

State of Washington
ARTHUR B. LANGLIE, Governor

Eleventh Biennial Report
of the
Department of
Conservation and Development

October 1, 1940 -- September 30, 1942



ED DAVIS
DIRECTOR

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LETTER OF TRANSMITTAL

DEPARTMENT OF CONSERVATION AND DEVELOPMENT

Olympia, Washington, January 2, 1943

To His Excellency, Arthur B. Langlie,
Governor of the State of Washington.

Sir:

There is submitted herewith, pursuant to law, the Eleventh Biennial Report of the Department of Conservation and Development, covering the period from October 1, 1940, to September 30, 1942.

Respectfully,

ED DAVIS,
Director

INTRODUCTION

The Department of Conservation and Development deals with subjects very close to the lives of the citizens of our state: land, water, forests, and minerals. It is, therefore, our hope to make it a very human and serviceable department.

The activities of the skilled personnel who make up our organization are very interesting: inspectors and engineers assisting irrigation, or diking and drainage districts with their many problems; engineers investigating the possibility of making new homes for people on unoccupied land, locating and inspecting dam sites for power and reclamation, studying flood control, issuing water rights and assisting with the proper use of those rights, the settling of disputes that grow out of the use of water; and the entire organization doing everything possible to assist in the development of the great Columbia Basin project; foresters, in observation towers, chasing smoke, fighting fires, building roads, enforcing forestry safety regulations, studying areas to determine if they will reforest themselves or if replanting is necessary, and—the most pressing need of all—the general study of reforestation; geologists and mining engineers inspecting mines and prospects, assisting the miners in the planning of their operations, determining the nature of their ore, the marketing of their product, and the finding of needed capital. Also, there are long, hard trips into the mountains for these men to determine the value of reported new strikes.

The war has greatly increased this entire program and intensified its importance to the government and our state. We are working closely with federal agencies toward the greater development and conservation of our resources, and we solicit the cooperation of every citizen.

DIVISION OF RECLAMATION

LARS LANGLOE

Engineer

As during many years past, no separate division or organization has been maintained in the department for operations under the State Reclamation Act. The director has acted as supervisor of reclamation, with the assistance of the general and technical staff of the department.

Partly due to the extensive refinancing and readjustments of the funded obligations of reclamation districts which have been made during the past eight or ten years largely with aid from the reclamation revolving fund, and partly due to recent improvement in agricultural conditions, the demands upon the reclamation fund have not been large during the past two years.

With certain notable exceptions, the financial condition of our reclamation districts appears to be fair and improving. Certain districts in which state funds have been invested are unmistakably in bad financial shape. Unless the unforeseen happens, rather drastic adjustments of their obligations appear unavoidable. The prospective main task of the department is to aid in effecting the necessary adjustments in a manner that is fair to the state as the principal creditor and will permit continued operation of the worthwhile agricultural areas involved.

THE RECLAMATION REVOLVING FUND

The assets of the reclamation revolving fund consist of cash, securities of reclamation districts, and other credits such as advances to districts against future delivery of bonds and miscellaneous bills receivable. Liabilities consist solely of outstanding collateral trust bonds issued under the authorization of Chapter 7, Laws of 1935. The book value of the fund as of September 30, 1942, exclusive of accrued and unpaid interest, is made up of the items as follows:

STATEMENT OF RECLAMATION REVOLVING FUND

September 30, 1942

Assets:	
Cash on hand—State Treasurer.....	\$212,784.77
Cash on hand—Peoples National Bank of Washington, Trustee.....	191,358.88
Bonds on hand (book value).....	2,451,528.94
Advances to reclamation districts (against future delivery of bonds).....	184,379.32
Sub-total	\$3,040,551.91
Miscellaneous book assets.....	33,714.38
Total	\$3,074,266.29
Liabilities:	
Collateral trust bonds yet outstanding.....	218,000.00
Net book value of Reclamation Revolving Fund.....	\$2,856,266.29

The cash held in the state treasury, when appropriated by the legislature, becomes available for investment in reclamation district securities. The cash held by the trustee represents a surplus accumulated from interest on and

redemption of bonds deposited as collateral and none of it is available for reinvestment until all collateral trust bonds have been redeemed.

The bonds owned by the reclamation revolving fund, including those held by the trustee (marked with asterisk), are listed as follows:

RECLAMATION DISTRICT BONDS OWNED BY DEPARTMENT

September 30, 1942

District	Interest Rate	Par Value
Agnew Irrigation District (Issue A).....	4%, 3%, 2%	\$48,200.00
Agnew Irrigation District (Issue B).....	4%, 3%, 2%	4,680.00
Agnew Irrigation District (Issue C).....	4%, 3%, 2%	2,660.00
Bacon Tracts Irrigation District.....	2%	1,200.00
* Cascade Irrigation District	4%	40,000.00
Chelan Falls Irrigation District.....	4%	25,500.00
* Cline Irrigation District (Issue A).....	4%	16,400.00
Columbia Irrigation District.....	2%	5,500.00
Cowlitz County Diking Improvement District No. 5.....	4%	17,500.00
Cowlitz County Diking Improvement District No. 11.....	4%	29,500.00
Cowlitz County Diking Improvement District No. 11, Sub-district A	4%	8,500.00
Cowlitz County Diking Improvement District No. 13.....	4%	18,000.00
Cowlitz County Diking Improvement District No. 15.....	4%	30,000.00
Cowlitz County Drainage Improvement District No. 1.....	4%	4,900.00
First Creek Irrigation District	2%	9,500.00
Franklin County Irrigation District No. 1.....	5%	7,747.34
* Grandview Irrigation District	2%	5,500.00
Grays Harbor County Diking and Drainage Improvement District No. 4.....	4%	38,000.00
* Hutchinson Irrigation District	5%, 4%, 3%, 2%	19,500.00
* Icicle Irrigation District	2%	213,000.00
Kennewick Irrigation District	1½%	234,700.00
King County Drainage and Irrigation Improvement District No. 12.....	4%	4,053.48
King County Drainage District No. 14.....	5%	1,920.00
* Kiona Irrigation District	2%	13,500.00
Lake Chelan Reclamation District (Third Issue).....	1%	100,000.00
Lake Chelan Reclamation District (Fourth Issue).....	1%	118,000.00
Lake Chelan Reclamation District (Fifth Issue).....	2%	163,000.00
Larrabee Irrigation District	4%	10,000.00
Lewis-Thurston Counties Joint Drainage Improvement District No. 7.....	4%	1,400.00
† Macleay-Lindsay Irrigation District.....		500.00
Methow Valley Irrigation District.....	2%	72,000.00
Oroville-Tonasket Irrigation District (1934 Issue).....	2%	258,400.00
Oroville-Tonasket Irrigation District (1941 Issue).....	2%	60,000.00
* Otis Orchards Irrigation District.....	2%	19,000.00
* Outlook Irrigation District (1933 Issue).....	2%	10,125.00
Outlook Irrigation District (1939 Issue).....	4%	7,000.00
* Pasadena Park Irrigation District.....	4%	15,900.00
Priest Rapids Irrigation District.....	2½%	89,000.00
* Richland Irrigation District	2%	104,000.00
* Snipes Mountain Irrigation District (1932 Issue).....	1%	13,750.00
* Snipes Mountain Irrigation District (1934 Issue).....	2%	4,500.00
Snipes Mountain Irrigation District (1934 Issue).....	2%	1,500.00
Snohomish County Diking District No. 1 (1932 Issue).....	1%	17,000.00
Snohomish County Diking District No. 1 (1934 Issue).....	2%	20,000.00
Snohomish County Diking District No. 2.....	2%	3,065.00
* Snohomish County Drainage District No. 1.....	2%	1,000.00
Stemilt Irrigation District	1¾%	73,800.00

* Bonds on deposit with Peoples National Bank of Washington, trustee.

† Bonds purchased for refunding and held by department.

The balance of the bonds are on deposit with the State Treasurer for safe keeping.

District	Interest Rate	Par Value
* Sunnyside Irrigation District	1%	79,900.00
* Union Gap Irrigation District.....	2%	500.00
* Wenas Irrigation District	2%	13,100.00
Wenatchee Reclamation District, Local Improvement District No. 1.....	4%	2,100.00
* Wenatchee-Chewawa Irrigation District.....	2%	10,000.00
* Wenatchee Heights Reclamation District.....	2%	75,000.00
White Salmon Irrigation District.....	1%	6,000.00
Whitstone Reclamation District	1%, 4%	40,000.00
Wolf Creek Reclamation District.....	2%	25,000.00
* Yakima County Drainage Improvement District No. 3, Sub-district No. 7.....	4%	22,000.00
* Yakima County Drainage Improvement District No. 3, Sub-district No. 8.....	2%	7,000.00
* Yakima County Drainage Improvement District No. 9..	4%	1,400.00
* Yakima County Drainage Improvement District No. 9, Sub-district "J"	4%	1,900.00
* Yakima County Drainage Improvement District No. 35..	2%	20,000.00
* Yakima County Drainage Improvement District No. 41..	2%	4,599.38
* Yakima County Drainage Improvement District No. 43..	2%	7,375.00
* Yakima and Benton Counties Joint Drainage Improvement District No. 1.....	4%	30,500.00
Yelm Irrigation District (1933 Issue).....	2%	138,500.00
† Yelm Irrigation District (1918 Issue).....	2%	6,500.00
Total.....		\$2,454,275.20

Advances to reclamation districts represent sums turned over to districts for construction, reconstruction or bond refunding purposes for which district bonds have not yet been received. In some instances these advances may be paid in cash before bonds become available.

ADVANCES TO RECLAMATION DISTRICTS BY DEPARTMENT

September 30, 1942

District	Interest Rate	Balance Sept. 30, 1942
Agnew Irrigation District	4%	\$7,431.52
Burbank Irrigation District		39,417.88
Cowlitz County Diking Improvement District No. 11.....	5%	1.74 Cr.
Cowlitz County Diking Improvement District No. 13.....	4%	86.50 Cr.
Highland Irrigation District	4%	2,070.66
Kittitas Reclamation District		1,210.59
King County Drainage Improvement District No. 14.....	5%	3.01 Cr.
Lake Chelan Reclamation District (Apple-box contract)....	2%	105,866.84
Moses Lake Irrigation District.....	4%	2,711.91
Okeh Irrigation District	4%	6,950.00
Otis Orchards Irrigation District	4%	5,496.79
Outlook Irrigation District	4%	9.54 Cr.
Pasadena Park Irrigation District	4%	0.37 Cr.
Snohomish County Diking District No. 1.....	2%	6,667.29
Snohomish County Diking District No. 1.....	4%	1,198.08
Spokane Valley Irrigation District.....	4%	5,000.00
Thurston County Drainage Improvement District No. 9....	4%	750.00
Wenatchee-Chewawa Irrigation District	2%	0.31 Cr.
Unpaid charges against districts to cover costs of investigations		209.23
Total.....		\$184,879.32

* Bonds on deposit with Peoples National Bank of Washington, trustee.

† Bonds purchased for refunding and held by department.

The balance of the bonds are on deposit with the State Treasurer for safe keeping.

Investigation charges represent cost to the department of investigating the physical and economic conditions of districts applying for funds and constitute obligations of the respective districts.

Miscellaneous book assets consist of three items. The first item consists of a charge on the department's books against the State Forest Board in the amount of \$6,990.97. The item dates back a great many years to a period when the legislature made at least two appropriations from the reclamation revolving fund for the benefit of the State Forest Board without, however, any provision for reimbursement. Without delving back into early accounts it is not possible to ascertain how this "book asset" originated. In any event, the item should be disposed of and cancelled by legislative enactment or otherwise.

The second item refers to an expenditure of \$24,122.22 made several years ago pursuant to legislative authority in an attempt to have the relative rights of Washington and Oregon to the waters of Walla Walla River judicially determined. The act provided that the cash should be reimbursed from assessments levied against property involved in proportion to benefits received. Since the resulting judgment was wholly adverse to Washington's interests, no property was benefited and no basis exists for allocating the cost to the properties involved. It is believed that the legislature should appropriate the amount from the general fund for the reclamation revolving fund or, in the alternative, by legislation otherwise authorize the removal of the item from the department's books.

The third item arose from an expenditure of \$2,601.19 made by the Division of Hydraulics pursuant to Chapter 150, Laws of 1933. Upon petition of the City of Walla Walla the supervisor of hydraulics in 1933 investigated and prepared tentative plans for control of the destructive floods in Mill Creek. The plans then suggested were later made the basis for the extensive federal Mill Creek flood control project later undertaken and now virtually completed by the Army Engineers. On account of certain provisions of the governing act, and also because the project as ultimately consummated embraced territory outside of the City of Walla Walla, the department has heretofore been unable to set in motion the extensive proceedings necessary to secure reimbursement for this comparatively small expenditure. Now that the project is completed, an effort at collection is in order and will be made. The results may be uncertain.

The department recommends that said Chapter 150, Laws of 1933, be repealed by the coming legislature, both because the act is cumbersome and impractical and because we now have other and more adequate legislation for the control of floods.

The liabilities of the fund are confined to the collateral trust bonds yet outstanding in the principal sum of \$218,000. The last maturities are due and payable in 1947. It is worth noting that the cash accumulation in the hands of the trustee amounts to about 88 per cent of the par value of outstanding collateral bonds. Efforts at using this cash for redemption of bonds ahead of maturity have been futile, because of the high regard in which they are held from investment, earning and safety standpoints.

The interest income received by the reclamation fund from October 1, 1940, to September 30, 1942, was \$93,909.54. This corresponds to 1½ per cent

per annum on \$2,822,552, which is the net book value of the fund after deducting the non-productive miscellaneous book assets discussed above.

Remembering that the two cash items totaling \$404,143.65 under present conditions of money market earn no interest, it will be noted that on the active or invested portion of the reclamation revolving fund the rate of interest **earned and received** is slightly below 2 per cent per annum.

It is apparent that, especially under present conditions, prudent management of the fund requires that it be invested in district securities whenever that can be done with safety to the State and to the advantage of the borrowing districts. Cash unproductive of earnings should be kept on hand sufficient for but not in excess of anticipated emergency demands.

Financial Transactions

October 1, 1940, to September 30, 1942

Settlements, investments and adjustments were made during the period as follows:

1. Delivery was taken of reclamation district bonds in settlement of advances and commitments made to the respective districts during prior bienniums as follows:

From Oroville-Tonasket Irrigation District (2% refunding).....	\$258,400.00
From Chelan Falls Irrigation District (4%).....	3,000.00
From Snipes Mountain Irrigation District (1%).....	1,500.00
Total.....	\$262,900.00

No transfers of funds were involved in these transactions during the present biennium.

2. Agnew Irrigation District original issue bonds in the par value of \$500.00 were purchased by the department from private owner for the sum of \$150.00. These bonds will be surrendered to the district for \$150.00 par value of its refunding bonds.

3. The following irrigation district bonds owned and held by the reclamation revolving fund were exchanged for refunding bonds of the districts. Interest rates and maturities (and in one instance principal) were adjusted in the transactions:

Priest Rapids Irrigation District	
\$89,000—5%, 3% and 2% original, for \$89,000—2½% refunding bonds	
Stemilt Irrigation District	
\$27,000—2% } original, for \$75,000—1¼% refunding bonds.	
and	
\$75,000—1% }	
Cascade Irrigation District	
\$40,000—6% original, for \$40,000—4% refunding bonds.	
Kennewick Irrigation District	
\$200,700—1% } original, for \$234,000—1¼% refunding bonds.	
\$21,000—2% }	
\$13,000—4% }	

These transactions involved no cash.

4. Bonds were purchased outright from districts as follows:

Drainage and Irrigation Improvement District	
No. 12 of King County.....	\$4,053.48 @ 4% interest
Bacon Tracts Irrigation District.....	1,200.00 @ 2% interest
Total.....	\$5,253.48

5. Loans for construction and betterments were made to the following districts, for which bonds have been or will be received, unless sooner repaid in cash:

	Amount of Loan	Settlement to Date		
		Cash	Balance	
Pasadena Park Irrigation Dist..	\$3,611.02		\$3,611.02	Bonds received
Oroville-Tonasket Irrigation District	60,907.74	\$907.74	60,000.00	Bonds received
Agnew Irrigation District.....	7,931.52	500.00	7,431.52	Open account
Moses Lake Irrigation District..	3,163.89	451.98	2,711.91	Open account
Totals.....	\$75,614.17	\$1,859.72	\$73,754.45	

RECOMMENDATIONS

With Respect to the State Reclamation Act

After mature consideration, it is recommended that Chapter 16, Laws of 1933, be repealed by the coming legislature. It is believed that the emergency declared by this act to be prevalent at the time of passage is now, fortunately, over. Furthermore, it is believed that the act permits employment of the reclamation fund for purposes never contemplated by the people at the time the fund was established and created from money raised by taxation. The reclamation revolving fund was established because private investment funds were no longer available for reclamation, and it filled a definite need. Under the 1933 act the process can be reversed, in that the reclamation revolving fund was made available for taking private interests out of their sometimes unfortunate reclamation investments. And, indeed, large sums have been so used. This we do not believe, at least under present economic conditions, to be a legitimate public purpose.

The repeal of Chapter 16, Laws of 1933, is therefore urgently recommended.

FIELD AUDITING OF RECLAMATION DISTRICTS

The management of the reclamation revolving fund is essentially a banking or investment matter. With nearly three million dollars loaned out to some seventy reclamation districts, common prudence requires that close contact be maintained between lender and borrower to their mutual advantage.

Shortly after taking office, the director, therefore, engaged an auditor who has had long and extensive experience with fiscal affairs of reclamation districts. He spends virtually all his time in the field calling upon and advising with the many districts whose obligations are held by the State or who have applied for loans from the revolving fund.

Conferences are generally held with district boards of directors and secretaries when budgets and assessment rolls are being prepared. From time to time through the year the field auditor checks with the county treasurers on payment of assessments, the status of the various district funds, amount of outstanding warrants, delinquencies, issuances of certificates of delinquencies, foreclosures on delinquent assessments, resale of lands taken by districts, and numerous other transactions pertaining to fiscal affairs of the districts. Unfavorable or unsatisfactory conditions thus disclosed are discussed with the district boards, and thus ways and means are often devised for maintaining districts' financial integrity. The margin between adequate assessments and a sound financial position and inadequate assessments and resulting financial

difficulties is often very small in terms of annual cost to the assessment payer. Very frequently, therefore, a careful analysis of a district's fiscal policy may indicate where slight increases in assessments, a stricter district policy with respect to collections and foreclosures or other changes in fiscal management will put a financially ailing district on its feet. Our theory is that an impartial and experienced outsider, such as the department's field auditor, is in a favorable position to discover and aid in correcting many of those laxities in fiscal management which are generally inherent in local organizations. That theory has proven correct, and beneficial results have been obtained already in many instances.

Whenever a reclamation district desires to adjust its indebtedness by refunding or otherwise, the field auditor is assigned to make a careful investigation of its past financial history and its present status. He also attempts, in cooperation with the district management, to make a careful forecast of future ability to pay assessments for all district purposes, and on the basis of the facts and estimates a readjustment plan is generally formulated.

We believe that this arrangement of close contact with the field will fulfill our expectations and result in greater financial stability for the districts and the reclamation revolving fund alike.

COLUMBIA BASIN ACTIVITIES

During the biennium the department has rendered all possible aid and cooperation to the Columbia Basin irrigation districts. The director attended virtually all joint meetings of the districts and participated in their deliberations on problems of common interest to them, such as the formulation of the Federal Columbia Basin Project Act and the furtherance of its early enactment by Congress.

The director and members of the staff also participated in the studies of several phases of the Columbia Basin joint investigations.

DIVISION OF HYDRAULICS AND WATER RESOURCES

CHAS. J. BARTHOLET
Supervisor

THE WATER CODE

The Water Code of the State of Washington, which provides for the proper use of one of the state's greatest natural resources, water, reached the twenty-fifth year of its existence on June 15 of this year.

A total of 3,590 permits for the appropriation of water have been issued out of 5,750 applications received since the code was adopted.

During this period 3,543 water rights, which were initiated before the water code went into effect, have been adjudicated on 56 streams, supplying water for the irrigation of 215,424 acres of land, in addition to water that is used for domestic, power, mining and other purposes.

Many disputes between water users have been settled on the ground, thus avoiding the expense of costly litigation. It has been said that this alone would have justified the adoption of the code.

Water users throughout the state have learned that a central office is maintained under the code where information and advice are given on all problems relating to the use of water. Both prospective and actual water users have freely taken advantage of this service, which constitutes much of the work of the office.

It has been the duty of the writer to have had a part in administering the water code throughout its existence, a service of which he is proud. The water code has accomplished even more than was expected by the farsighted men who framed the act and put it through the legislature. Its value to water users has been demonstrated many times, and in addition this legislation has stabilized water rights and this in turn has added greatly to the value of properties to which they are appurtenant.

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, which are related activities, 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 works.

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.

4. Snow surveys.

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 administration of the water code is carried on with the aid of 14 county water masters and 16 stream patrolmen. Most of these officers have seen years of service in their respective capacities and through their competence the regulation of waters according to rights has been very successfully carried on, notwithstanding an acute situation which existed during the last half of the irrigation season during both years covered by this report, due to insufficient water supply in the streams. During the biennium only one appeal has been made to the courts from orders issued by water masters or stream patrolmen and this case has not yet been pressed.

There are approximately 3,600 adjudicated water rights on sixty streams where water is used for irrigation, and 3,600 water rights under permits issued by the State Supervisor of Hydraulics for various purposes. We believe that our organization for the regulation of water according to water rights is so perfected that the work is being carried on at a minimum expense to the taxpayers.

2. Determination of Existing Water Rights.

The water code of the state provides a process for determining the extent and priorities of water rights initiated before June 15, 1917, the date on which the water code became effective. The irrigation waters of all the principal streams, 70 in number, in the arid sections of the state, have been adjudicated and water rights determined, except on the Yakima River and some of its tributaries. Of these 12 have already been adjudicated.

3. Initiation of New Water Rights.

During the past several years the number of applications for permits to appropriate water has been stimulated by the move toward irrigation of lands west of the Cascade Mountains. The increase of applications in this section has offset the decrease in the number of those received from east of the mountains during the same period.

During the first half of the present biennium the number of applications received was normal, but during the last half the number received was about 50 per cent of normal, decreasing toward the end of the biennium. The reason for this slump is due to the scarcity of man power and the inability to purchase equipment and materials for construction work, caused by rationing and priorities under rules of the War Production Board. However, many projects are being planned for construction after conditions again become normal, and, no doubt, many belated applications will then be filed.

This office cooperates with the State Departments of Game and Fisheries by forwarding to them notices of all water right applications for their examination, and if found that the quantity of water sought will be injurious to fish life in the streams, their recommendations are followed in reducing the

quantity of water; or if facilities are required at the diversion works to protect fish life, such requirements are made a provision of the permit. However, few recommendations are made by those departments for the complete rejection of applications.

We also notify other state and federal agencies when it appears that the proposed use of water under an application would be of interest to them.

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, 1938, for the biennium October 1, 1938, to October 1, 1940, and during the past biennium:

	June 15, 1917 to Oct. 1, 1938	Oct. 1, 1938 to Oct. 1, 1940	Oct. 1, 1940 to Oct. 1, 1942	Total
Application for permits to appropriate and store water	4,637	637	474	5,748
Permits to appropriate water.....	2,588	519	481	3,588
Permits to construct reservoirs and store water	122	5	5	132
Final water right certificates.....	1,123	293	451	1,867
Certificates of change (change of point of diversion and/or place and purpose of use of water).....	160	16	26	202
Applications cancelled	1,438	233	115	1,786
Permits cancelled	312	168	329	809

4. Collecting and Recording Hydrographic Data.

The collection and recording of hydrographic data are required by the water code for the following 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.
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.

This work is carried on in cooperation with the Water Resources Branch of the U. S. Geological Survey on a matching dollar-for-dollar basis and will be further mentioned under the heading "surface water resources." During the fiscal biennium, ending April 1, 1943, the state will have expended, including \$600 allotted by the State Fisheries Department, approximately \$28,000 and the federal government will expend approximately \$110,300, or approximately \$4.00 for each dollar expended by the state.

Included in the \$110,300 expended by the federal government is \$16,300 for work in obtaining stream flow measurements for municipalities in the state. The municipalities during the same period allotted \$20,000, for which work is carried on under the direction of the U. S. Geological Survey. Funds for the gathering of hydrographic data in cooperation with the U. S. Geological Survey, as well as those expended for other cooperative activities, come from power license fees collected under Chapter 105, Laws of 1929, as

amended by Chapter 209, Laws of 1939, and do not come from the general fund of the state. Therefore, they are not a burden to the general taxpayer.

In addition to the cooperative work in obtaining hydrographic data, estimates are made of the amount of the stream flow in streams on which applications have been made to appropriate water. Such estimates are made at the time the application is investigated on the ground. These give data for record on many small streams on which otherwise no information could be had.

We feel that good progress has been made in determining the value of our water resources, particularly on the larger streams, but much remains to be done in obtaining data on the smaller streams of the state, and as funds become available gaging stations will be established on such streams, as, in the aggregate, the smaller streams offer a water supply equal to that of the larger streams.

We are grateful to Mr. F. M. Veatch, District Engineer of the Water Resources Branch of the U. S. Geological Survey, located at Tacoma, for his consideration in carrying out and directing the work involved under the cooperative agreement between the state and federal government.

Following is a statement by Mr. Veatch concerning collecting and recording hydrographic data:

"The increasing use of its tremendous water resources has played a large and important part in the growth and development of the state. Growing population and industry have created new and increasingly difficult problems with respect to the apportionment, control, and development of its waters. Detailed information about stream flows must be obtained for the proper administration and engineering required in connection with these problems.

"Starting in 1909, successive state legislatures have made provision for carrying on hydrographic surveys. As in past bienniums, the Supervisor of Hydraulics has cooperated with the United States Geological Survey in the collection of stream-flow records, and state moneys made available for this work have been matched by the federal government. A district office of the Geological Survey is maintained within the state by virtue of this cooperation and, as a result of its location within the state, other state agencies and municipalities have taken advantage of its policy of matching public funds. Also other federal agencies have provided funds by transfer to the Geological Survey for expenditure within the state in the collection of stream-flow records.

"Through the combined financial support of the many sources mentioned above, daily records of gage heights or gage heights and discharge are being obtained at 162 gaging stations located on lakes, reservoirs and streams of the state. During the biennium 39 gaging stations were established and 10 were discontinued.

"It is important that a comprehensive state-wide network of gaging stations be provided and maintained over an indefinite period, or long enough to indicate long-time trends. The needs for stream-flow records must be foreseen several years in advance; otherwise they will not be available when needed. A network of basic key gaging stations should be maintained permanently and stations at less important locations should each be operated for a number of years. The State Division of Hydraulics and Water Resources in cooperation with the Geological Survey is working toward adequate gaging station coverage for the state as rapidly as available funds will permit.

"The result of inadequate stream-flow records is reflected in the history of many hydrographic projects in the state which have failed with a great loss of capital outlay, public and private, on that account. Progress demands the continuation and gradual expansion of the present stream-gaging program for the state, much of which is necessary in the interest of national defense and war offensive."

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 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.

Owing to priorities of materials and man power only two major dams are being constructed which required our examination or approval of the plans as to safety, these being constructed on the Nisqually River by the City of Tacoma for power purposes. Both structures are concrete, one having a height of 200 ft. and the other 300 ft. Plans of three small dams were also examined and approved as to safety.

The supervisor has compiled a list of seventy dams in the state which create reservoirs, impounding 10 acre-feet or more. The compilation shows the stream, the location, storage capacity of the reservoir, use, type of structure and height of dam. Of this list 24 may be considered major dams of modern construction, and some are the largest in the world.

During the period covered in this report there has been no dam failure in this state, and we have not been called upon to make an examination of more than six structures where the safety was questioned, but most of the dams have been examined not on account of any weakness in the structures but for the purpose of having a record in this office of their general condition.

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, without a permit from said Supervisor of Hydraulics.

Since the effective date of the act 16 zones have been established and 203 permits issued, 20 during the past biennium.

A map and description of each zone are on file in the office of the Supervisor of Hydraulics at Olympia and, for the convenience of the public, copies have been furnished to the respective county engineers, where they may be inspected.

2. River Utilization Surveys.

In addition to obtaining stream-flow data to determine the value of the state's resources in water, river utilization surveys are made. These surveys are made by the Conservation Branch (Water and Power Division) of the United States Geological Survey cooperating with the Supervisor of Hydraulics. The resulting maps show the physical characteristics of the streams and serve as the basis for evaluating potential developments such as power, irrigation, flood control, industrial and municipal water supply.

These surveys are made under the direction of Arthur Johnson, Hydraulic Engineer of the Conservation Branch of the U. S. Geological Survey. Owing to Mr. Johnson's limited staff, because of shortage of a trained personnel due to war activities, the surveys had to be curtailed. As a result the full allotment of funds by the state for that purpose was not used. This work has

been carried on over a period of years by Mr. Johnson, covering most of the important streams. We wish to acknowledge the cooperative spirit with which he and his staff have carried on this work during the biennium. For the biennium \$5,000 was allotted by the state with an equal amount allotted by the U. S. Geological Survey.

The surveys made are listed below:

Touchet River Basin, Columbia County:

South Fork Touchet River from confluence with North Fork to confluence of Burnt Fork and Green Fork which is the beginning of the South Fork, 14 miles.

North Fork Touchet River from confluence with South Fork upstream 10 miles; Wolf Creek, from mouth upstream 5 miles; Robinson Creek, from mouth upstream 2 miles.

A detailed survey was made on one dam site on the North Fork of Touchet River just below the mouth of Wolf Creek.

Green River Basin, King County:

Green River, from Kanasket to Humphrey, 14 miles.

Puyallup River Basin, Pierce County:

Carbon River, from a point 4 miles downstream from Fairfax to the boundary of Rainier National Park, 10 miles.

3. Ground-Water Resources.

Approximately 26 per cent of the people of the state reside in communities that are supplied wholly, or in part, from ground water which can be obtained at a reasonable cost. This does not include a scattered rural population which has no other source of water than from wells for domestic purposes and for stock. Thousands of acres are irrigated from wells. In addition, many industrial plants rely wholly on water from this source.

This source of supply is becoming more important with the diversion of all of the water in many of the streams for various purposes. The study of ground water is in a preliminary stage and is rather limited on account of lack of available funds for that purpose. It is hoped that eventually sufficient data will be available on the location and extent of such a water supply so that a ground water code, similar to our surface water code, can be enacted and administered in the interest of protecting investments in water supplies from that source.

It is very important that ground-water studies be made on the Columbia Basin Project in advance of the coming of settlers, as this will probably be the only source of domestic water supply on the project. Following is a statement by Arthur Piper, Senior Geologist, who has direct charge of the work for the U. S. Geological Survey, carrying on the work in cooperation with the State of Washington:

"During the biennium ending September 30, 1942, 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. This activity has been supplemented by work in cooperation with the City of Tacoma and in collaboration with the military forces. Progress in the programs supported by the state is summarized below:

"Canvass of public water supplies and state-wide net of observation wells.—The state-wide canvass of public water supplies from wells and springs and the continuing program of quarterly measurements of ground-water level in key observation wells^① have been combined into a single activity.

"Modifying earlier plans, the report on the canvass and the water-level data through September 30, 1942, will be assembled in a composite report for release to the public at the earliest practicable date and for ultimate publication as a Water-Supply Paper of the Geological Survey.

"Spokane Valley.—Data on water-table fluctuations in the Spokane Valley through 1938, heretofore released^②, will be published as Water-Supply Paper 889-B. Corresponding data for 1939 and 1940 have been published in Water Supply Papers 886 (pp. 915-923, 90-92) and 910 (pp. 163-175, 7-10); data for 1941 and 1942 will be included in future Water-Supply Papers in the series on water levels and artesian pressure in observation wells in the United States. The field program in the Spokane Valley, curtailed in June 1940, was resumed late in 1941 and the mapping of pertinent geologic features was completed in September 1942. Basic data will now be assembled and a comprehensive report drafted to describe the fundamental ground-water conditions. These data and the report will be released at the earliest practicable date."

Mr. Piper has been very attentive to matters called to his attention relative to ground-water problems and we appreciate his cooperation in dealing with this office.

An allotment of \$10,000 has been made for the fiscal biennium for carrying on ground-water studies, which amount is matched by the U. S. Geological Survey. One-half of this work is confined to the Columbia Basin Project area.

4. Snow Surveys.

Snow surveys are for the purpose of determining the amount of snow and its water content in various river basins in the state for the purpose of predicting the amount of water which will be available for various purposes. Such information is very helpful in preparing a program of operations, both for irrigation and hydroelectric plants, and may at times be used for protection against floods.

While some work of this nature has been carried on in the state, it has been limited in scope, but the state has recently entered into an agreement with the Federal Soil Conservation Service to expand snow survey work in other drainage basins where it is very much needed. Monthly reports will be made giving data concerning snow fall and water content so that it may be studied well before reservoirs are filled and water is needed for irrigation purposes. The work will be done under the direction of the Soil Conservation Service of the U. S. Department of Agriculture and the cost will be borne on a fifty-fifty basis with State of Washington, each expending \$300 between now and April 1, 1943. The work will eventually cost the state from \$500 to \$600 each biennium.

The Soil Conservation Service will also cooperate with the cities of Tacoma and Seattle, the Army Engineers and several power companies on a money matching basis for the purpose of obtaining snow survey results in drainage basins in which they are particularly interested.

^① Tenth Biennial Report of the Department of Conservation and Development, p. 23, 1941.

^② Tenth Biennial Report, p. 23.

POWER LICENSE FEES

The amount of annual power license fees collected under Chapter 105, Laws of 1929, is now running quite constant. The principal amount comes from power plants now in operation, but some fees are paid on undeveloped or partially developed projects for which permits have been issued by this office for the appropriation of water.

The fees are placed in the state reclamation revolving fund, from which they are appropriated to cover the cooperative activities with the federal government; viz., hydrographic surveys (gathering stream-flow data), river surveys, ground-water surveys, snow surveys, and topographic mapping.

During the biennium \$60,180.52 was paid on 76 claims to water for power purposes. The federal government is exempt from paying such fees, but fees are paid by municipalities as well as others operating power plants in the state.

RECEIPTS

The following table shows receipts for the biennium from October 1, 1940, to October 1, 1942:

<i>Source</i>	<i>Amount</i>
Examination Fees:	
Initial	\$ 2,395.54
Additional	1,923.50
Filing and Recording Fees:	
Permits	6,382.04
Certificates	735.29
Miscellaneous	126.80
Miscellaneous Copying	81.00
Extension of Time for Beginning of Construction	1,186.95
Adjudication of Water Rights	557.56
Dam Inspections	62.47
	<hr/>
	\$13,451.15
Power License Fees	60,180.52
	<hr/>
	\$73,631.67

EXPENDITURES

The following table shows expenditures under the supervision of the State Supervisor of Hydraulics for the biennium from October 1, 1940, to October 1, 1942:

<i>Purpose</i>	<i>Amount Expended</i>
Administration of Water Code	\$29,818.81
*Hydrographic Surveys	20,852.86
*River Utilization Surveys	2,982.77
*Underground-Water Surveys	5,055.19
	<hr/>
Total	\$58,709.63

DIVISION OF FORESTRY

T. S. GOODYEAR

Supervisor

1941 ANNUAL REPORT

The first damaging fires of 1941 occurred February 5. There were three bright, clear days with exceedingly heavy frosts and very low humidity. A 70-acre fire was reported burning in Dempsey Logging Company slashings. Another 300-acre fire in Skagit Mill Company works destroyed a railway trestle and several cold decks of logs. A fire also was reported burning uncontrolled near North Bend. From February 12 to 22, inclusive, the days were clear and cold with heavy frost at night. Many fern fires were burning throughout western Washington.

Between March 2 and 16 there were 15 successive clear, sunny days with comparatively low humidity. On March 10 the winds shifted to northeast and humidity dropped to 20 degrees. Numerous fern and slashing fires were reported burning in Cowlitz, Clark and Skamania counties. By March 12 most of the district and assistant district wardens were put to work. On March 13 it became necessary to supplement the organization by placing many of the regular rangers and patrolmen on the pay roll, and by March 14 there were 300 enrollees from the CCC camps fighting damaging fires in the Toutle and Coweeman rivers areas in Cowlitz County. A 1,000-acre fire was burning near Van Horn, and there were several large fires burning uncontrolled in Clark County. By March 15 there were fern and slash fires burning throughout western Washington and every available warden and ranger was on the fire lines. The most serious threat was a 4,000-acre fire near Beacon Rock on the Columbia River in Skamania County. On March 17 there were light, scattered showers, and on March 18, 19, 20 and 21 hard general rains temporarily relieved a critical situation and afforded an opportunity to get trails around the larger fires. March 23 was clear and warm. The balance of the month, with the exception of March 29, was bad fire weather, with northeast winds and humidity reaching as low as 17 degrees. During this period many damaging fern and slashing fires, set in western Washington, destroyed young trees on thousands of acres of cut-over lands.

In western Washington there were more consecutive bad fire days in March than in any of the summer months; a greater forest acreage burned, and there was more loss and damage to property (especially second-growth timber) during the months of February and March than during the entire fire season—April to October, inclusive.

The weather during most of April was favorable, with comparatively few fires. There were but three clear days from April 1 to 15. From April 16 to 28 the weather was clear and comparatively warm, with no rain. By April 20 the ground was dry and the humidity was low. Many fern fires were started by settlers and some of them got away, threatening buildings and young timber. From April 24 to 27 there were northeast winds, and on April 26 the temperature reached 87 degrees—the warmest April day recorded for many years. This period was also accompanied with unusually low humidity.

Many slashing and fern fires caused a heavy pall of smoke which settled over western Washington. There was a severe lightning storm in the Cascade Mountains and northern counties on April 28—scattered showers fell on April 29 and 30.

Most of May was cloudy or rainy, and consequently there were few fires. From May 21 to 25 the weather was clear, with recorded humidity of 28 and 20 degrees. On May 22 and 23, respectively, the temperature reached 80 degrees and there were strong northeast winds. Practically all of the 44 fires reported for May occurred during this one dry period.

There were but seven clear days in June. General rains and cloudy weather made it an exceedingly favorable month with but 68 fires, most of which were small and easily controlled.

With the exception of four cloudy days, the weather during July was hot and dry with low humidity. On July 14 and 15 the temperature reached 105 degrees—the hottest weather recorded in western Washington for 50 years. After 17 consecutive days of critical fire weather, the atmosphere became very sultry and the smoke from numerous fires burning throughout the state settled into a dense blanket close to the ground. There was no visibility from the lookouts. It was during this period of high temperatures and low humidities that a severe lightning storm struck, setting 386 fires in the forests of the state. Lightning continued to strike intermittently over widely scattered areas for three days. Sleeper fires could not be detected until they actually broke out. At this time the railroads set several large fires in the sagebrush areas of Yakima and Kittitas counties, three of which burned over very large areas and finally had to be controlled to keep them out of scattered timber on top of the ridges.

Labor was scarce and it was extremely difficult to recruit fire fighting crews. For the first time since 1933 there was practically no help available from the CCC camps. Some of the camps were abandoned July 1, others were in the process of transfer. The enrolled strength of the few remaining camps was so low there were barely enough men to maintain and operate the main camps—all side camps had long since been discontinued. By the time new recruits had undergone the quarantine and training period and were available for fire fighting, the season was over. About July 9 money appropriated by Congress for Cooperative Forest Fire Control (Emergency) became available and the process of hiring men and purchasing necessary supplies and equipment was under way. Approximately 238 boys of high school age were employed and assigned to the various districts. With practically no training and little, if any, woods experience, the boys were sent out to help control lightning fires. There was no other labor available and these boys did remarkably well, considering that the day after being hired they were sent out to fight fire. It was ten days before all the lightning fires were actually brought under control. Fortunately, none of the 833 July fires on state and privately owned forest land reached large proportions or caused much damage before they were corralled.

The combination of consecutive days of extremely hazardous fire weather, the severe lightning storm and unprecedented number of fires resulting therefrom, the labor shortage and extreme difficulty of obtaining fire crews, mark July, 1941, as one of the most critical periods in the annals of organized forest fire protection in Washington.

Fire weather during August was fairly favorable—there were but 12 clear days of high temperature and low humidity. The average precipitation was 1.32 inches above normal. On August 2 and 3 scattered, hard showers throughout the state temporarily relieved the fire danger and made it possible to put all existing fires under control. August 5 to 10, inclusive, were clear, hot days with average temperatures of 90 degrees and humidities of 30 degrees. Several scattered lightning fires were set in Whatcom and Skagit counties on August 9 and in the upper Clearwater region, Jefferson County.

By August 15 between 80,000 and 100,000 soldiers were scattered throughout the forests of Pacific, Lewis, Thurston, Mason and Grays Harbor counties for Army maneuvers. In spite of detailed rules and regulations relative to use of fire in the woods, formulated by Army and forestry officials, there was a noticeable disregard, by both officers and enlisted men, of the restrictions against smoking and open fires. Fortunately, the humidity remained fairly high during the first few days of intensive maneuvering. By August 22 there were scattered showers and cooler weather, and on August 25 hard general rains were reported in all parts of western Washington and as far east as Klickitat County. By August 26 one and a half inches of rain had been recorded during the preceding 48 hours, and Army maneuvers were suspended and troops were moving out of the woods.

All fires, except one, caused from Army activities were immediately extinguished. The exception was set from backfire of trucks near Bordeaux in unburned slashings and covered approximately nine acres before it was brought under control. This fire was directly in line with the burner of Mumby Mill and Shingle Company and was not detected by Capitol Peak Lookout. When finally discovered by members of a mill crew, it was several hours before the report was received by either Army or forestry authorities. Crews were dispatched by both the Army and Forestry Division and the fire was extinguished. All of the careful preparation and plans by the Army and forestry officials for prompt detection and suppression of fires completely broke down on this one small fire, which might have reached alarming proportions if weather conditions had been favorable.

It rained almost continuously during the balance of August. There were 315 fires reported for the month and the fire season—which normally runs to the middle of October—was brought to an abrupt end.

Above normal humidity, cloudy and cool weather, with excessive and frequent rains throughout September and October, definitely ended the normal fire threat for these months. There were but 20 fires reported during September and seven in October. In fact, there was no favorable fall burning weather and less than 5,000 acres of logging slash was burned. Consequently, the operators were compelled to carry some 80,000 acres of fresh logging slash into another fire season. This is a very serious additional hazard that must be reckoned with by forest protective agencies during the next year.

There was a considerable reduction in the number of man-caused fires: 145 incendiary fires, compared with 239 during 1940; 318 smokers fires in 1941, 641 in 1940; 87 campers fires in 1941, compared with 123 in 1940. This gratifying decrease of carelessly set fires may in some measure be attributed to the effective and intensive fire prevention campaign carried on by the Keep Washington Green Committee. Lightning fires increased from 332 in 1940 to 563 during 1941. While there were 438 fewer fires, from all causes, in

1941 than in 1940, the actual area burned increased by 3,504 acres. However, the total loss and damage to all classes of property dropped from \$329,019.00 in 1940 to \$89,020.00 in 1941. There were few damaging fires in logging operations outside the national forests and Indian reservations during 1941.

All trucks owned by State Division of Forestry were equipped with demountable water tanks, varying in capacity from 110 to 366 gallons, and Panama power pumps that operate off the fan belt of truck motors. The actual number of fires extinguished by tank trucks during the past season was exceptionally small and it is questionable whether the costs of this specialized equipment for roadside fires was justified. Fortunately, the demountable tanks made possible the use of automotive equipment for other purposes than hauling water.

The following climatological statistics, compiled from reports of the United States Weather Bureau, indicate atmospheric conditions from February to October, inclusive, for 1941.

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
February.....	1.93	1.86	.....	10	6	12	12	5	11
March.....	1.43	2.09	.....	15	8	8	18	9	4
April.....	1.87	0.38	.....	11	8	11	14	9	7
May.....	3.69	.....	1.79	8	8	15	9	10	12
June.....	2.07	.....	0.52	7	10	13	11	10	9
July.....	0.29	0.34	.....	18	9	4	22	8	1
August.....	2.08	.....	1.32	12	7	12	13	10	8
September.....	3.33	.....	1.58	6	8	16	9	10	11
October.....	2.74	0.34	.....	7	8	16	9	10	12

The following summary of fires by months indicates the direct relationship to atmospheric conditions.

	Feb.	March	April	May	June	July	August	Sept.	Oct.	Total
Western Washington.....	31	105	104	32	37	554	221	17	4	1,105
Eastern Washington.....	.....	3	32	12	31	279	94	3	3	457
Totals.....	31	108	136	44	68	833	315	20	7	1,562

Law Enforcement

A year ago the policy of giving publicity to convictions for forestry law violations was adopted. Judges were also contacted and impressed with the importance of fire prevention in their respective communities. Results have been satisfactory and the public is cooperating more closely with our field men in complying with forestry laws, particularly in obtaining burning permits for land clearing and slashing fires.

Forty-four arrests were made by the law enforcement officers, in addition to 24 made by the fire wardens—a total of 68. Convictions were obtained in each instance and there were no appeals. This is a remarkable record, for which credit is due Mr. Robert McColley and his law enforcement assistants.

Civilian Conservation Corps

The following tabulation shows the work accomplished by state and private land CCC camps during 1941. Two camps were transferred to Fort Lewis in June for work on military projects, one camp closed in August and another in November, which left only three camps on state projects at the end of the year. Due to compulsory military training and demands of the defense industries, the CCC enrollment was depleted. These facts account for the noticeable reduction in CCC performance compared with previous years.

Truck trails	30.0 miles
Telephone lines	16.1 miles
Road and trailside clearing	3.0 miles
Firebreaks	4.8 miles
Fire hazard reduction	2,116 acres
Landscaping fire halls and headquarters	6 acres
Tree planting	3,452 acres
Fire suppression	3,983 man-days
Fire presuppression	2,271 man-days
Nursery	2,256 man-days
Survey	180 man-days
Seed collections	1,538 bushels
Signs and markers	583
Vehicle bridges	4
Lookout towers	2
Storage houses	1
Residences	1
Garages	2
Other buildings	4

Equipment

The department purchased 20 Panama pumps, which were mounted on $\frac{1}{2}$ -ton pickup and $1\frac{1}{2}$ -ton stakeside trucks and powered by truck motors. Portable tanks of the following capacities were constructed at the state forestry shop to be used in connection with the Panama pumps:

10	136 gal. flat tanks for $\frac{1}{2}$ -ton pickup trucks
5	195 gal. flat tanks for $\frac{3}{4}$ -ton and $1\frac{1}{2}$ -ton trucks
16	366 gal. round tanks for $1\frac{1}{2}$ -ton stakeside trucks.

The following automotive equipment was purchased:

1	Chevrolet coupe
3	$\frac{1}{2}$ -ton Chevrolet pickup trucks
1	$\frac{3}{4}$ -ton Ford pickup truck
9	$1\frac{1}{2}$ -ton Chevrolet stakeside trucks.

Two caterpillar No. 212 Diesel motor patrol graders were purchased for maintenance of forest protection roads.

The usual replacements and additional purchases of hand tools and small equipment—such as axes, saws, hazel hoes, shovels, sledges, brush hooks, files, pump cans, pack boards, and packsacks—were made. It became increasingly difficult to secure certain items, and we received only slightly more than half the amount of fire fighting hose ordered.

With the advent of Cooperative Forest Fire Control (Emergency) some additional hand tools, together with cots, mattresses, sleeping bags, tents, cooking and mess equipment, were secured.

The shop was equipped with a heavy duty electric welding unit of sufficient capacity to handle any welding which might be needed on tractors, graders, or other state forestry equipment.

Radio

In 1941 radio communication was expanded sufficiently to permit radiophones to be installed in the Colville-Spokane region, where they proved very satisfactory. Radiophones were located at Colville, Deer Park, Newport, and on Mt. Spokane and Mt. Stranger.

During the 1941 fire season the United States Weather Bureau began to transmit weather forecasts directly to Porcupine Lookout, and from there the forecasts were sent to the different district wardens by means of radio. This was previously a telegraphic service.

Twenty new radiophones, suitable for service in lookout towers, were constructed by the National Youth Administration.

Slash Disposal

Applications for certificates of clearance on 93,580 acres were received during 1941. Clearances were issued for 78,706 acres, and 14,874 acres were rejected. However, most of this burning was done during 1940. The only slash burning in 1941 resulted from accidental fires in logging operations.

State Forest Land Acquisition

The Division of Forestry acquired 46,564.06 acres, by deeds from the counties, purchase, exchange and gift, as shown in the following table:

County	Deeded by Counties	Purchase Utility Bonds	Purchase Forest Dev. Fund	Exchange	Gift	Total
Clallam.....				16.08		16.08
Clark.....	490.00					490.00
Cowlitz.....			160.00			160.00
Grays Harbor.....		2,799.29				2,799.29
Jefferson.....	13,396.68					13,396.68
Lewis.....				40.00	5.00	45.00
Mason.....	17,986.56				550.00*	18,536.56
Pierce.....		1,636.44				1,636.44
Skagit.....	40.00					40.00
Skemanía.....	4,804.07					4,804.07
Snohomish.....	2,569.37					2,569.37
Thurston.....	799.73	995.17			275.67	2,070.57
Totals.....	40,086.41	5,430.90	160.00	56.08	830.67	46,564.06

* December, 1940—not included in 1940 report.

Forty-three transactions were completed during the year, involving timber sales and leases. The total receipts were \$4,460.60, of which \$3,746.88 was returned to the counties.

All logging operations have been completed in the Capitol Forest unit and the holdings acquired by gift or purchase.

Jefferson County has joined those turning over suitable forest land to the State Forest Board, thereby making it possible to establish a forest unit in the Port Ludlow-Quilcene area.

Forest units in many counties are being blocked into solid ownership areas. This trend is being stressed in acquisition to facilitate economical administration and protection of these lands. Educational work among the various county officials is beginning to bear fruit and many counties are tak-

ing off the market, for private sale, isolated tracts of land within a potential forest unit. Closer cooperation by the county commissioners and county planning councils is in evidence.

State Forest Nursery and Planting

Spring sowing of seed beds began at the nursery on March 13 and was completed May 22. A total of 1,331 4' x 12' beds, or an estimated production of more than 4,000,000 seedlings, was sown to the following species:

Douglas fir, <i>Pseudotsuga taxifolia</i>	1,323 beds
Western red cedar, <i>Thuja plicata</i>	8 beds

For the first time since the nursery was established in 1935, considerable deer damage was experienced in the 1-0 seed beds. This damage occurred mostly during the month of February when the deer came into the beds at night and browsed on the seedlings, cropping them short at the ground line or pulling them out completely over large areas. The loss amounted to more than 2,500,000 seedlings, leaving slightly less than 2,000,000 available to mature into 2-0 stock for the 1941-42 planting season. It is interesting to note that this damage occurred only to the 1-0 stock, with the 2-0 stock in adjacent beds being unmolested, and also that very little damage took place except during the month of February. In view of the fact that this type of damage had never occurred before under apparently similar conditions, and that the cost of a deer fence would be excessive, it was decided not to take any preventive measures other than observation and possibly the installation of an electric fence next year, should the need arise.

The labor problem at the nursery was somewhat changed from previous years during the summer, in that the CCC crew was supplemented by a Co-operative Forest Fire Control standby crew of four men. This worked out fairly well when the men were not away on fires. However, unquestionably the most efficient method of handling nursery work is with a small but adequate crew, hired primarily for that purpose.

During the spring and fall of 1941, a total of 2,764,568 2-0 seedlings was planted on 4,481 acres of state land in Clallam, Clark, Cowlitz, Grays Harbor, Lewis, Mason, Pacific, Pierce, Skagit, Snohomish, Thurston, and Wahkiakum counties by the CCC and hired civilian crews, as follows:

1941 PLANTATIONS

COUNTY	Number of Trees Planted	Number of Acres Planted
Clallam.....	71,707	142
Clark.....	50,025	80
Cowlitz.....	198,276	403
Grays Harbor.....	282,949	490
Lewis.....	381,102	577
Mason.....	23,850	50
Pacific.....	228,712	526
Pierce.....	350,482	467
Skagit.....	449,912	701
Snohomish.....	259,275	410
Thurston.....	256,990	421
Wahkiakum.....	105,288	214
Totals.....	2,764,568	4,481

An experimental plantation of 1,050 three year old shagbark hickory (*Hicoria ovata*) and pignut hickory (*Hicoria glabra*) was established in NW $\frac{1}{4}$ NW $\frac{1}{4}$ of Section 31, Township 28 North, Range 9 East, Snohomish County, in the spring, and a similar plantation of 1,100 hickory seedlings was also established in NW $\frac{1}{4}$ NE $\frac{1}{4}$ of Section 35, Township 17 North, Range 4 West, Thurston County.

Pupils of Kirkland high school added 3,800 2-0 Douglas fir seedlings to the school plantation which was established by them on State Forest Board land in 1940. The necessary seedlings, planting tools, and supervision were supplied by this department and the students were keenly interested in the growth made by their previous year's plantation.

Examination of an experimental plot of 20 acres which was seeded by airplane, at the rate of one pound of Douglas fir seed per acre, in October of 1939 on a slash area burned that fall, showed practically no germination. Considerable evidence of rodent damage was found, where mice had removed the seed kernel leaving the hull, and it is believed that this was the principal cause of failure in the experiment.

This year was an extremely good seed year in the Douglas fir region of Washington; however, it was poor in the Ponderosa pine area. CCC and regular protection crews collected 1,468 sacks of Douglas fir cones in western Lewis, Pierce, Snohomish, Skagit, Cowlitz, Thurston, and Grays Harbor counties, from which 1,156 pounds of seed were extracted. In addition to this, the following seed was collected:

Western red cedar, <i>Thuja plicata</i>	30 lbs.
Sitka spruce, <i>Picea sitchensis</i>	12 lbs.
Western hemlock, <i>Tsuga heterophylla</i>	8 lbs.
Noble fir, <i>Abies nobilis</i>	10 lbs.
Ponderosa pine, <i>Pinus ponderosa</i>	29 lbs.

Considering normal requirements at the nursery, this amount of Douglas fir seed will be sufficient for four years.

A 24' x 72' building, containing mess hall combined with a lounge and sleeping quarters, was completed by the CCC side camp from Elma. This modern, completely equipped unit is a much needed improvement and completes the building construction at the nursery.

Recommendations

1. That a sufficient number of fire wardens and patrolmen be employed in the early part of February to prevent the spring fern fires which annually destroy large areas of young trees.

2. That complete information regarding location and size of logging crews, power equipment and hand tools be compiled during the winter and made available to forest protection agencies by the beginning of 1942 fire season.

3. That colleges and high schools be immediately contacted for available man power, which may be hired for regular patrol and emergency fire fighting; and that arrangements be completed to give students some preliminary fire training before the end of school year.

4. Last year provisions of the Emergency Fire Control Act, or interpretations thereof by the United States Forest Service, confined the use of men paid with funds appropriated by the Act to either fire suppression or fire pro-

tection projects. Another year the requirements should be liberalized so that emergency fire crews or any concentration of men might be used during spare time for improvement work around fire halls or other forest stations, gathering cones for tree seed, weeding or packing at the forest nursery, checking forest plantation survivals or silvicultural experiments, or any other form of public forestry work. Such activities would keep the men better satisfied and help round out the entire state forestry program.

5. There should be 25-man standby emergency crews, fully trained and adequately equipped with transportation facilities, fire fighting tools and emergency rations, stationed at:

- (a) Deer Park, available for northeastern Washington.
- (b) Kelso, for southwestern Washington.
- (c) Olympia, for central western Washington.
- (d) Port Angeles, for Olympic Peninsula.
- (e) Sedro Woolley, for northwestern Washington.

This will partially replace the loss of CCC camps.

6. An emergency forest defense council composed of three members—one to represent all federal agencies, another to represent all private forest protective agencies, and the third to represent state agencies—would be most expedient for coordinating forest fire defense in case of emergencies.

7. Immediate contact should be made with proper Army and Air Force authorities, relative to the possible use of soldiers for fire fighting and air patrol for forest fire detection.

Table No. 1—ORIGIN, NUMBER AND CLASSIFICATION OF FIRES—1941

COUNTIES	Light-ning	Incen-dary	Camp-ers	Smok-ers	Slash-ing	Log-ging	Brush Burn'g	Rail-roads	Miscel-laneous	Total
Chelan.....	25			6			1	3	1	36
Clallam.....	12	1	4	12		8	2	1	4	44
Clark.....	5	11		8	2		21	2	12	63
Cowlitz.....	12	12	2	15	1	4	4	2	4	56
Ferry.....	14		3	2					2	18
Grays Harbor.....	10	8	3	15		1		2	5	45
Island.....	1		5	1			1		5	13
Jefferson.....	9	7	5	14			1		6	42
King.....	27	10	17	28		4	27	11	15	139
Kitsap.....	8	11	1	11	1		2		4	38
Kittitas.....	41		1	15			1	3	9	75
Klickitat.....	7	3	2	8		5	5	1	7	39
Lewis.....	32	15		14	1	10	10	7	10	99
Mason.....	22	13	11	7			1		4	58
Okanogan.....	57			1					1	59
Pacific.....	12	2	2	1		3			2	23
Pend Oreille.....	6	3	1	4			2	2	3	21
Pierce.....	20	9	4	51		5	9	1	5	104
San Juan.....	3		5	2					13	23
Skagit.....	121	4	4	10		4		3	1	151
Skamania.....	3		1	6			8		2	22
Spokane.....	8	6	6	14		4	15	3	12	68
Spokane.....	12	5	1	36			1	13	14	82
Stevens.....	67	3	3	9	1	2	7		18	110
Thurston.....	2	20	4	11	1		15	12	4	69
Wahkiakum.....	3						3			6
Whatcom.....	17		5	10	1		3	1	5	42
Yakima.....	7	2		7					1	17
Totals.....	563	145	87	318	9	52	144	75	169	1,502

Classification of fires: Class A ($\frac{1}{4}$ acre or less), 830; Class B ($\frac{1}{4}$ acre to 10 acres), 512; Class C (over 10 acres), 220.

Table No. 2—ACREAGE BURNED OVER—1941 FIRES

COUNTIES	FOREST LAND			NOT REFORESTED			NON-FOREST LAND			Total
	Mer- chant- able Timber	Reproduction		Old Burn	Outover Land		Pas- ture	Brush	Other	
		Cut Over	Old Burn		Slash Un- burned	Slash Burned				
Chelan.....	1,006	132					2,210	166	40	4,154
Clallam.....	195	80	7	3	10		3		114	412
Clark.....		485	733	354	305	10	457	8	33	2,385
Cowlitz.....	1	1,127	994	415	80	9	1	130		2,757
Ferry.....		1								1
Grays Harbor.....	1	62	89	310	1,330	720	2	4	3	2,521
Island.....		16	1	89			2	1	12	121
Jefferson.....	12	3		15	8	2	12	10	1	63
King.....	5	18	37	535	594	105	46	1,502	10	2,852
Kitsap.....			3	45	343		3	4	3	401
Kittitas.....	57	52					1,006	272	160	1,547
Klickitat.....	7	220	509		5	15	331	126	16	1,229
Lewis.....	184	69	1,017	121	3,225	250	109	131	23	5,129
Mason.....		76	166	29	3	4		12	2	292
Okanogan.....	14		330			562	3,145	6	240	4,237
Pacific.....	2	3		2	143	19	4			173
Pend Oreille.....		5		3			1			9
Pierce.....	22	476	36	77	422	1,008	142	159	1	2,343
San Juan.....		13		4			90	20	85	212
Skagit.....	153	615	17	1	1,463	53	8	110	1	2,421
Skamania.....	7	25	4,020	126	605		58	10	43	4,894
Snohomish.....		10	22	8	31	48	137	47	35	338
Spokane.....	5	818			7		192	45	238	1,307
Stevens.....	13	363	106	50	363		116	1	18	1,030
Thurston.....			39		30	1	485	157	12	724
Wahkiakum.....			10	170		253		20		453
Whatcom.....	15	31				3	4	25		78
Yakima.....	554	2					7,271		132	7,959
Totals.....	2,853	4,702	8,138	2,357	8,967	3,062	15,835	2,966	1,222	50,102

Table No. 3—LOSS AND DAMAGE—1941 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.....	285	35	250			\$355 00
Clallam.....	2,109		2,109		\$1,500 00	
Clark.....	40	9	31		700 00	448 00
Cowlitz.....	10	8	2	20	1,160 00	
Ferry.....						
Grays Harbor.....	20	10	10	150	400 00	147 00
Island.....						
Jefferson.....	266		266			1,100 00
King.....	1		1		2,550 00	23 00
Kitsap.....						25 00
Kittitas.....	82	48	34			3,050 00
Klickitat.....	34	18	16			740 00
Lewis.....	478	203	275	1,211	21,300 00	1,463 00
Mason.....						
Okanogan.....						3,617 00
Pacific.....	16	5	11	167	5,250 00	
Pend Oreille.....						
Pierce.....	38	26	12	1,287	1,985 00	175 00
San Juan.....						150 00
Skagit.....	642	430	212	700		
Skamania.....				25	160 00	120 00
Snohomish.....						
Spokane.....					9 00	1,297 00
Stevens.....	16	1	15			180 00
Thurston.....						789 00
Wahkiakum.....	3		3			
Whatcom.....	129	9	120			
Yakima.....	175	150	25			
Totals.....	4,344	952	3,392	3,560	\$35,014 00	\$13,658 00

Total loss and damage to all classes of property—\$89,020.00.

Table No. 4—BURNING PERMITS, CLASSIFICATION AND ACREAGE OF LAND BURNED UNDER PERMIT—ARRESTS AND FINES—1941

COUNTIES	BURNING PERMITS			ARRESTS AND FINES		
	Permits	Camp Fire Permits	Protection Acres	Agriculture Acres	Number	Fines and Costs
Asotin.....	17		740	63		
Chelan.....	97		151	397		
Clallam.....	300	10	1,606	394		
Clark.....	1,413	27	1,394	4,060	14	\$47 50
Columbia.....	35		300			
Cowlitz.....	1,069	90	6,062	2,787	1	12 00
Garfield.....	3		300			
Grays Harbor.....	808	26	1,728	882	7	55 00
Island.....	312	11	520	880	1	27 50
Jefferson.....	143	27	350	430		
King.....	2,556	46	1,223	1,974	4	66 00
Kitsap.....	2,885	251	4,496	839		
Kittitas.....	125	58	2,118	175		
Klickitat.....	583	35	5,463	4,803		
Lewis.....	1,757	29	12,008	7,447	2	2 00
Lincoln.....	15		7			
Mason.....	1,266	244	3,803	513		
Okanogan.....	2					
Pacific.....	783	20	5,683	2,314		
Pend Oreille.....	682	118	900		8	25 00
Pierce.....	1,153	42	1,404	1,076	1	27 50
San Juan.....	164	39	30	645		
Skagit.....	926	1	69	2,385	1	2 50
Skamania.....	205	5	618	265		
Snohomish.....	1,516	4	591	4,652	8	70 50
Spokane.....	860	46	5,727	13,386		
Stevens.....	1,954	198	7,506	7,816	4	31 00
Thurston.....	1,601	9	1,101	1,823	17	61 00
Wahkiakum.....	190	35	28	604		
Walla Walla.....	1		1			
Whatcom.....	1,075	7	2,664	2,657		
Yakima.....	4	31	2			
Totals.....	24,530	1,418	68,632	65,805	68	\$427 50

1942 ANNUAL REPORT

Early in January of 1942 a Forest Defense Council was formed, consisting of representatives from the United States Forest Service, the National Park and Indian Services, the private protective agencies, the lumbering industry, and the state. This council met once every two weeks until well along in the fire season, when monthly meetings were held. The Army, Navy and State Defense Council were usually represented.

The first decision was for all forest fire protective agencies to pool their man-power, equipment, and entire resources in case of a major disaster. Then the location, man-power, and equipment of all logging operations were catalogued. The next decision was to eliminate boundaries in so far as protection agencies' responsibilities were concerned. In case of fire, the nearest organization would combat it until the agency responsible for protection of the area in which fire originated could assume charge—the cause, responsibility, and costs of control to be determine after fire was trailed and reasonably safe.

The state purchased \$150,000 worth of new fire fighting equipment, in addition to rather large stores of supplies already on hand. Congress appropriated emergency funds for forest fire prevention and some \$300,000 was made available to the State of Washington for protection of state and private forest lands.

The armed forces and defense industries were rapidly depleting the available men normally used by protective agencies. The universities, normal, and high schools throughout the state were contacted and summer forest protection work assured to all students who were interested. Some preliminary training was given high school students during the week ends until the question of industrial insurance and liability for students off the school grounds was brought to attention. Apparently there was no coverage unless the students were actually on the pay roll of some recognized forest protective agency. This was not the case, so pre-season training of high school students was dropped in a hurry. The early response from large numbers of college students was gratifying. However, as the end of the school year approached it was very evident that those not subject to immediate draft were more interested in high paying defense jobs than in fire fighting. By early June some 550 high school students were organized into emergency fire fighting crews, given two weeks of rather intensive training, and distributed in crews of from three to twenty-five to the forested areas of the state. The state fire halls are all equipped with cooking and dormitory facilities. The larger crews were stationed in these fire halls, which are also district headquarters. Smaller crews of from three to five men were scattered out in the more hazardous fire areas and quartered in tents where buildings were not available. Fortunately, there were only a few fires on which it was necessary to use these inexperienced crews. However, on these fires they gave a very good account of themselves and their work was entirely satisfactory.

The council next decided to appoint one central dispatcher, to whom all the organized protective agencies would report all fires that required any unusual concentration of men or equipment. This was necessary on exceptionally few occasions during the summer.

The entire state forestry communication system was supplemented with an almost complete radio hookup which made possible continuous contact between the lookouts, dispatchers, district wardens and the main office. Radio installation more than paid for itself in one fire season. The costly elapsed time between fire detection and actual control was materially reduced by use of radio.

Minutest details for action in case of a major forest fire disaster, that might originate from normal sources or result from enemy bombings, were carefully planned between the council and Army authorities. It was fortunate that this preparation proved unnecessary.

One joint meeting of the Oregon and Washington Forest Defense Councils was held during the summer to discuss pooling of the two states' fire fighting resources should it become necessary for one state to aid the other.

Early in the season Army authorities decided it was for the best interests of all concerned to have no open fires. So no burning permits for any purpose whatsoever, except two federal defense housing projects, were issued during the entire summer, until September 9 when the ban was lifted by Army approval. This order preventing issuance of burning permits was a very important factor in reducing the number of man-caused fires. It kept the atmosphere fairly clear of smoke, which was imperative for aerial observation, and the fire lookouts also had much better detection. Any smoke in the woods was an illegal or accidental fire and no time was lost in reporting and taking control measures. The ban on permits also brought out a startling realization

of the number of costly fires that result from land clearing and other forms of permit fires during normal times.

Tire rationing practically eliminated the tourist travel which usually is the source of many roadside fires. The national emergency caused a labor shortage and consequently most everyone was occupied and did not have much time to travel or roam in the woods. The local sportsmen's clubs and associations approved the state closure of large, hazardous areas of forest land and helped discourage members from the usual Sunday and holiday fishing trips. Thus another cause of many fires was almost entirely removed.

The Keep Washington Green Committee put on a very intensive campaign, by radio and press, against the careless smoker. Ash trays were made a part of the automobile inspection service by the Highway Department and the State Patrol was ordered to arrest people for tossing lighted cigarettes from cars on the highways.

These factors all helped materially in reducing the usual number of man-caused fires. However, it is the weather that determines a disastrous or favorable fire season. An exceedingly wet spring eliminated fern fires which ordinarily burn over large areas and destroy considerable second growth. A wet and late spring produced an unusually rank growth of ferns and brush that remained green until late summer and afforded a most protective covering against fire. During the peak season the precipitation was about normal or slightly below. However, the summer rains and cloudy days were well distributed. There were very few consecutive extremely hazardous fire days. In fact, there was more hazardous fire weather in September than during the entire fire season. With a precipitation of but 0.26 of an inch, it was the driest September in 53 years according to United States Weather Bureau records. There was but one severe lightning storm during the summer, and fires from this cause alone were reduced 111 per cent, compared with 1941.

The loggers took advantage of approximately six weeks of favorable burning weather in the late fall and cleaned up some 82,000 acres of accumulated slashings.

In the spring of 1942, prospects for a successful fire season were far from reassuring. There was the additional risk of carrying two years' accumulation of unburned logging slashings through the summer. The defense requirements for lumber greatly increased the number of operations in the woods and resulted in abnormal activity. Labor shortage was serious and the protective agencies were instructed not to take men from the logging camps for fire fighting except in cases of extreme emergency. Essential fire fighting equipment, such as power pumps, hose, trucks, etc., was practically off the market. Incendiary bombings from the Axis enemies was not a remote possibility. Key men were rapidly being called or enlisting with the armed forces. On the other hand, to counteract these apparent obstacles, the national emergency had a very sobering effect upon the people generally and created a patriotic desire to protect the Nation's resources—the forests as well as defense industries. It provided everybody with work, it reduced travel, and entirely eliminated idleness. Lightning did not strike as often and hard as usual, the rains were bountiful and well distributed. Enemy invasion of the Pacific Coast states did not materialize, and another fire season—a fairly successful one—became a memory.

The following table of climatological statistics was compiled from reports of the United States Weather Bureau and indicates weather conditions during the 1942 fire season.

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.....	1.90	0.26	.....	7	9	14	11	11	8
May.....	2.94	.....	1.00	5	10	16	6	12	13
June.....	2.96	.....	1.29	8	8	14	11	11	8
July.....	1.28	.....	0.02	12	9	10	21	7	3
August.....	0.33	0.50	.....	17	8	6	24	5	2
September.....	0.26	1.54	.....	14	8	8	20	7	3
October.....	2.81	0.28	.....	9	9	13	15	9	7

A summary of fires by months is herewith shown to indicate the direct relationship to atmospheric conditions as set forth in the preceding table.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Total
Western Washington	12	1	26	44	26	33	116	233	143	28	602
Eastern Washington .....	.....	.....	2	8	6	28	157	154	77	35	467
Totals.....	12	1	28	52	32	61	273	387	220	63	1,129

A total of 1,129 fires burned over an area of 19,727 acres and resulted in property damage amounting to \$36,355.00. These acreage and property damage figures do not include slashing fires.

Law Enforcement

The past season marks a substantial increase over previous years in the number of arrests. This year 110 arrests were made by law enforcement officers and 42 by the fire wardens, or a total of 152. Of these, 107 were law violations in connection with fires, 35 were for entering closed areas, 5 for destruction of state property, 2 cascara bark thefts, 2 for non-compliance with tool requirements in logging operations, and one for violation of the logging shut-down order. Convictions were obtained in 150 cases, of which two were appealed to the Superior Court.

The comparatively large number of arrests during 1942 may be attributed to the following factors: war emergency regulation prohibiting all open fires, prompt report of all forestry law violations by the fire wardens, and the increased law enforcement staff which made early prosecutions possible.

Most of the courts are now cooperating with law enforcement officers in an educational program to inform the public of the necessity of contacting fire wardens before any land clearing, slashing, or camp fires are started.

Cooperation

Acknowledgment for effective cooperation during the fire seasons of 1941 and 1942 is extended to the following agencies: United States Weather Bureau; National Forest and Park Services; Indian Agencies; Civilian Conserva-

tion Corps; Pacific Northwest Forest and Range Experiment Station; Washington Forest Fire, West Coast Lumbermen's and Western Pine Associations; Army and Navy representatives—particular acknowledgment for outstanding cooperation is due Generals DeWitt and Muir and their able staffs. The Co-operative Forest Fire Control (Emergency) funds appropriated by Congress increased forest protection by providing much needed additional man-power and equipment.

Civilian Conservation Corps

It is hardly fair to compare a progress report of work accomplishments by the Civilian Conservation Corps during 1942 with those of previous years, since by July first the camps were entirely abandoned and for the preceding six month period the ranks of enrollees were so depleted there were scarcely enough men left in the three remaining camps to maintain the camp buildings. Nevertheless, the few enrollees who remained until camps were terminated built several lookout towers and completed fire halls at North Bend and Deming.

During its nine years of service the Civilian Conservation Corps carved a remarkable record of achievements in the State of Washington. The well-trained, organized fire fighting crews from CCC camps, that contributed the major fire suppression work, were conspicuous by their absence during 1942 and will be increasingly missed in coming years.

Equipment

Due to war emergency funds for additional protection, considerably more tools and equipment were purchased during the season of 1942 than in any previous year, including the following heavy equipment:

Tractors

- 1—BD Cletrac equipped with winch hoist and angledozer
- 2—D-2 caterpillars equipped with winch hoists and angledozers

Trucks

- 2—3-ton International flatbeds
- 5—¾-ton Chevrolet pickups
- 9—1½-ton Dodge stakesides

Passenger Cars

- 3—Chevrolet coupes

Portable Forest Fire Pumps

- 10—Pacific Marine Type Y
- 7—Panama pumps

Five hundred and eighty sleeping bags were purchased, together with 620 steel cots and mattresses. Sufficient cots, mattresses, and sleeping bags are now on hand to supply more than 800 men.

Enough cooking and mess equipment was obtained to feed 600 men. In addition to this equipment, which is of a semi-portable type, portable outfits were secured as follows:

- 2—6-man cooking and mess outfits
- 10—10-man cooking and mess outfits
- 4—25-man cooking and mess outfits
- 2—50-man cooking and mess outfits

Twenty-four Osborne fire finders and 72 box compasses were added to our present stock.

The Division of Forestry now has on hand enough small tools to equip more than 5,000 fire fighters.

Priorities required by the War Production Board on most of the tools and equipment ordered caused considerable delay. For this reason, delivery on some vital items was held up nine months and other items are undelivered. The War Production Board rejected a tractor for the nursery, one 3-ton truck for hauling a fire fighting tractor unit, two fire fighting pumpers, and two motor patrol graders. Less than 12,000 feet of fire fighting hose was delivered on an order of 32,000 feet.

A total of 565 miles of No. 9 telephone wire, together with brackets, insulators, and clips, was secured at intervals throughout the year.

The forestry shop was completely equipped.

Radio

Enough radiophones were on hand in 1942 to equip all districts except Ellensburg, Yakima, and Vancouver.

Twenty-five new radiophones were ordered from the United States Forest Service and also four radiophones for automobile service only. Due to war demands, we have so far only received shipment of the four automobile radios, which were highly successful.

Construction was started at our own radio shop on 100 six-pound two-way radiophones. These are expected to be completed by the spring of 1943.

Radio communication has been used during the entire year for Aircraft Warning Service.

Slash Disposal

It is generally recognized that slash disposal involves a certain amount of risk, particularly in the clear cut areas where broadcast burning is the only practical means of eliminating accumulated slash resulting from logging operations. With the exception of two rather large and destructive fires, which got beyond control during unpredictable and sudden weather changes, the fall burning was effective and resulted in nominal damage or property loss. The abnormal fire hazard created by large, unbroken areas of slashing should be considerably less for next year.

During 1942 applications were received for certificates of clearance on 68,848 acres. Clearances were issued on 24,418 acres, examinations are pending on 41,809 acres, and 2,621 acres were rejected.

State Forest Land Acquisition

In 1942 forest land acquisitions totalled 38,278.81 acres—by deeds from the counties, purchase, exchange and gift—as indicated in the following table.

County	Deeded By Counties	Purchase Utility Bonds	Purchase Forest Dev. Fund	Exchange	Gift	Total for 1942	Total to 12/31/42
Clallam.....	8,226.14					8,226.14	88,458.57
Clark.....	830.62					830.62	30,475.28
Cowlitz.....							10,870.88
Grays Harbor.....					2.45	2.45	29,176.82
Jefferson.....							13,306.08
King.....							23,577.92
Kitsap.....					10.00	10.00	6,190.27
Klickitat.....							21,073.68
Lewis.....	20.00		3,080.19			3,100.19	40,055.02
Mason.....							23,331.25
Okanogan.....							40.00
Pacific.....	8,062.97					8,062.97	23,810.52
Pierce.....							10,536.17
Skagit.....	40.00					40.00	58,427.61
Skamania.....				240.00		240.00	42,937.60
Snohomish.....							55,528.17
Thurston.....	1,422.22	550.50				1,981.81	45,577.74
Wahkiakum.....							13,441.93
Whatcom.....	15,064.63				720.00	15,784.63	28,463.05
Totals.....	33,666.58	550.50	3,080.19	240.00	732.45	38,278.81	565,368.66

Due to the great war demand for timber, returns from timber sales and leases on State Forest Board lands exceeded all previous years. The receipts, from over 40 transactions, amounted to \$92,000.00, of which approximately 85 per cent will be returned to the various counties.

There have been several condemnations of State Forest Board lands for military purposes, for which a fair value has been asked. The City of Tacoma condemnation for enlargement of LaGrande power project has been settled at the state appraised price, which valued second growth timber as well as mature.

The State Division of Forestry has purchased, for the Washington State Penitentiary Industries, a solid block of 3,100 acres in Lewis County. This land contains a vast quantity of fuel logs, which is needed to alleviate the present fuel shortage, and has potentialities for a well-situated state forest in the future.

Rapid development of the State Forest Board program and the war demand for timber have shown that these lands now constitute a very important asset to the state and can no longer be handled as a sideline. Protection, administration, sales, and management of these units now require a separate well-planned organization.

State Forest Nursery and Planting

Spring sowing of seed beds at the nursery started on March 31 and was completed May 20, during which time a total of 1,336 4' x 12' beds were sowed as follows:

Douglas fir, <i>Pseudotsuga taxifolia</i>	1,259 beds
Ponderosa pine, <i>Pinus ponderosa</i>	57 beds
Sitka spruce, <i>Picea sitchensis</i>	6 beds
Western red cedar, <i>Thuja plicata</i>	6 beds
Western hemlock, <i>Tsuga heterophylla</i>	6 beds
Noble fir, <i>Abies nobilis</i>	1 bed
Miscellaneous	1 bed

It was noticed that the deer were damaging the 1-0 stock by browsing, similar to the damage caused in 1941, and an electric fence was ordered early in January. Due to the increased difficulty of securing this type of equipment, it was not delivered until the latter part of April, after considerable damage had already occurred to the seed beds.

A total of 1,032,760 2-0 seedlings, most of which were Douglas fir, was planted in 1942. Ninety per cent of this planting was done in the spring by CCC and civilian crews. Owing to discontinuance of CCC in the late spring, scarcity of labor caused by the war, and adverse weather conditions, fall planting was held to less than 100,000 seedlings. It was apparent, with a labor shortage and rationing of gasoline and tires, that if the 1942 crop of seedlings was to be planted, the work must be done from small portable planting camps within walking distance of the plantations. Camps were therefore established on Galbraith hill in Whatcom County, Ebey hill in Snohomish County, and in the Sufico area of Pacific County. Materials for an additional camp were moved to the Elbe unit in Pierce County, preparatory to assembling. These camps, together with available buildings at the nursery and Cavanaugh Honor Camp, make ample housing facilities from which to complete planting of the 1942 nursery output in the spring of 1943, if labor is available.

County	Number of Trees Planted			Number of Acres Planted		
	Previous to 1942	1942	Total	Previous to 1942	1942	Total
Clallam.....	412,982	77,702	490,684	842	142	984
Clark.....	50,025	60,025	110,050	80	94	174
Cowlitz.....	1,647,002	.....	1,647,002	2,744	.....	2,744
Grays Harbor.....	2,400,120	9,925	2,410,051	3,889	10	3,905
Lewis.....	1,249,508	157,827	1,407,335	1,073	201	2,174
Mason.....	23,850	23,850	47,700	50	50	100
Pacific.....	501,662	155,772	657,424	808	244	1,052
Pierce.....	1,153,146	50,300	1,203,446	1,391	71	1,462
Skagit.....	1,645,243	260,187	1,905,430	2,511	380	2,891
Snohomish.....	1,522,400	39,000	1,558,400	2,225	60	2,285
Thurston.....	1,441,761	194,173	1,635,934	2,502	297	2,799
Wahkiakum.....	718,430	.....	718,430	1,373	.....	1,373
Whatcom.....	.....	7,000	7,000	.....	11	11
Totals.....	12,766,075	1,082,760	13,798,835	20,388	1,566	21,954

In the spring, pupils of Kirkland high school again added 7,000 2-0 Douglas fir seedlings to their school plantation, which was established in the spring of 1940 on State Forest Board land in SW $\frac{1}{4}$ of Section 21, Township 23 North, Range 6 East, King County.

Examination of three one-acre plots, that were seeded in hills of from four to eight seeds each, with a hand planter in the fall of 1939 on 8' x 8' spacing, shows the following results:

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

Plot 2: An area on which slash burned 5 to 10 years previous to seeding. A very dry area on high ground. Four 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. One per cent of seed spots showed one or more thrifty seedlings.

It appears from the results of this experiment that direct seeding is not advisable unless some method of seed treatment is developed to protect seeds against rodents.

An experimental Ponderosa pine plantation of 6,000 3-0 seedlings, established on the sand flat near Darrington in SE $\frac{1}{4}$ SE $\frac{1}{4}$ of Section 11, Township 32 North, Range 9 East, Snohomish County, during the spring of 1940, shows a survival of 75 per cent. However, growth was retarded by rodent damage and the trees do not average more than eight inches in height.

This was an extremely poor seed year in the Douglas fir region of Washington and for that reason, and the fact that a sufficient supply of 1941 seed is on hand, no attempt was made to collect cones.

Due to a multitude of pertinent questions asked by the general public regarding nursery and planting activities, it was deemed advisable to make a 16 mm. technicolor moving picture, giving the complete story in detail, from seed collection and extraction through the various steps of nursery operation and planting. Nine months was required to get 1,000 feet of film showing various seasonal operations; the first shots being taken in 1941 and the last in the summer of 1942. A portable projector and screen were purchased for use in showing the film, which was entitled "Trees for the Future." Through cooperation of the Department of Public Instruction, all schools were circularized regarding the availability of this picture and more than eighty requests for its use are now on file from schools, granges and service clubs throughout the state. Owing to a greater demand than anticipated, two duplicate films have been made from the original. Showings have thus far been made, by representatives of the Division of Forestry, to more than 10,000 school pupils, members of service clubs and granges—with many engagements yet unfilled.

Recommendations

1. In order to maintain forest protection at even its present level, there will have to be substantial increases of both field and office salaries.
2. The existing statute that requires slash disposal after logging operations should be amended and liberalized so that unconditional clearances may be issued where timber has been selectively cut and the burning of such areas would result in destruction of seed trees and second growth. A broadcast burn of slashings in selectively logged timber often results in the creation of a greater fire risk.
3. The present law provides that general utility bonds, issued for purchase of forest lands by the state, can be retired only by actual receipts from sale of timber on the lands involved. This statute should be amended so that money in the forest development fund may be used for retirement of any outstanding utility bonds, particularly those bearing the higher rates of interest, or for retirement of bonds in the order of the dates of issuance.

Comments

1. The matching requirement, for states allotted Cooperative Forest Fire Control (Emergency) funds from special congressional appropriations, is neither fair nor just. This is a national emergency and the states should not be penalized for their physical location or for concentration of defense industries.
2. Employees paid from federal emergency funds should not be limited strictly to fire protection work, particularly during favorable weather periods.

Emergency crews must be kept busy and in some localities fire protection projects are not always available.

3. Federal emergency fire prevention budgets, expenditures, and reports should conform to regular Clarke-McNary procedure.

Table No. 5—ORIGIN, NUMBER AND CLASSIFICATION OF FIRES—1942

Counties	Lightning	Incen-dinary	Camp-ers	Smok-ers	Slash-ing	Log-ging	Brush Burnl'g	Rail-roads	Miscel-laneous	Total
Chelan.....	3			5				1	3	12
Clallam.....			2	12	3	6	2	2	16	43
Clark.....	10	5		3			9	1	11	39
Cowlitz.....	13	2		4		2		7	3	31
Ferry.....	7			1					2	10
Grays Harbor.....	1	5		9		12		2	2	31
Island.....	1		2	6			2		2	13
Jefferson.....			5	6		1	1		3	16
King.....	11		1	24		1	16	2	12	67
Kitsap.....	1	1	3	14			8		13	40
Kittitas.....	16	3	2	30			3	11	15	80
Klickitat.....	26		1	9		2	2	2	10	52
Lewis.....	14	4	2	7	1	8	3	4	9	52
Mason.....		6	1	5		1	4	1	6	24
Okanogan.....	31			6					3	40
Pacific.....	4	4		4		1			1	14
Pend Oreille.....	4	2		4			3		3	16
Pierce.....	3	11	2	29		1	5	3	9	63
San Juan.....				2					1	3
Skagit.....	32	1	1	7	4	6	1	2	5	59
Skamania.....	2	3		2			1	2	3	13
Snohomish.....	23	2		7		1	9	1	9	52
Spokane.....	9	8	1	66			6	35	39	164
Stevens.....	32	2	4	11			9	1	16	75
Thurston.....	2	5	1	9	1		5	13	19	55
Wahkiakum.....	2								1	3
Whatcom.....	11	4		7	3	3		1	7	44
Yakima.....	8	1	1	5					3	18
Totals.....	266	60	29	294	12	45	97	91	226	1,129

Classification of fires: Class A ($\frac{1}{4}$ acre or less), 654; Class B ($\frac{1}{4}$ acre to 10 acres), 363; Class C (over 10 acres), 112.

Table No. 6—ACREAGE BURNED OVER—1942 FIRES

Counties	FOREST LAND			NOT REFORESTED			NON-FOREST LAND			Total
	Merch- antable Timber	Reproduction		Old Burn	Cutover Land		Pas- ture	Brush	Other	
		Cut Over	Old Burn		Slash Un- burned	Slash Burned				
Chelan.....	95						1,590	30	402	2,117
Clallam.....		57	5	5		40	6	9		122
Clark.....		92	40	110	4	12	41	15		314
Cowlitz.....		4	1	5	2	1				13
Ferry.....							1			1
Grays Harbor.....	21			1	381		2			405
Island.....				1			6		4	11
Jefferson.....							10	10		20
King.....		41	18	51	84	12	65	48	37	356
Kitsap.....		1					2	7		10
Kittitas.....	25	25	23				15	302	10	400
Klickitat.....	128	31			2		40	42	18	261
Lewis.....	61		10	10	245	56	13	69	2	466
Mason.....					3					3
Okanogan.....	2	3,209					3,297			6,508
Pacific.....			163	14	144					321
Pend Oreille.....		5			1					6
Pierce.....		39			16	2	49	96	30	232
San Juan.....					1				2	3
Skagit.....	7		15	2	96					120
Skamania.....	50				25		4	174		353
Snohomish.....	30			2	269		84	22	12	419
Spokane.....	12	2,171	25	153	374	23	1,096	381	512	4,749
Stevens.....	244	368	461		160	241	442	210	2	2,128
Thurston.....			1		3		80	56	11	151
Wahkiakum.....					2					2
Whatcom.....	2	65	1					9		77
Yakima.....	1	40					2	211	5	259
Totals.....	678	6,148	763	354	1,812	387	6,847	1,691	1,047	19,727

Table No. 7—LOSS AND DAMAGE—1942 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.....	4		4			\$500 00
Clallam.....					\$1,500 00	
Clark.....	5	3	2			1,266 00
Cowlitz.....						
Ferry.....						
Grays Harbor.....	289	231	58	464	1,325 00	
Island.....						
Jefferson.....						
King.....	1		1			150 00
Kitsap.....						
Kittitas.....	80	65	15	1	50 00	1,220 00
Klickitat.....	53	2	51			100 00
Lewis.....	10	5	5	550	2,575 00	20 00
Mason.....	4	2	2			100 00
Okanogan.....						350 00
Pacific.....	16	9	7			
Pend Oreille.....						
Pierce.....	1		1			151 00
San Juan.....						
Skagit.....	22	14	8	15	1,250 00	
Skamania.....	7		7			5 00
Snohomish.....				10		
Spokane.....	20	15	5			12,152 00
Stevens.....	10	2	8			25 00
Thurston.....						251 00
Wahkiakum.....						
Whatcom.....						
Yakima.....	7	4	3			
Totals.....	529	352	177	1,040	\$6,700 00	\$16,290 00

Total loss and damage to all classes of property—\$36,355.00.

Table No. 8—BURNING PERMITS, CLASSIFICATION AND ACREAGE OF LAND BURNED UNDER PERMIT—ARRESTS AND FINES—1942

COUNTIES	BURNING PERMITS				ARRESTS AND FINES	
	Permits	Camp Fire Permits	Protection Acres	Agriculture Acres	Number	Fines and Costs
Chelan.....	702	4	1,211	1,944		
Clallam.....	500	2	127	868		
Clark.....	1,186		2,485	1,218	22	\$438 80
Columbia.....	13		346	1		
Cowlitz.....	991	3	12,115	2,098		
Grays Harbor.....	960		8,528	1,232	35	436 00
Island.....	264		203	310	2	20 00
Jefferson.....	177		24	114		
King.....	2,666	9	5,822	1,312	14	275 50
Kitsap.....	1,719	1	559	211	8	111 00
Kittitas.....	293	42	531	1,291	1	10 00
Klickitat.....	327	3	801	1,090		
Lewis.....	2,026	10	37,725	6,982	1	52 50
Mason.....	709	13	3,325	391	14	140 00
Pacific.....	454	1	4,025	1,069		
Pend Oreille.....	706	6	197	577	1	7 50
Pierce.....	712	7	9,646	1,209	4	60 00
San Juan.....	128	2	125	179		
Skagit.....	1,238	1	220	5,863	9	54 00
Skamania.....	73		40	125		
Snohomish.....	648	3	133	511	12	137 00
Spokane.....	1,082	8	2,563	89,703	12	104 50
Stevens.....	1,455	30	870	7,761	4	37 50
Thurston.....	792	6	3,582	630	7	82 50
Wahkiakum.....	286	4	408	671		
Whatcom.....	1,908		4,500	4,087	6	73 00
Totals.....	22,015	155	100,201	132,347	152	\$2,039 80

DIVISION OF GEOLOGY

HAROLD E. CULVER
Supervisor

GENERAL STATEMENT

The work of the state division during the biennium of 1940-1942 has been directed entirely toward the accomplishment of economic objectives. Since the entry of the Nation into the present world war the staff has been engaged entirely with surveys of the state's resources in strategic minerals—those vital to the furtherance of the war effort. For some of these minerals, such as magnesite, Washington is recognized nationally as an important source of supply, while for others, such as chromite, the situation is not entirely clear. The aim in all of the work of the Division of Geology has been to secure enough information as to both the better known and the less well known deposits so that every one of value might be made available in the present emergency.

In an ever-increasing number of instances the division has been of assistance in the development of mineral deposits. Such aid has been largely based on the combination of the current studies and the data gained through the past forty years of geological work carried on by the state. In addition to independent investigations during the biennium the division has cooperated with some of the federal agencies, particularly the U. S. Geological Survey and the U. S. Bureau of Mines, both through the staff members in Washington, D. C., and their field representatives working in the state.

The division has continued to provide identification service to the citizens of the state. This constitutes important aid mainly to miners and prospectors but is increasingly appreciated by others with less technical knowledge or interest in the commercial possibilities of their discoveries. In the past it has been the policy not to provide assays or chemical analyses such as might be furnished by commercial laboratories. In general this policy is well-founded, but instances arise in which some analytical work would provide a basis for better advice as to the commercial value of certain ores. There should be provision for the efficient handling of such cases through the operation of a chemical laboratory.

While primarily intended as a service to citizens, it should not be overlooked that through its operation this identification work provides information on mineral occurrences which might otherwise not be gained for a long time. Some discoveries of both scientific and economic importance have been reported almost every year.

INVESTIGATION OF STRATEGIC METALS

Tungsten—This is one of the more important metals on the "strategic" list, and the Division of Geology has continued studies begun in 1938 and completed in this biennium. Examinations have been made of every mining property where either wolframite or scheelite has been reported in an effort to determine what quantity of tungsten ore might be recovered. The ultra-

violet light has speeded up the search for scheelite, which has proved to be much more common than was suspected. In fact new discoveries of this mineral are being constantly reported. Some important deposits have been found, and it is expected that the investigations as a whole will result in some additional commercial developments. A comprehensive report on all the known deposits of tungsten in the state is now being prepared.

Chromium—Ores of chrome have been reported from Whatcom, Skagit, Kittitas, and Okanogan counties. Some production from Cypress Island was made in 1917 and 1918. During the current biennium all of these areas have been re-examined to determine whether commercial production might be anticipated under the pressure of increased demand, although previous study had not revealed large enough masses of high-grade ore to meet commercial competition. Especial attention was therefore given to those areas which might contain large tonnages of lower grade disseminated ores which might be concentrated. The results of this work are not yet fully compiled, but it seems probable that large enough masses may be outlined to warrant development.

Molybdenum—Under prewar conditions there was no market for molybdenum produced in Washington, but the excessive demands of the present have had a stimulating effect on all potential producers. During this biennium the division staff has been active in promotion of interest in molybdenum development and has studied promising properties in Whatcom, Stevens, and Lincoln counties. An unsuspected relationship between tungsten and molybdenum deposits has been revealed by this work. In some instances, at least, tungsten deposits may lead to molybdenum deposits in depth.

Nickel—No production of nickel has ever been made in Washington, although nickel-bearing rocks have been known for half a century. Kittitas, Chelan, Skagit, and Ferry counties each have at least one promising area, and ores of nickel have been found elsewhere in the state in limited amount.

Field and laboratory study was made of the Skagit ores near Mount Vernon with the special objective of determining whether selective mining might produce a grade of ore higher than had previously been indicated. This study has not been concluded, but it is clear that the nickel is most abundant in the carbonates, and it seems possible that proper treatment will greatly improve the average grade of ore. Whether it can be made sufficiently high to be commercially feasible remains to be determined.

Copper—Under increased demand of wartime industry copper has become of unusual importance. Washington produced 19,224,000 pounds in 1940, and during the present biennium every effort was being made to step up the yield. As a part of this work the Division of Geology has, during both 1941 and 1942, studied copper production areas with the aim of suggesting extension of known deposits and development of new ones. Just as it was well begun this work had to be interrupted so that more pressing work could be undertaken. Late in 1942 the study of copper will be resumed in the field.

Iron—Within the past few years, largely because of changes in market and power factors, iron deposits in Washington have acquired new value. Previously considered of little importance because of small size, they are now regarded as potential sources of ore. To meet the demand for more reliable facts on which to base estimates of tonnage the Division of Geology

has undertaken to determine the probable dimensions of the known deposits. During the past season two areas have been studied and mapped. Surface exposures have been located, geologic relations determined, and a closely checked magnetic survey run. The results of the work in the Buckhorn Mountain area of Okanogan County have been partially compiled and will be published as Report of Investigations No. 8. This is already in the printer's hands. Similar results for the Blewett iron deposit in Chelan County will appear shortly after the first of the year as No. 9 in the same series. Continuation of these surveys westward to include the Cle Elum iron deposits of Kittitas County is planned for early spring. Certain iron deposits in Stevens County will also be mapped on the basis of both stratigraphic and structural study, supplemented by a net of magnetic traverses. From these investigations it will be possible to indicate the underground conditions and determine whether further geophysical work or actual drilling will be necessary to estimate tonnages with sufficient accuracy to meet commercial demands.

Magnesium—Washington is fortunate in its possession of immense quantities of two ores of this important metal. Magnesite, the carbonate of magnesium, containing over 20 per cent metallic magnesium, is practically restricted to Stevens County, but the quantity there available seems to be enormous. Dolomite, the double carbonate of magnesium and calcium, and therefore a lower grade ore of magnesium, is present in great volume in at least five counties, although the actual calculation of tonnages has not been attempted. The total amount available in readily accessible areas runs into billions of tons, each ton capable of yielding about 260 pounds of metallic magnesium.

During the current biennium the Division of Geology has completed two special studies relating to magnesium. One was the mapping and description of all magnesite deposits in the 30-mile belt lying in southern Stevens County. The results were published as Report of Investigations No. 5 in 1941. The second included the examination and analysis of some 5,000 feet of core taken from the Turk magnesite deposit at the southern end of the long magnesite belt. On the basis of the first report it is possible to indicate just where further prospecting for magnesite should be undertaken; the second study gives a basis for reasonable estimate of actual tonnage of magnesite. The drilling, accomplished in 1942, was a project of the Washington State Planning Council under the direction of the Division of Mines and Mining. It has demonstrated the existence of over a million and a half tons of high grade magnesite in the 40-acre tract of the Turk deposit. These data will appear in Report of Investigations No. 7, now in press.

Aluminum—The only ore of aluminum so far utilized is bauxite, a type of clay produced under unusual weathering conditions. In spite of considerable search no bauxite has yet been found in Washington, nor do the geologic conditions over most of the state suggest that it is likely to be found. On the other hand common clays ranging from 20 per cent to over 40 per cent alumina are now being selected for examination as to the possibility of their being used as aluminum ores. At present only those clays of high alumina content are being considered. During this biennium such clays have been examined in Clark, Cowlitz, Chelan, Stevens, and Spokane counties. Representative samples have been submitted to both private and public agencies interested in the use of clay for the production of aluminum. In the

prosecution of this work the recent report, Bulletin 24 of the Division of Geology series, has proved to be of the greatest value to all workers.

Topographic Mapping

The preparation of topographic maps for Washington has progressed slowly during the present biennium. So far as state funds are involved this work has been continued as a cooperative effort by the Department of Conservation and Development and the Topographic Branch, U. S. Geological Survey. Renewed yearly, this contract has provided for the services of the expert federal staff to be used on quadrangles mapped in Washington. In addition to such arrangements, independently financed projects have been under way by the U. S. Geological Survey and the Corps of Engineers, U. S. Army. Through all these agencies about 80 per cent of the area of the state has been mapped in 15- or 30-minute sheets. During the current biennium cooperative mapping has been in progress in the Reardan and Asotin quadrangles, while the Army work has been concentrated on coastal areas.

Publications

Comparison of the list of publications for the current biennium with those proposed in the earlier (tenth) biennial report will show some important changes which have been forced by the war-time emphasis upon strategic materials. Non-strategic work has been deferred and the publication postponed for all four of the proposed bulletins. On the other hand the importance of the work on chrome and tungsten has led to the preparation of comprehensive bulletins on each. Iron, too, has taken on unusual importance and two reports are practically ready for distribution. The entire list of reports, with some explanatory notations, follows:

The Clays and Shales of Washington. This report, appearing as Bulletin 24 early in the biennium, was, in reality, a delayed printing of studies completed in the preceding biennium. It may be noted here, however, that it has been in great demand by those interested in the examination of high-alumina clays as ores of aluminum.

Preliminary report on Magnesite of Stevens County. This Report of Investigations, No. 5, represents in part the results of an enlarged program of study of this important resource. It appeared in 1941 and will be followed by:

Character and Tonnage of Turk Magnesite, Stevens County, which is the first report of magnesite drilling to be made by the state. This is now in the hands of the State Printer and will come out as Report of Investigations No. 7.

Buckhorn Iron Deposits of Okanogan County. This Report of Investigations, No. 8, is already in the hands of the State Printer. It presents the areal and magnetic data obtained in the past season. A companion report dealing with the nickel-chrome-iron deposit of the Blewett district will be ready for printing before the end of the biennium.

Inventory of the Mineral Deposits of Snohomish County. This is the first of a series of economic reports in which is to be given the essential information relating to every mine, prospect, or quarry in each county. A similar report for Chelan County is nearing completion and will be ready for printing before the close of the biennium. Data for all counties have been accumulated in the division files during the past decade, and as rapidly as the supplemental field inspections can be concluded the reports for the other counties will be issued.

Recommendations

All activities of the Division of Geology are planned and carried out with regard to the present war-time need. From the brief outline of this work given in the preceding pages it is readily seen that three lines of service

are indicated, viz. *strategic mineral investigations, field service and publication of results*. The following recommendations relate to these lines alone:

1. The work of the past biennium makes clear that the early completion of investigations of the state's strategic mineral resources can only be accomplished by the addition of technical staff members and the purchase of some laboratory equipment. Under present conditions both of these may prove difficult, but it is recommended that both be attempted.

The application of modern geophysical methods to the problems of occurrence and extent of mineral deposits has been demonstrated to be both accurate and, considering the results, relatively inexpensive. Therefore it is recommended that steps be taken to either (a) secure geophysical equipment and add the necessary technicians to the staff, or (b) arrange for geophysical investigations to be carried on by technically competent persons not attached permanently to the staff. It is urged that consideration be given to the possibility of making such arrangements with the U. S. Geological Survey.

2. In view of the marked success attending the field work of staff geologists in aiding development in certain parts of the state during the past biennium, it is recommended that this work be expanded to include the services of one other geologist of qualified technical training and experience.

3. In the foregoing pages the plan of investigations proposed has been indicated. No great good can be derived from such work by the state as a whole until the data and conclusions have appeared in print. Reports aggregating many hundreds of pages are planned, for which much of the basic work has already been accomplished. It is therefore recommended that provision be arranged for such publication as is contemplated of regular bulletins, reports of investigations, and special papers together with the necessary maps and illustrative material.

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.

DIVISION OF MINES AND MINING

SHELDON L. GLOVER
Supervisor

INTRODUCTION

The activities of the Division of Mines and Mining during the period of October 1, 1940, to September 30, 1942, followed the pattern outlined by the Mines and Mining Act, under which the division was established in March, 1935. The functions authorized by this act are set forth in the First Biennial Report of the division, published in 1937 in the Eighth Biennial Report of the Department of Conservation and Development (for the period of October 1, 1934, to September 30, 1936). Briefly, they are to acquire all possible information on the occurrence and development of the state's mineral resources, to disseminate that information, and to aid in all ways in the proper understanding and efficient development and utilization of these resources.

PERSONNEL

Several changes in the personnel of the staff took place during the past biennium. Thomas B. Hill, supervisor of the division since its establishment, left on November 1, 1941, to take charge of other activities of the Department of Conservation and Development. He was succeeded by Sheldon L. Glover, who was formerly assistant supervisor of the Division of Geology and since September 18, 1941, had been associated with the Division of Mines and Mining. Ward Carithers, formerly with Chelan Division, Howe Sound Mining Co., was engaged as a geologist on February 13, 1942, replacing John W. Melrose, resigned. Stephen H. Green, mining engineer, was employed from May 25, 1942, to September 3, 1942, for work on a special magnesite investigation. Philip H. Holdsworth, mining engineer and geophysist, was engaged September 5, 1942, for special investigations of ore deposits, and Alton K. Guard, geologist and experienced miner, was employed as field assistant.

MINERAL RESOURCE DATA

The assembling of information on the mineral resources of the state continues to be one of the basic activities of the division. It is carried on as rapidly as possible, whenever more urgent investigations permit, and involves a large amount of work in both the office and the field. An immense volume of factual material is scattered through the more than 4,000 reports, articles, and references that deal with Washington geology. This extensive literature, and particularly the 62 publications of the Washington Geological Survey and its successor the State Division of Geology, is being searched for specific references to mineral occurrences, so that the information on any given resource may be put in concise usable form and made easily available when required. Many references that are obtained in this way are but little better than hearsay and rumors; these require field study for proper evaluation. Field investigations are also required by current reports of mineral

discoveries made by prospectors and others. These last are particularly numerous at the present time, when so many persons, commonly with scant knowledge of minerals, are searching for materials that may be of use in the war effort.

INFORMATION ON MINES AND PROSPECTS

It is highly desirable to have accurate information on the status of prospecting and mining. The needed data for a given property include: name, location, ownership, name of operators, size of operation, minerals sought or mined, representative analyses, amount and kind of development, general milling methods (if used), production (if any), and the essentials of the geology of the occurrence. One of the basic endeavors of the division is to acquire this information for every mine and for as many prospects as possible, and to distribute it for the use of the mining industry and all others who may be interested. It requires constant field work and a thorough canvassing of the mining districts. To obtain the desired data by questionnaire is not feasible, though that method may be used to supplement and bring up to date the information obtained by personal visits to the properties. This work was begun as soon as field work was possible in 1942. From then until September 30 some 260 field conferences were held and 74 mines and prospects were examined in more-or-less detail. Greater progress in this work was not possible, due to the fact that special inquiries and investigations pertaining to the war effort were given precedence at all times and continually interrupted scheduled activities.

The examination of mines and prospects has another and equally important purpose. It makes possible a personal acquaintance on the ground with the prospector and small miner, whereby the problems of the operator may be discussed. If desired, the member of the staff will make suggestions, give any possible advice, and aid in obtaining a proper understanding of the geology of the mineral occurrence. Also, in the case of nonproducing meritorious properties, he attempts to discover what is delaying production. This delay may be due to the lack of a road, to the need of adequate financing, to the absence of a mill, to insufficient or ill-advised development, or other causes. Once these difficulties are understood, the division may then be able to suggest a possible relief or recommend steps involving federal or other aid.

Personal acquaintance with those interested in the state's mineral resources, on either the side of production or utilization, is gained also in office conferences. An endless variety of problems, inquiries, and requests are brought to Olympia for attention. In this way, 325 conferences involving mines and minerals were held from January 1 to September 30, 1942. During this same period more than 900 additional inquiries were handled by correspondence. The division makes every effort to supply the information desired, to aid in mineral development, and to ascertain the value of local materials and further their use by industry.

PUBLICATIONS

Much of the information that is on hand and which is constantly being obtained does not lend itself to distribution by means of published reports. It is a composite made up of past experiences, observations, bits of history, and uncatalogued data that forms a necessary background for an understand-

ing of our mineral resources and which is only obtained through long familiarity with the state and its geology. Nevertheless, this is available and is drawn upon in conferences and in answering letters of inquiry. Other data are made the subject of printed or mimeographed reports with as little delay as possible. During the past biennium the following were distributed:

REPORTS OF INVESTIGATIONS

1. Olympic Peninsula manganese, by J. W. Melrose. 1940. 30 pp. (mimeographed.)
2. Washington iron ores, a summary report, by Sheldon L. Glover. 1940. 23 pp. (mimeographed.)
3. Mineral resources of the Wenatchee-Ellensburg-Yakima region, by Sheldon L. Glover. 1942. 13 pp. (mimeographed.)

INFORMATION CIRCULARS

6. Summary of information on iron ore deposits of Washington, by J. W. Melrose. 1940. 11 pp. (mimeographed.)
7. Directory of Washington metallic mining properties, by Thomas B. Hill and J. W. Melrose. 1941. 74 pp. (mimeographed.)

Also, an up-to-date list of publications of the Divisions of Geology and Mines and Mining was printed, and the expense of printing the Division of Geology Report of Investigations No. 6, entitled "Inventory of Mineral Properties in Snohomish County, Washington," was borne by the Division of Mines and Mining so that the public could have the information with the least possible delay.

AID IN THE WAR EFFORT

After December 7, 1941, all usual activities were subordinated to those which would aid in the war effort. The general trend of prospecting and mineral interest gradually shifted to the strategic and critical materials. The division found itself increasingly called upon to explain the new industrial trends and assist in reorienting the objectives of prospectors and miners. The accumulated information that the state had acquired from 50 years of work then became of the utmost importance. The attention of prospectors and operators could be directed to newly valuable mineral deposits and to areas where the geology was known to be favorable for the occurrence of desired materials. Equally important, industry could be directed to local sources of supply not hitherto considered.

The division has been called upon many times since the outbreak of war to supply information to various federal agencies that are interested in mineral development. Compliance with these requests is given precedence over all other activities. At times it has involved correspondence on well-known subjects that required no preliminary study; other inquiries and requests have necessitated considerable research and, on occasion, extended trips and field work. Agencies worked with include the U. S. Geological Survey, U. S. Bureau of Mines, Office of Production Management, War Production Board, and Reconstruction Finance Corporation. All these are offered and given complete cooperation in any investigations in which the personnel or facilities of the division can be of service.

MAGNESITE INVESTIGATION

On April 9, 1942, the State Planning Council approved a project involving the use of a special fund for the diamond drilling of magnesite properties, providing the work should be sponsored by the Department of Conservation

and Development. Accordingly, arrangements were made by the department to undertake a research program on the Turk deposit, located on state land in the south part of Sec. 36, T. 30 N., R. 37 E. This work was under the general supervision of the Division of Mines and Mining, and a member of the staff was continuously employed on the project to attend to the collection and shipment of cores and other samples, compile a log of the drilling, and maintain efficient operation.

The Division of Geology cooperated throughout and was responsible for the location of drill holes, the carrying on of analytical work, and the interpretation of results. The work was begun on April 15, 1942, and was completed about October 15, 1942. Nineteen holes were drilled, totalling 5,261 feet, and a commercial body of magnesite containing more than 2 million tons was proved and thoroughly sampled, showing that ample magnesite was available here to support an industry for the reduction of metallic magnesium.

MINERAL EXHIBIT

An extensive display of commercially important metallic and nonmetallic minerals and aggregates is maintained by the division. Most of these specimens are from state sources and are representative of valuable mineral types that are now being produced or which could be produced; some are from out-of-state sources and represent materials not known to occur in Washington but for which prospectors should be on the alert. The collection of these specimens was begun early in 1942 and now includes some 200 items; new material is constantly being added and the display revised.

The collection is designed to acquaint prospectors with the appearance and other physical characteristics of important minerals with which they may be unfamiliar. It also is used to apprise processors and manufacturers with Washington materials that may be available to augment or supplant out-of-state supplies. The interest shown in the display is sufficient proof that the space allotted it and the time spent in its collection and arrangement are amply justified.

Ore samples.—An additional collection, distinct from the display just mentioned, is gradually being acquired. This is designed to include representative hand specimens of the minerals characteristic of each prospect or mining property in the state. The samples are obtained by members of the staff when they visit the individual properties in order to obtain information on ore occurrence and development. They form an adjunct to the field notes and maps that apply to the property in question and are necessary to a proper understanding of the mineralization. When the samples have served their purpose in the laboratory, they are labeled and filed in a permanent collection for such future needs as may develop.

LABORATORY FACILITIES

The mineralogical laboratory of the division has acquired a considerable amount of essential equipment during the past biennium and has played an increasingly important part in current activities. Its basic purpose is to permit detailed study of minerals, and so supplement the investigations made at mines and prospects. The facilities for mineral identification have been

increased to allow a certain amount of qualitative analytical work. An excellent petrographic microscope was purchased, as well as equipment for preparing thin sections of rocks and ores for petrographic study. Also, additional equipment was procured for the identification of minerals by means of ultra violet light, and a valuable set of fluorescent minerals has been arranged for comparative purposes.

Plans adopted early in 1942 called for carrying on certain lines of investigation that required still other needed equipment, but the effect of priorities and instrument shortages slowed delivery on most items and effectually prevented the obtaining of some things. As the investigations are, for the most part, directly applicable to the war effort, the situation was greatly relieved by the War Production Board granting, first, an A-2 priority and, later, an A-1-a to the laboratory. It is expected that eventually the additional equipment may be secured to permit even greater use of the various techniques of mineral research.

MINERAL IDENTIFICATION SERVICE

The laboratory facilities are available to the general public, and any one interested may submit samples of minerals and rocks for examination. Assays and quantitative analyses are not made, but samples obtained in the state are identified without charge, possible commercial value is indicated, advice is given on the need for further work (such as chemical analysis or additional prospecting), and, if warranted, the names of commercial users of the material in question are suggested. This service is used and appreciated by miners, prospectors, and others throughout the state. During the past biennium 688 samples were submitted and were examined in the laboratory and reported on to the senders.

MINES-TO-MARKET ROADS

Petitions for 23 mines-to-market roads were submitted to the Mines-to-Market Road Commission in the biennium ending September 30, 1942. These requested construction of 113.75 miles of road to serve various mineralized areas in the state. Six roads had been constructed or were under construction at close of biennium, and surveys had been made on some of the others. With respect to most of the petitions the counties were unable to contribute one-half the cost as required by law, so construction could not proceed.

Following is a record of petitions received and the status of those roads upon which construction was begun:

Chelan County—For a 3-mile extension of the Stehekin road, previously constructed, into the Horseshoe Basin. Under construction.

For a road at Merritt, a distance of one-half mile. Constructed.

Grays Harbor County—For a road about 2½ miles in length up Cook Creek. Under construction.

Okanogan County—For a road on Squaw Creek near Methow, in the Methow Valley, a distance of 2¾ miles. Constructed.

For a road northwest of Monse, to serve certain sodium sulphate lakes, a distance of 4 miles. Construction started but suspended for lack of right of way.

Snohomish County—From Barlow Pass to Monte Cristo, a distance of about 5 miles. (This is modification of a petition previously submitted for a road from Big Four Inn to Monte Cristo.) Constructed.

Chelan County—For a road from the Stehekin River up Park Creek, a distance of 6½ miles.

King County—For a road up the Middle Fork Snoqualmie River for about 10 miles to serve a mineralized area near the summit of the Cascade Mountains.

For a road from River Crossing on the North Fork Snoqualmie River to the camp of Lenox Mining Company, a distance of about 6 miles.

For a road from Miller River up Coney Creek, a distance of about 2 miles.

Lewis County—For a road from near Riffe in a southerly direction to the Green River, a distance of about 12 miles, to serve the St. Helens mining district.

Okanogan County—For a road up North Creek from the Twisp River, for a distance of 2½ miles.

Pierce County—For a road from the forest boundary near Fairfax to Copley Lake, a distance of about 9 miles.

Skagit County—For a road up Thunder Creek from the Whatcom County line, a distance of 9 miles.

Skagit and Whatcom Counties—For a road about 12 miles in length to serve a chromite area in the Twin Sisters Mountains, in northern Skagit and south central Whatcom counties.

Skamania County—For a road 4 miles in length from the end of the present road on the south side of Spirit Lake, around the east end of the lake. This is in the Spirit Lake mining district.

Snohomish County—For a road from the Sultan River up Williamson Creek, a distance of about 6 miles.

For a road up Martin Creek from the South Fork Stilaguamish River, a distance of about 4 miles.

For a road up the South Fork Stilaguamish River near Big Four Inn, a distance of about 2½ miles.

For a road near Arlington to serve certain limestone deposits, a distance of 1½ miles.

For a road east of Mineral City, a distance of 2 miles.

For a road up Weden Creek, a distance of 1 mile.

Stevens County—For improvement of an existing county road to serve an area where magnesite is being mined.

STATEMENT OF EXPENDITURES

ROADS	COUNTY	Authorization	Expended
Cook Creek	Grays Harbor.....	\$12,855 00	\$3,786 02*
Barlow Pass	Snohomish.....	26,000 00	20,082 51
Horseshoe Basin Extension.....	Chelan.....	13,500 00	5,431 04
Squaw Creek	Okanogan.....	4,697 00	734 06
Monse	Okanogan.....	5,009 10	3,044 62
Merritt	Chelan.....	2,004 96	1,016 62
South Fork Snoqualmie.....	King.....	2,000 00	18 60
Mineral City	Snohomish.....	75 00	18 22
Totals.....		\$69,231 06	\$35,031 69

* Approximately \$10,000.00 had been expended by October 31, 1942.

The mines-to-market road law was enacted by the legislature in 1939, with an appropriation of \$100,000. During the biennium ending September 30, 1940, 15 petitions were received, and 3 roads constructed as follows:

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

SUMMARY

Appropriated in 1939.....	\$100,000.00
Expended in biennium ending September 30, 1940.....	93,363.08
Balance reappropriated	\$6,636.92
Appropriated in 1941.....	200,000.00
Amount available for biennium ending September 30, 1942....	\$206,636.92
Expending in biennium ending September 30, 1942.....	35,031.69
Unexpended balance in fund.....	\$171,605.23