State of Washington
CLARENCE D. MARTIN, Governor

Tenth Biennial Report

of the

Department of Conservation and Development

October 1, 1938 — September 30, 1940

JOHN BROOKE FINK
DIRECTOR

OLYMPIA
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LETTER OF TRANSMITTAL

DEPARTMENT OF CONSERVATION AND DEVELOPMENT

January 1, 1941

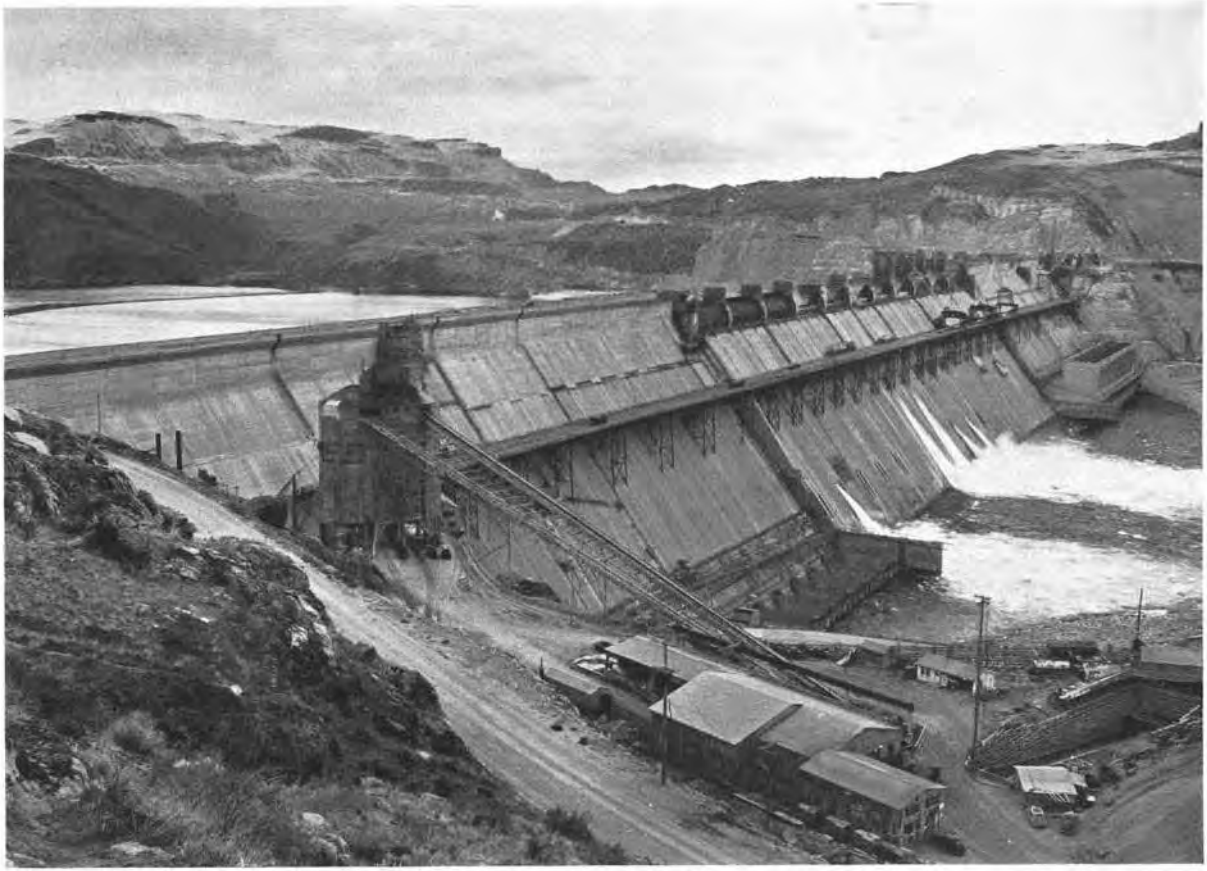
To His Excellency, Clarence D. Martin,
Governor of the State of Washington.

Sir:

I have the honor to submit herewith, pursuant to law, the Tenth Biennial Report of the Department of Conservation and Development, covering the period from October 1, 1938, to September 30, 1940.

Respectfully,

J. B. FINK,
Director



Looking across the downstream face of the dam from the east side on the first day of the new year, 1941. In the foreground is the contractor's concrete mixing plant which has been partially dismantled since it is no longer required to operate at full capacity. Out in the spillway, three of the eleven huge drum gates are undergoing erection in the upright or closed position. The drum gates will provide a movable spillway crest 1,485 feet long which will permit the raising of the Columbia River Reservoir level by any desired increment from 0 to 28 feet. (Date of photo: January 1, 1941.)

INTRODUCTION

The Department of Conservation and Development has been in existence twenty years, having been created in 1921 as part of the Administrative Code which was then adopted. In conformity with the purpose of the Administrative Code, to consolidate many independent administrative agencies for economy and efficiency, the following were included in this Department: State Board of Forest Commissioners and State Forester; Board of Geological Survey and State Geologist; State Reclamation Board; Columbia Basin Survey Commission, and Hydraulics Engineer. Five divisions were set up in the Department to administer these activities: Forestry, Geology, Reclamation, Columbia Basin Survey and Hydraulics.

In the twenty years of its existence a number of additional duties and functions have been placed under the charge of the Department, some with the status of Divisions. These are Mines and Mining, Flood Control, and Soil Survey. The Director of the Department is also Chairman of the Mines-to-Market Roads Commission, and a member of the Washington State Planning Council, the State Forest Board, and of the State Pollution Committee. The functions and responsibilities of the Department have been more than doubled since its creation twenty years ago.

The Columbia Basin project was initiated two years before this Department was created. Its promotion has been one of the important responsibilities of this administrative agency, which has been a prime factor in having the project adopted as a Federal undertaking, and then cooperating in its development which up to the present time includes the completion of the Coulee Dam and the organization of the irrigable area into districts. The stage is now set for the construction of the reclamation works and the settlement of the area.

The activities of the Division of Forestry are probably four times as great as they were twenty years ago. Although the problem of forest fire prevention and control has steadily increased with development and the construction of roads and trails, losses have declined. To obtain this result the work of the Division has substantially increased. Since the creation of the Civil Conservation Service, all the camps established in this state in connection with protection of state and private forest lands, and development of state forests, have been under the general supervision of the Division of Forestry. There are now seven camps of about 200 men each. There have been sixteen. In recent years the state has acquired nearly half a million acres of forest lands which are being blocked into state forest units. In 1935 a state forest tree nursery was established. It embraced sixteen acres, and has an annual capacity of 6,000,000 trees, sufficient to plant 10,000 acres of cut-over land.

As the problems of reclamation districts, which include irrigation, drainage and diking, have increased, they have added to the work and responsibilities of the Division of Reclamation. In recent years a separate Division of Reclamation has not been maintained, the work being performed by the Director of the Department.

As the Division of Hydraulics or Water Resources, has the administration of the waters of the state, the duties and work of the Division have increased as the state has developed and the demand for water for domestic, irrigation and industrial and power purposes has increased.

The activities of the Division of Geology have increased and include detailed investigations of metallic and non-metallic deposits, making geological maps, investigating oil and gas resources, and cooperating in the topographic mapping program with the United States Geological Survey.

Interest in the mineral resources of the state and their development had increased to such an extent that in 1935 the Division of Mines and Mining was created. It has been developing complete, dependable information on our mineral resources and has been aiding prospectors, miners and investors with their problems of development and production.

As Chairman of the Mines-to-Market Roads Commission the Director of the Department devotes such time as is necessary in helping to administer the law providing for construction of roads to open up mineral areas. As a member of the Planning Council, the Forest Board and the Pollution Commission, the Director devotes considerable time to these important activities.

In the interest of flood control the Department administers the laws relating to approval of structures and works which may adversely affect flood conditions and the establishment of flood control districts. It also aids and cooperates with the several branches of the Federal Government and with State Governmental Units, which are actively engaged in planning and construction of flood control works. Gratifying progress is being made, in both planning and construction, especially under the Federal Flood Control Act administered by the United States Corps of Engineers.

In looking back over the twenty years of the Department's existence it is gratifying to note its steady progress, and the important place it now occupies in the State's administrative set-up. The problems relating to the State's natural resources have increased. Conservation of these resources for economic use becomes more important each year. Functions and activities of the Department have expanded accordingly. The future welfare of this commonwealth largely depends on the careful administration of the laws relating to these resources.

DIVISION OF RECLAMATION

J. B. FINK
Director

The Division of Reclamation is primarily charged with the administration of the State Reclamation Act and the Reclamation Revolving Fund. As during former bienniums of the present administration the Director has himself acted as supervisor with the aid of the Supervisor of Hydraulics and his staff.

Continuing unsatisfactory returns to farmers on the reclamation projects have prevailed throughout the past two years. The curtailment of exports has created an especially difficult situation for the apple growers, who in the aggregate constitute a substantial percentage of the water users in many of our irrigation districts. The apple sections as a whole appear to be undergoing a readjustment. Orchards of low production or unfavorable varieties are being gradually pulled out. In some instances where conditions are favorable apples are being replaced by soft fruits which as a whole have recently been more profitable than apples. Elsewhere the proper utilization of former orchard lands presents quite a problem, especially in irrigation districts where the annual charge for water is too high for diversified farming.

Low incomes from both general and specialized farming are reflected in the inability of many irrigation districts to collect sufficient assessments to meet debt service, maintenance and operating costs and the renewals and betterments which become necessary from time to time.

During the past biennium the Department has continued to aid districts, whose indebtedness was definitely in excess of ability to pay, by helping them obtain debt adjustments. Eight districts have thus been refinanced by purchase of their refunding bonds from the reclamation revolving fund. In these transactions a total of $53,265.56 of outstanding district obligations were purchased at a price of $26,911.72 which is now evidenced by a like face value of refunding bonds held by the Reclamation Division. Not only were the face amounts of the debts thus reduced by one-half but interest rates were also quite generally lowered.

Funds for reconstruction and betterments were furnished to twelve districts in a total amount of $65,587.87 for which the Department accepted bonds at par. Two of these transactions completed commitments made in the previous biennium.

TABLE I

Loans to Reclamation Districts for Refunding of Outstanding Bond Issues Made from the Reclamation Revolving Fund For Which Refunding Bonds Have Been or Will Be Received October 1, 1938, to September 30, 1940

COUNTY	DISTRICT	Par Value Old Bonds	Purchase Price % of Par	Cost
Clallam	Agnew Irrigation District	$1,000 00	85	$850 00
Cowlitz	Drainage Improvement District No. 1	7,000 00	100	7,000 00
Okanogan	Okeh Irrigation District	13,900 00	50	6,950 00
Okanogan	Oroville-Tonasket Irrigation District	26,000 00	25-40	8,750 00
Thurston	Yelm Irrigation District	1,500 00	34	510 00
Yakima	Drainage Improvement District No. 9	1,969 46	100	1,969 46
Yakima	Drainage Improvement District No. 9 Sub. J	396 16	100	396 16
Yakima and Benton	Joint Drainage Improvement District No. 1	1,500 00	32.4	486 16
	Totals	$53,265 56		$26,911 72

TABLE II

Loans to Reclamation Districts for Construction and Betterments Made from the Reclamation Revolving Fund For Which Bonds of the District Have Been or Will Be Received October 1, 1938, to September 30, 1940

County	DISTRICT	Amount of Commitment	Prior Advances	Advances Oct. 1, 1938 Sept. 30, 1940
Chelan	Wenatchee-Chewawa Irrigation District	$1,754 67	.....	$1,754 67
Chelan	Chelan Falls Irrigation District	2,867 76	.....	2,867 76
Chelan	Wenatchee Reclamation District	2,800 00	.....	2,800 00
Clallam	Agnew Irrigation District	3,800 00	$3,744 92	55 08
Clallam	Highland Irrigation District	4,329 22	.....	4,329 22
King	Drainage District No. 14	3,031 83	2,539 87	491 96
Okanogan	Oroville-Tonasket Irrigation District	13,000 00	.....	11,496 00
Spokane	Otis Orchards Irrigation District	5,000 00	.....	4,997 42
Spokane	Pasadena Park Irrigation District	17,700 00	.....	14,377 90
Spokane	Spokane Valley Irrigation District	10,000 00	.....	9,933 24
Thurston	Drainage Improvement District No. 9	735 38	.....	735 38
Yakima	Outlook Irrigation District	12,000 00	.....	11,749 15
	Totals	$77,018 86	$6,284 79	$65,587 87

It is worth noting that several diking and drainage districts along the Columbia River in Cowlitz county, bonds of which are held in the Reclamation Revolving Fund to the amount of more than $125,000 have during the past three years received very substantial aid from Federal Flood Control funds. Under the supervision of the District Engineer, First Portland District of the Corps of Engineers, United States Army, the dikes and drainage systems of five districts, have been reconstructed and improved along substantial and permanent lines. The financial aid rendered by the State to these districts was in part used for the local contribution toward these improvements. These Federal works not only rendered the farmers and residents secure against floods but in a great measure increased the security of the State's investments.

Collateral Trust Bond Issue

For details concerning this issue reference is made to the Department's 9th Biennial Report.

During the past biennium no additional collateral trust bonds have been sold. It is gratifying to report that the transaction has proved satisfactory to the trustee and the bond purchasers and of incalculable benefits to the several reclamation districts who received badly needed assistance from the funds provided thereby.

As of September 30, 1940, the status of the issue was as follows:

TABLE III

Account of Department With the Peoples National Bank of Washington on September 30, 1940

Department of Conservation and Development Collateral Trust Bonds Series A, outstanding		$288,000.00
State-owned bonds held by Bank as collateral (see list)	$960,274.38	
Cash held in Trust Fund	135,294.79	
Total assets held by the Bank as collateral	$1,095,569.17	

TABLE IV—COLLATERAL TRUST BONDS

Authorized Issue of Collateral Trust Bonds		$600,000
Amount Sold	$492,000	
Amount Cancelled	53,000	
Amount Unsold	55,000	
	$600,000	$600,000

PRESENT STATUS OF BONDS SOLD

Amount		$492,000
Amounts Retired:		
September 1, 1936, at maturity	$ 6,000	
September 1, 1937, at maturity	12,000	
September 1, 1937, in advance of maturity	60,000	
March 1, 1938, in advance of maturity	42,000	
September 1, 1938, in advance of maturity	22,000	
September 1, 1938, at maturity	17,000	
March 1, 1939, in advance of maturity	4,000	
September 1, 1939, in advance of maturity	12,000	
September 1, 1939, at maturity	15,000	
September 1, 1940, at maturity	14,000	
Total Retired	$204,000	
Balance outstanding Oct. 1, 1940	288,000	
	$492,000	$492,000

Table V shows the state-owned bonds deposited with the Peoples National Bank of Washington as collateral. Bonds owned by the Reclamation Revolving fund but deposited in the vaults of the State Treasurer for safe keeping are listed in Table VI.

TABLE V—RECLAMATION DISTRICT BONDS

Held by the Peoples National Bank of Washington
To secure Department Collateral Trust Bonds, as of September 30, 1940

District	*Int. Rate*	*Par Value*
Cascade Irrigation District	6%	$ 40,000.00
Grandview Irrigation District	2%	5,500.00
Icicle Irrigation District	2%	245,700.00
Jefferson Co. Drainage District No. 1	2%	7,600.00
Kennewick Irrigation District	1%	200,700.00
Kennewick Irrigation District	2%	21,000.00
Kiona Irrigation District	2%	15,750.00
Otis Orchards Irrigation District	2%	20,000.00
Outlook Irrigation District	2%	10,800.00
Richland Irrigation District	2%	125,000.00
Snipes Mt. Irrigation District	1%	16,250.00
Snipes Mt. Irrigation District	2%	4,500.00
Snohomish County Drainage District No. 1	2%	4,000.00
Snohomish County Drainage District No. 2	2%	2,000.00
Stemilt Irrigation District	1%	75,000.00
Stemilt Irrigation District	2%	27,000.00
Sunnyside Irrigation District	1%	83,900.00
Union Gap Irrigation District	2%	4,000.00
Wenas Irrigation District	2%	13,100.00
Wenatchee-Chewawa Irrigation District	2%	5,500.00
Yakima County Drainage Improvement Dist. 35	2%	21,000.00
Yakima County Drainage Improvement Dist. 41	2%	4,599.38
Yakima County Drainage Improvement Dist. 43	2%	7,375.00
Total		$960,274.38

TABLE VI—RECLAMATION DISTRICT BONDS

Owned by the Department and held for safe-keeping by the State Treasurer on Sept. 30, 1940.

District	*Int. Rate*	*Par Value*
Agnew Irrigation District	4%	$ 58,040.00
Chelan Falls Irrigation District	4%	22,500.00
Cline Irrigation District	4%	18,800.00
Columbia Irrigation District	2%	8,500.00
Cowlitz County Diking Improvement Dist. No. 5	4%	17,500.00
Cowlitz County Diking Improvement Dist. No. 11	4%	32,500.00
Cowlitz County Diking Improvement Dist. No. 11-Sub A	4%	9,500.00
Cowlitz County Diking Improvement Dist. No. 13	4%	18,000.00
Cowlitz County Diking Improvement Dist. No. 15	4%	35,500.00
Cowlitz County Drainage Improvement Dist. No. 1	4%	6,700.00
First Creek Irrigation District	2%	9,500.00
Franklin County Irrigation District	5%	11,564.90
Grays Harbor Co. Dkg. & Drg. Improvement Dist. No. 4	4%	38,000.00
Hutchinson Irrigation District	5% and 4%	25,500.00
Kennewick Irrigation District	4%	13,000.00
King County Drainage District 14	5%	3,200.00
Lake Chelan Reclamation District, 3d issue	1%	100,000.00
Lake Chelan Reclamation District, 4th issue	1%	118,000.00
Lake Chelan Reclamation District, 5th issue	2%	169,000.00
Larrabee Irrigation District	4%	12,500.00
Lewis-Thurston Cos. Joint Drg. Improvement Dist. 7	4%	2,000.00
Methow Valley Reclamation District	2%	75,000.00
Oroville-Tonasket Irrigation District	2%	243,000.00
Otis Orchards Irrigation District	2%	1,000.00
Outlook Irrigation District	4%	11,000.00
Pasadena Park Irrigation District	4%	17,700.00
Priest Rapids Irrigation District	2½%	89,000.00
Snipes Mt. Irrigation District	2%	500.00
Snohomish Co. Diking District No. 1	1%	18,000.00
Snohomish Co. Diking District No. 1	2%	20,000.00
Snohomish Co. Diking District No. 2	2%	5,130.00
Wenatchee-Chewawa Irrigation District	2%	6,000.00
Wenatchee Heights Irrigation District	2%	78,000.00
Wenatchee Reclamation District	4%	2,800.00
Whitestone Reclamation District	1%	40,000.00
White Salmon Irrigation District	1%	7,000.00
Wolf Creek Reclamation District	2%	25,000.00
Yakima Co. Drg. Imp. Dist. No. 3-Sub 7	4%	27,000.00
Yakima Co. Drg. Imp. Dist. No. 3-Sub 8	2%	8,400.00
Yakima Co. Drg. Imp. Dist. No. 9	4%	6,000.00
Yakima Co. Drg. Imp. Dist. No. 9-Sub J	4%	2,800.00
Yakima-Benton Cos. Joint Drg. Imp. Dist. No. 1	4%	36,500.00
Yelm Irrigation District	2%	138,500.00
Total		$1,588,134.90

DIVISION OF HYDRAULICS AND WATER RESOURCES

CHAS. J. BARTHOLET
Supervisor

WATER RESOURCES

Water of springs, streams, lakes and underground sources comprise one of the State's greatest natural resources and one which is inexhaustible. The abundance of this resource when put to beneficial use will go far toward further development of the State, both for commercial and recreational purposes. Already the capital outlay for construction in connection with irrigation and power represents in Washington an investment of more than $275,000,000. In addition to this, large investments have been made for the use of water for municipal, domestic, fish propagation, industrial, mining and other purposes.

The State has approximately 600,000 acres of land now under irrigation and there are 1,981,000 acres in planned projects for which a water supply is available. In addition, thousands of acres on the West Side of the Cascade Mountains will be irrigated through individual efforts, and it is difficult to estimate the area that will eventually be irrigated in larger projects.

The State's water resources are also a very important factor in planning national defense, particularly in the use of water for hydroelectric power tor manufacturing purposes and for irrigation of lands to produce food stuffs.

THE WATER CODE

Section 1, Article 21 of the State Constitution provides that "The use of water for irrigation, mining and manufacturing purposes shall be deemed a public use." This is a declaration of ownership by the State of waters therein, and various federal acts concede such authority to the states.

Section 1, Chapter 117, Laws of 1917, of the State of Washington, provides that the State has the power to regulate and control waters within the State, and Section 8 of the same act provides for the supervision of public waters, their appropriation, diversion and use.

Prior to the enactment of the Water Code in 1917, rights to the use of surface waters in the State were in a chaotic condition. A great many conflicting and indefinite chapters of law, scattered throughout the statutes, relative to rights to the use of water, were responsible for continuous disputes and litigation among the water users throughout the State. The State Legislature in 1917 repealed the various laws relating to this subject and enacted a compact code of forty-four sections (Chapter 117, Laws of 1917) covering the entire subject of water rights, providing procedure for determination of existing rights and establishment of new rights, and for centralized administration. This law has proved very successful, and few amendments have been found necessary.

The Water Code gave central authority over the regulation and supervision of the State's water resources to an officer known as the "State Hydraulic Engineer," but in 1921, under the Administrative Code, this authority was

transferred to the "Supervisor of Hydraulics" under the Department of Conservation and Development.

In the case of Western Irrigation Company vs. Chase, 115 Wash. 146, our Supreme Court held that the State Supervisor of Hydraulics has jurisdiction over the vested water rights, as well as over rights acquired since the enactment of the Water Code, and has authority to enforce rights adjudicated in the Federal Court, and further stated that the Water Code is intended to cover the whole field of irrigation and to provide an inexpensive and ready manner of settling all disputes concerning such matters.

ADMINISTRATION

The work of the Division of Hydraulics is divided into eight major activities, five of which are provided for in the Water Code and three under other statutes.

Those provided for in the code are:

1. Supervision and regulation of use of water.
2. Determination of existing water rights.
3. Initiation of new water rights.
4. Collection of hydrographic data.
5. Examination of plans for proposed dams and inspection of hydraulic work.

Other activities:

1. Establishment of flood zones and regulation of proposed structures which might adversely affect flood conditions.
2. Cooperation with the U. S. Geological Survey in making utilization surveys of streams and lakes.
3. Cooperation with the U. S. Geological Survey in making an inventory of ground water resources.

Each of these activities will be discussed in the following pages.

1. Supervision and Regulation of Use of Water.

Sec. 8, Paragraph 3 of the Water Code provides that the Supervisor of Hydraulics shall regulate and control the diversion of water in accordance with the rights thereto.

The supervision of distribution of water is obtained through water masters and stream patrolmen. From time to time as conditions warrant, water masters are appointed for certain districts. The water master is paid by the county for the time actually devoted to his duties as water master. He is under the direct supervision of the Supervisor of Hydraulics, and has general charge, within his district, of the regulation and control of the distribution of water to those entitled thereto.

Where conditions on a stream are such as to require more constant attention than a water master with a large district can attend to, stream patrolmen are appointed. A stream patrolman has, within his limited district, the same power and authority as a water master. During the low water season he patrols his stream daily and makes distribution of the water in accordance with rights and so as to secure to all the best possible results. The stream patrolman has charge of one stream only and is under the general supervision of the water master of the district within which his stream lies, if a water master has been appointed, otherwise he is directly under the supervision of

this office. He is paid for his services by the water users themselves. Where a stream patrolman is employed the water users on the stream usually form a water users' association in order that funds may be collected in a systematic manner to pay for the services of the patrolman.

Regulation of waters of these streams has been carried on during the past biennium with the assistance of the following water masters, stream and ditch patrolmen. Six of these water masters have served in this capacity for ten years or more. These officers have often, without the assistance of this office, successfully and tactfully handled many difficult problems.

WATER MASTERS

1939-1940

COUNTY	YEAR 1939	YEAR 1940
Asotin	Harold Crawford	Henry Freeburn
Chelan	O. M. Bise	O. M. Bise
Clallam	Dick Duncan	Dick Duncan
Columbia	Ben Magill	Ben Magill
Ferry	C. A. Ledgerwood	W. S. Woodard
Garfield	Henry Freeburn	Henry Freeburn
Kittitas	Benjamin Vaughn	Benjamin Vaughn
Klickitat	August Hanson	August Hanson
Okanogan	Calvin Casteel	Calvin Casteel
Spokane	W. S. Douglass	W. S. Douglass
Stevens	C. A. Ledgerwood	W. S. Woodard
Walla Walla	Harlow Barney	Harlow Barney
Yakima	Loyd F. Fairbrook	Loyd F. Fairbrook
Pend Oreille	W. S. Douglass	W. S. Douglass

STREAM PATROLMEN

1939-1940

NAME OF STREAM	COUNTY	YEAR 1939	YEAR 1940
Stemilt Creek	Chelan	W. O. Quinn	W. O. Quinn
Squilchuck Creek	Chelan	T. R. Hawkins	T. R. Hawkins
Beaver Creek	Okanogan	Thos. R. Tuttle	C. L. Fritz
Reecer Creek	Kittitas	M. A. Moen	M. A. Moen
Bird & Frasier Creek	Klickitat	Albin Berglund	Osmar Ladiges
Ahtanum Creek	Yakima	Wallace Owen	Wallace Owen
Menashtash Creek	Kittitas	George Meek	George Meek
Coleman Creek	Kittitas	Chas. Cooke	Chas. Cooke
Colockum Creek	Chelan	Ed Ingersoll	Ed Ingersoll
Nanum Creek	Kittitas	Harry Covey	Dick Shuey
Wilson Creek	Kittitas		Dick Shuey
Taneum Creek	Kittitas	Ed Olson	Ed Olson
Peshastin Creek	Chelan	H. H. Kelley	H. H. Kelley
Mission Creek	Chelan		D. S. Fisher
Douglas Creek	Douglas		P. L. Davis
Wenas Creek	Yakima		Jess Stice
Mill, Garrison, Yellowhawk, Caldwell, Shelton Spring Branch	Walla Walla	Byron Shirrod	

2. Determination of Existing Water Rights.

For the purpose of this office, water rights are placed in two general classifications: (1) those acquired through use prior to June 15, 1917, when the Water Code went into effect and the State of Washington took over the administration of all unappropriated waters of the State, and (2) those granted by the Division of Hydraulics subsequent to 1917.

The Code provides that rights in the latter class may be acquired only by making application for and securing a permit from this office. In the case of the former, however, a formal filing was sometimes made in the office of the County Auditor or a notice was posted at the proposed point of diversion, or both; although more often the water was simply appropriated without the user going through these formalities. It should be noted that no right was established unless the filing or posting of notice was followed by actual use of the water within a reasonable time.

Conflicting claims made by the owners of these old rights caused extensive litigation, and in order to end such disputes between claimants the Code provided a system for determining the priority and extent of these rights acquired prior to 1917, and for regulating them thereafter.

In this proceeding a hearing is held by the Supervisor of Hydraulics at which testimony is taken relative to use of water by various claimants. A report, called the Report of Referee, based on the information presented at the hearing, is prepared for the Court. This report sets out the claims with their priorities and the quantities of water to which they are entitled. In some cases exceptions to the report are filed and, if necessary, further testimony is taken. Usually, however, the Court immediately orders that a decree be prepared, based on the findings of the Referee.

After a decree has been filed the Supervisor of Hydraulics presents a bill of costs in which the various rights are assessed in direct proportion to the quantities of water granted them.

Notwithstanding the fact that during the biennium there have been some requests for adjudications, in most cases such action would have benefitted but a few individuals. The Division of Hydraulics has therefore denied these requests because it was thought that the farmer is bearing enough burdens at present without new ones being added unnecessarily.

Decrees on two cases initiated in the preceding biennium were entered by the Superior Court of Lincoln County, these being South Fork of Crab Creek and Crab Creek between Moses Lake and Odessa. The last named case was appealed and the Superior Court decree was subsequently reversed by our Supreme Court.

Following is a list of streams adjudicated since the Water Code went into effect on June 15, 1917.

Stream	*County*	*No. of Rights*	*Acreage*
Ahtanum	Yakima	266	10,557.84
Alder Creek	Stevens	37	801.75
Alpowa	Asotin	43	919.70
Antoine Creek	Okanogan	6	165.61
Bacon Creek	Yakima	8	840.00
Bear Creek and Davis Lake	Okanogan	11	268.00
Beaver Creek	Okanogan	43	1,551.77
Big Creek	Kittitas	10	1,319.00
Bigelow Gulch Creek	Spokane	12	117.00
Bird and Frasier Creek	Klickitat	101	5,635.30
Black Canyon Creek	Okanogan	7	116.00
Bull Dog Creek	Stevens	22	282.35
Calispell Creek (Little)	Pend Oreille	9	170.00
Cheweka Creek	Stevens	22	242.00
Chewelah Creek	Stevens	124	1,132.61
Cook Creek	Kittitas	43	3,662.00
Corus Creek	Stevens	2	37.60
Cowiche Creek	Yakima	71	3,189.30

Stream	*County*	*No. of Rights*	*Acreage*
Crab Creek, South Fork	Lincoln	11	205.96
Crab Creek and Moses Lake	Grant	58	56,934.87
Crab Creek Between Sylvan Lake and Odessa	Lincoln	6	259.32
Crystal Springs Creek	Spokane	17	23.60
Deadman Creek	Garfield	73	504.80
Deer Creek	Stevens	36	1,142.50
Doan Creek	Walla Walla	15	363.50
Dungeness River	Clallam	20	28,988.00
Gold Creek	Okanogan	25	577.50
Hoffman Creek	Stevens	15	177.50
Icicle Creek	Chelan	10	7,894.00
Jennings Creek	Stevens	15	118.50
Joe Creek	Chelan	4	87.00
Johnson Creek	Chelan	3	16.00
Johnson Creek	Okanogan	20	433.01
Libby Creek	Okanogan	16	178.20
Meadow Gulch Creek	Garfield	25	77.55
McFarland Creek	Okanogan	8	683.60
Myers Creek	Okanogan	77	547.69
Oropahan Creek	Okanogan	7	105.00
Pingston Creek	Stevens	17	26.75
Quilisascut Creek	Stevens	26	276.10
Roaring Creek	Chelan	5	160.00
Safety Harbor Creek	Chelan	19	4,593.56
Salmon Creek (North Fork)	Okanogan	96	522.67
Sherwood Creek	Stevens	23	193.00
Similkameen River	Okanogan	2	10,889.00
Sinlahekin Creek	Okanogan	91	12,180.29
Squillchuck River	Chelan	171	3,448.70
Stemilt Creek	Chelan	189	4,764.00
Stone Creek	Walla Walla	59	835.16
Teanaway River	Kittitas	68	3,941.30
Thomason Creek	Stevens	43	72.18
Touchet River	Columbia	352	10,392.29
Twin Creek	Ferry	9	37.00
Walla Walla	Walla Walla	886	23,271.00
Wawawai Creek	Whitman	7	114.50
Wenas Creek	Yakima	182	9,381.44
		3,543	215,424.87

On the following stream hearings have been held and reports of referee have been presented to the courts, but no decrees have been handed down:

Stream	*County*	*No. of Rights*	*Acreage*
Bowman Creek	Klickitat	28	487.00
Chumstick Creek	Chelan	57	1,043.00
Hawk Creek	Lincoln	44	543.23
Hunter Creek	Stevens	45	1,160.00
Thompson Creek	Okanogan	8	251.00
Wolf Creek	Okanogan	11	872.40
Total		193	4,356.63

Although a determination of the rights on Magee Creek, Stevens County, was initiated, upon request of a majority of claimants to water, the work was abandoned.

3. Initiation of New Water Rights.

Applications are made on forms provided by this office. After being checked for accuracy, a notice for publication is made out and sent to the applicant, who must have two consecutive weekly publications made in a

newspaper of general circulation published in the county seat of the county or counties in which the storage, diversion and use are made. Copies of notices are also sent to the State Land Office, the State Departments of Game and Fisheries, and in special instances to the State Board of Health and the Federal Power Commission.

In order that persons affected may be given an opportunity to protest applications should they desire to do so, a period of thirty days after date of last publication is allowed to elapse before an examination is made on the ground. Examinations are made by an engineer of the Division of Hydraulics who ascertains the quantity of water flowing in the stream, the number and extent of other rights, and the quantity of water required and available for applicant's use. At this time protests are examined and their merits discussed with the protestants.

In cases where it is found that there is no public water available for appropriation, or that issuance of a permit would constitute an infringement on the rights of another or others, or in any way be detrimental to the public interest, permits are denied.

When a permit is granted certain specified times are given the permittee in which to begin and complete construction and to make complete application of water to the proposed use. If work is not completed in the time specified, extensions to a later date are frequently allowed when sufficient cause for such action is shown.

After the terms of a permit have been complied with, a certificate of water right is issued and the right becomes appurtenant to the land on which it was used, as described in the permit. Such rights, as well as those acquired by use prior to the enactment of the Water Code, remain appurtenant to the land and may not be transferred to other land or to other uses except with the approval of the Supervisor of Hydraulics. Such tranfers may be either seasonal or permanent, though only in the latter case is publication of notice required.

Much correspondence is carried on with prospective water users who seek information concerning the acquisition of water rights. Advice to them is readily offered and much assistance is given in the preparation of their water right applications. The following letter of instruction is sent out to each prospective applicant:

"Since June 15, 1917, the date when our State Water Code went into effect, it has been necessary, in order to legally appropriate and use water, to make application and obtain permit from the Supervisor of Hydraulics. The Water Code provides that 'Any person, municipal corporation, firm, irrigation district, association, corporation or water users' association hereafter desiring to appropriate water for beneficial use shall make an application to the State Supervisor of Hydraulics for a permit to make such appropriation.' "

However, if water was appropriated and used before June 15, 1917, the right has become vested for the **quantity of water** and **the purposes** for which it was **actually used** and it is not necessary to obtain a permit from this office for its use.

We are enclosing a blank form for making application for permit, together with section plats. **A $5.00 examination fee is due at the time application is filed.** Instructions and schedule of other fees will be found on the back of the application. However, the applicant will be notified of such fees as they become due.

Notice, prepared by this office, will be sent to the applicant, who must have it published in two consecutive weekly issues of a newspaper of general circulation published at the county seat of the county or counties in which the diversion and use are to be made, and the cost of such publication must be paid by applicant.

A period of thirty days after date of final publication is allowed for filing protests, after which an examination is made on the ground by a representative of this office. If he finds that there is water available and that the proposed use will not interfere with existing rights, permit will be granted. (The total cost, including publication, of obtaining a water right for domestic supply and irrigation of up to twenty acres, usually amounts to about $13.00.)

All permits from this office are issued subject to existing rights and **carry no right-of-way privilege.** For this applicant must deal with the landowner, unless structures are on his own property."

The following table shows the number of applications filed and permits and certificates issued, as well as the cancellation of applications and permits, since the enactment of the Water Code, for the period June 15, 1917, to October 1, 1936, for the biennium from October 1, 1936 to October 1, 1938, and during the past biennium:

	June 15, 1917 to Oct. 1, 1936	Oct. 1, 1936 to Oct. 1, 1938	Oct. 1, 1938 to Oct. 1, 1940	Total
Applications for permits to appropriate and construct reservoirs	4,295	342	637	5,274
Permits to appropriate water	2,301	287	519	3,107
Permits to construct reservoirs	120	2	5	127
Final water right certificates	952	171	293	1,416
Certificates of change (Change of point of diversion, and/or place and purpose of use of water)	151	9	16	176
Applications cancelled	1,264	234	233	1,671
Permits cancelled	137	175	168	480

The number of applications for permits to appropriate water for irrigation west of the Cascade Mountains indicates a growing attention to the importance of remedying moisture deficiencies, especially since water for irrigation is obtainable in a great many instances at a nominal cost, and the benefits in this area are not confined to increased crop yields but are reflected in the improved quality due to continued and sustained growth and a wider choice of crops.

The absence of rainfall during the best part of the growing season for the years 1938 and 1939 will be noted from the following precipitation table compiled from records of the U. S. Weather Bureau stations at Bellingham, Seattle, Olympia and Vancouver:

MEAN PRECIPITATION—DEPTH—INCHES PRINCIPAL GROWING PERIOD

YEAR—1938

	May	June	July	August	Sept.	May to Sept.	June, July & August	July & August
Bellingham	1.05	0.02	0.57	0.25	1.28	3.17	0.84	0.82
Seattle	1.04	0.39	0.18	0.48	0.48	2.57	1.05	0.66
Olympia	0.83	0.13	0.30	0.21	1.05	2.52	0.64	0.51
Vancouver	0.39	0.80	0.18	0.29	0.58	2.64	1.27	0.47

YEAR—1939

Bellingham	1.20	1.77	1.57	0.37	0.68	5.59	3.71	1.94
Seattle	1.27	1.58	0.64	0.59	1.30	5.38	2.81	1.23
Olympia	1.88	1.42	1.25	0.27	0.65	5.47	2.94	1.52
Vancouver	1.39	1.69	0.77	1.38	0.44	5.67	3.84	1.15

4. Collecting and Recording Hydrographic Data.

The collection and publication of daily records of stream flow are prime requisites to the proper planning of all hydraulic projects. The growth and development of the State have been attended by a steadily increasing use of its water resources and a corresponding need for investigation of the flow of its streams.

Water resources should be investigated for the following briefly summarized reasons:

(1) That the water supply may be accurately determined for the development of lands yet to be irrigated as room is afforded for much agricultural expansion.

(2) To determine the quantity of water which will be available for future power development, as only 6% of the State's potential water power is now being utilized.

(3) Ample supplies of water for domestic, municipal, fish propagation, and industrial use, will become increasingly important in the future.

(4) The menace of uncontrolled rivers to life, property, transportation, and industry was emphasized by the devastating floods of December, 1933, and January, 1934.

(5) Stream pollution should be curtailed, or regulated, in the interest of public health and to preserve fish and other wild life.

As was done during previous bienniums, the Supervisor of Hydraulics cooperated with the United States Geological Survey in the collection of stream-flow records. Since 1909 successive State legislatures have made appropriations for "Hydrographic Surveys" which have been matched by the Government. In addition to this fifty-fifty cooperation, there is similar cooperation between the Government and various cities and counties in Washington. Also a considerable amount of stream gaging in the State is financed by Federal agencies by transfers of funds to the Geological Survey. The entire cost of publishing the records annually is borne by the Government.

Continuous records of gage height and discharge are being obtained at 133 gaging stations located on the principal streams of the State. The water-stage recorder and cableway structures which have been installed on these stations now represent an investment of about $220,000. During the biennium 18 gaging stations were installed and 7 were discontinued. Several more gaging stations are now definitely scheduled for construction.

It is difficult to foresee many of the needs for stream-flow records before they develop and it is important that a comprehensive State-wide network be maintained for an indefinite period or long enough to indicate long-time trends. A number of hydrographic projects in Washington have failed with a great loss of capital outlay because they were planned without the benefit of a sufficiently long period of stream-flow records. It is the function of governmental agencies to determine the available water supply of the State in advance of actual need and on a basis adequate enough to prevent the failure of hydraulic projects through improper planning. The continuation and gradual expansion of the present program of stream gaging in the State is believed to be necessary in the interest of national defense as well as of the people of Washington.

We are grateful to Mr. F. M. Veatch, District Engineer of the Water Resources Branch of the U. S. Geological Survey, and his staff for the considera-

tion and assistance they have given in matters pertaining to cooperative affairs.

5. Examination of Hydraulic Works and Structures.

The Water Code provides that, to the extent necessary to insure safety to life and property, the Supervisor of Hydraulics shall inspect dams and other hydraulic structures, both during construction and during subsequent maintenance and operation. Whenever complaints are received or defects otherwise come to our attention, inspections are immediately made and necessary corrections arranged for.

Dams are inspected at such intervals as are deemed necessary in each individual case, but we aim, in general, to keep well posted on the current condition of all of them.

In March, 1940, the dam of James E. Stout on Chiliwist Creek, near Malott in Okanogan County, failed, causing several hundred dollars damage along the stream below. This failure occurred during construction and was caused by an unprecedented flood.

The following tabulation includes what may be termed the major dams in the State and gives pertinent information as to each. They are almost uniformly of comparatively recent and modern construction. None of them give cause for apprehension in regard to safety.

MAJOR DAMS IN STATE OF WASHINGTON

NAME	Type	Height Feet	Storage Capacity Acre-feet	Purpose	Lake or River	Ownership
Nine Mile	Concrete, gravity	58	5,210	Power	Spokane River	Washington Water Power Co.
Long Lake	Concrete, gravity	250	229,000	Power	Spokane River	Washington Water Power Co.
Little Falls	Concrete, gravity	66	4,250	Power	Spokane River	Washington Water Power Co.
Lake Chelan	Concrete, gravity	30	640,000	Power	Lake Chelan	Washington Water Power Co.
Rock Island	Concrete, gravity	86	25,000	Power	Columbia River	Puget Sound Power & Light Co.
Baker River	Concrete arch	264	140,000	Power	Baker River	Puget Sound Power & Light Co.
Diablo	Concrete arch	325	90,000	Power	Skagit River	City of Seattle
Cedar Lake	Concrete, gravity	160	52,500	Power	Cedar River	City of Seattle
Cushman No. 1	Concrete arch	275	440,000	Power	Lake Cushman	City of Tacoma
Cushman No. 2	Concrete arch	240	7,300	Power	Skokomish River	City of Tacoma
Elwha	Concrete, gravity	110	6,000	Power	Elwha River	Northwestern Power & Light Co.
Glines Canyon	Concrete arch	210	37,000	Power	Elwha River	Northwestern Power & Light Co.
Ariel	Concrete arch	200	220,000	Power	Lewis River	Inland Light & Power
Keechelus	Earth, rolled fill	100	152,000	Irrigation	Lake Keechelus	U. S. Bureau of Reclamation
Kachess	Earth	63	210,000	Irrigation	Lake Kachess	U. S. Bureau of Reclamation
Cle Elum	Earth	123	360,000	Irrigation	Lake Cle Elum	U. S. Bureau of Reclamation
Bumping Lake	Earth	42	34,000	Irrigation	Bumping Lake	U. S. Bureau of Reclamation
Tieton	Earth, semi-hydr. fill	222	202,500	Irrigation	Tieton River	U. S. Bureau of Reclamation
Salmon Lake	Earth, hydr. fill	33	10,500	Irrigation	Salmon Lake	U. S. Bureau of Reclamation
Conconully	Earth, hydr. fill	62	14,400	Irrigation	Conconully Lake	U. S. Bureau of Reclamation
Bonneville	Concrete	170	.....	Power and Navigation	Columbia River	U. S. Government
Grand Coulee	Concrete	550	10,000,000	Power, irrigation and Navigation	Columbia River	U. S. Government
*Mud Mountain	Earth, hydr. fill	430	130,000	Flood control, Irrigation	White River	U. S. Government
*Mill Creek	Earth, hydr. fill	145	6,000	Flood control, Irrigation	Mill Creek	U. S. Government

* Under construction.

OTHER ACTIVITIES

1. Regulatory Control of Works and Structures Placed in Stream Channels or on Flood Plains.

Chapter 159, Laws of 1935 (Sec. 9663 A-1 to Sec. 9663 A-20, Remington's Revised Statutes) provides for the establishment by the Supervisor of Hydraulics of Flood Control Zones within which it shall be unlawful to construct or maintain any works or structures, which may affect flood conditions, unless and until a permit has been secured from said Supervisor of Hydraulics.

To date 183 permits have been issued under this act, 68 of which have been during the past biennium.

The complete list of existing Flood Control Zones, all established prior to October 1, 1938, is as follows:

Puyallup Zone No. 1	Puyallup, Carbon, Stuck and White Rivers.
Green River Zone No. 2	Green, Black and Duwamish Rivers.
Cedar River Zone No. 3	Cedar River.
Sammamish Zone No. 4	Sammamish River watershed.
Snohomish Zone No. 5	Snohomish, Pilchuck, Snoqualmie, Skykomish, Sultan and Wallace Rivers.
Stilaguamish Zone No. 6	Stilaguamish River and its two forks.
Skagit Zone No. 7	Skagit, Baker, Sauk, Cascade and Samish Rivers.
Nooksack Zone No. 8	Nooksack River and its three forks and the Sumas River.
Yakima Zone No. 9	Yakima River and its tributaries, Naches, Teanaway, Cle Elum and Kachess Rivers.
Walla Walla Zone No. 10	Walla Walla and Touchet Rivers and Mill, Yellowhawk and Garrison Creeks.
Nisqually Zone No. 11	Nisqually River and Ohop Creek.
Deschutes Zone No. 12	Deschutes River.
Chehalis Zone No. 13	Chehalis, Wynooche, Satsop, Black, Skookumchuck and Newaukum Rivers.
Cowlitz Zone No. 14	Cowlitz, Toutle, Tilton and Cispus Rivers and Coweeman and Olequah Creeks.
Lewis River Zone No. 15	Lewis River and its two forks.
Skokomish Zone No. 16	Skokomish River and its two forks.

Maps and descriptions of each zone are on file in the office of the Supervisor of Hydraulics and copies may be obtained at the cost of reproduction.

Additional zones will be established as the need for them becomes apparent and as funds become available for the work involved.

Experience during the five years of operations indicates that the act is effective in preventing harmful encroachments upon the flood channels and floodways of our major streams and in the prevention of flood damages by reason of faulty manmade works and structures. Public appreciation of the benefits accruing from the operation of the act is evidenced by the wholehearted cooperation received from both private and public interests.

2. River Utilization Surveys.

These surveys are made by the Conservation Branch of the United States Geological Survey and the resulting maps and reports published by that organization. The maps are topographic maps of the stream valleys on a larger scale than the standard topographic quadrangles and show greater detail. These maps may be used to determine (1) the location of dam sites and the type and size of dam suitable to the site; (2) the location, area, and capacity of possible reservoir sites; (3) available fall for hydroelectric power;

(4) topography of water conduit locations; (5) area and character of irrigable lands; and (6) areas subject to flood overflow and probable methods of flood control.

During the biennium $5,800 of State funds were expended for this work and this was matched by the Federal government. The Inter-County River Improvement cooperated on the survey of the Carbon River, paying half the cost or about $500. The Water Department of the City of Tacoma cooperated on the surveys in the Green River basin, paying half the cost or about $1,000.

The following surveys were made during the biennium. These surveys, with the exception of the Spokane River, were on a scale of 1:24,000 (1 inch=2,000 feet) with 5, 10 or 20-foot contour interval. The Spokane River survey was on a scale of 1:12,000 (1 inch=1,000 feet) with 5-foot contour interval. The detailed dam site surveys were on a scale of 1:4,800 (1 inch=400 feet) with 10-foot contour interval.

Nooksack River Basin, Whatcom County:

Nooksack River, forks near Deming to Maple Falls, 13 miles; Middle Fork, mouth upstream 5 miles; South Fork, mouth to Saxon Bridge, 12 miles. (The above surveys, in each case, are connected with previous surveys.)

Green River Basin, King County:

Green River, Sunday Creek to Twin Camps Creek, 5.5 miles; Twin Camps Creek, 1.3 miles, and Tacoma Creek, 0.4 mile. A detailed survey was made of one dam site.

Smay Creek, mouth to forks, 1.7 miles; West Fork, 1.2 miles; and East Fork, 1.5 miles.

North Fork Green River, mouth upstream 3.5 miles. This survey also included an area of about two square miles between the North Fork and Taylor Creek, a tributary of the Cedar River, to show the divide between the two basins and a 1½ mile section along Taylor Creek.

Puyallup River Basin, Pierce County:

Carbon River, South Prairie Creek upstream 6 miles. A detailed survey was made of 1 dam site.

Chehalis River Basin, Lewis and Thurston Counties:

Chehalis River, from point 2 miles below South Fork to Pe Ell, 21 miles; South Fork, 5 miles; Lake Creek, 3 miles; Hope Creek, 2 miles; Dell Creek, 2 miles; and Elk Creek, 2 miles.

North Fork Newaukum River, Bear Creek upstream 5.0 miles; Bear Creek, 1.0 mile; Mitchell Creek, 2.0 miles, and tributary of Mitchell Creek, 1.0 mile.

Skookumchuck River, ¾ mile below Salmon Creek, upstream 9.2 miles; Salmon Creek, 2.0 miles; Johnson Creek, 4.0 miles; Bloody Run Creek, 2.3 miles; and Thompson Creek, 3.0 miles. A detailed survey was made of the Bloody Run Creek dam site.

Cowlitz River Basin, Lewis County:

Cowlitz River—A detailed survey of the Shut-In dam site near Mossy Rock, which had been previously started, was completed.

Tilton River from ¼ mile below Cinnabar Creek to Morton, 14 miles; North Fork Tilton, 1 mile; and Highland Creek, 2 miles.

Klickitat River Basin, Yakima County:

Klickitat River, Huckleberry Creek upstream 6 miles; Diamond Fork, 4 miles. (This survey was started in September, 1938, and was about 30 per cent complete on September 30, 1938, the end of the previous biennium.)

Spokane River Basin, Spokane County:

Spokane River, from point about 1 mile below falls in city of Spokane to Post Falls power plant near Post Falls, Idaho, 28 miles.

3. Ground Water Resources.

During the biennium the inventory of ground-water resources in Washington has been carried forward by the Geological Survey, United States Department of the Interior, in cooperation with the State Department of Conservation and Development. Certain activities supplementing this cooperative program have also been conducted by the Geological Survey in collaboration with the Soil Conservation Service of the United States Department of Agriculture. Progress in all these lines of investigation is summarized below.

Canvass of Public Water Supplies: Field reconnaissance in connection with the State wide canvass of public water supplies from wells and springs was completed in 1939 and a preliminary draft of a report was completed by January 1940. This preliminary draft has been held pending compilation of records for several municipal water departments. Recently, the compilation of these records has been completed so that the report can now be placed in line for release.

State-wide net of observation wells: In connection with the canvass of public water supplies, a skeleton net of observation wells was established over the State for quarterly measurements of ground-water level. These measurements of water level indicate the effects of fluctuations in rainfall and in withdrawals on the quantity of ground water available for use. The water-level data through 1939 will be included in the report on public water supplies from wells and springs; data for 1940, in the annual volume on water levels and artesian pressure in the United States in the series that is published by the Geological Survey.

Spokane Valley: Data on water-table fluctuations in the Spokane Valley through 1938 have been assembled in a progress report and released to the public (Piper, A. M., and La Rocque, G. A., Jr., Water-table fluctuation in the Spokane Valley and contiguous area, Washington-Idaho; U. S. Geol. Survey, typewritten report, 143 pp., October 1939.) Corresponding data for 1939 and 1940 will be included in the annual volumes on water levels by the Geological Survey. The initial basic survey of the Spokane River to determine channel capacities has also been made (Ninth Biennial Report, op. cit., p. 66), and one high-water profile (April 1940) has been run. To round out the data on channel capacity, it is contemplated that additional high-water profiles will be run and river stages observed periodically at a series of gage-height stations, as opportunity arises. In June 1940, the investigative program in the Spokane Valley was curtailed greatly in order that a preliminary reconnaissance of ground-water features might be started in the area of the Columbia

Basin Project. Thus, in the Spokane Valley only a bare minimum of observations are being made currently for continuity of essential records. Ultimate completion of the investigation in that area is deferred accordingly.

Quincy Valley: The investigation of ground-water resources in the Quincy Valley, proposed heretofore (Piper, A. M., Inventory of ground-water resources Washington, September 21, 1938) has been absorbed into the preliminary reconnaissance in the area of the Columbia Basin Project, to which reference is made in the next paragraph.

Columbia Basin Project area: To afford reliable information on ground-water features pertinent to development of the Columbia Basin Project, an intensive five-year program of investigation has been outlined (Piper, A. M., Columbia Basin Irrigation Project, program for investigation of Problem No. 22: U. S. Geol. Survey, typewritten memorandum, November 8, 1939.) The first element in this program, a preliminary reconnaisance, was started in late August 1940 with emphasis on the three subdivisions of the project area that are most likely first to be supplied with irrigation water. These three subdivisions are: the Quincy Valley, in the northern part of the area; the Wahluke Slope, in the southwestern part of the area; and the Pasco Slope, in the extreme southern part of the area. For these three subdivisions, the reconnaissance field work is now far advanced (November 1940); drafting of a progress report will be started at once.

MISCELLANEOUS ACTIVITIES

Litigation: During the past biennium no appeals to the Superior Court have been made from orders or determinations of this office. Few arrests were made by water masters for interference with water regulations made by them. Arrests are made only after every effort has been exerted by the water master to have his regulation respected. Owing to the diplomacy of the water masters they have the cooperation of the water users and only in rare instances is it necessary to cause the arrest of offenders. Such records are the result of years of experience and training of those in charge of making water regulations. Our water masters often secure water for short periods for those badly in need of it from water users who own superior water rights on the stream.

Waters in State Withdrawn from Appropriation: Chapter 88, Laws of 1905, provides that, on notification by the U. S. Bureau of Reclamation, any waters which the Bureau may require for any Federal reclamation project shall be withdrawn from appropriation for any other purpose.

The withdrawal of water is for a period of one year in order to permit the preparation of plans for the project. As soon as plans are completed the waters reserved must be appropriated by the United States in the same manner as any other prospective water user. If plans are not completed within one year and the project appears to be feasible, the Supervisor of Hydraulics may grant further extensions of time for three year periods to permit completion of plans.

Streams on which waters have been withdrawn from appropriation are as follows:

Yakima River and all tributaries are reserved for use of Yakima Project. (Withdrawal expires December 31, 1942.)

Columbia River, above Grand Coulee, reserved for use on Columbia Basin Project. (Withdrawal expires December 14, 1943.)

Wenatchee River, 300 second-feet, with definite quantities reserved from certain tributaries for use in connection with salmon propagation in order to preserve Columbia River salmon, as the Grand Coulee dam will not permit them to reach their natural spawning grounds. (Withdrawal expires December 22, 1941.)

Power License Fees: In 1929 the Legislature enacted the Power License Law (Chapter 105, Laws of 1929), which provides for the payment to the State of an annual license fee for the use of water for power purposes, both on developed and undeveloped projects of over fifty theoretical horse power. The fee is based on the theoretical horse power produced by the quantity of water claimed and the operating head of water involved. The fee for undeveloped projects is one-half of the rate specified for projects in operation.

The revenue from this source has diminished during the last few years because many who were holding water rights for future power developments relinquished them when construction of the Grand Coulee and Bonneville projects made uncertain the future market for power developed by private interests. The Government is exempt from paying fees on Government owned hydroelectric plants.

It was the mutual intent of the framers of the act and those who pay the fees that the proceeds therefrom should be used to carry on surveys and investigations of natural resources of the State. The fees are now placed in the Reclamation Revolving Fund, from which they are appropriated for the purpose for which they were intended.

Since the enactment of this law the following fees have been collected:

YEAR	Number of Claims on Which Fees Were Paid	Amount Collected
1929	125	$45,645 63
1930	137	42,354 20
1931	136	42,960 00
1932	126	42,332 64
1933	116	39,961 28
1934	121	41,513 88
1935	105	38,011 34
1936	101	37,321 26
1937	96	34,356 53
1938	91	34,506 34
1939	87	32,571 70
1940	80	30,819 06
Total	.....	$462,353 86

Cooperation with State Departments of Game and Fisheries: Naturally the settlement and development of any new country tends to disrupt both game and fish life. The abundance of these resources has already been greatly diminished in this State and careful consideration should be given to preserving these assets.

The State and Federal Governments are expending annually large sums of money in the construction of fish hatcheries, stream improvements, and fishways, and for patrolling streams to save one of the State's greatest natural

resources. The salmon is not only one of our food commodities, which may be had at a low cost, but with game fish, it is an asset to the State for its own citizens and it also attracts many sportsmen from other states. This office therefore aims to cooperate to the fullest extent in preserving both salmon and game fish in streams of this state. Sec. 30 of the Water Code provides that the State Departments of Game and Fisheries shall be notified of all applications for permits to appropriate and store water with pertinent information concerning them. This provision of the Water Code is being carefully followed and no action is taken on an application until a report has been received from either the Game or Fisheries Department, stating what effect the proposed diversion or works will have on fish life in the stream or lake from which the appropriation is to be made. If the diversion is found to be detrimental, the permit is either denied or contains provisions which protect the fish life, so that the combined interests of the use of water may be served.

Section 31 also provides that all permits issued shall contain a clause to the effect that the permittee shall comply with all fisheries and game laws in his diversion and use of the water. Section 31 also provides that the two departments be notified of all permits issued. This is for the purpose of permitting a check up by the Game and Fisheries Departments on water diversions for the purpose of preventing infractions of the laws for the protection of fish life.

Water Use Problems: The increasing appreciation of the role which water plays in our present day civilization is amply reflected in the numerous inquiries received at our office from personal callers and by mail. These inquiries range all the way from matters of simple hydraulic engineering to those of elementary laws and regulations governing small water supplies.

When, as is usually the case, the project and problems involved are too small to justify the owner in engaging professional services, we gladly give such advice as is possible without field examinations. Considerable time and correspondence are devoted to this type of service, because we believe that it not only assists the individual in solving his specific problems, but also imparts much needed information as to use of water by the individual for irrigation, domestic and allied purposes.

EXPENDITURES

The following table shows expenditures under the supervision of the State Supervisor of Hydraulics for the biennium from October 1, 1938, to October 1, 1940.

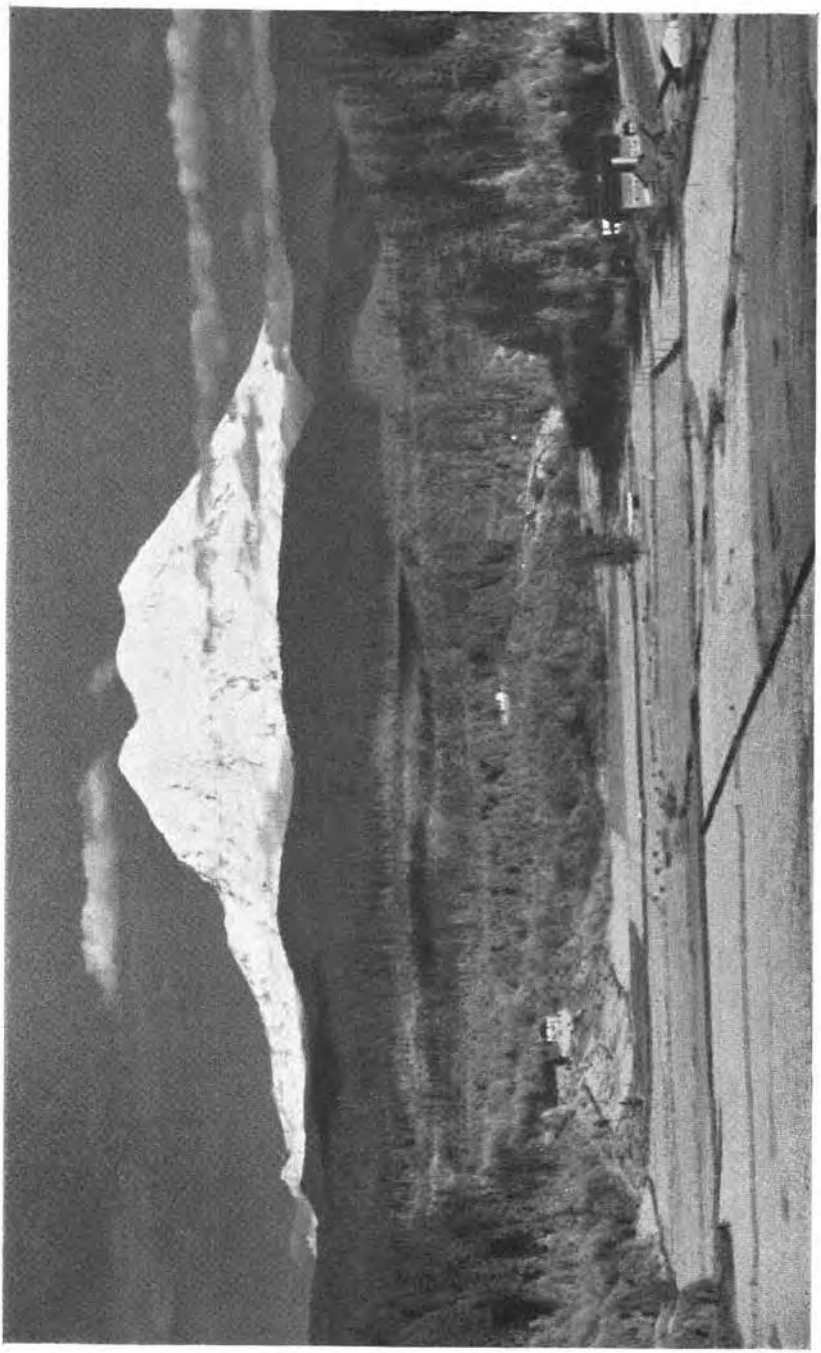
Purpose	*Expended from October 1, 1938 to October 1, 1940*
Administration of Water Code	$33,135.96
*Hydrographic Surveys	22,431.90
*River Utilization Surveys	6,292.67
*Underground Water Surveys	3,378.81
Totals	$65,239.34

* Expenditures for these purposes are made under cooperative agreements with the U. S. Geological Survey and are matched by Federal funds.

RECEIPTS

The following table shows receipts for the biennium from October 1, 1938, to October 1, 1940,

Source	*Received October 1, 1938, to October 1, 1940*
Examination Fees:	
Initial	$3,170.00
Additional	226.10
Filing and Recording Fees:	
Permits	3,114.09
Certificates	458.00
Miscellaneous	110.28
Miscellaneous Copying	79.43
Extension of time for beginning of construction	99.78
Adjudication of Water Rights	1,012.74
Dam Inspections	146.84
	$8,417.26
Power License Fees	63,390.76
Totals	$71,808.02



Mount Rainier from Ohop Valley. *By A. Schoeni.*

DIVISION OF FORESTRY

T. S. GOODYEAR
Supervisor

1939 ANNUAL REPORT

The fire season of 1939 was in reality two separate and distinct seasons, both marked by prolonged and severe dry spells.

The first fires were reported in Clark and Skamania counties on March 22—almost a month earlier than the usual crop of spring fires. March 22 until April 7 was a period of high temperatures and low humidity, accompanied by northeast winds. Fires were so numerous and threatening, it became necessary to put many of the fire wardens and patrolmen to work. On April 7, 8 and 9 the weather became cloudy with light, scattered showers. There was another critical fire weather period between April 12 and April 21, when many large and destructive fires resulted from fern and slash burning operations. On April 17 the temperature was 78 degrees with a humidity of 20 degrees. The entire western part of the State was covered by a dense mantle of smoke. The situation became critical in Cowlitz, King, Kitsap, Grays Harbor and Pierce counties. Many acres of second growth timber were destroyed and numerous settlers' homes threatened. Approximately 800 men were out on the fire lines. The weather changed April 21, becoming cloudy with lower temperatures and higher humidity. The following day brought southwest winds and scattered showers. Weather continued cool and cloudy until April 25, when there was a general rain west of Cascade Mountains. Fifty wardens and patrolmen, who had been hired temporarily to look after the early spring fires, were released. Fire weather conditions remained about normal for the balance of April and no new fires were reported during that period.

The average precipitation for the state in April was 0.91 of an inch, or 1.43 inches below normal and, according to the local weather observer, the driest April Olympia has experienced in the past 54 years. It came within 0.02 of an inch of equaling the all-time low mark set in 1885. A total of 310 fires, upon which it was necessary to take control measures, occurred during March and April. This is by far the largest number of early spring fires ever recorded.

Weather for the first nine days in May was about normal and fire danger nominal. May 10 to May 16 was unusually hot and dry with continued northeast winds. On May 12 temperature reached 96 degrees and humidity, 10 degrees; May 13, temperature 98 degrees with a humidity of 2 degrees. The situation again became critical. One large fire, that burned over 3,000 acres, was purportedly set by fishermen in the upper Lewis River area and required a crew of 500 men to control. Another 150 fires, set in widely scattered parts of the State, were threatening and required continued vigilance and patrol. Spotted showers and cloudy weather on May 17, 18 and general showers May 19 provided necessary relief and the opportunity to complete fire lines and put all fires under temporary control. The balance of month was cool, cloudy and fairly wet. No new fires were reported.

Unusually favorable weather conditions prevailed during the entire month of June. But 59 fires were reported and little difficulty was experienced in controlling them.

From July 1 to July 6, the weather was generally cool and cloudy with comparatively high humidity and scattered showers. July 7 to 11 was clear and warm with changeable winds. July 12 the winds shifted to northeast, the temperature went up and humidity reached 35 degrees. July 13 was cloudy and scattered showers were reported in parts of the Puget Sound area. The weather in Columbia Gorge was not so favorable and several fires broke out in the western pine regions. Fire weather during balance of July was extremely favorable west of Cascade Mountains; fires were few and readily controlled. The situation east of Cascades was entirely different. There were 12 consecutive days of extreme heat, low humidity and northeasterly winds. Temperatures varied between 96 and 110 degrees and humidity ranged from 8 to 20 degrees. Many fires were reported in northeastern part of the State and it became necessary to supplement the regular patrol force with additional temporary fire guards. There were 241 fires reported during the month of July, none of which reached major proportions.

The fire situation was extremely critical throughout the entire month of August, in which there was a prolonged dry spell with unusually high temperatures, low humidity and almost continuous northeast winds. More than a third of all fires reported during the season—four of which were major fires—occurred in August. Heavy concentration of men and equipment on the Deep Creek and Willard fires in western Clallam and Klickitat counties caused a shortage of available fire crews in other parts of the State and it was necessary to supplement CCC crews with civilians. The Deep Creek fire started from a logging operation on August 7 and burned over approximately 4,200 acres in the first run; on August 20, high winds blew this fire over the trails and it burned an additional 4,500 acres. On August 8 the Marty fire swept over 700 acres in Stevens county. August 9 the Willard fire assumed threatening proportions in Columbia National Forest and on August 11 it spread over 8,750 acres outside the national forest in Klickitat county. On August 5 and 12 the Blanchard Valley and Mica, both very destructive fires, burned large areas of cut-over lands in Spokane county. The major fires of the season all started between the dates of August 5 and 12, which was a period of terrific fire weather. There were days during the middle of August when over 3,000 men were working on some 200 fires in widely scattered sections of the State. For a time, fires were being set faster than control crews could be assembled and dispatched. The weather moderated somewhat on August 24 and the winds shifted to northwest; by the 26th, crews on most of the fires were reduced to a patrol basis. August 27 was the first day in weeks that new fires were not reported. There were still approximately 1,600 men concentrated on Deep Creek fire. On August 28 there was a severe lightning storm that set 20 fires in Clark, Skamania and Klickitat counties. August 31 was cloudy and cool, and during the night there was a general rain throughout western Washington, which afforded temporary relief to a tense and dangerous fire situation.

Although the precipitation for September was considerably below normal, the weather was moderate and, during the latter part of month, favorable for slash burning.

The following climatological statistics, compiled from reports of the United States Weather Bureau, indicate atmospheric conditions during the season of 1939.

Month	Average Precipitation for the State (Inches)	Below Normal (Inches)	Above Normal (Inches)	Western Washington			Eastern Washington		
				Clear	Partly Cloudy	Cloudy	Clear	Partly Cloudy	Cloudy
April	0.91	1.43	.....	11	8	11	16	8	6
May	1.52	0.42	.....	10	10	11	16	9	6
June	1.64	.....	0.04	8	8	14	12	10	8
July	0.84	.....	0.20	17	6	8	23	6	2
August	0.43	0.42	.....	19	6	6	25	4	2
September	0.84	0.99	.....	15	6	9	20	6	4
October	2.59	0.50	.....	7	9	15	13	8	10

A summary of fires by months is herewith shown, since it reflects such a direct relationship to atmospheric conditions.

	March	April	May	June	July	August	Sept.	Oct.	Nov.	Total
Western Washington	11	262	139	21	115	368	92	21	.....	1,029
Eastern Washington	1	36	51	38	126	166	54	14	1	487
Totals	12	298	190	59	241	534	146	35	1	1,516

A comparison with the 1938 fire season shows a marked reduction in number of fires from all causes except slash burning, in which there was a slight increase. There was nearly a 50 per cent decrease in incendiary, smokers and lightning fires. Total area burned over in 1939 was 103,139 acres, or 41,374 acres less than in 1938. There was also a notable decrease in property damage—from $157,973 in 1938 to $51,686 in 1939. However, while there were 843 fewer fires in 1939 than 1938, the average area burned per fire increased from 61.2 acres in 1938 to 68.0 acres in 1939. This is far from adequate fire protection and indicates unsatisfactory progress.

Boys from state and private land CCC camps again performed the major part of fire suppression. During emergencies every available enrollee was out on the fire lines. They carried on their work willingly and well, for which public acknowledgment is herewith extended.

Mechanized fire fighting equipment, such as bulldozers, power pumps and water tanks, was extensively and effectively used on all the larger fires.

The fire situation became so critical that on August 8 a general order was issued closing all logging operations in western Washington for two days; there being no improvement in weather conditions, the order was extended for another day to include August 10. By August 20 every available CCC man and all equipment were out on fires and it became necessary to supplement and relieve CCC crews by employing civilians for night fire fighting and patrol. New fires were being set at the rate of about 50 per day and several of the larger fires might easily have developed into major conflagrations. After consultation with weather experts and representatives of the logging industry, another general order was sent out August 20, closing all timber operations in

western Washington on August 21 and 22. The absolute cessation of all logging activities during these two extreme emergencies in August, undoubtedly avoided several disastrous forest fires. August, 1939, will long be remembered as one of the most critical fire weather periods since organized forest fire protection in the State of Washington.

The past fire season developed two notable weaknesses in forest protection which should be remedied before another season. First, the field force is not employed soon enough to take care of early spring fires that often come before the closed fire season, April 15. The State and private protective organizations were entirely unprepared for fires that occurred the latter part of March and in early April. These early fern fires annually destroy extensive areas of fine second growth trees. The statutory limits of the closed season should be advanced to April 1 and the district and assistant district wardens put to work on that date. Second, neither the state nor private protective association has sufficient trained men or equipment to take care of emergencies which are inevitable for short periods during each fire season. Can the protective agencies afford to maintain sufficient men and equipment throughout the season to handle adequately the occasional peak emergencies?

The only redeeming feature of the 1939 season is that there were no fatalities or serious injuries from forest fires. This is extremely gratifying, since thousands of men, many without previous woods experience, were engaged throughout the summer in the hazardous occupation of fire fighting. The entire field staff was frequently impressed with the necessity of exercising every possible precaution for the safety of crews. This was done in a most creditable manner.

Cooperation

Acknowledgment for able assistance is extended to the following agencies: United States Forest Service, particularly Region 6, for its effective work in connection with boundary line fires; the Civilian Conservation Corps, which was again the first line of defense, contributing 20,422 man-days of fire suppression. The enrollees, the Army officers, and technical representatives are entitled to a lot of credit. The speed and efficiency with which the United States Army established and organized fire camps, deserves special commendation. The Pacific Northwest Forest Experiment Station studies and investigations are exceedingly helpful and have materially contributed to the development of fire protection. Fire weather forecasts of the United States Weather Bureau are now quite dependable and a very important factor in the forest fire prevention program. The Weather Bureau mobile units rendered valuable assistance in connection with suppression of major fires. The Washington Forest Fire Association and the foresters maintained by West Coast Lumbermen's and Western Pine Associations were instrumental in promoting and developing better forest practice by the industry in logging operations. This is reflected by the small number of operators' fires and the unusual acreage of slashings successfully disposed of during the fall of 1939. Acknowledgment is herewith made to the State Parks Board for the liberal use of enrollees and equipment from its CCC camps for fire suppression throughout the season.

Civilian Conservation Corps

Below is a consolidated report of projects completed by the seven State and private land CCC camps during the past calendar year.

Truck trails	40.3	Miles
Telephone lines	33.1	Miles
Road and trailside clearing	10.8	Miles
Firebreaks	24.1	Miles
Fences	250	Rods
Fire hazard reduction	2,448	Acres
Tree planting	5,334	Acres
Forest stand improvement	3,430	Acres
Landscaping—fire halls and headquarters	6.4	Acres
Seed collection (conifer)	2,145	Bushels
Vehicle bridges	11	
Lookout tower	1	
Fire guard station	1	
Fire suppression	20,422	Man-days
Fire prevention	5,585	Man-days
Nursery	4,558	Man-days
Survey	467	Man-days
Signs and markers	1,271	Man-days
Headquarters construction	8,600	Man-days

Construction and Buildings

Construction of the following buildings was completed during the calendar year: one 83′ creosoted lookout tower on Abernathy Mountain in Cowlitz county; a two-room guard station and garage in the Rattlesnake ranger district, Yakima county; at the State forestry headquarters site, five miles east of Olympia, two 50′ x 76′ warehouses, one 50′ x 80′ machine storage building, one 24′ x 30′ gas and oil house, one 24′ x 80′ dormitory with accommodations for 30 men, one 24′ x 30′ four-car garage, one four-room caretaker's cottage complete with garage, one six-room office building, and a 15,000 gallon reservoir. A complete water system has been installed.

The grounds around fire halls at Raymond, Sultan, Kelso, Sedro-Woolley, Montesano and Shelton were landscaped.

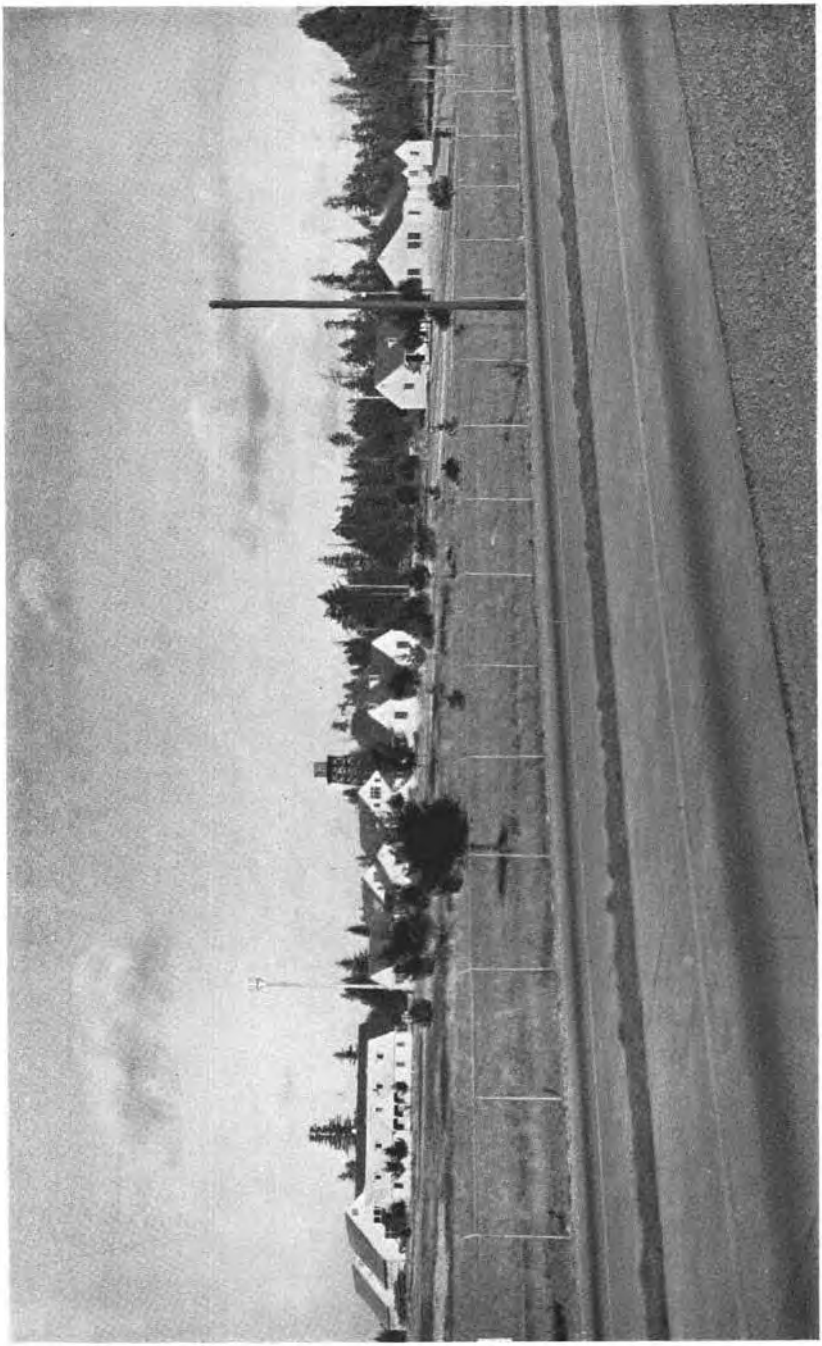
Of eleven bridges constructed, one was a 50′ Howe truss on concrete piers and another involved a 65′ log stringer span.

Equipment

Aside from an unusual amount of small fire fighting tools and ordinary replacements, the Division purchased 20,000 feet of cotton rubber-lined fire hose; two No. 40 and two No. 85 Edwards pumpers; one Type "A" Pacific pumper; 108 five-gallon Armstrong pump tanks; one light Forest Service trail tractor mounted with bulldozer; two Diesel caterpillar tractors, D-2; two 2½-ton G. M. C. trucks; two Chevrolet coupes.

For experimental purposes the following radio equipment was purchased:

2 type T, Model D Radiophones
2 type S, Portable Radiophones
3 type SV, Radiophones
1 U. S. F. S. Hetrodyne, U H F meter



State Forestry Shop and Warehouses.

Rather encouraging results were obtained from mounting 110-gallon water tanks on ½-ton pickup trucks, with Panama or light Edwards pumps attached direct to the truck motors. Three of these units were used throughout the season for suppression of roadside fires. In addition, seven 366-gallon detachable tanks were mounted on ordinary 1½-ton dump trucks, with two Edwards Model 40 and five Type "A" Pacific pumpers. The Edwards 40 has a pumping capacity of 15 to 40 gallons per minute and the Type "A" Pacific models, between 15 and 30 gallons per minute. These latter units were rather extensively used on larger fires in the high country and, in some instances, proved very effective.

Land Classification

During the year applications were received from 15 landowners for classification of approximately 80,000 acres of forest land under provisions of Reforestation Act. Field examinations were completed, public hearings advertised and held, and a total of 60,010 acres, situated in Cowlitz, Pacific, Grays Harbor, Jefferson and Mason counties was recommended as eligible for classification. The State Tax Commission accordingly ordered the lands set aside for reforestation purposes.

Slash Disposal

As previously mentioned, weather conditions during the latter part of September and early October were extremely favorable for slash burning. Many of the larger operators had made definite and complete plans for slash disposal. An unusual amount of slashings was burned in 1939, with nominal loss and damage to equipment and adjoining timber. Clearance applications were made on approximately 110,000 acres of cut-over lands. After very careful field examinations, certificates of clearance for effective slash disposal were issued on 90,697 acres.

Land Acquisition

In accordance with provisions of Chapter 154, Laws of 1935, large acreages of county owned forest land were examined and title to 42,841 acres, situated in Cowlitz, Clark, King, Mason, Skagit, Snohomish, and Thurston counties, was transferred to the State Forest Board. One small purchase was made during 1939, involving 820 acres within Capitol State Forest. No land exchanges were made by the Board.

During the year, 97 applications were received for purchase of timber and leases for mineral prospecting, oil prospecting, agriculture and grazing on State Forest Board lands, bringing the total number of transactions to 201.

The gross receipts from timber sales, trespasses, leases, and right of way easements on State Forest Board lands are now approximately $30,400. Of the gross income derived from lands acquired from the counties, $25,000 or 86 per cent was distributed to the counties in which transactions were completed. There is at present a balance in the Forest Development Fund of about $4,500. While these figures are not impressive, they indicate what may be accomplished with so-called worthless, tax title forest land when placed under intensive forest management. Receipts thus far have been principally derived from salvage operations and trespass. It requires no imagination to realize that under proper management these cut-over areas will soon come into

production, thereby insuring counties that participate in the state forest program a substantial and steady source of revenue, in lieu of lost taxes.

State Forest Nursery

Additional clearing of stump land this year has increased the nursery area to a total of nine acres available for seed beds. Three acres are occupied by roads, buildings, and lawn, and a small area of stump land remains to be cleared for seed beds. A 42,000 gallon concrete reservoir was completed in the spring. This brings the total reservoir storage capacity to 57,000 gallons which, together with present pumping facilities, is adequate for an annual production of 5,000,000 seedlings.

Three and one-quarter million 2-0 Douglas fir seedlings were planted on approximately 5,000 acres of state forest land in Cowlitz, Grays Harbor, Lewis, Skagit, Snohomish, Thurston and Wahkiakum counties by enrollees from six CCC camps. Most of the plantations are on lands acquired by counties through tax delinquency foreclosure and later deeded to State Forest Board under provisions of Chapter 126, Laws of 1935. Examination of the plantations established since this work began in 1936, shows an average survival of 74 per cent. An extensive cover survey was made preparatory to planting operations, for the purpose of determining percentage of natural stocking and amount of planting necessary to put the land into satisfactory production.

Sowing of 1,333 seed beds was completed in the spring for an estimated production of 4,000,000 seedlings, to be available for planting in the fall and spring of 1940-1941. Most of the beds are Douglas fir; however, there are a few sown to western red cedar, true firs, and western pine. To date, very little difficulty has been experienced with common nursery diseases or pests.

Experimental work in propagation of tung trees (aleurites fordii) proved unsuccessful. Although the seedlings made a vigorous summer growth, temperatures were apparently too severe and resulted in mortality of all plants the first winter.

Black walnut (juglans nigra), butternut (juglans cinerea), shagbark hickory (hicoria ovata), pignut hickory (hicoria glabra), and beech (fagus Americana) have all made vigorous growth and wintered without damage. These seedlings are now ready for transplanting in permanent locations and will be set out during spring of 1940.

Considerable rodent damage was experienced in the propagation of cascara sagrada. Mice were the offenders, burrowing for seed before it germinated. Results show that if cascara seed beds are not completely protected from rodents, excessive damage will result. This conclusion is based on experiments for two consecutive years.

On October 31, 1939, an experiment with broadcast seeding of Douglas fir by airplane was conducted. The purpose was to find a more economical means of artificially restocking logged-off land following slash burning and before rodent population becomes so numerous that sowing is useless and prohibitive because of the excessive amount of seed required. One pound of seed per acre was sown to twenty acres of freshly burned over land. It will require at least two years before the results of this experiment may be definitely determined.

Three one-acre plots, each representing widely different conditions, were seeded to Douglas fir, using 8' x 8' spacing and 6 to 10 seeds per hill. A hand corn planter was used for this work. The first plot was land on which slash was burned during current year; the second, land on which slash was burned 5 to 10 years ago; third, land on which slash had been burned 10 years and so heavily infested with rodents that planting of seedlings was a failure.

Nineteen thirty-nine was an excellent seed year—the best since 1936. Consequently, 1,424 sacks of Douglas fir cones were collected, from which 1,589 pounds of seed were extracted. The average cost of collecting cones was $1.75 per sack and the expense of drying them and threshing seed was $.05 per pound, or a total production cost of $1.80 per pound. These figures are not applicable to a private enterprise since CCC labor was employed and 1939 was better than an average seed year. Some sitka spruce, western hemlock, and western red cedar seeds were also harvested. A supply of 5 gallon seal-top glass containers was purchased for seed storage purposes, which, together with the 2½ gallon jars already in use, makes available ample storage facilities for 3,530 pounds of tree seed.

Table No. 1—ORIGIN, NUMBER and CLASSIFICATION of FIRES—1939

COUNTIES	Lightning	Incendiary	Campers	Smokers	Slashing	Logging	Brush Burning	Railroads	Miscellaneous	Total
Chelan	18		5	13	1		2	2	3	44
Clallam		8	2	11		4	2		9	36
Clark	1	12		10	1	2	23	2	10	61
Cowlitz	5	17	3	8	11	5	22	4	11	86
Ferry	4	1	2	5			1		3	16
Grays Harbor		11	2	16	1	1	7	3	6	47
Island			12	4			2		3	21
Jefferson		8	7	10		1	2		4	32
King	5	13	6	45	1	3	16	11	10	110
Kitsap	1	18	6	9	2		10		4	50
Kittitas	13	2	5	14		1	3	4	2	44
Klickitat	1	12	1	20	3	6	8	1	7	59
Lewis	3	36	1	8	1	7	12	2	8	78
Mason		14	7	9		3	5		5	43
Okanogan	56			7					3	66
Pacific		8		8			4	3	5	28
Pend Oreille	11	2	3	13		2	3	2	9	45
Pierce	9	26	3	51	1	3	18	1	12	124
San Juan			3	8	1		3		4	19
Skagit	5	3	3	8	1	4	13	4	6	47
Skamania	2	1	3	5	2	1	16	3	1	34
Snohomish	6	14	2	29		3	15		17	86
Spokane	5	2	7	53	1	1	6	11	13	99
Stevens	14	4	10	34			12	2	17	93
Thurston		57	6	8	1	2	16	2	2	94
Wahkiakum		2					2		1	5
Whatcom		6	3	3		3	8		5	28
Yakima	5	1	2	8		1			4	21
TOTALS	164	278	104	417	28	53	231	57	184	1,516

Classification of Fires: Class A (¼ acre or less), 527; Class B (¼ to 10 acres), 619; Class C (over 10 acres), 370.

Table No. 2—ACREAGE BURNED OVER—1939 FIRES

COUNTIES	FOREST LAND			NOT REFORESTED			NON-FOREST LAND			Total
	Merchantable Timber	Reproduction		Old Burn	Cutover Land		Pasture	Brush	Other	
		Cut Over	Old Burn		Slash Unburned	Slash Burned				
Chelan	74	38					10	112	5	239
Clallam	206	3,103	816	70	560	1,230		3,785		9,770
Clark	40	643	890	182	230	139	287	1,070	37	3,518
Cowlitz	77	4,594	3,958	339	3,655	1,325	43	1,794	46	15,831
Ferry	129	8	4						27	168
Grays Harbor		9	1,615	750	82		21	88	4	2,569
Island		25	10				3	9		47
Jefferson	1,420	1,100	1,030	502	460	1,704	7	1,018	80	7,321
King		57	552	951	2,292	3,094	45	1,040	1,084	9,115
Kitsap	3	130	1,624	362	639	247	45	847	7	3,904
Kittitas	278	12	2		48		219	50		609
Klickitat	5,276	188	2,144		442	240	15	1,290	151	9,746
Lewis	179	335	2,395	248	1,867	352	80	780	8	6,244
Mason		73	449	35	101			63	10	731
Okanogan	14	267					9	70	5	365
Pacific	16	30	396	283	357	105	2	9		1,198
Pend Oreille	11	9	100		7			220	1	348
Pierce	7	329	5	1,136	435	41	311	2,129	182	4,575
San Juan		53	20	10		32	26	51	30	222
Skagit	1	140	31		40	140	116	272		740
Skamania	18	806	1,093	102	29	462	48	226	5	2,789
Snohomish		10	15		175	60	76	137	24	497
Spokane	865	2,674	405	73	6,766	1	3,487	54	223	14,548
Stevens	374	1,108	90	390	1,418	3	184	7	43	3,617
Thurston	253	143	1,313	500	788	70	20	551	2	3,640
Wahkiakum	20		10					60		90
Whatcom	25	3	385		96		10	99		618
Yakima	25	12	20		8		1	5	9	80
TOTALS	9,311	15,899	19,372	5,933	20,495	9,245	5,065	15,836	1,983	103,139

Table No. 3—LOSS and DAMAGE—1939 FIRES

COUNTIES	MERCHANTABLE TIMBER			LOGS	LOSS AND DAMAGE TO PROPERTY	
	Timber Killed M. B. M.	Timber Salvable M. B. M.	Timber Destroyed M. B. M.	Logs Destroyed M. B. M.	Logging Equipment	Settlers and Others
Chelan	60	3	57			$ 100.00
Clallam	9,064	6,750	2,314	41	$ 30.00	127.00
Clark	13	11	2			456.00
Cowlitz	662	612	50	20	300.00	205.00
Ferry	32		32			40.00
Grays Harbor	51		51			18.00
Island						
Jefferson	500	450	50	20	100.00	
King						56.00
Kitsap						
Kittitas	144		144			352.00
Klickitat	15,307	7,788	7,519	3	1,200.00	
Lewis	390	23	367	159	1,650.00	221.00
Mason						250.00
Okanogan	54		54			100.00
Pacific				57		50.00
Pend Oreille	6	5	1	10		42.00
Pierce	45	36	9	20		192.00
San Juan						600.00
Skagit	10	3	7			
Skamania	6		6	100	35.00	
Snohomish					500.00	
Spokane	858	307	551			9,147.00
Stevens	357	264	93	10		377.00
Thurston	1,263	990	273		1,520.00	240.00
Wahkiakum	50	38	12			
Whatcom	100	100		180	1,000.00	70.00
Yakima	5		5			
TOTALS	28,977	17,380	11,597	620	$ 6,335.00	$ 12,643.00

Total loss and damage to all classes of property—$51,686.00.

Table No. 4—BURNING PERMITS, CLASSIFICATION and ACREAGE of LAND BURNED UNDER PERMIT—ARRESTS and FINES—1939

COUNTIES	BURNING PERMITS				ARRESTS AND FINES	
	Permits	Camp Fire Permits	Protection Acres	Agriculture Acres	Number	Fines and Costs
Asotin	7		360	81		
Chelan	263	11	53	637		
Clallam	1,495	12	1,426	3,008		
Clark	1,582	13	5,407	3,854	13	$ 66.50
Cowlitz	1,808	129	8,522	4,744	3	52.50
Ferry	98	16	351	245		
Garfield	3		1	50		
Grays Harbor	1,295	36	4,795	1,611	3	93.00
Island	338	3	155	818		
Jefferson	777	122	174	784		
King	2,961	60	2,926	2,675	1	25.00
Kitsap	1,152	107	1,543	1,457		
Kittitas	534	103	2,050	459	1	
Klickitat	540	79	9,118	586		
Lewis	3,336	54	12,614	10,783		
Lincoln	1					
Mason	1,372	320	6,879	1,133		
Okanogan	172	33	690	4,348		
Pacific	997	71	6,887	2,878		
Pend Oreille	884	101	4,832	1,960	2	10.00
Pierce	1,799	64	4,376	1,765		
San Juan	270	88	1,174	433	1	2.50
Skagit	1,127	58	6,198	2,703		
Skamania	241	24	1,035	130	3	2.50
Snohomish	2,113	6	5,009	3,997		
Spokane	699	59	7,227	3,663		
Stevens	1,970	256	7,954	9,296	3	37.50
Thurston	2,070	7	9,988	4,503		
Wahkiakum	392	18	2,983	800		
Whatcom	1,728	38	4,765	3,584	1	12.00
Yakima	55	47	2			
TOTALS	32,079	1,935	119,494	72,985	31	$ 301.50

1940 ANNUAL REPORT

The 1940 fire season was of average intensity. Due to a comparatively late spring with cool and cloudy weather and well distributed rains, there was not the usual crop of early fern fires.

April 15, the official beginning of fire season, was marked by cool weather and scattered showers throughout western Washington—a decided contrast to the same date of April, 1939, when there were a great many fires already burning when the district wardens commenced work.

There were few fires during the early part of May. Beginning May 18 there was a short period of warm weather with below normal humidity and northeast winds. On May 23 several slashing fires were set in Kitsap, King and eastern Lewis counties, most of which were controlled with little difficulty. On the night of May 25 there was an extremely heavy frost that killed many young fir trees in the central western counties. On May 30 there were severe thunder storms and a general rain.

June was an extremely dry month, with an average of 1.21 inches below normal precipitation. The temperatures throughout the month were above normal and accompanied by comparatively low humidity with frequent strong northeast winds. On June 12 a slashing fire in western Lewis county broke out of control and caused considerable damage and loss of equipment. June 20, slashing fires in western Clallam and Grays Harbor counties were fanned over fire lines by strong winds. June 24, the temperature on the west side exceeded 90 degrees, with humidity of 20 or below. On this date 22 berry picker fires were set, all of which necessitated control measures. On June 26 an operator's fire broke out in northern Whatcom county and caused considerable damage to equipment and bucked logs. The Hobart fire in King county burned some 2,000 acres of cut-over land and, for a time, threatened to develop into a major conflagation. One hundred fifty CCC men were dispatched to help control this fire. June 28 marked the 24th consecutive day without rain and there were a number of fires, each of which was over 100 acres, burning in Whatcom, King, Lewis and Wahkiakum counties. On June 29 two serious fires developed in logging operations in western Lewis county. By June 30 there was persistent pressure from both private protective agencies and timbermen to close all logging operations.

On July 5 there was a 30 mile wind that scattered at least three logging operation fires over the trails and beyond control. The weather continued hot and dry, with a number of fires burning over large areas. By July 7 conditions become so critical it appeared expedient to exercise the closure authority. Consequently, all logging and industrial operations tributary to the forests of western Washington were shut down July 8 until further notice. July 8, several new fires of incendiary origin were set in Cowlitz and Mason counties. On July 9 there was slightly higher humidity with traces of rain reported in Klickitat county and along Columbia Gorge. The fire situation became somewhat improved. In parts of Clallam and Grays Harbor counties .48 inch of rain was reported on July 10 and the closure order affecting logging camps and industrial operations was lifted at noon. The temperature in the eastern part of the State on July 11, and for several days, exceeded 100 degrees. July 12 was extremely smoky and lookouts experienced very poor visibility. New fires were reported near LaGrande in Pierce county and 75 men from CCC camps were dispatched to the Rocky Creek fire on upper

Lewis River. On July 15 a considerable number of lightning fires were set in northeastern Washington, particularly along the divide between Pend Oreille and Stevens counties. During the five days preceding July 20, weather became somewhat cloudy and considerably cooler, with above normal humidity. On July 20 there was a severe lightning storm, accompanied by scattered showers—the first noticeable precipitation in 52 days. There were hard showers during the night of July 21. However, the next day many lightning fires were reported in the high Cascades and eastern Washington. On July 26 there was sufficient rain in the northern counties to penetrate the woods and temporarily end fire danger. Cool weather and scattered showers continued throughout the balance of July and the first three days of August.

From August 4 to August 16, weather conditions were quite favorable and there was little difficulty experienced with fires. On August 16, 90 CCC's were dispatched to control a 300 acre fire at Copalis Crossings, Grays Harbor county. August 17 the atmosphere was extremely smoky and sultry throughout western Washington, with a temperature of 90 degrees and comparatively low humidity. Eight new fires were reported in Thurston and Cowlitz counties. On August 18 considerable difficulty was experienced in controlling a 3,000 acre fire on Pioneer Creek in Grays Harbor county, a 300 acre fire at North River and a 500 acre fire in Cowlitz county. At this time, men from the CCC camps were fighting over 50 fires throughout western Washington. During the balance of August the weather was cloudy and cool. Several slashing fires were purposely set in eastern Lewis county.

By September 5 there was sufficient rain in eastern Washington to terminate definitely further fire danger for the season. On September 7 the weather in western Washington again became extremely sultry and there was a severe electrical storm with hard rain on the night of September 9. The weather for balance of September and early part of October was very favorable and large acreages of slash were successfully burned.

On October 10 there was .65 inch of rain in 24 hours, which definitely ended the fire season.

About the middle of December there were several days of unusually cold, clear weather in western Washington. A 160 acre fire was set in Clark county on December 15, which did considerable damage to local settlers and also killed some second growth. On December 16 a 300 acre fern fire was reported burning within the City of Seattle watershed.

A summary of fires by months is shown herewith.

	Jan.	Feb.	April	May	June	July	Aug.	Sept.	Oct.	Dec.	Total
Western Washington	9	4	15	94	341	431	386	196	4	3	1,483
Eastern Washington	.....	.....	3	20	91	198	121	83	1	.....	517
Totals	9	4	18	114	432	629	507	279	5	3	2,000

The following climatological table, compiled from reports of the United States Weather Bureau, indicates atmospheric conditions in both eastern and western Washington during the fire season of 1940.

Month	Average Precipitation for the State (Inches)	Below Normal (Inches)	Above Normal (Inches)	Western Washington			Eastern Washington		
				Clear	Partly Cloudy	Cloudy	Clear	Partly Cloudy	Cloudy
April	2.79	.....	0.47	6	10	14	9	11	10
May	1.56	0.37	.....	13	10	8	18	9	4
June	0.40	1.21	.....	18	8	4	21	7	2
July	1.18	.....	0.53	11	10	10	16	10	5
August	0.37	.....	0.45	16	8	7	26	4	1
September	2.03	.....	0.19	11	8	11	14	9	7
October	4.85	.....	1.82	5	8	18	8	10	13

The 1940 fire season in eastern Washington was unusually favorable, as indicated by the fact there was only 5,124 acres burned during the entire season.

There was a slight increase over 1939 in fires resulting from logging operations. However, most of these were quickly controlled and held to comparatively small acreages. Unfortunately, four fires that originated within logging operations—two of which may have been incendiary, since they were set during week-end when the camps were down—burned 49 per cent of the entire acreage and caused 75 per cent of the property loss and damage. These fires were taken care of by the operators themselves and, since most of the other fires were under 100 acres, there were no unusual concentrations of CCC fire fighters or State equipment during the entire summer of 1940.

Men from the seven State and private land CCC camps operating under direction of this Division put in 8,292 man-days on fire suppression during the season, which is low compared with previous years. They were well organized and equipped, and their work was entirely satisfactory.

While there was an increase of 484 fires over the 1939 season, the actual acreage burned was reduced from 103,139 in 1939 to 46,598 in 1940. The increased number of fires started by campers, smokers, etc. may be attributed to the unusual number of tourists traveling through the State. This class of travel was 35 per cent more than that of the previous year. There was a decided increase in number of lightning fires and a marked decrease in incendiary and slashing fires.

This year emergency fire fighting crews, consisting of from five to twelve men, were maintained in seven fire halls throughout the State. In most cases they were very effective in controlling small fires or holding them until larger crews could be assembled. In some districts, for periods of ten to fifteen days, they were credited with controlling an average of eleven fires per day. More highly specialized crews of this nature may prove an effective means of reducing the annual fire losses. Tanks, varying in capacity from 50 to 300 gallons and operated from pumps attached directly to truck motors, were very successfully used in the suppression of fires along roads. In order to cut down the size of larger patrol districts, a considerable number of special patrolmen was hired during the peak season. All of these were important factors in materially reducing the average area burned per fire, which for 1940 was 23.2 acres compared with 68 acres per fire for 1939.

A "Keep Washington Green" publicity campaign, sponsored and paid for by private individuals, agencies and corporations, was extremely effective in arousing fire consciousness among the citizens of Washington and a large number of tourists. It is difficult to estimate actual dividends in dollars and cents resulting from this intensive forest fire prevention campaign, since a large percentage of the benefits will be realized in future years. However, it is notably reflected in the reduction of acreage burned and nominal property loss and damage from fires set by smokers, campers, berry pickers, hunters, and fishermen. In 1939 the acreage burned from this class of fires was 20,716 and the property loss $27,252.00, while in 1940 this acreage was reduced to 6,093 and the damage to $1,880.00, or less than one per cent of the total loss and property damage.

While there was continued progress in general forest fire protection during the current season, there is still much to be accomplished—namely, more adequate patrol in logging operations during normal shutdowns, additional fire fighting equipment for caterpillar and trucking operations, strengthening of compulsory forest patrol assessment statutes to eliminate exemption of the occupied lands, and improvement in present communication systems—before attaining the goal of adequate forest fire protection in the State of Washington.

Cooperation

Recognition for cooperation during the 1940 fire season is hereby given to the following: United States Forest Service, Civilian Conservation Corps, United States Army, Pacific Northwest Forest and Range Experiment Station, United States Weather Bureau, State Parks Board, Washington Forest Fire Association, West Coast Lumbermen's Association, Western Pine Association, the newspapers and radio broadcasting stations that so generously contributed space and time to warning the public of fire danger, the telephone companies which so promptly cleared fire calls, and the sponsors and contributors to the "Keep Washington Green" campaign.

Civilian Conservation Corps

The following is a consolidated progress report of work performed during 1940 by the seven CCC camps allotted to State Division of Forestry.

Truck Trails	46.0	Miles
Telephone lines	6.0	Miles
Road and trailside clearing	.6	Miles
Firebreaks	21.5	Miles
Fire hazard reduction	2,770	Acres
Landscaping fire halls and headquarters	6	Acres
Tree planting	4,050	Acres
Forest stand improvement	775	Acres
Fire suppression	8,292	Man-days
Fire presuppression	4,029	Man-days
Nursery	3,377	Man-days
Survey	143	Man-days
Signs and markers	1,600	Man-days
Vehicle bridges	5	
Lookout towers	2	
Fire halls	2	
Storage houses	2	
Residence	1	
Guard stations	2	
Water systems	3	

Buildings and Construction

During 1940 the old lookout tower on Abernathy Mountain, Cowlitz county, was dismantled and replaced by a new 83 foot ring-connected tower; also, a new 29 foot ring-connected tower and ground house were constructed on Elk Mountain.

Blue Mountain Lookout Tower and Ground House, Snohomish County.

Two new fire halls—at Chehalis in Lewis county and Port Orchard, Kitsap county—were completed during the year. A modern residence, garage, and oil house were built at the district ranger headquarters on Ahtanum Creek in Yakima county. A 14-car garage was constructed at the shop and warehouse headquarters site on Martin Way. Guard stations were built at the two main east and west entrances to the Capitol Forest.

Three complete water systems were installed—at the forestry headquarters site on Martin Way, the State forest nursery, and Ahtanum ranger headquarters.

Landscaping around several of the fire halls and at the forestry headquarters site is progressing and will undoubtedly be completed by early spring of 1941.

All of these projects were constructed by engineers and enrollees of the Civilian Conservation Corps.

Equipment

In the spring of 1940 a sufficient quantity of small fire fighting tools—such as axes, shovels, saws, mattocks, and back-pack pump cans—was purchased so that each patrolman could be supplied with enough tools to furnish a 5-man crew. The district headquarters were all supplied with necessary equipment to take care of a 100-man crew.

One 3-ton International truck and a Cletrac tractor, equipped with bulldozer, were obtained for fire trail construction in southwestern Washington. A 1½-ton stake-body truck was purchased for Glenwood district, Klickitat county, and a 1½-ton panel Chevrolet truck, completely equipped with apparatus for testing and repairing radio sets distributed to the field organization, was assigned to the radio engineer.

Eleven fire halls were equipped with complete electrically driven tool grinding outfits.

A Johnson 5 H. P. outboard motor was bought for use of the district warden in San Juan county.

The shop headquarters on Martin Way has been fully equipped with boring bars, drills, refacers, and bench grinders, so that practically all automotive repair may be done in the State shop.

The dormitory quarters of fire halls were furnished with steel beds, mattresses, and sleeping bags for maintenance of emergency crews. Also, additional field kitchen equipment and tents were obtained for large emergency fire fighting camps.

Radio

The 1940 fire season marked the advent of State Forestry Division into the field of radio, and consequently was one of experimentation, testing, and education of personnel in the operation of radio. Two hundred thirty men were given preliminary training and passed the federal examination for third class operator's permit, required for radio transmission.

The standard types of equipment used were United States Forest Service models S, SV, and T. Seven large radio sets were purchased from the State Highway Department. A total of 62 radio sets was assembled during the year—40 fixed sets and 22 portable, of which 25 fixed sets and 20 portable sets were completed for use during the fire season.

Radio stations were established at the fire halls in Elbe, Enumclaw, Glenwood, Montesano, Port Angeles, Raymond, Sedro-Woolley, Sultan, Thurston

A Mobile Trail Building Unit Leaving Headquarters.

county fire wardens' office, the headquarters site on Martin Way, and the main forestry office in Olympia; also, at the following lookouts: Blue, Devils, Elk, Grass, and Laurel Mountains, Abernathy, Blyn, Capitol Peak, Crescent Bay, Minot, National, Ohop, Porcupine, and Squally Jim.

Twenty portable radio sets were placed in the field to be used for direct contact with the lookouts. Small portable field sets were also successfully used for communication on several of the larger fires.

Results from radios installed in the fire halls were satisfactory, except at Kelso which is surrounded by high hills, making direct communication with tributary lookouts impossible.

Next year it is planned to expand the radio communication system so that all fire halls and lookouts will be fully equipped for transmitting and receiving by radio. An additional supply of small portable sets will be available for use on all of the more extensive fires.

Most of the radio sets used during the past fire season were entirely constructed by the National Youth Administration at Seattle, Washington.

Land Classification

But one application for classification of land under the Reforestation Act was received during 1940. This covered some 30,000 acres in Grays Harbor county and the required field examinations have not yet been completed.

Slash Disposal

During 1940 this office received applications for certificates of clearance on approximately 196,434 acres, of which 98,312 acres were found eligible for clearance, 83,324 acres are pending examination, and 14,798 acres were rejected.

In many of the clear cut logging operations, groups of seed trees were left standing and, preparatory to broadcast burning, considerable money and effort were expended to protect them. It is encouraging to report that in many cases of broadcast burning the seed trees were not seriously damaged.

State Forest Land Acquisition

The forestry office acquired during 1940, either by deeds direct from the counties, purchase through issuance of utility bonds, or exchange, 80,983.60 acres, as indicated in the following table.

COUNTY	Deeded	Purchase Utility Bonds	Exchange	Total
Clallam	26,311.65	.....	40.00	26,351.65
Clark	1,303.33	.....	.....	1,303.33
Grays Harbor	.....	3,602.07	.....	3,602.07
Kitsap	6,180.27	.....	.....	6,180.27
Klickitat	.....	.....	80.00	80.00
Lewis	11,150.80	.....	624.86	11,775.75
Pacific	7,431.87	.....	.....	7,431.87
Pierce	8,869.53	1,560.00	.....	10,429.53
Skagit	.....	.....	1,920.00	1,920.00
Snohomish	11,449.43	.....	139.70	11,589.13
Thurston	.....	320.00	.....	320.00
Totals	72,696.97	5,482.07	2,804.56	80,983.60

ng Operation in Western Washington.

Two school plantations were established in King county by Kirkland and Auburn high school students. Suitable State Forest Board land was selected for these projects, and seedlings, planting tools, and supervision were supplied by the Department. While this method is not recommended for extensive planting, it is highly recommended for educational and public relation values. School children who actually plant trees, learn by experience an appreciation for extreme necessity of care with fire in the woods.

In October of 1939, 20 acres were broadcast seeded to Douglas fir by airplane at the rate of one pound of seed per acre. This experimental area lies on top of Capitol Peak in Thurston county. While definite results on this project cannot be determined for another year, a general observation of the area shows that very few seedlings germinated and survived during the first year.

Examination of three one-acre plots that were hand seeded in the fall of 1939 on an 8′ x 8′ spacing, shows the following results:

Plot 1: An area where slash was burned 10 years ago and on which rodent infestation was so heavy that planting of seedlings was a failure. Nine per cent of seed spots showed one or more thrifty seedlings.

Plot 2: An area on which slash burned 5 to 10 years ago. A very dry area on high ground. Two and one-half per cent of seed spots showed one or more thrifty seedlings.

Plot 3: An area on which slash was burned one month previous to planting seed. A very dry site on ridge-

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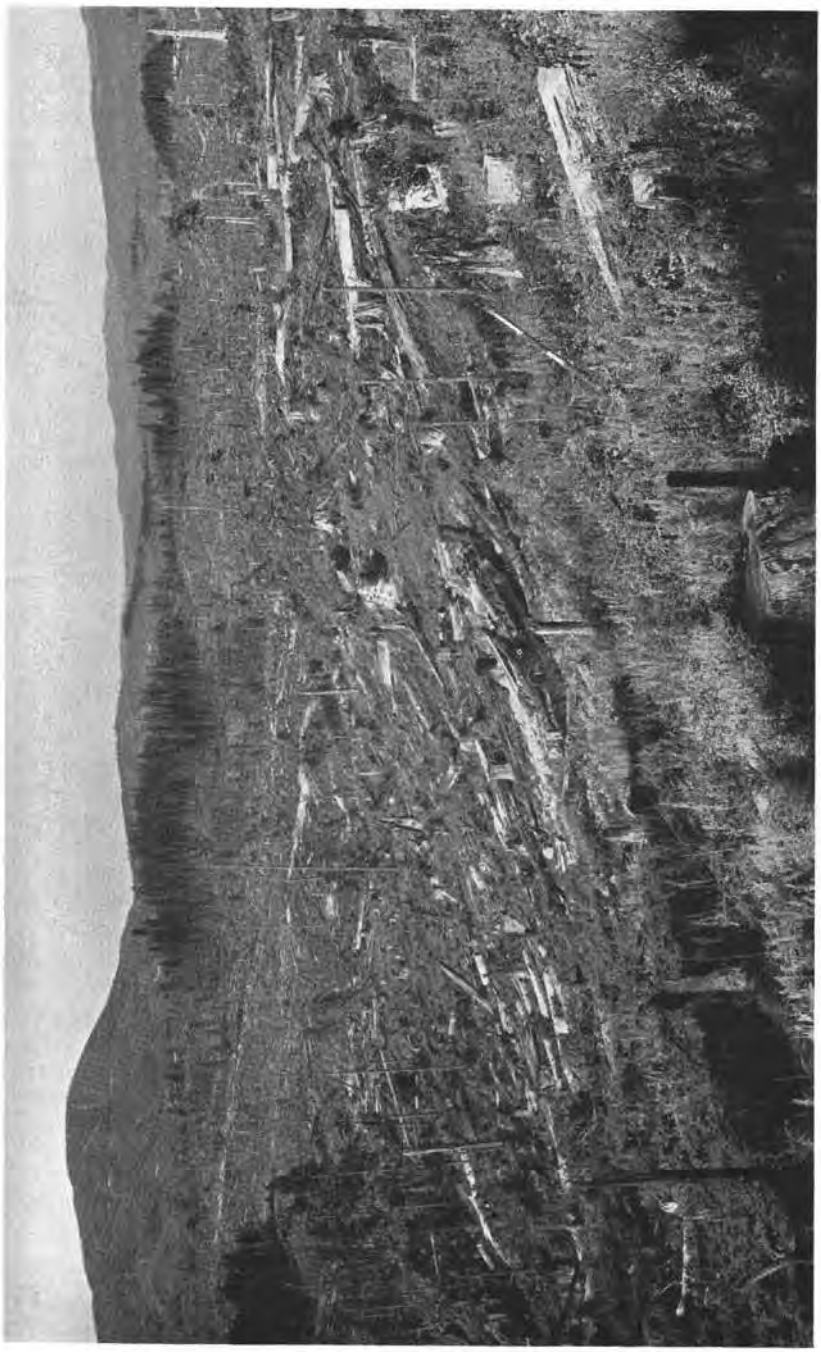

Groups of Seed Trees Left After a Clear Cut Logging Operation in Western Washington.

Considerable progress has been made in reestablishing corners, blazing section lines, and posting trespass signs on State Forest Board lands.

Approximately 125 transactions, involving timber sales, mineral and grazing leases, were completed by the State Forest Board, and not less than 80 per cent of the entire receipts was transmitted to the counties in which the lands are situated.

During the year there was considerable timber trespass, for which payments have either been made in full or are in the process of collection through the courts.

There was a noticeable decrease in Christmas tree trespass on state owned lands during 1940.

State Forest Nursery and Planting

An additional seven acres was cleared during 1940, making the total nursery area 19 acres, of which five are occupied by buildings, parking area, roads, lawn, and water storage tanks, and 14 acres are in seed and transplant beds.

Spring sowing began April 6 and, after several interruptions due to rain and adverse weather, was completed June 10. A total of 1,340 beds, 4' x 12' was sown to the following species:

Douglas fir	1,201 beds
Western red cedar	100 beds
Western hemlock	10 beds
Ponderosa pine	28 beds
Redwood	1 bed

Under normal conditions, an estimated production of 4,250,000 seedlings may be expected for planting in the fall, winter and spring of 1941-42.

During the spring and fall of 1940 a total of 4,545,225 seedlings was planted on 6,854 acres of state land in Cowlitz, Grays Harbor, Lewis, Pacific, Pierce, Skagit, Snohomish, Thurston, and Wahkiakum counties by enrollees of seven CCC camps. As in previous years, most of the planting was on State Forest Board lands. The principal species planted were 2-0 Douglas fir (Pseudotsuga taxifolia), and 14,000 2-0 western red cedars (Thuja plicata). An experimental hardwood plantation of 350 black walnuts (Juglans nigra), 60 beech (Fagus americana), and 30 butternuts (Juglans cinerea) was established near Gold Bar in Snohomish county during the spring. The first summer's growth was very favorable. While these hardwoods are planted in a typical forest location, the site is better than average, being a poor site I or a good site II, and the plantation therefore should not be taken as representative of what may be expected from hardwood species under average western Washington conditions.

A ponderosa pine plantation of 6,000 3-0 seedlings was established on the Sauk River sand flat near Darrington. This is an extremely dry, sandy site with the water table only a few feet below the ground surface. Although an actual survival count has not been made on this plantation, general observation shows that a reasonably good growth was made during the current year.

Available at the nursery for experimental planting during the season of 1940-41 are 2,150 three year old hickory seedlings, which are of two species, shagbark hickory (Hicoria ovata) and pignut hickory (Hicoria glabra).

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Plot 3: An area on which slash was burned one month previous to planting seed. A very dry site on ridge. Two per cent of seed spots showed one or more thrifty seedlings.

Observation of these plots will be continued in the future for more definite results.

The current year was almost a complete failure from the standpoint of seed production. In view of the scarcity of cones and the fact that a large quantity of 1938 seed was still available in the storage cellar, no effort was made to replenish the supply.

Summary

From 1933 to 1940 inclusive the scope and activities of the State Division of Forestry have greatly increased. For instance, it now extends organized forest fire protection to some 12,000,000 acres of State and privately owned forest land, situated in 31 of the 39 counties of Washington. The field organization during fire seasons prior to 1933 consisted of approximately 150 men. During the 1940 fire season, approximately 400 wardens, patrolmen, lookouts and temporary fire guards were engaged in fire protection.

The average area burned per fire in the 10 year period preceding 1933 was 128 acres. This has been reduced during the last eight years to an average of 49.8 acres. While the number of fires set has materially increased, owing to more extensive travel by both citizens of Washington and tourists, the actual damage to timber and property has materially decreased.

Since 1933 this Division has successfully operated from 7 to 16 CCC camps allotted for the purpose of improving fire protection on State and

privately owned lands. Through the facilities of these camps, approximately 1,500 miles of road, 900 miles of trail, and 700 miles of telephone line were constructed; 32 lookout towers have been either rebuilt or newly constructed, 25 fire halls and 25 ranger cabins were built. A great many of the old telephone systems have been supplemented by radio communication. These improvements have resulted in much earlier detection and control of forest fires.

The warehouses and shops constructed during 1939 and 1940 are ample for storage and repair of all State fire fighting equipment.

The State forest nursery is a complete modern plant with an annual production capacity of approximately 6,000,000 trees.

Since 1933 this Division has acquired for the State Forest Board 465,966.79 acres of forest land which are rapidly being blocked into State forest units. These lands, upon possession by the State, are immediately put under intensive fire protection and the barren lands, which are not satisfactorily restocking by natural means, are being planted at the rate of 9,000 acres a year from stock produced at the State forest nursery. The policy of the Division is to place all Forest Board lands containing merchantable timber on a sustained yield basis, where practical, and to get idle or barren cut-over lands back into production as soon as possible.

Recommendations

1. The statute authorizing State Supervisor of Forestry to close industrial operations in or adjacent to the forests during dangerous fire weather periods should be clarified; namely, as to whether the law contemplates a complete closure of every part of a logging operation or allows continuance of grading and maintenance work during a shutdown. The operators now contend that during closures there are no available men for controlling fires which may start. Certainly, the intent of the closure law is to increase protection efficiency rather than decrease it.
2. A central board of fire control—appointed by the Governor and composed, possibly, of the state forester, a representative of private protective agencies, and a representative of the United States Forest Service —with authority to plan staff organization, determine responsibility, coordinate efforts, and provide for costs of control in case of disastrous fires, may warrant serious consideration by the legislature.
3. There should be some statutory regulation to stop the indiscriminate cutting and enormous waste of Christmas trees. Until recently, the planting of trees by both Federal and State agencies has barely kept pace with the number of Christmas trees annually shipped out of the state.
4. The loggers have received considerable criticism from public agencies for the unproductive condition in which their lands have been left. However, there is no private agency from which young trees for planting purposes may be obtained in commercial quantities, nor is the State or Federal government authorized to produce or distribute trees for reforestation to the industry. The State Division of Forestry should be authorized by legislative enactment to dispose of its surplus nursery stock at cost to private landowners for the purpose of reforestation.

Table No. 5—ORIGIN, NUMBER and CLASSIFICATION of FIRES—1940

COUNTIES	Light-ning	Incen-diary	Camp-ers	Smok-ers	Slash-ing	Logging	Brush Burning	Rail-roads	Miscel-laneous	Total
Chelan	21		2	4				3	1	31
Clallam	4	3	3	21		4	3	5	15	58
Clark	7	12	2	22			16	1	15	75
Cowlitz	14	21	3	21	1	5	15	3	6	89
Ferry	1		1	4					3	9
Grays Harbor	11	30	8	32	1	7	2	1	11	103
Island	4	3	11	6			4		2	30
Jefferson	6	1	8	7			2		6	30
King	11	10	14	81			12	20	19	167
Kitsap	1	16	8	22	1	2	8		8	66
Kittitas	29		1	9		1	3	8	11	62
Klickitat	16	8	3	18		9	4		7	65
Lewis	22	28		15	5	5	9	3	10	97
Lincoln				1						1
Mason	2	21	12	21	1		3		10	70
Okanogan	23			6		2			2	33
Pacific	8	10	4	10		9	3	3	7	54
Pend Oreille	5	2		15		1		3	8	34
Pierce	5	19	5	102		3	14	11	21	180
San Juan	1		2	9			2		9	23
Skagit	19	1	13	19		5	13	13	9	92
Skamania	3	2		11		1	4	2	1	24
Snohomish	2	6	5	52		3	18	13	34	133
Spokane	24	9	4	48			1	8	25	119
Stevens	52	6	2	43		2	6	3	30	144
Thurston	6	30	2	15	1	2	13	7	26	102
Wahkiakum	1		1	1		1	3		1	8
Whatcom	25	1	9	21		2	11	6	7	82
Yakima	9			5					5	19
TOTALS	332	239	123	641	19	64	169	113	309	2,010

Classification of Fires: Class A (¼ acre or less), 1,007; Class B (¼ acre to 10 acres), 799; Class C (over 10 acres), 194.

Table No. 6—ACREAGE BURNED OVER—1940 FIRES

COUNTIES	FOREST LAND			NOT REFORESTED			NON-FOREST LAND			
		Reproduction		Old Burn	Cutover Land					Total
	Merch-antable Timber	Cut Over	Old Burn		Slash Un-burned	Slash Burned	Pasture	Brush	Other	
Chelan	1								229	230
Clallam			4	11	8		3	4	3	33
Clark	3	74	179	4	250	85	217	204	83	1,099
Cowlitz	145	995	142	191	549	39	31	264	5	2,361
Ferry		3							2	5
Grays Harbor	1	48	2,018	413	1,723		20	32	7	4,262
Island			2				5	17		24
Jefferson		6		1	90		26			123
King	30	147	152	74	6,592	291	114	665	20	8,085
Kitsap		9	30	8			2	14		63
Kittitas	6	476		4			181	13	3	683
Klickitat	111	75	92		28	3	120	106	8	543
Lewis	8,521	2,449	7	580	3,911	622	208	252	3	16,553
Lincoln		15								15
Mason	1	205	57	6	182		4	28	2	485
Okanogan	265				59				232	556
Pacific	63		1	65	1,263	267	25	19	3	1,706
Pend Oreille		61			1		3	1		66
Pierce	14	52	6	12	1,029	101	539	956	6	2,715
San Juan			7	1	4	78	69	55	3	217
Skagit		1					13	19		33
Skamania	2	3	15	8	95	6	10	17	14	170
Snohomish			51	92	135	2	72	66	32	450
Spokane	37	735	5	15	112	10	67	155	458	1,594
Stevens	20	314	3	14	67	10	207	78	18	731
Thurston	5	63	56	238	364		397	216	4	1,343
Wahkiakum		3		4		4		12	3	26
Whatcom	140	101	40		1,423	2	7	13		1,726
Yakima			1		235		380	40	45	701
TOTALS	9,365	5,835	2,868	1,741	18,120	1,520	2,720	3,246	1,183	46,598

Table No. 7—LOSS and DAMAGE—1940 FIRES

COUNTIES	MERCHANTABLE TIMBER			LOGS	LOSS AND DAMAGE TO PROPERTY	
	Timber Killed M. B. M.	Timber Salvable M. B. M.	Timber Destroyed M. B. M.	Logs Destroyed M. B. M.	Logging Equipment	Settlers and Others
Chelan						$ 3.00
Clallam					$ 2,000.00	315.00
Clark	40	14	26		70.00	595.00
Cowlitz	26	9	17			
Ferry						
Grays Harbor	102	58	44		2,830.00	
Island						150.00
Jefferson						250.00
King				50	1,100.00	303.00
Kitsap					600.00	
Kittitas	200	190	10			890.00
Klickitat	21	13	8	40	1,260.00	375.00
Lewis	5,120	545	4,575	23,298	84,515.00	
Lincoln						
Mason	3	1	2			85.00
Okanogan	1,088		1,088		5.00	
Pacific	170	45	125	15	5,758.00	40.00
Pend Oreille					200.00	
Pierce	52	27	25	8		1,697.00
San Juan						100.00
Skagit	6		6		25.00	
Skamania				37	180.00	385.00
Snohomish						390.00
Spokane	25	15	10	8		974.00
Stevens	10	8	2	250		220.00
Thurston	110	5	105	1		529.00
Wahkiakum	2		2			20.00
Whatcom	700	595	105	2,686	27,572.00	
Yakima	1		1			
TOTALS	7,676	1,525	6,151	26,393	$126,115.00	$ 7,321.00

Total loss and damage to all classes of property—$329,019.00.

Table No. 8—BURNING PERMITS, CLASSIFICATION and ACREAGE of LAND BURNED UNDER PERMIT—ARRESTS and FINES—1940

COUNTIES	BURNING PERMITS				ARRESTS AND FINES	
	Permits	Camp Fire Permits	Protection Acres	Agriculture Acres	Number	Fines and Costs
Chelan	149	4	88	89		
Clallam	1,590	11	1,291	3,261		
Clark	1,849	47	3,433	7,037	5	$ 42.00
Cowlitz	1,636	115	18,544	4,664		
Ferry	105		266	193		
Garfield	3			121		
Grays Harbor	1,379	6	1,335	1,414	4	105.00
Island	333	8	752	614		
Jefferson	592	13	612	389	2	2.50
King	3,045	21	1,851	2,810		
Kitsap	1,628	336	3,501	972		
Kittitas	76	51	1,191	38	4	42.50
Klickitat	622	54	5,052	2,156	3	42.00
Lewis	3,223	27	17,299	11,990		
Lincoln	7		610	600		
Mason	1,237	175	8,521	814		
Okanogan	162	13	544	737		
Pacific	1,286	38	5,485	2,553		
Pend Oreille	833	102	529	2,326		
Pierce	1,484	24	4,478	2,109	1	3.50
San Juan	184	45	560	949		
Skagit	1,255	12	7,861	2,545	7	91.00
Skamania	289	14	685	538	2	15.00
Snohomish	1,744	33	6,533	3,096	6	5.00
Spokane	1,099	44	6,229	6,703	3	88.20
Stevens	2,422	280	15,310	15,109		
Thurston	1,946	4	948	3,777	1	2.50
Wahkiakum	449	1	176	973		
Walla Walla	1			15		
Whatcom	1,983	25	746	2,871	1	12.00
Yakima						
TOTALS	32,611	1,503	114,430	81,463	39	$ 451.20

Table No. 9—STATE APPROPRIATION—GENERAL FUND
December 1, 1938 to March 31, 1939

	SALARIES AND WAGES		OPERATIONS	
Balance (1937-39 Appropriation)		$29,780.74		$22,340.43
Expenditures—				
Salaries and Wages:				
Office	$ 824.76			
Wardens and patrolmen	1,763.28			
Fire protection contracts				
Operations:				
Office and travel expense			$ 120.59	
Wardens and patromen expense			900.48	
Office supplies			170.19	
Office equipment				
Telephone and telegraph			40.00	
Postage, freight and express				
Printing			177.13	
Miscellaneous			245.96	
Equipment and tools			27.93	
Improvements				
Total expenditures		2,588.04		1,682.28
Balance March 31, 1939 (Reverted)		$27,192.70		$20,658.15

Table No. 10—STATE APPROPRIATION—GENERAL FUND
April 1, 1939, to March 31, 1940

	SALARIES AND WAGES		OPERATIONS	
Appropriation (1939-41)		$150,000.00		$65,000.00
Expenditures—				
Salaries and Wages:				
Office	$11,456.96			
Wardens and patrolmen	62,328.42			
Fire protection contracts	4,000.00			
Operations:				
Office travel expense			$ 285.19	
Warden and patrolmen expense			10,616.93	
Office supplies			100.76	
Office equipment			368.66	
Telephone and telegraph			202.60	
Postage, freight and express			815.88	
Printing			816.87	
Miscellaneous			1,200.01	
Equipment and tools			17,677.88	
Improvements			480.49	
Total Expenditures		$77,785.38		$32,565.27
Balance March 31, 1940		$72,214.62		$32,434.73

Table No. 11—STATE APPROPRIATION—GENERAL FUND
April 1, 1940 to November 30, 1940

	SALARIES AND WAGES		OPERATIONS	
Balance (1939-41 Appropriation)		$72,214.62		$32,434.73
Expenditures—				
Salaries and Wages:				
Office	$ 8,561.32			
Wardens and patrolmen	26,226.27			
Fire protection contracts				
Operations:				
Office travel expense			$ 156.81	
Wardens and patrolmen expense			7,276.86	
Office supplies			141.02	
Office equipment			209.97	
Telephone and telegraph			169.01	
Postage, freight and express			6.26	
Printing			1,294.73	
Miscellaneous			631.02	
Equipment and tools			8,885.01	
Improvements			131.01	
Total expenditures		$34,787.59		$18,901.70
Balance November 30, 1940		$37,427.03		$13,533.03

Table No. 12—CLARKE-McNARY FUND

	December 1, 1938 to March 31, 1939		April 1, 1939 to March 31, 1940		April 1, 1940 to November 30, 1940	
BALANCE		$114,551.94		$261,690.80		$175,584.04
Reimbursement		158,521.00				161,021.00
Credits		487.50		6.28		520.66
Totals		$273,560.44		$261,697.08		$337,125.70
EXPENDITURES—						
Salaries and Wages:						
Office	$ 2,364.02		$ 1,980.00		$ 2,063.33	
Wardens and Patrolmen	5,156.04		45,036.94		75,489.85	
Fire fighters	34.40		10,862.83		9,516.66	
Fire protection contracts	1,476.72		6,000.00			
Operations:						
Office traveling expense	388.09		916.31		130.71	
Warden's expense	1,267.54		10,980.44		10,290.45	
Office supplies	38.16		115.70		95.01	
Telephone and telegraph	56.25		57.09		63.76	
Postage, freight and express	2.05		17.78		110.16	
Printing			27.16		19.60	
Miscellaneous	714.43		774.93		378.20	
Equipment and tools	363.29		4,893.95		6,118.50	
Improvements	8.65		1,517.00		2,374.13	
Fire fighting expense			2,932.91		663.42	
Total expenditures		11,869.64		86,113.04		107,313.78
Balance		$261,690.80		$175,584.04		$229,811.92

Table No. 13—SPECIAL ASSESSMENT FUND

	December 1, 1938 to March 31, 1939		April 1, 1939 to March 31, 1940		April 1, 1940 to November 30, 1940	
BALANCE		$ 8,322.10		$ 9,197.92		$ 1,692.17
Receipts		1,889.02		2,018.03		3,434.74
Totals		$ 10,211.12		$ 11,215.95		$ 5,126.91
EXPENDITURES—						
Salaries and Wages:						
Wardens and patrolmen	$ 611.56		$ 7,394.58		$ 3,283.21	
Fire fighting	23.33		374.37			
Operations:						
Warden's expense	370.21		1,130.42		154.47	
Equipment and tools			11.79		139.81	
Improvements	8.10		235.58			
Fire fighting expense			377.04			
Total expenditures		1,013.20		9,523.78		3,577.49
Balance		$ 9,197.92		$ 1,692.17		$ 1,549.42

Table No. 14—FOREST ASSESSMENT

	December 1, 1938 to March 31, 1939		April 1, 1939 to March 31, 1940		April 1, 1940 to November 30, 1940	
BALANCE		$117,219.78		$123,088.85		$146,044.72
Receipts		18,351.77		104,599.52		70,918.47
Totals		$135,571.55		$227,688.37		$216,963.19
EXPENDITURES—						
Salaries and Wages:						
Warden and patrolmen	$ 135.34		$ 7,208.17		$ 19,875.95	
Fire fighting			5,678.49		485.24	
Fire protection contracts	11,749.32		62,419.44		43,841.93	
Operations:						
Transfers—Clerks fund	216.56		1,419.70		255.77	
Warden's expense	338.79		1,955.79		2,072.75	
Equipment and tools	12.52		123.15		728.36	
Improvements	29.00		49.08		51.64	
Fire fighting expense			2,771.92		261.08	
Refund	1.17		7.91			
Total expenditures		12,482.70		81,643.65		67,572.72
Balance		$123,088.85		$146,044.72		$149,390.47

Table No. 15—CLERKS FUND

	December 1, 1938 to March 31, 1939		April 1, 1939 to March 31, 1940		April 1, 1940 to November 30, 1940	
BALANCE		$ 28,856.78		$ 27,683.50		$ 28,454.60
Transfers from Forest Assessment Fund		216.56		1,419.70		255.77
Totals		$ 29,073.34		$ 29,103.20		$ 28,710.37
EXPENDITURES—						
Salaries and Wages:						
Office	$ 1,387.09		$ 509.70		$ 1,158.67	
Operations:						
Office supplies	.75		42.21		177.30	
Postage and express			72.00		120.00	
Miscellaneous	2.00		13.77		8.16	
Office equipment			10.92		4.08	
Total expenditures		1,389.84		648.60		1,468.21
Balance		$ 27,683.50		$ 28,454.60		$ 27,242.16

Table No. 16—RECOVERY FUND

	December 1, 1938 to March 31, 1939		April 1, 1939 to March 31, 1940		April 1, 1940 to November 30, 1940	
BALANCE		$ 551.40		$ 63.90		$ 596.96
Receipts				775.06		1,722.41
Totals		$ 551.40		$ 838.96		$ 2,319.37
EXPENDITURES—						
Fire fighting			$ 242.00		$ 486.88	
Transfers—Clarke-McNary Fund	$ 487.50				520.66	
Total expenditures		487.50		242.00		1,007.54
Balance		$ 63.90		$ 596.96		$ 1,311.83

Table No. 17—STATEMENT SHOWING NUMBER OF ACRES OF PRIVATELY OWNED FOREST LANDS ASSESSED FOR PROTECTION COSTS

COUNTIES	1939	1940
Asotin	15,598	17,275
Chelan	147,042	236,478
Clallam	96,870	87,605
Clark	35,613	34,929
Columbia	28,794	39,561
Cowlitz	91,745	99,602
Ferry	40,192	42,227
Garfield	7,520	7,520
Grays Harbor	245,985	150,342
Island	19,323	22,184
Jefferson	70,297	87,726
King	117,877½	119,594
Kitsap	36,845½	53,339
Kittitas	253,348½	253,898
Klickitat	221,215½	240,290
Lewis	174,372	179,634
Mason	103,391	125,194
Okanogan	93,331	107,256
Pacific	98,663	89,604
Pend Oreille	142,411	112,965
Pierce	71,760	87,877
Skagit	148,587	155,883
Skamania	91,282½	90,630
Snohomish	118,533	135,410
Spokane	167,089	174,088
Stevens	390,723	422,352
Thurston	92,328	93,730
Wahkiakum	27,207	20,349
Walla Walla	7,021	6,821
Whatcom	97,661	75,125
Yakima	93,811	95,266
	3,346,436½	3,464,754

NOTE:—1940 acreage not balanced with county assessors.

Table No. 18—STATEMENT SHOWING FOREST ASSESSMENT COLLECTIONS RECEIVED FROM COUNTY TREASURERS
December 1, 1938, to March 31, 1939

COUNTIES	1930	1931	1932	1933	1934	1935	1936	1937	1938	TOTAL
Asotin	$ 1.36	$ .68	$ 2.28	$ .68	$ 3.20	$ 3.88	$ 3.84	$ 87.63	$ 29.26	$ 132.81
Chelan		57.95	15.62	10.80	15.63	20.25	53.10	796.28	146.95	1,116.58
Clallam		22.17	6.65	13.68	10.15	11.76	15.75	354.14	56.53	490.83
Clark		4.00	8.26	7.20	12.23	19.58	24.83	119.35	45.95	241.40
Columbia								58.31		58.31
Cowlitz	15.60	13.80	50.89	19.56	13.94	15.58	19.26	127.08	135.30	411.01
Ferry			8.16	7.08	5.10	10.05	20.49	78.60	69.11	198.59
Garfield					3.60	7.20	7.20	16.80	17.72	52.52
Grays Harbor	4.00	12.20	2.80	17.97	1.03	37.69	27.32	1,040.17	149.67	1,292.85
Island	12.53	10.01	8.12	7.31	5.28	7.37	6.73	31.88	43.04	132.27
Jefferson			16.44	31.08	16.11	31.74	16.37	457.08	179.61	748.43
King			132.01	31.81	24.02	46.67	38.23	586.13	176.52	1,035.39
Kitsap			2.80	1.89	.30	5.10	4.18	39.25	13.03	66.55
Kittitas		3.60	1.22	2.62	5.82	9.99	18.53	539.91	93.13	674.82
Klickitat	7.26	.30	92.49	38.53	23.78	30.95	27.94	267.38	391.75	880.38
Lewis	2.00	7.25	14.87	19.26	17.44	25.11	35.54	66.99	138.56	877.02
Mason	1.50	19.50	13.58	7.35	8.89	31.61	25.53	403.31	94.72	605.99
Okanogan	45.12	97.92	27.60	46.93	67.05	52.05	97.73	453.76	175.03	1,063.19
Pacific	23.82	27.76	58.13	36.85	29.70	53.07	37.90	390.80	147.09	805.12
Pend Oreille	6.40	6.85	27.61	11.54	21.36	38.52	44.85	427.58	171.12	755.83
Pierce	55.29	38.45	29.83	35.93	30.19	56.08	44.55	196.00	92.39	578.71
Skagit			4.23	5.70	11.59	12.25	19.80	688.34	195.99	937.90
Skamania		32.84	11.01	—15.75*	—22.14*	8.15	—1.41*	98.70	112.14	223.54
Snohomish		5.00	1.78	14.22	11.67	24.03	37.07	280.14	94.41	468.32
Spokane								417.10	451.30	868.40
Stevens	3.48	3.76	37.56	38.10	159.26	131.50	185.79	1,175.20	676.59	2,411.24
Thurston		3.00	17.14	13.50	14.70	16.31	12.78	241.73	53.70	372.86
Wahkiakum			2.80	.72		1.59	1.12	.38	19.78	26.39
Walla Walla					.80	1.60	2.40	12.16	22.25	39.21
Whatcom	11.10	12.20	13.19	6.75	4.45	30.41	36.30	505.05	32.99	652.44
Yakima	3.20	3.20	3.20	3.20	3.20	3.20	3.20	73.25	34.50	130.15
TOTALS	$ 192.66	$ 382.44	$ 610.27	$ 414.51	$ 498.35	$ 743.29	$ 866.92	$10,580.48	$ 4,060.13	$18,349.05

* NOTE—Deduction to correct County Treasurer's error in making remittance to this office.

Table No. 19—STATEMENT SHOWING FOREST ASSESSMENT COLLECTIONS RECEIVED FROM COUNTY TREASURERS
April 1, 1939, to March 31, 1940

COUNTIES	1931	1932	1933	1934	1935	1936	1937	1938	1939	TOTAL
Asotin		$ 20.80	$ 17.25	$ 17.25	$ 20.05	$ 24.81	$ 32.03	$ 245.92	$ 15.51	$ 393.62
Chelan		135.57	124.84	113.35	184.71	207.99	565.58	3,513.82	196.91	5,042.77
Clallam	$ 66.71	175.33	246.93	280.60	458.70	319.31	490.11	1,483.85	373.83	3,895.37
Clark	19.70	42.54	46.22	39.67	85.78	81.55	174.34	685.85	81.38	1,257.03
Columbia		7.20	15.30	12.80	11.20	10.40	51.92	340.34		449.16
Cowlitz	16.00	116.78	130.49	108.32	195.66	139.29	522.04	1,923.93	112.16	3,264.67
Ferry	46.17	18.60	27.33	23.85	24.25	36.06	84.14	541.47	112.95	914.82
Garfield	1.60	1.60	6.40	6.80	6.40	11.20	14.40	84.80	18.80	152.00
Grays Harbor	806.82	491.20	481.40	578.48	957.55	687.46	1,212.45	3,194.73	255.96	8,666.05
Island	60.67	18.85	24.78	33.39	52.22	49.09	85.62	308.88	64.68	698.18
Jefferson		78.06	102.38	90.64	162.85	100.12	214.62	1,120.68	250.00	2,119.35
King		292.92	272.21	307.83	501.53	372.76	614.24	2,802.83	327.18	5,491.50
Kitsap		75.08	158.01	132.14	257.94	190.68	249.32	473.11	35.67	1,571.95
Kittitas	4.35	53.37	70.26	90.26	90.91	102.49	422.22	4,388.27	135.51	5,357.64
Klickitat	172.65	69.25	151.43	116.77	139.92	218.57	495.97	3,333.33	530.01	5,227.90
Lewis	33.45	68.65	115.76	161.55	411.19	315.13	893.75	3,296.19	275.39	5,571.06
Mason	312.86	137.88	215.26	210.02	356.54	256.28	470.96	1,940.08	336.82	4,236.70
Okanogan	37.94	62.46	63.96	102.30	139.23	163.66	360.70	1,834.40	306.50	3,071.15
Pacific	205.81	133.65	159.39	142.51	218.03	169.38	403.86	2,327.98		3,760.61
Pend Oreille		99.86	120.55	132.33	154.92	212.67	324.11	2,861.17	262.68	4,168.29
Pierce	54.72	72.65	80.31	71.23	159.61	127.11	220.98	1,219.88	165.08	2,171.57
Skagit		361.01	308.24	276.66	416.76	337.05	555.39	3,159.46	16.34	5,430.91
Skamania		.65	74.58	12.64	34.21	34.33	178.51	1,665.19		2,000.11
Snohomish	259.41	72.78	184.90	195.40	307.65	280.96	484.36	1,823.15	34.74	3,643.35
Spokane								4,092.01	508.52	4,600.53
Stevens		223.33	293.49	398.45	581.74	649.24	1,345.69	7,560.18	846.00	11,898.12
Thurston		111.96	83.90	102.54	168.23	132.49	250.34	2,019.93	204.67	3,074.06
Wahkiakum	163.65	68.67	67.17	70.33	98.65	68.84	111.25	323.51	71.86	1,043.93
Walla Walla	3.60	3.60	3.60	5.80	7.40	11.80	34.24	78.92	20.40	169.36
Whatcom	544.80	112.63	113.54	104.43	151.38	133.58	491.73	1,661.18	84.11	3,397.38
Yakima			6.40	6.40	6.40	6.70	122.78	1,711.70		1,860.38
TOTALS	$ 2,810.91	$ 3,126.93	$ 3,766.28	$ 3,944.74	$ 6,361.61	$ 5,451.00	$11,477.65	$62,016.74	$ 5,643.66	$104,599.52

Table No. 20—STATEMENT SHOWING FOREST ASSESSMENT COLLECTIONS RECEIVED FROM COUNTY TREASURERS
April 1, 1940, to November 30, 1940

COUNTIES	20 1931	1932	1933	1934	1935	1936	1937	1938	1939	TOTAL
Asotin			$ 4.24	$ 4.64	$ 4.64	$ 4.64	$ 2.24	$ 8.34	$ 217.43	$ 246.17
Chelan			67.58	26.38	28.15	42.04	74.25	111.26	2,711.21	3,060.87
Clallam		$ .25	17.33	4.00	40.84	28.50	86.66	183.58	1,302.19	1,663.35
Clark	$ 7.50	2.60	14.48	9.11	11.67	5.64	13.71	63.67	719.60	847.98
Columbia				18.50	29.78	16.98	34.40	50.97	400.94	551.57
Cowlitz	27.70	37.47	123.79	93.02	75.45	24.21	61.83	148.76	2,252.71	2,844.94
Ferry			42.30	16.68	15.60	19.20	35.14	73.93	367.07	569.92
Garfield				1.30	2.60	2.60	2.60	1.60	41.92	52.62
Grays Harbor		7.18	23.00	18.82	44.54	80.71	109.02	148.10	3,286.23	3,717.60
Island	47.06	47.74	27.19	17.98	26.30	29.74	36.86	30.32	313.12	576.31
Jefferson		8.91	18.72	6.27	31.01	22.28	33.43	281.17	1,392.89	1,794.68
King		49.36	66.36	17.74	27.16	30.07	79.23	138.92	2,635.92	3,044.76
Kitsap		20.12	31.20	10.95	12.07	16.20	123.00	136.71	579.55	929.80
Kittitas		2.66	24.72	18.41	18.27	7.09	16.76	323.00	3,947.03	4,357.94
Klickitat	61.41	67.85	145.80	84.61	82.53	91.65	30.15	281.20	2,606.41	3,551.61
Lewis	40.35	38.92	74.73	40.69	61.57	65.31	135.62	242.19	3,489.97	4,189.35
Mason	290.02	38.26	213.03	130.28	76.16	59.30	173.94	205.20	2,124.74	3,310.93
Okanogan	70.40		31.71	23.79	39.51	97.69	163.53	183.96	1,297.63	1,908.22
Pacific			16.94	23.51	30.40	27.04	139.73	99.09	2,764.92	3,101.63
Pend Oreille			65.91	50.34	86.97	92.85	114.97	163.46	2,361.42	2,935.92
Pierce	61.74	47.60	18.37	18.35	38.07	38.81	83.34	169.21	1,228.79	1,704.28
Skagit			19.83	6.48	23.03	18.42	44.41	173.65	3,461.23	3,747.05
Skamania			9.14	14.50	23.81	14.66	80.00	115.73	2,079.93	2,337.77
Snohomish		28.22	19.44	19.54	40.47	30.09	48.63	138.72	1,927.13	2,252.24
Spokane								570.26	2,469.12	3,039.38
Stevens		86.79	181.07	100.98	108.45	198.24	404.91	727.23	5,850.12	7,657.79
Thurston		4.20	55.03	16.43	45.74	56.42	102.78	165.76	2,030.38	2,476.74
Wahkiakum			38.82	1.88	4.19	2.23	6.52	12.55	339.46	405.65
Walla Walla	.80	.40	.40	.40	.40	1.60	5.60	6.94	64.05	80.59
Whatcom			7.25	52.39	90.16	67.49	99.30	168.72	1,840.03	2,325.34
Yakima	3.30	1.70	1.60	9.50	3.15	13.00	17.25	92.10	1,493.87	1,635.47
TOTALS	$ 610.28	$ 490.23	$ 1,359.98	$ 857.47	$ 1,122.69	$ 1,204.70	$ 2,459.81	$ 5,216.30	$57,597.01	$70,918.47

DIVISION OF MINES AND MINING

THOMAS B. HILL
Supervisor

SUMMARY OF MINERAL INFORMATION

The present widespread interest in the mineral resources of Washington had its beginning in 1933 when the Director of the Department of Conservation and Devlopment devoted a substantial part of an allocation of $80,000 from Washington Emergency Relief Administration to mineral investigations. Two years later, the Division of Mines and Mining was created, and has continued the investigations, the work of compiling information and promoting the development of the mineral resources.

Extensive information had been developed on the mineral resources of the State in the previous twenty-five years, largely through the Washington Geological Survey and the Division of Geology. This information had been published in some 50 or more bulletins and reports, about half of which are now out of print. The information, while extensive, was scattered and in many instances fragmentary.

The result of the work begun by the Department in 1933, and continued by this Division since 1935, is that now information is available on all the known mineral occurrences of the State. These include some 28 metallics and 44 nonmetallics. Much information on the location, extent and quality of these deposits has been developed. The pressing need now is for extensive field investigations to determine extent and character of the mineral materials, their commercial importance, their accessibility, and the particular problems of mining and metallurgy that may be involved. While there may be some discoveries of new deposits it is believed that the largest development in the future will result from detailed explorations of already known deposits.

In the past eight years work has been carried on constantly in compiling information on known metallic and nonmetallic mining properties, the Division of Geology having compiled the latter. The Division of Mines and Mining now has lists, practically complete, of metallic properties, showing locations, predominant values, status as to development, ownership where known, whether there has been production, and such other information as could be obtained. Investigations and checking in the field will provide Washington with as complete information on our minerals and mining properties as is available in any Western mining state.

As an important part of the information relating to mineral resources, the Division, through a WPA project, transcribed the mineral claim records, showing all the mineral claims that had been located on Federal lands and recorded in the auditors' offices in the respective counties. This showed that up to about January 1, 1937, more than 125,000 claims had been located in Washington. So far as known, Washington is the only state in which such record has been compiled.

In addition plats showing all claims that have been patented, or surveyed

for patent, have been transcribed from records in the office of the public surveyor.

In connection with the national defense program, and for use in relation to industrial development, a compilation of all known information on deposits of strategic minerals of the State was made, and there was also compiled a summary of information on iron ores of the State.

The general information on the mineral resources of the State has been compiled and is available, but it should be checked for accuracy, and additional information developed as rapidily as possible. Then the material should be put in form for the widest practical use and published for general distribution.

GREAT INCREASE IN MINERAL PRODUCTION

The rapid increase in mineral production in the State of Washington since 1935 has been almost spectacular, and yet there has been nothing in the nature of a boom in connection with it. The production of gold, silver, copper, lead, and zinc in 1940, was more than eighteen times the amount produced in 1935, while the total mineral production of the State in 1940 was about two and a half times the production five years earlier.

While comparison of production of metallics with 1935 may not be fair because that was a low year, the average production prior to 1935 was well under one million dollars, annually, less than one-seventh of the 1940 output.

The new high in the production of mineral wealth in the State of Washington established in 1940, shows an estimated output of $34,462,017, as compared with $34,162,000 in 1939, an increase of $300,017.

An all-time high was established in 1940 in the production of gold, silver, copper, lead, and zinc, which reached the impressive total of $7,193,391, as compared with $6,739,467 for 1939, or an increase over the previous year of $453,924.

There has been a consistent substantial increase in production in these five metals in the last six years, as follows, the production in 1940 having been $6,799,350 greater than in 1935:

1935	$394,041
1936	1,015,771
1937	2,253,054
1938	5,510,440
1939	6,739,467
1940	7,193,391

It is interesting to know that since the first recovery of a mineral in Washington in 1853, until 1936, a period of 83 years, the production of these five metals exceeded one million dollars in only 9 years, as follows:

1911	$1,056,017
1912	1,120,214
1913	1,053,135
1916	2,048,350
1917	2,289,285
1918	1,467,421
1920	1,200,982
1923	1,065,666
1925	1,092,464

In the table of production figures for 1939 and 1940, those for 1940, except gold, silver, copper, lead, and zinc, are estimated on the basis of 1939 produc-

tion. The production of coal was slightly less than the previous year. It is confidently believed that the figures for cement, sand, gravel, and stone will be greater for 1940 than for 1939, because of the immense amount of concrete poured in the construction of Coulee Dam, and the exceptional construction activities in the latter part of 1940 incident to the national defense program.

Imports of magnesite were cut off from Europe in 1939 and its use as a refractory has increased. This will enlarge the figures for magnesite in 1940 which in turn should increase the iron production where this product is used as a flux.

The rise in price of tungsten concentrates from $17.11 per unit in 1939 to a little above $23 per unit in 1940, should raise the yearly total of this substance. Although not large, the mercury production will be somewhat above 1939. Advance information indicates that the mining of diatomite was greater in 1940.

Of course some of the products will show a decrease but it will not be great. Probably the only decrease of consequence will be in coal production. An advance estimate from the State Coal Inspector shows a decrease of some 50,000 tons.

1940 MINERAL PRODUCTION IN WASHINGTON

PRODUCT	Quantity	Value
Gold, ounces	84,605	$2,963,275
Silver, ounces	365,670	260,032
Copper, pounds	18,858,000	2,130,954
Lead, pounds	5,658,000	282,900
Zinc, pounds	23,942,000	1,556,230
Coal, tons	1,675,592	5,220,058
Iron, tons	10,757	44,188
Manganese, tons	100	2,500
Molybdenum (concentrates) tons	10	9,000
Tungsten (concentrates) tons	221	125,412
Mercury	①	①
Antimony	①	①
Coke, tons	14,993	74,965②
Briquets, tons	19,086	114,516②
Peat	①	①
Petroleum	①	①
Natural Gas, cubic feet	67,000,000	53,563
Carbon Dioxide, Gas	①	.....
Cement, barrels	5,974,458	8,782,453
Stone, tons	3,875,656	3,122,370
Sand and gravel, tons	11,918,217	6,048,619
Lime, tons	47,458	484,667
Fire Clay	20,356	47,734
Miscellaneous Clay, tons	8,272	5,744
Clay Products	①	①
Magnesite, tons	①	①
Diatomite, short tons	①	①
Pulpstones and Grindstones	①	①
Talc and Soapstone	190	1,225
Gem Stones	①	①
Mineral Waters	①	①
Miscellaneous (estimated)	.....	3,250,000
Total	.....	$34,580,405

① Included in Miscellaneous.
② Not included in State Total.

MINERALIZATION

In considering present mineral production and potentialities for future development, one should have in mind the metallic mineralized areas of the State.

These areas of the State exist principally in the northern tier of counties that comprise Pend Oreille, Stevens, Ferry, Okanogan, and Whatcom and southward in the Cascade Range to include portions of Snohomish, Skagit, Chelan, King, Kittitas, Pierce, Yakima, Lewis, and Skamania Counties. In addition are parts of Clallam, Jefferson, Mason, and Grays Harbor Counties on the Olympic Peninsula. To include the substantial nonmetallic occurrences would be to mention every county in the State.

The valuable minerals are found in a variety of rocks. Such crustal materials as limestone, argillite, quartzite, schist, gneiss and volcanics mainly of Paleozoic age are widespread.

Throughout the area large masses of granitic rock occur and with the exception of a few cases where the minerals are related to younger volcanic rocks these granites are the source of the commercial ores.

The earliest producing mines were in northeastern Washington. The extensive belt of limy rocks in Stevens and Pend Oreille Counties was found to be a good host for the minerals of lead, silver, and zinc. The Cleveland, Old Dominion, Electric Point, Pend Oreille Mines & Metals, and Metaline Mining and Leasing, have been consistent producers. Many copper claims were located and Stevens County has long produced copper, notably near Chewelah. Tungsten is mined at a number of places in Stevens County. The Deer Trail Monitor mine near Fruitland is a consistent producer of molybdenum. The largest deposits of magnesite on the continent occur near Chewelah.

In the northern part of Stevens and Ferry Counties gold was discovered in a belt of volcanic rocks by the early prospectors. Production from this area reached its record output in 1939, due principally to the Republic Camp. Gold is by no means the only metal of commercial value in Ferry County. Copper is important and accompanied by lead, silver, and zinc. Many of the relatively low-grade prospects and mines opened in the past that have been abandoned will again be active where the costs of operating are today reduced and prices are more favorable. This is particularly true in the Keller and Danville districts.

In Okanogan County gold and silver are prominent. The Oroville-Nighthawk and Meyers Creek districts account for much of the State's gold production. The Nespelem and Ruby-Conconully districts have substantial silver production records, particularly from the Arlington, Mineral Hill, and Apache mines.

Gold is the principal metal occurring in the upper Methow Valley to the east of the range, proved by such mines as the American Flag, Mazama Queen and others.

The Cascade mountain range was one of the areas in the State that was prospected at an early date but because of the extreme ruggedness of the terrain it was not until recent years that production began.

Ore deposits of various kinds occur the length of the Cascades in Washington. The minerals have been deposited at various times in both the intruded crustal materials and the igneous rocks.

In the extreme northern and central portions of the range the most sought-for metals are gold and silver. Early prospecting revealed gold and silver-bearing quartz veins cutting conglomerate, sandstone and shale, in the upper reaches of Canyon Creek in what is now known as the Slate Creek district. Exposures show that the veins also traverse the underlying granite. Mines representative of the district are Azurite, New Light, Baltimore, Chancellor, and many others that under favorable conditions have produced.

From the Slate Creek area west to Mt. Baker in Whatcom County other metals besides gold and silver are found which include copper, lead, molybdenite, and chromite. Gold and silver are recovered in such mines as Boundary Red Mountain, Lone Jack, and Great Excelsior; copper and lead have been prospected along the Skagit River, molybdenum near Baker River and Silver Creek and chromite occurs many places in the Sisters Mountains.

South of the Slate and Canyon Creek portions of the Cascades gold, silver, copper, and lead are important. On the west flank of the mountains the Thunder Creek and Cascade River areas in Skagit County have long been known to contain veins in which these minerals are found and many claims are patented.

On the east side similar deposits are exposed in Horseshoe Basin and the upper Stehekin drainage in Chelan County. At Gilbert near Twisp Pass in Okanogan County mineralization of the country rock is important. Patches of schist, gneiss and less altered sediments that are a part of the rocks forming this portion of the Cascades have been excellent hosts for the mineralizing solutions that were squeezed upward from the earth's interior. In this respect the soft schists and sheared gneisses are found to be especially good hosts as demonstrated by such occurrences near Twisp Pass and in the Stehekin drainage. The geologist and mining engineer term these included patches or masses of altered sedimentary rock in the granite "roof pendants" and no better examples of these rocks may be given than those that carry an abundance of ore minerals at the Howe Sound and Royal Development mines south of the Stehekin district.

South of the Cascade River area and west of the Cascade crest prospecting has shown copper and molybdenum to be in evidence and in at least one case these minerals are in considerable quantities. This reference is made to the Glacier Park mine in Snohomish County. Gold, silver, lead, and enough arsenic to be of commercial importance have been recovered southeast of Glacier Peak in the vicinity of Monte Cristo. Just south of Monte Cristo near the town of Index veins containing an abundance of copper-bearing minerals have long been exploited.

The rocks of eastern King County and western Kittitas County have been favorable to ore deposition as demonstrated by the deposits along Foss and Miller Rivers and Money Creek in King County and the upper Cle Elum River and Gold Creek regions in Kittitas County. Gold, silver, copper, and lead are the metals recovered. Some chromite has been produced in northern Kittitas County. The Swauk Creek drainage near Liberty contains important gold placer deposits and a dredge is at present recovering gold from the gravels. Near Snoqualmie Pass deposits of magnetite are a possible source of iron. Within the past two years extensive deposits of alunite have been exposed along the White River in King and Pierce Counties.

North of Chinook Pass igneous intrusions into the volcanic rocks have deposited gold-bearing veins. The same igneous rocks have caused to be

formed veins carrying tungsten, copper, molybdenum, silver, and zinc in the vicinity of Bumping Lake. North of Mt. St. Helens similar veins occur carrying copper, lead, and zinc.

The principal quicksilver deposits in Washington have been worked near Morton, Lewis County, and recently a promising prospect has been reported as occurring in the Tieton district, Yakima County.

MINING OUTLOOK ENCOURAGING

The production of mineral wealth in Washington should remain above $25,000,000 annually, with many conditions favorable for steady expansion to an annual output of $50,000,000 or more. There is opportunity for a substantial increase in gold and silver production. Reserves of copper, lead, and zinc are sufficient to provide large production over many years if there is a continued market at profitable prices.

However, the big increase in mineral wealth can well come from sources which as yet have produced little. Increased interest in mining, availability of abundant cheap power, the growing need for certain metals in industry and for national defense, and solution of problems of recovery may all combine to bring about production two to three times as great as it was in the record year of 1940.

The great deposits of iron, chromite, manganese, magnesite, and alunite are sufficient to maintain a highly productive industry for many years. The recovery of magnesium and manganese metals and their use in the iron, steel and alloy industries, the use of iron in an expanding iron and steel industry in this State, and for alloys, might easily double and treble the production of wealth from minerals in Washington. Many problems must be worked out in connection with the establishment of these industries, much capital will be required, and markets to absorb the output developed. This will take time, patience and the fullest cooperation of all interests involved. Steady progress should be the aim, rather than an effort at sudden expansion. This sort of progress is indicated.

ACTIVITIES OF THE DIVISION

The Division of Mines and Mining in the biennium ending December 31, 1940, has carried out its functions as follows:

Continued collection and compilation of information on the mineral resources and mining industry of the State.

Compiled a complete Directory of Washington Metallic Mining Properties.

Continued special investigations through a WPA project of manganese deposits on the Olympic Peninsula, chromite area in Twin Sisters Mountains in Whatcom County, iron ore in Skagit County, and alunite deposits in King County.

Published an Outline of Mining Laws, a Preliminary Report on Strategic Metals, Summary of Information on Iron Ore Deposits, and Summary of Investigations on Manganese Deposits in the State.

Established special field service.

Established a laboratory for identification of minerals and rocks.

Collected and compiled figures on production of metallic and nonmetallic minerals in the State.

Cooperated in administration of new mines-to-market road law, under which three mines-to-market roads have been constructed.

Issued report on mineralization of Cascades for study conducted by State Planning Council in connection with reported proposal for creation of a national park in the Cascade Mountains.

Gave service to more than two thousand visitors to the office, practically all of whom were seeking information or advice on mineral resources and the mining industry.

FIELD AND LABORATORY SERVICE

Two important services were inaugurated by the Division of Mines in the biennium—a field service, and a laboratory for the identification of mineral materials.

For the field service, Mr. J. W. Melrose was transferred from the Division of Geology where he had been engaged in obtaining information on the geology and mineralization of Washington mines. After becoming a member of the staff of the Division of Mines and Mining fully one half of his time was spent in the field examining various mineral occurrences, obtaining or checking information on mining properties, consulting with and advising prospectors and miners, and having general supervision of mineral investigations under the WPA project.

This type of field service is one of the most important functions of the Division of Mines and Mining. It should be expanded as rapidly as funds can be provided.

The other service inaugurated was the identification of mineral materials in a small laboratory which was established in connection with the Division after occupying the new quarters in the Transportation Building. This laboratory was equipped at a cost of less than $40 and is proving of great importance. The purpose of the laboratory is two-fold: To identify samples of minerals without cost for any citizen, and to test mineral materials for our own information.

Any citizen of the State may send or bring in rocks or minerals. They will be identified and their character determined. The examination will disclose whether there are values that may be of commercial importance. The person sending the sample is advised of the result of the examination, and if values are indicated is informed as to what they are and whether an assay is desirable. This service has proved popular. The laboratory was established about July 1. The first samples were examined on July 8. In the following six months, until the first of the year, over three hundred determinations were made.

The practical value of this service to prospectors is great. A prospector finds a material which he believes has value but he does not know what to have it examined for, nor where to send it for assay, nor what the cost may be. If he sends it or brings it to the Division of Mines laboratory he is told what the material is, whether it has commercial importance, what values it should be assayed for, and such other advice as may be helpful to him.

In addition to the work that has been done on samples sent in by citizens much work has been done on samples in connection with the regular work of the Division.

MINES-TO-MARKET ROADS

The Division, from its creation in 1935, has consistently advocated the adoption of means to construct roads that would open mineralized areas to permit development and successful operation of mines. Such means were provided by the Mines-to-Market Road Law enacted by the Legislature in 1939, which carried an appropriation of $100,000. Under this law, roads to serve mineralized areas are initiated by petition and must be reported on favorably by this Division as to mineralization, and by the Department of Highways, as to feasibility and cost. It is required that the county in which the proposed road is located shall bear one half the cost.

Fifteen petitions or informal requests were submitted to the Mines-to-Market Road Commission. In three instances the counties involved submitted resolutions agreeing to bear one half of the cost, and other conditions having been found favorable, the roads were authorized and constructed. These roads were as follows:

King County—A road up Money Creek from Berlin Station on the Great Northern for a distance of eight miles to serve a highly mineralized area, including one developed mine. The cost of this road was about $59,000. As a result it is expected there will be substantial production from the developing mine and extensive activity in connection with other properties made accessible by this road.

Chelan County—A road up the Stehekin River from Bridge Creek into Horseshoe Basin to open a highly mineralized area where active development work was attempted many years ago, but could not be continued because of lack of transportation facilities. The cost of this road was about $25,000, and its construction has resulted in intensive activity in exploration and investigations.

Okanogan County—A road southwest of Twisp toward Lookout Pass to open a large area, where the values appear to be chiefly in gold. This road cost about $10,000. As a result one mine continued to operate to capacity, giving employment to about forty men, and producing in the neighborhood of a quarter-million dollars. In addition, there has been activity in explorations in the area, and in plans for development of other properties.

This Division and the mining industry which it represents are pleased with the successful inauguration of a mines-to-market road program. Its feasibility and usefulness have been demonstrated. Somewhat larger appropriations should be provided so that some very necessary roads may be constructed to facilitate development of many promising mining properties, particularly where the minerals are essential for national defense and for industry.

PUBLICATIONS

During the past year six publications have been issued by the Division of Mines and Mining. One of the bulletins was printed but because of lack of funds only a limited number of mimeographed copies of the other five were made. The Directory of Washington Metallic Mining Properties was first published, followed by a Preliminary Report on Strategic Metals, Summary Report on the Iron Ores, Outline of Mining Laws of Washington, Report on Olympic Peninsula Manganese, and Preliminary Report on the Alunite Deposits near Enumclaw.

DIRECTORY OF MINES

The Directory of Washington Metallic Mining Properties lists alphabetically the properties, the county and district in which they are located, their product and the legal description of the property. In addition to this information is included the owner or lessee and if the mine is active or idle and if it has a production record. Detailed information on more than a thousand mines are thus listed.

The information was gathered in the field, from office records and from many publications that included federal and state bulletins and mining magazines.

STRATEGIC MINERALS

Because of the urgent need for strategic minerals it was thought desirable to publish a bulletin listing the occurrences of such minerals in Washington. The minerals include those of aluminum, antimony, chromium, manganese, nickel, mercury, and tungsten. Substantial amounts of strategic metals are found in the State. Some are being produced now which include manganese on the Olympic Peninsula, mercury near Morton and tungsten in Stevens County. Development is progressing on aluminum (alunite deposits) in King and Pierce Counties, antimony in Okanogan County, chromium in Whatcom County and nickel near Mt. Vernon, Skagit County. Possibly the report on strategic mineral occurrences or the Directory of Metallic Mines will call to the attention of operators some of the now dormant mines in which strategic minerals occur that may be mined profitably as a result of increased prices.

IRON ORE DEPOSITS

During the past year considerable interest has been created in the possibility of the erection of a furnace for reduction of iron ore in the Northwest. Several publications by various agencies have described the iron ore localities in Washington. These publications are now out of print and as a result of many inquiries received regarding existing deposits the Summary of Information on Iron Ore Deposits of Washington was compiled. Besides drawing freely from old publications, other sources of information were from examinations in the field and office records.

OUTLINE OF MINING LAWS

In the previous biennium a Summary of the Federal and State Mining Laws was published in order to meet a popular demand for information relative to the mining laws. However, it was found that this summary was not sufficient and as a result Mr. M. H. Van Nuys of the Seattle Bar was called upon to prepare An Outline of Mining Laws of the State of Washington. The outline is intended for practical use by prospectors and mining men in general. It explains in simple language how to locate a claim properly, what the general rights and duties are between co-owners of a claim and in general to cover those matters to which the usual popular inquiries are directed.

MANGANESE OCCURRENCES

The Summary of Reports by WPA Mineral Investigations Project is a compilation of information gathered from the several localities where manganese

investigations were carried on. Each supervisor prepared a written report for the sponsor at the close of each project but rather than issue individual publications a summary of the results of all projects was prepared. In addition to the information gathered by each supervisor data were obtained from other sources and acknowledged in a bibliography accompanying the summary.

ALUNITE OCCURRENCES

A preliminary report on the alunite occurrences near Enumclaw has been prepared describing these little-known deposits. The report includes a brief description of the rocks in which the alunite occurs and the minerals with which it is associated. In general it tells just how the alunite is found in the field. The Kalunite Company very kindly provided valuable information such as drill logs, analyses, etc., which helped greatly in making the report. It is hoped that this report will aid in future prospecting.

WPA PROJECT INVESTIGATIONS

The WPA Mineral Investigations Project, sponsored by the Department of Conservation and Development for obtaining information on occurrences of certain strategic and critical minerals (particularly manganese and chromite deposits), was continued throughout the biennium. It was operated in Clallam and Jefferson, Grays Harbor, Thurston, King, Whatcom and Skagit Counties. The principal co-operating agencies were the county commissioners of the counties involved, the Department of Social Security, the University of Washington and the State Highway Department. The County Commissioners provided facilities to transport laborers, or furnished the oil and gas for the WPA truck. The Department of Social Security provided for the salaries of supervisors, chemist, etc., from a special fund that had been appropriated for co-operation with WPA projects. The University of Washington provided laboratory space and equipment, and the Department of Highways provided some blacksmith coal for sharpening steel used in the manganese investigations in Clallam County. Grateful acknowledgment is made for the co-operation and assistance received from Colleges of Mines of the University and State College of Washington, from United States Bureau of Mines and United States Geological Survey, and others who helped to make the work of the project successful.

MANGANESE

The project was set up primarily to investigate manganese occurrences on the Olympic Peninsula to determine whether the deposits were extensive and of commercial quality. As no widespread investigation has been made it was the general impression that the manganese ores of the Olympics were limited in extent and not of commercial grade. The investigations under this project were begun in January, 1937, and carried through to November, 1940.

The public lands examined were in Grays Harbor County southeast of Lake Quinault and in Clallam County west of Lake Crescent. Excellent results were obtained in each county and many new lenses of manganese ore were uncovered and analyzed.

In undertaking the investigations it was desired to determine the extent and quality of the ores in the manganese zone that existed on public lands.

It was recognized that in addition information obtained from other sources would be desirable and so descriptions of occurrences on private lands were obtained and included in the final reports.

IRON

The survey for iron occurrences on the State forest lands in Thurston and Grays Harbor Counties, begun in 1938, was concluded in this biennium. The result of this survey indicated that there are no deposits of iron ore of consequence within the boundaries of the State forest.

During the late summer and fall of 1940 a project was carried on in Skagit County near the town of Lyman for the purpose of outlining a deposit of iron ore on public land between two patented claims. The exploration was confined to a small area in the N½ Sec. 30, T. 35 N., R. 7 E. Forty-one trenches extending over a horizontal distance of about 1000 feet exposed the ore. The bed of iron ore averaged nearly seven feet in thickness.

The results of this investigation in addition to the ore already exposed on the patented claims indicated that a substantial amount of iron ore exists at this locality.

ALUNITE

Over a year ago several outcrops of the mineral alunite, a hydrous sulphate of potassium and aluminum, were reported about eight miles east of Enumclaw. A short time later the Kalunite Company became interested in the deposits and began a development program. This company had heretofore been active in the alunite deposits at Marysvale, Utah, and was developing a process to recover metallic aluminum from the mineral.

The units of the Mineral Investigations Project carried on investigations on state lands within the area in which the alunite occurred and continued operations until December 31, 1940. It was the desire of the project to uncover, if possible, sufficient quantities of the material to encourage the erection of a reduction plant to be located in this State. A plant of this kind would necessarily mean the investment of a large amount of capital and the employment of many men.

By applying the knowledge acquired as a result of studies made on exposed deposits it was possible to place the crews in positions where alunite was likely to be found. In some instances the material uncovered proved to be of no value but in many of the trenches and pits good alunite was exposed by the crew. The work was confined to exposing the surface of the alunite so no estimates of tonnage could be made. However, it is probable that several hundred thousand tons will be available, which, supplementing known deposits on private lands may provide a sufficient tonnage to support a large reduction plant.

CHROMITE

In the Twin Sisters Mountains in Whatcom County chromite occurs in a rock classified as dunite. In this area the chromite is only associated with this particular rock type. In order to define the boundaries of exposed dunite and therefore indicating an area where chromite might be found a project was undertaken in the fall of 1938 and later continued throughout the field season in 1939. As a result of this survey the area boundaries of the dunite have been mapped and a report made on the extent of this material. Dunite is valuable as a refractory in addition to being the host rock of chromite.

DIRECTORY WASHINGTON METALLIC MINING PROPERTIES

This directory of the metallic mining properties of Washington, arranged by counties, is the result of exhaustive research and is as complete and accurate as it has been possible to make it. Out of approximately 130,000 mineral locations on public and private lands only those are included upon which there has been appreciable development work.

The properties which are now in active development or on which development has been performed recently are indicated by a circle ①. Those that have produced at some time in the past are indicated by a circle ②. Those that are now producing or have produced recently are indicated by a circle ③. These indications and the names of owners and addresses are listed in accordance with the latest information obtainable. The products represented are as they have been reported.

The properties are located by county, district and legal description. Because the boundaries of some of the districts are indefinite we have arbitrarily included nearby properties. In some instances we have estimated the legal description from the geographical description. In these instances the locations are approximately correct.

Coal, oil, gas, placer and nonmetallic properties are not included. A directory of these will be compiled separately.

All additional available information, including sources from which obtained, is on file in the Division of Mines and Mining.

Metallic values are indicated as follows:

antimony	—Sb	gold	—Au	molybdenum	—Mo
arsenic	—As	iron	—Fe	nickel	—Ni
chromium	—Cr	lead	—Pb	silver	—Ag
cobalt	—Co	magnesium	—Mg	tin	—Sn
copper	—Cu	manganese	—Mn	tungsten	—W
		mercury	—Hg	zinc	—Zn

① Recent Development
② Past Producer
③ Recent Producer

CHELAN

Name	*District Location*	*Product*
②Alta Vista	Blewett S2-T22-R17E	Au
April Fool	Blewett S1-T22-R17E	Au Ag
②Aurora (now Paramount Mines, Inc.)		
③Black Jack	Blewett S1-T22-R17E	Au
Black Warrior	Stehekin S32-T35-R14E	Au Ag Cu
③Black & White P. C. Pangborn, Lessee, Wenatchee, Wash.	Blewett S1-T22-R17E	Au Ag
③Blewett J. B. Woodworth, 3857 Point Grey Road, Vancouver, B. C., Canada	Blewett S1, 2-T22-R17E	Au Ag
②Blinn	Blewett S2-T22-R17E	Au Ag
②Blue Bell (I. X. L.)	Blewett	Au Ag
②Bobtail	Blewett S34-T22-R17E	Au
Bryan	Chiwawa S9-T30-R16E	Au Cu Ag
Butte	Stehekin	Cu Au Ag

CHELAN—*Continued*

Name	*District Location*	*Product*
Caledonia	Blewett S1-T22-R17E	Au Ag
Champion	Chiwawa S10-T29-R16E	Au
③Chelan Division, Howe Sound Co. (see Howe Sound Co.)		
②Crown Point	Chelan S15-T31-R16E	Mo
②Culver	Blewett S2-T22-R17E	Au Ag
Davenport	Horseshoe Basin... S29-T35-R14E	Pb Cu Ag Au
Donaldson	Blewett S1-T22-R17E	Au Ag
Doubtful	Stehekin S31-T35-R14E	Au Ag Pb
②Eureka	Blewett	Au
②Fraction	Blewett S2-T22-R17E	Au
Gem	Blewett S11-T22-R17E	Au Ag
②Golden Eagle	Blewett	Au
②Golden Guinea	Blewett	Au Ag
③Golden King Mining & Development Co..... (Squillchuck) J. J. Keegan, Wenatchee, Wash.	Wenatchee S22-T22-R20E	Au Ag
③Holden (now Chelan Division, Howe Sound Co.)		
②Homestake	Blewett	Au
③Howe Sound Co., Chelan Division (Holden).... John J. Curzon, General Manager, Holden, Wash.	Chelan S18, 19-T31-R17E S12, 13-T31-R16E	Au Cu Ag
②Humming Bird	Blewett	Au Ag
Idaho	Chelan S36-T32-R18E	Cu Ag Au
Isoletta	Stehekin S6-T34-R14E	Au Ag
②Ivanhoe	Blewett	Au Ag
Little Jap.	Meadow Creek ... S2-T31-R18E	Ag
①②Lucky Queen	Blewett S12-T22-R17E	Au Ag
②Manistee	Blewett	Au Ag
②Marion	Blewett	Au Ag
Meridian	Blewett	Au Ag Cu
Minneapolis	Stehekin S32-T35-R16E	Au Ag Cu
Monarch	Blewett	Au
Nebraska	Chelan S35-T32-R18E	Cu Au Ag
North Pole	Blewett	Au
②North Star	Blewett	Au Ag
North Star	Chelan S6-T31-R16E	Pb Ag
②Olden	Blewett	Au Pb
Olympia	Blewett	Au Ag
Ontario	Blewett	Au Cu
P. I.	Leavenworth	
Pacific Investment	Cle Elum.....	
Palmer	Leavenworth S33-T28-R18E	
②Pangborn P. C. Pangborn, Wenatchee, Wash.	Entiat	Au
②Feshastin	Blewett S12-T22-R17E	Au

CHELAN—*Continued*

Name	*District Location*	*Product*
Phoenix	Blewett	
Phyllis	Chelan S35-T32-R18E	
Pickwick	Blewett	Au Ag
②Polepick	Blewett	Au
Prospect	Blewett	Au Ag
Quin Sabe	Stehekin S31-T35-R14E	
Rainier	Blewett	Ni
Red Butte	Blewett	Ni Au
Red Cap	Chiwawa S9-T30-R16E	Cu Au Ag
②Rex	Entiat S36-T26-R20E	Au Ag
Rothert	Blewett S13-T22-R17E	Fe
③Royal Development Co. A. J. Kennedy, Trinity, Wash.	Chiwawa S21, 22-T30-R16E	Cu Au Ag
Snowflake	Blewett	Au
③Squillchuck (see Golden King Mining & Development Co.)		
Sunset	Blewett S6-T22-R18E	
Texas Jack	Horseshoe Basin	Cu Ag
Tiger	Stehekin S4-T34-R16E	Cu Au Ag
③Tip Top P. C. Pangborn, Lessee, Wenatchee, Wash.	Blewett	Au
②Union & Dominion	Blewett	Au Ag
Venus	Blewett S1-T22-R17E	Au Ag
Washington Meteor	Blewett	Au
①Washington Nickel Mining & Alloys Co. 909 American Bank Bldg., Seattle, Wash.	Blewett S24-T23-R17E S19-T23-R18E S13, 14-T22-R17E	Fe Ni Ni Ni Fe
Wilder	Blewett	Au

CLALLAM

Bright Angel Ed Fitzpatrick, Pres., Ovington, Wash.	Olympic S19-T20-R9W	Mn
②Crescent Chas. S. Anderson, et al., Port Angeles, Wash.	Olympic S23, 24-T30-R10W	Mn
Daisey Joe Orris, et al., Port Angeles, Wash.	Olympic S19-T30-R10W	Mn
Hemlock	Olympic S29-T30-R8W	Mn
Lillian	Olympic S19-T30-R10W	Mn
Madeline & Dolaris (formerly Ed. Bo.) Ed Brooks, Port Angeles, Wash.	Olympic S19-T30-R10W	Mn
State Lease	Olympic S21-T30-R12W	Mn

CLARK

Silver Star Peter Hedstrom, Sec., 1063 S. E. 31 Ave., Portland, Oregon	S14, 15, 23-T3-R4E	Au Ag Cu Zn

FERRY

Addie B.	San Poil S32-T30-R33E	Cu Pb Ag
①Addison (see Pacific Mutual Silver-Lead Co.)		
②Admiral	Republic S35-T37-R32E	Au Ag

FERRY—*Continued*

Name	*District Location*	*Product*
Advance	Covada S35-T32-R36E	Pb Ag
①Advance (see Consolidated Mines & Smelting Co.)	Republic S12, 13-T36-R32E	Au Ag
③Anecia	Republic S33-T37-R32E	Au Ag
③Aurum Mining Co. (Ben Hur, Black Tail, Insurgent, Last Chance, Little Cove, Lone Pine, Pearl, Surprise, Tom Thumb, Trade Dollar) Republic, Wash.	Republic	Au Ag
②Belcher	Belcher S9-T37-R34E	Cu Au Fe
Belcher	San Poil	Au Ag
③Ben Hur (see Aurum Mining Co.)	Republic S32-T37-R32E	Au Ag
Big Bug	Covada S35-T32-R36E	Au Ag
Big Chief	Covada S35-T32-R36E	Mo
②Big Silver Mining Co. (Longstreet)	Covada S30, 31, 26, 25-T32-R37, 36E	Ag Au Cu As
Black Hawk	Covada S26-T32-R36E	Au Ag
③Black Tail (see Aurum Mining Co.)	Republic	Au Ag
Black Thorn	Covada S27-T32-R36E	Au Ag
Blue Bird	San Poil S25-T30-R32E	Cu
Blue Bird	Covada	Au Ag
Bodie	San Poil S10-T29-R33E	Cu
Butte & Boston	Republic	Au Ag
Butterfly	Covada	Au Ag
③California Everett Hoagland, Republic, Wash.	Republic	Au Ag
California	San Poil S5-T29-R33E	Cu Ag
Campbell	San Poil S30-T29-R33E	Cu
Chief Barnaby A. E. Aikman, Route 1, Kettle Falls, Wash.	Covada S4-T34-R35E S34, 35-T35-R35E	Ag Pb Zn
Cold Spring	Covada S24-T32-R36E	Cu Pb Zn
Colorado	Covada S26-T32-R36E	Au Ag
Colorado	San Poil S2-T31-R34E	Au Ag
Comstock and Walla Walla	Danville	
Congress Geo. Wilson, Wilbur, Wash.	San Poil S35-T32-R33E	Ni
①Consolidated Mines and Smelting Co. (Golden Cord) (Advance) (Silver Ridge) O. B. Brown, Pres., 210 Orondo Avenue, Wenatchee, Wash.	San Poil	Ag Cu Mo
②Copper Key	Belcher T37-R34E	Cu Au Fe
Dan Patch	Covada S13-T32-R36E	Au Ag
Delaware	San Poil S15-T31-R34E	Pb Ag
Dewey	Covada S1-T31-R36E	Ag
Dewey	San Poil S5-T29-R33E	Cu

FERRY—*Continued*

Name	*District Location*	*Product*
Drummond	Covada S26-T32-R36E	Au Ag
③El Caliph	Republic S34-T37-R32E	Au Ag
③Eureka (formerly Quilp) (see Eureka Mining & Milling Co.)	Republic S35-T37-R32E	Au Ag
③Eureka Mining & Milling Co. (Eureka, Princess Maud, Republic) H. N. Segerstrom, Pres., East Farms, Wash.	Republic S35, 34-T37-R32E	Au
②F. H. & C. (see Gold Stake Mining Corp.)		
③Flag Hill Mines Corp. (Flag Hill) Adam H. East, Pres., Wenatchee, Wash.	Republic T36, 37-R32E	Au Ag
Gold Cup Mining Co. (La Fleur-St. James) (formerly Comstock Mining Co.)	Danville S7, 17, 18-T40-R33E	Cu Au Ag
Golden Cord (see Consolidated Mines & Smelting Co.)	San Poil S36-T30-R33E	Ag
②Golden Harvest W. D. Ackerman, Wenatchee, Wash.	Republic S24, 25-T36-R32E	Au Ag
③Golden Valley Mine, Inc. (Valley) Chas. T. and Herman Sharp, Sec.-Treas., Washington Trust Bldg., Spokane, Wash.	Republic S6-T37-R33E	Au Ag
Goldsmith	Covada S22-T32-R36E	
③Goldstake Mining Corp. (F. H. & C. and Princess) Henry Mears, Pres., Orient, Wash.	Orient S19, 30-T40-R37E	Au
Gold Twenty	Covada S5-T33-R36E	Au Ag
Good Ore	Covada S22-T32-R36E	Au Ag
③Grand Forks	Danville	Cu
Grandview	Covada S3-T31-R36E	
Great Northern	San Poil S13, 24-T30-R32E	
Great Western	San Poil	Ag
Guin	Covada S11-T32-R36E	
Gwin	Covada S11-T32-R36E	Cu Ag Au
Handy Andy	San Poil T30-R34E	Ag
Hines	San Poil	Au
Humboldt	San Poil S32-T29-R33E	
I. X. L.	Covada S1-T31-R36E	Au Ag
Iconoclast	San Poil S6-T29-R33E	Ag
②Ida May	Republic S34-T37 R32E	Au Ag
Idora	Covada S1-T32-R36E	Au Ag
Illinois Copper & Silver	San Poil S5-T29-R33E	Zn Cu Ag Au
②Insurgent (see Aurum Mining Co.)	Republic S35-T37-R32E	Au Ag
②Iron Creek	San Poil	Ag Pb Cu
②Iron Mountain	Republic S6-T35-R34E	Ag Au
Ivanhoe (Southern Cross)	Covada S6-T31-R37E	Ag
Jay Bird	Covada	Au Ag
Jenny	Orient S34-T40-R36E	Au Ag
Kentucky Bell	Covada S36-T32-R36E	Au Ag

FERRY—*Continued*

Name	*District Location*	*Product*
Keystone	Covada S34-T32-R36E	Au Ag
King Richard	San Poil S25-T30-R32E	
King Solomon	Covada S1-T32-R36E	Au Ag
③Kob Hill Mines, Inc. (Kob Hill, Mountain Lion and Rebate)	Republic S27-T37-R32E	Au Ag
La Fleur-St. James (see Gold Cup Mining Co.)		
Last Chance	San Poil S2-T29-R32E	
③Last Chance (see Aurum Mining Co.)	Republic S35-T37-R32E	Au Ag
③Little Cove (see Aurum Mining Co.)	Republic S34-T37-R32E	Au
③Lone Pine (see Aurum Mining Co.)	Republic S34-T37-R32E	Au Ag
②Lone Star and Washington	Danville S2-T40-R33E	Cu
Longstreet (see Big Silver Mining Co.)		
③Lucile Dreyfus (see Morning Star Mining Co.)		
②Lucky Boy	Covada	Pb Ag
Mabel T.	San Poil S10-T31-R34E	Pb Ag
Malachite	San Poil S35-T30-R33E	Au Ag
②Manila	San Poil	Au Cu Ag
McJunkin	San Poil	Ag Pb
①Meadow Creek Mines	San Poil	Au Ag Pb Cu
②Meteor	Covada S33-T32-R36E	Ag
Mono	San Poil S24-T30-R32E	Zn Pb Ag
Montana James P. Reed, Inchelium, Wash.	Covada S28-T32-R36E	Au Ag Pb
③Morning Glory	Republic S34-T37-R32E S2-T36-R32E	Au Ag
③Morning Star Mining Co. (Lucile Dreyfus) Roger O. Oscarson W. 423 First Ave., Spokane	Danville S16-T40-R34E	Au Ag Cu
②Mountain Boy	Park City	Ag Cu Pb
②Mountain Daisy	Ferry	Au
③Mountain Lion (see Knob Hill Mines, Inc.)		
New York	Covada S33-T32-R36E	Au Ag
Northern Light	Covada S31-T32-R37E	Au Ag
North Star	San Poil S30-T30-R33E	
Ohio	Covada S26-T32-R36E	
Oom Paul	Covada S27-T32-R36E	Pb Ag
Orion	Covada S31-T32-R37E	Ag Au
②Oversight	Belcher S18-T37-R34E	Cu Au
②Pacific Mutual Silver Lead Co. (Addison) C. A. Gray, Manager, P. O. Box 432, Spokane	San Poil S6, 31, 36-T29, 30-R33, 34E	Au Ag Pb Cu W
②Pearl (see Aurum Mining Co.)	Republic S34-T37-R32E	
Perry	Covada S36-T32-R36E	Au Ag
Pin Money	Belcher	Cu Au Ag
Plymouth Rock	Covada S36-T32-R36E	Ag Pb
Polaris	Covada S36-T32-R37E	Au Ag

FERRY—*Continued*

Name	*District Location*	*Product*
Pole Pick No. 1	San Poil	Ag Cu Pb
Poor Man's Hope	San Poil S6-T29-R34E	
Princess (see Goldstake Mining Corp.)		
Princess Maud (see Eureka Mining and Milling) William H. Parr and Jack Buckner, Lessees, Republic, Wash.	Republic S12-T36-R32E	
③Quilp (now Eureka) (see Eureka Mining & Milling Co.)		
Rattler	Covada S30-T32-R37E	Au Ag
Rattle Snake	Covada S30-T32-R37E	Au Ag
Rebate (see Knob Hill Mines, Inc.)		
Red Chief	Covada S34-T32-R36E	Au Ag
③Republic (see Eureka Mining & Milling Co.)	Republic S12-T36-R32E	Au Ag
Reserve	Covada S32-T32-R36E	Au Ag
Robert E. Lee	Covada S36-T32-R36E	Au Ag Sb
Romulus	Covada S28-T32-R36E	Au Ag
Rosario	Covada S31-T32-R37E	Au Ag
Rover Bonanza	San Poil S30-T30-R33E	Au Ag Pb Zn
Royal Ann	Covada S26-T32-R36E	Au Ag
Salnave	San Poil S16-T31-R34E	
③San Poil (see Aurum Mining Co.)	Republic S34-T37-R32E	Au Ag
Schiminski	San Poil S1, 2-T28-R33E	Mo Au Ag
③Seattle J. A. Wiseman, Republic, Wash.	Republic S34-T37-R32E	Au Ag
Several	Covada S27-T32-R36E	Au Ag
②Shamrock	San Poil S2-T30-R33E S26, 27, 35-T31-R33E	Ag Pb
Shoofly	Covada S36-T32-R36E	
Silver Bell	Covada S25, 30-T32-R37E	
Silver Bell Mining Co. C. W. Freese, 403 Carlisle, Spokane, Wash.	Wauconda S25, 30-T38-R31, 32E	Ag
Silver Crown	Covada S1-T31-R36E	Au Ag
Silver Leaf	Covada	W
Silver Leaf	Covada S30-T32-R37E	Ag Pb Au
Silver Plume	Covada S2-T31-R36E	
Silver Queen	Covada S34-T32-R36E	Ag
Silver Ridge (see Consolidated Mines & Smelting Co.)	San Poil S6-T29-R33E	Cu Mo
Silver Spar	Covada S27-T32-R36E	
Stemwinder	Covada	Ag Pb
Stockwell	Kettle Falls	W
Stotesbury	San Poil S28-T30-R35E	
②Stray Dog	Covada S27-T32-R36E	Au Ag

FERRY—*Continued*

Name	*District Location*	*Product*
Summit	San Poil	
Sunflower (Java)	Covada S33-T32-R36E	
②Surprise	Kettle River	Au
③Surprise (see Aurum Mining Co.)	Republic S34-T37-R32E	Au
Syndicate	Covada S34-T32-R36E	Ag Pb
Three L's	Park City S12-T33-R31E	Ag Pb
②Tom Thumb (see Aurum Mining Co.)	Republic S15-T37-R32E	Au
③Trade Dollar (see Aurum Mining Co.)	Republic S27-T37-R32E	Au Ag
Traux	Covada S22-T32-R36E	Au Ag
③Tyler	Covada	
U. S.	San Poil S1-T31-R34E	Pb Ag Au
②Valley (see Golden Valley Mine, Inc.)		
Vernie	Covada S34-T32-R36E	Ag Pb
Vesuvius	San Poil S35-T30-R33E	Ag
Walla Walla	San Poil S5-T29-R33E	Cu Au
Walla Walla (see Comstock)		
Washington (see Lone Star)		
White Rose	Covada S33-T32-R36E	
Yellowstone	Covada S25-T32-R36E S30-T32-R37E	
Zip & Tedie	San Poil S3, 10-T29-R33E	

GRANT

Black Rosauer Mines Co. James O. Black, Pres., Electric City, Wash.	S1, 2, 12-T28-R30E	Mo Au Ag

GRAYS HARBOR

②Denis	S28-T18-R5W	Fe
②Egge Henry Egge, Star Rt., Box 134, Hoquiam, Wash.	Olympic S30-T22-R9W	Mn

JEFFERSON

American Manganese Corp. (Elkhorn or New Elkhorn) F. A. Barnes, Pres., 955 Empire Bldg., Seattle, Wash.	Olympic S6, 7, 13-T25, 26-R3, 4W	Mn
Lucky Creek	Olympic T26-R2W	Mn
Tubal Cain	Olympic S7, 18-T27-R3W	Mn

KING

③Aces Up and Cleopatra (see Silver Mountain Mines, Inc.)		
Anderson	Money Creek S11-T26-R10E	Fe
Annie	S2-T23-R8E	Cu Au Ag
③Apex Gold Mines, Inc. W. J. Priestly, Prs., Box 35, Skykomish, Wash.	Money Creek S34-T26-R10E	Au Ag Pb As

KING—*Continued*

Name	*District Location*	*Product*
Belle of Tennessee	Buena Vista S8-T25-R10E	Au Ag
Bergensen (Normandie) Arthur de Soucy, Norman, Wash.	Miller River S30-T26-R11E	Au Ag As
Big Chief A. O. Larson, 3920 Greenwood, Seattle, Wash.	Snoqualmie	
Black Jack	Snoqualmie T24-R8E	Au Ag Cu
②Carmack	Snoqualmie	Au Ag Pb
①Cascade Development Co., (Dutch Miller) Herbert Tozier, Pres., 730 Vance Bldg., Seattle, Wash.	Foss River S20-T24-R13E	Au Ag Cu Pb
Cleopatra & Aces Up (see Silver Mountain Mines, Inc.)		
③Cliff	Gold Creek S7-T22-R11E	Fe
Climax	Gold Creek S7-T22-R11E	Fe
②Climax	Money Creek S6-T26-R10E	Cu Ag
Commonwealth	Gold Creek S26-T23-R11E	
③Coney Basin	Miller River S18-T25-R11E	Ag Pb Au
Copper Chief	Snoqualmie S14-T23-R11E	Cu Pb
①②Damon and Pythias Wm. J. Priestley, Box 35, Skykomish, Wash.	Money Creek S33, 34-T26-R10E	Au
Della Jane	Snoqualmie S5-T22-R9E	Au
③Denny	Snoqualmie S31-T23-R11E	Fe
①Dutch Miller (see Cascade Development Co.)		
Emma	Gold Creek S14-T23-R11E	Cu
Gold Mountain	Money Creek S28, 29-T26-R11E	Au Ag Sb
②Great Republic	Miller River	Sb
Green Mountain	Snoqualmie S33-T24-R9E	Fe
Guye	Snoqualmie S29, 31-T23-R11E	Fe
Joamco R. R. Jones, Hoge Bldg., Seattle, Wash.	Buena Vista S6, 31, 32-T25-R10E	Cu Au
Kimball	Money Creek S29-T26-R11E	
King & Kinney	Miller River	Au Ag Cu
Last Chance and Lone Star John Maloney, Skykomish, Wash.	Miller River S1-T25-R10E	Ag Pb Au
Last Chance	Snoqualmie S11-T22-R9E	Au Ag
Laura Lindsay	Snoqualmie	Au Ag
Lenox Mining & Development Co. R. R. Jones, Pres., 309 Hoge Bldg., Seattle, Wash.	Buena Vista S18-T25-R10E	Au Ag Cu
Lone Star (see Last Chance)		
Lost Lode	Snoqualmie S12-T24-R9E	Au Ag Pb
Lucky Day Mining and Milling Co. Wm. T. Horn, Pres., Everett, Wash.	Foss River S5-T25-R12E	Ag
Mary Earhart (Bear Creek) (see Robinson Mines Co.)		
Metropolitan	Miller River	Au Ag
Mono	Miller River S34-T26-R11E	Cu Au Ag
Monte Carlo F. J. Jones, 922 Jefferson, Seattle	Buena Vista S4-T25-R10E	Au Ag

KING—*Continued*

Name	*District Location*	*Product*
Normandie (see Bergensen)		
San Jose	Snoqualmie S33-T22-R10E	
③Silver Mountain Mines, Inc. (Cleopatra and Aces Up) Edward R. Taylor, Sec.-Treas., 1377 Dexter Horton Bldg., Seattle, Wash.	Miller River S24-T25-R10E	Ag Au
Square Deal	Snoqualmie	Au Cu
①United Cascade Mining Co. Chas. W. Gilbreath, 901 East 43rd, Seattle, Wash.	Miller River S1, 36, 34-T23, 24-R11E	
Williams-Smith	Money Creek S35, 36-T26-R10E	

KITTITAS

American Eagle	Cle Elum S24-T14E	Au
②Aurora (now Paramount Mines, Inc.)		
Balfour-Guthrie	Cle Elum S1, 2-T22-R14E S26, 34, 35-T23-R14E	Fe
Beaver	Cle Elum S26, 23-T23-R14E	Au Ag Cu
①Big Z Vernon Zerwekh, Box 4, Wenatchee	Swauk S8-T21-R18E	Au
Boyles	Cle Elum S31-T23-R15E	Cu Au Ag
Camp Creek Phil Denny, 310 Blaine St., Seattle, Wash.	Cle Elum	Au Ag
②Cascade Chief	Swauk S30, 25-T21-R18E	Au
Cle Elum & Hawk	Cle Elum S31-T23-R15E	Au Ag
Durrwachter	Cle Elum S9-T19-R15E	Cu Au Fe
②Esther & Louisa	Gold Creek S26-T23-R12E	Au
②First of August	Swauk S2-T20-R17E	Au
Fish Eagle	Cle Elum	Cu
②Golden Fleece	Swauk S13-T21-R17E	Au Ag
②Gold Leaf	Swauk	Au Ag
Gold Reef A. E. Locke, Seattle, Wash.	Swauk	Au Ag
Good Luck	Gold Creek S27-T23-R12E	Pb Ag
Grandview	Cle Elum S33-T23-R15E	Au Cu
Granite King	Gold Creek S24-T23-R11E	Ag Cu
Great Western	Swauk	Au Ag
②Great Wonder	Swauk	Au
Huckleberry S. R. Justham, Box 94, Roslyn, Wash.	Cle Elum S24-T23-R13E	Au Ag Cu
Ida Elmore	Cle Elum S23-T23-R14E	Cu Au Ag
Jordon W. L. Palmer, Electric City, Wash.	Swauk	Au Ag
Jordon-Bonanza Mining & Development Co. Ollie Jordon, Liberty, Wash.	Swauk	Au Ag
Keystone	Cle Elum S33-T23-R15E	Hg

KITTITAS—*Continued*

Name	*District Location*	*Product*
King Solomon	Cle Elum S5-T23-R15E	Cu Au Ag
②Liberty A. C. Pellard, Mount Vernon, Wash.	Swauk S19-T21-R18E	Au
Maud O	Cle Elum	Au
Mercer Orren F. Fry, Mukilteo, Wash.	Swauk	Au
Mineral Creek Copper M. C. Remelin, Box 735, Yakima, Wash.	Cle Elum S6-T22-R13E	Au Ag Cu
Morning	Swauk	Au Ag
Morning Star	Cle Elum S24-T23-R14E	Cu Au Ag
②Morris	Swauk	Au
②Mountain Daisy	Swauk	Au
②Paramount Mines, Inc. (Aurora) Clarke H. Brooke, Pres., 1377 Dexter Horton Bldg., Seattle, Wash.	Cle Elum S26-T24-R14E	Au Ag Fe
Peerless Mining Co. Mrs. F. B. Denny, 404 S. K St., Tacoma, Wash.	Cle Elum S35, 36-T23-R14E	Cr
Red	Swauk	Au
Rocky Point	Cle Elum S12-T23-R14E	Au
Ruby	Cle Elum S20-T23-R14E	Au Ag
②Silver Creek Mining Co. W. A. Hoage, 11th and Pacific, Tacoma, Wash.	Cle Elum S12-T23-R14E	Au Ag
Silver Dump	Cle Elum S23-T23-R14E	Ag Au Cu
Silver Queen	Cle Elum S24-T23-R14E	Au
True Fissure Gold	Swauk S30-T21-R18E	Au
②Wall Street	Swauk	Au
War Eagle	Cle Elum S34-T22-R14E	
Washington Gold Co., Inc.	Swauk S10-T20-R17E	Au

LEWIS

Barnum & Patterson Mercury Co.	Morton	Hg
③Camp Creek Mining Co.	Niggerhead	Au
③Roy H. L. Wolf, Pres., Morton, Wash.	Morton	Hg

LINCOLN

Crystal		Ag Pb
①Prosperity (see Spokane Molybdenum Mines, Inc.)		
①Spokane Molybdenum Mines, Inc. (Prosperity) Frank P. Busch, Pres., Colton, Wash.	S32-T28-R37E	Mo

MASON

Apex	Olympic	Mn
②Black & White	Olympic S24-R5W	Mn Cu
Lucky Jack Cushman, Wash.	Olympic	Mn
Olympic Mines, Inc. (formerly Nelson Manganese)	Olympic	Mn
①Olympic Mining Co. (Beaver Falls) A. E. Schrimpf, 1109 Paulsen Bldg., Spokane, Wash.	Olympic	Mn

MASON—*Continued*

Name	*District Location*	*Product*
Steel Creek	Olympic S15-T23-R6W	Mn
Triple Trip	Olympic S31-T24-R5W	Mn

OKANOGAN

①Abernathy	Mazama	Cu Au Ag
③Alder (see Methow Gold Corp.)		
Allison	Oroville T40-R27E	Au
③American Flag (now Oriental) (see Leybold-Scales, Inc., lessee)		
②American Flag	Wauconda S36-T38-R31E	Ag Au Cu
③American Graphite and Metal Corp. (Molybdenum Mining Co.) J. R. Laycock, Omak, Wash.	Nespelem T34-R29E	Mo
③American Rand (Spokane) C. A. Wamba, 612 Lloyd Bldg., Seattle, Wash.	Wannacut Lake... S11-T39-R26E	Au Ag
Anaconda	Conconully	Ag Pb
①②Andy O'Neill Frank Beggs and G. H. Ostrowski, Nespelem, Wash.	Nespelem S27-T31-R30E	Au Ag Pb
①②Antimony Queen (Reddy or Dixie Queen) William Oldfield, lessee, Twisp, Wash.	Methow S11-T31-R21E	Sb
③Apache Gold Mines, Inc. Frank Beggs and G. H. Ostrowski, Nespelem, Wash.	Nespelem S27-T31-R30E	Au Ag
②Apex	Myers Creek	
③Arlington Mines, Inc. Carl M. Lunstrom, lessee, Electric City, Wash.	Conconully S5-T34-R25E	Ag Cu Au
Atkins	Park City S12-T34-R31E	Ag Pb Zn
Aurora Mining Co A. P. Grumbach, Pres., 935 N. 73rd St., Seattle, Wash.	Park City	Au
③Aztec (see Magnetic Mining Co.)		
Baltimore	Palmer Mountain.. S28-T39-R26E	Au Cu
Beaver Mrs. Ida Ollason, Sec., Republic, Wash.	Wauconda S21, 28-T39-R31E	Au Ag
②Bellevue	Palmer Mountain.. S4-T39-R26E	Au Ag
Big Eight	Twisp S3-T34-R18E	Au
Billy Goat Ernest Holtzheimer, Twisp and Winthrop, Wash.	Mazama	Au
Bi-Metallic	Meyers Creek S27-T39-R29E	Au Ag
③Black Bear and War Eagle (see Monte Oro Mining Co., Inc.)		
Black Jack	Methow S32-T31-R22E	Au Ag Cu
Blue Grouse	Conconully S30-T35-R25E	Cu Pb Ag
Blue Lake	Conconully S28-T37-R25E	Cu
③Bodie (see Toroda Gold Mines, Corp.)		
Bolinger	Methow	Au Ag
Bonanza and Maid of Erin	Park City S1-T34-R31E	Cu Au
Bridgeport	Conconully	Ag Pb
Buckhorn	Conconully	
Buckhorn	Chesaw S23, 24-T40-R30E	Au Cu
Bullfrog	Wannacut Lake... S2-T39-R26E	Au Ag

OKANOGAN—*Continued*

Name	*District Location*	*Product*
Bunker Hill (Hargrove Property) W. J. Miller and Pat Lowery, lessees, Conconully, Wash.	Conconully	Pb Ag
②Butcher Boy	Meyers Creek S21-T40-R30E	Au
Cabin	Nespelem S27-T31-R30E	Ag Au
Carl Frederick	Conconully	Ag
Castle Creek	Park City S1-T33-R31E	Au Ag Cu Pb
Central	Park City S12-T33-R31E	
③Central Mining Co. (Wheeler) (leased Seven Devils from Mineral Hill Mines, Inc.) Ed Forbes, et al., Conconully, Wash.	Conconully S2, 3-T35-R24E	Pb Ag
Chicago	Wannacut Lake S23-T39-R26E	Au Ag
③Chief Sunshine Chas. Davidson, Conconully, Wash.	Conconully S35-T36-R24E	Ag Pb
②Chloride Queen Mining & Smelting Co. (now Nighthawk Mines, Inc.)		
Cliff and Poorman	Park City S11-T33-R31E	
Combination	Palmer Mountain S29-T39-R26E	Au Ag
Contention	Wannacut Lake S22-T39-R26E	Au
Controller and Red Bird	Nespelem T31-R31E	Ag Cu
Copper King	Conconully S31-T36-R25E	Cu
②Copper World	Palmer Mountain S8-T39-R26E	Cu Au
②Copper World Extension	Palmer Mountain S7, 8-T39-R26E	Cu Au
Copper Zone Wm. Hargrove and Henry Barker, Conconully, Wash.	Conconully	Cu Ag Pb
Cougar	San Poil S2-T29-R32E	Au Ag
③Crescent, Triune and Hiawatha Dell Hart, Oroville, Wash.	Wannacut Lake S10-T39-R26E	Au Ag
Crescent Frank Heath, Twisp, Wash.	Twisp S15-T34-R18E	Cu
③Crystal Butte (see Mother Lode)		
Damfino	Methow S23, 28-T31-R22E	Au Ag Cu
Defiance	Palmer Mountain S29-T39-R26E	Au
③Denver City (see Grandview Gold Mining Co.)		
Detroit-Windsor	Palmer Mountain S24-T38-R25E	Au
Diamond Queen	Methow S20-T30-R23E	Au Ag
②Dixie Queen (see Antimony Queen)		
①Dorian (see No Monicker)		
Emerald	Methow S31-T31-R23E	Au Ag Cu
Empire	Palmer Mountain S30-T40-R26E	Cu Au Ag
Esther	Conconully S31-T36-R25E	Ag Pb Zn
Eureka	Park City S12-T33-R31E	Ag Pb
Evening	Nespelem S21-T31-R30E	Ag Pb
Favorite	Nighthawk	Pb Ag

OKANOGAN—*Continued*

Name	*District Location*	*Product*
③First Thought	Conconully S31-T34-R25E	Ag Pb Cu
Ford, Ferris (see Hatfield, John)		
②Forty-Ninth Parallel	Oroville	Au Cu Ag
③Four Metals Dr. Effner, Oroville, Wash.	Nighthawk S23, 14-T40-R25E	Ag Pb Cu
②Fourth of July	Conconully S5-T34-R25E	Ag Cu Au
②Friday	Methow S20-T30-R23E	Au
Fuller (Lone Pine)	Methow S26-T30-R23E	Fe
Gemini Mines, Inc. W. C. Williams, Sec., Wenatchee, Wash.	Nespelem	Cr
General Miles	Park City S13, 12-T33-R31E	Ag Pb
Gladstone	Palmer Mountain S31-T39-R26E	Au
Goat Creek	Mazama	Au Ag Cu
③Gold Axe	Meyers Creek	Au Cu
Gold Bar	Twisp S30-T34-R18E	Au
③Gold Crown	Methow	Au
②Golden Chariot	Oroville S6, 7-T40-R27E	Au Ag Cu
③Golden Zone	Nighthawk S28-T40-R25E	Au Ag
Gold Hill	Palmer Mountain	Au Ag
Gold Hill Mining Co. F. S. Munson, A. A. Ingalls, Box 102, University Station, Seattle, Wash.	Oroville	Au
Gold Quarry	Conconully S19, 20-T37-R25E	Au
Gold Ridge	Slate Creek	Au
Goodenuf	Nespelem S9, 8-T31-R30E	Ag Pb Au
Gould & Curry	Nespelem S27-T31-R30E	Ag Pb Au
③Grand Coulee Mines, Inc. (Panama & Little Chief) (see Nespelem Consolidated Mines)	Nespelem S26, 27, 34, 35-T31-R30E	Ag Au
③Grand Summit (see Palmer Summit Gold)		
③Grandview Gold Mining Co. (Leadville and Denver City) (formerly John Judge Gold Mining Assn.) Percy Eastman, Loomis, Wash.	Palmer Mountain S19, 20, 30-T39-R26E S24, 25-T39-R25E	Au
②Grant (now Teddy Roosevelt)		
Gray Eagle	Methow S25-T30-R22E	Au
③Gray Eagle C. N. Bagwell, M. L. Pearce, and Chas. Atchison, lessees, Chesaw, Wash.	Meyers Creek S16-T40-R30E	Au
Great Divide	Nespelem S16-T31-R30E	Ag Pb Au
Great Western	Nespelem	Ag Pb
①Gubser Hugh Rynquist, Conconully, Wash.	Conconully S31-T36-R25E S1-T35-R24E	Ag Pb Cu Au
Hanford	Park City S11-T33-R31E	Pb Ag
③Harris	Meyers Creek	Au
②Hatfield, John (formerly Ferris Ford Property) F. Don Zellweger, lessee, Box 1369, Wenatchee, Wash.		W
Henrietta	Methow	Au Ag Cu
Hercules (see Ramore)		
②Hiawatha (see Crescent)		
Hidden Treasure	Nespelem S33-T32-R30E	Ag Au Cu

OKANOGAN—*Continued*

Name	*District Location*	*Product*
③Hidden Treasure	Methow	Au Ag Cu
③Highland Light	Methow S11-T30-R22E	Au Ag Cu
②Hilo (St. Paul) E. J. Pooley, et al., Mason City, Wash.	Nespelem S26-T31-R30E	Au Ag
Home Run	Nespelem S8, 9-T31-R30E	Ag Cu Au
Homestake	Conconully S31-T36-R25E	Ag Pb
②Horn Silver	Nighthawk S21-T40-R26E	Ag Cu Au
Hotchkiss Mining Co. (Mountain Beaver) Edgar A. and S. A. Hotchkiss, Winthrop, Wash.	Mazama S30-T36-R20E	Au
Hudnut	Nespelem S17-T31-R30E	Au Ag
②Hunter (see Methow Mining and Milling Co.)	Methow S10-T30-R22E	Au Cu
Idaho	Conconully	Ag Pb
Imperial (Crown Point) Mahlon McCain, Twisp, Wash.	Twisp	Au
Independence (see Methow Mining and Milling Co.)	Methow S30-T31-R22E	Au Cu
Independent	Park City S23-T33-R31E	Ag
②Indiana Frank D. Hyde, 75 West St., New York City	Slate Creek S3, 4-T37-R17E	Au
Iron Crown	Twisp	Au Ag
Iron Dike	Park City S4-T33-R31E	Zn Cu
②Ivanhoe	Palmer Mountain S16, 21-T39-R26E	Ag Au
⑧John Judge Gold Mining Assn. (see Grandview Gold Mining Co.)		
②Judy	Palmer Mountain	Au
Jumbo	Nespelem S32-T33-R31E	Cu Ni
Jumbo Gold Mining Co., Inc. Dr. James Aldrich, Pres., E. 4504 Frederick, Spokane, Wash.	Oroville	Au Ag
Just In Time	Methow S11-T30-R22E	Au
①②Kaaba Texas S. Barghorn, Pres., 1624 Boren Avenue, Seattle, Wash.	Nighthawk S14, 23-T40-R25E	Cu Au Ag Pb
Kansas	Conconully S30-T35-R25E	Cu Pb Ag
Kankakee	Nespelem	Cu Ag Pb
Kelsey	Oroville S8-T40-R27E	Cu Ag Au
Key William Hargrove, Conconully, Wash.	Conconully S31-T36-R25E	Ag Pb
②Kimberly	Wannacut Lake S11-T39-R26E	Au
①King Solomon Fred A. Davis, 2935 Boone Ave., Spokane, Wash.	Nighthawk S13-T40-R25E	Ag Au Cu
①Lady of the Lake William Gamble, Conconully, Wash.	Conconully S6-T35-R25E	Au Ag Cu
②Last Chance	Conconully S31-T34-R25E	Ag Pb Cu
③Leadville (see Grandview Gold Mining Co.)		
②Leuena	Conconully	Ag
③Leybold-Scales, Inc. (Oriental) Wm. Leybold, et al., 1614 Puget Sound Bank Bldg., Tacoma, Wash.	Mazama S30-T36-R20E	Au
Lilman E. E. Latourett, Nespelem, Wash.	Nespelem S26-T31-R30E	Ag Au Cu

OKANOGAN—*Continued*

Name	*District Location*	*Product*
②Little Chief (see Nespelem Consolidated Mines)	Nespelem S35-T31-R30E	Ag
Little Chopaka	Nighthawk	Au Ag Pb
③London and Liverpool (see Methow Mining and Milling Co.)		
Lone Pine (see Fuller)		
②Lone Star	Conconully	Ag Pb
②Lucky Knock		Sb
Lucky Lady, Inc. (Silver Queen)	Conconully S33-T38-R26E	Au Ag
MacLean (now Teddy Roosevelt)		
③Magnetic Mining Co. (Neutral and Aztec) A. E. Wilson and John Citkovich, Colville, Wash.	Meyers Creek S24-T40-R30E	Fe
Maid of Erin (see Bonanza)		
Marguerite	Conconully S30-T35-R25E	Cu Pb Ag
③Mazama Pride	Mazama	Au
②Mazama Queen	Mazama S11, 12, 14-T36-R19E	Au
Methow	Methow	Ag Cu
③Methow Gold Corp. (leasing Alder from Chelan Mining Co.) Mahlon McCain, Pres., Twisp, Wash.	Twisp S25, 26, 35, 36-T33-R21E	Au Ag Cu
③Methow Mining and Milling Co. (Hunter, Independence, London & Liverpool) Geo. H. Watkins, et al., Insurance Bldg., Seattle, Wash.	Methow S30-T31-R22E S10-T30-R22E	Au Cu
②Mid Range	Methow	Au
③Mineral Hill Mines, Inc. (Seven Devils) (see Central Mining Co.)		
Modoc	Nespelem	Ag Cu
Mohawk	Conconully	Ag Pb
Molybdenum Mining Co. (see American Graphite & Metal Corp.)		
Monitor	Conconully S31-T36-R25E	Cu Zn
Montana	Nespelem S35-T31-R30E	Au Ag
③Monte-Oro Mining Co., Inc. (Black Bear and War Eagle) R. R. McPherson, 714 North L Street, Tacoma, Wash.	Palmer Mountain S36-T39-R25E	Au
Monterey	Meyers Creek S24-T40-R30E	Cu Au
③Mother Lode (Crystal Butte) R. C. Hirst and A. E. Shultz, Chesaw, Wash.	Meyers Creek S35-T40-R30E	Au Ag Pb
Mountain Beaver (see Hotchkiss Mining Co.)		
Mountain Lily	Methow	Au
Mountain Sheep	Nighthawk S28-T40-R25E	Ag
Multnomah	Nespelem S9-T31-R30E	Au Ag Cu Pb
②Nespelem Consolidated Mines (Panama and Little Chief) (formerly Grand Coulee Mines, Inc.) Frank Beggs, Nespelem, Wash.	Nespelem S35-T31-R30E	Ag Au
③Neutral and Aztec (see Magnetite Mining Co.)		
②Nevada	Conconully S30-T35-R25E	Cu Pb Ag
②Nighthawk (see Nighthawk Mines, Inc.)		
③Nighthawk Mines, Inc. (Nighthawk and Ruby) (formerly Chloride Queen Mining and Smelting Co.) C. A. Tuttle, Pres., Chelan, Wash.	Nighthawk S13-T40-R25E S28-T40-R25E	Ag Pb
Nine-Two	Palmer Mountain S22-T39-R26E	Au

OKANOGAN—*Continued*

Name	*District Location*	*Product*
②Nip and Tuck	Methow S27-T30-R22E	Au
Nip and Tuck	Meyers Creek S23-T40-R30E	Au Ag Cu
①No Monicker (Dorian) Chas. McLean, Okanogan, Wash.	Ruby S34-T35-R25E	Au
③Northern Gold Corp. (Bodie) (see Toroda Gold Mines, Corp., lessees)		
North Star George Gibson, Twisp, Wash.	Twisp S24-T33-R21E	Au Ag
Number One	Nighthawk S13-T40-R25E	Ag Pb
②O.K. Copper	Oroville	Cu Ag Au
Ocean Wave	Methow	
Okanogan	Methow S11-T30-R22E	Au Ag
Okanogan Copper	Conconully S20-T37-R25E	Cu Au
③Okanogan Free Gold (see Owasco)		
Old Glory	Park City S15-T33-R31E	Cu Au
Olentangy	Meyers Creek S8, 17-T40-R30E	Au
③Oriental (formerly American Flag) (see Leybold-Scales, Inc., lessees)		
Oversight	Nespelem S27-T31-R30E	Au Ag Pb
③Overtop Mining Corp. (Poland China) R. D. Dart, Pres., Molson, Wash.	Meyers Creek S11, 12, 13, 14-T40-R29E	Au Pb
③Owasco (formerly Okanogan Free Gold) Roy S. Meader, Oroville, Wash., and H. N. North, Omak, Wash.	Oroville	Au Ag
Palmer Mountain Tunnel (formerly Palmer Mountain Tunnel & Power Co. held group of fifty claims which are now dispersed among various owners)	Palmer Mountain S1-T38-R25E	Au
③Palmer Summit Gold (formerly Grand Summit) Dr. L. S. Eastman and F. C. Barber, Wenatchee, Wash.	Palmer Mountain S31-T39-R25E	Au
Panama (see Nespelem Consolidated Mines)		
Park	Park City S12-T33-R31E	
Par Value	Nespelem S35-T31-R30E	
①Pateros Mining Co. James C. Turner, E. 2818-4th Ave., Spokane, Wash.	Methow	Au Cu
Paymaster	Methow S15-T30-R22E	Au
Peerless	Nighthawk	
②Peterson	Meyers Creek	Au
②Phil Sheridan	Wauconda	
①②Pinnacle A. E. Schrimpf, 1109 Paulsen Bldg., Spokane, Wash.	Palmer Mountain	Au
Pittsburg	Nespelem S21-T31-R30E	Ag Pb
②Plant-Callahan	Conconully	Ag
③Poland China (see Overtop Mining Co.)		
Poorman and Cliff	Park City S11-T33-R31E	
Portland	Twisp S11-T34-R18E	
②Prize	Nighthawk	Ag Pb Au
Q. S.	Conconully S27-T37-R25E	Cu Au

OKANOGAN—*Continued*

Name	*District Location*	*Product*
Rainbow	Meyers Creek S23-T40-R30E	
Rainbow	Conconully S22-T39-R26E	Au
Ramore and Hercules	Park City S14-T33-R31E	
Ramsey	Nespelem S33-T32-R30E	Ag Cu Au
Read	Deer Trail..... S14-T30-R37E	Fe
Rebecca	Nespelem S32-T30-R30E	Ag Au Cu
②Reco T. J. Nopp, 140 Mont. St., Bremerton, Wash.	Meyers Creek	Au Ag
Red Bird (see Controller)		
Red Bird	Nespelem S36-T31-R31E	
④Red Shirt Mahlon McCain, Twisp, Wash.	Twisp	Au Cu Ag
②Reedy (see Antimony Queen)		
Republic	Conconully S30-T35-R25E	Cu Pb Ag
②Review	Meyers Creek	Au
Ruby	Conconully	Au Ag
③Ruby (see Nighthawk Mines, Inc.)	Nighthawk S28-T40-R25E	Ag Pb
③Ruby Mountain Mining Co. (Sonny Boy) Geo. R. Turner, Okanogan, Wash.	Conconully S34, 35-T24, 25E	Ag Au Cu
Rush	Nighthawk S28-T40-R25E	Au Ag
Salmon River Chief	Conconully S31-T36-R35E	Ag Pb
San Francisco	Wannacut Lake... S18, 19-T40-R26E	Au
Schulz & Chesney	Methow S20-T30-R23E	
Second Prize	Oroville	Au
③Seven Devils (see Central Mining Co.)		
Sharp & Balthus	Park City	Pb Ag
Silver Bell Mining Co. C. W. Freese, Sec., 403 Carlisle, Spokane, Wn.	Wauconda S25, 30-T38-R31, 32E	Ag
Silver Bluff	Conconully	Ag Pb
Silver Cliff & Newport	Nespelem S17-T30-R31E	Ag Pb
Silver Ledge	Methow S11-T31-R21E	Au Ag
Silver Queen (see Lucky Lady, Inc.)		
③Sonny Boy (see Ruby Mountain Mining Co.)		
Spokane (see American Rand)	Wannacut Lake... S11-T39-R26E	Ag Au
③Spokane Fred Dansbach, Sawyers Bar, California	Twisp	Ag Au Cu
Starr Molybdenum	Conconully	Mo
Standard & Louisa	Methow	
Star	Conconully S36-T36-R24E	
St. Anthony	Methow	Au
Stepstone	Nespelem S5-T32-R31E	Ni
Sterling	Nespelem S8-T31-R30E	Ag
St. Lawrence	Twisp S7-T33-R22E	
Submarine	Oroville S3-T40-R26E	Au
①②Teddy Roosevelt (Grant or MacLean)	Myers Creek S25, 24-T40-R30E	Cu Au Ag Fe

OKANOGAN—*Continued*

Name	*District Location*	*Product*
③Three Buttes R. R. McPherson, lessee, 714 North L. St., Tacoma, Wash.	Omak S15-T34-R26E	Mn
Tip Top	Nespelem	Ag Cu Au
Tom Hal	Methow	Au
③Toroda Gold Mines, Corp. (Bodie) (subleased from Northern Gold Corp.) Fred Williamson, Pres., 701 14th Ave., Spokane, Wash.	Wauconda S34,3-T39, 38-T31E	Au Ag
③Tough Nut	Conconully S31-T36-R25E	Pb Ag
Treasury	Conconully	Au
Trinidad	Conconully S10-T36-R25E	Au Ag
Trinity	Wannacut Lake S28-T40-R26E	Au Ag
Triune (see Crescent)	Wannacut Lake S10-T39-R26E	Au Ag
Twin Pine	Nespelem	Cu Ag Au
War Eagle	Conconully	
Wasco	Park City S9-T33-R31E	
Washington	Methow S11-T30-R22E	Au Cu
Wauconda	Wauconda S23, 10, 11-T37-R30E	Au
Wehe	Palmer Mountain S23-T39-R26E	Au
Whiskey Hill	Palmer Mountain	
White Stone	Wauconda	Au
Woo Loo Moo Loo	Conconully S5-T34-R25E	Ag Pb Cu
Wyandotte	Nighthawk S15-T40-R25E	
Wyoming	Conconully S30-T35-R25E	Cu Pb Ag
Yakima	Myers Creek	
Zalla-M-	Wauconda S30-T38-R32E	Ag Au

PEND OREILLE

Alger & McCullough	Newport S15, 22-T32-R45E	Pb
②Bead Lake	Newport	Pb Cu Zn
②Bella May	Metaline S29-T39-R43E	Pb Ag Zn
②Blue Bucket	Metaline S29, 30, 32-T39-R43E	Pb Zn
Clark (now Josephine) (see Pend Oreille Mines & Metals Co.)		
②Cliff H. J. McClelland, lessee, Metaline Falls, Wash.	Metaline	Pb Zn
①②Conquest (see Hoover Mining Co.)		
Copper Hill	Newport	Cu
Davenport-Troyer Rude Troyer, Metaline, Wash.	Metaline	Fe
②Diamond R.	Metaline S30-T39-R43E	Pb Zn
Fairview	Metaline	Au Ag Pb
③Farmer Jones F. L. Minnick, Spokane, Wash.	Newport	Au
Flusey	Metaline S26-T40-R43E	Pb Zn

PEND OREILLE—*Continued*

Name	*District Location*	*Product*
Gold Arrow Mines, Ltd. (Ries or Katydid)..... H. A. Ries, Pres., Newport, Wash.	Newport S12-T31-R45E	Ag Pb Au
③Grandview Mines, Inc..... (see Metaline Mining and Leasing Co. lessees)	Metaline S15-T39-R43E	Pb Zn
Hanley	Metaline	Pb Zn
Hoosier	Metaline S30, 31-T38-R43E S1-T38-R42E	Ag Au Cu
①②Hoover Mining Co..... (Conquest or Kootenai Conquest) Geo. C. Geisler, Hutton Bldg., Spokane, Wash.	Newport	Ag Pb
Huffman (now Mule Deer Mining Co.)		
Josephine (formerly Clark) (see Pend Oreille Mines & Metals)		
Katydid (see Gold Arrow Mines, Ltd.)		
①②Kootenai Conquest (see Hoover Mining Co.)		
②Lead King	Metaline S27, 34, 35-T43-R40E	Pb Ag
Little Noisy Mining Co..... I. E. Boswick, Ione, Wash.	Metaline S17-T38-R44E	Pb Zn
Meade	Metaline	Pb
Metaline Contact Mines (Polly-Molly)..... Steve W. O'Brien, Pres., Spokane, Wash.	Metaline S36-T40-R43E	Mo
③Metaline Mining and Leasing Co..... (leasing Sterling Zinc-Lead) (leasing Grandview Mines)	Metaline S29, 30, 32-T39-R43E	Zn Pb
Meteor	Newport	Au Ag Pb
①Mule Deer Mining Co. (formerly Huffman) P. P. Sharrick, et al., Ruby, Wash.		Au Pb Ag
O. K.	Metaline S1-T38-42E S30, 31-T38-R43E	Ag Au Cu Pb
②Oriole	Metaline S19, 20, 30-T39-R43E	Ag Zn Pb Cu
③Pend Oreille Mines & Metals (Josephine)..... L. P. Larsen, Pres., Old Nat. Bank Bldg., Spokane, Wash.	Metaline S16, 21-T39-R43E	Zn Pb
Polly-Molly (see Metaline Contact Mines)		
②Poorman	Metaline	Ag
②Ries (see Gold Arrow Mines, Ltd.)		
Riverside	Metaline	
③Schellenburg	Metaline S10-T39-R43E	Pb
①②Sterling Zinc-Lead Co..... (Metaline Mining & Leasing, lessee)	Metaline S32-T39-R43E	Zn Pb Fe
Sullivan	Metaline S16-T39-R43E	Pb Zn
Washington	Metaline S21-T39-R43E	
Wolf Creek Group.....	Metaline S4-T38-R43E	Pb Zn

PIERCE

Blue Star	Carbon River	Cu Au Ag
Chicago	Carbon River	Cu Au
Clipper	Carbon River S25-T18-R7E	Cu Au
③Eagle Peak Copper.....	Rainier	Cu Au Ag
Surprise	Carbon River	Au
Tacoma	Carbon River	Cu Au Ag
Washington Cascade Mining Co..... 1312 Puget Sound Bank Bldg., Tacoma, Wash.	Summit S25-T17-R10E	Ag Cu Pb

SKAGIT

Name	*District Location*	*Product*
Boston	Cascade S25-T35-R13E	Ag Pb Au
Cascade	Cascade S9-T34-R14E	Ag Pb Au
Chicago	Cascade	Ag Pb Au
Eldorado	Cascade S15-T35-R13E	Ag Pb Au
Grand Republic	Cascade S1-T34-R13E	Pb Ag
Industrial Mining, Inc. Geo. Peterson, 636 Bennett St., Sedro Woolley, Wash.	Twin Sisters	Cr
②Iron Mountain	Hamilton S23-T35-R6E	Fe
Johnsburg	Cascade S29-T35-R14E	Ag Pb
Lakeside	Thunder Creek ...	Au Ag
Last Chance	Cypress Island ...	Cr
Midas	Cascade S36-T35-R13E	Ag Pb
①②Pacific Nickel Co. James G. Smith, Pres., Mt. Vernon, Wash.	S9, 10-T33-R4E	Ni
②Ready Cash	Cypress Island ...	Cr
Soldier Boy	Cascade S36-T35-R13E	
Thunder Creek Silver-Lead W. H. Thompson, 1713 Arctic Bldg., Seattle, Wash.	Thunder Creek ... S16-T35-R14E	Ag Au Pb
Willis & Everett	Thunder Creek ...	Ag Au

SKAMANIA

Bronze Monarch	St. Helens	Au Ag Cu
Chief (see Ripper)		
Germania	St. Helens S8, 17-T10-R6E	Au
Golconda	St. Helens S21-T10-R6E	Au
Independence	St. Helens S10, 11, 3, 2-T10-R5E	Cu Au
Juanita	St. Helens	Au Cu
Minnie Lee	St. Helens S2, 3-T10-R5E	Cu Au
Mount Fairy	St. Helens S32-T10-R6E	Au Ag Pb
Norway	St. Helens S31-T10-R6E	Au Ag Cu
P. F. R. Lee Perry, Randle, Wash.	Niggerhead	Au
Plamondon Indian Mines, Inc. Guy W. Owens, Sec., Martin Apts., Olympia, Wash.	S18-T8-R8E	Au
Polar Star Geo. S. Reid, 410 Gerlinger Bldg., Portland, Oregon	St. Helens S7, 18-T10-R6E	Cu Au Ag
③Primary Gold E. Anderson, 10 North 6th Ave., Yakima, Wash.	Niggerhead S10-T10-R8E	Au Ag
Rainbow Henry Gapsch, 2700 E. 30th St., Vancouver, B. C.	S32, 33-T3-R5E	Pb Cu
Ripper and Chief	St. Helens	Au Cu

SKAMANIA—*Continued*

Name	*District Location*	*Product*
Samson	St. Helens S16-T10-R6E	Cu Au
Skamania		
Sweden	St. Helens S31-T10-R6E	Au Ag Cu
Toledo	St. Helens	Cu
Washington	St. Helens	Cu
Young America	St. Helens	Cu

SNOHOMISH

Alki and Ellen	Silver Creek S31-T29-R11E	
③ Alleghany Corp. of Nevada (Penn.) M. H. Van Nuys, Sec.-Treas., 627 Central Building, Seattle, Wash.	Monte Cristo S13-T29-R11E	Au Ag
② American Arsenic Reiter, Wash.	Index	As
Anacortes (see Ore Recoveries, Corp.)		
Annie Laurie	Monte Cristo S31-T30-R11E	
Arlington	Silverton S30-T30-R10E	Cu Au Ag
Bald Mountain	S17-T34-R6E	Cu Au
Ben Butler	Silver Creek S6-T28-R11E	Au
Big Four	Silverton S28-T30-R10E	Ag Fe
Big Raymond	Silver Creek S29-T29-R11E	Cu Au Ag
Billy Lee	Silver Creek S7-T28-R11E	Au
Bitter Creek	Index S11-T27-R10E	Cu
Black Hawk	Index S29-T28-R11E	Au Cu
Blue Bird	Darrington	Au Ag
Bonanza	Silver Creek	Au
Bonanza Queen	Silverton S17-T30-R10E	Au Cu Ag
Broken Ridge (see Silver Creek Copper Mining Co.)		
Brooklyn	Monte Cristo S11, 14-T29-R11E	Au
② Buckeye	Index S33-T7-R10E	Au Ag Cu
Burns	Darrington	Au Cu
Burgesen (see Taylor & Nunn Co.)		
Butte & Big Bear	Silverton S4-T30-R9E	Au Ag
Calumet	Index T27-R10E	
① Calumet (see Glacier Peak)		
Cleveland (see Ore Recoveries, Corp.)		
Colts	Silverton S7-T30-R10E	Cu Au
② Commonwealth Mining Co. Stanley S. Stein, Sec.-Treas., 727 Insurance Building, Seattle, Wash.		Au Ag Cu
Cooperative	Index	Ag Cu
③ Copper Bell	Index	Cu
Copper Chief	Silver Creek	Au Ag Cu
Corona	Silver Creek S10-T28-R11E	Au Ag
Crown Point	Silver Creek S8-T28-R11E	Cu Au Ag

SNOHOMISH—*Continued*

Name	*District Location*	*Product*
Daisy	Monte Cristo S9-T28-R11E	Au Ag
Deer Lake	Silverton S2-T30-R9E	Cu
Diamond Hitch	Silver Creek S31-T29-R11E	Au Ag Cu
Eclipse (see Ore Recoveries, Corp.)		
Edison	Silver Creek S29-T29-R11E	Cu Au Ag
Ellen and Alki (see Alki)		
②Ethel Consolidated	Index S34, 35-T28-R10E	Cu
Eureka (see Ore Recoveries, Corp.)		
Evergreen	Silver Creek..... S20-T28-R11E	Cu Au Ag
③Florence Rae Mining Co. (Florence Rae)..... Geo. W. Tweeddale, 621 Colby Avenue, Everett, Wash.	Index S3-T27-R10E	Cu
②Foggy (Penn)		
Forest Hope	Darrington S19-T32-R10E	Au Ag Cu
②Fortunate	Monte Cristo.....	Au Ag
②Forty-Five	Silverton S32-T30-R10E	Au Ag Cu Pb
①Glacier Peak (Calumet)..... Mark Hanna Coal Co., Lessees, Cleveland, O.	Glacier Peak..... S10-T31-R15E	Mo Cu
②Glory of the Mountain.....	Monte Cristo..... S2-T29-R11E	Au Ag
Gold Eagle	Silver Creek..... S33-T29-R11E	Au Cu
②Golden Cord	Monte Cristo..... S26-T29-R11E	Au Ag
Golden Tunnel	Index S6-T26-R11E	Au Ag Cu
Gold Mountain	Darrington S30-T32-R10E	Au Ag Cu
Good Hope ..... F. P. Hallinan, 2797 S. W. Summit Drive, Portland, Oregon	Monte Cristo..... S33-T29-R11E	Au Ag Cu Pb
Granite	Silverton S20-T30-R10E	Au Ag
Great Northern	Sultan S26-T29-R8E	Au Ag Cu
Gunn Peak	Index S14-T27-R10E	Cu Ag Au
Hannah	Silverton S17-T30-R10E	Cu
③Helena	Silverton S17-T30-R10E	Au Ag Cu
Helena	Index S16-T27-R10E	Cu
Homestead	Index	Cu Au Ag
Hoodoo (see Ore Recoveries Corp.).....	Silverton S20-T30-R10E	Au Ag Cu
Hope	Silver Creek..... S33-T29-R11E	Cu
Imperial	Silverton	Cu Ag Au
②Independent (see Ore Recoveries Corp.).....	Silverton S20-T30-R10E	Au
Index-Bornite	Index S23-T27-R10E	Cu Ag
③Index Gold Mines, Inc..... Henry Sipmann, Pres., 2128½ 8th Ave. W., Seattle, Wash.	Silver Creek..... S18, 19-T28-R11E	Au Ag Pb
Index-Independent	Index S30, 31-T27-R10E	Cu

SNOHOMISH—*Continued*

Name	*District Location*	*Product*
Index Peacock	Index S14-T27-R10E	Cu
Iowa (see Sultan Basin Mining Co.)		
Iron Clad	Silver Creek S18-T28-R11E	Au
Jasperson W. Eggert, Warminster Hotel, Seattle, Wash.	Silver Creek S6-T28-R11E	Cu Au Ag
Jim Dandy	Silver Creek S6-T28-R11E	Cu Au Ag
Jumbo	Monte Cristo S29-T29-R11E	Au Ag Cu
Justin	Darrington S30-T32-R10E	Au Ag Cu
Keystone	Monte Cristo S26-T29-R11E	Au Ag
Keywinder	Darrington S35-T32-R9E	Cu Au Ag
Kittanning	Index	Cu
①Kromona Mines, Inc. J. F. Drom, Peyton Bldg., Spokane, Wash.	Sultan Basin S13-T28-R9E	Cu Au Ag
Lalla Rookh	Monte Cristo S22-T29-R11E	
Larson C. A. Larson, Route 3, Arlington, Wash.	Darrington S19, 30-T32-R9E	Ag Au Pb
②Last Hope	Monte Cristo	Au Ag
Lily James	Silverton S17-T30-R10E	Au Ag
Little Chief	Sultan	Au Cu
Lockwood Wm. Entwistle, 342-16th Ave. N., Seattle, Wash.	Sultan Basin S25, 36-T29-R8E	Ag Pb Au Zn
③Louise	Monte Cristo	Au Ag
Lula	Silverton S20-T30-R10E	Au Ag
Mackinaw Metals Co. R. D. Taft, 2805 Lombard Ave., Everett, Wash.	Monte Cristo S19-T29-R11E	Ni
Manley	Darrington S35-T32-R9E	Au Cu
Merchant R. A. Merchant, Index, Wash.	Index S17, 18, 19, 20-T27-R11E	Cu Au Ag
Michigan	Silver Creek S18-T28-R11E	Au Ag
Mineral Mines, Inc. 2104 Northern Life Tower, Seattle, Wash.	Silver Creek	Au Ag Cu Zn Pb
Minnehaha	Silver Creek S25-T29-R11E	Au Ag
Molly	Darrington	Au Ag Cu
Monitor and Sterling	Silverton S18-T30-R10E	Cu Ag
②Monte Cristo	Monte Cristo S26-T29-R11E	Au Ag
Morning Star	Silver Creek S33-T29-R11E	Ag
Myrtle C.	Darrington S30-T32-R10E	Au Cu Ag
②Mystery	Monte Cristo S26-T29-R11E	Au Ag
Mystery	Sultan Basin	Cu
②Mystery Hill	Monte Cristo S26-T29-R11E	Au Ag
National	Monte Cristo S31-T29-R11E	Au Ag
Nemo Group	Silverton S17-T30-R10E	Au Ag Cu
Non-Pareil	Index	Cu

SNOHOMISH—*Continued*

Name	*District Location*	*Product*
North Star	Index	Cu
②Northwest Consolidated	Monte Cristo	Au Ag
②O & B A. H. Reiser, 1231 N. 50th, Seattle, Wash.	Monte Cristo S28-T29-R11E	Ag Au Cu
Old Gray Mare	Darrington	Ag Pb
Ontario	Silver Creek	Pb Ag Au
Ore Recoveries, Corp. (Eclipse, Eureka, Anacortes, Independent, Cleveland, and Hoodoo)	Silverton S20-T30-R10E	Au Ag
Oro Fino	Silver Creek S18-T28-R11E	Cu Au
Peabody	Monte Cristo	
Penn (Foggy) (see Alleghany Corp. of Nevada)		
Philo	Monte Cristo S26-T29-R11E	
②Pride	Monte Cristo S23-T29-R11E	
Rainy	Monte Cristo S22-T29-R11E	Au Ag
Red Cross	Index	Cu
Remonville	Monte Cristo S33-T29-R11E	Au
Ruby King	Monte Cristo S6-T20-R11E	Au Cu
Seattle	Monte Cristo	Au Ag Cu
Seventy-Six	Monte Cristo S34-T29-R11E	Au Ag Cu
Silver Creek Copper Mining Co. (Broken Ridge) Fred Magnuson, Index, Wash.	Silver Creek S18, 19-T28-R11E	Au Ag Cu
Silver Lake	Monte Cristo S28-T29-R11E	
Silver Slipper	Silver Creek S6-T28-R11E	Ag Cu
Skrinde, W. E.	Silver Creek S18-T28-R11E	Cu Au Ag
Sloman	Darrington S32-T32-R9E	
Sterling (see Monitor)		
St. Louis	Silverton	
St. Louis & Jackson	Silverton S6, 7-T30-R10E	
Sultan Basin Mining Co. (Iowa)	Sultan Basin S27-T29-R8E	Cu Au Ag
②Sultan King Mining Co.	Silver Creek S1-T28-R10E S36-T29-R10E	Ag Au Cu
Sunrise	Sultan Basin S17-T29-R10E	Cu Au Ag
Sunset	Monte Cristo S11-T29-R11E	
③Sunset Copper	Index S1-T27-R10E	Cu
Taylor & Nunn Co. (Burgesen & Tum Tum)	Darrington S29-T32-R9E	Au Ag
Threadwell	Monte Cristo	Au Ag
Three Sisters	Silverton S18-T30-R10E	Au Ag
Tobique	Monte Cristo S27-T29-R11E	Au Ag
Tum Tum (see Taylor & Nunn Co.)		
Uncle Sam	Index S23-T27-R10E	Cu
Undaunted	Sultan S31-T29-R11E	Au Ag
Vandalia	Sultan S6-T28-R11E	Au Ag Pb

SNOHOMISH—*Continued*

Name	*District Location*	*Product*
②Vanguard Metals, Inc. (Wayside)	Granite Falls S9-T30-R7E	Au Ag Cu
Webster W. Eggart, Warminister Hotel, Seattle, Wash.	Silver Creek S6-T28-R11E	
Westland	Silver Creek S18-T28-R11E	
Whistler	Monte Cristo S26-T29-R11E	
Wildcat	Monte Cristo S25-T29-R11E	
Wild Rose	Monte Cristo S32-T29-R11E	
Wilman Peak	Monte Cristo	Au
Yellow Jacket	Index	Au

SPOKANE

Loon Lake Tungsten Mines, Inc. Chas. H. Zucker, Pres., N 4240-5th, Spokane, Wash.	Loon Lake S15, 17-T30-R42E	W
Spokane Tin Mine Co. Chas. P. Robbins, Pres., Box 1910, Spokane, Wash.	Silver Hill S23, 24-T24-R43E	Sn W

STEVENS

A & C	Northport S3-T37-R39E	Au Cu Zn
Abe Lincoln	Orient S36-T40-R36E	Au Cu
Acme	Kettle Falls S27-T35-R37E	Pb Ag Cu
②Admiral J. Richard Brown, Pres., 409 Metals Bldg., Spokane, Wash.	Chewelah S28-T31-R39E	Cu Ag Au
②Aichan Bee Silver-Lead H. M. Howard, W 3411 Providence, Spokane, Wash.	Deer Trail S15-T29-R37E	Ag Pb
③Aladdin M. P. Stoll, Manager, 1211 South J. Tacoma, Wash.	Northport S9, 16-T37-R41E	Au Ag Cu Pb Zn
Alanadale	Chewelah S36-T33-R39E	Cu
Alice C.	Orient S18, 17-T39-R37E	Au
Alma	Kettle Falls S27-T35-R37E	Au
③Amazon (now Chinto Mining Co.)		
American	Northport S16-T38-R39E	
②Anaconda and Copper King	Northport S30-T40-R42E	Ag Au Zn
②Antelope	Orient	Au Cu
③Ark Mines Co. (leased its Silver Queen to Ben Melby) J. J. Budd, Kettle Falls, Wash.	Kettle Falls S11-T35-R37E	Ag Pb Zn
②Avondale-Dome (formerly Tenderfoot)	Colville S23-T37-R39E	Pb Ag
③Bechtol	Northport S23-T39-R41E	Pb Zn
②Beecher	Orient S31-T40-R37E	Au Ag
Belcher	Chewelah S30-T33-R40E	Ag Cu Au
Benvenue	Colville S9-T36-R38E	Cu Au
Big Bear	Colville S4-T36-R38E	

STEVENS—*Continued*

Name	*District Location*	*Product*
Big Chief (formerly Tenderfoot) (see Royal Mines)	Colville S14-T37-R39E	Pb Ag
②Big Iron Mining Co. (Big Iron)	Orient S24-T40-R37E	Cu Fe
Black Canyon	Northport	Pb Zn Ag
Black Rock Zinc Wm. Siegmann, Northport, Wash.	Northport S25, 24-T39-R40E	Zn
Blue Creek	Chewelah	Cu
Blue Grass	Orient	Au
③Blue Grouse Tungsten, Inc. (Tungsten King) W. H. Allgeier, et al. Deer Park, Wash.	Loon Lake S16-T30-R42E	W
Blue Ridge	Northport S19, 20, 29-T38-R41E	Au Ag Zn Fe
②Blue Star (Eagle) (see Chewelah Eagle Mining Co.)		
②Bonanza Copper (see Maryland)		
②Bonanza	Northport S2-T37-R38E S11-T37-R38E	Pb Ag
Botts	Northport S3, 10-T37-R39E	Ag Pb
③Brooks	Deertrail S11-T29-R37E	Ag Pb
Bruce Creek (M. Kelly Jackson and Wm. Hamill, Owners) (Archie and Donald McDonald, Lessees)		Ag Pb
Bruder Mining Co. (Royal Gold)	Northport S32-T40-R39E	
③Bryan, W. J.	Northport	Pb
Bryant	Orient S36-T40-R36E	Cu Au
Buck Mountain	Colville	Ag Cu Pb Au
Bullion	Northport S8-T39-R39E	Cu Ag Pb
③Burrus (see Rock Creek)		
Chamokane	Loon Lake S9, 10, 11,15-T30-R38E	
Checops	Chewelah S24-T32-R39E	
Chewelah Consolidated	Chewelah S25-T34-R40E	Au Cu Pb
④Chewelah Copper King (same as Copper King) (now Chinto Mining Co.)		
②Chewelah Eagle Mining Co. (Blue Star or Eagle) (formerly Chewelah Standard) S. P. McPherson, Chewelah, Wash.	Chewelah S5, 32-T32, 33-R41E	Pb Ag
②Chewelah Standard (now Chewelah Eagle Mining Co.)		
③Chinto Mining Co. (Amazon & Copper King) Tom Condit, Mgr., 725 Realty Bldg., Spokane, Wash.	Chewelah S29, 32-T33-R41E	Cu
②Chloride Queen (see Colville Queen Mining Co.)		
City View	Colville S16-T36-R38E	
②Clara	Northport S10, 11-T40-R41E	Au Ab Cu
③Cleveland Joe and Clarence R. Carr, Valley, Wash.	Deer Trail S3, 4, 9, 10-T30-R38E	Ag Zn Pb
Coffer	Orient S28-T39-R37E	
Coffin A. E. Torelle, 401 Old Nat'l Bank Bldg., Spokane, Wash.	Metaline S16-T38-R42E	Zn Pb Mo
③Columbia River Copper Co. (Turk or High Grade) W. E. Allen, 618 Hyde Bldg., Spokane, Wash.	Deer Trail S6-T29-R38E	Cu

STEVENS—*Continued*

Name	*District Location*	*Product*
②Columbia River	Colville S7-T36-R38E	Au Ag Cu
③Columbia Tungsten Corp. S. Harry Draper, Pres., 714 W 17th, Spokane, Wash.	Deer Trail S19-T32-R38E	W
③Colville Queen Mining Co. (Chloride Queen) R. D. Baker, Route 2, Colville, Wash.	Colville S23, 24-T37-R39E	Ag Pb Zn
Comstock	Orient S26, 25-T40-R36E	Ag Au Cu
Copper Butte	Orient	Cu Au
Copper Butte	Loon Lake S11-T30-R38E	Cu
③Copper King (Chewelah Copper King) (now Chinto Mining Co.)		
②Copper King & Anaconda	Northport S25-T40-R41E	Pb Ag Zn
Copper Queen R. C. Thomason, Box 166, Chewelah, Wash.	Chewelah S6-T33-R41E	Cu Ag
②Copper Queen	Chewelah S29-T33-R41E	Cu Ag Pb
②Cuprite Mining Co. (Young America)	Northport S29-T38-R38E	Au Ag Cu Pb
②Daisey-Tempest	Kettle Falls S7-T33-R38E	Ag Pb
③Deer Trail M. C. Slate, Albany, Oregon	Deer Trail S1, 12-T29-R37E	Ag Pb
③Deer Trail Monitor J. Richard Brown, Pres., 409 Metals Bldg., Spokane, Wash.	Deer Trail S12, 13, 24-T30-R37E	Mo
Defender	Orient	Cu Au
③Delmonico	Chewelah	Cu Pb Ag
Denver	Chewelah S29-T31-R39E	
Diamond C.	Chewelah S7-T32-R41E	Cu
①②Double Eagle (see Westvaco Chlorine Products, Corp., Lessee)		
③Double Eagle (see Duke of Windsor Mines Corp., Lessee)		
Double Standard	Northport S3-T40-R39E	Cu Ag Au
③Duke of Windsor Mines Corp. (leasing Double Eagle) Otto K. Quast, W. 409 Second Ave., Spokane, Wash.	Chewelah S17, 18-T31-R39E	Pb Ag
E. M. C.	Kettle Falls S11, 12-T35-R37E	Ag Pb Cu
②Eagle (Blue Star) (see Chewelah Eagle Mining Co.)		
②Easter Sunday	Orient S22-T40-R37E	Cu Au Ag
Echo (see Royal Mines)		
②Edna	Chewelah S9-T31-R39E	Cu Au Ag
③Electric Point Arthur Simonton, Leadpoint, Wash.	Northport S17, 18-T39-R42E	Pb Ag
③Evergreen	Northport S25-T40-R42E	Pb Zn
Examiner	Northport	Au Ag
②Farmer Leonard Hoff and R. E. Crosby, Spokane, Wash.	Northport	Ag Zn
Fidelity	Northport S6-T40-R40E	Au Cu
③First Thought	Orient S18-T39-R37E	Au Ag
First Thought Extension	Orient S18, 19-T39-R37E	Ag

STEVENS—*Continued*

Name	*District Location*	*Product*
Fred B.	Chewelah S28-T32-R41E	Ag Pb
②Frisco-Standard ..... Ben Hofer and Harold Rush, Northport, Wash.	Northport S12-T40-R42E	Ag Pb
Galena Farm.....	Northport S7-T37-R40E	Ag Pb
②Galena Hill	Orient S35-T40-R36E	Pb Zn Ag
③Gem	Orient S30-T39-R37E	Au
④General Electric Co. (Germania)..... H. H. Barrows, 1648-16th St., Oakland, California	Deer Trail..... S18, 13-T29-R38E S12, 14, 23, 24-T29-R37E	W
Georgic	Orient S27-T39-R37E	Au Pb
③Germania (see General Electric Co.)		
③Gladstone Mountain..... A. W. Shellady, Pullman, Wash.	Northport S18-T39-R42E	Pb
Globe	Orient	Au Cu
①Gold Bar Mining Co..... L. R. Phillips, Manager, Bossburg, Wash.	Orient S15, 22-T37-R38E	Au Ag
Golden Hope Mining Co. (Sunday Morning Star) Paul Wendt, Pres., W. 1708 College, Spokane, Wash.	Colville S7-T36-R38E	Au Ag
③Gold Reef ..... M. I. Stellman and Geo. F. Gundry, Meyers Falls, Wash.		Au
②Gorien Zinc	Northport	Zn
Gray Eagle	Colville S17-T36-R38E	Cu
Great Republic	Northport S3-T40-R39E	Cu Au Ag
②Great Western	Northport S24-T39-R40E	Zn Pb
Hartford	Chewelah	Au Ag Cu
Hazel (Lake View).....	Northport S19-T40-R42E	Ag
Hecla	Chewelah S4-T32-R41E	Cu Au Ag
Hidden Treasure	Orient S18-T39-R36E	Au
High Grade (Turk) (see Columbia River Copper Co.)		
High Grade (Delmonica).....	Chewelah S31-T33-R41E	Ag Cu
③Hill Property (Iron Jack).....	Chewelah S17, 20-T31-R39E	Fe
Honest John	Chewelah	
②Hope and Twin Cabins.....	Northport S18-T39-R38E	Au Cu Ag
②Hubbard Mining Co. (Reorganized 1939)..... (sold Royal Gold to Bruder Mining Co.) M. K. Jackson, Pres., Colville, Wash.	Northport S32-T40-R39E	Ag Pb
I. O. U.....	Colville S7-T36-R38E	Ag
Ibex	Northport S7-T39-R40E	Ag Pb
Imperial Copper	Chewelah S6-T32-R41E	Cu Ag
Independent Keystone	Chewelah S32-T33-R41E	Cu
②Indian (see Orient-Eureka)		
③Industrial Tungsten Corp..... (Sand Creek Tungsten) (formerly Regina Mining Co.) Ray B. Green, E. 1117 Third Ave., Spokane, Wash.	Deer Trail.....	W

STEVENS—*Continued*

Name	*District Location*	*Product*
International	Orient S6-T39-R37E	Au Ag
Iron Jack (see Hill Property)		
Iron Mask	Orient S29-T40-R37E	Cu Au
②Iroquois (Flannigan)	Northport S29, 30-T40-R42E	Ag Pb Zn
①②Jay-Dee Mining Co. W. B. Stuart, Chewelah, Wash.	Chewelah S31-T33-R41E	Pb Ag
②Jay Gould	Chewelah S8-T32-R41E	Cu Au Ag
Jayhawker	Orient S22-T40-R37E	Au Ag Pb Cu
Jim Dandy	Chewelah S32-T33-R41E	Cu
③Juno Echo (see Western Molybdenum Corp.)		
②Jupiter (see Last Chance)		
Just Time	Northport S15-T40-R42E	Pb Zn
③Keith James Keith, E. 1827 Sprague Ave., Spokane, Wash.	Deer Trail S23-T29-R37E	W
②Kemp-Komar (see Loon Lake Copper)		
①Kettle River Gold Mining Co. (White Elephant) Samuel B. Holbert, Pres., 2001 First, Spokane, Wash.	Orient S19-T40-R37E	Au Ag
Keystone	Chewelah S30-T33-R41E	
Keystone Lead C. R. McDonald, Star Route, Northport, Wash.	Metaline S17, 20-T39-R42E	Pb Fe
③Kulzer	Chewelah S20, 17-T31-R41E	Fe
Krug	Chewelah S26-T33-R39E	Au Ag Cu
Lakeside	Orient	Au Cu
Lakeview	Northport S7-T40-R41E	
②Last Chance (Jupiter) Ben Rockley, et al. Lessees, Northport, Wash.	Northport S24-T39-R40E	Pb Ag
②Leadhill Chas. Bostrom and Ivar W. Luhr	Northport T40-R42E	Pb
Lead King	Northport S12-T39-R41E	Pb
③Lead Trust	Northport S12-T39-R41E	Pb
Liberty	Chewelah S2-T32-R39E	Cu Au Ag
②Little Giant	Orient S30-T40-R37E	Cu Au
②Loon Lake Blue Bird Copper John P. Orchgar, Box 95, Loon Lake, Wash.	Loon Lake S34-T31-R41E	Cu
②Loon Lake Copper (Kemp-Komar)	Loon Lake S33-T31-R41E	Cu
③Lottie	Northport S19-T39-R38E	Au Cu Ag
②Lucile E. C. Owens, 523 S. Washington, Spokane, Wash.	Northport S19-T40-R42E	
Lucky Boy	Northport S7-T37-R40E	Ag Pb
Lucky Charlie	Orient	Au Cu
②Magma Mines Otto Bergland, Colville, Wash.	Northport S28-T38-R41E	Ag Pb Au
②Maryland (formerly Bonanza Copper)	Deer Trail	Cu
Mayflower	Chewelah S28-T32-R41E	Cu
McKale	Chewelah S19-T32-R40E	

STEVENS—*Continued*

Name	*District Location*	*Product*
McKinley	Orient	Au
①McNalley	Orient S33, 34-T40-R37E	Ag Pb
③Melrose W. H. West, Lessee, Northport, Wash.	Northport S28-T40-R41E	Ag Au Cu
Michigan (see Treasure Gold Mining Co.)		
③Middleport	Colville S1-T36-R41E	Zn Pb Au Ag
Mineral Belt	Northport S35-T40-R39E	Pb
Minnehaha	Chewelah	Ag Au Cu
②Minorca	Northport S19-T39-R38E	Au Ag Cu
Mint	Northport	Au Ag Cu
Monday Morning	Northport S4-T37-R41E	Ag Pb
Monitor	Orient	Au
Monohan	Chewelah S18-T32-R40E	
Montana & Washington	Orient S30-T40-R37E	Au Cu Ag
Montezuma	Chewelah S13-T32-R39E	
Montgomery	Chewelah S17, 20-T32-R41E	Ag Cu Pb
Morning A. E. Wilkerson and J. H. McKittrick, Colville, Wash.	Colville	
Mountain View Ben Hofer, Northport, Wash.	Northport S35, 3-T40-39-R39E	Ag Pb Zn
Myeerah P. H. Graham, Colville and Hugh Rieper, Northport, Wash.	Northport S11-T40-R42E	Ag Pb Au
Mystery	Orient S29-T40-R37E	Au Cu
Napoleon	Orient S3-T37-R37E	Fe
Neglected	Northport S10, 11-T37-R39E	
Nest Egg	Northport S30-T39-R37E	Au Ag Cu
Nevada	Chewelah S23-T32-R39E	Cu Pb Zn Ag
New England	Northport S23-T39-R40E	Pb Zn
New Leadville	Northport S3, 10-T37-R39E	Pb Zn
Northport	Northport S16-T39-R40E	Au
North Star	Orient S18, 19-T39-R37E	Au
③Northwest Magnesite Co. Earl Garber, General Manager, Chewelah, Wash.	Chewelah S14-T32-R40E	Mg
③Old Dominion Alexander McLaren, Lessee, Livingston, Montana	Colville S4-T35-R40E	Ag Pb
②O-lo-lim Copper (now Orazaba)		
②Ora	Northport	Cu Ag Au
②Orazaba (see West King Mining Co.)		
③Orchid	Deer Trail	Ag Pb
Ore Cache	Colville S9-T35-R40E	Pb
Orient	Orient	
①③Orient-Eureka (Indian) A. B. Hansen, Orient, Wash.	Orient S25-T40-R36E	Au Cu
Oropacum	Orient S7-T39-R37E	Au

STEVENS—*Continued*

Name	*District Location*	*Product*
Orpha	Northport S19-T39-R38E	Au Cu
Pacific Copper	Chewelah S13-T32-R39E	
①Plug Mrs. Helen Johnson, Northport, Wash.	Northport S33-T39-R41E	Pb Zn
Pomeroy	Orient S22-T40-R37E	
Pop	Orient S27-T39-R37E	Au Cu Ag
Providence	Northport S34-T40-R39E	Cu Ag Pb
①②Queen Seal Lee Thorp, Empire State Bldg., Spokane, Wash.	Deer Trail..... S11-T29-R37E	Ag Pb
R. J.	Northport S3-T37-R39E	Ag Pb
Rambler	Deer Trail..... S15-T30-R38E	Cu
Red Iron	Northport S8, 7, 18-T39-R42E	Pb
Red Lion	Orient S1-T39-R38E	Au Cu
②Red Top Mining Co. J. Richard Brown, Mgr., 409 Metals Bldg., Spokane, Wash.	Northport S24, 25-T40-R42E	Ag Pb Zn
Redwood	Chewelah S5-T32-R41E	Pb
Regina	Orient S33, 34-T40-R37E	Au Cu
③Regina Mining Co. (now Industrial Tungsten Corp.)		
③Rock Creek (formerly Burrus) J. W. Burrus and Ben Melby, Aladdin, Wash.	Northport S8-T37-R41E	Ag Au
Rocky Lake Ross Moorehead, et al. Colville, Wash.	Colville S34-T35-R39E	Au Ag
②Roosevelt	Northport	Au Ag
Royal	Chewelah S28-T33-R41E	
②Royal Gold (formerly operated by Hubbard Mining Co.) (see Bruder Mining Co.)		
Royal Mines (Big Chief and Echo) (leasing from Silver Key Mines Corp.) A. T. Slawson, 727 Garland, Spokane, Wash.	Colville S14-T37-R39E	Ag Pb Zn
Salina	Orient	
③Sand Creek Tungsten (see Industrial Tungsten Corp.)		
②Saturday Night and Sunday Morning	Deer Trail..... S11-T29-R37E	Ag Pb
②Scamen	Northport S19-T40-R42E	Pb
Scotia	Orient S30-T39-R37E	
Second Thought	Orient S18, 19-T39-R37E	Au Ag
Security Copper	Chewelah S6, 7-T32-R41E	Cu
②Silver Basin J. F. Long, Deep Creek, Wash.	Deer Trail..... S11-T29-R37E	Ag Pb Au
②Silver Key Mines Corp. (Big Chief) (leased to Royal) J. McCarthy, 810 Paulsen Building, Spokane, Wash.	Northport S14-T37-R39E	Ag Pb Zn
Silver King	Northport	Ag Pb
Silver Queen	Deer Trail.....	Ag
③Silver Queen (formerly operated by Ark Mines Co.) Ben Melby, et al., Colville, Wash.	Kettle Falls..... S11-T35-R37E	Ag Pb Zn

STEVENS—*Continued*

Name	*District Location*	*Product*
②Silver Seal Fraction	Deer Trail	Ag Pb
Silver Trail J. Richard Brown, 409 Metals Bldg., Spokane	Northport S33-T38-R39E	Ag Pb
St. Crispin	Northport S25-T40-R39E	Cu Au Ag
①②Steel Galena	Colville	Ag Pb Au
St. Paul-Express	Colville	Au Ag Cu
Summit	Colville	
Sunday	Colville S7-T36-R38E	
Sunday Morning (see Saturday Night)		
Sunday Morning Star (see Golden Hope Mining Co.)		
①Sunrise Mining Co. (Uncle Sam) John A. Finch, Spokane, Wash.	Colville S3-T37-R39E	Ag Pb
Sunset	Northport S30-T40-R40E	Au Ag Pb
Superior Copper	Chewelah S29-T32-R40E	Cu Au
Swamp King	Orient S30-T40-R37E	Au
Syndicate	Orient S28-T40-R37E	
Tenderfoot (see Avondale-Dome and Big Chief)		
②Thompson	Northport S23-T39-R41E	Pb Fe
Three Orphans	Orient S26-T40-R36E	Au
Titanic	Orient S7-T39-R37E	Au
①②Togo	Deer Trail	Cu Au
Tramp	Northport	Cu Au
Treadwell	Northport	Pb
Treasure Gold Mining Co. (Michigan) Dr. W. M. Newman, Pres., 310 Rookery Bldg., Spokane, Wash.	Orient S7, 18, 19-T39-R37E	Au Ag
Trojan	Orient S30-T39-R37E	Au
Trophy	Orient S18-T39-R36E	Au
①②Tungsten King (see Blue Grouse Tungsten, Inc.)	Loon Lake	W
①②Tungsten Mines, Inc. (formerly Washington Metals Inc.) Addy, Wash.	Colville	W
①②Tungsten Products, Inc. Deer Park, Wash.	Loon Lake	W
②Turk (High Grade)		
Twilight	Orient S4-T39-R37E	Au Cu
②Twin Cabins (see Hope)		
②U. S. Copper-Gold	Chewelah S17-T32-R41E	Cu Au
Udehard	Orient S17-T40-R37E	Au Cu
Uncle Sam	Orient S27-T39-R37E	Cu Au Pb
①Uncle Sam (see Sunrise Mining Co.)		
②United Copper	Chewelah S30-T33-R41E	Ag Cu
United Treasure	Northport S11-T40-R42E	Ag Pb
②Van Stone	Northport	
Vigilant	Chewelah S18-T31-R41E	Fe
Viking	Orient S36-T40-R36E	Au Cu

STEVENS—*Continued*

Name	*District Location*	*Product*
Vulcan	Chewelah S16-T31-R39E	Cu
Wabash-Detroit	Chewelah S10-T31-R39E	
Washington	Chewelah S29-T32-R40E	
Washington Black Rock (see Black Rock Zinc)		
Wells Fargo	Deer Trail S36-T31-R38E	Sb Ag
①② Western Molybdenum Corp. (Juno Echo) H. C. Swan, Sec., 707 Realty Bldg., Spokane, Wash.	Chewelah S7-T32-R41E	Cu Mo
① West King Mining Co. (Orazaba) Otto Quast, Manager, W 409 2nd, Spokane, Wash.	Deer Trail S9-T28-R37E	Au Ag
① Westvaco Chlorine Products (Double Eagle) J. B. Perry, Gustine, California	Chewelah S17, 18, 19-T31-R39E	Mg
① White Elephant (see Kettle River Gold Mining Co.)		
Windfall	Chewelah S18-T32-R41E	Au Ag
Winslow	Chewelah S26-T33-R41E	
Young America (see Cuprite Mining Co.)		

WHATCOM

③ Anacortes	Slate Creek S24-T38-R15E	Au
③ Azurite Mrs. Chas. Ballard, Pres., Twisp, Wash.	Slate Creek S30, 31-T37-R17E S25, 36-T37-R16E	Au
①② Baltimore Mines, Inc. E. R. Carlisle, Gen. Mangr., 314 Virginia St., Seattle, Wash.	Slate Creek S36, 25, 26-T38-R17E	Au Ag
Beck	Slate Creek	Au Ag Cu
Bonita (see Monica Mines, Inc.)		
③ Boundary Red Mountain (International Gold) (see Red Mountain)		
② Chancellor F. D. Hyde, 75 West St., New York City	Slate Creek	Au
② Eureka	Slate Creek	Au Ag
② Evergreen	Mt. Baker S29-T40-R9E	Au Ag
① Gargott	Mt. Baker	Au Ag Pb
Gold Hill (see Northern Cascade Mines, Inc.)		
Gold Ridge	Slate Creek	Au
② Gold Run	Mt. Baker	Au Ag Cu
Great Excelsior (see President)		
② Harts Pass Mining Co. (Mammoth) Reuben E. Pierson, 620 Olympic Place, Seattle, Wash.	Slate Creek S4-T37-R17E	Au Ag
Hematite	S2-T39-R4E S35-T40-R4E	Fe
Hyatt	Mt. Baker S17-T40-R5E	Cu
③ Indiana Frank D. Hyde, 75 West St., New York City	Slate Creek S3, 4-T37-R17E	Au
Industrial Mining, Inc. Geo. Peterson, 636 Bennett St., Sedro Woolley, Wash.	Twin Sisters	Cr
International Gold (Boundary Red Mountain)		
② Lone Jack (Post Lambert)	Mt. Baker T40-R9E	Au Ag
Lone Star	Mt. Baker	Au

WHATCOM—*Continued*

Name	*District Location*	*Product*
②Mammoth (see Harts Pass Mining Co.)		
③Monica Mines, Inc. (Bonita) (Formerly New Light) B. X. Dawson and R. V. Hale, Lessees, 730 Peyton Bldg., Spokane, Wash.	Slate Creek S27-T38-R17E	Au Ag
③New Light (see Monica Mine, Inc.)		
Ninety-Nine	Slate Creek	Au Ag
Nooksack	Mt. Baker	Au
②North American (Velvet)	Slate Creek	Au Ag
①Northern Cascade Mines, Inc. (Gold Hill) (formerly Gold Hill Operating Co.) M. E. Pulver, Wenatchee, Wash.	Slate Creek S25-T37-R16E	Ag Pb Au Zn
Pierce	Mt. Baker	Au
①Post-Lambert (see Lone Jack)		
President (Great Excelsior)	Mt. Baker S6-T39-R8E	Au Ag
Randall (Gold Coin)	Slate Creek S4-T37-R17E	Au
③Red Mountain Mines (formerly Red Mountain or International Gold) W. W. Wagner and Tom Brown, 445-16th, Bellingham, Wash.	Mt. Baker	Au
②Rockefeller	Slate Creek	Au Ag
Saginaw	Mt. Baker	Cu Au
Silver Tip	Mt. Baker S34-T40-R9E	Au Ag
②Square Shooter	Mt. Baker	Au
Tacoma	Slate Creek	Au
Terra Alta	Mt. Baker	Au
U. S. Chrome Mining Co. (leasing Washington Chrome Co.) A. H. Wilde, Russ Bldg., San Francisco, Calif.	Twin Sisters S7, 18-T37-R7E	Cr
②Velvet (North American)		
Verona	Mt. Baker	Zn Pb Ag
②Washington Chromium Co. (see U. S. Mining Co., lessee) Geo. R. Cooley, Sec., 620 Fourth Ave., Seattle, Wash.		
②Whistler	Slate Creek S8, 17-T37-R14E	Au

YAKIMA

Black Hawk	Summit S25-T17-R10E	Au
Black Jack	Bumping Lake S36-T15-R11E	Zn Cu
③Copper Mining Co. (see Rare Metals Corp., Lessee)		
Gold Hill Consolidated G. A. Mosbar, Route 3, Yakima, Wash.	Summit S17-T11E	Au Ag Cu W
Gold Links Mining Co. H. H. Harris, P. O. Box 570, Yakima, Wash.	Summit S4, 5-T17-R11E	Au
Keystone Sam Harlow, Route 8, Yakima, Wash.	Bumping Lake S35-T16-R12E	W
Manitau Mining & Milling Co.	Summit	Au Ag
③Rare Metals Corp. (leasing Copper Mining Co.) Yakima, Wash.	Bumping Lake	W Mo Cu
Richmond	Bumping Lake	Ag Pb Au
Welcome	Summit	

DIVISION OF GEOLOGY

HAROLD E. CULVER
Supervisor

INTRODUCTION

First official survey. 1890-1891. The first geological survey work in Washington was officially authorized in 1890 by act of the first legislature to convene in the newly established State. The difficulties of operation were greater than was anticipated, and after about 2 years of activity the office of State Geologist was closed. During this period, however, two publications were issued. As required by law these were reports to the Governor and the Legislature and constituted a preliminary statement of such examination of the mineral resources of the State as the limited facilities at hand permitted. No further allocation of funds was made, and the survey work lapsed for 8 years.

Washington Geological Survey. 1900-1921. In 1900 a Geological Survey for the State was again authorized and has been continually in existence since that date. In prescribing the functions for the new Geological Survey the plan of operations of the first State Geologist was almost totally disregarded, and there was provided instead a list of eight specific objectives which the Survey was to seek. In abbreviated form these were:

(1) An examination of the economic products of the State, metallic and nonmetallic, including all mineral substances of value.
(2) An examination and classification of soils.
(3) Investigation of water supplies, both surface and subsurface, with reference to their use.
(4) An examination into the different road-building materials.
(5) An examination of the physical features of the State with reference to occupations of the people.
(6) The preparation of geological and economic maps to illustrate the State's resources.
(7) The preparation of special reports embracing both the general and detailed description of geology and resources of the State.
(8) A consideration of related scientific and economic questions.

Another provision in the act required the printing of reports by the Survey so that the benefit of the scientific work might become speedily available to the State.

The First Annual Report of the new Survey appeared in 1901 in six parts representing an amount of work far in excess of anything previously undertaken. Part I included a brief outline of the geology of the State, Part II dealt with the metalliferous resources except iron, Part III dealt with the nonmetalliferous resources except coal, Part IV presented all information then known on the iron and coal deposits of the State, Part V was a preliminary report on water resources, and Part VI comprised of brief bibliography of literature referring to geology of Washington.

The Second Annual Report, in 1902, was patterned after the preceding issue but dealt with only two of the resources of the state, i. e., building and ornamental stones and coal deposits. There followed a period of several

years during which the work appears to have been greatly reduced in scope, for it was not until 1910 that another publication appeared. This report was the first of an extended series of Bulletins which followed in the course of the next 11 years. These covered a wide range of resources, as indicated in the following list:

1. Geology and ore deposits of Republic mining district. 1910. 67 pp.
2. The road materials of Washington. 1911. 204 pp.
3. The coal fields of King County. 1912. 247 pp.
4. Cement materials and industry in Washington. 1913. 268 pp.
5. Geology and ore deposits of the Myers Creek and Oroville-Nighthawk districts. 1911. 111 pp.
6. Geology and ore deposits of the Blewett mining district. 1911. 104 pp.
7. Geology and ore deposits of the Index mining district. 1912. 96 pp.
8. Glaciation of the Puget Sound region. 1913. 244 pp.
9. The coal fields of Kittitas County. 1914. 204 pp.
10. The coal fields of Pierce County. 1914. 146 pp.
11. The mineral resources of Washington, with statistics for 1912. 1914. 53 pp.
12. Bibliography of Washington geology and geography. 1913. 63 pp.
13. The Tertiary formations of western Washington. 1916. 327 pp.
14. A preliminary report on the Quincy Valley irrigation project. 1912. 49 pp.
15. A preliminary report on the Tertiary paleontology of western Washington. 1912. 80 pp.
16. Geology and ore deposits of the Covada mining district. 1913. 87 pp.
17. A geographic dictionary of Washington. 1917. 346 pp.
18. The country about Camp Lewis. 1918. 105 pp.
19. The coal fields of southwestern Washington. 1919. 155 pp.
20. The mineral resources of Stevens County. 1920. 350 pp.
21. The mineral resources of Washington, with statistics for 1919. 1921. 155 pp.
22. The road building sands and gravels of Washington. 1919. 307 pp.
23. The metal mines of Washington. 1921. 366 pp.
25. The magnesite deposits of Washington, their occurrence and technology. 1921. 194 pp.

The manuscript for Bulletin 24, a very important contribution on the clays of the State of Washington, was ready for submission to the State Printer in 1921, but its publication was not authorized at that time.

Division of Geology. 1921-. Under the Civil Administrative Code of 1921 all of the prescribed duties of both the Board of Geological Survey and the State Geologist were transferred to the Director of the Department of Conservation and Development. Meanwhile all work with reference to soils and their adaptibility to crops had been undertaken in cooperation with the United States Department of Agriculture and resulted in the publication of a series of soil reports illustrated by large-scale maps of many areas of the State. This work is now continued under the guidance of the Supervisor of the Division of Soils. In precisely the same way, investigation of water supplies had been undertaken in cooperation with the Water Resources Branch of the United States Geological Survey and results published in the regular Water Supply Papers of the Federal organization. This work is now continued under the guidance of the Supervisor of Hydraulics.

In 1921, then, the official name of the organization was changed from the State Geological Survey to the State Division of Geology as a unit of the Department of Conservation and Development, and the Survey offices were transferred from Seattle to Pullman. This change resulted in only slight interruption of activities, and for the first 4 years the Division of Geology was operated along lines laid down during the preceding 20 years, both

field studies and publications following the same general pattern. Funds were available for publication of the following reports:

26. Underground water supply of the region about White Bluffs and Hanford. 1922. 41 pp.
27. Iron ores, fuels and fluxes of Washington. 1922. 160 pp.
28. Geological investigation of the coal fields of western Whatcom County, Washington. 1923. 135 pp.
29. Geological investigation of the coal fields of Skagit County, Washington. 1924. 63 pp.
30. The mineral resources of Washington, with statistics for 1922. With an article on coal and coke. 1924. 224 pp.
31. Lead deposits of Pend Oreille and Stevens counties, Washington. 1924. 153 pp.

Beginning in 1925 a somewhat different policy for operations of the Division of Geology was necessitated by a very sharp restriction of the funds made available by the administration at Olympia. No money whatever was provided for publication of investigational results between 1924 and 1935, so that period is represented only by administrative reports and one brief mimeographed Report of Investigations.

Under these conditions there was no point in attempting specific economic studies, and such funds as became available for field investigations, therefore, were utilized in the study of the structural and stratigraphic features of the State. In the progress of this work the boundaries of the great masses of sedimentary and granitic rocks were determined and an understanding of the regional geology for most of the State secured. As the work of this decade progressed it became more and more evident that a complete geologic map of the whole State could be made by compiling and editing the accumulated facts. For more than 30 years there had been attempts to prepare such a map, and from 1932 to 1935 the work of the Division was centered on that task.

When the Director of the Department of Conservation and Development provided some funds for publication in 1935 the most important and largest expenditure was for the printing of a large-scale lithographed geologic map of the State. Without the interest and financial assistance of the State Planning Council this would not have been accomplished. A short descriptive bulletin was also written to explain the construction and use of the geologic map. This appeared as Part I of Bulletin 32 under the title, General Features of Washington Geology. Other publications which appeared during this biennium were:

Report of Investigations No. 2, a detailed examination of the oil and gas possibilities of western Whatcom County. 1935. 69 pp.

Report of Investigations No. 4, a preliminary report on petroleum and natural gas in Washington. 1936. 24 pp.

Bulletin 33, a comprehensive report on the nonmetallic resources of every county in the State, with statistics of production for 1933. 1936. 135 pp.

Information Circular No. 1, the status of topographic mapping. 1935. 10 pp.

Information Circular No. 2, a summary of Washington minerals, production, and resources. 1935. 10 pp.

During the biennium of 1937-38 the restriction of funds for geologic activities again prevented the publication of results, but the investigational work continued. Following a plan worked out several years earlier, all available information on every mining property had been studied, abstracted, and the results placed in a completely indexed card file. There followed the actual

field study of the mining properties themselves. This work was vigorously prosecuted during the whole biennium, and mine examinations were made of some of the properties in every county which has produced metals.

DIVISION ACTIVITIES 1939-1940

Economic Objective. Without knowledge of where commercially valuable materials may be found, little or no efficient progress toward commercial development can be made. Thus the primary object of any survey dealing with natural resources is an accurate inventory of those resources. Few people realize that the enumeration of mineral resources is a matter entirely different from that of the enumeration of most other natural resources. In the forest, for example, it is possible to make a complete inventory of the trees down to the last stick of merchantable timber. All that is required is a knowledge of woods and of their measurement.

Far different is the situation in the field of mineral resources. Few deposits are exposed at the surface of the ground, and in those few the cover of mantle rock, soil, and vegetation prevents exact measurement. For such materials as clay, which may lie near the surface in horizontal beds, variations in character and thickness demand thorough drilling for estimation of available tonnages in advance of actual operations. For such substances as coal there is a further difficulty due to the folding, faulting, and deep burial of the beds. In metallic deposits the complications are so tremendously multiplied as to make any reasonably accurate estimate of resources extremely difficult. Direct measurement of such resources is impossible. Instead there must be employed an indirect procedure through an understanding of how the deposit was formed.

Whatever the difficulties of achievement, it is necessary to estimate probable tonnage of mineral resources on some basis, since only from a knowledge of the amounts involved is it possible to determine whether a given deposit is commercially workable. The application of geology in preliminary exploration is therefore of the highest importance, and most of the work of the State Division has been along this economic line.

Scope of geologic work. During the current biennium the Division of Geology has concentrated efforts on five lines of economic work. These are (1) metals, (2) nonmetals, (3) strategic minerals, (4) field services, and (5) laboratory identification service, each of which is described in the following paragraphs.

Investigations of metals. Past work has demonstrated beyond doubt that a large number of metallic substances occur within the boundaries of the State. The practical aspect of development, however, demands that before any plans for operations are formulated there must be very careful field and laboratory studies made to determine just where commercially important deposits are to be found, just what their character is, and approximately what ore tonnages may ultimately become available. Since 1933 the most important specific work of the Division of Geology has been a thorough study of all mines and prospects within the State. Every available scrap of information ever published on any property has been studied and abstracted in the preparation of a complete card file, which now numbers about 15,000 items. During the current biennium, even with the limited facilities at our

disposal, the examination of metalliferous deposits has been vigorously pushed, and many additional properties have been studied. The object here is not merely to catalog mining operations and equipment but to record geologic facts only obtainable from the workings. By this means our knowledge of the regional geology of a district is tremendously increased. Only on the basis of such understanding of the structural and mineralogic conditions is it possible to indicate the probable commercial development in a given area.

This work was carried on in Chelan, Ferry, Skagit, Skamania, Snohomish, Stevens, Whatcom, and Yakima counties during 1939-1940. As rapidly as possible every operation, whether producing or not, in each mining district is being studied. As fast as money becomes available the results of these investigations will be published.

In addition to the detailed study of the geology of mining operations, about 5 weeks of August and September, 1940, were spent in the Cascade-Stehekin district of Skagit and Chelan counties. The exceptional withdrawal of snow and ice during the past season made the rocks of this region unusually accessible. This survey covered the five mineralized areas centering about Boston Peak. They are locally known as Boston, Doubtful, Horseshoe, Park Creek, and Thunder Creek basins. Plane-table surveys were made in the first three to determine the exact locations of most of the important workings. Many details of the geology were determined and a large number of rock specimens and ore samples were selected for laboratory study.

Investigations of nonmetals. Previous to this biennium oil and gas studies were completed for Whatcom and Skagit counties, although only the first has been published. In that report the results of testing in the "shallow field" were given and attention was called to the very favorable structures present in the area where deeper tests should be made. Since that time drilling has been almost continuous and is still under way in the Bellingham field. Of the large number of wells which have been sunk in the State of Washington, more than a score have been located in the Olympic Peninsula. The results of many of the tests have made it clear that there was reasonable hope of finding oil pools of commercial importance, and the Division's studies have served to accentuate the possibility. One serious drawback has been the lack of any basis on which the logs of the several wells could be correlated, so that the stratigraphic zones penetrated could be recognized. During the present biennium there has been completed a detailed plane-table survey of the only portion of the Olympic Peninsula in which such geologic information could be obtained, namely, along the coast. Three seasons of field work have resulted in the detailed mapping of the coast from Cape Flattery to Grays Harbor. These preliminary studies are of the greatest practical value in any subsequent tests made in this region.

In addition to this specific project the Division has continued during the entire biennium to keep in contact with all operators of drilling that has been undertaken, and in this work the Division is glad to acknowledge the very cordial cooperation which has been manifested almost universally. After understanding the nature of the work of the Survey, operators and drilling men alike have been more than willing to aid in the proper logging of holes and have been willing to share all samples collected from the tests.

As has been pointed out in earlier reports, a carefully planned system for the examination, description, and filing of all samples in such way that

the results are readily available and at the same time are held strictly confidential has been in operation for many years. It has been possible to be of considerable assistance to drillers in many instances, and this aid will be greatly increased by the continued addition of accurate logs and representative drill samples.

Because of the importance of our supplies of magnesite it was determined several years ago to start an investigation which would aid in the determination of the actual amount of magnesite present in the State. In the course of two seasons most of the known magnesite deposits were mapped and carefully sampled. This work had to be discontinued until the present biennium. During 1940 some additional studies were made, and the samples collected are now being analyzed through the cooperation of the United States Bureau of Mines. Further field studies will be undertaken as soon as these results are at hand.

Strategic minerals. In view of the need for certain materials for national defense, work has been undertaken in a few areas where detailed information was needed. Among the more important strategic minerals known to occur in Washington, those most commonly mentioned are chromium, tungsten, manganese, nickel, and tin. No production of nickel has ever been recorded, although encouraging reports of nickel deposits have been made recently. Only small quantities of tin have appeared, these from Spokane County, and the outlook does not appear favorable for commercial production. During the earlier World War there was production of both tungsten and chromium, and immediately thereafter considerable production of manganese. To many interested persons it has seemed that even greater production of these metals would follow increased demand with corresponding increase of prices. Nothing could be farther from the truth. The pressure of high prices only serves to stimulate prospecting. Production can only follow if that search is successful. In the public mind our mountains are full of mineral wealth only waiting to be mined. It is not realized that even such a deposit as that of molybdenum at Climax, Colorado, requires detailed exploration as well as special methods of development.

It has been possible to examine all of the more important tungsten deposits so far reported. These include the interesting vein deposits in western Yakima County, those in southern Stevens County, as well as some near the Canadian boundary in northwestern Okanogan County. The results of these field studies are now being supplemented by laboratory and office investigations, so that any statement of results at this time would be premature. The work so far makes it clear, however, that certain deposits, while distinctly not of as high grade as has been reported, show much greater possibilities in low grade ores than have been recognized.

Chromium has been commercially produced from only two deposits in Whatcom and Skagit counties, but the showings at several other localities, including Kittitas and Okanogan counties, indicate commercial possibilities. Preliminary studies have been made in the latter district, and a detailed survey has been made of all claims in the Twin Sisters district of Whatcom and Skagit counties. The actual occurrences of chromite have been studied, and the mapping has included also the entire area of dunite in which the chromium occurs. Laboratory examination of all these materials is essentially complete, and the manuscript for the report is now being written.

Strategic mineral investigations within the State have been conducted during 1940 by representatives of the United States Geological Survey and the United States Bureau of Mines. All Divisional work on strategic minerals has been closely correlated with the Federal work so that there has been no duplication of effort.

Field service. In the course of their economic work staff members of the Division continually meet prospectors and others who have geologic problems to solve in connection with exploration and development. In some cases it is a matter of the mineralogy of ores or the structure of rock formations; in others it is a question of where to drift or drill for ore bodies. On the basis of an understanding of the formation of mineral deposits and particularly a knowledge of the local geologic conditions it is usually possible to furnish reliable answers to these questions which save both time and money for the operators. The warm reception and grateful recognition of this service is universal, and an enlargement of the scope of this activity is planned. By such expansion it will be possible to provide such aid to all who are engaged in the development of our mineral industry.

Laboratory identification service. More and more generally it is becoming known that rocks and minerals found in the State may be submitted for examination without charge. Since neither chemical analyses nor assays are made in the Division laboratories, the State is not competing with the commercial chemist. Instead, the sender is advised not only as to what assays to have made but as to any warranted development. This service is closely tied in with the field service and provides a means by which laboratory answers to many geologic and mineralogic questions can be given without charge to those needing information.

In all of the foregoing economic work of the Division there has continued during the present biennium the same cordial cooperation between the staff members and the people of the State which has characterized all earlier efforts. Properties and records have been freely opened for inspection and all phases of the work greatly aided by operators and prospectors alike. It is a pleasure to acknowledge with gratitude the personal contribution of hundreds of the State's citizens.

Other geologic work. Besides the economic studies which constitute the predominant activity of the Division of Geology, there are some investigations which need to be undertaken because of their value to future economic work. One such task was forced into prominence by the dam construction at Grand Coulee. The rising waters upstream from the dam site will flood a large acreage in which the rocks have been laid bare by long years of stream erosion. Once covered, these formations will be lost to view and an important source of geologic information obliterated. For the past several seasons, through the cooperation of the State College of Washington, surveys of this area have been carried out, and during the current biennium the field work has been finished. The results of this study are already proving important in the solution of some of the problems of mineral deposits of Ferry and Stevens counties.

Publications. In 1939 the Director set aside funds for the printing of two important publications, Bulletin 35, entitled Bibliography and Index of

Geology and Mineral Resources of Washington, and later in the biennium, Bulletin 24, entitled The Clays and Shales of Washington.

The Bibliography is a list of all printed or mimeographed articles which relate to the geology of the State. Each author's work appears together, the authors' names being in alphabetical order. In addition to the title there is given the length of the article, the book or periodical in which it was published, and the date of publication. Here are included for the first time all available references on both mineral deposits and geology of the State of whatever nature. The search for such material in books, official reports, or articles covered publications from the year 1814 to the close of 1936. With the Bibliography was printed an Index thereto, providing a ready means of reference to any article on any phase of geology for any county or district of the State.

The clay report, Bulletin 24, is the geologic part of a threefold cooperative project begun before 1920 by the State Geological Survey, the United States Bureau of Mines, and the Engineering Experiment Station of the University of Washington. The publication of the Experiment Station's Bulletin 18 giving analytical results was to have been followed by Geological Survey Bulletin 24 giving geologic results, but lack of funds prevented immediate publication of the Survey's contribution. Since its original preparation in 1921 the report has been brought completely down to date both by additional field work and careful revision of the manuscript. Here is presented exactly the information needed by a clay user, both as to physical and chemical properties, for every known deposit of clay, whether it has ever produced or has merely been prospected.

Until results are published the people of the State can hardly benefit from Divisional studies. The printing of reports is properly considered to be of the greatest importance. Sufficient funds for publication have been lacking for more than 15 years, and there are great masses of accumulated data for which inquiries and requests come in continually. During the coming biennium every effort will be made to push the preparation of manuscripts so that publication can be made as rapidly as money is available for that purpose. It is proposed to publish these results in the following reports:

BULLETINS

32. Part II. Index to the stratigraphy of Washington.
34. Metallic resources of Washington.
36. Geology of the south half of the Colville quadrangle.
37. Geology of the Chewelah quadrangle.

REPORTS OF INVESTIGATIONS

5. Oil and gas possibilities of western Skagit County.
6. Chromite deposits of Twin Sisters Mountains.
7. Stratigraphy and structure of the west coast of the Olympic Peninsula.
8. Preliminary report on tungsten deposits in Washington.
9. Mineral deposits of the Cascade-Stehekin district.
10. Geology of the Columbia Valley above Grand Coulee Dam.
11. Preliminary report on magnesite and dolomite resources in Washington.

TOPOGRAPHIC MAPPING

Although topographic mapping in the State of Washington has been done under the auspices of more than a score of separate government agencies as well as many more private agencies, the standard topographic sheets of 15-

or 30-minute quadrangles have been prepared mainly by the expert staff of the Topographic Branch of the United States Geological Survey and, during the past few years, by the United States Army. With few exceptions the Army mapping and much of the United States Geological Survey mapping has been entirely financed by Federal funds, but in accordance with Federal regulations in effect since 1909 a considerable portion of the topographic mapping has had to be done on a cooperative basis by which each dollar expended by the Federal Government has been matched by a dollar of State money.

The cost of this surveying varies greatly with the roughness and relief of the different parts of the State. For example, the Mount Constance quadrangle in the Olympic Mountains cost approximately $18,000, while the Chehalis quadrangle cost about $14,500, and the Connell quadrangle cost somewhat less than $13,000.

A tabulated statement of topographic mapping in Washington is given below, followed by a summary showing progress to date. It will be noted that the earlier mapping was entirely on 30-minute quadrangle units and also that in the cooperative mapping the more valuable 15-minute units have predominated. Experience has shown that the advantages of mapping in 15-minute units more than compensate for the increased cost. Practically all of the recent work by the Army is in the preparation of maps of this scale.

WASHINGTON TOPOGRAPHIC QUADRANGLES

Quadrangle	*Location by index number*①	*Date mapped*	*Remarks*
Aberdeen	N4645-W12345/15	Authorized	Includes south ½ Hoquiam quadrangle
Allyn	N4715-W12245/15	Authorized	
Anacortes	N4830-W12230/15		
Anderson Island	N4700-W12230/15	1939	
Arlington	N4530-W12000/30	1912-13	
Asotin	N4600-W11700/30		
Astoria	N4600-W12345/15	1935-36	
Bacon	N4715-W11915/15		Partly mapped; special.
Badger Pocket	N4645-W12015/15	Authorized	
Beverly	N4645-W11945/15	1909-10	
Birch Bay	N4845-W12250		30' of lat., 5' of long.
Bissell	N4800-W11800/30		
Blaine	N4845-W12230	1905	15' of lat., 20' of long.
Blalock Island	N4530-W11930/30	1906	
Boylston	N4645-W12000/15	Authorized	
Brookfield	N4615-W12330/15	Authorized	
Cape Disappointment	N4615-W12400/15	1936	
Cape Elizabeth	N4715-W12415/15	Authorized	
Cape Flattery	N4815-W12430/15	1934-35	
Cape Shoalwater	N4630-W12400/15	1936	
Cathlamet	N4600-W12315/15	Authorized	
Cedar Lake	N4700-W12130/30	1910-11	
Chehalis	N4630-W12230/30	1913-14	
Chelan	N4730-W12000/30	1897-98	
Chewelah	N4800-W11730/30	1924, 27	
Chiwaukum	N4730-W12030/30	1900-01	
Chopaka	N4830-W11930/30	1902-03	

① The index number gives the latitude and longitude of the southeast corner of the quadrangle. The last two digits give the size of the quadrangle in minutes. Example: the Anderson Island quadrangle, N4700-W12230/15, extends north 15' and west 15' from the intersection of 47°00' north latitude and 122°30' west longitude.

Quadrangle	*Location by index number*①	*Date mapped*	*Remarks*
Clallam	N4815-W12415/15	1934-35	
Clatskanie	N4600-W12300/15	Authorized	
Colockum Pass	N4700-W12000	1919-20	South ½ of a 30' quad.
Colville	N4830-W11730/30	1927-29	
Connell	N4630-W11830/30	1916	
Corfu	N4645-W11950/15	1921	
Coulee City	N4730-W11900/30		Partly mapped; special.
Coupeville	N4800-W12230/15	Authorized	
Coyote Rapids	N4630-W11930/15	1913-14	
The Dalles	N4530-W12100/30		
Davenport	N4730-W11800/30		
Deception Pass	N4815-W12230/15	1936	Mostly mapped.
Destruction Island	N4730-W12415/15	Authorized	
Dungeness	N4800-W12300/15	1936	
East Sound	N4830-W12245/15		
Eatonville	N4630-W12200/30	1930, 32, 34	
Elk Park	N4730-W12345/15		
Ellensburg	N4630-W12030/30	1899	
Ephrata	N4715-W11930/15		Partly mapped; special.
Ford	N4645-W12315/15	Authorized	
Forks	N4745-W12415/15	1934-36	
Fort Columbia	N4615-W12345/15	Authorized	
Friday Harbor	N4830-W12300/15		
Gate	N4645-W12300/15	Authorized	
Gig Harbor	N4715-W12230/15	Authorized	
Glacier Peak	N4800-W12100/30	1897-99	
Goldendale	N4530-W12030/30		
Grayland	N4645-W12400/15	Authorized	Includes south ½ Ocosta quadrangle.
Hanford	N4630-W11915/15	1922	
Hillsboro	N4530-W12245/15	1915	
Hog Ranch Buttes	N4630-W12200/15	Authorized	
Hood River	N4530-W12130/30	1925-26	
Hoquiam	N4652½-W12345/15	1911-12	
Humptulips	N4700-W12345/15	Authorized	Includes north ½ Hoquiam quadrangle.
Jameson	N4730-W11930/30		
Kalama	N4600-W12245/15	Authorized	
Kanaka Bay	N4815-W12300/15		
Keller	N4800-W11830/30		
La Center	N4545-W12230/15	Authorized	
La Push	N4745-W12430/15	1934-36	
Lake Crescent	N4800-W12345/15	1918	
Lake Nahwatel	N4700-W12315/15	Authorized	
Lookout Mountain	N4545-W12200/15	Authorized	
Malaga	N4715-W12000/15	1911-12	
Marblemount	N4830-W12100/30		
Marcus	N4830-W11800/30	Authorized	
Mazama	N4830-W12000/30		
Meskill	N4630-W12300/15	Authorized	
Metaline	N4830-W11700/30	Authorized	
Methow	N4800-W12030/30	1897, 99	
Moclips	N4700-W12400/15	Authorized	Includes north ½ Ocosta quadrangle.
Mohrweis	N4715-W12315/15	Authorized	
Montesano	N4645-W12330/15	Authorized	

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Quadrangle	*Location by index number*①	*Date mapped*	*Remarks*
Moses Lake	N4700-W11915/15	1910	
Mount Adams	N4600-W12100/30	1903-04	
Mount Aix	N4630-W12100/30	1900-02	
Mount Baker Dist.	N4830-W12130/30	1907, 09	
Mount Constance	N4730-W12300/30	1930-31, 34	
Mount Hood & Vic.	N4518-W12139	1907, 1909-11	26′ of lat., 36′ of long.
Mount Olympus	N4745-W12330/15	1935	
Mount Rainier	N4630-W12130/30	1924	
Mount Rainier National Park	N4644-W12130	1910-13	Special map
Mount St. Helens	N4600-W12200/30	1913-14, 16	
Mount Stuart	N4700-W12030/30	1896-97	
Mount Tom	N4745-W12345/15	1937	
Mount Vernon	N4800-W12200/30	1909	
Mowbray	N4700-W12330/15	Authorized	
Newport	N4800-W11700/30	Authorized	
Oakesdale	N4700-W11700/30	1903	
Ocosta	N46$52\frac{1}{2}$-W12400/15	1913	
Okanogan	N4800-W11930/30	1903	
Olequa	N4615-W12245/15	Authorized	
Olympia	N4700-W12245/15	1934	
Omak Lake	N4800-W11900/30		
Osoyoos	N4830-W11900/30	1902	
Othello	N4645-W11900/15	1922	
Ozette Lake	N4800-W12430/15	1934-35	
Pacific Lake No. 1	N4715-W11830/15		
Pacific Lake No. 2	N4715-W11845/15		
Pacific Lake No. 4	N4700-W11830/15		
Palisades	N4715-W11945/15		Partly mapped; special.
Pasco	N4600-W11900/30	1904, 14	
Pierce	N4730-W12330/15		
Pigeon Springs	N4600-W12230/15	Authorized	
Pleasant Lake	N4800-W12415/15	1934-35	
Point Misery	N4730-W12245/15	1936	
Point Roberts	N4850-W12300		Irregular area.
Pomeroy	N4600-W11730/30	Authorized	
Port Angeles	N4800-W12315/15	1917	
Port Crescent	N4800-W12330/15	1917-18	
Port Gamble	N4745-W12230/15	1936	
Port Orchard	N4730-W12230/15	Authorized	
Port Townsend	N4800-W12245/15	1936	
Portland	N4530-W12230/15	1896	
Potlatch	N4715-W12300/15	Authorized	
Priest Rapids	N4630-W11945/15	1913-14	
Prosser	N4600-W11930/30	1915	
Pullman	N4630-W11700/30	1903-05	
Pysht	N4800-W12400/15	1918	
Queets	N4730-W12400/15	Authorized	
Quilcene	N4745-W12245/15	1936	
Quinault Lake	N4715-W12345/15	Authorized	
Quincy	N4700-W11945/15	1909	
Raft River	N4715-W12400/15	Authorized	
Reardan No. 1	N4745-W11730/15	Authorized	
Reardan No. 2	N4745-W11745/15		
Reardan No. 3	N4730-W11745/15		
Reardan No. 4	N4730-W11730/15	Authorized	
Red Rock	N4645-W11930/15	1909	

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Quadrangle	*Location by index number*①	*Date mapped*	*Remarks*
Republic	N4830-W11830/30	1901	
Richardson	N4815-W12245/15		
Riparia No. 1	N4645-W11800/15		
Riparia No. 3	N4630-W11815/15		
Riparia No. 4	N4630-W11800/15		
Ritzville	N4700-W11800/30		
Rock Lake	N4700-W11730/30		
St. Helens	N4545-W12245/15	Authorized	
Samish Lake	N4830-W12215/15	1917	
Satsop	N4715-W12330/15	Authorized	
Schrag	N4700-W11845/15	1923	
Scootenay Lake	N4630-W11900/15	1922	
Seattle	N4730-W12215/15	1893	Special map
Shelton	N4700-W12300/15	Authorized	
Skamokawa	N4615-W12315/15	Authorized	
Skykomish	N4730-W12100/30	1897, 1902	
Slate Pass	N4830-W12030/30		
Snohomish	N4730-W12200/30	1893-95	
Snoqualmie	N4700-W12100/30	1900-01	
South Bend	N4630-W12345/15	1938	
Spokane	N4730-W11700/30	1898	Now being remapped.
Spruce Mountain	N4745-W12400/15	Authorized	
Steamboat Mountain	N4600-W12130	1924-26	
Stehekin	N4800-W12030/30	1901-02	
Stilaguamish	N4800-W12130/30	1897-99	
Sultan	N4730-W12130/30	1919-21	
Sumas	N4845-W12215/15	1906	
Svenson	N4600-W12330/15	Authorized	
Tacoma	N4700-W12200/30	1894-95	
Toutle	N4615-W12230/15	Authorized	
Troutdale	N4530-W12215/15	Authorized	
Umatilla	N4530-W11900/30	1907	
Van Zandt	N4845-W12200/15	1917-18	
Walla Walla	N4600-W11800/30	1916, 19	
Wallula	N4600-W11830/30	1915	
Walville	N4630-W12315/15	Authorized	
Washtucna	N4645-W11815/15	1923	
Wenatchee	N4715-W12015/15	1911-13	
Wheeler	N4700-W11900/15	1923	
White Swan	N4600-W12030/30	1934	
Wickersham	N4830-W12200/15	1917-18	
Wilbur	N4730-W11830/30		
Wildwood	N4615-W12300/15	Authorized	
Willapa	N4630-W12330/15	Authorized	
Wilson Creek	N4715-W11900/15		Partly mapped; special.
Winchester	N4700-W11930/15	1909	
Winona	N4630-W11730/30		
Yacolt	N4545-W12215/15	Authorized	
Yakima East	N4630-W12015/15	Authorized	
Zillah	N4600-W12000/30	1906	

Examination of the foregoing tables shows that final maps or advance sheets are now available for about 69% of the total area of the State. Mapping has been begun or authorized for an additional 9%, making a total completed and authorized of some 78% of the State's area. Of the new work now in progress or authorized, that by the United States Army covers 5,541 square miles, while that by the United States Geological Survey covers about 308

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square miles. During the current biennium the State has cooperated in the surveying of the Badger Pocket, Boylston, and Reardan quadrangles.

RECOMMENDATIONS

The economic basis for all activities of the Division of Geology has been indicated and the work of the present biennium briefly outlined in the foregoing pages. There follow some specific recommendations relating to the future activities of the Division along three distinct lines, (1) economic investigations, (2) field service, and (3) publication of results of investigations.

(1) Economic investigations of some of the more important industrial minerals, both metals and nonmetals, have been begun. With present facilities it will be several years before this work can be completed. *Therefore, it is recommended that the scope of this work be expanded sufficiently to permit the early completion of studies on the State's resources of the metals chromium, tungsten, nickel, mercury, and manganese; and of the nonmetals magnesite, coal, alunite, salines, and diatomite.* This short list by no means includes all the important industrial minerals with which the State is provided, but it does represent those on which geologic work has already been begun by the Division.

(2) No feature of the Divisional work has received wider approval than the field services which have been rendered more or less incidentally in connection with economic investigations. Provisions should certainly be made to permit the much needed expansion of this work. Other basic industries such as fisheries, lumbering, and agriculture have for a long time been receiving official aid from governmental bureaus. The mineral industry is entitled to the same sort of assistance from the Division of Geology. *It is therefore recommended that the staff of the Division of Geology be augmented by the addition of three economic geologists, two to be properly trained and experienced in the field of metallic resources, and one to have corresponding training and experience in the nonmetallic field.* By this assignment of all members of the enlarged staff to more or less specialized fields it would be possible to furnish adequate geologic aid in our rapidly growing mineral industry.

(3) As indicated earlier in this report, money for publication has been in large part lacking for the past 15 years. During this period it has not been possible to provide the public with the maximum benefit of much of the investigational work done.

In the foregoing pages under the heading of Publications is given a list of reports for which the field and laboratory work has been carried well along toward completion so that publication can be made as rapidly as funds are available. While the value and importance of the several reports is not the same in all cases, there is urgent need for the publication of every one. *It is recommended that a specific sum be allocated for the printing of reports during the coming biennium.* Since the total cost of publication of reports above referred to will be about $4,000 it is desirable that an appreciable portion of the money be made available during the coming biennium.

When giving consideration to these three recommendations it should particularly be noted that the requests are not for expansion of the work of the Division of Geology in new and untried lines, but instead are wholly planned to provide the citizens of the State with the benefit of work either already completed or in progress.

FLOOD CONTROL

LARS LANGLOE
Flood Control Engineer

The State flood control policy established by the 1935 Legislature delegates its administration to the Director of Conservation and Development. He is directed to cooperate with any Federal and State agencies engaged in flood control planning and is authorized to participate in flood control works which he deems to be of general benefit to the State.

Since no funds were available for participation in actual construction of flood control works the Department's activities were necessarily confined to investigation and study of some of the more pressing problems both independently and in cooperation with other active agencies. The Department's flood control engineer thus spent considerable time assisting the United States District Engineer Office at Seattle in the study of some of the more important flood control projects under investigation by that agency.

During the biennium the Department organized the Upper Grays River Flood Control District in Wahkiakum County. This is the first district launched under the 1937 flood control district act. The initiation of organization efforts was immediately followed by construction of the Federal Project for improvement of Upper Grays River described elsewhere in this report.

Petitions were received by the Department for the organization of two other districts, one in Skagit County and the other in Walla Walla County. Preliminary investigations of these proposed projects indicated the desirability of further preliminary local discussion and revision of areas proposed to be included. The Department therefore concluded that, for the time being, it was not justified in going through with the rather costly procedure incident to organization of these two districts.

FEDERAL FLOOD CONTROL WORK

Construction Work

Under the supervision of the United States Army Engineers construction work has been undertaken or continued during the past biennium on several important projects which were authorized by Congress under the Federal Flood Control Act.

Mud Mountain Dam

This dam on White River 7 miles southeast of Enumclaw creates sufficient storage capacity to fully protect the Puyallup Valley and the Tacoma industrial area against floods to the magnitude of 80,000 cubic feet per second at Puyallup. The greatest discharge so far observed was 57,000 cubic feet per second in December, 1933. The project was authorized by the Federal Flood Control Act of 1936. It is to be owned by the United States and operated and maintained by the Army Engineers. The dam will be of the rock-filled type with an earthen core. It is 425 feet high above bed rock and the basin created will detain 129,000 acre-feet below the crest of the spillway. It will be operated for flood control purposes only. The contract for its construction was

entered into with the Guy F. Atkinson Company in August 1939. Work was commenced immediately and has been prosecuted continuously since. The work is on schedule and is expected to be completed on or before the contract date which is November 15, 1942. Construction of the dam is being supervised by the District Engineer at Seattle.

Mill Creek Flood Control Project

The Mill Creek Flood Control Project in Walla Walla County is being constructed by the United States in cooperation with and primarily for the benefit of the Walla Walla Mill Creek Flood Control District, organized in 1936. When completed the project will protect the City of Walla Walla and adjacent territory from disastrous floods such as have frequently occurred in Mill Creek since the first advent of white men. The project was authorized by the Federal Flood Control Act of 1938. The contract for its construction was let to Parker-Schram Company and Eaton and Smith of Portland, Oregon. Work was commenced in June 1940 and is scheduled for completion by October 1941.

The project substantially embodies the features recommended by this Department in the report of its investigations in 1933. The flood control dam, located in a small valley tributary to Russell Creek, separated from Mill Creek Valley by a low divide, will be 3,200 feet long and of 145 foot maximum height. It creates a storage basin of 6,000 acre-feet. Excess flood waters to be stored are diverted from Mill Creek by a long low diversion dam and a channel excavated through the low rim intervening between Mill Creek and the storage basin. The storage basin will be emptied by an outlet conduit extending under the dam and a canal leading back to Mill Creek.

Mill Creek channel is to be improved from the diversion dam 1,400 feet down stream to a connection with that part of the channel heretofore rectified by the City of Walla Walla and the Flood Control District in cooperation with the Work Projects Administration. This former improvement extends to the west city limits. Provision is also made for division structures in Mill Creek to apportion water to the two branches, Yellowhawk Creek and Garrison Creek. The work is being supervised by the United States District Engineer at Bonneville, and will be owned and operated by the Federal Government.

When these improvements are completed the City of Walla Walla and adjoining areas will be protected against floods greatly in excess of any known to have occurred heretofore.

Diking Districts Along Lower Columbia River

During the biennium October 1, 1938, to September 30, 1940, the District Engineer of the Portland District prosecuted construction work on several diking projects along the lower Columbia River under authorization of the Federal Flood Control Act of 1936. Practically all such projects authorized by that Act have been either completed or are under contract.

In Cowlitz County work was prosecuted on Diking Improvement District No. 5 at Woodland. An existing pumping plant was enlarged and improved and the Burris Creek diversion canal constructed. The total cost of the Federal work in this district has been about $161,380.

Improvements made in Consolidated Diking Improvement District No. 1 (at Longview) consisted of spur levee, river front and back levees, stone re-

vetments, drainage ditches, and a new pumping plant. The total cost was $151,950.

In Wahkiakum County construction work was done on Diking Districts 1 and 2, on Puget and Little Islands, consisting of pile and stone dikes, reconstruction of levees and drainage ditches, placing of stone bank protection and construction of core trenches to correct seepage. The cost was $244,100.

In Diking Improvement District No. 4 several miles of levees were reconstructed; stone revetments were placed and drainage ditches excavated; a pumping plant was constructed and borrow pits filled—all at a cost of about $79,900.

In the Skamokawa Creek Area over 5 miles of levee and three diversion canals were constructed and banks were protected by stone riprap. A contract now in force, to be completed in August 1941, together with prior work, will call for an expenditure of about $131,700. In the Deep River Area a contract is in force which by January 1941 will have completed levees, tide boxes and drainage ditches at a total estimated cost of $60,100.

In the Upper Grays River Flood Control District various types of bank revetments were constructed, and the river channel was enlarged and improved at a total cost of $61,250.

In Pacific County Diking District No. 1 the construction of levees, tide boxes and interior drainage was undertaken under a contract to be completed by January 1, 1941, at an estimated cost of about $21,900.

These works along the lower Columbia River have been of immense benefit to the affected areas. Thus in Cowlitz County six districts embracing nearly 19,000 acres have been provided with substantial flood protection at a total cost of about $707,650. Works in Wahkiakum County have benefited about 9,100 acres at a total cost to date of $577,000. The protective works are of a very substantial character and their future maintenance by the several districts may be accomplished at a minimum cost.

Flood Control Surveys

During the biennium the Corps of Engineers have continued their surveys and investigations of flood control projects.

The Seattle Engineer District reports the status of its investigations in Washington as of September 30, 1940, to be as follows:

1. Surveys are completed and reports submitted by both the District Engineer and the Division Engineer for Naselle, Nisqually, Nooksack, Sammamish, Snohomish and Willapa Rivers.

2. Field surveys are under way or completed and reports will be submitted before end of 1940 on Chehalis and Green Rivers, on Whatcom Creek and Moses Coulee.

3. Field surveys are under way on the Cedar, Colville, Skagit, Skokomish, Spokane, Stilaguamish and Yakima Rivers.

4. Projects which have been adopted by Acts of Congress include one on Spokane River at Spokane estimated to cost $30,700, but so far inactive; one on Yakima River at Yakima, estimated cost $163,000 for which specifications are under preparation; and the project for enlargement and improvement of the Puyallup River through the City of Tacoma, construction of which will be so scheduled that its completion will coincide with that of Mud Mountain Dam.

No new flood control projects in the Seattle Engineer District were adopted by the Federal Government during the past biennium.

The Bonneville Engineer District reports that during the biennium preliminary examination and an interim report on the Palouse River were submitted and the Chief of Engineers sanctioned final survey of that project. A report of the final survey of the Touchet River was also submitted and has been published.

These brief accounts indicate that the Federal Flood Control program is making gratifying progress in our State. It seems appropriate to again call attention to the fact that construction projects have mainly been undertaken by the Federal Government where some cooperating local agency is available, such as a flood control or diking district, which is authorized to levy and collect taxes or assessments against benefited property for maintenance and operation after the project is completed. It appears that such cooperation is necessary except in connection with flood storage dams and certain other projects such as that on the Puyallup River through Tacoma. The majority of the projects now in various preliminary stages on our rivers may have to await the organization of some governmental unit to assume the local responsibilities imposed by Federal law.

The Federal Soil Conservation Service with C.C.C. forces and in cooperation with individual landowners has prosecuted minor flood protection works on Pilchuck River in Snohomish County and on the Wynooche River in Grays Harbor County.

The Work Projects Administration has also cooperated with local interests in flood control construction. The most extensive of such projects has been operated in King County where levies for the County River Improvement Fund are regularly made and proceeds used for materials and equipment on W.P.A. projects.

COLUMBIA BASIN PROJECT

JOHN BROOKE FINK
Director

There have been two major activities in connection with the Columbia Basin project in the biennium closing December 31, 1940—the construction of the Grand Coulee Dam by the Bureau of Reclamation, and the activities by and on behalf of the landowners in the organization of districts in preparation for the reclamation of the lands. In the latter the Department of Conservation and Development played an important part.

Organization and Legislation—The provisions of the Anti-Speculation Law, enacted by Congress to prevent speculative prices being charged settlers for lands within the project, required the landowners to organize the project into a district or districts so that they might enter into contract with the Federal Government to repay the costs of reclamation allocated to the lands. In this connection it was necessary to have enacted certain state legislation. This Department took a leading part in the preparation of the bills, and in promoting their passage. The various laws that were adopted in this connection were the following:

Chapter 13, Session Laws 1939 (S. B. 125) Pertains to irrigation districts of over 200,000 acres, and provides for director divisions, so that all parts of the district shall have representation on the board. The Act also provides that until water is available annual assessments shall not exceed two cents per acre.

Chapter 14, Session Laws 1939 (S. B. 126) Ratifies and adopts the Federal Anti-Speculation Act, and makes it applicable to Columbia Basin lands; authorizes and directs the inclusion of state lands in Columbia Basin districts and accepts appraisal thereof under the Federal Act; limits individual holdings to 40 acres; and authorizes county commissioners to bring county-owned lands under the Act.

Chapter 90, Session Laws 1939 (S. B. 376) Relating to election in Columbia Basin districts to vote on proposed contract with the Federal Government, and providing that such contract include provisions under the Anti-Speculation Act.

Chapter 150, Session Laws 1939 (S. B. 343) Outlining procedure for the inclusion of additional lands in any of the Columbia Basin districts.

Under the provisions of these laws and in conformity with the Anti-Speculation Act, the landowners of the project created three districts, and then organized these districts, and elected five directors in each district.

The Department of Conservation and Development, assisted the landowners in the work by employing an organizer who devoted all of his time for a period of six months until the districts were organized and the directors of each district elected.

Repayment Contracts—The Department is cooperating with the landowners and Bureau of Reclamation in the preparation of the repayment contracts which must be entered into by the districts and the Federal Government. When completed this contract must be submitted to the landowners

for their approval. In the matter of informing landowners, and in the election that must be held for the ratification of the contract, this Department will provide leadership and full cooperation.

Problems of Development—For the purpose of planning orderly development of the entire project the Bureau of Reclamation has undertaken a plan of joint investigations under the direction of Dr. Harlan H. Barrows of Chicago University. This plan includes the study of twenty-seven problems, in all of which the Department is interested and cooperates. It has been requested by the Bureau of Reclamation to give special consideration to the following problems:

How may equitable payments toward the cost of the primary irrigation works best be secured, directly or indirectly, from nonrural settlers (villagers, etc.) in the project area?

How may financial aid best be extended in comparatively adequate amount to needy settlers?

How may the requisite control of state lands, county lands, and railroad lands best be secured?

What are the essential facts with respect to underground waters throughout the project area?

To formulate plans to promote the recreational use of the reservoir above Coulee Dam.

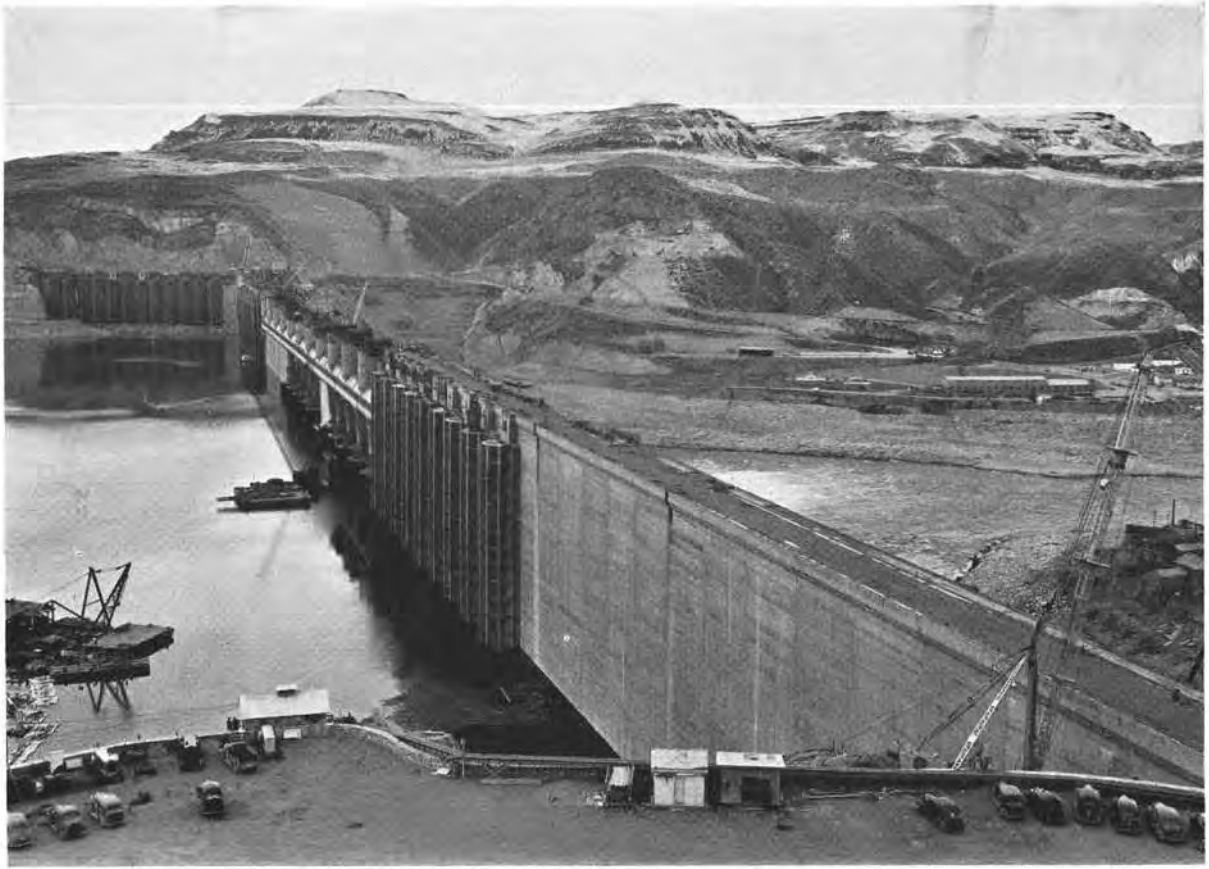
GRAND COULEE DAM ACTIVITIES

Following is a resume of Grand Coulee Dam activities during the period from October 1, 1938, to January 1, 1941, submitted by F. A. Banks, Supervising Engineer, United States Bureau of Reclamation. Activities prior to October 1, 1938, are outlined in previous reports of the Columbia Basin Commission and of this Department.

Engaged in completing the Grand Coulee Dam and the left power house, and in building the foundation for the pumping plant, Consolidated Builders, Inc., on January 1, 1941, had 93 per cent of the contract work completed with only 70 per cent of the contract time elapsed. With close to 98 per cent of the required concrete in place, the remaining work was scheduled for completion in 1941, and consisted of the following principal items: Spillway drum gate installation, construction of the spillway bridge, concrete placing for the spillway bridge, elevator towers, sidewalks and parapet walls, excavation and removal of the overburden in the left tailrace slide area, and miscellaneous work at the left power house.

Major Events of the Two-Year Period.—In the construction annals of Grand Coulee Dam, the year 1939 will be outstanding for the record-breaking concrete placing program followed by the contractor. On two occasions, world records for mass concrete production were established. On May 25, 1939, a total of 20,684½ cubic yards of concrete was placed during a continuous run of 24 hours. Again, in the month of October, 1939, a total of 536,264 cubic yards of concrete was placed, to maintain a daily average of 17,300 cubic yards for the 31-day period. These records may never be surpassed.

In October, 1938, the Secretary of the Interior approved the change order which authorized the completion of rock excavation for the twelve pumping plant discharge tunnels. Consolidated Builders, Inc. performed this work, and by April, 1939, all twelve of the tunnels had been driven to completion.



Looking across the upstream face of the dam from the east side on the first day of the new year, 1941. The dam has been completed to the final height, 550 feet above lowest bedrock, with the exception of the spillway section where the drum gates are to be installed and the spillway bridge is to be built. The cage-like structures along the dam and at the pumping plant foundation are the trashracks for the protection of the intakes to the penstocks, the outlet works, and the pump inlet pipes. The Columbia River flow is now being diverted through the outlet works which consist of 60 conduits, each 8′-6″ in diameter. (Date of photo: January 1, 1941.)

The contract held by the Western Pipe and Steel Company of San Francisco, for furnishing, fabricating, and installing 8,000 tons of plate steel for penstock and pump inlet pipe linings, was completed in May, 1940, several months ahead of schedule.

In the spring of 1940, Government forces began the installation of the two 12,500 kv-a. station service generators, and their control equipment. A temporary tie line was made to the Bonneville transmission system, and it was expected that the first power would be delivered from the Grand Coulee power plant early in 1941. During the latter part of 1940, main unit turbine parts began to arrive from the manufacturer, Newport News Shipbuilding and Drydock Company, and at the close of the year, the installation of two 150,000 horsepower turbines was in progress.

The Leavenworth hatchery system for the preservation of salmon in the upper Columbia and tributaries was completed and placed in operation during 1940.

In December, 1938, the W.P.A. project for clearing the shore lands of the Columbia River Reservoir was launched. By the close of 1940, W.P.A. forces had advanced the work to the following status: clearing 79 per cent complete, grubbing 71 per cent complete, and logging of merchantable timber 79 per cent complete.

In November, 1940, a contract valued at $249,000 was awarded to the Max J. Kuney Company of Spokane for channel enlargement and riprapping of the shore at the Little Dalles on the Columbia River, which point of river channel improvement is about 135 miles above the dam. This work, which was started by the close of the year 1940, will involve an estimated 300,000 cubic yards of excavation and 18,000 cubic yards of riprap.

On the construction of roads and bridges to replace those that will be inundated by the Reservoir, good progress was made, and by the close of 1940, 49.75 miles of primary state highway had been completed, 33.72 miles were under construction, and 5.12 miles were proposed for future work. On county and secondary roads, 24.62 miles had been completed, 26.03 miles were under construction, and 25.18 miles were proposed for future work. On the construction of a highway bridge across the Columbia River Reservoir at Kettle Falls, the piers and approaches were completed and the erection of the steel superstructure was in progress at the close of 1940. The construction of piers and approaches for a bridge across the Spokane River portion of the Reservoir was also in progress at the end of the year.

On the relocation of the Great Northern Railway in the Columbia River Reservoir area, involving 29 miles of new railroad, a contract was awarded in July, 1940, to J. A. Terteling & Sons of Boise, Idaho, on their low bid of $1,044,000. They immediately awarded several subcontracts for various phases of the relocation work, and by the end of the year the entire contract was 55 per cent complete with 52 per cent of the contract time elapsed. On the construction of a railroad bridge across the reservoir at Kettle Falls, the abutments and piers were completed and erection of the steel superstructure was in progress at the close of 1940.

Other important contracts awarded during 1939 and 1940 included the following: Three 150,000 horsepower hydraulic turbines to the Newport News Shipbuilding and Drydock Company; three 36,000 kv-a. power transformers

to General Electric Company; two 350-ton traveling cranes for the left power house to the Whiting Corporation; eleven spillway drum gates to the American Bridge Company; one 150-ton gantry crane to the Star Iron and Steel Company; penstock coaster gates to the American Bridge Company; and numerous other contracts for various metalwork items, electrical equipment, pipe, fittings, etc.

A brief discussion of the principal construction activities in progress or completed during the two-year period follows:

Concrete Placing—During the peak of concrete placing operations, ten regular and four auxiliary placing cranes were used, and as high as 1500 round trips were made in one day by the concrete trains operating on the construction trestle. A total of 3,686,362 cubic yards of concrete was placed in 1939, and in 1940 concrete placing was continued steadily but at a reduced rate, to place 1,407,900 cubic yards and advance the total in Grand Coulee Dam and appurtenant structures to 10,485,691 cubic yards. The right and left abutment sections of the dam, and the pumping plant foundation were advanced to the ultimate height, elevation 1311.08, and the spillway section was completed to the crest height, where the 11 huge spillway drum gates are now being installed. Formwork and concrete placing for the spillway bridge piers was also started in 1940, and was partially completed at the close of the year.

Excavation—The driving of the twelve pumping plant discharge tunnels, and the 500-foot pumping plant drainage tunnel, and the completion of all foundation rock work were included in the contract with Consolidated Builders, Inc. All of this excavation was completed in 1939 and 1940. In December, 1940, an extra work order was issued to Consolidated Builders, Inc. to cover the excavation and removal of the overburden and rock in the left tailrace slide area. Earth movements in this area have been observed over a period of several years, and in 1940 they began to occur with increasing frequency. Due to the possibility that a major slide in this area would block the left tailrace channel and interrupt the generation of power, it was decided to excavate the material and relocate the highway and railroad across the slide zone. This excavation will add about 1¼ million cubic yards to the 22,645,570 already excavated for the Grand Coulee Dam and appurtenant structures.

Dismantling Operations—With sufficient aggregate on hand to finish the required concrete placing, Consolidated Builders, Inc. began on the dismantling and removal of the aggregate processing plant, and the cleanup of the Brett gravel pit. Conveyors, rock crushers, screens, sand classifiers, hydro-separators, etc., were nearly all removed by the close of the year. Some of this equipment was shipped directly to the Shasta and Friant dam projects in California; the remainder was taken to the contractor's storage yard at Odair.

At the concrete mixing plant, four of the eight 4-yard concrete mixers and the respective batchers, controls, etc., were dismantled and removed. The remaining concrete will be mixed by the four 4-yard mixers, the controls for which have been combined to permit one man to operate the entire plant. About 35,000 cubic yards of concrete remain to be mixed and placed during 1941.

When the concrete in the dam had been advanced above the trestle level, the seven double-boom or Colby hammerhead gantry cranes could no longer be used. They were gradually dismantled and taken out of service; some were shipped directly to the Friant dam project and to shipyards on the Coast. To continue concrete placing above the trestle level, the contractor used two sidehill gantry cranes and four single-boom, full circle swing gantry cranes. The sidehill crane operates with one crane runway at the deck level and the other 36 feet higher on the downstream face of the dam.

River Diversion—During construction of the spillway section of the dam, the river required almost constant attention and planning to provide for the control and diverison of a flow ranging from 40,000 to 300,000 second feet. The outlet works at elevation 934 (twenty conduits each 8'-6" in diameter through the spillway section) were completed and placed in operation in May, 1939. In addition, 17 spillway diversion channels were also used to successfully control the flood stage of the Columbia River during 1939. As the flood waters receded, the eight steel closure gates were used to close off the spillway diversion channels and allow the resumption of concrete placing therein. The entire river flow was then diverted through the elevation 934 outlet works.

In 1940, a flood peak of 265,600 second feet was easily controlled by using the outlet works conduits and nine spillway channels. The elevation 1036 and 1136 conduits (20 at each elevation) although not fully completed were released for diversion purposes during the high water season, and a total of 54 was used. The contractor found that it was not necessary to use the closure gates as the flood waters receded rapidly and the entire river flow was diverted through the lower outlet works. Concrete placing was then resumed in the spillway diversion channels.

Drum Gate Installations—The Grand Coulee drum gate is 135 feet in length, 28 feet high, and including embedded parts weighs 735 tons. Although some riveting and assembly is done on each gate at the factory (American Bridge Company), it is estimated that about 5,600 parts remain to be assembled and 46,000 rivets to be driven in each gate as it is installed in the crest of the spillway section of the dam. The gates are placed between the piers of the spillway bridge, and are pivoted on hinge castings anchored in the spillway crest at elevation 1260. There are 40 anchor hinges for each gate. The drum gate is essentially a buoyant vessel which floats in a drum gate chamber. Water is admitted to or drained from the chamber, as required, with either automatic or manual controls. The rate of flow and to a certain extent the quantity of water held in storage in the Columbia River Reservoir will be controlled by the 11 huge drum gates at the crest of the spillway.

Erection of three of the 11 gates was undertaken by the contractor, and by the close of 1940 these three gates were practically installed with the exception of final welding, painting, riveting, etc.

Penstocks and Pump Inlet Pipes—The penstock system at Grand Coulee Dam, which will deliver water to three 14,000 horsepower station service turbines and eighteen 150,000 horsepower main unit turbines, consists of three 72-inch diameter and eighteen 18-foot diameter penstocks. Under the Western Pipe and Steel Company contract, each of the three station service

penstocks was lined with welded plate steel, varying from ⅜" to 9/16" in thickness. Each is 320 feet in length. The main unit penstocks, 292 feet in length, were lined with plate steel ¾" to 1½" in thickness. Into the top sections of the main unit penstocks were welded hemispherical steel bulkheads, which will be removed at the time the respective turbine units are put into operation. The pump inlet system consists of twelve 14-foot diameter pipes, each 56 feet in length and of plate steel ⅜" to ½" in thickness. Hemispherical steel bulkheads were welded to the downstream ends of the pump inlet pipes, and will be removed as the respective pumps are installed. The station service penstock sections were fabricated in the East and shipped to the project by rail. The main unit penstock and pump inlet pipes were too large in diameter to be shipped by rail so the contractor erected a fabricating plant near the dam. Rolled steel plate was shipped from the East, and at this plant it was welded into the cylindrical sections required for the penstocks and pump inlet pipes. All of this work, including the installation activities, was completed by May, 1940.

Left Power House Equipment Installations—With the exception of finishing of concrete floor surfaces and other miscellaneous work, the left power house building was completed early in 1940, and the two 350-ton traveling cranes were then installed on the runway rails. With the cranes in operation, Government forces began moving in the station service turbine equipment. The two 14,000 horsepower hydraulic turbines, manufactured by the Pelton Water Wheel Company of San Francisco, were installed and embedded in concrete. Installation of the two 12,500 kv-a. generators manufactured by the Westinghouse Electric and Manufacturing Company was then started, and was practically completed by the close of 1940. Other equipment such as transformers, switchboard, circuit breakers, control cubicles, cooling and fire protection systems, power and lighting conduits, etc., were installed or were being installed at the close of the year. Installation was also started on two of the three main unit turbines, for which some parts had been received.

It is expected that the two station service generators will deliver power to the Bonneville transmission system early in 1941, which will be a temporary arrangement until the large generators, each 108,000 kv-a., are ready to be connected to the line. The first of the three large units, which are now being manufactured by the Westinghouse Company, is scheduled to be placed in operation by the fall of 1941.

Migratory Fish Control—At the beginning of 1939, the approved plans for maintaining and increasing the runs of migratory fish were briefly as follows: On their upstream migration, the salmon would be trapped at Rock Island Dam and transported to a hatchery station near Leavenworth. At this station, the fish would be retained in special holding ponds until ready for artificial spawning. Based upon the well established law that mature salmon will return to spawn in the stream where they began life, the artificially hatched fish would be planted in the tributaries of the Columbia, and thereby salmon formerly spawning above the Grand Coulee Dam would be permanently transferred to four tributaries below the dam, viz., Wenatchee, Entiat, Methow, and Okanogan Rivers. Since the construction of the dam had progressed to the point where it was impossible for the fish to pass upstream, it was essential that the initial phase of the program go into operation

in the spring of 1939. The fish traps at Rock Island Dam and the fish hauling tank trucks were ready for use, but the Leavenworth hatchery station was still under construction. Therefore, it was decided that the 1939 runs of migratory fish would be hauled directly to the streams for spawning therein in a natural manner. Racks were placed in these streams to prevent the fish from returning downstream and to their usual spawning grounds, and a total of 35,992 fish were placed in the various streams. The fish hauling program was quite successful, and there were practically no losses with the exception of a few large Chinook salmon which died in transit during the hot August weather.

In the spring of 1940, the holding ponds and hatchery building at the Leavenworth station were completed in advance of the other facilities. They were immediately turned over to the Federal Fish and Wildlife Service in order to take care of the 1940 runs of salmon. As in 1939, the fish were trapped at Rock Island Dam, but were then hauled to the Leavenworth holding ponds for the first time. There they remained until ready for artificial spawning, when the eggs were transferred to the hatchery building. Since the small tributary hatcheries were not yet built and not all of the Leavenworth station was in operation, the entire 1940 run could not be hauled to the Leavenworth holding ponds. A total of 26,100 fish were hauled to the hatchery ponds, and 15,127 were relased in the tributary streams for natural spawning.

In order to reduce the cost of the distribution of the fingerlings and to use the waters of the particular tributary to which it is desired that the migratory fish return after their ocean sojourn, the construction of two small tributary hatcheries was started in 1940. One of these will be on the Entiat River and the other on the Methow River. Construction was still in progress at the close of the year. A site was also selected for a small hatchery in the Spokane River valley where game fish will be hatched to stock the Columbia River Reservoir waters. No work was done on this hatchery during 1940.

Highway Relocation in the Columbia River Reservoir Area—Surveys for the relocation of highways and railroads that would be inundated by the Columbia River Reservoir were started in 1935. In the spring of 1939 it was imperative that the construction of the new roads be started. A plan whereby the State Highway Department would invite bids for the construction of the new roads and supervise the work was approved. The Bureau of Reclamation then agreed to repay the State a lump sum based on the items of work performed at the unit bid prices. In accordance with this plan, the State Highway Department launched the road construction program in the summer of 1939, and continued it on the same basis throughout 1940.

The primary state highways, of which sections totaling 88.59 miles are to be relocated on higher ground, are Nos. 3, 4, and 22. At the close of 1940, 49.75 miles had been completed. Included in the highway program are two bridges and two overcrossings at intersections with the Great Northern Railway. Work on these structures is progressing satisfactorily.

County and secondary roads to be relocated in the Columbia River Reservoir area total 75.83 miles, and are in Stevens, Ferry, and Lincoln Counties. This work is not being done by the State Highway Department, but by other agencies including the Public Roads Administration, U. S. Indian Service,

and the Bureau of Reclamation. In December, 1940, a contract valued at $153,094 was awarded to the Erickson Paving Company, of Seattle, for the construction of 18.45 miles of road in Ferry County. At the close of 1940, 24.62 miles of road had been completed and 26.03 miles were under construction.

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Economic Surveys in the Columbia Basin Irrigable Area

Engineering—Engineering surveys, including retracement of property corners, monumenting, and topographic mapping within the proposed irrigation area of the Columbia Basin, were started in the fall of 1935, and have been carried on continuously since that time. As of January 1, 1941, retracement, monumenting, and leveling for the topographic mapping were 100 per cent completed. Topographic mapping has now been completed over 1,889,684 acres, and is 96.5 per cent finished.

Land Classification—The land classification program, which was started in August, 1937, is for the purpose of classifying all of the project lands with reference to their adaptability to agriculture and irrigation farming. As of January 1, 1941, this work was 88.8 per cent completed, with 1,674,679 acres examined.

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FUTURE WORK

The year 1941 will see the completion of practically all of the items of construction under the contract with Consolidated Builders, Inc. The 11 huge spillway drum gates will be installed, and the bridge over the spillway section will be built to complete the Grand Coulee Dam from end to end. At the left power house, it is expected that the two 12,500 kv-a. station service generators will deliver the first power to the Bonneville system sometime in the spring of 1941. The first of the main unit generators, 108,000 kv-a., will be ready in the summer of 1941, and the second main unit will be on the line in October or November of 1941, with the third unit scheduled for the spring of 1942. This proposed program is contingent upon the delivery of equipment and materials from the various manufacturers; some delay has already been experienced in the receipt of control equipment for the station service generators.

In the Columbia River Reservoir area, the W.P.A. clearing program and the major portion of the highway relocation contracts, as well as the entire railroad relocation contract, are expected to be completed in 1941. The Columbia River Reservoir is now 100 miles long, and contains 1,900,000 acre feet of water; next year it is expected to reach 8,600,000 acre feet and a length of 140 miles. The ultimate capacity of the reservoir is 10,000,000 acre feet, with a length of 151 miles.

Construction of migratory fish control facilities is expected to be completed in 1941, and the entire program placed in operation. Some of the work has now been discontinued for the duration of the winter weather, but will be resumed in the spring.

The financial requirements for completing the construction of the Grand Coulee Dam, the power plant including two station service and three main power units and the required power switching station, highway and railroad relocation in the Columbia River Reservoir including clearing of shore lands

and acquisition of right of way, and for surveys and investigations in the Columbia Basin irrigable area, totals $29,150,000. Of this amount, an appropriation of $12,000,000 is required for the fiscal year of 1941.

GRAND COULEE DAM ACTIVITIES

Following is a resume of Grand Coulee Dam activities during the period from October 1, 1938, to January 1, 1941, submitted by F. A. Banks, Supervising Engineer, U. S. Bureau of Reclamation. Activities prior to October 1, 1938, are outlined in previous reports of the Columbia Basin Commission.

Engaged in completing the Grand Coulee Dam and the left power house, and in building the foundation for the pumping plant, Consolidated Builders, Inc., on January 1, 1941, had 93 per cent of the contract work completed with only 70 per cent of the contract time elapsed. With close to 98 per cent of the required concrete in place, the remaining work was scheduled for completion in 1941, and consisted of the following principal items; spillway drum gate installation, construction of the spillway bridge, concrete placing for the spillway bridge, elevator towers, sidewalks and parapet walls, excavation and removal of the overburden in the left tailrace slide area, and miscellaneous work at the left power house.

Major Events of the Two-Year Period—In the construction annals of Grand Coulee Dam, the year 1939 will be outstanding for the record-breaking concrete placing program followed by the contractor. On two occasions, world records for mass concrete production were established. On May 25, 1939, a total of 20,684½ cubic yards of concrete was placed during a continuous run of 24 hours. Again, in the month of October, 1939, a total of 536,264 cubic yards of concrete was placed, to maintain a daily average of 17,300 cubic yards for the 31-day period. These records may never be surpassed.

In October, 1938, the Secretary of the Interior approved the change order which authorized the completion of rock excavation for the twelve pumping plant discharge tunnels. Consolidated Builders, Inc., performed this work, and by April, 1939, all twelve of the tunnels had been driven to completion.

The contract held by the Western Pipe and Steel Company of San Francisco, for furnishing, fabricating, and installing 8,000 tons of plate steel for penstock and pump inlet pipe linings, was completed in May, 1940, several months ahead of schedule.

In the spring of 1940, Government forces began the installation of the two 12,500 kv-a. station service generators, and their control equipment. A temporary tie line was made to the Bonneville transmission system, and it was expected that the first power would be delivered from the Grand Coulee power plant early in 1941. During the latter part of 1940, main unit turbine parts began to arrive from the manufacturer, Newport News Shipbuilding and Drydock Company, and at the close of the year, the installation of two 150,000 horsepower turbines was in progress.

The Leavenworth hatchery system for the preservation of salmon in the upper Columbia and tributaries was completed and placed in operation during 1940.

In December, 1938, the W.P.A. project for clearing the shore lands of the Columbia River Reservoir was launched. By the close of 1940 W.P.A. forces had advanced the work to the following status: Clearing 79 per cent complete,

grubbing 71 per cent complete, and logging of merchantable timber 79 per cent complete.

In November, 1940, a contract valued at $249,000 was awarded to the Max J. Kuney Company of Spokane for channel enlargement and riprapping of the shore at the Little Dalles on the Columbia River, which point of river channel improvement is about 135 miles above the dam. This work, which was started by the close of the year 1940, will involve an estimated 300,000 cubic yards of excavation and 18,000 cubic yards of riprap.

On the construction of roads and bridges to replace those that will be inundated by the reservoir, good progress was made, and by the close of 1940, 49.75 miles of primary state highway had been completed, 33.72 miles were under construction, and 5.12 miles were proposed for future work. On county and secondary roads, 24.62 miles had been completed, 26.03 miles were under construction, and 25.18 miles were proposed for future work. On the construction of a highway bridge across the Columbia River Reservoir at Kettle Falls, the piers and approaches were completed and the erection of the steel superstructure was in progress at the close of 1940. The construction of piers and approaches for a bridge across the Spokane River portion of the reservoir was also in progress at the end of the year.

On the relocation of the Great Northern Railway in the Columbia River Reservoir area, involving 29 miles of new railroad, a contract was awarded in July, 1940, to J. A. Terteling & Sons of Boise, Idaho, on their low bid of $1,044,000. They immediately awarded several subcontracts for various phases of the relocation work, and by the end of the year the entire contract was 55 per cent complete with 52 per cent of the contract time elapsed. On the construction of a railroad bridge across the reservoir at Kettle Falls, the abutments and piers were completed and erection of the steel superstructure was in progress at the close of 1940.

Other important contracts awarded during 1939 and 1940 included the following: Three 150,000 horsepower hydraulic turbines to the Newport News Shipbuilding and Drydock Company; three 36,000 kv-a. power transformers to General Electric Company; two 350-ton traveling cranes for the left power house to the Whiting Corporation; eleven spillway drum gates to the American Bridge Company; one 150-ton gantry crane to the Star Iron and Steel Company; penstock coaster gates to the American Bridge Company; and numerous other contracts for various metalwork items, electrical equipment, pipe, fittings, etc.

A brief discussion of the principal construction activities in progress or completed during the two-year period follows:

Concrete Placing—During the peak of concrete placing operations, ten regular and four auxiliary placing cranes were used, and as high as 1,500 round trips were made in one day by the concrete trains operating on the construction trestle. A total of 3,686,362 cubic yards of concrete was placed in 1939, and in 1940 concrete placing was continued steadily but at a reduced rate, to place 1,407,900 cubic yards and advance the total in Grand Coulee Dam and appurtenant structures to 10,485,691 cubic yards. The right and left abutment sections of the dam, and the pumping plant foundation were advanced to the ultimate height, elevation 1311.08, and the spillway section was completed to the crest height, where the 11 huge spillway drum gates are now being installed. Formwork and concrete placing for the spillway bridge

piers was also started in 1940, and was partially completed at the close of the year.

Excavation—The driving of the twelve pumping plant discharge tunnels, and the 500-foot pumping plant drainage tunnel, and the completion of all foundation rock work were included in the contract with Consolidated Builders, Inc. All of this excavation was completed in 1939 and 1940. In December, 1940, an extra work order was issued to Consolidated Builders, Inc., to cover the excavation and removal of the overburden and rock in the left tailrace slide area. Earth movements in this area have been observed over a period of several years, and in 1940 they began to occur with increasing frequency. Due to the possibility that a major slide in this area would block the left tailrace channel and interrupt the generation of power, it was decided to excavate the material and relocate the highway and railroad across the slide zone. This excavation will add about 1¼ million cubic yards to the 22,675,570 already excavated for the Grand Coulee Dam and appurtenant structures.

Dismantling Operations—With sufficient aggregate on hand to finish the required concrete placing, Consolidated Builders, Inc., began on the dismantling and removal of the aggregate processing plant, and the cleanup of the Brett gravel pit. Conveyors, rock crushers, screens, sand classifiers, hydro-separators, etc., were nearly all removed by the close of the year. Some of this equipment was shipped directly to the Shasta and Friant dam projects in California; the remainder was taken to the contractor's storage yard at Odair.

At the concrete mixing plant, four of the eight 4-yard concrete mixers and the respective batchers, controls, etc., were dismantled and removed. The remaining concrete will be mixed by the four 4-yard mixers, the controls for which have been combined to permit one man to operate the entire plant. About 35,000 cubic yards of concrete remain to be mixed and placed during 1941.

When the concrete in the dam had been advanced above the trestle level, the seven double-boom or Colby hammerhead gantry cranes could no longer be used. They were gradually dismantled and taken out of service; some were shipped directly to the Friant dam project and to shipyards on the Coast. To continue concrete placing above the trestle level, the contractor used two sidehill gantry cranes and four single-boom, full circle swing gantry cranes. The sidehill crane operates with one crane runway at the deck level and the other 36 feet higher on the downstream face of the dam.

River Diversion—During construction of the spillway section of the dam, the river required almost constant attention and planning to provide for the control and diversion of a flow ranging from 40,000 to 300,000 second feet. The outlet works at elevation 934 (twenty conduits each 8'-6" in diameter through the spillway section), were completed and placed in operation in May, 1939. In addition, 17 spillway diversion channels were also used to successfully control the flood stage of the Columbia River during 1939. As the flood waters receded, the eight steel closure gates were used to close off the spillway diversion channels and allow the resumption of concrete placing therein. The entire river flow was then diverted through the elevation 934 outlet works.

In 1940, a flood peak of 265,600 second feet was easily controlled by using

the outlet works conduits and nine spillway channels. The elevation 1036 and 1136 conduits (20 at each elevation) although not fully completed were released for diversion purposes during the high water season and a total of 54 was used. The contractor found that it was not necessary to use the closure gates as the flood waters receded rapidly and the entire river flow was diverted through the lower outlet works. Concrete placing was then resumed in the spillway diversion channels.

Drum Gate Installations—The Grand Coulee drum gate is 135 feet in length, 28 feet high, and, including embedded parts, weighs 735 tons. Although some riveting and assembly is done on each gate at the factory (American Bridge Company), it is estimated that about 5,600 parts remain to be assembled and 46,000 rivets to be driven in each gate as it is installed in the crest of the spillway section of the dam. The gates are placed between the piers of the spillway bridge, and are pivoted on hinge castings anchored in the spillway crest at elevation 1260. There are 40 anchor hinges for each gate. The drum gate is essentially a buoyant vessel which floats in a drum gate chamber. Water is admitted to or drained from the chamber, as required, with either automatic or manual controls. The rate of flow and to a certain extent the quantity of water held in storage in the Columbia River Reservoir will be controlled by the 11 huge drum gates at the crest of the spillway.

Erection of three of the 11 gates was undertaken by the contractor, and by the close of 1940 these three gates were practically installed with the exception of final welding, painting, riveting, etc.

Penstocks and Pump Inlet Pipes—The penstock system at Grand Coulee Dam, which will deliver water to three 14,000 horsepower station service turbines and eighteen 150,000 horsepower main unit turbines, consists of three 72-inch diameter and eighteen 18-foot diameter penstocks. Under the Western Pipe and Steel Company contract, each of the three station service penstocks was lined with welded plate steel, varying from ⅜" to 9/16" in thickness. Each is 320 feet in length. The main unit penstocks, 292 feet in length, were lined with plate steel ¾" to 1½" in thickness. Into the top sections of the main unit penstocks were welded hemispherical steel bulkheads, which will be removed at the time the respective turbine units are put into operation. The pump inlet system consists of twelve 14-foot diameter pipes, each 56 feet in length and of plate steel ⅜" to ½" in thickness. Hemispherical steel bulkheads were welded to the downstream ends of the pump inlet pipes, and will be removed as the respective pumps are installed. The station service penstock sections were fabricated in the East and shipped to the project by rail. The main unit penstock and pump inlet pipes were too large in diameter to be shipped by rail so the contractor erected a fabricating plant near the dam. Rolled steel plate was shipped from the East, and at this plant it was welded into the cylindrical sections required for the penstocks and pump inlet pipes. All of this work, including the installation activities, was completed by May, 1940.

Left Power House Equipment Installations—With the exception of finishing of concrete floor surfaces and other miscellaneous work, the left power house building was completed early in 1940, and the two 350-ton traveling cranes were then installed on the runway rails. With the cranes in operation, Government forces began moving in the station service turbine equipment. The two 14,000 horsepower hydraulic turbines, manufactured by the Pelton

Water Wheel Company of San Francisco, were installed and embedded in concrete. Installation of the two 12,500 kv-a. generators manufactured by the Westinghouse Electric and Manufacturing Company was then started, and was practically completed by the close of 1940. Other equipment, such as transformers, switchboards, circuit breakers, control cubicles, cooling and fire protection systems, power and lighting conduits, etc., were installed or were being installed at the close of the year. Installation was also started on two of the three main unit turbines, for which some parts had been received.

It is expected that the two station service generators will deliver power to the Bonneville transmission system early in 1941, which will be a temporary arrangement until the large generators, each 108,000 kv-a., are ready to be connected to the line. The first of the three large units, which are now being manufactured by the Westinghouse Company, is scheduled to be placed in operation by the fall of 1941.

Migratory Fish Control—At the beginning of 1939, the approved plans for maintaining and increasing the runs of migratory fish were briefly as follows: On their upstream migration, the salmon would be trapped at Rock Island Dam and transported to a hatchery station near Leavenworth. At this station, the fish would be retained in special holding ponds until ready for artificial spawning. Based upon the well established law that mature salmon will return to spawn in the stream where they began life, the artificially hatched fish would be planted in the tributaries of the Columbia, and thereby salmon formerly spawning above the Grand Coulee Dam would be permanently transferred to four tributaries below the dam, viz. Wenatchee, Entiat, Methow, and Okanogan Rivers. Since the construction of the dam had progressed to the point where it was impossible for the fish to pass upstream, it was essential that the initial phase of the program go into operation in the spring of 1939. The fish traps at Rock Island Dam and the fish hauling tank trucks were ready for use, but the Leavenworth hatchery station was still under construction. Therefore, it was decided that the 1939 runs of migratory fish would be hauled directly to the streams for spawning therein in a natural manner. Racks were placed in these streams to prevent the fish from returning downstream and to their usual spawning grounds, and a total of 35,992 fish were placed in the various streams. The fish hauling program was quite successful, and there were practically no losses with the exception of a few large Chinook salmon which died in transit during the hot August weather.

In the spring of 1940, the holding ponds and hatchery building at the Leavenworth station were completed in advance of the other facilities. They were immediately turned over to the federal Fish and Wildlife Service in order to take care of the 1940 runs of salmon. As in 1939, the fish were trapped at Rock Island Dam, but were then hauled to the Leavenworth holding ponds for the first time. There they remained until ready for artificial spawning, when the eggs were transferred to the hatchery building. Since the small tributary hatcheries were not yet built and not all of the Leavenworth station was in operation, the entire 1940 run could not be hauled to the Leavenworth holding ponds. A total of 26,100 fish were hauled to the hatchery ponds, and 15,127 were released in the tributary streams for natural spawning.

In order to reduce the cost of the distribution of the fingerlings and to use the waters of the particular tributary to which it is desired that the migratory fish return after their ocean sojourn, the construction of two small

tributary hatcheries was started in 1940. One of these will be on the Entiat River and the other on the Methow River. Construction was still in progress at the close of the year. A site was also selected for a small hatchery in the Spokane River valley where game fish will be hatched to stock the Columbia River Reservoir waters. No work was done on this hatchery during 1940.

Highway Relocation in the Columbia River Reservoir Area—Surveys for the relocation of highways and railroads that would be inundated by the Columbia River Reservoir were started in 1935. In the spring of 1939, it was imperative that the construction of the new roads be started. A plan whereby the State Highway Department would invite bids for the construction of the new roads and supervise the work was approved. The Bureau of Reclamation then agreed to repay the State a lump sum based on the items of work performed at the unit bid prices. In accordance with this plan, the State Highway Department launched the road construction program in the summer of 1939, and continued it on the same basis throughout 1940.

The primary state highways, of which sections totaling 88.59 miles are to be relocated on higher ground, are Nos. 3, 4, and 22. At the close of 1940, 49.75 miles had been completed. Included in the highway program are two bridges and two overcrossings at intersections with the Great Northern Railway. Work on these structures is progressing satisfactorily.

County and secondary roads to be relocated in the Columbia River Reservoir area total 75.83 miles, and are in Stevens, Ferry, and Lincoln Counties. This work is not being done by the State Highway Department, but by other agencies including the Public Roads Administration, U. S. Indian Service, and the Bureau of Reclamation. In December, 1940, a contract valued at $153,094 was awarded to the Erickson Paving Company, of Seattle, for the construction of 18.45 miles of road in Ferry County. At the close of 1940, 24.62 miles of road had been completed and 26.03 miles were under construction.

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MINES-TO-MARKET ROAD COMMISSION

JOHN BROOKE FINK
Chairman

The Mines-to-Market Road Commission was authorized by Chapter 175, of the Session Laws of 1939, and was composed of the Director of Conservation and Development, the Director of Highways and the Executive Officer of Washington State Planning Council. Under the provisions of the law the Director of Conservation and Development was the chairman. At the first meeting of the Commission the Executive Officer of the Planning Council was elected secretary.

The purpose of the Act was to provide for the construction of roads into mineralized areas, so that the mineral resources might be developed. The sum of $100,000 was appropriated for the purpose. The Act provided that a road must be initiated by petition, and that costs of construction, after deducting any contributions made by other agencies or individuals, must be borne equally by the State, and the county in which the road was located. The Act directed that the Department of Conservation and Development should cause to be made an investigation of the mineralization of the area to be served by the proposed road and the Director of Highways should make a survey to determine the feasibility and cost of construction. The Director of Highways should be in charge of the construction and of the expenditures of all funds made available for the purpose.

The Commission, in its first meeting, determined that the roads to be constructed be of minimum standard to serve the necessary transportation purposes of the area, generally speaking of the type commonly known as "cat and wagon road."

In the biennium fifteen requests for mines-to-market roads were received. Some were formal petitions. Others were informal. The following are the petitions received and action taken thereon:

In Whatcom County petition was submitted for a road up Ruby and Canyon Creeks. This was accompanied by a letter from the County Commissioners agreeing to match state money in the construction of the road.

The Department of Conservation and Development submitted reports of investigations shown in the area to be served by the proposed road to be sufficiently mineralized to justify construction of the road.

The Department of Highways submitted a report showing the road to be feasible and the cost reasonable. The Commission then authorized the construction of the road at a cost not to exceed $25,000. The County Commissioners by resolution agreed to deposit one half the total cost, or $12,500 in the Motor Vehicle fund for construction of the road. However, before construction was begun the County Commissioners submitted a resolution rescinding the former resolution thus making no funds available from county sources, the Commission officially deferred further action on this road until the county makes funds available to cover its share of the cost.

In Chelan County petition was submitted for a road up the Stehekin River,

from Bridge Creek, into the Horseshoe Basin, a distance of approximately 8 miles. As the Board of County Commissioners had indicated the county would bear its share of the cost, and as the reports on mineralization and feasibility and cost were favorable, the construction of the road was authorized and the sum of $25,000 allotted for the purpose.

This road was completed as authorized.

In King County petition was submitted for a road up Money Creek from Berlin Station, on State Highway No. 15, for a distance of 6½ miles. The County Commissioners having agreed to bear one half of the cost and the reports on mineralization and feasibility and cost being favorable the construction of the road was authorized and an amount not to exceed $15,000 for expenditure in the fiscal year 1939-40 was allocated to the project. In the fiscal year 1940-41 the Commission authorized completion of the road, to the extent of any unexpended balance in the fund.

In Okanogan County a petition was submitted for a road from the vicinity of Twisp in southerly direction toward Lookout Mountain, a distance of approximately 5 miles. The County Commissioners submitted a resolution agreeing to bear one half the cost. Investigations as to mineralization and feasibility and cost having been made with favorable results, the Commission authorized construction at a cost not to exceed $10,000.

In Snohomish County petition was submitted for a bridge over the South Fork of the Stillaguamish River at Silverton. As no evidence was submitted to indicate that the county would assume one half of the cost, the Commission took no action.

In Whatcom County an informal application was submitted for a road into the chromite area in Twin Sisters Mountains. Formal petition was requested by Commission. As there was no response to this request no further action was taken.

In Snohomish County petition was submitted for a road from vicinity of Big Four Inn to the old town of Monte Cristo, a distance of about ten miles. Accompanying the petition was a letter from the County Commissioners stating the county could not contribute its part of the cost. No further action was taken by the Commission.

In Pierce County a petition was submitted for a road a few miles east of Fairfax to Copley Lake, a distance of approximately 9 miles. As no evidence was submitted to indicate that the county would bear its share of the cost, no action was taken.

In Yakima County an informal petition was submitted for a road from the end of present road near Bumping Lake to the White Pass road at Leach Lake. As the petitioners stated that the county would not share the costs, no action was taken.

In Lewis County a petition was submitted for a road from east of Toledo to the boundary of the National Forest in Green River to open the St. Helens mineral area. As no evidence was submitted that the county would bear its share of the cost, no action was taken.

In King County petition was submitted for a road up Lennox Creek. As no evidence was submitted to indicate that the county would bear its share of the cost, no action was taken.

In Whatcom and Skagit Counties informal request was submitted for a

mines-to-market road up Thunder Creek from Lake Diablo to a point near the summit of the Cascades. No action was taken.

No action was taken on the following petitions as all available funds for the biennium had been allocated.

In Grays Harbor County, for a road in Townships 22 and 21, Range 10 W., for a distance of about three miles, to serve manganese deposits.

In Stevens County for a road southwest of Chewelah, for a distance of about 6 miles to serve some magnesite deposits.

In Skagit and Whatcom Counties, north of Hamilton for a road to serve a chromite area.

Final report on construction costs, on roads established, except costs of final notices estimated at about $20, show the following:

Stehekin Road in Chelan County	$24,587.20
Money Creek Road in King County	58,890.47
Twisp—Lookout Mountain Road in Okanogan County	9,885.41
Total	$93,363.08

DIVISION OF SOIL SURVEY

L. C. WHEETING
Supervisor

The Division of Soil Survey was established as an integral part of the Department in April, 1939, as a result of the appropriation of $25,000 for that purpose by the Legislature. In previous years, this work had been carried on through the joint efforts of the State Planning Council, who administered it, State relief organizations, and the State College of Washington. The Federal government, through its Soil Survey Division, has been able to match state funds on a fifty-fifty basis and it is expected that they will continue to do so.

Objectives

The objectives of the Soil Survey are:

(a) To study and map the different kinds of soil in the State.
(b) To determine their value for use as agricultural, forest and grazing lands.
(c) To so provide a sound basis for the orderly development of the State soil resources.
(d) To provide a basis for successful land settlement by our growing population.

Earlier Surveys

The soil survey of the State was started in 1909 as a part of the work of the State Department of Geology, cooperating with the Federal government. From 1909 to 1917 the following surveys were made:

Reconnaissance Soil Survey of Southwestern Washington, 1909.
Reconnaissance Soil Survey of the Eastern Puget Sound area, 1910.
Reconnaissance Soil Survey of the Western Puget Sound Area, 1910.
Soil Survey of the Quincy area.
Soil Survey of Franklin County.
Soil Survey of Spokane County.
Soil Survey of Benton County.
Soil Survey of the Wenatchee area.

Following completion of the survey of the Wenatchee area, the work was suspended. Copies of all maps and reports covering this work are available to all citizens of the State at no cost, with the exception of those for Spokane County and the Eastern Puget Sound area, which are out of print.

In 1925-27 a Soil Survey of the Columbia Basin area was completed through the cooperation of the Federal Government and the Washington Agricultural Experiment Station. This has been a valuable aid in the development of the irrigation plans for the present Grand Coulee project. Copies of this report are now difficult to obtain.

Organization of Recent Work

After a lapse of seven years, soil survey work was again resumed in 1933 and has been carried on continuously since that time. The heavy influx of agricultural settlers and the demand for information about suitable places for settlement was largely responsible for the revival of the work. The interest of the State Planning Council and of Governor Martin was strong and funds

from a number of sources were obtained. Drainage troubles in the Ellensburg District had become so acute in 1935 that the Legislature appropriated $3,000 for a soil map of this area. The Emergency Relief Administration supported the work in western Washington from 1934 to 1936. The State Planning Council received a grant from the Governor for the work in 1937-38. In 1939, the present Division in the Department of Conservation and Development was established and a more stable organization is now possible.

Soil Surveys Completed

Since 1933 the following surveys have been completed:

Soil Survey of Kitsap County.
Soil Survey of Snohomish County.
Soil Survey of Kittitas County.
Soil Survey of Clallam County.
Soil Survey of King County.
Soil Survey of Pierce County.
Soil Survey of Skamania County.
Soil Survey of Whatcom County.

Soil Surveys Published

To date the printed map and report is available for Kitsap County only. The publication is done by the Federal Government at no cost to the State of Washington but there is a lag of about four years between the date of completion of the field work and the date of publication.

The reports of Kittitas County, Snohomish County, King County, and Clallam County may be expected, however, within the next year.

Soil Surveys in Progress

Soil Survey work is now in progress in the following areas:

Yakima County
Lewis County

Both areas will be completed in July, 1941, unless personnel is reduced through compulsory service in the Army.

Soil Surveys Contemplated

During the next two years the inauguration and completion of Soil Survey work in Skagit, Thurston and Mason Counties is contemplated if funds are available.

The Staff of the Division, on January 1, 1941, consisted of:

Soil Surveyors:
R. Hardiman Fowler
Arnold O. Ness
Robert D. Flannery

Assistant:
Solomon Stroh

Draftsman:
Ray J. Wagner

Part-time Clerk:
Jean Howard

Staff Changes

W. W. Anderson, Soil Surveyor, terminated his services with the Division at his own request on June 1, 1939, to join the Soil Conservation Service.

Scientific Publications

The staff of the Division has published two scientific papers during the present biennium, resulting from laboratory work conducted in the laboratories of the State College of Washington:

1. "Nature of Organic Matter in Western Washington Prairie Soils as Influenced by Differences in Rainfall," Fowler, R. H., and Wheeting, L. C., in *Journal of American Society of Agronomy*, January, 1941.
2. "Physical Character and Chemical Composition of the Forest Floors Under Selected Forest Types in Western Washington," R. D. Flannery, in Ecology, March, 1941.