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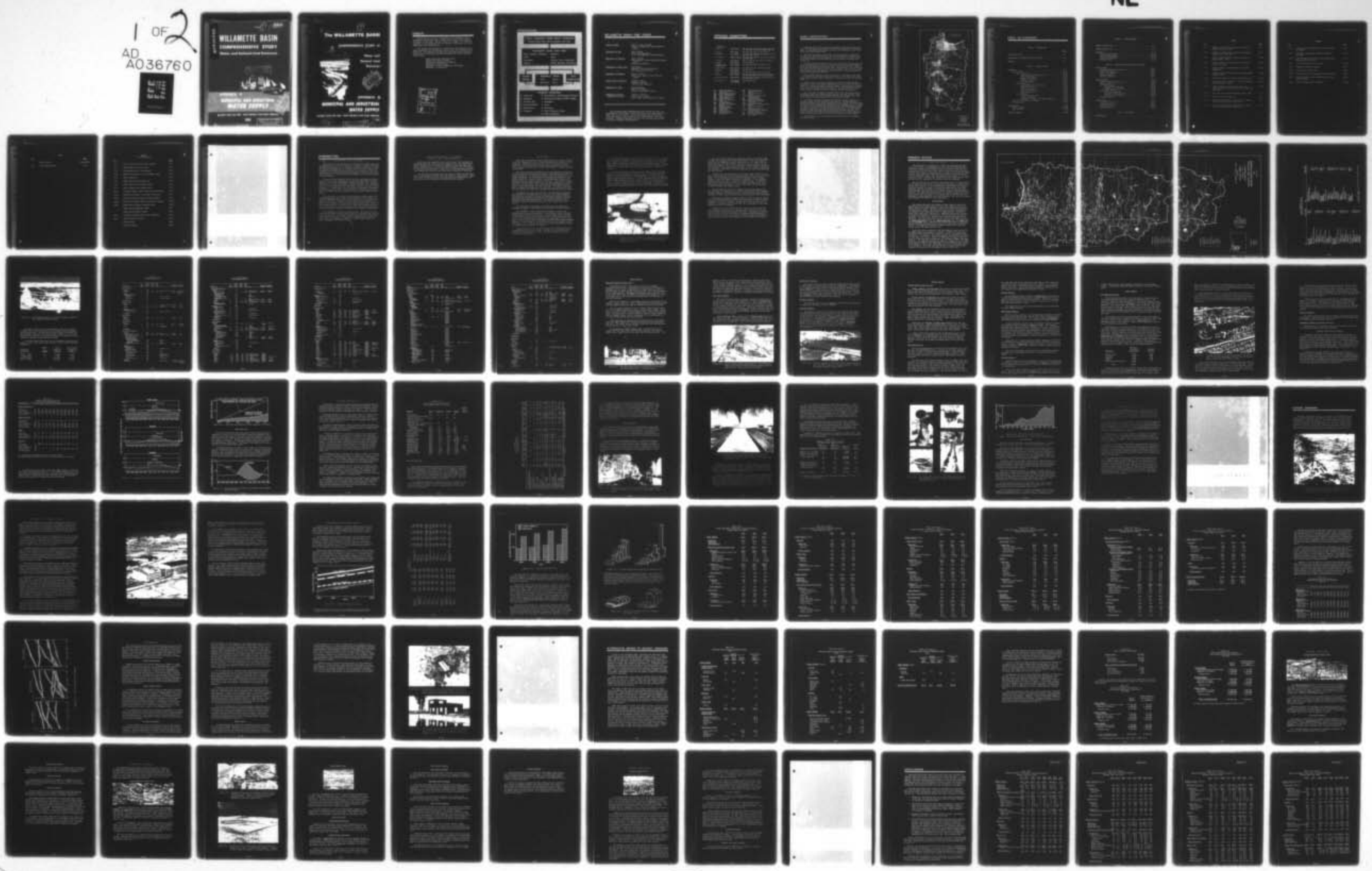
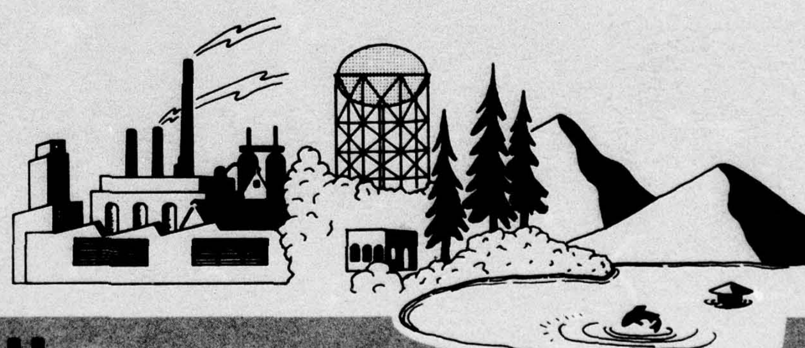


WILLAMETTE BASIN

COMPREHENSIVE STUDY

Water and Related Land Resources



APPENDIX H

MUNICIPAL AND INDUSTRIAL WATER SUPPLY

WILLAMETTE BASIN TASK FORCE - PACIFIC NORTHWEST RIVER BASINS COMMISSION

1969

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Water and Related Land Resources.

APPENDIX H.

MUNICIPAL AND INDUSTRIAL WATER SUPPLY.

WILLAMETTE BASIN TASK FORCE - PACIFIC NORTHWEST RIVER BASINS COMMISSION

(11) 1969

(12) 99p.

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CREDITS

This is one of a series of appendices to the Willamette Basin Comprehensive Study main report. Each appendix deals with a particular aspect of the study. The main report is a summary of information contained in the appendices plus the findings, conclusions, and recommendations of the investigation.

This appendix was prepared by the Municipal and Industrial Water Supply Committee under the general supervision of the Willamette Basin Task Force. The committee was chaired by the Federal Water Pollution Control Administration and included representation from the agencies listed below.

Oregon State Water Resources Board
Oregon State Board of Health
Oregon State Department of Commerce
Department of the Interior
Department of Health, Education, and Welfare
Department of Agriculture

ORGANIZATION

PACIFIC NORTHWEST RIVER BASINS COMMISSION

Columbia Basin Inter-Agency Committee until 1967

WILLAMETTE BASIN TASK FORCE

State of Oregon - Chairman	Commerce
Army	Labor
Agriculture	Federal Power Commission
Interior	Health, Education and Welfare

REPORT WRITER

TECHNICAL STAFF

Army	Interior
Agriculture	State

PLAN FORMULATOR

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B. Hydrology	H. Municipal and Industrial Water Supply
C. Economic Base	I. Navigation
D. Fish and Wildlife	J. Power
E. Flood Control	K. Recreation
F. Irrigation	L. Water Pollution Control
	M. Plan Formulation

WILLAMETTE BASIN TASK FORCE

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Department of Labor	Horace Harding Regional Economist Bureau of Employment Security
Department of Health, Education & Welfare	Francis L. Nelson Public Health Service Water Supply and Sea Resources Program

The Willamette Basin Comprehensive Study has been directed and coordinated by the Willamette Basin Task Force, whose membership as of April 1969 is listed above. The Task Force has been assisted by a technical staff, a plan formulator, and a report writer - Executive Secretary. Appendix committees listed on the following page carried out specific technical investigations.

APPENDIX COMMITTEES

Appendix-Subject		
A - Study Area	OSWRB - Chairman:	FWPCA, USBPA, USBLM, USBM, USBOR, USBR, USBSF&WL, USCE, USERS, USFS, USGS, USNPS, USSCS, OSDC, OSDF, OSDG&MI, OSS&WCC, OSU
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M - Plan Formulation	Plan Formulator - Chairman:	USCE, USDA, USDI, OSWRB

FPC - Federal Power Commission
FWPCA - Federal Water Pollution Control Administration
USBPA - Bonneville Power Administration
USBCF - Bureau of Commercial Fisheries
USBLM - Bureau of Land Management
USBM - Bureau of Mines
USBOR - Bureau of Outdoor Recreation
USBR - Bureau of Reclamation
USBSF&WL - Bureau of Sport Fisheries and Wildlife
USCE - Corps of Engineers
USDA - Department of Agriculture
USHEW - Department of Health, Education and Welfare
USDI - Department of Interior
USDL - Department of Labor
USERS - Economic Research Service
USFS - Forest Service
USGS - Geological Survey
USNPS - National Park Service
USSCS - Soil Conservation Service
USWB - Weather Bureau

OSBH - Oregon State Board of Health
OSDC - Oregon State Department of Commerce
OSDF - Oregon State Department of Forestry
OSDG&MI - Oregon State Department of Geology and Mineral Industries
OSE - Oregon State Engineer
OSFC - Fish Commission of Oregon
OSGC - Oregon State Game Commission
OSHD-PD - Oregon State Highway Department - Parks Division
OSMB - Oregon State Marine Board
OSS&WCC - Oregon State Soil and Water Conservation Committee
OSWRB - Oregon State Water Resources Board
OSU - Oregon State University
PSC-PR&C - Portland State College - Center for Population Research and Census Service
UO - University of Oregon
LCPD - Lane County Parks Department
OCPA - Oregon County Parks Association
POP - Port of Portland

BASIN DESCRIPTION

Between the crests of the Cascade and Coast Ranges in northwestern Oregon lies an area of 12,045 square miles drained by Willamette and Sandy Rivers--the Willamette Basin. Both Willamette and Sandy Rivers are part of the Columbia River system, each lying south of lower Columbia River.

With a 1965 population of 1.34 million, the basin accounted for 68 percent of the population of the State of Oregon. The State's largest cities, Portland, Salem, and Eugene, are within the basin boundaries. Forty-one percent of Oregon's population is concentrated in the lower basin subarea, which includes the Portland metropolitan area.

The basin is roughly rectangular, with a north-south dimension of about 150 miles and an average width of 75 miles. It is bounded on the east by the Cascade Range, on the south by the Calapooya Mountains, and on the west by the Coast Range. Columbia River, from Bonneville Dam to St. Helens, forms a northern boundary. Elevations range from less than 10 feet (mean sea level) along the Columbia, to 450 feet on the valley floor at Eugene, and over 10,000 feet in the Cascade Range. The Coast Range attains elevations of slightly over 4,000 feet.

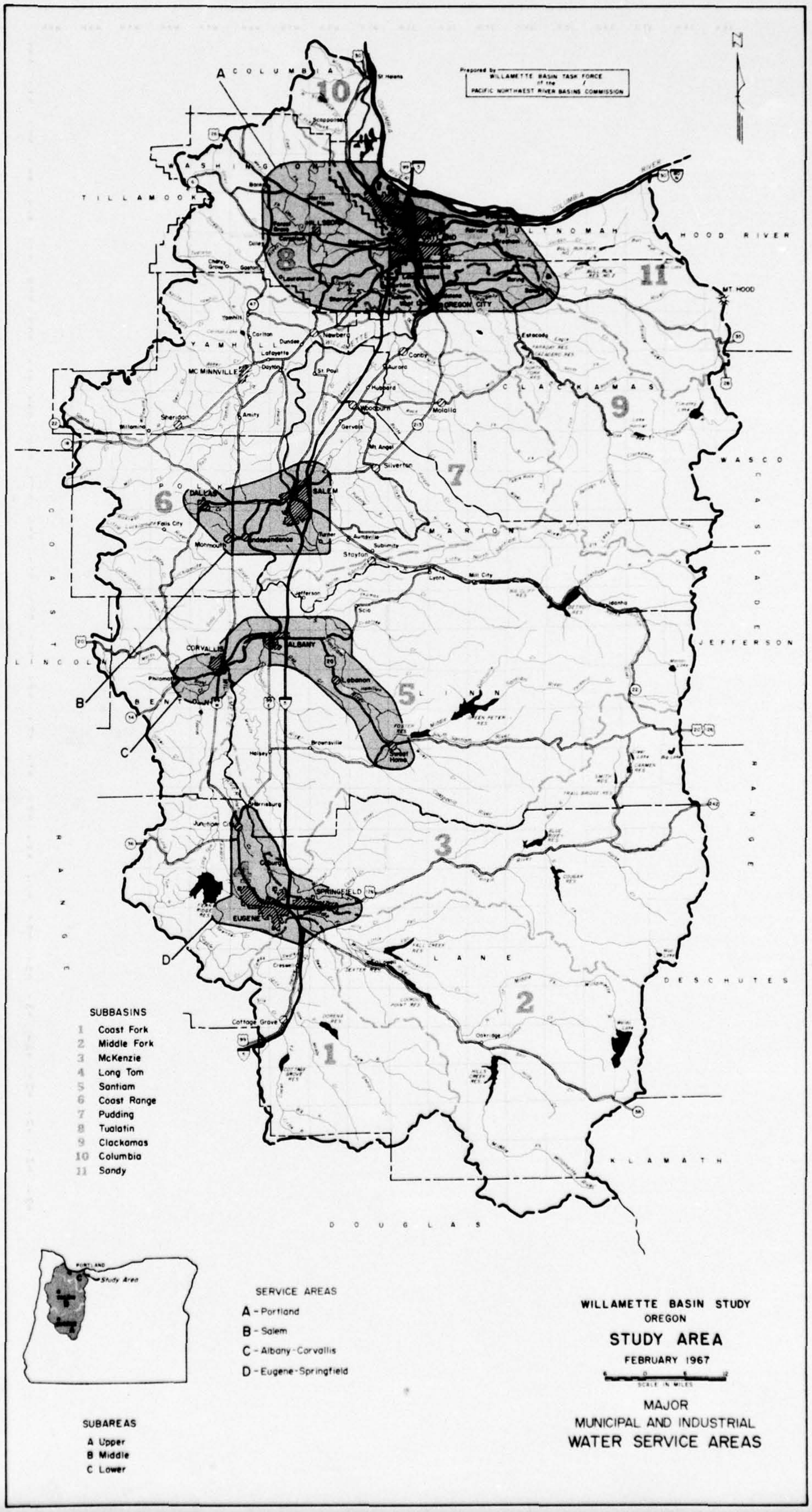
The Willamette Valley floor, about 30 miles wide, is approximately 3,500 square miles in extent and lies below an elevation of 500 feet. It is nearly level in many places, gently rolling in others, and broken by several groups of hills and scattered buttes.

Willamette River forms at the confluence of its Coast and Middle Forks near Springfield. It has a total length of approximately 187 miles, and in its upper 133 miles flows northward in a braided, meandering channel. Through most of the remaining 54 miles, it flows between higher and more well defined banks unhindered by falls or rapids, except for Willamette Falls at Oregon City. The stretch below the falls is subject to ocean tidal effects which are transmitted through Columbia River.

Most of the major tributaries of Willamette River rise in the Cascade Range at elevations of 6,000 feet or higher and enter the main stream from the east. Coast Fork Willamette River rises in the Calapooya Mountains, and numerous smaller tributaries rising in the Coast Range enter the main stream from the west.

In this study, the basin is divided into three major sections, referred to as the Upper, Middle, and Lower Subareas (see map opposite). The Upper Subarea is bounded on the south by the Calapooya Mountains and on the north by the divide between the McKenzie River drainage and the Calapooia and Santiam drainages east of the valley floor and by the Long Tom-Marys River divide west of it. The Middle Subarea includes all lands which drain into Willamette River between the mouth of Long Tom River and Fish Eddy, a point three miles below the mouth of Molalla River. The Lower Subarea includes all lands which drain either into Willamette River from Fish Eddy to its mouth or directly into Columbia River between Bonneville and St. Helens; Sandy River is the only major basin stream which does not drain directly into the Willamette.

For detailed study, the three subareas are further divided into 11 subbasins as shown on the map.



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(Titles abridged)

INTRODUCTION

PURPOSE AND SCOPE

The purpose of this appendix is to appraise the present municipal and industrial water supply situation, to analyze its future needs and development potential, and to evaluate the needs of subareas as a basis for making recommendations for measures which will serve those needs. Consideration of municipal and industrial water supply as a part of a comprehensive plan for development and management of water and related land resources is essential to provide a means for orderly development of water supplies.

The scope of this appendix limits projection of municipal and industrial water supply requirements to the years 1980, 2000, and 2020. Appraisal of the 1980 requirements includes consideration of quantity, quality, and seasonal variations of supply and demand. The need identified is of an immediate nature and may be directly related to the development of a comprehensive plan for readily foreseeable developments. The long-range plans, which are naturally more conjectural, are more general in nature and point toward the needs of major subareas of the basin.

The study area is confined to the Willamette Basin; however, the strong geographical and economic interrelations and interactions between the Willamette Basin, the Pacific Northwest, and the Nation will influence the level of municipal and industrial water demand in the basin. As an example, increased market area population will result in an enlarged market for processed food. Additional food-processing capacity will result in an increased demand for process water and water for the additional population supported by the industrial employment.

This appendix is primarily single-purpose. The first four sections are developed on the assumption that the water resource will not be a limiting factor if adequate facilities are provided. The conclusions (Part V) are based on the fact that competition for the use of water exists, and suggest an approach to meeting supply needs that would accommodate this competition.

RELATIONSHIP TO OTHER PARTS OF THE REPORT

Data from other appendices were used to obtain the assessment of future municipal and industrial water supply needs. Data showing the growth of population and industry in Appendix C--Economic Base--were used to determine the level of future use or demand. The availability of naturally occurring waters in the basin to meet municipal and industrial demands was evaluated from basic data in Appendix B--Hydrology.

The functional appendices were also used as a source of some data used in the evaluation of municipal and industrial water supply. Appendix L--Water Pollution Control--provided specific information on the quality of water for municipal and industrial water supply.

HISTORY

Municipal and industrial water supply has been a function related to man for thousands of years. Major advancements are related to technologically improved means of delivery and to the quality of water delivered. Delivery has evolved from carrying containers from the tribal spring, or water hole, to wells, and finally to modern distribution systems.

The quality of water available for use has undergone considerable change and has been influenced by mankind. During the early period of sparse population, the surface and ground waters were affected only by natural phenomena. As the population increased, the quality was degraded largely as a result of man's lack of knowledge, neglect, and disregard for the rights and welfare of others. At one time the major approach in maintaining the quality of the water supply was to separate man from the water source. The result was the development of watersheds or wells which were relatively isolated. Even with precautions, man's influence encroached upon the water sources, and means of cleaning and disinfection replaced or supplemented protection of the source.

The quantity of water used for municipal and industrial purposes has continually increased, both in total and in per capita amounts. The total use has risen in response to population increase, and this trend has been reinforced by increased per capita consumption resulting largely from industrialization. Per capita water use in the Willamette Basin has increased about 30 percent during the last 20 years.

The development of municipal and industrial water supply in Portland and Eugene is an example of the evolution of water systems.

In the 1850's, a water system was developed in the City of Portland utilizing Caruthers Creek in the southwest part of town and a distribution system of bored logs. In 1862, after several changes in ownership, the system was incorporated as the "Portland Water Company." The Caruthers Creek supply was then augmented by a well at the foot of Market Street and an impoundment on Balch Creek above Willamette Heights. A small stream in Portland Heights was later tapped to add to the supply. Many residents continued to use wells and springs because the distribution system was not adequate.

Pumping stations were put into service on the Willamette River as an additional water source in 1869. In 1885, the city charter was amended and legislative action was taken which allowed the city to enter the water business.

The Bull Run River was selected as the new source of water for the City of Portland in 1886. By 1891, legal restraints had been overcome, and a contract was awarded for construction of conduit No. 1 from Bull Run. Almost concurrently, Federal action provided protection of the watershed by establishment of a Public Forest Reserve in 1892. By 1904, Congressional action had enlarged the protected area and prohibited trespass.

The first watershed impoundment was provided in 1915 by construction of a low dam and dike at Bull Run Lake. This project provided about three billion gallons of storage capacity. In 1929, Bull Run Dam No. 1 was built to provide 8.8 billion gallons of storage capacity. Construction of Bull Run Dam No. 2 in 1961 and improvements at Bull Run Lake in 1962 increased the total storage capacity to 23.2 billion gallons. A recent joint city-Forest Service report has indicated the watershed will be adequate until about the year 2000. Chlorination has been the only treatment required for water from the protected watershed.

Photo I-1. Part of the Bull Run reservoir complex, City of Portland municipal water supply. (City of Portland, Bureau of Water Works Photo)

The first water franchise in Eugene was granted in February 1886. By 1906, the original source from the Willamette River near Skinner's Butte had been expanded to include several wells. In 1906, there occurred what was then described as "the worst typhoid epidemic in the history of Oregon." As a result, filtration and disinfection equipment was installed, and political pressure built up for a general cleanup of the waterways. Soon after, the city purchased the system and installed two sand filters.

In 1914, the city reverted to a well supply upon completion of a well on the north bank of the Willamette River. This served until 1927 when a 30-inch transmission line from the McKenzie River at Hayden Bridge to the filter plant in Eugene was completed. A new treatment plant was built in 1932 to replace the original plant. The McKenzie River has since been used as the water source for Eugene. The last major change was construction of a new filter plant at Hayden Bridge in 1947 to replace the plant in town.

The availability of water in adequate quantity and quality has been important in industrial site selection (see Part II for examples). In most instances, careful evaluation of the available supplies before selection of plant sites has precluded eventual process water shortages.

Municipal and industrial water supply for both the present and the future was made a function of Federal storage projects under the Water Supply Act of 1958, as amended. Storage for future water use may be provided if assurance is given that the cost of storage will be repaid during the life of the project.

Ground water is the source for more than half of the municipal water systems in the basin, but supplies only 10 percent of the one million people served by municipal facilities. Development of ground-water supplies for most urban areas has lagged because good-quality surface water was readily available. Problems of quantity and quality have restricted ground-water development in some parts of the basin.

PRESENT STATUS

W A T E R   U S E

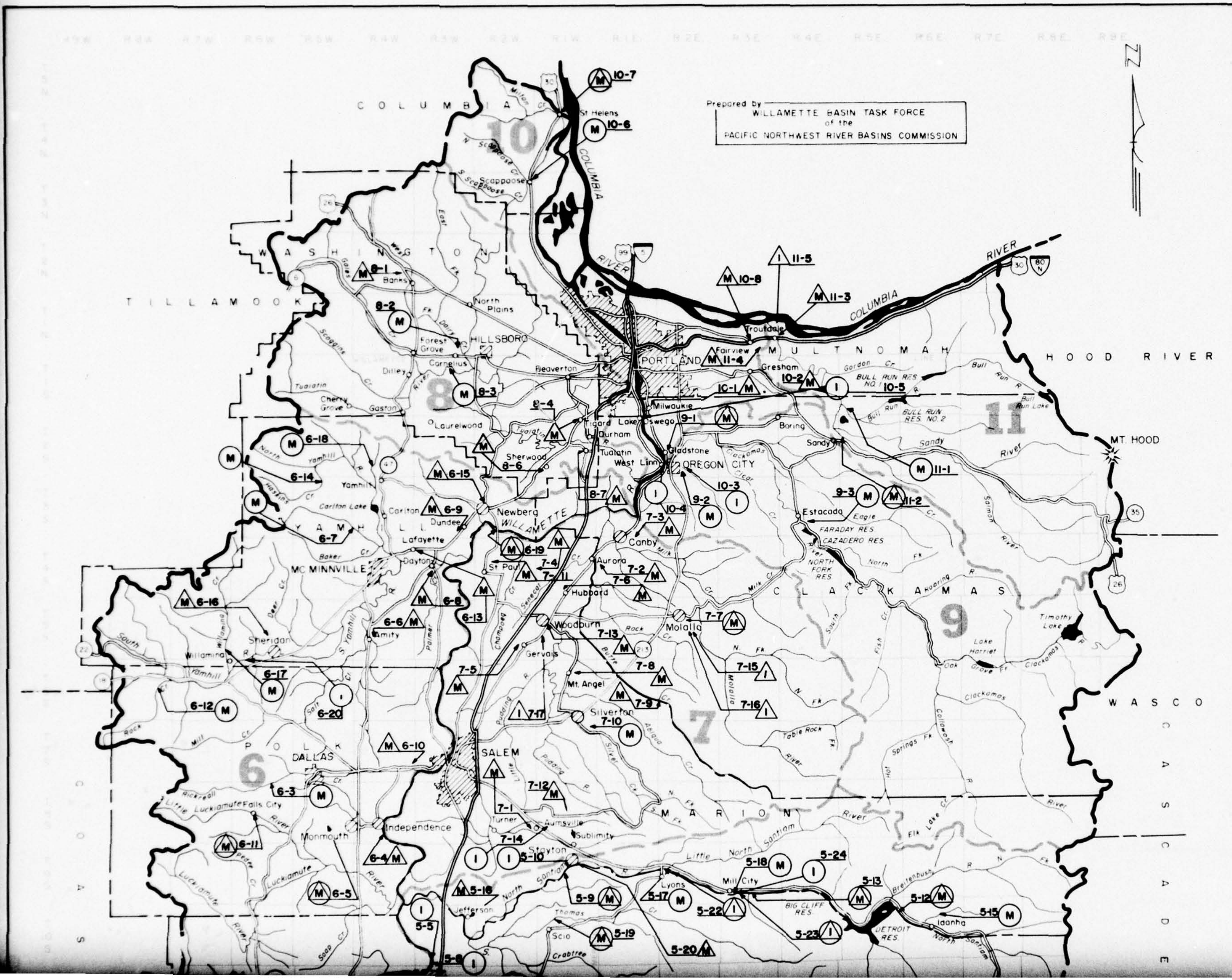
The importance of availability of water for municipal and industrial uses cannot be overemphasized. While early settlements were scattered throughout the Willamette Basin in locations that had sufficient water to satisfy their small needs at that time, only those settlements with access to large supplies of suitable water have continued to grow. Most early-day industries were located at sites having water for transportation, power, use, and residual waste disposal. The importance of water for power and transportation has become minor in comparison with its importance for plant use and waste disposal.

The availability of relatively high-quality water in large amounts has not been the sole factor in location of industries in the basin in recent years; however, it has unquestionably contributed to continual industrial growth. The major "wet process" industries in the basin that have experienced growth are food processing, and pulp and paper manufacturing. The pulp and paper industry is nearly 100 percent self-supplied. The food-processing industry is supplied primarily by municipal systems, and its demand is an integral part of the municipal requirement. Other industries also rely upon water, but the size of their water demands individually is not significant.

WATER SERVICE

The present municipal and industrial water supply situation is summarized by major water-service areas and by subbasins within the Upper, Middle, and Lower Subareas to facilitate comparing and projecting future water needs. The major water-service areas are groupings of communities and industries within a common sphere of influence. These could logically be served by an integrated water supply system, or should be considered interrelated. They are amenable to, and are expected to be centers of, regional water resource planning and development. The four major water-service areas (frontispiece) include the Eugene-Springfield area, the Albany-Corvallis area, the Salem area, and the Portland area. Together, they contain 80 percent of the total Willamette Basin population and 95 percent of urban and incorporated places. The subbasin presentations include those parts of the subbasins outside the major service areas.

Municipal, major industrial, and rural-domestic water use in the Willamette Basin is presented, by subarea, in Tables II-1 and II-2. The tables identify major water supplies, sources, and present water consumption. In addition, the present quality and quantity limitations of each source are shown. Table II-1 summarizes the total water use in each of the three major categories for the Upper, Middle, and Lower Subareas. The complete inventory of water use within each of the four major service areas and the remainder of the 11 subbasins (as of 1965) is presented in Table II-2, subdivided into each of the primary water-use categories. The study area map (Map II-1) locates water-using entities, indicated by the key numbers shown in Table II-2.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OREGON CITY
SALEM
HILLSBORO
DALLAS
MC MINNVILLE
St Helens
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Tigard
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Fairview
Troutdale
Monmouth
Independence
Falls City
Turner
Aumsville
Sublimity
Stayton
Lyons
Mill City
Jefferson
Scio
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BULL RUN RES. NO. 2
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CAZADERO RES
NORTH FORK RES
BIG CLIFF RES.
DETROIT RES
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Lake Harriet
Carlton Lake
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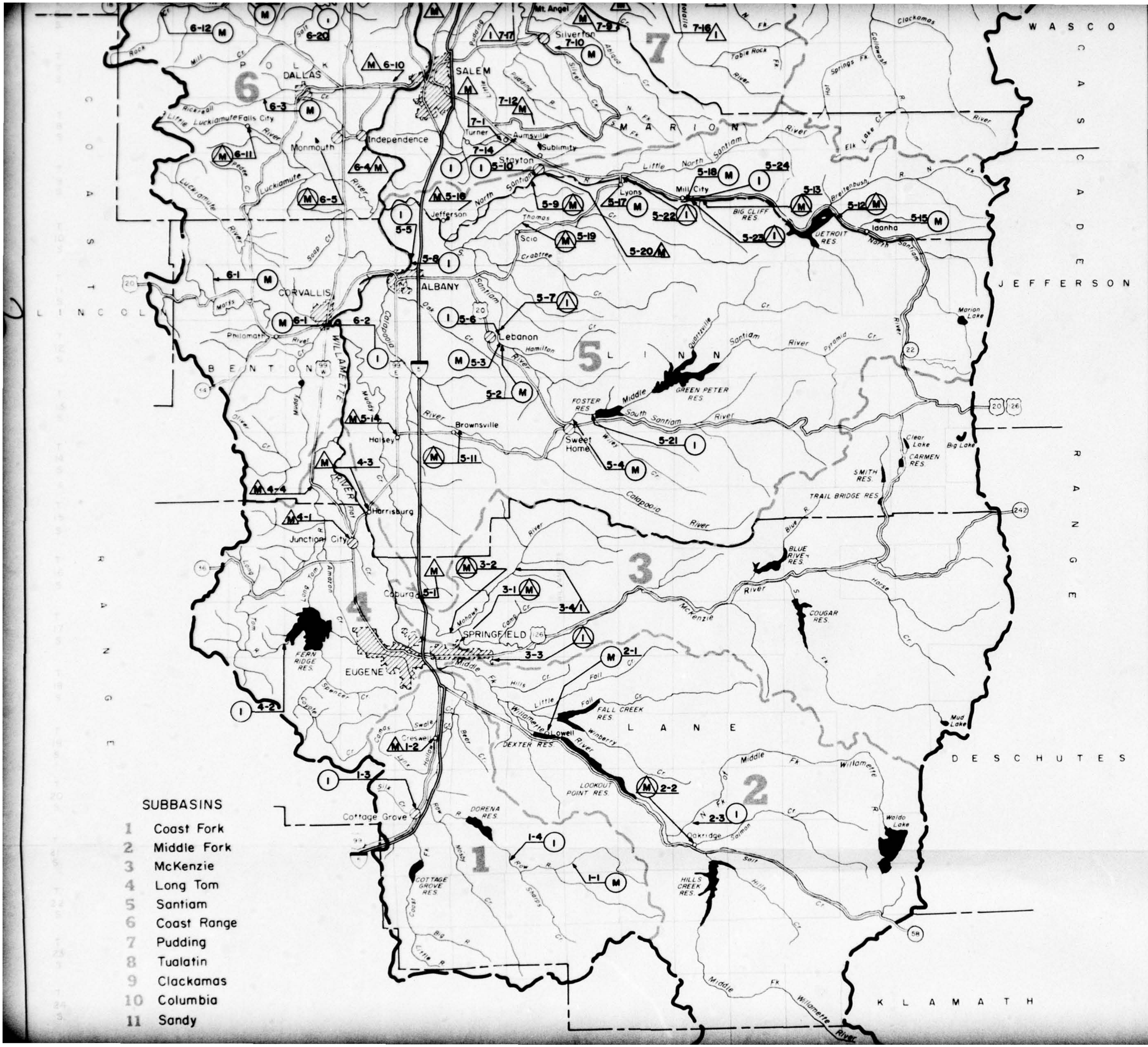
SUBBASINS
1 Coast Fork
2 Middle Fork
3 McKenzie
4 Long Tom
5 Santiam
6 Coast Range
7 Pudding
8 Tualatin
9 Clackamas
10 Columbia
11 Sandy
WASCO
CASCADE RANGE
JEFFERSON
DESCHUTES
KLAMATH
COAST RANGE
LINCOLN
POLK
MARION
BENTON
LINN
LANE
SALEM
ALBANY
CORVALLIS
EUGENE
SPRINGFIELD
DALLAS
Independence
Monmouth
Stayton
Lebanon
Sweet Home
Cottage Grove
Junction City
Harrisburg
Oakridge
DETROIT RES.
GREEN PETER RES.
FOSTER RES.
BLUE RIVER RES.
COUGAR RES.
FERN RIDGE RES.
FALL CREEK RES.
DEXTER RES.
LOOKOUT POINT RES.
HILLS CREEK RES.
DORENA RES.
COTTAGE GROVE RES.
BIG CLIFF RES.
WILLAMETTE RIVER

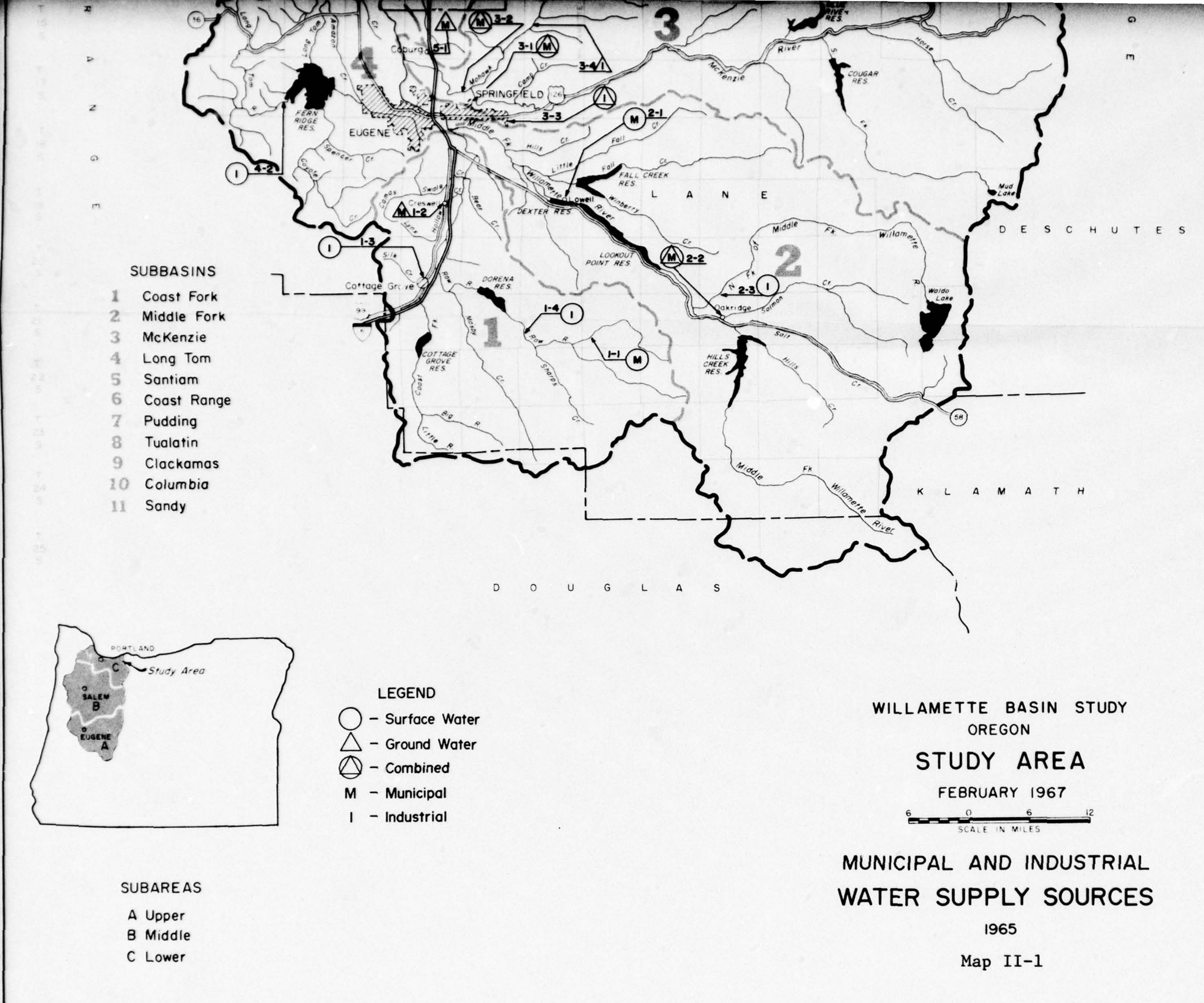

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Table II-1

Summary of Municipal, Industrial and Rural-Domestic Water Use, 1965

AREA	Annual Average Water Use MGD
UPPER SUBAREA	55.03
Municipal	20.79
Industrial	30.79
Rural-Domestic	3.45
Eugene-Springfield Service Area	
Municipal	18.72
Lumber and Wood Products	(0.61)
Food Products	(0.68)
Industrial	19.29
Pulp and Paper	7.80
Lumber and Wood Products	8.69
Chemicals	2.80
Rural-Domestic	0.65
Remainder of Upper Subarea	
Municipal	2.07
Industrial	11.50
Lumber and Wood Products	11.50
Rural-Domestic	2.80
MIDDLE SUBAREA	107.39
Municipal	39.56
Industrial	58.80
Rural-Domestic	9.03
Albany-Corvallis Service Area	
Municipal	9.76
Lumber and Wood Products	(1.26)
Food Products	(0.28)
Primary Metals	(0.06)
Industrial	19.49
Pulp and Paper	15.28
Lumber and Wood Products	2.56
Primary Metals	1.65
Rural-Domestic	0.45
Salem Service Area	
Municipal	17.39
Lumber and Wood Products	(0.86)
Food Products	(1.67)
Industrial	18.58
Pulp and Paper	16.09
Food Products	0.49
Chemicals	2.00
Rural-Domestic	0.80

AREA	Annual Average Water Use MGD
MIDDLE SUBAREA (Cont.)	
Remainder of Middle Subarea	
Municipal	12.41
Food Products	(5.22)
Industrial	20.73
Pulp and Paper	12.86
Lumber and Wood Products	6.02
Food Products	1.45
Manufacturing	.40
Rural-Domestic	7.78
LOWER SUBAREA	208.29
Municipal	110.35
Industrial	94.25
Rural-Domestic	3.69
Portland Service Area	
Municipal	106.69
Food Products	(3.87)
Chemicals	(2.13)
Manufacturing	(1.27)
Industrial	64.84
Pulp and Paper	49.97
Lumber and Wood Products	0.93
Food Products	2.39
Primary Metals	7.09
Manufacturing	4.46
Rural-Domestic	0.97
Municipal	3.66
Industrial	29.41
Pulp and Paper	26.64
Lumber and Wood Products	0.11
Manufacturing	2.66
Rural-Domestic	2.72
WILLAMETTE BASIN	370.71
Municipal	170.70
Industrial	183.84
Rural-Domestic	16.17

Parenthetical figures on this table represent the amount of municipal water used by industry.

Photo II-1. The Willamette Valley in the Middle Subarea; typical of rural-domestic water-use areas.

Municipal, industrial, and rural-domestic water use currently averages about 370 million gallons per day (mgd), with peak demands approaching 750 mgd. The municipal and major industrial demands are about 180 mgd each, while the rural-domestic demand is about 15 mgd. Approximately 18 mgd of the municipal demand is for major water-using industries supplied through municipal systems.

In the Willamette Basin there are 78 independent municipal water supply systems. The size of these systems is shown in the following tabulation:

Population of System	Number of Systems	Total Population Served	Total Annual Average Use MGD
Under 5,000	63	79,900	17.36
5,000-10,000	7	53,400	9.50
10,000-50,000	5	115,500	15.54
Over 50,000	3	887,600	127.26

Table II-2
Inventory of Municipal, Industrial and Rural-Domestic Water Use, 1965

Subbasin Service Area	Map Location Number	Annual Average Water Use MGD	Peak Demands MGD 30-Day	Present Water Right MGD	Source	Limitations on Present Use Quantity	Limitations on Present Use Quality
Coast Fork Subbasin							
Municipal		1.08					
Cottage Grove	1-1	1.00	2.00	12.50	Layng Cr. & Prather Cr.	Adequate	Adequate
Creswell	1-2	0.08	0.20	4.15	4 wells	Adequate	Arsenic concentrations n.w. of Creswell
Industrial		11.33					
Lumber and Wood Products		11.33					
Cottage Grove							
Weyerhaeuser Co.	1-3	10.00			Coast Fork Willamette		
Dorena							
Bohemia Lumber Co.	1-4	1.33			Coast Fork Willamette		
Rural-Domestic		0.34					
Middle Fork Subbasin							
Municipal		0.73					
Lowell	2-1	0.13	0.30	0.65	Infiltration at Dexter Reservoir	Adequate	Adequate
Oakridge	2-2	0.60	1.20	4.66	Salmon Cr. & well	Adequate	Adequate
Industrial		0.17					
Lumber and Wood Products		0.17					
Westfir							
Edward Hines Lumber Co.	2-3	0.17			Middle Fork Willamette		
Rural-Domestic		0.48					
McKenzie Subbasin							
Municipal		0.05					
Marcola	3-4	0.05	0.10	0.07	3 wells	Add'l w.r. req.	Adequate
Rural-Domestic		0.44					
Long Tom Subbasin							
Municipal		0.21					
Harrisburg	4-3	0.17	0.30	0.11	4 wells	Add'l w.r. req.	Excessive hardness
Monroe	4-4	0.04	0.10	0.23	Kyle & Belknap Springs		
Rural-Domestic		1.54					
Eugene-Springfield Service Area							
Municipal		18.72					
Coburg and vicinity	5-1	0.08	0.20	1.80	2 wells	Adequate	
Eugene-Springfield Urban Area		16.90	34.60	195.10	McKenzie R. & 16 wells	Adequate	Adequate
Eugene Water & Electric Board	3-1						
Pacific Power & Light							
Springfield Utility Board	3-2						
Rainbow Water District							
Lumber & Wood Products							
Giustina Lumber & Veneer		0.25			Eugene		
United States Plywood Corp.		0.36			Eugene		
Food Products							
Eugene Fruit Growers Assn.		0.68			Eugene & well		
Junction City	4-1	0.45	0.90	1.99	5 wells	Adequate	Adequate
Industrial		19.29					
Pulp and Paper Mills		7.80					
Springfield							
Weyerhaeuser Co.	3-3	7.80		51	McKenzie R. & well		
Lumber and Wood Products		8.69					
Eugene							
Jones Veneer & Plywood		0.26			5 wells		
Zip-O-Log Veneer, Inc.		0.25			Well		
Springfield							
Rosboro Lumber Co.		0.52			Long Tom River		
Vancouver Plywood Co.		0.32			McKenzie R. & well		
Weyerhaeuser Co.	3-3	4.92			McKenzie R. & well		
Veneta							
International Paper Co.	4-2	2.42			Long Tom River		
Chemicals		2.80					
Rural-Domestic		0.65			Primarily ground	Low yield in some areas.	Hard water. Arsenic s.w. of Eugene

Table II-2 (Cont.)

Inventory of Municipal, Industrial and Rural-Domestic Water Use, 1965

Subbasin Service Area	Map Location Number	Annual Average Water Use MGD	Peak Demands MGD 30-Day	Present Water Right MGD	Source	Limitations on Present Use Quantity	 Quality
Albany-Corvallis Service Area							
Municipal		9.76					
Adair Air Force Station				1.94	Willamette River	Adequate	Adequate
Albany	5-2	2.40	4.50	Claimed	South Santiam River	Need firm w.r.	Adequate
Lumber & Wood Products							
Wood Fibreboard Co.		0.46			Albany		
Food Products							
Albany Frozen Foods, Inc.		0.18			Albany		
D. E. Nebergall Meat Co.		0.10			Albany & well		
Primary Metals							
Oregon Metallurgical Corp.		0.06			Albany		
Corvallis	6-1	4.03	7.40	23.30	Rock Cr. & Willamette R.	Adequate	Adequate
Philomath					Corvallis		
Lebanon	5-3	1.05	2.10	Claimed	South Santiam River	Need firm w.r.	Adequate
Sweet Home	5-4	0.68	1.30	4.91	South Santiam River	Adequate	Adequate
Lumber and Wood Products							
Santiam Lumber Co.		0.80			Sweet Home		
Industrial		19.49					
Pulp and Paper Mills		15.28					
Albany							
Western Kraft Corp.	5-5	7.38			Willamette River		
Lebanon							
Crown Zellerbach Corp.	5-6	7.90			South Santiam River		
Lumber and Wood Products		2.56					
Corvallis							
Georgia-Pacific Corp.	6-2	0.64			Willamette River		
Lebanon							
United States Plywood Corp.	5-7	1.92			Santiam River & well		
Primary Metals		1.65					
Albany							
Wah Chang Corp.	5-8	1.65			Willamette River		
Rural-Domestic		0.45					
Salem Service Area							
Municipal		17.39					
Dallas	6-3	1.49	2.90	9.04	6 creeks	Storage needed	Adequate
Lumber and Wood Products							
Willamette Valley Lumber Co.		0.86			Dallas		
Independence	6-4	0.31	0.60	1.51	5 wells	Adequate	Some hardness
Inter-Institutional				4.51	Surface & wells		
Monmouth	6-9	0.39	0.80	2.02	Theil Cr. & springs	Adequate	Adequate
Salem	5-9	12.67	26.00	121.35	North Santiam R. & wells	Adequate	Some high iron
Food Products							
Blue Lake Packers, Inc.		0.43			Salem		
California Packing Corp.		0.21			Salem & well		
Dole Corp.		0.42			Salem		
Kelley, Farquhar & Co.		0.35			Salem		
Oregon Turkey Packers		0.14			Salem		
USP Corporation		0.12			Salem		
Keizer Water Dist.				3.10	Salem & 3 wells	Adequate	Adequate
Turner					Salem	Adequate	Adequate
Industrial		18.58					
Pulp and Paper Mills		16.09					
Salem							
Boise Cascade Corp.	5-10	16.09			North Santiam River		
Food Products		0.49					
Salem							
United Flav-R-Pac Growers, Inc.		0.19			Well		
West Food, Inc.		0.30			Well		
Chemicals		2.00					
Rural-Domestic		0.80					
Santiam Subbasin							
Municipal		6.19					
Brownsville	5-11	0.14	0.30	0.75	Calapooia R. & well	Limited	
Detroit	5-12	0.02	0.10	0.65	Mackey Cr. & well	Adequate	
Gates	5-13	0.02	0.10	0.07	North Santiam River	Adequate	
Halsey	5-14	0.02	0.10	0.29	1 well	Adequate	High iron & Mn
Idanha	5-15	0.03	0.10	0.97	Rainbow Creek	Adequate	
Jefferson	5-16	0.08	0.20	0.50	3 wells	Adequate	Adequate
Lyons	5-17	0.06	0.10	0.78	North Fork Santiam R.	Adequate	
Mill City	5-18	0.11	0.20	1.15	North Santiam River	Adequate	Excess iron
Scio	5-19	0.06	0.10	2.36	Thomas Cr. & 2 wells	Adequate	Adequate

Table II-2 (Cont.)
Inventory of Municipal, Industrial and Rural-Domestic Water Use, 1965

Subbasin Service Area	Map Location Number	Annual Average Water Use MGD	Peak Demands MGD 30-Day	Present Water Right MGD	Source	Limitations on Present Use Quantity	Limitations on Present Use Quality
Santiam Subbasin (Cont.)							
Scravel Hill		0.01	0.10	-	Well		
Stayton	5-20	0.74	1.40	8.19	Infiltration N. Santiam	Adequate	Adequate
Food Products							
Stayton Canning		4.90			Stayton & 1 well		
Industrial		3.44					
Lumber and Wood Products		3.24					
Foster							
Willamette Natl. Lbr. Co.	5-21	2.48			Santiam River		
Lyons							
Simpson Timber Co.	5-22	0.10			Santiam River & well		
Mill City							
Frank Lumber Co.	5-23	0.39			Santiam River & well		
North Santiam Plywood Co.	5-24	0.27			Santiam River		
Manufacturing		0.20					
Rural-Domestic		1.55					
Coast Range Subbasin							
Municipal		4.06					
Amity	6-6	0.07	0.20	0.94	Spring & well	Adequate	Adequate
Carlton	6-7	0.08	0.20	0.32	Panther Creek	Adequate	
Dayton	6-8	0.11	0.20	1.19	Springs & well	Adequate	High Fe & Mn
Dundee	6-9	0.08	0.20	0.60	Springs & well	Adequate	Adequate
Eola Village	6-10	0.08	0.20	-	Well	Adequate	
Falls City	6-11	0.13	0.30	1.03	Teal Cr. & springs	Adequate	
Grande Ronde	6-12	0.03	0.10	-	Rock Creek		
Lafayette	6-13	0.08	0.20	0.82	Springs & well	Adequate	
McMinnville	6-14	1.64	3.30	12.98	Haskins Creek	Adequate at present limit	
Food Products							
Farmers Coop. Creamery		0.32			McMinnville		
Newberg	6-15	0.71	1.40	9.34	Springs & wells	Adequate	Adequate
Sheridan	6-16	0.21	0.40	5.47	Springs	Adequate	Adequate
Willamina	6-17	0.26	0.60	2.00	Willamina & Lady Creeks	Adequate	High iron
Yamhill	6-18	0.26	0.50	0.83	Turner Creek	Adequate	Adequate
Industrial		14.65					
Pulp and Paper Mills		12.86					
Newberg							
Publishers' Paper Co.	6-19	12.86			Willamette R. & well		
Lumber and Wood Products		1.48					
Willamina							
U. S. Plywood Corp.	6-20	1.48			Yamhill River		
Food Products		0.11					
Dayton							
Stayton Canning Company		0.11			2 wells		
Manufacturing		0.20					
Rural-Domestic		4.57					
Pudding Subbasin							
Municipal		2.16					
Aumsville	7-1	0.03	0.10	0.30	2 wells	Adequate	
Aurora	7-2	0.03	0.10	0.29	Wells	Adequate	Excessive iron
Barlow		0.02	0.10	0.21	Well	Adequate	Adequate
Canby	7-3	0.26	0.50	2.78	Springs & wells	Adequate	Slightly hard
Colton		0.04	0.10	-	Canyon Creek	Adequate	
Donald	7-4	0.03	0.10	-	2 wells	Adequate	
Gervais	7-5	0.05	0.10	0.62	2 wells	Adequate	Hard, iron
Hubbard	7-6	0.07	0.20	-	2 wells	Adequate	High iron & Mn
Molalla	7-7	0.18	0.40	4.50	Infiltration,Molalla R.	Adequate	
Mt. Angel	7-8	0.18	0.40	2.64	3 wells	Adequate	Adequate
Mulino		0.05	0.10	-	2 springs & well	Adequate	
Scotts Mills	7-9	0.02	0.10	0.16	Springs	Adequate	
Silverton	7-10	0.65	1.20	10.41	Abiqua Cr. & Silver Cr.	Adequate	
St. Paul	7-11	0.02	0.10	0.42	2 wells	Adequate	Hard
Sublimity	7-12	0.05	0.10	0.56	2 wells	Adequate	High iron
Woodburn	7-13	0.48	1.00	3.74	6 wells	Adequate	Excessive iron
Industrial		2.64					
Lumber and Wood Products		1.30					
Aumsville							
Willamette Plywood Corp.	7-14	0.82			Santiam River		
Molalla							
Avison Lumber Co.	7-15	0.22			Well		
A. F. Lowes Lumber Co.	7-16	0.26			Well		
Food Products		1.34					
Woodburn							
General Foods Corp.-Birds Eye	7-17	1.34			2 wells		

Table II-2 (Cont.)
Inventory of Municipal, Industrial and Rural-Domestic Water Use, 1965

Subbasin Service Area	Map Location Number	Annual Average Water Use MGD	Peak Demands MGD 30-Day	Present Water Right MGD	Source	Limitations on Present Use: Quantity	Limitations on Present Use: Quality
Pudding Subbasin (Cont.)							
Rural-Domestic		1.66					
Portland Service Area							
Municipal		106.69					
Banks	8-1	0.07	0.20	0.27	Springs	Adequate	Adequate
Fairview	10-8	0.09	0.20	2.28	2 wells	Adequate	Adequate
Forest Grove	8-2	1.16	2.30	6.33	Clear & Gales Creeks	Near limit	
Food Products							
Gray & Company		0.07			Forest Grove		
Gladstone	9-1	0.40	0.80	5.16	Infiltration,Clackamas R.	Adequate	Some hardness
Hillsboro	8-3	1.93	3.60	9.04	Tualatin R. & Sain Cr.	Near limit	
Municipal							
Aloha-Huber W.D.				2.86	Hillsboro & wells		
Cornelius					Hillsboro		
Industrial							
Food Products							
Birds Eye		0.18			Hillsboro		
Haley's Food, Inc.		0.10			Hillsboro		
Milwaukie	10-1	1.10	2.10	3.79	4 wells	Adequate	Moderately hard, some iron
Portland	11-1	87.60	180.00	Bull Run	Bull Run Watershed	Adequate	Adequate
Municipal					Portland		
Barwell Park W.D.					Portland		
Baseline W.D.					Portland		
Beaverton					Portland		
Capitol Hwy. W.D.					Portland		
Clackamas W.D.		(0.80)	2.00	9.69	Portland		
Collins W.D.					Portland		
Community Water Co.					Portland		
Englewood Park Water Co.					Portland		
Garden Home W.D.					Portland		
Gilbert W.D.					Portland		
Gresham					Portland		
Hazelwood W.D.					Portland		
Kendall Water & Improve. Co.							
Killingsworth Mutual Water							
Lake Oswego	10-2	(1.10)	2.1	3.82	Portland & wells	Adequate	Wells of poor qual. (hardness)
Menlo Park					Portland		
Metzger W.D.					Portland		
Mount Scott W.D.					Portland		
Oak Lodge W.D.					Portland		
Palatine Hill W.D.					Portland		
Parkrose W.D.					Portland		
Powell Valley No. 2 W.D.					Portland		
Powell Valley Road W.D.					Portland		
Progress W.D.					Portland		
Raleigh W.D.					Portland		
Rockwood W.D.					Portland		
Rose City W.D.					Portland		
Russellville W.D.					Portland		
Stanley W.D.					Portland		
Sylvan W.D.					Portland		
Tigard W.D.	8-4			1.51	Portland & 3 wells	Adequate	Moderately hard
West Slope W.D.					Portland		
Wichita W.D.					Portland		
Wolf Creek Hwy. W.D.					Portland		
Tektronix, Inc.		(0.34)			Wolf Creek Hwy. W.D.		
Industrial							
Food Products							
Brander Meat Co.		0.10			Portland		
Gresham Berry Growers		3.18			Wells & Portland		
National Biscuit Co.		0.12			Portland		
Western Farmers Assn.		0.12			Portland		
Chemical Products							
Chipman Chemical Co.		0.22			Portland		
Pennsylvania Salt Co.		1.81			Portland		
Shell Oil Co.		0.10			Portland		
Manufacturing							
Esco Corp.		0.74			Portland		
Jantzen, Inc.		0.29			Portland & well		
Northwestern Ice & Cold Storage		0.12			Portland		
Timber Structures, Inc.		0.12			Portland		
Other							
Union Pacific R.R.		0.21			Portland		

Table II-2 (Cont.)

Inventory of Municipal, Industrial and Rural-Domestic Water Use, 1965

Subbasin Service Area	Map Location Number	Annual Average Water Use MGD	Peak Demands MGD 30-Day	Present Water Right MGD	Source	Limitations on Present Use Quantity	Limitations on Present Use Quality
Portland Service Area (Cont.)							
Municipal (Cont.)							
Richland W.D.		0.40		1.26	Well		
River Grove W.D.				0.65	Well		
Sandy	11-2	0.21	0.40	1.55	Springs & Beaver Cr.	Adequate	
Sherwood	8-6	0.08	0.20	1.28	3 wells	Adequate	Adequate
South Fork Water Commission	9-2	5.00	11.70	75.00	Clackamas River	Adequate	Adequate
Municipal							
Oregon City				36.18	South Fork W.D.		
West Linn					South Fork W.D.		
Troutdale	11-3	0.04	0.10	0.43	Springs & well	Adequate	Adequate
Tualatin	8-7	0.05	0.10	Hillsboro	2 wells	Adequate	
Wood Village	11-4	0.04	0.10	0.29	Well	Adequate	Adequate
Industrial		64.84					
Pulp and Paper Mills		49.97					
Oregon City							
Publishers' Paper Co.	10-3	10.46			Willamette River		
West Linn							
Crown Zellerbach Corp.	10-4	39.51			Willamette River		
Lumber and Wood Products		0.93					
Forest Grove							
Stimson Lumber Co.		0.77			Scoggins Creek		
Portland							
Multnomah Plywood Corp.		0.16			Columbia River		
Food Products		2.39					
Forest Grove							
Portland Canning Co.		0.05			Well		
Portland							
Carnation Company		0.51			Well		
Farmers Dairy Assn.		0.11			Well		
Pacific Meat Co.		0.20			Well		
Swift and Co.		1.52			Well		
Primary Metals		7.09					
Portland							
Oregon Steel Mills		0.52			Willamette River		
Troutdale							
Reynolds Metals Co.	11-5	6.57			7 wells		
Manufacturing		4.46					
Portland							
Electronic Specialty Co.		0.23			Well		
Mail-Well Envelope Co.		0.24			Well		
Omark Industries, Inc.		2.05			Well		
Oregon Portland Cement Co.	10-5	0.48			Willamette River		
Union Carbide Corp.		1.22			Well		
Willamette Iron & Steel		0.24			Well		
Rural-Domestic		0.97					
Tualatin Subbasin							
Rural-Domestic		1.44					
Clackamas Subbasin							
Municipal		0.27					
Estacada	9-3	0.27	0.50	1.29	Clackamas River		
Rural-Domestic		1.02					
Columbia Subbasin							
Municipal		1.30					
Scappoose	10-6	0.10			S. Scappoose & Gourley Cr.	Adequate	
St. Helens	10-7	1.20		48.45	Ranney wells, Columbia R.	Adequate	Adequate
Industrial		29.41					
Pulp and Paper Mills		26.64					
St. Helens							
Boise Cascade Corp.		26.64			Columbia River		
Lumber and Wood Products		0.11					
Portland							
Dwyer Lumber and Plywood		0.11			Well		
Manufacturing		2.66					
St. Helens							
Crown Zellerbach Corp.		0.53			Well		
Kaiser Gypsum Co., Inc.		2.13			Columbia River		
Rural-Domestic		0.26					
Sandy Subbasin							
Municipal		2.09					
Bonneville		0.64		0.80	Well	Adequate	Adequate
Corbett		0.25	0.50	2.58	Gordon Creek		
Zig Zag (summer)		1.20		0.65	Lady Creek	Add'l w.r. req.	
Rural-Domestic		-					

Upper Subarea

Eugene-Springfield Service Area

The McKenzie River is the primary source for the Eugene-Springfield Service Area. Approximately 75 percent of the annual requirement for this area is supplied by the Eugene Water and Electric Board through its Hayden Bridge treatment plant. The existing resource is more than adequate. The Eugene-Springfield Service Area also utilizes ground water from the McKenzie and Middle Fork Subbasins. There is no major use of water from the Willamette River for municipal or industrial purposes.

Most of the industries in the Eugene urban area are served by city systems or water districts. About 7 mgd withdrawn by municipal systems from the McKenzie River are used for commercial-industrial purposes.

The two largest industrial users in Eugene (Eugene Fruit Growers and U. S. Plywood) used 250 and 133 mg, respectively, in 1965. Of the total city system intake from the McKenzie River, Eugene Fruit Growers used 3.7 percent and U. S. Plywood used 2.8 percent. Other industrial users in Eugene include dairies, creameries, soft drink bottlers, an ice plant, steam plants, and custom canners.

Some industries in Springfield are supplied water by the Pacific Power and Light Company water system, which has wells developed near the river. The amount used by industry from PP&L totals approximately 250 mg annually, or less than one mgd.

The Weyerhaeuser Timber Company plant in Springfield is the largest and only significant self-supplied industry. The company holds a water right for 80 cfs (51 mgd) from the McKenzie River. The

Photo II-2. The Weyerhaeuser plant in Springfield is the major industrial water user in the Upper Subarea.

quality of water is such that the Weyerhaeuser Company treats only about 6 mgd at the present time. During heavy runoff periods, which result in high turbidity, the solids in the water cause excessive wear of the hydraulic debarker nozzles. It is presently economical for the company to buy water from the Rainbow Water District during these periods instead of providing additional treatment. Chemically, the water is always of satisfactory quality. The quantity of water available in the basin is adequate to satisfy the immediate requirements of industry.

Coast Fork Subbasin

The existing water supply is adequate in quantity and quality to fulfill needs in the Coast Fork Subbasin. The City of Cottage Grove diverts water from Layng and Prather Creeks. These waters are chlorinated at the headworks and flow through a 23-mile transmission conduit to the treatment facility in town where they are flocculated, settled, and rechlorinated before distribution. Ground water obtained from four wells is the source of supply for Creswell. Higher than desirable concentrations of arsenic from natural sources have been noted in some other wells in the vicinity.

The Weyerhaeuser Timber Company mill at Cottage Grove has an average intake of 10 mgd, or 3,650 mg annually. Water is used primarily for steam production, hydraulic debarking, and log-pond filling. Other industrial users include small sawmills and gravel-washing concerns.

Photo II-3. One of several sawmill installations in the Willamette Basin. This one, at Foster Reservoir, demonstrates the common use of a large pond for log storage.

Middle Fork Subbasin

In the major water use area within the Middle Fork Subbasin, there is ample water to satisfy present municipal requirements. The community of Lowell takes water from an infiltration gallery adjacent to the Dexter Reservoir. This reservoir is used extensively for recreation, but no quality problems in the water supply have been noted. The lumber and wood products plant operated by Pope and Talbot, Inc., located near Oakridge, is the major industrial water user in this subbasin. Other smaller mills have adequate water supplies.

McKenzie Subbasin

The municipal water supply for Marcola, obtained from ground water, is adequate to satisfy the present demand.

Long Tom Subbasin

The seasonal variation of streamflow in the Long Tom River above Fern Ridge Reservoir and inferior quality of the reservoir and downstream waters have delayed development of adequate water systems using surface sources. The community of Veneta relies upon ground water. The high cost of extending the Eugene system to Veneta and Elmira has resulted in an indefinite deferral of the suggested project. Monroe utilizes springs but is short of water supply. Harrisburg relies on four wells which produce water of excessive hardness. There is no significant demand at present for industrial water in this subbasin.

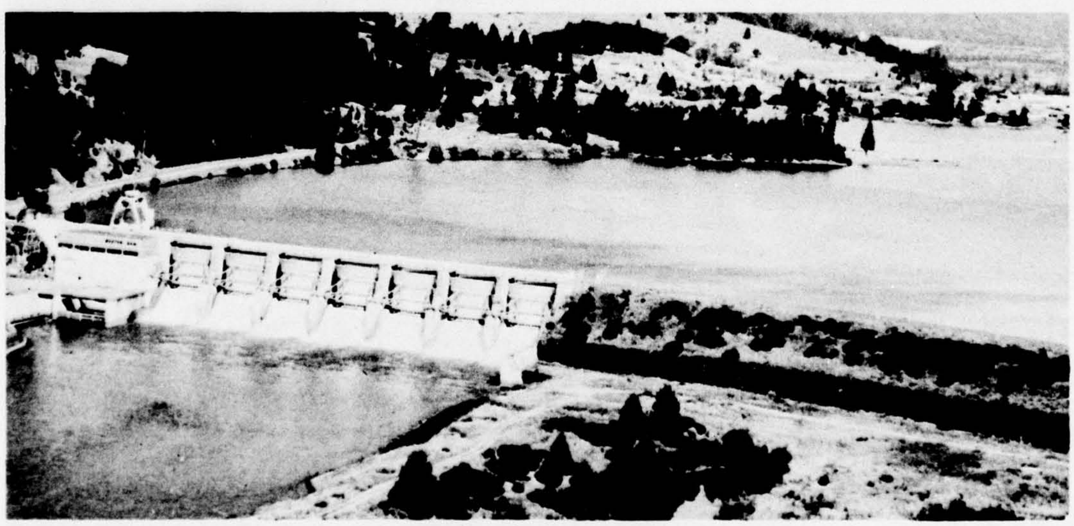


Photo II-4. Water is supplied by infiltration from Dexter Reservoir for the City of Lowell in the Upper Subarea. (Corps of Engineers, Portland, Oregon, Photo)

Middle Subarea

Albany-Corvallis Service Area

Albany, Lebanon, and Sweet Home obtain water from the South Santiam River. Water is withdrawn directly from the river at Sweet Home, while Lebanon and Albany are supplied by the Lebanon-Albany power canal. Natural flow of the South Santiam River is sufficient to meet demands.

Present demands of Corvallis are served from natural flow of the Marys River and from the Rock Creek watershed on Marys Peak, supplemented by water from the Willamette River. A storage reservoir of 100 mg capacity was constructed on the watershed but failed to satisfy peak demands of the Corvallis area during dry years, so an additional source from the Willamette River was developed.

Near Albany, two major industrial water users--the Western Kraft and Wah Chang Corporations--obtain water from the Willamette River. Western Kraft uses about 7 mgd, all untreated except for boiler feed water to control scale and corrosion; its existing water right is for about 20 mgd, and the plant has sufficient water. Wah Chang uses about 2 mgd; treatment has been limited to simple chlorination, although turbidity is a wintertime problem.

Industries near Lebanon and Sweet Home withdraw water from the South Santiam River. Crown Zellerbach pulp and paper plant at Lebanon uses 8 mgd. United States Plywood Corporation at Lebanon uses about 2 mgd. Other minor industrial users are either self-supplied or obtain water from the Sweet Home and Lebanon municipal water systems.

A part of the water withdrawn from the Willamette River by the City of Corvallis is ultimately used for industrial purposes, mainly food processing. Blue Lake Packers, the major Corvallis-supplied industry, uses about 30 mg annually, mostly during July to October. The only industrial use of water from Marys River is for small sawmills.

Salem Service Area

The City of Salem obtains its municipal and industrial water supply from the North Santiam River. A portion of the water diverted by the City of Salem is used for industrial purposes. Food processing, the major user, has an annual average requirement of about 1.5 mgd, with 5 mgd peaks during the canning season. The demands are easily satisfied.

The only major self-supplied industrial user in Salem is the pulp and paper mill operated by Boise Cascade Corporation. This plant completely treats and uses about 16 mgd, diverted through a canal from the North Santiam River. The paper mill shares a right to 254 cfs (164 mgd) from the North Santiam River for power and manufacturing; this right, dated 1856, is subject only to a prior right of 50 cfs for the Oregon State Game Commission. The mill also shares in a 342.6

cfs right from Mill Creek, subject to about 230 cfs prior appropriation, which may not be satisfied during the summer. It is, however, assumed that there is sufficient water available to meet immediate needs of the plant. Two food-processing concerns in Salem are also self-supplied, but together use only about 0.5 mgd.

Santiam Subbasin

On the Calapooia River, the City of Brownsville has been forced to alter the streambed during summer periods of extreme low flow in order to flood the city's infiltration gallery. There are no large industrial uses of water in this drainage at present, but a few sawmills use minor amounts of water.

The communities along the North Santiam River do not experience any water supply problems.

Coast Range Subbasin

The total water resource of the Yamhill River drainage is adequate to satisfy annual demands, but seasonal deficiencies make storage or transbasin diversion necessary. The largest community, McMinnville, has constructed storage facilities to satisfy peak summer demands.

A major withdrawal of water from the Willamette River is made by the Publishers' Paper Company at Newberg (13 mgd). The company's existing water right is adequate. Quality of the water is controlled by filtration, chlorination, and deionization. Quality problems are primarily turbidity resulting from transport of silt and other floating material, and changes in chemical quality. It is also necessary to supplement the river supply with city water during the summer (0.1 mgd during August and September), when the river water is too warm for acid-mixing.

Industrial use of water within the Yamhill drainage is presently limited primarily to a few wood-products mills and several industries using city water in McMinnville. Sufficient water to satisfy any significant industrial need is not presently available without storage or transbasin diversion.

Only minor development has occurred in the Luckiamute drainage, and there are no significant municipal or industrial supplies or demands.

Pudding Subbasin

Seasonal deficiencies of streamflow have accelerated consideration of upstream storage in the Pudding Subbasin. Silverton (4,000 served) relies primarily upon surface water. The other communities generally use ground water.

There is no major industrial use of surface water within the subbasin. Birds Eye Frozen Foods at Woodburn, the largest single user, relies upon ground water for its supply. This company was using about

2 mgd in 1961 but has since expanded, and present use is somewhat greater. Ground-water quantity appears sufficient to meet near-future needs.

Lower Subarea

Portland Service Area

The Portland Service Area is the most densely populated area in the Willamette Basin and has the greatest demand for water. The sources of supply are many and varied, but the largest single one has been developed by the City of Portland in the Bull Run watershed (Sandy Subbasin). The present Bull Run storage totals 23,200 mg. The transmission facility consists of three conduits about 25 miles long with a total capacity of 225 mgd. The natural quality of the water and the present watershed management practices have made it possible to provide water satisfactory for distribution after treatment by simple chlorination only.

Other sources of supply include ground water and water imported from the Clackamas River. Complete treatment is required of water from the lower reaches of the Clackamas River. Lake Oswego chose the Clackamas River as a new source to replace wells, foregoing a less expensive Willamette River source.

Municipalities in the Tualatin Valley rely partially upon water from other subbasins for their supplies at the present time, and it is expected that greater demand will be made on out-of-basin sources in the future. These communities have become very water-conscious, having experienced shortages and having lost industries for lack of water. Forest Grove and Hillsboro have an immediate need for additional water. Beaverton,.Tigard, and Lake Oswego Corporation are also augmenting their sources. Actions taken to gain an adequate supply for present demands include authorization of the U. S. Bureau of Reclamation's Tualatin Project (Scoggins Reservoir), which will provide municipal and industrial water storage as shown in the following tabulation:

Community	M&I Water Allocation (Acre-Feet)	Adequate to Year
Forest Grove	4,500	1998
Hillsboro	4,500	1986
Beaverton	1,500	1983
Tigard	2,500	1982
Lake Oswego Corporation	1,000	----
Total	14,000	

Industrial water use in the Portland Service Area is primarily for pulp and paper production at Oregon City. Publishers' Paper Company at Oregon City withdraws approximately 30 mgd from the Willamette River. About 15 mgd are treated (cost $33 per mg) for use as process water, and the remainder is used for non-process purposes such as fluming. An additional quantity of water is used nonconsumptively for power generation. The mill's total water right is 822 cfs (priority date pre-1842), and its water demands are easily satisfied.

Crown Zellerbach operates a plant at West Linn, across the river from Publishers' Paper mill, which produces newsprint and printing paper from sulfite and ground-wood processes. This mill also withdraws water from the Willamette River, treating approximately 20 mgd. The direct cost of treatment (chemicals and labor) is about $17.65 per million gallons.

Photo II-5. The pulp and paper mill complex at Oregon City and West Linn (top center) withdraws a combined total of approximately 50 mgd from the Willamette River.

Other industrial water uses on the Willamette River are individually smaller but nevertheless important to the basin economy. In some instances, industry finds it more economical to purchase water from a municipal system for boiler use than to treat river water. The farthest downstream right is the Pennsylvania Salt Company's water right for withdrawal of 8.90 cfs near the St. Johns Bridge.

A tremendous amount of ground water is used for industrial purposes along the lower Willamette and Columbia Rivers. It is used for heating and cooling, and for process water in food and kindred industries, and fabricating and concrete plants. No attempt has been made to determine the total annual withdrawal; in 1959, there were more than 500 wells in east Portland, with a total capacity of over 82 mgd, but the amount used is not known.

A large industrial user of ground water is the Reynolds Metals Company at Troutdale, supplied by 14 wells with an annual yield of four billion gallons. The plant used 2.4 billion gallons of water during 1962, but was not operating at full capacity. Most of the water (75-80 percent) is used for scrubbing stack gases; the remainder is used for various purposes such as cooling bearings, castings, and cleanup.

Tualatin Subbasin

The existing surface-water sources within this subbasin are fully appropriated. Further surface-water utilization will be possible only with storage and/or transbasin diversion.

Clackamas, Columbia, and Sandy Subbasins

Present sources are adequate to meet needs of areas outside the Portland Service Area within these subbasins.

SEASONAL DISTRIBUTION OF DEMAND

In order to properly evaluate the total demand for water in a particular area, the seasonal and monthly distribution must be considered. Table II-3 presents monthly demands by the major water-user groups in the four major water-service areas. The monthly demands are shown as a percent of the average monthly use. Those values below 100 indicate less-than-average demands, while those exceeding 100 represent months of higher-than-average demands. The maximum water demands generally occur from July through October, the period of low streamflow.

A comparison of daily, monthly, and annual use patterns of Portland, Salem, and Eugene is presented graphically in Figure II-1. These hydrographs show that use is greater than the average demand during less than half the months, while the peak use is generally double the average demand. Although the general yearly pattern remains quite constant for any given municipality, quantities change from year to year, reflecting growth and climatic fluctuations.

Table II-3
Monthly Demand by Service Area as Percent of Average Month, 1960

Service Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Eugene-Springfield												
Municipal	71	63	67	70	71	151	221	172	104	79	64	65
Pulp & paper	78	89	92	102	108	113	108	111	108	107	105	78
Lbr. & wood prod.	107	113	100	121	103	102	94	106	106	89	84	76
Food products	8	7	7	4	8	5	62	183	361	276	160	120
Albany-Corvallis												
Municipal	75	74	77	74	76	137	191	166	99	79	74	78
Pulp & paper	1/											
Lbr. & wood prod.	91	105	97	100	106	105	93	98	98	91	111	106
Food products	100	18	3	5	7	10	59	242	602	86	46	22
Primary metals	59	29	13	39	30	40	45	81	180	267	200	216
Salem												
Municipal	62	54	59	67	70	132	203	183	130	106	66	68
Pulp & paper	1/											
Lbr. & wood prod.	53	72	88	94	80	110	104	191	79	95	109	125
Food products	200	100	80	49	60	124	53	124	151	135	75	49
Portland												
Municipal	74	119 2/	76	85	80	103	168	127	112	100	78	78
Pulp & paper	1/											
Lbr. & wood prod.	1/											
Food products	29	3	0	0	0	17	102	48	248	302	302	149
Primary metals	1/											

1/ No monthly data available--relatively constant demand.
2/ Demand appears excessively high, but is substantiated by city records.

An indication of the effect of the dry summer weather on municipal water use is presented in Figure II-2. This figure demonstrates one of the reasons for the sharp increase in municipal water demand during the summer months, showing that the water deficiency for yard and garden use can be as much as 12.6 inches per year in Portland.

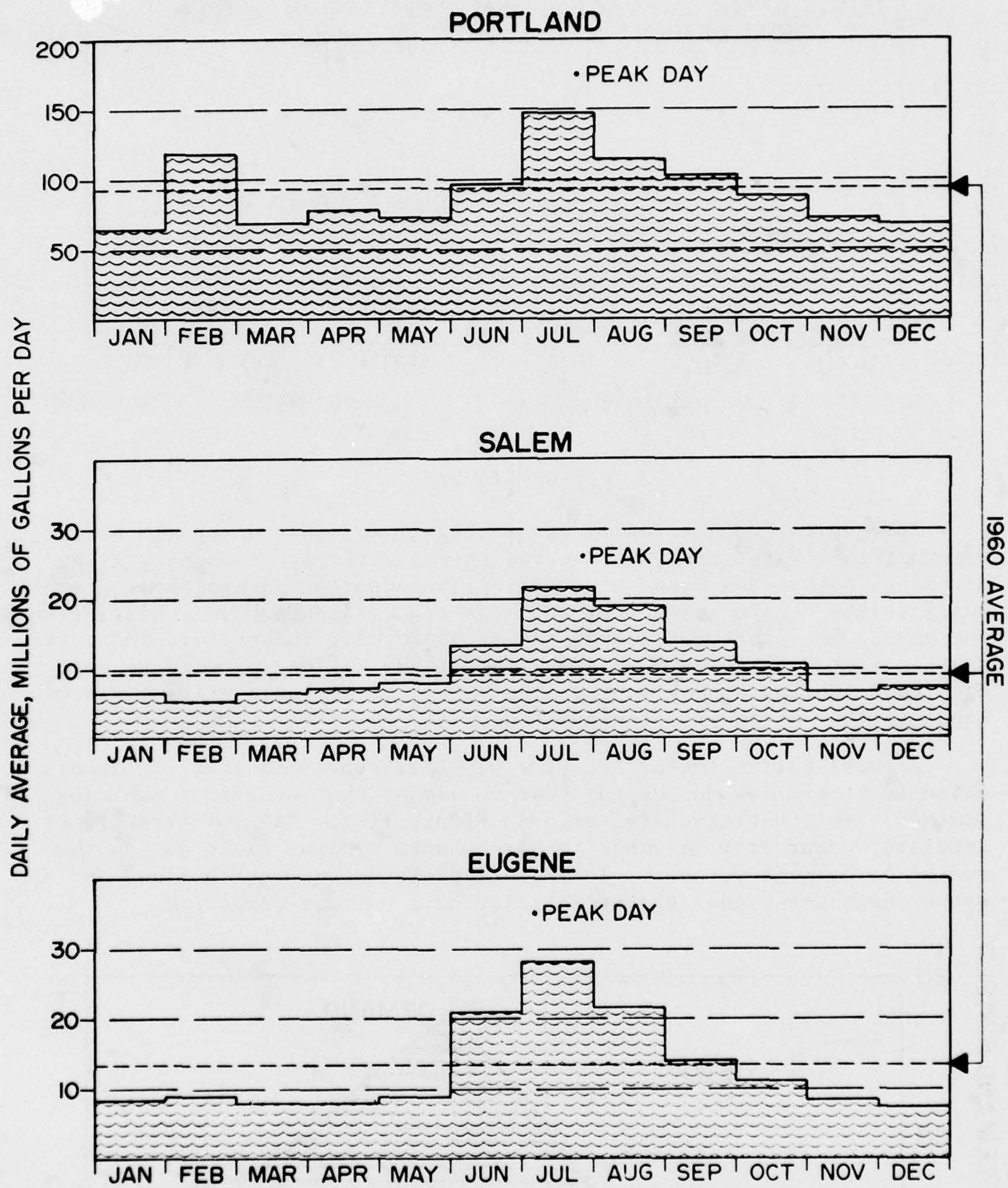


Figure II-1. Typical Water Use Patterns at Portland, Salem, and Eugene.

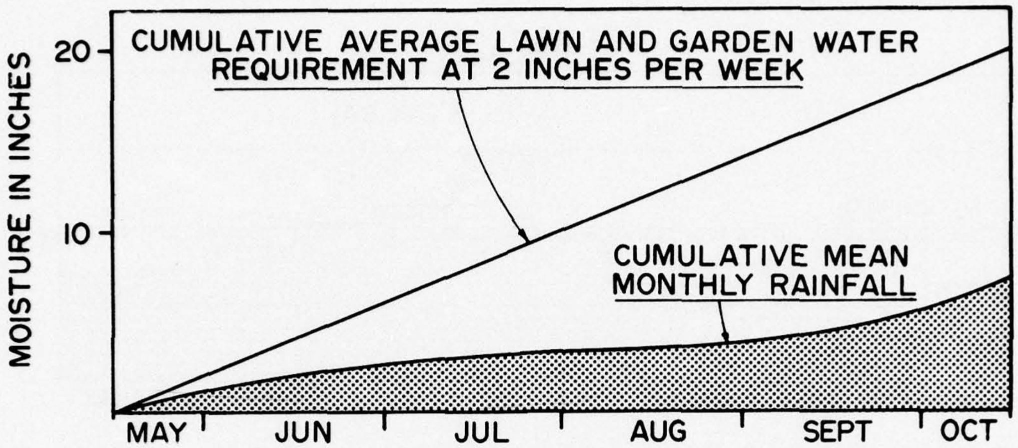


Figure II-2. Lawn Water Requirements and Mean Rainfall in Portland.

PER CAPITA USE

Per capita consumption rates are highly variable among the basin communities. Water cost, yard-watering restrictions, community size, metering, number and types of municipally supplied industries, the economic status of the residents, and many other factors have a bearing on the amount of water used. Analysis of municipal, industrial, and rural uses indicates a range up to a maximum of 590 gallons per capita per day (gpcd) during a peak month. The demand of the pulp mills alone is equal to that of several large cities.

A complicating factor in terms of water supply is that the fluctuation in streamflow during the year is almost the inverse of municipal demands. This variation is shown in Figure II-3. Maximum streamflows generally occur from December to March, with minimum flows during the months of July to October. The relationship between streamflows and water needs determines the probability of a deficit occurring.

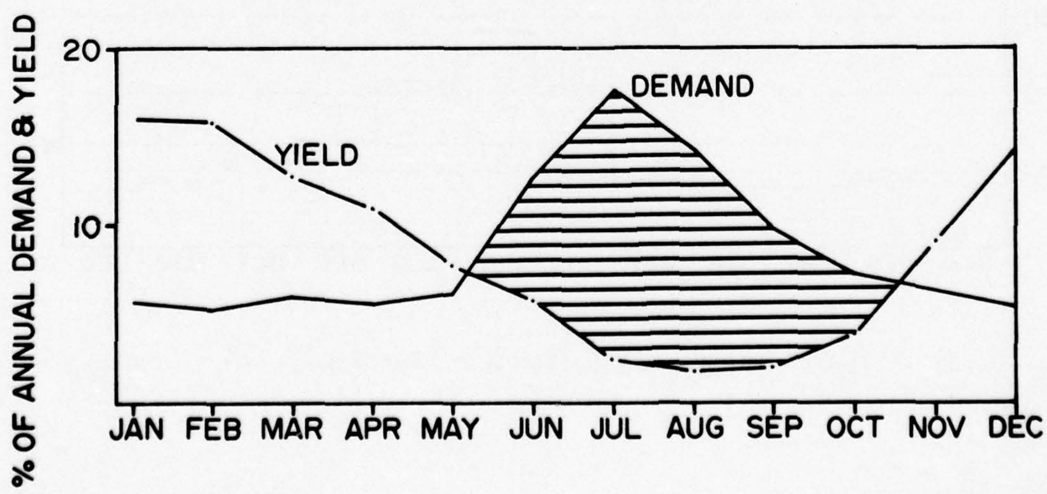


Figure II-3. Mean Streamflow Distribution and Typical Water Demand Pattern at Salem.

WATER QUALITY

The quality of the basin's surface waters used for municipal and industrial supply is generally good. The primary detrimental constituents that must be removed or treated before use are sediment, taste- and odor-producing biological growths, and bacteria. For a detailed discussion of water quality, see Appendix L--Water Pollution Control.

Suspended sediment occurs in appreciable amounts in nearly every surface stream during periods of high runoff. The same condition occurs periodically downstream from gravel-removal sites and construction areas. Occurrence of sediment increases treatment costs and decreases the utility of water.

Biological organisms which impart obnoxious tastes and odors may be attributed to algal growths in upstream reservoirs and natural pools. Occurrence of obnoxious biological organisms results in higher treatment costs and decreased palatability.

Bacterial contamination is present in nearly every stream in the basin. Coliform bacteria, the usual stream quality test organisms, although non-pathogenic in themselves, are found in the intestines of all warm-blooded animals and, therefore, serve to alert public health officials of possible fecal contamination and its associated disease hazard. In lowland streams traversing developed areas, the presence of high concentrations of coliform bacteria can usually be traced to domestic sewage discharges, animal feedlots, etc.; whereas comparatively lower concentrations in the more remote streams may be from human and animal sources or may have been washed from the soil or plant life.

The mineral quality of surface water shown in Table II-4 (for the cities of Portland, Salem, and Eugene) is typical of the major surface-water supplies. Some industrial uses of these waters would require specific treatment. For example, additional treatment is required for boiler feed water; nearly all high-temperature and high-pressure boilers require scale and corrosion inhibitors in their makeup water.

Small streams and springs are also used for rural-domestic supplies as a matter of individual choice. Protection of the quality of these sources is difficult, if not impossible. Most sources of this type are in remote areas, but trespass by hunters, fishermen, and others is unavoidable. Treatment is rarely provided, and any pollution in the water source is present in the water used.

The Public Health Service drinking water standards are established by the Department of Health, Education, and Welfare. These standards apply to drinking water and water supply systems used by common carriers and others subject to Federal quarantine regulations. The American Water Works Association has also accepted these as minimum standards for all public water supplies.

Table II-4

Mineral Quality of Surface Water at Portland, Salem, and Eugene

Content	Unit	Portland	Salem	Eugene	USPHS Recom. Limit
Total Solids (residue on evaporation)	mg/l	35	35	59	
Volatile Solids (loss on ignition)	mg/l	3	NR	28	
Fixed Solids (residue after ignition)	mg/l	32	NR	31	
Alkalinity (as $CaCO_3$)					
Carbonate	mg/l	0	0	0	
Bicarbonate	mg/l	11.0	15.0	28.0	
Hardness (as $CaCO_3$)	mg/l	11.7	15.5	NR	
Silica (SiO_2)	mg/l	8.0	14.0	21.6	
Calcium (Ca)	mg/l	2.7	3.8	6.7	
Magnesium (Mg)	mg/l	1.2	1.5	1.1	
Iron (Fe)	mg/l	0.13	0.07	0.26	0.30
Aluminum (Al)	mg/l	0.1	0.3	0.028	
Manganese (Mn)	mg/l	0.00	0.0	<0.015	0.05
Sodium (Na)	mg/l	1.1	2.0	4.12	
Potassium (K)	mg/l	0.5	0.1	1.04	
Chloride (Cl)	mg/l	2.4	3.0	1.59	250.
Sulfate (SO_4)	mg/l	1.3	1.2	1.2	250.
Nitrate (NO_3)	mg/l	0.13	0.0	0.06	45.
Fluoride (F)	mg/l	0.04	0.0	0.08	1.0
Phosphate (PO_4)	mg/l	0.0	NR	0.125	
pH	SU	7.3	6.8	7.75	

NR = Not reported.

Water quality frequently reduces the desirability of ground water as a municipal source. The mineral quality of ground-water supplies at selected communities is listed in Table II-5. Hardness, salinity, and iron content have prevented extensive use of ground water in some areas. The constituent most commonly exceeding the recommended limit is iron. Excessive iron content imparts a rusty-pipe taste to beverages and causes staining of laundry and plumbing fixtures. There is no significant toxic hazard from excessive iron.

The recommended manganese concentration is also exceeded in some cases, but again the danger is economic and aesthetic, rather than toxic, producing a brownish color in laundered goods and impairing the taste of beverages.

Table II-5

Mineral Quality of Ground Water
at Selected Communities
(Units--mg/l except as noted)

	Total Solids	Silica (SiO_2)	Chloride (Cl)	Sulfate (SO_4)	Calcium (Ca)	Magnesium (Mg)	Aluminum (Al)	Hardness (as $CaCO_3$)	Sodium (as Na)	Iron (Fe)	Manganese (Mn)	Fluoride (F)	pH Std. Unit
U. S. Public Health Service 1962 Drinking Water Standards--Recommended Limits	500		250	250						0.3	0.05	1.0	
Clackamas Heights W.D.													
New Well 1-13-54	250	45	13	1.2	19.4	3.6	0	93	28	0.1	0.02	0.3	7.5
Dayton													
Well #1 4-20-54	101	3.2	3.5	3.8	4.5	4.5	0	23	7.4	5	0.1	0.2	7.4
Well #2 4-20-54	392	3.8	6.8	6.0	33	9	0	116	8.6	NR	0.5	0.1	7.8
Fairview													
Well at City	165	28	5.9	2.6	16.2	16.7*	0.05	109.0	8.5	<0.01	<0.01	0.2	8.35
Independence													
System-4 Wells 8-19-60	222	31.2	10.8	7.4	28.8	18.2*	0.05	146.7	NR	0.20	0.05	0.3	6.9
Jefferson													
Well #1 4-10-61	223.0	33.5	6.7	33.2	17.3	25.0*	<0.05	146.0	8.0	0.08	<0.05	0.1	7.30
Well #2 4-10-61	223.0	34.0	6.3	41.0	18.6	27.7*	<0.05	160.0	7.0	0.58	<0.05	0.1	7.40
Well #3 4-10-61	204.0	33.0	7.7	39.6	16.2	25.0*	<0.05	143.0	9.0	1.78	<0.05	0.1	7.50
Newberg													
System-Wells & Springs 7-14-60	163.0	49.0	4.7	4.6	15.1	13.4	0.08	92.8	7.8	3.0	0.14	0.05	7.8
Scio													
Well #1 4-10-61	101	27.0	6.3	16.8	13.7	8.5*	<6.02	69.1	6.0	1.8	0.53	<0.1	6.85
Well #2 4-10-61	155	25.0	27.2	5.0	11.9	9.2*	<0.05	67.4	8.0	0.11	<0.05	0.1	7.40
Springfield-PP&L System													
System-Wells 6-15-61	52.0	20.5	3.5	1.3	6.0	7.1*	0.05	44.2	3.8	6.08	<0.05	<0.05	6.6
Woodburn													
Well #1 2-9-54	155	41	0.2	1.4	15.4	12.4	0	91	5.3	4	0	0.3	7.4
Well #2 2-9-54	165	41	0.2	0	15.6	13.3	0	87	5.2	1.5	0.05	0.3	7.5
Well #4 2-9-54	250	41	1.2	NR	22.0	11.3	0	91	5.0	0.6	0.05	0.3	7.8
Wood Village (Portland)													
Well 4-4-60	175	NR	.90	<1.0	16.2	16.2*	NR	107.6	NR	0.05	0.23	<0.01	7.48

NR--Not reported. * Calculated. Underlined figures exceed USPHS recommended limits.

The natural quality of ground water used for rural-domestic supplies is important since such supplies rarely receive treatment before use. Bacterial contamination of the aquifers is not uncommon in urban areas, and some supplies have been rendered unfit for human use. The natural quality of ground water is quite variable. Hardness is the most widespread objectionable feature in ground waters, but other natural contaminants such as arsenic also occur in limited areas. Deep wells in some places encounter saline water, particularly in the Coast Range, and shallow wells frequently produce hard water and have objectionable iron content.

WATER TREATMENT

The treatment given water before it is distributed by municipal water facilities is determined by the requirements of the Oregon State Board of Health and by the desires of the consumer. In certain places, additional treatment is provided to assure water of a satisfactory quality to meet the (Federal) Public Health Service requirements as an interstate carrier watering point, as well as to satisfy State requirements.

Treatment to reduce suspended sediment is accomplished either as a single measure or in combination with other practices. Suspended sediment is controlled to some extent by source impoundments and/or by utilizing an infiltration gallery at the intake. Further treatment is accomplished by chemical and mechanical aids to flocculation. Filtration is the ultimate means of reducing the suspended sediment concentration.

Photo II-6. Infiltration galleries. City of Salem water supply system on Stayton Island. (City of Salem, Municipal Water Works Photo)

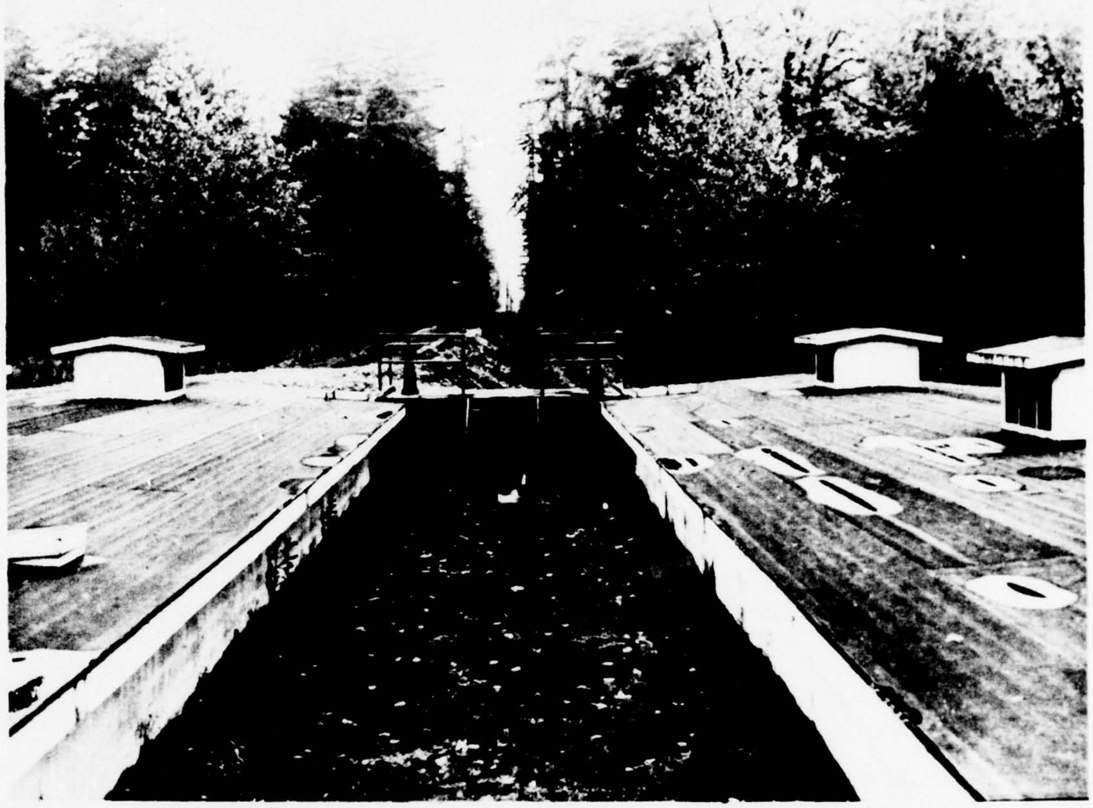


Photo II-7. Part of the Salem water supply system are these sand filters, located downstream from the infiltration galleries on Stayton Island. (City of Salem, Municipal Water Works Photo)

Measures for controlling obnoxious tastes and odors from biological growths also start at the source. Copper sulfate and activated carbon are sometimes added at source impoundments. Further control measures include superchlorination, dechlorination, use of activated carbon, and filtration at the treatment plant.

Control of bacterial contamination, aside from anti-pollution programs, is accomplished by filtration and disinfection. Chlorine has been used as the only acceptable disinfectant at all water-treatment plants in the basin. While bacterial contamination of water is not immediately identifiable, a chlorine residual may be determined in a matter of minutes. An adequate residual of available chlorine assures a complete kill of bacteria within a short period of time.

It is the policy of the Oregon State Board of Health to require complete treatment (sedimentation, filtration, and disinfection) of all water from surface sources prior to use in public systems. Those systems using closely controlled access watersheds which have traditionally been required only to chlorinate their supplies are exempted from this general policy. Such deviations will likely continue as long as the quality of water delivered to their consumers is satisfactory or the use of the watershed does not change sufficiently to create a public health hazard.

Ground-water supplies must also be treated in some instances. Wells in shallow aquifers and domestic wells which are not adequately sealed are subject to bacterial contamination and, therefore, chlorination is required. Mineral removal is practiced at Newberg, and softeners are used on an individual basis at Lake Oswego and other places using hard water from ground sources.

A summary of treatment practices is presented in Table II-6. The majority of the basin's population is provided with disinfected surface water from the Portland system.

Table II-6
Summary of Sources and Treatment for Municipally Supplied Water

Source and Treatment	Number of Municipal Facilities	Number of Developed Sources 1/	Population Served	Percent of Total
Surface, no treatment	12	22	6,000	0.6
Surface, disinfection	42	61	750,500	75.1
Surface, disinfection and filtration	9	13	143,000	14.4
	63	96	899,500	90.1
Ground, no treatment	47	93	42,000	4.2
Ground, disinfection	25	66	57,000	5.7
Ground, disinfection and filtration	--	--	--	--
	72	159	99,000	9.9
Total all sources	135	225	998,500	100.0

1/ Facilities with sources other than water purchased from other systems, for distribution.

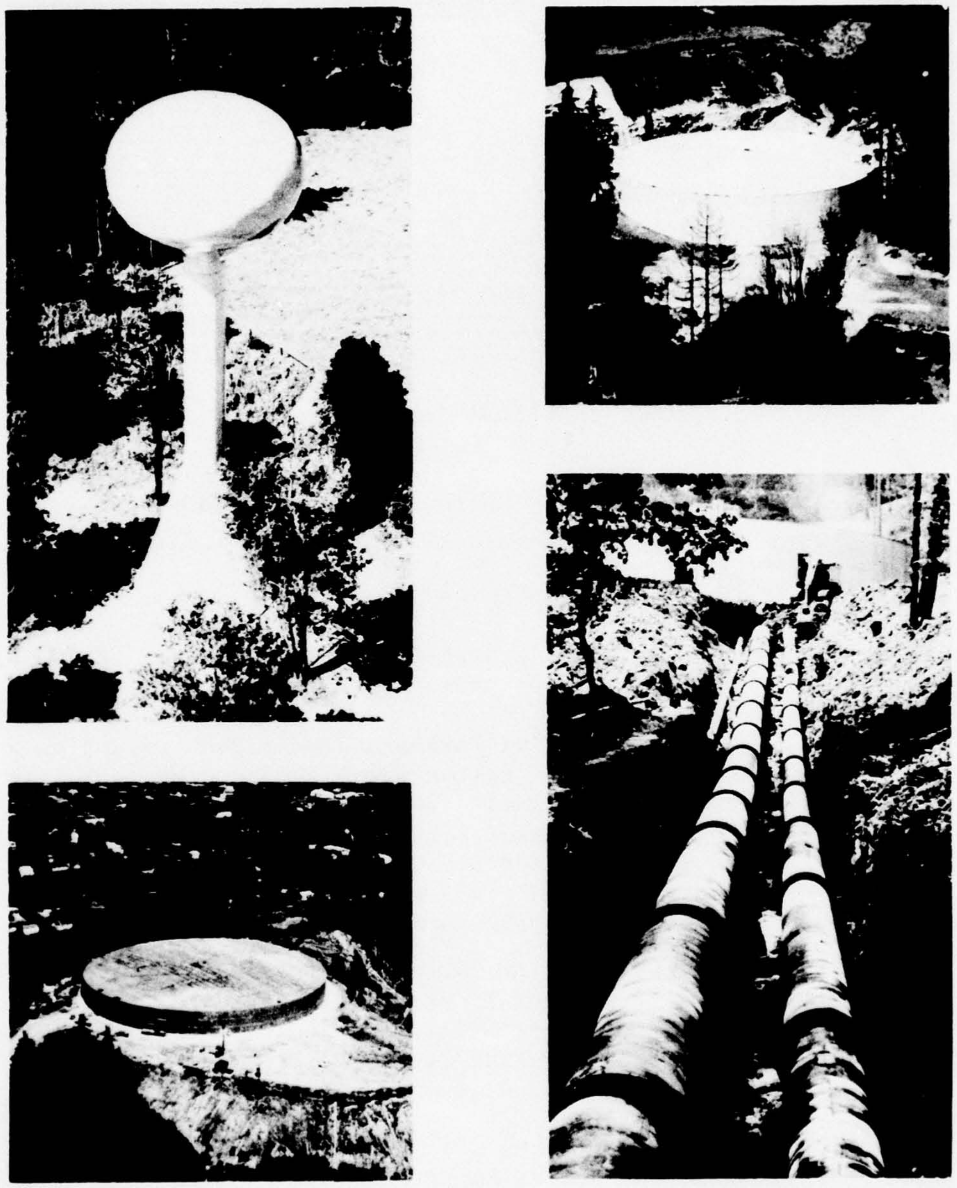


Photo II-8. Some components of the City of Portland's water storage and distribution system. (City of Portland, Bureau of Water Works Photo)

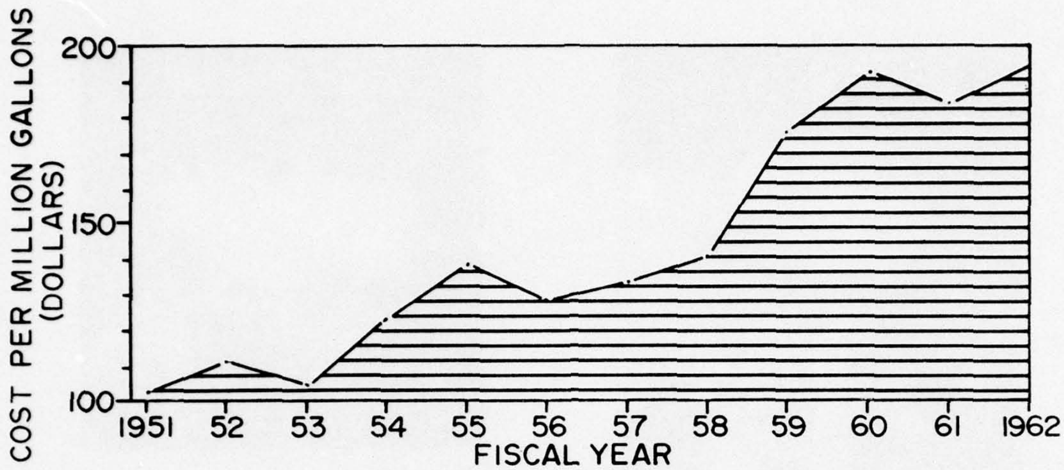


Figure II-4. Cost of Water, City of Portland.

Source: City of Portland, Bureau of Water Works Annual Reports

COST OF WATER

The cost of water varies according to several factors. Examples are given to point out the cost of providing high-quality water.

The cost of water delivered in Portland almost doubled during a recent 11-year period (1951-62). System expansion to keep pace with community growth, including reservoir storage construction, makes up a substantial share of the increased cost. Figure II-4 indicates the actual cost per million gallons for the City of Portland. Addition of a complete treatment facility to the existing Portland system would increase the cost of water by approximately $40/mg.

In contrast, the City of Salem, which does not have upstream storage, experienced only a 12 percent increase in cost during the eight years prior to 1962. The cost per million gallons ranged from $106.60 in 1954 to $119.45 in 1962. New facility construction and greater operating cost caused this increase.

The City of Corvallis operates two complete treatment plants. A part-time plant, located on the Willamette River, is used only during the summer months. The full-time plant, located on Marys Peak to the west, utilizes natural flow and stored water. The total cost of delivered water was $154.50 per million gallons during fiscal year 1959; treatment costs accounted for $41.00 per mg of the total.

At Adair Air Force Station near Corvallis, the total cost was $176.91 per million gallons during 1960. The station has a full-time treatment plant using Willamette River water.

The City of Eugene operates a complete treatment plant at Hayden Bridge on the McKenzie River. The total cost of delivered water increased from $92.30 per million gallons in 1950 to $139.00 in 1960.

SOURCE OF WATER

Few streams in the Willamette Basin have undergone water rights adjudication. Many minor but important (in terms of community water supplies) streams and springs are not gaged. Without identifying legally available water, it is not possible to evaluate the present adequacy of a source, except to say that it has been generally adequate in the past.

Currently, only four municipalities must utilize storage impoundments to meet their water needs. These include: Portland, 23,200 million gallons (mg) of storage on the Bull Run watershed; McMinnville, 250 mg on Haskins Creek; Corvallis, 100 mg on Rock Creek; and Dallas, 25 mg on six small creeks. Of these, only Dallas needs additional storage to meet immediate requirements.

Ground water is the primary supply for individual rural-domestic use within the basin. The supply is generally adequate along the alluvial plains of the valley floor, but in the low hills above the floor the supply is variable. This is particularly true on the west side of the valley.

Extensive use also is being made of the ground-water resource by communities and industries. Detailed information on the availability of ground water in the basin is presented in Appendix B--Hydrology. Except in the Tigard district and the west-side business district in Portland, no significant permanent drawdown of the water table is evident; therefore, the resource is generally assumed to be adequate for present levels of use.

Wells along the flood plain of the Willamette, Columbia, and lower tributary rivers have capabilities up to 1,500 gallons per minute (gpm). Yields of 300 to 600 gpm are obtained from wells in the alluvial plain adjacent to the flood plain, but this area is variable. Lava flows in the upper Cascades are excellent aquifers and have potential yields of over 1,000 gpm, but the remoteness of these areas has precluded development. Volcanics and sediments of the lower slopes of the Cascades are highly variable, with yields normally about 10 gpm. On the eastern slopes of the Coast Range, yields seldom exceed five gpm.

for withdrawal of 8.90 cfs near the St. Johns Bridge.

FUTURE DEMANDS

Abundant, good-quality water is available in the Willamette Basin to meet present municipal and industrial needs and to satisfy present requirements of other water uses. The basin's growth potential may be restricted or unnecessary problems may arise if future municipal and industrial needs are not provided for at an early date. This section presents the trends in municipal, industrial, and rural-domestic water uses, together with the projections of future water needs. These projections are used in formulating the basinwide water resources plan.

Photo III-1. Cold, clean water is plentiful in the upper reaches of the Willamette River's tributary streams. (Oregon State Water Resources Board Photo)

TRENDS IN WATER USE

Significant changes due to scientific advances will occur in our mode of life during the next fifty years, and emphasis will shift in urban living and recreation. New activities and means of enjoying leisure time will result. New products, methods of production, and materials will be introduced into industry. Municipal and industrial water use and methods of supplying water needs will reflect these changes.

The major sociological trend to be observed will be the continuation of urbanization. Major growth in population is expected to occur in concentrated areas along the Willamette River and its lower tributaries (see Appendix C--Economic Base). Cities with vast suburban areas will develop and, as a result, municipal water systems will greatly expand in size and scope of operation.

As people move from city core areas into suburban bedroom communities, they will demand the extension of municipal services into those areas. Water systems will be one of their prime demands, both for convenience and for adequate fire protection. Municipal water systems will feature central water purveyors selling bulk water to secondary suppliers in outlying communities as well as supplying adequate service to those within city limits. Furthermore, many industries will be served by municipal systems.

Municipalities vying for new industries will supply good-quality water to well-planned industrial parks as major attractions. Industries which require high-quality water and which are faced with problems in obtaining water rights or in developing their own separate systems will be tempted by such municipal enticements. This trend has become especially apparent in the food-processing industry, which is already largely supplied with water from municipal systems.

As municipal systems are expanded and replaced, communities will inevitably shift to a high degree of purification of their raw surface-water supplies. Controlled, limited-access watersheds (such as Portland's Bull Run) will become increasingly rare due to greater pressure on these areas for additional compatible uses to develop. Increased recreational pressure from larger populations with more leisure time is expected. The Oregon State Board of Health already requires filtration and chlorination for most new surface-water systems to provide more assured public health protection. The U. S. Public Health Service has similar requirements for certification of water supplies for interstate common carriers where protection by natural means is inadequate. Exemptions from mandatory filtration through watershed protection will become rare.

New, separate industrial water systems will also be developed, and many of the present industrial sources of supply will be expanded. Increased plant automation and closer quality-control tolerances are expected to lead to demands for higher quality process waters. Concurrently, suitable unappropriated raw water supplies will diminish. As a result, industrial water treatment will be greatly expanded in the

Photo III-2. Industrial parks, such as this Tektronix installation, will exercise an increased water-use demand wherever located. (Oregon State Water Resources Board Photo) future. Chlorination, softening, iron removal, and even filtration will become increasingly common as better process controls are developed or required.

Rural-domestic water demands will continue to be supplied primarily from individual ground-water systems. Water use is expected to increase due to expanding rural population and a more modern form of rural life. Development trends will continue to be governed by the availability of sufficient local ground water to supply needs. Centralized rural water distribution systems are expected to develop where the population density and demand are sufficient. However, these systems will be the exception rather than the rule. Comprehensive water and sewer plans are being prepared in cooperation with the Farmers Home Administration in Polk, Marion, Yamhill, Columbia, Linn, and Lane Counties.

As total water use expands and man uses the watersheds more intensively, the availability of waters suitable for high-quality uses without purification will diminish. As a result, more reliance on lower quality sources (such as the Willamette River and the lower reaches of its tributaries) can be expected. Improved water purification will permit a shift from developing the highest quality water source to developing the most economical source.

The total annual runoff from the Willamette Basin is more than sufficient to support projected municipal and industrial development. However, supply deficits are likely to occur occasionally because of maximum demands during the dry summer months when water yields are minimal. A major obstacle in determining the availability of water for future use, particularly during low-flow periods, is the lack of water-rights adjudication. It is conceivable that much of the water for the Lower Subarea will be supplied from the Columbia River.

PROJECTED WATER USE

Trends in municipal, industrial, and rural-domestic water use are analyzed and future water demands are projected for the basin. Gross water needs are projected for each subbasin and service area. Many of these projections indicate areas of future water shortages and point up possible storage project needs.

Water demand forecasts are made for areas and user groups rather than for individual industries or communities. The accuracy of projections is greater for large areas or groups than it is for their components. Projections of demands for smaller units should be made by the individual industries and communities concerned, in conjunction with competent consulting engineers. The area-wide projections will provide the framework for such forecasts.

Present and projected populations for the Willamette Basin subareas and major service areas are presented in Table III-1, while future basin population growth trends are shown in Figure III-1. A recent[1/] study resulted in the projections of per capita water demand in the Willamette Basin (Figure III-2). The per capita demand, applied directly to population projections (Appendix C--Economic Base), provides municipal water demand projections for these major service areas and subbasins as subsequently given in Table III-2.

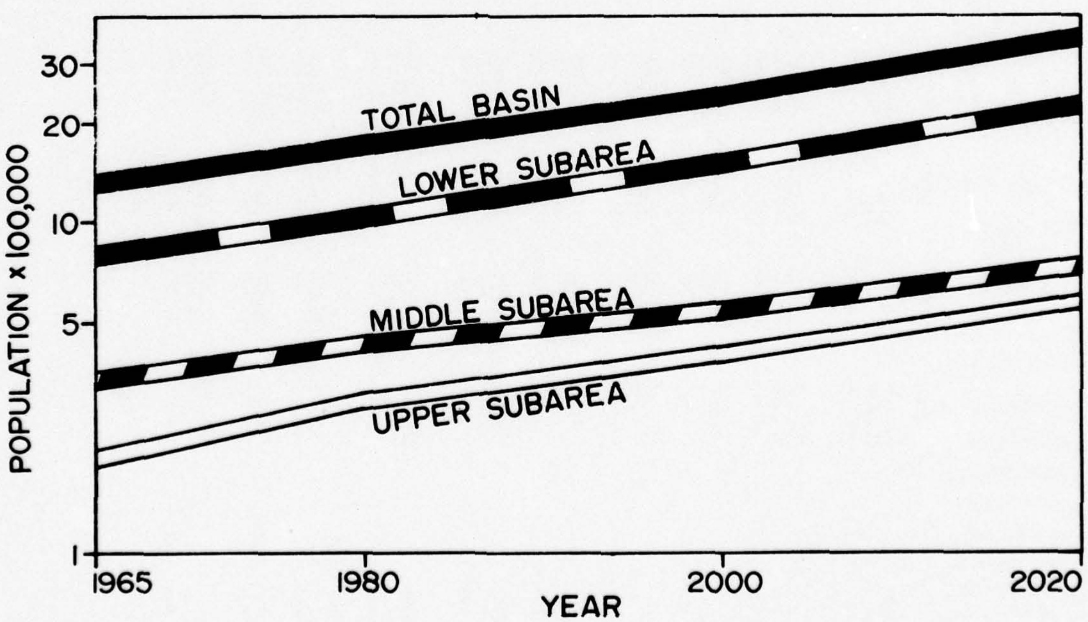


Figure III-1. Population Growth by Subarea.

1/ Municipal Water Needs in the Pacific Northwest to the Year 2020, Working Paper No. 54, Columbia River Basin Comprehensive Project, p. 8.

Table III-1

Population Growth, by Subarea and Service Area

	1965	1980	2000	2020
UPPER SUBAREA	198,000	282,500	390,000	564,000
Municipal	149,300	229,400	338,500	516,700
Rural-Domestic	48,700	53,100	51,500	47,300
Eugene-Springfield Service Area	143,300	212,400	301,500	438,900
Municipal	131,300	198,700	288,000	426,500
Rural-Domestic	12,000	13,700	13,500	12,400
Long Tom	15,600	20,200	25,600	35,900
Municipal	4,100	7,500	13,300	24,700
Rural-Domestic	11,500	12,700	12,300	11,200
Coast Fork	19,000	22,900	29,200	40,800
Municipal	7,600	11,500	18,100	30,600
Rural-Domestic	11,400	11,400	11,100	10,200
McKenzie	6,900	10,200	11,600	15,000
Municipal	1,100	3,800	5,800	10,700
Rural-Domestic	5,800	6,400	5,800	4,300
Middle Fork	13,200	16,800	22,100	33,400
Municipal	5,200	7,900	13,300	24,200
Rural-Domestic	8,000	8,900	8,800	9,200
MIDDLE SUBAREA	329,900	437,700	556,000	729,000
Municipal	237,000	347,030	473,700	656,700
Rural-Domestic	92,900	90,670	82,300	72,300
Albany-Corvallis Service Area	63,300	98,700	143,500	210,500
Municipal	63,300	98,700	143,500	210,500
Salem Service Area	107,000	160,700	222,500	311,600
Municipal	107,000	160,700	222,500	311,600
Santiam	38,100	39,500	36,000	35,200
Municipal	9,600	13,300	15,400	18,100
Rural-Domestic	28,500	26,200	20,600	17,100
Coast Range and Pudding	22,000	25,200	28,300	25,900
Rural-Domestic	22,000	25,200	28,300	25,900
Coast Range	48,900	53,700	59,400	70,100
Municipal	31,300	36,800	45,200	57,800
Rural-Domestic	17,600	16,900	14,200	12,300
Pudding	50,600	59,900	66,300	75,700
Municipal	25,800	37,530	47,100	58,700
Rural-Domestic	24,800	22,370	19,200	17,000
LOWER SUBAREA	811,000	1,047,300	1,476,000	2,298,000
Municipal	750,200	959,200	1,352,500	2,117,800
Rural-Domestic	60,800	88,100	123,500	180,200
Portland Service Area	738,500	939,200	1,320,200	2,065,500
Municipal	738,500	939,200	1,320,200	2,065,500
Tualatin	46,500	74,300	110,000	165,900
Rural-Domestic	46,500	74,300	110,000	165,900
Clackamas	17,900	22,400	29,400	42,000
Municipal	5,800	11,100	18,700	31,100
Rural-Domestic	12,100	11,300	10,700	10,900
Columbia	2,300	3,100	4,800	8,000
Municipal	2,300	3,100	4,800	8,000
Sandy	5,800	8,300	11,600	16,600
Municipal	3,600	5,800	8,800	13,200
Rural-Domestic	2,200	2,500	2,800	3,400
TOTAL WILLAMETTE BASIN	1,338,900	1,767,500	2,422,000	3,591,000
Municipal	1,136,500	1,535,630	2,164,700	3,291,200
Rural-Domestic	202,400	231,870	257,300	299,800

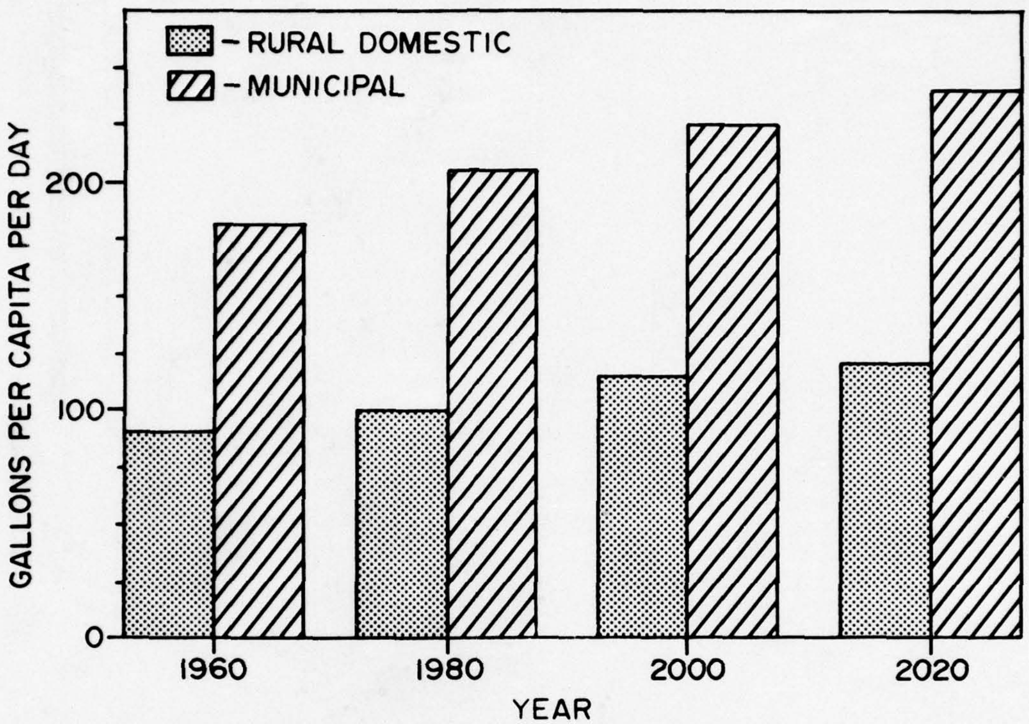


Figure III-2. Projections of Water Need.

The rural-domestic demands are forecast on the same basis as the municipal demands. In an attempt to eliminate commercial and small industrial demands (included in the municipal study), 50 percent of the gpcd figures used for municipal demands are applied to the rural components of population.

Future water use in industry will be greatly affected by in-plant water management improvements and technological changes. Some new processes will lead to higher water use per unit of product, but most changes will reduce water use per unit, in response to pressure for waste volume reduction from pollution control agencies. Since the timing or impact of such changes cannot be accurately estimated, future and present water use per unit of production are assumed to be equal, except for the pulp and paper industry. Recent information compiled by the FWPCA in The Cost of Clean Water, dated January 10, 1968, provided realistic future unit water uses for various types of pulping and paper production.

Industrial water demands are projected for pulp and paper, lumber and wood products, food products, primary metals, chemicals, and other manufacturing industries by service area and subbasin. Projections are obtained by multiplying present water use by a growth index. The growth indices derived from data contained in Appendix C--Economic Base--are shown in Figures III-3 and III-4. Because of the importance of pulp

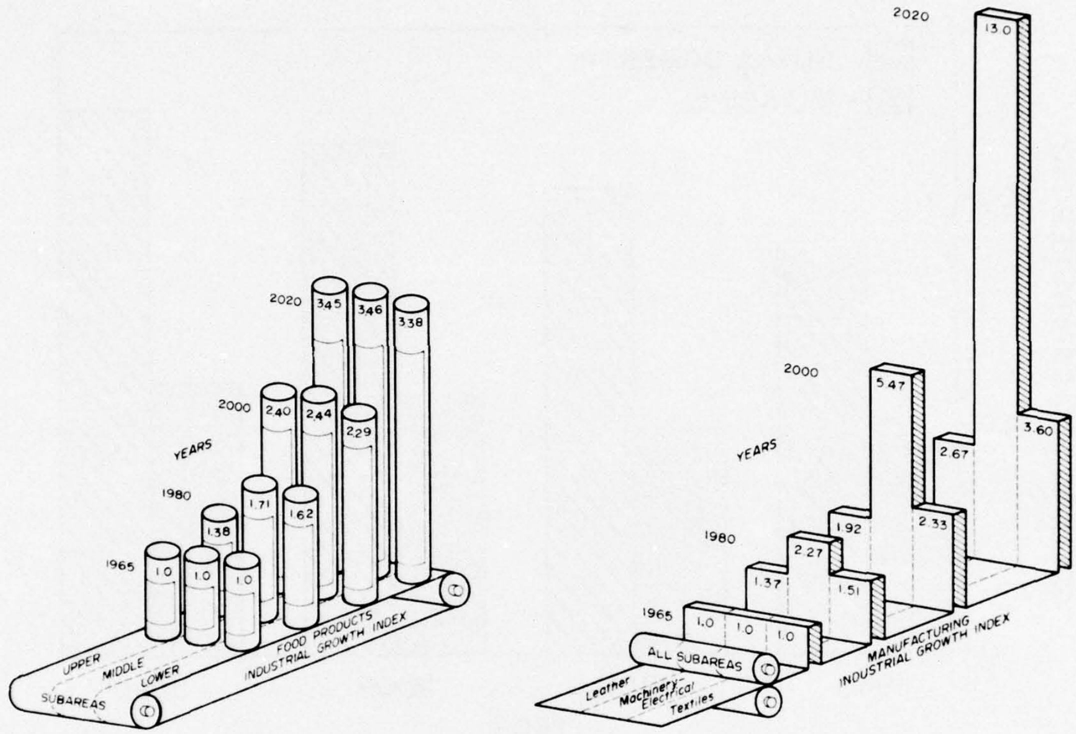


Figure III-3. Growth Indices--Food Products, and Manufacturing.

and paper production, it was considered judicious to use projections established by the most recent comprehensive study. Accordingly, projections of pulp and paper productivity established by the Columbia-North Pacific Region Framework Study were substituted for those of the Willamette Basin Study. Water use projections for this industry utilized estimates of future reduced unit water use to present a more realistic picture.

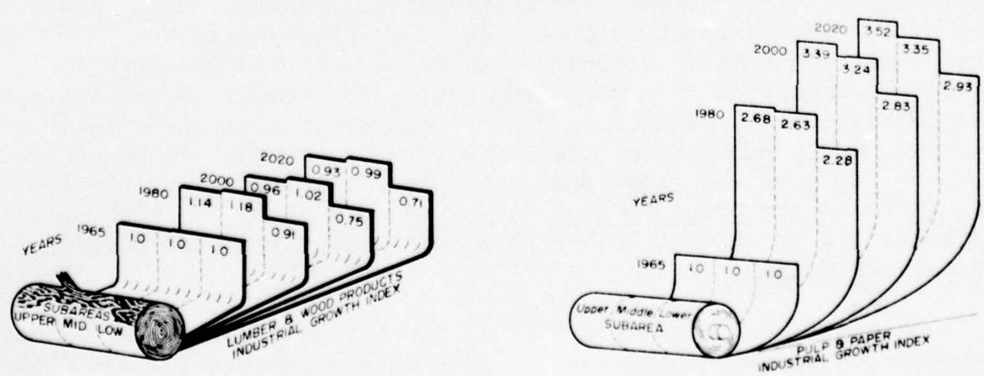


Figure III-4. Growth Indices--Lumber and Wood Products, and Pulp and Paper

Table III-2
Future Municipal, Industrial, and Rural-Domestic
Average Water Use (MGD)

	1980	2000	2020
UPPER SUBAREA	114.5	169.8	244.1
Municipal	48.8	78.4	127.1
Industrial	60.4	85.4	111.4
Rural-Domestic	5.3	6.0	5.6
Eugene-Springfield Service Area	91.0	142.9	207.5
Municipal	42.3	67.0	105.3
Eugene-Springfield Urban Area	38.0	59.0	90.5
Coburg	0.6	1.4	3.1
Junction City	1.3	2.7	5.6
Elmira-Veneta	0.8	1.7	3.2
Lumber and Wood Products	0.7 1/	0.6 1/	0.6 1/
Food Products	0.9 1/	1.6 1/	2.3 1/
Industrial	47.3	74.3	100.7
Pulp and Paper	31.4	51.1	64.9
Lumber and Wood Products	9.8	8.4	8.0
Chemicals	6.1	14.8	27.8
Rural-Domestic	1.4	1.6	1.5
Long Tom	2.9	4.4	7.3
Municipal	1.6	3.0	6.0
Monroe	0.5	0.9	1.9
Harrisburg	1.1	2.1	4.1
Rural-Domestic	1.3	1.4	1.3
Coast Fork	16.4	16.3	19.1
Municipal	2.4	4.1	7.4
Cottage Grove	1.9	3.3	6.0
Creswell	0.5	0.8	1.4
Industrial	12.9	10.9	10.5
Lumber and Wood Products	12.9	10.9	10.5
Rural-Domestic	1.1	1.3	1.2

Table III-2 (Cont.)
Future Municipal, Industrial, and Rural-Domestic Average Water Use (MGD)

	1980	2000	2020
UPPER SUBAREA (Cont.)			
McKenzie	1.4	2.0	3.1
Municipal	0.8	1.3	2.6
Blue River	0.5	0.9	1.9
Marcola	0.3	0.4	0.7
Rural-Domestic	0.6	0.7	0.5
Middle Fork	2.8	4.2	7.1
Municipal	1.7	3.0	5.8
Lowell	0.5	0.9	1.9
Oakridge	1.2	2.1	3.9
Industrial	0.2	0.2	0.2
Lumber and Wood Products	0.2	0.2	0.2
Rural-Domestic	0.9	1.0	1.1
MIDDLE SUBAREA	166.3	240.1	333.9
Municipal	86.2	126.8	184.6
Industrial	71.1	103.8	139.6
Rural-Domestic	9.0	9.5	9.7
Albany-Corvallis Service Area	59.1	85.2	111.1
Municipal	22.4	34.6	52.9
Albany Urban Area	6.3	10.5	16.9
Corvallis Urban Area	10.0	16.5	26.6
Philomath	0.8	1.3	2.0
Lebanon	1.8	2.3	2.7
Sweet Home	1.4	1.7	2.1
Other Municipal	-	0.2	0.2
Lumber and Wood Products	1.5 1/	1.3 1/	1.2 1/
Food Products	0.5 1/	0.7 1/	1.0 1/
Primary Metals	0.1 1/	0.1 1/	0.2 1/
Industrial	36.7	50.6	58.2
Pulp and Paper	31.2	44.1	50.4
Lumber and Wood Products	3.0	2.6	2.5
Primary Metals	2.5	3.9	5.3
Rural-Domestic	-	-	-

Table III-2 (Cont.)

Future Municipal, Industrial, and Rural-Domestic
Average Water Use (MGD)

	1980	2000	2020
MIDDLE SUBAREA (Cont.)			
Salem Service Area	49.6	80.0	122.2
Municipal	36.5	55.1	81.2
Salem Urban Area	28.1	43.7	65.3
Dallas	1.7	1.9	2.2
Independence	0.9	1.5	2.4
Monmouth	1.4	2.2	3.4
Turner	0.5	0.8	1.3
Lumber and Wood Products	1.0 1/	0.9 1/	0.8 1/
Food Products	2.9 1/	4.1 1/	5.8 1/
Industrial	13.1	24.9	41.0
Pulp and Paper	6.2	6.2	6.2
Food Products	0.8	1.2	1.7
Chemicals	6.1	17.5	33.1
Santiam	18.3	23.4	34.2
Municipal	11.2	15.4	21.3
Mill City	0.5	0.6	0.6
Stayton	0.7	0.9	1.0
Brownsville	0.5	0.7	1.1
Other Municipal	1.1	1.3	1.7
Food Products	8.4 1/	11.9 1/	16.9 1/
Industrial	4.5	5.6	9.8
Lumber and Wood Products	3.8	3.3	3.2
Manufacturing	0.7	2.3	6.6
Rural-Domestic	2.6	2.4	3.1
Coast Range and Pudding	2.5	3.3	3.1
Rural-Domestic	2.5	3.3	3.1
Coast Range	22.9	30.8	41.2
Municipal	8.2	11.1	15.0
Falls City	0.4	0.5	0.7
McMinnville	2.1	2.4	2.9
Sheridan	0.5	0.6	0.6
Newberg	2.6	4.5	6.8
Dundee	0.5	0.7	1.1
Other Municipal	1.5	1.6	1.8
Food Products	0.6 1/	0.8 1/	1.1 1/

Table III-2 (Cont.)
Future Municipal, Industrial, and Rural-Domestic
Average Water Use (MGD)

	1980	2000	2020
MIDDLE SUBAREA (Cont.)			
Coast Range (Cont.)			
Industrial	13.0	18.1	24.7
Pulp and Paper	10.4	14.0	16.2
Lumber and Wood Products	1.7	1.5	1.5
Food Products	0.2	0.3	0.4
Manufacturing	0.7	2.3	6.6
Rural-Domestic	1.7	1.6	1.5
Pudding	13.9	17.4	22.1
Municipal	7.9	10.6	14.2
St. Paul	0.5	0.7	1.1
Mt. Angel	0.7	0.8	1.0
Silverton	1.6	2.1	2.6
Woodburn	1.8	2.3	3.0
Canby	1.1	1.7	2.5
Molalla	0.8	1.3	1.8
Sublimity	0.5	0.7	1.1
Other Municipal	0.9	1.0	1.1
Industrial	3.8	4.6	5.9
Lumber and Wood Products	1.5	1.3	1.3
Food Products	2.3	3.3	4.6
Rural-Domestic	2.2	2.2	2.0
LOWER SUBAREA	334.0	514.9	862.8
Municipal	226.1	357.6	608.4
Industrial	99.1	143.1	232.8
Rural-Domestic	8.8	14.2	21.6
Portland Service Area	260.5	414.1	715.3
Municipal	218.7	345.1	586.7
Food Products	6.3 1/	8.8 1/	13.1 1/
Chemicals	4.5 1/	10.8 1/	21.3 1/
Manufacturing	4.1 1/	8.8 1/	23.1 1/

Table III-2 (Cont.)

Future Municipal, Industrial, and Rural-Domestic Average Water Use (MGD)

	1980	2000	2020
LOWER SUBAREA (Cont.)			
Portland Service Area (Cont.)			
Municipal (Cont.)			
Portions of Multnomah County			
Incorporated	100.7	141.1	225.8
Unincorporated	37.5	55.8	88.8
Portions of Clackamas County			
West of Willamette River			
Lake Oswego	3.7	6.5	11.3
West Linn	1.6	2.9	4.9
Unincorporated	2.2	4.2	7.8
East of Willamette River			
Milwaukie	3.8	6.8	11.8
Oregon City	3.0	5.1	8.6
Gladstone	1.1	1.8	3.0
Unincorporated	14.2	26.5	49.7
Portions of Washington County			
Beaverton	2.5	4.4	7.5
Tigard	1.2	2.5	5.2
Cornelius	0.9	1.5	2.5
Forest Grove	3.3	5.9	10.0
Hillsboro	6.2	11.0	18.6
Sherwood	0.4	0.8	1.4
Other Municipal	21.5	39.9	72.3
Industrial	41.8	69.0	128.6
Pulp and Paper	13.4	18.9	21.9
Lumber and Wood Products	0.8	0.7	0.7
Food Products	3.9	5.5	8.1
Primary Metals	9.5	13.5	16.9
Manufacturing	14.2	30.4	81.0
Tualatin	7.4	12.7	19.9
Rural-Domestic	7.4	12.7	19.9
Clackamas	3.4	5.4	8.8
Municipal	2.3	4.2	7.5
Boring	0.7	1.4	2.9
Estacada	1.1	2.1	3.5
Other Municipal	0.5	0.7	1.1
Rural-Domestic	1.1	1.2	1.3

Table III-2 (Cont.)

Future Municipal, Industrial, and Rural-Domestic Average Water Use (MGD)

	1980	2000	2020
LOWER SUBAREA (Cont.)			
Columbia	61.2	80.4	115.3
Municipal	3.9	6.3	11.1
Remainder of Multnomah County	0.6	1.1	1.9
St. Helens	3.0	4.7	8.3
Scappoose	0.3	0.5	0.9
Industrial	57.3	74.1	104.2
Pulp and Paper	48.7	55.7	55.7
Lumber and Wood Products	0.1	0.1	0.1
Manufacturing	8.5	18.3	48.4
Sandy	1.5	2.3	3.5
Municipal	1.2	2.0	3.1
Sandy and Corbett communities	1.2	2.0	3.1
Rural-Domestic	0.3	0.3	0.4
TOTAL WILLAMETTE BASIN	614.8	924.8	1,440.8
Municipal	361.1	562.8	920.1
Industrial	230.6	332.3	483.8
Rural-Domestic	23.1	29.7	36.9

1/ Amount of municipal water used by industry.

Average daily needs for municipal, industrial, and rural-domestic future water requirements are shown in Table III-2. The projections are intended for use in comprehensive water resource planning rather than for fulfillment of the requirements of consulting engineers and others who may be interested in specific municipalities or industries. As an aid to resource planning, Table III-2 does include estimates of future water use for communities with a population of 2,500 or more. The water use projections are also summarized graphically in Figure III-5.

Water demand can fluctuate widely, depending on the type of use, season of the year, weather, time of day, and industrial peak-use periods. Monthly patterns of present water demands are shown in Table II-3. Municipal use in the basin follows a definite pattern, and monthly variations in water demand of communities are independent of geographic location or size of the municipality. Accordingly, the projected monthly distribution of municipal water demand, shown in Table III-3, can be used for planning purposes.

Industrial water use does not follow the same consistent pattern. Water use by the pulp and paper, and lumber and wood products industries is projected to be rather uniform throughout the year (Table III-3). On the other hand, water use by the food products and primary metals industries will vary widely on a monthly basis--in the case of food processing, up to 375 percent of the average monthly mgd. Representative values for industry, based primarily on present use, are also shown in Table III-3 to assist in determining future needs.

Table III-3
Future Municipal and Industrial Water Use
Monthly Demand as Percent of Annual Average MGD
1980-2020

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Upper Subarea (Subbasins 1,2,3 & 4)												
Municipal	73	72	68	75	75	120	185	175	120	88	77	76
Pulp and Paper	80	90	100	110	110	110	110	110	110	105	105	80
Lumber & Wood Prod.	105	115	100	120	100	100	100	105	105	90	85	75
Food Products	5	5	5	5	10	10	60	185	360	275	160	120
Middle Subarea (Subbasins 5,6 & 7)												
Municipal	73	72	68	75	75	120	185	175	120	88	77	76
Pulp and Paper	90	105	95	100	105	105	95	100	100	90	110	105
Lumber & Wood Prod.	70	85	95	95	95	105	100	145	90	95	110	115
Food Products	150	60	40	25	35	65	55	185	375	110	65	35
Primary Metals	60	30	15	40	30	40	45	80	180	265	200	215
Lower Subarea (Subbasins 8,9,10 & 11)												
Municipal	73	72	68	75	75	120	185	175	120	88	77	76
Pulp and Paper	100	100	100	100	100	100	100	100	100	100	100	100
Lumber & Wood Prod.	100	100	100	100	100	100	100	100	100	100	100	100
Food Products	30	5	0	0	0	15	100	50	250	300	300	150
Primary Metals	100	100	100	100	100	100	100	100	100	100	100	100

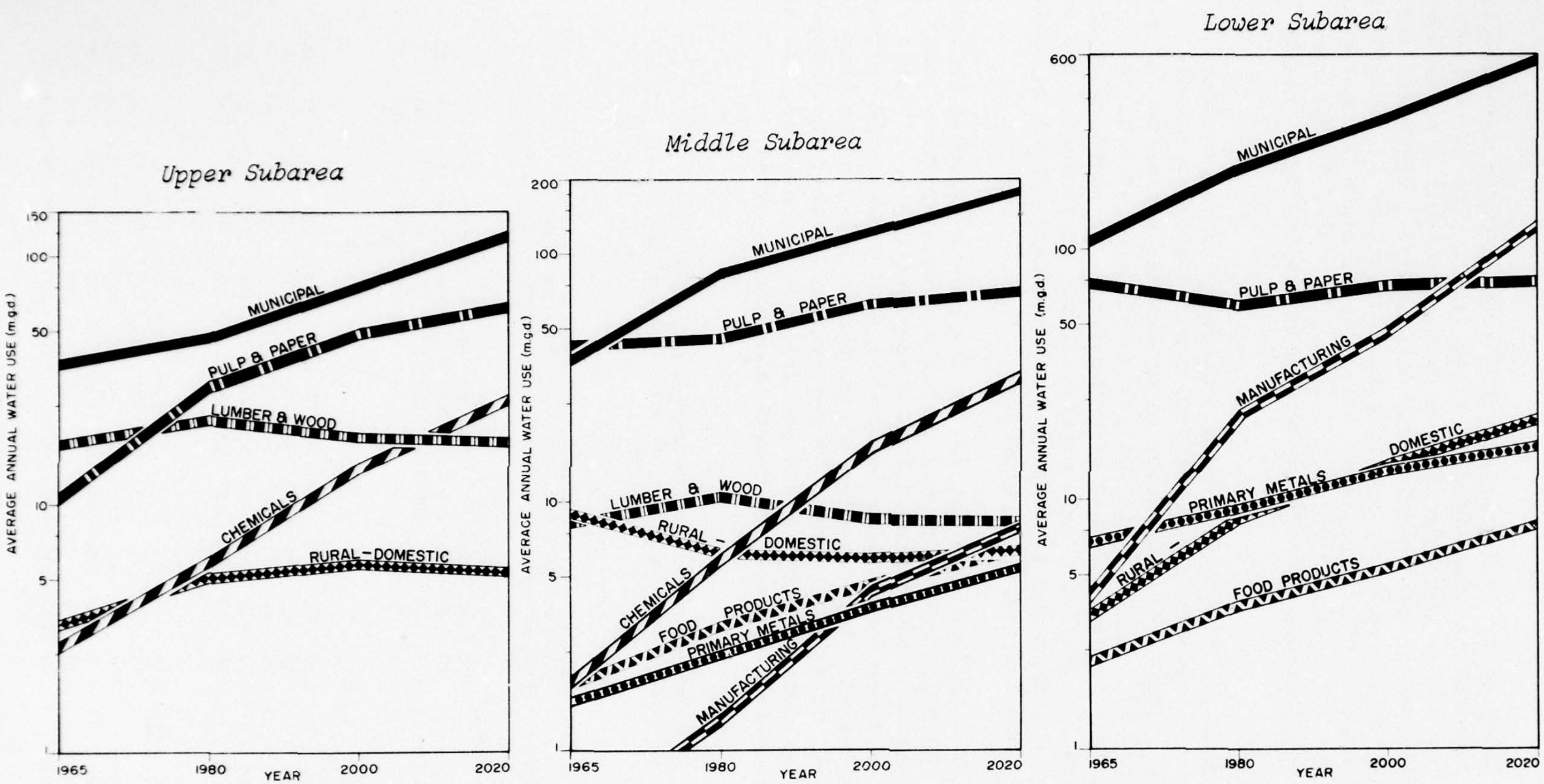


Figure III-5. Water Use Projections by Subarea.

PROBLEMS

The steadily mounting need for municipal and industrial water will not strain the abundant water resources of the Willamette Basin during the period of study, but localized supply difficulties are certain to emerge. Additional storage capacity must be developed for water supply purposes. The coincidence of peak water demands with summer low-flow periods makes increased storage for water supply purposes a fast-approaching necessity. A substantial portion of the need for storage could be met by Federal multipurpose reservoirs.

STORAGE RESERVATIONS

Under the provisions of the Water Supply Act of 1958 (P.L. 500), as amended, space may be reserved, on a reimbursable basis, in Federal reservoirs to supply municipal and industrial water requirements. Effectiveness of the Act, however, is limited by the incapacity of most municipalities and industries to estimate their long-term water supply needs during the planning phase of Federal projects. Legislation enabling the State of Oregon to request storage on behalf of the ultimate municipal and industrial users would do much to insure that growing water supply needs are met as required for potential Willamette Basin users. This would also provide economies by meeting municipal and industrial water supply requirements from reservoirs concurrently used for other purposes.

SOURCE IDENTIFICATION

Availability of water is a major factor in future source identification. Determination of physically and legally available flow in most watershed areas is not possible at present. Gaging facilities in the upper reaches of most streams are nonexistent. Withdrawals authorized under state water rights may be identified but are not descriptive of the actual water withdrawn. Installation of gaging facilities would cost approximately $5,000 per station for installation and $1,600 annually for operation and maintenance. Adjudication of water rights within each minor basin is also expensive. The Office of the State Engineer has estimated that it would cost about $1.5 million to complete adjudication of water rights in the Willamette Basin.

It is difficult to identify future source developments by location. Civic pride and aesthetics have been inseparable major factors of source selection and have at various times over the years overruled economics as the deciding factor. Even though a potential source happens to be both close and the least expensive of several alternates, it may not be selected for development.

WATERSHED MANAGEMENT

A major problem that faces several purveyors but mainly Portland concerns possible future changes in management of their limited-use watersheds to permit additional uses and the associated need for water treatment. Many considerations, including strongly held public opinions, are involved. Since complete treatment of water from controlled use watersheds is not now required by the Oregon State Board of Health, the cost of water to the consumer is also significantly affected. Research is adding to the basic information on the public health aspects of multiple use of watershed lands and reservoirs used for municipal supply. Other problems, however, call for assessment of rather complex economic and social benefits of multiple use. These considerations are important in our present society because people are willing to pay not only for basic needs and protection from injury, disease, and death, but for basic aesthetics as well. It is important, then, that multiple-use decisions take cognizance of both tangible and intangible benefits, which determine true economic feasibility. On one hand, recreation is, and will continue to be, one of the major water and related land uses. On the other hand, the residential water user has a strong desire to have a source of supply free of pollution and as close to its pristine state as possible.

If it is necessary to compromise these divergent desires by multiple use, primarily recreation, of existing single-purpose municipal water supply reservoirs or watersheds, stringent control to prevent water quality deterioration caused by these uses will be necessary. Water treatment facilities commensurate with the degree of quality degradation must be installed to adequately protect the water consumers' health. Thus, one aspect of the question is the economic feasibility of controls and treatment, and methods of financing the cost increment.

A complete evaluation becomes especially important politically, as well as economically, when the cost of additional treatment must be borne by a limited group of water consumers, while multiple-use benefits may pass to a much larger (separate) group. It has been suggested that additional treatment costs of public water supplies in equipment, operation, and maintenance resulting from public recreational use should be assigned to the recreation function. When the water consumers constitute a basically different group than those receiving the recreation benefits, some method of reimbursing the water purveyor for increased treatment costs should be derived.

Even with consideration of the above, however, compatible uses of municipal water supply reservoirs and watersheds should be carefully controlled to assure the best quality of the public raw water sources. In areas where a recreational deficit does not exist, single-purpose reservoirs should be held in reserve and restricted to the single-purpose water supply use until such time as it becomes necessary to use them to satisfy definitive recreation demand, where economically justified and financially feasible.

DEMAND GROWTH

Increased demands for municipally supplied water may be measured by a per capita demand increase as well as by an increase in the number of persons served. The number of persons served is increasing at a more rapid rate than the basin population because local ordinances require public water supplies for new housing developments, and because a reliable supply of safe water for household use is needed in established suburban areas. In some suburban areas, each household is served by individual subsurface waste disposal and water supply until increased housing density and ground-water polluticn or contamination become critical. Then the people residing in the area must either form a legal body such as a water district to operate a public water system or annex to an adjacent community for municipal services. In some places, county or city land-use-control agencies recognize an area as unsuitable for individual water supply and will not permit development until a public water system is assured.

Industrial use of municipally supplied water is also increasing, primarily for economic reasons. Some industries have found it to be less expensive to purchase finished water than to develop an individual water system. The largest industrial user of municipally supplied water is the food-processing industry. By the nature of this industry, it is essential that large amounts of high-quality water be available.

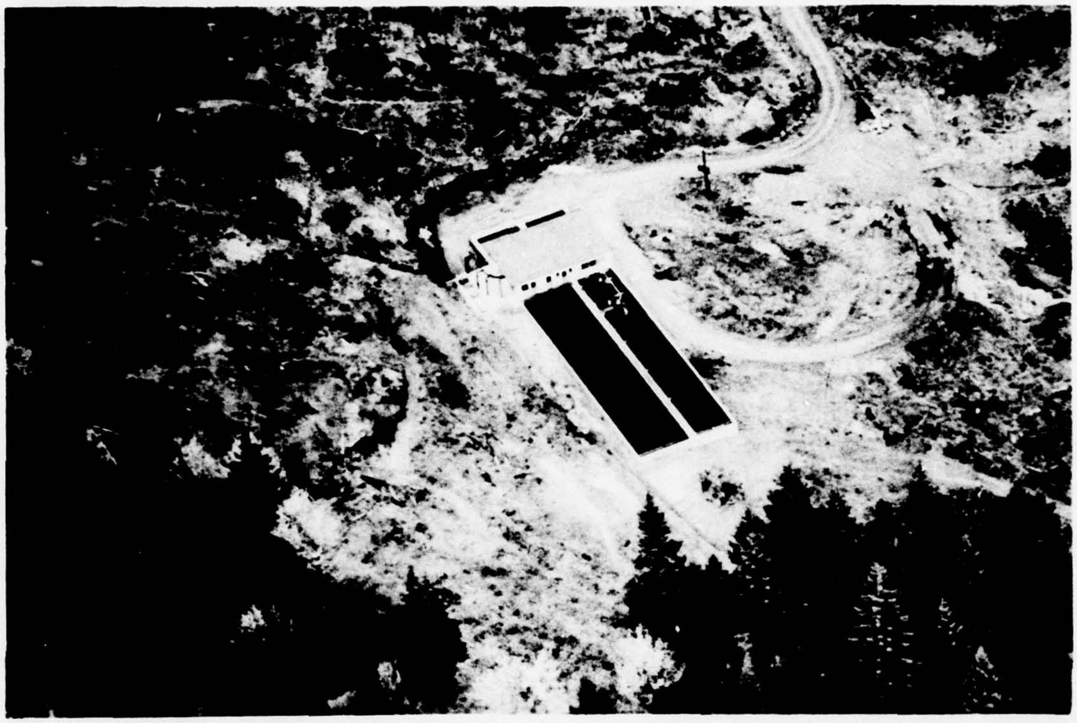


Photo III-3. The Corvallis water treatment plant located on Rock Creek is the city's main water supply. (Cornell, Howland, Hayes and Merryfield, Corvallis, Oregon, Photo)

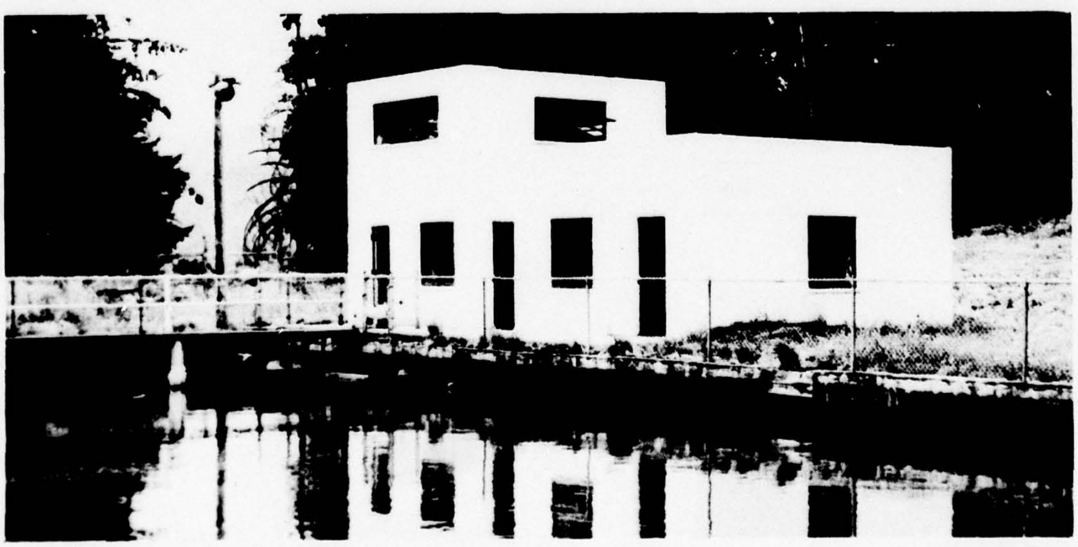


Photo III-4. Water drawn from Clear and Gale Creeks receives treatment here before distribution to the City of Forest Grove. (Cornell, Howland, Hayes and Merryfield, Corvallis, Oregon, Photo) obtained by multiplying present water use by a growth index. The growth indices derived from data contained in Appendix C--Economic Base--are shown in Figures III-3 and III-4. Because of the importance of pulp

ALTERNATIVE MEANS TO SATISFY DEMANDS

In most of the Willamette Basin, municipal and industrial water supplies may be derived from ground water, surface water, or a combination. Surface-water sources may require storage for regulation during summer low-flow periods. The individual selection of the source depends upon an evaluation of several factors, chief among which are cost, adequacy of supply, and aesthetic considerations. A system-by-system appraisal of alternatives and selection of the source likely to be developed in the future was not feasible, chiefly because of the highly subjective and variable basis for this decision by the operating entities. Thus, a generalized approach was taken where adequacy of supply and economic development costs were the primary criteria in projecting solutions to the needs.

Short-term municipal water supply development needs by 1985 are summarized in Table IV-1. Long-term water use and associated development needs are less well defined. Table III-2 does provide a guide regarding future needs for the years 2000 and 2020. These projected demands can be used to identify the areas that warrant priority in future detailed planning efforts.

The supply of water within the Willamette Basin, on an annual basis, is adequate for existing and projected municipal and industrial requirements. Some systems do experience short-term shortages, due to seasonal streamflow deficiencies, and transmission and treatment limitations, but these can be overcome. Smaller communities normally have the most difficulty in meeting water supply needs. Most physical water supply problems within the basin may be solved by storage, transmission, or treatment, but small communities are seldom able to finance the required improvements.

Three major steps will have to be taken in order to satisfy future municipal water demands: (1) In some cases, water in upstream or out-of-basin storage must be acquired (preferably from a multipurpose development for use during periods of low natural streamflow). (2) Transmission line and distribution storage capacity must be sized to satisfy peak demands without imposing excessive hourly or daily withdrawals from the source. (3) People must become willing to accept streams now considered to be of poor quality as a water source; treatment plants will be required. Use of reclaimed waste water may also occur in the future. Historically, the voters of Salem and Eugene have shown a willingness to pay a premium for water from a river of higher apparent quality rather than to treat water from the Willamette River, a more conveniently located stream, to the same finished standards.

Table IV-1

Municipal Water Supply Development Needs
1985

	SUPPLY: Natural Flow (MGD)	SUPPLY: Ground Water (MGD)	SUPPLY: Storage (MG)	Purification Plant Capacity (MGD)
UPPER SUBAREA	3.7	2.95	100	7.65
Eugene-Springfield Service Area				
Junction City		0.35		
Elmira-Veneta	2.0		100	1.5
Long Tom				
Monroe	0.5			0.75
Harrisburg		1.8		
Coast Fork				
Cottage Grove				3.5
Creswell		0.4		
McKenzie				
Blue River	1.0			0.9
Marcola		0.4		
Middle Fork				
Lowell	0.2			1.0
MIDDLE SUBAREA	19.0	12.45	5,837	143.6
Albany-Corvallis Service Area				
Albany Urban Area				10.0
Corvallis Urban Area	15.0			22.0
Lebanon				5.0
Sweet Home				1.5
Other		0.15		
Salem Service Area				
Salem Urban Area			5,100	80.0
Dallas			250	5.0
Independence		1.5		
Monmouth	2.0		250	4.0

Table IV-1 (Cont.)

Municipal Water Supply Development Needs
1985

	SUPPLY Natural Flow (MGD)	Ground Water (MGD)	Storage (MG)	Purification Plant Capacity (MGD)
MIDDLE SUBAREA (Cont.)				
Santiam				
Mill City	0.5			
Brownsville	0.8		55	1.3
Other		1.0		
Coast Range				
Falls City	0.2			
McMinnville				6.0
Sheridan			60	1.5
Newberg				4.5
Dundee		1.0		
Other	0.5	.45	90	.15
Pudding				
St. Paul		0.8		
Mt. Angel		1.1		
Silverton			32	
Woodburn		2.7		
Canby		1.8		
Molalla				2.5
Sublimity		1.1		
Other		0.85		.15
LOWER SUBAREA	13.45	33.0	13,985	65.5
Portland Service Area				
City of Portland System			11,000	
South Fork Water Comm.				9.0
Clackamas Water District				5.0
Gladstone				1.0
Milwaukie		6.0		
Lake Oswego	11.0		550	11.0
Banks	0.2		60	0.4
Forest Grove			775	7.0
Hillsboro			1,500	25.0
Other		24.9		

Table IV-1 (Cont.)

Municipal Water Supply Development Needs

1985

	SUPPLY			
	Natural Flow (MGD)	Ground Water (MGD)	Storage (MG)	Purification Plant Capacity (MGD)
LOWER SUBAREA (Cont.)				
Clackamas				
Boring		2.1		
Estacada	2.0		100	3.5
Sandy				
Sandy and Corbett	0.25			3.6
TOTAL WILLAMETTE BASIN	36.15	48.4	19,922	216.75

Water treatment practices vary at the present time, but it should be assumed that all surface water will be subject to complete purification at some time in the future. Tables IV-2, IV-3, and IV-4 indicate representative costs of water purification for moderately sized facilities. These estimates, which can be used for planning purposes, were recently developed for a similar area in the Pacific Northwest.

In most instances the precise amount of stored water required for a given user is not easily identifiable, because only a few of the Willamette River tributary streams have been adjudicated, and the status of existing rights is not certain (see Part III). Present water use under power claims in places such as Lebanon, Albany, Salem, and Oregon City clouds the issue even further.

Ground water is used in large quantities, primarily for heating or cooling, but not for the more common municipal and industrial uses. Both the quantity available and the quality of ground water vary throughout the basin, and only a small part of the population now relies on ground water as a source of supply. In the future, ground water will become a major source of supply for only a limited number of people. However, many of the smaller communities can adequately meet their needs for many years to come by continued use of ground water.

Along the Willamette Valley floor, some of the small, contiguous communities should consider inter-municipal systems. Planning funds and construction loans are available from the Farmers Home Administration for such development. However, as long as individual community ground-water supplies can be utilized, the greater expense of an integrated system using surface water with attendant water purification facilities will not be financially attractive.

Table IV-2
Costs of Water Purification

Capital Costs	Per MGD
Filtration	$75,000
Iron removal	30,000
Chlorination equipment	2,000
Annual Operation and Maintenance Costs	
Filtration	6,000
Iron removal	4,500
Gas chlorination	400
Hypochlorination	1,100

Capital, and operation and maintenance costs (both short- and long-range) for purification of surface-water sources are indicated in Tables IV-3 and IV-4.

TABLE IV-3
Costs of Municipal and Industrial Water Supply Purification Facilities 1/
1965-1985

	Capital Costs	Annual Operation and Maintenance Costs
UPPER SUBAREA		
Eugene-Springfield Service Area	$ 2,240,000	$ 189,000
Remainder of Subarea	467,000	39,400
Subarea Total	2,707,000	228,400
MIDDLE SUBAREA		
Albany-Corvallis Service Area	4,230,000	357,000
Salem Service Area	7,070,000	595,000
Remainder of Subarea	134,000	11,300
Subarea Total	11,434,000	963,300
LOWER SUBAREA		
Portland Service Area	4,430,000	374,000
Remainder of Subarea	2,660,000	224,000
Subarea Total	7,090,000	598,000
TOTAL WILLAMETTE BASIN	$21,231,000	$1,789,700

1/ Costs shown are based upon needs shown in Table IV-1.

TABLE IV-4
Costs of Municipal and Industrial Water Supply Purification Facilities 1/
1985-2020

	Capital Costs	Annual Operation and Maintenance Costs
UPPER SUBAREA		
Eugene-Springfield Service Area	$ 8,820,000	$ 743,000
Remainder of Subarea	760,000	64,000
Subarea Total	9,580,000	807,000
MIDDLE SUBAREA		
Albany-Corvallis Service Area	3,950,000	333,000
Salem Service Area	5,520,000	465,000
Remainder of Subarea	4,180,000	352,000
Subarea Total	13,650,000	1,150,000
LOWER SUBAREA		
Portland Service Area	31,200,000	2,620,000
Remainder of Subarea	4,630,000	391,000
Subarea Total	35,830,000	3,011,000
TOTAL WILLAMETTE BASIN	$59,060,000	$4,968,000

1/ Costs shown are based upon data presented in Table III-2.

U P P E R   S U B A R E A

EUGENE-SPRINGFIELD SERVICE AREA

The Eugene-Springfield Service Area will continue to utilize surface water from the McKenzie River and ground water from the McKenzie and Middle Fork Subbasins. No major use of the main stem Willamette River for municipal purposes is foreseen. Other communities in this service area--Coburg and Junction City--will continue to rely upon ground water to satisfy their future demands.

The existing resource and the proposed storage will more than satisfy all projected municipal and industrial demands on the McKenzie River. The need for storage will depend upon adjudication of existing water rights and power claims as well as the future water use policy of the State of Oregon.

With the exception of requirements for thermal power plants, no significant withdrawals of water from the main stem Willamette River for industrial purposes are anticipated in the future. The projections for thermal power can be found in Appendix J--Power.

COAST FORK SUBBASIN

The supply of water within the subbasin appears adequate to satisfy future demands. Cottage Grove relies upon flow from several watershed streams. Ground water will probably continue to be the source for Creswell. Although arsenic has been observed in wells deeper than 100 feet in the Creswell area, shallower wells should be satisfactory.

The existing subbasin water supply is adequate in quantity and quality to fulfill projected needs of industry.

MIDDLE FORK SUBBASIN

The water supply within the subbasin is adequate for all projected municipal and industrial requirements. Ground-water supplies for such communities as Lowell, Oakridge, and Westfir should be adequate for future growth.

McKENZIE SUBBASIN

The supply of water within the subbasin is adequate to satisfy foreseeable demands of communities in the area. Communities such as Coburg, Marcola, Blue River, and Vida should be able to rely on ground water in the future.

LONG TOM SUBBASIN

Seasonal variation of the streamflow above Fern Ridge Reservoir and the water quality in the reservoir and downstream have delayed development of adequate water systems in subbasin communities.

The community area of Veneta-Elmira recently developed a water system using ground water as the source. If this area grows substantially, ground water may be insufficient to provide for future needs. At that time, there will be three alternatives: (1) Install a transmission line to Eugene and purchase water from the Eugene Water and Electric Board. This has been contemplated and is presently considered to be economically infeasible. (2) Purchase storage space in Fern Ridge Reservoir, if possible, or any new upstream reservoir, and treat the water for distribution. (3) Construct single-purpose storage on a watershed stream for low-flow period use, and erect a treatment plant.

No significant future industrial water demand is anticipated in this subbasin. The Long Tom River is not desirable either as a source of water for industrial purposes or as a receiving stream for large amounts of industrial wastes, and therefore should not be considered as a likely location for any significant industrial development.

M I D D L E   S U B A R E A

The communities in this area utilize ground water, tributary streams, and the Willamette River to satisfy their needs. The means of satisfying their future requirements are somewhat dependent upon the results of an adjudication of the Willamette River and its tributaries. In all cases, there is sufficient water available on an annual basis, but the streams presently used as sources do not always have sufficient summer flow to satisfy the needs.

ALBANY-CORVALLIS SERVICE AREA

Communities obtaining water from the South Santiam River--Albany, Lebanon, and Sweet Home--may experience difficulty in supplying future demands from natural flow if all existing water rights and power claims are utilized. Upstream reservoirs existing or under construction will have storage space for water which the cities, water companies, and industries may purchase if existing rights cannot be satisfied from natural flow. Ground-water sources are another alternative available for these cities.

The City of Corvallis, after developing a watershed area on Marys Peak to the limit of its economic feasibility, turned to the Willamette River as an additional source. Additional water supply development on Marys River will be dependent upon upstream storage. However, most of the populated area is in the lower portion of the drainage and is more convenient to the Willamette River as an alternate source.

The pulp and paper mill at Albany has an existing water right for 20 mgd. Based on present state water allocation policy, there will be an adequate supply for projected growth of this industrial activity within the service area.

Photo IV-1. Willamette River water is withdrawn and treated here before use by the people of Corvallis during summer low-flow months. (Cornell, Howland, Hayes and Merryfield, Corvallis, Oregon, Photo)

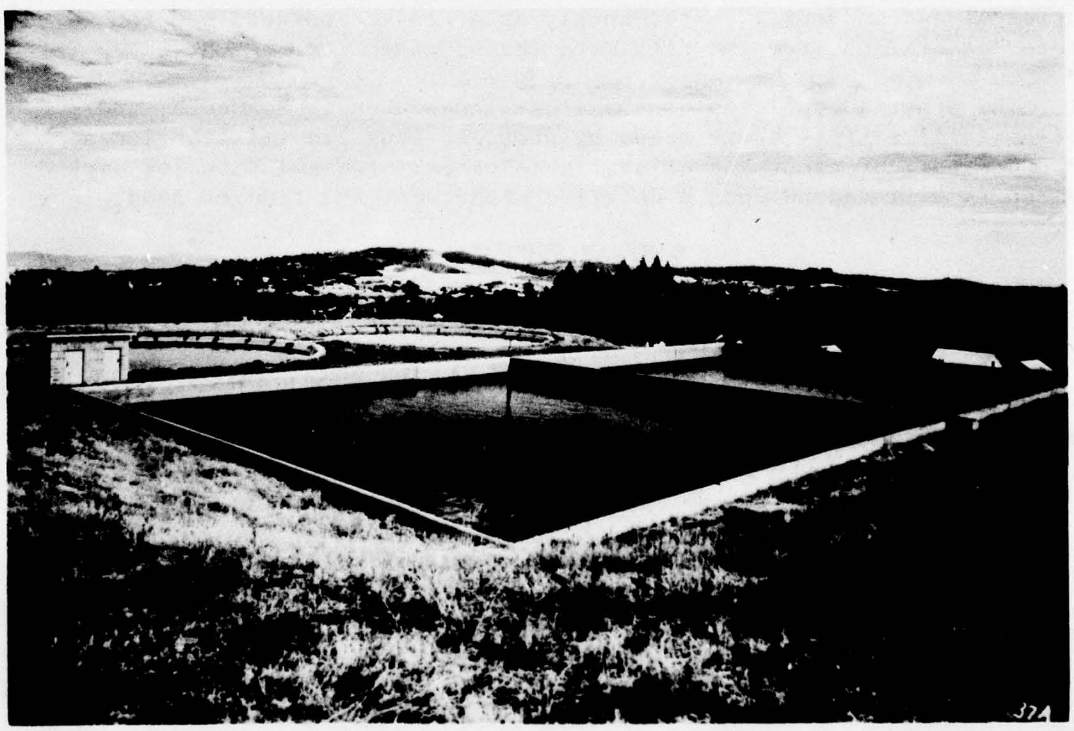
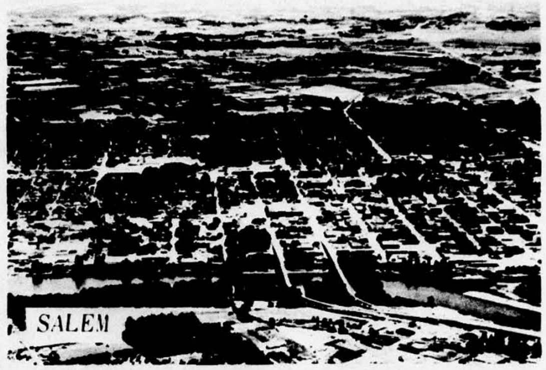


Photo IV-2. The City of Dallas draws surface water from six local streams for storage in this reservoir complex. (Cornell, Howland, Hayes and Merryfield, Corvallis, Oregon, Photo)

SALEM SERVICE AREA



The City of Salem obtains its water from the North Santiam River through a 20-mile transmission line. Complete treatment has been temporarily avoided by using this source, but it will probably be required eventually. Storage from Detroit Reservoir, or any new reservoir upstream from the intake to the Salem transmission line, can be considered as a future source for Salem, assuming the cost allocations to allow municipal and industrial water supply as a project purpose and the proper assurances from the city were forthcoming.

The other communities of the area--Independence, Monmouth, and Dallas--will satisfy their needs by storage, long transmission lines, ground water, or treatment of available water. The solution for each community will depend upon a detailed study near the time of need.

SANTIAM SUBBASIN

Santiam River Drainage

Communities deriving water from the North Santiam River are not expected to encounter any water supply problems in the future. The smaller communities in the subbasin which now rely on ground water or Ranney wells can enlarge their well fields or systems to provide adequate water supply into the future.

Calapooia River Drainage

The City of Brownsville may satisfy its future demands through upstream storage. Other water supplies within this drainage will have to be developed either from ground water or by storage for use during periods of low flow. Two areas--Sodaville and Holley--are expected to have public water systems by 1985.

There are no significant industrial uses of water anticipated in this drainage. The stream is not suitable for assimilation of large amounts of industrial wastes and is not, therefore, a likely location for industrial development.

COAST RANGE SUBBASIN

Marys River Drainage

The only industrial use, existing or foreseen, in this drainage is for small sawmills. Any significant increase in industrial utilization of water within the drainage would require either storage or transbasin diversion.

Luckiamute River Drainage

Only minor development has occurred within this drainage, and no significant increase of municipal and industrial water requirements is projected. It is anticipated that the demands will be satisfied from Luckiamute River and its tributaries, Willamette River, and ground water. Such communities as Monmouth or Falls City could use stored water for future supplies.

The existing and foreseeable industrial use of water in the Luckiamute River drainage is minor. However, any major demands would be best satisfied from stored water.

Yamhill River Drainage

The total water resource of the Yamhill River drainage is adequate to satisfy projected demands, but seasonal deficiencies will make storage or transbasin diversion necessary. The largest community (McMinnville) has used storage facilities (capacity 250 mg) for some time in order to satisfy peak summer demands. This city has also had other sources investigated. After investigating the three major alternatives available (transmission from the Willamette River, Yamhill Basin storage, or transbasin diversion from coastal streams), the city is constructing the latter.

Other smaller communities, such as Carlton, Dayton, Dundee, Lafayette, Newberg, and Yamhill, are faced with the same problem on a smaller scale. It is probable that participation in proposed upstream multipurpose storage projects will provide a satisfactory solution for them.

Industrial use of water within the Yamhill River drainage is presently limited primarily to a few sawmills, a plywood mill at Willamina, and several industries using city water in McMinnville. No significant industrial supply is available without storage or transbasin diversion. However, no appreciable increase in self-supplied industrial water demand is projected for the foreseeable future.

The pulp and paper mill at Newberg has a water right for 13 mgd from the Willamette River, which should be adequate for future growth.

PUDDING SUBBASIN

Seasonal deficiencies of streamflow in this subbasin have accelerated the consideration of upstream storage. Silverton (4,000 served) relies primarily upon surface water. The city is developing single-purpose storage on Silver Creek. The remainder of the communities rely primarily upon ground water.

There is no present or projected major industrial water supply demand within the Pudding Subbasin. The largest single user (Birds Eye Frozen Foods at Woodburn) relies upon ground water for its supply. This source will be satisfactory for the foreseeable future. There is no storage needed now for municipal and industrial water supply within the Molalla River drainage, and it is not anticipated that any will be needed in the future.

LOWER SUBAREA

PORTLAND SERVICE AREA

This service area will continue to be the most densely populated area in the Willamette Basin and will have the greatest demand for water. In the Bull Run watershed, the City of Portland has storage for 23,200 mg, with plans for an additional 11,000 mg by 1985. Alternatives and additional sources include the Columbia, Willamette, and Clackamas Rivers, and ground water. The water resource of the Clackamas River is adequate to satisfy projected demands, but future seasonal deficiencies and use conflicts must be overcome.

Communities in the Tualatin Valley rely partially upon water from other subbasins for municipal water supply at the present time, and it is expected that a greater demand will be made on out-of-basin sources in the future. Alternatives available include storage in the Tualatin Basin or diversion from coastal streams and the Willamette, Clackamas, and Columbia Rivers. A complete evaluation must be made of the existing subbasin resource and demands before a plan may be developed. Such an evaluation, investigating potential sources, is being made by consulting engineers under the auspices of the Columbia Region Association of Governments. Municipal and industrial water storage in Scoggins Reservoir will satisfy short-term needs of five communities--Beaverton, Tigard, Hillsboro, Forest Grove, and the Lake Oswego Corporation.

Industrial utilization of water from the lower Willamette River will continue to be primarily for pulp and paper production. Based on projected expansion and present water policy, the mills should not experience a water shortage. Other industrial uses are individually smaller in quantity but are important to the basic economy.

The presence of relatively large quantities of ground water in the lower Willamette River area has permitted the development of significant amounts of water for industrial purposes without overdrafting the supply. The laws, regulations, and policies are designed to prevent waste of water or impairment of quality to insure beneficial use within the limits of the resources. Water levels and chemical quality are being monitored; and while strict regulation of quantities has not been imposed as yet, it will become necessary to insure optimum use of the supply.

Use of a tremendous amount of ground water for industrial purposes along the lower Willamette River has not been restricted under present water policy. However, it is assumed that restrictions intended to maintain the ground water in sufficient quantity and quality for beneficial uses will be proposed eventually.

Industrial users of water in the area are able to satisfy their needs from public water supplies or ground water, or are close enough to the Columbia River to consider it as an alternative source. Even with the projected industrialization, the area should not be short of water in the foreseeable future. Some industries, such as the cement plant at Lake Oswego, plan to use stored water for future expansion.

TUALATIN SUBBASIN

There is a shortage of water for industrial purposes in the Tualatin Subbasin. No major water-using industry is expected to locate in this subbasin in the future.

The existing natural flow, surface-water sources within the subbasin during low-flow periods are presently overappropriated, and further surface-water utilization is possible only with storage. Transbasin diversion might provide alternative supplies.

A local committee stated at an Oregon State Water Resources Board public hearing that an additional 900 acre-feet will be required annually for food processing by 1975. An additional 1,000 acre-feet will likely be utilized, if available, by 1985. The present pattern of industrial water use within the subbasin indicates that the need will be satisfied by municipal systems. The ground-water resource in the subbasin is not sufficient to furnish any significant increase in water supply. Lowered water levels in deep wells in the Tigard-Bull Mountain area may lead to its early designation as a critical ground-water area and restrictions on pumping.

CLACKAMAS SUBBASIN

At the present time, little use is made of water in the Clackamas Subbasin for industrial purposes. No significant industrial use is projected for the future. However, the Clackamas River has large untapped potential supplies for future development to help serve the metropolitan areas' projected needs.

COLUMBIA AND SANDY SUBBASINS

The water resources of these subbasins are adequate to satisfy projected municipal and industrial requirements.

CONCLUSIONS

Relatively high-quality water has historically been available in adequate quantities to meet all municipal and industrial needs. A broad look into the future shows continued excess of total supplies over total demands. However, focusing projections down to specific areas and imposing changing social and technological conditions reveal that certain present-day policies and attitudes must be reevaluated if available resources are to be used efficiently to serve the people in the basin.

The most significant item involves the development of water supplies from mountain tributaries, conveying the water long distances to the service areas, and applying simple disinfection prior to distribution and use. Some foreseeable changes that affect this policy include:

1. Greater use and pressure for use of these remote watersheds for recreation, introducing wastes and potential disease problems to the waters originating there.

2. The changing philosophy concerning the adequacy of simple disinfection to protect any water supply regardless of source. There is an increasing tendency to require complete purification to provide adequate protection, under future changing environmental conditions.

3. Changing technology in water purification plants, potentially lowering costs while raising effectiveness.

4. Increasing costs and limited supplies of high-quality tributary sources. The shift of supply sources from the tributaries to the main stem Willamette River, as its quality continues to improve, with adequate purification of supplies will result in less costly and more reliable supplies for the basin residents. Adjustment in basin plans to allow for changing diversion points will also be required. There is probably no more pressing need presently in the Willamette Basin and the State of Oregon than to complete the adjudication of water rights and the rigorous implementation of existing water right law and regulations.

Another consideration is the planning for combining and centralizing municipal supply systems, assuming the Willamette becomes a common source. Unit water purification costs would be lower and service would be more professional.

Many of the projections presented have been couched in extensions of present policies and approaches. Thus, many of the expected developments would be modified if the suggested revisions are carried out. Since planning is a continually evolving process, these adjustments can be made in the future if adequate resources are developed or set aside at present.

The municipal and industrial water supply plan for the Willamette Basin, as well as an analysis of the impact of the comprehensive plan, is presented in Appendix M--Plan Formulation.

Table III-2
Future Municipal, Industrial, and Rural-Domestic Average Water Use (MGD)

	Sept 1970	AvAn 1970	AvAn 1980	AvAn 1990	AvAn 2000	Sept 1980	AvAn 2020	Sept 1990
UPPER SUBAREA	86.5	75.3	114.5	141.7	169.8	131.7	244.1	163.5
Municipal	38.0	30.3	48.8	63.0	78.4	60.7	127.1	78.5
Industrial	43.5	40.8	60.4	73.0	85.4	64.6	111.4	78.2
Rural-Domestic	5.0	4.2	5.3	5.7	6.0	6.4	5.6	6.8
Eugene-Springfield Service Area	65.4	[illegible]	91.0	116.5	142.9	105.5	207.5	135.3
Municipal	33.4	26.5	42.3	54.2	67.0	52.9	105.3	68.1
Eugene-Springfield Urban Area	28.2	23.5	38.0	47.7	59.0	45.6	90.5	57.2
Coburg	0.5	0.4	0.6	1.1	1.4	0.7	3.1	1.3
Junction City	1.0	0.8	1.3	2.2	2.7	1.6	5.6	2.6
Elmira-Veneta	0.6	0.5	0.8	1.4	1.7	1.0	3.2	1.7
Lumber and Wood Products	0.6	0.6	0.7 1/	0.5	0.6 1/	0.8	0.6 1/	0.6
Food Products	2.5	0.7	0.9 1/	1.3	1.6 1/	3.2	2.3 1/	4.7
Industrial	30.8	28.7	47.3	60.8	74.3	50.9	100.7	65.4
Pulp and Paper	17.3	15.7	31.4	41.2	51.1	34.5	64.9	45.3
Lumber and Wood Products	9.6	9.1	9.8	9.2	8.4	10.3	8.0	9.7
Chemicals	3.9	3.9	6.1	10.4	14.8	6.1	27.8	10.4
Rural-Domestic	1.2	1.0	1.4	1.5	1.6	1.7	1.5	1.8
Long Tom	2.4	2.0	2.9	3.6	4.4	3.5	7.3	4.3
Municipal	1.1	0.9	1.6	2.2	3.0	1.9	6.0	2.6
Monroe	0.4	0.2	0.5	0.7	0.9	0.6	1.9	0.8
Harrisburg	0.7	0.6	1.1	1.5	2.1	1.3	4.1	1.8
Rural-Domestic	1.3	1.1	1.3	1.4	1.4	1.6	1.3	1.7
Coast Fork	15.3	14.2	16.4	16.4	16.3	17.7	19.1	17.8
Municipal	1.7	1.4	2.4	3.2	4.1	2.9	7.4	3.8
Cottage Grove	1.3	1.1	1.9	2.6	3.3	2.3	6.0	3.1
Creswell	0.4	0.3	0.5	0.6	0.8	0.6	1.4	0.7
Industrial	12.5	11.9	12.9	12.0	10.9	13.5	10.5	12.6
Lumber and Wood Products	12.5	11.9	12.9	12.0	10.9	13.5	10.5	12.6
Rural-Domestic	1.1	0.9	1.1	1.2	1.3	1.3	1.2	1.4

September

Table III-2 (Cont.)

Future Municipal, Industrial, and Rural-Domestic
Average Water Use (MGD)

	1970	1970	1980	1990	2000	1980	2020	1990
UPPER SUBAREA (Cont.)								
McKenzie	1.2	1.0	1.4	1.7	2.0	1.7	3.1	2.0
Municipal	0.6	0.5	0.8	1.1	1.3	1.0	2.6	1.3
Blue River	0.4	0.3	0.5	0.7	0.9	0.6	1.9	0.8
Marcola	0.2	0.2	0.3	0.4	0.4	0.4	0.7	0.5
Rural-Domestic	0.6	0.5	0.6	0.6	0.7	0.7	0.5	0.7
Middle Fork	2.2	1.9	2.8	3.5	4.2	3.3	7.1	4.1
Municipal	1.2	1.0	1.7	2.3	3.0	2.0	5.8	2.7
Lowell	0.4	0.3	0.5	0.7	0.9	0.6	1.9	0.8
Oakridge	0.8	0.7	1.2	1.6	2.1	1.4	3.9	1.9
Industrial	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Lumber and Wood Products	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Rural-Domestic	0.8	0.7	0.9	1.0	1.0	1.1	1.1	1.2
MIDDLE SUBAREA	163.9	121.9	166.3	201.9	240.1	231.5	333.9	284.0
Municipal	82.6	52.4	86.2	105.4	126.8	134.5	184.6	163.6
Industrial	70.7	60.6	71.1	84.3	103.8	86.3	139.6	109.4
Rural-Domestic	10.6	8.9	9.0	9.2	9.5	10.7	9.7	11.0
Albany-Corvallis Service Area	44.0	39.2	59.1	71.8	85.2	66.4	111.1	80.9
Municipal	17.6	14.0	22.4	22.2	34.6	28.0	52.9	35.0
Albany Urban Area	4.6	3.8	6.3	[illegible]	10.5	7.6	16.9	10.1
Corvallis Urban Area	7.2	[illegible]	10.0	13.2	16.5	12.0	26.6	15.8
Philomath	0.6	0.5	0.8	1.0	1.3	1.0	2.0	1.2
Lebanon	1.3	1.1	1.8	2.0	2.3	2.2	2.7	2.4
Sweet Home	1.0	0.8	1.4	[illegible]	1.7	1.7	2.1	1.8
Other Municipal	-	-	-	-	0.2	-	0.2	-
Lumber and Wood Products	1.2	1.3	1.5 1/	1.4	1.3 1/	1.4	1.2 1/	1.3
Food Products	1.5	0.4	0.5 1/	0.6	0.7 1/	1.9	1.0 1/	2.2
Primary Metals	0.2	0.1	0.1 1/	0.1	0.1 1/	0.2	0.2 1/	0.2
Industrial	26.4	[illegible]	36.7	[illegible]	50.6	38.4	58.2	45.9
Pulp and Paper	[illegible]	[illegible]	31.2	[illegible]	44.1	31.2	50.4	37.6
Lumber and Wood Products	2.4	[illegible]	3.0	[illegible]	2.6	2.7	2.5	2.5
Primary Metals	3.4	1.9	2.5	3.2	3.9	4.5	5.3	5.8
Rural-Domestic	-	-	-		-	-	-	-

Table III-2 (Cont.)

Future Municipal, Industrial, and Rural-Domestic Average Water Use (MGD)

	1970	1970	1980		1990	2000		1980	2020		1990
MIDDLE SUBAREA (Cont.)											
Salem Service Area	49.5	37.2	49.6		64.5	80.0		71.1	122.2		94.2
		162.5	227.1		237.3			247.6			
Municipal	28.4	20.4	36.5		45.5	55.1		50.9	81.2		63.0
Salem Urban Area	18.7	15.6	28.1		35.8	43.7		33.7	65.3		43.0
Dallas	1.2	1.0	1.7		1.9	1.9		2.0	2.2		2.2
Independence	0.6	0.5	0.9		1.2	1.5		1.1	2.4		1.4
Monmouth	1.0	0.8	1.4		1.7	2.2		1.7	3.4		2.0
Turner	0.4	0.3	0.5		0.6	0.8		0.6	1.3		0.7
Lumber and Wood Products	0.5	0.6	1.0	1/	1.0	0.9	1/	0.9	0.8	1/	0.9
Food Products	6.0	1.6	2.9	1/	3.4	4.1	1/	10.9	5.8	1/	12.8
Industrial	21.1	16.9	13.1		19.0	24.9		20.2	41.0		31.2
Pulp and Paper	12.8	12.8	6.2		6.2	6.2		6.2	6.2		6.2
Food Products	2.2	0.3	0.8		1.0	1.2		3.0	1.7		3.8
Chemicals	6.1	3.4	6.1		11.8	17.5		11.0	33.1		21.2
Santiam	29.5	14.2	18.3		20.7	23.4		42.0	34.2		49.2
Municipal	22.3	7.1	11.2		13.2	15.4		34.8	21.3		41.6
Mill City	0.4	0.3	0.5		0.5	0.6		0.6	0.6		0.6
Stayton	0.5	0.4	0.7		0.8	0.9		0.8	1.0		1.0
Brownsville	0.4	0.3	0.5		0.6	0.7		0.6	1.1		0.7
Other Municipal	0.8	0.7	1.1		1.2	1.3		1.3	1.7		1.4
Food Products	20.2	5.4	8.4	1/	10.1	11.9	1/	31.5	16.9	1/	37.9
Industrial	4.0	4.4	4.5		5.0	5.6		4.1	9.8		4.6
Lumber and Wood Products	3.6	4.0	3.8		3.6	3.3		3.4	3.2		3.2
Manufacturing	0.4	0.4	0.7		1.4	2.3		0.7	6.6		1.4
Rural-Domestic	3.2	2.7	2.6		2.5	2.4		3.1	3.1		3.0
Coast Range and Pudding	2.8	2.3	2.5		2.9	3.3		3.0	3.1		3.5
Rural-Domestic	2.8	2.3	2.5		2.9	3.3		3.0	3.1		3.5
Coast Range	22.0	18.9	22.9		26.6	30.8		26.7	41.2		31.0
Municipal	8.5	6.1	8.2		9.5	11.1		11.3	15.0		13.2
Falls City	0.4	0.3	0.4		0.4	0.5		0.5	0.7		0.5
McMinnville	1.6	1.3	2.1		2.3	2.4		2.5	2.9		2.8
Sheridan	0.4	0.3	0.5		0.5	0.6		0.6	0.6		0.6
Newberg	1.9	1.6	2.6		3.5	4.5		3.1	6.8		4.2
Dundee	0.4	0.3	0.5		0.6	0.7		0.6	1.1		0.7
Other Municipal	2.3	1.9	1.5		1.5	1.6		1.8	1.8		1.8
Food Products	1.5	0.4	0.6	1/	0.7	0.8	1/	2.2	1.1	1/	2.6

September

Table III-2 (Cont.)

Future Municipal, Industrial, and Rural-Domestic Average Water Use (MGD)

	1970	1970	1980	1990	2000	1980	2020	1990
MIDDLE SUBAREA (Cont.)								
Coast Range (Cont.)								
Industrial	11.5	11.1	13.0	15.5	18.1	13.4	24.7	15.9
Pulp and Paper	8.7	5.7	10.4	12.2	14.0	10.4	16.2	12.2
Lumber and Wood Products	1.6	1.8	1.7	1.6	1.5	1.5	1.5	1.4
Food Products	0.8	0.2	0.2	0.2	0.3	0.8	0.4	0.8
Manufacturing	0.4	0.4	0.7	1.5	2.3	0.7	6.6	1.5
Rural-Domestic	2.0	1.7	1.7	1.6	1.6	2.0	1.5	1.9
Pudding	16.1	10.1	13.9	15.4	17.4	22.3	22.1	25.2
Municipal	5.8	4.8	7.9	9.0	10.6	9.5	14.2	10.8
St. Paul	0.4	0.3	0.5	0.6	0.7	0.6	1.1	0.7
Mt. Angel	0.5	0.4	0.7	0.7	0.8	0.8	1.0	0.8
Silverton	1.2	1.0	1.6	1.9	2.1	1.9	2.6	2.2
Woodburn	1.3	1.1	1.8	2.0	2.3	2.2	3.0	2.4
Canby	0.8	0.7	1.1	1.4	1.7	1.3	2.5	1.7
Molalla	0.6	0.5	0.8	1.0	1.3	1.0	1.8	1.2
Sublimity	0.4	0.3	0.5	0.6	0.7	0.6	1.1	0.7
Other Municipal	0.6	0.5	0.9	0.9	1.0	1.1	1.1	1.1
Industrial	7.7	3.1	3.8	4.2	4.6	10.2	5.9	11.8
Lumber and Wood Products	1.3	1.4	1.5	1.4	1.3	1.6	1.3	1.3
Food Products	6.4	1.7	2.3	2.8	3.3	8.6	4.6	10.5
Rural-Domestic	2.6	2.2	2.2	2.2	2.2	2.6	2.0	2.6
LOWER SUBAREA	271.6	231.5	334.0	421.5	514.9	401.0	862.8	495.5
Municipal	178.6	144.4	226.1	288.9	357.6	285.4	608.4	353.5
Industrial	84.4	79.9	99.1	121.1	143.1	105.0	232.8	128.2
Rural-Domestic	8.6	7.2	8.8	11.5	14.2	10.6	21.6	13.8
Portland Service Area	208.1	170.3	260.5	334.5	414.1	324.3	715.3	404.2
Municipal	173.6	140.3	218.7	277.1	345.1	276.6	586.7	341.7
Food Products	11.8	4.7	6.3 1/	7.4	8.8	1/ 23.6	13.1	1/ 18.5
Chemicals	2.9	2.9	4.5 1/	7.5	10.8	1/ 4.5	21.3	1/ 7.5
Manufacturing	2.2	2.2	4.1 1/	6.3	8.8	1/ 4.1	23.1	1/ 6.3

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September

Table III-2 (Cont.)

Future Municipal, Industrial, and Rural-Domestic
Average Water Use (MGD)

	1970	1970	1980	1990	2000	1980	2020	1990
LOWER SUBAREA (Cont.)								
Portland Service Area (Cont.)								
Municipal (Cont.)								
Portions of Multnomah County								
Incorporated	77.4	64.5	100.7	119.9	141.1	120.8	225.8	143.9
Unincorporated	28.8	24.0	37.5	46.2	55.8	45.0	88.8	55.4
Portions of Clackamas County								
West of Willamette River								
Lake Oswego	2.8	2.3	3.7	5.1	6.5	4.4	11.3	6.1
West Linn	1.2	1.0	1.6	2.2	2.9	1.9	4.9	2.6
Unincorporated	1.7	1.4	2.2	3.2	4.2	2.6	7.8	3.8
East of Willamette River								
Milwaukie	2.9	2.4	3.8	5.3	6.8	4.6	11.8	6.4
Oregon City	2.3	1.9	3.0	4.0	5.1	3.6	8.6	4.8
Gladstone	0.8	0.7	1.1	1.4	1.8	1.3	3.0	1.7
Unincorporated	10.9	9.1	14.2	20.1	26.5	17.0	49.7	24.1
Portions of Washington County								
Beaverton	1.9	1.6	2.5	3.4	4.4	3.0	7.5	4.1
Tigard	1.0	0.8	1.2	1.8	2.5	1.4	5.2	2.2
Cornelius	0.7	0.6	0.9	1.2	1.5	1.1	2.5	1.4
Forest Grove	2.5	2.1	3.3	4.6	5.9	4.0	10.0	5.5
Hillsboro	4.8	4.0	6.2	8.5	11.0	7.4	18.6	10.2
Sherwood	0.4	0.3	0.4	0.6	0.8	0.5	1.4	0.7
Other Municipal	16.6	13.8	21.5	30.4	39.9	25.8	72.3	36.5
Industrial	34.5	20.0	41.8	55.4	69.0	47.7	128.6	62.5
Pulp and Paper	10.5	12.5	13.4	16.1	18.9	13.4	21.9	16.1
Lumber and Wood Products	0.9	0.9	0.8	0.8	0.7	0.8	0.7	0.8
Food Products	7.5	3.0	3.9	4.7	5.5	9.8	8.1	11.8
Primary Metals	7.9	7.9	9.5	11.5	13.5	9.5	16.9	11.5
Manufacturing	7.7	7.7	14.2	22.3	30.4	14.2	81.0	22.3
Tualatin	6.8	5.7	7.4	10.0	12.7	8.9	19.9	12.0
Rural-Domestic	6.8	5.7	7.4	10.0	12.7	8.9	19.9	12.0
Clackamas	3.0	2.5	3.4	4.4	5.4	4.0	8.8	5.2
Municipal	1.6	1.3	2.3	3.2	4.2	2.7	7.5	3.8
Boring	0.5	0.4	0.7	1.0	1.4	0.8	2.9	1.2
Estacada	0.7	0.6	1.1	1.6	2.1	1.3	3.5	1.9
Other Municipal	0.4	0.3	0.5	0.6	0.7	0.6	1.1	0.7
Rural-Domestic	1.4	1.2	1.1	1.2	1.2	1.3	1.3	1.4

Table III-2 (Cont.)

Future Municipal, Industrial, and Rural-Domestic
Average Water Use (MGD)

	1970	1970	1980	1990	2000	1980	2020	1990
LOWER SUBAREA (Cont.)								
Columbia	52.3	51.9	61.2	70.7	80.4	62.0	115.3	71.8
Municipal	2.4	2.0	3.9	5.0	6.3	4.7	11.1	6.1
Remainder of Multnomah County	0.4	0.3	0.6	0.8	1.1	0.7	1.9	1.0
St. Helens	1.8	1.5	3.0	3.8	4.7	3.6	8.3	4.6
Scappoose	0.2	0.2	0.3	04	0.5	0.4	0.9	0.5
Industrial	49.9	49.9	57.3	65.7	74.1	57.3	104.2	65.7
Pulp and Paper	45.2	45.2	48.7	52.2	55.7	48.7	55.7	52.2
Lumber and Wood Products	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Manufacturing	4.6	4.6	8.5	13.4	18.3	8.5	48.4	13.4
Sandy	1.4	1.1	1.5	1.9	2.3	1.8	3.5	2.3
Municipal	1.0	0.8	1.2	1.6	2.0	1.4	3.1	1.9
Sandy and Corbett communities	1.0	0.8	1.2	1.6	2.0	1.4	3.1	1.9
Rural-Domestic	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4
TOTAL WILLAMETTE BASIN	522.0	428.7	614.8	765.1	924.8	764.2	1,440.8	943.0
Municipal	299.2	227.1	361.1	457.3	562.8	480.6	920.1	595.6
Industrial	198.6	181.3	230.6	[illegible]	332.3	255.9	483.8	315.8
Rural-Domestic	24.2	20.3	23.1	26.4	29.7	27.7	36.9	31.6

1/ Amount of municipal water used by industry.

Average daily needs for municipal, industrial, and rural-domestic future water requirements are shown in Table III-2. The projections are intended for use in comprehensive water resource planning rather than for fulfillment of the requirements of consulting engineers and others who may be interested in specific municipalities or industries. As an aid to resource planning, Table III-2 does include estimates of future water use for communities with a population of 2,500 or more. The water use projections are also summarized graphically in Figure III-5.

Water demand can fluctuate widely, depending on the type of use, season of the year, weather, time of day, and industrial peak-use periods. Monthly patterns of present water demands are shown in Table II-3. Municipal use in the basin follows a definite pattern, and monthly variations in water demand of communities are independent of geographic location or size of the municipality. Accordingly, the projected monthly distribution of municipal water demand, shown in Table III-3, can be used for planning purposes.

Industrial water use does not follow the same consistent pattern. Water use by the pulp and paper, and lumber and wood products industries is projected to be rather uniform throughout the year (Table III-3). On the other hand, water use by the food products and primary metals industries will vary widely on a monthly basis--in the case of food processing, up to 375 percent of the average monthly mgd. Representative values for industry, based primarily on present use, are also shown in Table III-3 to assist in determining future needs.

Table III-3
Future Municipal and Industrial Water Use
Monthly Demand as Percent of Annual Average MGD
1980-2020

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<u>Upper Subarea</u>												
<u>(Subbasins 1,2,3 & 4)</u>												
Municipal	73	72	68	75	75	120	185	175	120	88	77	76
Pulp and Paper	80	90	100	110	110	110	110	110	110	105	105	80
Lumber & Wood Prod.	105	115	100	120	100	100	100	105	105	90	85	75
Food Products	5	5	5	5	10	10	60	185	360	275	160	120
<u>Middle Subarea</u>												
<u>(Subbasins 5,6 & 7)</u>												
Municipal	73	72	68	75	75	120	185	175	120	88	77	76
Pulp and Paper	90	105	95	100	105	105	95	100	100	90	110	105
Lumber & Wood Prod.	70	85	95	95	95	105	100	145	90	95	110	115
Food Products	150	60	40	25	35	65	55	185	375	110	65	35
Primary Metals	60	30	15	40	30	40	45	80	180	265	200	215
<u>Lower Subarea</u>												
<u>(Subbasins 8,9,10 & 11)</u>												
Municipal	73	72	68	75	75	120	185	175	120	88	77	76
Pulp and Paper	100	100	100	100	100	100	100	100	100	100	100	100
Lumber & Wood Prod.	100	100	100	100	100	100	100	100	100	100	100	100
Food Products	30	5	0	0	0	15	100	50	250	300	300	150
Primary Metals	100	100	100	100	100	100	100	100	100	100	100	100