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NORTH DAKOTA CRUDE OIL INVENTORY AS OF JANUARY 1, 1972

by

Clarence B. Folsom, Jr. P. E.

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Clarence B. Folsom, Jr. P. E. ¹

ABSTRACT

North Dakota's reserves of crude oil, recoverable with present technical knowledge, available equipment and current operating practices, were 667,679,383 barrels on 1 January 1972. This figure is a decrease from the 670,404,566 barrels reported for 1 January 1971.

The decrease in inventory reflected the lack of drilling activity in the state during 1971.

315,200,000 barrels, or 47% of the total reserves, will be recovered by energy supplementation.

Reports of 167 well completions were received by the Geological Survey in 1971. Of these 13 were completed as producing wells. About 54.8% of the production in the month of December, 1971 came from unit operations and 35.2% of the producing wells are considered to be marginal, or stripper wells.

Seven new pools were opened during the year. With permits issued for 73 wildcat prospects the success ratio was 1 in 10.

The methods used, the data sources, and the assumptions made in previous reports in this series have been followed so that the results may be compared and valid conclusions drawn therefrom.

Results of the Study

On 1 January 1972 North Dakota's reserves of crude oil were 667,679,383 Stock Tank Barrels. This oil is considered to be technically recoverable with present equipment and techniques. Because of economic factors ultimate recovery may be less, but it is expected that improved techniques will offset this and may even add to the total.

Cumulative production to 1 January 1972 was 368,969,860 barrels. Production for the year of 1971 was 18,630,681 barrels, an average of 43.3 barrels per well per producing day. The total production for 1971 was 5% below that for 1970.

Energy supplementation was under way in 29 of the 139 producing pools and 47% of the reserves will be recovered from these pools. No new projects were initiated in 1971.

During 1971 there were 31 producing wells abandoned and only 13 new producers completed. Operators completed 105 dry holes. Seven new pools were discovered as the result of the 73 wildcats drilled.

¹Chief Petroleum Engineer, North Dakota Geological Survey

There were 2042 wells capable of producing oil at the end of the year. Of these 721 were classified as marginal on the basis of their production in December.² This represented an increase of 42, or 6.2% during 1971. Forty-six wells became marginal and 13 were plugged, or converted to service wells.

The North Dakota Geological Survey issued 129 permits and received 167 completion reports. There were 40 active locations at the end of the year.

The results of the study have been tabulated in several ways and the tables appear at the end of the report.

Explanation of Methods used in this Study

Throughout this inventory the standard volumetric method of estimating reserves has been used, according to the following formula:

$$R=7758 A h p (1-s)r/B \text{ where}$$

- R Recoverable reserves by presently known techniques
- A Proven acreage
- h Net average productive thickness in feet
- p Percent porosity
- s Percent water saturation
- r Recovery factor-percent
- B Reservoir volume factor - Barrels per barrel

The recovery factor, used here, does not take into account the economics of production. Since the study is intended to serve the same purpose as the annual inventories conducted by private business concerns, the economic situation was considered to be beyond the scope of the work.

For the purpose of this inventory a 40-acre tract was considered proven acreage if it contained a producing well, or if it offset a producing well. Credit given to offsetting 40-acre tracts was reduced if they contained dry holes or were offset in turn by dry holes.

The net average productive thickness was determined by Sidney B. Anderson, Chief Subsurface Geologist for the North Dakota Geological Survey, from mechanical logs on file in his office. Drill stem tests, core analyses, and other information were considered. Additional development, particularly in relatively new pools, tended to reduce the average thicknesses used in earlier estimates.

Porosities and saturations were taken from core analyses, where available, or from log calculations. When such data was not available, values were assigned by analogy to other nearby pools producing from the same geologic intervals under similar conditions.

The formation volume factors were obtained from reservoir fluid analyses, when available, or by analogy.

² A well is classified as marginal if it produces less than ten barrels of oil per day. The average is computed on the basis of the actual number of days produced during December, 1971, or last month produced.

The final result of the calculation was rounded off to the nearest thousand barrels, if the total was over 1 million, or to the nearest 500 barrels. The cumulative production to 1 January 1972 was then deducted to arrive at the final figure. Since the production is known to the exact barrel, this results in the final figure being shown to the single barrel.

The reserves found in the Heath Formation are credited to the Permo-Pennsylvanian, reflecting the present thinking of the subsurface section of the Survey.

A word of caution should be given concerning the figures in the column headed "Producing Acres." The figures shown are the total of all producing spacing units in the pool. Thus, where there are several pools in a field, the same acreage may be included in one or all of the pools. The area classified as productive will be less than that shown, but no effort was made to account for this in the tabulation. Perhaps this can be included in future reports.

Totals for "Fields" and "Pools" are given in Table II only since marketing districts are defined in such a way that no "Field" or "Pool" crosses a marketing district boundary, although they can, and do, cross county lines.

Stripper Well Survey

Table IVa provides data on the stripper wells in North Dakota. Table IVb shows comparable data for 1 January 1971. These wells account for about 4700 barrels per day of production. They also represent about 18% of the producing acreage in North Dakota.

In attempting to analyze the information in Tables IVa and IVb it should be kept in mind that the average production for December, 1971, is figured on the basis of actual producing days while the average for the year is based on 365 days.

1971 in Retrospect

While the number of permits issued in 1971 fell far below the 171 issued in 1970 it will be recalled that a number of drilling programs were carried out in the search for geologic data on the "Muddy" during that year. This also explains the increase in discoveries over 1970.

Production continued to drop during the year as the older fields continued their natural decline. The new fields, discovered during 1971, were not sufficiently developed to offset this decline. Also, the lack of new energy supplementation projects to add additional reserves resulted in a reduction of total remaining reserves.

Four of the new pools discovered during the year were in the Madison. Wildcat drilling was most active in the north central part of the state in Renville, Bottineau, and Ward Counties. McKenzie was the site for six wildcats. The north central area also led in development drilling.

Williams County continued to lead in oil production, providing one-third of the state total. McKenzie furnished one-fifth, and Bottineau and Burke Counties about 10% each.

April 4, 1971, marked the 20th Anniversary of the discovery of oil in the Silurian Formations in the Clarence Iverson #1, south of the town of Tioga. This well is considered to be the initial discovery in the Williston Basin and the site is marked by a granite monument. Since that time North Dakota has produced more than a third of a billion barrels of oil.

North Dakota production was about 51,000 barrels per calendar day during 1971. Based on the actual days produced the average well in North Dakota produced 43.3 barrels per day. It is interesting to note that this is only 0.1 barrels per day less than the comparable figure for 1970.

The national energy crisis that surfaced in the last quarter of 1970 reached major proportions in 1971. Testifying before the Senate Interior Appropriations Subcommittee Hollis Dole, Assistant Secretary for Mineral Resources, told the Senators that, "The U.S. petroleum supply has eroded even more rapidly than we had anticipated just a year ago, and the nation's energy situation has now become urgent."

As reasons for the deterioration he cited the delay in the construction of the Alaskan pipeline, delays in off-shore leasing, the approach of domestic producing capacity to its limit, rising demand in the rest of the world, and the increase in posted prices by foreign producing countries.

A Look at 1972

If Federal policies in such areas as OCS development, imports, off-shore leasing and production, and delays in permitting construction of needed facilities such as pipelines and tanker terminals are continued the situation should become even more critical this year.

With foreign imports now more expensive than domestic deliveries to the same points we can look forward to more upland drilling in the lower 48 as companies find it impossible to expend their 1972 drilling budgets on the OCS, in Santa Barbara channel, and on the North Slope.

If the proposed regulations regarding drilling permits on Federal lands are allowed to become effective in their present form we can also expect to see a sharp drop in the drilling of such leases.

All of these factors should result in increased drilling in the Mid-Continent and Rocky Mountain regions and North Dakota can expect to share in this development.

Should such drilling result in new oil production it will find a ready market as the demand for North Dakota crude continues to exceed the supply. Increased crude prices, which seem inevitable at this time, should not act as a deterrent to increased exploration.

ACKNOWLEDGMENTS

All of the information and data used in making this inventory was obtained from the files and records of the North Dakota State Industrial Commission, at the office of the North Dakota Geological Survey in Grand Forks.

In addition to Mr. Anderson, recognition is herewith given to the help and assistance of Mr. F. E. Wilborn, Jr., Assistant Petroleum Engineer for the Survey, and Mr. Ray Simons, the Survey's Statistician.

TABLE I

Crude Oil Inventory in North Dakota

	Primary Reserves Bbls. STO	Secondary Reserves Bbls. STO	Total Recoverable Bbls. STO	Production to 1-1-72 Bbls. STO	Remaining Recoverable Bbls. STO	% of Total	Fields Disc. to 1-1-72	Pools Disc. to 1-1-72	Fields Aband.	Pools Aband.	Producing Acres
District I	361834550	283147000	644981550	240248309	404733241	60.6	37	58	1	6	167635
District IIa	69388200	8297000	77685200	30063686	47621514	7.1	23	23	4	4	66103
District IIb	107991400	235000	108226400	45561808	62664592	9.4	35	26	3	4	63090
District IIc	44136500	10938000	55074500	22520968	32553532	4.8	18	19	2	2	35945
District IIIa	31247000	-	31247000	2665337	28581663	4.3	3	4	-	-	3721
District IIIb	107503500	12583000	120086500	27909752	92176748	13.8	17	21	4	5	39478
Totals	722101150	315200000	1037301150	368969860	668331290		133	151	14	21	375972
Gasoline Plant Recovery & Misc.				+651907	-651907						
				369621767	667679383						

TABLE II

Crude Oil Inventory in North Dakota

	Primary Reserves Bbls. STO	Secondary Reserves Bbls. STO	Total Recoverable Bbls. STO	Production to 1-1-72 Bbls. STO	Remaining Recoverable Bbls. STO	% of Total	Fields Disc. to 1-1-72	Pools Disc. to 1-1-72	Fields Aband.	Pools Aband.	Producing Acres
Billings	50325500	4750000	55075500	18377808	36697692	5.5	5	8	2	3	23749
Bottineau	89765500	10938000	100703500	36280578	64422922	9.6	32	33	3	3	59105
Bowman	48173500	6178000	54351500	8305074	46046426	6.9	5	6	2	2	11569
Burke	79798200	26106750	105904950	40502886	65402064	9.8	23	23	3	3	68685
Divide	15068000	9052500	24120500	4446216	19674284	2.9	9	9	1	1	9158
Dunn	390000	-	390000	349361	40639	-	1	1	0	0	360
Golden Valley	530500	-	530500	161405	369095	-	2	2	0	0	1360
McHenry	5850000	-	5850000	367522	5482478	0.8	1	1	0	0	1000
McKenzie	145396000	71773000	217169000	88257056	128911944	19.3	17	29	1	6	64846
Mountrail	28329000	43944000	72273000	25691320	46581680	7.0	3	3	0	0	15060
Renville	37181000	235000	37416000	21865366	15550634	2.3	13	13	1	1	22530
Slope	2691000	-	2691000	86652	2604348	0.4	2	2	0	0	1080
Stark	19041400	-	19041400	7994616	11046784	1.7	7	8	1	2	13600
Ward	3579000	-	3579000	1696538	1882462	0.3	3	3	0	0	4240
Williams	195982550	142222750	338205300	114587462	223617838	33.5	14	24	0	1	80630
Totals	722101150	315200000	1037301150	368969860	668331290						375972
Gasoline Plant Recovery & Misc.				+651907	-651907						
				369621767	667679383						

TABLE III

Crude Oil Inventory in North Dakota

	Primary Reserves Bbls. STO	Secondary Reserves Bbls. STO	Total Recoverable Bbls. STO	Production to 1-1-72 Bbls. STO	Remaining Recoverable Bbls. STO	% of Total	Fields Disc. to 1-1-72	Pools Disc. to 1-1-72	Fields Aband.	Pools Aband.	Producing Acres
Devonian	54627000	36670000	91297000	28483987	62813013	9.4	-	19	6	-	3440
Mississipian	590369479	261252000	851621479	293532636	558025843	83.5	-	110	5	-	320676
Ordovician	20277000	6178000	26455000	3999397	22455603	3.3	-	13	2	-	16400
Permo-Penn	12895000	-	12895000	9656151	3238849	0.5	-	1	-	-	4380
Silurian	15725000	1100000	16825000	8309840	8515160	1.3	-	4	1	-	10171
Triassic	28270671	10000000	38207671	24987849	13282822	2.0	-	4	-	-	20905
Totals	722101150	315200000	1037301150	368969860	668331290			151	14	-	375972
Gasoline Plant Recovery & Misc.				+651907	-651907						
				369621767	667679383						

TABLE IVa

North Dakota Stripper Wells

	Number of Wells	1971 Prod. Bbls.	Acres	Abandoned During 1971	Remaining Primary Reserves 1-1-72	Secondary Reserves 1-1-72	Ave. Daily Production Dec. 1971	Ave. Daily Production Per Well 1971
Billings	17	44713	4320	1	5240275	3017000	6.27	7.2
Bottineau	105	181852	7904	5	5133968	952300	6.9	4.74
Bowman	6	56355	480	0	2445604	497000	5.69	25.96
Burke	133	166960	16976	0	10982570	6805000	5.91	3.43
Divide	6	13482	960	0	1388728	1099000	8.61	6.15
Dunn	0	-	-	0	-	-	-	-
Golden Valley	0	-	-	0	-	-	-	-
McHenry	1	1826	80	0	136800	-	8.58	5.0
McKenzie	130	114008	12226	3	9688117	14807000	5.13	2.4
Mountrail	69	84216	5455	1	413545	18264000	6.77	3.34
Renville	33	73736	2640	0	2039035	30000	7.17	6.12
Slope	0	-	-	0	-	-	-	-
Stark	5	11994	1120	0	540276	-	6.64	6.57
Ward	2	179	320	0	172204	-	-	-
Williams	214	186631	17875	3	18325000	43614000	7.26	2.38
Totals	721	936454	67356	13	56506122	89085300	6.56	3.55

TABLE IVb

North Dakota Stripper Wells

	Number of Wells	1970 Prod. Bbls.	Acres	Abandoned during 1970	Remaining Primary Reserves 1-1-71	Secondary Reserves 1-1-71	Ave. Daily Production Dec. 1970	Ave. Daily Production Per Well 1970
Billings	20	40613	5680	1	6329943	1643500	7.22	5.5
Bottineau	93	169117	5544	1	5182640	621708	6.44	4.9
Bowman	4	5334	320	0	2037128	327434	5.88	4.0
Burke	128	171548	15966	0	10179953	5226880	3.97	3.7
Divide	3	3638	480	0	581704	860962	7.87	3.3
Dunn	0	-	-	-	-	-	-	-
Golden Valley	0	-	-	-	-	-	-	-
McHenry	1	1905	80	0	194649	-	0	5.2
McKenzie	132	170018	12221	0	7569951	13893158	5.68	3.5
Mountrail	68	57824	5400	0	979242	17313936	6.8	2.3
Renville	25	43421	2000	1	978980	-	6.98	4.7
Slope	0	-	-	0	-	-	-	-
Stark	7	32223	1440	0	574650	-	6.17	12.6
Ward	1	0	80	0	12000	-	-	-
Williams	197	157615	16420	0	13705627	52496648	5.8	11.8
Totals	679	853756	65631	3	48326472	92384050		5.6

APPENDIX A

MARKETING DISTRICT I

Geographical description: Township 148 North to 161 North, Ranges 94 West to 97 West, inclusive.

Fields: Gros Ventre, Viking, North Tioga, Tioga, McGregor, West Tioga, East Tioga, White Earth, Beaver Lodge, Capa, Hofflund, Delta, Charlson, Blue Buttes, Antelope, Croff, Bear Den, Lost Bridge, Pershing, Camel Butte, Fancy Buttes, Dimmick Lake, Clear Creek, Keene, Sand Creek, Northwest McGregor, Stoneview, Wildrose, Hawkeye and Hamlet.

MARKETING DISTRICT II

Subdistrict A

Geographical description: Township 164 North, Range 88 West to 103 West, inclusive, Township 163 North, Ranges 88 West to 103 West, inclusive, Township 162 North, Ranges 88 West to 103 West, inclusive, Township 161 North, Ranges 88 West to 93 West, and 98 West to 103 West, inclusive and Township 160 North, Ranges 88 West to 93 West, and 98 West to 103 West, inclusive.

Fields: Baukol-Noonan, East Goose Lake, Noonan, Short Creek, Columbus, Coteau, Portal, Rival, Black Slough, Foothills, Northeast Foothills, Rennie Lake, Lignite, Flaxton, Stony Run, Woburn, Bowbells, Perella, Flat Lake East and Writing Rock.

Subdistrict B

Geographical description: All of the state not included in other districts or subdistricts.

Fields: Dickinson, Haas, North Haas, Kuroki, Wayne, Wiley, Elmore, Sherwood, Eden Valley, Pratt, Glenburn, Lake Darling, Lansford, Lone Tree, Mackobee Coulee, Mohall, North Maxbass, South Antler Creek, Southwest Haas, Tolley, Chola, South Lone Tree, Southwest Aurelia, Mouse River Park, Zenith, Loraine, North Grano, Seven Mile Coulee and Blaine.

Subdistrict C

Geographical description: Townships 160 North to 164 North, Ranges 77 West to 80 West, inclusive.

Fields: North Souris, Scandia, Northeast Landa, Roth, Starbuck, South Starbuck, North Westhope, Westhope, South Westhope, Newburg, East Newburg, West Roth, Boundary Creek, Russell and Eidsvold.

MARKETING DISTRICT III

Subdistrict A

Geographical description: Townships 158 North to 160 North, Ranges 98
West to 107 West, inclusive.

Fields: Grenora

Subdistrict B

Geographical description: Townships 129 North to 158 North, Ranges 98
West to 107 West, inclusive.

Fields: Alexander, Little Missouri, Cedar Creek, Coyote Creek, Horse
Creek, Medicine Pole Hills, Rocky Ridge, Round Prairie, Fryburg,
Medora, Rough Rider, Square Butte, Rider and Foker Jim.