GEOLOGIC MAP ATLAS AND SUMMARY OF ECONOMIC MINERAL RESOURCES OF CONVERSE COUNTY, WYOMING

By

DONALD W. LANE IN COLLABORATION WITH FORREST K. ROOT AND GARY B. GLASS

COUNTY RESOURCE SERIES CRS-1

CONVERSE COUNTY

THE GEOLOGICAL SURVEY OF WYOMING

DANIEL N. MILLER, JR., State Geologist

APRIL, 1972


STATE OF WYOMING
1933
GEOLOGICAL SURVEY

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UNIVERSITY OF WYOMING

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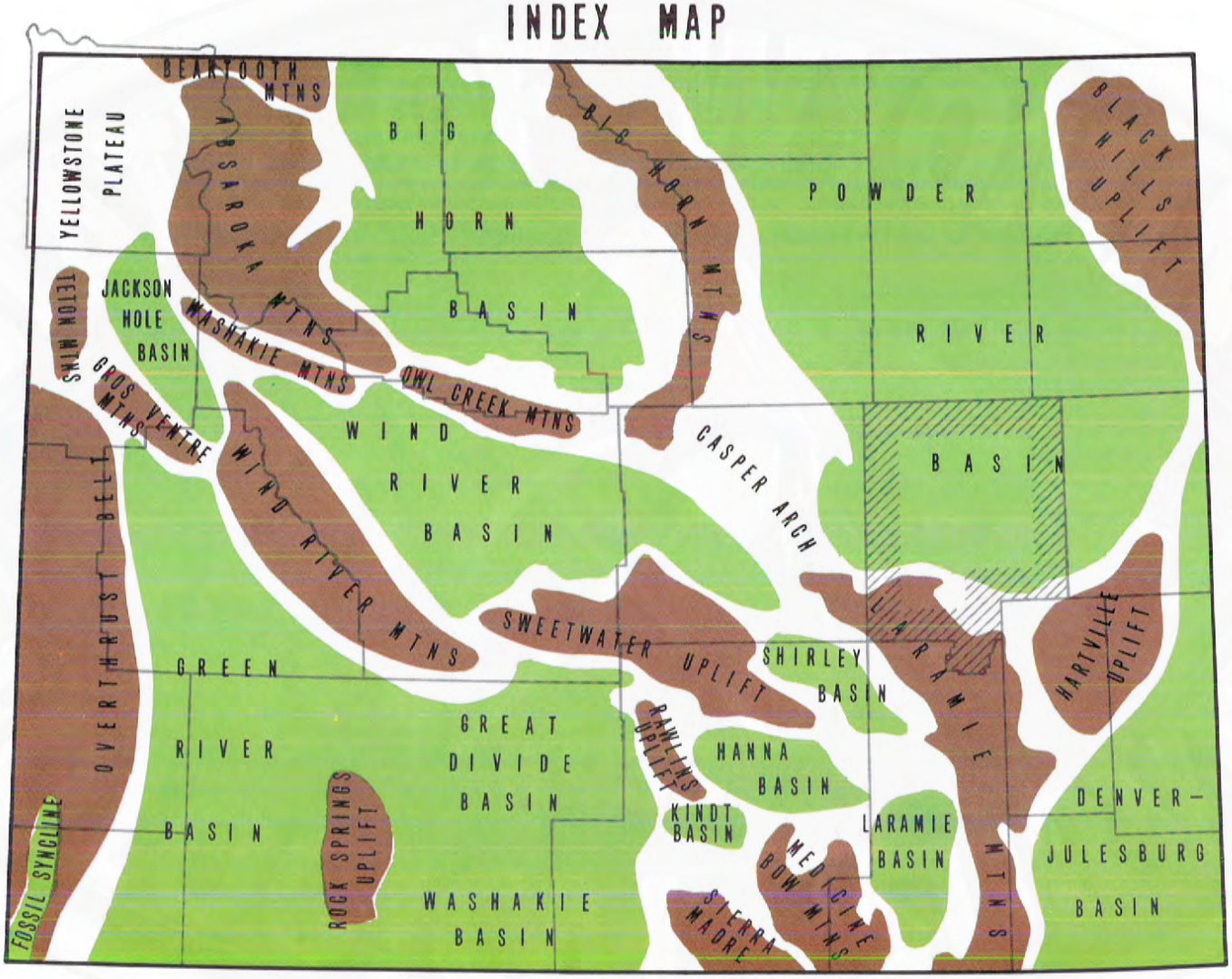
TABLE OF CONTENTS

TEXT FIGURES

TABLES

INDEX MAP



C.R.S. 1 — Converse County

Converse County—mountains to the south and prairieland to the north separated by the Platte River. Total area—4281 square miles, 1970 population—5938, County Seat—Douglas. Principle industries—ranch management, agriculture, electrical power generation, oil and gas production, and coal, lignite and uranium mining.

FOREWORD

The search for valuable minerals began in Converse County during the mid 1800's at a time when there were no maps and little information. Armed with eternal optimism and a knowledge of geology, prospectors have continued the quest for three generations. In the beginning it was gold and silver and other precious metals that attracted attention in the mountains of the Laramie Range; later this changed to a search for copper, tungsten and chromium, iron, and vermiculite. In more recent time men have found their just reward in sedimentary rocks of the Powder River Basin in the form of petroleum, natural gas, coal, and uranium. Who knows what other new and important mineral resources will some day be discovered in Converse County? What role will these resources play in Wyoming's economy and in helping to meet the growing needs of the nation?

Dan Miller
State Geologist

ACKNOWLEDGMENTS

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INTRODUCTION

The land now included in Converse County was originally a part of the Louisiana Purchase of 1803 and Dakota Territory. In 1890, Wyoming became the 44th state to join the Union, and in the years that followed counties were established and named, in this case after A. R. Converse, a native of New York state. The boundaries of the county have been changed a number of times since then, most recently in the southeastern corner where a small portion was added from Albany County.

During the latter part of the 1800's many pioneers and fortune hunters passed this way along the North Platte River valley enroute west over the Oregon and Bozeman trails. The United States Army established Fort Fetterman on the banks of the river seven miles northwest of the present site of Douglas in 1867. Camp Marshall, an earlier site erected in 1863 six miles southeast of Douglas, served somewhat the same purpose for a time. Douglas, the county seat and largest community, grew up on the banks of the North Platte River with the development of the railroad. Today it remains the central hub of traffic for this area.

Weather, topography, and drainage were of major concern to the early pioneers and prospectors of Converse County just as they are today. The early maps of the area were sketches showing the major streams and tributaries with notations as to prominent landmarks. Later, when the first actual surveys were conducted establishing the present township system, the grid provided a base for the mapping of many important features as illustrated in this booklet.

Although ranching and agriculture have played an important role in the development of Converse County, it has been exploration for minerals and petroleum that has sustained the county's economy through lease rental payments and royalties and taxes paid on production. The following maps and illustrations help to show the geological circumstances that prevail and perhaps provide some insight into the possibilities for future development.

PHYSIOGRAPHY & CLIMATE

Figure 1 is a topographic map of Converse County which shows the configuration of the surface of the land. The brown contours indicate the elevation above sea level in increments of 500 feet. The hilly and mountainous terraine in the southwestern part of the county is due in part to the harder and more resistant igneous rocks that make up the core of the Laramie Range. North of the North Platte River the land elevation is between 4500 and 5000 feet and consists of grass-covered prairieland, low sandstone escarpments, and small canyons and valleys shaped by intermittent streams.

Surface streams within Converse County flow into three drainage basins: The streams to the south flow into the North Platte River, the streams in the northern and central parts of the county flow into the Cheyenne River, and the streams in the extreme northwest flow intermittently into the Powder River. With the exception of the North Platte the volume of stream flow is seasonal and directly related to local climatic conditions.

About 80 per cent of Converse County has an elevation between 4500 and 5500 feet with an overall average precipitation of 12 to 14 inches per year. Snow accumulations are generally light and contribute little to the total. Most of the precipitation results from local rain-bearing thunderstorms. The prevailing fair-weather, near-surface winds are from the west and southwest.

The most pronounced winter storms pass through Converse County in a south or south-easterly direction with temperature differentials of 30° to 40° across the leading edge of the cold-front.

Summer temperatures range widely, typically with warm sunny days and cool nights. Record high and low temperatures are about 105° F. and -32° F. respectively. In and around Douglas the mid-day summer temperatures reach 90° F. about 27 days each year. During winter nights temperatures fall to 0° F. about 20 times per year. There are on the average 100 to 120 freeze-free days a year in the central and northern part of the county but at higher elevations, in the Laramie Range, these figures drop to 60—100.

More detailed topographic maps (See Index Map, Figure 2) of Converse County may be purchased from various engineering and sporting goods stores in Casper and Cheyenne, and the following sources:

By mail from

Distribution Section
U. S. Geological Survey
Federal Center, Bldg. 41
Denver, Colorado 80225

Over-the-counter sales only

Wyoming Geological Survey
Room 103, Geology Bldg.
University of Wyoming
Laramie, Wyoming 82070

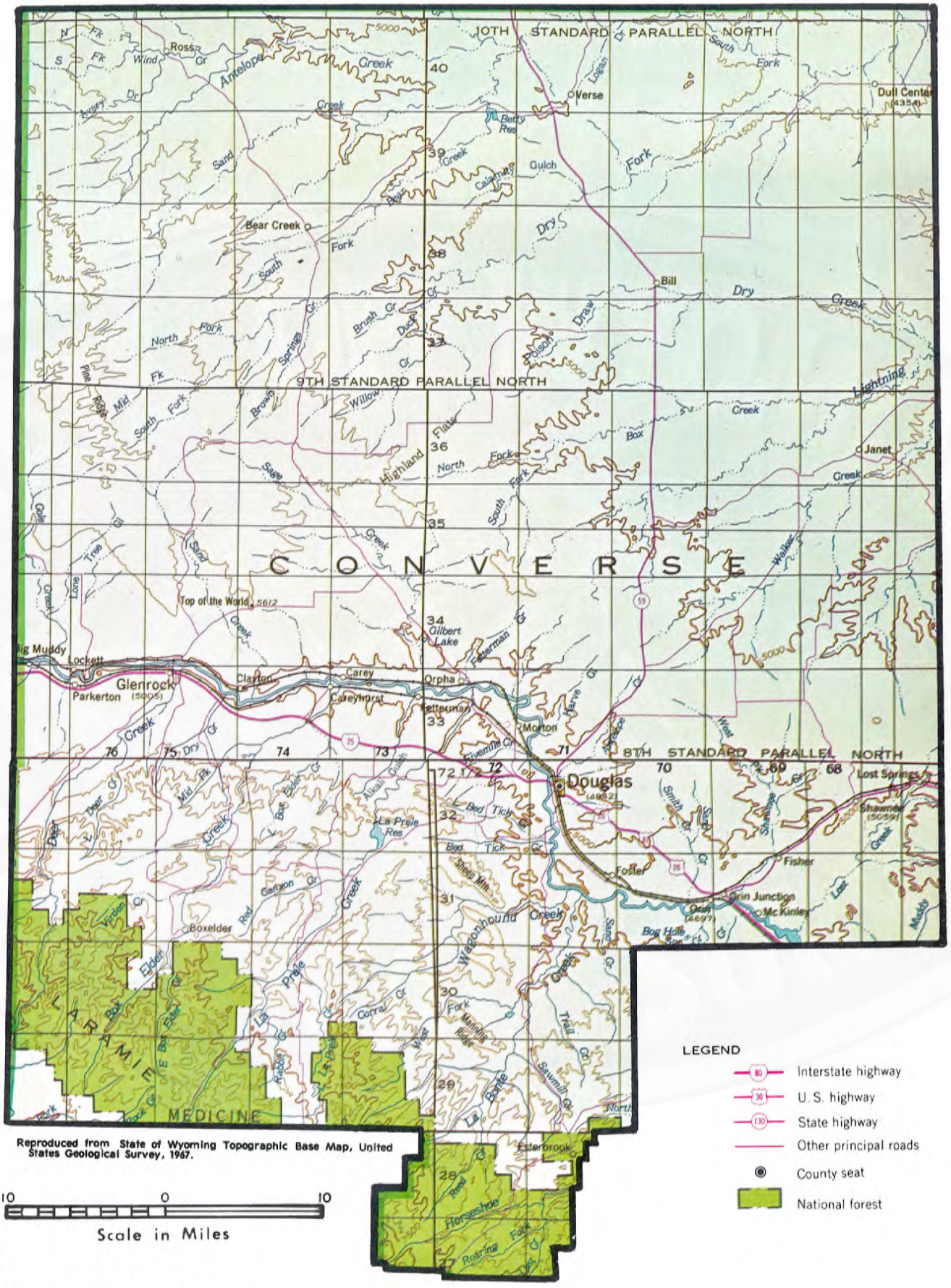


Figure 1. Topographic map

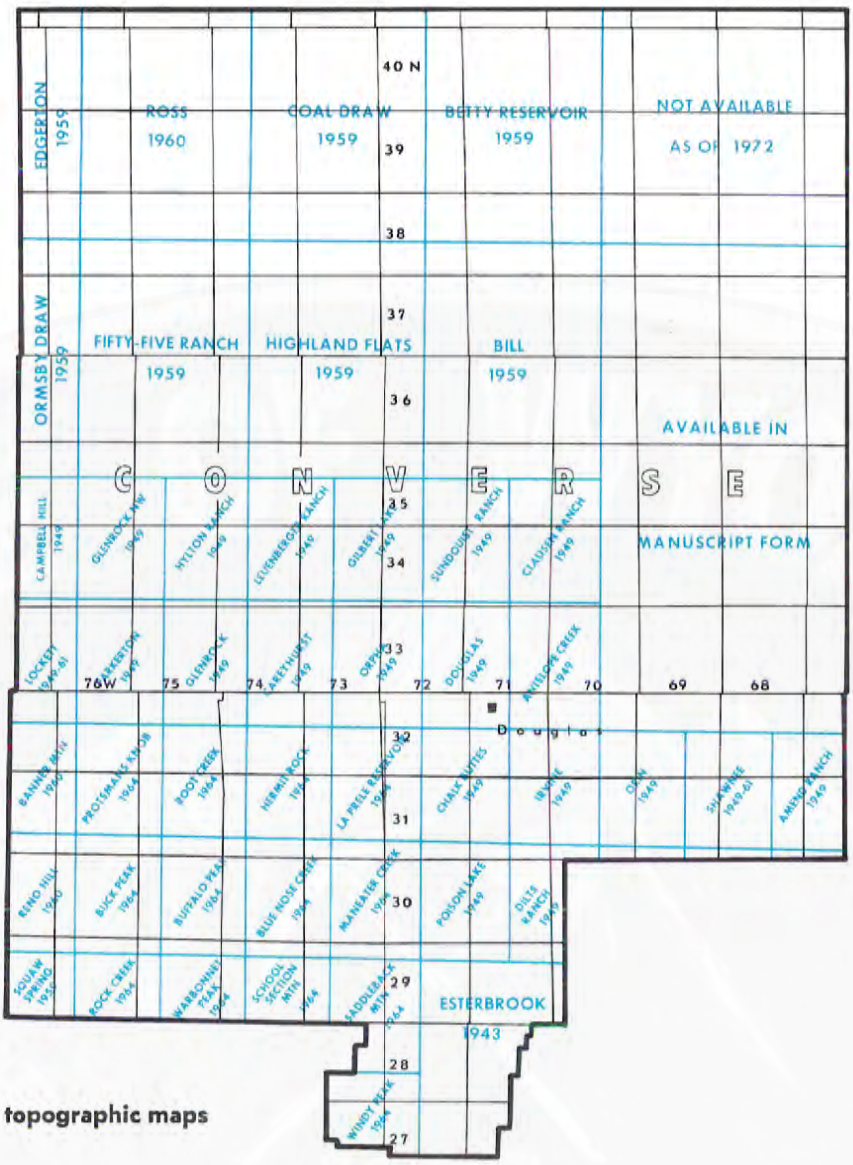


Figure 2 Index to topographic maps

SURFACE RIGHTS AND LAND OWNERSHIP

Ownership of the surface rights in Converse County is complex and changes from time to time. Figure 3 shows the broad categories of federal, state, and private ownership as compiled in 1967 by the United States Department of Interior, Bureau of Land Management.

Although the bulk of the surface rights in Converse County are privately owned, the federal government is the largest owner of the subsurface mineral rights.

For more detailed and up-to-date information on both surface and mineral ownership, the reader should contact the appropriate agencies as follows:

Federal Lands	Director Bureau of Land Management Federal Building Cheyenne, Wyoming 82001
State Lands	Commissioner of Public Lands State Capitol Building Cheyenne, Wyoming 82001
Private Lands	Converse County Clerk County Court House Douglas, Wyoming 82633
National Forest Lands	District Ranger U. S. Forest Service Douglas, Wyoming 82633

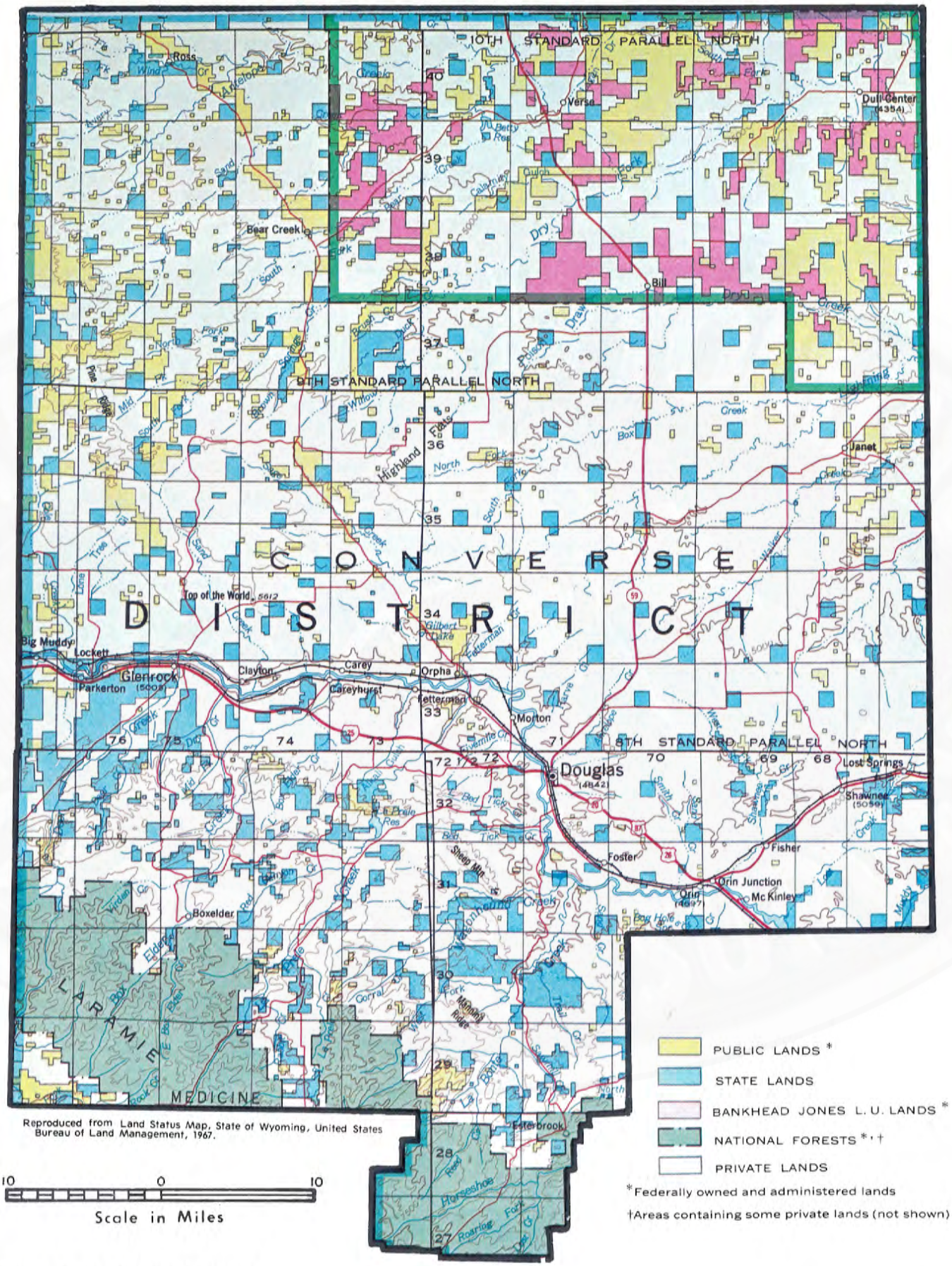


Figure 3. Land ownership map

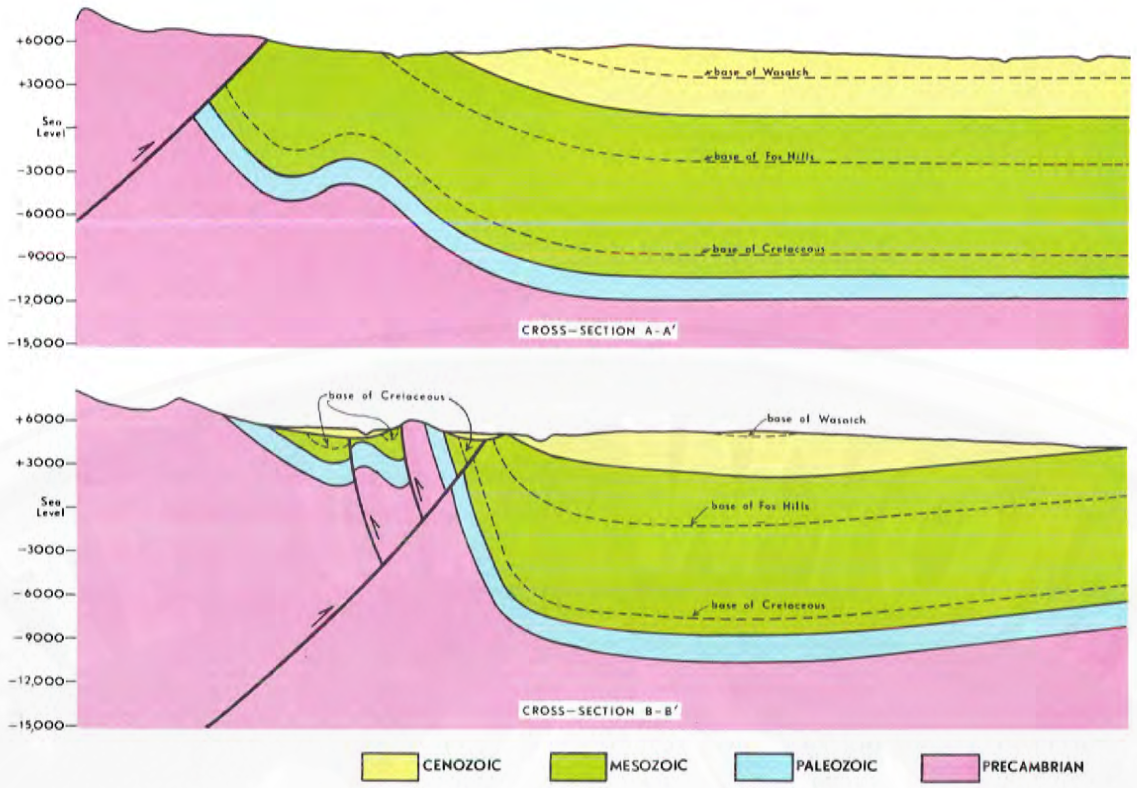


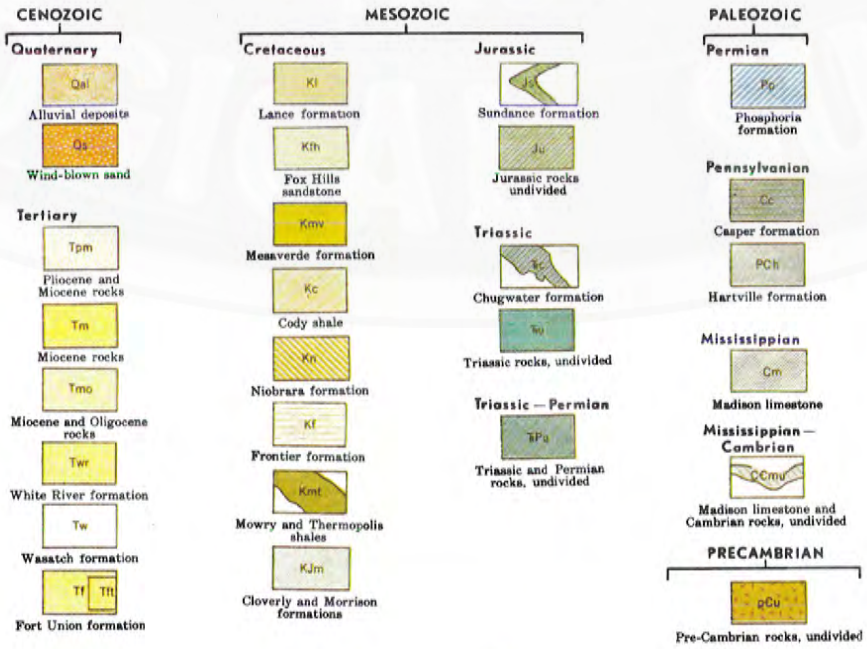
Figure 4. Geologic cross-sections

GEOLOGY

Bedrock and Surface Exposures

Two different kinds of bedrock are exposed on the surface in Converse County (Fig. 5). The oldest and perhaps the most notable is the non-stratified, igneous and related metamorphic rock of Precambrian age that occurs in the Laramie Range. These rocks have a granitic composition rich in silicate minerals such as quartz and feldspar. They form the "basement complex" and underlie the entire county at great depth. The other kind of bedrock is the stratified sedimentary rock that overlies the basement complex. A generalized column section showing this relationship along with the age of each rock unit, its thickness, and the formation names appears in Figure 6. Vertical cross-sections A-A and B-B (Fig. 4) offer a subsurface view of the strata in the Powder River Basin in relation to the basement complex in the Laramie Range.

Explanation of Geologic Map



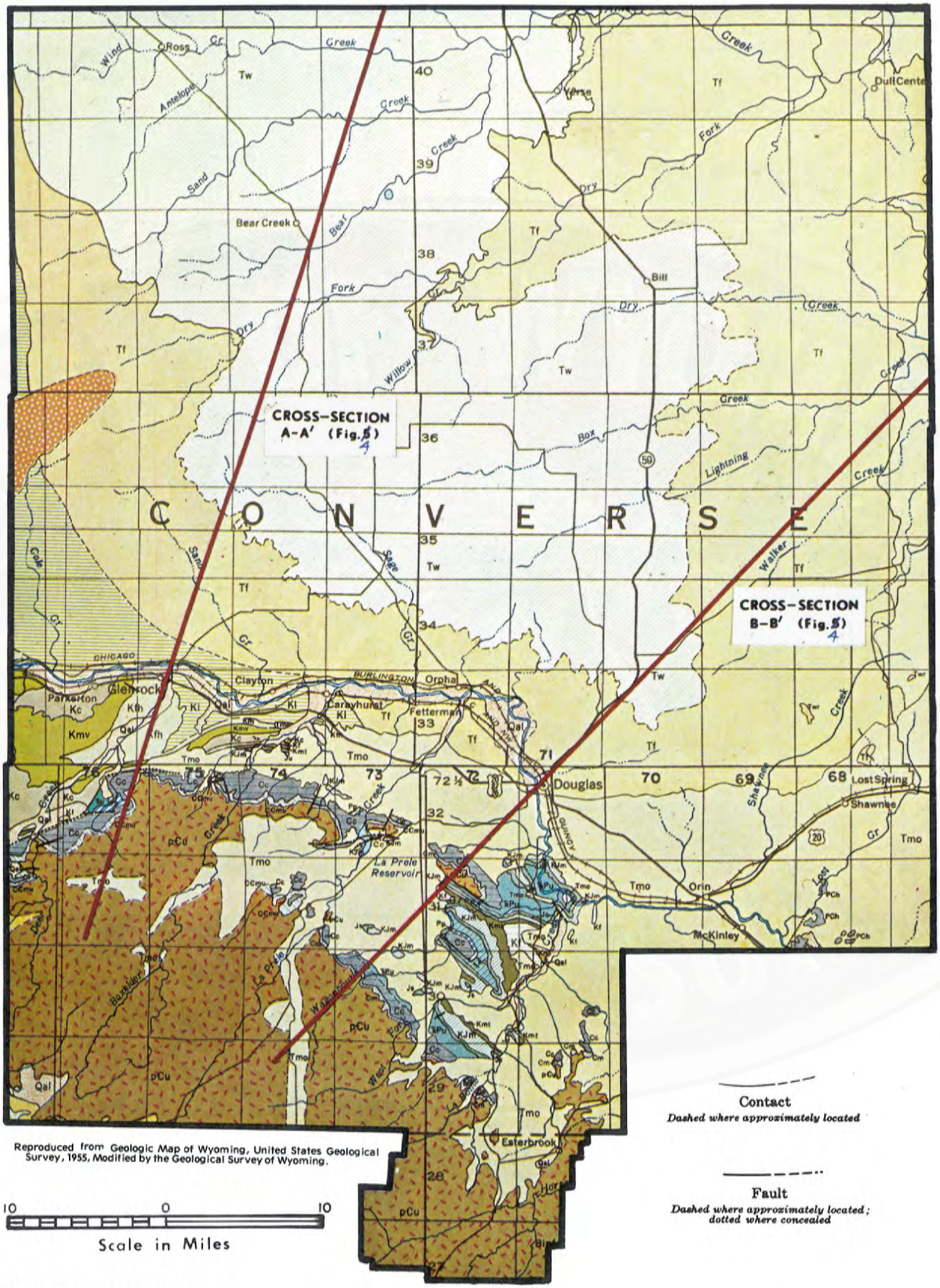


Figure 5. Geologic map

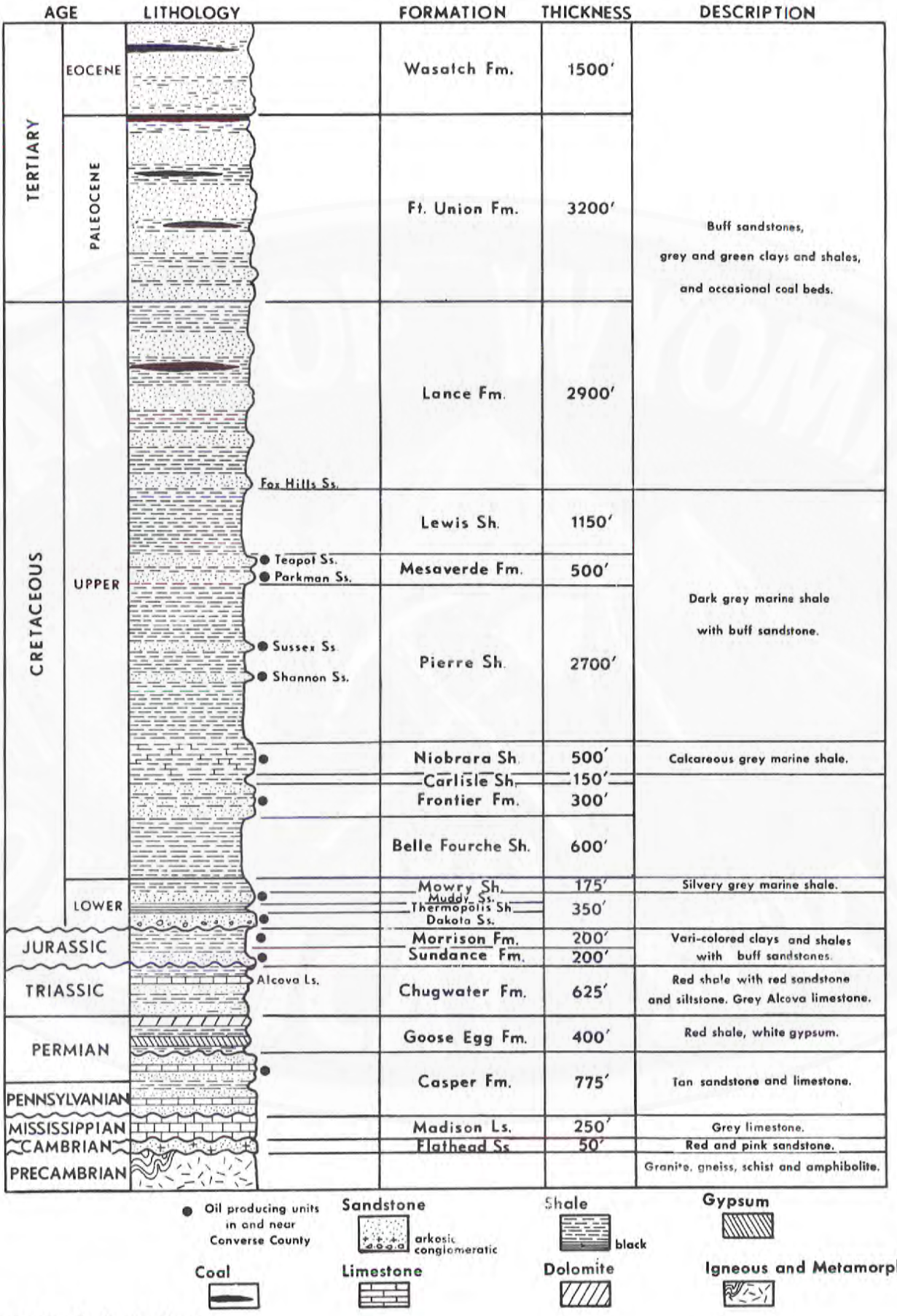


Figure 6. Geologic column

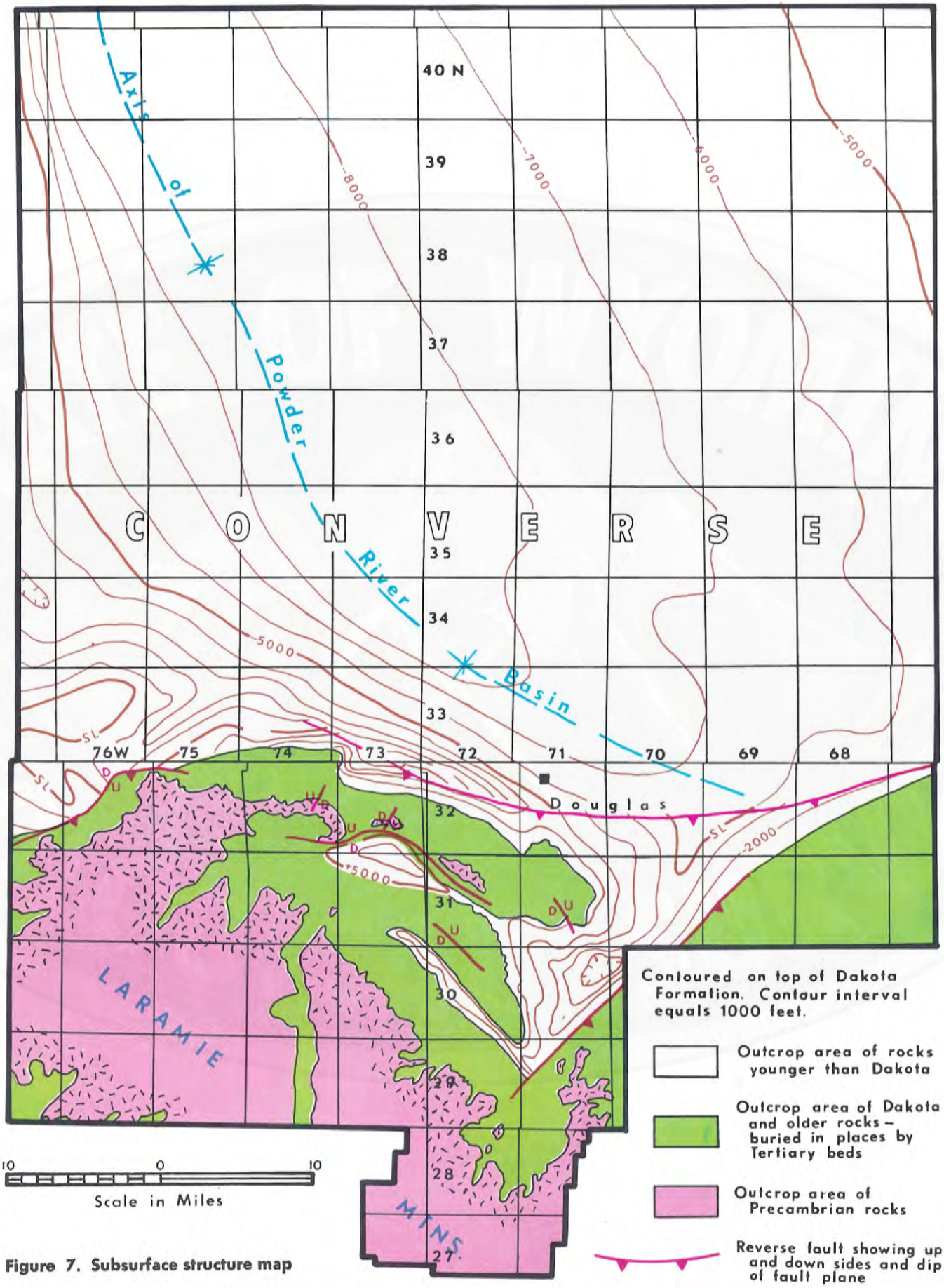


Figure 7. Subsurface structure map

For practical purposes the great thickness of sedimentary rocks has been subdivided into recognizable formational units that permit identification from place to place. It is then possible to use the tops and bottoms, or stratigraphic markers within the formations, as reference surfaces and to map their position in the subsurface. For example, when the top of the Dakota Formation is mapped, as shown in Figure 7, the subsurface axis of the Powder River Basin becomes conspicuous, and the map reveals that the Dakota Formation along that line is more than 8000 feet below sea-level, or more than 13,000 feet below the surface.

There are other places in the county, two to three miles south of Douglas, where the strata have been tilted up to extremely high angles, or fractured and separated by faults. A major east-west trending zone of faults crosses through the county in Townships 32 to 33 north. There is no evidence of movement along these faults within historic time.

Fossils—Many of the sedimentary rocks of Converse County contain fossils. Some are found in their original position in the enclosing host sediment; others are found in stream or terrace gravels or in float, i.e., separated and moved apart from the bed in which they originally were formed.

The Tertiary and uppermost Cretaceous strata contain remains of terrestrial and freshwater animals and plants. Teeth, fragments of jawbones and skulls, and leaf and bark impressions are relatively common in certain beds. Formations older than the Fox Hills Sandstone contain a variety of small invertebrate fossils largely of marine origin. The Mowry Shale is well known for its abundance of fish scales and the siltstone and clay of the Morrison Formation are known to contain fossil remains of large reptiles and amphibians.

Persons desirous of collecting fossils should have permission of the landowner, and, if on federal or state lands, they must have a valid collector's permit.

Water Resources

Converse County encompasses 4281 square miles within which there has been a continuous search for sources of underground water.

Figure 9 shows the location of most of the water wells that have been drilled to depths in excess of 500 feet. Obviously, if the required quality and volume of water could have been obtained at a lesser depth these wells would not be as deep as they are. The availability of ground water is controlled by the permeability and porosity of the sandstone aquifers. Knowledge of the local geology is helpful in determining where the largest quantities of ground water are likely to occur.

There are many shallow water wells in the county, not shown on Figure 9, that recover sufficient water to meet the owner's immediate needs. These wells produce from sandstone aquifers in Recent or Pleistocene alluvium and terrace gravels, the older Oligocene White River Formation, the Eocene Wasatch Formation, and the Paleocene Fort Union Formation, and from stray sandstones in the Cretaceous Benton Shale. Along the foothills of the mountains where the older formations are nearer the surface, the Cretaceous Dakota Sandstone and the Pennsylvanian Casper Formation provide good sources of potable water.

The quality of water obtained from underground sources depends upon the concentration of dissolved mineral content, usually calcium, and magnesium, measured in terms of milligrams (mg.) per liter (1.). Soft water ordinarily contains less than 61/mg. 1., moderately hard water 61-120/mg. 1., hard water 121-180/mg. 1., and very hard water more than 180/mg. 1. Any water containing more than 300/mg. 1. of sulfate is generally considered to be unfit for human consumption.

The graphs in Table 1 show a random sampling of water analyses from different aquifers within the county. They show that the most desirable sources of groundwater from bedrock are found in the Wasatch and Fort Union Formations. The White River Formation ordinarily yields water with a high mineral content which is not desirable for household use.

Analyses of surface waters in the Platte River Basin show that the amount of dissolved minerals ranks them as very hard water, but they are within the limits for drinking and general household use, food processing, and irrigation. Calcium and magnesium concentrations are generally too high for the water to be used in high pressure boilers without special treatment.

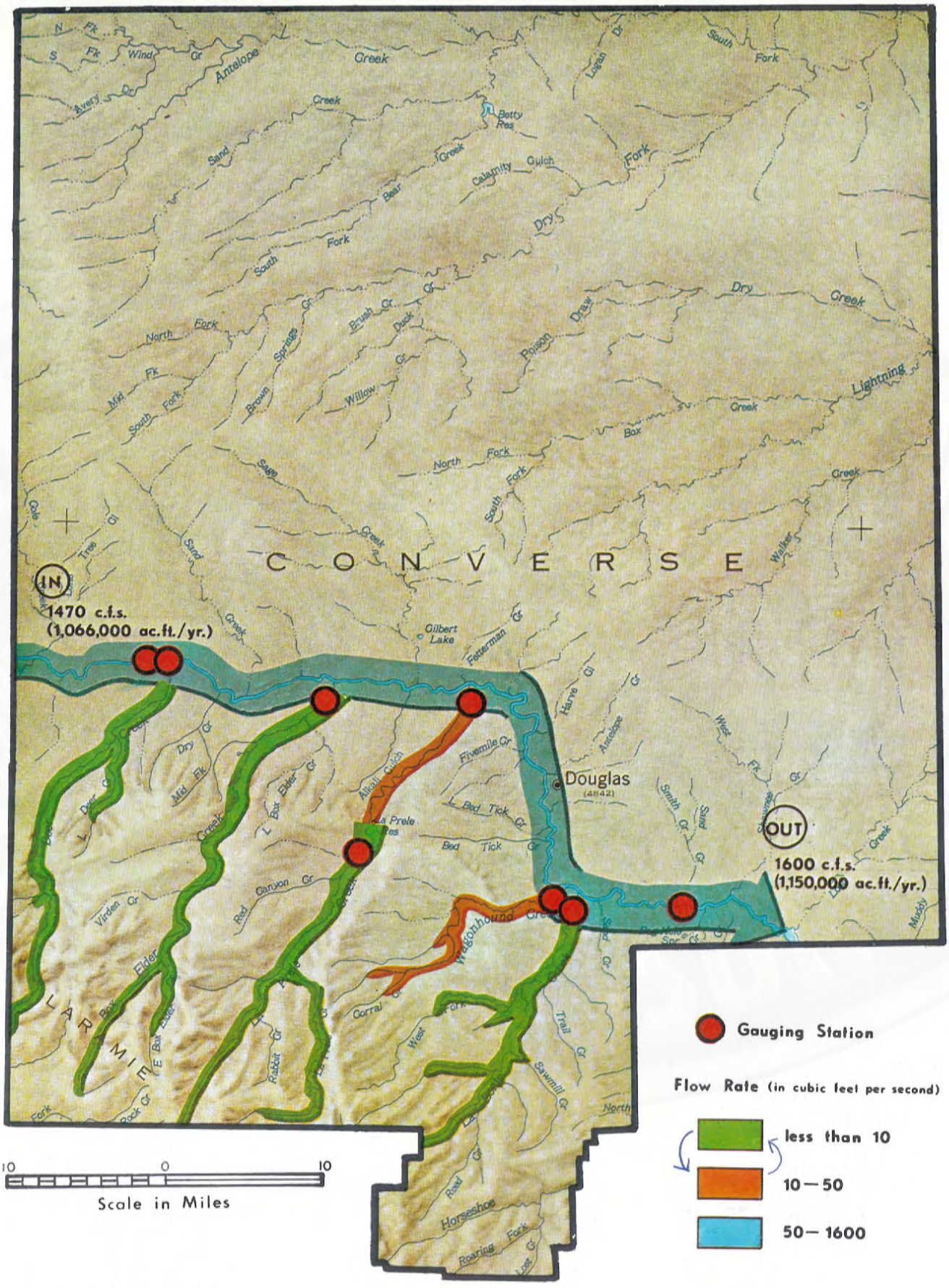


Figure 8. Surface water map

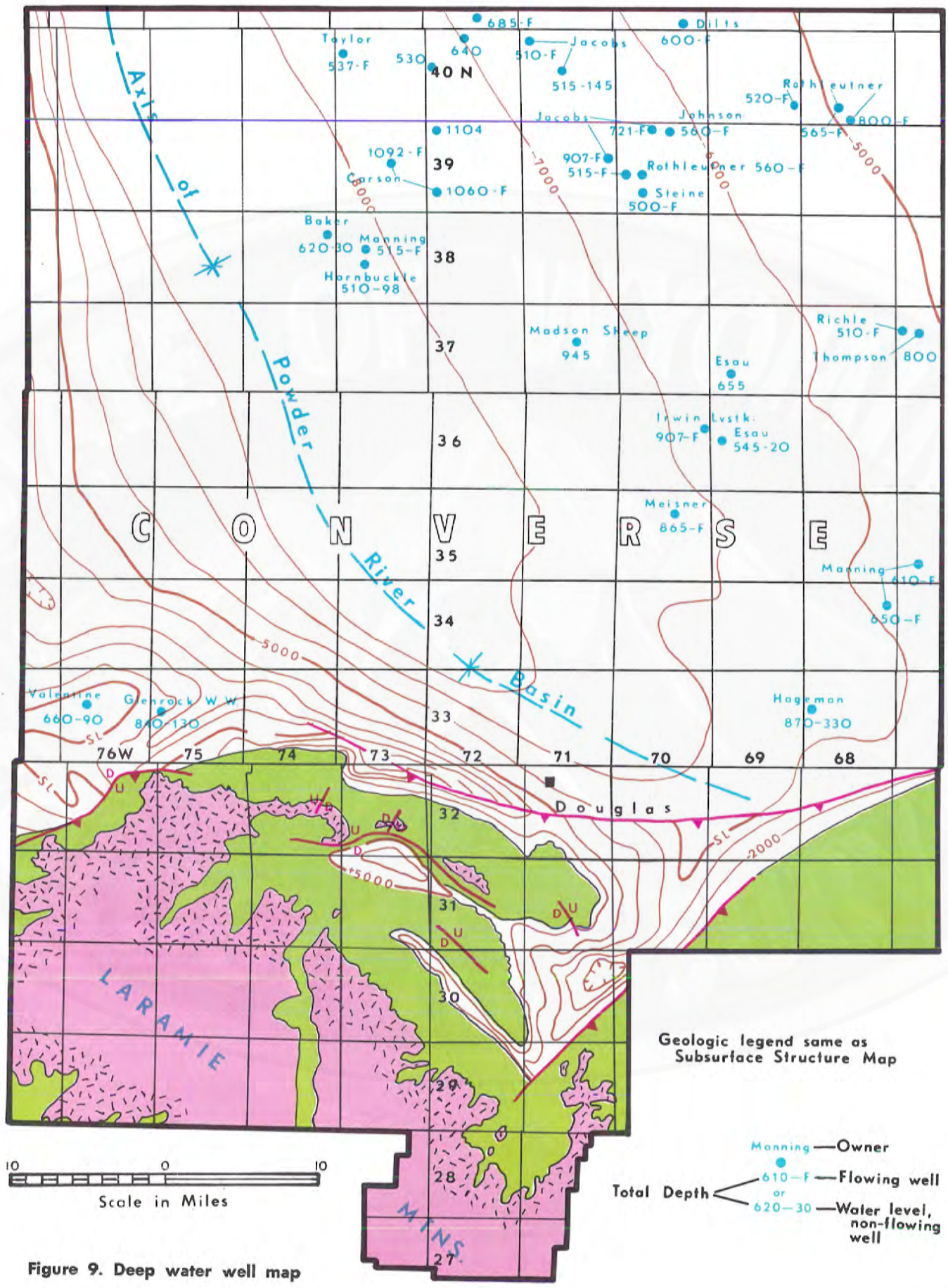
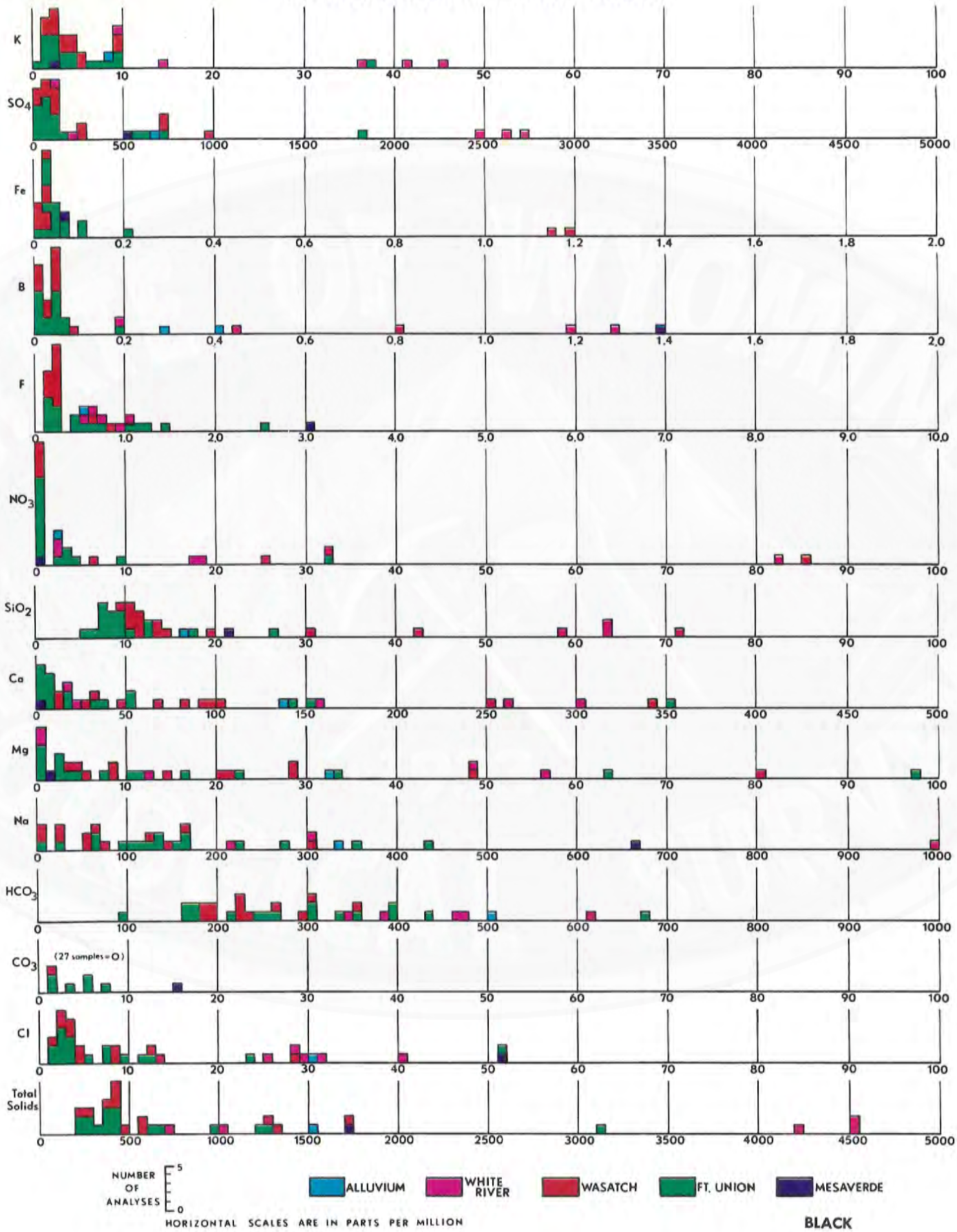


Figure 9. Deep water well map

TABLE I
GROUNDWATER ANALYSES CHARTS



Non-Fuel Mineral Resources

As illustrated on the mineral resource distribution map, Converse County is particularly well endowed with a variety of economic minerals. Of these, perhaps coal and uranium ore have attracted the greatest exploration effort in recent years. In earlier times other minerals were the objects for which men searched.

Copper - While no significant amount of copper ore has ever been mined in the county, prospecting activity which began in the late 1800's has disclosed a number of occurrences of copper mineralization at or near the surface in the northern Laramie Range. At least three of these prospects were developed to some extent and reported minor ore production.

About 50 tons of ore were reportedly taken from the Copper King claim in T.29N., R.75W., thirty miles southwest of Douglas on Crazy Horse Creek. Copper minerals were found in thin lenses and quartz veins within Precambrian schists and granites.

An unknown amount of copper ore production was also reported at the Swede Boy Mine in the Deer Creek area, T.31N., R.76W., about sixteen miles south of Glenrock. The copper minerals are said to have been recovered from quartz veins in Precambrian granite.

It has also been reported that copper ore was shipped from the Jasper Mine in T.32N., R.75W., during World War I, but there is no record of the amount. Unlike the other two previously mentioned occurrences copper minerals at the Jasper Mine were found to be fracture-fillings and mineralized replacement in the top of the Cambrian Flathead Sandstone.

A number of other occurrences of copper minerals have been reported, principally in the Esterbrook and Deer Creek areas, but deposits of size and quality sufficient for economic development are yet to be discovered.

Chromium- Between 1905 and 1920, chromite ore was found in a metamorphosed ultramafic intrusive body of Precambrian age on the west side of Deer Creek in Section 11, T.31N., R.77W. An open-pit mine was developed that reportedly produced 1080 tons of ore averaging 40 percent Cr_2O_3. While there has been no chromite production since that time anywhere in Wyoming, there are sizable bodies of chromite-rich, actinolite-talc-chorite schist, and ultramafic rocks in the northern Laramie Range that are deserving of additional exploration.

Iron - Several occurrences of magnetite-bearing Precambrian rocks have been reported in southern Converse County. No large deposits have as yet been defined.

To the east, near Hartville in Platte County, and far to the west in the Seminoe Mountains, large iron ore deposits occur in Precambrian metasediments similar to those in the northern Laramie Range.

Increased development of Wyoming's Precambrian iron ore deposits seems certain, and if detailed field mapping and modern geophysical techniques are employed, occurrences like those in the Laramie Range of Converse County can be expected to attract attention.

Explanation of Map

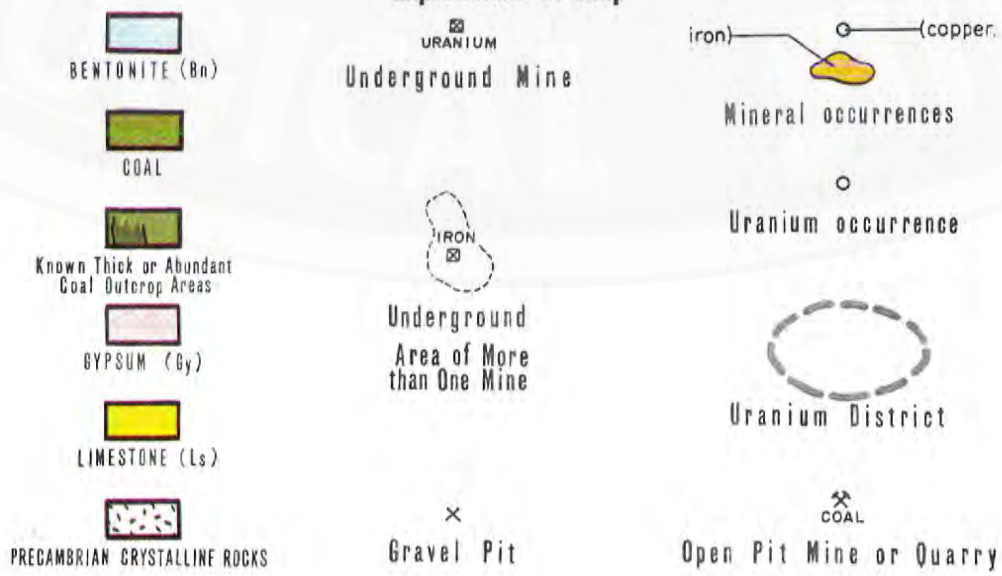


Figure 10. Mines and minerals map.

Tungsten - A deposit of scheelite, an ore mineral of tungsten, is known in Sections 11, 12, 13 and 14 of T.32N., R.76W. The scheelite is normally found associated with garnet, actinolite, epidote and glaucophane in Precambrian quartz veins. Reports of assays show a range from 0.33 to 1.0 WO_3.

Asbestos - Like chromite, asbestos is commonly found in metamorphosed ultramafic intrusive rocks of Precambrian age. One small occurrence of both the amphibole and chrysotile varieties of asbestos lies in Section 15, T.31N., R.77W. Development of this deposit is not likely to be undertaken, as attempted production of larger deposits of a similar nature at Casper Mountain and Smith Creek in Natrona County has proven economically unfeasible.

Vermiculite - Vermiculite is a mica-like mineral which exfoliates or swells up to 20 times its original thickness when heated. Exfoliated vermiculite is an extremely lightweight material used for insulation, fireproofing, aggregate in plaster and concrete, and as a filler. Two deposits of vermiculite have been worked commercially in Converse County. The Smith deposit in Section 20, T.32N., R.76W., produced a total of 450 tons. The vermiculite of these and numerous other scattered occurrences in the Laramie Mountains is generally found at or near the contact between Precambrian mafic and ultramafic meta-igneous rocks and intruding granitic pegmatites.

Leonardite - Leonardite, a soft, earthy, naturally oxidized form of subbituminous coal has been mined in a series of open-pit operations in the Powder River Basin north of Glenrock. The coallike substance was processed at a plant in Glenrock where it was sold as a soil conditioner and fertilizer.

Sand, Gravel and Other Stone - Most of the sand and gravel in Converse County is available on demand from pits in the alluvium of the North Platte River Valley. There has been only limited quarrying of stone aggregate.

Other Minerals - Because of the variety of rock types found in Converse County, it is not unusual to find traces of many metallic minerals. Foremost among the minerals and elements that have been noted at several locations are gold, silver, beryl, zinc, lead, bismuth and the rare earths. None of these has ever been produced in significant quantities.

In addition to metallic minerals there is also economic potential for non-metallic minerals in the sedimentary rocks overlying the Precambrian. The Mississippian Madison Limestone (limestone-dolomite) and the Pennsylvanian Casper Formation may be sources of calcium carbonate, aggregate, and even dimension stone at some localities. The Permian-Triassic Goose Egg Formation contains beds of gypsum, and the Cretaceous Mowry Shale has beds of the clay mineral bentonite. All of these stratified deposits crop out along the foothills on the north side of the Laramie Range.

It should be pointed out that the information presented here is based solely on published reports and historical records. No systematic field mapping or analytical study has ever been done of the mineral deposits in Converse County.

Energy Resources

Coal - Exploration for fuel and energy resources in Converse County has had a long history, probably beginning with the mining of thin coal and lignite beds along the banks of the North Platte River. Both the Fort Union and Wasatch Formations contain thick, subbituminous coal deposits. The coal is non-coking and non-agglomerating and has an average sulphur content of 0.7 percent. An average of twenty random, as-received analyses shows the following characteristics: moisture content 25.6 percent, fixed carbon content 33.1 percent, volatile matter 33.4 percent, ash content 7.9 percent, and an average heat value of 8155 BTU per pound.

The Dave Johnston Fuel Recovery Pit in T.34-35N., R.75W. was the State's largest producer of coal in 1970 with approximately 1.8 million short tons. They expect to be producing and utilizing some 3 million tons per year by 1973. This particular coal has an as-received analysis of 26 percent moisture, 14 percent ash, less than 0.5 percent sulphur, and a heat value of 7500 BTU per pound. The only other coal mine operating at present is in T.41N.,R.71W., on the north edge of the county.

Because thick coal deposits underlie much of the Powder River Basin portion of Converse County, underground mines can also be expected to develop in the future when the economics become more favorable.

The in-situ recovery of liquids and natural gases from coal is also a very real probability in this area provided that sufficient water can be made

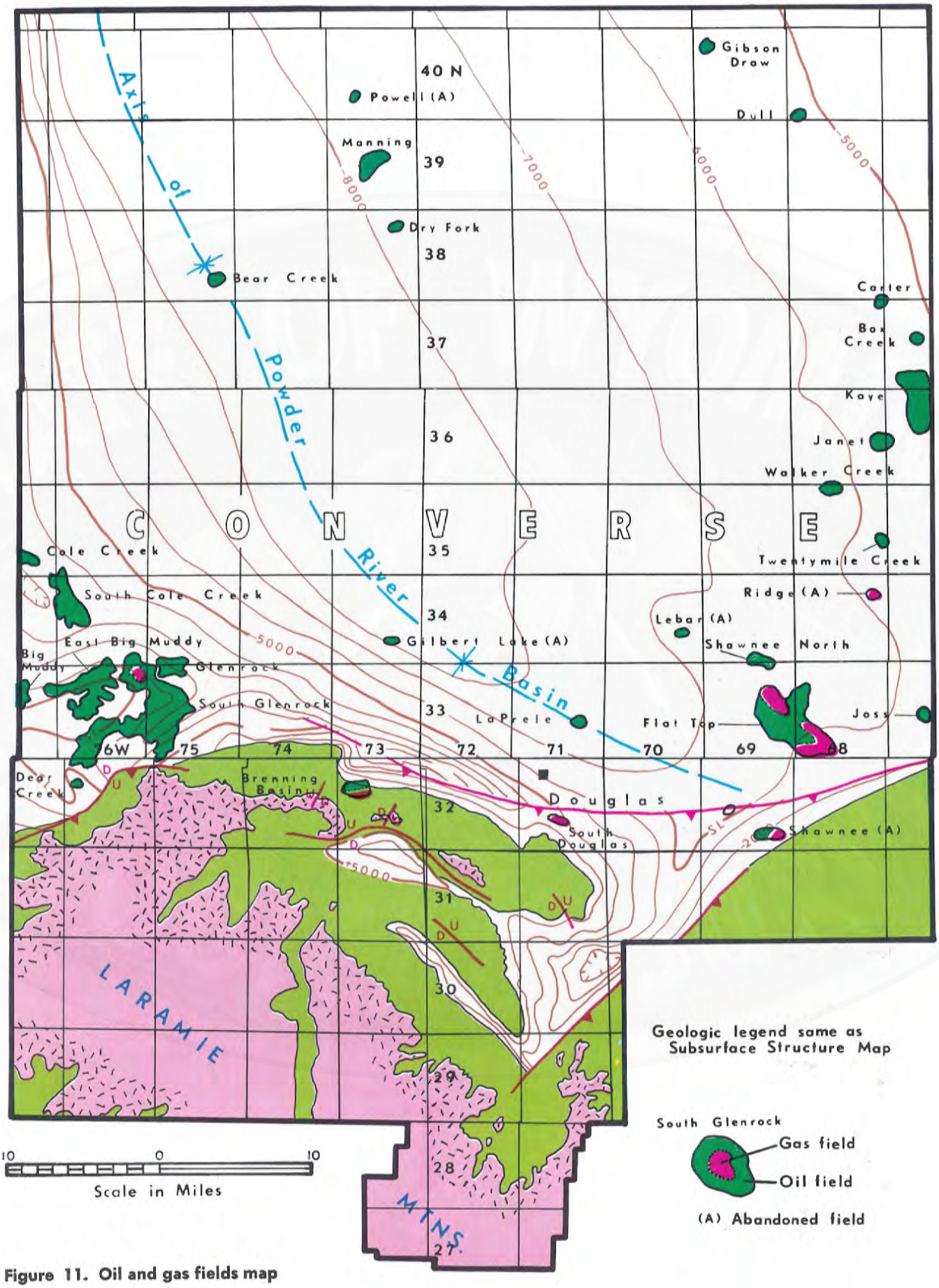


Figure 11. Oil and gas fields map

available. Presently, this type of development is still on an experimental basis in other parts of the country, and only time can tell whether such an operation in Converse County could compete economically. Obviously, with well over 100,000 acres of coal under lease in the county speculation on development is running high.

Petroleum and Natural Gas - Records from 1896 show that Wyoming Oil and Development Company drilled the first test hole in Converse County to a depth of 500 feet and recovered a small amount of oil. The area was later drilled more extensively and became known as Brenning Basin. The first significant oil discovery was made in 1916 when Continental Oil Company began development of Big Muddy field. Exploration has continued, and to date there have been thirty separate oil fields discovered and developed that have already produced almost 150 million barrels, worth in excess of $400 million in gross revenues. Four fields account for more than 90 percent of the total production: Big Muddy, South Glenrock, South Cole Creek, and Cole Creek (part of which is in Natrona County).

Natural gas production has been minor in comparison to the oil, totalling some 27 billion cubic feet, mostly from the Big Muddy (East) and Flat Top fields.

Practically all of the oil and gas production in the county is derived from sandstone and siltstone reservoirs of Cretaceous age. The geologic column (Fig. 6) shows by a black dot those formations that have yielded significant shows of oil or gas. To date, the more important producing reservoirs have been the Muddy, Dakota, and Lakota Sandstones that contain 35° to 36° (API) gravity oils and only minor amounts of water. In recent months there has been a revitalized interest in the Parkman, Teapot, Sussex, and Shannon Sandstones in the Upper Cretaceous.

As in any area, exploration activity for new oil and gas fields has advanced and declined in relation to the number of discoveries made. New discovery potential remains high throughout this south end of the Powder River Basin. Recent activity in Campbell County to the north has defined several trends of stratigraphic oil fields that may well extend into Converse County. Equally important, but intangible at this point, is the possibility of large structurally controlled reservoirs that are not evident at the surface. Only time will tell just how significant these new discoveries may be, but it is safe to say that few other counties in Wyoming have more favorable geology and potential reservoir rocks.

Uranium-Vanadium - Uranium is a relative newcomer to Converse County in terms of exploration activity and production. Although minor occurrences of uranium-bearing minerals have been known to occur in the Precambrian igneous rocks of the Laramie Range for some time, all of the commercial deposits that have been found are in the Wasatch or upper Fort Union Formations in the Powder River Basin.

The uranium ore occurs as an intergranular void filler and mineral replacement in sandstones and siltstones. The ore occurs in its unoxidized state principally as the mineral uraninite or some closely related mineral. Exploration is conducted using airborne radiometric surveys, through trace element analysis of groundwater, through the use of gamma-ray and electrical logging of closely spaced drillholes, and through drill cutting analysis.

There is no way to forecast just how much uranium ore may eventually be found and produced in Converse County. A number of large properties like Highland are now being developed by Humble Oil and Refining Company and others as open-pit operations.

Humble Uranium site north of Douglas, 1971

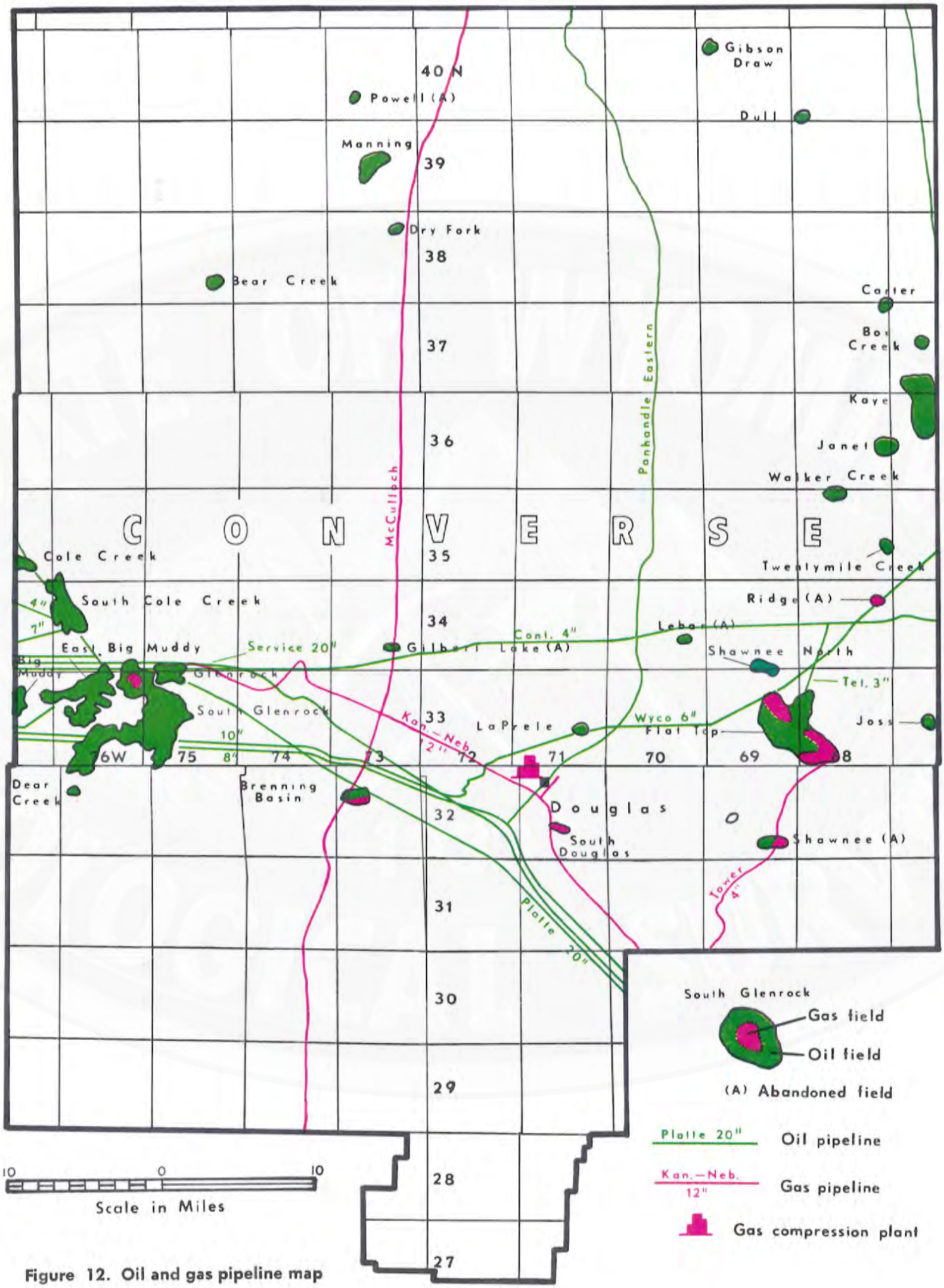


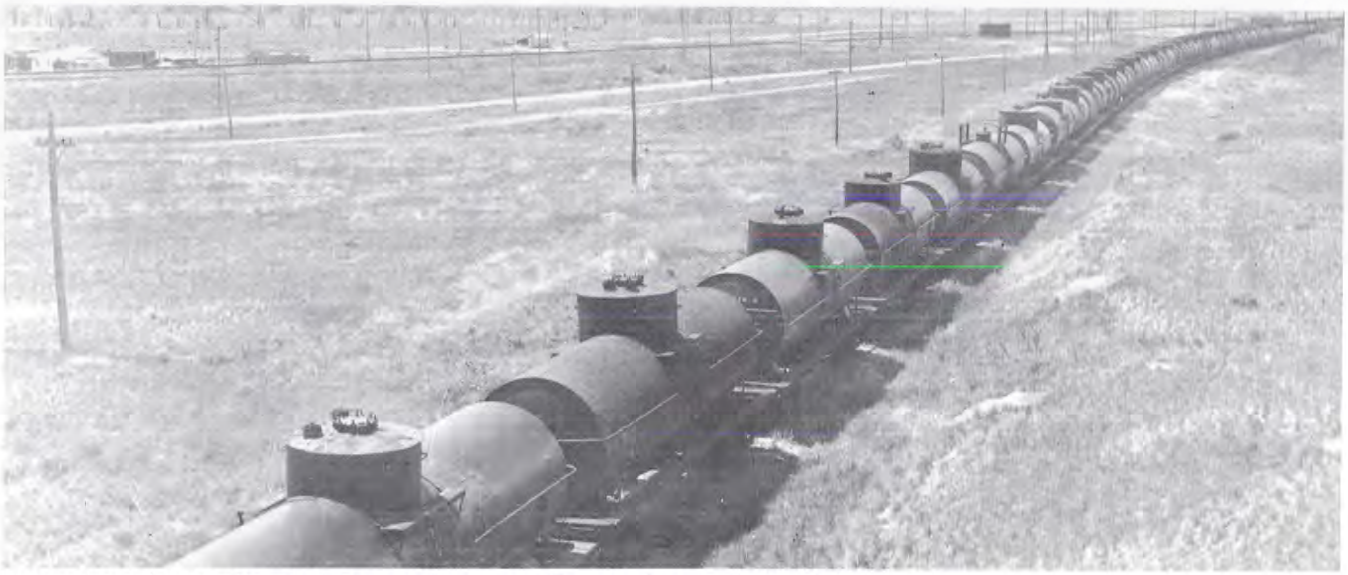
Figure 12. Oil and gas pipeline map

TABLE II
OIL AND GAS FIELD PRODUCTION

TOTAL CUMULATIVE PRODUCTION AND STATUS OF OIL AND GAS FIELDS

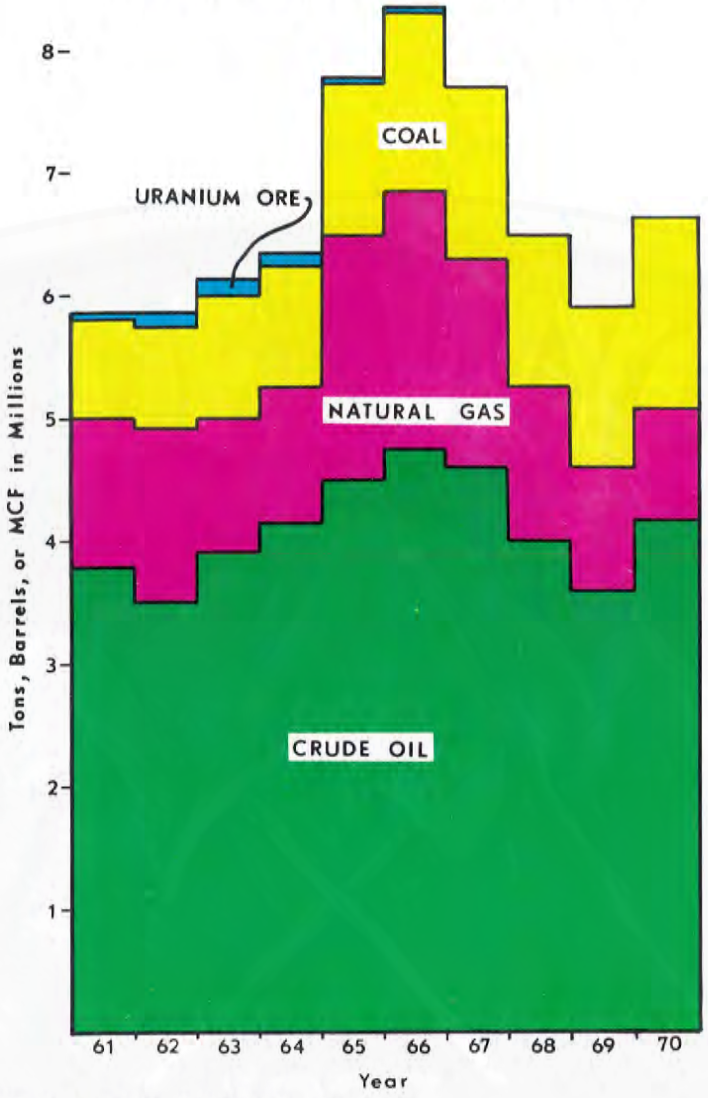
FIELD NAME	DISCOVERY DATE	TOTAL PRODUCTION TO DEC. 31, 1970 OIL (Barrels)	GAS (MCF)	FIELD STATUS
Bear Creek	1966	200,960	1,099,249	prod.
Big Muddy	1916	50,393,632		prod.
Big Muddy, East	1961	2,446,127		prod.
Box Creek	1955	53,855		prod.
Brenning Basin	1902	7,052		aband.
*Brooks Ranch	1957	2,271,890		prod.
Carter	1969	18,683		prod.
*Cole Creek	1938	15,173,475		prod.
Cole Creek, South	1948	13,437,496		prod.
Deer Creek	1950	158,282		aband.
Douglas, South	1946	44,194		prod.
Dry Fork	1970	17,704	92,304	prod.
Dull	1970			new field
Flat Top	1961	1,212,415	13,730,808	prod.
Gibson Draw	1970	597		prod.
Gilbert Lake	1960	5,082		aband.
Glenrock	1949	2,029,508	135,854	prod.
Glenrock, South	1950	62,355,216	29,848,658	prod.
Janet	1968	1,578	204	aband.
Joss	1969	382	8	aband.
Kaye	1969	214,099	62,491	prod.
LaPrele	1964	never produced		
Lebar	1962	235		aband.
Manning	1970	13,841	27,682	prod.
Powell	1954	1,225		aband.
Ridge	1962	4,083		aband.
Shawnee	1936	66,902		prod.
Shawnee, North	1959	21,975		aband.
Twentymile Creek	1956	31,523		aband.
Walker Creek	1969	3,918		prod.
TOTAL		150,185,929	44,997,258	

*(indicates field is partly in Natrona County)



Since their discovery, oil fields in Converse County have produced approximately 150 million barrels of petroleum worth more than four hundred million dollars in gross revenues. Railroad tank cars like those shown above leaving Converse County have played an important role in transporting the oil to midwestern and eastern markets.

TABLE III
MINERAL RESOURCE PRODUCTION



TAXABLE MINERAL PRODUCTION AND ASSESSED VALUATION

The sedimentary rocks of Converse County will continue to be the treasure-trove of the County's wealth. Annual lease payments and bonuses paid during exploration, and royalties and taxes paid on production have contributed significantly to the overall economy and will continue to do so in the future.

Of the County's 2,741,120 acres, at least half (1,918,784) can be considered potentially productive of coal, oil, gas or uranium, and therefore subject to rather continuous leasing or mineral claims by exploration companies. Estimates of the mineral ownership within the potential area show that approximately 60 percent of the minerals are owned by the federal government, 9 percent are State, and about 31 percent are privately owned (fee).

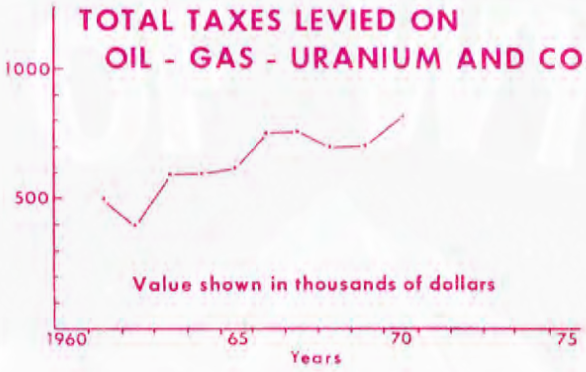
Table IV shows a nine-year relationship, from 1961-1970, between taxable minerals production, measured in terms of barrels, tons and cubic feet, and the tax assessed valuation measured in dollars. It is significant that the total taxes levied on oil, gas, coal, and uranium production has increased approximately 60 percent and can be expected to exceed one million dollars per year after 1973. It is also significant that the total value of mineral production in Converse County now exceeds 16 million dollars per year. These conditions prevail first, because of the natural distribution of mineral resources within the bedrock, second, because of the resourcefulness and capability of the mineral industries, and third, because of the cooperative spirit of all of the people involved in helping to develop these natural resources.

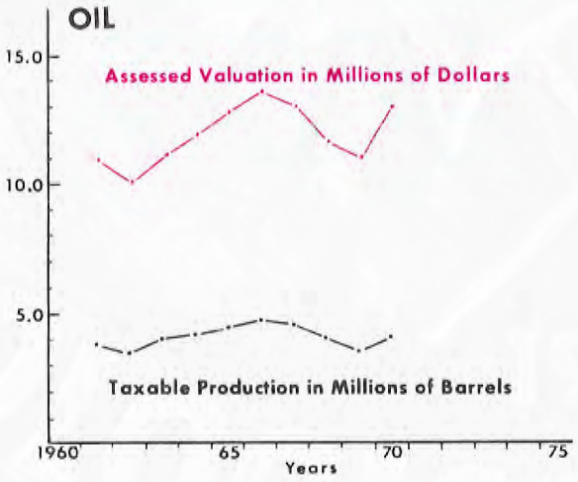
TABLE IV

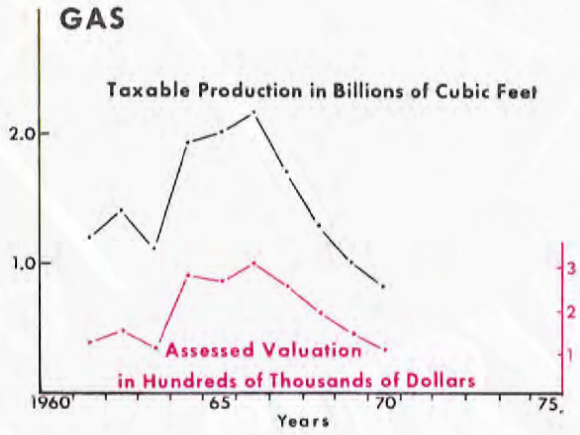
TAXABLE MINERAL PRODUCTION

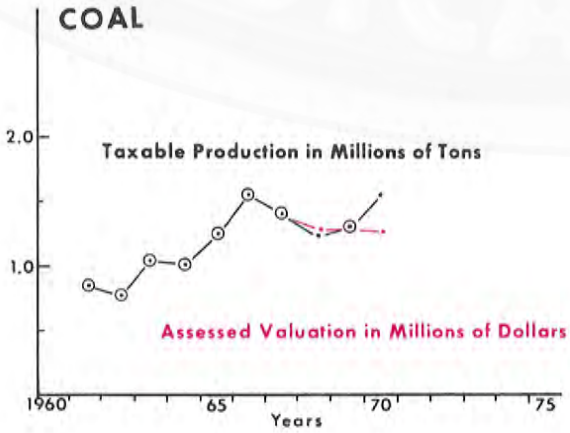
MINERAL PRODUCTION AND TAXES LEVIED IN CONVERSE COUNTY

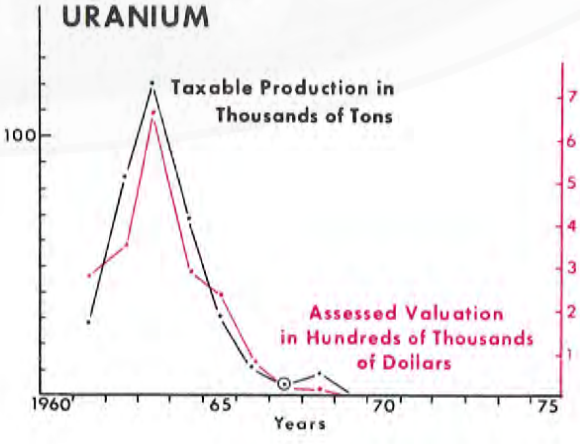
(1961 - 1970)











SELECTED REFERENCES

Copies of the following material are on file at most public libraries in Wyoming, or they may be purchased from the publisher as indicated.

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Wyoming Oil and Gas Statistics, (1970), Published by Wyoming Oil and Gas Conservation Commission, Casper.

Wyoming Data Handbook, (1971), Published by Wyoming Department of Economic Planning and Development, Cheyenne.

Questions regarding more technical publications on the geology of Converse County may be directed to the Director, Geological Survey of Wyoming, P.O. Box 3008, University Station, Laramie, Wyoming, 82070.

Development of the Dave Johnston power plant in 1956 by Pacific Power and Light Company in southwestern Converse County was a milestone in Wyoming history. Subbituminous coal from the Fort Union Formation provides the heat necessary to drive generators that develop electricity.

Photograph courtesy of Pacific Power and Light Company

STATE OF WYOMING
1933
GEOLOGICAL SURVEY

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