STATE OF WASHINGTON
ARTHUR B. LANGLIE, Governor

Department of Conservation and Development
W. A. GALBRAITH, Director

BIENNIAL REPORT NO. 6

of the

DIVISION OF MINES AND GEOLOGY

For the Period Commencing July 1, 1954
and Ending June 30, 1956

By

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Supervisor

STATE PRINTING PLANT
OLYMPIA, WASH.

DIVISION OF MINES AND GEOLOGY

Biennial Report No. 6

SHELDON L. GLOVER, Supervisor

GENERAL STATEMENT

The following report applies to the organization and activities of the Division of Mines and Geology, Department of Conservation and Development, for the period July 1, 1954 to June 30, 1956.

The technical staff for the full period included Sheldon L. Glover, Supervisor; Marshall T. Huntting, Assistant Supervisor; and W. A. G. Bennett, Geologist. C. Phillips Purdy, Jr., who had been on the staff as a geologist since April 7, 1947, resigned on October 15, 1954. Howard E. Banta was employed as an assistant geologist on January 24, 1955 and resigned on February 24, 1956; he was replaced June 11, 1956 by Vaughn E. Livingston. Temporary employees included Gerald L. Gould and Nathan R. Segel, draftsmen. Non-technical employees included two short-time field assistants during the summers of 1954 and 1955 and one in 1956. The clerical staff consisted of Dorothy Rinkenberger, Secretary, and Gloria DeRossitt, clerk-stenographer.

The Division was particularly active during the biennium in acquiring further information on the metallic and nonmetallic resources of the state and in supplying data on these resources to all inquirers who indicated an interest in prospecting or in mineral development and utilization. The outstanding feature of the period, of course, was the phenomenal activity of prospectors in the search for uranium; this is the subject of a separate section in the present report. In general, the requests for information have far exceeded in number those of previous years. They have been handled, as before, by office conferences, occasional out-of-town conferences and meetings, by an increasingly voluminous correspondence, and by the issuance of bulletins and reports of investigations when the commodities discussed were of general interest.

The Division continued to cooperate with the U. S. Geological Survey in topographic mapping, with the U. S. Bureau of Mines in the collection of statistics of mineral production, and with various other Federal agencies in matters of mutual interest. As usual, the Division supplied information and assistance to other state agencies in problems involving geology and mineralogy whenever such services were requested.

The volumes in the Division's reference library were augmented by additional publications of the U. S. Geological Survey, U. S. Bureau of Mines, and other state surveys. Also, a considerable number of texts and reference works dealing with uranium were acquired, owing to the unusual interest in this subject. Similarly, a large collection of uranium minerals and representative ores were added to the mineral display which is maintained particularly for the information of prospectors and miners.

SELECTED MINERAL PRODUCTION①—1948 THROUGH 1955

PRODUCT	1948		1949		1950		1951	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Clay (except for cement)....short tons	.....	$282,260	219,738	$267,300	217,000	$251,850	265,000	$285,631
Coal ....short tons	1,219,903	7,892,123	899,046	6,028,636	844,000	5,828,355	867,000	6,031,460
Copper ....short tons	5,665	2,458,610	5,275	2,078,350	5,05[illegible]	2,103,[illegible]12	4,089	1,979,0[illegible]6
Gold ....troy ounces	70,075	2,452,625	71,994	2,519,.90	92,117	3,224,095	67,405	2,359,175
Lead ....short tons	7,147	2,558,626	6,417	2,027,772	10,334	2,.90,180	8,002	2,768,692
Peat ....short tons	②	②	②	⑤	.....	.....	45,304	98,965
Pumice ....short tons	26,675	47,787	8,610	18,221	11,0.3	22,672	5,105	10,852
Sand and gravel....short tons	9,267,225	6,657,129	9,215,914	6,391,412	10,606,000	7,435,340	10,547,000	7,595,837
Silver ....troy ounces	375,831	340,146	357,853	323,8.5	364,000	329,127	335,000	303,145
Stone ....short tons	5,229,500	6,382,462	3,688,890	4,105,516	4,931,000	5,734,563	5,030,000	5,664,433
Tungsten ore (60% conc.)....short tons	.....	.....	.....	.....	.....	.....	9	33,417
Zinc ....short tons	12,638	3,361,708	10,740	2,663,520	14,807	4,205,188	18,189	6,620,796
Miscellaneous ③	.....	16,514,367	.....	14,438,177	.....	17,129,354	.....	20,802,940
Total.....	.....	$48,928,000	.....	$40,863,000	.....	$49,055,000	.....	$54,554,000

PRODUCT	1952		1953		1954		1955 ④	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Clay (except for cement)....short tons	225,000	$352,576	198,233	$312,141	189,212	$246,384	280,000	$340,000
Coal ....short tons	844,000	5,986,129	689,831	5,047,928	④623,778	4,255,400	610,000	4,200,000
Copper ....short tons	4,357	2,108,788	3,740	2,146,760	3,636	2,145,240	3,953	2,925,220
Gold ....troy ounces	54,776	1,917,160	62,560	2,189,600	66,740	2,335,900	76,280	2,669,800
Lead ....short tons	11,744	3,781,568	11,064	2,898,768	9,938	2,723,012	10,415	3,103,670
Peat ....short tons	42,580	111,386	32,107	104,274	43,134	153,058	②	②
Pumice ....short tons	3,604	8,089	②	②	②	②	②	②
Sand and gravel....short tons	13,322,000	9,422,117	11,182,835	9,317,793	16,011,438	13,494,144	15,500,000	13,000,000
Silver ....troy ounces	316,000	285,675	321,202	290,704	313,735	283,946	422,300	382,248
Stone ....short tons	4,591,000	5,491,525	4,438,259	5,890,849	4,006,724	5,369,388	5,000,000	8,750,000
Tungsten ore (60% conc.)....short tons	4	14,008	5	19,710	18	65,812	20	75,000
Zinc ....short tons	20,102	6,673,864	32,786	7,540,780	22,304	4,817,664	29,591	7,279,386
Miscellaneous ③	.....	19,985,862	.....	18,817,913	.....	16,642,728	.....	15,418,676
Total.....	.....	$56,139,000	.....	$54,577,000	.....	$52,533,000	.....	$58,144,000

① Compiled by State Division of Mines and Geology from statistics obtained in cooperation with U. S. Bureau of Mines and, in part, published in Minerals Yearbook.

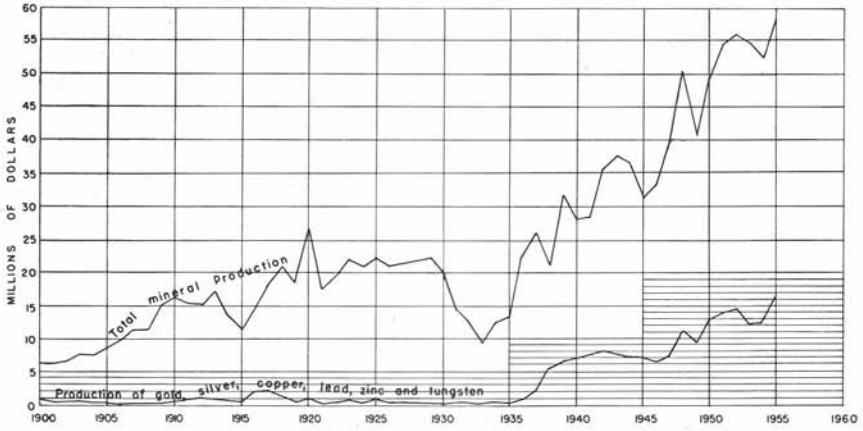
② Included in "Miscellaneous."

③ Includes items indicated by ② above; also in various years the following: carbon dioxide (natural), diatomite, epsomite, gem stones, gypsite, iron ore, lime, magnesite, manganese, olivine, portland cement, quartz, strontium, uranium, and other mineral commodities.

④ Preliminary statistics, subject to revision.

THE STATE'S MINERAL INDUSTRY

The healthy condition of the state's mineral industry is indicated by the accompanying graph, showing a general, average rise in the value of annual mineral production since 1933. The detailed statistics of this production are



Value of Washington's Mineral Production, 1900-1955

given in the accompanying tabulation for the years 1948 through 1955. Final figures are shown except for those of 1954, which are still preliminary though essentially correct, and 1955, which are strictly preliminary and subject to revision. It is doubted that the final statistics for 1955, when available, will indicate any marked change in the total for that year—an amount that reached $58 million, a value of production that broke all previous records for the state and exceeded by $2 million the hitherto record year of 1952. The commodities chiefly responsible for this large production are clay, copper, gold, lead, magnesite, portland cement, stone, tungsten, and zinc, all of which were produced in record or near-record amounts.

URANIUM PROSPECTING AND DEVELOPMENT

The search for uranium minerals during the past year or so has caused the greatest prospecting boom in the state's history. No particular interest had been shown in this element prior to the development of the "atomic bomb" and the finding of extensive uranium deposits in the Colorado Plateau region. However, three entirely unsubstantiated reports of uranium occurrences in Washington had been made. The earliest was in 1897, when a Mr. R. F. Brown mentioned finding "a 5-foot ledge of uranium 12 miles from Peshastin Station on the Great Northern Railway" in Chelan County. Another, in 1903, spoke of uranium associated with other minerals on O'Toole Mountain in Stevens County. Still another, in 1916, mentioned the finding of uranium-bearing ore 5 miles west of Sultan, Snohomish County. These reports were before the days of the Geiger counter. Just what occurrences were found and assumed to be minerals of uranium is unknown, as are the identification techniques, if any, that may have been employed.

So far as the Division of Mines and Geology has been able to ascertain, the first authentic occurrence of uranium mineralization was discovered in March

1949 when, in the course of investigating columbite and beryl on a mining claim in eastern Stevens County, staff geologists of the Division identified scattered crystals of uraninite in a pegmatite dike. By this time prospecting was definitely increasing and the use of Geiger counters was becoming quite common. As a result, reports of radioactivity began to come from various parts of the state. By 1954 some 15 or 20 such occurrences had been reported. In some of these, uranium minerals had been isolated and definitely identified, but very little of apparent commercial importance had been found.

It was not until the winter months of 1954 that the uranium rush, which had previously spread through the Colorado Plateau region, finally reached stampede proportions in Washington. The rush had its beginning in the summer of 1954, when John and James LeBret, while prospecting for tungsten at night with an ultraviolet light, found some bright yellowish-green fluorescing material which was identified as autunite, a secondary uranium mineral. The prospect, named the Midnite, is on the Spokane Indian Reservation in southern Stevens County. Exploration of the deposit soon revealed its commercial possibilities, and by December of that year, the first shipment of ore had been made. This initial shipment focused attention of the mining industry on Washington, and the northeastern part of the state in particular.

In the next few months literally thousands of prospectors swarmed the hills, and scores of companies, large and small, became involved. Most of the companies were newly organized specifically for uranium ventures, but many of the old, well-established mining concerns, including some of the largest in the industry and also one prominent oil company, were quick to enter the field and acquire land.

Within 6 weeks after the initial shipment of ore from the Midnite property, over 600 applications for mineral leases on State-owned land were received by the State Department of Public Lands, and in a short time nearly all such available land in Stevens, Pend Oreille, Ferry, and Spokane Counties was leased for minerals. A record number of more than 2,300 mining claims were staked in 1955 on open Federal land in the first three of these counties. In addition, many thousands of acres of privately owned land were leased.

The scramble for land was further intensified in February 1955, when uranium was found on the Dahl ranch on the northwest flank of Mount Spokane, 20 miles northeast of Spokane. This discovery resulted from the alertness of Leonard and Alfred Dahl in noticing and later remembering some greenish-yellow mineral observed while they were digging post holes on their father's ranch in the early 1940's. They had saved a sample of the flaky mineral but did not recognize it or realize its importance until after the discovery of autunite on the Spokane Indian Reservation. The greenish-yellow flakes from the post holes were autunite also. Exploration on the Dahl ranch disclosed ore of commercial grade and quantity, and by August 1955 the first ore shipment had been made.

Most of the several hundred uranium occurrences that have now been found, and all the deposits that so far have proved to be commercial, are in the northeast part of the state. It might be assumed that this is due to one of two factors: either because most of the uranium is localized in southern Stevens County and northern Spokane County, or because the most intensive prospecting has centered there. However, as the intensive search has spread to new areas, the area of discoveries of uranium has also spread, as illustrated

by later finds in Pend Oreille County, northern Stevens County, northern Lincoln County, at Sherman Pass and additional localities in Ferry County, in Snohomish County, and in other parts of the state.

Uranium occurrences, or at least radioactive anomalies, have been found in nearly half of the counties of Washington, though mostly in the northern row of counties along the Canadian boundary and in those counties that include the Cascade Mountains. To date, shipments of ore have been made from six properties, but with the completion of the uranium processing mill, scheduled for construction near Spokane, it is expected that many more mines will go into production. This mill is to be built at Ford, in southern Stevens County. The plans call for a capacity of 400 tons per day, which will make it one of the largest plants in the nation. Upon completion of the mill, Washington will be the first state having a completely integrated uranium industry—from mine to mill to plutonium-production plant.

The future for uranium mining in Washington seems bright indeed, with the northeastern part of the state already considered to be one of the country's major uranium-producing fields outside the Colorado Plateau.

PUBLICATIONS

The reports and bulletins issued by the Division are an important means of providing information for those who desire data on the mineral resources, the geology, and the status of the mining industry of Washington. During the biennium the following material has been made available for distribution:

1955 Directory of Washington Mining Operations, by Marshall T. Huntting. 79 pages, 2 maps, photo-offset, free.

1956 Directory of Washington Mining Operations, by Howard E. Banta. 87 pages, 2 maps, photo-offset, free.

Molybdenum Occurrences of Washington, by C. Phillips Purdy, Jr., Report of Investigations No. 18, 118 pages, 7 plates, 50 cents.

An Outline of Mining Laws of the State of Washington, compiled by Morton H. Van Nuys, Bulletin No. 41, 142 pages, 50 cents. This was a reprinting without change of a bulletin issued in 1953, the first edition being entirely exhausted in May 1956.

Gold in Washington, by Marshall T. Huntting, Bulletin No. 42, 158 pages, 2 plates, $1.00.

Reports in preparation

Eocene Stratigraphy of the Lower Cowlitz River-Eastern Willapa Hills Area, Southwestern Washington, by Donald A. Henriksen, Bulletin No. 43, 122 pages, 2 plates, 49 figures, $1.50. This report is in the hands of the printer and may be ready for distribution by the time the present biennial report is released. The Division, by providing the funds for printing, was able to obtain without other expense the manuscript of a Stanford University doctorate dissertation embodying the results of a detailed geologic investigation of a part of southwest Washington that is of particular interest to those persons and concerns engaged in the search for oil.

Inventory of Washington Minerals: Nonmetallic Minerals, by Grant M. Valentine, Bulletin No. 37, pt. 1, 113 pages, 39 plates. The edition of this report, published in 1949, was entirely exhausted in April 1956. As there is a continuous demand for data on the state's industrial minerals, the bulletin

is being revised, brought up to date, and considerably enlarged for reprinting. The project is in charge of Marshall T. Huntting. The completion date cannot be estimated, but it is hoped that it will be during the coming biennium.

Inventory of Washington Minerals: Metallic Minerals, by Marshall T. Huntting, Bulletin No. 37, pt. 2, in two volumes totaling nearly 500 pages, 27 plates, $4.50. This was completed in January 1956 and sent to the printer; distribution should be possible in the fall of 1956. It is the largest and most complex project ever undertaken by the Division. The included comprehensive data on all known and reported metallic mineral deposits of the state will provide the mining industry with information that is in constant demand.

Supplement No. 1 to An Outline of Mining Laws of the State of Washington, compiled and annotated by M. H. Van Nuys, Supplement No. 1 to Bulletin No. 41, approximately 28 pages, free. Various changes—some major and some minor—have been made in mining laws since the publication of Bulletin No. 41 in 1953. It appeared desirable to include these changes in a short supplemental pamphlet which will accompany the original bulletin (No. 41) on mining laws and can also be distributed separately on request. It has the effect of bringing the original bulletin up to date—a less expensive procedure than making a complete revision of the earlier material.

Uranium in Washington, by Marshall T. Huntting. This is to be a separate printing of approximately 12 pages and 1 plate, which constitutes one section or chapter of Inventory of Washington Minerals, pt. 2, Metallic Minerals, and will be issued for free distribution to the uranium prospectors and miners. Two objectives are served: the included information can readily be placed in the hands of those desiring this section only and who are not interested in purchasing the complete Inventory, and the Division will be saved the necessity of writing lengthy replies to inquiries which can be handled only inadequately by the usual correspondence. The material should be available for distribution in the fall of 1956.

Three other projects are in various stages of completion: (1) A report on the peat resources of the state, by Dr. George B. Rigg, Professor Emeritus, Botany Department, University of Washington, is in final manuscript form except for a considerable number of illustrative maps and charts. Difficulty in obtaining necessary drafting services is delaying the completion of this report. (2) A geologic investigation of the structure, stratigraphy, and ore deposits of the south half of the Colville quadrangle in Stevens County is underway but with an indefinite completion date. (3) The entire remaining edition of the geologic map of Washington was quickly exhausted when uranium prospecting became active. This necessitated the immediate start on a complete revision of the state map—a meticulous, time-consuming, and expensive project that may require two years or more to complete. It is the most important new project scheduled by the Division.

MINERAL IDENTIFICATION SERVICE

Aside from the distribution of published bulletins and reports, the service of this Division that apparently has the widest public appeal is the identification of samples of Washington minerals and rocks. Not only prospectors, but an increasingly large number of the general public are becoming mineral conscious and recognize the Division as a state agency that is interested in their finds and which will provide, with the least possible delay, the information that is desired. No assays or chemical analyses are made—these are available from commercial concerns—but the mineral materials are identified without charge and the senders advised of possible value.

The search for uranium, obviously, has had a lot to do with the increase in the number of samples submitted for testing. But it is interesting to observe that persons who originally may have had nothing but uranium in mind are now actively searching for other minerals of value and could well discover deposits hitherto unknown. All such work adds to the available knowledge of the state's mineral resources. The extent of this activity, in so far as it affects the laboratory of the Division, is indicated by the fact that 2,119 samples were submitted for identification in the current biennium. This compares with 1,106 in the 1952-'54 biennium and 742 in the 1950-'52 biennium.

OIL AND GAS

The Supervisor of the Division of Mines and Geology is also State Oil and Gas Supervisor, being designated by the Oil and Gas Conservation Committee as its agent for the purpose of carrying out the provisions of the Oil and Gas Conservation Act and the rules and regulations adopted thereunder (see Biennial Report No. 5, pages 6-7). In connection with these prescribed duties, attention was given during the biennium to the activities and results obtained by 12 companies, all engaged in oil and gas exploration. Permits were issued for the drilling of 76 stratigraphic (core) holes and for 23 oil and gas tests. A total of only 96 separate holes were drilled, as 2 were deepened as oil tests under original permits issued for stratigraphic holes, and 1 oil test was planned but not started. The required records pertaining to all this work were collected and filed by the Supervisor. No significant discoveries of either oil or gas were made during this period, but very extensive information was obtained on subsurface geologic conditions.

TOPOGRAPHIC MAPPING

Topographic mapping throughout the state was actively carried on during the biennium, both as a cooperative project, whereby the State and Federal governments divided the mapping costs, and as an independent function of the Federal government alone. Mr. Robert O. Davis, Pacific Region Engineer, Topographic Division, U. S. Geological Survey, Sacramento, California, has kindly supplied the following information on the progress of mapping in Washington.

Quadrangles worked on and financed as cooperative projects between the State and Federal governments included the following:

Names of quadrangles	*Counties in which located*
*Bald Knob	Ferry and Stevens
*Centralia	Lewis
*Seventeenmile Mountain	Ferry
Stillaguamish 2	Skagit and Snohomish
Stillaguamish 3	Snohomish
Stillaguamish 4	Snohomish
Sultan 1	Snohomish

Also, the following quadrangle maps were completed and published through the use of Federal funds alone. (In parentheses are the new official names of certain quadrangles.)

Names of quadrangles	*Counties in which located*
Allyn NE (Belfair)	Kitsap
Allyn NW (Lake Wooten)	Kitsap
Allyn SE (Vaughn)	Mason and Pierce
Allyn SW (Mason Lake)	Mason
Beverly	Grant and Kittitas
Beverly NE	Grant
Beverly NW (Vantage)	Grant and Kittitas
Beverly SE	Grant
Beverly SW (Beverly)	Grant and Kittitas
Brush Prairie (Orchards)	Clark
Camano	Island
Camas NW (Lackamas Creek)	Clark
Cathlamet	Wahkiakum
Cedar Lake 2 NE (North Bend)	King
Cedar Lake 2 NW (Hobart)	King
Cedar Lake 2 SE (Eagle Gorge)	King
Cedar Lake 2 SW (Cumberland)	King
Copper Mountain (Mt. Challenger)	Whatcom
Coupeville	Island
Edmonds NE (Mukilteo)	Snohomish
Edmonds NW (Maxwellton)	Snohomish
Edmonds SE (Edmonds East)	Snohomish
Edmonds SW (Edmonds West)	Snohomish
Everett NE (Snohomish)	Snohomish
Everett NW (Everett)	Snohomish
Everett SE (Maltby)	Snohomish
Everett SW (Bothell)	Snohomish
Ford (Malone)	Grays Harbor, Lewis, and Pacific
Freeland	Island
Gardiner	Clallam and Jefferson
Gate (Rochester)	Grays Harbor, Lewis, Thurston
Gig Harbor NE (Olalla)	King, Kitsap, and Pierce
Gig Harbor NW (Burley)	Kitsap and Pierce
Gig Harbor SW (Sylvan)	Pierce
Kalama	Cowlitz
Kalama NE (Mt. Brynion)	Cowlitz

*Published during biennium.

Names of quadrangles	*Counties in which located*
Kelso	Cowlitz
La Center SE (Battle Ground)	Clark
Lookout Mountain	Skamania
Marblemount	Whatcom
Medical Lake NE (Airway Heights)	Spokane
Medical Lake SE (Four Lakes)	Spokane
Medical Lake SW (Medical Lake)	Spokane
Meskill (Adna)	Lewis
Mohrweis (Mt. Tebo)	Mason
Mt. Baker	Whatcom
Mt. Shuksan	Whatcom
Nahwatzel Lake (Elma)	Grays Harbor and Mason
Nordland	Island and Jefferson
Oakesdale 1 (Fairfield)	Spokane
Oakesdale 2 (Spangle)	Spokane
Olequa (Castle Rock)	Cowlitz and Lewis
Omak Lake	Okanogan
Othello NE (Warden)	Adams
Othello NW (Soda Lake)	Adams
Othello SE (Bruce)	Adams
Othello SW (Othello)	Adams
Pigeon Springs	Cowlitz
Point Misery NE (Seabeck)	Jefferson and Kitsap
Point Misery NW (Brinnon)	Jefferson
Point Misery SE (Wildcat Lake)	Kitsap and Mason
Point Misery SW (Holly)	Kitsap and Mason
Point Roberts NE (Point Roberts)	Whatcom
Port Gamble NE (Hansville)	Island and Kitsap
Port Gamble NW (Port Ludlow)	Jefferson
Port Gamble SE (Port Gamble)	Kitsap
Port Gamble SW (Lofall)	Jefferson and Kitsap
Port Orchard NE (Suquamish)	Kitsap
Port Orchard NW (Poulsbo)	Kitsap
Port Orchard SE (Bremerton East)	Kitsap
Port Orchard SW (Bremerton West)	Kitsap
Port Townsend North	Island and Jefferson
Port Townsend South	Jefferson
Potlatch	Mason
Quilcene NE (Center)	Jefferson
Quilcene NW (Uncas)	Clallam and Jefferson
Quilcene SE (Quilcene)	Jefferson
Quilcene SW (Mt. Walker)	Jefferson
Rainier	Cowlitz
Reardan	Lincoln and Spokane
Ridgefield	Clark
Salkum (Onalaska)	Lewis

Names of quadrangles	*Counties in which located*
Shelton	Mason and Thurston
Skamokawa	Lewis, Pacific, and Wahkiakum
Spokane	Spokane
Sprague	Lincoln and Spokane
Sultan 2 SE (Sultan)	King and Snohomish
Sultan 2 SW (Monroe)	King and Snohomish
Sultan 3 NE (Lake Joy)	King
Sultan 3 NW (Carnation)	King
Sultan 3 SE (Snoqualmie)	King
Sultan 3 SW (Fall City)	King
Toutle	Cowlitz and Lewis
Walville (Pe Ell)	Lewis and Pacific
Wellpinit	Lincoln and Stevens
Wildwood (Ryderwood)	Cowlitz and Lewis