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DEPARTMENT OF NATURAL RESOURCES
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DIVISION OF GEOLOGY AND EARTH RESOURCES
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GEOLOGIC MAP GM - 30

## GEOLOGIC MAP GM-30

# AVAILABILITY OF FEDERAL LAND FOR MINERAL EXPLORATION AND DEVELOPMENT IN THE STATE OF WASHINGTON

By

D'Arcy P. Banister, Donald J. Barnes, and Warren D. Longwill

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TO ACCOMPANY GEOLOGIC MAP GM-30

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## ABSTRACT

Bureau of Mines investigators (1) inventoried Federal lands in the State of Washington and classified them in detail, section by section, according to their availability for mineral exploration and development as affected by legal status and agency management practices; (2) prepared maps showing significant known metallic deposits with their associated geologic terranes and areas underlain by reported coal deposits and known coal reserves; and then (3) spatially compared the availability of Federal land to areas of known mineral deposits.

Legal land availability status was primarily derived from Bureau of Land Management Master Title Plats; land management practices affecting availability status were based primarily on individual agency management plans or documents. The metallic mineral map was developed mainly from Bureau of Mines file data and the published State Geologic Map (Huntting and others, 1961); the coal map was primarily derived from State publications.

Washington State is 42.7 million acres in size, of which 12.8 million acres or 30 percent are Federal. Approximately 5 million acres of the Federal land or 39.5 percent are routinely available for mineral exploration and development. Various legal withdrawals and management practices have effectively made 7 million acres of Federal land or 54.5 percent unavailable for exploration for the locatable minerals and 5.4 million acres or 42.4 percent unavailable for mineral leasing. An additional 0.8 million acres or 6 percent are considered significantly restricted for locatable minerals, and 2.3 million acres or 17.6 percent are significantly restricted for mineral leasing.

The maps show approximately 2.2 million acres of geologic terranes associated with known metallic mineral deposits in Washington State. About 1.4 million acres or 61.9 percent of these terranes underlie Federal land. An estimated 677,000 acres or 49.8 percent of this Federal land are available, 47,000 acres or 3.5 percent are restricted, and 635,000 acres or 46.7 percent are unavailable for locatable mineral exploration and development.

One of the principal leasable commodities in Washington is coal. An estimated 435,000 acres or 22.9 percent of the area of coal-bearing formations underlie Federal land. Approximately 266,000 acres or 61.2 percent are available for leasing, 46,000 acres or 10.6 percent are restricted, and 123,000 acres or 28.2 percent are unavailable.

## INTRODUCTION

The Federal land of the United States has been a vital source of mineral materials for the Nation in the past and will continue to be a vital source in the future. Federal land, which comprises nearly one-third of the Nation's land, provides a great variety of resources, including timber, wildlife, water, and mineral resources. To protect and preserve this array of resources for the public, a body of laws and policies have been developed. As a result, some areas of Federal land have been legally segregated or are managed for specific purposes which frequently restrict the use of the land for other purposes, such as mineral exploration and development.

This Bureau of Mines Federal land study for Washington State is one of a series being done by the Bureau for the 11 conterminous Western States, where nearly one-half of the Federal land is concentrated. Similar studies for Oregon, Colorado, New Mexico, and Arizona are underway.

Earlier studies have discussed the issue of Federal land availability, but none performed a comprehensive detailed section by section inventory of Federal land availability based on legal and agency management practices. Furthermore, no study to date has addressed in comparative detail the spatial relationship of available Federal land to areas of geologic terranes associated with known mineral deposits on a statewide basis. The Bureau of Mines made a comprehensive study to accomplish both of these objectives for Federal land in the State of Washington. This report is a result of that detailed comparative analysis.

Such an analysis can be helpful to policymakers and land planners at all levels of government, especially those who are concerned with domestic mineral supply and the future use of the public land. The report should also be useful to those who manage Federal lands and to those who use them.

* U.S. Bureau of Mines staff.

## ACKNOWLEDGMENTS

We wish to thank personnel of each of the numerous land management agencies contacted during the course of this study for their aid and assistance. We also wish to thank Howard E. McKinney, physical scientist; Robin B. McCulloch, mining engineer; James M. Spear, mining engineer; Theodore R. Brandt, cartographic technician; and Larry Reigel, technician of the U.S. Bureau of Mines in Spokane, for their contributions.

## DATA SOURCES AND COMPILATION

Bureau of Land Management (BLM) Master Title Plats (MTP's) were used as the basic source of data for this study. The MTP's provided the information necessary to compile the detailed ownership maps and to identify the legal availability status of Federal land.

All Federal land management agencies within the State of Washington were contacted during this study, including the Forest Service, Bureau of Land Mangement, Army, Air Force, Navy, Bureau of Indian Affairs, Park Service, Department of Energy, Fish and Wildlife Service, Corps of Engineers, and Bureau of Relcamation.

Agency management practices were derived from environmental statements, management directives, planning maps, and other miscellaneous documents. The status of each land parcel was then categorized, using agency management practices, to assess the practical effect of restrictions on possible mineral exploration and development.

To avoid extremely complicated assessments of the effects of various legislation and management practices, the status assessment was limited to three categories. These simplified categories consider legally unavailable or withdrawn lands plus the practical effect upon the mineral industry of legislation and management practices. The way private industry perceives these various constraints is one of the most important factors in their decision to risk exploration money in an area. Thus, the practical effect of some agency management practices is that private industry may consider an area as no longer available. If private companies already have rights to a known valuable deposit or know of an exceptional exploration target, they may maintain their program, but they will probably avoid new exploration programs elsewhere in such an area. The following definitions form the basic guidelines for this assessment of land status:

*Available:* The practical effect of agency regulations and management practices is such that private industry will routinely initiate major exploration programs in these areas.

*Restricted:* The practical effects are such that private industry will hesitate to initiate major exploration programs in these areas.

*Unavailable:* Areas that are withdrawn by statues, executive orders, or regulations (that is, any area legally unavailable) or are managed so the practical effects are such that private industry will not initiate major exploration programs in these areas.

These practical effect definitions apply to both the locatable and leasable minerals of this report. Typical examples of each category are given in appendix A to further illustrate the use of these definitions. In some areas, private owners of the surface estate overlying or surrounding Federal mineral estate impose the restrictions that affect access or availability.

The vast amount of information reflecting ownership and availability status was compiled in township books detailing the status in each section according to legal withdrawals and pertinent management practices. These books represent the basic documentation and back-up compilation for this report and are available at the Western Field Operations Center in Spokane. These data have been computerized; tabulations are readily retrievable and easily updated.

Several shortcomings were recognized with the use of the MTP's. For example, there were numerous small parcels of land owned by Federal agencies, such as the 21-acre storage facility of the Bureau of Mines, and even larger tracts of more than 1,000 acres, such as Fairchild Air Force Base, which were not shown as Federal land on the MTP's. In these cases the information was acquired from either the managing agency or published material.

Some parcels of land may have been listed with more than one agency. For example, land reserved for reservoir projects by the Corps of Engineers or Bureau of Reclamation may have the shore land of the project dedicated to managment by the U.S. Fish and Wildlife Service. These apparent discrepancies were resolved to the best of our knowledge, and the land in question credited to the actual managing agency. Also, the accuracy of the land status acreages is limited in areas where more than one management practice exists within a section. In these cases, acreage was estimated because the management practice boundary generally did not follow legal subdivisions.

A base map of Washington State at a scale of 1:500,000 was selected to display Federal land and our assessment of land status based upon the practical effects of withdrawals and management practices. This scale is too small to allow parcels of land less than one section (640 acres) to be displayed; therefore, on the status maps, sections with dots indicate the section contains some Federal land but is predominantly private. Conversely, sections indicated as Federal without dots are predominantly Federal but may contain some private land.

After the status categories were plotted on maps, these maps were reviewed with personnel in offices of the appropriate Federal land managing agencies. The purpose of the review process was to check for local agency management practices, compare their actual practices with our previous interpretations based on available written descriptions, and check for recent changes. The land status in this report represents the Bureau's assessment of mid-1982 conditions; undoubtedly changes have occurred since that time.

Information regarding the metallic mineral deposits identified on plate 3 was derived primarily from the Bureau of Mines Mineral Industry Location System (MILS) data base and associated Bureau mineral production and property files. Each of the computer-generated (MILS) location points identifies one or more mineral deposit sites within a 3-mile radius. The symbols associated with the mineral location points illustrate the type of metal concentrations occurring at that locality. Solid symbols represent commodities with past production or estimated resources of more than $1 million, using 1981 prices. A few open symbols are also shown. These were shown for one of the following reasons: (1) the commodity has been produced at this site, though output was worth less than $1 million; (2) the deposit is considered significant, but there is a lack of data for a resource and (or) reserve estimate; or (3) the deposit location is important to understanding and outlining the associated geologic terrane. Numbers refer to the properties named in appendix D. The geologic base is from the most recent published Geologic Map of Washington (Huntting and others, 1961).

The coal map portion of plate 4 shows reported deposits, areas of known reserve estimates, and areas of known or possible coal-bearing formations. These features of the coal resources are compared to the availability status for leasable minerals on plate 4. Map data on coal resources were largely derived from Washington Division of Geology and Earth Resources publications (Beikman and others, 1961; Livingston, 1974) and personal contacts with their personnel.

## FEDERAL LAND IN WASHINGTON STATE

Federal land in the State of Washington totals 12,823,528[1] acres (fig. 1). Included in this total are numerous small parcels of Federal mineral estate under private surface. Generally, the surface estate ownership and the underlying mineral estate ownership coincide, but the status data show 304.975 acres where the Federal

[1]This total represents the leasable mineral acreage. A difference between the locatable and leasable mineral acreage exists because in some cases the Federal Government owns or has an interest in only leasable minerals, such as oil and gas only or coal only.

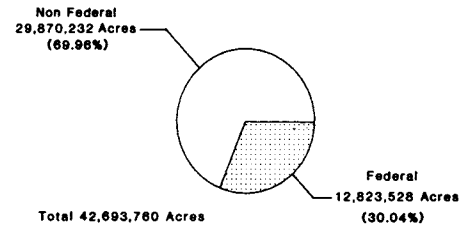


**Figure 1. — Land ownership in Washington.**

Government owns all or part of the minerals under private surface. The data also show 56,749 acres where the surface estate is Federal but the mineral estate is privately owned. These surface estate acres, although Federal, are not included in the totals as the data reflect only mineral interests. The majority of the Federal land lies in the mountainous regions along the Cascade Mountains, northeastern Washington, and the Olympic Peninsula. Other large Federal holdings are the military and U.S. Department of Energy reservations near the city of Yakima, and the Bureau of Reclamation land in the Columbia Basin.

The Forest Service manages the largest acreage of Federal land in Washington State. Other agencies with responsibility for large areas of land are the National Park Service and the Bureau of Reclamation (fig. 2). Indian Reservations have not been included in this report because of their unique character of being held in trust by the Federal Government. Further details specific to Indian land are included in appendix B.

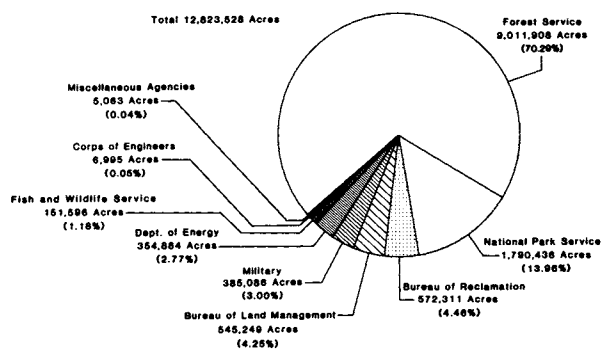


**Figure 2. — Federal land ownership by agency in Washington.**

## APPLICABLE FEDERAL MINERAL LAWS

Access for exploration and development of the vast majority of mineral resources on Federal land is provided by two Federal mineral laws. The General Mining Law of 1872, as amended, is the basic law for locatable minerals. The Mineral Leasing Act of 1920 provides for most of the leasable minerals. This report does not include minerals that are considered salable

under Federal mineral laws, such as common deposits of sand and gravel, stone, clay, pumice, and cinders. Additional laws pertaining to mineral resources are given in appendix C.

Various legislative acts and management practices that affect the availability of land for mineral exploration are discussed in more detail in the Bureau of Mines publication, "Federal Land Status in the Overthrust Belt of Idaho, Montana, Utah, and Wyoming" (Schumacher and others, 1979), and in the Mining Congress Journal article by Benethum and Lee (1975).

Because of their different treatment under law, locatable minerals and leasable minerals are treated separately in this report.

## LOCATABLE MINERALS

Locatable minerals are those mineral commodities that can be claimed or located by mining claim under the Federal mining laws, principally the General Mining Law of 1872, as amended. These minerals include most of those mined for precious and nonferrous metals. Non-Federal land, such as private and State land, is not available for claim location. Also, some categories of Federal land, such as acquired land, are legally unavailable to mineral location unless they were made available by special legislation.

## LEASABLE MINERALS

Leasable minerals are those mineral commodities that have been legally excluded from mining claim location. Principal laws providing for the leasable minerals include the Mineral Leasing Act of 1920, the Acquired Lands Leasing Act of 1947, and the Geothermal Steam Act of 1970. Typical examples are coal, oil and gas, phosphate, salts of sodium and potassium, and geothermal resources. Acquired land is legally unavailable to mineral leasing unless it has been made available under provisions of the Reorganization Plan No. 3 of 1946 and the Acquired Land Leasing Act of 1947. Minerals considered traditionally locatable on other Federal land may be obtained only by lease on acquired land (see appendix C).

## AVAILABILITY STATUS FOR MINERAL EXPLORATION AND DEVELOPMENT

Specific areas of Federal land have been legally withdrawn or made unavailable by legislation. The purpose of these withdrawals was to preserve the land for specific activities or people. Examples of these withdrawals include national parks, wildlife refuges, and the military and Indian reservations.

Some Federal land is also affected by the management practices imposed by the Federal agencies that manage the land. The principal management practice by which a land managing agency assigns land use priorities can affect mineral exploration and development. The land use restrictions imposed vary from minor, inconsequential restrictions to major restrictions requiring expensive and time-consuming procedures, which may seriously discourage any mineral exploration and development.

The availability status of Federal land is shown on plates 1 and 2.

Following the identification and plotting of all Federal land in the State, the related legislative acts and management practices were assessed to determine the practical effects upon private industry interest in a particular area. Status assessments were totaled by agency for both locatable and leasable minerals (tables 1 and 2, respectively, and fig. 3). Of the total Federal locatable mineral estate of 12,769,311 acres, 39.5 percent is considered available for major exploration programs. The assessment indicates 0.8 percent is legally restricted and 29.2 percent is legally unavailable. Management practices have had the practical effect of making 5.3 percent restricted and 25.3 percent unavailable.

Totals concerning the legal and management practice effects for leasable mineral exploration are shown in table 2 and figure 3.

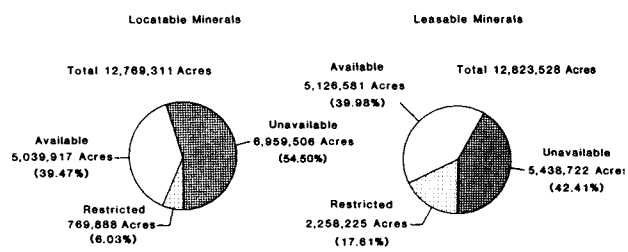


**Figure 3. — Availability status of Federal land in Washington.**

## AVAILABILITY STATUS BY MANAGEMENT AGENCY

The largest Federal land manager is the Forest Service. This agency manages about 70 percent of the Federal land in the State. Discussions were conducted with personnel from each of the various forests, and up-to-date land management information was obtained from each. At the time each forest supervisor's office was visited, most forest plans were incomplete, so present management direction was used in assessing which land would be categorized as available, restricted, or unavailable.

The categories of Forest Service land are graphically displayed in figure 4. Of the 9,006,346-acre total for locatable minerals, the legal and management practices

TABLE 1. — *Acreage of Federal land by agency and restriction category — locatable minerals*

| Agency | Available | Legal | | Management practice | | Total |
|---|---|---|---|---|---|---|
| | | Restricted | Unavailable | Restricted | Unavailable | |
| Forest Service[1] | 4,763,960 | 94,305 | 486,114 | 671,842 | 2,990,125 | 9,006,346 |
| Park Service[2] | 0 | 0 | 1,790,436 | 0 | 0 | 1,790,436 |
| Bureau of Reclamation[1] | 0 | 200 | 543,050 | 0 | 23,965 | 567,215 |
| Bureau of Land Management[1] | 275,957 | 2,791 | 10,245 | 116 | 212,668 | 501,777 |
| Military[1 3] | 0 | 0 | 384,961 | 0 | 125 | 385,086 |
| Department of Energy[1] | 0 | 0 | 354,884 | 0 | 0 | 354,884 |
| Fish and Wildlife Service[1] | 0 | 0 | 151,236 | 0 | 360 | 151,596 |
| Corps of Engineers[1] | 0 | 0 | 6,965 | 0 | 30 | 6,995 |
| Miscellaneous Federal ownership[1] | 0 | 0 | 3,890 | 634 | 452 | 4,976 |
| Category totals | 5,039,917 | 97,296 | 3,731,781 | 672,592 | 3,227,725 | 12,769,311 |

[1] In-house tabulation.
[2] Olympic National Park acreage from National Park System (U.S. National Park Service, 1982).
[3] Data supplied by Army and Air Force real estate offices.

TABLE 2. — *Acreage of Federal land by agency and restriction category — leasable minerals*

| Agency | Available | Legal | | Management practice | | Total |
|---|---|---|---|---|---|---|
| | | Restricted | Unavailable | Restricted | Unavailable | |
| Forest Service[1] | 4,849,759 | 521 | 103,008 | 1,085,043 | 2,973,577 | 9,011,908 |
| Park Service[2] | 0 | 0 | 1,790,436 | 0 | 0 | 1,790,436 |
| Bureau of Reclamation[1] | 0 | 0 | 1,842 | 570,039 | 430 | 572,311 |
| Bureau of Land Management[1] | 276,822 | 0 | 2,743 | 264,834 | 850 | 545,249 |
| Military[1 3] | 0 | 0 | 60,460 | 324,623 | 3 | 385,086 |
| Department of Energy[1] | 0 | 0 | 354,884 | 0 | 0 | 354,884 |
| Fish and Wildlife Service[1] | 0 | 0 | 147,133 | 4,183 | 280 | 151,596 |
| Corps of Engineers[1] | 0 | 0 | 1,000 | 5,995 | 0 | 6,995 |
| Miscellaneous Federal ownership[1] | 0 | 0 | 2,076 | 2,987 | 0 | 5,063 |
| Category totals | 5,126,581 | 521 | 2,463,582 | 2,257,704 | 2,975,140 | 12,823,528 |

[1] In-house tabulation.
[2] Olympic National Park acreage from National Park System (U.S. National Park Service, 1982).
[3] Data supplied by Army and Air Force real estate offices.

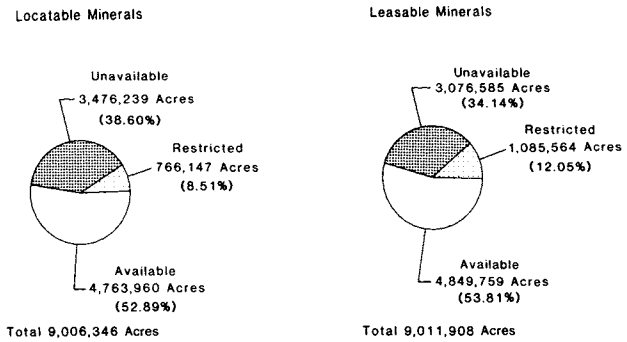


**Figure 4. — Availability status of Forest Service land.**

affecting this land indicate 52.9 percent is available, 8.5 percent is restricted, and 38.6 percent is unavailable. The leasable land under Forest Service management totals 9,011,908 acres, of which 53.8 percent is available for lease, 12.1 percent is restricted, and 34.1 percent is unavailable.

The second largest Federal land manager in the State is the National Park Service. All National Park land is legally unavailable for both location and leasing of minerals (fig. 5).

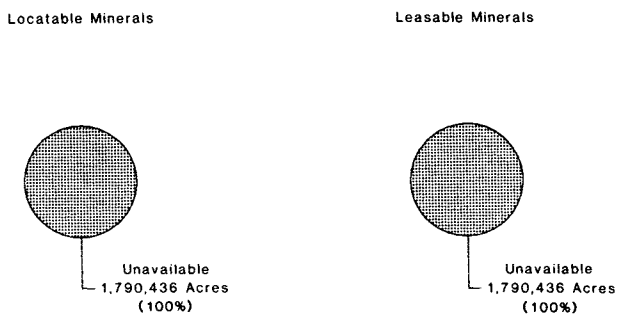


**Figure 5. — Availability status of National Park Service land.**

The third largest manager of Federal land is the Bureau of Reclamation. The land is mostly in scattered parcels totaling 567,215 acres for locatable minerals; almost all, 99.9 percent, of this land is unavailable. The total leasable mineral acreage managed by the Bureau of Reclamation is 572,311 acres; 99.6 percent of the land has lease restrictions. Availability status is summarized in tables 1 and 2 and illustrated in figure 6.

Unlike many Western States, the amount of Bureau of Land Management land is relatively minor in the State of Washington. This land is mostly in small, widely scattered parcels. The legal and managment practices affecting locatable mineral land, totaling 501,777 acres, show 55 percent is available, 0.6 percent is restricted, and 44.4 percent is unavailable. Leasable land totals 545,249 acres, of which 50.7 percent is available for lease, 48.6 percent is restricted, and 0.7 percent is unavailable. The availability status for location and leasing is displayed in figure 7.

Availability status of land for mineral location and leasing managed by other Federal agencies (Military, Department of Energy, Fish and Wildlife Service, Corps of Engineers, and miscellaneous others) is shown in figures 8 through 12 and in tables 1 and 2. Most of the Federal land managed by these agencies is either restricted or unavailable to both mineral location and leasing.

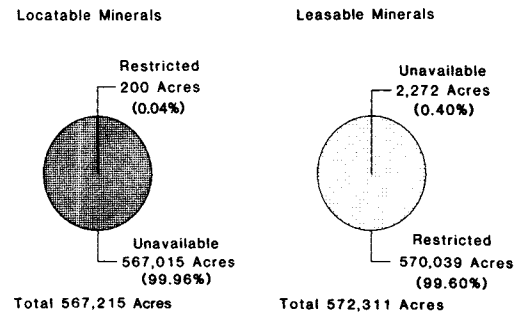


**Figure 6. — Availability status of Bureau of Reclamation land.**

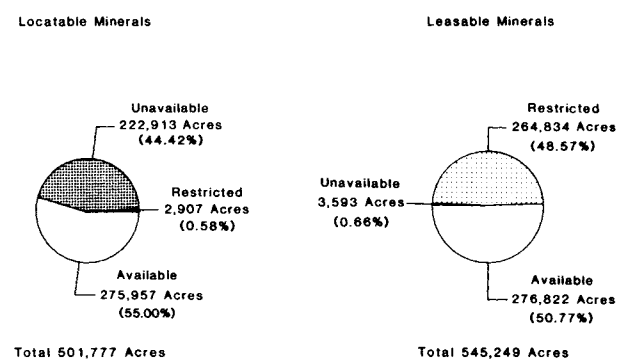


**Figure 7. — Availability status of Bureau of Land Management land.**

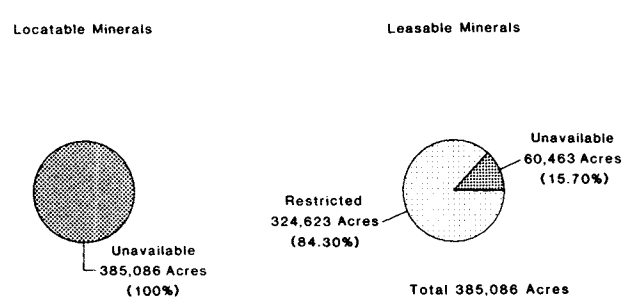


**Figure 8. — Availability status of military land.**

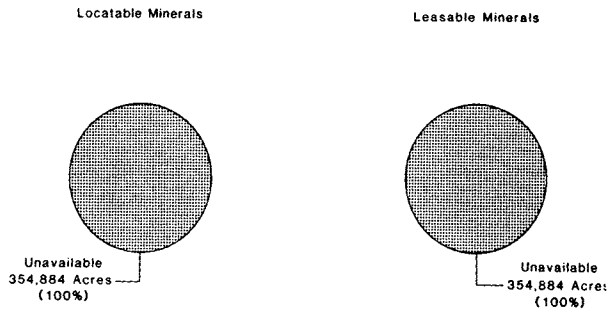


**Figure 9. — Availability status of Department of Energy land.**

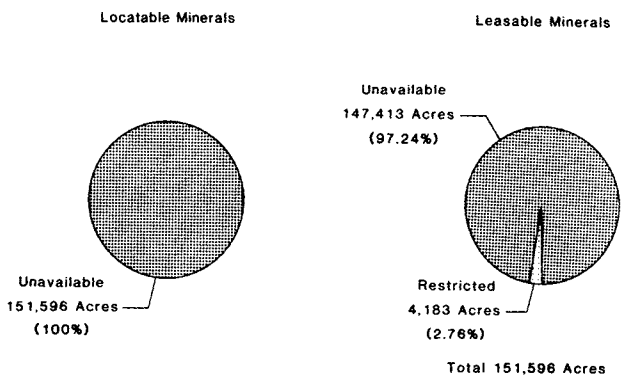


**Figure 10. — Availability status of Fish and Wildlife Service land.**

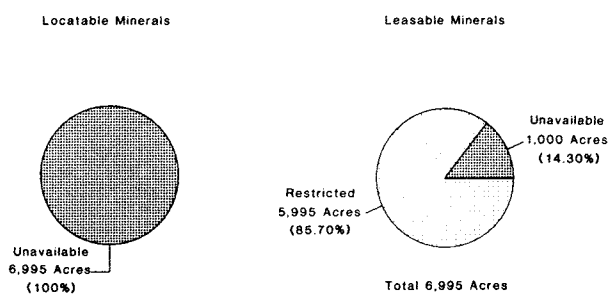


**Figure 11. — Availability status of Corps of Engineers land.**

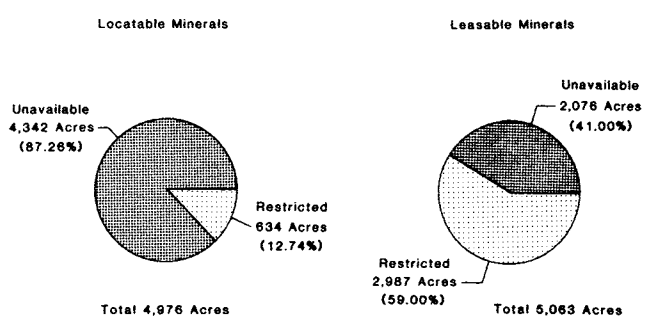


**Figure 12, — Availability status of miscellaneous Federal Agency lands.**

## MINERAL DEPOSITS AND RELATED GEOLOGIC TERRANES

### INTRODUCTION

Maps showing Federal land status with the extent of withdrawals and restrictions have been combined with maps depicting geologic terranes related to the distribution of metallic minerals and coal. These maps show the degree to which mineral areas related to known mineral deposits have been withdrawn or restricted on Federal lands (pls. 3 and 4).

The mineral study is concerned primarily with the metallic minerals. Although of no less importance, the nonmetallic mineral resources, with the exception of coal, have not been included because of geologic distribution and the economic complexities concerning access to markets for these deposits. Likewise, certain metals associated with extensive sediments, such as aluminum in clay deposits, are not included because this type of metal-bearing deposit has never been economic in the State and is not considered to be viable in the foreseeable future. Oil and gas resources are largely unknown and were not included.

Plate 3, showing significant known metallic mineral deposits (listed in appendix D) and associated geologic terranes, was generated from the Bureau of Mines (BM) mineral production and property files, BM Mineral Industry Location System data, and published State geologic maps. The coal map (pl. 4) delineating known or favorable areas is from previously published sources (Beikman and others, 1961; Livingston, 1974) and recent unpublished field studies by the State.

The State of Washington is shown as seven distinct physiographic provinces on figure 13. These provinces are the Willapa Hills, Olympic Mountains, Puget Lowlands, Cascade Mountains, Columbia Basin, Blue Mountains, and Okanogan Highlands.

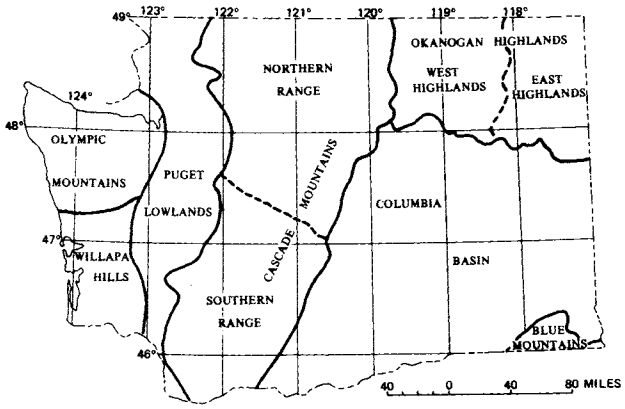


**Figure 13. — Physiographic provinces of Washington. (Adapted from U.S. Geological Survey and others, 1966).**

The main distinction between these provinces is one of topography, which is primarily a reflection of its geologic history and rock type. These in turn dictate the kinds and amounts of mineral resources that occur in each province.

Of the several physiographic provinces in Washington, two – the Cascade Mountains and Okanogan Highlands – contain most of the areas of known metallic mineral concentrations. The Olympic Mountains province has minor, but possibly important, amounts of manganese. The other provinces have few, if any, metallic mineral deposits. Most of the coal resources occur in the Puget Lowlands province, although lesser resources are located in the Cascade Mountains province on the west side of the range. The potential for coal in the remaining physiographic provinces is mostly unfavorable or unknown.

## METALLIC MINERALS

Since 1853, a wide variety of metallic mineral deposits has been discovered in Washington. Zinc has been the principal metal produced. Additional metals recovered in major quantities were gold, lead, copper, silver, and uranium. Lesser amounts of tungsten, mercury, iron, antimony, manganese, molybdenum, chromite, arsenic, nickel, and cobalt have been mined.

Plate 3 does not show all deposits. It does, however, highlight the most significant known deposits of metallic minerals and their associated geologic terranes.

The geologic terranes related to known metallic mineral concentrations and possible future mining opportunities are discussed in the following sections.

### Cascade Mountains Province

The Cascade Mountains province is probably the most important physiographic division in the State in terms of the known significant metal deposits and the possibilities for discovery of additional deposits.

The Cascade Mountains form part of a nearly unbroken mountain chain that extends along the western edge of the North American Continent from south of Mexico to Alaska.

The core of the northern Cascades in Washington consists mostly of crystalline plutonic and metamorphic rocks. To the south, these older rocks are mostly overlain by Tertiary age volcanics, which thicken southward.

The major intrusive granitic rocks (granite to quartz diorite) are more exposed in the northern Cascades. Several previously unmapped stocks have recently been found in the southern Cascades of Washington. One well-mineralized stock was discovered in 1975. No doubt others remain to be discovered.

Several areas in the Cascade Mountains province contain exposures of intrusive ultramafic rock. The ultramafic rocks are of both pre-Tertiary and Tertiary age.

As can be seen on plate 3, most of the significant metal deposits appear to be associated with two distinct geologic terranes – the Tertiary intrusive granitic rocks and the intrusive ultramafic rocks. The composite Tertiary intrusives shown in red on plate 3 are the most obvious areas of metal occurrence. Most of the significant base and precious metal deposits are located within or adjacent to them.

The early prospecting and mining in the Cascade Mountains province were mostly for vein deposits of gold, silver, copper, lead, zinc, and tungsten. In addition to these numerous deposits, later exploration has focused on other types of larger, more significant deposits, such as copper-molybdenum porphyry systems, associated breccia-pipe occurrences, and volcanogenic gold and massive sulfide deposits. Laterites and alpine-type ultramafic iron-chromium-nickel-cobalt deposits also have been explored.

While to date no porphyry-type deposits have been mined, most investigators consider the Cascades to be, metallogenically, a porphyry copper-molybdenum province. Grant (1975) lists 25 areas within the Tertiary intrusive masses in which there is strong or proven evidence of a porphyry system and 7 additional areas with likely possibilities. The majority of these are located in the central and southern portions of the Cascade Mountains province. Most of the exploration efforts in recent years have been in the southern area, possibly because most of the Tertiary intrusive areas of the northern and central portions of the Cascades are no longer available for exploration. The Cascade Mountains province, with more detailed exploration, could prove to be a significant copper porphyry area in the United States.

Metals commonly associated with ultramafic rocks are iron, chromium, nickel, and cobalt. Production of these metals from the ultramafic rocks in Washington, shown in purple on plate 3, has been minimal. Small amounts of chromite were mined from a few of the higher grade pods during the World Wars.

Surrounding the ultramafic rocks is a narrow zone of iron-nickel-cobalt laterite exposed in the Cle Elum-Blewett area east of the large Snoqualmie batholith. The laterite was derived from tropical weathering of the ultramafic rocks. The zone has been intensively investigated, but to date there has been no production. The ultramafic rocks represent a potential domestic source of strategic minerals.

The possibility of gold and massive sulfide volcanogenic-type deposits occurring in Phanerozoic rocks, such as those in the northern part of the province, has only recently been explored, and little is known about these areas for this type of deposit. Near Wenatchee, in the eastern Cascades, large low-grade gold deposits are associ-

ated with the Chiwaukum graben (pl. 3). Of particular interest for this type of deposit is the upper Jurassic Newby volcanic group of rocks that crop out in the vicinity of the Chewack and Methow Rivers. These rocks are shown in brown on plate 3.

### Okanogan Highlands Province

The Okanogan Highlands cover most of northeastern Washington, comprising the area essentially east of the Okanogan River and north of the Columbia Basin.

The Okanogan Highlands are further divided into east and west sections, roughly along the north-south course of the Columbia River. The eastern Highlands expose mostly miogeosynclinal marine sedimentary rocks of Precambrian and lower Paleozoic age, intruded by Cretaceous to Tertiary age granitic plutons. The northern portion is primarily a lead-zinc area.

The most productive lead-zinc deposits are large Mississippi Valley-type deposits in Cambrian carbonate rocks, shown in dark blue on plate 3. Zinc is the predominant metal, with lesser amounts of lead and minor silver. Subordinate production from smaller but higher grade silver-lead-zinc deposits was associated with Precambrian carbonate rocks in the southern part of the eastern Highlands. These units are shown in dark pink on plate 3.

Formations containing the lead-zinc deposits extend from near the southern end of this province into Canada, making this area one of the major lead-zinc provinces of the world.

At the southern edge of the eastern Highlands are numerous uranium deposits; at least four have proven to be significant. The uranium deposits may be divided into east and west zones, which are about 40 miles apart. Two of the significant deposits in the western zone (Spokane Mountain and Midnite mine deposits, nos. 222 and 223) occur at the contact between Mesozoic intrusive rocks (outlined in light pink on plate 3) and Precambrian metamorphic rocks (shown in dark green). Most of the uranium mineralization is concentrated in the metamorphic rocks. The Sherwood deposit (no. 224), about 6 miles to the south, occurs in a Tertiary conglomerate.

In the eastern uranium zone, several uranium-bearing deposits occur in or near a zone of highly altered alaskite within granitic rocks bordering the contact with Precambrian metamorphic rocks.

Additional uranium-bearing deposits may be discovered in the future, given the expanse of favorable intrusive and metamorphic rocks along the southern edge of the eastern Highlands.

The western Highlands, by contrast, have a predominantly eugeosynclinal rock assemblage of upper Paleozoic to Mesozoic age with younger Tertiary sedimentary and volcanic rocks. In the western Highlands, which were also extensively intruded by Cretaceous to Tertiary granitic plutons, the most pervasive areas of mineral concentrations appear to be in extensive areas along the borders of roof pendants, where both vein and contact metamorphic type deposits of gold, silver, copper, tungsten, and iron occur. The pendant area extends north from Omak to the Canadian border, along both sides of the Okanogan River. The roof pendant border areas are shown on plate 3 as light green (pre-Tertiary metamorphic and(or) sedimentary rocks) bordering light pink (surrounding plutonic rocks).

Two very large, low-grade porphyry-type deposits have been found to date, associated with pre-Tertiary age intrusive complexes. The Kelsey deposit (no. 122), occurring in a feldspathized greenstone, is located near Chopaka Mountain on the northwest edge of the pendant area. The Mount Tolman property (no. 171), located near Keller, southeast of the Republic graben, occurs in an altered granodiorite of the Colville batholith. Although several altered and mineralized systems have been identified in the region, the State Geologic Map only shows very large expanses of pre-Tertiary intrusive rocks; therefore, outlining this unit would not adequately discriminate to justify showing it in conjunction with the Mount Tolman deposit.

To the east of the pendant area is the Republic graben, a major structural feature of northeastern Washington that contains significant gold and silver deposits. The deposits (nos. 138-168) occur in contact zones associated with late Paleozoic to Mesozoic age metamorphic rocks and Tertiary age intrusives and, in the southern part of the graben, within the assemblage of Tertiary volcanic rocks (pl. 3).

### Olympic Mountains Province

The Olympic Mountains province is located in northwest Washington, just south of the Juan De Fuca Strait, and comprises an area of about 4,000 square miles (fig. 13).

The rocks exposed in this province are Tertiary age eugeosynclinal sedimentary and volcanic rocks. The core of the Olympic Mountains is composed of distorted sedimentary rocks surrounded on the north, east, and south by a discontinuous horseshoe-shaped band of Eocene to Miocene age submarine volcanic and sedimentary beds dipping steeply outward.

Unlike the physiographic provinces to the east, the Olympic Mountains contain few known metal deposits. The only ones that may be significant are scattered, relatively small manganese-bearing lenses, most of which occur in the broad, semicircular band of Tertiary volcanic and sedimentary rocks surrounding the core. These rocks are shown in yellow on plate 3. The tabular manganese-

bearing lenses range in overall size from a few inches up to 500 feet in length and up to 30 feet thick, in limestone along contacts with submarine basalt. The genesis of these manganese deposits is subject to debate, but is believed to be associated with submarine volcanism. Total production of manganese from these deposits is small, reportedly about 47,000 tons, most of which came from the Crescent mine (Magill, 1960). Although these deposits are not a current source for our national manganese requirements, they do represent a limited potential supply source for minerals critical to domestic industry. The industry is currently dependent upon imports.

## COAL

Coal deposits were discovered and mined in Washington State during the late 1800's and early 1900's. All but a very few of the operations during this period were underground mines. However, the only important mine since 1960 has been a moderately large open pit operation near Centralia. The coal is used to power a large electric generating plant near the mine site; annual production has been about 4.5 million tons in recent years.

There are an estimated 6 billion tons of recoverable coal in Washington (Livingston, 1974). This is a conservative estimate, because the extent of coal-bearing rocks is much greater and most are concealed under a thick mantle of younger rocks. Many of the coal fields are sporadically distributed along the western foothills of the Cascade Mountains, extending south from Canada to the Oregon border (pl. 4). Similar deposits exist east of the Cascades near Cle Elum, in Kittitas County, and in numerous isolated occurrences throughout the State.

Most of the coal is of Tertiary age, primarily middle Eocene and of bituminous rank, although lesser amounts of anthracite and lignite also occur.

With the exception of the field near Centralia, which is being mined by open pit, the coal generally is in relatively deep, small deposits of variable quality and would have to be mined by more expensive underground methods.

## SUMMARY

Data used in preparing this report indicate that approximately 5,040,000 acres, or 39.5 percent of the Federal land in Washington State, are available for mineral exploration and development for locatable minerals, and 5,127,000 acres or 40 percent are available for leasable minerals. The combined metallic mineral occurrence and land status map indicates that the trends of known significant metallic mineral deposits and their related geologic terranes often do not coincide with land available to mineral entry.

It is estimated that these related geologic terranes cover approximately 2.2 million acres in the State, of which 1.4 million acres (61.9 percent) are Federal land. Nearly 677,000 acres or 49.8 percent are available for locatable mineral exploration and development, 47,000 acres or 3.5 percent are restricted, and 635,000 acres or 46.7 percent are unavailable.

One of the principal leasable commodities in the State of Washington is coal. Most of the coal-bearing formations underlie non-Federal land, especially those presumed to be the better deposits in the Puget Lowlands. An estimated 435,000 acres, or 22.9 percent of the area of coal-bearing formations shown on plate 4, underlie areas of Federal land. Most of this, estimated at 266,000 acres or 61.2 percent, is in land available for lease, 46,000 acres or 10.6 percent are restricted, and 123,000 acres or 28.2 percent are unavailable.

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## APPENDIX A. — FEDERAL LAND STATUS CATEGORIZED BY LEGAL AND MANAGEMENT PRACTICE
**(Lo-locatable, Le-leasable)**

| Agency | Available | Unavailable | | Restricted | |
|---|---|---|---|---|---|
| | | legal | mgmt | legal | mgmt |
| Agricultural Research Service | | | | | |
| Administration Site | | Lo | | | Le |
| Quarantine Station | | Lo | | | Le |
| Department of Army | | | | | |
| Civil Projects - Corps of Engineers (leasables vary with Withdrawal, Public Land Order, Executive Order) | | Lo/Le | | | Le |
| Military Reserves (leasables may vary with Withdrawal, Public Land Order, Executive Order) | | Lo | Le | | |
| Bureau of Land Management | | | | | |
| Recreation and Public Purposes Withdrawal (R&PP) | | Lo | | | Le |
| Classification and Multiple Use Withdrawal (C&MU) | Le | Lo | | | |
| Research Areas Withdrawal | | Lo | | | Le |
| Special Land Use Permit Withdrawal (SLUP) (normally available but varies with each case) | Lo/Le | | | | |
| Free Use Permit Withdrawal (FUP) | Lo/Le | | | | |
| Communication Site Withdrawals | | Lo/Le | | | |
| Desert Land Entry Application (DLE) | | Lo/Le | | | |
| State Selection (SS) | | Lo/Le | | | |
| State in Lieu Selection (IL) | | Lo/Le | | | |
| Indian Fee Application (no mineral effect) | | | | | |
| Townsites | | Lo/Le | | | |
| Mineral Material Sites Withdrawals | Lo/Le | | | | |
| Minerals Withdrawals | | Lo/Le | | | |

APPENDIX A. — FEDERAL LAND STATUS CATEGORIZED BY LEGAL AND MANAGEMENT PRACTICE - Continued
(Lo-locatable, Le-leasable)

| Agency | Available | Unavailable | | Restricted | |
|---|---|---|---|---|---|
| | | legal | mgmt | legal | mgmt |
| Acquired | Le | Lo/Le | | | |
| (locatables may be made available by legislation; leasables may be made available by order) | | | | | |
| Exchange Application | Le | Lo | | | |
| Reconveyed All Minerals | Lo/Le | | | | |
| Reconveyed No Minerals (surface) | Millsite | | | | |
| All Minerals Reserved by U.S. | | | | | Lo/Le |
| Oil and Gas Reserved by U.S. | | | | | Le |
| Coal Reserved by U.S. | | | | | Le |
| Known Geothermal Resource Area (KGRA) | Le | | | | |
| Wilderness | | Lo/Le | | | |
| Wilderness Under Review | | | Lo/Le | | |
| Research Natural Areas (RNA) | | Lo/Le | Lo/Le | | |
| (may vary with Withdrawal) | | | | | |
| Area of Critical Environmental Concern (ACEC) | | Lo/Le | Lo/Le | | |
| (may vary if withdrawn) | | | | | |
| Botanical Areas | | Lo/Le | Lo/Le | | |
| (may vary if withdrawn) | | | | | |
| Small Tracts (ST) | | Lo | Le | | |
| (may vary with Act) | | | | | |
| Administration Sites | | Lo | Le | | |
| Recreation Site | | Lo | Le | | |
| Public Water Reserve (nonmetal only) | Le | | | | Lo |
| Classification for Coal Reserve | | | | Le | |
| Bureau of Reclamation | | | | | |
| Reclamation Projects | | Lo | Le | | |
| (usually unavailable for location but may vary) | | | | | |
| Coast Guard | | Lo | Le | | |
| Federal Aviation Administration | | | | | |
| Air Navigation Site | | Lo/Le | Le | | |
| (leasing may vary) | | | | | |
| Federal Energy Regulatory Commission | | | | | |
| Powersite | | Lo | | | Le |
| Fish and Wildlife Service | | | | | |
| National Wildlife Refuges | | Lo/Le | Le | | |
| (leasable, may vary with Withdrawal) | | | | | |
| Forest Service | | | | | |
| Campgrounds | | Lo | Le | | |
| Recreation Areas | | Lo | Le | | |
| Road Zones | | Lo | Le | | |
| Admin. Sites | | Lo | Le | | |
| Research Area | | Lo | Le | | |
| Watershed | | Lo | Le | | |
| Wilderness | | | Lo/Le | | |
| National Recreation Areas | | Lo/Le | Lo/Le | | |
| (may vary if withdrawn) | | | | | |
| Wild and Scenic River | | | Lo/Le | | |
| National Forest | Lo/Le | | | | |
| Ranger Station | | Lo | Le | | |
| Classification for Coal Reserve | | | | Le | |
| KGRA | Lo/Le | | | | |
| Designated Special Interest Areas | | | Lo/Le | | |

## APPENDIX A. — FEDERAL LAND STATUS CATEGORIZED BY LEGAL AND MANAGEMENT PRACTICE - Continued
(Lo-locatable, Le-leasable)

| Agency | Available | Unavailable | | Restricted | |
|---|---|---|---|---|---|
| | | legal | mgmt | legal | mgmt |
| Designated Wildlife Management Area | | | Lo/Le | | |
| Research Natural Areas Proposed | | | Lo/Le | | |
| Geological Survey | | | | | |
| Power Site Reserve (PSR) | | | Lo | | Le |
| Water Power Designation (WPD) | | | Lo | | Le |
| Indian Power Site Reserve (IPSR) | | | Lo | | Le |
| Reservoir Site Reserve (nonmetal) | | Lo | Le | | |
| National Park Service | | | | | |
| Administration Sites | | Lo | Le | | |
| National Monument | | Lo/Le | | | |
| National Park | | Lo/Le | | | |
| AID Legislation | | Lo | Le | | |
| Navy | | | | | |
| Naval Reservation | | Lo | Le | | |

## APPENDIX B. — INDIAN LAND AVAILABILITY STATUS

Indian held-in-trust land is a significant source of leasable mineral estate in the State of Washington; the status of this land is considered unique. The legal ownership is vested with the Federal Government, but in practice it is not considered to be part of the Federal land, nor is it considered to be private land (James, 1975). The Bureau of Indian Affairs (BIA) is the Federal Government agency responsible for Indian land. For the most part, exploration programs for all minerals require mineral leases negotiated with the Tribal Council. Once a lease is negotiated with the Tribal Council, it must be reviewed by, and receive concurrence from, the BIA.

Indian land for which the BIA recognizes responsibility totals 2,498,979 acres in the State of Washington. The BM acquired this total directly from the BIA office in Portland because the MTP's do not give acreage of Indian lands. The MTP's showed the sections that contain Indian land but not the amount. Because of its unique status, the BIA has been responsible for surveying this land rather than the BLM.

All of the Indian land has been legally withdrawn for several years from claim staking under the General Mining Law. Some valid claim rights or patented claims may exist from earlier years.

## APPENDIX C. — HIGHLIGHTS OF FEDERAL MINERAL LAWS[1]

1807 Leasing Act -- Lead mines on public land leased to private enterprises by the Government. No provision for administration.

1820 Mines in southwestern Wisconsin and northwestern Illinois developed in 1820's under a permit system under the Ordnance Bureau of War Department. Worked moderately well until 1830's when mineral properties were illegally sold as agricultural lands.

1846 On July 11, 1846, Congress authorized sale of mines in the upper Mississippi Valley and in Arkansas at public auction at $2.50/acre.

1850 Lands containing iron ore "merely" deemed to be not mineral lands. Sold as agriculture lands (Minnesota mineral lands passed into private ownership in late 1880's and early 1890's under fraudulent land law enteries).

[1]Based on unpublished BLM data.

1864 Coal lands subject to sale to highest bidder, minimum of $20/acre, maximum of 160 acres.

1866 Mining Act declared all mineral lands of the Public Domain free and open to exploration and occupation. Patents could be obtained to lodes and veins for payment of $5/acre.

1870 Placer Mining Act. Placers could be patented at a rate of $2.50/acre.

1872 Mining Law of 1872. Mineral lands identified as a distinct class of public lands subject to exploration, occupation, and purchase. To obtain patent it is necessary to (1) have claim surveyed, (2) make application and pay for lands at the rate of $2.50 an acre for placer claims and $5.00 an acre for lode claims, (3) have a valid mineral discovery, and (4) invest a minimum of $500 in improvements on claim.

1873 Authorized location and sale of lands valuable for coal deposits. An association of not less than 4 persons could purchase up to 640 acres of land if not less than $5,000 was expended in work and improvements. Minimum price of $10/acre if more than 15 miles from railroad. Within 15 miles, $20/acre minimum.

1892 Public lands valuable for building stone included under General Mining Laws.

1897 Petroleum and other mineral oils included under the Placer Mining Law.

1901 Location and sale of saline lands authorized under the Mining Laws.

1914 Provided for leasing of lands chiefly valuable for coal in Alaska.

1916 Stock-Raising Homestead Act. All minerals reserved to U.S. and open to location and patent under the mining laws.

1917 Potash deposits subject to disposition under prospecting permits and leases.

1920 Act of February 25, 1920, established the Mineral Leasing System for private extraction of oil, gas, coal, phosphate, sodium, native asphalt, solid and semi-solid bitumen and bituminous rocks.

1927 Potassium included in Mineral Leasing Act on February 7.

1946 Reorganization Plan No. 3 of 1946 provided for the Secretary of the Interior to lease hardrock minerals on acquired lands.

1947 Materials Act authorized disposition by the Federal Government of vegetative and mineral materials not otherwise expressly authorized or prohibited by Federal Law.

Acquired Lands Leasing Act of 1947. Provides for leasing of oil, gas, coal, etc., on acquired lands.

1953 August 7, 1953, the Outer Continental Shelf Lands Act, authorized the Secretary of the Interior to issue on a competitive basis leases for oil and gas, sulphur, and other minerals in submerged lands of the OCS.

Act of August 12, 1953, Public Law 250, provided relief for the locators of mining claims between July 31, 1939, and January 1, 1953, on lands included in permits or leases issued under the Mineral Leasing Acts.

1954 Act of August 13, 1954, Public Law 585, Multiple Mineral Development Act. Amended the mining laws and mineral leasing laws to permit multiple development of all minerals, locatable and leasable, on the same tract of lands.

1955 Act of July 23, 1955, Public Law 167, Multiple Surface Use Act. Authorized the Government to manage and dispose of the surface vegetative resources and other resources on unpatented mining claims. Excluded from location under the mining laws common varieties of mineral materials such as sand, stone, gravel, pumice, pumicite, cinders, etc.

Act of August 11, 1955, Public Law 357. Provided for the location of mining claims for uranium and other fissionable source materials on public lands classified or known to be valuable for deposits of lignite coal (primarily Montana, North Dakota, and South Dakota).

Act of August 11, 1955, Public Law 359. Provided for the location of mining claims on lands withdrawn or reserved for powersite development. The only mining law that requires the filing of location notices with the U.S. Land Office.

1962 Petrified wood included as a "common variety" classification by the Act of September 28, 1962.

1970 Geothermal Steam Act of December 24, 1970. Provides for the leasing of geothermal resources on Federal lands.

## APPENDIX D. — METALLIC MINERAL DEPOSITS LOCATED ON PLATE 3

| Number | Name | Number | Name | Number | Name |
|---|---|---|---|---|---|
| 1. | Beaver Creek (State lease) | 25. | Great Excelsior (Lincoln) | 48. | Golden Cord |
| 2. | Victor (Bear Creek) | 26. | Fuller (Pateros, Lone Pine) | 49. | Justice |
| 3. | Littleton | 27. | Bumper | 50. | Ben Lomond (Rainy) |
| 4. | Crescent | 28. | Galbraith | 51. | O and B |
| 5. | Bright Angel | 29. | Meadow-Leader | 52. | New York-Seattle |
| 6. | Thompson (Sutherland) | 30. | Danny | 53. | Kromona (Florence Ray) |
| 7. | Hurricane | 31. | Second Basin | 54. | Ethel |
| 8. | Esther-Irene | 32. | Twin Sisters | 55. | Copper Bell |
| 9. | Lizard | 33. | Hamilton | 56. | Sunset |
| 10. | Stevens Creek | 34. | Mount Vernon | 57. | Merchant |
| 11. | Burnt Peak | 35. | Sam Strom | 58. | Lake Serene |
| 12. | Egge (Quinault) | 36. | Helena | 59. | Buckeye |
| 13. | Black and White | 37. | Wayside | 60. | Anderson (Baring) |
| 14. | Apex, Blackrock | 38. | Arlington | 61. | Apex |
| 15. | Triple Trip | 39. | Bonanza Queen | 62. | Damon and Pythias |
| 16. | Black Hump | 40. | Forty Five (Lydia Pinkham) | 63. | Mono |
| 17. | Elma (Dennis) | 41. | Sunrise Breccia | 64. | Cleopatra (Aces Up) |
| 18. | Cypress Island | 42. | Mountain Cedar | 65. | Rainy (Western States) |
| 19. | Stephens | 43. | Mackinaw | 66. | Cardinal Reward |
| 20. | Sumas Mountain | 44. | Iowa (Mint) | 67. | Mineral Creek |
| 21. | Boulder Creek | 45. | Sultan King | 68. | Copper Queen |
| 22. | Boundary Red Mountain | 46. | Foggy | 69. | Huckleberry |
| 23. | Lone Jack (Post and Lambert) | 47. | Mystery (Monte Cristo) | 70. | Cle Elum River, North |
| 24. | Silver Tip | | | 71. | Cle Elum River, South |
| | | | | 72. | Denney (Guye, Mount Logan) |

## APPENDIX D. — METALLIC MINERAL DEPOSITS LOCATED ON PLATE 3 - Continued

| Number | Name |
|---|---|
| 73. | Mount Hawkins |
| 74. | Iron Peak |
| 75. | Stafford Creek |
| 76. | Nigger Creek |
| 77. | Blewett |
| 78. | Culver |
| 79. | Phoenix |
| 80. | Pole Pick |
| 81. | Blackjack (Culver Group, Blewett) |
| 82. | Gold Bond |
| 83. | Peshastin |
| 84. | Tip Top |
| 85. | Cannon Mine |
| 86. | Golden King |
| 87. | H-O-M-E |
| 88. | Surprise |
| 89. | Starbo |
| 90. | Chinook |
| 91. | Eagle Peak |
| 92. | Copper Mining Co. |
| 93. | Fisher lease |
| 94. | N.P. |
| 95. | Section One (Spencer) |
| 96. | Roy (Fisher) |
| 97. | Barnum-McDonnell |
| 98. | Polar Star |
| 99. | Sweden |
| 100. | Camp Creek |
| 101. | Wind River |
| 102. | Silver Star |
| 103. | Miners Queen |
| 104. | Maybee |
| 105. | Skamania (Last Chance) |
| 106. | Copper Canyon |
| 107. | Newlight (Mammoth Group) |
| 108. | Azurite |
| 109. | Johnsburg |
| 110. | Black Warrior |
| 111. | Glacier Peak |
| 112. | Big Chief (Trinity, Royal Development) |
| 113. | Holden Group |
| 114. | Blue Jay |
| 115. | Rex Group |
| 116. | Alder |
| 117. | Red Shirt |
| 118. | Holden-Campbell (Grubstake) |
| 119. | Sullivan (Pateros) |
| 120. | Chopaka Mountain |
| 121. | Kaaba |
| 122. | Kelsey |
| 123. | Ruby |
| 124. | Triune (Crescent) |
| 125. | Pinnacle |
| 126. | Black Bear (Alice) |
| 127. | Starr (Silvertip) |
| 128. | Alameter-Gora |
| 129. | Mineral Hill (Seven Devils, Washington Consolidated) |
| 130. | Arlington (Fourth of July) |
| 131. | Funkhouser (Johnson Creek) |
| 132. | Poland China (Molson) |
| 133. | Butcher Boy |
| 134. | Eagle |
| 135. | Magnetic |
| 136. | Bi-Metallic |
| 137. | Windiate-Auberton |
| 138. | Lone Star (Washington) |
| 139. | Gold Dike |
| 140. | Morning Star |
| 141. | Bodie (Northern Gold) |
| 142. | Kelly Camp |
| 143. | Lamefoot (Valley) |
| 144. | Copper Key |
| 145. | Tom Thumb |
| 146. | South Penn |
| 147. | Aurum Group (Apex, Pearl) |
| 148. | Ben Hur |
| 149. | Surprise |
| 150. | Lone Pine |
| 151. | San Poil |
| 152. | Trade Dollar |
| 153. | Blacktail |
| 154. | El Caliph |
| 155. | Insurgent |
| 156. | Knob Hill |
| 157. | Last Chance |
| 158. | Morning Glory |
| 159. | Mountain Lion |
| 160. | Seattle |
| 161. | Quilp (Imperator, Eureka) |
| 162. | Flag Hill |
| 163. | Blaine Republic |
| 164. | Republic |
| 165. | California Group |
| 166. | California |
| 167. | Golden Harvest |
| 168. | Mount Jumbo (Stepstone) |
| 169. | Hidden Treasure |
| 170. | Apache |
| 171. | Mount Tolman |
| 172. | Belcher |
| 173. | Congress |
| 174. | Talisman (Snowbank) |
| 175. | First Thought |
| 176. | Providence |
| 177. | Calhoun (A. Anderson) |
| 178. | Red Top |
| 179. | Admiral Consolidated |
| 180. | Lead Hill |
| 181. | Metaline |
| 182. | Cliff |
| 183. | Electric Point |
| 184. | Gladstone Mountain |
| 185. | Lead Trust |
| 186. | Farmer (Deep Lake) |
| 187. | Advance |
| 188. | Black Rock |
| 189. | Deep Creek (Gorlan) |
| 190. | Great Western |
| 191. | Last Chance |
| 192. | Sterling |
| 193. | Pend Oreille |
| 194. | Bella May (Blue Bucket) |
| 195. | Josephine |
| 196. | Grand View |
| 197. | Young America |
| 198. | Napoleon Group |
| 199. | Silver Trail |
| 200. | Van Stone |
| 201. | Copper King |
| 202. | Blue Ridge (Sierra Zinc) |
| 203. | Bonanza |
| 204. | Gold Reef (Benvenue) |
| 205. | Northwest |
| 206. | Longshot (Newland, Pioneer) |
| 207. | Silver Queen (Ark) |

## APPENDIX D. — METALLIC MINERAL DEPOSITS LOCATED ON PLATE 3 - Continued

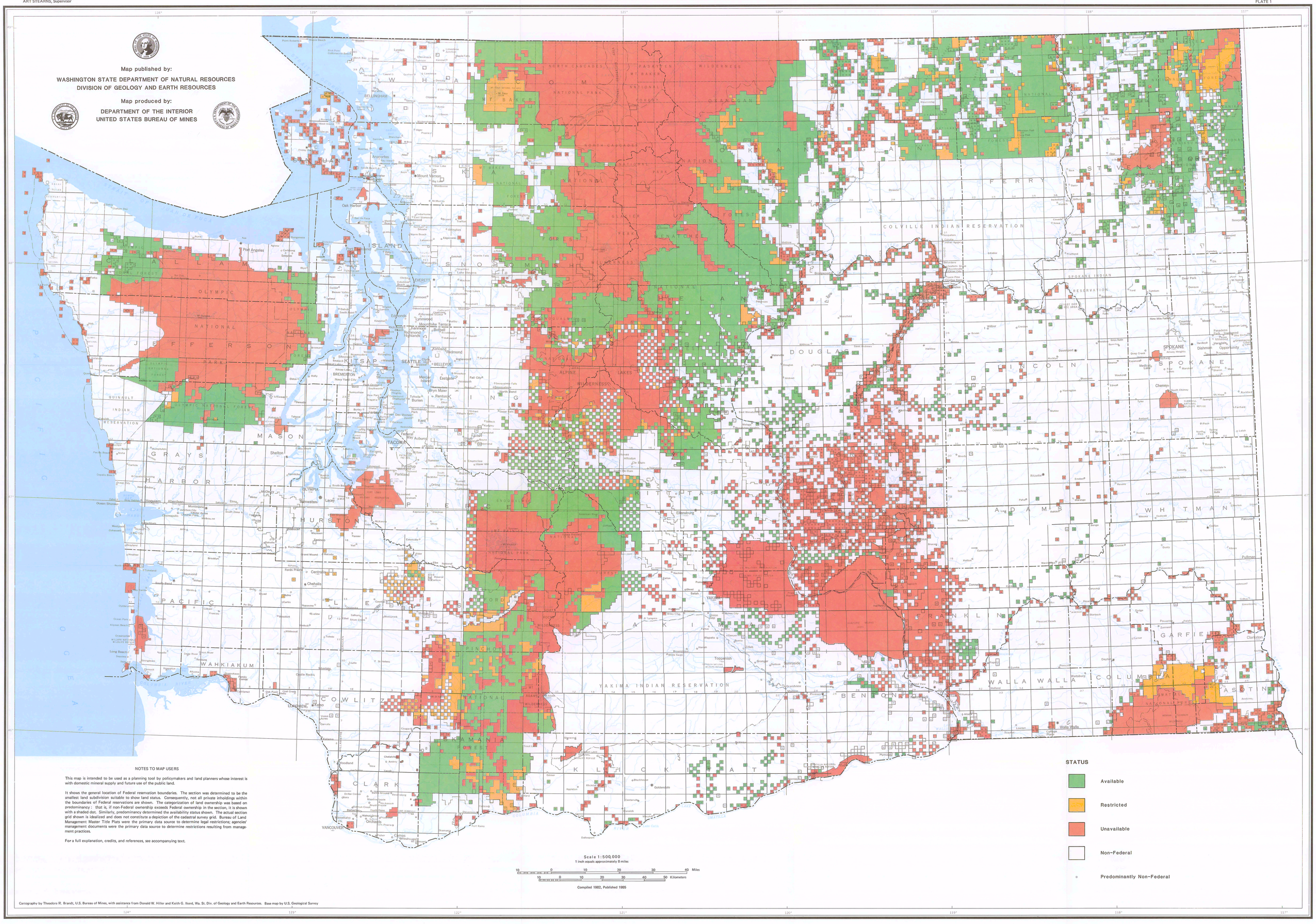
| Number | Name | Number | Name | Number | Name |
|---|---|---|---|---|---|
| 208. | Old Dominion | 218. | Blue Grouse (Tungsten Products) | 225. | Dahl |
| 209. | Daisy-Tempest | 219. | Deer Trail | 226. | Stapleton |
| 210. | ChinTo | 220. | Queen | 227. | Graham |
| 211. | United Copper | 221. | Germania/Germania Consolidated | 228. | Miner |
| 212. | Eagle | 222. | Spokane Mountain | 229. | Daybreak |
| 213. | Washington Metals | 223. | Midnite | 230. | Smith |
| 214. | Columbia | 224. | Sherwood (Northwest, Peters lease) | 231. | Section 21 |
| 215. | Deer Trail Monitor | | | 232. | Section 32 |
| 216. | Cleveland | | | 233. | Dawn |
| 217. | Loon Lake | | | 234. | Anaconda Uranium |
| | | | | 235. | Tungsten Uranium |

STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES
BRIAN J. BOYLE, Commissioner of Public Lands
ART STEARNS, Supervisor

# AVAILABILITY STATUS OF FEDERAL LAND IN WASHINGTON FOR EXPLORATION AND DEVELOPMENT – LOCATABLE MINERALS

BY
D'ARCY P. BANISTER, DONALD J. BARNES, and WARREN D. LONGWILL

DIVISION OF GEOLOGY AND EARTH RESOURCES
RAYMOND LASMANIS, State Geologist
GEOLOGIC MAP GM-30
PLATE 1




NOTES TO MAP USERS

This map is intended to be used as a planning tool by policymakers and land planners whose interest is with domestic mineral supply and future use of the public land.

It shows the general location of Federal reservation boundaries. The section was determined to be the smallest land subdivision suitable to show land status. Consequently, not all private inholdings within the boundaries of Federal reservations are shown. The categorization of land ownership was based on predominancy: that is, if non-Federal ownership exceeds Federal ownership in the section, it is shown with a shaded dot. Similarly, predominancy determined the availability status shown. The actual section grid shown is idealized and does not constitute a depiction of the cadastral survey grid. Bureau of Land Management Master Title Plats were the primary data source to determine legal restrictions; agencies' management documents were the primary data source to determine restrictions resulting from management practices.

For a full explanation, credits, and references, see accompanying text.

Carrography by Theodore R. Brandt, U.S. Bureau of Mines, with assistance from Donald W. Hiller and Keith G. Ikerd, Wa. St. Div. of Geology and Earth Resources. Base map by U.S. Geological Survey

STATE OF WASHINGTON
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# AVAILABILITY STATUS OF FEDERAL LAND IN WASHINGTON FOR EXPLORATION AND DEVELOPMENT – LEASABLE MINERALS

BY
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DIVISION OF GEOLOGY AND EARTH RESOURCES
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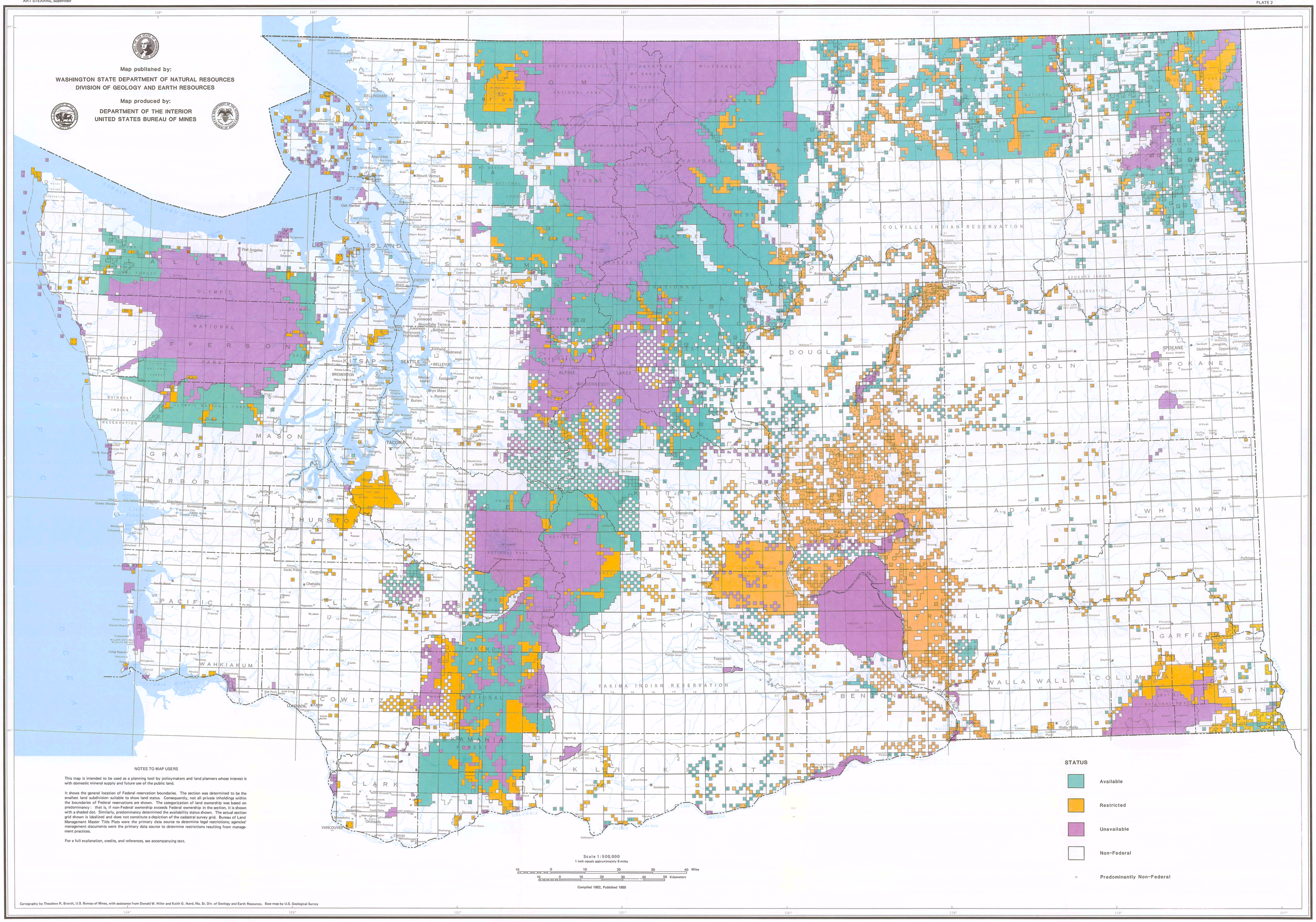
GEOLOGIC MAP GM-30
PLATE 2

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Cartography by Theodore R. Brandt, U.S. Bureau of Mines, with assistance from Donald W. Hiller and Keith G. Ikerd, Wa. St. Div. of Geology and Earth Resources. Base map by U.S. Geological Survey

# SIGNIFICANT METALLIC MINERAL DEPOSITS AND RELATED GEOLOGIC TERRANES OF WASHINGTON COMPARED TO FEDERAL LAND AVAILABILITY STATUS – LOCATABLE MINERALS

BY
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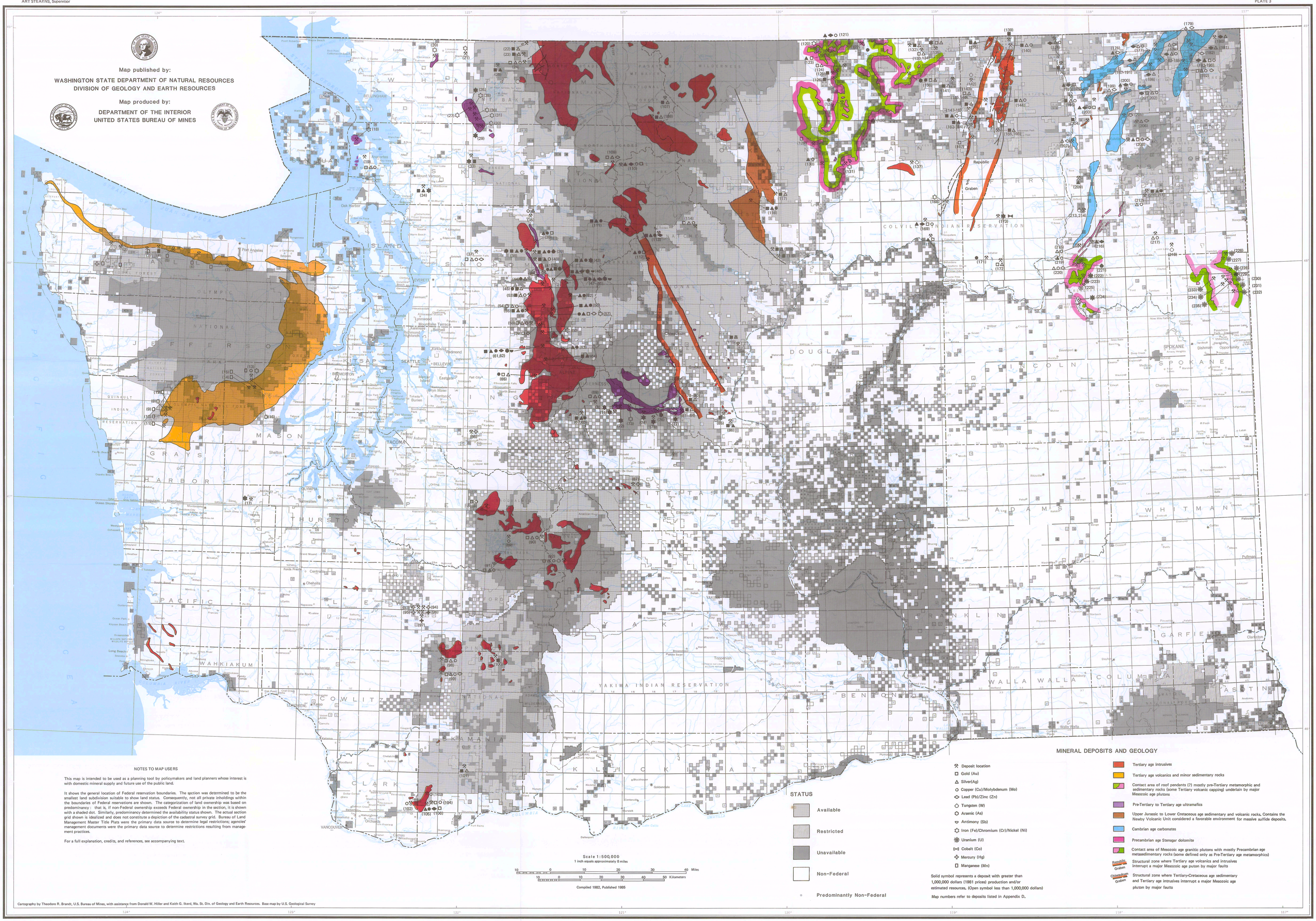
GEOLOGIC MAP GM-30
PLATE 3



STATE OF WASHINGTON
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# COAL RESOURCES OF WASHINGTON COMPARED TO FEDERAL LAND AVAILABILITY STATUS – LEASABLE MINERALS

BY
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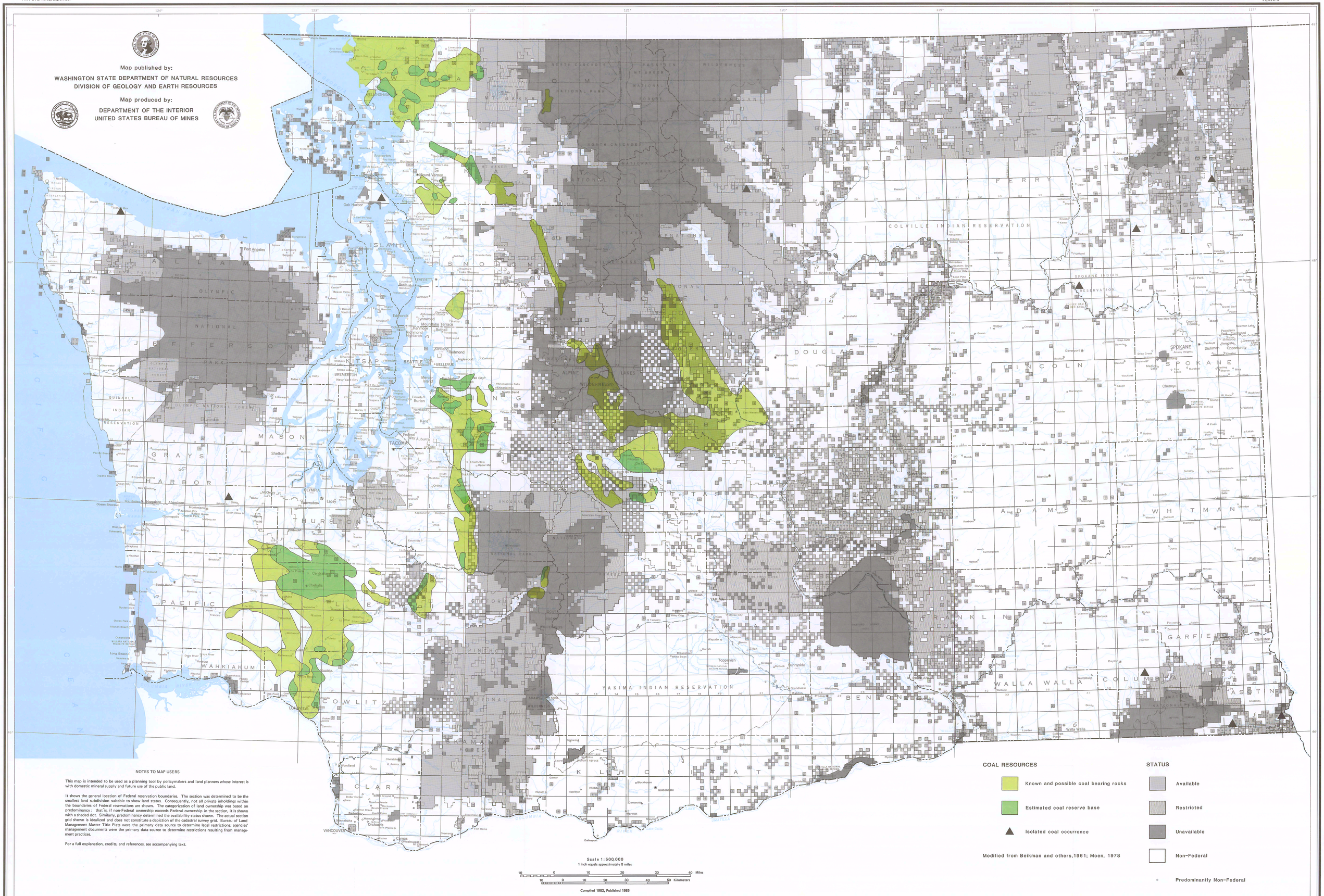
DIVISION OF GEOLOGY AND EARTH RESOURCES
RAYMOND LASMANIS, State Geologist
GEOLOGIC MAP GM-30
PLATE 4

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