USDA Report on
WATER and RELATED LAND RESOURCES

UMATILLA DRAINAGE BASIN
OREGON

Based on a cooperative Survey by

THE STATE WATER RESOURCES BOARD OF OREGON

and

THE UNITED STATES DEPARTMENT OF AGRICULTURE

Prepared by · · ECONOMIC RESEARCH SERVICE · · FOREST SERVICE · ·
SOIL CONSERVATION SERVICE
December 1962

cc: Beattie 4/23/64

M-3829

USDA Report on

WATER AND RELATED LAND RESOURCES

UMATILLA DRAINAGE BASIN

OREGON

Based on a Cooperative Survey by

THE STATE WATER RESOURCES BOARD OF OREGON

and

THE UNITED STATES DEPARTMENT OF AGRICULTURE

Report Prepared by

USDA River Basin Survey Field Party, Salem, Oregon

H. H. Ralphs, Soil Conservation Service, Leader
D. D. Raitt, Economic Research Service
J. H. Poppino, Forest Service
H. E. Carnahan, Soil Conservation Service
D. G. Price, Soil Conservation Service
K. K. Smith, Soil Conservation Service, Typist

Under Direction of

USDA Field Advisory Committee

T. P. Helseth, Soil Conservation Service, Chairman
C. E. Stewart, Economic Research Service
K. W. Linstedt, Forest Service

December 1962

CONTENTS

TABLES

FIGURES

INTRODUCTION

This report presents information concerning the water and related land resources of the Umatilla Drainage Basin, the result of a cooperative study by the U. S. Department of Agriculture and the State Water Resources Board of Oregon.

The State Water Resources Board of Oregon is making a survey and investigation of the Umatilla Drainage Basin to develop information needed for planning the coordinated development of the area's water resources. The information needed for its study includes: (1) the kind and location of desirable water resource developments; (2) the amounts of water required; (3) the physical opportunities for installation of development to meet water needs; and (4) the broad economic aspects of possible development. The State will use this information to formulate and implement plans and programs to secure the most beneficial use and control of the area's water resources. The State's programs are intended, by legislative decree, to be dynamic in nature with provision for changes as new information is available and as the physical or economic situation changes. The current survey is only the beginning of the State's work in this area.

Upon request of the State Water Resources Board, the U. S. Department of Agriculture cooperated in this survey under the provisions of section 6 of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, as amended).

The objectives of the cooperative survey were to gather basic data and information pertinent to the use and control of water for agriculture in the area, to highlight such major water related problems as erosion, flood prevention, and drainage, and to outline a general program for water and related land resource management to be used as a background for future detailed study and planning. No final solutions are intended for it is felt that watershed planning must be a dynamic, continuing process requiring further cooperative work by all groups concerned.

This report should be of use to anyone interested in the area's land and water resources. It should be of value in appraisal of present and future use of water for agriculture in relation to other water uses for planning, evaluation, development, and operation of the various agricultural programs of federal, state, and local agencies.

The survey consisted partly of an accumulation and evaluation of previously recorded data, both published and unpublished. Much of these data were furnished by other cooperating groups. In addition, the USDA Field Party made limited surveys to gather basic information that was not otherwise available including physical characteristics of certain reservoir sites, land and water availability and use, problems and needs for many tributary watersheds, and forest land resources and ownership. These were not detailed surveys; much of the information was obtained through consultation with local, public, and private of-

ficials. The basic data used as a foundation for statistical information presented in this report are in the files of the USDA Field Party.

Several agencies and organizations provided helpful assistance in making this survey. The field offices of the Soil Conservation Service furnished much of the basic information concerning reservoir sites and tributary watersheds. The County Extension Service also assisted in the collection of tributary watershed data. Most of the landownership data was obtained from County Assessor's records of the counties concerned. Much information on the forest land was furnished by the various field offices of the U. S. Forest Service, the Pacific Northwest Forest and Range Experiment Station, the Bureau of Land Management, and the State Forester of Oregon. Much of the agricultural data were obtained from publications of the U. S. Bureau of the Census. Several of the above-mentioned agencies also provided helpful consultation and comment concerning the preparation of this report. In accordance with the cooperative agreement the State Water Resources Board developed and furnished information concerning existing water rights, major resources and their use, and other pertinent information in addition to furnishing hearing reports and numerous maps.

USDA REPORT ON WATER AND RELATED LAND RESOURCES

UMATILLA DRAINAGE BASIN, OREGON

SUMMARY

GENERAL DESCRIPTION OF THE BASIN

The Umatilla Drainage Basin in northeastern Oregon has an area of 4,554 square miles, which is 4.7 percent of the total area of the state. It includes the Walla Walla, Umatilla, and Willow Creek watersheds with elevations ranging from 200 feet at Irrigon to more than 5,000 feet at the summit of the highest mountains. The geology of the area consists of two physiographic provinces, the Blue Mountains uplift and the Umatilla plain. Most of the soils have been derived from transported materials. The climate is temperate and semiarid characterized by low annual precipitation, low winter temperatures, and high summer temperatures. The average annual precipitation varies from 7 inches near Boardman to over 50 inches in the Blue Mountains. The growing season in the major agricultural areas varies from 150 to 190 days. The recorded temperature extremes at Pendleton are -22° F. and 110° F.

Settlement of the basin, beginning in 1858, was by ranchers with miners arriving in 1862. Dryland grain farming, irrigation, and lumbering developed later while mining diminished. The population of the basin was about 48,400 in 1960.

Forty-eight percent of the basin is range; 36 percent is cultivated; 14 percent is forest; and 2 percent is devoted to other uses. Eighty-five percent of the basin is privately owned.

FORESTRY

Use of the timber, water, forage, wildlife, and recreational resources of the forest land in the basin has increased markedly in the last 25 years. The 403,800 acres of forest land have an estimated annual sustained timber production of 45 to 60 million board feet. The average annual timber cut for Morrow and Umatilla Counties during the period of 1955 to 1960 was 147 million board feet, with approximately 50 percent coming from outside this basin. In addition, the forests produce forage for big game and livestock and are also used for recreational purposes. Recreational uses such as winter sports, picnicking, camping, hunting, and sightseeing are expected to continue to increase. Because of their location and natural characteristics, the forested watersheds furnish a large portion of the basin's streamflow during the summer months.

Consumptive uses of water on forest land include requirements for plant growth, residents of forest areas, recreational visitors, livestock, wildlife, and other purposes. The annual consumptive uses other than for plant growth on national forests are about 2.7 million gallons.

This use is expected to increase by about 50 percent in the next 40 years. Nonconsumptive uses include environmental requirements for fish life and recreation.

AGRICULTURE

Agriculture is the major source of income in the basin. The 1,071,150 acres of cropland and 1,597,570 acres of grazing land in the basin are used mainly for the production of dryland wheat and livestock. About 83 percent of the cropland is used for the production of small grains with 41 percent in wheat and barley and 42 percent fallow or idle. Other major uses of cropland are for the production of green peas, pasture, and hay. Acreage in farms and cropland both doubled from 1899 to 1929 but have since remained fairly stable.

The 2,380 farms in the basin average 1,230 acres in size and represent an average investment of $93,400. Farm numbers are decreasing while average farm size is increasing.

Beef cattle, milk cows, and sheep are the major types of livestock in the basin. The number of beef and feeder cattle have been increasing since 1930 while the number of dairy cattle and sheep have been decreasing.

Agricultural income from the sale of crops and livestock in the basin in 1959 was estimated at $49.5 million. Income from the sale of crops accounted for 69 percent; livestock accounted for 30 percent; and farm forest products accounted for one percent. Since 1939, the value of crops sold has been increasing more rapidly than the value of livestock sold.

Irrigation began in the basin in 1870 and irrigated acreage has gradually increased to the present level of 73,680 acres. About 68 percent of the irrigated land is producing hay and pasture. Other irrigated crops include field corn, sugar beets, potatoes, peppermint, hops, vegetables, and fruits.

Water costs for farmers in irrigation districts varied from $2.90 to $6.50 per acre in 1960. Natural streamflow is the chief source of water, supplying almost half of the irrigated land while stored water and ground water are each the source for one-fourth. Gravity irrigated acreage is about twice that irrigated by sprinklers.

Potentially irrigable land is plentiful in the basin so water rather than land is the limiting physical factor on future irrigation development. Economic factors will govern the degree and rate of irrigation development. In the higher rainfall areas of the basin, wheat farms are well established and successful farmers are not interested in irrigation. Future irrigation development is expected to be concentrated in the lower more arid regions of the basin.

WATER RELATED PROBLEMS

The water supply is becoming more critical to all phases of the economy of the basin. Water for irrigation, fish habitat, and other uses is generally inadequate during the late summer. If all irrigated and potentially irrigable land were adequately irrigated, approximately 11 percent more water than the total annual yield of the basin would be required. Other water related problems include gravity diversions from streams; transmission and control of water after diversion in canals; inefficient irrigation systems and water management; and sedimentation from cultivated hill lands. Excessive wetness is a problem on about 20 percent of the irrigated land. Floods resulting from winter and spring runoff and summer cloudbursts cause extensive floodwater damage to agricultural land, crops, and other property.

Lack of consideration of slopes, soil stability, and disposal of waste material in road construction is a problem in forest and range areas. Inadequate fire protection on nonforested rangeland is contributing to the water management problem.

NEEDS AND OPPORTUNITIES FOR IMPROVED MANAGEMENT OF WATER AND RELATED LAND RESOURCES

There is need for continuing improvement in management of land and water in the basin. One of the most important factors relevant to future water control and development in this basin is the continuing need to develop and establish more conservation cropping systems and erosion controlling practices on cultivated land to reduce sedimentation. Additional needs are improved irrigation systems and methods, drainage of wet lands, and channel stabilization.

The limited water in this basin should be developed to better serve all phases of the economy. It is estimated that ground water could be developed to irrigate 19,000 acres. The opportunity for conservation of excessive, often damaging, runoff water in reservoirs for flood protection and subsequent use for irrigation, stockwater, industry, domestic, recreation, pollution abatement, and fish life has considerable potential in the Umatilla Drainage Basin. Estimates from various sources indicate that it will be necessary to construct both large and small reservoirs as well as use water from outside the basin to achieve optimum irrigation development.

OPPORTUNITIES FOR WATERSHED PROTECTION AND FLOOD PREVENTION PROJECTS

The USDA Field Party made a reconnaissance survey of 24 small watershed areas in the basin. A purpose of this survey was to delineate those watersheds with problems which can be solved under P. L. 566. A summary report was written for each watershed. Reconnaissance data on land and water use and water related problems and needs were evaluated for each watershed area. It was concluded that through P. L. 566 project action physical problems in 8 small watersheds might be solved. The watersheds with the best possibilities are generally those with a high potential for agricultural development.

Three small watersheds have been approved for planning under P. L. 566.

Coordinated action by all agencies, organizations, and individuals concerned is needed if the best use of this basin's land and water resources is to be realized.

GENERAL DESCRIPTION OF THE BASIN

LOCATION AND SIZE

The Umatilla Drainage Basin in northeastern Oregon includes the watersheds of the Walla Walla River, the Umatilla River, and Willow Creek. It is bounded by the Grande Ronde Basin on the east, the John Day Basin on the south and west, and the Columbia River and Oregon-Washington state line on the north (fig. 1). The basin has a total area of about 4,554 square miles, which is 4.7 percent of the total area of Oregon. It includes most of Umatilla and Morrow Counties and minor portions of Gilliam, Union, and Wallowa Counties.

For the purpose of this report, the Umatilla Drainage Basin is divided into three subbasins. Subbasin 1, the Walla Walla Subbasin, has an area of 486 square miles and includes the Walla Walla River and its tributaries in Oregon. Subbasin 2, the Umatilla Subbasin, has an area of 2,666 square miles and includes Juniper Canyon and all the drainage area of the Umatilla River. Subbasin 3, the Willow Subbasin, has an area of 1,402 square miles and includes the Willow Creek drainage and some smaller tributaries of the Columbia River between Willow Creek and the Umatilla River.

TOPOGRAPHY

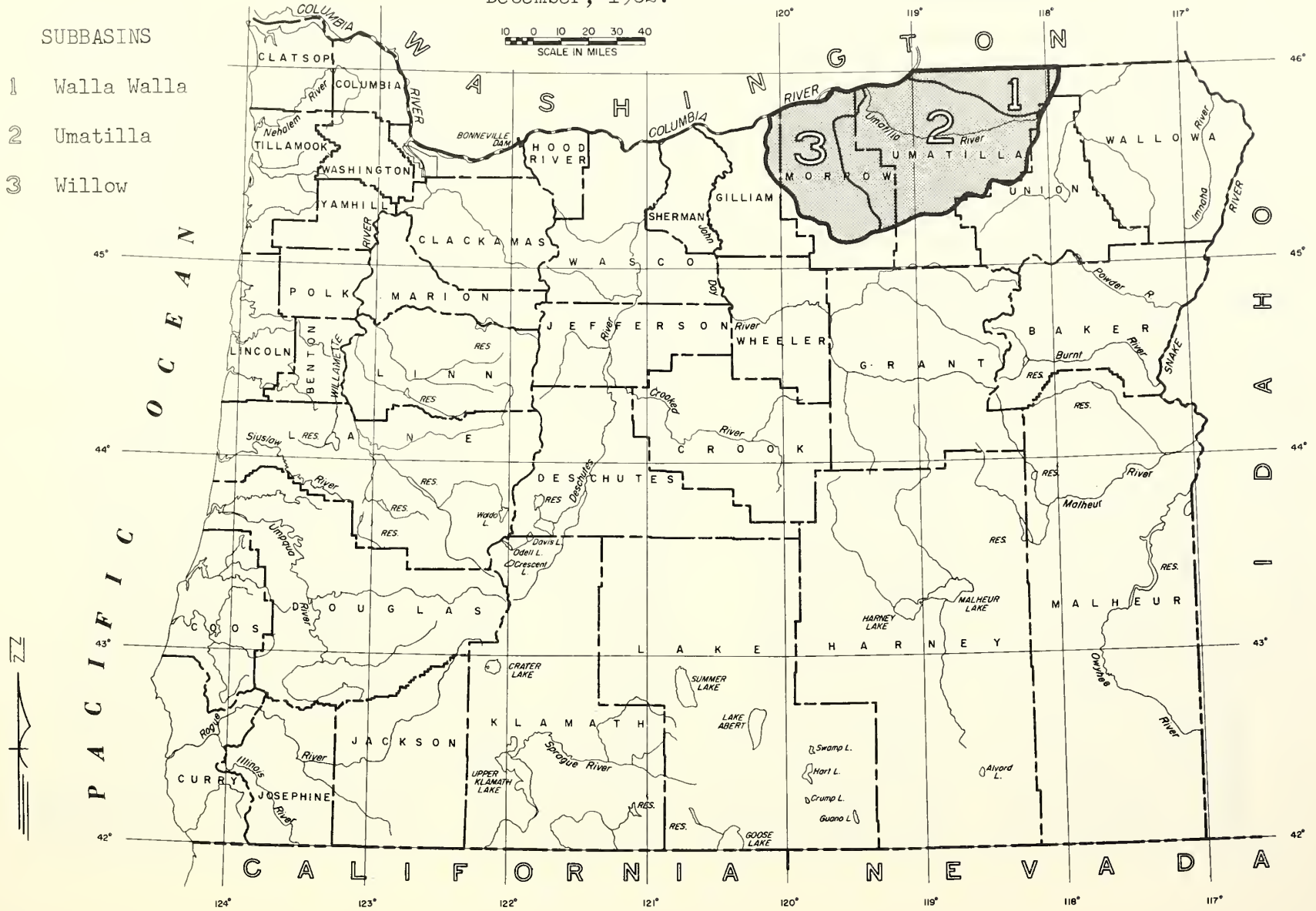
The topography of the Umatilla Drainage Basin is largely a result of the structure imposed upon the Columbia River basalt. The basin generally slopes to the northwest. The south and east boundary is the northeasterly-trending crest of the Blue Mountains. Two major areas are discernible, the Blue Mountains section and the Umatilla plain section.

Blue Mountains Section

This section will be discussed in two parts, the Blue Mountains highland and the Blue Mountains slope. The Blue Mountains highland is a nearly horizontal, platform-like crest of a broad anticline. The elevation ranges from 3,500 feet at Cabbage Hill to more than 5,000 feet at Huckleberry Mountain. The area has been eroded by consequent streams, creating drainage patterns following the pattern of fracturing in the bedrock. Steep walled canyons with narrow alluvial bottoms separated by narrow to broad remnants of the older surface of the bedrock lavas compose the general landform.

The Blue Mountains slope is a gentle, ramp-like descent down to the lowlands of the Umatilla plain. This area descends from the highland area to an elevation of 2,000 feet in the east. It is approximately 15 miles wide east of Athena, 5 miles wide from Emigrant Hill to Battle Mountain, and 25 miles wide from Battle Mountain west to the edge of the basin. Here the drainage system has advanced to a mature stage.

Figure 1: Location Map, Umatilla Drainage Basin, Oregon. December, 1962.



The Umatilla Plain

This section is a broad, topographic and structural trough lying east to west in the basin. It is bounded by the Blue Mountains section on the south and east, the Columbia River on the northwest, and includes the Horse Heaven anticline on the north central area. This trough is divided in the central part by a northeasterly-trending crest of the Rieth anticline.

The Rieth anticline forms the division between the Pendleton plain on the east and the Umatilla lowland on the west. On the Pendleton plain is the Agency syncline whose axis trends southwest from Athena to the vicinity of Pilot Rock. Its surface slopes gently to the northwest with elevations of 1,200 to 2,000 feet. The remaining part of the Pendleton plain is gently rolling with elevations ranging from 1,300 to 2,100 feet.

The Umatilla lowland is a gently sloping surface to the northwest broken by the remnants of the Service anticline, the Service Buttes, Emigrant Buttes, Hermiston Buttes, Umatilla Buttes, and Sillusi Butte in Washington. The Umatilla lowland is slightly dissected and has gently rolling topography. It rises from an elevation of about 200 feet at Irrigon to about 2,000 feet at the foot of the Blue Mountains slope and the crests of Rieth Ridge and the Horse Heaven Hills.

GEOLOGY

The Umatilla Drainage Basin consists of two physiographic provinces, the Blue Mountains uplift and the Umatilla plain. The underlying rock of the entire basin is the Columbia River basalt. It is the prominent rock in the south and east where it occurs as a structural unit known as the Blue Mountains uplift. It is also the most important rock in the second unit where it occurs as a westward plunging synclinal surface which is overlain by sedimentary and aeolian formations. This unit will be discussed as the Umatilla plain. The generalized geologic map (fig. 2) illustrates the geologic formations of the basin.

The Blue Mountains Uplift

The folded and faulted Columbia River basalt occurs in the major portion of this province. This formation overlies a combination of older rocks including metamorphic rocks, intrusive acid igneous rocks, and sedimentary rocks (Clarno formation). These formations are exposed on the surface of approximately 3 percent of this province in the southern part near Battle Mountain.

The Miocene volcanic composite consists of many individual flows ranging in thickness from 10 to 100 feet and in lateral extent from less than 1 to more than 10 miles. The maximum thickness has not been determined, but the Umatilla River near Gibbon has cut through 2,500 feet of this formation without exposing its base. The bottom few inches of each lava flow generally consists of fine-grained, fractured

rock which grades upward into columnar joint patterns. The upper few feet of each flow is commonly finer grained and vesicular, or scoriaceous.

The Columbia River basalt is the most productive and widespread aquifer in the basin. The fractured scoriaceous zones at the tops of many of the flows are porous and permeable, but the more compact central and lower parts of most flows are relatively impermeable. Where the lava beds are tilted, the parts that are at lower elevations may contain water under artesian pressure. Numerous small springs occur in the southerly walls of the east-west canyons cut in the Blue Mountains slope. At higher elevations of the Blue Mountains, ground water is available only in limited quantities from small zones of perched water.

The Umatilla Plain

This province includes the area described in the topography section as the Pendleton plains and Umatilla lowland. The Columbia River basalt acts as a foundation for five types of terrace-like deposits.

Two large terrace deposits of conglomerates of Pliocene age immediately overlie the Columbia River basalt at low elevations. These are the McKay beds in the Agency syncline near Pilot Rock and the Shutler formation in western Umatilla County and central Morrow County. Both of these units contain subangular to well-rounded, lime caliche-coated, basaltic particles ranging in size from grit to boulders.

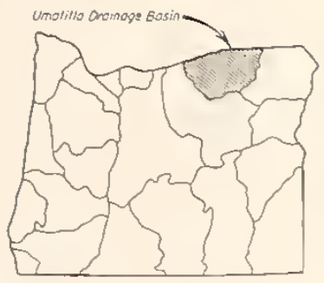
The Pliestocene glacial-lake sediments lie mostly between 1,150 and 750 feet elevations. They consist of poorly stratified silts and sands. The beds are generally less than 80 feet thick and rest upon the basalts and large terrace deposits of conglomerates of Pliocene age. Ice-rafted erratics are scattered on the surface.

Coarse-textured glacial deposits compose most of the area lying below 750 feet, except for areas where the Columbia River basalt is exposed. These deposits consist of rather clean sand and fine gravel with some large boulders and local silt lenses. Ice-rafted erratics are scattered on the surface.

A deposit of loessial silts derived in part from the glacial-lake silts is called the Palouse formation. The loess varies in depth from 1 to 2 feet on the summit of the Blue Mountains to more than 50 feet at Holdman and Helix. Minor aeolian deposits of white volcanic ash are also found.

Thin ribbons of recent alluvium border the streams. Other areas of older alluvium are the outwash from the glacial deposits.

Large quantities of ground water are available in the basalt at places where structural conditions are favorable and recharge is available, as in the lower part of the Blue Mountains slope, the Agency syncline, and in most of the Umatilla plain. Moderate quantities of ground water are present under water-table conditions in parts of the glacial



DRAINAGE BASIN LOCATION

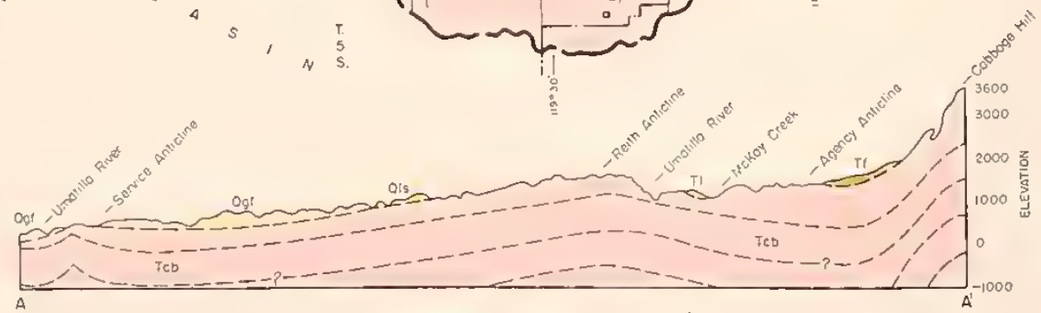
COUNTY LOCATION

SUBBASINS

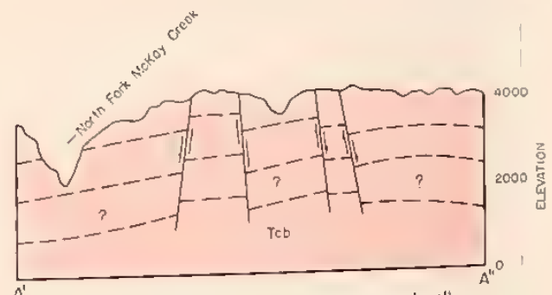
1 WALLA WALLA

2 UMATILLA

3 WILLOW



GEOLOGIC SECTION ALONG LINE A-A'



GEOLOGIC SECTION ALONG LINE A'-A''

LEGEND

- Anticline Axis
- Synclinal Axis
- Fault Traces (U / D)
- Province Boundary
- S-2 Sediment Station
- Drainage Basin Boundary
- Subbasin Boundary
- National Forest and/or Indian Reservation Boundary
- Qal Alluvium
- Qgf Glaciofluviatile Deposits
- Qls Glacial Lake Deposits
- Tf Fanglomerate
- Tcb Columbia River Basalt
- Tc Clarno Formation
- gd Intrusive Rocks
- sg Metamorphic Rocks

FIGURE 2

GENERALIZED GEOLOGIC MAP

UMATILLA DRAINAGE BASIN

OREGON

DECEMBER 1962

2 0 2 4 6 8 SCALE IN MILES

7-E-17406-N

deposits. The recharge is from streams and irrigation water. A minimum amount of water remains in the recent alluvium because the water readily percolates into the streams.

SOILS

Most soils of the basin are derived from transported materials. At the lower elevations on the west the soil material is of glacial origin with areas of medium textured, clacareous sediments and areas of coarse textured sediments. At higher elevations over most of the basin is the Palouse formation of aeolian (wind transported) silts which is complimented by a later aeolian deposit of white volcanic ash found in small pockets on north exposures and relatively large areas in the Blue Mountains. Alluvial soil material from the uplands is found along the streams. The exceptions are the Blue Mountains and their footslopes which have soils that have partially developed from the underlying rock. The basin is dissected by drainages with south exposures of shallow, stony, residual soils from basalt.

A generalized soil map (fig. 3) is presented showing the location and extent of the different soil associations. These associations are described below.

A--Alluvial Soils

The alluvial soils are on nearly level to gently sloping valley bottoms near the rivers and creeks. They vary in texture from silt loam to sandy loam, sometimes mixed with gravels. Volcanic ash deposits are found in pockets and in horizons in the soils. They vary from neutral to strongly alkaline in reaction and from excessively to poorly drained. The following soils are included: Caldwell, Catherine, Yakima, Onyx, Pedigo, Stanfield, Umapine, and Snow.

These soils are often irrigated and are adapted to a wide variety of crops.

At--Athena-Palouse-Waha

This association occurs on the loessial plain and on the lower footslopes of the Blue Mountains. The topography is gently rolling at lower elevations and gently rolling to steep on the footslopes. Athena and Palouse are very deep, dark brown, well drained, medium textured soils. Less than a fifth of the area is the moderately deep Waha series.

Most of the Athena and Palouse and a part of Waha is cultivated in an annual cropping rotation of winter wheat and green peas. The remainder of these soils is in range with a dominant native vegetation of Idaho fescue and bluebunch wheatgrass. These soils are well adapted to irrigation except in areas with unfavorable topography.

Co--Condon-Walla Walla-Lickskillet

This association occurs predominately on nearly level to gently sloping upland plateaus and associated steeply sloping canyon walls. Condon and Walla Walla are moderately deep to deep, well drained, grayish brown, medium textured soils. The canyon walls have deep soils on the north exposures and shallow stony soils on the south exposures.

The deep soils of the association are used primarily for wheat production in a wheat-fallow rotation. The remainder of the area is used for range. These soils on favorable slopes are well adapted for irrigation.

Mc--McKay

This soil association includes soils that have developed from loess which was deposited over gravels and conglomerate. The principal soil is the McKay series which is an imperfectly drained, moderately fine to fine textured soil.

Most of this soil area is in wheat production in a wheat-fallow rotation, and the remainder is in range. This soil presents problems under irrigation because of the drainage restriction.

Mo--Morrow-Bakeoven-Lickskillet

This association occurs on nearly level to gently sloping upland plateaus and steeply sloping canyon walls. Morrow is a moderately shallow to moderately deep, well drained, grayish brown, medium textured soil. The canyon walls have deep soils on the north exposures and shallow, stony soils on the south exposures.

Morrow soils are used primarily for small grains in a rotation with fallow. The remainder of the area is very well adapted and used for range. The potential for irrigation of these soils is limited because of relatively shallow depth and location.

Pi--Pilot Rock

This soil association includes soils that have developed from loess. Pilot Rock, the principal soil, is well drained, medium textured soil over a calcareous hardpan or cemented gravel at 14 to 60 inches.

Most of the area of this soil is used for wheat production in a wheat-fallow rotation. It is fairly well adapted for irrigation but could develop drainage problems.

Q--Quincy-Ephrata

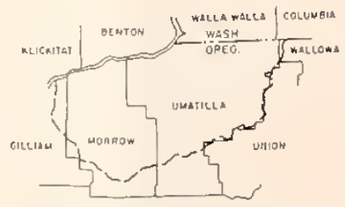
This association of soils was developed from the coarse-textured glacial sediments which have been reworked by water and wind. The topography is gently undulating, and dunes are quite common, some of which are still active. These sandy soils are weakly developed, light color-

SUBBASINS

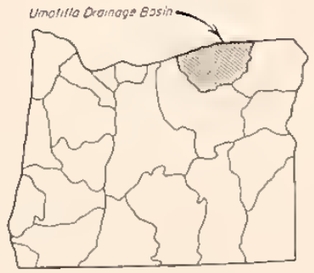
1 WALLA WALLA

2 UMATILLA

3 WILLOW



COUNTY LOCATION



DRAINAGE BASIN LOCATION

LEGEND

SYMBOL	SOIL ASSOCIATION
A	Alluvial soils
At	Athena–Palouse–Walla
Co	Condon–Walla Walla–Lickskillet
Mc	McKay
Mo	Morrow–Bakeoven–Lickskillet
Pi	Pilot Rock
Q	Quincy–Ephrata
Ri	Ritzville–Starbuck
Ro	Rockland–Quincy
Sa	Sagemoor–Quincy–Taunton
T	Talo–Klicker
Wa	Walla–Snipe
Wc	Walla Walla, coarse textured solum
Wd	Walla Walla, low rainfall
Wl	Walla Walla
Wm	Walla Walla, high rainfall

Drainage Basin Boundary

Subbasin Boundary

National Forest and/or Indian Reservation Boundary

FIGURE 3

GENERALIZED SOIL MAP

UMATILLA DRAINAGE BASIN

OREGON

DECEMBER 1962

2 0 2 4 6 8

SCALE IN MILES

7-E-17369-N

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE M-3829

ed, excessively drained, and neutral to slightly alkaline in reaction. Included in this association are the Quincy, Ephrata, Rupert, and Taunton series.

Winter range for sheep is the principal use of this association. The dominant vegetation is annual grasses and sagebrush. A smaller area is irrigated, producing forage and other crops. Some of these soils respond well to irrigation while others do not. Good water management is of utmost importance for the entire group.

Ri--Ritzville-Starbuck

This association of soils is developed from loess. The principal soil is Ritzville which is a deep, pale brown, well drained, medium textured soil. Starbuck occurs on the south exposures on gently to very steep canyon walls and is shallow and stony.

Most Ritzville soils are used for small grain in a rotation with fallow. Most of the Starbuck and some Ritzville is used for range. Ritzville soils are well adapted for irrigation.

Ro--Rockland-Quincy

This association occurs in the area of coarse-textured glacial sediments that have been severely eroded by water and wind so that basalt has been exposed. Rockland is a miscellaneous land type and is mapped separately as a complex with Quincy and Ephrata. The only agricultural use of this land is range and primarily winter range for sheep. The dominant vegetation is annual grasses and sagebrush.

Sa--Sagemoor-Quincy-Taunton

This association is formed on the medium-textured glacial sediments. The major soil is Sagemoor which is a well drained, medium textured soil. Quincy, Ephrata, and Taunton are the other soils in this group.

Winter range for sheep is the principal use of these soils with the vegetation being bluebunch wheatgrass, annual grasses, and sagebrush. A small portion of Sagemoor is producing wheat successfully. These soils are reasonably well adapted to irrigation.

T--Tolo-Klicker

This association occurs in the high country of the Blue Mountains with nearly level to gently sloping uplands which break off to very steeply sloping canyon walls. Tolo, Couse, and Helmer are deep soils developed primarily from loess and volcanic ash and to a lesser extent the underlying rock. Klicker and Kilmerque are moderately deep soils developed from the underlying rock and to a lesser extent from aeolian sediments. Rock Creek and Snipe are shallow to very shallow, very stony soils developed from the underlying rock.

Most of these soils support a forest or mixed forest-grass type vegetation which is used for summer grazing of livestock. Minor areas of all the deep soils are cultivated and produce small grain, legumes and grass, and berries. The shallow, stony soils are used for range.

Wa--Waha-Snipe

This association of soils is found on the footslope of the Blue Mountains on nearly level to very steep slopes. On the east portion of the basin the Waha, Couse, and Palouse series occur in almost equal parts with a minor area of shallow stony soils. On the south and west portion approximately half of the area is composed of the Waha and Hurwall series with the remainder being shallow stony Snipe soils.

These soils are used mostly for relatively high producing range. The major vegetation is Idaho fescue, bluebunch wheatgrass, and shrubs.

Wc--Walla Walla, coarse textured solum

The Walla Walla series is a deep to very deep, medium textured, grayish brown to dark grayish brown soil which has developed from loess. Because of its extensive area of occurrence and wide range of productivity, it has been mapped with four phases.

The coarse textured solum phase differs from the other phases in being lighter colored and having a silt loam texture with a smaller amount of clay and silt and a larger portion of very fine sand. A minor area of shallow stony soils are found on the south exposures.

Wheat production in a wheat-fallow rotation is the predominant use of this soil. It would be very well adapted for irrigation.

Wd--Walla Walla, low rainfall

This phase is very similar to the phase described above except for being heavier textured and occurring on slightly higher elevations with higher precipitation.

Its use is the same as the phase described above, but it is capable of higher production. It would be very well adapated for irrigation.

Wl--Walla Walla

This phase is very similar to the other phases described except for being darker colored and occurring on higher elevations with higher precipitation.

Although its use is the same as the above described phases, production capability is higher. It would be very well adapted for irrigation.

Wm--Walla Walla, high rainfall

This phase differs from the other phases in having the darkest color and being on higher elevations with greater precipitation.

These soils are used for wheat production in both a wheat-fallow rotation and a wheat-green pea rotation. It would be very well adapted for irrigation.

Land Capability

Table 1.--Estimated acreage of land by capability class and subclass, Umatilla Drainage Basin, Oreg., 1962

Land capability class	Subbasin 1 Walla Walla	Subbasin 2 Umatilla	Subbasin 3 Willow	Basin totals
	Acres	Acres	Acres	Acres
I	1,500	3,700	3,000	8,200
IIe	52,700	237,700	55,200	345,600
IIw	2,000	3,000	...	5,000
IIs	6,500	7,600	2,000	16,100
Total II	61,200	248,300	57,200	366,700
IIIe	70,300	337,000	196,800	604,100
IIIs	5,500	6,200	4,800	16,500
Total III	75,800	343,200	201,600	620,600
IVe	26,600	103,900	84,100	214,600
IVw	3,200	5,000	1,600	9,800
IVs	4,500	44,000	26,300	74,800
Total IV	34,300	152,900	112,000	299,200
Total I-IV	172,800	748,100	373,800	1,294,700
VIe	83,300	506,900	194,800	785,000
VIs	1,000	25,700	25,000	51,700
Total VI	84,300	532,600	219,800	836,700
VIIe	9,700	137,900	213,700	361,300
VIIs	44,000	280,900	79,200	404,100
Total VII	53,700	418,800	292,900	765,400
VIII	200	6,700	10,800	17,700
Total	311,000	1,706,200	897,300	2,914,500

Source: Compiled by USDA, Soil Conservation Service.

An interpretive grouping of soils into "Land Capability Classification" has been developed by the Soil Conservation Service. Soil characteristics such as depth, texture, wetness, slope, erosion hazard, permeability, structure, reaction, water-holding capacity, inherent fertility, and climatic conditions as they influence use and management of land are considered in grouping soils into eight land capability classes. These eight classes are designated by Roman numerals as indicated on the "Generalized Land Capability Map" (fig. 4). The hazards and limitations of use of the groups increase as the class number increases. Class I land has few hazards or limitations, whereas Class VIII land is so limited that it is unfit for safe or economical cultivation and grazing and should be used only for recreation, wildlife habitat, and watershed.

Generally speaking, the classification can be broken into two divisions: (1) land in capability classes I through IV is land suited for cultivation and other uses, and (2) land in capability classes V through VIII is best suited for range, forestry, and wildlife because of its own limitations. Land capability classes are sometimes broken into subclasses to indicate the dominating limitation or hazard. The subclasses are: "e" for wind or water erosion, "w" for wetness or frequent inundation from overflow, "s" for soil limitation, and "c" for climatic limitations.

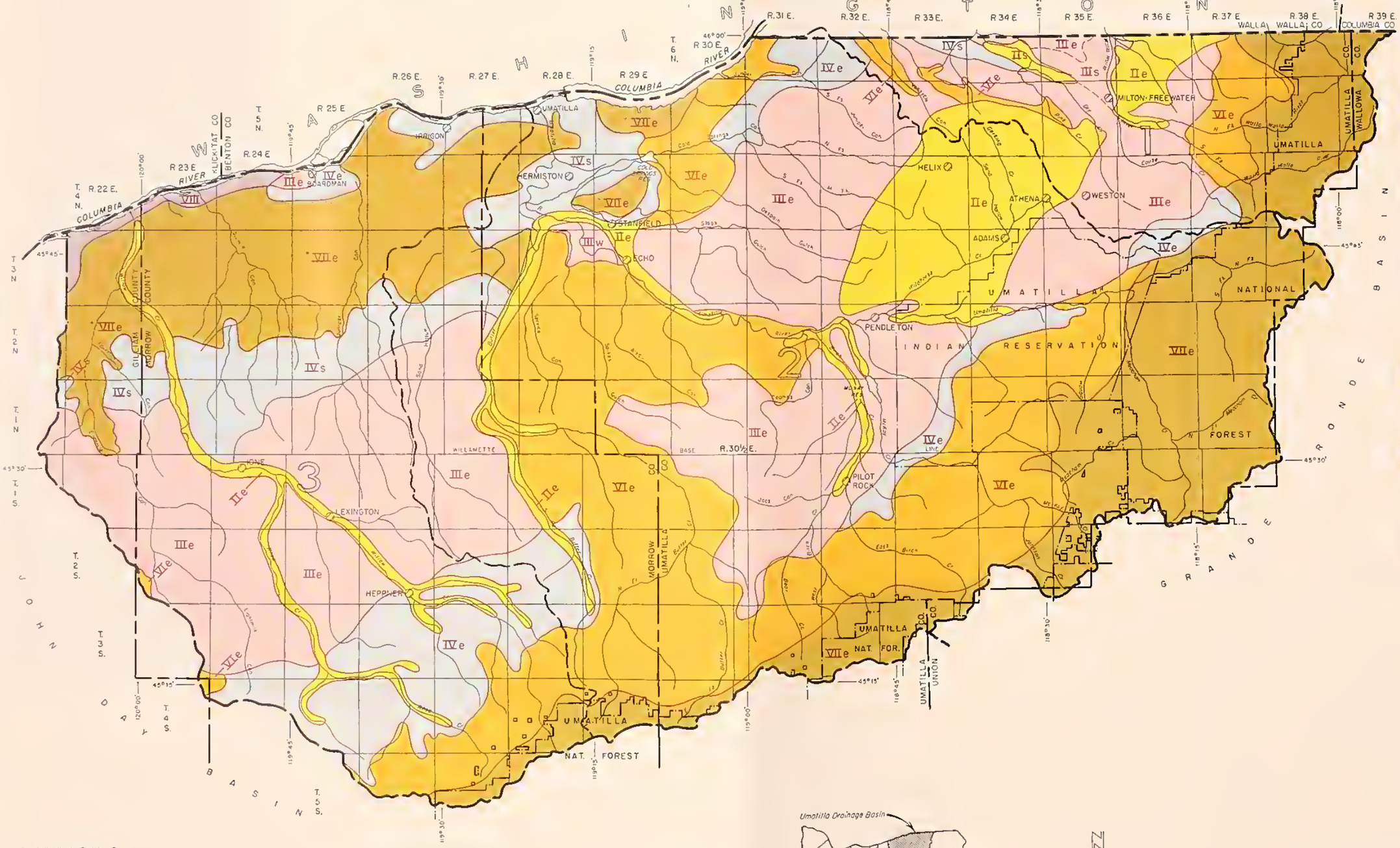
An estimate of the amounts of land in each subbasin has been made for each land capability class and subclass. These data were developed from the Conservation Needs Inventories and soil surveys within the Umatilla Drainage Basin and are summarized in table 1. The general location of the major groups within the Umatilla Drainage Basin is shown in figure 4.

CLIMATE

The climate of the Umatilla Drainage Basin is temperate and semiarid characterized by low annual precipitation, low winter temperatures, and high summer temperatures. Much of the basin is subject to violent convection (cloudburst) summer storms of small areal extent and high intensity. These storms are the cause of severe soil erosion and flood damage and add very little to the soil moisture. Strong winds, generally from the west and southwest, may occur at any time of the year, drifting snow in the winter and causing soil movement and excessive evaporation during other seasons.

Average annual precipitation varies from 55 inches in the upper reaches of the basin near Bald Mountain to 7 inches in the Boardman area along the Columbia River (fig. 5). Annual precipitation in most of the agricultural areas of the basin varies from 8 to 20 inches. Precipitation during the irrigation season, April 1 to September 30, averages less than 6 inches in most agricultural areas and is as low as 2.5 inches at Umatilla.

Mountain snowpacks are important sources of water for irrigation, fish, wildlife, domestic, and other uses. The mean annual snowfall is 157 inches at Meacham in the Blue Mountains and 19 inches at Pendleton.



LEGEND

LAND SUITED FOR CULTIVATION AND OTHER USES

CLASS II — Soils in Class II have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

CLASS III — Soils in Class III have more limitations and hazards than those in Class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

CLASS IV — Soils in Class IV have greater limitations and hazards than Class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

LAND LIMITED IN USE--GENERALLY NOT SUITED FOR CULTIVATION

CLASS VI — Soils in Class VI have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, or wildlife.

CLASS VII — Soils in Class VII have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, or wildlife.

CLASS VIII — Soils and land forms in Class VIII have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, or water supply.

NOTE
**Under irrigation most of this area would be changed to Class IIe*

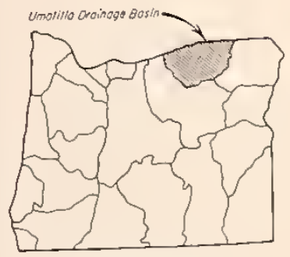
SUBCLASSES
e : erosion
w : wetness
s : soil problem

Drainage Basin Boundary
Subbasin Boundary
National Forest and/or Indian Reservation Boundary

SUBBASINS

1 WALLA WALLA
2 UMATILLA
3 WILLOW

COUNTY LOCATION



DRAINAGE BASIN LOCATION

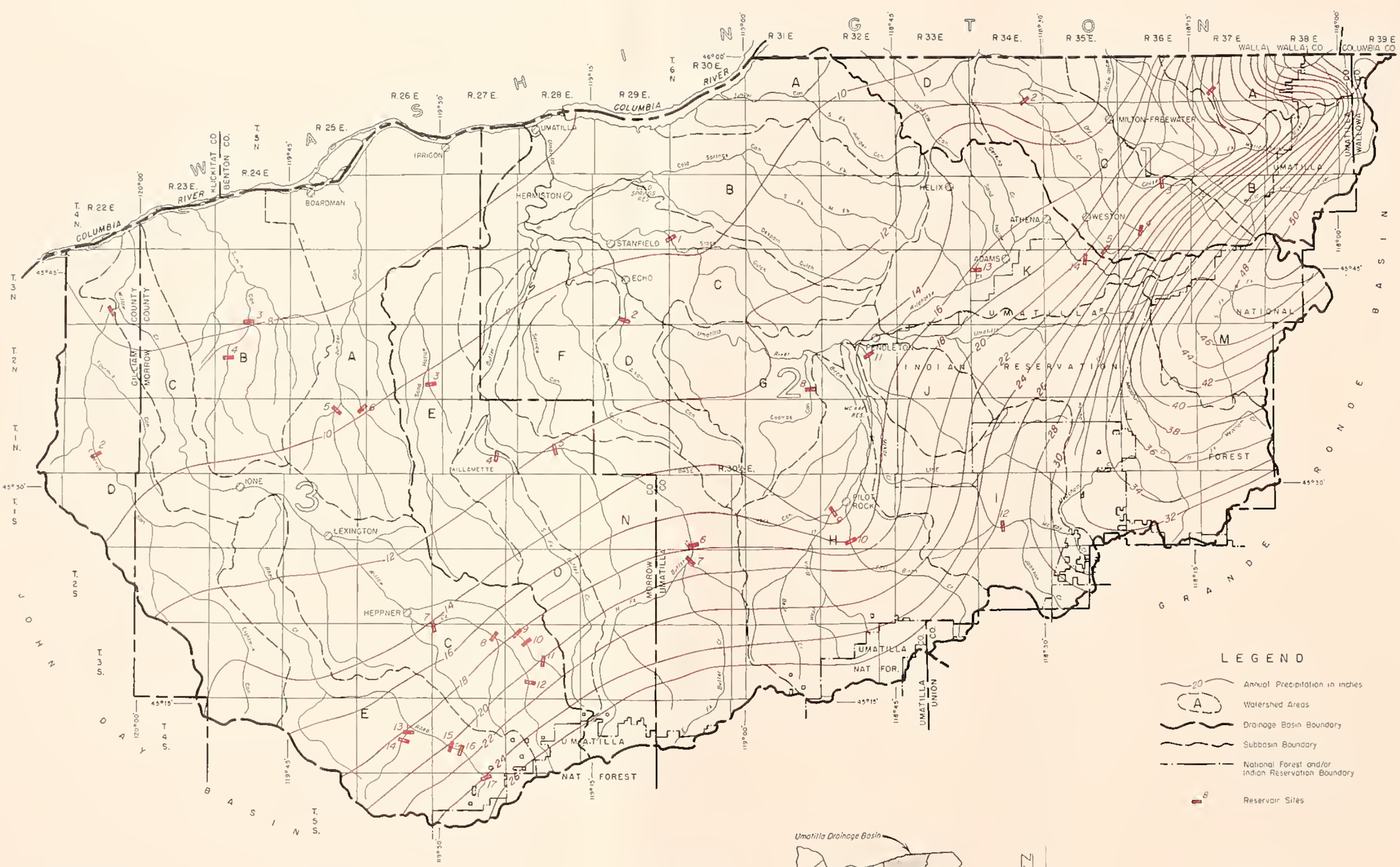
FIGURE 4
GENERALIZED LAND CAPABILITY CLASSES
UMATILLA DRAINAGE BASIN
OREGON

DECEMBER 1962

SCALE IN MILES 0 2 4 6 8

7-E-17382-N

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE ... M-3829



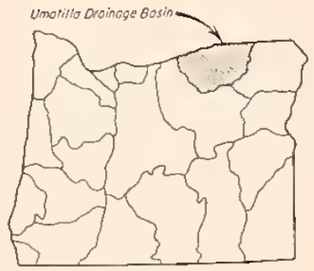
SUBBASINS

1 WALLA WALLA

2 UMATILLA

3 WILLOW

COUNTY LOCATION



DRAINAGE BASIN LOCATION

LEGEND

- 20 — Annual Precipitation in inches
- A — Watershed Areas
- Drainage Basin Boundary
- Subbasin Boundary
- National Forest and/or Indian Reservation Boundary
- 8 — Reservoir Sites

FIGURE 5

PRECIPITATION MAP

UMATILLA DRAINAGE BASIN

OREGON

DECEMBER 1962

SCALE IN MILES 2 0 2 4 6 8

7-E-17402-N

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE PORTLAND, OREGON M-3829

The mean annual recorded temperature varies from 43° F. at Meacham, elevation 4,050 feet, to 53° F. at Hermiston, elevation 624 feet. Milton-Freewater at elevation 962 feet also has an average temperature of 53° F. Recorded temperature extremes at Pendleton varied from -22° F. to 110° F.

The frost-free growing season varies from 30 days at higher elevations to around 200 days along the Columbia River. At Pendleton the growing season is about 160 days; in the area around Milton-Freewater it is 190 days. The growing season in the dryland grain areas ranges from 150 to 180 days.

SETTLEMENT AND HISTORY

It was not until 1858 that cattlemen came to stay in the Umatilla Drainage Basin. Settlement was hampered by the severe winter of 1861-62, which caused widespread losses to livestock throughout the area. The discovery of gold in the Blue Mountains in 1862 attracted attention, and mining became an important industry. Completion of a railroad into Pendleton in 1883 gave impetus to settlement and opened new markets, and wheat production rapidly became the major agricultural enterprise.

One of the earliest industries was logging. The mining rush of the 1860's provided the necessary market, both at the mines and in the community. This promoted the establishment of sawmills, and by 1900 there were several in the basin. The industry was reasonably stable until the late 1930's when there was a general expansion which has been sustained.

Irrigation began in the late 1800's near the streams, and alfalfa was introduced as a hay crop. Irrigation water supplies were increased by the completion of the Cold Springs Reservoir in 1908 and the McKay Reservoir in 1926.

Agriculture is the major enterprise in the basin. The growing of peas in the higher rainfall areas brought processing plants to the basin. In recent years mining has almost disappeared, but recreational developments have added to the growth of the basin.

POPULATION

In 1960, the population of the Umatilla Drainage Basin was about 48,400, or about 11 persons per square mile. About 47 percent of the people live in the urban areas of Pendleton, Hermiston, and Milton-Freewater; 15 percent live on farms; and 38 percent live in rural towns with populations of 2,500 or less (table 2).

The most populous of the three subbasins is the Umatilla with about 70 percent of the population. Major cities in this subbasin are Pendleton, Hermiston, and Pilot Rock with populations of 14,434; 4,402; and 1,695 respectively. All other towns in the subbasin have populations of less than 1,000 each.

Table 2.--Population distribution, Umatilla Drainage Basin, Oreg., 1960

Place of residence	Number of inhabitants			
	Subbasin			
	1	2	3	
	Walla Walla	Umatilla	Willow	Total
	Number	Number	Number	Number
Urban areas 1/	4,110	18,840	...	22,950
Rural areas:				
Farm	2,310	3,700	1,130	7,140
Nonfarm	2,760	12,010	3,570	18,340
Total	9,180	34,550	4,700	48,430

1/ Cities having 2,500 or more inhabitants.

Source: Rural farm population estimated on the basis of number of farms. Other data furnished by the State Water Resources Board of Oregon.

About 20 percent of the basin's population is in the Walla Walla Subbasin. Milton-Freewater is the major city in this subbasin with a population of 4,110. Weston with a population of 783 is the only other sizeable town in the Walla Walla Subbasin.

The Willow Subbasin, the least populous of the three subbasins, has about 10 percent of the basin's population. Heppner, the major town in this subbasin, has a population of 1,661. All other towns and communities have populations of less than 500 each.

The total population of the basin increased steadily from 1900 to 1920, decreased slightly from 1920 to 1940, and then increased substantially from 1940 to 1960 (fig. 6). Since 1900, the population of Morrow County has remained fairly stable between 4,000 and 5,000. During this same time, the population of Umatilla County has more than doubled.

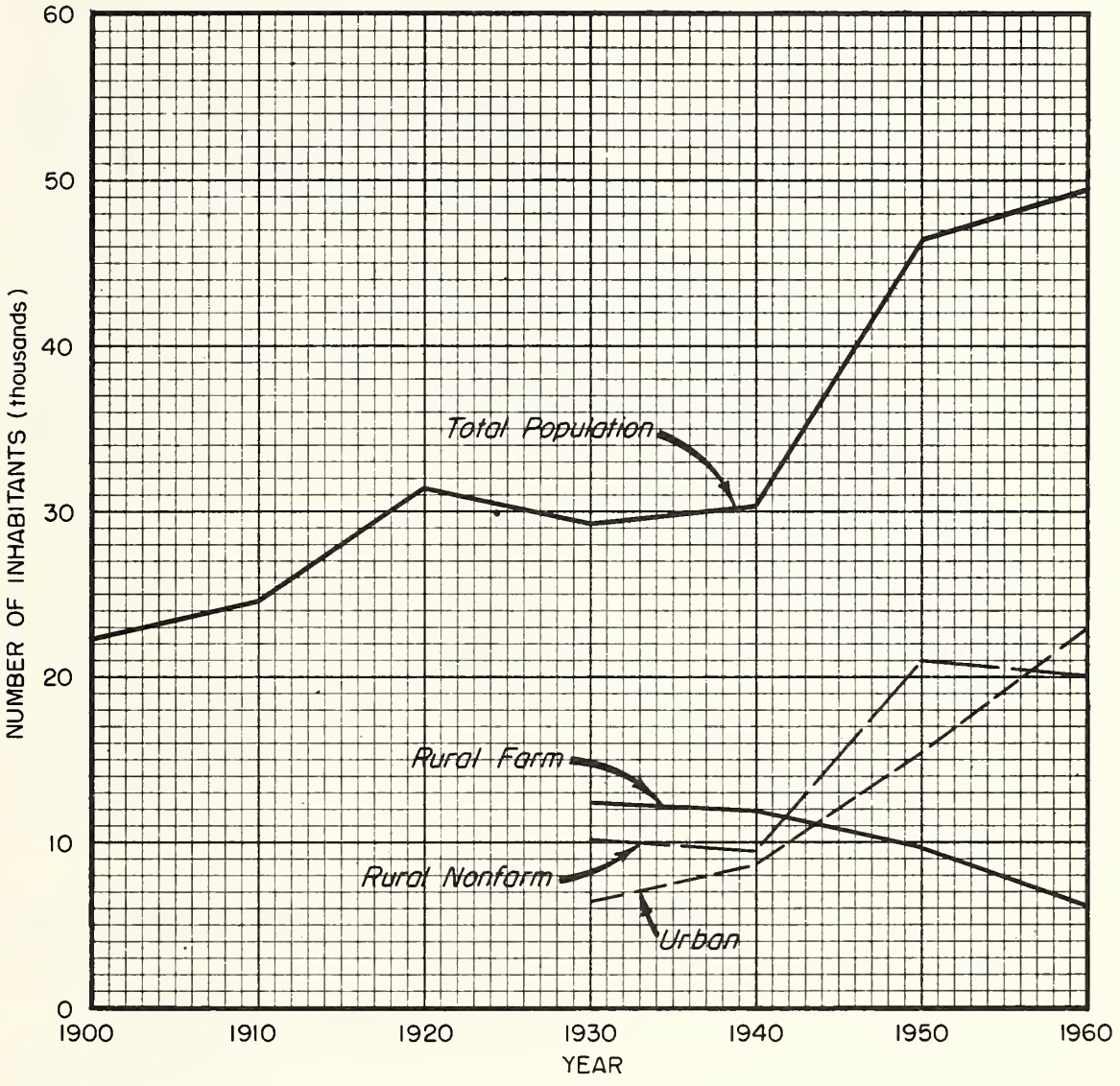
Rural farm population has continually declined since 1930. The expanded farm size resulting from improved technology and mechanization has been the major factor contributing to the decline in rural farm population.

The decline in rural farm population was more than offset by an increase in urban and rural nonfarm population. The expansion of wood manufacturing and food processing industries was a major factor in contributing to the population growth.

EMPLOYMENT

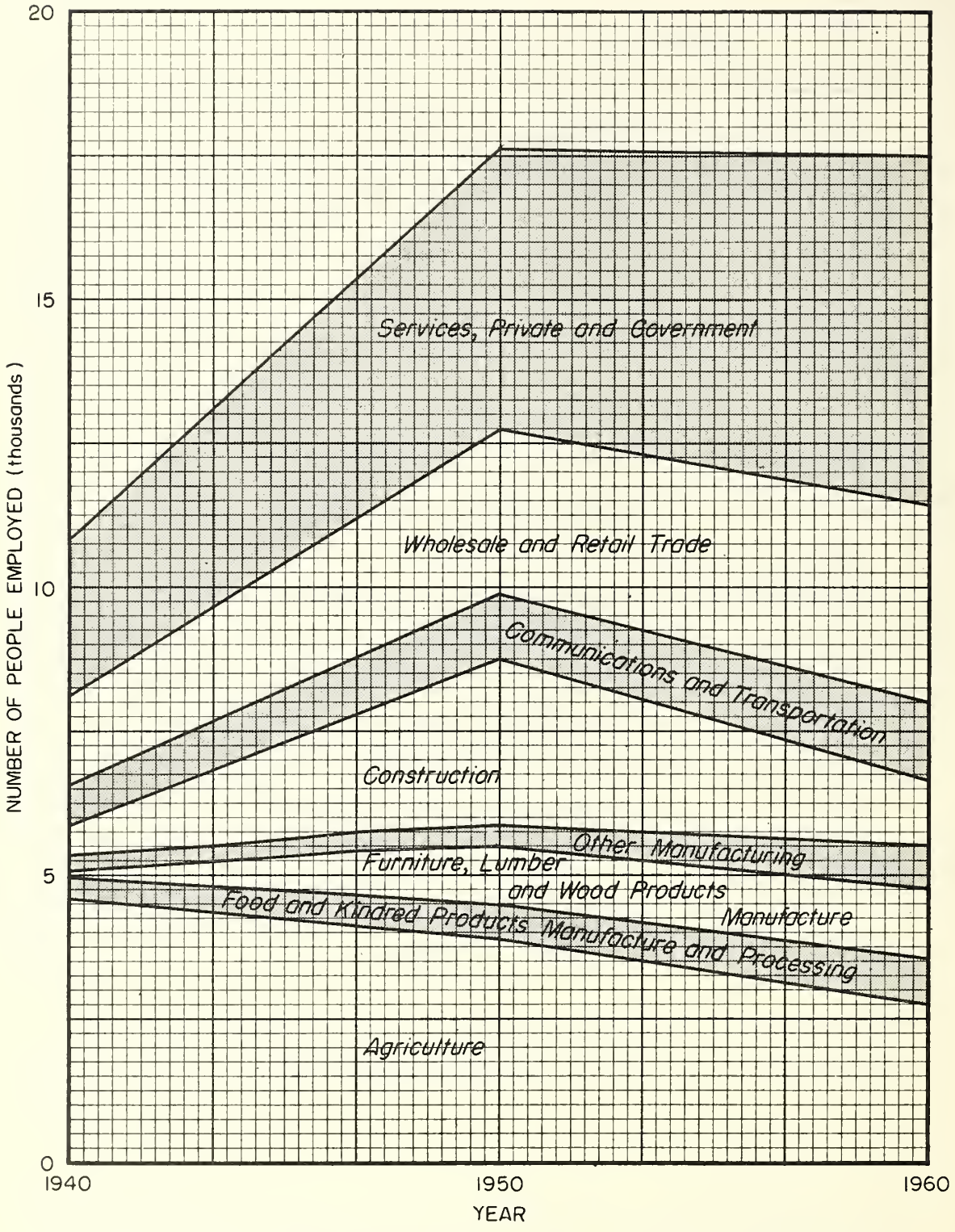
In 1960, about 17,500 people, or 36 percent of the population in Morrow and Umatilla Counties, were employed. About 34 percent of the working force was employed in private and government services, and 20

Figure 6: Population of two principal counties in the Umatilla Drainage Basin, Oreg., 1900-1960



Source: U. S. Census of Population, Morrow and Umatilla Counties.

percent was employed in wholesale and retail trades. Manufacturing and agriculture each employed about 16 percent of the labor force. However, this does not include the seasonal workers employed for harvesting peas, fruit, and other agricultural products. About 7 percent of the labor force was employed in communication and transportation, and the remaining 7 percent worked in construction.



Source: U. S. Census of Population, Morrow and Umatilla Counties.

Figure 7: Employment in two principal counties in the Umatilla Drainage Basin, Oreg., 1940-1960

Trends in employment in Morrow and Umatilla Counties are shown in figure 7. Employment in agriculture has declined since 1940 while employment in all other occupations has increased. Employment increased most in furniture, lumber, and wood products manufacturing, expanding from 223 people in 1940 to 1,231 in 1960. Employment in both the food and kindred products manufacturing and processing industry and the wholesale and retail trades industries more than doubled from 1940 to 1960 while employment in the communications, transportation, and service industries increased only slightly.

TRANSPORTATION

The Umatilla Drainage Basin has excellent transportation facilities. The main line of the Union Pacific Railroad into the Pacific Northwest passes through Pendleton and other towns along the Umatilla River. Spur lines run from Pendleton south to Pilot Rock, northeast up Wildhorse Creek through Milton-Freewater to Walla Walla, Wash., and south from Heppner Junction to Heppner. A branch line of the Northern Pacific Railroad reaches Pendleton from the north through Vansycle Canyon. Two federal highways transverse the basin, U. S. 30 in an east-west direction and U. S. 395 in a north-south direction intersecting at Pendleton. U. S. Highway 730 parallels the Columbia River from Boardman through Umatilla to the Oregon state line. Several state highways and numerous well maintained county roads link the population centers.

Regular bus service is available on U. S. Highways 30, 395, and 730 and also on Oregon 11. Freight service is available on a regular basis to the larger towns, and irregular service can be secured to nearly all points in the basin.

Umatilla is a port of call for Columbia River barges. Its terminal and public docks facilitate the interchange of cargoes between barge and rail or motor freight carriers.

Pendleton has the only airport in the basin that is used by commercial airlines. United Air Lines and West Coast Air Lines provide regular service in and out of the basin. There are also several smaller public and private airports and landing strips in the basin.

LANDOWNERSHIP

In this report landownership in the Umatilla Drainage Basin was classified as federal, state, county and municipal, and private. The federal land is administered by the Department of Agriculture, Department of Defense, and Department of the Interior. The acreage in each ownership is shown in table 3, and the general location of the various ownerships is shown in figure 8.

About 85 percent of the basin is privately owned. Ninety-two percent of the private land is either cultivated or rangeland, and almost 8 percent is forest land. The small area remaining is made up of small private holdings in towns and other areas.

Table 3.--Land use and ownership, Umatilla Drainage Basin, Oreg., 1962

Class of ownership	Federal departments: Agriculture	Federal departments: Defense	Federal departments: Interior	State of Oregon	County and municipal	Private	Total
	Acres	Acres	Acres	Acres	Acres	Acres	Acres
1. Walla Walla Subbasin:							
Forest	48,710	...	920	...	640	37,930	88,200
Range	5,120	...	1,270	...	...	79,910	86,300
Cultivated	...	...	...	...	...	133,200	133,200
Other	1,520	...	...	40	490	1,250	3,300
Subtotal	55,350	...	2,190	40	1,130	252,290	311,000
2. Umatilla Subbasin:							
Forest	136,720	...	7,730	2,790	...	123,080	270,320
Range	45,150	430	29,740	560	300	702,920	779,100
Cultivated	...	...	520	800	300	631,480	633,100
Other	5,230	4,570	1,030	1,740	1,230	9,880	23,680
Subtotal	187,100	5,000	39,020	5,890	1,830	1,467,360	1,706,200
3. Willow Subbasin:							
Forest	12,300	...	100	...	...	32,910	45,310
Range	50	46,440	25,170	48,000	...	406,830	526,490
Cultivated	...	...	...	...	...	304,850	304,850
Other	400	10,160	...	2,590	80	7,420	20,650
Subtotal	12,750	56,600	25,270	50,590	80	752,010	897,300
Total Umatilla Drainage Basin:							
Forest	197,730	...	8,750	2,790	640	193,920	403,830
Range	50,320	46,870	56,180	48,560	300	1,189,660	1,391,890
Cultivated	...	...	520	800	300	1,069,530	1,071,150
Other	7,150	14,730	1,030	4,370	1,800	18,550	47,630
Total	255,200	61,600	66,480	56,520	3,040	2,471,660	2,914,500

Source: Compiled from data furnished by USDA Field Party, U. S. Forest Service, Bureau of Land Management, Bureau of Indian Affairs, and County Assessors.

SUBBASINS

1 WALLA WALLA

2 UMATILLA

3 WILLOW

LEGEND

National Forest

Bureau of Land Management

Indian Service

Department of Defense

U.S. Fish and Wildlife Service

State and Municipal

Private

COUNTY LOCATION

DRAINAGE BASIN LOCATION

FIGURE 8

LAND STATUS

UMATILLA DRAINAGE BASIN

OREGON

DECEMBER 1962

SCALE IN MILES

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE ... M-3829

7-E-17411-N

The Federal Government owns 13 percent of the basin. Of this, the Forest Service of the Department of Agriculture manages 69 percent; the Army and Navy, Department of Defense, control the 17 percent in the bombing range and ordnance depot near Hermiston; and the Department of the Interior controls 14 percent.

The major portion of the Department of Interior land is managed by the Bureau of Land Management. Minor amounts are managed by the Bureau of Sport Fisheries and Wildlife and the Bureau of Indian Affairs.

The Indian lands owned by the tribe amount to less than one percent of the land in the basin. This tribal land has been included in the Department of the Interior tabulations. The major portion of the Indian lands are owned by or allotted to individuals and are included in the private ownership tabulations.

The State of Oregon owns approximately two percent of the land in the basin. The major portion, approximately 90 percent, is in the Boardman Space Age Industrial Park. The rest is in road right-of-ways and parcels of less than 1,000 acres scattered throughout the basin.

County and municipal holdings amount to less than one percent of the total land in the basin.

LAND USE

The present land use has evolved under the physical and economic conditions in the basin. The generalized pattern of land use is shown in figure 9, and a tabulation of land use by ownership class is presented in table 3.

Rangeland constitutes the largest use of land in the basin. About 1,391,890 acres, or 48 percent of the land, are used for this purpose. The rangeland lies in two belts, one along the Columbia and another at higher elevations between the cropland and the forest land. The land along the Columbia is limited to use as rangeland primarily because of low rainfall, whereas soils and topography are the factors which determine the land use in the upper belt.

Between the two belts of rangeland lies the majority of the cropland, the second most extensive use of land in the basin. About 36 percent of the land is used for this purpose. The cropland lies in an area with rolling topography, fairly deep soils, and an annual rainfall of 8 to 20 inches. Part of the cropland is irrigated. It lies along the creeks and streams throughout the basin and in areas reclaimed by projects.

At the higher elevations, above 3,000 feet, in the basin is the forest land belt. Forests cover about 14 percent of the land in the basin. Climate and topography are the principal factors which limit the use of this land to forests.

Other land uses in the basin include such purposes as cities, towns, roads, reservoirs, industrial sites, and others. About two percent of the land in the basin is used for these purposes.

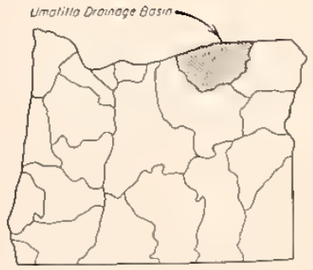
SUBBASINS

1 WALLA WALLA

2 UMATILLA

3 WILLOW

COUNTY LOCATION



DRAINAGE BASIN LOCATION

LEGEND

- Land Use Boundary
- Drainage Basin Boundary
- Subbasin Boundary
- National Forest and/or Indian Reservation Boundary
- Irrigated Cultivated
- Dry Cultivated
- Mixed Cultivated and Range
- Range
- Forest

FIGURE 9

GENERALIZED LAND USE

UMATILLA DRAINAGE BASIN

OREGON

DECEMBER 1962

SCALE IN MILES

7-E-17383-N

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE M-3829

INTRODUCTION

Forested land occupies 403,800 acres, or 14 percent, of the Umatilla Drainage Basin. The forested land occurs mainly as a narrow rim on the south and east sides of the basin. Precipitation limits the forest to the area above 3,000 feet elevation on the eastern side and above 4,000 feet on the southern side of the basin.

About 367,800 areas, or 91 percent, of forested land are commercial forest land (land that is capable of producing crops of sawtimber or pulpwood and not reserved from timber harvest by statutory or administrative authority).

About 16,800 acres, or 4 percent, of forested land are noncommercial forest land (forested land that is incapable of producing crops of sawtimber or pulpwood because of adverse growing conditions). Noncommercial forest land occurs in small, scattered tracts at low elevation or on precipitous slopes with shallow soils.

About 2,000 acres, or less than one percent, of forest land are in reserved forest status where timber harvesting is prohibited by statutory or administrative authority. State parks and waysides account for the majority of this land. There are 640 acres in the Mill Creek drainage owned by the city of Walla Walla which are reserved for watershed protection. In addition to these formally reserved lands, timber harvest on approximately 6,800 acres of national forest land within the Mill Creek watershed is presently restricted pending improvement of logging methods to insure adequate protection of the soil.

Approximately one-half of the forest land within the drainage is owned by the Federal Government and managed by the Forest Service. Minor amounts of federal forest land are managed by the Bureau of Indian Affairs and Bureau of Land Management of the Department of the Interior (tables 4 and 5).

Except for two or three large private parcels, the remainder of the forest land is made up of scattered individual, state, county, and municipal ownerships.

FOREST MANAGEMENT

Forests are an ever changing association of plants and animals which are affected by man's actions. They are the source and storage area for much of the basin's water. They are the source of the raw material for a large segment of the basin's industry. They are the home of a large variety of game animals and the summer range for livestock. They are the center for the rapidly expanding field of outdoor recreation. Each of these key values will be discussed in the following sections of the report. Other fields of forest land management will be discussed where they are directly pertinent to the forest situation.

Table 4.--Timber volume on commercial forest land by species and ownership class, Umatilla Drainage Basin, Oreg., 1962

Subbasin and ownership class	Species						
	Ponderosa pine	Douglas-fir	Lodgepole pine	Western larch	Englemann spruce	True firs	Total
	MM bd. ft.	MM bd. ft.	MM bd. ft.	MM bd. ft.	MM bd. ft.	MM bd. ft.	MM bd.ft.
1. Walla Walla Subbasin:							
Federal:							
National forest	87	...	10	...	...	511 1/	608
National land reserve	1	2	...	...	...	1	4
Indian	...	...	...	...	...	...	...
State of Oregon	...	...	...	...	...	...	...
County and municipal	...	1	...	...	...	...	1
Private	44	101	...	33	18	90	286
Total	132	104	10	33	18	602	899
2. Umatilla Subbasin:							
Federal:							
National forest	302	...	33	...	...	1,773 1/	2,108
National land reserve	2	1	...	1	...	...	4
Indian	40	24	1	37	3	15	120
State of Oregon	3	2	...	3	...	1	9
County and municipal	...	...	...	...	...	...	...
Private	182	162	6	117	26	117	610
Total	529	189	40	158	29	1,906	2,851
3. Willow Subbasin:							
Federal:							
National forest	53	...	2	...	...	43 1/	98
National land reserve	1	...	...	...	...	...	1
Indian	...	...	...	...	...	...	...
State of Oregon	...	...	...	...	...	...	...
County and municipal	...	...	...	...	...	...	...
Private	141	31	2	11	6	9	200
Total	195	31	4	11	6	52	298
4. Total Umatilla Baain:							
Federal:							
National forest	442	...	45	...	...	2,327 1/	2,814
National land reserve	4	3	...	1	...	1	9
Indian	40	24	1	37	3	15	120
State of Oregon	3	2	...	3	...	1	9
County and municipal	...	1	...	...	...	...	1
Private	367	294	8	161	50	216	1,096
Total	856	324	54	202	53	2,560 1/	4,049

1/ Includes Douglas-fir, Western larch, Englemann spruce, and true firs for national forest land.

Table 5.--Forest land area and timber volume by cover type and ownership class, Umatilla Drainage Basin, Oreg., 1962

Ownership class	Commercial forest land												Reserved forest land		1/ Non-commercial and grass	Total forest land	
	Sawtimber stands				Young growth				Hard-wood stands	Non-stocked land	Total commercial forest land						
	Ponderosa pine		Other		Ponderosa pine		Other										
	Area	Volume	Area	Volume	Area	Volume	Area	Volume	Area	Area	Area	Volume	Area	Volume	Area	Area	Volume
	Acres	MMBF	Acres	MMBF	Acres	MMBF	Acres	MMBF	Acres	Acres	Acres	MMBF	Acres	MMBF	Acres	Acres	MMBF
1. Walla Walla Subbasin:																	
Federal:																	
Department of Agriculture	6,110	105	36,400	503	130	...	800	...	...	...	43,400	608	...	...	5,270	48,710	608
Department of the Interior	10	...	410	4	...	...	...	...	...	...	420	4	...	...	500	920	4
State of Oregon	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
County and municipal	...	...	...	...	...	...	...	...	...	...	...	...	640	6	...	640	6
Private	4,200	35	21,100	240	600	...	11,280	9	550	120	37,850	284	...	...	80	37,930	284
Total	10,320	140	57,910	747	730	...	12,080	9	550	120	81,710	896	640	6	5,850	88,200	902
2. Umatilla Subbasin:																	
Federal:																	
Department of Agriculture	21,900	302	82,170	1,806	620	...	2,260	...	...	...	106,950	2,108	...	...	29,770	136,720	2,108
Department of the Interior	5,000	100	1,800	20	200	...	200	...	500	30	7,730	120	...	...	...	7,730	120
State of Oregon	700	6	330	2	130	...	240	...	...	70	1,470	8	1,320	8	...	2,790	16
County and municipal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Private	45,000	268	40,700	319	11,000	11	23,000	12	1,600	1,000	122,300	610	...	...	780	123,080	610
Total	72,600	676	125,000	2,147	11,950	11	25,700	12	2,100	1,100	238,450	2,846	1,320	8	30,550	270,320	2,854
3. Willow Subbasin																	
Federal:																	
Department of Agriculture	5,600	53	5,770	45	260	...	30	...	...	...	11,660	98	...	...	640	12,300	98
Department of the Interior	50	1	50	1	...	...	...	...	...	...	100	2	...	...	...	100	2
State of Oregon	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
County and municipal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Private	25,500	161	5,900	39	1,100	...	300	...	...	...	32,800	200	...	...	110	32,910	200
Total	31,150	215	11,720	85	1,360	...	330	...	...	...	44,560	300	...	...	750	45,310	300
Total Umatilla Drainage Basin:																	
Federal:																	
Department of Agriculture	33,610	460	124,340	2,354	1,010	...	3,090	...	...	...	162,060	2,814	...	...	35,680	197,730	2,814
Department of the Interior	5,060	101	2,260	25	200	...	200	...	500	30	8,250	126	...	...	500	8,750	126
State of Oregon	700	6	330	2	130	...	240	...	...	70	1,470	8	1,320	8	...	2,790	16
County and municipal	...	...	...	...	...	...	...	...	...	...	...	...	640	6	...	640	6
Private	74,700	464	67,700	598	12,700	11	34,580	21	2,150	1,120	192,950	1,094	...	...	970	193,920	1,094
Total	114,070	1,031	194,630	2,979	14,040	11	38,110	21	2,650	1,220	364,720	4,042	1,960	14	37,150	403,830	4,056

1/ Intermingled with forest land.

Source: Compiled from data furnished by U. S. Forest Service.

Protection from Insects, Disease, Wind, and Animals

Part of the job of forest management is the protection of forests from fire and other damage causing agents. Sometimes overlooked by people unfamiliar with forest management is the need for protection from insects, disease, animals, and weather. These needs are considered in planning timber harvest.

One of the guides for selecting ponderosa pine for harvest is based on the relative health of each tree as indicated by the size and density of the crown. Healthy trees are much more resistant to attacks from insects and diseases.

Protection from wind damage is considered when cutting areas are chosen. The location and shape of the areas may be altered to reduce damage from winter storms.

In some areas animal damage is severe and prevents the re-establishment of forests after harvest. Small rodents eat the seed and also nip the seedlings that may have sprouted or have been planted. Big game animals sometimes congregate in areas and eat everything green that is within their reach. Not only does this reduce the productiveness of the land, but it also leads to accelerated erosion when the ground cover is reduced or removed entirely. Studies aimed at reducing animal damage are being conducted by the Oregon State Game Commission, Forest Service, and other parties.

Fire Protection

There are almost 3 million acres in the basin, but it is estimated that less than 500,000 acres are within the boundary of the state and federal fire protection agencies. Generally, the Forest Service protects the area within the national forest boundary and the Oregon State Board of Forestry protects the forested area outside the forest boundary. There are a few rural fire districts which are geared mainly to protect buildings in and near towns although they do take action on grass, stubble, and brush fires within their boundaries. This leaves approximately 80 percent of the basin without adequate fire protection for the control of range and field fires.

It is the range fires and fires resulting from grain harvesting which are the most devestating. If a fire escapes from control in this area, it can spread almost unchecked to a town or forested area. When it reaches the protection area boundary, it is occasionally so large that control is all but impossible. The State Board of Forestry may take action on a fire before it reaches the protection area as a defensive measure.

There are about as many lightning as man caused fires in the basin, but the major damages result from the man caused fires. There are several reasons for this. Among them are the following:

1. Lightning fires frequently occur in the protected areas and are readily controlled.

2. There is usually at least a small amount of moisture with the lightning storms.

3. Man caused fires frequently escape because the conditions are so bad that they can't be controlled at the point of origin.

TIMBER

The forest stands do not occur as a solid block over a large area. Generally, there are open areas of varying size on south slopes and on ridge tops. In some watersheds such as Meacham Creek in subbasin 3 forest stands are limited to the draws and stream bottoms.

Table 5 shows that virgin sawtimber stands predominate in the basin occupying 251,600 acres, or 68 percent, of the commercial forest land. Thirty percent of this area is covered by virgin ponderosa pine. Cutover sawtimber stands occupy about 60,000 acres, or 15 percent, of the commercial forest land. The acreage of cutover stands is increasing rapidly through partial cutting. Poletimber and seedling-sapling stands occupy about 52,400 acres, or 14 percent, of the commercial forest land.

Volume-wise ponderosa pine comprises one-fifth of the available sawtimber in the basin; the major portion of this species is classed as virgin sawtimber (table 5). A characteristic of the ponderosa pine in this basin is that it is found in scattered small patches usually on the drier south slopes.

Development of the Timber Industry

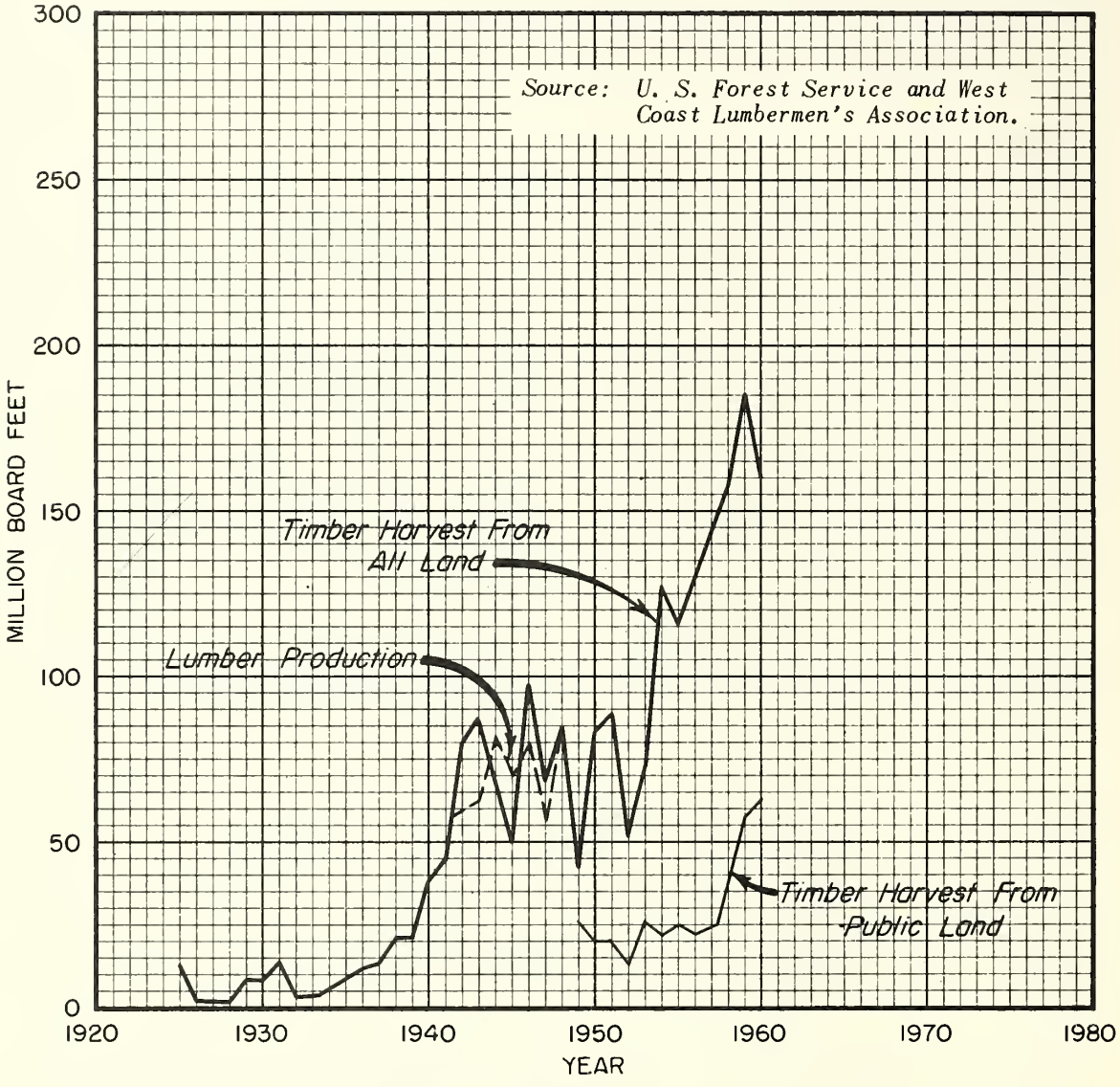
The early timber harvesting was done mainly on private land. Harvesting on national forest lands became important after World War II. In 1955, 15 percent of the timber harvest in the basin was from publicly owned lands while in 1960 publicly owned lands accounted for 40 percent of the harvest (fig. 10).

Logging began in the most accessible ponderosa pine stands because pine was the most valuable species. Since 1950, a significant amount of white fir, Douglas-fir, and associated conifers have been harvested. These species are still not nearly as marketable as ponderosa pine.

Lumber is almost the exclusive product manufactured from the basin's timber. There are some box and furniture factories that have been operating for many years. The fiber board plant at Pilot Rock started in the early 1950's. This plant uses what was previously sawmill wastes in producing many kinds of hard and soft boards.

In 1960, there were sawmills located near Athena, Gibbon, Heppner, Meacham, Milton-Freewater, Pendleton, and Pilot Rock. These mills have and installed annual capacity of 170 million board feet.

Figure 10: Timber harvest, 1925-1960, and lumber production, 1941-1948, for Morrow and Umatilla Counties, Oreg.



Most of the pine lumber is planed and dried; most of the other species are sold as rough green or air dried lumber. Except for that used locally, the lumber is shipped by rail to markets throughout the nation.

Utilization of harvested timber has improved greatly in the last few years, but there are still opportunities for more improvement. There is one plant in the basin that uses mill residues, and it receives almost 60 percent of its raw material from one sawmill. The residue from the other mills in the area is either burned to produce power to run the mills, used locally as fuel, or burned in a refuse burner. There is probably enough raw material available in the area

to operate other fiberboard plants in the basin. However, there are several economic factors which currently tend to discourage the construction of additional plants including:

1. High transportation costs. The sawmills are scattered throughout the basin so chips would generally have to be hauled long distances to a central manufacturing point. Small logs from thinnings would also have to be hauled long distances.

2. High cost of barking and chipping equipment.

3. Lack of a dependable year-round water supply.

4. Lack of suitable disposal system for waste liquors.

Harvesting and Regeneration Methods

Various species, or species groups, require different harvesting and regeneration methods. One major difference in various species is their degree of tolerance. In forestry this refers to the tree's ability to survive under deep shade. Ponderosa pine is classed as an intolerant tree which means it needs openings in the crown to successfully reproduce. This results in trees of varying ages growing in the same stand. Since the trees are of many age classes, a few individual trees may be selected for harvest with an overall beneficial effect on the stand. Not only does this selection remove the old or more slowly growing trees, it also produces the proper environment for seedlings.

Because of the difference in tolerance, the true firs and other associated species require different harvesting systems. Tolerant trees can reproduce and survive in deep shade. When they form an understory beneath the crowns of their own species or intolerant species, they are very persistent, clinging to life in spite of very small growth for many years. The tolerant trees, therefore, form stands of more uniform ages. Since there is not a staggering of age classes, mature trees can be clear cut.

Clear cuts in this forest type should be kept small because trees suffer from shock and can be killed if their local climate is changed abruptly. Small clear cuts which enable natural reproduction to spread in from the cool, shady side are considered by some foresters to be nearly optimum management for this type of forests.

Private Land. Timber harvesting on private land varies greatly with ownership. The larger timber owners, particularly those with sawmills that are dependent on a continuous raw material supply, are practicing conservative cutting with provisions for regeneration. Much of the timber harvesting in the past was on a near-clear-cutting liquidation basis. On many private tracts the owner is mainly interested in growing forage for livestock. Therefore, some land is gradually converted to grassland.

Publicly Owned Lands. National forest timber is managed by law on a sustained yield basis; that is, harvesting is kept in balance with growth. Management practices are followed which will result in optimum production of timber crops without impairment of the productivity of the land.

Since natural regeneration is sometimes slow and uncertain because of drought conditions, nursery grown seedlings are planted where necessary. Livestock grazing is controlled, as necessary, to protect seedlings.

Harvesting practices on other federal lands are very similar to those on national forest land.

Logging Methods

Most of the cutover land in the basin has been logged by tractor methods. Where the ground is steep, or the soil is of an erosive nature, or where skidroads are located without sufficient regard for soil protection needs, considerable damage to the watershed may result. This has been true to some extent in the past logging operations on all ownerships. Today logging operations on national forest land are carefully planned for soil and watershed protection. Skid trails and other areas where the vegetative cover has been disturbed are seeded to grass if an erosion hazard exists. Even with these measures, some erosion may result because vegetative cover is slow in re-establishing and because of heavy spring runoff from melting snow. Much of the mixed-conifer stands that are beginning to be harvested on national forest land are located on steep ground and require some form of cable yarding to prevent watershed damages.

Logs are generally skidded in 16 to 32 foot lengths and are hauled by truck to the sawmill over the network of timber access roads financed by development of the basins's timber resources. These roads make the forest land more readily accessible for all phases of management and use but present a soil erosion potential if not properly built and maintained.

Sustained Yield Potential

National Forest Land. The present allowable annual timber harvest from national forest land in the basin is 25 million board feet (table 6). This is derived by pro-rating the allowable cut figures for the various national forest working circles 1/ included in the basin to the portion of each working circle that is in the basin. This is an empirical figure because national forest working circle allowable cuts are determined for an entire working circle. The location of cutting may vary widely from one portion of a working circle to another from year to year. Thus, in a given year the entire cut for a working circle that is partially inside the basin may occur on land in the

---

1/ A working circle is the basic planning unit for national forest timber management. It generally consists of several drainages with a common market point for harvested timber.

Table 6.--Allowable cut, rotation age, and ultimate sustained yield, national forest land, Umatilla Drainage Basin, Oreg.

Subbasin	Allowable cut	Ultimate sustained yield	Rotation age	Average site index
	MM bd. ft.	MM bd. ft.	Years	(Ponderosa pine)
1. Walla Walla	5.8	5.9	115	85
2. Umatilla	18.0	18.3	115	85
3. Willow	.7	.7	125	79
Total	24.5	24.9		

basin while in other years there may be no cutting in the basin. The actual cut in any one year may also fluctuate widely with varying market conditions as illustrated by table 7. Thus, the figures derived for the report are of value only as long-term indications of sustained yield.

Allowable cuts are subject to recalculation at approximately 10 year intervals. Such factors as degree of wood utilization, rapidity of regeneration of cutover land, and accessibility of salvagable dead timber may affect the allowable cut. For instance, increased demand for small logs, defective logs, and low valued species in recent years has resulted in allowable cuts being increased because material now utilized was not included in early calculations. Improved techniques of collection and evaluation of inventory data may also affect the allowable cut. Under intensified management, a gradual long-term increase in allowable cut is expected.

Table 7.--National forest timber cut, Umatilla Drainage Basin, Oreg., 1957-61

Subbasin	Year				
	1957	1958	1959	1960	1961
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.
1. Walla Walla	...	...	...	...	328.74
2. Umatilla	1,962.51	6,925.26	14,636.67	7,884.19	12,321.93
3. Willow	...	551.75	3,751.71	4,157.00	...
Total	1,962.51	7,477.01	18,388.38	12,001.19	16,150.67

Other Federal and State Land. These lands are comparable in productivity and management to national forest land. Thus, an allowable annual cut in proportion to its acreage might be assumed for this land, or about 3 million board feet.

Private Land. Because of present rapid depletion of the timber stand on private land, it is difficult to assign it a sustained yield

volume. For the immediate future continuing depletion may be expected with near exhaustion of merchantable sized private timber within twenty-five years followed by an extended period of little or no cutting while present young stands are attaining merchantable size. During this period, the timber supply for the basin will be almost entirely from public land. Thereafter, timber production from private lands will be closely related to intensity of management. Under optimum management an allowable cut at least comparable to expected national forest yields, or 28 million board feet, might be expected. However, there are several conditions in this basin which will tend to limit the extent of forest conservation practices on private land. These conditions include:

1. The generally low productivity of much of the forest land.

2. The low market value for species other than ponderosa pine and the limited market for small second-growth logs.

3. High transportation cost for forest products because of the relatively great distance to markets.

4. Long-term capital investment requirements and various tax considerations.

Improved markets for forest products may change some of these conditions, but private forest land management is expected to remain on a generally extensive basis for some time. Thus, a sustained production of 20 million board feet annually is thought to be realistic for these lands.

Therefore, the annual sustained yield of all commercial forest land in the Umatilla Drainage Basin is estimated at 45 to 60 million board feet depending upon intensity of management.

RECREATION

Recreational use of the Umatilla Drainage Basin is concentrated in the eastern and southern forested areas. There is some boating, swimming, fishing, and waterfowl hunting along the Columbia River (fig. 11). The great majority of the forest land is used by the public as a recreation area. Most of the generally accepted forms of outdoor recreation are enjoyed in developed areas such as camping, picnicking, hiking, riding, and winter sports. They account for the largest numbers of recreationists, but hunting and fishing bring out the more hardy type. During the hunting season people are scattered throughout the forested area with little thought of developed campsites.

Presently there are ten U. S. Forest Service camp and picnic areas, and the state has four recreation areas. There are no developed campgrounds on private forest land, but the majority of these lands are open for use except during periods of high fire danger.

Figure 11.--Hat Rock State Park is an example of water centered recreation in subbasin 2. SCS photo. 7-1264-10

The most readily available data on forest recreation use comes from the Umatilla National Forest (tables 8 and 9). This information has been modified to include only recreation visits to the area within the Umatilla Drainage Basin. In the last five years there has been a 40 percent increase in recreational use with a 348 percent increase in camping. This increase is very significant, and as more and better roads are developed, this figure will continue to increase as more and more people head for the hills to escape the extreme summer heat of the valleys. It is estimated that by the year 2000 there will be 5 times as many people camping in the forested areas of the basin.

There are a few summer homes and two organizational camps in the national forest. As a general policy the U. S. Forest Service is establishing camp and picnic grounds and encouraging organizational camps while discouraging the establishment of summer homes. It is felt by many recreation planners that a summer home is an exclusive use to a few and drastically limits the use of an area.

The state has land available that could be developed for recreation. It is possible that some of the private owners may in the future develop recreation areas.

Table 8.--Summary of national forest recreational use, Umatilla Drainage Basin, Oreg., 1957-1961

Primary purpose of visit	Year				
	1957	1958	1959	1960	1961
	Visits	Visits	Visits	Visits	Visits
Camping	4,900	9,300	11,400	12,900	17,100
Picnicking	12,200	16,500	17,800	28,200	29,100
Swimming	...	...	...	...	...
Winter sports	46,800	46,800	48,000	48,600	56,800
Hunting:					
Big game	11,200	12,240	12,760	12,280	13,400
Small game	...	...	...	1,590	1,570
Fishing	5,340	4,700	5,530	6,540	7,340
Hiking and riding	1,600	1,500	1,500	1,900	2,400
Wilderness travel	400	400	...	...	...
General enjoyment and sightseeing	6,500	7,150	8,050	8,700	10,300
Other	8,600	8,560	8,660	1,400	1,260
Total	97,540	107,150	113,700	122,100	139,270

Table 9.--Recreational use of national forests by subbasin, Umatilla Drainage Basin, Oreg., 1957-1961

Subbasin	Year				
	1957	1958	1959	1960	1961
	Visits	Visits	Visits	Visits	Visits
1. Walla Walla	36,000	45,200	50,500	56,900	62,800
2. Umatilla	61,320	61,730	62,750	64,740	75,940
3. Willow	220	220	450	470	510
Total	97,540	107,150	113,700	122,110	139,270

Source: Annual Recreation Reports and Umatilla National Forest.

As the recreational use of forest land increases, the maintenance of recreational zones bordering lakes, streams, roads, and trails will become more important. Commercial development such as resorts, stores, and motels are needed in some recreation areas, but they should be designed to harmonize with the natural setting. Timber harvesting should be modified in heavy use recreational zones to preserve recreational values.

MIXED FOREST AND RANGE

In the early days sheep roamed the forested rangeland in large bands. The owners of these bands gave little thought to what we now call "range management"; the grass was there, and the herds grazed it.

Over the years heavy grazing and trailing have left the vegetation on the side slopes too sparse to graze without harming the range, soil, and watershed resource.

Grazing Systems

The majority of the forested rangeland has some form of control. In some cases the range is actively managed, and the manager can identify the specific system or combination of systems used. In other cases the owner uses his own judgement based on his experience with no attempt to identify the specific system used.

Public Land. There are three federal public ownerships in the forested range area. Each one has a little different approach. The Bureau of Indian Affairs has their land divided into several grazing units and has up-to-date formal grazing management plans for most of these units. The Bureau of Land Management's lands are scattered small parcels which are, for the most part, leased to bordering ranchers. These lands are then used by the rancher as a part of his holdings. The U. S. Forest Service has most of the high elevation rangeland on which grazing permits have been issued to ranchers with established preference.

Private Land. The owners of large tracts of forested grazing land lease the range to selected ranchers. The rancher is expected to manage the range so that it will not be harmed. Many of these lands do not have formal range management plans and do not receive a specific system of range management.

Grazing practice on small ownerships varies so widely that no generalizations can be made.

Range Condition

Overuse in the past has had a lasting effect on the range condition because with continued weakening of the soil protecting vegetation by grazing and trailing, soil erosion also occurs (fig. 12). No amount of management or reseeding can return the range to full productivity if the soil will not support the desired plants. Because of the moisture needed to develop new soil from the parent material, it may take hundreds of years to restore soil that has been destroyed on the higher ranges in this basin.

The forest range condition varies from good to poor with the major portion in the lower classifications. Range condition information is available for national forest lands. Ninety-four percent of these lands, or 59,000 acres, are classed as poor. This is the result of heavy grazing and trailing over a long period of time. The Bureau of Indian Affairs feel that the majority of their land is in fair condition.

Figure 12.--Erosion resulting from overgrazing and trailing by sheep. USFS photo.

Range Revegetation

Because of many factors only 5 percent, or 3,000 acres, of national forest range can be reseeded by conventional methods. These factors include steep topography, poor soils, and dry sites. Because of the value of the range resource, studies are being conducted to find out if different methods of mulching or amounts of fertilizer can hasten the job of range restoration.

Wildlife Needs

Oregon State Game Commission data indicates that there is a relatively stable population of mule deer and Rocky Mountain elk. In the past few years, however, elk have been increasing their range with the overall effect of increased numbers and increased demand for the forage resource.

	Elk	Deer
Estimated population	3,470	4,750
Harvest	810	1,250
Hunter success	20%	60%

Expected Impact of Increased Wildlife

As the elk herd increases, the demand for forage increases. As the demand for wildlife hunting by people increases, the importance of wildlife range increases. In the past most of the suitable forage was alloted to domestic stock. It is apparent that a conflict exists, and studies are being conducted on the national forest to determine the degree of use between wildlife and livestock. It is planned to identify the key user of the forage on each range and take steps to manage the resource for the key use.

Over Population by Big Game

Data from the Oregon State Game Commission 1961 Annual Report shows a very low number of anterless deer and elk killed as compared to antlered animals since 1952. This large carry-over of females each year may result in overstocking of the ranges.

WATER

Water Yield

In an undisturbed forest precipitation returns to the atmosphere through evaporation and transpiration or moves slowly to streams or underground storage. Surface runoff occurs only during periods of prolonged and heavy rainfall. Vegetation and soil porosity are responsible for this watershed stability. A protective canopy of tree crowns and brush catches rain and snow, breaking its fall and preventing some of it from reaching the ground. Litter and humus, plant roots, and soil organisms increase soil porosity so water filters into the soil very readily reducing surface runoff and increasing ground water storage. Trees and other vegetation along streams maintain cool water temperatures by providing shade.

Much of the precipitation in the Umatilla Drainage Basin falls on forest land at the higher elevations. Most of this precipitation occurs as snow, which accumulates through the winter and melts between April and July. Because of this great snow storage capacity and the forest soil's water detention capacity, most of the late spring and summer water in the basin's streams comes from forested land.

The net effects of maintaining a healthy cover on a watershed are: (1) sustained flows and a more uniform hydrograph; (2) cooler water temperatures which are highly beneficial to fish life; (3) better controlled streamflows with peak flows at the time of heavy spring snow melting; (4) minimum sediment loads; and (5) less land damage.

Water Quality. The primary responsibility of the forest land manager with relation to water quality is to manage forest lands to maintain water purity, temperature, color, and taste. Some measures that should be taken to meet this responsibility are:

1. Protection of the soil mantle over the entire watershed to prevent accelerated erosion and resulting siltation.

2. Protection of streambanks and channels against disturbance by road construction, logging, and grazing by domestic livestock.

3. Maintenance of sufficient tree and brush shade along streams to keep summer water temperatures at tolerable levels for fish life.

4. Prevention of stream pollution.

Water Quantity. Both the total yield and seasonal variations in yield of water may be affected by forest land management. For instance, creation of small openings in the forest canopy may significantly increase snow storage. Less snow is intercepted by the crowns of large trees and evaporated without reaching the ground. Thus, carefully designed logging in the stands of lodgepole pine and mixed conifers in subbasin 1 might result in a reshaped hydrograph with significantly higher late summer water yields. This effect is highly variable depending upon many factors including shape and size of openings created, exposure, elevation, and prevailing winter winds.

The Target Meadows timber sale in subbasin 1 has narrow clear-cut strips instead of selection cut or large clear-cut areas in an attempt to increase the snow pack and lengthen the period of snow melt. This sale is patterend after experiments in lodgepole pine in Colorado. It is planned to lay out more sales in the basin using this principle where topography and available machinery will allow.

Preservation of good soil condition, mainly through maintenance of the plant cover, results in an optimum rate of water infiltration into the soil and minimum surface runoff. Then water is gradually released from the watershed instead of running off immediately.

It is doubtful whether either of these measures will have a large long-term effect on total water yields; however, destructive land management practices if carried on extensively would have a serious effect on the seasonal distribution of streamflows in this basin.

Water Use

Consumptive Uses. The maintenance of plant growth requires a large amount of water on forest land. This is generally referred to as the evapo-transpiration process, and water quantities involved cannot be measured accurately. However, forests do not commonly occur where annual precipitation is less than 16 inches. This quantity represents the environmental requirement for tree growth; the consumptive requirement is somewhat less. Other tree species have greater requirements for water and occur only where precipitation is heavier.

Other consumptive water needs on national forest land in the basin are presented in table 10. Administrative and recreational water needs are based on surveys of present consumption. Consumption for domestic livestock is based on an estimated requirement of 300 gallons per animal

unit month 1/ and the presently permitted range use. Road construction and maintenance and fire control use is based on estimates by local forest officers.

Table 10.--Estimated national forest consumptive water use 1/, Umatilla Drainage Basin, Oreg.

Use	Subbasin 1 Walla Walla	Subbasin 2 Umatilla	Subbasin 3 Willow	Total
	Thousands of gallons per year			
Domestic at administration sites 2/	...	95.1	...	95.1
Domestic at recreation sites	53.2	441.6	22.5	517.3
Domestic livestock	120.8	979.5	30.0	1,400.3
Road construction and maintenance	125.0	312.5	62.5	500.0
Fire control	25.0	100.0	25.0	150.0

1/ This includes only water actually used and should not be confused with amount stored to provide for this consumption.
2/ Does not include water obtained from municipal sources.

No consumptive use is identified for wildlife because it is impossible to generalize about the need of wild animals for water. Some animals appear to survive without free water but will use it if it is readily available.

Indications are that mule deer can obtain all the moisture they need from eating green and succulent vegetation when it is available. However, they will go to water during hot and dry periods when herbaceous vegetation has matured and dried.

Water rights are held for only a very small portion of the present national forest consumptive use. For instance, 90 percent of the administrative water consumption and 40 percent of the recreational water consumption is covered by existing water rights.

Consumptive water needs on other forest land are unknown but are believed to be comparative to that on national forest land.

Nonconsumptive Uses. It is important that water be provided in lakes, streams, and reservoirs as an environment for such recreational activities as fishing, boating, swimming, and general enjoyment. The quantity and quality of this water is important as it affects its suit-

---

1/ This is an empirical figure, for it includes only the water actually consumed by livestock. The amount of water stored for livestock may be many times larger to account for seepage and evaporational losses.

ability for fish life and its aesthetic appearance. Plans for development of the water resources of the basin should recognize these needs.

Nonconsumptive water uses in forest industries are those required for log ponds, hydraulic log barkers, and manufacture of pulp and wood particle products.

INTRODUCTION

The economic foundation of the Umatilla Drainage Basin is agriculture. The most important agricultural product is dryland wheat. Second only to wheat is the production of livestock. These enterprises are compatible with each other and are well adapted to the extensive cropland and rangeland in the basin. In more recent years, peas produced in rotation with dryland wheat have become an important crop in the basin.

Strengthening and stabilizing the economy of the basin is the production from the irrigated lands. Pasture and hay produced on irrigated land provide the feed base for dairy animals and supplementary feed for other livestock. The more intensive row crops, vegetables, fruits, and other crops produced under irrigation add to the economy of the basin.

LAND USE IN THE BASIN

Grazing Land

Grazed forest land and rangeland constitute the major agricultural use of land in the basin. About 1,600,000 acres, or 55 percent of the total area in the basin, are used for this purpose (table 11). Rangeland accounts for 69 percent of the grazing land, and the rest is forest land. Grazed forest land is defined as land grazed by livestock that is at least 10 percent stocked with trees.

The history of grazing land use in this basin is typical of grazing history in the West. Extensive grazing of domestic livestock began in the 1870's. Rangeland was in excellent condition before livestock numbers were introduced which exceeded the sustained capacity of the resource. The first indications of range depletion occurred during a series of dry summers in the early 1900's. However, no significant reduction in livestock numbers occurred until the early 1920's. By then large areas of the grazing land had reached a depleted condition from which it has only now begun to recover.

The grazing resource includes three general range types, the sagebrush-grass-annual grass, foothill bunchgrass, and the conifer-shrub-grass types.

The sagebrush-grass-annual grass type is found at lower elevations in the north and west part of the basin where the annual precipitation is from 7 to 10 inches. The soils are generally coarse to medium textured with a low water-holding capacity. The predominate vegetation is cheatgrass with some bluebunch wheatgrass, Sandberg bluegrass, needlegrass, squirreltail, sagebrush, rabbitbrush, and bitterbrush. Because of overgrazing, the condition of this range is poor. Much of this area is owned or controlled by big sheep ranchers and is used for late fall, winter, and early spring range for sheep.

Table 11.--Agricultural land use, Umatilla Drainage Basin, Oreg., 1962 1/

Agricultural land use	Subbasin 1 Walla Walla	Subbasin 2 Umatilla	Subbasin 3 Willow	Total
	Acres	Acres	Acres	Acres
Grazing land:				
Open rangeland	86,300	779,100	526,490	1,391,890
Forested land	38,800	133,560	33,320	205,680
Total	125,100	912,660	559,810	1,597,570
Cropland:				
Wheat	50,000	158,000	110,000	318,000
Barley	16,000	65,000	46,000	127,000
Other small grains	1,100	2,800	2,100	6,000
Subtotal	67,100	225,800	158,100	451,000
Alfalfa hay	6,800	13,200	7,100	27,100
Other hay	3,500	1,600	3,100	8,200
Subtotal	10,300	14,800	10,200	35,300
Green peas	16,100	36,800	...	52,900
Other vegetables	1,500	2,100	300	3,900
Subtotal	17,600	38,900	300	56,800
Row crops 2/	4,520	3,500	530	8,550
Orchards and vineyards	3,080	100	20	3,200
Other crops	4,200	9,800	1,000	15,000
Pasture	11,200	20,000	16,800	48,000
Total harvested and pastured	118,000	312,900	186,950	617,850
Idle and fallow	15,200	320,200	117,920	453,300
Total cropland	133,200	633,100	304,850	1,071,150

1/ Includes land in public ownership.
2/ Field corn, sugar beets, potatoes, hops, and peppermint.

The foothill bunchgrass type occurs in the intermediate elevations on the rolling uplands and in the main cropland area on the steep, non-cultivated areas with shallow soils. This is the most productive of the range type grasses because of the favorable soil and climatic conditions. Consequently, grass in this area has recovered from misuse faster and is presently in fair to good condition. The vegetation occurs in two distinct types, the bluebunch wheatgrass and Sandberg bluegrass type, and the Idaho fescue and bluebunch wheatgrass type. In areas where the rangeland is intermixed with cropland, forage production from the rangeland is supplemented by grazing of grain stubble. In the area where no cropland is present, the rangelands are grazed in the spring and fall.

Figure 13.--Intermingled rangeland and cropland in subbasin 3. SCS photo. 7-42

The conifer-shrub-grass type occurs in the higher elevations. This area has a forest overstory and a shrub-grass understory. The shrubs include bitterbrush, sagebrush, snowberry, ninebark, and ocean spray. The grasses include bluebunch wheatgrass, Idaho fescue, pine grass, needlegrass, and elk sedge. The range is grazed by cattle and sheep in the summer and early fall. The condition varies from poor to good. This area is owned by the Federal Government, large timber companies, and by ranchers. Most of the area not owned by ranchers is leased by them for summer range.

Cropland

About 37 percent of the basin area, or 1,071,150 acres, is cropland. The major uses of cropland are for the production of wheat, barley, green peas, pasture, and hay (table 11). Smaller acreages are devoted to the production of row crops, fruits, vegetables, and other crops. Wheat and barley are the most extensively grown crops in the basin occupying 445,000 acres, or about 41 percent of the cropland. The 453,300 acres of idle and fallow land is also predominantly used for small grain in alternate years. Thus, about 83 percent of the cropland in the basin is used for the production of wheat and barley. In addition to producing grain, the grain stubble also provides fall grazing for livestock.

In general, the wheat belt extends diagonally across the basin from southwest to northeast, between the 10 and 20 inch isohyets (figs. 5 and 9). In the lower areas of the basin where the annual rainfall is less than 14 inches, the alternate crop-fallow system is practiced in order to store moisture. In most of the upper areas of the basin where rainfall exceeds 14 inches, annual cropping of wheat or rotation of wheat and peas is practiced.

About 92 percent of the wheat is planted in the fall. Spring wheat is planted when winter kill occurs or when weather conditions prevent sowing in the fall. The main varieties grown are club and other soft wheats that are low in protein and suitable for pastry and flour.

The average wheat yield for the years 1958 to 1961 was about 33 bushels per acre. During this period, wheat yields varied from a high of about 36 bushels per acre in 1958 to a low of 23 bushels per acre in 1961. In general, wheat yields increase from west to east in the basin as precipitation increases. The average barley yield for the 1958 to 1961 period was about 36 bushels per acre. During this period, the average barley yield varied from a high of 37 bushels in 1960 to a low of 33 bushels in 1961.

In conjunction with the grazed forest and rangeland the 48,000 acres of cropland pasture and 35,300 acres of hayland provide the forage base for the livestock industry in the basin. About three-fourths of the hayland is alfalfa. The rest is clover, grass, and grain hay. In 1959, the average yield for alfalfa was 3.6 tons per acre while the yield for other hay was 1.5 tons per acre. In addition to producing hay, much of the hayland is also pastured.

Green peas are the second most important cash crop in the basin. Although only about 5 percent of the cropland in the basin is used for pea production, almost 10 percent of the agricultural income is from this source. Peas are grown in rotation with dryland wheat in the upper areas of the Umatilla and Walla Walla Subbasins. In addition to increasing and stabilizing agricultural income, peas increase nitrogen in the soil and help prevent soil erosion on land that might otherwise lie fallow every other year. All other vegetables raised in the basin are under irrigation and include such crops as sweet corn, watermelon, beans, asparagus, and carrots.

About 8,550 acres, or less than 1 percent of the cropland in the basin, are used for growing row crops. These crops are all irrigated and include field corn, sugar beets, potatoes, peppermint, and hops. Almost all of the orchard and vine crops are confined to the Milton-Freewater area of the Walla Walla Subbasin where they are raised under irrigation. Orchard crops include apples, prunes, plums, cherries, peaches, and pears. The fruit industry is still attempting to re-establish after suffering from a disastrous freeze in 1955. This freeze killed most of the prune, plum, and cherry trees and 85 percent of the apple trees. Small acreages of raspberries, grapes, and other vine crops are also raised in the basin.

Figure 14.--Harvesting wheat, the most important crop in the Umatilla Drainage Basin, Oreg. SCS photo. F-50-7

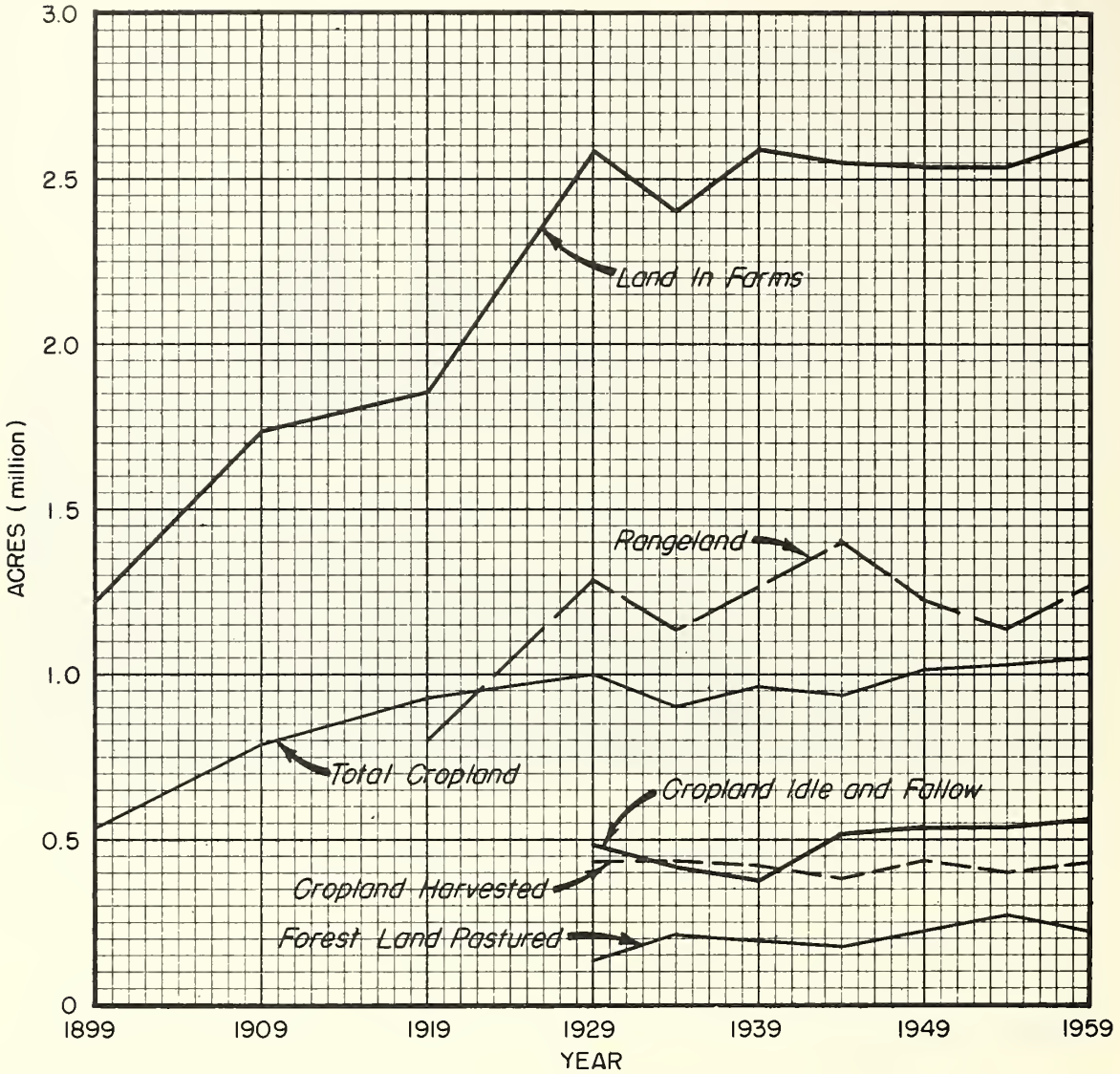
The 15,000 acres listed as "other crops" in table 11 are predominantly grass and legume seed crops.

Trends in Land Use

Land in farms and cropland both doubled from 1899 to 1929 (fig. 15). This was a period of settlement and development, and large areas of land were brought under cultivation. Since 1930, land in farms has remained fairly stable. There have been changes in land use; some marginal cropland has been shifted to rangeland, but other areas have been brought under cultivation so the balance between cropland and rangeland in the basin has remained about the same. There has been a slight upward trend in idle and fallow cropland and in forest land pastured.

Wheat acreage and production in the Umatilla Drainage Basin have been affected by rainfall, technology, prices, and government programs. From 1929 to 1939 wheat acreage and production declined in response to low prices and drought conditions (fig. 16). From 1939 to 1953 wheat acreage and production both increased rapidly in response to higher prices and generally higher rainfall. Technological advances in mechanization and cultural practices also contributed to the increase in acreage and production. Since 1953, wheat acreage has been reduced as

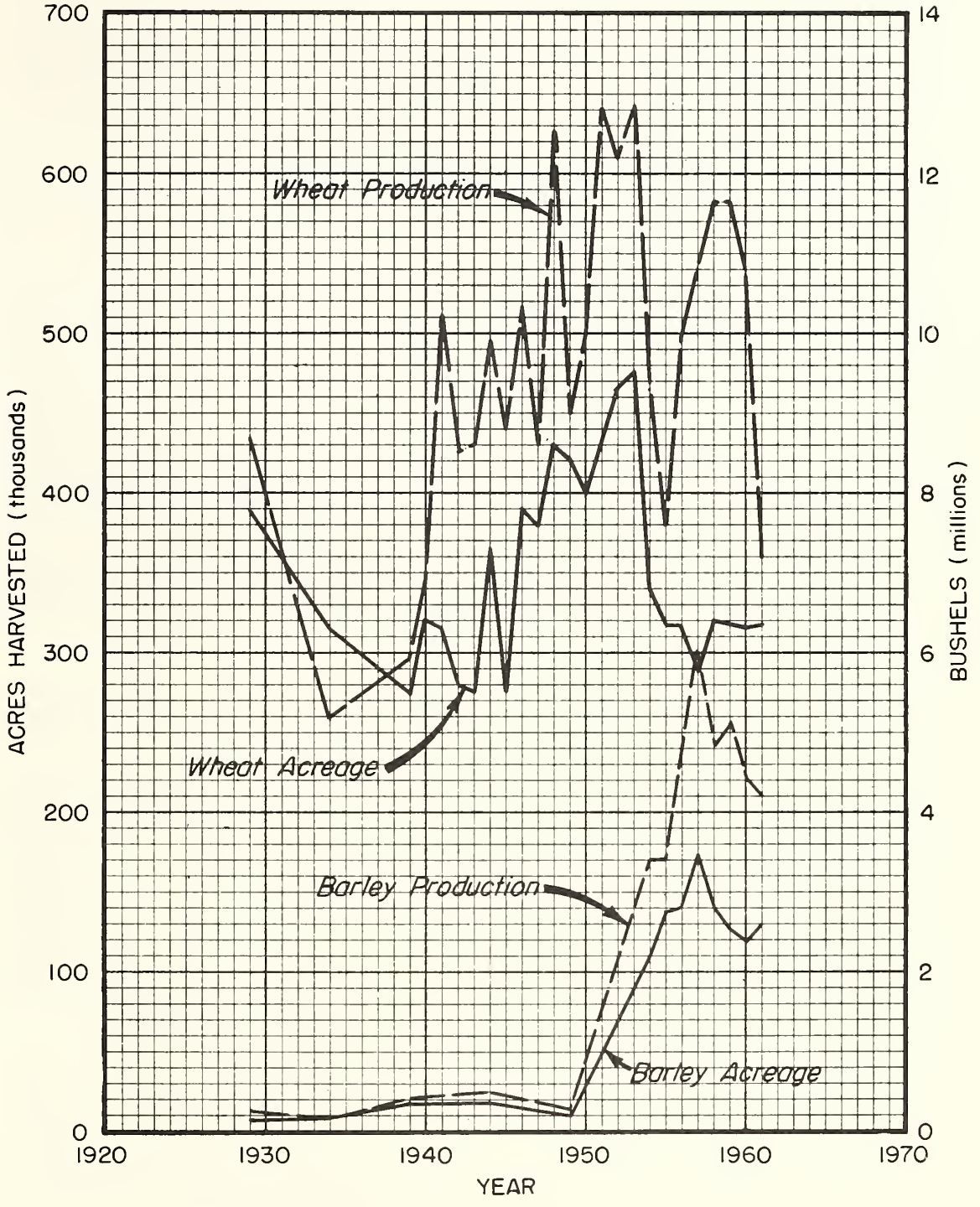
Figure 15: Farmland use for two principal counties in the Umatilla Drainage Basin, Oreg., 1899-1959



Source: U. S. Census of Agriculture data for Morrow and Umatilla Counties.

a result of the allotment program. Wheat production has varied considerably since 1953, but the trend is downward. The wide variations in yields from one year to the next are a result of climatic conditions. The reduction in wheat acreage and production has been more than offset by a corresponding increase in the acreage and production of barley.

Figure 16: Wheat and barley acreage and production for two principal counties in the Umatilla Drainage Basin, Oreg., 1929-1961



Source: U. S. Census of Agriculture and Statistical Reporting Service data for Morrow and Umatilla Counties.

Figure 17: Hay acreage for two principal counties in the Umatilla Drainage Basin, Oreg., 1929-1959

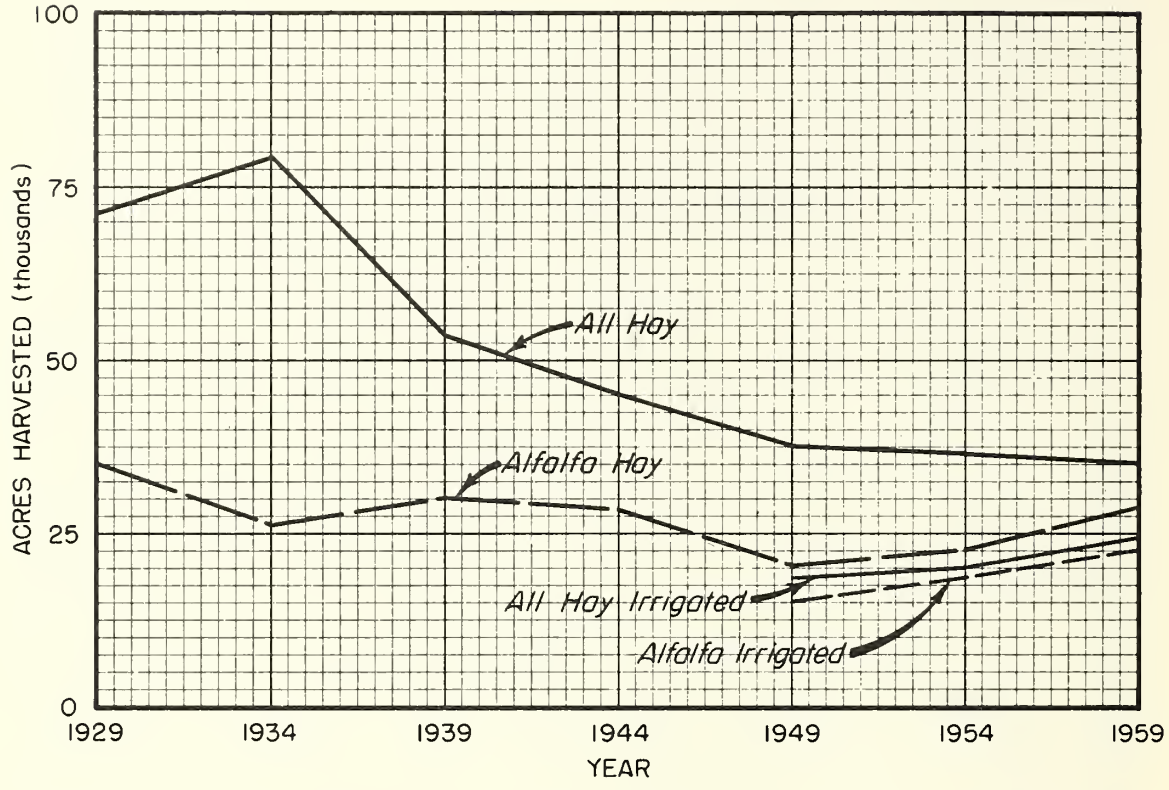
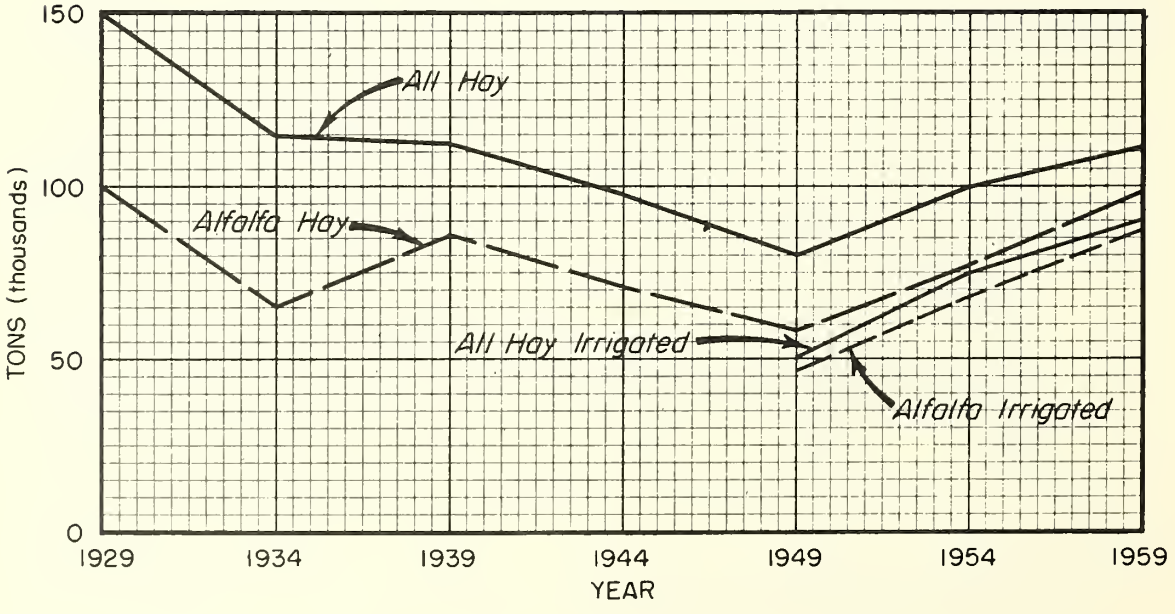


Figure 18: Hay production for two principal counties in the Umatilla Drainage Basin, Oreg., 1929-1959



Total hay acreage and production declined by about one-half from 1929 to 1949. At the same time, alfalfa acreage and production declined by about 40 percent. Since 1949, alfalfa acreage has increased while other hay acreage has continued to decrease. From 1949 to 1959, alfalfa acreage increased by 35 percent while alfalfa production increased by 45 percent. The trend is toward more higher producing irrigated alfalfa and less nonirrigated hayland. There has been a corresponding increase in cattle numbers in the basin since 1949.

CHARACTERISTICS OF AGRICULTURE

Number and Size of Farms

There are about 2,380 farms in the basin. Census data indicate that approximately 64 percent are commercial farms; 25 percent are part-time farms; and 11 percent are part-retirement farms. 1/ There are 1,233 farms in subbasin 2, 770 farms in subbasin 1, and 377 in subbasin 3.

Ranches and dryland grain farms in the basin must be quite large in order to be successful. In 1959, the average farm contained 1,230 acres and represented a $93,400 investment.

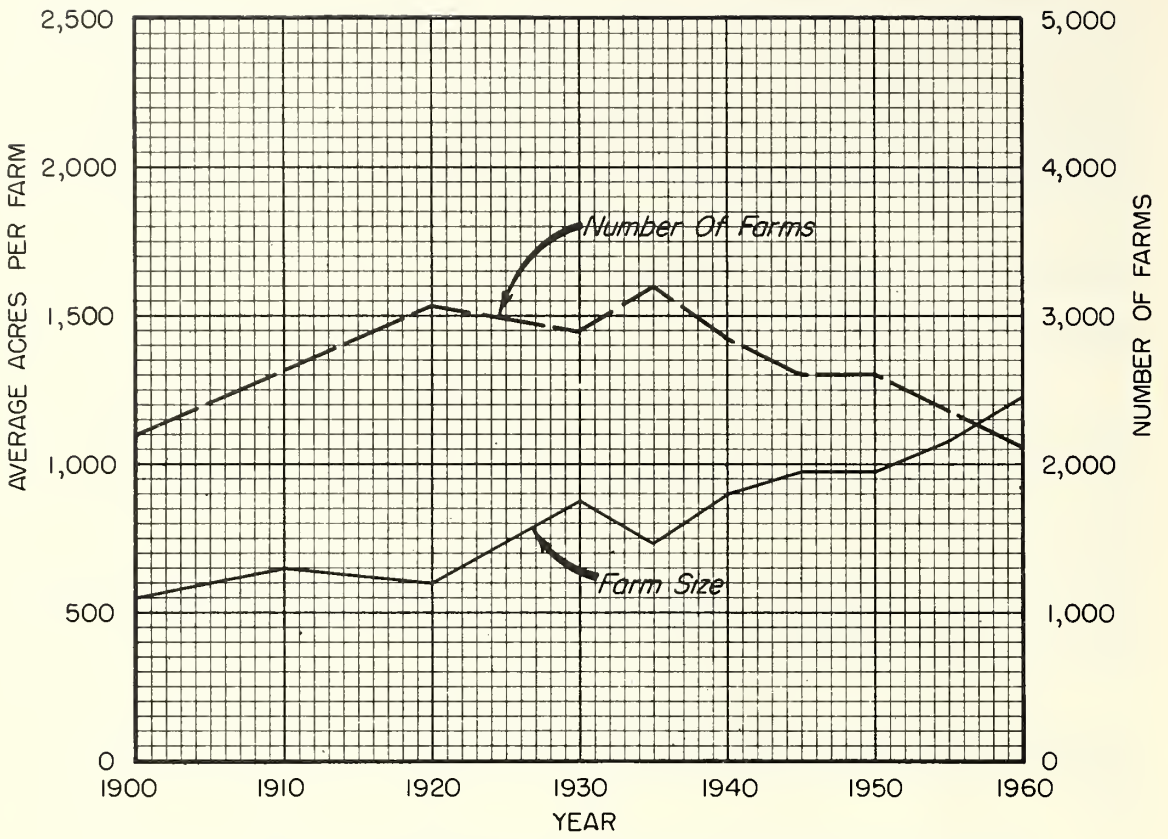
Farms in the basin are rapidly increasing in size. While the number of farms has been decreasing since 1935, the average size of farm has almost doubled (fig. 19).

There are a number of reasons for the increase in farm and ranch size. Cost-price problems of recent years have encouraged a constant search for economies in operation. The extensive dryland grain and range livestock operations are particularly conducive to economies of scale. Technology, a major factor in a number of agricultural changes, has influenced expansion in ranch and farm size in at least two ways. First, the use of more efficient equipment and methods makes possible additional work with the same number of man-hours; and second, the cost of new inovations, a fixed expense, must often be spread over a larger number of acres to be economically justified.

Tenure

Over half of the farmers own all of their land. Census data indicate that in 1959, 53 percent of the farmers were full owners; 34 percent were part owners; 12 percent were tenants; and 1 percent were professional managers.

1/ Commercial farms include all farms with a value of sales amounting to $2,500 or more. Part-time farms include farms with a value of sales of farm products of $50 to $2,499 and operators under 65 years of age that either worked off the farm 100 days or more or had other income from nonfarm sources that was greater than the total value of farm products sold. Farms with a value of sales of farm products of $50 to $2,499 were classified as part-retirement if the farm operator was 65 years old or over.



Source: Census of Agriculture data for Morrow and Umatilla Counties.

Figure 19: Number of farms and average acres per farm for two principal counties in the Umatilla Drainage Basin, Oreg., 1900-1906

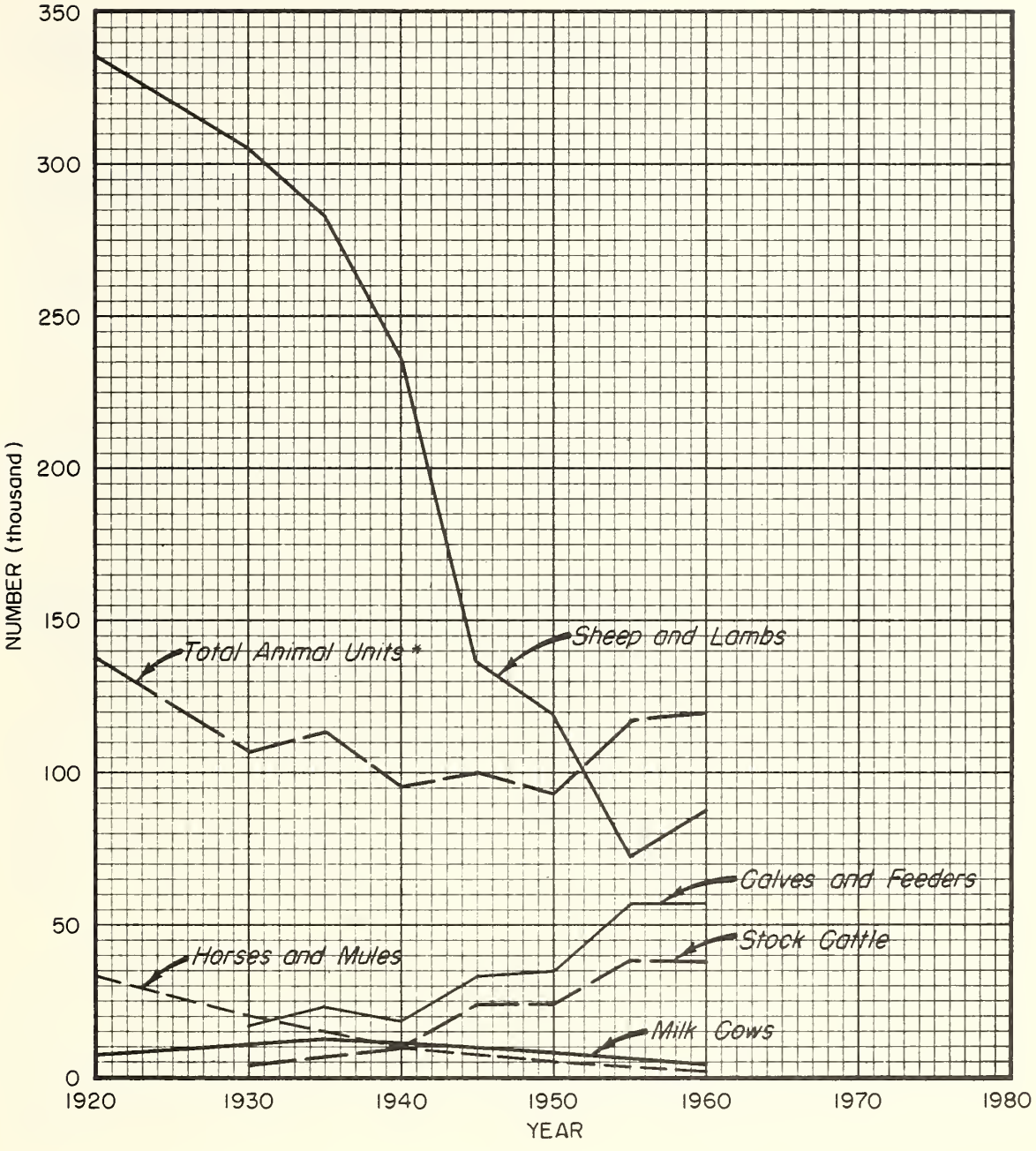
Livestock

The land and water resources of the Umatilla Drainage Basin support a livestock population of about 88,600 cattle, 86,200 sheep and lambs, 16,700 hogs and pigs, and 2,800 horses and mules (table 12). In addition, about 73,000 layer hens and 107,000 turkeys are raised annually in the basin.

The 4,300 milk cows are raised predominantly in the irrigated areas of the basin where forage from irrigated cropland pasture and hay is readily available. Milk cow numbers have declined since 1953 (fig. 20). This decline is consistent with the national trend and is associated with the decline in consumption of dairy products per capita and the rapid rise in milk production per cow.

Although beef cattle are raised throughout the basin, they are most numerous in the Umatilla and Willow Subbasins where extensive grazing land is available. Livestock feeding operations are more important in the Walla Walla Subbasin where considerable quantities of low cost cannery by-products are available. Also, in recent years

Figure 20: Livestock numbers for two principal counties in the Umatilla Drainage Basin, Oreg., 1920-1960



1/ Factors used to convert livestock into animal units are: 1 cow = 1AU, 1 sheep = .2AU, 1 horse = .8AU.

Source: U. S. Census of Agriculture data for Morrow and Umatilla Counties.

Table 12.--Livestock numbers, Umatilla Drainage Basin, Oreg., 1960

Type of livestock	Subbasin 1 Walla Walla	Subbasin 2 Umatilla	Subbasin 3 Willow	Total
	Number	Number	Number	Number
Milk cows	2,500	1,000	800	4,300
All other cattle	10,000	52,000	22,300	84,300
Total cattle	12,500	53,000	23,100	88,600
Sheep and lambs	9,000	44,400	32,800	86,200
Horses and mules	500	1,600	700	2,800
Hogs and pigs	5,400	8,100	3,200	16,700

barley production has increased and contributed to the local supply of feed grain. Cattle are often raised as a supplementary enterprise to wheat farming to utilize the forage on intermingled rangeland and wheat stubble. Stock cattle and feeders have been increasing in numbers since 1930 (fig. 20).

Sheep are also most prevalent in the Umatilla and Willow Subbasins where large areas of rangeland are available. They are trailed from the lower fall and winter grazing areas to the higher summer grazing areas of this basin and adjoining basins. Supplemental feeding is necessary during the winter months. Although once numerous in the basin, sheep have decreased significantly in the last 40 years. This decrease is attributed to inadequate summer range and low prices for sheep and wool.

There are about 2,800 horses and mules in the basin. With the advent of mechanized power on the farm, horses and mules are no longer needed and have continually decreased in numbers since 1920.

Hogs, although of minor importance in the basin, have been increasing in numbers and provide another outlet for local feed grains.

The net result of the changes in animal numbers is shown in figure 20 in terms of animal units. The decrease in animal units from 1920 to 1950 is a reflection of the precipitous drop in sheep and lamb numbers. Since 1950, total animal units have increased reflecting the increase in number of stock and feeder cattle.

Agricultural Income

Agricultural income in the basin was about $49.5 million in 1959 (table 13). Crops accounted for 69 percent of the agricultural income, and livestock accounted for 30 percent. Forest products sold by farmers accounted for the other 1 percent.

Field crops accounted for 57 percent of the agricultural income in the basin. Wheat was the most important crop with receipts of about

Table 13.--Value of farm products sold for two principal counties in the Umatilla Drainage Basin, Oreg., 1959

Commodity sold	Value of farm products sold	Percentage of total
	Thousand dollars	Percent
Dairy products	1,366	2.8
Poultry products	1,152	2.3
Cattle and calves	9,661	19.5
Sheep, lambs, and wool	1,490	3.0
Other livestock	1,262	2.5
Total livestock	14,941	30.2
Field crops 1/	28,189	57.0
Vegetables	5,378	10.9
Fruits and nuts	168	0.3
Horticultural specialties	409	0.8
Total crops	34,144	69.0
Forest products	413	0.8
Total agricultural income	49,498	100.0

1/ Other than vegetables, fruits, and nuts.

Source: U. S. Census of Agriculture data for Morrow and Umatilla Counties.

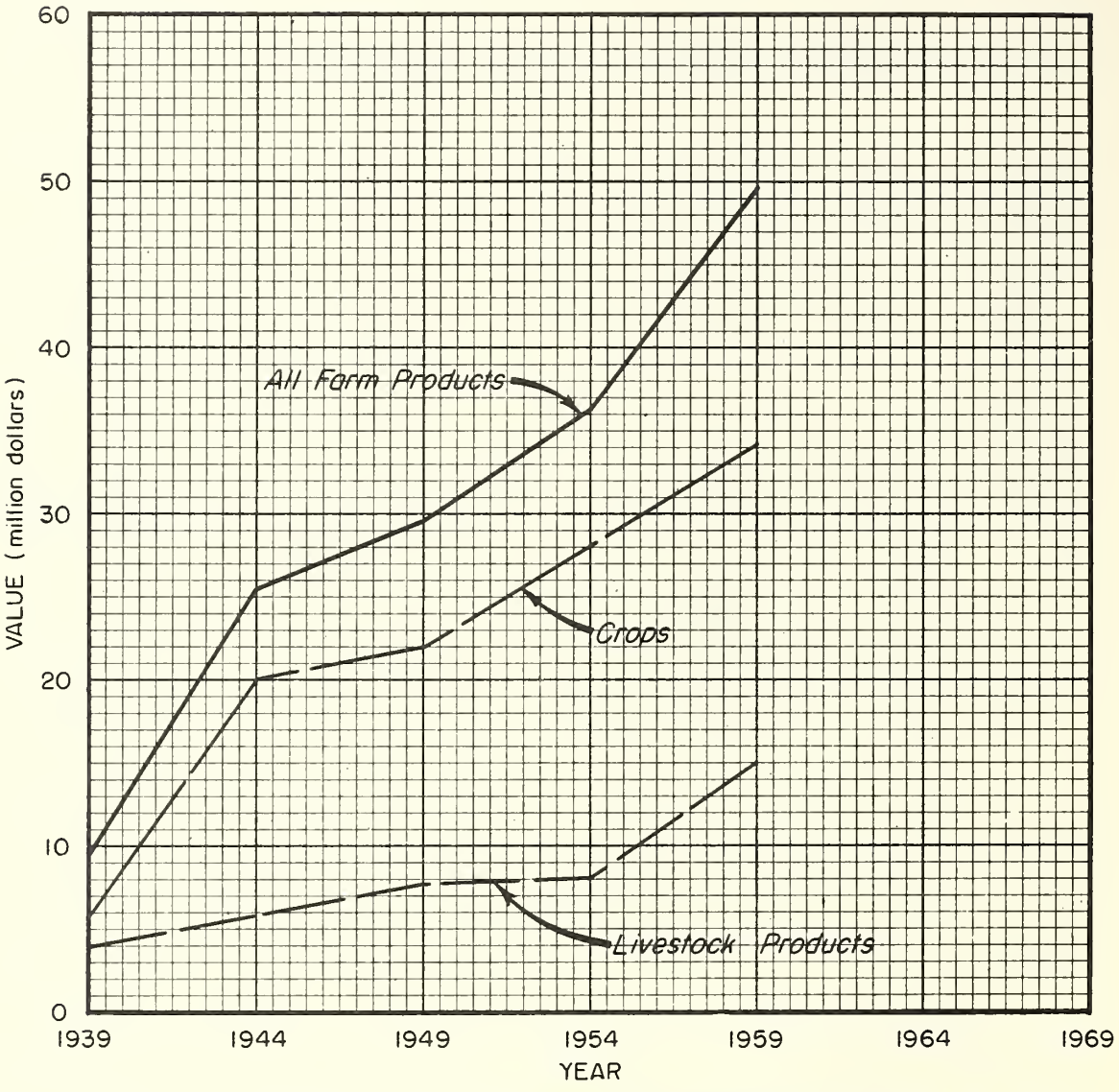
$20 million, which was 42 percent of the agricultural income. Vegetables were the second most important cash crop accounting for over $5 million, or about 11 percent of the income. Fruits, nuts, and horticultural specialty crops together accounted for only 1 percent of the income.

Trends in the value of crops and livestock are shown in figure 21. Since 1939, the value of crops sold has increased more than six times while the value of livestock and livestock products has increased about four times. The increase in value of crops is primarily a result of both higher wheat production and higher prices for wheat. The increase in value of livestock products is primarily a result of higher production and prices for cattle which has more than offset the decline in sheep production.

Markets

Since the basin has no large population centers, most of the agricultural products are marketed outside of the basin. Wheat is transported via rail, truck, and barge to Portland where it is marketed worldwide. Cattle are marketed through various channels. Finished beef cattle and sheep are sold through buyers and go to western Oregon and California while feeder cattle and sheep are generally shipped east. Since there are no sizeable milk product manufacturing plants

Figure 21: Value of farm products sold for two principal counties in the Umatilla Drainage Basin, Oreg., 1939-1959



Source: U. S. Census of Agriculture data for Morrow and Umatilla Counties.

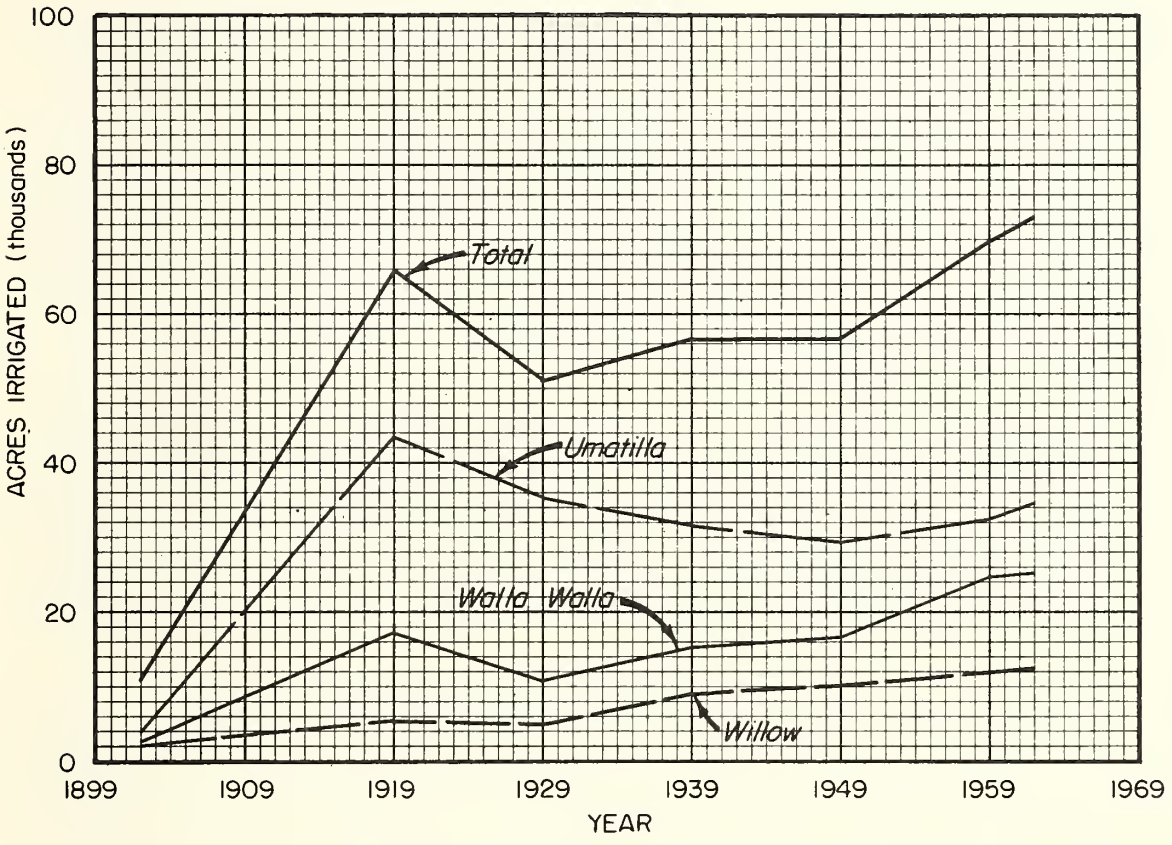
in the basin, most milk is marketed locally although some is transported to Portland. Most vegetables, fruits, and truck crops are processed by six major processing plants in the basin.

IRRIGATION

History of Irrigation Development

Irrigation began in the basin in 1870. By 1902, 10,800 acres were under irrigation. From 1902 to 1919 irrigation expanded rapidly

to 66,000 acres and then declined during the 1920's to 51,900 acres in 1929 (fig. 22). Since 1929, irrigated acreage has gradually increased to the present level of 73,680 acres.



Source: U. S. Census of Irrigation and field survey data.

Figure 22: Irrigated acreage by subbasins, Umatilla Drainage Basin, Oreg., 1902-1962

Irrigation development in the Umatilla Subbasin began with simple diversions of streams to adjacent bottom lands. In 1909 water from the Cold Springs Reservoir was delivered to lands of the federally constructed Umatilla Project. Irrigated acreage expanded until 1919 when about 43,600 acres were under irrigation (fig. 22). However, high irrigation water requirements on the sandy soils and over appropriation of summer flows led to water shortages. Also, some soils in the area proved to be unsuited for irrigation. The results were a decrease in irrigated acreage. Supplemental water was made available by construction of McKay Reservoir in 1926. However, the additional water supplies did not check the decline in irrigated acreage, and it was not until after 1949 that this decline was reversed. About 24,900 acres of land in the Umatilla Subbasin are irrigated by group facilities, and the rest are irrigated by individual developments.

Irrigation development in the Walla Walla Subbasin has been accomplished by individuals and privately organized groups. There are no federal irrigation projects in this subbasin. About 11,500 acres are irrigated by group facilities, and the rest is irrigated by individual developments.

Irrigated acreage in the Walla Walla Subbasin increased rapidly from 1902 to 1919, decreased from 1919 to 1929, and then increased gradually from 1929 to 1962. Most of the increase in irrigated acreage since 1949 has been accomplished by development of ground water.

With the exception of the 5,500 irrigated acres in the federally developed West Extension Project, irrigation development in the Willow Subbasin has also been accomplished on an individual basis. Irrigated acreage in this subbasin has been gradually increasing since 1902.

Irrigated Crops and Yields

Although agriculture is predominantly based on dryland wheat and cattle ranching, irrigation has permitted some diversification and intensification of agriculture in the basin. In 1962, 73,680 acres, or 7 percent of the cropland in the basin, were irrigated. The location of the irrigated land is shown in figure 9. The major irrigated crops and the extent to which they are irrigated are shown in table 14. Crop yields are shown in table 15.

Table 14.--Irrigated land use, Umatilla Drainage Basin, Oreg., 1962

Irrigated crop	Subbasin 1 Walla Walla	Subbasin 2 Umatilla	Subbasin 3 Willow	Total	Percentage of crops irrigated
	Acres	Acres	Acres	Acres	Percent
Wheat	3,020	1,340	360	4,720	... 2/
Barley	880	600	140	1,620	... 2/
Other small grain	100	200	90	370	... 2/
Subtotal	4,000	2,140	590	6,710	... 2/
Alfalfa hay	5,840	12,120	6,630	24,610	91
Other hay	1,060	600	400	2,060	25
Subtotal	6,900	12,720	7,030	26,670	76
Vegetables	1,500	2,100	300	3,900	7
Row crops 1/	4,520	3,500	530	8,550	100
Orchards and vineyards	3,050	100	20	3,170	99
Other crops	500	710	40	1,250	8
Pasture	5,430	14,000	4,000	23,430	49
Total	25,900	35,270	12,510	73,680	7

1/ Field corn, sugar beets, potatoes, hops, and peppermint.
2/ Less than one percent.

Table 15.--Crop yields from irrigated land for two principal counties in the Umatilla Drainage Basin, Oreg., 1959

Irrigated crop	Unit	Yield per acre
Field corn	Bushel	86
Wheat	Bushel	40
Barley	Bushel	53
Alfalfa hay	Ton	3.9
Irish potatoes	CWT	189
Sugar beets	Tons	19
Peppermint	Pounds	82

Source: U. S. Census of Agriculture data for Morrow and Umatilla Counties.

The most extensively irrigated crops in the basin are hay and pasture. About 36 percent of the irrigated acreage is hay, and 32 percent is pasture. These two crops provide the forage base for the dairy enterprises and also provide supplemental forage for the range livestock. Alfalfa, the major irrigated hay crop, yielded 3.9 tons per acre in 1959.

Row crops constitute the third major use of irrigated land in the basin. All of the row crops require irrigation to be successfully grown in the basin. About half of the 8,550 acres of row crops is field corn, and a third is sugar beets. Potatoes, peppermint, and hops are the other major row crops raised in the basin. Yields for these crops are shown in table 15.

The 6,710 acres of irrigated small grains is relatively insignificant in comparison to the total acreage of these crops. Irrigation is generally practiced in the lower rainfall areas of the basin where the irrigation facilities have been developed for some other crop, and small grains are grown as a rotation crop.

With the exception of green peas, which are grown in rotation with wheat in the higher rainfall areas, the vegetable crops in the basin are all irrigated. The major irrigated vegetable crops include sweet corn, watermelons, beans, asparagus, and carrots.

Orchards and vineyards also require irrigation in order to be successfully grown. These crops are predominately grown near Milton-Freewater. The major fruits grown are apples, prunes, plums, cherries, peaches, and pears. Small acreages are devoted to vine crops.

Other irrigated crops include various grass and legume seeds, specialty field and drug crops, and horticultural, nursery, and greenhouse crops.

Figure 23.--Irrigated pasture in subbasin 2. SCS photo. F-251-11

Size of Irrigated Acreage

In 1959, the average irrigated acreage per farm was 50 acres. However, almost half of the farmers reporting irrigation had 19 acres or less under irrigation and nearly three-fourths irrigated less than 49 acres (table 16).

Costs of Irrigation

Data on water costs for individual irrigation developments are not available. The only current data on irrigation water costs are for irrigation districts in subbasins 2 and 3. In 1960, these costs varied from $2.90 per acre for the West Extension Irrigation District to $6.50 per acre for the Stanfield Irrigation District. Water costs for other districts were $3.50 per acre for the Westland Irrigation District and $6.00 per acre for the Hermiston Irrigation District. 1/

Consumptive Use and Irrigation Requirements

Because of low annual rainfall in the lower areas of the basin, irrigation requirements are quite high. Table 17 shows consumptive

---

1/ Twenty-Eighth Biennial Report of the State Engineer, Lewis A. Stanley, State Engineer, June 30, 1960.

Table 16.--Distribution of farms reporting irrigation by acreage intervals, Morrow and Umatilla Counties, Umatilla Drainage Basin, Oreg., 1959

Irrigated acreage distribution	Number of farms reporting irrigation	Percentage distribution
	Number	Percent
1 to 9 acres	366	27
10 to 19 acres	291	21
20 to 29 acres	171	12
30 to 49 acres	178	13
50 to 99 acres	189	14
100 to 199 acres	103	7
200 to 499 acres	62	5
Over 500 acres	14	1
Total	1,374	100

Source: U. S. Census of Agriculture.

Table 17.--Consumptive use and irrigation requirements of selected crops in the Hermiston area, Umatilla Drainage Basin, Oreg.

Irrigated crop	Annual water requirements	
	Consumptive use 1/	Irrigation requirement 2/
	Inches	Inches
Pasture	29.0	26.5
Alfalfa	30.8	28.3
Corn	23.8	22.0
Small grain	17.6	16.1
Potatoes	21.0	19.2

1/ Includes water from all sources and represents water used by the plants and the amount evaporated from the surface of the ground.

2/ Net irrigation requirement figures are consumptive use minus effective precipitation and do not include application losses.

Source: Irrigation Requirements, F. M. Tileston and John W. Wolfe, Statistical Bulletin 500, Agricultural Experiment Station, Oregon State College, Corvallis, Oreg.

use and irrigation requirements for selected crops in the Hermiston area. This area has an average annual rainfall of about 8.5 inches and a frost-free growing season of about 153 days. However, less than 3 inches of rainfall can be expected during the growing season. Since application losses are high in this area, the gross irrigation water used is much higher than the plant requirements shown in the table.

Source of Water and Method of Application

Streamflow is the chief source of irrigation water in the basin, supplying almost half of the irrigated land while stored water and ground water are each the source for about one-fourth (table 18). However, in many cases a combination of sources are used. For instance, in subbasin 2 streamflow is the source of early water and reservoir storage is used for late season irrigation. In subbasins 1 and 3 ground water is often used to supplement the late season streamflows.

Table 18.--Primary source of irrigation water and method of application, Umatilla Drainage Basin, Oreg., 1962

Item	Subbasin 1 Walla Walla	Subbasin 2 Umatilla	Subbasin 3 Willow	Total
	Acres irrigated	Acres irrigated	Acres irrigated	Acres irrigated
Irrigation water source:				
Streamflow	12,000	10,120	10,970	33,090
Storage reservoir	...	20,010	140	20,150
Ground water	13,900	5,140	1,400	20,440
Total	25,900	35,270	12,510	73,680
Method of application:				
Sprinkler	11,200	10,730	3,200	25,150
Gravity	14,700	24,540	9,290	48,530
Total	25,900	35,270	12,510	73,680

Source: USDA Field Party survey data.

Classification of water source in the basin is difficult. For instance, the primary source of irrigation water for the 5,500 acres in the West Extension Project in subbasin 3 is streamflow. However, most of this water is return flow from other irrigation projects in the Hermiston area, which was originally stored in reservoirs.

About two-thirds of the acreage in the basin is irrigated by gravity methods, and one-third is irrigated by sprinklers. In some cases a combination of these two methods of irrigation are employed on the same acreage. The gravity method is used in the early season when streamflows are adequate and sprinklers are used to apply late season water from either ground water or low streamflows.

Future Irrigation

Future irrigation in the basin will be governed by several physical and economic factors. The two most important physical factors are the availability of suitable land and the availability of suitable

irrigation water. There are about 1,294,700 acres of land in capability classes I through IV in the basin (table 19). On the basis of soils alone this is the amount of land that is generally susceptible to irrigation. However, location of the land in relation to water supplies and the present use of this land precludes the possibility of irrigating most of it in the foreseeable future.

Table 19.--Estimated potentially irrigable land, Umatilla Drainage Basin, Oreg., 1962

Item	Subbasin 1 Walla Walla	Subbasin 2 Umatilla	Subbasin 3 Willow	Total
	Acres	Acres	Acres	Acres
Land in capability classes I-IV	172,800	748,100	373,800	1,294,700
Total cropland	133,200	633,100	304,850	1,071,150
Irrigated land	25,900	35,270	12,510	73,680
Potentially irrigable land	19,200	125,700	35,260	180,160

Source: USDA Field Party survey.

It is anticipated that irrigation development will continue to be limited primarily to land in valleys and at lower elevations where surface and ground water is more accessible. Data gathered by the USDA Field Party on a reconnaissance study of small watersheds in the basin indicate that at least 180,160 acres of land fits this criteria. However, potential water supplies from ground water and stored surface water in the basin would not be adequate to irrigate all of this land. Thus, water rather than land will be the limiting physical factor on future irrigation in the basin, and there are usually several alternative areas that can be irrigated from any given water development project.

It is apparent that physical opportunities for additional irrigation exist in the basin. However, the degree and rate of development will depend on several economic factors.

In order to be economically feasible irrigation water, like any other input used in producing agricultural products, must either result in a higher net profit to the user or add stability to the farm enterprise.

In the higher rainfall areas of the basin, dryland wheat farming is well established. In recent years, favorable yields and prices for wheat have made wheat farms one of the most successful types of farms in Oregon. Because of the favorable returns from wheat, these farmers are not interested in irrigation.

Recently, trial plantings of a new semidwarf variety of winter wheat (Gaines) have been made in the area. 1/ Information from these plantings indicate that Gaines uses nutrients and moisture more efficiently and yields from 7 to 72 percent higher than other varieties grown in the basin. In most other respects such as winter hardiness, disease resistance, and milling quality, Gaines equals or exceeds existing varieties. Thus, it appears that farmers will be able to increase wheat yields per acre with little additional costs. Unless there is a corresponding decrease in the price of wheat, irrigation in this area will be in a less competitive position than it is now. Government allotment and support programs for wheat will also have an important effect on land use in the basin.

In the lower more arid regions of the basin the only alternative use of agricultural land without irrigation is the production of range forage. Because of the limited alternatives, benefits from irrigation are higher and future irrigation developments are expected to continue to be concentrated in these areas.

The Bureau of Reclamation has investigated several possible irrigation projects in the Umatilla Subbasin. 2/ Five different areas with a total arable acreage of 83,500 acres were considered in these plans. Irrigation was considered not economically justifiable in one area that was devoted to the production of dryland wheat and peas. The recommended charges for water in the other four areas varied from $8 to $17 per acre. However, because of insufficient local interest, none of the proposed plans have been authorized.

Agricultural production and markets are predominantly oriented to wheat, livestock, and peas. Irrigation is predominantly oriented to supplying supplemental forage for livestock. About 68 percent of the irrigated land is used for the production of hay and pasture. Although several other crops are and can be raised under irrigation in the basin, pasture and hay will probably continue to be the most extensively irrigated crops for several reasons. Livestock operations are well established, and feed grains for livestock are readily available. Marketing outlets for hay and livestock are more readily available and easier to expand than some of the other products. For instance, sugar beet acreage is controlled by quotas and vegetable crops are raised under contract. Fruit and vegetable processors in the Milton-Freewater area have expressed an interest in obtaining more early and late season products in order to more fully utilize plant capacities so some opportunities exist for increasing the irrigated acreage in these crops.

A comprehensive economic analysis would be necessary to determine the future economic returns from irrigation. Such an analysis should consider several factors that as yet have not been appraised comprehensively. Among these factors are the following:

1/ Gaines, A Semidwarf Winter Wheat for the Pacific Northwest, Extension Circular 332, Washington State University, Pullman, Washington, August 1962.

2/ Pendleton Project, Oregon, U. S. Department of Interior, Bureau of Reclamation, Region 1, Boise, Idaho, February 1954.

1. A combined effect on national requirements for agricultural products based on projected population growth, improved dietary standards resulting from higher levels of economic output per capita, and expected shifts in foreign demand for agricultural products.

2. Shifts in economic advantage between regions of the country for production and marketing of major classes of agricultural products.

3. Growth of nonagricultural uses of the land and water resources, depletion of resources now used for agricultural production, retirement of low capability land from agricultural use, and the probable effects of these factors on availability of land for agricultural production.

4. Advancement in agricultural production technology resulting from research and educational and technical assistance programs, and the resulting increase in production and utilization of crops and pasture.

5. Opportunities for resource development with expected levels of agricultural output and costs.

An essential first step in analyzing the feasibility of water developments is the establishment of the current situation with respect to the agricultural use of the land and water resources as a means of identifying some of the problems involved, which in turn indicate opportunities for adjustments and improvements. The scope of the material presented here consists of (1) the collection and analysis of historical data that could be oriented to or would be indicative of the current agricultural situation in the basin and (2) an indication of some of the needs and opportunities for water resource development in the basin.

WATER SUPPLY

The limited water supply is becoming more critical to all segments of the economy of the Umatilla Drainage Basin. Irrigation is essential to produce most types of crops. It is necessary to produce any crops in the area with less than 8 inches of precipitation. The industrial growth of the area is adding to the competition for the limited water resources. While the basin population is not increasing as fast as some parts of the state, many of the urban communities are growing, and their existence and growth are dependent on water for domestic and municipal use. As population increases, there is greater demand for water for agriculture, recreation, fish life, and pollution abatement. Thus, yield and seasonal availability of water are of prime importance in the area.

If the waters of the Columbia River, which form much of the north boundary of the basin, are not included, the total water resources of the Umatilla Drainage Basin are not adequate for all possible future agricultural development. It is, therefore, important that waters from the Columbia River be considered for use in all broad water development plans for the future.

Precipitation ranges from 55 inches annually in the Blue Mountains to 7 inches in the northwestern desert area (fig. 5). The runoff is estimated to vary from 49 inches to 0.1 inch annually. The total average annual yield to surface streams for this 4,554 square mile basin is about 1,140,000 acre feet.

Subbasin 1 has an estimated average annual yield of 13 inches while some streams in the subbasin have an average annual yield of as much as 36 inches. The average annual yield from subbasin 2 is about 5 inches while subbasin 3 averages only about 1 inch annually. The entire basin averages about 5 inches.

Almost all areas are currently short of water during the summer. Only those streams originating in the higher elevations in the Blue Mountains of the Walla Walla and Umatilla Subbasins have sufficient snowpack to store winter precipitation for a significant yield during this period. Summer yields vary from one-fourth of the annual yield to practically nothing.

The principal problems involved in the development of ground water are the great depths to water which makes it expensive to develop and insufficient knowledge as to location, extent, and safe yields of aquifers. The quality is generally good although it is slightly hard in some areas, and it is already being used extensively for municipal, industry, domestic, and agricultural purposes. The lower Butter Creek area is considered one of the critical ground water areas in the state due to extensive use, primarily for agriculture.

The faults in the basalt layer complicate the determination of source, rate, and route of the movement of ground water since these

faults act as barriers to movement in some strata, facilitate movement in others, and may serve as channels for lateral movement. Artesian water is often found near these natural barriers. It may be possible in some instances to recharge the aquifers by detaining surface waters in the catchment areas, but the amount of water that would actually become available for recovery by wells is not measurable.

Some ground water is also available from shallow wells in the alluvium along stream channels.

Irrigation

Based upon an assumed 5 feet of water per acre, the water requirement for the 73,680 acres of irrigated crops is 368,400 acre feet per year. This is about 32 percent of the gross yield from the basin and about two-thirds of the gross yield during the irrigation season of April through October. However, most of the surface flows occur during the early part of the irrigation season. In addition to the acreage irrigated by natural streamflows is the 10,000 acres irrigated from ground water and the 20,000 acres from stored water. Also, there are two small diversions bringing water into this basin from the John Day River Basin. One diverts water into Butter Creek in subbasin 2 to irrigate 122 acres and supply supplementary water for 848 acres. The other diverts .7 cubic feet per second for municipal use in subbasin 3. Nevertheless, there is a serious shortage of water in the late season months in all areas relying on natural surface flows (table 20).

Table 20.--Summary of tributary watersheds with inadequate irrigation water supply, Umatilla Drainage Basin, Oreg., 1962

Item	Unit	Subbasin 1 Walla Walla	Subbasin 2 Umatilla	Subbasin 3 Willow	Total
Tributaries studied	Number	4	15	5	24
Tributaries with water shortages for presently irrigated land	Number	4	11	4	19
Presently irrigated land with water shortages	Acres	23,900	10,300	10,480	44,680
Tributaries with inadequate water for potential irrigable land	Number	4	14	5	23
Potential irrigable land needing surface water development	Acres	14,200	118,400	28,660	161,260

Source: USDA Field Party survey data.

It is estimated that an additional 180,160 acres could be easily irrigated in the basin if water was available. This is nearly two and one-half times the present irrigated acreage. All but one of the watersheds studied have some potentially irrigable land (table 24). If all irrigated and potentially irrigable land was adequately irrigated and growing about the same types of crops presently grown, approximately 1,269,200 acre feet of water would be required. This is about 129,000 acre feet more than the total estimated annual yield of the basin and more than twice the average annual yield during the irrigation season. It is obvious that water must be conserved, developed, and brought in from outside sources before irrigation of agriculture land could be expanded to this extent. Water from outside the basin is all ready stored in McNary Reservoir built by the Corps of Engineers, U. S. Army, on the Columbia River. The John Day Dam will also create a reservoir adjacent to this basin. Both reservoirs are near the most arid portion of the basin. This water should be considered for use whenever it is economically feasible, and the stored water on small streams used on the land more distant from the Columbia River.

Livestock

Normally water for animals is adequate during the spring growing season in the southern and eastern higher range portions of the basin. However, during the summer and fall water from ponds and wells is required to supplement the few perennial streams and springs in the area. A major portion of the northwestern arid section of the basin has a year around livestock water shortage except where an adequate supply has been developed from ground water or stored surface water. It is impossible to estimate the total volume of water needed for livestock because no generally acceptable figures are available for the overall use efficiency of stockwater developments in the basin. Strategic location of stock ponds for proper utilization of available forage is often as important to good range management as the capacity.

Forestry and Related Uses

The water supply problems on forest land are relatively minor in the Umatilla Drainage Basin. Some pollution, debris, and silt problems have developed where improper timber harvesting, road construction, or fires have left an area vulnerable to the elements.

The principal water supply problems at present are low flows and high temperatures in the small tributary streams during the summer. These conditions create an unfavorable fish habitat.

Water supply problems are expected to become greater as use of forested land for recreation is intensified by pressures from an increasing population.

IRRIGATION MANAGEMENT

The problems and needs in the efficient management and use of irrigation water in the basin are many and varied. Irrigated land in the Umatilla Drainage Basin is served almost entirely by individual

systems except in the vicinity of Hermiston, Stanfield, Boardman, and Milton-Freewater where most of the land is irrigated by project type development. Most of the organized projects in the vicinity of Hermiston, Stanfield, and Boardman are under the Umatilla Project constructed by the Bureau of Reclamation. This project delivers water to 11 irrigation districts or ditch companies. The primary water source is the Umatilla River and its tributaries. The Cold Springs and McKay Reservoirs are both part of this project. The Bureau of Reclamation has made investigations and proposals for several other projects in the basin. Some would make use of Columbia River water, and others would depend upon basin streams. Several reservoir sites in the Umatilla Drainage Basin have been studied and proposed. One of the current studies involves a proposed flood prevention dam on Willow Creek by the Corps of Engineers, U. S. Army, with supplementary irrigation water for the land below Heppner. All other existing group irrigation projects in the basin have been developed in various ways by local people.

The many gravity water diversions from the creeks and rivers cause problems such as accumulation of silt and debris, obstructions to fish, and heavy construction and maintenance costs. Census data indicate that in 1950, 372 individual diversion dams were used in the basin. Of these 54 percent were concrete or masonry; 15 percent were timber; and 31 percent were earth, gravel, rock, manure, straw, et cetra. Most of the latter group require replacement each year.

In addition, the transmission and control of water after it is diverted presents a difficult situation. The 1950 census indicates there are 542 miles of open ditches as well as 48 miles of flumes, pipelines, and syphons which gives an indication of the rough terrain some delivery systems must traverse. Because of the many miles of structures, seepage losses are high, and constant maintenance is required due to siltation in the systems. The ditches cross many natural channels and are subject to sedimentation and washouts from floodwater (fig. 24).

The water lost in conveyance structures through seepage, breaks, rodent holes, and other defects is only part of the water management problems in the basin. The efficiency of water application to the soil is often very low due to rough topography. Also, it is difficult to apply water uniformly and efficiently to some soils. One of the areas in the basin having this problem is the Umatilla Project in subbasin 2. The soils in much of this area are coarse-textured. Consequently, losses in ditches are high, and irrigation efficiencies are low except where the ditches have been lined and methods of irrigation giving adequate control of the water have been adopted. As an example, the Bureau of Reclamation reported in 1960 that 70,653 acre feet of water was diverted to the West Extension Irrigation District. This is equivalent to 12.7 acre feet per acre irrigated. They report a 27 percent loss of water in the main canals. An additional 3 percent occurred in the laterals. Thus, only 70 percent of the diverted water, or 47,500 acre feet, was delivered to the farms. This amounted to 8.52 acre feet per acre. A Ladino clover pasture, one of the heaviest users of water, has a net irrigation requirement in the Hermiston area of

Figure 24.--Sedimentation damage to crops, land, fences, utilities, and roads resulting from a break in a canal in subbasin 2. SCS photo. 7-253-11

2.36 1/ acre feet per acre. This would indicate an average farm irrigation efficiency of only 28 percent for this district in 1960. About 19 percent of the water diverted from the river was actually used by the plants in the field. This situation is fairly typical in the other districts in this area. However, some of the losses indicated by the above example are recovered in the form of ground water and return flow to be used in other areas.

DRAINAGE

Before man began irrigating in this basin, drainage was probably a minor problem as wet soils were found only in small seep areas. However, as irrigation increased, the problems of drainage have increased (fig. 25). Perhaps drainage in this basin could be considered a water management problem rather than a drainage one as it is usually caused by excess irrigation water.

At the present time, it is estimated 14,800 acres, or only one percent of the total arable soils in the basin, have a major problem

---

1/ Taken from Irrigation Requirements by Fred M. Tileston and John W. Wolfe, Station Bulletin 500.

Figure 25.--A cow can barely wade across a field wet from seepage that was once an arid desert before the advent of irrigation, subbasin 2. SCS photo.

7-1022-10

of excessive wetness (table 21). More than half of these soils are in subbasin 2. These figures are based upon a capability inventory as much of the basin has not been surveyed, and those areas that are surveyed have not been summarized by capability class and problems. Some wet soils have been drained to a degree suitable for its present use or are being used for purposes that do not require drainage. An estimated 7,660 acres, or 52 percent of the excessively wet soils, need to be drained for best production under present use.

WATER RELATED DAMAGES

Floods in the Umatilla Drainage Basin are the result of two different weather condtions, snowmelt, and late spring and summer convection storms. First, and most routine, is runoff from winter and spring snowmelt, sometimes combined with rain. The most serious floods usually occur when the ground is frozen. These floods occur during the winter and early spring and vary with elevation of the watershed. They could be divided into two categories depending on seriousness and frequencies. The less frequent and more serious occur once very three to five years, originate in the mountains as the result of rainstorms of low intensity, wide areal extent, and long duration. They are associated with warm south to southwest chinook winds which cause rapid melting of snow.

Table 21.--Estimate of soils whose major problem is wetness within land capability classes I-IV, Umatilla Drainage Basin, Oreg.

		Subbasin			
		1	2	3	
	Unit	Walla Walla	Umatilla	Willow	Total
I	Acres	...	...	...	...
II	Acres	2,000	3,000	...	5,000
III	Acres	...	...	...	...
IV	Acres	3,200	5,000	1,600	9,800
Total	Acres	5,200	8,000	1,600	14,800
Area needing drainage	Acres	500	7,160	...	7,660
Distribution of soils with major problem of wetness	Percent	35	54	11	100
Distribution of acres needing drainage	Percent	7	93	...	100

Source: USDA Field Party survey and USDA, Soil Conservation Service (table 1).

The more frequent less serious are local floods that occur one or more times annually and are associated with the same weather conditions of less areal extent and duration. The second type of flood is the result from convectionary spring and summer storms, commonly called cloudbursts. They are less frequent at any one point and cover a limited area. Crops are especially vulnerable to these floods due to the season in which they occur. They can be expected throughout the basin but are most frequent in the late spring and early summer (May-June) just below the forested areas.

Major floods in the basin can develop from either type storm and seem to have a frequency rate of about 25 years. An example of one of the most serious, although not the most extensive flood, was the Heppner flood on Willow Creek of June 14, 1903 (figs. 26 and 27). In this flood 247 people were drowned, and the property damage was estimated at $250,000.

Forest and Range Areas

Approximately 62 percent of the basin is currently used for growing of forest products and/or forage in the form of range. Soils, topography, and precipitation limit the land use.

Erosion hazards on forest and rangeland are generally minor as long as human activity does not destroy the natural cover. However, severe erosion in some range areas is caused by grass fires and overgrazing by livestock. Some forested areas, too, are adversly affected by harvesting operations, fire, and grazing of livestock. These problems can become more formidable in the future if proper land management is not practiced.

Figure 26.--City of Heppner before the flood of 1903, subbasin 2. Private photo.

Figure 27.--City of Heppner was almost washed away by flood in 1903, subbasin 2. Private photo.

Road locations are often planned and constructed over the cheapest route where slopes, soil stability, and drainage are often ignored and waste material is handled inadequately. This makes roadways one of the most serious erosion problems in the forest and range areas.

Tractor logging is the method most often used in the basin. Landings tend to be located at the lowest point, which is usually beside a stream. Thus, the skid roads converge on it, and runoff, debris, and eroded material are channeled directly into the stream. The accumulation of debris and sediment causes channel changes and bank erosion.

Nonforested range and agricultural areas do not usually have adequate fire protection. There are a few rural fire departments, but they are mainly equipped to handle building fires. Consequently, when a fire starts on agricultural land, there is a good chance that it will spread, unchecked, to the forest land. These fires traveling fast hit the forest land on a large front.

One problem associated with fire protection is finances. The rural departments are financed on an ad-valorem basis. This limits the amount that can be taxed to 4 mils per $100 of land value. The State Department of Forestry fire protection is financed by prorating the actual cost experienced to the acreage protected. Last year (1961) this amounted to $0.09 per acre. This cost would be prohibitive to landowners of the marginal agriculture, range, and forest lands when added to the existing taxes.

Fires leave the soil vulnerable to water and wind erosion. In most of the basin the natural re-establishment of vegetative cover is slow, and resulting erosion of the top soil makes it even less hospitable to new growth.

Wind erosion is especially hazardous in the low lying low rainfall range areas near the Columbia River as most of the soils are moderately coarse to coarse textured of glacial origin.

On public land all resource values can be evaluated and recognized, but this is not always true on private land. As an example, the foraging habits of elk very closely resemble those of cattle. If elk are allowed to increase by popular demand on public land, they will also increase on neighboring private land. The private landowner derives very little benefit from this use of his forage so he is in effect subsidizing the State of Oregon and its big game program.

Cultivated and Other Areas

Floodwater and wind damage is widespread and often devastating in the Umatilla Drainage Basin. Erosion and deposition both cause heavy damages to crops and property. There have also been cases of heavy loss of human lives.

Damage from water in this basin is in some cases the result of "too little" and in others the result of "too much". In the area of less than 10 inches of precipitation annually the major problem is

erosion from wind action when the moderately coarse to coarse textured soils are disturbed or left unprotected. Wind erosion is damaging to crops, soil, and structural development in the area (fig. 28). When water can be developed for irrigation for such land, the crops grown and additional water supply minimizes this particular problem. The Umatilla Irrigation Project is a good example.

Figure 28.--Less than 10 acres from a 160 acre field of dryland wheat was left, and the road was nearly closed after a three day windstorm, subbasin 2. SCS photo. 7-578-9

While damage from excess water is prevelant in all parts of the basin, it is more frequent and severe in the zone where the annual precipitation is over 10 inches. In the higher rainfall areas the soil losses from sheet and rill erosion on the dryland wheat fields are among the heaviest in the state and nation (fig. 29).

Sediment produced by erosion of these cultivated hill lands is one of the most serious problems facing the economic and future agricultural development in the basin. It is carried to more gentle slopes and bottom lands where a portion is deposited, frequently smothering out the crop. These numerous areas of crop loss by sedimentation are generally too small and scattered to reseed resulting in complete loss

of production. It has been estimated that this could account for as much as 75 percent of the total damage to crops from erosion.

Structures such as fences, buildings, bridges, culverts, roadside ditches, and roads are damaged by both erosion and sedimentation (fig. 30).

The sediment carried by the flood flows in the perennial and intermittent streams is a serious problem to the development of water in many parts of the basin. It increases the maintenance costs of irrigation ditches and shortens the life of storage reservoirs. Three reservoirs have been studied which give a picture of this problem.

The Furnish Reservoir was built five miles above Nolin on the Umatilla River by farmers. Much of the lower part of the contributing watershed is cultivated land. The reservoir was abandoned in 1934 after loosing 82 percent of its 5,500 acre feet capacity to sediment in 22 years (fig. 31).

The federally constructed Cold Springs Reservoir, built in 1906, was constructed for off-channel storage of Umatilla River water. Its original capacity was 49,709 acre feet. Besides receiving water from

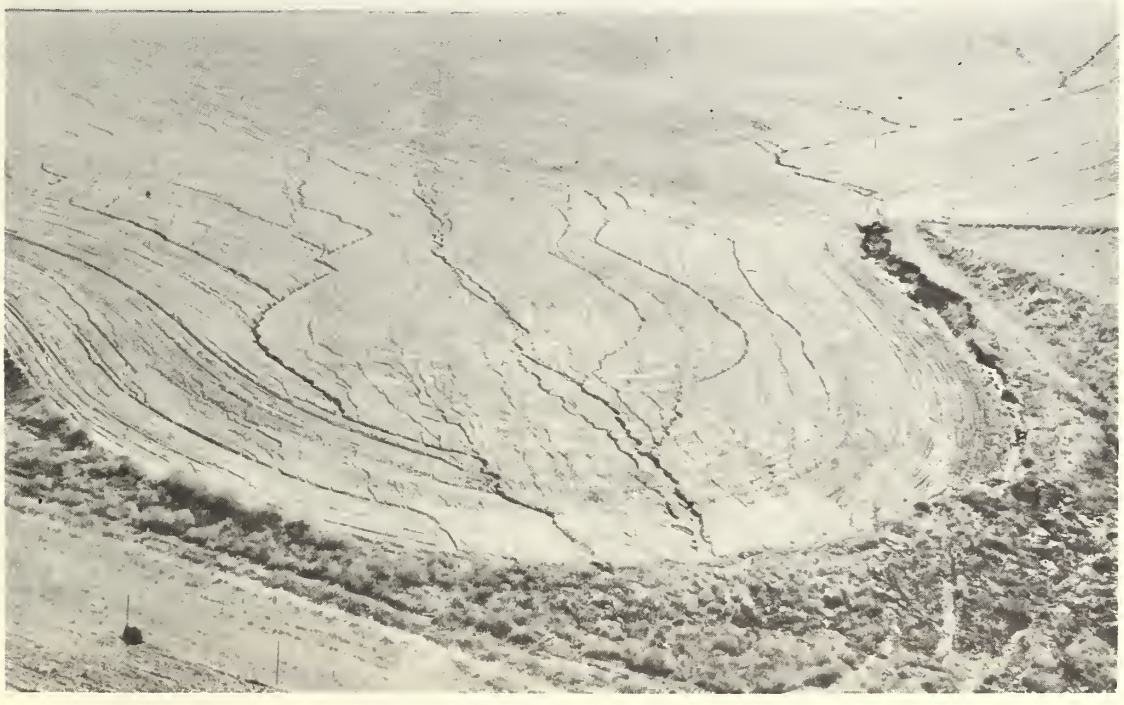


Figure 29.--This field has lost the equivalent of .2 of an inch of top soil in one year, or 30 tons per acre, subbasin 2. SCS photo. F-124-1

Figure 30.--The road is closed due to flood damage, subbasin 2. SCS photo. 7-908-7

Figure 31.--Furnish Reservoir was abandoned due to sediment after 22 years. Alluvial fill in the old reservoir is now being cropped and in turn eroded away by the Umatilla River, subbasin 2. SCS photo. B-627-5

the Umatilla River by canal, it is the recipient of all the runoff from about 148 square miles of watershed from Cold Springs Canyon and Despain Gulch. Almost 80 percent of this area is cropped to winter wheat alternated with fallow. Surveys made by the Soil Conservation Service in 1951 and reported by Elliott M. Flaxman in "Sedimentation in Cold Springs Reservoir" show the reservoir capacity was reduced 5,041 acre feet by sediment. The average rate of sedimentation is 116.3 acre feet per year. He divides the sediment by source as follows:

1. Seven hundred and thirteen acre feet are from the Umatilla River via the diversion canal.

2. One hundred and twenty-five acre feet are from wave action in the reservoir area.

3. The remaining 4,203 acre feet came from Cold Springs Canyon and Despain Gulch.

The rate of sedimentation per square mile per year from the latter area is 0.66 acre feet. If this sedimentation continues in the future as in the past, it will eventually create a water shortage during low runoff years.

Compare this with the McKay Reservoir on McKay Creek, a tributary of the Umatilla River. This reservoir also supplies water for irrigation in the Umatilla Irrigation Project and was built by the Bureau of Reclamation before 1926. Only 10 percent of this watershed is wheat and fallow with 90 percent in forest and grass. A reconnaissance sedimentation survey was made by the Soil Conservation Service on July 11, 1946. It was found that about 263 acre feet of sediment were deposited in the nearly 20 year period. This is equivalent to 13.3 acre feet of deposition per year and about .07 acre feet per square mile per year.

From this comparison it is plain that there are serious problems involving land treatment in planning storage structures if the watershed above is predominantly cultivated.

Many of the creeks in this basin have a gradient of 50 to 30 feet per mile, which is quite erosive under flood conditions. Consequently, some have eroded channels from 10 to 30 feet deep. This situation increases land destruction by bank cutting and caving. Such channels also have the effect of prematurely lowering the water table in the narrow valleys in the spring to the detriment of the crops where water shortage is already a problem.

WATERSHED MANAGEMENT

There is need for continuing maintenance and improvement of the condition of all tributary watersheds in the basin. In general, the best watershed conditions will prevail when all resources are managed in a manner that insures optimum sustained production. The most important management items pertaining to forestry and agriculture are outlined in the following section.

Forested Watersheds

There is a definite correlation between profitable forest management and good watershed management. That is, in areas where forest management is profitable on a continuing, long-term basis, there will also probably be good watershed management practices. It is likewise true that good watershed management is beneficial to the forest landowner, but its benefits are even more important to the landowners downstream.

Timber Harvesting. Orderly timber harvesting is a desirable part of well managed watersheds. Through proper harvesting, a healthy forest can be maintained, and overall watershed conditions can be favorably influenced.

In some areas of thin soils and steep slopes timber harvesting should be postponed until techniques that will insure adequate soil protection become practical. Some down hill cable systems can possibly be modified or used as they are to remove the timber crop with only minor disturbance to the existing ground cover.

Study is needed on the interrelationship and effect of the cutting system and the size of the opening on regeneration, erosion, amount of surface runoff, and season of runoff.

Debris removal from streams should also be encouraged. This is a job of education because this practice is a cost to the forest owner that more than likely exceeds the cost of the potential damage to his land. He is responsible for any damage resulting from leaving this material in streams.

Restoring Ground Cover. There is need for answers to the problem of prompt restoration of ground cover on all disturbed areas. This includes all phases of study--biotic as well as genetic. Among the many things that are needed are:

1. Exploration of the possibilities of regenerating from a natural seed source, planted seed, or nursery grown seedlings.

2. Rehabilitation of disturbed areas by planting a cover crop.

3. Reduction of animal damage to revegetation.

Access Roads. Construction of a well planned access road system is necessary to promote fire protection, resource management, and public use. Lack of access has prevented orderly development of some watersheds. Access roads would allow restorative measures to be taken in denuded areas; permit harvest of insect, disease, and fire killed timber; and hasten development of the many resources.

The roads should be in the location best suited for the many purposes that they will serve. Roads should be located far enough away from streams so that the waste material will not enter the streams. Some measures needed to reduce erosion on roads include selection of proper culvert size for stream crossings; correct location and size of cross drain culverts; good dispersal of cross-drainage out-flow; timely revegetation of cut and fill slopes; and periodic maintenance. Existing material should be reviewed and made available to landowners throughout the basin, but complete studies may be needed on subjects such as economical methods to revegetate cut and fill slopes. Roads shoud not be built in many places where the country is so rugged that the soil and water resources cannot be adequately safeguarded.

Recreation. Sanitary facilities should be developed at recreation sites to eliminate this source of stream pollution. Recreation facilities should be included in the plans for every reservoir in the basin. People are traveling over 100 miles to utilize the water oriented recreation facilities at Hat Rock State Park (fig. 11). This indicates the importance of adequately developing recreational sites along streams and reservoirs.

Range Areas

Information is needed on the relative importance of game versus domestic stock for the range resource. An economic balance of game and domestic stock should be determined for the range. In some areas the range will not adequately support the existing wildife population without continued deterioration of the vegetation.

Big Game Control. Additional information is needed on methods for control of big game numbers. In many years hunting alone has not provided enough control. Even with the lengthened and either sex seasons of recent years, the game population is still controlled primarily by the severity of winter weather and available food supply.

Stockwatering Improvements. Additional stock and game watering improvements are needed. With the increased development of the forest and range areas improvements are needed to conserve existing water supplies and preserve the quality of the water.

Range Revegetation. Further study is needed to determine the most economical way to return the range to full productivity. Realizing that some areas will take generations to reach this point, study should be concentrated on how to stop the downward trend and eventually improve range conditions.

Livestock Distribution. Continued emphasis should be placed on the importance of good distribution of livestock on the range. This is being done to some degree now by fencing, salting, range riding, and watering.

Cultivated Areas

Industry and urban developments are already competing with agriculture for the rather limited water resources in some parts of the Umatilla Drainage Basin. A comprehensive development plan should be made in order to make the best sustained use of the available water supply. One of the most important factors to future water development in this basin is the continuing establishment of more conservation cropping systems and erosion controlling practices on cultivated land, especially on the land devoted to dryland wheat and fallow. Improved irrigation water control and management are essential. Marginal land and irrigated fields of marginal hay and pasture should be planted to adapted species of grasses and legumes. A summary of needed measures directly related to water follows.

Irrigation. Of equal importance to the need for a supplementary late-season water supply is the need for improved management of the existing water. Much of the land is still irrigated by "wildflooding" methods or by other flooding methods not adapted or designed for the texture of the soil. Land shaping, leveling, and properly designed control structures and systems would in many cases improve the efficiency of water use (fig. 32).

Many conveyance structures are the sources of excessive water losses. The water supply could be further utilized if ditches were lined and old flumes and diversion structures were repaired or replaced (fig. 33).

Even well planned and designed irrigation systems are sometimes mismanaged by not moving the water or lateral lines soon enough or waiting too long between irrigations. There is need for more factual information on water-holding capacity and intake rates of soils by both technicians and irrigators to facilitate more efficient use of the available water. In addition, full use should be made of advance water supply estimates in planning irrigation operations and selection of crops to make better use of low water supplies in dry years.

Sediment has long been a maintenance problem in this basin for the irrigator. Often weed seeds are carried with the sediment and add to the operation costs of the farmer as well as the organized irrigation districts. Figure 34 shows one method some farmers are using to reduce this problem.

Drainage. An estimated 14,800 acres of land is subject to excessive wetness. Much of this problem could be corrected by better irrigation water management and control. However, it is sometimes necessary to develop more storage capacity to accomplish better management as the existing problem is often the result of the irrigator's attempt to store surplus winter and early spring water in the soil to compensate for low

Figure 32.--Land is leveled for more efficient application of irrigation water, subbasin 3. SCS photo. 7-736-2

Figure 33.--A concrete pipe has been installed to replace an old wooden flume, subbasin 1. SCS photo. 7-1116-11

Figure 34.--This structure screens out weed seeds and some silt from irrigation water in subbasin 1. SCS photo. 7-1116-7

Figure 35.--Tile drainage system is newly installed to drain land in subbasin 2. SCS photo. 7-1077-7

late season supplies. There are many other cases where drainage could only be accomplished by open or closed drainage systems (fig. 35).

Erosion Control. Erosion on cultivated land is of three types: (1) soil losses from bank and channel cutting by streams, (2) soil losses from rilling and sheet erosion on unprotected fields, and (3) soil losses from wind erosion on unprotected fields.

Channel stabilization structures, rock riprap, and removal of gravel bars and drift are needed on many streams. Often stream channel work is most beneficial when a complete unit of stream channel is improved in a single coordinated project rather than by piecemeal work by individual landowners.

Soil and water conservation practices are especially important on the dryland wheat fields to control the basic problems of wind and water erosion. Strip cropping has been very successful in reducing both wind and water erosion and should be used more extensively (figs. 36 and 37).

Stubble mulch, as shown in figure 37, also helps protect the soil from wind and water and increases the organic content of the soil. Deep furrow planting in the stubble mulch is helpful in conserving the limited precipitation and reducing wind and water erosion.

Figure 36.--An aerial view of strip cropping across prevailing winds to prevent wind erosion on a field in subbasin 2. SCS photo. B-520-2

Figure 37.--Stubble mulch in a strip cropped field for protection from both wind and water erosion in subbasin 3. SCS photo. 7-736-10

Grassed waterways and field diversions should be used more to protect fields from water erosion (fig. 38).

Figure 38.--A diversion terrace helps hold the soil in place in subbasin 2. SCS photo. F-54-6

Cover crops are sometimes used to build up the organic matter and protect the soil from erosion in fields where orchard, vegetable, and berry crops are grown. Cover crops help maintain a high water intake rate and high water-holding capacity in the soil (fig. 39).

Figure 39.--A permanent cover crop of grass and clover protects the soil in this irrigated orchard in subbasin 1. SCS photo. 7-1116-9

Some fields with a high erosion hazard should be planted to permanent grass for seed or forage production (fig. 40).

WATER DEVELOPMENT

The limited water in this basin should be developed to serve all phases of the economy. Because there is not sufficient water yield to supply all possible future needs, water development plans should be comprehensive with due consideration given to the use of Columbia River water wherever possible. A major purpose of future water development projects in the basin will be for the development of adequate water supplies for agriculture. For instance, it is estimated that at least 180,160 acres could readily be irrigated if sufficient water supplies were available. In addition, over half of the 73,680 acres of land

Figure 40.--Beardless wheatgrass is planted for seed production in a high wind erosion hazard area to replace wheat in subbasin 2. SCS photo. 7-1264-12

presently irrigated is short of late season water. Better utilization of existing supplies and careful development of all sources of supply, including water from outside the basin, would be necessary to meet this demand. However, most future water development projects will need to include other phases of water use and control such as flood control, power, domestic, municipal, livestock, industrial, fish, wildlife, recreation, and pollution abatement which are sometimes compatible with irrigation but may more often be competitive. The demand for all uses will probably increase in the future.

Since the agricultural need for water is the major purpose of this report, agricultural water uses are emphasized in the following sections.

Ground Water

Agriculture is already a heavy user of ground water. It is used to irrigate over 20,000 acres, or about 28 percent of the total irrigated acreage in the basin (table 26).

It is believed that ground water could be developed to irrigate an additional 19,000 acres.

Investigations have been made of the possibility of developing more ground water in areas where the normal directional flow of underground water has been interrupted by faults. Recharging of these aquifer layers would permit the development of more wells. There is need of more study and experiments of this type especially in subbasin 1. If recharging can materially increase the ground water supplies, the aquifers could be used as underground storage in place of surface storage.

Additional wells are needed for stockwater in the basin. The potential of ground water development from springs for this purpose has not been fully exploited in some areas. In addition, many existing developments should be rehabilitated. The rate of yield from springs is usually too limited to meet irrigation requirements.

Drainage water from wet soils can sometimes be used for irrigation by developing shallow wells or sumps. The rate of yield can often be increased by collecting the water with a drainage system of tile and ditches. Supplemental water supplies can be developed in a few irrigated areas through planning drainage systems to utilize this source of water.

Surface Water

There is little excess natural flowing surface water in the basin during the middle and late summer months. However, if ground water aquifers were artificially recharged in the winter, natural flows in some of the streams would probably increase. A few streams have some late spring and early summer surface water that could have limited development.

Storage

The opportunity for conservation of excessive, often damaging, runoff water in reservoirs for flood protection and subsequent use for irrigation, stockwater, industry, domestic, recreation, pollution abatement, and fish life has considerable potential in the Umatilla Drainage Basin (fig. 41).

Estimates from various sources indicate that it will be necessary to construct both large and small reservoirs as well as use water from outside the basin to achieve optimum irrigation development (table 26). This storage could be developed when and where it is needed. Although there is a definite potential for more small stock and multiple use ponds, sites of this type have not been studied or enumerated. In addition, there are many medium sized reservoir sites of 100 to 25,000 acre feet storage capacity that should be considered for water development for individual and group needs. Table 22 summarizes reconnaissance data assembled by the USDA on 36 sites that appear to have some merit and warrant future consideration. The locations of these sites are shown in figure 42.

The all ready constructed McNary Dam and the John Day Dam now under construction on the Columbia River are potential sources of ir-

Table 22.--Reconnaissance data on some reservoir sites, by subbasin, Umatilla Drainage Basin, Oreg., 1962

Subbasin and stream	Watershed index	Reservoir index	Location			Drainage area	Estimated annual yield	Storage capacity	Reservoir water depth	Reservoir surface area	Top length of embankment	Estimated embankment volume	Volume/ acre ft.	Possibilities
Number and name	Letter	Number	Township	Range	Section	Sq. mi.	Ac. ft.	Ac. ft.	Ft.	Acres	Ft.	Cu. yds.	Cu. yd. ac. ft. 1/	Uses 2/
1. Walla Walla Subbasin:														
Cottonwood Creek	A	1	6N	37E	32	12.9	4,800	7,280	140	130	1,100	1,350,000	185	I,F,R
Pine Creek	C	2	6N	34E	35	57.4	7,700	2,400	60	100	850	273,000	114	I,F,R
Couse Creek	C	3	4N	36E	3	14.1	6,400	4,850	130	83	950	1,035,000	213	I,F,R
Dry Creek	C	4	4N	36E	16	14.6	6,600	4,000	100	100	800	557,300	139	I,F,R
Pine Creek	C	5	3N	35E	1	14.2	6,500	12,470	165	189	800	1,318,300	106	I,F,R
2. Umatilla Subbasin:														
Stage Gulch	C	1	4N	29E	36	84.5	4,500	6,000	50	300	1,000	226,000	38	I,F
Alkali Canyon	D	2	3N	29E	33	52.3	4,200	4,200	70	150	750	346,900	83	I,F
Sand Hollow	E	3	2N	26E	25,26	74.0	4,000	2,500	50	125	1,300	272,300	109	I,F
South Butter Creek	O	4	1N	27E	27	74.6	8,000	3,080	77	100	850	387,000	126	I,F,R
Butter Creek	N	5	1N	28E	22	291.	23,300	10,370	80	324	1,400	833,300	80	I,F,R
do.	N	6	1S	30E	33	169.8	22,600	32,000	100	800	1,700	436,000	14	I,F,R
do.	N	7	2S	30E	9	166.9	22,300	14,400	90	400	1,400	820,700	57	I,F,R
Coombs Canyon	G	8	2N	31E	25	39.7	2,500	3,000	60	125	1,050	316,000	105	I,F
Birch Creek	H	9	1S	32E	17	119.	15,900	5,000	70	256	1,850	451,000	90	I,F,R
do.	H	10	1S	32E	33	72.	10,800	5,000	89	160	3,000	1,013,000	203	I,F,R
Tutuilla Creek	J	11	2N	32E	15	62.	6,600	31,200	120	820	2,300	1,425,000	46	I,F,R
McKay Creek	I	12	1S	34E	29	60.	19,200	16,000	100	400	1,260	630,000	39	I,F,R
Greasewood Creek	K	13	3N	34E	18	31.7	2,500	6,480	50	324	1,900	375,600	58	I,F
Wildhorse Creek	K	14	3N	35E	3	15.1	5,600	16,000	100	400	1,300	600,000	38	I,F,R
3. Willow Subbasin:														
Eightmile Canyon	D	1	3N	22E	26	261.7	12,600	3,000	50	150	2,640	514,500	172	I,F
do.	D	2	1N	22E	28	160.6	7,700	1,200	40	75	650	98,600	82	I,F
Sixmile Canyon	B	3	3N	24E	33	65.2	7,000	12,800	50	640	1,300	300,000	24	I,F
do.	B	4	2N	24E	18	32.5	3,500	7,000	50	350	1,000	282,000	40	I,F
Juniper Canyon	A	5	1N	25E	10	32.9	3,500	4,800	60	200	1,300	405,000	84	I,F
Sanford Canyon	A	6	1N	25E	1	17.5	1,900	10,000	84	300	1,000	773,000	77	I,F
Willow Creek	C	7	3S	27E	6	71.	13,300	1,450	67	54	850	113,500	78	I,F,R
do.	C	8	3S	27E	1	54.	11,500	300	38	20	400	30,000	100	I, R
Hinton Creek	C	9	3S	28E	6	11.	1,800	230	32	25	765	22,300	97	I, R
do.	C	10	3S	28E	8	10.	1,600	290	43	25	750	47,300	163	I, R
do.	C	11	3S	28E	16	6.5	1,200	350	53	30	535	60,600	173	I, R
Willow Creek	C	12	3S	28E	29	22.	5,900	420	53	20	400	69,000	164	I, R
Balm Canyon	E	13	4S	26E	14	25.	3,500	460	60	20	200	63,500	138	I,F,R
do.	E	14	4S	26E	15	24.	3,300	470	48	20	275	56,700	121	I,F,R
Rhea Creek	E	15	4S	27E	20	38.4	8,200	10,360	100	259	1,600	1,114,700	108	I,F,R
do.	E	16	4S	27E	29	32.8	7,000	8,320	160	130	1,000	1,575,600	189	I,F,R
do.	E	17	5S	27E	2	9.	2,600	1,050	67	80	700	107,000	102	I,F,R

1/ A comparative figure derived from dividing the estimated earth fill in cubic yards by the estimated water storage capacity in acre feet.
2/ I-irrigation, F-flood protection, R-recreation--fishing, hunting, and boating.

Source: Based on a survey by the U. S. Department of Agriculture Field Party.

rigation water from outside the basin. The Bureau of Reclamation and the Corps of Engineers, U. S. Army, have proposed several other large reservoirs within the basin which have potential for agricultural use. In the future all new reservoirs should be developed for multipurpose use.

Figure 41.--A typical small reservoir constructed for multiple use in subbasin 3. SCS photo. 7-1255-9

Table 23.--Reconnaissance data on tributary areas, Walla Walla, Subbasin 1, Umatilla Drainage Basin, Oreg., 1962

Item	Unit	A Cottonwood Creek	B Walla Walla River	C Hudson Bay	D Van Cycle Canyon	Total Subbasin 1
Farms	Number	20	290	430	30	770
LAND USE:						
Total watershed area	Acres	44,400	120,400	109,000	37,200	311,000
Forest land	do	25,600	51,600	11,000	...	88,200
Rangeland	do	9,800	29,300	24,000	23,200	86,300
Other	do	200	1,500	1,000	600	3,300
Cropland	do	8,800	38,000	73,000	13,400	133,200
Dryland	do	8,500	31,400	55,000	12,400	107,300
Irrigated	do	300	6,600	18,000	1,000	25,900
Water source:						
Streamflow	Acres	300	2,700	8,800	200	12,000
Storage reservoir	do	...	...	...	...	...
Ground water	do	...	3,900	9,200	800	13,900
Method of application:						
Sprinkler	Acres	200	2,500	8,000	500	11,200
Gravity	do	100	4,100	10,000	500	14,700
Water shortage	do	300	6,600	16,000	1,000	23,900
POTENTIAL:						
Cropland	Acres	...	...	...	...	...
Irrigable land	do	300	10,000	8,500	400	19,200
Water source:						
Natural flow and ground	Acres	200	3,100	1,500	200	5,000
Storage needs	do	100	6,900	7,000	200	14,200
STORAGE:						
Existing ponds	Number	4	6	15	2	27
Existing reservoirs	do	...	...	...	...	...
Possible reservoir sites studied	do	1	...	4	...	5
DRAINAGE:						
Arable land needing drainage	Acres	...	300	200	...	500
FLOODS:						
Area	Acres	100	600	1,500	120	2,320
Frequency	Years	1	1	1	1	1

Source: Based on estimates provided by local personnel of the Soil Conservation Service, Forest Service, County Extension Service, and others gathered by the USDA River Basin Field Party.

Table 24. -Reconnaissance data on tributary areas, Umatilla, Subbasin 2, Umatilla Drainage Basin, Oreg., 1962

Item	Unit	A Juniper Canyon	B Cold Springs	C Stanfield	D Westland	E Sand Hollow	F Teel	G Lower Umatilla	H Birch Creek	I McKay Creek	J Tutuilla Creek	K Wildhorse Creek	L Mid-Umatilla	M Upper Umatilla	N Butter Creek	O South Butter Creek	Total Subbasin 2
Farms	Number	40	300	260	180	30	23	15	80	37	36	130	50	...	34	18	1,233
LAND USE:																	
Total watershed area	Acres	62,700	160,200	93,700	91,800	94,500	71,100	88,400	187,000	122,600	40,000	125,200	203,100	80,000	230,900	55,000	1,706,200
Forest land	do	...	...	...	...	...	...	...	38,800	45,100	200	4,700	97,800	58,400	24,120	1,200	270,320
Rangeland	do	42,300	30,000	3,000	57,600	26,900	38,900	81,700	82,200	66,050	17,800	4,200	73,100	21,100	189,500	44,750	779,100
Other	do	200	1,800	2,500	5,500	600	300	1,200	1,700	1,500	500	4,000	2,000	500	880	500	23,680
Cropland	do	20,200	128,400	88,200	78,700	67,000	31,900	5,500	64,300	9,950	21,500	112,300	30,200	...	16,400	8,550	633,100
Dryland	do	20,000	120,740	81,490	17,900	66,340	31,900	5,000	60,300	9,230	21,300	112,000	30,000	...	14,230	7,400	597,830
Irrigated	do	200	7,660	6,710	10,800	660	...	500	4,000	720	200	300	200	...	2,170	1,150	35,270
Water source:																	
Streamflow	Acres	30	...	...	2,500	150	...	500	3,500	520	100	300	100	...	1,270	1,150	10,120
Storage reservoir	do	...	7,260	6,050	6,700	...	...	...	...	...	...	...	...	...	...	...	20,010
Ground water	do	170	400	660	1,600	510	...	...	500	200	100	...	100	...	900	...	5,140
Method of application:																	
Sprinkler	Acres	200	1,500	1,800	2,650	660	...	500	1,000	720	200	300	200	...	1,000	...	10,730
Gravity	do	...	6,160	4,910	8,150	...	...	...	3,000	...	...	...	...	...	1,170	1,150	24,540
Water shortage	do	170	240	...	2,500	150	...	500	3,500	520	200	100	...	...	1,270	1,150	10,300
POTENTIAL:																	
Cropland	Acres	5,000	11,000	2,000	200	13,000	3,200	300	...	...	...	1,400	1,500	...	200	100	37,900
Irrigable land	do	5,000	12,500	36,500	5,200	14,300	16,900	100	4,000	1,400	6,400	11,700	5,000	...	6,200	500	125,700
Water source:																	
Natural flow and ground	Acres	100	2,000	1,000	500	300	...	...	300	200	300	400	1,500	...	600	100	7,300
Storage needs	do	4,900	10,500	35,500	4,700	14,000	16,900	100	3,700	1,200	6,100	11,300	3,500	...	5,600	400	118,400
STORAGE:																	
Existing ponds	Number	...	8	6	13	7	...	1	...	3	...	4	...	...	20	50	112
Existing reservoirs	do	...	1	...	2	...	...	...	...	1	...	...	...	...	...	...	4
Possible reservoir sites studied	do	...	...	1	1	1	...	1	2	1	1	2	...	...	3	1	14
DRAINAGE:																	
Arable land needing drainage	Acres	...	2,500	1,500	2,660	...	...	...	...	...	500	...	...	...	...	...	7,160
FLOODS:																	
Area	Acres	...	...	500	100	300	...	100	400	...	200	600	2,000	...	900	900	6,000
Frequency	Years	...	...	5	5	2	...	5	1	...	5	1	2	...	5	5	...

Source: Based on estimates provided by local personnel of the Soil Conservation Service, Forest Service, County Extension Service, and others gathered by the USDA River Basin Field Party.

Table 25.--Reconnaissance data on tributary areas, Willow, Subbasin 3, Umatilla Drainage Basin, Oreg., 1962

Item	Unit	A Boardman	B Sixmile Canyon	C Willow Creek	D Eightmile Canyon	E Rhea Creek	Total Subbasin 3
Farms	Number	122	13	138	50	54	377
LAND USE:							
Total watershed area	Acres	188,000	140,200	246,800	175,500	146,800	897,300
Forest land	do	...	...	19,550	...	25,760	45,310
Rangeland	do	100,900	97,700	135,150	93,300	99,440	526,490
Other	do	12,600	500	4,600	1,700	1,250	20,650
Cropland	do	74,500	42,000	87,500	80,500	20,350	304,850
Dryland	do	68,360	42,000	83,000	80,250	18,730	292,340
Irrigated	do	6,140	...	4,500	250	1,620	12,510
Water source:							
Streamflow	Acres	4,900	...	4,500	...	1,570	10,970
Storage reservoir	do	40	...	...	100	...	140
Ground water	do	1,200	...	...	150	50	1,400
Method of application:							
Sprinkler	Acres	2,320	...	600	250	50	3,220
Gravity	do	3,820	...	3,900	...	1,570	9,290
Water shortage	do	4,260	...	4,500	150	1,570	10,480
POTENTIAL:							
Cropland	Acres	11,000	2,000	2,800	5,000	1,000	21,800
Irrigable land	do	11,000	12,800	2,700	7,800	960	35,260
Water source:							
Natural flow and ground	Acres	2,500	3,000	400	300	400	6,600
Storage needs	do	8,500	9,800	2,300	7,500	560	28,660
STORAGE:							
Existing ponds	Number	9	...	100	11	25	145
Existing reservoirs	do	1	...	...	...	1	2
Possible reservoir sites studied	do	2	2	6	2	5	17
DRAINAGE:							
Arable land needing drainage	Acres	1,600	...	...	...	...	1,600
FLOODS:							
Area	Acres	500	...	4,450	1,500	1,600	8,050
Frequency	Years	1	...	5	5	5	...

Source: Based on estimates provided by local personnel of the Soil Conservation Service, Forest Service, County Extension Service, and others gathered by the USDA River Basin Field Party.

Table 26.--Summary of reconnaissance data on tributary areas, Umatilla Drainage Basin, Oreg., 1962

Item	Unit	Subbasin 1 Walla Walla	Subbasin 2 Umatilla	Subbasin 3 Willow	Total
Farms	Number	770	1,233	377	2,380
LAND USE:					
Total watershed area	Acres	311,000	1,706,200	897,300	2,914,500
Forest land	do	88,200	270,320	45,310	403,830
Rangeland	do	86,300	779,100	526,490	1,391,890
Other	do	3,300	23,680	20,650	47,630
Cropland	do	133,200	633,100	304,850	1,071,150
Dryland	do	107,300	597,830	292,340	997,470
Irrigated	do	25,900	35,270	12,510	73,680
Water source:					
Streamflow	Acres	12,000	10,120	10,970	33,090
Storage reservoir	do	...	20,010	140	20,150
Ground water	do	13,900	5,140	1,400	20,440
Method of application:					
Sprinkler	Acres	11,200	10,730	3,220	25,150
Gravity	do	14,700	24,540	9,290	48,530
Water shortage	do	23,900	10,300	10,480	44,680
POTENTIAL:					
Cropland	Acres	...	37,900	21,800	59,700
Irrigable land	do	19,200	125,700	35,260	180,160
Water source:					
Natural flow and ground	Acres	5,000	7,300	6,600	18,900
Storage needs	do	14,200	118,400	28,660	161,260
STORAGE:					
Existing ponds	Number	27	112	145	284
Existing reservoirs	do	...	4	2	6
Possible res. sites studied	do	5	14	17	36
DRAINAGE:					
Arable land needing drainage	Acres	500	7,160	1,600	9,260
FLOODS:					
Area	Acres	2,320	6,000	8,050	16,370

Source: Based on estimates provided by local personnel of the Soil Conservation Service, Forest Service, County Extension Service, and others gathered by the USDA River Basin Field Party.

SUBBASINS

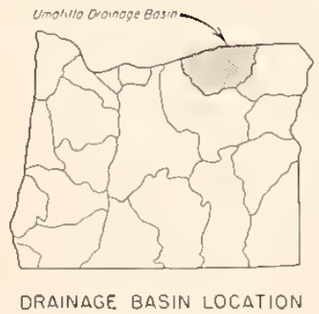
1 WALLA WALLA

2 UMATILLA

3 WILLOW

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE ... M-3829

COUNTY LOCATION



DRAINAGE BASIN LOCATION

LEGEND

A Watershed Areas

3 Possible Reservoir Site

Drainage Basin Boundary

Subbasin Boundary

National Forest and/or Indian Reservation Boundary

WATERSHED CLASSIFICATION

Best P.L. 566 Possibilities

Application Approved P.L. 566

Others

FIGURE 42

INDEX MAP OF WATERSHED AREAS AND POSSIBLE RESERVOIR SITES

UMATILLA DRAINAGE BASIN

OREGON

DECEMBER 1962

SCALE IN MILES

7 - E - 17401 - N

OPPORTUNITIES FOR WATERSHED PROTECTION AND FLOOD PREVENTION PROJECTS

The Watershed Protection and Flood Prevention Act, Public Law 566, as amended, authorizes the Secretary of Agriculture to cooperate with local organizations in planning and carrying out works of improvements for flood prevention and/or for the conservation, development, utilization, and disposal of water in watershed or subwatershed areas smaller than 250,000 acres. The act provides for technical, financial, and credit assistance by the U. S. Department of Agriculture to landowners, operators, and other people living in small watersheds. Project-type action under the act is intended to supplement other soil and water conservation programs and other programs for the development and flood protection of major river valleys.

The USDA Field Party made a survey of the potential for P. L. 566 projects in the Umatilla Drainage Basin to provide information as a guide to long range coordination and planning of possible future projects. The basin was divided into 24 tributary watershed areas which are designated by letter and are delineated on figure 42. A preliminary survey was made of each watershed to gather basic reconnaissance data on land and water use and water related problems, which are summarized in tables 23 through 25.

Information in these tables was estimated by local personnel of the Soil Conservation Service, the County Extension Service, and the U. S. Forest Service. Although the information is of a reconnaisance nature, published data such as the U. S. Census of Agriculture were used as a cross check on several items. Data from this survey are used throughout much of this report.

A field reconnaissance and an evaluation of available data for each watershed was made to obtain information on opportunities for P. L. 566 action based upon watershed area, physiographic conditions, land use, water yield and its seasonal distribution, and water related problems and needs. However, information on some items is limited because of a lack of time for making detailed field observations. It was determined many of the water related problems of the Umatilla Drainage Basin could be reduced or solved under P. L. 566. Under existing conditions and laws it appears that a solution of these problems may be practicable and feasible in several watersheds.

The field party's findings indicate that watersheds with the best possibilities for P. L. 566 action have a combination of some of the following conditions:

1. Part of the watershed is at higher elevation with relatively high water yields.

2. The watershed has, or has potential for, a high degree of agricultural, residential, or urban development.

3. The watershed has a large area suitable for irrigation development, and lacks water sources that can be develop-

ed by individual farmers but has water sources that can be developed by group action.

4. The watershed has localized flooding and/or drainage problems which are related to floods of moderate duration which are not influenced by flooding of large streams outside the watershed under consideration.

5. The watershed contains one or more storage sites which appear feasible for multipurpose development.

6. The watershed contains highly erodable soils that are subject to action from wind and/or water.

Some watersheds do not appear to be suitable for P. L. 566 action. These watershed usually have a combination of some of the following conditions:

1. The total water yield and peak flow of the watersheds are so large that flooding and drainage problems are beyond the scope of P. L. 566.

2. Most of the watershed needs are for land treatment on forest and rangeland, which of itself is usually not sufficient justification for a P. L. 566 project.

3. A minor part of the watershed that would benefit materially from flood control and drainage is under agricultural, residential, industrial, or urban uses; and there is limited potential for expansion of these land uses.

4. The watershed has minor drainage, flooding, and water supply problems or has major problems that can be solved by individual action.

5. Group irrigation development is not feasible in the watershed because of land capability and/or water supply limitations.

There are several factors that were not considered in this study which may affect the feasibility of a given watershed for P. L. 566 action.

1. Changes in laws and policies to give greater recognition to land treatment, flood control, and other benefits would improve the possibility for P. L. 566 action in some watersheds.

2. Unforeseen demands for water arising from increased urbanization, industrialization, and variation in prices and needs for some agricultural crops may improve the need for P. L. 566 action in some watersheds.

3. The degree of local interest in a given project will influence the immediate prospects for P. L. 566 action in watersheds where projects appear to be physically and economically feasible. Interest in irrigation and more intensive land use will be particularly important as many potential projects center around irrigation development.

4. In a few instances, changing the area included in a small watershed might improve its possibility for P. L. 566 action.

Further detailed investigations would be necessary to determine engineering and economic feasibility of a given project. The field party's findings are presented in individual watershed reports summarized in table 27 and shown on figure 42.

Table 27.--Summary of watershed reports, Umatilla Drainage Basin, Oreg.

Subbasin and watershed	Project possibilities under P. L. 566
1. Walla Walla Subbasin:	
A. Cottonwood Creek..	A project does not appear to be feasible because of limited benefits in the area studied. If the part of the watershed in Washington were included, it might be feasible.
B. Walla Walla River.....	A project for flood control, irrigation, drainage, land treatment, recreation, and fish management appears to be feasible. The Corps of Engineers have already completed channel work through Milton-Freewater.
C. Hudson Bay.....	An application for a P. L. 566 plan has been received and approved. A project including flood control, land treatment, and water development for irrigation, recreation, domestic, municipal, and industry appears to be faasible.
D. Vansycle Canyon...	A project does not appear to be feasible for the area studied.

Table 27.--Summary of watershed reports, Umatilla Drainage Basin, Oreg.--Continued

Subbasin and watershed	Project possibilities under P. L. 566
2. Umatilla Subbasin:	
A. Juniper Canyon	A limited project for irrigation, using water from outside the basin, and including land treatment might be feasible.
B. Cold Springs	A limited project for irrigation, using water from outside the basin, and including land treatment might be feasible.
C. Stanfield	A project does not appear feasible under existing conditions and laws.
D. Westland	A project does not appear feasible under existing conditions and laws.
E. Sand Hollow	A project does not appear feasible under existing conditions and laws.
F. Teel	A project does not appear feasible under existing conditions and laws.
G. Lower Umatilla River	A project does not appear feasible under existing conditions and laws. Work has been completed on portions of the watershed, and studies are being made by the Corps of Engineers.
H. Birch Creek	An application for a P. L. 566 plan has been received and approved; but because of inability to obtain water storage rights, the project is inactive. It appears to be feasible if water rights can be obtained.
I. McKay Creek	A project does not appear feasible under existing conditions and laws.
J. Tutuilla Creek	An application for a P. L. 566 plan has been received and approved. A project including land treatment, channel stabilization, flood control, and perhaps irrigation appears to be feasible.
K. Wildhorse Creek	A project including land treatment, multiple-purpose structures, channel alignment, and water management might prove feasible.

Table 27.--Summary of watershed reports, Umatilla Drainage Basin, Oreg.--Continued

Subbasin and watershed	Project possibilities under P. L. 566
2. Umatilla Subbasin:--Continued	
L. Mid-Umatilla.....	Problems are probably not within the scope of P. L. 566. Studies have been authorized and are being made by the Corps of Engineers and Bureau of Reclamation.
M. Upper Umatilla....	A project does not appear feasible under existing conditions and laws. This watershed is part of the Umatilla River which the Corps of Engineers and Bureau of Reclamation have authorized studies.
N. Butter Creek.....	A project including flood control, irrigation, land treatment, recreation, and wildlife appears to be feasible.
O. South Butter Creek.....	A project including flood control, irrigation, land treatment, recreation, and wildlife appears to be feasible.
3. Willow Subbasin:	
A. Boardman.....	A limited project to supply additional irrigation water from outside the basin might prove feasible.
B. Sixmile Canyon.....	A limited project to supply irrigation water from outside the basin might prove feasible.
C. Willow Creek.....	A project including channel work, irrigation, and land treatment appears feasible and would benefit works of improvement proposed by other agencies.
D. Eightmile Canyon....	A limited project to supply irrigation water from outside the basin might be feasible.
E. Rhea Creek.....	A project including flood protection, irrigation, land treatment, and recreation appears to be feasible.

Narrative reports for each watershed are presented by subbasin in the following section.

1. WALLA WALLA SUBBASIN

Watershed A, Cottonwood Creek

Description. The Cottonwood Creek watershed occupies 44,400 acres in northeastern Umatilla and northwestern Wallowa Counties in Oregon as shown in figure 42. It lies within the boundaries of the East Umatilla and Wallowa Soil Conservation Districts. The Cottonwood Creek watershed includes several drainages tributary to the Walla Walla River of which Cottonwood Creek is the largest. This report covers only the Oregon portion of the watershed which contains a minor portion of the agricultural land. The watershed parallels the state boundary for about 18 miles and averages about 4 miles in width. Elevations range from 1,100 feet above sea level to 5,000 feet in the Blue Mountains. Annual precipitation ranges from 30 inches in the valley to over 50 inches in the mountains.

This watershed contains four general groups of soils. The Walla Walla, Athena, and Palouse soils and minor areas of Lickskillet, Hurwall, Waha, Snipe, and Thatuna occur on the loessial plain in the west part. On the footslopes of the Blue Mountains Waha, Palouse, and Couse soils occur in almost equal proportions. The Blue Mountains group on the east includes Tolo, Klicker, Helmer, Couse, Rock Creek, and Snipe soils. The alluvial bottom land soils are Caldwell, Hermiston, Onyx, Stanfield, Snow, Umapine, Veazie, and Yakima.

Forest covers about 25,600 acres, 58 percent of the total watershed. About 51 percent of the forest land is in public ownership.

Approximately 18,600 acres in 20 farms are devoted to agricultural production including 8,800 acres of cropland and 9,800 acres of rangeland. About 300 acres are irrigated pasture. The remaining cropland is planted to grass or to a rotation of grain and peas.

Watershed Problems and Needs. Approximately 100 acres of cropland are flooded annually. This results in some damage to irrigation facilities, farm facilities, roads, and culverts.

Approximately 300 acres of additional land are suitable for irrigation. It is estimated that ground water is available for about 200 acres. Additional water storage would be necessary to irrigate the remaining 100 acres and to provide supplementary late season water for the presently irrigated land. One reservoir site (index number 1) was investigated and found to have a storage capacity of about 7,000 acre feet.

The Cottonwood Creek watershed includes part of the Mill Creek drainage which supplies water to Walla Walla, Wash. The Mill Creek drainage is managed under the provisions of a 1918 agreement between the city and the Secretary of Agriculture. This agreement was made

to assure the city of a pure water supply. Use of the area is limited to that allowed in the agreement. The agreement provides for:

1. Protection and care of the national forest.

2. Establishment of sanitation requirements proposed by the city and approved by the Secretary.

3. Improvement of the land cover by seeding and planting where practical.

A large portion of the private land has been cutover with little attention given to watershed management. Erosion is evident on some of the roads, and there is a significant amount of debris in the streams.

Opportunities under P. L. 566. The problems in this watershed are applicable to P. L. 566, but the benefits are quite limited. A project under this law does not appear to be feasible in the area studied. However, a project including the watershed area in the State of Washington where more benefits may accrue might be feasible.

Watershed B, Walla Walla River

Description. The Walla Walla River watershed contains 120,400 acres, most of which lies in northeastern Umatilla County with smaller acreages in Wallowa and Union Counties. This watershed lies within the East Umatilla, Wallowa, and Elgin Soil Conservation Districts. The area of the Walla Walla River considered in this study is that portion which lies in the State of Oregon from river mile 37.5 to the headwaters as shown in figure 42. The north and south forks of the river head in the Blue Mountains and flow east to river mile 48 where they join and flow in a northerly direction to the state line. The watershed is about 27 miles in length and averages 7 miles in width. Elevations range from 850 feet at the state line to 5,400 feet in the Blue Mountains. Annual precipitation averages from 16 inches to 24 inches in the valley to 55 inches maximum in the mountains. The average frost-free growing season in the area of Milton-Freewater is 194 days.

This watershed contains four general groups of soils. The western half on the loessial plain includes Ritzville, Walla Walla, Athena, and Palouse and minor areas of Lickskillet, Nansene, Waha, Hurwall, Snipe, and Thatuna. On the footslopes of the Blue Mountains, Waha, Palouse, and Couse soils occur in almost equal proportions. In the Blue Mountains on the east Tolo, Klicker, Helmer, Couse, Rock Creek, and Snipe are found. The alluvial bottom land soils are Catherine, Caldwell, Hermiston, Onyx, Pedigo, Stanfield, Snow, Umapine, Veazie, and Yakima.

Forest land, which is 73 percent publicly owned, covers about 51,600 acres, 42 percent of the total watershed studied. Approximately 29,300 acres are range. About 83 percent of the 38,000 acres of cropland are dry farmed. Dryland cropping is predominantly a rotation of

wheat and peas with some grass being grown. About 6,600 acres of cropland are irrigated producing alfalfa, pasture, row crops, grain, and fruit crops.

Watershed Problems and Needs. Approximately 600 acres of cropland flood annually. Damage in the form of erosion, sediment and debris deposits occur to irrigated canals, diversions, and farm facilities. The municipal area of Milton-Freewater is fairly well protected by a Corps of Engineers channel and revetment project. Estimates show that 300 acres of arable land need drainage. Tile drains would be necessary on most of this land. Shortage of water for irrigation is a problem in early summer when both streamflow and existing ground water supplies are depleted. There are about 10,000 acres of additional land that is readily suitable for irrigation development. It is estimated that 3,100 acres could be irrigated from ground water. Stored water would be required for development of the remainder. The Bureau of Reclamation has investigated several reservoir sites in the upper reaches of the Walla Walla River for the purpose of expanding and supplementing the irrigation water supply.

Lack of access roads into the forested area presents a problem because fire crews can't take prompt action and efficient management of the land resources is difficult. Construction of roads along many of the stream bottoms and steep side slopes is likely to be so destructive that development is not justified. Almost all routes are difficult so careful planning and extreme care is needed in all phases of engineering and construction.

Opportunities under P. L. 566. Opportunities exist for water development for supplementary use as well as for potentially irrigable land. Drainage and flood control benefits would result from channel work and water storage. Land treatment measures are needed to reduce damage from flooding, erosion, and sediment. It appears that a project under P. L. 566 offering protection or benefits from these problems would be feasible.

Watershed C, Hudson Bay

Description. The Hudson Bay watershed occupies 109,000 acres in north central Umatilla County. It is in the East Umatilla Soil Conservation District. This watershed consists of three principal drainages; they are Pine Creek and Couse Creek which are directly tributary to the Walla Walla River and Dry Creek which is tributary to Pine Creek. The headwaters originate in the Blue Mountains, and all the creeks flow in a generally northwest direction. This report includes only the Oregon part of the watershed as shown in figure 42. The watershed is about 24 miles long in a northeast-southwest direction and averages 7 miles in width. Elevations range from around 600 feet to 4,000 feet in the Blue Mountains. Average annual precipitation ranges from 9 inches to 44 inches. The average frost-free growing season in the lower reaches is 190 days.

This watershed has five general groups of soils. A small area on the northwest has Sagemoor, Quincy, and Taunton soils which have devel-

oped from glacial sediments. The remainder of the western half is a loessial plain with Ritzville, Walla Walla, Athena, and Palouse soils and minor areas of Lickskillet, Starbuck, Nansene, Waha, Hurwall, Snipe, and Thatuna. On the footslopes of the Blue Mountains Waha, Palouse, and Couse occur in almost equal proportions. In the Blue Mountains group is Tolo, Klicker, Helmer, Couse, Rock Creek, and Snipe soils. The alluvial bottom land soils are Catherine, Caldwell, Hermiston, Onyx, Pedigo, Stanfield, Snow, Umapine, Venzie, and Yakima.

Forest land covers about 11,000 acres, 10 percent of the total watershed. It is all privately owned.

About 97,000 acres in 430 farms are used for agricultural production including 73,000 acres of cropland and 24,000 acres of rangeland. Approximately 18,000 acres of irrigated land are producing alfalfa, pasture, row crops, grain, and fruit crops.

Watershed Problems and Needs. Approximately 1,500 acres of irrigated cropland are flooded annually. This results in damage through crop loss and sediment deposition to irrigation ditches and structures, farm facilities and roads, and culverts. Rangeland is overgrazed in some areas and is subject to erosion of varying degrees. It is estimated that 200 acres of arable land need drainage. Closed drain tile would be necessary to remedy this problem. Irrigation water supply becomes a problem in late spring and early summer. It is estimated that an additional 8,500 acres of land are suitable for irrigation if adequate water is developed. There is need of water development for domestic, municipal, industrial, and recreational use. This watershed has potential for additional water development from both ground water and stored surface water. Four storage sites (index numbers 2 thru 5) were investigated with a storage potential of around 20,000 acre feet. It is estimated that an additional 1,500 acres could be irrigated from ground water.

Opportunties under P. L. 566. An application has been received and approved for a P. L. 566 project on this watershed. The features of this project are land treatment and water development, control and management for irrigation, recreation, domestic, municipal, and industrial uses. A multiple-purpose P. L. 566 project appears feasible.

Watershed D, Vansycle Canyon

Description. The Vansycle Canyon watershed occupies 37,200 acres in northern Umatilla County. The portion of the watershed studied includes the area within the State of Oregon as shown in figure 42. The Vansycle Canyon watershed contains the upper two-thirds of Vansycle Canyon and the upper half of Warm Springs Canyon which are direct tributaries of the Walla Walla River and most of Raymond Gulch, a tributary of Pine Creek. Elevations in the watershed range from 600 feet to 2,200 feet. The average annual precipitation ranges from 9 inches to 14 inches.

This watershed contains three general groups of soils. Glacial sediments cover a small area on the northeast upon which Sagemoor,

Quincy, and Taunton soils have developed. The remainder of the watershed is on the loessial plain which includes Ritzville and Walla Walla soils and minor areas of Starbuck and Nansene. The alluvial bottom land soils are Catherine, Caldwell, Hermiston, Onyx, Pedigo, Stanfield, Umapine, and Yakima.

About 36,600 acres in 30 farms are used for agricultural production including 13,400 acres of cropland and 23,200 acres of rangeland. About 1,000 acres of irrigated land produce pasture, alfalfa, row crops, grain, and fruit crops. The irrigated land lies in the northeast portion of the basin which resembles the lower Hudson Bay area. The dry cropland is either alternated between grain and fallow or produces grass.

There is no forest land in the Vansycle Canyon watershed.

Watershed Problems and Needs. Flooding occurs annually on about 120 acres of cropland. This is generally summer flooding resulting from cloudburst type storms. Damage to crops, farm facilities, roads, and culverts result. Rangeland that is in poor condition is subject to erosion during heavy storms. Water shortage occurs on irrigated lands early in the summer. Additional ground water development should be investigated as well as upstream storage in adjoining watersheds. It is estimated that an additional 400 acres are suitable for irrigation if additional water were developed. Storage of water is a problem due to the low yield of the watershed.

Opportunities under P. L. 566. Many of the problems of this watershed are in the irrigated area and are similar to the problems of the adjoining watershed to the east. The possible benefits on Vansycle Canyon are limited. Therefore, it appears that at the present time and under present watershed conditions a project under P. L. 566 would not be justified.

2. UMATILLA SUBBASIN

Watershed A, Juniper Canyon

Description. The Juniper Canyon watershed occupies 62,700 acres in the northern part of Umatilla County. A portion of this watershed is in the West Umatilla Soil Conservation District. The creek flows in a westerly direction from its origin on the Umatilla plateau to its confluence with the Columbia River. The watershed is approximately 17 miles long and averages 5 miles in width. Elevations in the watershed range from 300 feet to 2,000 feet above sea level. The average annual precipitation ranges from 8 to 12 inches. The temperature is mild with an average annual growing season of 180 days.

This watershed contains three general groups of soils. Glacial sediments cover a small area on the west near the Columbia River. In this area Quincy and Ephrata occur intermixed with Rockland soil. Ritzville and Walla Walla soils are found on the loessial plain with

their associated soils, Starbuck, Nansene, and Lickskillet. The bottom land soils are the Catherine, Caldwell, Pedigo, Onyx, Stanfield, Yakima, and Hermiston.

An estimated 62,500 acres in 40 farms are used for agricultural production including 20,200 acres of cropland and 42,300 acres of rangeland. About 200 acres of cropland are irrigated with pasture the principal crop. The remainder of the cropland is used primarily for the production of grain in rotation with peas or fallow.

Watershed Problems and Needs. Wind and water erosion are probably the biggest problems in this watershed. Wind erosion occurs on about 4,000 acres of cropland and 4,000 acres of rangeland annually. Water also causes erosion of croplands, especially in the upper watershed. Grassed waterways and stubble mulching are needed to help reduce these losses. The irrigated land is short of water after early August. It is estimated that an additional 5,000 acres could be irrigated if water was available. The possibility of using Columbia River water on the lower part of the watershed should not be overlooked.

Opportunities under P. L. 566. The problems of this watershed are applicable to P. L. 566. However, the benefits from flood control and erosion are probably not great enough to justify project action. However, an irrigation project supplying water from the Columbia River may be feasible under existing conditions and laws.

Watershed B, Cold Springs

Description. The Cold Springs watershed contains 160,200 acres in northern Umatilla County. It is partly in the West Umatilla Soil Conservation District. Because of influences on water related problems by structures of the Hermiston Irrigation District, the area below the Cold Springs Reservoir was included (fig. 42). Cold Springs Canyon and its principal tributary, Despain Gulch, flows west into Cold Springs Reservoir from their headwaters north of Pendleton. Below the reservoir Cold Springs Canyon curves to the north and enters the Columbia River. The watershed is approximately 30 miles long and averages 8 miles in width.

The Cold Springs watershed is located in the Columbia plateau physiographic province and has a gently rolling to hilly topography. Elevations range from 300 feet near Umatilla to about 1,900 feet at the eastern divide. Average annual precipitation ranges from 7.8 inches at Umatilla to about 12 inches along the eastern boundary. Summers are warm, and winters are comparatively mild. The average frost-free period is 170 days.

Three general groups of soils are in this watershed. Soils in the west half have developed from glacial sediments. These soils are Sagemoor, Quincy, Ephrata, and Taunton. Near the Columbia River Rockland occur intermixed with Quincy and Ephrata soils. On the loessial plain Ritzville and Walla Walla soils occur in association with Starbuck, Nansene, and Lickskillet. Catherine, Caldwell, Hermiston, Onyx, Pedigo, Stanfield, Umapine, and Yakima soils occur on the bottom lands.

Land in the watershed is used predominantly for agricultural production. Approximately 120,740 acres of cropland are rotated between grain and fallow or grain and peas. About 30,000 acres are rangeland. Most of the 7,660 acres of irrigated land is used to produce pasture. Other irrigated crops include alfalfa hay, row crops, grain, and orchards.

There is no forest land in the Cold Springs Canyon watershed.

Watershed Problems and Needs. In the upper watershed the most prevalent problem is sheet and rill erosion on cultivated land. Gully erosion is not a major problem but does exist. Records show that by 1951 the Cold Springs Reservoir had lost over 5,000 acre feet of capacity to sedimentation; this is an average rate of about 116 acre feet per year since the dam was built. Surveys show most of this silt came from the dry farmed land in Cold Springs Canyon and Despain Gulch.

There is some flood damage to roads, irrigation canals, and stock ponds. In the lower areas it is estimated that 2,500 acres of arable land are in need of drainage.

Approximately 12,500 acres of additional land could be readily irrigated. About 7,500 acres lie below the Cold Springs Reservoir, and 5,000 acres are above the reservoir. Water for developing most of this land would have to come from outside the watershed. There is a possibility of developing ground water for about 40 percent of the acreage above the reservoir. The Columbia River would be a possible source of water for the rest of the land. Supplemental water is needed after the first part of August for about 240 acres of land now irrigated with ground water.

Opportunities under P. L. 566. Opportunities exist for water development, control, and management to increase irrigation and permit more intensive land use. Land treatment measures are badly needed to reduce damage from erosion and sedimentation. However, many of the problems can be resolved without a group project. It appears that an irrigation project using water from the Columbia River combined with land treatment and water control measures might be feasible on part of the watershed.

Watershed C, Stanfield

Description. The Stanfield watershed contains 93,700 acres in northwestern Umatilla County. It is partly in the West Umatilla Soil Conservation District. The main drainage in the watershed is Stage Gulch which flows in a westerly direction from its headwaters north of Pendleton to its confluence with the Umatilla River near Stanfield. The watershed boundaries include some additional land west of the Stage Gulch watershed (fig. 42). This area is included because the irrigation canals of the Stanfield Irrigation District change the surface flow pattern of the watershed making it a potential benefit area. The watershed is about 27 miles long in an east-west direction and averages about 4 miles in width. Elevations range from 600 feet at Stanfield to 1,500 feet in the headwaters. The topography of the watershed is

gently rolling to hilly. The climate is characterized by warm summers and comparatively mild winters; average annual precipitation is 10 inches. The average frost-free period is 170 days.

In this watershed are three general groups of soils. The west end has Quincy, Ephrata, and Taunton soils. The main area is composed of Ritzville and Walla Walla series on the loessial plain with their associated soils, Starbuck, Nansene, and Lickskillet. On the bottom lands are the Catherine, Caldwell, Hermiston, Onyx, Pedigo, Stanfield, Umapine, and Yakima soils.

Approximately 88,200 acres in 260 farms are cropland; of this 81,490 acres are dryland cropped alternately to grain and fallow, and the remaining 6,710 acres are under irrigation. Irrigated crops include row crops, pasture, alfalfa, and a small acreage of grain. There is also about 3,000 acres of this watershed in range. There is no forest land in the watershed.

Watershed Problems and Needs. Flooding occurs in the lower reaches on an average of one out of five years. Most damage is in the form of sediment deposits on cropland, roads, culverts, and irrigation facilities. Estimates show that 1,500 acres of arable land needs drainage.

There is approximately 36,500 acres of additional land readily suitable for irrigation providing water can be developed. A small portion could probably be irrigated with ground water, but most would require water development from outside the basin. One reservoir site (index number 1) was investigated, but the potential yield is not dependable.

Opportunities under P. L. 566. Land treatment measures and improved water management practices would be beneficial in relieving the problems of this watershed and can be implemented without group action. It appears that the development of irrigation in the area may be beyond the scope of P. L. 566. Under present laws and conditions it would appear this watershed has little opportunity for project action under P. L. 566.

Watershed D, Westland

Description. The Westland watershed contains 91,800 acres in Umatilla and Morrow Counties. It lies within the Heppner, West Umatilla, and South Umatilla Soil Conservation Districts. It includes the Alkali Canyon drainage; the area between the Westland Main Canal and the Umatilla River; an area between the Sand Hollow and Butter Creek watersheds that drains into the Westland B Canal; an area bounded by the subbasin boundary; the Umatilla River; and the Columbia River (fig. 42). Elevations in the watershed range from 250 feet at the mouth of the Umatilla River to 2,700 feet at the headwaters of Alkali Canyon. The topography is generally gently rolling to hilly. The climate is characterized by warm summers and comparatively mild winters.

Average annual precipitation varies from 7.8 inches at Umatilla to 16 inches in the upper watershed. The average growing season is around 170 days.

There are four general areas of soils in this watershed. The area of glacial sediments on the north end includes the Sagemoor, Quincy, Ephrata, and Taunton soils. On the loessial plain in the central part of the watershed the Ritzville and Walla Walla soils occur along with their associated soils, Starbuck, Nansene, and Lickskillet. On the south end is the upland plateau where Condon and Morrow soils are associated with Lickskillet, Nansene, and Bakeoven. The alluvial soils are Caldwell, Catherine, Hermiston, Onyx, Pedigo, Stanfield, Umapine, and Yakima.

Approximately 28,700 acres of cropland is in 180 farms. About 17,900 acres are dryland farmed in a grain and fallow rotation. About 10,800 acres are under irrigation. Irrigated crops include pasture, alfalfa, row crops, and a small acreage of grain. There are 57,600 acres of land devoted to range. There is no forest land in this watershed.

Watershed Problems and Needs. Approximately 100 acres of cropland are flooded one year out of five. Flooding causes deposition of sediment on the fields and in irrigation facilities. There is also bank cutting and local flooding along the Umatilla River.

Estimates show that 2,660 acres of arable land need drainage. Improved surface drainage and open drains are needed to transport the excess water.

Irrigation water is in short supply after the middle of July. About 5,200 acres of additional land could be irrigated if an adequate water supply were developed. Some additional ground water is available, but the majority of the requirement would have to be developed outside of the watershed. One reservoir site (index number 2) was investigated on the Alkali Canyon drainage but because of an undependable water yield and high sediment rate, it may not be feasible. One source of water for some of the area could be the Columbia River.

Opportunities under P. L. 566. A program of land treatment and erosion control on the upper watershed would greatly reduce the problem of sedimentation. The bank cutting and problems adjacent to the Umatilla River are probably more adapted to the program of the Corps of Engineers. The development of irrigation water for most of the watershed is probably beyond the scope of P. L. 566. It, therefore, appears that a project under P. L. 566 would probably not be feasible.

Watershed E, Sand Hollow

Description. The Sand Hollow watershed occupies an area of 94,500 acres in the northeastern portion of Morrow County in the Heppner Soil Conservation District. Sand Hollow flows north from the Hinton Creek watershed to a point in Section 7, Township 3 North, Range 27 East where during normal years it ceases to flow above ground. When flood-

ing occurs, the higher flows continue on into the drainage to the east which outlets into the Umatilla River. The watershed is 27 miles long in a north-south direction and averages about 5 1/2 miles in width. Elevations in the watershed range from 600 feet to 3,300 feet in the headwaters. The topography is gently rolling to hilly. Average annual precipitation ranges from 8 to 14 inches.

Four general areas of soils have developed in the watershed. In the north end on glacial sediments are the Sagemoor, Quincy, Ephrata, and Taunton soils. Ritzville, Walla Walla, and associated soils including Starbuck, Nansene, and Lickskillet have developed on the loessial plain in the central section. On the upland plateau in the southern end are Condon and Morrow with their associated soils, Lickskillet, Nansene, and Bakeoven. Alluvial soils occur on the bottom land including Caldwell, Hermiston, Onyx, Stanfield, Umapine, and Yakima.

Land use in the watershed is predominantly for agricultural production. Approximately 67,000 acres, or 71 percent of the land, is cropland. Grain and fallow are alternated on 66,340 acres of dryland, and 660 acres produce irrigated alfalfa and pasture. About 26,900 acres are range. There is no forest land in the Sand Hollow watershed.

Watershed Problems and Needs. The major problem of the watershed is probably the shortage of a water supply. Approximately 300 acres of cropland are flooded every other year. The resulting damage is erosion and deposition of sediment and debris. Cultivated land and sparsely covered rangeland are subject to severe wind erosion resulting in dune formation. Some damage to irrigation facilities, farm facilities, roads, and culverts is caused by both wind and water erosion.

Estimates show that an additional 14,300 acres are suitable for irrigation development. About 300 acres of the above could be irrigated from ground water sources, but the remainder of the acreage would need a stored source of water. One reservoir site (index number 3) was investigated with a potential storage of 2,500 acre feet. The yield in this watershed is low and not dependable enough to develop more than a few acres of irrigated crops. The useful life of a reservoir would be comparatively short due to sediment unless an intensive land treatment program was installed.

Opportunities under P. L. 566. Several problems in this watershed are applicable to project action under P. L. 566. A program of land treatment and erosion control measures could greatly reduce the flooding, sedimentation, and erosion problems. To develop the irrigation potential to its fullest would necessitate bringing water from outside the watershed and would probably be beyond the scope of P. L. 566. It would appear that a watershed program would not be feasible under present conditions and laws.

Watershed F, Teel

Description. The Teel watershed contains 71,100 acres in northwest Umatilla County and northeast Morrow County. It is in the Heppner, West Umatilla, and South Umatilla Soil Conservation Districts. The upper watershed boundary is the Butter Creek watershed, and the north boundary is the Westland Main Canal. The watershed includes a proposed Bureau of Reclamation irrigation project of 15,000 to 20,000 acres and the rolling hill lands that drain into the project area. Elevations range from 600 feet on the plateau to 2,200 feet in the headwaters. Average annual precipitation is about 12 inches. The annual frost-free growing season averages 170 days.

There are four general groups of soils in the watershed. Sagemoor, Quincy, and Taunton soils have developed on the glacial sediments in the north end. On the loessial plain in the central section are Ritzville, Walla Walla, and the associated soils, Starbuck, Nansene, and Lickskillet. Condon and Morrow along with their associated soils, Lickskillet, Nansene, and Bakeoven are on the upland plateau. Alluvial soils occur on the bottom land including Caldwell, Hermiston, Onyx, Stanfield, Umapine, and Yakima.

The watershed is used exclusively for agricultural production with the exception of about 300 acres. A rotation of grain and fallow is practiced on approximately 31,900 acres while 38,900 acres are utilized as range. There are no significant irrigated areas.

Watershed Problems and Needs. In general the most significant problem in this watershed is the water shortage to irrigate the potential land which estimates show to be around 16,900 acres. The development of water must be from outside the watershed with the Umatilla or Columbia Rivers as the possible source with the greatest potential. There are also problems from wind erosion. Sparsely vegetated rangeland and unprotected cultivated fields are highly susceptible to wind erosion.

Opportunities under P. L. 566. Under existing laws and conditions a project under P. L. 566 does not appear to be feasible.

Watershed G, Lower Umatilla River

Description. The Lower Umatilla River watershed contains an area of 88,400 acres in central Umatilla County. It is partly in the South Umatilla and West Umatilla Soil Conservation Districts. The watershed includes all the land draining into the Umatilla River except Birch, McKay, and Tutuilla Creeks from river mile 33 upstream to Pendleton. The length of the watershed is 26 miles in an east-west direction. Elevations range from 640 feet to 2,600 feet in the headwaters of Coombs Canyon. Annual precipitation varies from 11 inches to 17 inches. The average frost-free growing season along the river is 165 days.

The soils of this watershed are of three main groups. The northwest one-third is the loessial plain on which Ritzville and Walla Walla with their associated soils, Starbuck, Nansene, and Lickskillet have

developed. The southeast two-thirds is the upland plateau with Condon and Morrow and their associated soils, Lickskillet, Nansene, and Bakeoven. The alluvial soils along the streams include Caldwell, Hermiston, Onyx, Stanfield, Umapine, and Yakima series.

Approximately 87,200 acres in 15 farms are used for agricultural production including 81,700 acres of range and 5,500 acres of cropland. About 500 acres of cropland are irrigated and used for pasture and alfalfa production. The remaining cropland is dry farmed to a grain and fallow rotation. This watershed contains no forest land.

Watershed Problems and Needs. Flooding problems occur only on the land adjacent to the Umatilla River. Approximately 100 acres flood about once in five years. Resulting damage is generally confined to streambank cutting and deposition of silt on croplands. There has been some revetment and streambank protection work completed by the Corps of Engineers. Considerable silt is produced from some of the side drainages and is a serious problem. The Furnish Reservoir which stored irrigation water for the Stanfield Irrigation District completely filled with silt and was abandoned. Land treatment measures and desilting basins could be utilized to greatly reduce this problem.

Irrigation water supply is a problem beginning about the middle of July. The ground water supply is not adequate for irrigation purposes so upstream storage should be considered. Estimates show that an additional 100 acres of land are suitable for irrigation. One reservoir site (index number 8) exists in Coombs Canyon which has a potential storage of 3,000 acre feet, but the water yield is not very dependable.

Opportunities under P. L. 566. In general the problems of the Umatilla River are not within the scope of P. L. 566. The entire Umatilla River watershed, of which this section is only 24 percent, is authorized for study by the Corps of Engineers for flood control. Irrigation studies have also been made by the Bureau of Reclamation. The regular program of the Soil Conservation Service should be used to supplement programs by other agencies.

Watershed H, Birch Creek

Description. The Birch Creek watershed contains 187,000 acres and is located mostly in southwestern Umatilla County with a small area in Union County. It is entirely in the South Umatilla and First Union County Soil Conservation Districts. The creek flows in a northerly direction from the Blue Mountains to its confluence with the Umatilla River about 5 miles west of Pendleton. The watershed is divided into two distinct parts. The northern half is at low elevation and fairly flat. The southern half consists of sharp steep ridges and canyons. Elevations range from just under 1,000 feet at the mouth of Birch Creek to just over 5,000 feet on the southern rim of the watershed. Average annual precipitation ranges from about 12 inches at the lower end of the watershed to 32 inches at the upper end.

Five general groups of soils are in this watershed. On the lower elevations on the loessial plain Pilot Rock is the principal soil. The upland plateau in the central portion of the watershed has Condon and Morrow with associated soils of Lickskillet, Bakeoven, and Nansene. Waha is the principal soil of the footslopes of the Blue Mountains with Hurwall, Rock Creek, and Snipe. In the Blue Mountains on the south Tolo, Klicker, Snipe, Kilmerque, Couse, and Rock Creek soils are found. The narrow alluvial valley bottom has the Caldwell, Onyx, Stanfield, Umapine, Yakima, Hermiston, Snow, and Veazie soils.

Forest land covers about 38,800 acres, 21 percent of the total watershed. About 52 percent of the forest land is publicly owned.

Approximately 146,500 acres in 80 farms are used for agricultural production including 64,300 acres of cropland and 82,200 acres of rangeland. About 4,000 acres of cropland are irrigated alfalfa and pasture. The remaining cropland is dry farmed mostly to a rotation of grain and fallow with some grass.

Watershed Problems and Needs. The flood problem area extends from the mouth of Birch Creek upstream approximately 14 miles to the vicinity of Pilot Rock. The city of Pilot Rock is within the floodplain. Also, farm land along the west branch of Birch Creek for some 10 miles and the east branch for 8 miles are within the floodplain. Approximately 400 acres of this area are flooded annually. Damages include sediment deposits on cropland and in irrigation canals, loss of farm bridges, diversion dams, fences, small structures, and some livestock. Stream channel erosion and bank cutting is the most critical erosion problem of the watershed. Bank cutting along the main channel in the lower valley takes its toll of good cropland each year. Sheet erosion varying from slight to moderate and some gully erosion occurs on cropland and rangeland. Most irrigation water is diverted by gravity from Birch Creek, but some is pumped. There is some pumped from wells. The early spring supply is adequate for the present acreage; however, by midsummer it is inadequate. Estimates show that 4,000 acres of additional land are suitable for irrigation. The watershed yield is great enough to irrigate this land adequately if storage is provided; however, there is a filing for a permit to divert all water not already used to the proposed Teel Project by way of the McKay Reservoir. Two storage sites (index numbers 9 and 10) have been investigated with a total storage potential of 10,000 acre feet. A need also exists for industrial, municipal, and recreational water development.

Opportunities under P. L. 566. An application for a plan under P. L. 566 has been received, approved, and a preliminary report made. An overall watershed program including land treatment, flood prevention, irrigation, municipal, industrial, fish, wildlife, and recreational facilities has been investigated and appears to be feasible under P. L. 566 if the right to store and use the winter water can be obtained.

Watershed I, McKay Creek

Description. The McKay Creek watershed contains 122,600 acres in Umatilla and Union Counties. It is entirely in the South Umatilla and

First Union County Soil Conservation Districts. McKay Creek flows in a generally northwest direction from the Blue Mountains to its confluence with the Umatilla River about 4 miles west of Pendleton. The watershed forms a narrow canyon in the extreme lower reaches but is about 18 miles wide at the widest point and is about 40 miles long. Elevations in the watershed range from 1,100 feet at the Umatilla River to over 4,500 feet in the mountains. Annual precipitation averages about 26 inches ranging from 12 inches in the valley to 40 inches in the mountains.

In this watershed four general groups of soils occur. Pilot Rock and McKay are the principal soils on the loessial plain on the north. The footslopes of the Blue Mountains have the Waha, Hurwall, Rock Creek, and Snipe soils. Tolo, Klicker, Snipe, Kilmerque, Couse, and Rock Creek occur in the Blue Mountains. Caldwell, Onyx, Stanfield, Umapine, Yakima, Hermiston, Snow, and Veazie soils are found on the narrow valley bottoms.

Forest land covers about 45,100 acres, 37 percent of the total watershed. About 17 percent of the forest land is in public ownership.

About 9,950 acres in 37 farms are cropland with 720 acres irrigated. Irrigated land is cropped to alfalfa and pasture with a rotation of grain and fallow on the dryland. There are approximately 66,050 acres of range in the watershed.

Watershed Problems and Needs. McKay Reservoir built by the Bureau of Reclamation controls most flooding. Strip cropping is used extensively to control wind and water erosion. The irrigated land lies in a narrow strip along the creek. Water upstream from the reservoir is inadequate by the latter part of July. Some land is irrigated from underground water sources. An estimated additional 1,400 acres of land are suitable for irrigation if water were available. One reservoir site (index number 12) was investigated, but the McKay Reservoir stores all available water.

Opportunities under P. L. 566. It appears under present conditions and laws that a project under P. L. 566 is not feasible.

Watershed J, Tutuilla Creek

Description. The Tutuilla Creek watershed comprises an area of approximately 40,000 acres in Umatilla County. The watershed is completely within the Southern Umatilla Soil Conservation District. The topography ranges from gently sloping terrace to mountains. The main creeks are Tutuilla and Parawa, the latter of which is divided into a north and south branch and is a tributary of Tutuilla. Tutuilla Creek flows in a northwesterly direction to its confluence with the Umatilla River at Pendleton. Elevations range from 1,048 feet near the mouth of Tutuilla Creek to 3,600 feet at the upper boundary of the watershed. The climate is temperate and semiarid with considerable daily and yearly temperature ranges. Precipitation occurs mostly in the winter and spring. Summers are dry with the period of lowest rainfall in July

and August. Average annual precipitation ranges from 30 inches in the mountains to 14 inches in the lower watershed. The average frost-free growing season is 160 days.

This watershed covers three general groups of soils. On the loessial plain to the north the principal soils are Pilot Rock and McKay. The Waha, Hurwall, Rock Creek, and Snipe are on the footslopes of the Blue Mountains. Caldwell, Onyx, Stanfield, Umapine, Yakima, Hermiston, Snow, and Veazie soils are on the narrow valley bottoms.

Forest land comprises about 200 acres at the extreme upper edge of the watershed. About 39,300 acres in 36 farms are used for agricultural production including 21,500 acres of cropland and 17,800 acres of rangeland. About 200 acres of the cropland are in irrigated alfalfa. The dry farmed cropland is predominantly a rotation of grain and fallow with a small acreage of alfalfa and peas. Approximately 30,000 acres of this watershed lies within the boundaries of the Umatilla Indian Reservation; of this only about 29 percent remains in public ownership.

Watershed Problems and Needs. The main problem in the area is one of soil erosion by water. Excess water drains from the surface of the cultivated fields into road ditches causing cutting, silting, and loss of topsoil. The main channels present a constant maintenance problem due to the growth of weeds and willows and lodging of debris. The winter and spring floodwaters in these inadequate channels cause serious damages in the form of erosion and deposition of sediment on adjacent farmlands. A section of Pendleton also receives damage from flooding and debris deposition. Irrigation water shortage is a problem after mid August. An estimated 6,400 acres of land are suitable for irrigation development with an adequate source of water. One reservoir site (index number 11) was investigated, but its location is not the best for irrigation.

Opportunities under P. L. 566. An application for a plan under P. L. 566 has been received and approved. A program including land stabilization measures, alignment and enlarging of the existing channels, and the installation of a series of drop structures to reduce stream velocities during periods of flooding has been investigated and proposed. These investigations indicate that a feasible plan for land treatment, recreation, channel stabilization, flood control, and perhaps irrigation can be developed for this watershed under P. L. 566.

Watershed K, Wildhorse Creek

Description. The Wildhorse Creek watershed covers an area of 125,200 acres in Umatilla County and is not in a Soil Conservation District. The creek flows west and northwest from the Blue Mountains to Athena where its direction changes to southwest to its confluence with the Umatilla River at Pendleton. The watershed is approximately 25 miles long and averages about 8 miles wide with the creek flowing for a distance of 34 miles.

Elevations in the watershed range from 1,300 feet to 3,700 feet. The average annual precipitation is about 27 inches ranging from 14

inches to 40 inches. The temperature is generally mild with an average annual growing season of 180 days.

This watershed has four general groups of soils. On the loessial plain on the main part of the watershed Walla Walla, Athena, and Palouse are the major soils with smaller areas of Lickskillet, Wrentham, and Waha. A small area in the footslopes of the Blue Mountains has Waha, Hurwall, and Snipe soils. On a small area in the Blue Mountains are found Tolo, Couse, Helmer, and Snipe soils. The narrow alluvial bottoms have the Caldwell, Onyx, Stanfield, Umapine, Yakima, Hermiston, Snow, and Veazie soils.

Forest land covers about 4,700 acres, less than 4 percent of the basin. The forest land is outside of the national forest.

About 116,500 acres in 130 farms are used for agricultural production including 112,300 acres of cropland and 4,200 acres of rangeland. About 300 acres of the cropland are irrigated and used for the production of alfalfa and pasture. The remaining cropland is primarily cropped to grain-peas, grain-fallow, and some grass.

Watershed Problems and Needs. Approximately 600 acres of cropland are flooded annually. Sediment and debris deposition are quite damaging to croplands, farm facilities, bridges, culverts, and roads. There is some severe channel erosion along the lower reaches. Moderate to severe erosion often results from heavy spring runoff. Moderate erosion is also a problem on forest land and rangeland as a result of heavy spring runoff.

Irrigation water is in short supply around the first part of June. Water development would be necessary to irrigate an additional 11,700 acres of potentially irrigable land. Some additional ground water can be developed but not in large quantities. Two reservoir sites (index numbers 13 and 14) were investigated, but storage would not be sufficient for the total acreage mentioned above.

Opportunities under P. L. 566. It appears that this watershed might prove feasible for project action under P. L. 566. A program of land treatment, multiple-purpose structures, channel alignment and revetment, and water management should be investigated on this area if an application is made.

Watershed L. Mid-Umatilla

Description. The Mid-Umatilla River watershed contains 203,100 acres of which 202,000 acres lie in Umatilla County and the remainder is in Union County. It is partly in the South Umatilla and First Union County Soil Conservation Districts. This watershed includes a 28 mile portion of the Umatilla River from Pendleton upstream to a point 3 miles above Gibbon. The principal side drainage is Meacham Creek which flows in a northerly direction from its headwaters in the Blue Mountains to the Umatilla River near Gibbon. Elevations range from 1,069 feet along the Umatilla River to more than 5,800 feet in

the headwaters of Meacham Creek. Average annual precipitation varies from 13 inches at Pendleton to over 40 inches in the Blue Mountains.

Four general groups of soils are in this watershed. Pilot Rock, McKay, and Walla Walla are the major soils with smaller areas of Lickskillet and Nansene soils on the loessial plain on the west. A band of Waha, Hurwall, Rock Creek, and Snipe soils are on the footslope area. Tolo, Klicker, Snipe, Rock Creek, and Couse are in the Blue Mountains area. Caldwell, Onyx, Stanfield, Umapine, Yakima, Hermiston, Snow, and Veazie soils are on the narrow alluvial bottom lands.

Approximately 103,300 acres in 50 farms are used for agricultultural production; this includes 73,100 acres of rangeland and 30,200 acres of cropland. About 200 acres of cropland are irrigated and used for the production of pasture and alfalfa. The remaining cropland is dry farmed to a rotation of grain and fallow or peas and grain. Forest land covers 97,800 acres, or 48 percent of the total watershed. About 60 percent of the forest land is in public ownership. There is a large portion of Indian lands, both tribal lands and privately owned, in this watershed.

Watershed Problems and Needs. Flooding occurs on approximately 2,000 acres every other year. Resulting damage is generally confined to streambank cutting and deposition of silt on croplands. Roads, farm facilities, and small towns receive some flooding. The Corps of Engineers have completed some channel improvement and revetment work in the vicinity of Pendleton.

Estimates show that an additional 5,000 acres are suitable for irrigation development. Natural streamflow is adequate for about 1,000 acres, and ground water would adequately supply another 500 acres. The remaining water requirement could be supplied from one of the proposed reservoirs by the Corps of Engineers or Bureau of Reclamation.

The major rangeland problem is erosion resulting from overgrazing on the lower slopes. Steps have been taken to correct it, but it takes many years to repair the damages. The timber is mainly in the stream bottoms and heads of drainages. The slopes are steep and the soil somewhat shallow. Therefore, the forest area problems are erosion from road building and logging.

Opportunities under P. L. 566. The problems of this portion of the Umatilla River watershed are probably not within the scope of P. L. 566. The entire Umatilla River watershed, of which this section is 55 percent, has been authorized for study by the Corps of Engineers for flood control. Irrigation studies have also been made by the Bureau of Reclamation.

Watershed M, Upper Umatilla

Description. The Upper Umatilla River watershed contains 80,000 acres in eastern Umatilla and western Union Counties. It is almost all in the South Umatilla and Elgin Soil Conservation Districts. The main drainages in the watershed are the South Fork of the Umatilla

River which flows in a northerly direction and the North Fork of the Umatilla River which flows in a westerly direction to a point in Section 22, Township 3 North, Range 37 East where they join and flow in a westerly direction. Elevations in the watershed range from 1,750 feet sea level to 5,500 feet in the Blue Mountains. Average annual precipitation ranges from 40 inches to 50 inches.

There are two general groups of soils in this watershed. The Blue Mountains area includes the Tolo, Klicker, Snipe, Couse, Rock Creek, and Helmer soils. Caldwell, Onyx, Stanfield, Umapine, Yakima, Hermiston, Snow, and Veazie soils are on the narrow alluvial bottoms.

Forests cover about 58,400 acres, 73 percent of the total watershed. About 91 percent of the forest land is in public ownership. Approximately 21,100 acres are classified as rangeland. There is no cultivated land in this watershed.

Watershed Problems and Needs. The Upper Umatilla area is getting increased recreation use which calls for increased sanitation facilities along streams and well traveled roads to reduce stream pollution.

Logging is also increasing and with it erosion problems. Some streams have had debris left from logging and road building. This problem has been recognized for the most part, and steps are being taken to eliminate it.

Opportunities under P. L. 566. The entire Umatilla River watershed, of which this section is 21 percent, has been authorized for study by the Corps of Engineers and the Bureau of Reclamation for flood control and irrigation. Opportunities for project action under P. L. 566 in the Upper Umatilla River watershed does not appear to be feasible.

Watershed N, Butter Creek

Description. The Butter Creek watershed, a tributary of the Umatilla River, contains 230,900 acres of which approximately 50 percent lies in southwestern Umatilla County and the remainder in southeastern Morrow County. It is entirely in the Heppner, West Umatilla, and South Umatilla Soil Conservation Districts. Butter Creek flows northward from its source in the Blue Mountains to the Umatilla River near Bucks Corner. The watershed north boundary is at a point about 3 1/2 miles upstream at the Westland Canal crossing. Butter Creek watershed is about 50 miles long and varies from 2 miles to about 17 miles in width. Elevations range from 500 feet to 5,500 feet. Average annual precipitation ranges from 10 inches in the valley to 30 inches in the mountains. The average annual growing season is 160 days.

Six general soil groups are in this watershed. On the north end is a small area of glacial sediments with Sagemoor, Quincy, and Taunton soils. South of this area is the loessial plain with Ritzville and its associated soils, Starbuck, Nansene, and Lickskillet. On the upland plateau Condon and Morrow are associated with Lickskillet, Bake-

oven, Hurwall, and Nansene soils. On the footslopes of the Blue Mountains Waha is the principal soil occurring with Hurwall, Rock Creek, and Snipe. The soils in the Blue Mountains section are Tolo, Klicker, Snipe, Rock Creek, and Kilmerque. Caldwell, Onyx, Stanfield, Umapine, Yakima, Hermiston, Snow, and Veazie occur in the narrow alluvial bottoms.

Forest covers about 24,120 acres, 10 percent of the total watershed. About 34 percent of the forest land is in public ownership.

About 16,400 acres in 34 farms are used for crops, and an additional 189,500 acres are range. About 2,170 acres are irrigated predominantly for pasture and alfalfa production. The remaining cropland is dry farmed with a rotation of grain and fallow.

Watershed Problems and Needs. About 200 acres of cropland are flooded on an average of once every five years, and 1,000 acres are flooded one year out of ten. Erosion from both water and wind is a problem in the lower dry farmed area. Some damage is caused by streambank cutting to croplands, but it is not severe. Silting and deposition of debris occurs on fields, culverts, roads, and fences.

Surface water for irrigation is in short supply after the middle of June. An additional 6,200 acres of land are suitable for irrigation. Perhaps more than 600 acres could be irrigated from ground water. Three storage sites (index numbers 5, 6, and 7) with a total storage capacity of approximately 57,000 acre feet were investigated. These sites would also offer some protection and recreation.

Opportunities under P. L. 566. It appears that a multipurpose project including flood control, irrigation, land treatment, wildlife, and recreation would be feasible under P. L. 566.

Watershed O, South Butter Creek

Description. The South Butter Creek watershed (locally known as Little Butter Creek), a tributary of Butter Creek in southeastern Morrow County, contains 55,000 acres within the Heppner Soil Conservation District. South Butter Creek flows in a northerly direction from the Blue Mountains into Butter Creek at Pine City Junction. The watershed is 26 miles long in a north-south direction and about 3 miles wide. Elevations in the watershed range from 1,200 feet to 5,000 feet. The average annual precipitation is about 19 inches ranging from 12 to 26 inches. The average annual growing season is 160 days.

There are four different groups of soils in the watershed. A small area in the north is the loessial plain and has Ritzville, Starbuck, and Nansene soils. The upland plateau is the largest area with Condon and Morrow associated with Lickskillet, Nansene, Hurwall, and Bakeoven soils. The south part on the footslopes of the Blue Mountains has Waha associated with Hurwall, Rock Creek, and Snipe soils. The narrow alluvial bottoms have Caldwell, Onyx, Stanfield, Umapine, Yakima, Hermiston, Snow, and Veazie soils.

Forest covers about 1,200 acres, around 2 percent of the watershed. About 8,550 acres in 18 farms are used for crops with an additional 44,750 acres in range. Approximately 90 percent of the cropland has a grain and fallow rotation with the remaining 10 percent, or about 1,150 acres along the alluvial bottom, growing irrigated alfalfa and pasture.

Watershed Problems and Needs. An estimated 900 acres are flooded on the average of once in every 5 years. Flood damage is limited due to the fact that most of the flooded area is in alfalfa and pasture. Silting and debris deposition cause some damage to irrigation facilities, fences, roads, and culverts.

Some water erosion occurs on the rangeland; water and wind erosion is experienced on the dry cultivated land in the lower reaches of the watershed.

Irrigation water is adequate only for one complete spring application. There is very little water left by the middle of June. One reservoir site (index number 4) was investigated, but because of its location it would benefit only a few acres in this watershed. The potential storage of this site is 3,000 acre feet; it also has possibilities for some flood protection. It has been estimated that an additional 500 acres are suitable for irrigation with ground water being available for about 100 acres.

Opportunities under P. L. 566. The problems in this watershed are applicable to P. L. 566 action. It would be necessary to locate storage sites further upstream to benefit both irrigation and flood prevention. Channel work could also be beneficial in decreasing the flooding problems. Land treatment measures would be required to reduce erosion sedimentation. The reservoir site studied could be used for both irrigation and flood control for the lower part of Watershed N, Butter Creek. Perhaps a change in the areas considered in these watersheds might show improved benefits. A project for flood control, irrigation, land treatment, recreation, and wildlife appears to be feasible under P. L. 566.

3. WILLOW SUBBASIN

Watershed A, Boardman

Description. The Boardman watershed occupies an area of 188,000 acres in northern Morrow County with a small portion in Umatilla County. It is entirely in the Boardman, Heppner, and West Umatilla Soil Conservation Districts. The upper watershed area is drained by Juniper Canyon which flows in a northerly direction from the Willow Creek watershed to a point in Section 13, Township 4 North, Range 25 East where it is intercepted by the West Extension Irrigation Canal. The northern boundary of the area is the Columbia River which bounds it for approximately 24 miles. The watershed is 30 miles long, and the upstream width varies from 5 to 10 miles. Elevations range from 2,500 feet at the Willow Creek divide to 200 feet at the Columbia River. Annual precipitation ranges from 7 inches along the Columbia River to

12 inches in the upper watershed. The average annual frost-free period is from the middle of April to the middle of October, a period of 188 days.

Soils in this watershed can be divided into two general groups. The area of glacial sediments in the northern two-thirds has the Sagemoor, Quincy, Ephrata, and Taunton soils. On the loessial plain the Ritzville and Walla Walla are associated with the Starbuck and Nansene soils. The alluvial soils of the bottom lands are Caldwell, Catherine, Stanfield, Onyx, Umapine, Yakima, and Pedigo.

Approximately 74,500 acres in 122 farms are cropland. Ninety-two percent of the cropland is dry farmed with a rotation of grain and fallow. About 6,140 acres are irrigated and grow alfalfa, pasture, row crops, grain, and orchards. Around 100,900 acres are range. There is no forested land in this watershed. About 22 percent of the watershed is administered by the Department of Defense; part is used for storing ordnance material and the remainder as bombing range.

Watershed Problems and Needs. Flooding is not a serious problem; approximately 500 acres are flooded annually, but the damage is minor. Wind erosion is a problem on sparsely vegetated rangeland and cropland without protection. Wind damage is often severe to crops, soil, irrigation facilities, farm facilities, roads, and culverts.

It has been estimated that an additional 11,000 acres are suitable for irrigation. Ground water could be developed for about 25 percent of the acreage. The remaining 75 percent would require water from the Columbia River. Two reservoir sites (index numbers 5 and 6) were investigated in the upper watershed; they have good potential for storage, but the water yield is very low and undependable with serious sediment problems. About two-thirds of the irrigated land is short of water by July.

Opportunities under P. L. 566. Land treatment measures are needed to reduce flooding and erosion. The development of storage sites for irrigation water would not be adequate or dependable and would probably be more costly than utilizing Columbia River water. Most irrigation development in this area has been undertaken in the past by the Bureau of Reclamation, and further development could probably be accomplished through the extension of existing projects. A project involving land treatment and irrigation water from the John Day Reservoir might be feasible under P. L. 566.

Watershed B, Sixmile Canyon

Description. The Sixmile Canyon watershed occupies an area of 140,200 acres in western Morrow County and is in the Boardman and Heppner Soil Conservation Districts. The watershed lies in a northerly direction between Willow Creek and the Columbia River. It is 22 miles long and averages 10 miles wide. Elevations range from 1,500 feet to 200 feet. Mean annual precipitation ranges from 7 inches along the

Columbia River to 10 inches in the upper areas. The average annual growing season is about 188 days from the middle of April to the middle of October.

Soils in the watershed can be divided into two general groups. On the area of glacial sediments in the north three-fourths of the watershed are the Sagemoor, Quincy, Ephrata, Taunton, and Rockland soils. On the loessial plain are Ritzville with its associated soils of Starbuck and Nansene. The alluvial soils of the bottoms include Catherine, Pedigo, Caldwell, Stanfield, Umapine, and Hermiston.

Approximately 42,000 acres in 13 farms are cropland growing grain rotated with fallow. There is very little irrigated land in the watershed. About 97,700 acres of land are used for range. There is no forested land in the watershed. The Department of Defense uses about 11 percent of the watershed as bombing range.

Watershed Problems and Needs. Wind erosion is probably the major problem of the area. It is damaging to areas of sparsely vegetated rangeland and unprotected cropland. Cleanup is a problem to roads, culverts, and farm facilities. Flooding does not present a serious problem due to the low rainfall and coarse textured soils. It is estimated that 12,800 acres are suitable for irrigation. Possibly one-third of this acreage could be irrigated from ground water while Columbia River water would be required for the remainder. Two storage sites (index numbers 3 and 4) were investigated, but the water yield is unreliable with a serious sediment problem.

Opportunities under P. L. 566. Land treatment measures through the efforts of the local Soil Conservation Service technicians can aid in the wind erosion problem; the local people formed the Lexington Blow District to help solve this problem. Probably the cheapest and most reliable source of water to develop for irrigation in the watershed would be from the Columbia River.

Action under P. L. 566 might be possible in the future for a project to pump water from the John Day Reservoir for irrigation.

Watershed C, Willow Creek

Description. The Willow Creek watershed contains 246,800 acres in Morrow and Gilliam Counties. It is within the boundaries of the Heppner and Gilliam County Soil Conservation Districts. For this report the Willow Creek watershed excludes the Rhea Creek and Eightmile Canyon drainages which were studied as separate watersheds. Willow Creek flows in a generally northwest direction from its headwaters in the Blue Mountains to the Columbia River at Heppner Junction. The watershed is about 56 miles long and varies from 2 miles to 12 miles in width. Elevations in the watershed range from 200 feet to 4,500 feet. Average annual precipitation varies from about 7 inches at the mouth of Willow Creek to over 30 inches in the mountains. Late spring and summer precipitation is from convectionary storms (cloudbursts) of high intensity, short duration, and small areal coverage. The climate of the watershed is characterized by relatively hot dry summers and

moderately cold and damp winters. The average frost-free period at Heppner, the largest town in the watershed, is from early May through early October, or about 152 days.

Soils in this watershed can be divided into six general groups. On the area of glacial sediments are the Sagemoor, Quincy, Ephrata, Taunton, and Rockland soils. The loessial plain has Ritzville, Walla Walla, and their associated soils of Starbuck, Nansene, and Lickskillet. On the upland plateau in the south central section are Condon and Morrow with their associated soils, Lickskillet, Bakeoven, and Nansene. On the footslopes of the Blue Mountains Waha is the principal soil along with Hurwall, Rock Creek, and Snipe. The south end of the watershed has Tolo, Klicker, Snipe, and Rock Creek soils. The narrow valley bottom has the following soils: Caldwell, Catherine, Pedigo, Onyx, Stanfield, Umapine, Yakima, Hermiston, Snow, and Veazie.

Forest covers about 19,550 acres, 8 percent of the total watershed. About one-third of the forest land is in the national forest.

Approximately 87,500 acres in 138 farms are cropland. Ninety-five percent of this area is dry farmed with a rotation of grain and fallow. About 4,500 acres of cropland are irrigated and grow alfalfa and pasture. There are also about 135,150 acres of land devoted to range.

Watershed Problems and Needs. Flood damages are caused by two types of storms, late spring and summer cloudburst type storms and general warm rain causing rapid snowmelt in the winter and early spring. The cloudburst type storm results in severe flood and sediment damage to buildings, equipment, roads, bridges, fences, land, irrigation systems, crops, and human life. In 1903, 247 people lost their lives in a flood of this type that devastated the town of Heppner (figs. 26 and 27). The flooding from general rainstorms and snowmelt results in less severe damages. It has been estimated that 4,450 acres of land flood one year out of five. Wind erosion is a problem in the lower reaches of the watershed.

It has been estimated that 2,700 acres of additional land are suitable for irrigation should water be developed. There is probably sufficient ground water for about 400 acres; the remaining acreage would require storage. At present, the water supply is often inadequate for the land under irrigation after June 15. Investigations were made on six reservoir sites (index numbers 7 thru 12) in connection with this study, and other agencies also made some studies. The practice of winter irrigation is prevelant and is an obstacle to any plans to store winter runoff. However, if there is sufficient late season water through storage, there should be no need to irrigate in the winter.

Opportunities under P. L. 566. The Corps of Engineers are actively engaged in planning a dam above Heppner to control the floods on Willow Creek. The plans include storage of water for irrigation to be administered by the Bureau of Reclamation. There are additional problems that can be handled under P. L. 566. A program of land treatment

in the upper watershed could conserve both soil and water and would greatly reduce sediment in downstream reservoirs. Channel shaping, stabilization, and bank protection are needed to reduce bank cutting. There are also opportunities for additional storage facilities to supply water to areas not in the Corps of Engineers and Bureau of Reclamation plans. It would appear that a program of channel work, irrigation, and land treatment under P. L. 566 is feasible and would greatly benefit works of improvement proposed by other agencies.

Watershed D, Eightmile Canyon

Description. The Eightmile Canyon watershed, a tributary of Willow Creek, contains 175,500 acres in western Morrow County and eastern Gilliam County. It is within the boundaries of the Heppner and Gilliam County Soil Conservation Districts. Eightmile Canyon lies in a northerly direction and is 40 miles long and averages 7 miles wide. Elevations range from 400 feet to 3,200 feet. The average temperatures range from 32° F. in January to 69° F. in July. The average annual precipitation is 11 inches varying from 8 to 14 inches. The average frost-free period is from about the middle of April to the middle of October, or around 170 days.

Soils in the watershed can be divided into four general groups. The area of glacial sediments in the north includes the Sagemoor, Quincy, Taunton, Ephrata, and Rockland soils. On the loessial plain in the central part of the watershed Ritzville and Walla Walla are associated with Starbuck, Nansene, and Lickskillet soils. On the upland plateau at the southern end of the watershed Condon and Morrow soils are associated with Lickskillet, Nansene, and Bakeoven. The narrow valley bottom has the following soils: Caldwell, Onyx, Stanfield, Umapine, Yakima, Hermiston, Snow, and Veazie.

About 80,500 acres in 50 farms are cropland with 250 acres of irrigated alfalfa and pasture. The dryland crops are grain and fallow and about 750 acres of grass. Approximately 93,300 acres of this watershed are used as range. No forested land exists in this watershed.

Watershed Problems and Needs. An average of 1,500 acres flood once in 5 years; about 85 percent is cropland. Farm facilities, crops, and land receive some damage from flooding and debris. There is also considerable damage to roads and culverts. The watershed experiences erosion from wind and water. These problems are due mainly to unprotected cropland and over grazed rangeland.

It has been estimated that irrigation water shortages occur as early as the middle of May in some wells and the first of July for stored water. An additional 7,800 acres of land are suitable for irrigation in this watershed. Much of the potentially irrigable land lies in the lower reaches of the watershed where the possibility of pumping water from the Columbia River should be investigated. Several years ago a similar proposal was determined to be not feasible, but economic and technical advances may have changed the situation. In

connection with this study two reservoir sites (index numbers 1 and 2) were investigated with a total potential storage of 4,200 acre feet. However, the water yield is quite low and unreliable.

Opportunities under P. L. 566. Land treatment measures to reduce wind and water erosion, channel alignment, bank protection, and small dams for flood protection and irrigation water storage would be beneficial to the watershed. But at the present time, due to the low, unreliable water yield and low benefit returns of the area, it appears that project action under P. L. 566 would not be feasible. An irrigation development in the plateau area above the Columbia River using river water might be feasible.

Watershed E, Rhea Creek

Description. The Rhea Creek watershed, a tributary of Willow Creek in west central Morrow County, contains 146,800 acres within the Heppner Soil Conservation District. Rhea Creek flows in a generally northerly direction from the Blue Mountains to Willow Creek at Jordan. The watershed is about 35 miles long and varies from 3 miles to 10 miles in width. Elevations range from 1,800 feet at Jordan to 5,200 feet in the mountains. Average annual precipitation varies from about 11 inches at Jordan to around 28 inches in the Blue Mountains. Average temperatures range from 32° F. in January to 69° F. in July. The average frost-free period is 170 days from the latter part of April to the middle of October. The watershed is subject to violent convection summer storms of small areal extent and high intensity.

This watershed includes five general soil groups. The loessial plain on the north is composed of Ritzville and Walla Walla soils associated with Starbuck, Nansene, and Lickskillet. On the upland plateau in the central part the Condon and Morrow soils are associated with Lickskillet, Bakeoven, and Nansene. Waha is the principal soil of the footslopes of the Blue Mountains along with Hurwall, Rock Creek, and Snipe. Tolo, Klicker, Snipe, and Rock Creek are the soils in the Blue Mountains. The narrow valley bottom soils are Caldwell, Onyx, Stanfield, Umapine, Yakima, Hermiston, Snow, and Veazie.

Forest covers about 25,760 acres, 18 percent of the watershed. About 30 percent of the forest land is national forest.

About 20,350 acres in 54 farms are cropland. Approximately 1,620 acres are irrigated alfalfa and pasture, and the remainder is dryland rotated with grain and fallow. It is estimated that 99,440 acres of the watershed are range.

Watershed Problems and Needs. Flooding occurs on approximately 1,600 acres about one year out of five. Irrigation systems receive some damage from sediment and debris, but cropland, buildings, fences, diversion structures, and road culverts receive the most damage.

There is erosion and debris deposition due to logging operations on the forest land. Wind and water erosion is a minor problem on the

rangeland and a more serious one on the dry farmed cropland. This is due mainly to unprotected cropland during critical seasons.

About 15 percent of the irrigated land receives only one application in the spring, and the supply is usually exhausted by the middle of June. Some winter irrigating is done to store water in the soil. There are an estimated 960 acres of additional land that could readily be irrigated depending on the development of an adequate water supply. Five reservoir sites (index numbers 13 thru 17) were investigated in connection with this report, and at least one has been studied by the Corps of Engineers. The maximum storage potential is about 16,000 acre feet. At least two of these sites would reduce flood damages.

Opportunities under P. L. 566. The problems of this watershed are suitable for project action under P. L. 566. A complete program including flood protection, irrigation, land treatment, and recreation would greatly enhance the area. It appears at this time an overall watershed project under P. L. 566 would be feasible.

PROGRAMS OF USDA

Several agencies within the U. S. Department of Agriculture administer programs that are directly concerned with various aspects of water and related land resources. Many of the department's activities and programs are, or can be, helpful in the solution of problems and the accomplishment of needed work in the Umatilla Drainage Basin.

COORDINATION OF USDA PROGRAMS AND OTHER BASIN ACTIVITIES

In general, the forestry and agricultural aspects of water and related land resource problems are often intimately connected with uses of land and water for other purposes such as cities and towns, recreation, navigation, industry, and highways. The degree of relationship varies between geographic areas depending primarily upon the resource base available and pressures upon that base.

The U. S. Department of Agriculture is concerned with all agricultural and forest land in the basin and is responsible for the administration of the 9 percent of the basin that is in national forests. The U. S. Department of Interior is responsible for the administration of about 5 percent of the area and the Department of Defense for about 4 percent. Therefore, the Federal Government is directly responsible for the administration of approximately 18 percent of the Umatilla Drainage Basin. The management of this land is an important factor in the economy of the basin and influences the timing of water flows and the quality of water flowing from the upper watersheds.

The Corps of Engineers, U. S. Army, under assignment by Congress is charged with the public civil works program to control, regulate, and improve river and harbor resources, to administer the laws pertaining to the preservation of navigable waters, and to plan, construct, and operate flood control works. Many of the existing and possible future projects under the Corps' jurisdiction affect agricultural lands. Substantial assistance in the solution of basin agricultural problems has and will accrue from the coordination of the Corps' work and that of other interests in the basin.

The Bureau of Reclamation is authorized at the public request to locate, construct, operate, and maintain works for storage, diversion, and development of waters for the reclamation of arid and semiarid lands in the Western States. Projects constructed by the Bureau should be coordinated with other land and water developments in the basin.

Private and municipal water developments for power and industrial uses in some instances affect agricultural and forest lands. In many cases, substantial mutual benefits can result from the coordination of projects so as to solve or mitigate existing problems.

From an agricultural standpoint, there is a need for coordination of effort on present and future problems on an individual, group, and project basis. In turn it is important that agricultural water control

and utilization developments recognize to the extent feasible all other land and water uses and values. Such coordination is necessary to secure a diminishment of mutual problems instead of their compoundment. Notable coordination has occurred and should be continued. This coordination ranges from informal contacts on individual problems to formal liaison between organizations and agencies on the inter-relationship of major projects.

Future small watershed projects need to be coordinated to insure the inclusion of all feasible features to enhance the use of both the watershed and its waters for all worthwile purposes. In addition, small watershed projects need to complement other major water projects in the basin and make the best use of improvements provided under other programs.

It is hoped that the information in this report and the data gathered for its preparation will be of assistance to others in future coordination of the water and related land resources in the Umatilla Drainage Basin.