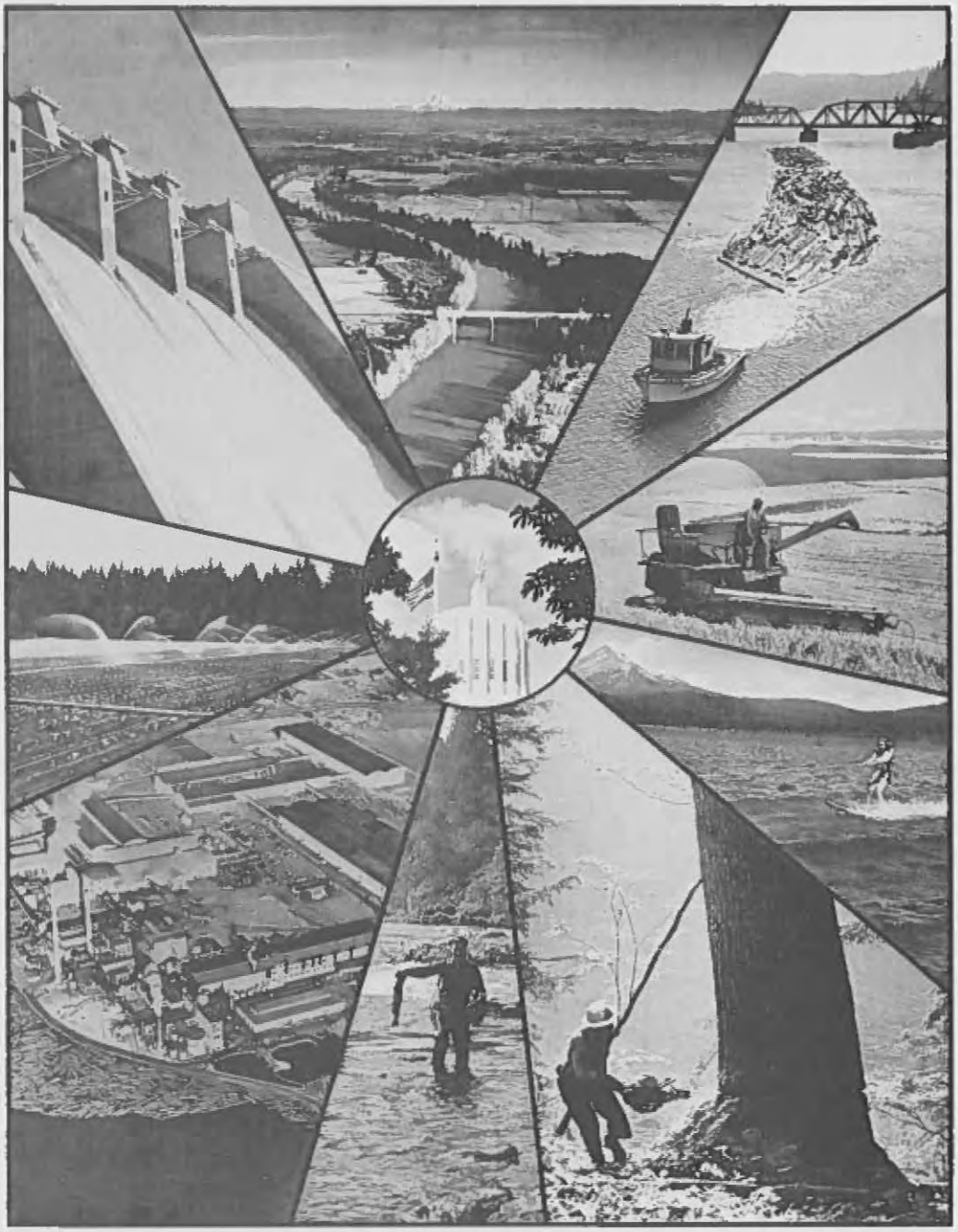
On the wheat farms there is increasing evidence of soil erosion problems. Reports indicate that some farms have lost 25 to 75 percent of their fertile, virgin topsoil. The County Agent has estimated that if erosion losses were to continue at their present rate, wheat farming would become uneconomical in 60 years.

The loessial soils of the Walla Walla, Dufur, and Condon types are the main cropland soils. Their major management consideration is erosion control on steeper slopes.

Soil losses are from rill and sheet erosion, wind erosion, and channel cutting on unprotected fields and streams. Severe streambank erosion occurs annually to valuable bottom land fields

bordering approximately 43 miles of Fifteenmile, Eightmile, and Fivemile Creek channels. An intensified conservation program is needed, including floodwater storage, channel stabilization, strip cropping, stubble mulch, grassed waterways, cover crops, and permanent grasses for erodible areas.

DEVELOPMENT POTENTIAL



PART IV

DEVELOPMENT POTENTIAL

General

The water resource potential of the Hood Basin has not been fully realized. Within the foreseeable future the irrigated acreage could be expanded by 85 percent and inadequately irrigated land could receive needed supplemental water supplies. Water resource based recreation and fish life uses should experience dynamic growth. Population and small industries are expected to sustain a slow, fairly steady growth.

Water resource development factors to be considered include provision for adequate storage; diversion and transmission facilities; control of the quantity and quality of surface return flows for reuse; maximum utilization and protection of ground water supplies; improvement in methods of control and application; and the desire and economic ability of water users to develop the existing potential.

If maximum beneficial use of the water resource is to be achieved, compromises will be necessary. Compatibility requires that development in any one area must be related to developments in other areas. The interrelationship between all beneficial uses of water must be determined so that all interests will receive adequate consideration in project planning and development.

The minimum, maximum, and average runoff of principal streams is listed in Table 9. Table 10 lists the average annual runoff as 1,380,000 acre-feet, of which about 90 percent is yield from the Hood area. This analysis helps confirm the fact that the basin yields far more usable water than is needed for envisioned potential developments. It points out, also, however, the disparity in water yield between the two major subdivisions of the basin, the Hood and Wasco areas.

Table 24 lists the average annual diversion requirements in acre-feet by watersheds.

This table should be used in connection with Table 21, for the Hood area, which lists the irrigation district managers' estimates of future diversion requirements. The diversion requirements varied from 2.8 to 5.7 acre-feet per irrigable acre depending upon system efficiency, crops grown, and climate.

Storage requirements will be approximately 2 acre-feet per acre more than the irrigation requirements which will vary between 20

TABLE 24

AVERAGE ANNUAL DIVERSION REQUIREMENTS
In Acre-feet

AREA AND STREAM	NET ACRES		WATERSHED RUNOFF	IRRIGATION NEED		DO., MU., IN. NEED		TOTAL DO., MU., IN.		IR. Shortage	ACTION NEEDED
	Irrigated	Irrigable		Present	Future	Present	Future	Av. Diverted	Future Need		
HOOD											
East Fork Hood River	7,000	2,000	285,000	39,300	50,500	1,500	1,800	41,000	52,300	11,300	Storage or canal lining
Middle Fork Hood River	6,000	2,000	158,000	12,900	17,200	400	500	13,600	17,700	4,100	Storage and other source
West Fork Hood River	1,000	100	371,000	2,700	3,000	2,700	3,300	6,900	6,300	0	System rehabilitation
Oak Grove	4,900	2,000	87,000	27,800	39,000	2,700	3,000	26,600	42,000	15,400	Storage and canal rehabilitation
Columbia Gorge	100	100	279,000	300	300	300	400	600	700	100	Storage or other source
SUBTOTAL	19,000	6,200	1,180,000	23,000	110,000	7,600	9,000	88,700	119,000	30,900	
WASCO											
Fifteenmile Creek	2,500	8,000	44,000	10,000	40,500	200	300	5,200	40,800	35,800	Storage and Columbia River
Eightmile Creek	1,100	1,000	26,000	4,400	8,400	100	100	2,600	8,500	5,900	Storage
The Dalles	2,400	5,000	28,000	6,000	21,100	24,000	28,000	23,500	49,100	25,600	Columbia River and storage
Mosier	200	1,300	16,000	600	4,500	100	200	200	4,700	4,400	Columbia River or stored water
SUBTOTAL	6,200	15,300	114,000	21,000	74,500	24,400	28,600	31,500	103,100	71,600	
GRAND TOTAL	26,200	21,500	1,294,000	104,000	184,500	32,000	37,600	120,200	222,100	102,500	

Data Source: SWRB compilations from USDA, Oregon State Engineer, and irrigation district records

and 28 inches per acre. Domestic, municipal, and industrial requirements are based on present needs of about 330 gallons per capita per day plus projected future growth requirements.

In Table 24 supplemental irrigation requirements are based on an average of one acre-foot in the Hood area and two acre-feet per acre in the Wasco area.

Ground water and Columbia River water withdrawals are based on pumping between 2.8 and 3.0 acre-feet per irrigable acre to pressure distribution systems. Present and future irrigation requirements equal about 80 percent of total consumptive diversion requirements of the basin.

Figures presented in Table 24 must be varied slightly for individual projects but should quite closely depict water quantities to be developed by watersheds.

The present diversion requirements within the Hood Basin resulting from irrigation of agricultural lands, use of water for urban and domestic areas, and use of water for industrial purposes averages 136,000 acre-feet annually. Divertable supplies fall short of present needs by nearly 16,000 acre-feet. By adding all diversion needs in the foreseeable future, the annual shortage will be over 100,000 acre-feet which can be obtained from storage, ground water, the Columbia River, improvement of water distribution systems, and greater use of return flows.

Although quantities used are small in comparison to basin yield, special developmental problems exist in supplying future domestic, municipal, and industrial water supplies to the Cascade Locks, Hood River, West Side, Crystal Springs, Chenowith, The Dalles, and Dufur public water systems. Up to the present time municipal supplies have generally been developed separately from larger group irrigation facilities and this trend will probably continue.

The following sections will deal with the water related resources and development potential in the two diverse basin areas.

Hood Area

The Hood area, with an average annual runoff of 1,250,000 acre-feet, has sufficient water to support future growth of its 13,400 population, increase the present irrigation acreage from 19,000 by the proposed 33 percent, and handle all other beneficial

needs. Requirements can be met by constructing relatively small impoundments in water-short areas and improving water distribution systems.

Ground water has and will probably continue to supply a minute portion of the area's water needs. There is insufficient technical knowledge about the ground water potential to make an intelligent appraisal of its future use.

Individual domestic and livestock water use in the Hood area is less than 1,000 acre-feet per year at present, with little anticipated increase in the future. This water is obtained from springs, wells, streams, and irrigation ditches by an estimated 15 percent of the population who are rural people living in fringe areas of the valleys. Only local shortages exist along Trout Creek ridge, the high west side, and around Lenz, due to inadequacy of distribution facilities.

Most of the municipal and industrial needs of about 6,600 acre-feet are supplied by municipal or group water systems. These needs are expected to increase to about 8,000 acre-feet in the foreseeable future, mainly from available spring sources. The State Water Resources Board is presently cooperating with the federal government and Hood River County to further determine domestic, municipal, and industrial future water needs along with methods of supplying these needs.

Major seasonal industrial water users are the lumber and fruit processing industries. Present indications suggest a normal expansion in the level of industrial development in the fields of fruit processing and small compatible industries. Needs for forest product processing will probably decline until such time that greater use is made of forest by-products.

Irrigation is the large consumptive water user in the Hood area. Present diversion requirements are about 83,000 acre-feet to serve 19,000 irrigated acres. Future requirements will increase to about 110,000 acre-feet when 6,200 additional irrigable acres are brought under irrigation.

According to a recently completed soil survey, these irrigable lands are located within and on the fringes of the six presently established irrigation districts. Potential irrigation development is practically limited to the stated acreage due to lack of suitable land rather than available water resources.

Even though valley lands are located within the 28-inch to 60-inch

rainfall zone, irrigation is utilized wherever practicable because normal precipitation is inadequate to sustain maximum plant growth throughout the growing season. The use of irrigation in the production of high income fruit crops has been and will probably continue to be an economically profitable enterprise.

An evaluation of the previously identified surface yields indicate that all development proposals could be fully realized by constructing small reservoir impoundments and by rehabilitating present distribution systems. Water shortages of up to 30 percent are reported to exist on the east side of the Hood River Valley. Project lands include the East Fork and Mt. Hood Irrigation Districts serving 670 farms. Reported requirements include development of 11,500 acre-feet through storage. The proposed Horsethief Meadow and Neal Creek Reservoirs could supply considerably more water than needed for supplemental irrigation requirements plus water to the 2,000 additional acres which are suitable for irrigation.

The U. S. Corps of Engineers have prepared a reconnaissance report on the possible Horsethief Meadow Reservoir site which could store up to 50,000 acre-feet of East Fork Hood River waters for irrigation and sediment control purposes. Many questions still need to be answered on the size, type, efficiency, and cost of this reservoir. Important considerations include the life expectancy and cleaning effects which could be expected when handling a fairly large discharge of glacial silt from Mt. Hood glaciers. There is a present need for multipurpose storage on the East Fork because irrigation users deplete summer streamflows below the East Fork diversion dam. A reservoir would enhance recreation proposals, stabilize flows for fishing and supplement present irrigation water supplies so further studies are recommended at this site. Another study needed in this connection is to determine whether glacier flows in Newton and Clark Creeks could be diverted to the White River and thereby limit the objectionable "white water" which flows through the Hood area. Also to be considered would be the desilting of "white water" from Polallie Creek.

In 1945 Sporseen and Associates prepared a report on the Neal Creek Project for the East Fork Irrigation District. They proposed construction of a 5,900 acre-foot reservoir on Neal Creek to supplement present irrigation supplies and enable additional lands to be irrigated. Floodwaters would be diverted from the East Fork Hood River through the existing main canal to be stored in this reservoir. Because of the multipurpose reclamation,

recreation, and fish life benefits presently envisioned for this reservoir and the availability of an ample water supply, serious consideration should be given to its construction.

The same objective could be accomplished by lining porous sections of the 70 miles of main canals and laterals but economic justification for this alternative has not been determined.

A Public Law 566 project has been approved for construction of a dam on Clear Branch, a tributary of Middle Fork Hood River to serve future needs of 125 farms on the Middle Fork Irrigation District and to develop 2,000 additional irrigable acres. Project objectives will be accomplished by constructing a multipurpose reservoir for irrigation water storage and fish culture along with new diversion structures, sediment trapping facilities, a regulating reservoir, an improved gravity pressure pipeline system, and land treatment measures. An improved water distribution system will be provided for 6,000 acres presently irrigated, 1,000 acres in dryland crops, and 1,000 acres now in brush.

Total base flow from streams entering the west side of the valley appears to be generally adequate. The Dee Irrigation District is plagued more by diversion and distribution facilities than by a lack of yield. Major needs include a concrete diversion dam and lined distribution canals. The adjacent 100-acre Aldrich Ditch Company operation needs an improved concrete diversion structure at the headworks on Tony Creek and minor improvement in water quality for domestic users.

When available supplies are analyzed it is found that the Farmers and Hood River Irrigation Districts have water shortage problems that are more involved with distribution than with yield. Of the two, the Hood River Irrigation District is less favored by an adequate water supply for their 200 farmers. In recent years, up to 93 percent of the diverted water has been lost to seepage in their long canals transversing porous geological terrain. Since 1958, partial success has been obtained by using wood fiber hardboard waste to seal porous canals. A canal rehabilitation program is badly needed for conserving present water supplies and for developing the 2,000 acres of additional irrigable land in the Oak Grove area. This rehabilitation should include developing and saving through rehabilitation a maximum of 15,400 acre-feet for critical years. Additional small reservoirs in the Ditch Creek and Greenpoint watersheds should adequately supply late summer shortages.

DEVELOPMENT POTENTIAL

The Farmers Irrigation Company, serving 137 farms of 10 acres or over and 297 accounts, has no serious water shortage problem. Their major problem is algae which plugs their diversion intake screens and irrigation ditch structures. Glacial silt settles in the ditch system and erodes sprinkler distribution facilities. Improved revolving screens and silt traps are needed at the intake.

As part of this study the U. S. Department of Agriculture has conducted a preliminary review of eight reservoir sites in the Hood area watershed. Plate 4 and Table B of the Appendix list available data pertaining to these sites. Table 22 lists present lakes and reservoirs with over three surface area acres. The Clear Branch multiple-purpose reservoir is presently being designed to impound 2,660 acre-feet of which 2,208 acre-feet are reserved for irrigation purposes. With high base streamflows, this reservoir will be used more to regulate flows than for long-period storage. Most of the reservoirs in the Hood River watershed will probably be of this type. All of the streams have an annual yield in excess of the estimated potential use in the watersheds.

Most of the above reported water development proposals have been made by the U. S. Department of Agriculture for execution by the Soil and Water Conservation Service under Public Law 566. Neither the U. S. Bureau of Reclamation nor the U. S. Corps of Engineers have active project proposals within this area at present and no large reclamation or flood control projects are anticipated in the foreseeable future.

Fish life requirements must be considered in any development planning for the Hood area because fish life populations support the recreation enterprise and contribute to the Columbia River and Pacific Ocean sport and commercial fishing.

Heavy sport fishing use is made of the East Fork Hood River around the east side of Mt. Hood downstream to agricultural areas. Summer rearing flows recommended by the Oregon State Game Commission at the confluence of Polallie Creek are 60 cfs. Without the proposed Horsethief Meadow storage, these flows could be maintained to the East Fork diversion canal. Efforts should be made to maintain minimum flows beyond this point because they are often presently depleted during summer heavy-use periods.

On the Middle Fork Hood River correlation of available streamflow data indicates there may be 10 cfs available for minimum rearing flows. Due to the abrasive "white water" nature of the Middle

Fork and several of its tributaries there is also some question of success to be achieved in establishing anadromous fish runs very far up affected streams.

However, an agreement has been reached by the Middle Fork Irrigation District, the Oregon State Game Commission, and the Fish Commission of Oregon regarding construction, operation, and fishery utilization of Clear Branch reservoir and channel.

The State Engineer's Order on application numbers R 37284 and 37285, dated March 22, 1962, stipulates that the minimum reservoir pool shall be 150 acre-feet; minimum flow below the Clear Branch Dam shall be 3 cfs May 15 through August 31 and provides for other fish protection features.

The Game Commission has recommended establishing minimum flows of 100 cfs at USGS-State Engineer Gage 14-1185 on the West Fork Hood River and 25 cfs on Lake Branch. Due to available flows and reservoir sites on Lake Branch and the large stable yield on the West Fork reasonable minimum flows could be maintained downstream to cropped areas for fish life and recreation purposes. The West Fork Hood River from the Punchbowl to confluence of McGee and Elk Creeks is closed to all fishing to enhance the spawning and rearing of anadromous fish. Gaging records are inadequate to support establishing minimum flows on Elk and McGee Creeks. Flows of Green Point Creek are involved in proposed irrigation developments.

Additional studies are needed and litigation must be settled before minimum flows can be established for anadromous fish passage in the Hood River channel at Powerdale. The fish biologists of the Pacific Power and Light Company and the Game Commission wish further time to set minimum summer flows which are adequate to support anadromous fish passage.

Statutory restrictions under ORS 538.200 protect minimum flows of Eagle Creek, Herman Creek, and other Columbia Gorge streams for recreation and fish life purposes. A considerable expansion in the program for salmonid (fingerling) reproduction for river and ocean stocking purposes is being programed by fisheries agencies.

No wildlife problems relative to water were encountered but water resource developments may have wildlife enhancement benefits. Mining and pollution abatement are not considered potentially important users of water in this area. Some water is used for pollution abatement on Emil Creek below Parkdale and Odell Creek below Odell but these problems should soon be alleviated by

recommended sewer districts. Only one of the basin's 25 power rights is being used commercially and no active plans exist for other hydroelectric power developments from basin water sources.

The U. S. Corps of Engineers are studying and developing small recreation, dredging, and diking facilities along Lake Bonneville on the basin's north boundary. Their two most active proposals include boat docks upstream from Cascade Locks and channel dredging at the mouth of Herman Creek.

Many water-based recreation facilities are planned for the Hood area where increased importance is being placed on the recreation resource. Development of water-based recreational facilities should help in justifying projects for irrigation and flood control. The increasing importance of tourism and recreation warrants careful consideration in any future planning.

Wasco Area

The Wasco area, with an average annual runoff of 130,000 acre-feet, has sufficient water to support the future growth of its 17,600 population, increase the present irrigated acreage from 6,200 by 15,300 acres and handle other anticipated beneficial needs. Requirements can be met by constructing fairly large storage reservoirs in water short watersheds, improving water distribution systems, developing the small available ground water resource and pumping additional needed supplies from the Columbia River.

There is insufficient technical knowledge about the ground water potential outside The Dalles Ground Water Pool to make definite determinations about its future use. Present indications are that The Dalles Pool is lowering to a point where the withdrawal must be reduced or a successful recharge program must be initiated. Ground water has been successfully located in the Dufur area to supply supplemental irrigation water for 112 acres. Ground water is used for supplemental irrigation in the Eightmile, Fivemile, Threemile, and Mill Creek Valleys. The U. S. Geological Survey has reported ground water aquifers in the Mosier Valley which could be used to irrigate the reported potentially irrigable land. Outside of these area, the presently known ground water supplies are sufficient only to supply individual domestic and other reported needs.

Individual domestic and livestock water use in the Wasco area is less than 2,000 acre-feet per year at present, with little if any

increase anticipated in the future. This water is obtained from wells, springs, streams, and irrigation ditches by an estimated 15 percent of the population who are rural people who mainly operate large grain and livestock farms. Periodic shortages exist throughout the area when artesian wells, pumped wells, springs, and streams do not yield required flows.

Most of municipal and industrial needs of about 22,500 acre-feet are supplied by about five municipal, group, or industrial water systems. These needs are expected to increase to about 27,000 acre-feet in the foreseeable future. About 98 percent of this need exists in The Dalles environs where choices include Mill Creek, ground water, or the Columbia River as water sources. One of the most critical needs is a detailed study of the location, size, and cost of one or more reservoirs in the Mill Creek-Dog River watersheds. Also needed are further floodwater recharge trials into The Dalles Pool. The major industrial users are fruit processors and the aluminum plant.

Irrigation at the present time diverts less than one-half of the total water diverted for consumptive use in the Wasco area. Due to lack of adequate supplies, present diversions average under 10,000 acre-feet to serve 4,060 irrigated acres. The remaining 2,140 irrigated acres, 1,600 of which are in The Dalles area, are supplied from ground water. Future requirements will increase to around 75,000 acre-feet when presently irrigated land is provided supplemental water and when 15,300 additional acres are irrigated. Irrigable lands are greatly in excess of the limited water resources in the high wheat land area. High-lift pumping requirements will probably limit the irrigation of potentially irrigable acreages for many years.

An evaluation of the previously identified surface water yield indicates that development proposals within the interior portion of the basin would require fairly large and costly reservoirs with an excess carry-over capacity for dry years. Water shortages of up to 85 percent are reported throughout the area after July 1 in most summers. The U. S. Department of Agriculture has made a preliminary survey of 20 reservoir sites where storage potentials exist, to supply the reportedly irrigable acres. These are described in Plate 4 and Table B of the Appendix.

Twelve reservoirs, Columbia River and ground water sources have been investigated as sources to serve the irrigation potential in the Fifteenmile Creek watershed. About 2,500 acres need supplemental water and 8,000 acres are potentially irrigable, requiring about 35,600 additional acre-feet. The 12 proposed

reservoirs would supply supplemental water to presently irrigated lands and water for 6,500 acres of potentially irrigable land. An additional 1,500 acres of potentially irrigable land could be supplied from the Columbia River. There is an undetermined ground water potential.

Three reservoir sites were studied in the Eightmile Creek watershed to serve 2,100 acres, of which 1,100 acres are inadequately irrigated. The 7,400 irrigable acres around The Dalles could be served by the Columbia River, supplementing present sources. The 1,500 acres in the Mosier area could be served from either ground water plus storage or from the Columbia River.

The U. S. Bureau of Reclamation is presently constructing the 5,420-acre Western Division, The Dalles Project located in a semi-circle around the southern portion of the city. Service will be through a pressure pipeline system for sprinklers from the Columbia River to mainly cherry, peach, and apricot crops. From the physical standpoint of soil and water this development could be extended eastward, but further economic justification is needed.

In connection with the above project justification, the U. S. Bureau of Reclamation in the past has studied alternative plans for obtaining water from Fivemile Creek, Eightmile Creek, Fifteenmile Creek, Dog River, Salmon River, White River, and Iron Creek but the plans were abandoned due to insufficient water supply, excessive costs, or interference with existing water rights. Within-basin-sites for fairly large reservoirs are at Jap Hollow off Eightmile Creek and Fifteenmile Creek Reservoir near Rice. These sites reported by the Bureau of Reclamation need further study to determine their desirability as reservoir locations for the proposed irrigation developments.

Except for The Dalles Project by the U. S. Bureau of Reclamation, neither the Bureau nor the U. S. Corps of Engineers has active project proposals within the Wasco area at present and no large reclamation or flood control project proposals are anticipated by them in the foreseeable future. However, the proposed Fifteenmile, Eightmile, Mill, and Mosier Creek irrigation developments could conceivably be built under the U. S. Bureau of Reclamation Small Projects Act. Present local preference is to handle this development through U. S. Department of Agriculture Public Law 566 assistance.

Oregon State Game Commission recommendations as to fish life

requirements as shown in Table G of the Appendix should be considered in any development planning on Mill, Eightmile, and Fifteenmile Creeks since these streams support small anadromous fish runs. However, there are problems of considerable magnitude involved in supplying the 15 to 20 cfs for spawning flows or the 2 to 4 cfs rearing flows recommended by the Oregon State Game Commission for any of these streams. Available flows on all of these streams are fully depleted to satisfy existing water rights during dry years according to State Engineer's records. The valuable fishery resource will increasingly face a losing battle against silt-laden floodwaters, dams, and fluctuating flows unless other resource developments are limited and expensive fish life structures are installed. Resident fish life habitat in the upper portion of streams could be enhanced by the proposed developments.

Wildlife problems related to water are mainly associated with locating and improving springs, farm ponds, and wells to avoid concentrated range grazing. The proposed water resource developments would also have wildlife enhancement benefits.

Power, mining, and pollution abatement are not considered potentially important uses of water in this area.

To aid in further studies of the Hood basin a much better knowledge of stream and diversion flows is needed. The present study was hampered by short, intermittent gage records, the need for correlating known stream yields with short records on these streams and lack of records on water consumptively used. Additional gages are needed where streams enter farming areas, at junctions with larger tributaries, and at the mouths of smaller streams which are subject to resource development.

APPENDIX

AUTHORITY

The authority for the preparation and presentation of this report is set forth in ORS 536.300. The Legislative Assembly recognizes and declares in ORS 536.220 (1) that:

"(a) The maintenance of the present level of the economic and general welfare of the people of this state and the future growth and development of this state for the increased economic and general welfare of the people thereof are in large part dependent upon a proper utilization and control of the water resources of this state, and such use and control is therefore a matter of greatest concern and highest priority.

"(b) A proper utilization and control of the water resources of this state can be achieved only through a coordinated, integrated state water resources policy, through plans and programs for the development of such water resources and through other activities designed to encourage, promote and secure the maximum beneficial use and control of such water resources, all carried out by a single state agency.

"(c) The economic and general welfare of the people of this state have been seriously impaired and are in danger of further impairment by the exercise of some single-purpose power or influence over the water resources of this state or portions thereof by each of a large number of public authorities, and by an equally large number of legislative declarations by statute of single-purpose policies with regard to such water resources, resulting in friction and duplication of activity among such public authorities, in confusion as to what is primary and what is secondary beneficial use or control of such water resources and in a consequent failure to utilize and control such water resources for multiple purposes for the maximum beneficial use and control possible and necessary."

The authority for the report, the study on which it is based, and the actions effected are specifically delegated to the State Water Resources Board in ORS 536.300 (1) and (2) which state:

"(1) The board shall proceed as rapidly as possible to study: existing water resources of this state;

means and methods of conserving and augmenting such water resources; existing and contemplated needs and uses of water for domestic, municipal, irrigation, power development, industrial, mining, recreation, wildlife, and fish life uses and for pollution abatement, all of which are declared to be beneficial uses, and all other related subjects, including drainage and reclamation.

"(2) Based upon said studies and after an opportunity to be heard has been given to all other state agencies which may be concerned, the board shall progressively formulate an integrated, coordinated program for the use and control of all the water resources of this state and issue statements thereof."

Within the limits of existing data and knowledge, the study has taken into full consideration the following declarations of policy under ORS 536.310:

"(1) Existing rights, established duties of water, and relative priorities concerning the use of the waters of this state and the laws governing the same are to be protected and preserved subject to the principle that all of the waters within this state belong to the public for use by the people for beneficial purposes without waste;

"(2) It is in the public interest that integration and coordination of uses of water and augmentation of existing supplies for all beneficial purposes be achieved for the maximum economic development thereof for the benefit of the state as a whole;

"(3) That adequate and safe supplies be preserved and protected for human consumption, while conserving maximum supplies for other beneficial uses;

"(4) Multiple-purpose impoundment structures are to be preferred over single-purpose structures; upstream impoundments are to be preferred over downstream impoundments. The fishery resource of this state is an important economic and recreational asset. In the planning and construction of impoundment structures and milldams and other artificial obstructions, due regard shall be given to means and methods for its protection;

"(5) Competitive exploitation of water resources of this state for single-purpose uses is to be discouraged when other feasible uses are in the general public interest;

"(6) In considering the benefits to be derived from drainage, consideration shall also be given to possible harmful effects upon ground water supplies and protection of wildlife;

"(7) The maintenance of minimum perennial streamflows sufficient to support aquatic life and to minimize pollution shall be fostered and encouraged if existing rights and priorities under existing laws will permit;

"(8) Watershed development policies shall be favored, whenever possible, for the preservation of balanced multiple uses, and project construction and planning with those ends in view shall be encouraged;

"(9) Due regard shall be given in the planning and development of water recreation facilities to safeguard against pollution;

"(10) It is of paramount importance in all cooperative programs that the principle of the sovereignty of this state over all the waters within the state be protected and preserved, and such cooperation by the board shall be designed so as to reinforce and strengthen state control;

"(11) Local development of watershed conservation, when consistent with sound engineering and economic principles, is to be promoted and encouraged; and

"(12) When proposed uses of water are in mutually exclusive conflict or when available supplies of water are insufficient for all who desire to use them, preference shall be given to human consumption purposes over all other uses and for livestock consumption, over any other use, and thereafter other beneficial purposes in such order as may be in the public interest consistent with the principles of this Act under the existing circumstances."

STATUTORY REFERENCES

ORS 538.200

"Streams forming waterfalls near Columbia River Highway; withdrawal from appropriation or condemnation; diversion or interruption prohibited. The following streams and waters thereof forming waterfalls in view of, or near, the Columbia River Highway, from Sandy River to Hood River, the first 13 of which are in Multnomah County and the remainder of which are in Hood River County, are withdrawn from appropriation or condemnation, and shall not be diverted or interrupted for any purpose whatsoever, except as mentioned in ORS 538.210, to wit: . . .

"Eagle Creek - forming Metlako Falls.
Ruckle Creek, formerly known as Deadman's Creek.
Herman Creek.
Summit Creek - forming Camp Benson Falls.
Lindsey Creek - forming Lindsey Falls.
Spring Creek.
Warren Creek.
Cabin Creek.
Starvation Creek - forming Starvation Falls.
Viento Creek.
Phelps Creek, except those creeks which are tributary to Phelps Creek and which arise in the north one-half of section 5, township 2 north, range 10 east of the Willamette Meridian, subject to prior rights."

ORS 538.210

"Condemnation of lands for park not prevented; vested and riparian rights not affected; condemnation of lands or appropiration of waters for fish culture not prevented. ORS 538.200 shall not prevent the condemnation for public park purposes of any lands through which any of the streams flow; nor affected vested rights or the rights of riparian proprietors of such lands in or to the waters of the creeks or streams; nor prevent the condemnation of any lands through which any of the streams flow, for the purpose of establishing, maintaining and operating thereon salmon fish culture work, nor prevent the Fish Commission of Oregon from appropriating any waters for fish culture work; provided, that no waters shall be taken from above the falls in the streams mentioned in ORS 538.200."

W I T H D R A W A L S B Y S T A T E E N G I N E E R

HOOD RIVER, EAST FORK OF HOOD RIVER AND THEIR TRIBUTARIES IN THE VICINITY OF MT. HOOD, ZIG ZAG RIVER, LITTLE ZIG ZAG RIVER, SAND CANYON, SALMON RIVER, STILL CREEK AND OTHER TRIBUTARIES OF SALMON RIVER AND ZIG ZAG RIVER IN THE VICINITY OF MT. HOOD, WARM SPRINGS RIVER, BADGER CREEK, BEAVER CREEK AND OTHER TRIBUTARIES OF WARM SPRINGS RIVER

"I, John H. Lewis, State Engineer of the State of Oregon, in accordance with the authority in me by virtue of Chapter 87, Laws of Oregon for 1913, do hereby withdraw and withhold from appropriation on behalf of the State of Oregon, all unappropriated water of Hood River, East Fork of Hood River and their tributaries in the vicinity of Mt. Hood, Zig Zag River, Little Zig Zag River, Sand Canyon, Salmon River, Still Creek and other tributaries of Salmon River and Zig Zag River in the vicinity of Mt. Hood, Warm Springs River, Badger Creek, Beaver Creek and other tributaries of Warm Springs River, either by direct flow or by storage, for irrigation, power and domestic purposes, for the reclamation of the lands in the White River Project which was investigated under the provisions of said Act and that certain contract between the United States of America, by Franklin K. Lane, Secretary of the Interior and the State of Oregon, by John H. Lewis, State Engineer, approved by Oswald West, Governor, on the 5th day of May, 1913, executed thereunder, or for the reclamation of lands on the Fifteen Mile Creek Project in Wasco County, to be investigated hereafter as further information may demonstrate to be feasible and practical.

"Dated this 5th day of September, 1917.

/s/ JOHN H. LEWIS

John H. Lewis,
State Engineer of the State of Oregon."

"It is the purpose of this instrument to withdraw and withhold from general appropriation any unappropriated waters of the above named streams for use and benefit of the irrigation project known as the Tygh Valley-Wamic Irrigation Project, which is designated in the Cooperative Report as the White River Project, which was investigated under the provisions of said Chapter 87,

Laws of 1913, and the contract between the State and the United States, executed thereunder, or for the reclamation of lands on the Fifteen Mile Creek Project in Wasco County, to be investigated hereafter as further information may demonstrate to be feasible and practical."

APPLICATION NO. 5728, dated September 5, 1917, is in the name of John H. Lewis, State Engineer, for a permit to appropriate the waters listed in the above withdrawal.

O R D E R S B Y S T A T E E N G I N E E R

"ON THE QUESTION OF DETERMINATION)
OF A CRITICAL GROUND WATER AREA) O R D E R
IN THE DALLES AREA, OREGON)

"(1) NOW, THEREFORE, IT IS ORDERED that The Dalles Area be declared a critical ground water area and is to be known as 'The Dalles Critical Ground Water Area'. . . . It shall include all diversions of ground water from the 'Dalles Ground Water Reservoir' . . . and the 'Threemile Ground Water Reservoir'. . . .

"(2) It is FURTHER ORDERED that the water master shall regulate the control works on all wells in the above described critical ground water area other than those wells whose use of ground water is specifically exempted in ORS 537.545, so that the rate and total quantity of ground water withdrawn does not exceed that allowed under their ground water right certificates or permits. The procedure for regulating and posting such changes shall be as set forth in ORS 540.040.

"(3) It is FURTHER ORDERED that all unlawful diversions of ground water within The Dalles Critical Ground Water Area shall cease. To this end, the water master shall investigate all known or reported violations of ORS 537.535 and shall regulate the control works of all wells found to be operating in violation of ORS 537.535 so as to prevent such violation. Written notices shall be posted at all wells so regulated stating that further unlawful diversions from that well shall result in the arrest and prosecution of the violator.

"(4) It is FURTHER ORDERED that all applications to appropriate ground water from The Dalles Ground Water Reservoir that are pending on the effective date of this order . . . (G-2, G-4, G-7, G-23, G-1415, G-1607) shall be approved with a priority as of the date of their filing providing the applications are completed in the form and contents as set forth in ORS 537.615 within a reasonable length of time as provided by ORS 537.620. Should it be found that a further reduction in withdrawals besides that accomplished by paragraphs 2 and 3 of this order are necessary, such additional reductions shall be made on the basis of priority.

"(5) It is FURTHER ORDERED that all applications for permits to appropriate ground water from within The Dalles Critical Ground Water Area that are filed after the effective date of this order shall be approved only on condition that no water shall be appropriated from The Dalles Ground Water Reservoir or the Threemile Ground Water Reservoir. New appropriators shall

be required to develop water from either the Dalles formation, or from ground water reservoirs that underlie The Dalles Ground Water Reservoir. In the development of ground water from the reservoirs underlying The Dalles Ground Water Reservoir, wells shall be cased from the surface to at least 50 feet into the basalt flow that underlies The Dalles Ground Water Reservoir and adequately cemented into this rock unit. Wells developing water from the Dalles formation shall not penetrate into the Columbia River basalt formation.

"(6) It is FURTHER ORDERED that all applications to appropriate ground water from the Threemile Ground Water Reservoir that are pending on the effective date of this order . . . (G-1, G-9, G-31, G-58, G-70) shall be approved only on condition that they shall be drilled into The Dalles Ground Water Reservoir and effectively cased so that no water will be withdrawn from the Threemile Ground Water Reservoir.

"(7) It is FURTHER ORDERED that the appropriation of ground water from the Threemile Ground Water Reservoir be restricted to those wells having a priority of 1932 or earlier.

"(8) It is FURTHER ORDERED that all wells that are drilled through the Threemile Ground Water Reservoir shall be maintained in a condition so as to prevent subsurface leakage from the Threemile Ground Water Reservoir into underlying formations.

"(9) It is FURTHER ORDERED that additional withdrawals from The Dalles Ground Water Reservoir other than those covered by paragraphs 4 and 6 of this order shall be restricted solely to the exempted uses and limitations set out in ORS 537.545.

"(10) It is FURTHER ORDERED that additional withdrawals of ground water from The Threemile Ground Water Reservoir shall be restricted solely to stock and domestic uses. Ground water appropriated from this ground water reservoir for stock shall be piped to watering tanks or troughs which shall be equipped with control works so as to prevent the overflow and waste of ground water. Ground water appropriated for domestic purposes shall be restricted to a maximum beneficial use of 15,000 gallons per day, as set forth in ORS 537.545. Additional development of ground water from the Threemile Ground Water Reservoir for any commercial or industrial purpose, even in amounts less than 5,000 gallons per day, is prohibited.

"(11) It is FURTHER ORDERED that the owners or operators of all wells in the above described critical ground water area other

than those whose use of ground water is specifically exempted in ORS 537.545 and . . . (U-86, U-589, G-1096) shall, prior to any ground water withdrawal after 90 days from the date of this order, equip their wells with totalizing water meters and shall maintain a record of the monthly withdrawal of ground water from each well. A copy of these records shall be furnished to the State Engineer within 30 days from the close of each calendar year.

"(12) It is FURTHER ORDERED that the owners or operators of all wells in the above described critical ground water area other than those whose use is specifically exempted in ORS 537.545 and . . . (U-86, U-589, G-1096) shall, prior to any ground water withdrawal after 90 days from the date of this order, equip their wells with control valves so that the discharge can be regulated to the rate of withdrawal allowed under this water right certificates or ground water permits.

"(13) It is FURTHER ORDERED that the State Engineer shall make an annual review of the ground water situation in The Dalles Critical Ground Water Area for the purpose of determining whether the control provisions provided by the order are effective or whether additional controls, provisions, or additional reduction in ground water withdrawals are required.

"Dated at Salem, Oregon this 11th day of December 1959.

/s/ LEWIS A. STANLEY

Lewis A. Stanley
State Engineer"

"ON THE QUESTION OF DETERMINATION)
OF A CRITICAL GROUND WATER AREA)
IN THE DALLES AREA, OREGON)

STAY OF ORDER

"The State Engineer's Order of December 11, 1959, declaring The Dalles Area, Wasco County, Oregon to be a Critical Ground Water Area and prescribing corrective control provisions has been appealed to the Circuit Court for Wasco County.

"On April 25, 1960, the Circuit Court for Wasco County ordered a stay of enforcement of the State Engineer's Order upon the appealing parties.

"NOW THEREFORE, it is ORDERED that the enforcement of paragraphs 7, 11, and 12 of the State Engineer's Order of December 11, 1959 is hereby stayed for all parties concerned until the questions before the Circuit Court have been answered.

"Dated at Salem, Oregon, this 9th day of May, 1960.

/s/ LEWIS A. STANLEY

Lewis A. Stanley
State Engineer"

"IN THE MATTER OF APPLICATIONS NOS. R-37284 AND 37285 IN THE NAME OF THE MIDDLE FORK IRRIGATION DISTRICT

ORDER

"It is STIPULATED and AGREED that the Middle Fork Irrigation District shall:

"1. Provide an absolute minimum pool of 150 acre feet which would be reserved specifically for fish life use. Such pool will have a surface area of approximately 11.5 acres and a maximum depth of approximately 40 feet. This situation should not occur more than 20 percent of the years.

"2. The project will be designed so that a minimum pool will be at least 300 acre feet for 75 percent of the years, and 900 acre feet at least 50 percent of the years. All available forecast information will be used at the earliest possible date to predict the minimum which the pool will reach in any year. These forecasts will be coordinated between the project operating personnel and fishery management agencies.

"3. The applicant shall release water from the reservoir to provide the following minimum flow regimens in Clear Branch below the project dam.

"a. 3 cfs for the period starting no earlier than May 15 and extending through August 31 of each year.

"b. Actual stream flow up to 15 cfs from September 1 through September 15 of each year.

"c. Actual stream flow up to 30 cfs from September 16 until the said reservoir has been filled.

"d. Actual stream flow throughout the remainder of the non-irrigation season.

"e. These flows can be reduced at the discretion of the fishery management agencies if it would be in the interest of fishery resources to do so insofar as such reduction does not interfere with the primary function of the reservoir.

"4. Make certain improvements in the channel of Clear Branch between the project dam and the mouth of Coe Creek so that adequate conditions can be maintained for the survival of fish with the minimum flows stipulated in 3 above. Specific details on these improvements will have to be defined at a later date but they will be in the form of low retaining walls to create pools and channels where found necessary to concentrate low stream flows.

"5. Provide protective screening of all irrigation diversions from natural waterways supporting fish life.

"6. Provide a drain outlet at the base of the dam so as to make possible complete drainage of the reservoir for fish propagational purposes and to be accomplished only with the mutual consent of the state fishery agencies. Any drainage will be coordinated with the operating Irrigation District so as not to interfere with the primary function of the reservoir.

"7. The applicant shall attempt to operate the reservoir, in conjunction with the other segments of their irrigation system, to do the least possible damage to the fishery resource. Whenever possible to do so, water from Eliot Creek and the smaller streams within the system will be fully utilized and only the essential needs beyond their capacities diverted from Clear Branch flow or storage.

"IT IS FURTHER AGREED AND STIPULATED by the Oregon State Game Commission and the Fish Commission of Oregon that in consideration of

said applicants having executed this stipulation the said Commissions will withdraw a protest to said applications, provided that this stipulation is accepted by the State Engineer and its terms are made a part of any permit which might be issued under this application.

"IT IS FURTHER AGREED AND STIPULATED that the terms and conditions of this stipulation shall be made a part of any permit issued by the State Engineer under said application, by reference hereto, to the same effect and as fully as if it were fully set out in said permit. After the first five years of operation of the project and upon agreement between the parties of this stipulation or their successors, the requirements of this stipulation with regard to minimum releases and minimum pool may be modified. Any such modification shall be reduced to writing and filed with the State Engineer. When so filed and upon order of the State Engineer based upon such agreement, the permits to store and appropriate water or the water right covered by such permits shall be modified and amended so as to carry out the provisions of such agreement.

"DATED this 21st day of February, 1962.

MIDDLE FORK IRRIGATION DISTRICT

By /s/ SHELDON E. LAURANCE
Sheldon E. Laurance, Chairman

OREGON STATE GAME COMMISSION

By /s/ P. W. SCHNEIDER
P. W. Schneider, Director

FISH COMMISSION OF OREGON

By /s/ ROBERT W. SCHONING
Robert W. Schoning, Director"

SELECTED BIBLIOGRAPHY

FEDERAL AGENCIES

Agriculture, Department of

Forest Service

Directory of National Forest Camps, 1962-1963
Forest Statistics for Hood River County, Oregon, Pacific Northwest Forest and Range Experiment Station, Forest Survey Report No. 125, July 1958
Forest Statistics for Wasco County, Oregon, Pacific Northwest Forest and Range Experiment Station, Forest Survey Report No. 127, July 1958
Production of Logs in Oregon and Washington, 1925-1948, Forest Survey Report No. 101, April 1950
Production of Lumber in Oregon and Washington, 1869-1948, Forest Survey Report No. 100, December 1949
Timber Harvest by Ownership in State of Oregon, Annual Reports, 1949-1960

Soil Conservation Service

Annual Snow Surveys and Water Supply Forecasts, 1953-1963
Oregon Soil and Water Conservation Needs Inventory, September 1962
Watershed Work Plan, Middle Fork of Hood River Watershed, April 1962

Weather Bureau

Climatic Summary of The United States, Climatic Data from the Establishment of Stations to 1930, inclusive, Section 3, Western Oregon, 1936

Commerce, Department of

Census, Bureau of the

Census of Agriculture
Census of Manufactures
Census of Mineral Industries
Census of Population
Oregon Census County Division Map, 1960

S E L E C T E D B I B L I O G R A P H Y

Weather Bureau

Climatic Summary of the United States - Supplement for 1931-1952, Oregon, Climatography of the United States, No. 11-31, 1956
Climatological Data, Oregon, Annual Summaries and Monthly Reports, 1948 to date
Index of Oregon Weather Stations by Counties, State Climatologist, October 1958
Sub-station History, Oregon, Key to Meteorological Records Documentation No. 1.1, 1956

Defense, Department of

U. S. Army, Corps of Engineers

Annual Fish Passage Report, North Pacific Division Bonneville, The Dalles and McNary Dams, Columbia River, Oregon and Washington, 1961
Columbia River and Tributaries, H. D. 308 Review Report, Appendix K, October 1948

Health, Education and Welfare, Department of

Public Health Service

Municipal and Industrial Waste Facilities, 1957 Inventory

Interior, Department of the

Bonneville Power Administration

City of Cascade Locks, Load Study and Plan of Service, September 1961
Columbia River Power and the Aluminum Industry, July 1953
Hood River Electric Cooperative, Load Study and Plan of Service, June 1961

Bureau of Reclamation

Report of Preliminary Investigation of Irrigation Possibilities in Vicinity of The Dalles, Oregon, September 1936
The Dalles Project, Oregon, Western Division, November 1959

S E L E C T E D B I B L I O G R A P H Y

Geological Survey

Artificial Recharge through a Well Tapping Basalt Aquifers at The Dalles, Oregon, Water Supply Paper in Preparation
Geology and Ground-Water Resources of The Dalles Region, Oregon, Water Supply Paper 659-B, 1932
Storage of Ground Water behind Subsurface Dams in the Columbia River Basalt, Washington, Oregon, and Idaho, Professional Paper 383-A, 1961
Surface Water Supply of the United States: Part 12-C, North Pacific Slope Basin, Water Supply Papers for 1924-1934; and Part 14, Pacific Slope Basins in Oregon, Water Supply Papers for 1935-1960
Surface Water Records of Oregon, 1961-1963

STATE AGENCIES

Education, Higher, Department of

University of Oregon, Bureau of Municipal Research and Service

Growth, Hood River County, July 1963
A Summary of the Salient Features of the Geology of the Oregon Cascades, 1917

Employment, Department of

Oregon Covered Employment and Payrolls by Industry and County, 1950-1961

Engineer, State

Preliminary Report on the Occurrence of Ground Water in the Hood River Valley, January 1965
Water Laws of Oregon, 1963
Water Resources of the State of Oregon, Bulletins 4 and 7-10, 1878-1941

S E L E C T E D B I B L I O G R A P H Y

Fish Commission

Environmental Survey Report Pertaining to Salmon and Steelhead in Certain Rivers of Eastern Oregon and the Willamette River and its Tributaries, Part III, September 1961

Research Division

Summary Report of Hood River Studies, 1959, 1960, and 1961

Game Commission

Game Division, Annual Reports, 1951 to date, Basin Investigations, Hood Basin, December 1963
Biennial Reports, 1946-1948 to date
Fish Division, Annual Reports, 1952 to date

Geology and Mineral Industries, Department of

Ground Water in the Orchard Syncline, Wasco County, Oregon, U. S. Geological Survey; The Ore-Bin, August 1963
Oregon's Mineral Industry Zooms Upward, The Ore-Bin, September 1964

Health, Board of

Sanitary Authority

Eleventh Biennial Report on Water Pollution Control for the period July 1, 1958 to June 30, 1960

Highway Department

Parks and Recreation Division

Annual Reports, 1954 to date

Water Resources Board

Water Quality Data Inventory, Bulletin No. 1, June 1956 and Bulletin No. 2, June 1957
Hearing Record in the Matter of a Water Resource Program for the Hood River Basin, January 1964

S E L E C T E D B I B L I O G R A P H Y

COOPERATIVE PROGRAMS

U. S. Department of Agriculture, Economic Research Service, Forest Service, Soil Conservation Service, and Oregon State Water Resources Board

Water and Related Land Resource, Hood Drainage Basin, Oregon, February 1964

U. S. Department of Health, Education and Welfare, Public Health Service and Oregon State Sanitary Authority and Washington Pollution Control Commission

Columbia River Basin below Yakima River, a Cooperative State-Federal Report, 1953

U. S. Department of the Interior, Geological Survey, and Oregon State Department of Geology and Mineral Industries

Geologic Map of Oregon West of the 121st Meridian, Miscellaneous Geologic Investigations Map I-325, 1961

MISCELLANEOUS REPORTS

An Engineering Investigation of a Municipal Water Supply for The Dalles; Cornell, Howland, Hayes and Merryfield, Engineers and Consultants, June 1960

Chambers of Commerce and Port Commissions, Miscellaneous Reports

Geology of Oregon, 1964, by Ewart M. Baldwin, Professor of Geology, University of Oregon

Late Cenozoic Geology of Lower Columbia River Valley, Oregon and Washington, Bulletin of Geological Society of America, September 1960

Planning for Tomorrow, 1958 Planning Conference Report, by the Hood River County Planning Council

S E L E C T E D B I B L I O G R A P H Y

Preliminary Report, Neal Creek Project, East Fork Irrigation District by Sporseen and Associates, April 1945

Recreation Survey of the Pacific Northwest Region, Part One, Existing Recreation Areas by Recreation Subcommittee, Columbia Basin Inter-Agency Committee, March 1961

Regional Development Program, Prepared for the Mid-Columbia Planning Council and Department of Planning and Development, State of Oregon by Ebasco Services Incorporated, April 1963

Soil and Water Conservation Needs Inventory by the Oregon Conservation Needs Committee, September 1962

Wasco County's 1956 Report of Agricultural Planning Conference, by Wasco County Agricultural Planing Council

Water Supply Policy, Rate Study and Evaluation of Transmission Line for City of Hood River, Clark and Groff Engineers, April 1963

TABLE A

HYDROLOGICAL STATION SUMMARY

MAP INDEX NO.	NAME	USGS STA. NO.	LOCATION			ACTIVE	TYPE	DRAINAGE AREA Sq. Mi.	WATER YEARS OF RECORD	COMPLETE WATER YEARS
			Twp.	Rng.	Sec.					
	STREAM GAGING									
1	COLD SPRINGS CREEK NEAR PARKDALE		2S	10E	19		Recorder		1928-33	1
2	DOG RIVER NEAR PARKDALE	1134	2S	10E	11	x	Recorder	4.50	1960-	2
3	EIGHTMILE CREEK NEAR BOYD	1050	1N	14E	31		Recorder	56	1947-53	7
4	EAST FORK HOOD RIVER NEAR DEE	1155	1N	10E	18		Recorder	108	1917	0
5	EAST FORK HOOD RIVER NEAR MT. HOOD	1150	1S	10E	5		Staff	78.8	1913-15	1
6	EAST FORK HOOD RIVER ABOVE INTAKE NEAR MT. HOOD	1135	1S	10E	4		Recorder	77.2	1915-23	3
7	FIFTEENMILE CREEK NEAR DUFUR	1040	2S	12E	14		Staff	19.6	1918-19	1
8	FIFTEENMILE CREEK NEAR WRENTHAM	1045	1S	14E	3		Recorder	171	1947-53	7
9	FIVEMILE CREEK NEAR THE DALLES	1065	1N	13E	25		Recorder	32.4	1926-31, 1949-53	5
10	GORTON CREEK NEAR WYETH	1260	2N	8E	1		Recorder	2.28	1918-20	1
11	GREEN POINT CREEK BELOW NORTH FORK NEAR DEE	1180	1N	9E	11		Recorder	20.0	1949-54	5
12	GREEN POINT CREEK NEAR DEE	1165	1N	9E	10		Staff	10.0	1919-21	0
13	HOOD RIVER AT DEE	1160	1N	10E	7		Recorder	155	1913-18	2
14	HOOD RIVER AT TUCKER BRIDGE	1200	2N	10E	15		Chain	278	1898-1900, 1913-17	5
15	HOOD RIVER AT WINANS	1190	1N	9E	1		Staff	259	1906-07, 1910-13	1
16	HOOD RIVER NEAR HOOD RIVER	1210	3N	10E	36	x	Recorder	329	1913-	47
17	LOST LAKE CREEK AT LOST LAKE		1S	8E	10		Recorder		1928	0
18	NORTH FORK GREEN POINT CREEK NEAR DEE	1175	1N	9E	3		Staff	7.6	1919-21	0
19	SOUTH FORK MILL CREEK NEAR THE DALLES	1058.5	1N	12E	28	x	Recorder	28.0	1960-	2
20	WEST FORK HOOD RIVER NEAR DEE	1185	1N	9E	1	x	Recorder	96	1913-16, 1932-61	30
	CANAL GAGING									
21	DEE IRRIGATION CANAL NEAR DEE	1162	1N	9E	22	x	Staff		1925-	23
22	EAST FORK IRRIGATION DISTRICT CANAL NEAR MT. HOOD	1140	1N	10E	34	x	Recorder		1913-	4
23	FARMERS CANAL NEAR OAK GROVE	1195	2N	10E	20	x	Staff		1917, 1920-22, 1925	0
24	HOOD RIVER IRRIGATION CANAL NEAR OAK GROVE	1170	2N	10E	19	x	Staff		1925-30, 1932-	24
25	HOOD RIVER IRRIGATION DISTRICT HIGH LINE CANAL NEAR OAK GROVE		2N	10E	19		Staff		1925-30, 1932-49	21
26	HOOD RIVER IRRIGATION DISTRICT CANAL NEAR DEE	1170	1N	9E	10		Staff		1919-20	0
27	MIDDLE FORK IRRIGATION DISTRICT CANAL NEAR PARKDALE	1157	1S	9E	26	x	Staff		1926-	24
28	MT. HOOD CANAL NEAR MT. HOOD	1145	1S	10E	5	x	Staff		1917-20, 1925-32, 1934-43, 1947-53, 1955-	0
29	PACIFIC POWER AND LIGHT COMPANY CONDUIT NEAR HOOD RIVER	1205	3N	10E	36	x	Electric meter		1914-52	37

	CLIMATOLOGICAL						ELEVATION	CALENDAR YEARS OF RECORD
30	BIG EDDY	2N	14E	30		Prec., Temp.	125	1916-1957
31	CASCADE LOCKS	2N	8E	7		Prec., Temp.	102	1879-1954
32	DUFUR	1S	13E	25	x	Prec., Temp.	1,335	1890-91, 1909-
33	FRIEND 2 W	2S	12E	35	x	Prec., Temp.	2,490	1923-
34	HOOD RIVER	3N	10E	26		Prec.	393	1940-41
35	HOOD RIVER AIRPORT	2N	10E	11		Prec.	600	1937-40
36	HOOD RIVER EXPERIMENT STATION	2N	10E	1	x	Prec., Temp.	500	1884-
37	LONGWOOD	2N	10E	21		Prec.	800	1912-17
38	MEADOW BROOK RANCH	2N	8E	5		Prec., Temp.	850	1912-14
39	MOSIER	2N	12E	32		Prec., Temp	1,950	1915-16
40	MOUNT PARK	1N	9E	34		Prec., Temp.	1,440	1906-10
41	ORTLEY	2N	12E	14		Prec., Temp.	1,600	1912-23
42	PARKDALE	1S	10E	6		Prec., Temp.	1,719	1909-
43	PARKDALE 9 SSW	2S	9E	15	x	Prec.	3,800	1961
44	RAMSEY	2S	13E	6		Prec., Temp.	1,350	1902-18
45	THE DALLES	1N	13E	3	x	Prec., Temp.	102	1850-66, 1874-
46	TYGH RIDGE	3S	14E	6		Prec.	2,700	1932-35

TABLE B

RECREATION AREA SUMMARY

MAP INDEX NO.	NAME	GENERAL				FACILITIES						NATURAL FEATURES	
		TYPE*	PRESENT OWNERSHIP	ACREAGE	USE**	NUMBER OF CAMPING SITES	NUMBER OF TRAILER SITES	NUMBER OF PICNIC SITES	COMFORT STATIONS	DEVELOPED WATER SYSTEM	OTHER FACILITIES	MAJOR WATER FEATURE	OTHER FEATURES
	EXISTING												
1	ALPINEES	O.C.	Fed.								Building		Mt. Hood
2	AMERICAN LEGION	O.C.	Fed.								Building		Mt. Hood
3	BOTTLE PRAIRIE	F.C.	Fed.	1	C,P,F	2			Yes			Stream	
4	CAMP BALDWIN	O.C.	Priv.								Building	Res.	
5	CAMP WINDY	F.C.	Fed.	1	C,P	2							
6	CAMP WYETH	O.C.	Fed.	5					Yes	Yes			
7	CELILO	Park	Co.		P,S,B,F			20	Yes	Yes	Boat ramp	Col. R.	
8	CLOUD CAP SADDLE	F.C.	Fed.	1	P			4	Yes	Yes	Trails		Mt. Hood
9	COE PARK		Mun.	1	P			11			Playground		
10	COOPER SPUR	Park	Co.										
11	COOPER SPUR SKI AREA		Fed.		W						Rope tow		
12	DUFUR PARK		Mun.		C,P,S,F	5	3	5	Yes	Yes	Playground	Pool	
13	EAGLE CREEK	F.C.	Fed.	12	C,P,F	10	5	51	Yes	Yes			
14	EIGHTMILE CREEK	Park	Co.	5	C,P,F	5	3	10		Yes		Stream	
15	EIGHTMILE CROSSING	F.C.	Fed.	6	C,P,H	14		8	Yes				
16	FIFTEENMILE	F.C.	Fed.	1	C,P,F			4	Yes			Stream	
17	FOLEY LAKES RES.	Park	Priv.		P,S,F,B						Boat ramp		
18	HERMAN CREEK	F.C.	Fed.	3	C,P,F	5						Stream	Geologic
19	HOOD RIVER	R.R.A.	State		P			x	Yes	Yes			
20	HOOD RIVER BOAT BASIN	B.L.	Co.		B						Boat ramp	Col. R.	
21	HOOD RIVER MEADOW	F.C.	Fed.	6	C,P,F	8		2	Yes	Yes		Stream	
22	HOWE PARK		Mun.	1	P			4			Playground		
23	INDIAN BUREAU PARK		Fed.										
24	INDIAN SPRING	F.C.	Fed.	1	C,P,H	2		1	Yes	Yes			
25	JACKSON PARK		Mun.	5	P			15	Yes	Yes	Playground		
26	KINGSLEY	F.C.	Fed.	5	C,P,S,B,F	8	2	1	Yes			Res.	
27	KINGSLEY	O.C.	Priv.								Building	Res.	
28	KOEBAL SPRINGS	F.C.	Fed.	1	C,P	2		4					
29	KOBERG BEACH	Park	State	68	C,P,S,F,B	x		x	Yes	Yes			
30	LADD CREEK	F.C.	Fed.	1	C,P,F,H			3	Yes	Yes			
31	LANG	Park	State	162	C,P	x		x	Yes	Yes			
32	LINDSEY	Park	State	129						Yes			
33	LOST LAKE	F.C.	Fed.	17	C,P,S,B,F	40		41	Yes	Yes	Boat ramp	Lake	
34	LOST LAKE	O.C.	Priv.								Building	Lake	
35	LOWER EIGHTMILE CROSSING	F.C.	Fed.	4	C,P,F,H			3	Yes			Stream	
36	MAYER	Park	State	308	C,P,B,S,F	x		x	Yes	Yes	Boat ramp	Slough	Overlook
37	MEMALOOSE	R.R.A.	State		P			x	Yes	Yes		Col. R.	Overlook
38	MOSIER BATTLEMENTS	R.R.A.	State									Col. R.	Geologic
39	OLD LOCKS PARK		Co.		P,B			x	Yes	Yes	Boat ramp	Col. R.	
40	OVERLOOK	F.C.	Fed.	4	P			28	Yes	Yes			
41	PANORAMA POINT	V.P.	Co.					10	Yes	Yes			Overlook
42	PEEBLE FORK	F.C.	Fed.	1	C,P,F	3			Yes			Stream	
43	POLALLIE	F.C.	Fed.	3	C,P,F	10		2	Yes			Stream	
44	RADNEY LAKE	F.C.	Fed.	1	C,P,B,F	5			Yes			Lake	
45	ROBIN HOOD	F.C.	Fed.	6	C,P,F,H	16		31	Yes	Yes		Stream	
46	ROUTSON	Park	Co.	80	C,P,F	50	x	10	Yes	Yes		Stream	

TABLE B

RECREATION AREA SUMMARY
(Continued)

MAP INDEX NO.	NAME	GENERAL				FACILITIES						NATURAL FEATURES	
		TYPE*	PRESENT OWNERSHIP	ACREAGE	USE**	NUMBER OF CAMPING SITES	NUMBER OF TRAILER SITES	NUMBER OF PICNIC SITES	COMFORT STATIONS	DEVELOPED WATER SYSTEM	OTHER FACILITIES	MAJOR WATER FEATURE	OTHER FEATURES
	EXISTING												
47	SENECA FOUTS	Park	State	226								Col. R.	
48	SEUFERT	Park	Co.		C,P	20	10	50	Yes	Yes	Playground Museum		Dam
49	SHERIDAN	Park	State	12								Col. R.	Overlook
50	SHERWOOD	F.C.	Fed.	21	C,P,F	21	4	45	Yes	Yes		Stream	
51	SNOW SHOE CLUB.	O.C.	Fed.								Building		Mt. Hood
52	SOROSIS PARK	V.P.	Mun.	15	P			50	Yes	Yes	Playground		
53	STARVATION CREEK	Park	State	153	C,P	x		x	Yes	Yes	Trails		Waterfalls
54	THE DALLES BOAT BASIN	B.L.	Co.		B						Boat landing	Col. R.	
55	THE DALLES CITY PARK		Mun.	0.5	P			20	Yes	Yes	Playground		
56	TILLIE JANE	F.C.	Fed.	9	C,P	16	6		Yes	Yes	Trails		Mt. Hood
57	TOLL BRIDGE	Park	Co.	160	C,P,F	30	x	15	Yes	Yes		Stream	
58	TUCKER BRIDGE	Park	Co.		C,P,F	50	12	20	Yes	Yes	Playground	Stream	
59	VIENTO	Park	State	244	C,P,S	45		x	Yes	Yes		Col. R.	
60	VINZENZ LOUSMANN	Park	State	126									
61	WAHTUM LAKE	F.C.	Fed.	1	C,P,B,S,F	12			Yes			Lake	
62	WAHTUM LAKE TRAIL	F.C.	Fed.	3	C,P,F	5			Yes			Lake	
63	WALCOMA PARK		Mun.	0.5	P			4		Yes	Playground		
64	WYGANT	Park	State	691	C,P,F	x		x	Yes	Yes	Trails	Col. R.	Overlook
65	ZIBE DEMMICK	Park	State	23	C,P,F	x		x	Yes	Yes		Hood R.	
	PROPOSED												
66	BEAR LAKE	F.C.	Fed.		P,F							Lake	
67	BLACK LAKE	F.C.	Fed.		C,P,S,F,H	8		x	Yes	Yes		Lake	
68	CASCADE LOCKS	Park	Co.		C,P,F,B				Yes			Col. R.	
69	GOOSEBERRY LAKE	Park											
70	HICKS LAKE	F.C.	Fed.		P,F							Lake	
71	HOOD RIVER MEADOWS SKI AREA		Fed.										
72	INDIAN CREEK LAKES	Park										Lakes	
73	INSPIRATION POINT	F.C.	Fed.						Yes				Overlook
74	KNOTTINGHAM	F.C.	Fed.		C,P	65		x	Yes	Yes			
75	LAMBERSON BUTTE SKI AREA		Fed.										
76	LAVA FLOW	Park											
77	McCLURE LAKE	Park										Lake	
78	NEAL CREEK RES.	Park										Res.	
79	NORTH LAKE	F.C.	Fed.		C,P,F							Lake	
80	OTTERTAIL LAKE	F.C.	Fed.		C,P,B,F,H	6		x	Yes	Yes		Lake	
81	PUNCH BOWL	V.P.	Co.										
82	RUTHTON	Park	Priv.										
83	SCOUT LAKE	F.C.	Fed.		C,P,F,H	8		x	Yes	Yes		Lake	
84	TAYLOR LAKE	Park											
85	TOOLEY LAKE	Park										Lake	
86	WARREN LAKE	F.C.	Fed.		C,P,S,B,F,H							Lake	

Note: *F.C. - Forest Camps, O.C. - Organizational Camps, R.R.A. - Roadside Rest Areas, V.P. - View Point, B.L. - Boat Landing.
**C - Camping, P - Picnicking, B - Boating, S - Swimming, H - Hunting, F - Fishing, W - Winter Sports.
x - Indicates an unknown number of facilities exist.

TABLE C

RECONNAISSANCE DATA ON SMALL WATERSHEDS

ITEM	UNIT	WASCO RESOURCE AREA				HOOD RESOURCE AREA					TOTAL
		A FIFTEENMILE CREEK	B EIGHTMILE CREEK	C THE DALLES	D MOSIER CREEK	E EAST FORK HOOD RIVER	F OAK GROVE	G COLUMBIA GORGE	H MT. FORK HOOD RIVER	I WEST FORK HOOD RIVER	
FARMS	Number	100	60	240	60	220	240	20	240	60	1,240
GENERAL LAND USE:											
Forest land grazed	Acres	18,600	8,700	27,400	16,300	1,200	200	-	-	-	72,400
Forest land not grazed	Acres	16,400	20,000	13,800	21,500	73,000	28,600	52,000	27,800	43,500	296,600
Cropland	Acres	93,200	31,500	14,000	2,200	7,500	5,300	200	7,000	1,100	162,000
Rangeland	Acres	33,000	14,400	29,400	2,800	7,600	300	100	200	200	88,000
Other	Acres	2,100	1,100	3,100	1,400	8,200	4,500	6,100	5,500	3,500	35,500
TOTAL WATERSHED AREA	Acres	163,300	75,700	87,700	44,200	97,500	38,900	58,400	40,500	48,300	654,500
CROPLAND USE:											
Dryland	Acres	90,700	30,400	11,600	2,000	500	400	100	1,000	100	136,800
Irrigated land	Acres	2,500	1,100	2,400	200	7,000	4,900	100	6,000	1,000	25,200
Water Source:											
Streamflow	Acres	2,400	440	800	60	7,000	3,600	100	6,000	1,000	21,400
Storage reservoir	Acres	-	360	-	-	-	1,300	-	-	-	1,660
Ground water	Acres	100	300	1,600	140	-	-	-	-	-	2,140
Method of application:											
Sprinkler	Acres	1,700	760	2,400	200	6,000	3,900	100	5,400	800	21,260
Gravity	Acres	800	340	-	-	1,000	1,000	-	600	200	3,940
Water shortage	Acres	2,050	980	800	-	3,600	3,000	-	-	-	10,430
POTENTIAL:											
Potential cropland	Acres	1,000	600	400	200	3,500	2,300	300	2,000	1,000	11,300
Potential available water	Ac. ft.	47,000	25,000	26,000	23,000	296,000	149,000	288,000	260,000	326,000	1,440,000
Potential irrigable land	Ac. ft.	8,000	1,000	5,000	1,300	2,000	2,000	100	2,000	100	21,500
Water source:											
Natural flow and ground water	Acres	100	100	500	1,300	100	-	100	2,000	100	4,300
Storage needs	Acres	7,900	900	4,500	-	1,900	2,000	-	-	-	17,200
DRAINAGE:											
Land needing drainage	Acres	-	-	-	-	1,000	1,800	-	500	400	3,700
STORAGE:											
Ponds	Number	15	35	20	14	3	7	2	6	2	104
Reservoirs	Number	3	-	1	-	-	-	-	-	-	4
Possible reservoir sites studied	Number	12	4	3	1	-	1	-	-	2	23
FLOODED AREAS:											
Area	Acres	1,500	800	100	10	50	40	100	800	200	3,600

Data Source: USDA

TABLE D

POTENTIAL WATER DEVELOPMENT PROJECTS
DAM AND RESERVOIR SITES

MAP INDEX NO.	WATERSHED AND STREAM	DR. AREA Sq. Mi.	AVERAGE ANNUAL YIELD Ac. ft.	PURPOSE	DAM		RESERVOIR				LOCATION				DATA SOURCE NO.
					HEIGHT Feet	CREST LENGTH Feet	MAX. POOL ELEV. Ft.-MSL	MAX. POOL AREA Acres	USABLE STORAGE Ac. ft.	TOTAL STORAGE Ac. ft.	Twp.	Rng.	Sec.	Str. Mile	
	HOOD RIVER														
1	Neal Creek	1.5	162,000*	I	94	1,100	1,568	280	5,700	5,900	1N	10E	11		4
	WEST FORK HOOD RIVER														
2	Green Point Creek	20.0	80,400	I-R	100	500		31		1,240	1N	9E	11		1
3	Lake Branch	25.1	99,000	I-R	186	400		106		7,890	1N	9E	29	1	1
4	Lake Branch	10.6	52,200	I-R	200	700		112		8,960	1N	8E	26	5	1
	MIDDLE FORK HOOD RIVER														
5	Clear Branch	8.75		I-F	106	1,350	2,974.9	114	2,510	2,660	1S	9E	27	1	1
	EAST FORK HOOD RIVER														
6	East Fork Hood River	26.0	62,000	I	220					50,000	3S	10E	10	20	2
7	Evans Creek	4.5		I	27	280	1,676.6	2.3	15	16.3	1S	10E	5		1
8	Clear Creek			I	12		2,830	2.5	10.5	12.5	1S	9E	24		1
9	Dog River	4.95		D-M-In							2S	10E	11	6	5
	COLUMBIA RIVER MISCELLANEOUS														
10	Mosier Creek	22.9	8,900	I-F-R	160	900		100		6,400	2N	12E	31		1
11	Rowena Creek	5.0	1,100	I-F-R	80	400		19		610	2N	12E	16		1
12	Chenoweth Creek	19.9	5,300	D-M-I-In-F-R	53	500		37		790	2N	12E	36		1
13	Mill Creek, North Fork	8.8	4,700	D-M-I-In-F-R	65	200		13		330	1N	11E	25	4	1
14	Mill Creek, South Fork	28.6		D-M-I-In			800			1,000	1S	11E	20	10	5
15	Dry Hollow			I						64	1N	13E	16		3
	FIFTEENMILE CREEK														
16	Fifteenmile Creek			I					61,000	100,000	1S	14E	3	24	3
17	Fifteenmile Creek	18.5	12,500	D-M-I-In-F-R	55	480		27		680	2S	12E	14	39	1
18	Fifteenmile Creek	17.8	12,400	D-M-I-In-F-R	200	1,200		249		19,920	2S	12E	15	40	1
19	Fifteenmile Creek	15.5	11,600	D-M-I-In-F-R	125	700		75		3,750	2S	12E	19	44	1
20	Dry Creek	75.2	12,000	I-F-R	50	900		100		2,000	1S	14E	16		1
21	Dry Creek	60.1	9,600	I-F-R	120	1,400		324		15,500	1S	14E	20		1
22	Dry Creek	51.0	8,200	I-F-R	50	900		100		2,000	1S	14E	29		1
23	Dry Creek	21.7	3,500	I-F-R	100	1,200		150		6,000	2S	14E	18		1
24	Mays Canyon Creek	18.0	2,900	I-F-R	100	800		125		5,000	2S	13E	1		1
25	Pine Creek	26.2	11,200	I-F-R	100	1,700		200		8,000	2S	13E	15		1
26	Larch Creek	15.6	7,500	I-F-R	100	1,300		126		5,000	2S	13E	19		1
27	Larch Creek	6.2	3,300	I-F-R	58	700		39		900	2S	12E	28		1
28	Ramsey Creek	9.0	5,800	I-F-R	53	500		15		320	2S	12E	3		1
	EIGHTMILE CREEK														
29	Eightmile Creek	30.6	10,400	I-F-R	200	900		125		10,000	1S	13E	19/30	17	1
30	Eightmile Creek	21.0	7,300	I-F-R	125	700		75		3,750	1S	12E	26	19	1
31	Fivemile Creek	33.3	10,600	I-F-R	80	600		106		3,390	1N	13E	25	5	1
32	Jap Hollow	11.5	2,700	I-F-R	70	900		131		3,670	1N	14E	31		1
32	Jap Hollow	60*	50,000*	I-FC	157					25,000	1N	14E	31		2

Note: This table includes damsites with conflicting reservoir area
*Including diversions

Data Sources:
1 - USGS
2 - Corps of Engineers
3 - Bureau of Reclamation
4 - East Fork Irrigation District
5 - City of The Dalles

Purpose: D - Domestic and Livestock
M - Municipal
I - Irrigation
In - Industrial
P - Power
R - Recreation, fish and wildlife
FC - Flood Control

TABLE E

WATER YIELD AND CONSUMPTIVE USE

SCA WATERSHED	TOTAL AREA Acres	MEAN AREA[1] PRECIPITATION Inches	YIELD FROM RAINFALL Acre Feet	TIMBERLAND[2]	RANGE[2] AND OTHER	DRY[2] CROPLAND	IRRIGATED[2] LAND	TOTAL CONSUMPTIVE Acre Feet	RUNOFF[3] Ac. Ft.	DIFFERENCE MAINLY GROUND WATER
WASCO AREA										
A. FIFTEENMILE CREEK	163,300	13.9	189,000	35,000	35,100	90,700	2,500		44,000	
				33,500	27,800	84,200	5,800	131,300		14,000
B. EIGHTMILE CREEK	75,700	20.1	127,000	28,700	15,500	30,400	1,100		26,000	
				29,900	14,900	27,900	2,600	75,300		26,000
C. THE DALLES	87,700	23.9	175,000	41,200	32,500	11,600	2,400		28,000	
				42,900	31,100	10,700	6,000	91,700		56,000
D. MOSIER	64,200	28.0	103,000	37,800	4,200	2,000	200		16,000	
				39,400	4,200	2,000	500	46,100		41,000
TOTAL			594,000					343,400	114,000	137,000
HOOD AREA										
E. EAST FORK HOOD RIVER (not including Mid Fork)	97,500	49.3	401,000	74,200	15,800	500	7,000		285,000	
				80,400	15,800	500	16,300	113,000		3,000
F. OAK GROVE	38,900	57.7	187,000	28,800	4,800	400	4,900		87,000	
				33,600	4,800	500	12,300	51,200		49,000
G. COLUMBIA GORGE	58,400	85.5	416,000	52,000	6,200	100	100		279,000	
				65,000	6,700	100	300	72,100		65,000
H. MIDDLE FORK HOOD RIVER	40,500	71.6	242,000	27,800	5,700	1,000	6,000		185,000	
				32,400	5,700	1,000	14,000	53,100		4,000
I. WEST FORK HOOD RIVER	48,300	111.0[4]	447,000	43,500	3,700	100	1,000		371,000	
				54,400	4,000	100	2,500	61,000		15,000
TOTAL			1,693,000					350,400	1,207,000	136,000
GRAND TOTAL	654,500	41.9	2,287,000	369,000	123,500	136,800	25,200	693,800	1,321,000	272,000
				411,500	115,000	107,000	60,300			

Note: 1 SWRB Ischyetal

2 Upper number in acres

Lower number in acre feet

3 USGS records and SWRB correlations

4 Estimated by SWRB

Data Source: USDA, USGS and SWRB

TABLE F

AVERAGE ANNUAL RUNOFF OF SELECTED STREAM SYSTEMS

DRAINAGE	DRAINAGE AREA Acres[1]	AVE. ANNUAL PRECIPITATION Inches[2]	ANNUAL RUNOFF Ac. Ft.	ANNUAL RUNOFF Inches[3]	PERCENT OF RUNOFF
EAGLE CREEK	22,700	101.4	173,000***	91.3**	90.0**
HERMAN CREEK	12,500	86.7	81,000***	78.0**	90.0**
GORDON CREEK	2,400	75.0	15,000*	75.3*	100.4
HOOD RIVER	223,300	67.0	863,000*	46.4	69.3
Phelps Creek	4,300	44.1	14,000***	39.7**	90.0**
Indian Creek	4,500	37.1	13,000***	33.4**	90.0**
Neal Creek	19,600	34.2	28,000***	17.1**	50.0**
Odell Creek	8,400	35.5	12,000***	17.8**	50.1**
WEST FORK HOOD RIVER	65,400	96.2	431,000*	79.0	82.1
Green Point Creek	13,200	77.4	60,000***	54.2**	70.0**
Lake Creek	18,500	108.0	142,000***	91.8**	85.0**
Lost Lake Creek at Lost Lake	1,800	125.0	14,000*	92.0*	73.6
EAST FORK HOOD RIVER	101,600	64.2	403,000***	47.6*	74.1
Evans Creek	3,600	62.3	9,000***	31.2**	50.0**
Cold Springs Creek	5,700	74.9	17,000*	36.2*	48.3
Dog River	8,200	39.3	14,000*	19.8*	50.4
Middle Fork Hood River	29,800	79.4	158,000***	63.5**	80.0**
Tony Creek	5,600	78.2	22,000***	39.1**	50.0**
Clear Branch	12,600	92.5	104,000*	99.4*	107.5
MOSIER CREEK	32,900	28.9	16,000***	5.8**	20.0**
CHENOWETH CREEK	17,600	22.1	5,000***	3.3**	14.9**
MILL CREEK	39,900	29.7	20,000***	5.9**	19.9**
Above Wicks Reservoir	17,400	36.0	13,000*	9.2*	25.6
THREEMILE CREEK	13,000	16.0	3,000***	3.2**	20.0**
FIFTEENMILE CREEK	233,500	15.9	70,000***	3.6**	22.6**
Eightmile Creek	75,200	20.2	26,000*	4.1*	20.3
Fivemile Creek	26,900	22.6	12,000*	5.5*	24.3
Fifteenmile Creek at Gage No. 1040	13,800	29.6	21,000*	18.3*	61.8
Fifteenmile Creek at Stream Mile No. 36	24,200	26.1	29,000***	14.4*	55.2**
Fifteenmile Creek at Gage No. 1045	110,500	15.5	40,000*	4.3*	27.7
Fifteenmile Creek below Eightmile Creek and Gage No. 1045	47,800	10.8	4,000***	1.1**	10.0**

Note: 1 Planimetered from USGS 15' quadrangles
2 Determined from isohyetal map
3 Computed from USGS records

* Contains correlated values of varying degrees of accuracy
** Estimated from isohyetal map and adjacent or similar drainages
*** Computed from estimated values

TABLE G

OREGON STATE GAME COMMISSION RECOMMENDED MINIMUM FLOWS FOR FISH LIFE
IN CFS

AREA AND STREAM	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	LOCATION
HOOD AREA													
Eagle Creek	70	70	70	70	70	70 50	20	20	20 70	70	70	70	Above hatchery dam intake[1]
Herman Creek	60	60	60	60	60	60 30	15	15	15 60	60	60	60	Mouth
Hood River[2]													
East Fork Hood River	150	150	150	150	150	100 75	60	60	60	150	150	150	Confluence of Polallie Creek
East Fork Hood River	75	75	75	75	75	75	50	40	40	75	75	75	Confluence of Middle Fork[3]
Dog River	12	12	12	12	12	8 6	6 4	4	4	12	12	12	Mouth
Evans Creek	-	-	-	-	-	-	2	2	2	-	-	-	Mouth
Middle Fork Hood River	150	150	150	150	150	100 75	60	40	40	150	150	150	Mouth
Clear Creek	-	-	-	-	-	-	-	10	10	-	-	-	Confluence of Pinnacle Creek
Neal Creek	20	20	20	20	20	15 10	5	5	5	20	20	20	Mouth
Odell Creek	-	-	-	-	-	-	8	8	8	-	-	-	Mouth[4]
West Fork Hood River	150	150	150	150	150	150	125	100	100	150	150	150	USGS Gage No. 1185
Elk Creek	-	-	-	-	-	-	-	3	3	-	-	-	Mouth
Greenpoint Creek	-	-	-	-	-	-	-	5	5	-	-	-	Mouth
Lake Branch	100	100	100	100	100	75	50 40	25	25	100	100	100	Mouth
McGee Creek	-	-	-	-	-	-	-	6	6	-	-	-	Mouth
Lindsey Creek	20	20	20	20	20	15 6	3	3	3	20	20	20	Mouth
WASCO AREA													
Fifteenmile Creek	15	15	15	15	15	15 5	2	2	2	-	-	15	Dufur
Fifteenmile Creek	20	20	20	20	20	15 8	4	4	4	-	-	20	Confluence of Eightmile Creek
Eightmile Creek	15	15	15	15	15	10 4	2	2	2	-	-	15	Mouth
Eightmile Creek	10	10	10	10	10	6 3	2	2	2	-	-	10	Highway 197
Mill Creek	15	15	15	15	15	8 5	4	4	4	-	-	15	Mouth
North Fork Mill Creek	7	7	7	7	7	-	1	1	1	-	-	7	Mouth
South Fork Mill Creek	10	10	10	10	10	-	3	2	2	-	-	10	Mouth

Note: Two figures are given where substantial flow changes occur during the month

1 Recommended flow to arrive at the dam

2 A cooperative study by the Fish Commission, Game Commission and Pacific Power and Light Company biologists is presently in progress to determine minimum water volumes necessary for fish in Hood River downstream from Powerdale Dam

3 The 75 cfs listed from October to June is the minimum flow volume necessary for upstream passage of anadromous fish in the East Fork from the headgate of Eastside Ditch downstream to the confluence of Middle Fork

4 Flow for trout fishing only; other flows listed are intended primarily for production of anadromous species

Data Source: Oregon State Game Commission

ABBREVIATIONS AND SYMBOLS

Ac.ft.	Acre-feet
Bd.ft.	Board feet
BLM	Bureau of Land Management
Br.	Branch
Can.	Canyon
Cert.	Certificate
CFS, cfs	Cubic feet per second
Co.	Company, county
Cr.	Creek
DO.,D.	Domestic and livestock
E.	East
Elev.	Elevation
° F.	Degrees Fahrenheit
FC	Flood control
Fk.	Fork
FS	Fish life
Ft.	Foot, feet
Ft./sec.	Feet per second
G.	Gulch
Gpd	Gallons per day
Gpm	Gallons per minute
IN	Industrial
IR.,I.	Irrigation
Is.	Island
Kw	Kilowatts
Kwh	Kilowatt hours
L.	Lake, Little
Max.	Maximum
Mdw.	Meadow
Mgd	Million gallons per day
Mi.,MI.	Mile, mining
Min.	Minimum
Misc.	Miscellaneous
MSL	Mean sea level
Mtn.	Mountain
MU.,M.	Municipal
N.	North
PP&L	Pacific Power and Light Company
Pt.	Point
PW.,P.	Power
R.,Riv.	River
R.,Rng.	Range
R.S.	Ranger Station
RE.,R.	Recreation
Res.	Reservoir
Rk.	Rock
S.	South
S.P.	State Park
Sec.	Section
Spr.	Spring
Sq.	Square
Sq.mi.	Square mile
Sta.	Station
Str.	Stream
SWRB	State Water Resources Board
T.,Twp.	Township
Temp.	Temperature
Trib.	Tributary
USDA	U. S. Department of Agriculture
USGS	U. S. Geological Survey
W.	Wayside, west
WL	Wildlife

APPROXIMATE HYDRAULIC EQUIVALENTS

1 acre foot
= a volume 1 acre in area and 1 foot in depth
= 326,000 gallons
= 43,560 cubic feet
= 0.5 cubic feet per second for 1 day

1 cubic foot per second
= 7.5 gallons per second
= 450 gallons per minute
= 2.0 acre-feet per day
= 650,000 gallons per day

1 inch per day
= 0.04 cubic feet per second per acre
= 27 cubic feet per second per square mile
= 19 gallons per minute per acre

1 inch per hour
= 1.0 cubic feet per second per acre
= 640 cubic feet per second per square mile
= 450 gallons per minute per acre

1 million gallons per day
= 690 gallons per minute
= 1.5 cubic feet per second
= 3.0 acre-feet per day


R7E
R8E
R9E
R10E
R11E
R12E
R13E
R14E
R15E
121 45
122 00
122 15
122 30
45 45
45 30
45 15
T3N
T2N
T1N
T1S
T2S
T3S
STEVENSON
CASCADE LOCKS
NORTH BONNEVILLE
Bonneville
WHITE SALMON
BINGEN
HOOD RIVER
MOSIER
THE DALLES
DUFUR
SKAMANIA CO
HOOD RIVER CO
KLICKITAT CO
WASCO CO
WASHINGTON
OREGON
HOOD RIVER CO
MULTNOMAH CO
HOOD RIVER CO
CLACKAMAS CO
SHERMAN CO
WASCO CO
COLUMBIA RIVER
HOOD RIVER
DESCHUTES RIVER
SANDY
BASIN
DESCHUTES
BASIN
VALLEY
UPPER
Mt. Hood
Willamette Base Line
Lost Lake
Trout Creek
Parkdale
Odell
Dufur
Maupin
Tygh Valley
Wamic
Pine Grove
Friend
Grass Valley
Moro
Kingsley Field
Celilo
Wishram
Bingen
Underwood
Carson
Hood River
Cascade Locks
Rockford
Oak Grove
Van Horn
Conway
Dukes Valley
Winans
Dee
Rowena
Lyle
Klickitat
Dallesport
Chenoweth
Crates
Rock Island
Smithville
Spearfish
Petersburg
Fairbanks
Emerson
Wrentham
Rice
Enderby
Boyd
Wishram Hts.
Biggs
To Sandy
To Maupin
DRAINAGE BASIN KEY
NORTH COAST 1
SANDY 3
HOOD 4
UMATILLA 7
GRANDE RONDE 8
MID COAST 18
WILLAMETTE 2
JOHN DAY 6
POWDER 9
DESCHUTES 5
2A
MALHEUR 10
UMPQUA 16
GOOSE & SUMMER LAKES 13
OWYHEE 11
SOUTH COAST 17
ROGUE 15
KLAMATH 14
MALHEUR LAKE 12
LEGEND
COUNTY SEAT
OTHER INCORPORATED CITIES
UNINCORPORATED TOWN
STREAM OR CANAL GAGE
CANAL OR DITCH
PIPELINE
NUMBERED HIGHWAY
OTHER PRINCIPAL ROADS
Numbers on streams indicate miles above mouth
Planimetric control based on U.S.G.S. quadrangle maps
SCALE OF MILES
1 0 1 2 3 4 5
STATE WATER RESOURCES BOARD
SALEM, OREGON
1964
HOOD
DRAINAGE BASIN
MAP NO. 4.6
PLATE 1

HOOD DRAINAGE BASIN

HYDROLOGICAL STATIONS AND AVERAGE ANNUAL PRECIPITATION

MAP NO. 4.62

STATE WATER RESOURCES BOARD
SALEM, OREGON
1964

SCALE OF MILES
1 0 1 2 3 4 5

LEGEND

ACTIVE	INACTIVE	
▲	△	Stream or Canal Gaging Station
⬢	⬡	Climatological Station (precipitation only)
-⬢-	-⬡-	Climatological Station (precipitation and air temp.)

NOTE: Index numbers refer to Hydrological Station Summary in Appendix.

DATA SOURCE: U. S. Dept. of Agriculture
U. S. Geological Survey
U. S. Weather Bureau

Numbers on streams indicate miles above mouth

Planimetric control based on U.S.G.S. quadrangle maps

LEGEND

- COUNTY SEAT
- OTHER INCORPORATED CITIES
- UNINCORPORATED TOWN
- STREAM OR CANAL GAGE
- CANAL OR DITCH
- PIPELINE
- NUMBERED HIGHWAY
- OTHER PRINCIPAL ROADS

DRAINAGE BASIN KEY

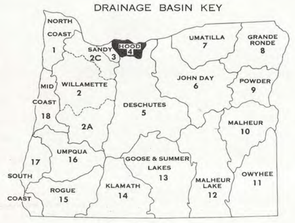


PLATE 2

R7E R8E R9E R10E R11E R12E R13E R14E R15E

T3N T2N T1N T1S T2S T3S

SKAMANIA CO.
HOOD RIVER CO.

KLICKITAT CO.
WASCO CO.

HOOD RIVER CO.
WASCO CO.

HOOD RIVER
MULTNOMAH CO.

HOOD RIVER
CLACKAMAS CO.

SHERMAN CO.
WASCO CO.

WASHINGTON
OREGON

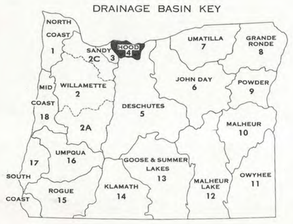
COLUMBIA RIVER

STEVENSON
CASCADE LOCKS
NORTH BONNEVILLE
WHITE SALMON
BINGEN
HOOD RIVER
MOSIER
THE DALLES
DUFUR

SANDY BASIN

DESCHUTES BASIN

DRAINAGE BASIN KEY



LEGEND

RECREATION AREAS

- Present
- Potential

NOTE: Index numbers refer to Recreation Areas Summary in Appendix.

Numbers on streams indicate miles above mouth

Planimetric control based on U.S.G.S. quadrangle maps

LEGEND

- COUNTY SEAT
- OTHER INCORPORATED CITIES
- UNINCORPORATED TOWN
- STREAM OR CANAL GAGE
- CANAL OR DITCH
- PIPELINE
- NUMBERED HIGHWAY
- OTHER PRINCIPAL ROADS

SCALE OF MILES

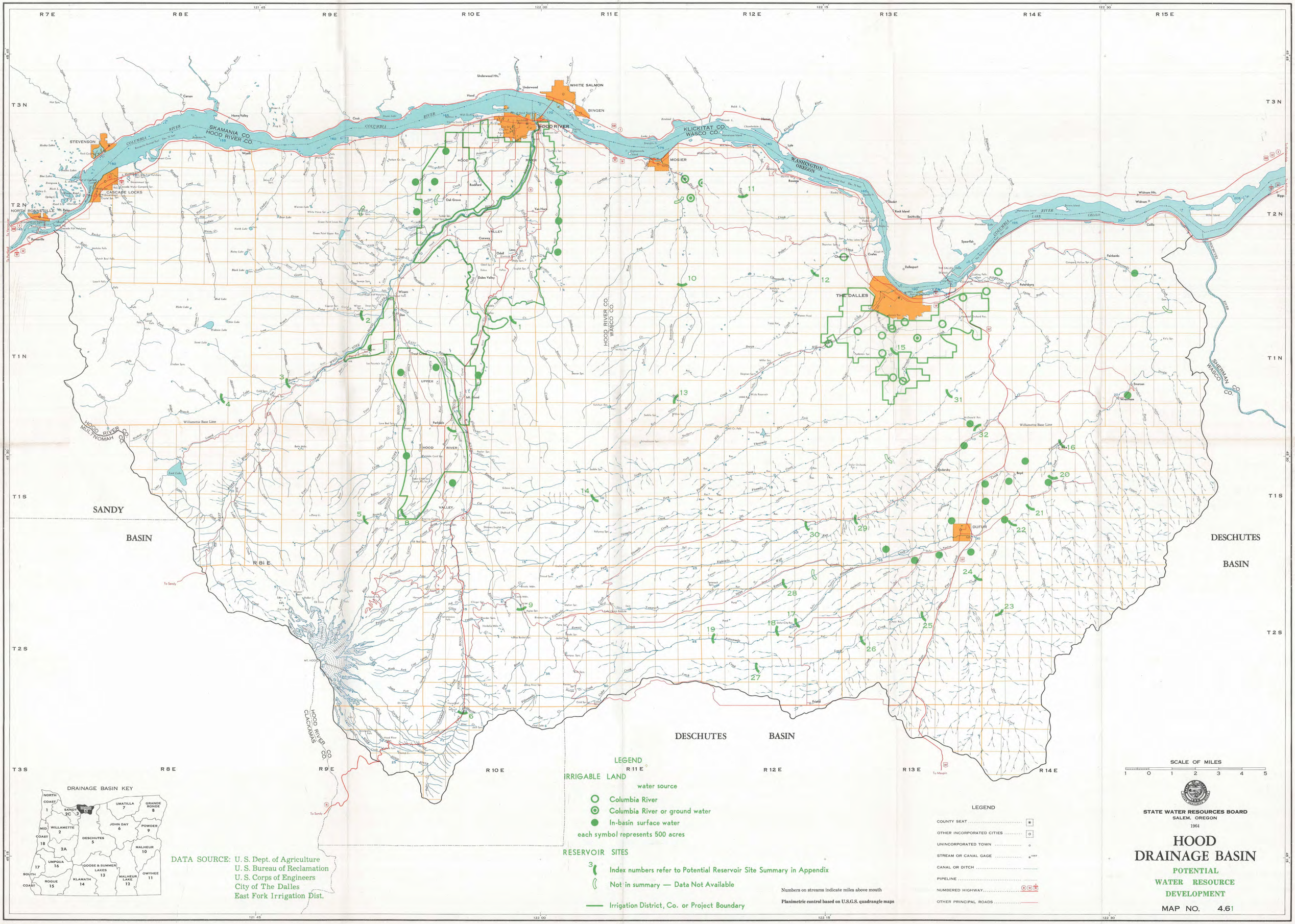
1 0 1 2 3 4 5

STATE WATER RESOURCES BOARD
SALEM, OREGON
1964

HOOD DRAINAGE BASIN

RECREATION AREAS

MAP NO. 4.617



DRAINAGE BASIN KEY

DATA SOURCE: U. S. Dept. of Agriculture
U. S. Bureau of Reclamation
U. S. Corps of Engineers
City of The Dalles
East Fork Irrigation Dist.

LEGEND

IRRIGABLE LAND

water source

- Columbia River
- Columbia River or ground water
- In-basin surface water

each symbol represents 500 acres

RESERVOIR SITES

- 3 Index numbers refer to Potential Reservoir Site Summary in Appendix
- Not in summary — Data Not Available

— Irrigation District, Co. or Project Boundary

Numbers on streams indicate miles above mouth

Planimetric control based on U.S.G.S. quadrangle maps

LEGEND

- COUNTY SEAT
- OTHER INCORPORATED CITIES
- UNINCORPORATED TOWN
- STREAM OR CANAL GAGE
- CANAL OR DITCH
- PIPELINE
- NUMBERED HIGHWAY
- OTHER PRINCIPAL ROADS

SCALE OF MILES

1 0 1 2 3 4 5

STATE WATER RESOURCES BOARD
SALEM, OREGON
1964

HOOD DRAINAGE BASIN

POTENTIAL
WATER RESOURCE
DEVELOPMENT

MAP NO. 4.61

PLATE 4