WORKING PAPER NO. 31

COLUMBIA RIVER BASIN PROJECT
For Water Supply and Water Quality Management

PRELIMINARY INVESTIGATION OF MUNICIPAL AND INDUSTRIAL WATER SUPPLY AND STREAM QUALITY CONTROL REQUIREMENTS AND BENEFITS ASSOCIATED WITH MULTIPLE-PURPOSE STUDIES OF THE PROPOSED LOWER GRANDE RONDE AND CATHERINE CREEK RESERVOIR PROJECTS, OREGON

DATE: June 1962

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Water Supply and Pollution Control Program, Pacific Northwest
Region IX, Portland, Oregon

This working paper contains preliminary data and information primarily intended for internal use by the Columbia River Basin Project staff and cooperating agencies. The material presented in this paper has not been fully evaluated and should not be considered as final.

REPORT ON THE GRANDE RONDE RIVER BASIN STUDIES

Preliminary Investigation of Municipal and Industrial
Water Supply and Stream Quality Control Requirements
and Benefits Associated with Multiple-Purpose Studies
of the Proposed Lower Grande Ronde
and Catherine Creek Reservoir Projects, Oregon

Prepared at the Request of and
in Cooperation with the
U.S. Army Engineer District,
Walla Walla Corps of Engineers
Walla Walla, Washington

U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
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INTRODUCTION

This report represents a preliminary examination of present and future municipal and industrial water supply and stream quality control needs in the Grande Ronde River Basin, Oregon with particular reference to the feasibility of providing storage and/or flow regulation to serve these needs in the Corps of Engineers' proposed Lower Grande Ronde and Catherine Creek Reservoir Projects.

Request for the investigation and report was made by the U. S. Army Engineer District, Walla Walla Corps of Engineers, Washington by letter dated January 24, 1962 asking for assistance in carrying out provisions set forth in the Water Supply Act of 1958 (Title III, P. L. 500, 85th Congress) for implementation of water supply programs and for an evaluation of needs, release schedules and benefits applicable to flow regulation for control of stream quality as provided in the Federal Water Pollution Control Act Amendments of 1961.

The report identifies uses and sources of water in areas within and adjacent to the proposed project area and describes sources and effects of waste and land drainage materials on the quality of various reaches of Grande Ronde River Basin streams.

Included also is a preliminary economic evaluation of the project area, the findings of which form the basis for the projected municipal and industrial water demands and waste and land use effects on stream quality presented.

Since this investigation has been made in advance of study schedules planned for establishment of a Comprehensive Water Supply and Water Quality Control Program for the Columbia River Basin and Pacific Northwest coastal regions, certain materials presented must necessarily await later confirmation.

It is believed, however, that the needs for municipal and industrial water supply as described, the low flow releases for quality control indicated, and allied benefits as given, possess a degree of finality suitable for project planning and use in determining project feasibilities and justifications.

SUMMARY

1. The primary source of municipal and industrial water supply at La Grande is a reservoir and intake system on Beaver Creek and its tributaries supplemented by artesian wells.

2. Limitations of the La Grande system are both storage and transmission.

3. Problems of taste, odor, color, iron and turbidity exist in the La Grande supply. High temperatures of the ground water supply make this source unpalatable without precooling.

4. The community of Union obtains water for municipal and industrial purpose from Catherine Creek but has not completed application for firm rights to this supply.

5. Turbidity of Catherine Creek water is the most objectionable quality factor affecting the Union supply and transmission line capacity is limited.

6. According to projected area growth expectations, the annual demand for M&I water supply at La Grande will be approximately 3500 acre-feet by the year 1985, 5000 acre-feet by the year 2010 and 9000 acre-feet by the year 2060.

7. According to area growth expectations at Union, the annual demand for M&I water supply is expected to be 900 acre-feet by the year 1985,

1300 acre-feet by 2010 and 1900 acre-feet by the year 2060.

8. Additional water source development and system revisions are needed at La Grande and Union to meet summertime demands.

9. Municipal and industrial wastes originating both at Union and La Grande enter the Grande Ronde system in the middle and lower reaches of Catherine Creek.

10. Irrigated land from which irrigation return flows originate exist along both the east and west side of Catherine Creek and the proposed lands to be irrigated are located mainly north and westerly along the Grande Ronde River between La Grande and Elgin.

11. Catherine Creek passes through many barnyards and places to which the public has free access. Some sanitary hazards have been eliminated in recent years, but others remain and more are likely to develop.

12. Sizeable runs of Steelhead trout, runs of Coho salmon, and remnant runs of fall Chinook salmon utilize the Grande Ronde drainage. The system supports increasing sports fisheries and is important to the maintenance of Snake and Columbia River runs.

13. Resident game fish in Grande Ronde River systems include Rainbow and Dolly Varden trout and about eight additional species of game fish.

14. Stream flow requirements for control of Catherine Creek and Grande Ronde River quality are based on the effect of organic loadings

originating from treated municipal and industrial wastes and land drainage sources relating to dissolved oxygen objectives required to protect existing stream uses.

15. The natural flows of Catherine Creek and the Grande Ronde River are not sufficient to at all times assure suitable water quality for nuisance control, sanitation and protection of fish and other aquatic life.

16. Flow regulation for quality control would apply only to the Catherine Creek project.

17. Minimum flow requirements for quality control from the Catherine Creek site to the community of Elgin on the Grande Ronde River are as follows:

Year	May-Oct cfs	Nov-April cfs
1960	33.5	25.0
1985	37.0	27.7
2010	41.0	30.7
2060	44.5	33.5

CONCLUSIONS

1. Inclusion of water supply storage in the proposed Lower Grande Ronde reservoir would provide an assured supply to meet year-round and/or seasonal fluctuations in demand at La Grande, thus eliminating the uncertainties of natural flow at the present intakes and intermittent operation of the Beaver Creek impoundment and well supplies. Raw water quality would remain relatively consistent throughout the various seasons of the year and line pressures could at all times be maintained.

2. Provisions for water supply storage in the proposed Catherine Creek reservoir would result in an assured and legal supply to meet future demands at Union and advantage could be taken of gravity flow from the reservoir. Turbidities of raw water upon detention in the reservoir would be significantly reduced.

3. The benefit associated with provisions for 2,000 acre-feet of storage in the Lower Grande Ronde Reservoir for supplemental water supply at La Grande as based on single-purpose development costs and local financing rates estimated by the Corps of Engineers is $24,000 annually.

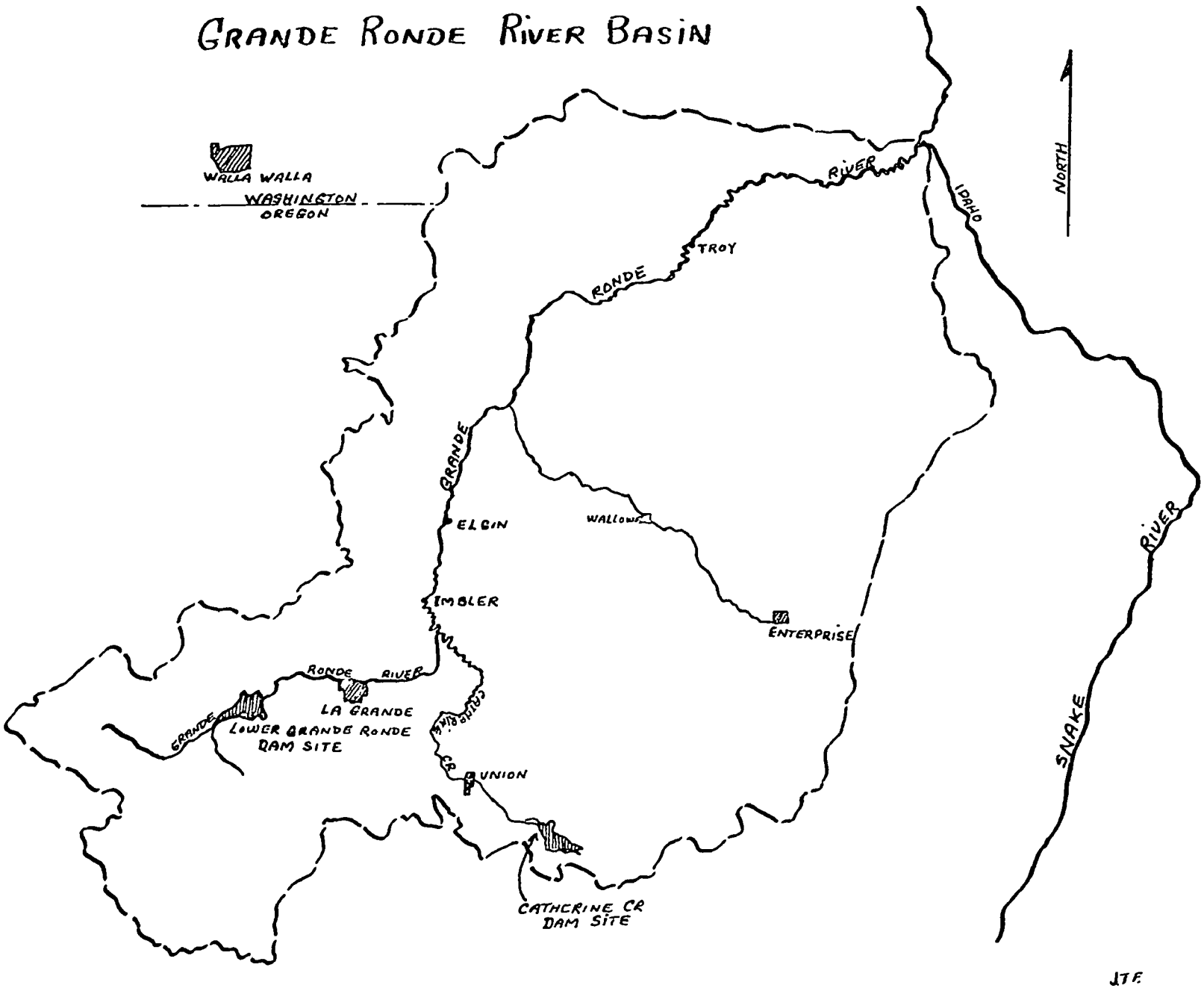
4. According to alternate cost estimates associated with single-purpose development of supplemental waters for M&I purposes at Union as determined

by the Corps of Engineers, the benefit assignable to provisions for 1,000 acre-feet of storage in the Catherine Creek project is $12,000 annually.

5. Water treatment consisting of sedimentation, filtration and chlorination of project waters would be required. Treatment, transmission and any such associated costs would be the responsibility of the participating interests.

6. According to cost estimates prepared by the Corps of Engineers, the single-purpose cost and therefore, the benefit assignable to 8,000 acre-feet of storage in the Catherine Creek project for quality control is $85,000 annually.

7. In view of the multiplicity of beneficiaries and extent of local participation included in the achievement of water quality goals in this region, benefits attributable to provisions for water quality control as a project function are believed to be of public interest and, therefore, may be regarded as widespread and national in scope.


GRANDE RONDE RIVER BASIN
WALLA WALLA
WASHINGTON
OREGON
NORTH
IDAHO
RIVER
TROY
RONDE
GRANDE
ELGIN
WALLOWA
IMBLER
ENTERPRISE
SNAKE
RIVER
RONDE
RIVER
LA GRANDE
GRANDE
LOWER GRANDE RONDE
DAM SITE
CATHERINE CR
UNION
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DESCRIPTION OF REGION

LOCATION AND SIZE

The Grande Ronde River subbasin drains the extreme northeastern part of the state of Oregon, and is tributary to the Snake River. The watershed occupies most of Union and Wallowa Counties in Oregon, and small parts of Columbia, Garfield, and Asotin Counties in Washington. Total drainage area above the confluence with the Snake River at river-mile 168.7 is 4,070 square miles. [1] The basin is irregularly rectangular in shape, with an appended small rectangle in the headwaters at the southwest corner above La Grande.

Rising in the Elkhorn Mountains, the Grande Ronde River flows northeasterly along the east side of the Blue Mountains. Its tributaries drain the Blue Mountains and the north and west sides of the Wallowa Mountains. From the Anthony Lakes divide the Grande Ronde flows northwesterly some twenty miles to its confluence with Fly Creek, thence north about five miles to its confluence with Starkey Creek, thence northeast ten miles to its confluence with Rock Creek, thence east about eight miles to La Grande at the edge of the Grande Ronde Valley. Continuing generally eastward, the river meanders across the valley, loops around Nibley, where Catherine Creek joins it from the south, and meanders northwest to Imbler ten miles away. From Imbler, the Grande Ronde River flows north-northeast through Elgin about

1/ U. S. Corps of Engineers "308" Report, 1948.

twenty-five miles to its junction with its principal tributary, the Wallowa River, at Rondowa. This is the northern end of the valley; below Rondowa the Grande Ronde River winds its way northeast some sixty miles through a steep-walled canyon between the Blue Mountains and the Chesnimnus Hills to its confluence with the Snake River.

PHYSIOGRAPHY

The southwest corner of the Grande Ronde subbasin lies at elevations of 7,000 to 7,500 feet in the north end of the Elkhorn Mountains. Easterly, the basin rim drops almost to 3,000 feet crossing the gap south of Union, rises to 8,000 feet at the head of Catherine Creek, rises higher yet to 9,700 feet at the head of the Wallowa River, then turns north along the Imnaha divide at elevations of 5,000 feet and drops off in the last five miles to 850 feet at the mouth of the river. Thence the basin rim runs westerly through the northern Blue Mountains in Washington, climbing to elevations of 6,400 feet. At Willow Spring the rim turns south and runs southwesterly along the crest of the Blue Mountains at elevations of 5,000 to 6,000 feet, turns southeast at the end of the Birch Creek divide and rises gradually to elevations of 7,000 to 7,500 feet at the Anthony Lakes divide at the southwest corner. The agricultural valley areas lie at elevations from 2,500 to 4,000 feet.

Topography of the basin is extremely rough except in the Grande Ronde Valley and the Wallowa Valley. Along the rim on the west side the crest of the Blue Mountains is rolling, but the slopes drop sharply

into deep canyons. The Chesnimnus Hills in the northeastern part of the basin are similar. The Elkhorn and Wallowa Mountain blocks, however, are characterized by fairly sharp-crested ridges and long steep slopes to the valleys below.

Major tributaries of the Grande Ronde River are Starkey Creek from the westernmost end of the basin in the Blue Mountains, Catherine Creek from the west side of the Wallowa Mountains, the Wallowa River from the north side of the Wallowa Mountains, the Wenaha River from the east side of the Blue Mountains near their northern end, and Joseph Creek from the Imnaha divide and eastern Chesnimnus Hills on the east side of the basin. Of these, the Wallowa River is the largest, draining a high elevation area with considerable precipitation, nearly a fifth of the whole basin. Since the Grande Ronde River for the most part flows along the eastern edge of the southwest-northeast trending Blue Mountain block, most of the tributaries flow north to join it. The Wenaha River, flowing south and east, is the only major exception.

Canyons of the Wallowa River and its principal tributaries, Minam River, Bear Creek, Lostine River, and Hurricane Creek are deep and U-shaped, carved by glacial action. Numerous small lakes occur at high elevations in the Elkhorn and Wallowa Mountains, but the single large lake, Wallowa Lake, was formed behind a glacial moraine at the upper end of Wallowa Valley below the mountains. In the Grande Ronde Valley, channel gradients are less than two feet per mile; but in the mountains, they range from 100 to 350 feet per mile.

GEOLOGY AND SOILS

Most of the basin is covered with Miocene and other earlier volcanic rocks. The highest mountains, in the Elkhorn and Wallowa ranges, are composed of Jurassic intrusive granitic rocks, Paleozoic argillites and schists and other metamorphic rocks, and some Triassic limestones. Bodies of quarternary alluvium, some of it lakebed deposits, are found in the valleys between La Grande and Elgin, and near Wallowa.

Soils on the granitic rocks are loose, sandy, and readily eroded when the plant cover is damaged. Soils on the various volcanic rocks are medium to heavy in texture with heavy subsoils and are readily eroded when denuded lighter-textured soils are found on limited areas of the metamorphic rocks. Alluvial soils are quite variable, some being heavy-textured throughout the profile, others being light and permeable to considerable depth. Moisture-holding capacities are generally moderate to high, depending on soil depth and subsoil characteristics.

PLANT COVER

The Elkhorn, Blue, and Wallowa Mountains and the Chesnimnus Hills are forested except for grassy ridges and rocky barrens in the highest parts. The open grassy areas are range land, as is most of the Imnaha divide and the north part of the Chesnimnus Hills where they slope down to the lower Grande Ronde River. The foothills around the Grande Ronde and Wallowa Valleys are also in grass, weed, and brush cover and used as range land. The flat valley sections are cropland, much of it irrigated.

At higher elevations in the Elkhorn mountains and at the head of Catherine Creek and the Minam River there are patches of lodgepole pine forest. The rest of the high elevation forest is a mixture of spruce, fir, and hemlock. At middle and lower elevations the forest is ponderosa pine; this type covers more than half of the total forest area and contains the principal commercial timber. Much of the forest is noncommercial, with sparse scrubby stands of poorly-formed trees.

Range land areas include some mountain brush, but are mainly sagebrush, perennial grasses, and weeds. Long-continued heavy use of most of the range has resulted in depletion of the cover, serious soil erosion, and invasion of rabbitbrush, cheatgrass, and unpalatable and noxious weeds.

Large fires have at time burned over both range and forest, creating temporary erosion hazards. At the head of the Grande Ronde in the Blue Mountains and at the head of Catherine Creek, the threat has been sufficiently severe that many acres of the denuded slopes have been contour trenched to hold the soil and runoff.

CLIMATE

Situated at a fairly high elevation and 300 miles inland from the ocean, from which it is separated by three mountain ranges, the Grande Ronde basin has a continental climate. Winters are cold and summers hot. The precipitation is light and fairly well distributed through the seasons; though July, August and September are drier than other months of the year. Only in the crest of the Wallowas and the Blue Mountains does the

average precipitation reach or exceed fifty inches annually, and most of it is snow. Much of the basin is semi-arid or subhumid.

Precipitation data for representative stations are as follows:

Station	MONTH J	F	M	A	M	J	J	A	S	O	N	D	Annual
Starkey (Blue Mtn.)	1.56	1.48	1.30	1.68	1.93	1.72	0.92	0.91	1.13	1.35	1.82	1.50	17.30
La Grande (Valley)	2.14	1.90	2.05	1.17	2.93	1.53	0.59	0.63	1.12	1.57	2.12	2.06	20.35
Wallowa (Valley)	1.78	1.54	1.53	1.39	1.53	1.63	0.59	0.68	1.09	1.48	1.93	1.64	16.81

Snow courses show the following:

Station & Location	Elevation, feet	Water Content April 1 inches
Anthony Lakes (Elkhorn Mtns.)	7125	27.1
Aneroid Lake #1 (High Wallowas)	7480	35.0
Moss Spring (West Side Wallowas)	5850	24.8
Tollgate (Blue Mtns.)	5070	27.1

The high elevation snowfields provide an almost continuous flow of water through the dry summer season. Snow accumulates to depths of 10 to 15 feet at many stations.

During the summer months small local storms are fairly common. Sometimes they are electric storms, relatively dry, resulting in numerous fire starts from lightning. Other times they produce high-intensity rainfall and cause severe erosion. Rainfall of a third of an inch in five minutes has been recorded.

Temperatures vary according to altitude, but cover a wide range in any case. The extremes recorded at La Grande are 108°F and -34°F; at Wallowa 108°F and -38°F. Average January temperature is 24°F at Wallowa, average July temperature 65°. La Grande is warmer, with a January average of 30°F and a July average of 70°F. Nearly every winter has temperatures below zero. Length of frost-free growing season in the main valleys ranges from 120 to 160 days.

Winds are prevalent throughout the entire year, the average being about 7 miles per hour at valley stations, with little seasonal variation. Highest velocities rarely reach 40 miles per hour.

Sunshine averages about 60 percent of total possible. Evaporation is estimated to amount to about 40 inches for the April to September period.

HYDROLOGY

Few of the streams in the Grande Ronde basin are gaged, and of them only the Grande Ronde River itself very far from the headwaters. At Troy below the junction with the Wenaha River, with a drainage area of 3,275 square miles, the average flow is 3,312 cfs, equivalent to about 14 inches depth over the entire drainage. Annual runoff varies between 55 and 145 percent of the mean. Average monthly runoff is as follows:

AVERAGE DISCHARGE, CFS

J	F	M	A	M	J	J	A	S	O	N	D
2029	2908	3970	7408	8584	6302	2345	878	787	1013	1332	2193

The hydrograph is almost bimodal, with a small late fall rise due to rainfall, and a high spring rise due, of course, to snowmelt. Monthly variation in winter is from a third to nearly three times the mean; in summer from two-thirds to nearly twice the mean.

The runoff is relatively greater at this station than at La Grande because of the large contribution from the Wallowa and Wenaha Rivers; at La Grande the runoff is equivalent only to some 8 inches depth. Catherine Creek yields the equivalent of 15 inches depth from its watershed, and the Lostine River the equivalent of 38 inches, both draining from the Wallowa Mountains.

The spring snowmelt runoff peak comes in April, May, or June. Snowmelt begins in March or April at the lower elevations; the timing of the peak depending on elevation of the particular watershed, temperature sequence during the melting season, and depth and distribution of the snow pack. Alternate warm and cool periods during the 60 or 90-day snowmelt season may cause several secondary peaks. Major floods of record on the Grande Ronde occurred in May 1948, December 1946, March 1932 and March 1928, indicating that the momentary peak does not necessarily correlate with high monthly average.

Intense convective summer storms occur in the foothills and mountains, usually over areas of 50 square miles or less. Occasionally, high rates of runoff from these storms produce flash floods. Streams rise quickly, reach their crest within an hour following the period of

maximum rainfall, and recede to normal in a few hours. Runoff volume of these floods is small; though they may cause severe local damage, they exert little influence on the main stream or the larger tributaries.

Absolute minimum flows at the Rondowa gage (drainage area 2,555 square miles) have dropped as low as 225 cfs. Most of the minimum flows have occurred in December, but some have occurred as early as September. The December lows are probably due to sudden drops in temperature following dry periods.

Ground water has been unimportant as a source of supply because surface sources have been adequate for most needs. Practically no exploration has been done and little is known about ground water potentialities.

PROPOSED PROJECTS

Grande Ronde River development proposed by the Corps of Engineers consists of flood control storages at the Lower Grande Ronde and Catherine Creek reservoir sites and channelization and levee improvements.

The proposed Lower Grande Ronde site is located on the Grande Ronde River immediately downstream from the mouth of Spring Creek, about 10 miles upstream from La Grande, Oregon. The proposed Catherine Creek site is located immediately downstream from the mouth of Little Catherine Creek about 10 miles upstream from the town of Union, Oregon.

The reservoir capacities and purpose allocations at the present time are as follows:

Lower Grande Ronde Site	Acre-Feet
Sedimentation	5,000
Conservation Pool-Fish	5,000
Supplemental Water Fish (1)	15,000
Exclusive Irrigation and Power	80,000
Joint Flood Control/Irr./Power(1)	30,000
Exclusive Flood Control	25,000
Total	160,000

(1) Downstream

Catherine Creek Site	Acre-Feet
Sedimentation Pool	1,000
Conservation Pool-Fish	5,000
Joint Flood Control/Fish (1)	10,000
Joint Flood Control/Irr. or Power(1)	28,000
Exclusive Flood Control	7,000
Total	51,000

(1) Downstream

The two reservoirs would be operated so that during periods of high runoff, no downstream releases would be made. Minimum pools would be required by November 1 and maximum pools would be achieved in June. Maximum pool elevations would be maintained until October 1, after which the reservoirs would be drawn down to minimum pool level. During periods of refill at the reservoirs, flow from tributaries below the dam sites should be sufficient for fish conservation and pollution control.

STUDY OBJECTIVES AND PROCEDURES

The objective of this study and report is to establish, by use of existing and projected data, preliminary conclusions on the feasibility of providing in Lower Grande Ronde and Catherine Creek projects, storage space for municipal and industrial water supply and storage and/or flow regulation for stream quality control and to enumerate where practicable the benefits that would accrue to the projects with these purposes included.

Existing sources of municipal and industrial water supply are examined and with projected demand data, the adequacy or suitability of these sources in meeting future demands is estimated. Where warranted, alternate supplies to either replace or supplement rights or developed sources are identified and explanations are given on procedures to be followed for determining whether use of the Federal projects, in lieu of other development possibilities, would be feasible or justified and if so, on what basis benefits may be derived.

Where it is estimated that developed sources or water rights would not adequately meet projected demands or that quality would limit continued use of these supplies, such information is indicated.

Stream flow requirements for quality control are based on specific quality parameters to be controlled and objectives to be achieved as governed by the beneficial uses enumerated and the particular

quality required to satisfy these uses. Where municipal and/or industrial wastes are involved, flow regulation for quality control is regarded only as a supplement to adequate waste treatment or other measures of control at the source of pollution. Computations, involving needs for waste assimilation and dilution in the stream, reflect prior provisions for such treatment. Where it is predicted that irrigation return flows would contribute significantly to reduced stream quality, i.e., nutrient or mineral enrichment, toxicity, turbidity, bio-chemical oxygen demand, etc., flow requirements for control of these effects are also estimated.

Whereas flow regulation requirements for the control of quality incorporates a reasonable degree of waste treatment or control at the source for achievement of this quality, an alternate method and hence, the benefit assignable to such regulation because it is not possible to evaluate directly the benefits to users, is considered to be the equivalent of costs to construct, operate and maintain the least costly single-purpose alternative impoundment structure designed to accomplish the improvement. Although, for example, waste distillation or underground disposal would accomplish similar improvements, these methods are not considered to be feasible or equivalent alternates. Annual benefits assignable to project regulation for control of waste or land drainage effects, for the purpose of this analysis, are based on amortized costs plus annual operation and maintenance expenses involved in achieving similar regulation by the single-purpose impoundment and release method.

In the event that it is not possible, with a given multiple-purpose project, to provide the storage capacity or releases necessary to meet specific quality objectives or that future needs (without a comprehensive study) cannot be defined, it is assumed that any unsatisfied requirements would be incorporated in future projects or water allocations.

PRELIMINARY ECONOMIC REPORT AND ESTIMATE OF GROWTH, 1960-2010

INTRODUCTION

Purpose of Analysis

This analysis is intended to provide a preliminary estimate of the economic potentials and economic growth of the subject area.

Definition of Area

For the purposes of this analysis, the study area has been defined as Union County, Oregon. It is assumed that, although these arbitrary boundaries do not exactly coincide with the sub-basin boundaries, the various discrepancies will be compensating in their net effect. In addition, this area constitutes an entity convenient for economic base analysis.

Study Period

The study period is the 50-year period ending in 2010 with the year 1980 taken as an interim point. This period has been statistically extended to 2060 in order to provide a 100-year estimate.

Limitations of Analysis

Two limitations apply to this study. The first is that it is intended only as a preliminary estimate of the outlook for the subject area's growth. Subsequently, in connection with the Columbia River Basin Project for Water Supply and Water Quality Management, an analysis will be made on an industry-by-industry

basis of the growth potential in the various sub-basins. At that time, this preliminary estimate will be reviewed, and revised if necessary.

The second limitation is that this study is intended for use particularly in assessing future water needs. Emphasis has been placed on the analysis of those industries which make heavy demands upon the water resource. Other industries have been considered only insofar as they may have a significant effect on future population. For this reason, this study is not submitted as a detailed industrial forecast.

PRESENT ECONOMIC BASE

Locational and Geographic Influences

The study area is in a sparsely settled mountainous area. The valley area, which contains most of the agriculture and population of the basin, is surrounded and isolated by high wooded mountains. A major highway (U.S. 30) crosses the basin. The surrounding mountains contain many wilderness-type recreational areas.

Land Uses

Union County contains about 1.3 million acres of land. About 60 percent of this is classed as commercial forest land and about 15 percent is cropland. The major land cover classifications of the county are described in Table I. Agricultural land use is described in the section on industry and in Table IV.

Table 1
Land Cover for Union County, Oregon

Forest Land		Acres
Commercial		778,630
Ponderosa pine	253,940	
Other	524,690	
Noncommercial		43,390
Nonforest Land		
Vegetative land (cultivated, grass or brush)		439,560
Nonvegetative land (including barrens and cities)		36,660
Reservoirs		1,260
TOTAL, all land		1,229,500

Source: Forest Statistics for Umatilla and Union Counties, Oregon, Forest Survey Report 135, Pacific Northwest Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture, April 1960.

Water Uses

The Grande Ronde River and its tributaries are used for municipal and industrial water supplies as well as providing water for irrigation. Irrigation use is limited to serving 3,300 acres with a full water supply and about eight times this acreage with a partial supply. These water supply uses are discussed in more detail in the section on water quality.

The fish and wildlife uses of the Grande Ronde River and tributaries have been examined by the U. S. Fish and Wildlife Service. It is understood that these streams support a considerable fishery involving both resident and anadromous fish. The streams of the area are important as spawning areas.

There are also significant recreational uses of these streams for purposes other than fishing. Above LaGrande, U. S. Highway 30 is adjacent to the Grande Ronde River for about eight miles. This highway is a main tourist artery in the summer months, and the river constitutes one of the important scenic resources of an area noted for its scenery. Several state parks are along the Grande Ronde River above LaGrande. Red Bridge State Park (recreation area) has 0.7 mile of river frontage. An estimated 18,465 visitors attended this park in 1960. Hilgard Junction State Park (wayside) has 0.2 mile of river frontage. It had 27,309 visitors in 1960 and 1,816 overnight visitors. No attendance data are available for Riverside Municipal Park at LaGrande. Residents of LaGrande, however, indicated that the Grande Ronde River below LaGrande receives some swimming use.

The nature of the Grande Ronde River below LaGrande is sluggish and rather unattractive in the areas where it meanders between eroded banks through flat valley farm land. A major waterfowl management area (Ladd Marsh Wildlife Refuge) is adjacent to the river in this area.

The upper reaches of the basin's streams generally are very attractive and have considerable recreation potential. No estimate has been made, however, of the shore uses of this area for recreation, cottages, etc.

Population

The population of Union County has been relatively stable since 1900. Between 1950 and 1960, the county's population increased 0.7 percent compared to Oregon's growth of 15.5 percent and a national growth of 18.5 percent. Half of the county's 1960 population resided in LaGrande and about a third lived outside the four major communities of the county. Population trends and distribution for Union County are shown in Table II.

Table II
Population Statistics of Union County, Oregon

	Number of Persons							
	1890	1900	1910	1920	1930	1940	1950	1960
County Total	12,044	16,070	16,191	16,636	17,492	17,399	17,962	18,180
LaGrande	2,583	2,991	4,843	6,913	8,050	7,747	8,635	9,014
Union	604	937	1,483	1,319	1,107	1,398	1,307	1,490
Cove	223	---	433	399	307	321	282	311
Elgin	227	603	1,120	1,043	728	997	1,223	1,315
Remainder of County	8,407	---	8,312	6,962	7,300	6,936	6,515	6,050

Distribution of Population in 1960

LaGrande	49.6%
Union	8.2
Cove	1.7
Elgin	7.2
Other	33.3

Source: Based on population counts by the U. S. Bureau of Census.

Industry

Agriculture and forest products are the major basis for the county's economic activity. The distribution of employment for 1950 and 1960 is shown in Table III. This Table indicates that agriculture is the

largest employer and lumber and wood products manufacturing is second among the basic or primary industries.

Table III
Union County Employment Distribution

	Number of Workers			
	1950		1960	
All employed		6,598		6,254
Agriculture		1,391		977
Forestry, Fisheries, Mining		31		50
Construction		401		376
Manufacturing		948		821
Food and Kindred	122		113	
Lumber and Wood Products	699		588	
Other	127		120	
Transportation and Utilities		876		760
Trade		1,189		1,257
Wholesale	183		193	
Retail	1,006		1,064	
Other		1,762		2,013

Source: 1950 and 1960 Census of Population, U. S. Bureau of the Census.

Comparison of 1960 to 1950 indicates that there has been little change in the employment pattern since 1950. There was a decline in transportation and utilities employment, and there was a small amount of growth among the various secondary industries such as trade and services. From examination of the 1959 Census of Agriculture, there is also an indication that there is a downward trend in agricultural employment.

The forest products industry of the county is based on the large forested areas in and adjacent to the county. As indicated in Table I, about 60 percent of the county's land is classed as

commercial forest land and about half of this is in Ponderosa pine. The timber harvest in 1959 was slightly over 110 million board feet (Scribner log rule). Almost three-fourths of this was from private lands. The pattern of recent years has been similar to this. Manufacturing of forest products is confined to lumber, furniture, and millwork.

The present agriculture of the county is mainly based on the production of small grains and seed. The land use of agricultural land is described in Table IV. Of the acreage indicated for cropland harvested, about half was devoted to small grains in 1959, about one-third to hay (mainly alfalfa) and significant amounts to seed crops, peas, and vegetables. The Bureau of Reclamation has estimated that the study area includes a total of 150,000 acres of agricultural lands. Although the 1959 Census of Agriculture indicates that 27,000 acres were irrigated, only about one-eighth of these were considered to have an adequate supply.

Table IV
Agricultural Land Use in Union County

	1959
Number of farms	873
Average size of farm, acres	604
Land in farms, acres	527,355
Cropland harvested, acres	107,501
Cropland used only for pasture, acres	21,085
Cropland not harvested or pastured, acres	48,662
Cropland summer fallow, cultivated, acres	(35,285)
Woodland pastured, acres	19,590
Other pasture, acres	174,324
Irrigated land in farms, acres	27,073

Source: 1959 Census of Agriculture

The mineral industry of the county is almost entirely confined to materials for the construction industry. The 1959 value of mineral production was $663,000, which is slightly over 1 percent of the State's total production of minerals. The county's mineral products, listed in order of value, are as follows: stone, sand and gravel, clays, gold.

Employment in transportation and utilities has been reduced since 1950 because the Union Pacific Railroad abolished its shops at LaGrande. Employment in this category at the present time is limited to that required to serve the local area. The remaining categories, which account for about half the total employment, are also considered to be of a service or secondary nature. Part of this employment, however, is in activities which benefit from tourists and the recreational opportunities of the adjoining Wallowa and Blue Mountains.

ESTIMATED GROWTH, 1960-2010

Factors Influencing Future Growth

Three principal possibilities for growth are considered likely. The net result of all three is anticipated to produce only a small increase in the study area's population during the study period. This increase is considered to be of about the same order of magnitude as the area's historical growth trends.

Agriculture on much of the basin floor is anticipated to gradually convert to irrigation if satisfactory water supplies are made available. The Grande Ronde Project, as described in the March 1955 report of the U. S. Bureau of Reclamation, proposed to irrigate almost 59,000 acres. This project was not carried out because of the lack of desire of local residents to alter their cropping practices. The land limitation of 160 acres per person was probably also a major contributor to the reluctance to participate in the project. Although much of the same sentiment towards irrigation still exists, it is considered likely that a gradual shift would take place if a multiple-purpose project would make water available at a lesser cost than previously proposed. This shift would be accelerated if a dry cycle occurred or if price supports for wheat were less favorable. A shift to irrigation would bring about a growth in farm employment due to the more intensive farming practices likely to occur. The growth in farm employment would be much greater except that it is considered likely to be partially offset by farm mechanization. Estimates by persons in the county connected with agriculture place the increase in farm employment at from 50 percent to 100 percent on the acreage converted to irrigation. Considering total farm employment, this would be a growth in the range of 17 percent to 33 percent during the study period if irrigation comparable to the Bureau of Reclamation proposal occurs. Such an increase in irrigated acreage is not considered likely to create a significant

growth in the food processing industry of the area. Although a sugar beet refinery is a possibility in this regard, it would require a major conversion to sugar beets by most farm operators in the basin and in adjacent areas in order to make a minimum sized refinery practical. A more likely possibility is the increased production of livestock as part of the crop from irrigated land. This activity lends itself to gradual conversion and is not inconsistent with the capabilities of the existing operations. Such an operation might possibly make a local meat packing operation feasible, but the availability of such facilities in the Pendleton area will lessen this possibility considerably.

The forest products industry of the study area is considered likely to experience a small amount of growth during the study period. The forest resource is presently being utilized at more than its maximum long range capability. Timber on the Federal lands is being harvested at the sustained yield capacity, while timber on private lands is being harvested at a rate greater than the sustained yield capacity. In the near future, some drop in harvest and in employment will occur until the old cutover lands are again ready for harvest. In about ten years increased utilization of currently noncommercial species will also increase the harvest and employment opportunities in the forest. Manufacturing operations are not expected to change drastically. Increased automation might be offset by increasing the amount of manufacturing done on the raw materials. A pulp plant is

not considered likely because manufacturing operations providing the main source of chips are part of the same company's operations which owns a pulp mill at Wallula, Washington, on the Columbia River. The Wallula pulp mill, which is within reasonable transportation distance, is currently being expanded and will be able to continue to handle the chips from the study area. A further (and severe) limiting factor to the location of a pulp mill in the study area is the difficulty of obtaining an adequate water supply and disposing of industrial waste. Although a fiberboard plant is a possibility, it would be in competition with the pulp mill for most of its raw materials, and is not considered likely in the near future.

The third potential for growth in the study area is the increase in service activities due to such factors as increased tourist and recreational activities in the surrounding area, growth of the college at LaGrande, and an increasing ratio of service activities to primary or basic industry. These factors, of course, have been in operation in the past and have helped to offset some of the declines in certain other parts of the area's economy.

Future Population

The growth of population over the next 50 years is expected to be similar to the historical growth which amounted to a 12 percent increase in the last 50 years.

In deriving potential population figures for the area, the future growth rate has been divided into two segments, with the community

of LaGrande estimated to grow at the rate of 0.3 percent a year and the rest of the county estimated to grow at a rate of 0.2 percent a year. These estimates were rounded to the nearest 50 persons. The result of this statistical maneuver is to produce a total growth estimate for the county over the next fifty years of slightly more than 13 percent. An estimate for the 50-year period 2010-2060 was prepared by applying a 12 percent increase equally to each of the 2010 population figures. The computed forecast of population is shown in the following tabulation.

	1960	1980	2010	2060
County Total	18,180	19,050	20,550	23,000
LaGrande	9,014	9,550	10,450	11,700
Union	1,490	1,550	1,650	1,850
Elgin	1,315	1,350	1,450	1,600
Remainder of County	6,361	6,600	7,000	7,850

Based on this projection, the average number of persons in the county for the 50-year period (1960-2010) will be 19,365 and for the 100-year period (1960-2060) the average number of persons will be 20,590.

Future Land Uses

The changes which can be anticipated in land uses are a matter of intensity of use rather than change in classification of use. Although about the same relative amounts of forest land can be expected to be in the various stages of production and harvest, the actual areas will be rotated according to the production cycle. It is expected, also, that there will be a gradual trend toward production from younger forests, the use of species not previously

considered to be commercial, and the increased use of insecticides and fertilizers on the forest crop.

The conversion of agricultural land to irrigated land would bring about a major change in the intensity of land use, as well as in the type of crops and cultivation practices, and will bring annual cropping to many areas now summer fallowed in alternate years. The elimination of floods through storage projects would also make possible a greater utilization of the agricultural land.

Future Water Uses

The construction of water control projects in the area would make several changes in water use likely. These would include a large increase in the use of water for irrigation, the availability of water for augmenting municipal and industrial water supplies, the creation of reservoirs with recreation potentials, and the augmentation of low river flows during critical periods.

It is understood that the U. S. Fish and Wildlife Service has forecast a considerable increase in the use of the basin's streams (particularly the reservoir areas) for fishing. The development of reservoir areas would also provide an opportunity for such water-based activities as boating and swimming. Based on the attendance records of other reservoirs in the area, the annual recreational attendance would be numbered in the thousands. The growth rate of such recreational activities is expected to be considerably greater than the estimated growth of the study area population for two

reasons. First, increasing amounts of leisure and income have greatly increased the per capita demand for recreational opportunities. Second, because this area is a recognized tourist and recreation area, the demand for its use (and the growth rate of this demand) is based on an area much larger than the study area.

PRESENT WATER SUPPLY

LA GRANDE

The primary source of water for the La Grande municipal system is a reservoir and intake system on Beaver Creek and its tributaries. Water is conveyed to the city by a 15.5-mile pipeline where it is then chlorinated, stored, metered and distributed by gravity. Limitations of the system are both storage and transmission. Transmission is limited to 2.7 MGD and the Beaver Creek source is limited to 6.5 MGD. The city has two municipal water rights totalling 5.5 MGD on Beaver Creek.

During periods of high summertime demand, the Beaver Creek supply is supplemented by water from three artesian wells located along the railroad tracks within the city. About 1.55 MGD may be obtained from these sources.

A chlorinator and ammoniator are used for bacteriological control of Beaver Creek water. Problems of taste, odor, and color have occurred in this supply and are presently under study by the city. Stabilizing chemicals are added on occasion during winter months to control iron. (Samplings have indicated upper ranges of iron between 0.4 and 1.1 ppm).[1] Occasional turbidity problems occur in the Beaver Creek supply. Readings of 33 ppm (units) turbidity have been recorded during winter months.[2]

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[1] Recommend no greater than 0.3 ppm iron.
[2] Recommend domestic water contain no greater than 5 units turbidity.

According to studies made by Cornell, Howland, Hayes, and Merryfield, Consulting Engineers for the city of La Grande, the most probable cause of the especially bad taste and odor which occurs in the early spring is reservoir turnover and subsequent release of decaying algae produced during summer months. This firm suggests that a water treatment plant providing sedimentation and filtration would remove tastes and odors but that such a plant in lieu of available control measures and ground water development possibilities for meeting future demands does not appear economically justified.

Chemical and bacteriological data on the existing well water supplies indicate favorable quality with the exception that high temperature makes this water unpalatable without precooling.

The La Grande water supply system serves approximately 2,750 services including a population of about 9000 persons. Large industrial users in the area are lumber mills, railroads, packing plants and flour mills. The railroads have developed wells; packing plants use wells and city water; and lumber and flour mills use self-supplied surface water and city water. The largest industrial use of water at La Grande is for lumber milling. For example, one plant uses about 0.5 MGD of which about one-half is purchased from the city with the balance obtained from the Grande Ronde River and wells.

It is estimated that about 1900 acre-feet of water is taken annually from the Beaver Creek supply for municipal and industrial use. About

65 percent of this demand occurs during the months of May-October with July being the heaviest month of use (17.5 per cent). The total developed municipal supply including ground water is about 4.3 MGD.

For sustained periods of time, the total natural stream flow at the various intakes on Beaver Creek tributaries has been less than 1 MGD. During such times and/or during high demand periods, waters are released to the intake system from the Beaver Creek impoundment. Operated alone, the Beaver Creek impoundment would supply approximately six weeks of the present summer demand.

UNION

The community of Union obtains water for its system from Catherine Creek. Treatment facilities include two 250,000 gallon settling basins, a 52,000 gallon reservoir and a modern chlorinator with positive metering.

Turbidity of Catherine Creek water is the most objectionable quality factor affecting this supply. Problems with the supply system consist mainly of undersized settling basins and lack of filtration facilities. Extremely high leakages also occur in the transmission lines. Transmission line capacity is the limiting quantity factor at the present time.

The Union water supply system serves approximately 500 connections including service to 1450 persons. Average water consumption is about 0.85 MGD or 1000 acre-feet annually. With correction of leakages

in the system it is estimated that annual consumption would be reduced to about 500 acre-feet or 0.4 MGD.

About 65 per cent of the annual demand occurs during the months of May-October with July being the heaviest month of use (17.5%). In relation to the dependable supply of Catherine Creek, more than one-half of the entire stream flow is withdrawn during peak demand periods.

The community of Union has not completed application for water rights on Catherine Creek. As time goes on and demands for water increase, a greater infringement on established rights is likely to occur.

FUTURE WATER SUPPLY

LA GRANDE

According to projected area growth expectations, the annual demand for M&I water supply at La Grande will be approximately 3,500 acre-feet by the year 1985, 5,000 acre-feet by the year 2010 and 9,000 acre-feet by the year 2060.

On an average annual basis, the 1985 demand would utilize about 60 percent of the developed supply and the 2010 demand would utilize essentially the entire developed supply. However, by 1985 the reserve Beaver Creek and developed ground water sources together would sustain only slightly more than one month's mid-summer demand and by 2010 would sustain only about three weeks of the mid-summer demand. Table IV shows the projected M&I demands by months expected for the La Grande, Oregon area.

UNION

According to area growth expectations, the annual demand for M&I water supply at Union is expected to be 900 acre-feet by the year 1985, 1300 acre-feet by 2010 and 1900 acre-feet by the year 2060.

It could be expected that during future peak demand periods, essentially the entire dependable flow in Catherine Creek would be withdrawn. At such times, no greater than 50-60 percent of this water could be expected to be returned to the stream to satisfy water rights downstream. Table V shows the projected M&I demands by months expected for the Union, Oregon area.

Table IV
La Grande, Oregon
Municipal and Industrial Water Supply
Acre-Feet

	1960	1985	2010	2060
Jan.	115.9	213.5	305.0	549.0
Feb.	112.1	206.5	295.0	531.0
Mar.	115.9	213.5	305.0	549.0
Apr.	121.6	224.0	320.0	576.0
May.	125.4	231.0	330.0	594.0
Jun.	235.6	434.0	620.0	1,116.0
Jul.	330.6	609.0	870.0	1,566.0
Aug.	209.0	385.0	550.0	990.0
Sep.	176.7	325.5	465.0	837.0
Oct.	129.2	238.0	340.0	612.0
Nov.	115.9	213.5	305.0	549.0
Dec.	112.1	206.5	295.0	531.0
	1,900.0	3,500.0	5,000.0	9,000.0

Table V
Union, Oregon
Municipal and Industrial Water Supply
Acre-Feet

	1960	1985	2010	2060
Jan.	30.5	54.9	79.3	115.9
Feb.	29.5	53.1	76.7	112.1
Mar.	30.5	54.9	79.3	115.9
Apr.	32.0	57.6	83.2	121.6
May	33.0	59.4	85.8	125.4
Jun.	62.0	111.6	161.2	235.6
Jul.	87.0	156.6	226.2	330.6
Aug.	55.0	99.0	143.0	209.0
Sep.	46.5	83.7	120.9	176.7
Oct.	34.0	61.2	88.4	129.2
Nov.	30.5	54.9	79.3	115.9
Dec.	29.5	53.1	76.7	112.1
	500.0	900.0	1,300.0	1,900.0

WATER SUPPLY BENEFITS

LA GRANDE

It is apparent that additional water supply development is necessary and that supply system revisions will eventually be required at La Grande. Decisions as to the course to be followed are plainly those of the city.

Inclusion of water supply storage in the proposed Lower Grande Ronde project would provide several advantages to the city. An assured supply to meet year-round and/or seasonal fluctuations in demand would be obtained thus eliminating the uncertainties of natural flow at the present intakes and intermittent operation of the Beaver Creek impoundment and well supplies. Raw water quality would remain relatively consistent throughout the various seasons of the year and line pressures could at all times be maintained. Provisions for treatment consisting of sedimentation, filtration and chlorination facilities and transmission appurtenance, however, would be required at local expense.

For benefit computation and cost allocation purposes relative to Lower Grande Ronde project formulations, it is assumed that only supplemental storage for M&I supply would be provided.

The benefit assignable to supplemental storage may be considered equivalent to the long range improvement costs incurred by the city of La Grande in accomplishing similar improvements by the least costly single-purpose alternative means. Costs to develop supplemental ground

water would not in this instance be an equivalent alternate in that this source possesses neither the degree of dependency nor the gravity benefit that surface storage would provide.

The benefit associated with provisions for 2,000 acre-feet of storage for supplemental water supply at La Grande (derived from estimated future water needs relative to existing system limitations) as based on single-purpose development costs and local financing rates estimated by the Corps of Engineers is $24,000 annually. It has been assumed in the derivation of this benefit that surface waters stored in any alternate impoundment or in the proposed project would require complete conventional treatment and that transmission costs and appurtenances would in each case be essentially the same.

UNION

Provisions for water supply storage in the proposed Catherine Creek reservoir would result in several advantages to the community of Union. An assured and rightful supply to meet future anticipated demands would be made available; advantage could be taken of gravity flow from the reservoir; and the turbidity of raw water upon detention in the reservoir would be significantly reduced. Treatment consisting of sedimentation, filtration and chlorination would, however, be required and at local expense.

For benefit computation and cost allocation purposes relative to Catherine Creek project formulations, it is assumed that only supplemental

storage for M&I supply would be provided. The amount of storage is based on projected demands and water right limitations on Catherine Creek.

According to alternate cost estimates associated with single-purpose development of supplemental surface waters for M&I supply at Union as determined by the Corps of Engineers, the benefit assignable to provisions for 1000 acre-feet of storage in the Catherine Creek project would be $12,000 annually. It has been assumed in the derivation of this benefit that surface waters stored in any alternate impoundment as in the proposed reservoir would require complete conventional treatment and that transmission costs and appurtenances would in each case be essentially the same.

WATER QUALITY CONTROL

Catherine Creek passes through many barnyards and places to which the public has free access. The creek is also subject to contamination by irrigation runoff from fertilized fields and barnyards. Some sanitary hazards have been eliminated in recent years but others remain and more are likely to develop.

Municipal and industrial wastes originating both at Union and La Grande enter the Grande Ronde system in the middle and lower reaches of Catherine Creek. Wastes from Union are received directly in Catherine Creek and those from La Grande enter by way of Mill Creek.

The town of Union has no collection or treatment facilities and relies on individual septic tanks. Failures in the performance of some of these systems are known to result in discharges of waste materials to Catherine Creek.

La Grande sewage treatment plant effluent is discharged to Mill Creek about 6 miles upstream from its confluence with Catherine Creek. According to a recent survey conducted by the Oregon State Sanitary Authority, Mill Creek was grossly polluted. Following is a summary of data collected during this survey of Mill Creek:

Dissolved Oxygen	0.6 ppm
BOD_5	60 ppm
MPN	770,000/100 ml.

The city of La Grande has since passed a bond issue to finance construction of a 100 acre sewage lagoon. No definite information is available on the

exact location of the lagoon outfall on Mill Creek.

Irrigated lands from which irrigation return flows originate exist along both the east and west side of Catherine Creek and the proposed lands to be irrigated are located mainly north and westerly along the Grande Ronde River between La Grande and Elgin. The City of Elgin has no sewage collection or treatment facilities at the present time.

Sizeable runs of steelhead trout and spring Chinook salmon, runs of coho salmon and remnant runs of fall Chinook salmon utilize the Grande Ronde drainage. Salmon and steelhead trout support increasingly popular sport fisheries in the Grande Ronde River system and are important to the maintenance of the Snake and Columbia River runs.

Resident game fish in Grande Ronde River systems include rainbow and Dolly Varden trout, mountain whitefish, channel catfish, brown bullheads, yellow perch, largemouth bass, crappies, bluegills, and white sturgeon.

The Grande Ronde River is open to steelhead trout and salmon fishing, and Catherine Creek is open to fishing for steelhead trout and Chinook salmon from its mouth upstream to the municipal water supply dam at Union.

During 1960, about 3,000 man-days of fishing were expended in the area influenced by the Lower Grande Ronde Dam, and about 5,200 man-days were expended along the area on Catherine Creek influenced by the Catherine Creek project.

Stream flow requirements for control of quality are, in this instance, based on the effect of organic loadings originating from municipal, industrial and land sources as measured by the extent of dissolved oxygen deficits that would occur in the stream at various rates of stream flow.

In view of the fishing uses in the area and desirability of maintaining a high standard of stream quality for recreation and general sanitation, a minimum dissolved oxygen objective of 6 parts per million at 25° C is used. It should be understood that stream flow regulation to control dissolved oxygen at this level would provide substantial control of various other quality parameters.

Following are the treated waste loads (assuming 85 percent BOD_5 removal) and organic land loadings considered in the determination of stream flows required from the Catherine Creek site on Catherine Creek to the community of Elgin on the Grande Ronde River.

	Years/lbs. Ultimate BOD/Day			
Source	1960	1985	2010	2060
Municipal and Industrial	900	1000	1100	1200
Land drainage	180	200	220	240

Figure 1 shows the levels of dissolved oxygen that may be expected at various rates of stream flow during critical summertime conditions. Shown in Figure 1 also is the recommended minimum stream flow associated with the objective of 6 ppm of dissolved oxygen.

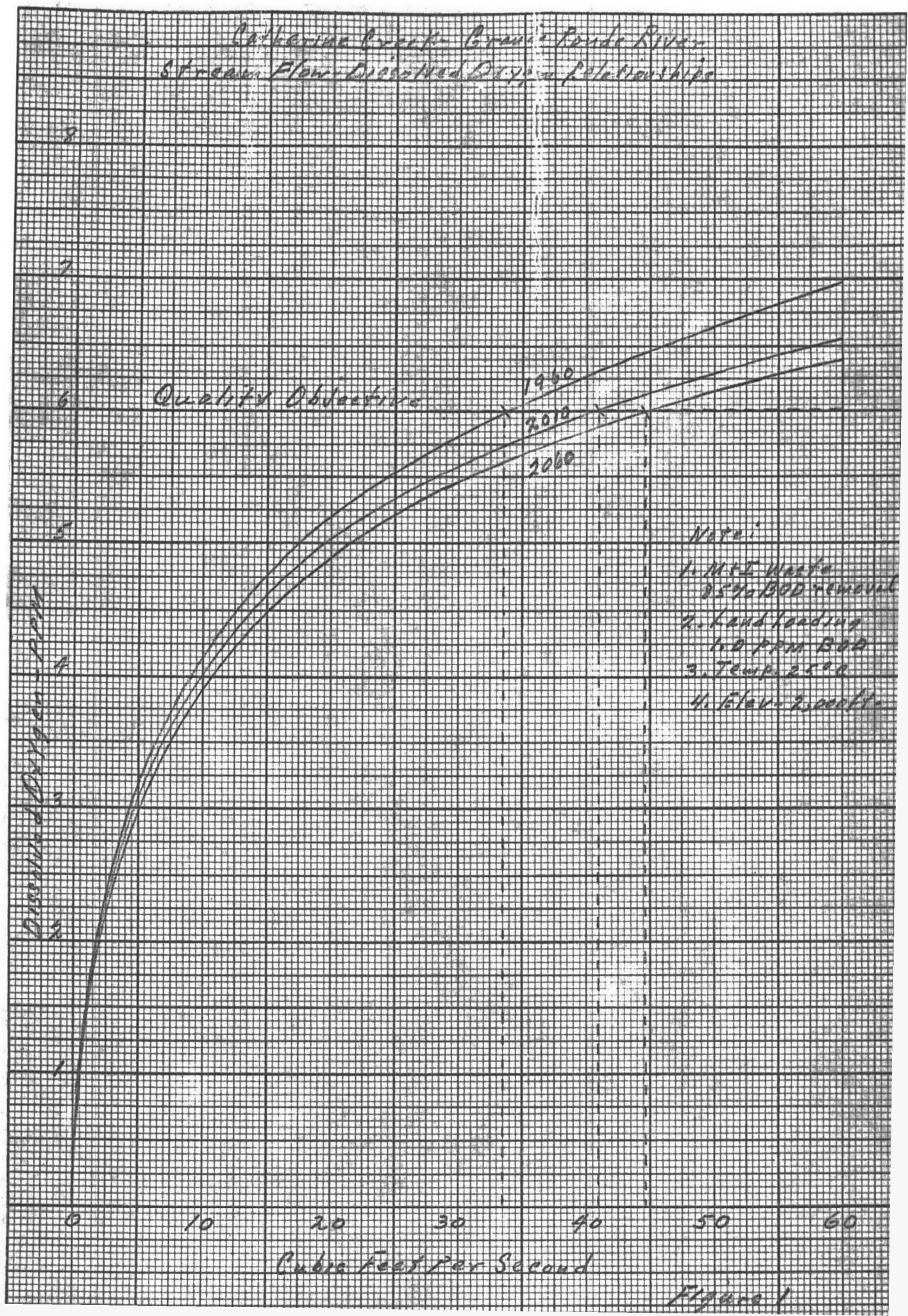

Figure 1

Inasmuch as greater loadings may be tolerated as water temperatures become lower, less flow would be required during winter and intermediate seasons. Table VI lists the estimated stream flows required to control stream quality for fish life, recreation and general sanitation during the various months and future years shown.

Table VI
Minimum Stream Flow Requirements
Catherine Creek Site to Elgin (Grande Ronde)

Year	May-Oct. cfs	Nov.-April cfs
1960	33.5	25.0
1985	37.0	27.7
2010	41.0	30.7
2060	44.5	33.5

QUALITY CONTROL BENEFITS

Inasmuch as stream flow computations for quality control in Catherine Creek and the Grande Ronde River have incorporated reasonable local provisions for waste control at the sources, any provisions specifically designed to augment natural stream flows or any storage releases that would result in accomplishment of the established stream quality objectives would possess value in terms of costs to provide such regulation.

The benefit assignable to storage and/or storage releases for quality control as a separable or joint function of the Catherine Creek project is considered equivalent, therefore, to costs to provide the required augmented stream flow by the least costly single-purpose alternative means.

According to cost estimates prepared by the Corps of Engineers, the single-purpose cost, and therefore the benefit assignable to 8,000 acre-feet of storage in the Catherine Creek project for quality control is $85,000 annually. The amount of single-purpose storage considered in this determination corresponds to the mid-study period requirement of 41 cfs for May-October and 30.7 cfs for November-April.

DISCUSSION

The protection of public health through the provision of a safe and potable water supply has long been a matter of primary concern to the public health profession and has been a significant, contributing factor to the high health standards of the Nation. However, the problem of providing adequate amounts of safe, potable water has become increasingly difficult due to the pyramiding water demands of a rapidly expanding population. Furthermore, the resulting increase in waste and land drainage flows has caused a gradual degradation in the quality of the Nation's waters and has decreased their value for many beneficial uses. While improved methods of treatment and disinfection of both wastes and water have served to maintain the quality within tolerable limits for water supply, the progress in pollution abatement and water treatment has not kept pace with this population growth and industrial expansion, and water uses.

The familiar problems of pollution by bacteria, organic matter, and chemicals of known toxicity and behavior have been further intensified and complicated by problems of mineral enrichment due to water re-use and by new types of contaminants associated with our chemical and atomic age. The effects of these newer contaminants on water treatment processes and on the human consumer are largely unknown. The deficiencies in knowledge and the prospect of even great quantities of yet more complex pollutional materials reaching our surface waters emphasize the urgency of intelligent water quality management.

It is recognized that water for human consumption holds the highest priority of all water uses. The increased demands on quantity by an increasing variety of uses has also brought about many conflicts which can be solved only by intelligent and long-ranged management practices. Unfortunately, practically every water use results in some degradation of quality. As the supply becomes more critical and conflicts in use increase, water quality is assuming increasing importance.

Where alternate sources are available, it is desirable to reserve the highest quality water available for domestic use and to satisfy other lower priority demands with waters of lesser quality. In areas of limited supply, the ultimate water requirements can be met only by water re-use. Thus, dependence must be placed upon improved and more effective methods of water and waste treatment and other control methods in order to maintain the highest possible standards of quality for human consumption and other uses. However, in such instances every effort should still be made to reserve a sufficient quantity of high quality natural waters for domestic use before they flow on to supply other less critical demands.

It is sound planning to utilize highest quality water for highest priority uses, and the protection of this quality against irreversible and potentially hazardous degradation must be practiced to the fullest extent possible.

Because maintenance of a high level of water quality for all uses is basic to public health and the general well-being of the populations

and economy, planning for future water demand and uses requires the utmost of care. This is especially true when planning for needs many years in advance as is the objective of this evaluation.

Natural water quality is altered by man in many ways. Materials of certain types and quantities when disposed to stream water can unbalance the biological equilibrium, reduce recreational values, prevent use of the stream waters for municipal and industrial purposes, and create serious nuisance and public health hazards, all of which become liabilities to the area affected.

Because progress in pollution abatement and water treatment practices has not kept pace with population growth and industrial expansion, flow regulation as a supplement to conventional methods of abating pollution and controlling water quality possesses control value of particular significance.

Provisions for future municipal and industrial water supply is of paramount importance to the La Grande and Union, Oregon areas. If these communities are willing to participate in the project, favorable consideration should be given. The primary need is for supplemental water of high quality to satisfy short-term needs during high-demand periods.

The quality objectives and related flow requirements recommended in this report are designed for achievement of the following purposes:

1. Prevent development of nuisance conditions;

2. Enhance the aesthetic and health values of the stream and adjacent areas;

3. Provide an environment suitable for propagation of resident and anadromous fish life;

4. Protect and enhance the natural self-purification capabilities and assets of the stream waters;

5. Reduce and neutralize the effect of residual fertilizers, weedicides, and insecticides.

The beneficiaries of water quality maintenance and values resulting from achievement of the above purposes are:

1. Land values--protection and enhancement;

2. Resident populations--health, social and economic improvement;

3. Livestock--health and well-being;

4. Natural resources--

   a. Fish and wildlife preservation;

   b. Preservation of the natural self-purification assets of the water resource;

5. Recreation--protection and enhancement;

6. Waste disposal--assimilative capacity (supplemental waste treatment).

By virtue of the multiplicity of values (tangible and intangible) that are derived through maintenance of stream quality, the benefits attributable to provisions specifically designed for such maintenance may be regarded as "widespread."

Inasmuch as the water quality control program set forth in this report involves a reasonable degree of local participation in achieving the stated goals, it is believed of interest to the public that low flow augmentation as one of the requisites in achieving fulfillment of this goal be provided. Benefits attributable to provisions for water quality control where shown to be justified as a project function, therefore, are believed to be national in scope.

ACKNOWLEDGMENTS

This investigation and study was aided materially by officials in the La Grande and Union area, the Oregon State Health Department, Oregon State Sanitary Authority, Oregon Water Resources Board, and Walla Walla Corps of Engineers. Information furnished in the references listed below is also acknowledged.

1. U. S. Geological Survey, Water Supply Papers, Part 13.

2. U. S. Department of Agriculture, County Soil Survey Reports.

3. U. S. Weather Bureau, Climatological Data, Annual Summary Sheets.

4. U. S. Department of Agriculture, Columbia Basin Agricultural Program Reports, 1954.

5. U. S. Census of Agriculture, 1959.

6. U. S. Census of Population, 1950.

7. U. S. Census of Population, 1960.

8. Bureau of Reclamation, Grande Ronde Project, Oregon, March 1955.

9. Union County Water Development Committee, Report to Corps of Engineers, November 3, 1961.

10. Cornell, Howland, Hayes and Merryfield, Engineers, Water Supply and Distribution System, City of La Grande, Oregon, October 1961.

11. Clark and Groff, Engineers, Water Supply and Distribution System, City of Union, June 1953.

12. Oregon State Sanitary Authority and Board of Health, Unpublished Data.