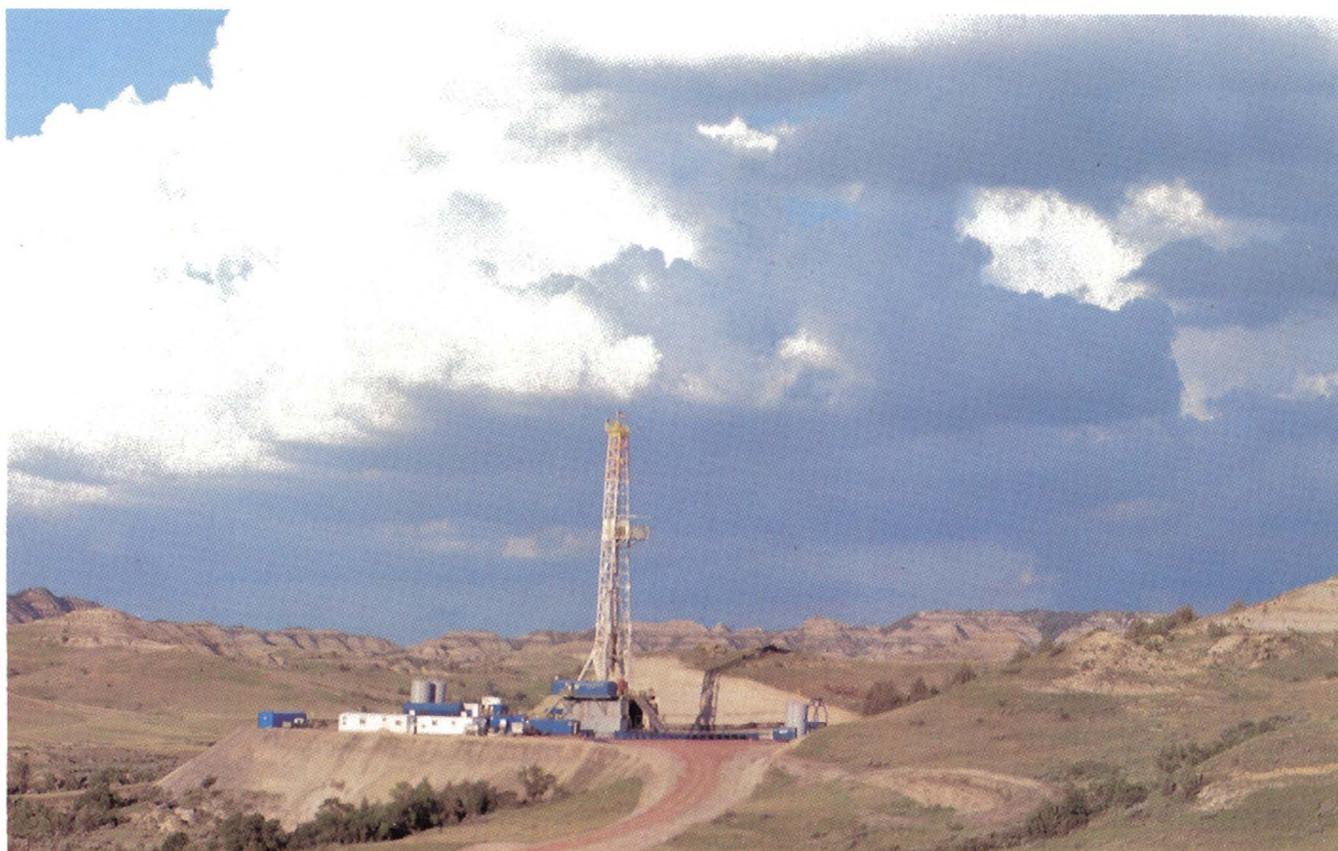


# OIL EXPLORATION AND DEVELOPMENT IN THE NORTH DAKOTA WILLISTON BASIN : 1981 UPDATE

by

Sidney B. Anderson  
and  
John P. Bluemle



MISCELLANEOUS SERIES NO. 62

NORTH DAKOTA GEOLOGICAL SURVEY

Don L. Halvorson, State Geologist

1982

SYSTEMS	GROUPS	ROCK UNITS
QUATERNARY		GLACIAL
TERTIARY	WHITE RIVER	GOLDEN VALLEY
	FORT UNION GROUP	SENTINEL BUTTE
		BULLION CREEK
		SLOPE
		CANNONBALL
		LUDLOW
		HELL CREEK
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
		SPEARFISH 
PERMIAN		MINNEKAHTA
		OPECHE
	MINNELUSA GROUP	BROOM CREEK
PENNSYLVANIAN		AMSDEN
		TYLER 

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

● OIL PRODUCTION  
 GAS PRODUCTION

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The rig shown on the cover is Westburne Drilling's Rig 3, shown drilling the Elkhorn Canterra/COGC 23-143-102 BN 1-23, a wild-cat well eventually completed as a Red River producer in Elkhorn Field (NW¼NE¼sec 23, T143N, R102W, Billings County). Photo by Ed Murphy.

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## INTRODUCTION

It is appropriate on this, the beginning of the fourth decade of oil production in North Dakota, to review the state's discovery and production history, briefly outline the exploration cycles the Williston Basin has undergone, review development of significant reservoirs, and offer our best prognosis of future possibilities. The data presented are from the files of the North Dakota Geological Survey.

## PRE-1951 EVENTS

Natural gas, known to most people in the early days of the century as "marsh gas," was 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 via 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. This 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.

Also, early in the century, at about the same time the gas in the Lansford area was being utilized, natural gas associated with the artesian "Dakota" aquifer in southeastern North Dakota was used in the Edgeley area. This methane gas was used for lights, cooking, and heating. 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. This gas occurred at a depth of about 1,100 to 1,200 feet.

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 of 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 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 to a depth of 3,980 feet, into the Cretaceous Inyan Kara Formation, but it proved to be non-productive. It was located only about 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 in Williams County. This well was drilled only 1,866 feet from a well drilled in 1956 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, and any shows were overlooked. This well was the first in North Dakota on which an electric log was run.

Due to the absence of State Geologist Dr. Wilson Laird, Acting State Geologist, Mr. 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 have been completed in North Dakota and another is now in progress. 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 (40 million barrels in 1980 and 45.7 million barrels in 1981).

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 the 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 (fig. 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 1 to 3 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 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 (fig. 5).

Second, OPEC, which was formed in 1973, emplaced production controls (embargoes) and price increases on production in OPEC countries.

OPEC created the first substantial worldwide increase in the price of oil. 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 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 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 per 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 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") finally became productive in a big way with the discovery of the TR, 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 remains. One of the major reasons for this was the discovery of the 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 production exceeding 400 to 500 barrels of oil per day and several with initial production above 2,000 barrels of oil per day.

Mondak Field continues to grow steadily. It has encompassed Earl Field and currently shares a boundary with Poker Jim Field. It, too, is a multiple-pay field with the Madison being the primary producing horizon. Its wells are not as prolific as those on the Billings Nose, but its size is currently over 110 square miles in North Dakota alone.

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.

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 (fig. 7). This is now the easternmost Red River production in North Dakota.

In addition to the new counties, discoveries were made in Golden Valley and Slope Counties 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 is important because it produces from a horizon that has been largely overlooked in the past.

The amount of gas being found from the deep Red River pays in the central parts of the basin, as well as the amounts of associated gas being produced in western North Dakota, have been significant factors since 1979 in western North Dakota.

By nearly all standards, 1981 was North Dakota's most successful oil and gas year--new pool discoveries, total production, and revenues all reached new highs. Some of the vital statistics are most conveniently shown in the form of graphs (figs. 8 through 13). Of the total of 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. Production of oil reached 45.7 million barrels, up from the 39.9 million recorded in 1980. The gross production tax raised about 71 million dollars for the state and the extraction tax another 92 million dollars. In addition, oil and gas lease bonus income from state lands totaled 19 million dollars.

Table 1 shows how many drilling permits were issued for each county during 1981.

We have also compiled a listing of oil and gas discoveries in 1981, showing how many were recorded in each county and how many discoveries were made from the various geologic horizons (table 2). As usual, McKenzie County was the most successful, with a total of 34 new pools--discoveries were made in 12 counties in 1981. The Red River Formation accounted for 37

of the 83 new pool discoveries, the Madison had 22, and the Duperow had 13. All the 1981 discovery wells are arranged in chronological order in table 3.

Several of the new pool discoveries recorded in 1981 may be 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. This deep gas discovery should keep interest high in the deeper horizons throughout the Williston Basin. Terra's Interlake completion (Terra Resources, Inc.--#1-17 Prange), also in Stark County, should help to maintain interest in the Silurian. 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 appears to have the potential to become an important field. 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. The deeper pays coming in along the Nesson Anticline show that the potential for new discoveries still exists.

## THE PRESENT AND FUTURE

Lower prices resulting from an oversupply of crude oil, high drilling costs, and certain other economic factors have resulted in a downturn in exploratory drilling activity in 1982 in the Williston Basin. However, with prices apparently now on the rise, exploratory drilling activity again appears to be picking up. Furthermore, even with fewer drilling rigs operating in North Dakota so far in 1982, wildcat completions, some of which may prove to be significant and may provide an impetus for future exploratory activities, continue to be recorded at a relatively high rate.

Future possibilities in North Dakota include shallow gas prospects along the eastern margin of the Williston Basin. The already-proven, deeper, gas-producing horizons of southwestern North Dakota will also probably lead to

deeper exploration in other parts of the state.

Assessment of the future requires an evaluation of source rocks as well as reservoir capabilities. Geochemical studies have classified Williston Basin oils into three types and, based on carbon isotope studies, it has been postulated that the source rocks for most of the oil are type I--Winnipeg shale; type II--Bakken Formation; and type III--Tyler shale. In a 1974 paper, Dow (1974) further estimated volumes as type I--600 million barrels; type II--10 billion barrels; and type III--300 million barrels. He estimated that 50% of type I, 30% of type II and lesser quantities of type III had been discovered at that time.

Various researchers who have studied the rock sections in the Williston Basin would agree that the Winnipeg, Bakken, and Tyler represent the most concentrated source of organic materials; however, we believe that many producing horizons contain sufficient organic material to be self-sourcing. Specifically, the Red River, Birdbear, Duperow, Winnipegosis, and Madison Formations have sufficient indigenous organics to provide large quantities of liquid hydrocarbons. If this is so, much more oil remains to be found in the Williston Basin.

If new pool discoveries during the past four years are compared to preceding years, the significance of the present development boom becomes obvious. Except for the 1954 east side and 1968 "Muddy" Sandstone wildcat programs, high levels of wildcat activity have a corresponding peak of new pool discoveries. However, the number of new pool discoveries per wildcat well drilled has risen dramatically in the last four years. This increase in success is attributed first to use of CDP (Common Depth Point) seismic,

second, to a better understanding of reservoir geology, and third, to completely revised testing and completion techniques.

Dramatic expansion of producing areas has occurred during the present cycle. This includes new producing counties, new pay horizons, and new producing depths. At one time in 1970, about 20 active locations existed in the United States portion of the basin; in 1981, there were in excess of 140 active locations in North Dakota alone.

A significant recent development is the deeper horizon exploration along the Nesson trend. Here it should be emphasized that the Beaver Lodge Duperow Pool is outperforming the Madison Pool.

Shallow gas plays are in their infancy in the basin, but they are in process. Air drilling is necessary for adequate testing of Pierre (Judith River and Eagle Sands), Greenhorn, "Muddy," Inyan Kara, and Niobrara rocks, but these rigs are uncommon in the basin and surface holes can be a problem with air drilling. Little testing has been done on the southeast extension of the Antelope Anticline, an area we have only recently begun to delineate as a major potential hydrocarbon area. Stratigraphic traps around the Cedar Creek, Nesson, and Poplar Anticlines are untested for the most part, as is much of the eastern and western basin flanks.

The northwest shelf, west of the Nesson Anticline, holds promise, and has been tested mostly on the Montana side of the basin. Many prospects remain to be drilled. The independents who kept the basin oil industry going in the 1960s have been largely frozen out of the main activity by lease prices. With lower prices since early 1982, these independents should be back in business.

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Figure 1. Map locating the Williston Basin.

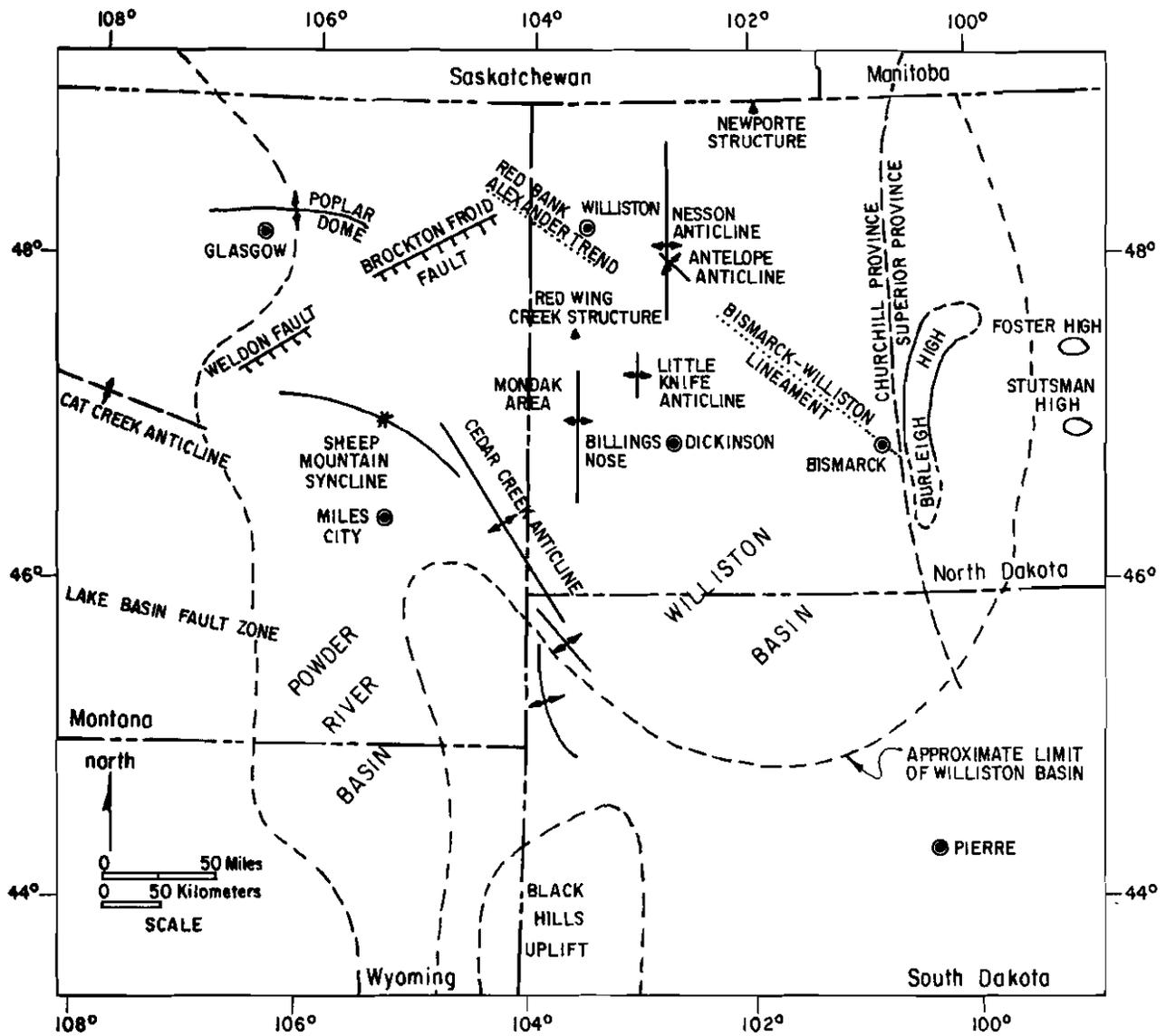


Figure 2. Map showing the major structural features in western North and South Dakota, eastern Montana, and northeastern Wyoming.

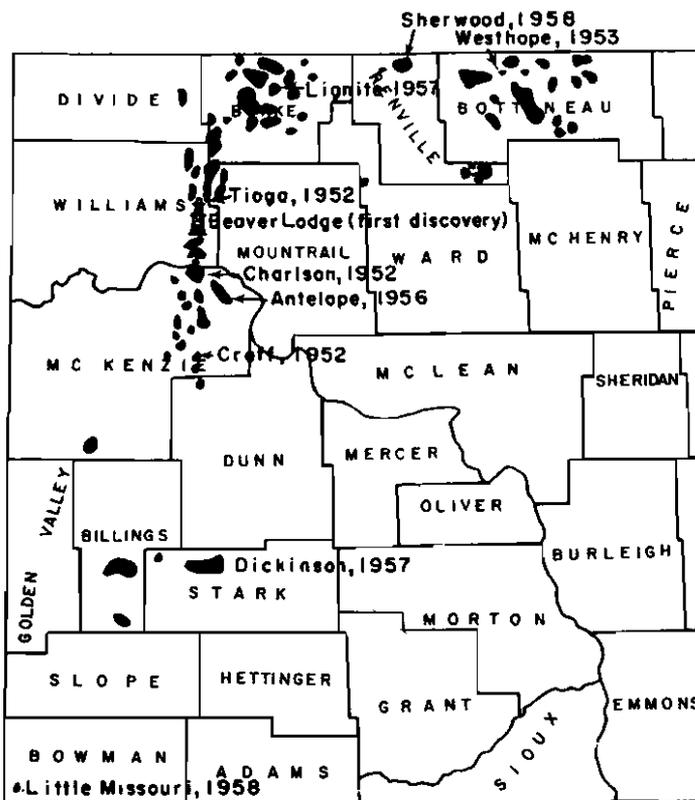


Figure 3. Upper map of western North Dakota shows the location of the Beaver Lodge discovery in 1951. Lower map shows major discoveries during the 1950s.

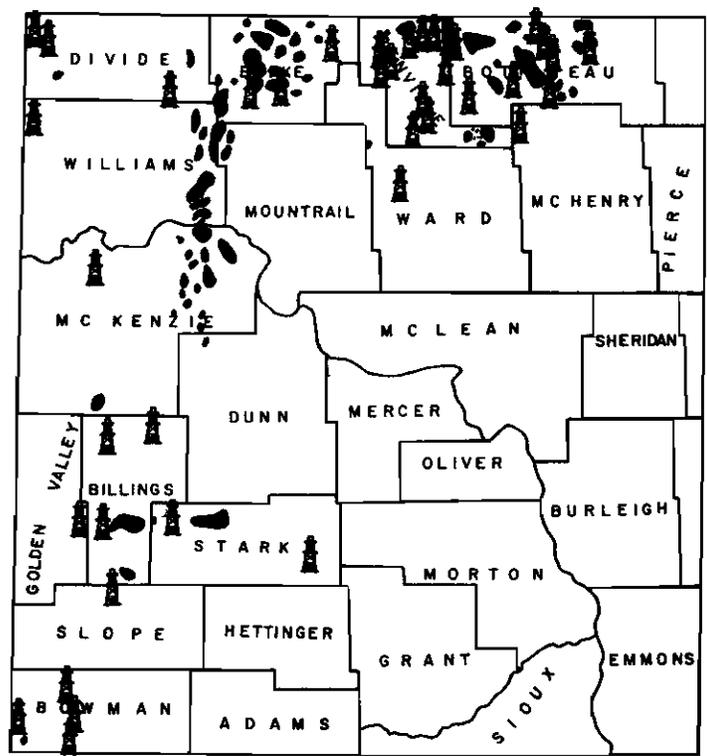


Figure 4. Major new field discoveries (represented by the derrick symbols) in North Dakota between 1960 and 1969.

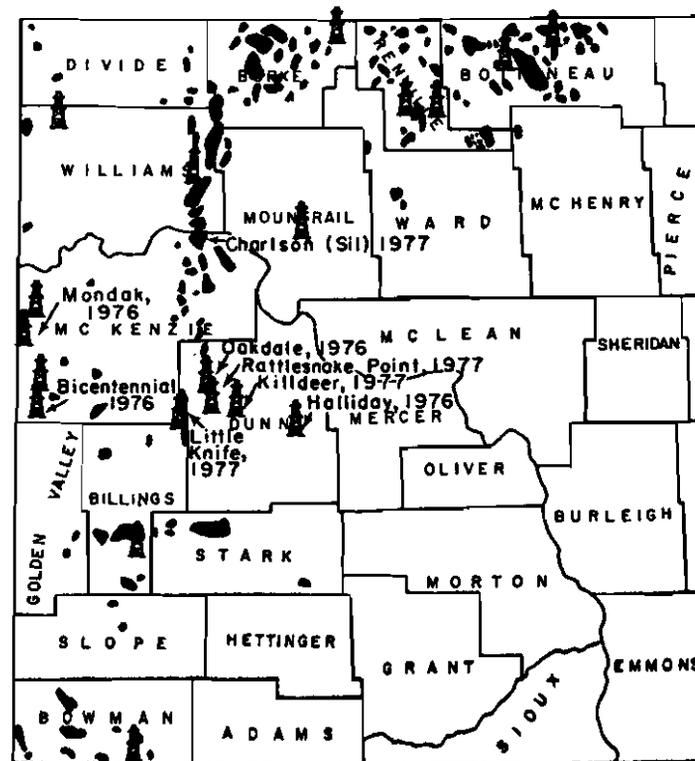
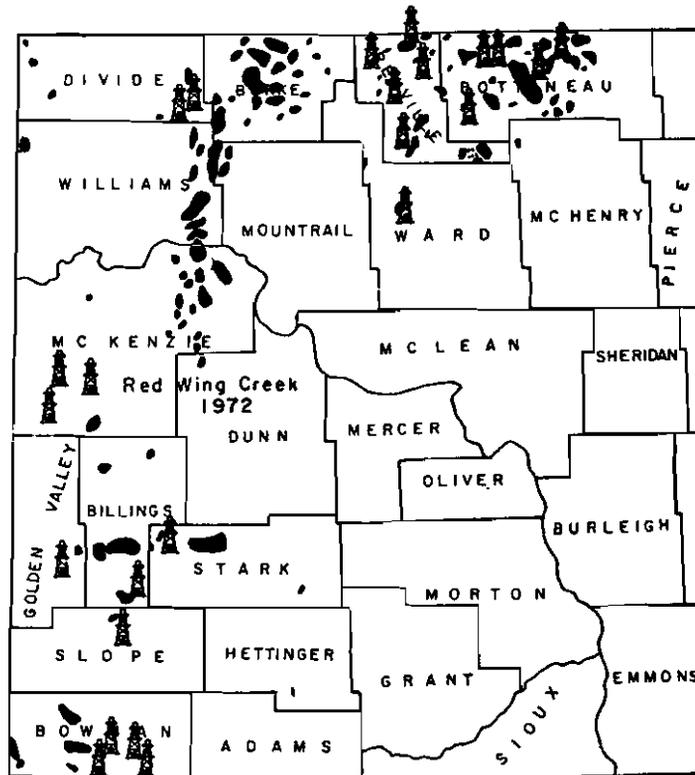


Figure 5. Major new field discoveries between 1970 and 1975 (upper map) and in 1976-1977 (lower map) in North Dakota.

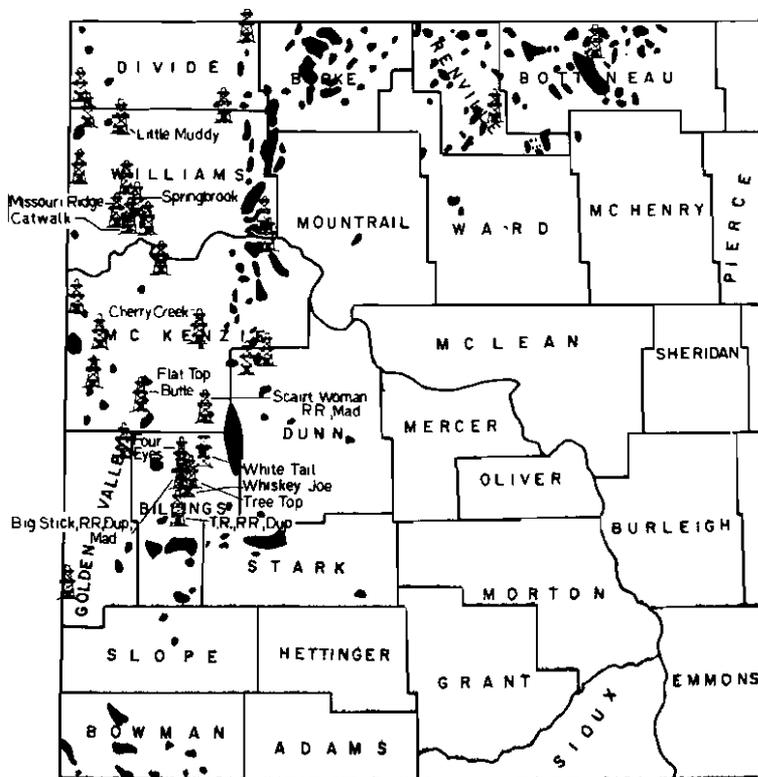
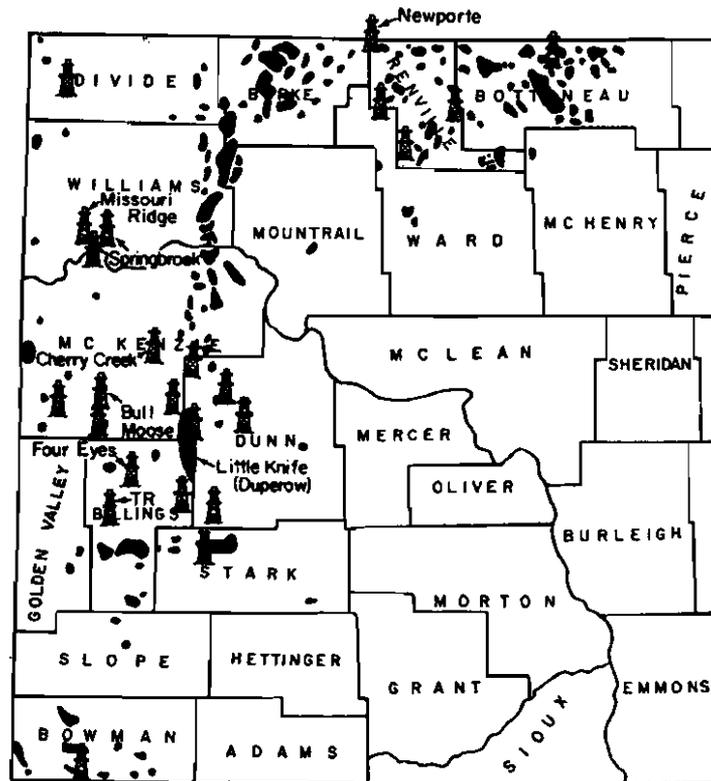


Figure 6. Major new field discoveries in North Dakota in 1978 (upper map) and in 1979 (lower map) in North Dakota.

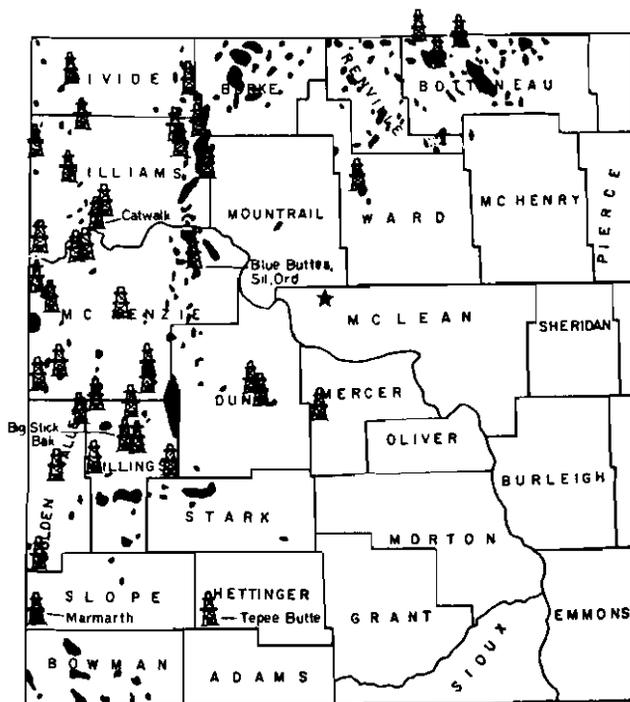
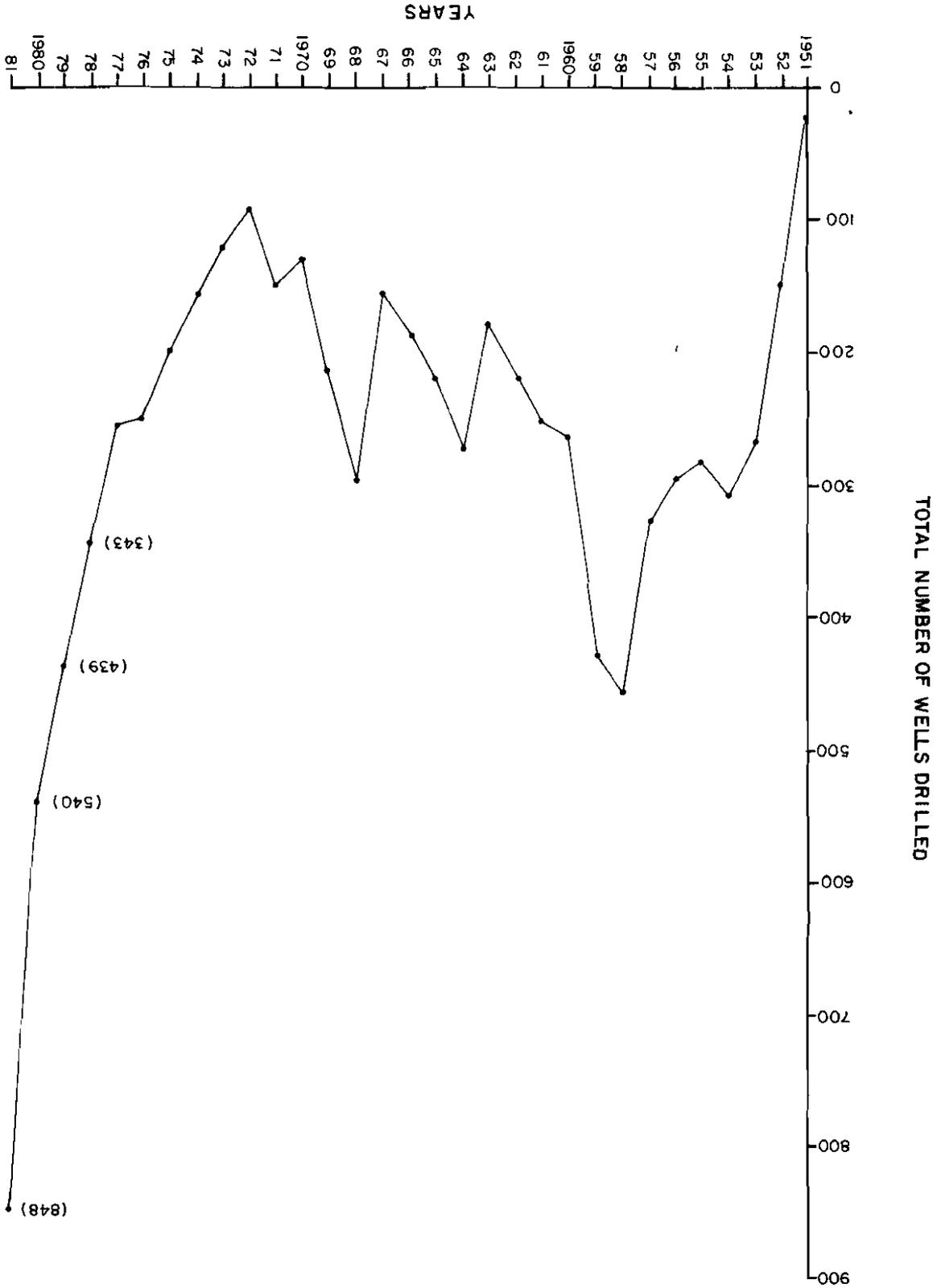


Figure 7. Major new field discoveries in North Dakota in 1980.

Figure 8. Total number of wells drilled in North Dakota each year since 1951.



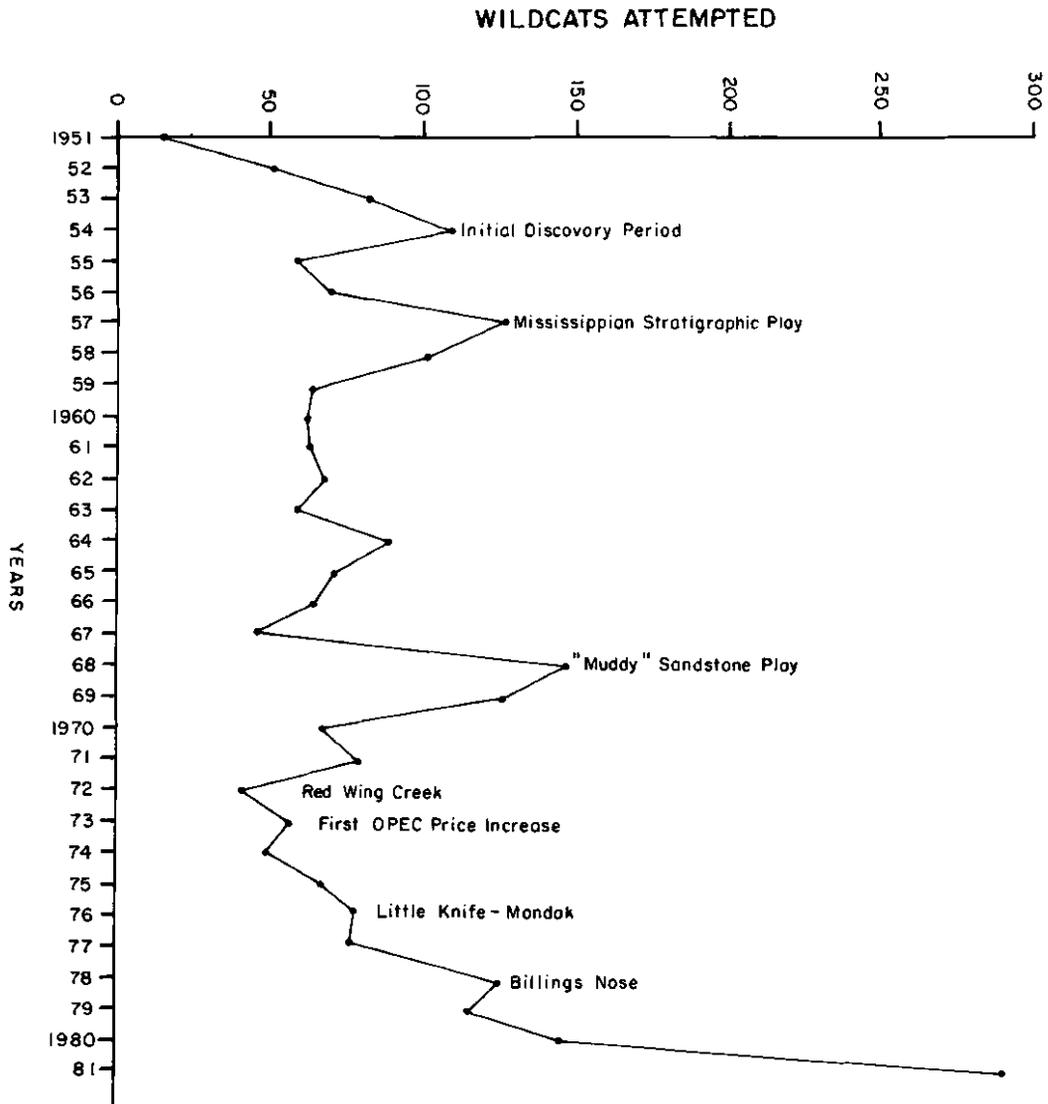


Figure 9. Total number of wildcat wells attempted in North Dakota each year since 1951.

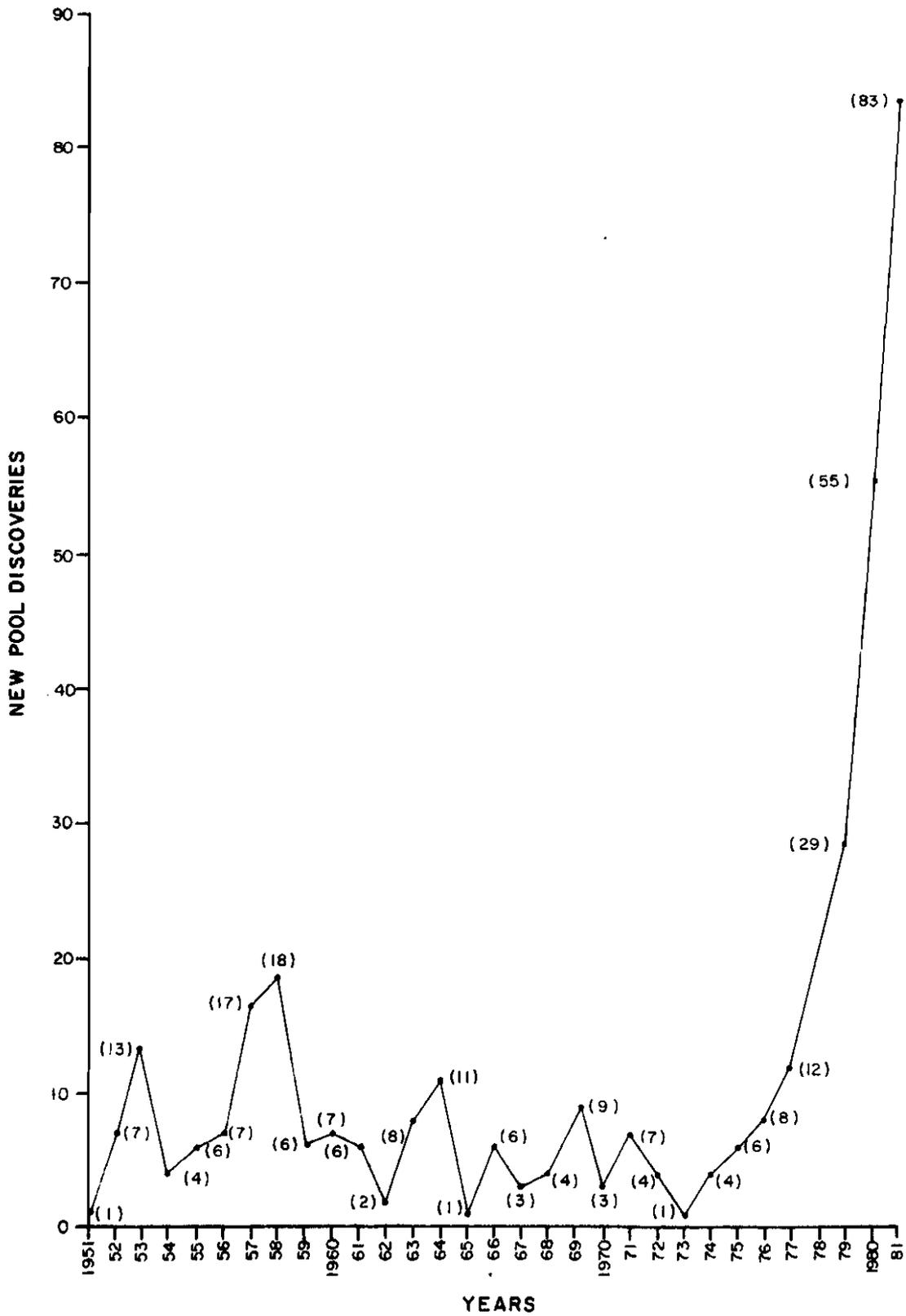


Figure 10. New pool discoveries in North Dakota each year since 1951.

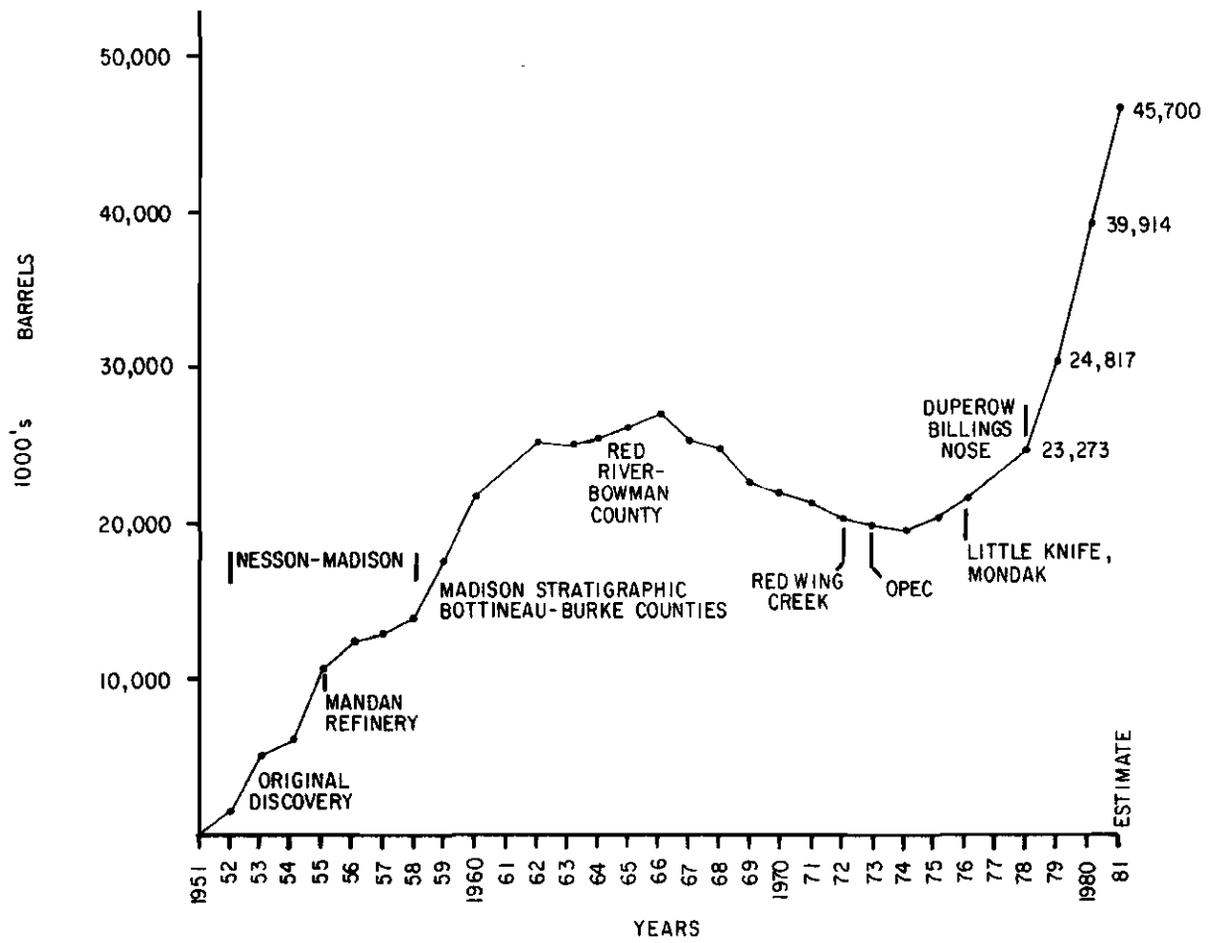


Figure 11. Annual crude oil production in North Dakota.

# NET OIL AND GAS TAX COLLECTIONS

(Includes the Extraction Tax in 1981)

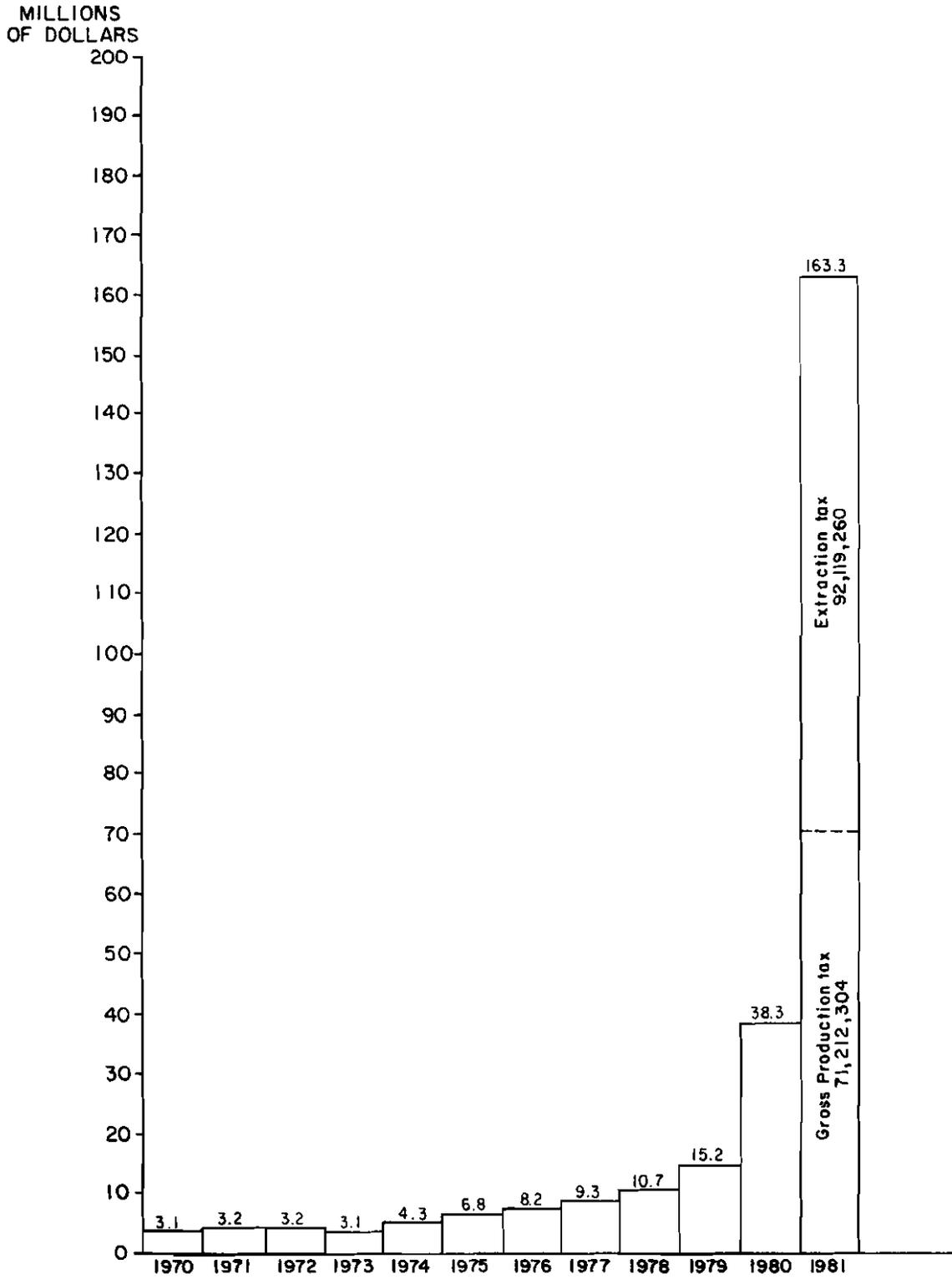


Figure 12. Net oil and gas tax collections in North Dakota since 1970.

# OIL AND GAS LEASE BONUS INCOME FROM STATE LANDS

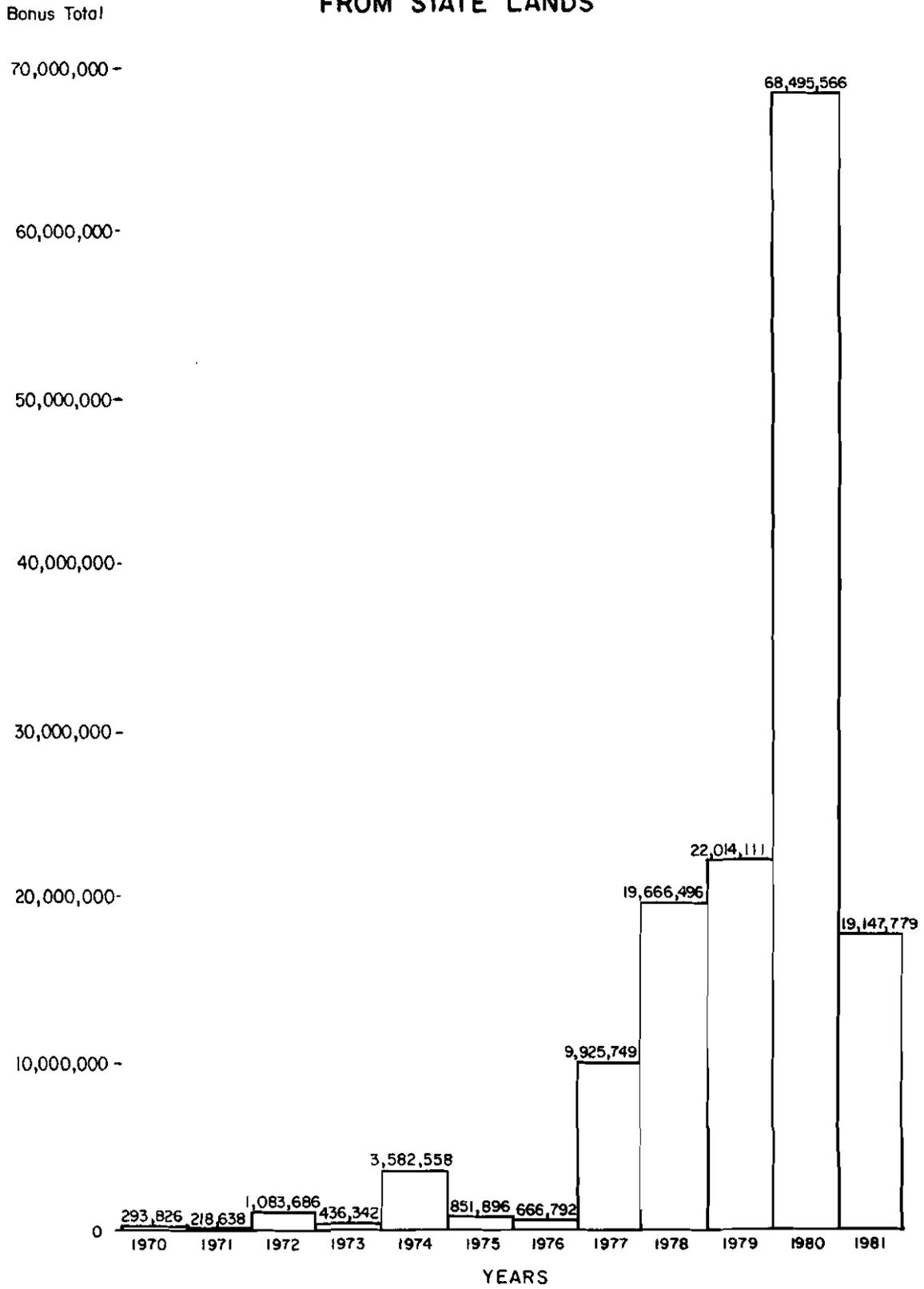


Figure 13. Oil and gas lease bonus income from state lands since 1970.

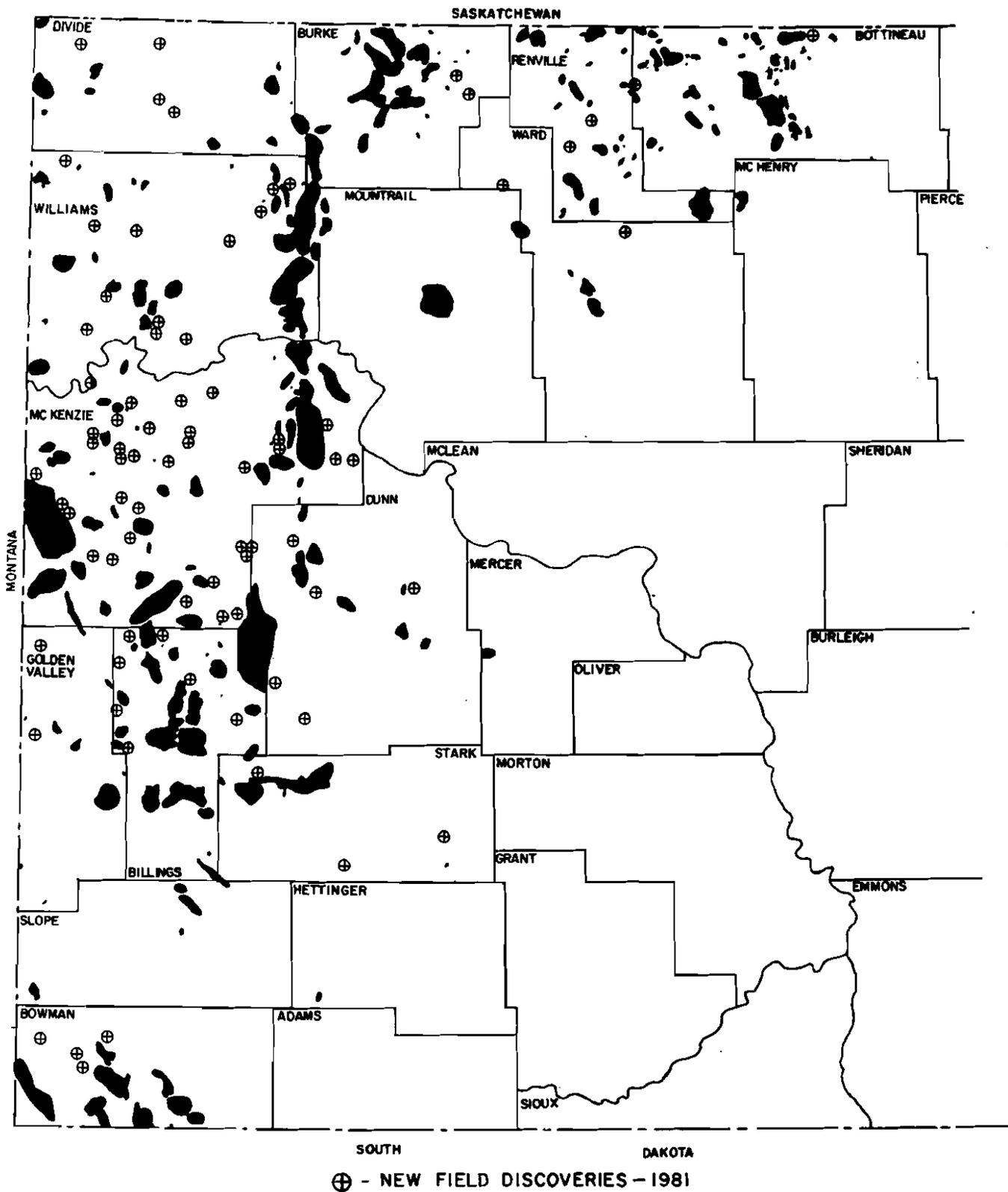


Figure 14. North Dakota oil fields through 1980 with discoveries (cross symbols) made during 1981.

TABLE 1.--North Dakota Permitting Activity During 1981

The table below lists the total number of drilling permits issued for each county in North Dakota during 1981. The listing specifies the number of permits issued for wildcat wells and the number for wells drilled in areas of proven production.

County	Total Permits	Permits for Wildcat Wells	Permits for Wells in Areas of Proven Production
Billings	172	29	143
Bottineau	90	24	66
Bowman	40	8	32
Burke	55	13	42
Burleigh	3	3	0
Divide	22	17	5
Dunn	118	40	78
Emmons	5	5	0
Golden Valley	30	16	14
Grant	11	11	0
Griggs	1	1	0
Hettinger	3	3	0
McHenry	4	4	0
McKenzie	243	78	165
McLean	13	13	0
Mercer	3	3	0
Morton	3	3	0
Mountrail	25	17	8
Nelson	3	3	0
Oliver	1	1	0
Pierce	4	4	0
Ransom	1	1	0
Renville	67	15	52
Rolette	2	2	0
Sheridan	2	2	0
Slope	9	7	2
Stark	20	8	12
Ward	25	17	8
Williams	111	40	71
<b>TOTALS</b>	<b>1086</b>	<b>388</b>	<b>698</b>

TABLE 2.--North Dakota Oil & Gas Discoveries in 1981

New Pool Discoveries by County

<u>Billings County</u>	
Madison	2
Bakken	3
Birdbear	1
Duperow	2
Red River	3
Total	11

<u>Dunn County</u>	
Madison	3
Red River	1
Duperow	1
Total	5

<u>Stark County</u>	
Silurian	1
Red River	1
Winnipeg/ Deadwood	1
Total	3

<u>Bottineau County</u>	
Madison	1
Total	1

<u>Golden Valley County</u>	
Red River	2
Total	2

<u>Ward County</u>	
Madison	2
Total	2

<u>Bowman County</u>	
Red River	4
Total	4

<u>McKenzie County</u>	
Madison	5
Bakken	1
Tyler	1
Duperow	8
Silurian	1
Gunton	1
Red River	17
Total	34

<u>Williams County</u>	
Madison	4
Birdbear	1
Duperow	1
Red River	6
Total	12

<u>Burke County</u>	
Madison	2
Total	2

<u>Divide County</u>	
Duperow	1
Red River	3
Total	4

<u>Renville County</u>	
Madison	3
Total	3

Chronological listing of oil and gas discoveries drilled in North Dakota during 1981

County	Comp. Date	Operator, Well, Location	Field	Total Depth	Prod. Depth	Oil (Bbls.)	Gravity	Gas	Water	Producing Formation
McKenzie	1- 3-81	Texaco, Inc. Felland #1 (A) SESW Sec. 15-150-99	Tobacco Garden	14,896	14,042-14,124	72	49.2°	18,055 GOR	20%	Red River
McKenzie	1- 3-81	Pennzoil Expl. & Prod. Co. Mile Butte #36-42 SENE Sec. 36-147-103	Pierre Creek	13,320	12,992-13,044	88	48.2°	2,700 GOR	55%	Red River
Renville	1- 6-81	Abraxas Pet. Corp. Sandburg #1 NENW Sec. 23-161-85	Des Lacs	4,993	4,883- 4,887	35	30.0°	110 GOR	25%	Madison
McKenzie	1-14-81	Texaco, Inc. C. M. Loomer #12 NESE Sec. 6-150-95	Blue Buttes	11,392	11,226-11,232	405	40.7°	731 GOR	61.79%	Duperow
McKenzie	1-31-81	Hilliard Oil & Gas, Inc. Lillibridge #1 C SWNE Sec. 15-150-96	Johnson Corner	14,077	13,908-13,938	271.51	--	4,272 GOR	0%	Red River
McKenzie	1- 5-81	Shell Oil Co. USA 24-4 SESW Sec. 4-149-104	Estes	13,130	12,884-12,870	1,024	40.6°	1,000 GOR	3%	Red River
Billings	2- 3-81	Diamond Shamrock Corp. Rauch Shapiro #21-9 NENW Sec. 9-142-102	Roosevelt	12,762	10,512-10,534	264	44.0°	909 GOR	0%	Bakken
Williams	2-13-81	N. W. Exploration Co. Pederson #2 NESW Sec. 18-158-95	Temple	8,535	8,192- 8,256	47	37.4°	1/2 cu. ft./bbl.	87%	Madison
Williams	2-20-81	W. H. Hunt Trust Est. Cunningham #1 C SWSW Sec. 23-157-100	Marmon	13,400	13,096-13,106 13,138-13,088 13,142-13,091	168	45.0°	1,000 GOR	4.5%	Red River
McKenzie	2-20-81	Ladd Petroleum Corp. Duncan Fed. #30-22 NWNW Sec. 30-145-99	Scairt Woman	13,592	13,110-13,124	184	45.6°	2,060 SCF/bbl.	48%	Gunton
McKenzie	3- 6-81	Shell Oil Co. Burns #44-21 C SESE Sec. 21-149-104	Mondak	13,050	10,995-10,981	116	38.0°	1,000 GOR	64%	Duperow
Billings	3-14-81	Supron Energy Corp. F-6-144-101 #2 NWNW Sec. 6-144-101	Devils Pass	12,990	11,044-11,054	1,540	--	1,500 MCF	45 BWPD	Duperow
Bowman	3-22-81	Roger E. Canter Roger E. Canter #1 NWNW Sec. 33-131-105	Austin	9,234	8,975- 9,106	11	27.8°	100 GOR	18%	Red River
McKenzie	4- 4-81	W. H. Hunt Trust Est. Schlangen #1 C SESE Sec. 26-145-98	Charlie Bob	11,900	11,806-11,811	85	41.5°	590 GOR	50.9%	Duperow

<u>County</u>	<u>Comp. Date</u>	<u>Operator, Well, Location</u>	<u>Field</u>	<u>Total Depth</u>	<u>Prod. Depth</u>	<u>Oil (Bbls.)</u>	<u>Gravity</u>	<u>Gas</u>	<u>Water</u>	<u>Producing Formation</u>
Stark	4-22-81	Gulf Oil Corporation Leviathan #1-21-1B C NENW Sec. 21-138-92	Richardton	12,218	11,374-11,394	149 BBL Cond/Day	52.0°	3,588 MCF	225%	Winnipeg- Deadwood
McKenzie	4-23-81	Texaco, Inc. Stenberg "A" #1 C SWSW Sec. 10-151-99	Tobacco Garden	15,266	12,001-12,012	45	43.8°	1,080 GOR	60.5%	Duperow
Williams	4-24-81	Depco, Inc. Fischer #34-18 C SWSE Sec. 18-159-102	Hanks	12,650 (KB-Drlr)	7,900- 7,906	324 (15.5 hrs.)	46.0°	120 GOR	2%	Madison
McKenzie	4-24-81	Gulf Oil Corp. Bob Creek Fed. 1-13-3B NESE Sec. 13-147-98	Lone Butte	9,800	9,320- 9,336	368 (est.)	46.6°	868 GOR	0%	Madison
McKenzie	4-28-81	Al-Aquitaine Explor., Ltd. Thurlow #1-13 NENE Sec. 13-151-102	Lonesome	14,115	13,450-13,569	686	49.3°	1,300 GOR (est.)	1%	Red River
Bowman	4-30-81	Mosbacher Production Co. Helen Hron et al #4-1 NENW Sec. 4-131-106	Ives	9,150	8,858- 8,880	56	36.7°	982 GOR	26%	Red River
Bowman	5-10-81	Anadarko Prod. Co. Bowman Fed. "A" #1 NENW Sec. 1-131-104	Rhame	10,250	9,966- 9,972	13	36.7°	1,230 GOR 16 MCF	85 BWPD	Red River
McKenzie	5-13-81	Pennzoil Co. & Depco Covered Bridge #3-22 BN SENE Sec. 3-146-102	Covered Bridge	13,705	13,036-13,094	466	49.5°	1,494 GOR	11%	Red River
Williams	5-14-81	Samedan Oil Corporation Minerals #1 C SWSW Sec. 13-154-100	Avoca	14,207	14,112-14,004	1,332	48.0°	1,243 GOR	7%	Red River
Williams	5-14-81	Burnett Oil Co., Inc. Germundson #1 C NESW Sec. 2-158-95	Lindahl	8,310	8,128- 8,134	63.58	39.2°	325 GOR	67% 132.36 BWPD	Madison
McKenzie	5-15-81	Amoco Production Co. Storm #1 C SENE Sec. 1-145-100	Beicegel Creek	13,800	11,636-11,644	168	43.0°	892 GOR 150 MCFD	10% 19 BWPD	Duperow
Williams	5-22-81	Getty Oil Co. Temple #32-5 SWNW Sec. 32-157-96	Ray	13,600	13,418-13,422 13,460-13,478	85	55.0°	9,329 GOR	0%	Red River
Williams	5-23-81	Universal Resources Corp. Bendixson #1 C SWNW Sec. 17-157-101	Good Luck	12,985	12,771-12,883	111	34.9°	946 GOR	12 BWPD	Red River
Billings	5-26-81	Apache Corporation Fed. #1-5 C NESE Sec. 5-143-102	Mikkelson	10,464	10,262-10,302	10.01	--	--	0%	Bakken

County	Comp. Date	Operator, Well, Location	Field	Total Depth	Prod. Depth	Oil (Bbls.)	Gravity	Gas	Water	Producing Formation
McKenzie	5-30-81	Pennzoil Co. Grassy Butte #21-21 NENW Sec. 21-146-99	Grassy Butte	14,100	11,842-11,904	409	44.5°	1,491 GOR	13%	Duperow
McKenzie	5-31-81	Energetics, Inc. Tank #22-22 C SENW Sec. 22-151-96	Camel Butte	14,100	12,385-12,428	109	40.0°	4,000 GOR	45%	Silurian
Renville	5-31-81	Monsanto Co. Witteman #1 SWSE Sec. 24-162-84	Cutbank Creek	4,412	4,385- 4,387	10	27.7°	215 GOR	93%	Madison
McKenzie	6- 2-81	Gulf Oil Corporation Rehberg #1-8-2D C SWNE Sec. 8-152-102	Marley	13,500	13,207-13,233 13,254-13,284	94	43.2°	1,260 GOR	31.39%	Red River
Renville	6- 6-81	Clarion Resources, Inc. Lundgren #1-23 C NENW Sec. 23-160-86	West Greene	5,501	5,314- 5,319	51.7	--	--	24%	Madison
Golden Valley	6-7-81	Terra Resources, Inc. Ueckert #1-11 C NENW Sec. 11-141-105	Hoot Owl	12,240	12,041-12,065	295	28.6°	128 GOR	21%	Red River
Dunn	6-19-81	Al-Aquitaine Expl. Co. #1-17 BN SWNE Sec. 17-143-97	Crooked Creek	11,690	9,760- 9,766 9,712- 9,730 9,697- 9,700 9,738- 9,744	120	--	--	76%	Madison
Billings	6-19-81	Patrick Pet. Co. Harris-Fed. #1-30 NESE Sec. 30-141-102	Wannagan	12,380	12,198-12,272	265	44.0°	962 GOR	3% 7 BWPD	Red River
McKenzie	6-29-81	HNG Oil Company Link #34-1 SWSE Sec. 34-151-102	Unnamed	13,700	13,469-13,583	142	53.0°	563 GOR	21%	Red River
Dunn	7- 1-81	Supron Energy Corp. F. V. Buresh #1 C NENE Sec. 32-142-96	Russian Creek	9,550	9,469- 9,500	160	38.6°	1,881 GOR	124%	Madison
McKenzie	7- 2-81	Gulf Oil Corporation Morman Butte Fed. #1-25-3C SESE Sec. 25-147-98	Lone Butte	14,200	13,958-13,994	0 inactive as of 8-21-81	0.0°	5,714 MMCF	0%	Red River
Ward	7- 8-81	Petroleum, Inc. Rudie #1 SWNE Sec. 19-157-84	Hartland	5,715	5,606- 5,610	29	29.2°	TSTM	55%	Madison
McKenzie	7-11-81	Texas Gas Explor. Corp. Nygaard #1-29 NENW Sec. 29-150-101	Pronghorn	13,870	13,747-13,753 13,664-13,670 13,620-13,624 13,614-13,616 13,572-13,575	348	57.6°	4,672 GOR 50 BWPD	12.56%	Red River

<u>County</u>	<u>Comp. Date</u>	<u>Operator, Well, Location</u>	<u>Field</u>	<u>Total Depth</u>	<u>Prod. Depth</u>	<u>Oil (Bbls.)</u>	<u>Gravity</u>	<u>Gas</u>	<u>Water</u>	<u>Producing Formation</u>
McKenzie	7-12-81	Petroleum, Inc. Nygaard State #1 SENW Sec. 23-150-101	Rawson	13,990	11,617-11,647	70	46.5°	--	52%	Duperow
McKenzie	7-14-81	Pennzoil Company Four Creeks 6-32F SWNE Sec. 6-147-101	Bowline	13,498	9,506- 9,604	11	35.8°	1,200 GOR	97%	Madison
McKenzie	7-16-81	Apache Corporation Bear Den #1 C NWSE Sec. 23-150-94	Unnamed	14,575	10,868-10,904	13.6	--	--	0%	Bakken
McKenzie	7-19-81	Helmerich & Payne, Inc. Matthew #1-20 SWSW Sec. 20-150-94	Spotted Horn	13,700	9,220- 9,395	141 (H <sub>2</sub> S Cont.)	40.0°	--	80%	Madison
Ward	7-20-81	Clarion Resources, Inc. Pullen #1-33 C NENE Sec. 33-159-88	Baken	6,673	6,532- 6,534	7.0	--	--	93.0 BWPD	Madison
McKenzie	7-25-81	Traverse Oil Co. #1-30 Nygaard SESE Sec. 30-150-101	Pronghorn	11,722	9,402- 9,452	36	--	--	76%	Madison
McKenzie	7-31-81	Shell Oil Co. USA #43-3-116 NESE Sec. 3-148-104	Mondak	13,293	8,114- 8,056	17	35.5°	1,176 GOR	89%	Heath
Divide	8- 1-81	Texas Internat'l Pet. Corp. Bakke #1 C SWSE Sec. 14-163-99	Ambrose	11,200	8,458- 8,464	81	36.0°	900 GOR	9%	Duperow
McKenzie	8-12-81	W. H. Hunt Trust Est. Cross #1 NWSW Sec. 32-149-102	Moline	13,567	13,490-13,498	490	48.9°	1,326 GOR	0%	Red River
McKenzie	8-13-81	The Superior Oil Co. Donald Link et al "A" #1 SENE Sec. 34-152-102	Elk	13,850	13,687-13,737	319	48.3°	1,411 GOR	4.2%	Red River
Williams	8-13-81	Nucorp Energy, Inc. Rieder #2 C NWNE Sec. 9-155-101	Missouri Ridge	10,905	10,752-10,757	187	39.8°	936 GOR	17%	Birdbear
Burke	8-14-81	C. & K. Pet., Inc. Koch #2-28 C NWNE Sec. 28-162-89	Minnesota	7,105	5,863- 5,868 5,873- 5,875 5,877- 5,882	525	30.1°	900 GOR (est.)	0.58%	Madison
Billings	8-23-81	Supron Energy Corp. F-7-144-101 #1 NWNE Sec. 7-144-101	Devils Pass	11,150	9,275- 9,281	112	36.7°	1,443 GOR 162 MCF	148 BWPD	Madison
Billings	8-24-81	Diamond Shamrock Corp. Red. #34-4 SWSE Sec. 4-142-102	Roosevelt	12,770	12,634-12,646	866	50.5°	3,344 GOR	0%	Red River

<u>County</u>	<u>Comp. Date</u>	<u>Operator, Well, Location</u>	<u>Field</u>	<u>Total Depth</u>	<u>Prod. Depth</u>	<u>Oil (Bbls.)</u>	<u>Gravity</u>	<u>Gas</u>	<u>Water</u>	<u>Producing Formation</u>
Dunn	8-27-81	Mesa Pet. Co. #1-10 Pelton NESW Sec. 10-147-96	Bear Creek	14,306	13,970-13,985 14,040-14,047 14,054-14,065 14,069-14,072 14,080-14,094 14,106-14,162	405	52.0°	2,753 GOR	10 BWPD	Red River
McKenzie	8-27-81	Mobil Oil Corporation Harold J. Rogness #1 C NENE Sec. 26-150-100	Timber Creek	14,620	14,095-14,159	120 BCPD (Cond.)	57.0°	3,200,000 CFGPD	0%	Red River
Williams	9- 6-81	Mosbacher Pruett Oil Co. James F. Martin #1 NENE Sec. 22-153-102	Trenton	13,322	13,164-13,184	323	43.8°	981 GOR	11%	Red River
Divide	9- 7-81	Tenneco Oil Co. Wehrman #1-19 C SESE Sec. 19-163-101	Big Dipper	11,025	10,848-10,928	342	31.8°	269 GOR	59.4%	Red River
McKenzie	9-17-81	Consolidated Crude Oil Flying J. Skjelvik #4-35 C NENE Sec. 35-150-97	North Fork	14,280	14,048-14,214	152	57.6°	10,263 GOR	0%	Red River
Billings	9-20-81	Tenneco Oil Co. Graham USA #1-15 NESW Sec. 15-144-102	Buckhorn	10,513	10,350-10,380	222 (22.5 hrs.)	--	178 MCF	0%	Bakken
Williams	9-22-81	Kissinger Pet. Corp. Skarderud #2-7 NENE Sec. 7-158-95	Temple	12,850	12,631-12,716	158	55.5°	5,557 GOR	1%	Red River
McKenzie	10- 3-81	W. H. Hunt Trust Est. Larson #1 NENE Sec. 10-148-101	Bear Butte	15,059	11,604-11,610	17	41.0°	542 GOR	24%	Duperow
Williams	10- 8-81	NW Exploration Co. Long Creek #3 SWSE Sec. 36-154-99	Long Creek	12,300	11,740-11,773	82	38.5°	780 GOR	44%	Duperow
Stark	10-15-81	Terra Resources, Inc. #1-17 Prange SW/4 SE/4 Sec. 17-137-95	Scheffield	12,050	10,476-10,518	251	37.0°	TSTM	59%	Silurian
Bottineau	10-22-81	Petroleum, Inc. Norderhus #1 C NENE Sec. 36-164-78	Souris	3,105	3,004- 3,010	33	--	not tested	86%	Madison
Dunn	10-27-81	Amoco Production Co. Skachenko "A" #1 C SWNE Sec. 30-146-95	Jim Creek	13,960	11,542-11,578	1,652	45.0°	821 GOR (1,357 MCFD)	1% 16 BWPD	Duperow
Billings	10-27-81	Wm. H. Hunt Trust Estate Ted Fedora #1 NENE Sec. 34-143-100	Unnamed (St. Jacobs)	9,702	9,670- 9,702	107	41.2 at 60°	1,897 GOR	6.9%	Madison

County	Comp. Date	Operator, Well, Location	Field	Total Depth	Prod. Depth	Oil (Bbls.)	Gravity	Gas	Water	Producing Formation
Billings	10-28-81	W. H. Hunt Trust Est. #1 Hlebechuk SESW Sec. 27-143-100	St. Jacobs	13,815	11,076-11,083	35	43.0°	3,800 GOR	45%	Birdbear
Billings	10-29-81	Adobe Oil & Gas Corp. State Kordonowy #34-31 C SWSE Sec. 31-142-98	Bullsnake	13,670	13,045-13,048	240	49.0°	1,500 GOR	0%	Red River
McKenzie	10-30-81	Traverse Oil Co. #1-19 Nygaard SESW Sec. 19-151-100	Patent Gate	13,956	13,827-13,834	368.8	53.3°	1,184 GOR	1%	Red River
Stark	10-30-81	Coastal Oil & Gas & Al-Aq. #1 BN C NENE Sec. 27-140-98	Green River	12,510	12,344-12,348	374	46.0°	5,313 GOR	7%	Ordovician (Red River)
Divide	11- 5-81	Lear Pet. Explor., Inc. #1 Gordon Hall NWNE Sec. 30-161-98	Plumer	11,765	11,624-11,634	44	37.7°	909 GOR	79.6%	Red River
McKenzie	11-14-81	Getty Oil Company Alexander #3-7 SWNE Sec. 3-150-102	Unnamed	13,610	9,374- 9,514	8	--	1,500 GOR	60%	Madison
Burke	11-24-81	Monsanto Company Peterson #1 SWNW Sec. 9-162-89	Spiral	6,800	5,704- 5,706	18	36.0°	450 GOR	94%	Madison (Bluell)
Billings	11-24-81	Apache Corporation Federal #2-4 SWSW Sec. 2-144-102	Buckhorn	11,429	11,329-11,333	23	36.0°	550 GOR 12.67 MCFD	67% 47 BWPD	Duperow
Bowman	11-25-81	Davis Oil Co. #1 Buchholz C N/W SW Sec. 1-130-105	Skull Creek	9,530	9,311- 9,221	160	28.5°	--	50%	Red River
Dunn	11-25-81	TXO Production Co. McMahon State #1 NENE Sec. 36-146-93	Werner	12,819	9,081- 9,087	97	31.7°	--	0%	Madison
McKenzie	12-12-81	Patrick Petroleum Co. Enderud #1-17 SWNE Sec. 17-152-98	Banks	15,300	14,617-14,636	3.48 MMCF/D	--	--	--	Red River
McKenzie	12-22-81	Exeter Expl. Co. Hystad #11-31 NESW 31-152-99	Poe	14,370	14,180-14,255	6.2 MMCFD & 621 RCPD	56.5°	11,900 GOR	1%	Red River 'C'
Golden Valley	12-22-81	Anderson Petroleum, Inc. Gasho #2-23 NWSW Sec. 23-144-105	Trotters	12,611	12,365-12,436 12,532-12,535 12,557-12,560	B & C Zones 439.8	40.0°	--	B Zone-15.5% C Zone-44.8%	Red River
Divide	12-29-81	Lear Petroleum Explor. Kvigne #1 SWNW Sec. 11-161-99	Garnet	11,686	11,482-11,490	138	42.0°	3,565 GOR	47.9%	Red River

<u>County</u>	<u>Comp. Date</u>	<u>Operator, Well, Location</u>	<u>Field</u>	<u>Total Depth</u>	<u>Prod. Depth</u>	<u>Oil (Bbls.)</u>	<u>Gravity</u>	<u>Gas</u>	<u>Water</u>	<u>Producing Formation</u>
Williams	12-29-81	Samedan Oil Corp. Donahue #1 NENE Sec. 23-154-100	Avoca	14,824	9,714-10,126	113	35.5°	TSTM	45%	Madison