

OIL EXPLORATION AND DEVELOPMENT IN THE NORTH DAKOTA WILLISTON BASIN : 1982 - 1983 UPDATE

by

Sidney B. Anderson
and
John P. Bluemle



MISCELLANEOUS SERIES NO. 65

NORTH DAKOTA GEOLOGICAL SURVEY

Don L. Halvorson, State Geologist

1984

SYSTEMS	GROUPS	ROCK UNITS
QUATERNARY		GLACIAL
TERTIARY	WHITE RIVER	GOLDEN VALLEY
	FORT UNION GROUP	SENTINEL BUTTE
		BULLION CREEK
		SLOPE
		CANNONBALL
		LUDLOW
	CRETACEOUS	
MONTANA GROUP		FOX HILLS
		PIERRE
		JUDITH RIVER
		EAGLE 
		NIOBRARA
COLORADO GROUP		CARLILE
		GREENHORN
		BELLE FOURCHE
		MOWRY
DAKOTA GROUP		NEWCASTLE ^{SS}
		SKULL CREEK
		INYAN KARA
JURASSIC		MORRISON
		SWIFT
		RIERDON
		PIPER
TRIASSIC		SPEARFISH 
PERMIAN		MINNEKAHTA
		OPECHE
PENNSYLVANIAN	MINNELUSA GROUP	BROOM CREEK
		AMSDEN
		TYLER 

MISSISSIPPIAN	BIG SNOWY GROUP	OTTER	
	MADISON GROUP	KIBBEY 	
		FORMAL INTERVALS	POPLAR INTERVAL
			RATCLIFFE INTERVAL 
			FROBISHER ALIDA INTERVAL 
			TILSTON INTERVAL 
			BOTTINEAU INTERVAL 
		DEVONIAN	BAKKEN 
	THREE FORKS 		
	BIRDBEAR 		
DUPEROW 			
SOURIS RIVER 			
DAWSON BAY 			
PRAIRIE			
WINNIPEGOSIS 			
SILURIAN		INTERLAKE 	
	BIG HORN GROUP	STONEMOUNTAIN 	
ORDOVICIAN		STONY MOUNTAIN 	
		RED RIVER 	
CAMBRIAN	WINNIPEG GROUP		
		DEADWOOD 	
PRECAMBRIAN			

 OIL PRODUCTION
 GAS PRODUCTION

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The pump shown on the cover is Amerada-Hess Corporation's well No. H-818, which is located in the Fryburg Heath-Madison Unit (SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec 35, T140N, R101W, Billings County). The well produces from a depth between 9,700 and 9,750 feet. Little Missouri River badlands in the background. Photo by John Bluemle.

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INTRODUCTION

North Dakota is now (1984) heading for its sixth consecutive year of record oil production figures, its second straight year producing over 50 million barrels of oil. It is appropriate now to review the state's discovery and production history as we did in earlier versions of this booklet in 1981 and 1982. We will briefly outline the several exploration cycles the Williston Basin has undergone, review development of significant reservoirs, and offer our best prognosis of current conditions and future possibilities. The data presented here are largely from the files of the North Dakota Geological Survey. Much of the data for the years since 1980 were provided by the Oil and Gas Division of the North Dakota Industrial Commission, but all of the interpretations are our own.

PRE-1951 EVENTS

Natural gas, known to most people around the turn of the century as "marsh gas," was first reported in southeastern North Dakota in 1892 in an artesian well producing from the "Dakota" sandstone. Subsequently, the gas was obtained from many artesian wells in a belt extending south from Jamestown to Merricourt. This methane gas was used for lights, cooking, and heating at Edgeley. It apparently occurred in an unsaturated solution with the artesian water and, as the water pressure was released as it flowed to the surface, the gas was collected in tanks. Although enough gas was found to supply the small towns in the area, improper drilling and maintenance of the wells resulted in blowouts, plugging, and loss of head. When the artesian head was lowered below the land surface, gas production stopped, and by 1920 the gas was used only on a few scattered farms. No record was made of pressure or production of the gas, which occurred at a depth of about 1,100 to 1,200 feet.

Natural gas was also utilized in the Westhope and Lansford areas of Bottineau County prior to 1910. This gas, which was used to heat and light 13 homes in Lansford by use of an underground pipeline system, occurs in the glacial deposits. Many local farmers in that area had installed separators and

used the gas to heat barns and other structures, apparently for several years before 1910. At Lansford, the gas was found at depths of 175 to 210 feet from a 19-foot-thick glacial sand. At about that time too, a company known as the North Dakota Gas Company supplied gas to the town of Westhope. The gas was delivered to the town through a 20-mile pipeline. The eight wells cost 13.6 cents per foot to drill and charges to the townspeople were 30 cents per 1,000 cubic feet of gas in summer, 40 cents in winter.

In April, 1916, State Geologist Dr. A. G. Leonard visited the Williston area to determine the likelihood of finding oil or gas in that vicinity. His report on his findings advised against going to the expense of drilling a well there. The following month, Leonard visited Marmarth for a similar purpose at the request of Governor Hanna and recommended drilling in that area.

In September, 1916, a wildcat well was started by the Des Lacs Western Oil Company on the farm of A. F. Blum, about 1½ miles southeast of Lone Tree in Ward County. The well was abandoned at 244½ feet in October, 1916.

In September of 1917, the Des Lacs Western Oil Company asked the North Dakota Geological Survey to investigate the possibilities of finding oil and gas in the Minot area. Dr. Leonard and Assistant State Geologist, Howard Simpson, found enough evidence to recommend further exploration. On the basis of their report, a well was drilled about two miles west of Des Lacs in 1923. The well penetrated 3,980 feet deep, into the Cretaceous Inyan Kara Formation, but it was nonproductive. It was located only two miles east of present Madison production in the Lone Tree Field.

In 1933, Professor William E. Budge of the School of Mines had taken an interest in the occurrence of oil shale and oil seeps along the Sheyenne River south of the Fort Totten Indian Reservation. These had been called to his attention by interested citizens of Warwick. He made several trips to the area and attempted to get an appropriation from the 1935 Legislature to make further studies of the area, but he was unsuccessful in obtaining funding. Professor Budge believed that the best way to evaluate the area would be by seismic methods

as the area is covered by glacial sediment.

On August 15, 1938, the California Company abandoned its Nels Kamp #1 well in Williams County. This well was drilled only 1,866 feet from a 1956 well that became a producer. At 10,281 feet, total depth, the Kamp well had penetrated the Madison Formation, which is a productive zone in the area today. Apparently, the Kamp well was circulating mud at the time it penetrated the productive zone, and any shows were overlooked. This well was the first in North Dakota on which an electric log was run.

State Geologist, Dr. Wilson M. Laird, was out of town and Acting State Geologist, Nicholas Kohanowski, signed the drilling permit for Amerada Petroleum Corporation's #1 Clarence Iverson well to be drilled in the SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec 6, T155N, R95W, Williams County. The permit was issued on August 4, 1950. Drilling began at 6:00 a.m. on September 3. On January 4, 1951, a drill-stem test (from 10,452 to 10,803 feet) recovered one pint of free oil in the bottom of the test tool. The recovery was from the Devonian Duperow Formation. However, the well was completed in the Silurian Interlake Formation on April 4, 1951.

POST-1951 EVENTS

North Dakota's 1951 Nesson Anticline discovery was not the first oil production from the Williston Basin (fig. 1). Oil was discovered in the Williston Basin in Montana on the Cedar Creek Anticline (fig. 2) in 1936 and in Manitoba in 1950. Since 1951, several significant cycles of exploration and production have been completed in North Dakota. Annual production increased in North Dakota until 1966 (26 million barrels) then declined until 1974 (19.6 million barrels), and is now on an uptrend again. Production in 1979 (31 million barrels) surpassed the previous 1966 high and new highs are now being recorded each year (47.3 million barrels in 1982 and 50.7 million barrels in 1983).

Although the initial oil discovery in North Dakota was from Silurian rocks, the early development of the Nesson Anticline (fig. 2) was primarily of the Madison reservoirs. The peak discovery period was 1952-1953, with development along the 75-mile anticline

trend being nearly complete by 1960 (fig. 3). Producing capacity at that time exceeded the available market (the Mandan refinery). Production was limited then by prorationing until November of 1965, when natural decline of these reservoirs equaled the market demand. The only significant deeper horizons developed along the Nesson trend during the early 1960s were the Duperow and Interlake Pools in the Beaver Lodge and Antelope Fields and the Sanish Pool in Antelope Field.

Significant discoveries between 1952 and 1959 included the Mississippian oil fields of Bottineau, Burke, and Renville Counties (fig. 3). The increasing production between 1958 and 1961 largely reflects development of these pools.

Tyler sand reservoirs, which were discovered at Rocky Ridge in 1957 and Fryburg in 1959, became important developments in the mid-60s in the Stark and Billings County areas. Peak production occurred in 1966 at Medora Field and in 1967 in the Dickinson Field. This helped to offset declines in the older producing areas.

In 1960, discovery of the Cedar Creek Pool extended the Red River production along the Cedar Creek Anticline into North Dakota (figs. 2 and 4). The Bowman County Red River play extended production in southwestern North Dakota to small "bumps" along the eastern flank of the structure in the period from 1967 to the mid-70s.

The decline in production from 1966 to 1974 represents the failure of new discoveries to replace the natural decline of the major producing areas. The normal pattern is discovery, followed by development, leading to peak production for one to three years, followed by a gradual decline. Secondary recovery methods are used in an attempt to alter this pattern. Water injection for pressure maintenance was installed in many of the Madison reservoirs along the Nesson trend, and in Burke County, but this was relatively unsuccessful. Similar programs, begun in 1967 in the Newburg-Spearfish and Madison reservoirs, in 1970 in the Medora Field, and in 1973 in the Tyler sand reservoirs in the Dickinson Field increased production levels above the initial development in those fields. However, these successful programs could not offset

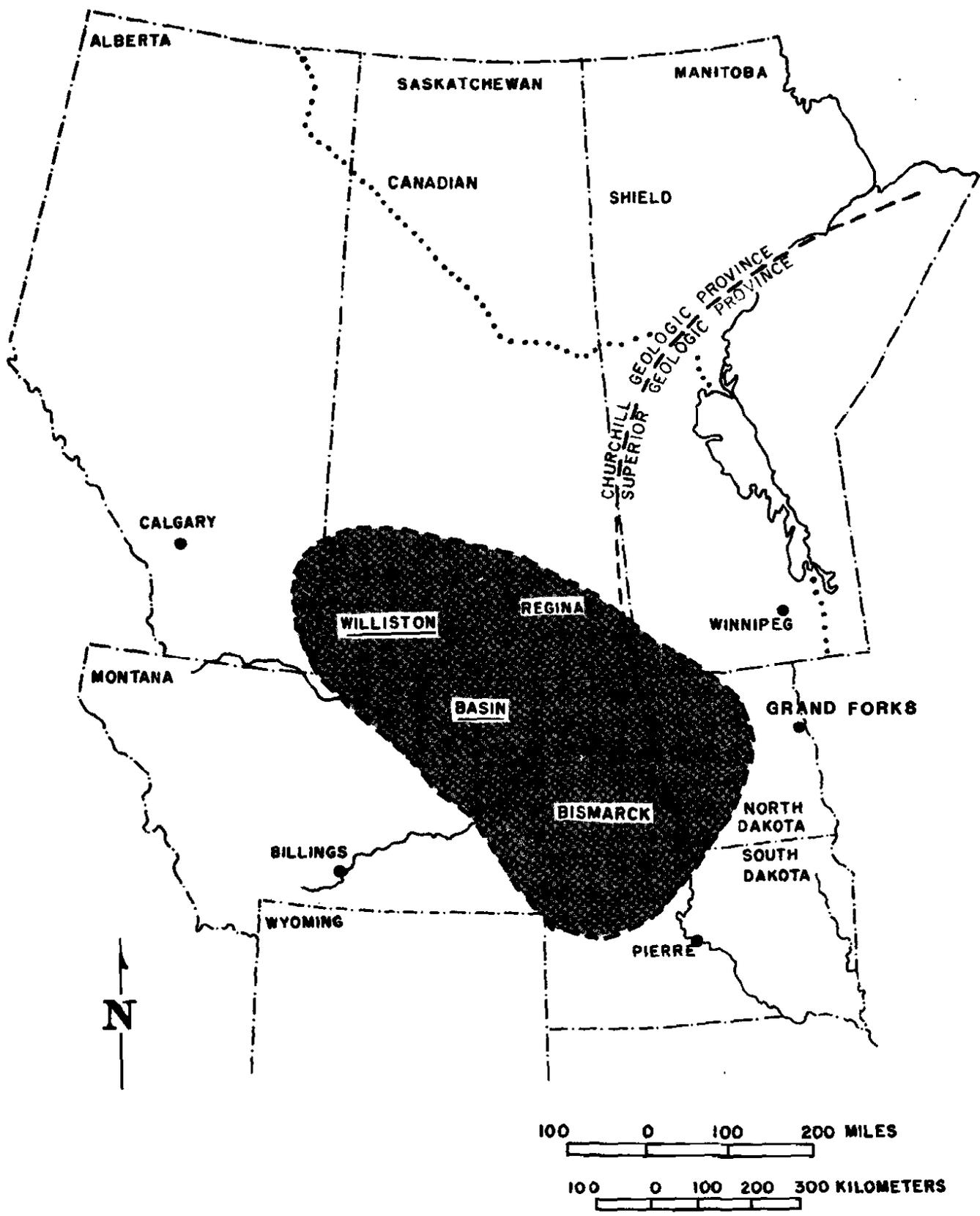


Figure 1. Map locating the Williston Basin.

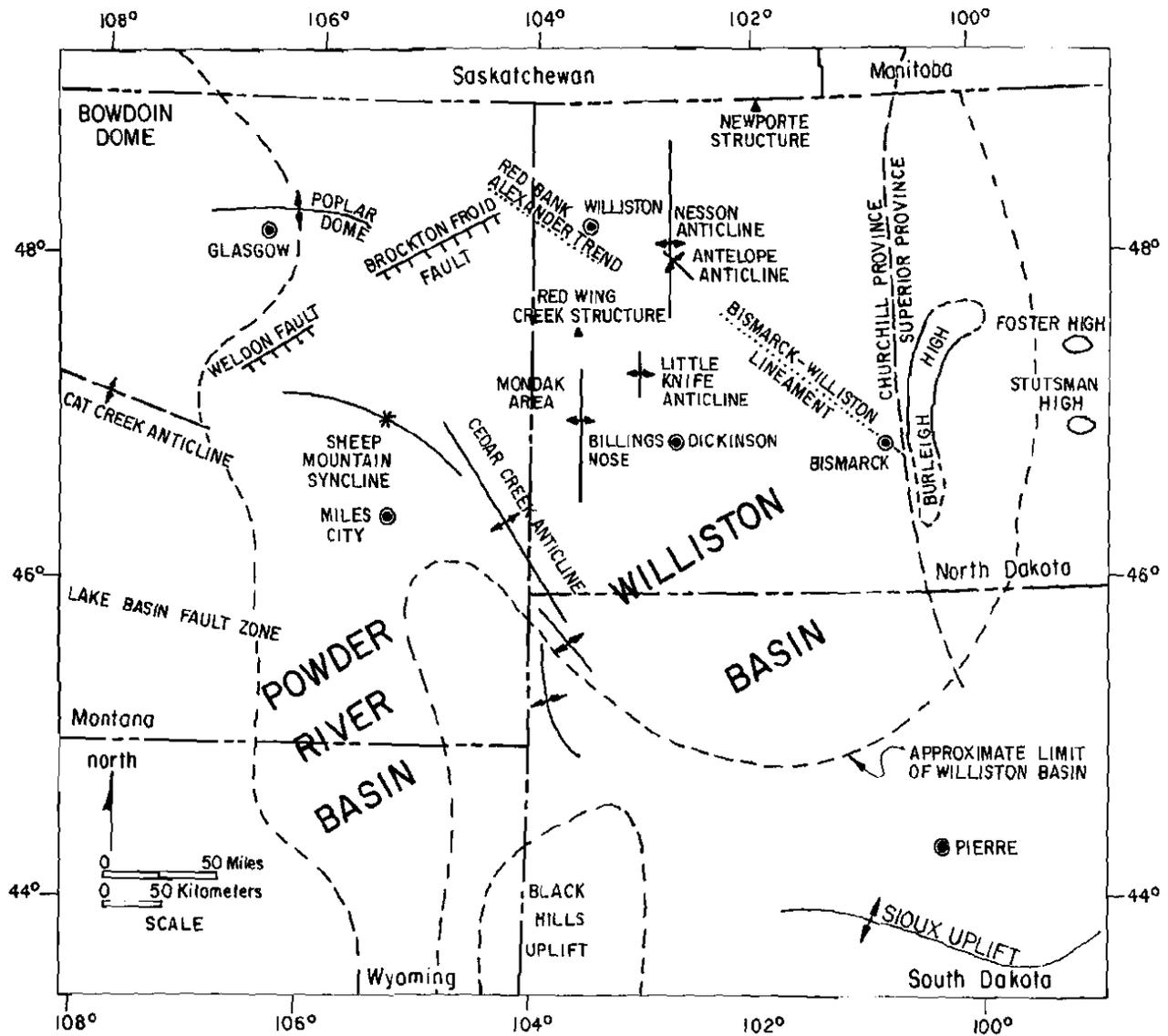


Figure 2. Map showing the major structural features in western North and South Dakota, eastern Montana, and northeastern Wyoming.

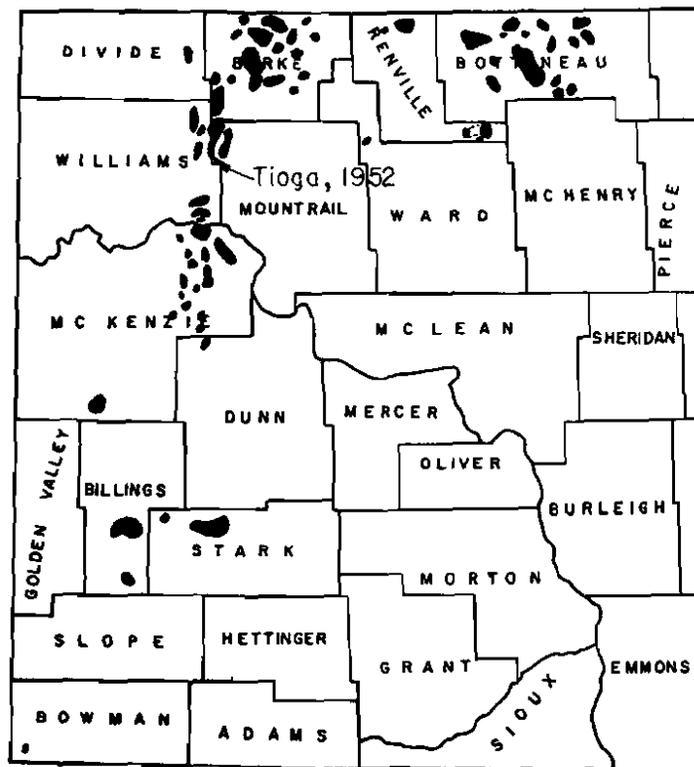
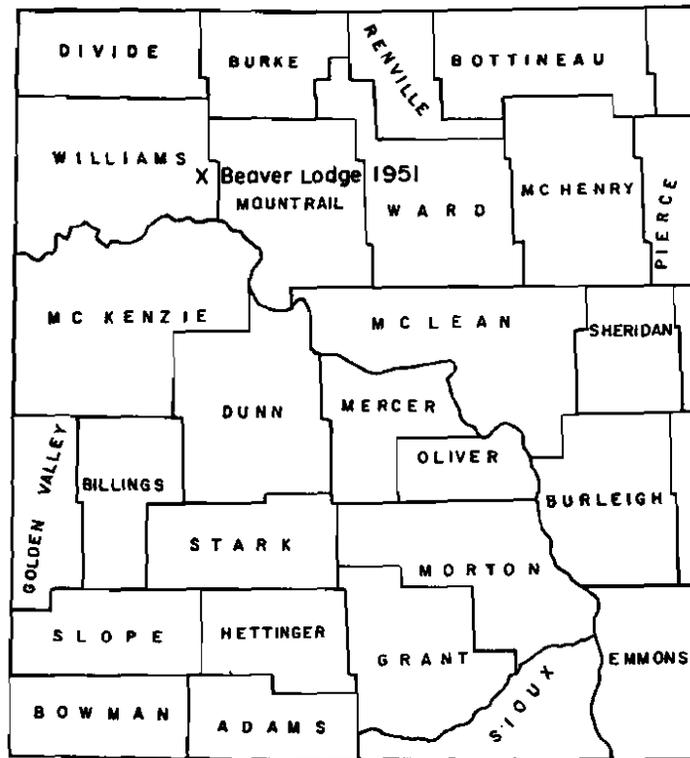


Figure 3. Upper map of western North Dakota shows the location of the Beaver Lodge discovery in 1951. Lower map shows oil fields developed by the end of the 1950s. The Tioga discovery of 1952 is also located.

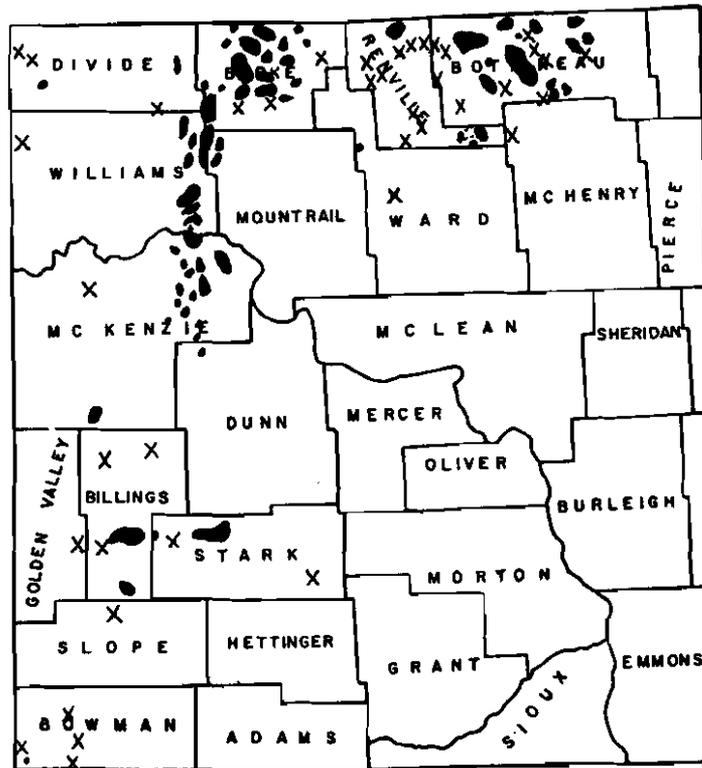


Figure 4. Major new field discoveries (represented by the x symbols) in North Dakota between 1960 and 1969.

the natural decline of the major producing areas.

The trend to lower exploratory activity during the 1960s generally followed the national trend. The upsurge of wildcatting in 1968 in North Dakota has been referred to as the "Muddy sand" (Newcastle) play. It followed development of the Bell Creek Field in Montana, but no similar occurrences were found in North Dakota and exploration activity again slowed down.

THE 1970s RESURGENCE

Two events that occurred close together in the early 1970s significantly changed Williston Basin production history. First, Red Wing Creek Field was discovered in 1972 in McKenzie County, North Dakota (figs. 2 and 5). Second, OPEC, which was formed in 1973, enacted production controls (embargoes) and price increases on production in OPEC countries.

OPEC created the first substantial worldwide increase in the price of oil. The price rose from about \$4.00 a barrel in 1973 to about \$9.00 in 1974

and prices continued to rise through the 1970s. As a result, exploration was once again a profitable venture. Prior to this, many companies found that exploration risk money had a better return in a regular bank savings account than in actual wildcat drilling. The increased price created risk capital, and thus exploratory drilling was enhanced.

The Red Wing Creek discovery at about the same time excited basin oil operators because of the relatively high productivity of the wells and the anomalously thick pay section. Since no one really understood the nature of the Red Wing Creek structure (fig. 2) at the time, industry's response was to gain lease foothold in the area. The lease play set off by the Red Wing Creek discovery set the stage for further development. The five-year-term leases taken in western North Dakota tended to increase exploratory activity. The availability of venture capital, coupled with the five-year leases, caused exploratory drilling to increase in 1975 and 1976, in part in response to the lease expiration dates.

In 1977, two additional significant

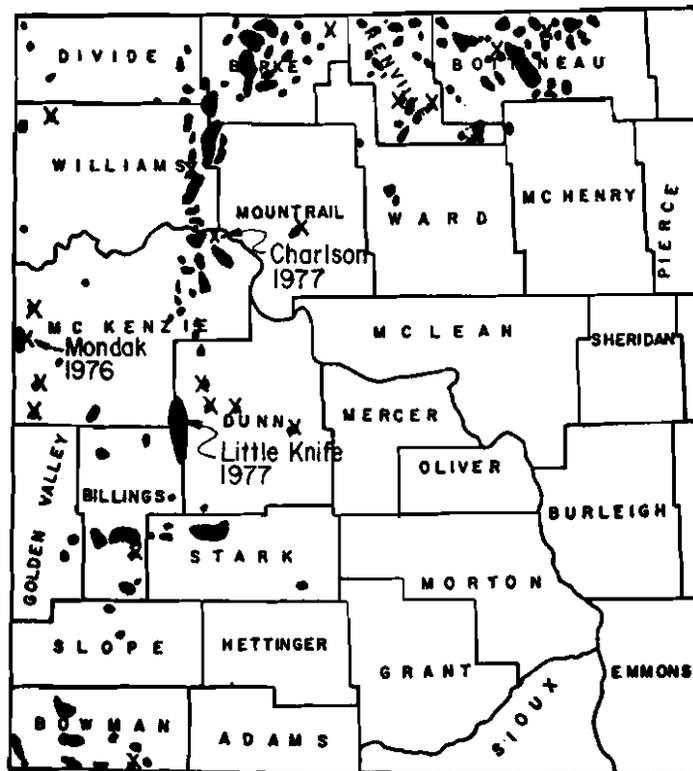
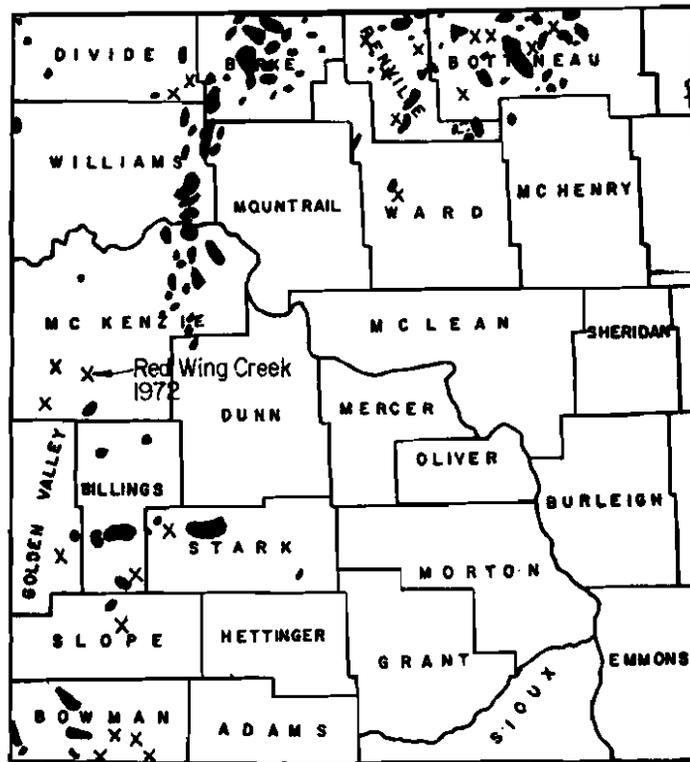


Figure 5. Major new field discoveries (x symbols) between 1970 and 1975 (upper map) and in 1976-1977 (lower map). Some of the important discoveries mentioned in the text are located on the maps.

discoveries were drilled. The first of these, the Charlson-Silurian Pool (fig. 5), proved that production rates in excess of 2,000 barrels of oil a day were possible in North Dakota. Although the multiple-pay Mondak Field, discovered in 1976, turned out to be one of North Dakota's largest oil fields, it was the discovery of Little Knife in 1977 (fig. 5) that drew national attention to North Dakota. Located at the junction of Billings, Dunn, and McKenzie Counties, Little Knife Field demonstrated potential for several zones of production. It is easily over a 100-million-barrel-reserve field.

Drilling continued to increase in 1978 and the wildcat success ratio also improved. Several important 1978 discoveries changed exploration ideas about North Dakota's Williston Basin. Perhaps the most interesting of these was the discovery of Shell Oil Company's Newporte Field in northern Renville County (fig. 6). This opened the first significant Cambrian production in the state, although some Cambrian gas and Cambro-Ordovician hydrocarbons had been produced on the Nesson Anticline. The discoveries at Missouri Ridge and Springbrook north of Williston opened production in southern Williams County and northern McKenzie County. The north-south structural trend through Billings and McKenzie Counties, the "Billings Nose" (fig. 2), finally became productive in a big way with the discovery of the T.R., Four Eyes, and Bull Moose Fields, so that major production was established throughout the western Dunn County, Billings County, and McKenzie County regions.

Continued successes on the Billings Nose and the Mondak Field were highlights in 1979 and 1980 (figs. 6 and 7). The success on the Billings Nose vaulted Billings County into the number one producing spot in North Dakota, where it remained until May, 1984 when it was overtaken once again by McKenzie County. One of the major reasons for this success was the discovery of Big Stick Field in 1979. This field is typical of other Billings Nose fields in that it is a multiple-pay field, producing from the Ordovician Red River, Devonian Duperow, Mississippian Bakken, and Mississippian Madison, with the Madison being the major producing interval. The field has many wells with initial productions

exceeding 400 to 500 barrels of oil per day and several with initial productions above 2,000 barrels of oil per day.

Mondak Field is another multiple-pay field with the Madison being the primary producing horizon. The wells there are not as prolific as those on the Billings Nose, but the field currently covers about 125 square miles in North Dakota alone with 181 wells in the Madison, 4 in the Red River, 2 in the Bakken, and 1 each in the Tyler and Duperow.

THE 1980s

Deep pool successes on the Nesson Anticline were the highlights of this older producing feature in 1979 and 1980. Notable among them were Texaco's Silurian and Ordovician Red River discoveries near the southern end in Blue Buttes Field (an old Madison field), and Northwest Exploration's Dawson Bay and Red River successes along its western flanks near the north end. The Dawson Bay production was also important because it added a new formation to the list of producing formations in the state (however, the Dawson Bay production has since been plugged).

Two new counties were added to the list of North Dakota producers in 1980 with Amoco's Red River discovery in Hettinger County (Tepee Butte Field) and Conoco's Red River success in Mercer County (Dodge Field) (fig. 7). Tepee Butte Field continues to produce from one well, but the single Mercer County well was plugged in 1982.

Discoveries were also made in Golden Valley and Slope Counties in 1980, far from already-existing production. Amerada Hess completed the southernmost Madison producer in North Dakota in Golden Valley County (Bull Run Field) and Terra Resources completed a Red River well in what is now the Marmarth Field in western Slope County.

To the north, in northern Williams County, Hunt completed a Lodgepole producer in the Corinth Field near the town of Wildrose. This was not a big well, but it was important because it produced from a horizon that was largely overlooked in the past. The two wells that were completed in Corinth Field have since been abandoned.

The year 1981 was a successful

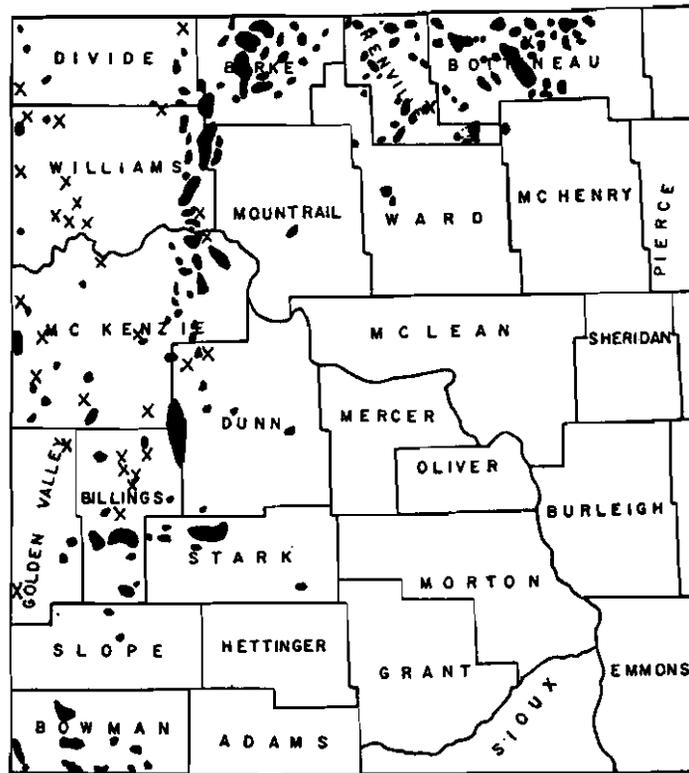
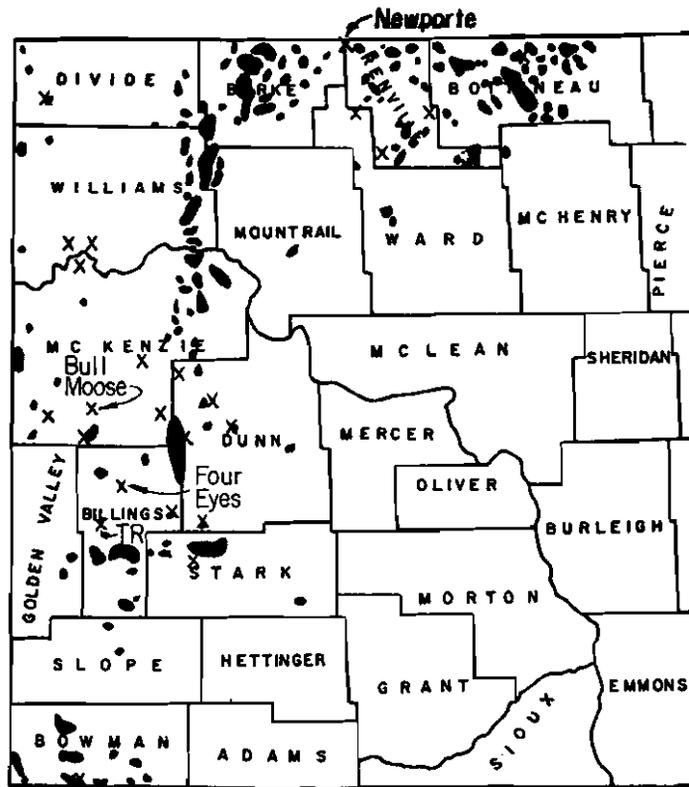


Figure 6. Major new field discoveries in North Dakota in 1978 (upper map) and in 1979 (lower map).

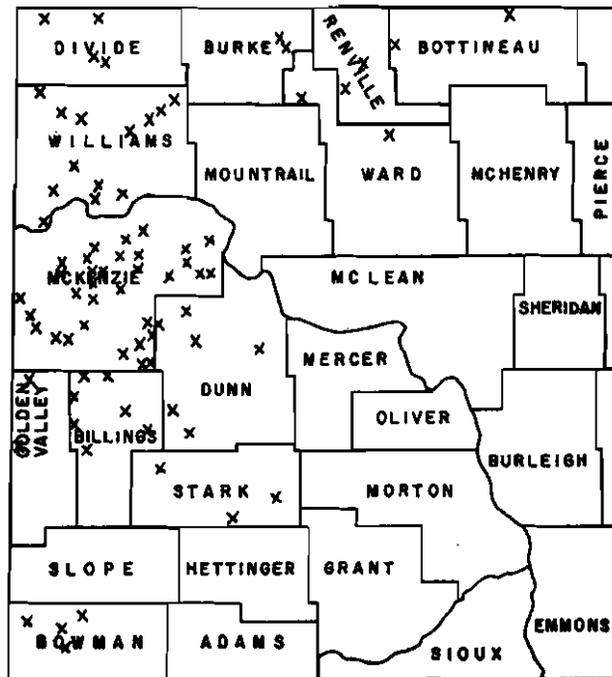
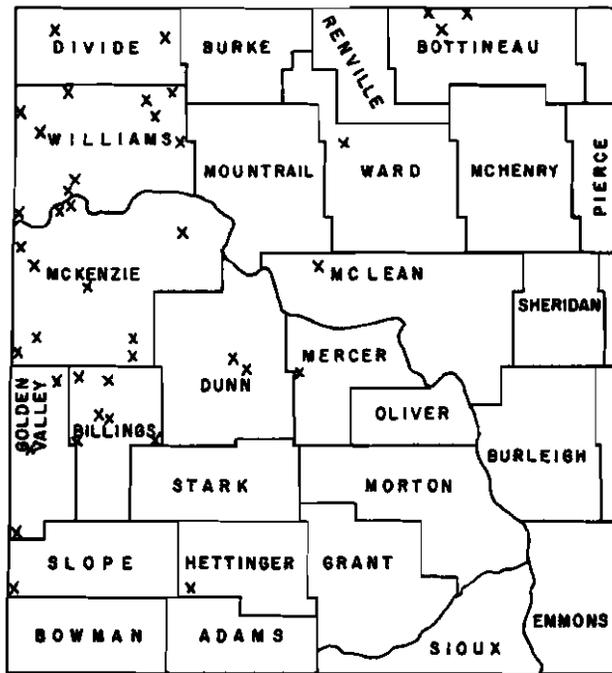


Figure 7. Major new field discoveries in North Dakota in 1980 (upper map) and in 1981 (lower map). Existing fields are not included on the maps from 1980 on to minimize clutter.

one in North Dakota (refer to figs. 7 and 8 for 1981-83 discoveries). New pool discoveries, total production, and revenues all reached new highs. Of the 848 wells that were drilled in North Dakota in 1981, 463 were listed as capable of producing oil or gas. Of the 286 wildcat wells that were drilled, 83 were listed as producers (refer to figs. 9 through 17 for statistical information). Production of oil reached 45.7 million barrels, up from the 39.9 million recorded in 1980. The gross production tax raised about \$77 million for the state and the extraction tax another \$70 million. In addition, oil and gas lease bonus income from state lands totaled \$19 million. McKenzie County was the most successful area, with a total of 34 new pool discoveries in 1981. The Red River Formation accounted for 37 of the 83 new pool discoveries, the Madison 22, and the Duperow 13 (table 1).

Several of the new pool discoveries recorded in 1981 are of more than passing interest. Gulf's Leviathan #1-21-1B (Richardton Field in Stark County) came in with an initial gas production of 3,588 MCF and 150 barrels of oil per day condensate from the Winnipeg-Deadwood. Gulf's two Lone Butte discoveries (Gulf Oil Corp.--Bob Creek Federal #1-13-3B in the Madison and Gulf Oil Corp.--Morman Butte Federal #1-25-3C in the Red River) extended the trend of the Little Knife Field northward. Lone Butte went on to become an important field; a total of 19 wells currently produce there. In Dunn County, Amoco's Skachenko "A" #1 came in with 1,652 barrels of oil per day from the Duperow, placing the Jim Creek Field between the Killdeer and Rattlesnake Point Fields, both of which also produce from the Devonian. This well was still producing almost 500 barrels of oil a day in July, 1984.

The discovery of oil in 1981 in the Bluell beds of the upper Mission Canyon Formation in north-central Burke County heightened interest in this horizon as well as in the slightly deeper Sherwood bed. Earlier production was from the higher Midale and Rival subintervals. As a result of the discovery (Monsanto--Bird #1) in the Bluell beds, new production is being established from these new horizons. Another result of the discovery is that the industry is now re-evaluating the Burke County area where previous

drilling had penetrated only the Midale and Rival subintervals of the Frobisher-Alida.

Lower prices resulting from an oversupply of crude oil, high drilling costs, and certain other economic factors resulted in a downturn in exploratory drilling activity in 1982 in the Williston Basin (figs. 9 and 10). Reductions also occurred in permitting activity (622 permits issued, 174 of them for wildcat locations), total number of wells drilled in the state (683), and in the number of drilling rigs operating (fig. 13). However, even with fewer drilling rigs operating in North Dakota in 1982, successful wildcat completions, some of which proved to be significant, continued at a relatively high rate, reaching a new high of 102 (of 207 attempted), compared to the 83 completed in 1981 (fig. 11). Oil production also continued to rise in 1982, reaching 47.3 million barrels, up from the 45.6 million barrels produced in 1981 (fig. 12). Revenues to the state continued at a high level, with net oil and gas tax collections exceeding \$160 million during calendar year 1982 (fig. 14). Table 2 indicates the percentage of the income in North Dakota from several sources (please note that the data in table 2 are given for fiscal years, not calendar years).

Of the 102 new pool discoveries recorded in North Dakota in 1982 (tables 1 and 3) about 80 were still producing oil or gas at the end of 1983. McKenzie County led the way with 50 new pool discoveries in 1982, followed by Williams County with 16 and Billings County with 9. Although the rate of discoveries on the Billings Nose slackened in 1982 and 1983, at least two new (1982) discoveries along the southwestern flank of that feature are worth mentioning. Discoveries in the Duperow in the Roosevelt Field, currently producing from 4 wells, and the new Morgan Draw-Madison Pool, currently with 4 wells also, have both continued to be good producers. Gulf's Snow-Madison (Gulf Oil Corp.--Zastoupil #1-26-3B) may extend the Little Knife trend southward some distance.

In McKenzie County, 1982 discoveries of new producing horizons in established fields added considerable production to these older areas. A few examples are the Elk-Silurian Pool, now with 5 wells; Keene-Silurian Pool with 8 wells (the average Keene-

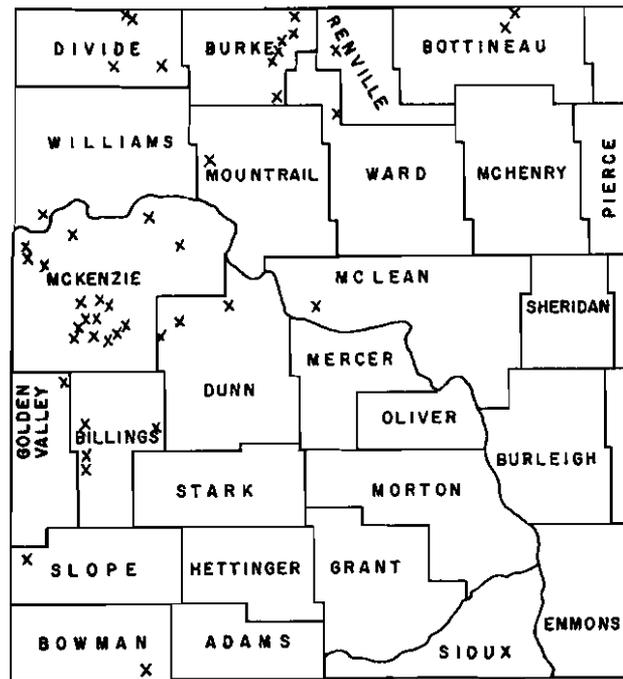
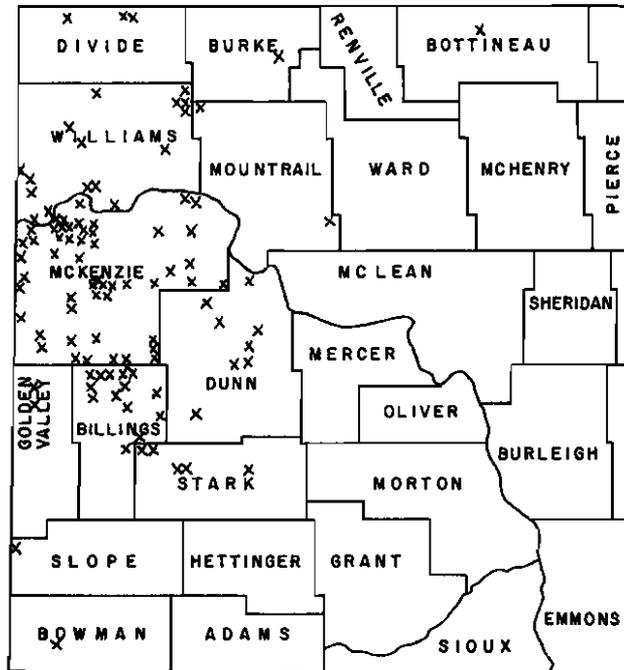


Figure 8. Major new field discoveries in North Dakota in 1982 (upper map) and in 1983 (lower map).

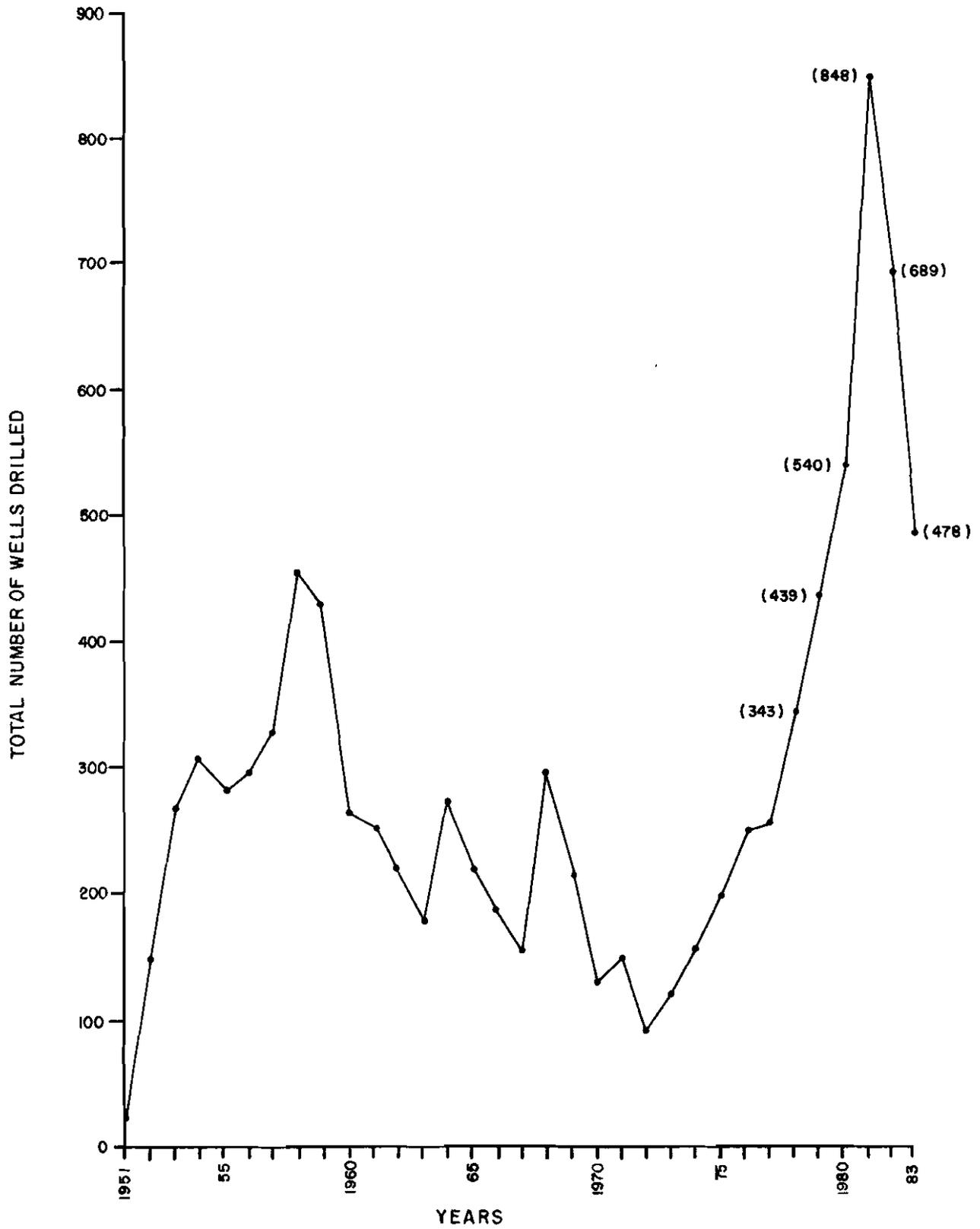


Figure 9. Graph showing the number of wells drilled in North Dakota each year since oil was discovered in 1951. The total for each year includes both exploratory and development wells.

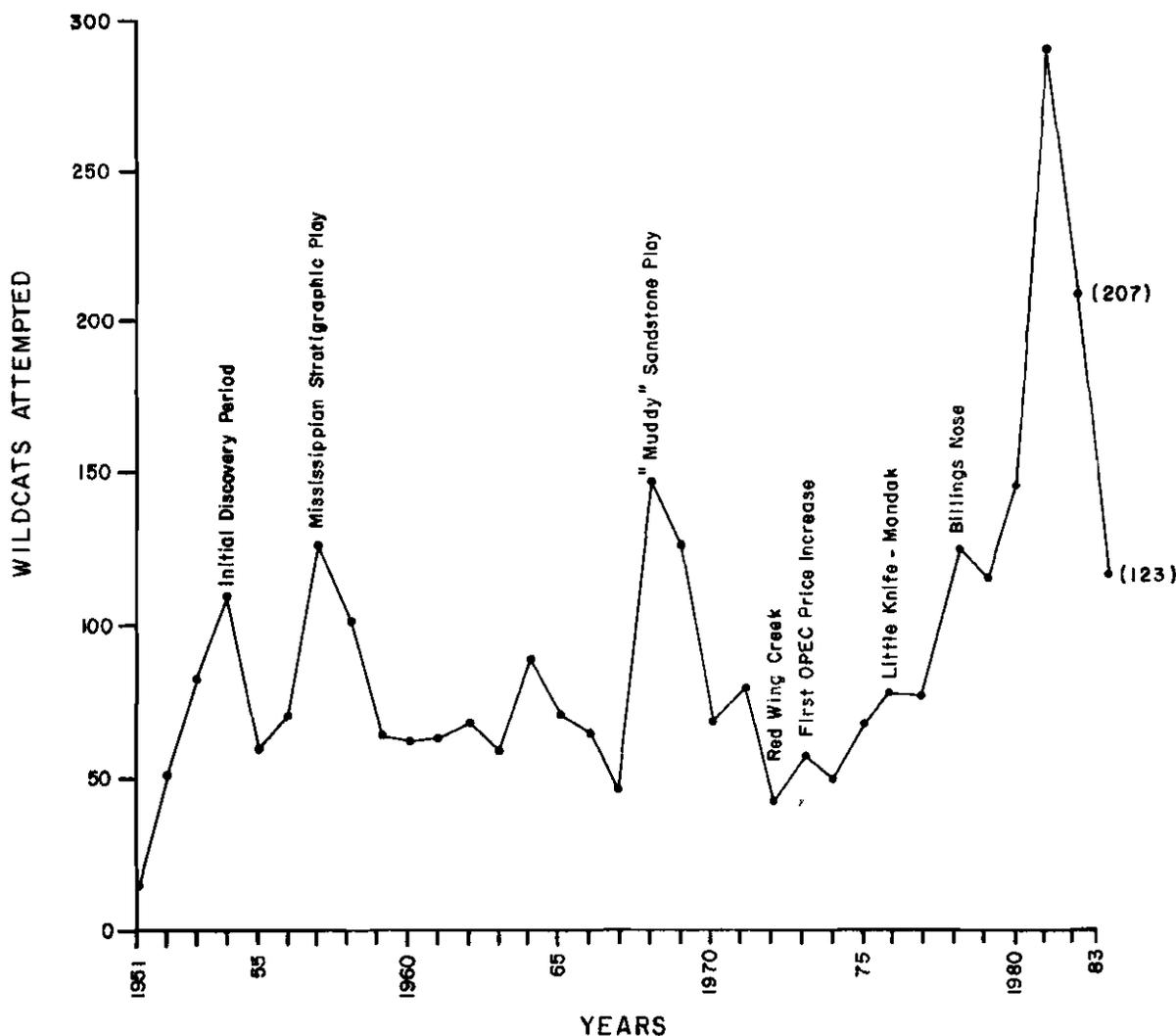


Figure 10. Graph showing the number of wildcat wells drilled in North Dakota each year since oil was discovered in 1951. Some of the major events affecting drilling activity are noted on the graph.

Silurian well currently produces over 100 barrels of oil a day); Indian Hill-Silurian Pool (6 wells, averaging nearly 500 barrels daily each); and Indian Hill-Madison Pool (19 wells averaging about 200 barrels a day). Discoveries in McKenzie County in 1982 also included North Branch-Red River, Buffalo Wallow-Duperow, the multiple-pay Camp Field (12 wells in the Madison, Silurian, and Red River), Glassbluff-Madison, Ragged Butte-Madison (9 wells), and Poe-Madison and Red River (5 wells).

Elsewhere, the Bell Field, discovered in 1982 by the Southport--Decker #1-32 well, continues the Tyler trend through Stark County. Currently, the Bell Field has 9 wells. The discovery

well has continued to be a good producer, coming in at 511 BOPD and currently producing about 175 BOPD. The Dobson Butte--Silurian Pool, discovered by NRM Petroleum's Kirkwood--Kostecky #44-29 well, adds to the several isolated deep-pool discoveries in that area of Stark County. So far, not enough of these Silurian, Red River, and Deadwood/Winnipeg Pools have been found to establish trends in this as yet relatively unexplored area, but continued successes may help to better define the geological relationships and direct future drilling. Certainly, the area deserves continued attention.

In Williams County, activity was concentrated in the Williston area with

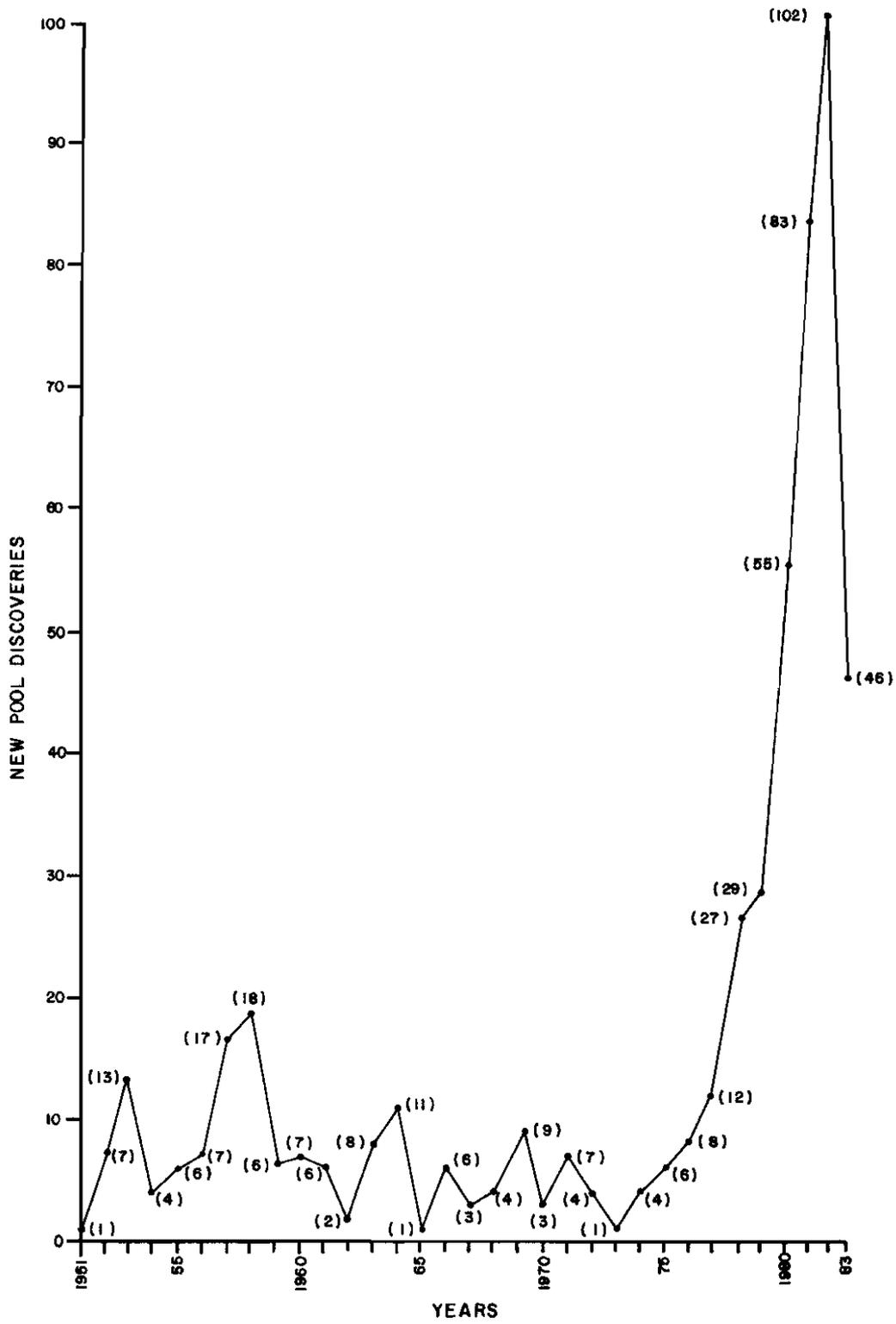


Figure 11. Graph showing the number of new pools discovered each year in North Dakota.

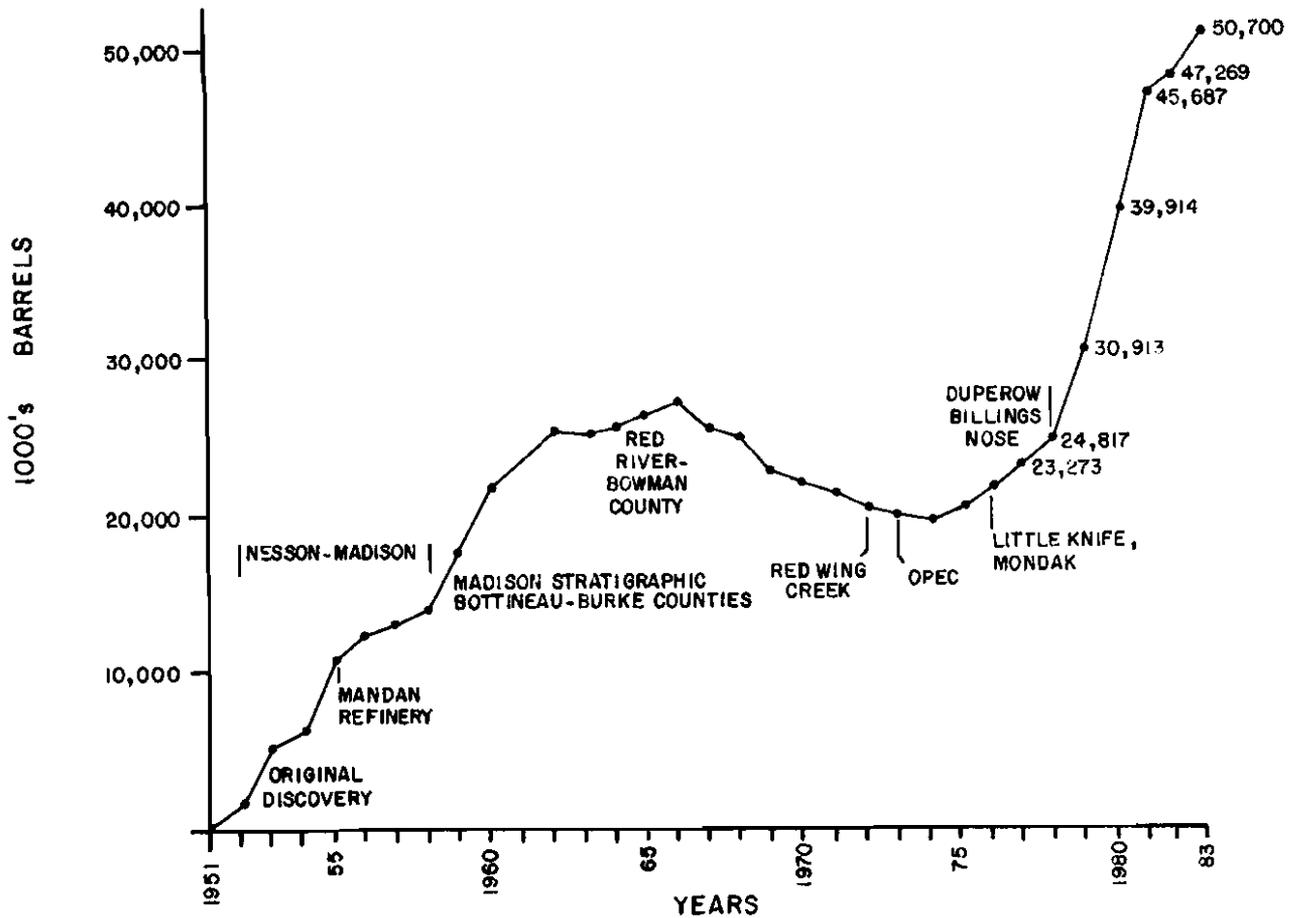


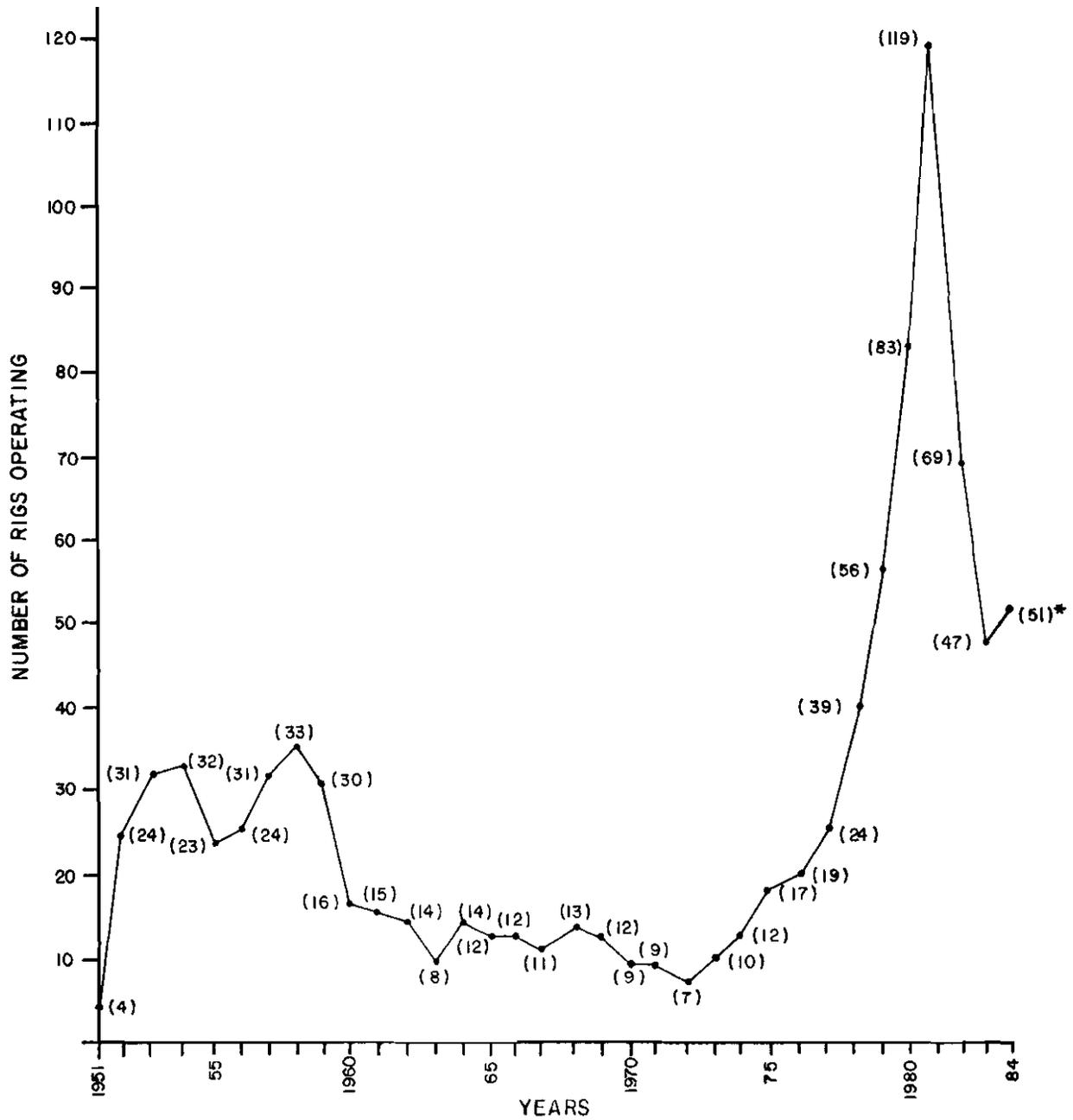
Figure 12. Annual crude oil production in North Dakota. Figures (since 1977) are given in thousands of barrels; thus, the production in 1982 was 47,269,000 barrels. Major events affecting oil production history are noted on the graph.

major new development in the East Fork Field area. Development also continued in Missouri Ridge, Cow Creek, Last Chance, and other fields. Temple Winnipegosis Field, discovered in 1982 by Northwest Exploration's Pederson #3 well, is currently producing from 11 wells, which average about 175 barrels per well daily. Hardscrabble-Red River Pool, with an initial production from Gulf Oil's Skurdal #1-24-3B of 254 BOPD, remains a one-well field.

Of the 473 wells drilled in North Dakota during 1983, a total of 289, or 61 percent of them, were listed as being capable of production. The average well was a little shallower in 1983 than in 1982 (9,154 feet, compared to 10,253 feet), but, more importantly, the depth of the average discovery was 9,245 feet, compared to the 12,000-foot plus recorded in 1982. This reflects the decrease in the

number of Red River Formation and other deep-target tests drilled in 1983. A total of 123 wildcat wells were drilled in 1983 and 46 new pools were discovered (table 4). Permitting activity was also down slightly in 1983, with 614 permits issued, compared to the 666 issued in 1982. The number of rigs operating in North Dakota in 1983 ranged from a low of 16 in April to as many as 75 in mid-December at the end of the fourth quarter.

Some of the 1983 discoveries may prove significant, although conclusive production histories have not yet been established and full development of the new pools has not yet been accomplished. A few of the more promising 1983 discoveries include Adobe's Kordonowy--Fryburg #34-31, a Madison discovery in Bullsnake Field in Billings County currently producing almost 600 BOPD, and Diamond Chemical's Ramona--Federal #21-6 (Knutson



*Figure for 1984 is for first nine months only.

Figure 13. Average number of drilling rigs operating in North Dakota each year since 1950 (weekly average divided by 52).

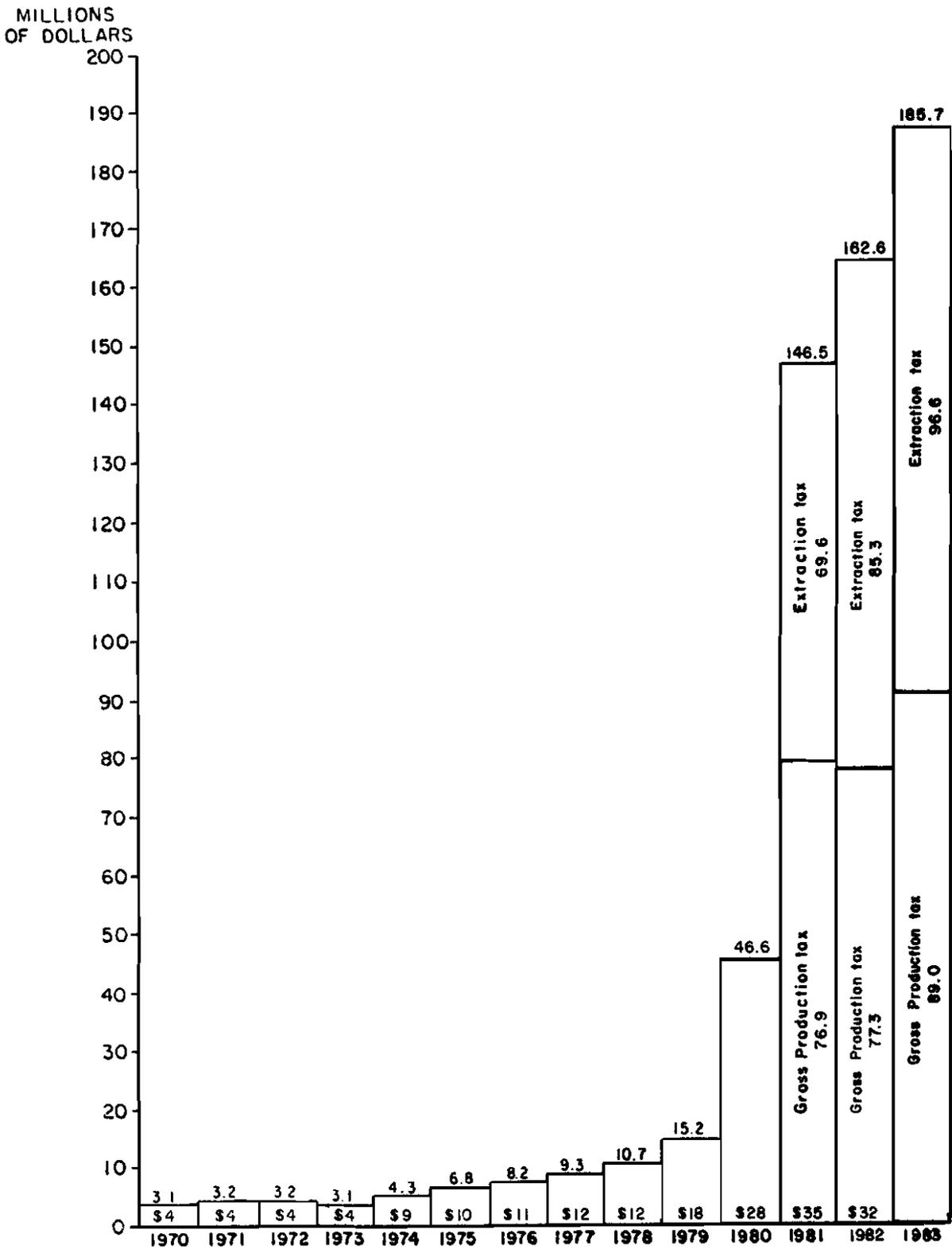


Figure 14. This graph shows the dramatic increase in oil and gas tax revenue to the state of North Dakota resulting from increased production, increased prices, and the new extraction tax. Figures are in millions of dollars; thus, oil and gas tax revenue in calendar year 1983 totalled \$185,700,000. Refer also to table 2.

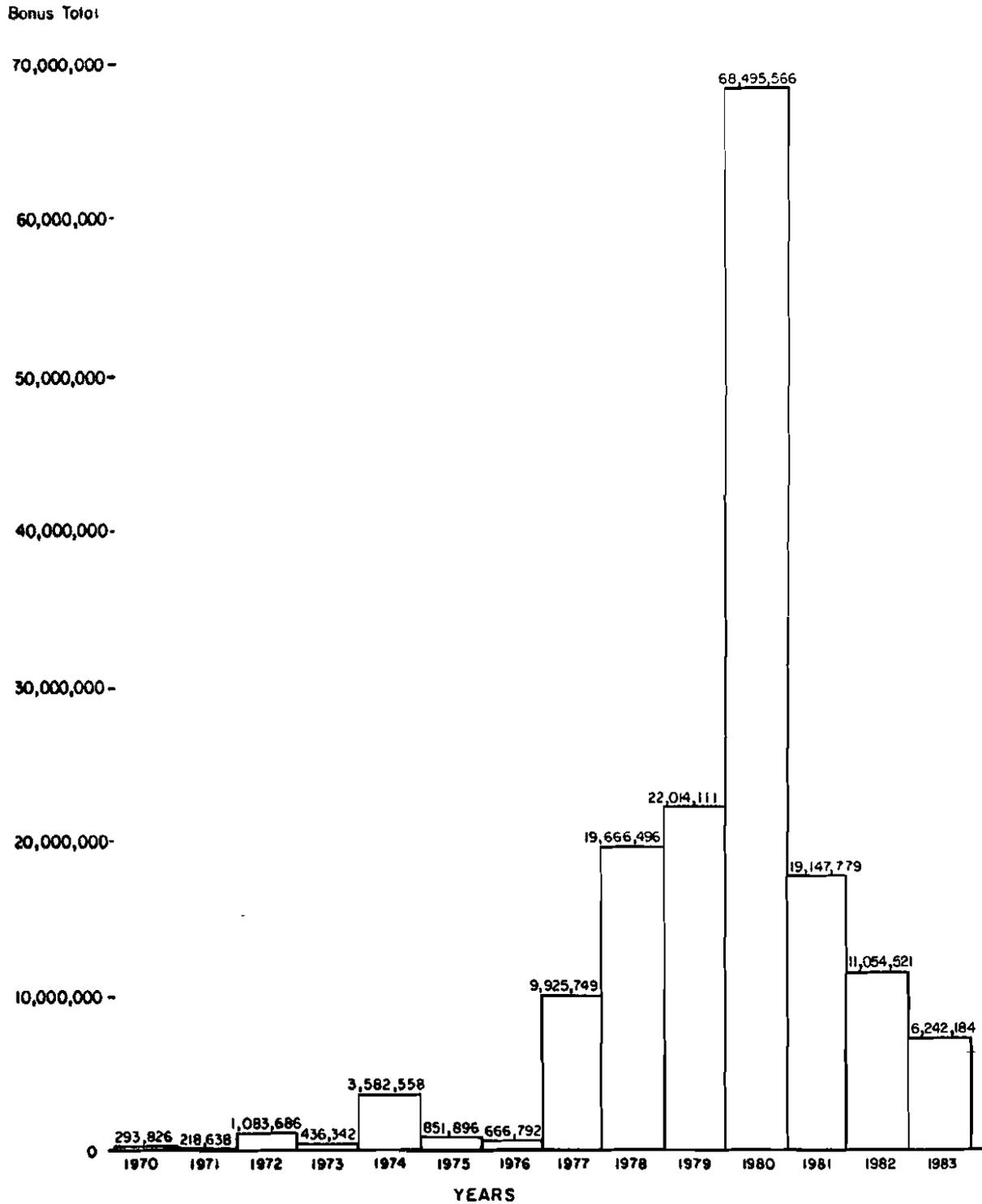


Figure 15. Income to the State of North Dakota from the sale (public auction) of oil and gas leases for state-owned lands. The leases are currently mostly for a 5-year term, with a 1/6 royalty rate and at an annual rental of \$1.00 per mineral acre. Bidding is on the bonus, which is for a minimum of \$1.00 per mineral acre.

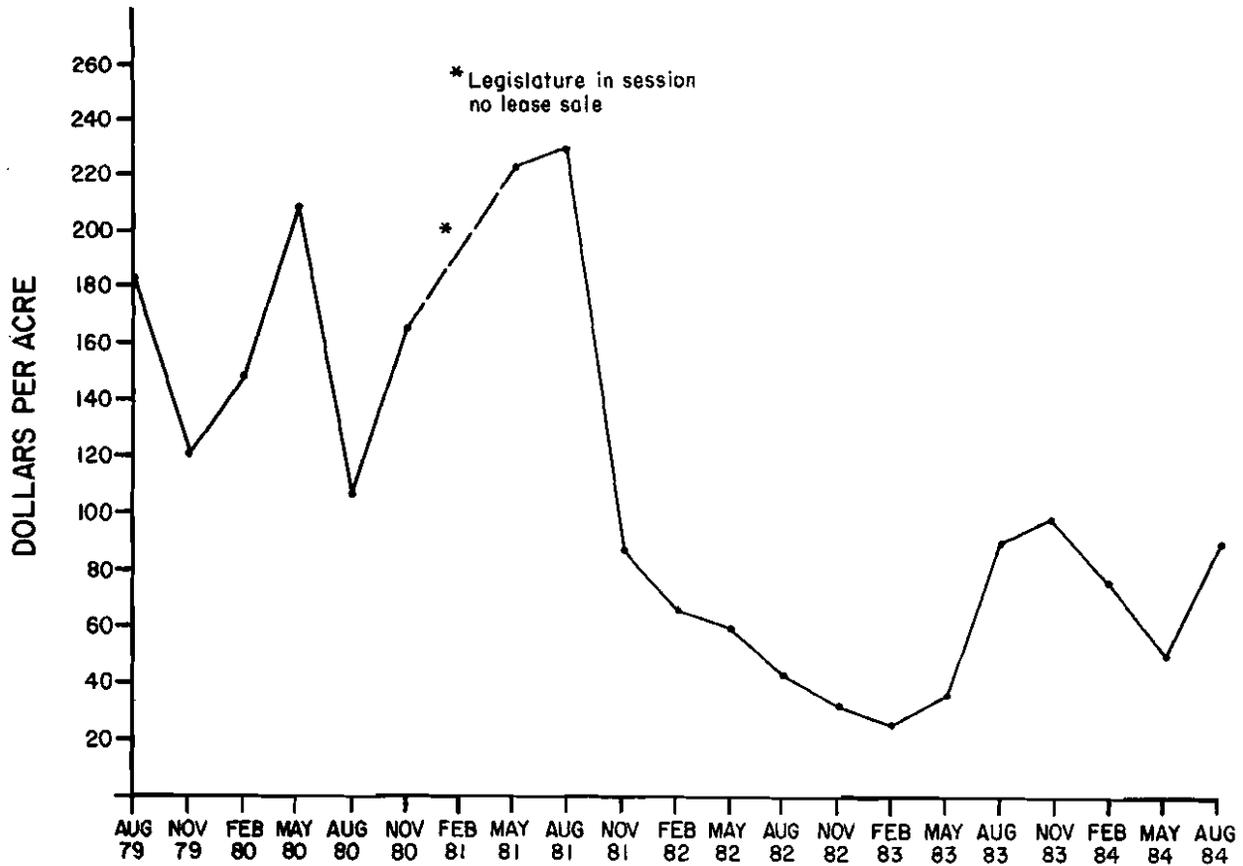


Figure 16. Average price per acre paid in oil and gas lease sales (see fig. 15 also). Lower per-acre prices reflect large offerings in eastern North Dakota away from known producing areas. Highest prices are for lands with good potential.

Field), a Madison discovery immediately west of the South Unit of Theodore Roosevelt National Park. The park is rapidly becoming surrounded by highly productive fields, with new development including Knutson Field and a southerly extension of Whiskey Joe Field on the north.

Increased exploratory activity in Divide County, headed by Conoco, Louisiana Land and Exploration, and Texaco, resulted in several discoveries in the Red River and Duperow Formations. Texaco's Gin Han--NCT #1 in the Red River (Paulson Field) may be a significant discovery. Others include the Clinton, Garnet, and Plumer Fields (all Red River discoveries), and the Musta-Duperow Field. Getty Oil's Wildrose #36-5 well in the Winnipegosis (Moraine Field) came in at 497 BOPD and continues to be a good producer.

Major McKenzie County activity in

1983 and since has been concentrated mainly in the area south of Williston (Glassbluff, Indian Hills, Elk, Camp, and Sioux Fields) where a number of prolific wells have been completed. Continued deep development on the Nesson Anticline in McKenzie County resulted in a number of Silurian completions in Keene, Blue Buttes, and Camel Butte Fields in 1983. Elsewhere in McKenzie County, wildcat drilling in 1983 resulted in a number of discoveries, particularly in the northern and western parts of the county, ranging from Red River to Madison. Discoveries in western McKenzie County included Pennzoil's Duperow discovery in Boxcar Butte Field (Pennzoil--Spring Creek BN #27-31) and its discovery of the Snowcover-Red River Pool (Pennzoil--Snowcover #13-33 BN). Getty Oil's Dore #3-10X of the Nelson Bridge-Red River Pool also helped to show the

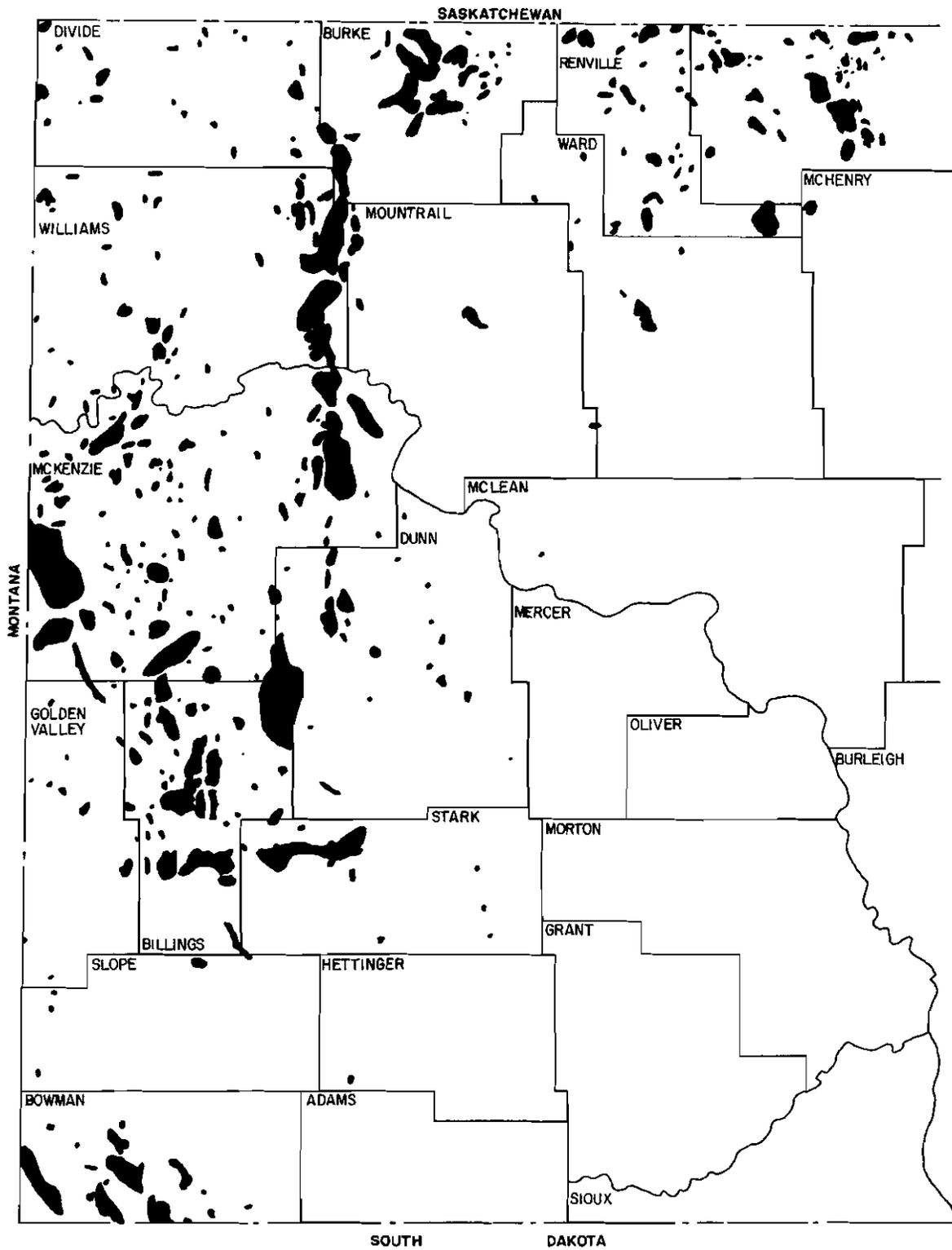


Figure 17. Map of western North Dakota showing areas of known oil pools as of the end of 1983.

TABLE 1.--North Dakota Oil and Gas Discoveries in 1982 and 1983.

	<u>1982</u>	<u>1983</u>		<u>1982</u>	<u>1983</u>
Billings County Total	14	4	McKenzie County (Cont.)		
Madison	3	2	Devonian, undiff.	1	0
Bakken	2	0	Silurian	8	1
Duperow	6	0	Red River	21	6
Red River	3	1	McLean County Total	0	1
Tyler	0	1	Madison	0	1
Bottineau County Total	1	2	Mountrail County Total	2	1
Spearfish	0	2	Madison	2	0
Madison	1	0	Red River	0	1
Bowman County Total	1	1	Renville County Total	0	1
Red River	1	1	Madison	0	1
Burke County Total	1	6	Slope County Total	1	1
Madison	1	6	Red River	1	1
Divide County Total	3	4	Stark County Total	4	0
Madison	0	2	Tyler	1	0
Winnipegosis	0	1	Silurian	1	0
Red River	3	1	Red River	1	0
Dunn County Total	7	2	Deadwood	1	0
Bakken	3	0	Ward County Total	0	1
Duperow	3	1	Madison	0	1
Red River	1	1	Williams County Total	16	1
Golden Valley Co. Total	2	1	Madison	4	0
Duperow	1	0	Bakken	2	0
Red River	1	1	Lodgepole/Bakken	1	0
McKenzie County Total	50	19	Duperow	2	1
Madison	10	6	Dawson Bay	1	0
Bakken	4	2	Winnipegosis	2	0
Birdbear	2	1	Silurian	1	0
Duperow	4	3	Red River	3	0

continuing potential of the deeper basin horizons.

Mesa's Fenton 27 #1 Duperow discovery in 1983 in Dunn County (Bear Creek Field), with an initial production of 926 BOPD, along with at least four excellent development wells, helps to fill in the Croff-Bear Den-Rattlesnake Point trend in the Killdeer Mountains area. The Bear Creek-Duperow discovery well is currently producing about 150 BOPD and the average well in the pool is producing almost 500 BOPD.

The Randolph-Duperow Pool, discovered by the Tom Brown-Federal #19-42, had an initial production rate of 1,119 BOPD (currently it produces at 180 BOPD) and may prove to be significant. Other potentially important

discoveries include Aminoil's Buffalo Wallow-Mission Canyon and Duperow Pools and the Covered Bridge-Birdbear Pool (Getty Oil--Covered Bridge #10-11).

Discovery of oil in the Spearfish in the Souris Field (Norcen Energy--Fylling Fee #1) is an apparent extension of the highly successful Waskada oil play just across the international border in Manitoba. Over 200 productive wells have been drilled in the Waskada Field, an area of about 8,000 acres. Spearfish fields discovered in North Dakota as a result of this exploratory activity are the North Roth, Southwest Starbuck, Souris, and Red Rock Fields, all in Bottineau County. The Red Rock discovery is now the farthest east production in North

TABLE 2.--Percentage of Tax Income to State of North Dakota from Various Sources (figures given as percent of total revenues).

<u>Tax</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>
Oil and Gas *	9	22	35	35
Sales	33	29	26	27
Income	26	25	17	16
Motor Vehicle	14	10	10	7
Coal Severance	4	4	4	4
Cigarette	3	2	2	2
Other	12	8	6	9

* Oil and gas taxes equal the sum of the revenues from the gross production tax and the oil extraction tax.

The increasing importance of oil and gas tax revenues to the State of North Dakota is shown on this table. Oil and gas taxes increased from 9 percent of total tax revenues in fiscal year 1980 to 35 percent in 1982 and 1983. During that same period of time, total tax revenues were as follows (oil and gas taxes in parentheses): \$325.8 million (\$29.7 million) in 1980; \$402.9 million (\$87.6 million) in 1981; \$484.3 million (\$169.2 million) in 1982; and dropping back to \$471.8 million (\$166.7 million) in 1983.

Dakota. Prior to this, the Spearfish had produced in the Newburg, South Westhope, Landa, Northeast Landa, Roth, West Roth, and Russell Fields, but with the exception of the Northeast Landa Field (Phillips Petroleum--Oscar M. Aftem #1 well) and the Roth Field (Phillips--Arthur Nelson #1 well), production was from a slightly lower pay interval at the base of the Spearfish. The Aftem and Nelson wells produce from the same interval as wells in the Waskada Field in Canada. However, it was not until Waskada production began that any attention was given those wells. It is anticipated that, over the next few years, exploratory activity for Spearfish targets will increase.

TAX REVENUES

According to figures supplied by the Office of the State Tax Commissioner, taxes collected on oil and gas production during the 1981-83 biennium became the most important single source of tax revenues to the state

(table 2). In the 1981-83 biennium, collections of oil and gas taxes totaled \$336 million, an increase of \$218.8 million from the \$117.2 million collected in 1979-81. Collections of oil and gas taxes stood at only \$24.3 million during the 1977-79 biennium. Of the total tax revenues to the state during the 1981-83 biennium (\$956.1 million), the \$336 million from oil and gas represents 35 percent of the total (table 2). By comparison, the number two producer of tax revenue for the state, the sales tax, amounted to 27.2 percent of the total tax revenues and income taxes accounted for 16.4 percent.

Collections of the oil and gas gross production tax increased during the 1981-83 biennium to \$159.7 million, up \$66.1 million from the \$93.6 million collected during 1979-81 (fig. 14; but please note that figures on figure 14 are for calendar years, not fiscal years). In 1981, the state began collecting the new oil and gas extraction tax that was adopted in 1980. In summary, the reasons that oil and gas taxes became the number one source of tax revenues to North Dakota are: (1)

Table 3.—Oil and Gas Discoveries in North Dakota During 1982.

County, File No., Order No.	Comp. Date	Operator, Well, Location	Field, Pool (Number of Wells Currently in Pool)	Spacing	Total Depth	Interval Perforated	Initial Prod. (Current Daily Production) (Bbls. Oil)	Gravity	GOR	Water %
Billings 8601 2745	01-30-82	Cities Service Co. Federal DF #1 NWNW Sec. 6-144-100	Ice Caves- Red River (-)	320	13,647	13,516-13,520	42 (-)	-	42,857	23
Billings 8601 2745	03-03-82	Cities Service Co. Federal DF #1 NWNW Sec. 6-144-100	Ice Caves- Duperow (2)	320	13,647	11,606-11,614	552 (240)	40°	833	15
Billings 8596 2692	02-12-82	Diamond Shamrock Corp. Federal #11-10 NWNW Sec. 10-142-102	Roosevelt- Duperow (4)	320	12,635	10,828-10,838	336 (36)	37.8°	1,062	17
Billings 9200 2633	03-27-82	Adobe Oil & Gas Corp. Kordonowy Twin #34-31 SWSE Sec. 31-142-98	Bullsnake- Duperow (1)	320	12,140	11,311-11,359	559 (140)	35°	900	0
Billings 8972 2788	03-03-82	Everett Drlg Ventures Inc. Federal #5-22 SWNW Sec. 22-143-100	St. Jacobs- Duperow (1)	160	11,486	11,208-11,248	76 (14)	44.5°	1,237	63
Billings 8234 2703	03-31-82	Coastal Oil & Gas Corp. BN 29-144-102 #1 NWNW Sec. 29-144-102	Morgan Draw- Madison (4)	160	12,754	9,215- 9,219 9,231- 9,236	152 (50)	29.5°	165	60
Billings 8070 2846	10-05-82	Coastal Oil & Gas Corp. BN 19-144-102 #1 SESE Sec. 19-144-102	Morgan Draw- Duperow (-)	320	11,150	10,932-10,938 10,944-10,947 10,975-10,984	9 (-)	43.5°	163	6
Billings 8070 2846	10-05-82	Coastal Oil & Gas Corp. BN 19-144-102 #1 SESE Sec. 19-144-102	Morgan Draw- Bakken (-)	320	11,150	10,443-10,453	81 (-)	43.5°	1,470	57
Billings 8363 2815	05-12-82	Al-Aquitaine BN #1-23 NWNE Sec. 23-143-102	Elkhorn Ranch- Red River (-)	320	12,650	12,470-12,479	60 (-)	43°	1,000	34
Billings 9410 2853	05-20-82	Gulf Oil Corp. Zastoupil #1-26-3B NESE Sec. 26-142-98	Snow-Madison (2)	160	10,040	9,668- 9,674	282 (255)	40.6°	908	3
Billings 9218 2854	03-17-82	Jerry Chambers Expl. Co. Allred Federal #11-1 NESW Sec. 1-141-102	DeMores-Bakken (1)	320	11,050	10,424-10,454	64 (22)	40°	1,100	0
Billings 9070 2847	11-22-82	Adobe Oil & Gas Corp. L. Luptak #23-31X NESW Sec. 31-141-99	Park-Madison (1)	320	13,404	9,618- 9,624	182 (13)	39°	TSTM	6
Billings 9321 2998	10-07-82	Davis Oil Co. Jackrabbit Federal #1 SESE Sec. 8-143-100	Gorham-Duperow (1)	320	13,398	11,423-11,432	253 (46)	41°	1,518	1
Bottineau 9299 2755	01-07-82	Leeman Energy Corp. Aune #1 NWSW Sec. 6-162-79	Sergis-Madison (1)	80	3,530	3,343- 3,360	40 (6)	32°	-	75
Bowman 9805 3041	11-10-82	Williams Co. Wallman #1 NESW Sec. 32-130-104	Nebo-Red River (1)	160	9,967	9,185- 9,186	52 (13)	37°	-	40
Burke 9151 2649	02-01-82	Resources Invest., Corp. Lostwood #1-11 SWSE Sec. 11-161-90	Lostwood- Madison (3)	80	6,800	6,186- 6,218	492 (15)	35.3°	950	-
Divide 9413 2774	04-13-82	Texaco, Inc. Haugland #1 SESE Sec. 16-163-98	Blooming Prairie- Red River (1)	320	11,400	10,791-10,808	338 (41)	43.8°	876	5

Table 3.--Continued

County, File No., Order No.	Comp. Date	Operator, Well, Location	Field, Pool (Number of Wells Currently in Pool)	Spacing	Total Depth	Interval Perforated	Initial Prod. (Current Daily Production) (Bbls. Oil)	Gravity	GOR	Water %
Divide 9528 2975	08-20-82	Conoco, Inc. Moore #20-1 NNW Sec. 20-163-102	Skjermo-Red River (4)	320	11,120	10,628-10,650	65 (31)	38°	TSTM	31
Divide 9622 2968	08-21-82	Texaco, Inc. Arnold Hagen State #1 NNW Sec. 10-163-98	CanDak-Red River (2)	320	11,350	10,682-10,692	50 (26)	41.7°	1,020	82
Dunn 8491 2679	01-12-82	Mesa Petroleum Co. Bullinger #1-30 NESW Sec. 30-142-96	Russian Creek- Red River (1)	320	13,200	13,042-13,070	72 (35)	60°	15,278	57
Dunn 9044 2680	01-21-82	ANR Production Company Hansen #1-11A SESW Sec. 11-146-93	Wolf Bay- Duperow (1)	320	14,120	10,974-11,022	401 (60)	32.2°	220	40
Dunn 8313 2740	02-15-82	Mesa Petroleum Co. Hausauer 22 #1 NWSW Sec. 22-145-93	Lake Ilo- Duperow (1)	320	13,848	10,824-10,866	250 (87)	36°	99	23
Dunn 8448 2458	03-04-82	Samedan Oil Corp. Lost Bridge State #1-16 NENE Sec. 16-148-96	Lost Bridge- Bakken (1)	320	11,801	10,949-11,070	10 (13)	42°	-	0
Dunn 9402 2895	06-29-82	Amoco Production Co. Kupper Amoco "A" #1 SWNW Sec. 15-146-95	Chimney Butte- Duperow (1)	320	14,025	11,476-11,482 11,490-11,502	71 (26)	42.3°	1.3	77
Dunn 8709 3074	08-10-82	Shell Oil Co. Burbank BIA #23-8 NESW Sec. 8-147-93	Moccasin Creek- Bakken (1)	320	14,430	10,516-10,624	34 (97)	39.7°	382	26
Dunn 9502 2987	10-01-82	Crawford Energy, Inc. Kovaloff #1 NESE Sec. 13-144-96	Murphy Creek- Bakken (1)	160	13,812	10,806-10,818 10,854-10,864	34 (10)	37.3°	571	5
Golden Valley 8959 2772	03-24-82 (Plugged 02-01-83)	Al-Aquitaine Expl., LTD. Jones Ranch #14-34 SESW Sec. 34-143-104	Pearl-Duperow (-)	320	12,550	10,937-10,945	30 (-)	26.9°	1,000	0
Golden Valley 8324 2897	08-13-82	Gulf Oil Corp. Barkland #1-18-2A NWNW Sec. 18-142-104	Bonnie View- Red River (1)	320	12,440	12,335-12,381	109 (28)	28.1°	750	4
McKenzie 9006 2709	01-28-82	The Superior Oil Co. Barrows #1 SESE Sec. 23-152-102	Elk-Interlake (5)	320	14,200	13,234-13,262	528 (22)	45.5°	994	21
McKenzie 9037 2714	02-04-82	Amarex Inc. Fettig #1 SESE Sec. 21-149-94	Squaw Creek- Red River (1)	320	14,501	14,141-14,155	346 (27)	50°	1,500	3
McKenzie 9138 2797	02-25-82	W.H.H.T.E. Koller #1 SWSE Sec. 22-146-98	Ranch Coulee- Red River (1)	640	14,200	13,839-13,844 13,846-13,850	19 (0)	52.1°	51,579	75
McKenzie 8340 2717	02-08-82	Belco Petroleum Corp. Edgar BN #11-13 SENE Sec. 13-145-101	Rough Rider- Red River (1)	320	13,270	13,016-13,092	189 (0)	52°	5,862	17
McKenzie 9005 2779	02-05-82	Gulf Oil Corp. Federal #1-21-3D SWSE Sec. 21-145-100	Rhoades- Red River (1)	320	13,924	13,311-13,319	63 (SI)	-	27,619	23
McKenzie 9034 2887	01-02-82	Tom Brown, Inc. Melland #29-6 SESW Sec. 29-150-104	Estes-Madison (2)	160	9,367	9,043- 9,099 9,131- 9,156	32 (20)	38°	1,875	89

Table 3.-Continued

County, File No., Order No.	Comp. Date	Operator, Well, Location	Field, Pool (Number of Wells Currently in Pool)	Spacing	Total Depth	Interval Perforated	Initial Prod. (Current Daily Production) (Bbls. Oil)	Gravity	GOR	Water %
McKenzie 8400 2858	05-12-82	Pennzoil Expl. & Prod. Co. BN Six Creek #27-13 NWSW Sec. 27-145-102	Six Creek- Red River (1)	320	12,922	12,688-12,701	72 (4)	40°	417	48
McKenzie 9252 2859	05-08-82	Pennzoil Expl. & Prod. Co. BN Riverside #25-32 SWNE Sec. 25-146-102	Riverside- Red River (1)	320	13,265	13,104-13,136	866 (59)	50.4°	1,519	21
McKenzie 8883 2860	04-25-82	Pennzoil Expl. & Prod. Co. BN Bowline Creek #35-24 SESW Sec. 35-148-102	North Branch- Red River (2)	320	13,427	13,292-13,310	659 (66)	49.8°	1,704	0
McKenzie 9470 2855	06-11-82	Aminoil USA, Inc. Nelson #1-7X NENE Sec. 7-148-100	Buffalo Wallow- Red River (-)	320	13,906	13,754-13,764	319 (-)	54.6°	11,325	0
McKenzie 9470 2999	06-11-82	Aminoil USA, Inc. Nelson #1-7X NENE Sec. 7-148-100	Buffalo Wallow- Duperow (2)	320	13,906	11,610-11,618	408 (131)	44°	1,074	7
McKenzie 9318 2836	06-18-82	Universal Resources Corp. T. K. #1-30 SENE Sec. 30-153-95	Keene-Silurian (8)	160	13,157	11,940-11,946	575 (113)	50°	1,804	0
McKenzie 7167 2936	06-19-82	Pennzoil Expl. & Prod. Co. Little Tank BN #19-21 NENW Sec. 19-148-101	Little Tank- Red River (1)	320	13,650	13,470-13,514	557 (70)	54.1°	2,200	8
McKenzie 8604 2937	06-16-82	Pennzoil Trailside #3-21F NENW Sec. 3-146-100	Trailside- Duperow (1)	320	13,514	11,355-11,361	116 (15)	44.2°	458	34
McKenzie 9334 2869	07-07-82	Broschat Engr./Jogruss Oil Kirkland #1 NENW Sec. 12-149-96	Croff-Red River (1)	320	14,288	14,116-14,162	192 (182)	54°	10,900	0
McKenzie 8187 2896	07-08-82 (Test)	W.H.H.T.E. Lyvoid Larson #1 NWNE Sec. 10-148-101	Bear Butte- Birdbear (1)	320	15,059	11,348-11,352	15 (29)	44.3°	1,125	83
McKenzie 9504 2880	08-12-82	The Superior Oil Co. Stepanek et al #1 E/2 NW Sec. 28-152-101	Camp-Silurian (1)	320	13,890	13,286-13,304	140 (28)	45.7°	2,807	23
McKenzie 8963 2804	09-13-82	Pogo Producing Co. Schmitz #1-9 NWSW Sec. 9-152-101	Camp-Red River (3)	320	13,825	13,588-13,624	58 (36)	N/A	1,103	46
McKenzie 9593 3052	10-20-82	The Superior Oil Co. Nelson "A" #1 SESW Sec. 29-152-101	Camp-Madison (8)	160	13,900	9,320-10,009	25 (13)	38.2°	1,570	82
McKenzie 9403 2939	08-20-82	Sun Expl. & Prod. Co. Erickson #1-27 NWSE Sec. 27-152-103	Glass Bluff- Madison (12)	160	13,600	9,244- 9,266	97 (42)	38.1°	404	17
McKenzie 9507 2963	09-02-82	The Superior Oil Co. Nelson et al #2 SWSE Sec. 1-152-102	Indian Hill- Silurian (6)	320	13,850	13,168-13,271	325 (212)	45.1°	1,207	48
McKenzie 6501 2994	09-24-82	Gulf Oil Corp. Eckert Foundation #1 NESE Sec. 6-152-101	Indian Hill- Madison (19)	160	13,985	9,462- 9,468	305 (86)	37.1°	426	1
McKenzie 9617 2957	09-21-82	SunBehm Gas, Inc. Bolken #24-12 NWSW Sec. 24-151-101	Alexander- Madison (4)	160	13,846	9,474- 9,484	174 (54)	41°	1,084	36

Table 3.-Continued

County, File No., Order No.	Comp. Date	Operator, Well, Location	Field, Pool (Number of Wells Currently in Pool)	Spacing	Total Depth	Interval Perforated	Initial Prod. (Current Daily Production) (Bbls. Oil)	Gravity	GOR	Water %
McKenzie 8992 3072	11-24-82	Shell Oil Co. USA #11-4-76 NWNW Sec. 4-149-104	Estes-Bakken (-)	320	12,935	10,375-10,450	13 (-)	37.8°	308	73
McKenzie 8322 2734	03-21-82	HNG Oil Co. Link #34-1 SWSE Sec. 34-151-102	Nameless- Silurian (2)	320	13,700	13,163-13,191	340 (124)	52°	2,588	0
McKenzie 9180 2799	03-22-82	Pogo Producing Co. Johnsrud #1-3 SESE Sec. 3-149-98	Pembroke- Red River (-)	320	14,432	14,284-14,395	58 (-)	61.5°	39,199	0
McKenzie 8933 2769	03-13-82	Flying J Expl. & Prod. Co. State #13-26 SWSW Sec. 26-150-97	North Fork- Silurian (1)	320	13,760	13,558-13,568	120 (19)	56°	3,942	32
McKenzie 7997 2783	03-02-82	Amoco Prod. Co. Mork #1 NESW Sec. 8-149-99	Pleasant Hill- Red River (1)	320	14,200	14,006-14,016 14,028-14,056	182 (13)	54.8°	35,819	25
McKenzie 8985 2775	04-10-82	Ladd Petroleum Corp. Paulson #24-43 NESE Sec. 24-151-104	Assiniboine- Red River (2)	160	13,300	13,098-13,182	2,359 (122)	45°	890	0
McKenzie 8737 2765	04-01-82	Abraxas Petroleum Corp. Burning Mine Butte #4-33 NWSE Sec. 4-147-102	Burning Mine- Red River (2)	320	14,005	13,216-13,228	282 (34)	50.1°	3,400	22
McKenzie 9309 2813	04-30-82	Gulf Oil Corp. Lindvig #1-11-3C SESE Sec. 11-153-101	Baker-Madison (1)	160	13,800	9,429- 9,439	107 (52)	33.2°	486	0
McKenzie 9163 2792	03-29-82	Puma Petroleum Co. Paschke #2-18 NENW Sec. 18-149-103	Winter Butte- Red River (2)	320	13,020	12,856-12,866	427 (37)	48°	1,390	1
McKenzie 8898 2792	04-17-82	Puma Petroleum Co. Amerada State #1-16 NENW Sec. 16-149-103	Winter Butte- Devonian (-)	320	11,617	11,162-11,240	127 (-)	38.5°	1,158	49
McKenzie 8481 3073	03-24-82	Shell Oil Co. BN #33-7 NWSE Sec. 7-146-103	Poker Jim-Bakken (-)	320	11,317	10,646-10,660	7 (-)	38.9°	429	77
McKenzie 8717 2809	05-20-82	SunBehm Gas, Inc. Chitwood #32-7 SWNE Sec. 32-149-101	Sather Lake- Madison (1)	160	13,765	9,472- 9,484	15 (27)	41.7°	1,824	89
McKenzie 9363 2852	05-14-82	Amorex, Inc. Becken #1 NENE Sec. 7-151-97	Elidah-Red River (-)	320	14,654	14,411-14,465	16 (-)	55°	75,000	90
McKenzie 9004 2851	05-19-82	Exxon Corp. Fleck #1 NESE Sec. 10-150-100	Farland- Red River (-)	320	15,000	14,066-14,092	80 (-)	51.6°	5,625	20
McKenzie 8945 2866	05-27-82	Canterra Petroleum, Inc. Hovde #1-6 NENE Sec. 6-150-100	Spring Creek- Silurian (-)	320	14,000	13,451-13,464	380 (-)	49.5°	1,400	3
McKenzie 8935 2874	05-10-82	Ranger Oil Co. Rolfsrud #11-17 NESW Sec. 17-152-96	Westberg- Birdbear (-)	160	14,140	10,906-10,911	42 (-)	38.7°	3,310	88
McKenzie 8935 3034	12-13-82	Ranger Oil Co. Rolfsrud #11-17 NESW Sec. 17-152-96	Westberg- Bakken (1)	160	14,140	10,620-10,656	99 (17)	42.1°	1,535	27

Table 3.--Continued

County, File No. Order No.	Comp. Date	Operator, Well, Location	Field, Pool (Number of Wells Currently in Pool)	Spacing	Total Depth	Interval Perforated	Initial Prod. (Current Daily Production) (Bbls. Oil)	Gravity	GOR	Water %
McKenzie 9668 2967	09-24-82	Tom Brown, Inc. Bratcher State #10-24 SESW Sec. 10-151-101	Ragged Butte- Madison (9)	160	13,750	9,384- 9,392	230 (35)	39°	1,200	19
McKenzie 7932 2982	09-22-82	Exxon Corp. State of North Dakota #1 SWSE Sec. 36-152-102	Sioux-Madison (1)	160	13,800	9,414- 9,421	53 (46)	39.2°	TSTM	25
McKenzie 9669 3013	10-06-82	W.H.H.T.E. Brockmeier #2 SWNE Sec. 1-146-98	Mary-Red River (-)	640	14,170	13,996-14,006	20 (-)	60°	133,366	30
McKenzie 9519 3028	11-09-82	Tenneco Oil Co. Tank #1-3 NWSE Sec. 3-150-96	Johnson Corner- Bakken (1)	160	14,163	10,786-10,812	206 (26)	50°	1,334	2
McKenzie 9689 3055	11-21-82	Edwin L. & Berry R. Cox Bertinuson #11-30 NWNW Sec. 30-151-100	Patent Gate- Duperow (1)	320	14,025	11,578-11,589	628 (152)	43°	1,911	2
McKenzie 9662 3085	11-17-82	Texaco, Inc. L. M. Stenehjem #1 SENW Sec. 10-151-100	Poe-Madison (2)	160	14,200	9,676- 9,684	70 (40)	39°	1,414	0
McKenzie 9662 3085	11-19-82	Texaco, Inc. L. M. Stenehjem #1 SENW Sec. 10-151-100	Poe-Red River (3)	640	14,200	14,077-14,133	370 (-)	53.9°	6,486	15
McKenzie 8314 3135	12-01-82	Shell Oil Co. USA #42-8 SENE Sec. 8-147-103	MonDak-Bakken (2)	320	14,430	10,594-10,614	14 (SI)	39.7°	1,714	88
McKenzie 8399 3087	12-28-82	SunBehm Gas, Inc. Nygaard #1-29 NENW Sec. 29-150-101	Pronghorn- Duperow (-)	320	13,870	11,582-11,602	25 (-)	43.8°	TSTM	17
McKenzie 9635 2988	10-06-82	Placid Oil Co. Eide #35-11 NESW Sec. 35-149-99	Juniper- Red River (1)	320	14,350	14,200-14,234	20 (9)	62.6°	150,000	50
Mountrail 9098 2678	02-25-82	Nortex Gas & Oil Co. KOK #1-13 SWNW Sec. 13-152-88	Wabek-Madison (1)	160	7,545	7,340- 7,346	11 (18)	33°	100	82
Mountrail 8689 2873	07-06-82	Ranger Oil Co. Rice #14-3 SESW Sec. 3-158-94	Powers Lake- Madison (-)	160	13,295	8,236- 8,306	13 (-)	46.6°	TSTM	92
Slope 9209 2758	03-14-82	Anadarko Prod., Co. Cash Creek Federal "A" #1 SESW Sec. 14-135-106	Cash-Red River (1)	320	10,164 DTD	9,948- 9,957	162 (79)	35.3°	271	0
Stark 9056 2675	01-05-82	Gulf Oil Corp. Ogre #1-24-1C SENW Sec. 24-139-93	Taylor-Winnipeg- Deadwood (1)	640	11,928	11,768-11,784	120 (24)	57.9°	25,000	0
Stark 9322 2743	07-31-82	William C. Kirkwood Kostelecky #44-29 SESE Sec. 29-139-96	Dobson Butte- Silurian (3)	320	12,756	11,018-11,054	383 (56)	41.4°	610	59
Stark 9422 2935	07-22-82	Union Texas Petr. Corp. Kuntz #9-1 SENE Sec. 9-140-98	New Hradec- Red River (-)	320	12,779	12,541-12,563	89 (-)	49.1°	2,169	13
Stark 9706 2934	08-27-82	Southport Expl., Inc. Decker #1-32 NWSW Sec. 32-140-99	Bell-Tyler (9)	160	9,500	8,192- 8,202	571 (183)	35.6°	-	0

Table 3.-Continued

County, File No., Order No.	Comp. Date	Operator, Well, Location	Field, Pool (Number of Wells Currently in Pool)	Spacing	Total Depth	Interval Perforated	Initial Prod. (Current Daily Production) (Bbls. Oil)	Gravity	GOR	Water %
Williams 8910 2732	01-28-82	Texaco, Inc. Slette Stangeland NCT #1 NWNW Sec. 13-153-100	Willow Creek- Red River (2)	320	14,200	14,037-14,051	423 (50)	52.6°	6,619	15
Williams 9100 2676	01-22-82	Texas Gas Expl. Corp. Esterby #1-11 NWSW Sec. 11-159-100	Green Lake- Madison (1)	160	12,825	8,148- 8,165	232 (44)	29.3°	107	0
Williams 8964 2756	02-16-82	National Oil Co. Gohrick #43-17 NESE Sec. 17-158-95	McGregor-Bakken (1)	320	10,864	9,555- 9,574	75 (9)	40.4°	26	4
Williams 8731 2654	05-27-82	Pogo Producing Co. Anderson #1-27 SWNE Sec. 27-154-103	Painted Woods- Winnipegosis (-)	320	13,380	11,928-11,992	61 (-)	30°	TSTM	22
Williams 8998 2789	03-16-82	Everett Drlg Ventures Inc. Long Creek #4 NWNE Sec. 1-153-99	Long Creek- Red River (1)	320	14,591	14,312-14,328	217 (0)	53.7°	4,871	0
Williams 9067 2771	03-26-82	Ranger Oil Co. Toftness #9-8 NESE Sec. 8-159-95	Sauk-Bakken (1)	320	10,185	9,236- 9,282	28 (7)	41.6°	TSTM	0
Williams 8645 2702	04-15-82	Donald C. Slawson Moe #2-1 NWSW Sec. 2-156-96	West Bank- Lodgepole-Bakken (-)	160	13,400	9,630- 9,900	28 (-)	35°	1,920	50
Williams 8867 2857	04-23-82	Sun Exploration & Prod. Co. E. Horob #1-15 SWNE Sec. 15-155-104	Hebron-Madison (-)	160	9,800	9,080- 9,676	6 (-)	35°	TSTM	82
Williams 9207 2814	05-01-82	Ranger Oil Co. McGnarity #14-6 SESW Sec. 6-158-95	Temple-Silurian (1)	320	12,780	12,144-12,258 (4 intervals)	296 (5)	47.4°	1,303	15
Williams 9361 2856	06-23-82	Northwest Expl. Co. Pederson #3 SWNE Sec. 18-158-95	Temple- Winnipegosis (11)	320	12,980	11,174-11,184	157 (-)	46°	1,000	8
Williams 9417 2811	06-11-82	Lousiana Land & Expl. Co. Bratlien 41-33 #1 NENE Sec. 33-154-100	Last Chance- Madison (11)	160	14,100	9,494- 9,521	81 (15)	37.6°	1,116	18
Williams 9206 2884	06-15-82	Universal Resources Corp. Bendixson #2-17 SWNW Sec. 17-157-101	Good Luck- Duperow (-)	160	10,850	10,458-10,528	31 (-)	34°	806	76
Williams 9342 2898	07-08-82	Gulf Oil Corp. Skurdal #1-24-3B NESE Sec. 24-153-102	Hardscrabble- Red River (1)	320	13,350	13,204-13,210	254 (180)	47°	1,035	0
Williams 9518 2926	07-29-82	Sun Expl. & Prod. Co. Johnsrud #1-3 NWNW Sec. 3-152-103	Eightmile- Madison (5)	160	13,500	8,954- 8,972	232 (110)	38.1°	452	70
Williams 7079 3057	10-28-82	Mosbacher Prod. Co. Earl Hefflefinger #3-1 NWNW Sec. 3-154-100	Williston- Duperow (-)	160	14,000	11,484-11,494	60 (-)	37°	980	27
Williams 7903 3039	11-06-82	W.H.H.T.E. Cunningham #1 SSWSW Sec. 23-157-100	Marmon- Dawson Bay (-)	320	13,400	11,258-11,266	48 (-)	47°	625	16

Table 4.--Oil and Gas Discoveries in North Dakota During 1983.

County, File No., Order No.	Comp. Date	Operator, Well, Location	Field, Pool (Number of Wells Currently in Pool)	Spacing	Total Depth	Interval Perforated	Initial Prod. (Current Daily Production) (Bbls. Oil)	Gravity	GOR	Water
Billings 10385 3478	11-29-83	Samson Resources Co. Cameron #1-20 NESW Sec. 20-139-102	Dance Creek- Mission Canyon (-) (recompleted in the Tyler)	160	9,000	8,905- 8,907-	(37)	35.2°	N/A	98%
Billings 9534 3100	04-07-83	Coastal Oil & Gas Corp. Canterra 29-142-102 BN #1 NWSE Sec. 29-142-102	Divide-Red River & Three Forks (1)	320	12,730	10,576-10,592 12,557-12,566	30 (SI)	49°	600	85%
Billings 10220 3353	10-09-83	Diamond Chemical Ramona Federal #21-6 NENW Sec. 6-140-102	Knutsen-Madison (3)	160	9,335	9,139- 9,146	151 (137)	34.9°	--	92 bbls.
Billings 10479 3469	12-16-83	Adobe Oil & Gas Corp. Kordonowy-Fryburg #34-31 SWSE Sec. 31-142-98	Bullsnake-Madison (2)	320	9,858	---	515 (521)	41°	900	20%
Bottineau 10443 3534		ICG Petroleum, Inc. ICG Norcen-Sveen #2 SESW Sec. 18-163-78	North Roth- Spearfish (1)				(15)			
Bottineau 9956 3083	01-13-83	Norcen Energy, Inc. Fylling #1 NWNE Sec. 35-164-78	Souris-Spearfish (4)	40	3,085	2,940- 2,945 2,974- 2,978 2,987- 2,996 3,002- 3,008 2,952- 3,072	23 (4)	38°	400	74%
Bowman 10307 3406	09-28-83	Quadra Oil & Gas, Inc. #21-8 Battes Palczewski SENE Sec. 21-129-100	Gold-Red River (1)	320	9,600	9,360- 9,374	156 (85)	42.4°	984	20%
Burke 10507 3540	12-15-83	Monsanto Oil Co. Castor State #1 SWSW Sec. 16-159-90	Vanville-Madison (3)	--	7,525	7,282- 7,294	23 (35)	26.85°	1,869	32 bbls.
Burke 10081 3254	05-10-83	Conoco Peterson #20-1 NWNW Sec. 20-161-90	Coteau-Madison (1)	160	7,100	6,414- 6,426	52 (16)	35.6°	288	30 bbls.
Burke 10383 3452	10-31-83	Monsanto Oil Co. Kinson-Hilbert #1 SWSE Sec. 13-162-90	Carter-Madison (2)	40	6,100	5,850- 5,858	67 (12)	34°	896	100 bbls.
Burke 10392 3471	11-08-83	Monsanto Co. Kinson-Hansen #1 NWSE Sec. 12-161-90	Ward-Madison (1)	80	6,410	6,146- 6,156 6,165- 6,168	7 (.6)	34°	1,085	175 bbls.
Burke 10382 3470	11-17-83	Monsanto Co. Kinson-Leo #1 NWNW Sec. 11-163-89	Northgate- Madison (1)	80	5,500	5,212- 5,220	10 (5.5)	39.1°	1,500	30 bbls.
Burke 10504 3521	12-15-83	Chandler & Assoc., Inc. Schultz #14-28 SESW Sec. 28-162-90	Dale-Madison (4)	160	6,283	6,027- 6,055	46 (16)	43°	2,430	22 bbls.
Divide 9942 3160	03-12-83	Getty Oil Wildrose #36-5 SWNW Sec. 36-161-98	Moraine- Winnepegosis (2)	320	12,035	10,472-10,482	497 (223)	45.2°	1,368	20%
Divide 9918 3138	03-15-83	Texaco P. A. Landstrom #1 SESW Sec. 33-164-97	Crosby-Madison (3)	160	10,845	10,725-10,785	71 (57)	30.4°	TSTM	66.97%
Divide 9913 3250	04-03-83	Texaco Gov't Gin Han Prospect NCT-1 #1 SWNE Sec. 11-163-97	Paulson-Red River (1)	320	10,805	10,573-10,589 10,602-10,610	594 BC 2,389 MCF (232)	53.6°	4,021	25%

Table 4.--Continued

County, File No., Order No.	Comp. Date	Operator, Well, Location	Field, Pool (Number of Wells Currently in Pool)	Spacing	Total Depth	Interval Perforated	Initial Prod. (Current Daily Production) (Bbls. Oil)	Gravity	GOR	Water
Divide 10210 3362	09-22-83	Superior Tangsrud #12-1 NWNE Sec. 12-160-96	Nelson Lake- Madison (1)	160	9,916	7,660- 7,756	33 (183)	38.6°	818	67.6%
Dunn 9710 3196	03-15-83	Patrick Petroleum BIA Hale #1-7 NESE Sec. 7-148-94	Eagle West- Red River (1)	320	14,350	14,090-14,101	81 (31)	49.0°	1,605	59%
Dunn 9682 3373	09-13-83	Mesa Petroleum Co. Fenton 27 #1 NWSW Sec. 27-148-96	Bear Creek-Duperow (4)	320	14,176	11,432-11,464	926 (208)	44°	660	13%
Golden Valley 10076	11-01-83	Coastal Oil & Gas Eagle Draw Prospect #1 NWSE Sec. 33-144-103	Eagle Draw- Red River (-)	160	12,836	12,616-12,628 12,670-12,676 12,684-12,688	35 (--)	42°	23 MCF	70.1%
McKenzie 9762 3122	01-11-83	Belco Development Corp. Sheep Creek Storm #2-1 SENE Sec. 1-145-100	Beicegal Creek- Madison (1)	160	9,850	9,704- 9,709	63 (31)	39°	1,158	58%
McKenzie 9669 3013	10-26-83	W.H.H.T.E. Brockmeir #2 SWNE Sec. 1-146-98	Mary-Interlake		14,170	13,436-13,445 13,448-13,462 13,479-13,491	534 MCF 13	53.6°	41,041	7 bbls.
McKenzie 10094 3311	07-27-83	Milestone USA #11-9 NWNW Sec. 9-146-99	Butte-Madison (1)	160	10,023	9,850- 9,870	18.5 (10)	39.6°	--	21 bbls.
McKenzie 9995 3159	03-24-83	Getty Oil Dore #3-10X NWSE Sec. 3-150-104	Nelson Bridge- Red River (1)	320	12,930	12,770-12,778	249 (89)	47.1°	402	27%
McKenzie 9957 3191	04-05-83	Texaco L. S. Grantier A #1 Lot 8, Sec. 5-152-97	Twin Valley- Red River (1)	320	14,644	13,922-13,935 12,401-12,461	Condensate 2,500 MCFG	N/A	N/A 2.7 MMCF	100% 261 BSW
McKenzie 9858 3205	04-22-83	Pennzoil Snowcover #13-33 BN NWSE Sec. 13-147-102	Snowcover- Red River (2)	320	13,450	13,280-13,335	543 (26)	48.1°	1,599	0%
McKenzie 9212 2999	02-08-83	Aminoil USA, Inc. State Nelson #1-6 SWSE Sec. 6-148-100	Buffalo Wallow- Duperow (2)	320	13,880	11,595-11,602	79 (10)	42.2°	1,215	4.8%
McKenzie 9655 3111	02-07-83	Aminoil, USA, Inc. Schultz #1-8 NENW Sec. 8-148-100	Buffalo Wallow- Mission Canyon (6)	320	14,000	11,618-11,674 13,835-13,895	106 (52)	39.3°	830	16.5%
McKenzie 9860 3112	02-13-83	Aminoil, USA, Inc. USA Ketterling #1-21 SENE Sec. 21-151-104	Dore-Red River (1)	320	12,935	12,740-12,751	209 (71)	47.1°	2,086	29%
McKenzie 9698 3315	06-28-83	Pogo Producing Co. Pogo/Martin-Scott #1-13 NWSE Sec. 13-151-102	Lonesome-Duperow/ Madison (1)	160	11,514	9,360- 9,393	90 (61)	39°	952	3.2%
McKenzie 10053 3312	08-12-83	Milestone BN #14-35 SWSW Sec. 35-148-101	South Red Wing Creek- Madison (1)	320	13,682	9,424- 9,450 9,488- 9,520	41 (9)	38°	1,258	38%
McKenzie 9982 3235	06-01-83	Basic Earth Science Systems, Inc. Beicegel-Carson #1-34 W/2 NW/4 Sec. 34-146-101	Flat Top Butte- Bakken (2)	320	11,300	10,474-10,522	33.36 (44)	44.8°	749	0%
McKenzie 9909 3239	05-26-83	Milestone Petroleum, Inc. BN #21-7 NENW Sec. 7-147-101	Bowline-Red River (2)	320	13,410	13,202-13,294	153 (67)	43°	850	3 bbls.

County, File No., Order No.	Comp. Date	Operator, Well, Location	Field, Pool (Number of Wells Currently in Pool)	Spacing	Total Depth	Interval Perforated	Initial Prod. (Current Daily Production) (Bbls. Oil)	Gravity	GOR	Water
McKenzie 9882 3251	06-02-83	Getty Oil Co. Covered Bridge #10-11 NESW Sec. 10-146-102	Covered Bridge- Birdbear (1)	320	13,297	10,881-10,920	140 (135)	44.6°	1,071	82 bbls.
McKenzie 9806 3234	02-11-83	Adobe Oil & Gas Corp. Adobe Western Federal Storm #13-6 NWSW Sec. 6-145-99	Beicegel Creek- Red River (1)	320	13,862	13,661-13,682	180 (94)	59°	16,600	25%
McKenzie 9727 3131	01-16-83	Pennzoil Expl. Spring Creek BN #27-31 NWNE Sec. 27-148-102	Boxcar Butte- Duperow (1)	320	13,475	11,410-11,426	781 (94)	43.5°	870	0.2%
McKenzie 7479 3435	08-31-83	Pennzoil Co. Grassy Butte #16-24 SESW Sec. 16-146-99	Grassy Butte- Madison (1)	160	14,620	---	132 (103)	44°	1,133	5%
McKenzie 10320 3426	11-06-83	Tom Brown, Inc. Federal #19-42 SENE Sec. 19-150-103	Randolph-Duperow (1)	320	13,410	11,374-11,389	1,119 (228)	37.4°	829	0%
McKenzie 10226 3390	11-04-83	Ranger Oil Co. Tank Exchange #13-2 SWSW Sec. 2-151-96	Camel Butte- Bakken (1)	320	12,561	10,714-10,750	58 (8)	43°	810	11%
McLean 9941 3264	04-25-83	Davis Oil Co. Bears Tail #12-1 NESE Sec. 12-148-90	Bears Tail-Madison (1)	40	10,200	8,102- 8,118	10 (SI)	31.4°	--	83 bbls.
Mountrail 8936 3363	08-22-83	Bonray Energy Corp. Thompson #1 NENE Sec. 4-155-94	Manitou- Red River (1)	320	14,277	13,956-13,971	70 (20)	43.6°	1,181	35%
Renville 10381 3454	11-02-83	Monsanto Corp. Kinson-Davidson #1 SESW Sec. 7-161-86	McKinney-Madison (8)	160	5,500	5,332- 5,340	120 (80)	28.2°	185	0%
Slope 9883 3114	04-22-83	Anadarko Tennant #1-A SWSE Sec. 26-135-106	Cannonball- Red River (1)	320	9,900	9,658- 9,666 9,726- 9,756	90 (39)	39°	444	70%
Ward 10275 3355	10-05-83	Inexco Oil Co. Wehrman #1-32 NWNW Sec. 32-158-87	Aurelia-Madison (1)	80	6,865	6,611- 6,634 6,626- 6,637	50 (0)	26°	400	83%
Williams 9241 3282	06-12-83	Mosbacher Charles Bowen #21-1 NWNE Sec. 21-153-102	Trenton-Duperow (1)	320	13,300	10,883-10,888 13,052-13,196	202 (103)	42.3°	619	85 bbls.

the adoption of an initiated measure in 1980 creating the new oil and gas extraction tax; (2) dramatic increases in the price of oil on worldwide markets in recent years; and (3) significant increases in oil production in North Dakota.

In addition to the tax revenues collected on oil and gas production, the sale of oil and gas lease bonuses by the North Dakota Board of University and School Lands earns substantial amounts of money for the state (figs. 14 and 15). In calendar year 1980, for example, the four lease sales netted \$68.5 million. The amount earned during the sales depends largely on the location of the offer-

ings; acreages in active areas can go for considerable sums whereas acreages on the eastern edge of the Williston Basin generally go for lower prices.

Revenues from taxes on oil and gas production will continue to be extremely important to North Dakota for the foreseeable future. It should be noted, however, that current and future levels of production in North Dakota, as well as exploration for new reserves, are subject to a variety of closely related factors including world market prices, levels of consumption, and local tax climate. The maintenance of current high production levels is dependent upon continued vigorous exploratory activity.

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