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MICHIGAN'S OIL AND GAS FIELDS, 1973

STATE OF MICHIGAN
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ACKNOWLEDGEMENTS

Functional elements within the Geological Survey
 Division are being reorganized. The Oil and Gas
 Conservation Group will be called the Oil and Gas
 Section and will be composed of a Regulatory Control
 Unit, a Proration-Production Unit, and a Petroleum
 Geology Unit.

The several Units of the Oil and Gas Section are
 responsible for the collection and maintenance of certain
 kinds of oil and gas field data. The compilation and
 assembly of the various data into a yearly report is done
 by the Petroleum Geology Unit. Unit supervisors, under

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the general guidance of R. M. Acker, Assistant State Geologist and Chief of the Oil and Gas Section, directed staff members in the gathering and maintenance of basic records. Unit supervisors who contributed specific data are:

V. F. Sargent, Supervisor, and S. L. Alguire, Field Coordinator, Regulatory Control Unit. Contribution: All data in columns under the headings "Number of Oil and Gas Wells" and "Brine Production" on Tables 2, 3, and 4.

W. G. Smiley, Supervisor, and J. S. Lorenz, Production and Proration Unit. Contribution: All Michigan oil and gas production data, oil import and export figures, monetary valuations, refinery and LPG storage data, and oil recovery per acre drilled (on Table 2). Oil and gas production figures are compiled from records obtained from the Michigan Department of Treasury.

Gas import figures are obtained from the Gas Section, Public Utilities Division, Department of Commerce.

All hydrocarbon production figures are preliminary and subject to correction as warranted.

G. D. Ells, Supervisor and B. L. Champion, Petroleum Geology Unit. Contribution: All general drilling statistics and well completion data, discovery well and deep-test data, drilled acreage figures, cumulative records, and all other summary information not specifically provided by those mentioned above.

Inquiries concerning information contained in this summary should be directed to the appropriate personnel as noted above.

The annual oil and gas summaries are not printed in large volume. They are distributed to various federal government agencies and to various government agencies in all 50 states, to numerous libraries in the United States and several abroad, and to many individuals and companies engaged in petroleum or other mineral industries.

Current issues are available from Publications Room, Department of Natural Resources. A limited number of back issues are available from the Geological Survey Division.

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Lansing, Michigan
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COVER ILLUSTRATION

The cover illustration shows structure contours on the top of the Niagaran formation, Columbus Section 3 reef, St. Clair County. This multi-pinnacle reef, discovered in 1968, produced 387,212 barrels of oil in 1973. Cumulative production through 1973 amounted to 1,750,017 barrels. Developed on 20-acre stand-up drilling units, the field has been under proration since early 1970. Daily oil allowable per producing well is 75 barrels of oil and/or not more than 100,000 cubic feet of gas per day. According to public hearing testimony in March 1974, immediate initiation of Unit operation, and recycling of gas and pressure maintenance would result in a calculated additional recovery of over 2-1/4 million barrels of oil.

INTRODUCTION

Oil and gas are one of Michigan's important natural resources. The estimated value of these raw products produced during 1973 amounted to about \$76,907,437. In addition, monies spent in leasing, exploration and development and other auxiliary activities connected with the exploitation of these natural resources contribute substantially to the State's economy each year. To help further the orderly development of these hydrocarbon resources, statistical and other useful data have been maintained and published for many years.

This issue of the oil and gas field statistical summary brings together data on various facets of Michigan's oil and gas industry during 1973. Certain indices which show the trend of activities from year to year are shown in chart form along with figures for prior years. Other charts show cumulative figures and other information of an historical nature, useful in oil and gas field evaluation. Furthermore, the gathering, maintenance and compilation of the data reflect, in part, the varied functions of the Oil and Gas Conservation Group, Geological Survey Division.

Certain figures for 1973, such as the number of exploratory, development and service wells drilled, and the number of new field and pool discoveries, may differ from figures reported for that year by regional or national trade journals or by industry reporting services. Preliminary 1973 oil and gas production and valuation figures cited in other publications may differ slightly from those shown herein. The differences in the various statistics are generally minor and due to methods of gathering and reporting well data, determining cut-off dates for reporting statistics on a yearly basis, and the necessity of making estimates and projections of data for some types of reports.

Statistical data on Michigan oil and gas activities are also published by Oil and Gas News, Mt. Pleasant, Michigan; Petroleum Information, Incorporated, Denver, Colorado; American Petroleum Institute, Washington, D.C.; American Association of Petroleum Geologists, Tulsa, Oklahoma; Interstate Oil Compact Commission, Oklahoma City, Oklahoma; World Oil, Houston, Texas;

and the Oil and Gas Journal, Tulsa, Oklahoma. The differences in figures which may occur in these publications from time-to-time are almost always due to the factors stated in the preceding paragraph.

The kinds of data listed herein are mainly derived from records received and maintained by the Oil and Gas Conservation Group, Geological Survey Division. None of the data is obtained from aforementioned publications. The data contained in this and previous oil and gas summaries have been treated uniformly as near as possible from year to year, so they reflect as accurately as possible the actual figures and other information that should be credited to the year in review.

This publication is essentially divided into three parts. The first summarizes significant statistics on oil and gas field activities for 1973 and includes other related records kept by the Oil and Gas Conservation Group. Part 2 contains specific information on the State's oil and gas fields, gas storage fields and other related subjects. Part 3 contains cumulative records of importance to the industry. Data for 1973 have been included in the Part 3 cumulative records.

PART I 1973 STATISTICAL DATA

* * * OIL AND GAS PERMITS * * *

Oil and gas drilling permits issued during 1973 began with number 29170 and ended with number 29612.

The same permit number (29549) was inadvertently assigned to another well location but was then corrected by adding the suffix "A" (29549A). Thus the total number issued during 1973 was 444 as compared with 423 in 1972. The initial classification of wells to be drilled under these permits was as follows:

INITIAL CLASSIFICATION	1971	1972	1973
Exploratory wells	173	211	225
Development wells	179	133	149*
Gas storage facility wells .	60	74	66
LPG storage operations . .	13	5	4
	425	423	444

*Includes 4 water injection and 1 water supply well

In addition to regular permits, 1 brine disposal permit (BDW 155) was issued. The single BDW permit issued in 1972 was No. 154 rather than 155 as reported. Deepening permits were issued for 24 wells during 1973 as compared with 26 the previous year. Deepening permit numbers began with number 1688 and ended with number 1711. There were no geological test permits issued in connection with oil and gas exploration during 1973.

[Permits Terminated in 1973]

The distribution of oil and gas permits according to oil and gas districts (See oil and gas districts map) through a five-year period including 1973 was as follows:

DISTRICTS	DRILLING PERMITS BY DISTRICT				
	Permits Issued				
	1969	1970	1971	1972	1973
Basin	113	169	138	154	120
Northern	32	52	81	137	173
Southeastern	126	121	130	62	67
Southwestern	41	33	30	32	28
Western	67	50	46	38	56
Totals	379	425	425	423*	444**

Permits issued under Act No. 61, Public Acts of 1939, as amended, are terminated six months after date of issue if actual drilling operations have not begun. Terminated permits were cited for the first time in Annual Statistical Summary 16, 1972. Permits issued for wells drilled under previous permits were cited for the first time in Annual Statistical Summary 18, 1973. The following lists relate to permits issued in 1972 and 1973.

*The following permits issued in 1972 were terminated in 1972 or 1973 after operators failed to commence drilling operations within 6 months of issue date:

28750(1972)	28851(1972)	28945(1973)	29077(1973)
28751 "	28855 "	28958 "	29098 "
28754 "	28867 "	28963 "	29134 "
28779 "	28871 "	28994 "	29139 "
28836 "	28908 "	29005 "	29145 "
28844 "	28933 "	29017 "	28890 "
28849 "	28944(1973)	29044 "	

**In addition to the 27 permits issued in 1972 and subsequently terminated, 6 of the 1973 permits were issued for wells either drilled under a previous number or for well locations previously permitted and then terminated. They are:

29233 issued for well drilled or permitted under	26506
29249 " " " " " " " "	19046
29357 " " " " " " " "	22419
29359 " " " " " " " "	22159
29550 " " " " " " " "	29496
29577 " " " " " " " "	29496
	& 29550

**The following permits issued in 1973 were also terminated in 1973:

29177	29184	29210	29231	29287
29180	29185	29228	29257	29290
29181	29190	29229	29266	

**Included in the 444 permits issued in 1973 were 16 issued for directionally-drilled holes. They were:

29175	29363	29474	29550
29344	29366	29487	29573
29345	29393	29536	29577
29354	29433	29549A	29600

The fluctuation in the number of permits issued for gas storage wells and other service well types over a five-year period is as follows:

TYPE OF SERVICE WELL	1969	1970	1971	1972	1973
Gas storage	48	115	60	74	66
LPG, Water Injection	10	1	16	9	8
Brine disposal, etc.	-	-	3	1	1
	58	116	79	84	75

The distribution, by county, of oil and gas permits issued in 1973 is shown in Table 1.

In addition to issuance of permits for various types of wells, 145 applications were received and approved for

rework operations on existing wells. Transfers of ownership were processed for 418 wells plus blanket transfer of wells from Humble Oil and Refining Company to Exxon Corporation, and from Melvin F. Lanphar and Company to Lanphar's, Inc. Corrections of location, well name or other detail involving specific permits were made for 44 wells, and cancel and transfer of permit were made for 10 other wells.

***** WELL COMPLETIONS *****

There were 301 new-hole exploratory and development wells which reached total depth and were completed as producers or dry holes during 1973. The 301 well completions do not include service wells, old wells drilled to deeper objectives, or reworked wells. The fluctuation in the number of new-hole completions and the resulting number of oil, gas, or dry holes over a five-year period is as follows:

Year	Exploratory Wells			Development Wells			Totals
	Oil	Gas	Dry	Oil	Gas	Dry	
1969	7	3	148	66	6	91	321
1970	8	6	139	43	9	72	277
1971	28	11	122	55	20	64	300
1972	34	23	124	50	15	62	308
1973	38	37	117	43	10	56	301

The number of new-hole service well completions, mainly facility wells in gas storage reservoirs, amounted to 68 in 1973. The figure does not include reworked wells or old wells converted to service wells of various types. The fluctuation of service well completions over a five-year period is as follows:

Year	GS	INJ	LPG	BDW	Totals
1969	20	5	0	1	26
1970	110	0	3	0	113
1971	81	0	13	2	96
1972	57	3	4	2	66
1973	60	5	2	1	68

Well completion figures for individual counties are shown in Table 1. The number of well completions within the several oil and gas districts is shown in the Chart below.

Certain kinds of completion data for exploratory, development and other types of wells are provided to the American Association of Petroleum Geologists (AAPG) and the American Petroleum Institute (API) during the year. Statistical data published for Michigan by these agencies are correct according to data submitted and approved, but sometimes differ from Geological Survey figures published later in the year. The differences are primarily due to determining a cut-off date for handling statistics on a yearly basis as required by these agencies. Another factor is internal decisions of the Geological Survey in regards to final year-end status of a completed well and decisions stemming from public hearings on oil and gas matters. For example, a well originally classified as a development well may be designated as the discovery well for a new pool or field or a gas well might be declared an oil well completion. Frequently, these changes of well status cannot be

readily passed on to other agencies so that their records can be up-dated.

Figures for Michigan exploratory and development well completions were provided to the American Petroleum Institute during 1973. Completion figures, shown below, have been extracted from the Quarterly Review of Drilling Statistics for the United States, Fourth Quarter 1973, and Annual Summary 1973, American Petroleum Institute Vol. VII, No. 4, March 1974, Tables I, II, III and V, pages 14-22. Geological Survey figures for 1973 are shown for comparison. Wells not included in 1973 API figures will be accounted for in 1974 figures.

Year	Exploratory Wells			Development Wells			Totals
	Oil	Gas	Dry	Oil	Gas	Dry	
1973	38	31	107	35	10	57	278
M.G.S.	38	37	117	43	10	56	301

Classification of New Well Completions	Basin		Northern		Western		Southwestern		Southeastern		Total	
	1972	1973	1972	1973	1972	1973	1972	1973	1972	1973	1972	1973
Exploratory wells												
Oil	7	5	24	24	3	6	0	2	0	1*	34	38**
Gas	2	2	14	22	2	10	4	3	1	0	23	37
D&A	35	31	34	51***	7	10	12	7	36	18	124	117
Total	44	38	72	97	12	26	16	12	37	19	181	192
Development wells												
Oil	15	11	26	23	2	4	2	2	5	3	50	43
Gas	10	1	2	5	0	2	2	1	1	1	15	10
D&A	25	13	13	26	1	3	8	7	15	7	62	56
Total	50	25	41	54	3	9	12	10	21	11	127	109
Service wells												
MI	3	5	0	0	0	0	0	0	0	0	3	5
BDW	0	0	0	0	0	0	2	0	0	1	2	1
Miscellaneous wells												
GS	47	29	0	0	9	17	1	3	0	12	57	61
LPG	0	0	0	0	0	0	0	0	0	4	1	4
Total completions	144	97	113	151	24	52	31	25	62	44	374	369

*This was an old well re-opened and made a significant extension discovery; no new footage drilled.

**Does not include old new shallower pool oil discovery.

***Includes 1 well drilled in Chippewa County, Northern Peninsula

***** DRILLED FOOTAGE *****

The average depth, statewide, of exploratory wells drilled in 1973 was 5,278 feet compared with 5,050 feet in 1972 and 4,374 feet in 1971. Development well depths averaged 5,262 feet as compared with 4,580 feet in 1972 and 3,992 feet in 1971. Service well depths, mostly gas storage facility wells completed in shallow Mississippian Stray Sandstone reservoirs, averaged 1,768 feet. Drilled footage figures and average well depths for specific counties are shown in Table 1.

Drilled footage figures extracted from the aforementioned API publication and tables are as follows:

Exploratory Wells			Development Wells		
Oil	Gas	Dry	Oil	Gas	Dry
217,984	192,010	543,317	190,217	57,753	267,681
Total Exploratory Footage: 953,311			Total Development Footage: 515,651		

Differences in total drilled footage figures as reported by API and by the Geological Survey are due to factors previously mentioned. Total drilled footage figures from Survey records for 1973 and several prior years are as follows:

Well Class	1970	1971	1972	1973
Exploratory	615,952	704,192	913,797	1,013,470
Development	559,936	454,016	554,968	573,522
Service Well (all types)	162,344	180,418	110,177	132,577
Totals:	1,232,312	1,439,578	1,605,860	1,719,569

*** 1973 OIL AND GAS PRODUCTION ***

Final year-end oil and gas production figures for 1973 include estimates for the last several months of the year. Oil figures are based on records for January through August, then projected to January 1, 1974. Gas figures are based on records through October, then projected to January 1, 1974. Figures shown on the several charts in this publication and in Table 2, Part 2, which covers production for individual fields and pools, include estimates. The current production record system is being revised, so adjustments are anticipated in oil and gas figures cited in previous statistical summaries. Corrected figures will be shown in the 1975 edition covering 1974 oil and gas activities.

Oil production, including condensate, was estimated to be 14,529,952 barrels in 1973 as compared with 12,989,977 barrels produced in 1972. Gas production for 1973 is estimated to be 43,703,215 Mcf as compared with 33,567,638 Mcf in 1972. These figures differ slightly from estimates published elsewhere (14,613,854 bbls. oil and 44,799,317 Mcf gas). Increase in oil and gas production is primarily due to new Niagaran reef reservoirs found since 1969 in the northern and southern parts of the Lower Peninsula. A number of newly discovered reef fields, mostly single-well pools, are shut-in awaiting gathering facilities, or are shut-in due to prohibition of flaring of oil well gas and lack of market connections. When these wells are put on production, a significant increase in annual oil and gas production is expected. Production by month and by oil and gas district during 1973 is shown in charts below.

District	Barrels Oil	MCF Gas
*Basin	4,766,953	6,795,292
*Northern	5,151,573	16,698,325
*Southeastern	3,164,993	16,118,470
*Southwestern	1,229,006	4,069,485
*Western	217,427	21,643
Totals	14,529,952	43,703,215

*Includes estimated production

*** LPG PRODUCTION ***

Total LPG production in 1973 amounted to 1,160,530 barrels as compared with 1,312,642 barrels in 1972. LPG's are stripped from Michigan produced gas and gas imported via pipeline from western sources. Additional data on LPG production and gas plant operations are found in Part 2 of this publication.



	Barrels Oil	MCF Gas
January	1,169,404	3,234,696
February	1,068,056	2,938,726
March	1,101,018	3,005,086
April	1,138,777	3,492,313
May	1,271,719	3,834,509
June	1,201,635	3,554,970
July	1,254,683	4,174,674
August	1,270,223	3,859,955
September	*1,186,634	3,803,218
October	*1,287,216	4,179,233
November	*1,224,358	*3,765,797
December	*1,356,229	*3,860,038
Totals	14,529,952	43,703,215

*Production estimated from tax revenue data

*** CONDENSATE PRODUCTION ***

Condensate is a new Michigan resource, the first having been produced from the northern Michigan retrograde reservoirs found the past few years. There were 74 definite gas-condensate fields located in the reef belt running through counties of the Lower Peninsula as of April 1, 1974. Some are 1974 discoveries and thus not listed in this report. Condensate production is shown in Part 2 for pools classified as gas-condensate but is included in the yearly oil production total cited in various tabulations in this publication. Condensate production is as follows:

Year	Barrels
1969	0
1970	18,946
1971	98,668
1972	125,768
1973	335,041
Total	578,423

*** OIL AND GAS PRODUCTION BY COUNTY ***

Oil and gas production by counties in 1973 is tabulated below. Production by individual field and pool within a county is found in Part 2, Table 2. Annual and cumulative production figures by year and geologic formation is found in Part 3. As noted, the figures for 1973 include estimates for the last few months of the year.

Significant gains were again made in certain northern Lower Peninsula counties during the year. But conservation measures (the no-flare order) tend to temporarily curtail production. The no-flare order in effect since late 1971 prohibits the flaring of oil well gas and requires Niagaran oil wells in specified counties to be closed in until a market connection is achieved or an exception to the order is granted. Another special order put into effect in April, 1973, deals with spacing and proration of Niagaran oil wells in specified counties. The counties covered by the no-flare order and spacing-proration order are shown on the inset map. This latter order established 80-acre spacing for Niagaran oil wells and statewide proration for Niagaran oil reservoirs in these specified counties. Drilling unit, well spacing, and oil-gas allowables are shown on the inset map. Both orders may be rescinded or revised as warranted. These prudent and justifiable conservation measures effectively prevent waste of millions of cubic feet of needed gas, and should ultimately result in more efficient drainage of reef reservoirs and a greater recovery of the liquid hydrocarbons.

*** OIL AND GAS VALUATION ***

The average price paid at the wellhead for Michigan produced crude, including condensate, was \$4.07 per barrel compared with \$3.20 per barrel in 1972. The gross value of these products amounted to \$59,412,710 as compared with \$41,556,432 in 1972.

The average price of Michigan produced gas sold at the wellhead was \$.39 per Mcf. The gross value of this product amounted to \$17,494,727 as compared with \$10,314,222 in 1972.

The price of LPG's varied during the year. Butane and iso-butane reportedly ranged from \$.17 to \$.24 per gallon and pentanes as high as \$.40 per gallon. The average price per gallon for all components was about \$.07 per gallon, the same as last year. Estimates of the total value of LPG's produced in gas plant operations in 1973 were not available. The 1972 gross value was estimated as \$3,859,167, but was probably higher for 1973.

*** OIL AND GAS IMPORTS AND EXPORTS ***

Imports of U.S. domestic crude oil to Michigan refineries via pipeline from western and midwestern states decreased during 1973. Imports of domestic crude amounted to 13,949,230 barrels in 1973 compared with 28,522,233 barrels in 1972.

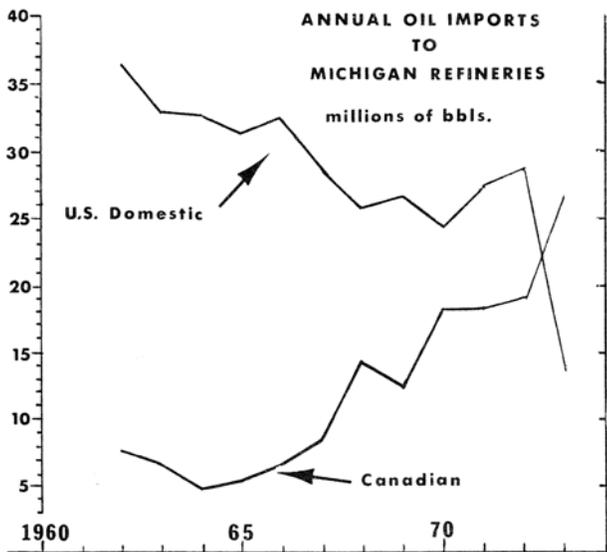
Imports of Canadian crude via pipeline from western Canada oil fields continued to increase. Canadian imports to Michigan refineries amounted to 26,826,153 barrels in 1973 compared with 18,959,192 barrels in 1972.

Total imports, Canadian and domestic, decreased substantially. Imports for 1973 amounted to 39,775,383

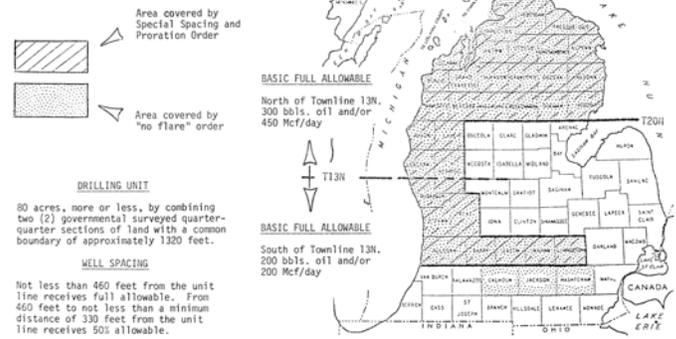
barrels in 1973 as compared with 47,481,425 barrels the prior year.

OIL AND GAS PRODUCTION BY COUNTY IN 1973		
County	Barrels Oil	MCF Gas
Allegan	102,961	56,407
Antrim	189	---
Arenac	189,677	---
Barry	10,994	---
Bay	201,535	---
Calhoun	994,957	3,676,651
Clare	346,372	166,019
Crawford	771,045	504,075
Eaton	18,933	515,692
Genesee	45,348	---
Gladwin	267,787	---
Grand Traverse	186,651	3,822,693
Gratiot	521	1,556
Hillsdale	1,600,225	4,465,431
Huron	135	---
Ingham	1,419,626	4,794,117
Isabella	177,322	---
Jackson	600,308	3,116,296
Kalkaska	1,613,911	9,394,607
Kent	47,307	10,560
Lake	99,953	---
Lapeer	86,428	36,468
Lenawee	---	---
Macomb	389	1,753,892
Manistee	3,281	---
Mason	47,726	---
Mecosta	42,499	45,706
Midland	99,609	---
Missaukee	657,509	724,409
Monroe	4,772	---
Montcalm	87,846	---
Muskegon	13,912	---
Newaygo	11,134	---
Oakland	612	---
Oceana	40,072	---
Ogemaw	426,279	290,562
Osceola	418,151	---
Oscoda	1,121	---
Otsego	2,578,656	2,976,950
Ottawa	66,679	325,867
Presque Isle	---	---
Roscommon	296,705	257,231
Saginaw	17,917	---
Shiawassee	1,760	---
St. Clair	848,898	6,746,383
Tuscola	51,557	---
Van Buren	6,108	---
Washtenaw	3,159	---
Wayne	20,067	---
Wexford	1,349	21,643
Totals	14,529,952	43,703,215

	1973 CRUDE OIL IMPORTS (Bbls.)		Total
	Domestic	Canadian	
January	1,104,149	2,307,231	3,411,380
February	909,422	1,904,261	2,813,683
March	1,157,297	2,089,913	3,247,210
April	1,135,483	2,022,718	3,158,201
May	1,213,178	2,103,419	2,316,597
June	1,287,882	1,825,363	3,113,245
July	1,362,674	2,264,966	3,627,240
August	1,339,481	2,197,996	3,537,477
September	1,346,220	2,399,340	3,745,560
October	1,287,505	2,750,066	4,037,571
November	854,337	2,488,960	3,343,297
December	951,602	2,471,920	3,423,522
Totals	13,949,230	26,826,153	39,775,383



[Special Orders: No-Flare, Spacing and Proration, Explanation]



***** NEW FIELD AND POOL DISCOVERIES *****

Gas imports to Michigan markets and gas storage fields via pipelines, primarily from Texas, Louisiana, Oklahoma and Kansas fields, amounted to 907,122,475 Mcf in 1973, an increase over the 906,684,020 Mcf imported in 1972. Compilations by the Gas Section, Michigan Public Service Commission, show the following imports, by month, during 1973:

1973 PIPELINE GAS IMPORTS (Mcf)	
January	48,292,345
February	45,839,672
March	78,058,981
April	78,327,326
May	88,056,292
June	94,623,887
July	100,047,066
August	88,954,467
September	91,607,332
October	88,717,861
November	58,656,696
December	45,940,550
Total	907,122,475

1973 CRUDE OIL EXPORTS (Bbls.)	
January	82,230
February	98,230
March	131,730
April	101,296
May	388,887
June	305,750
July	311,990
August	204,745
September	227,321
October	220,622
November	181,033
December	407,699
Total	2,661,533

The bulk of Michigan produced crude goes to Michigan refineries, but some is exported. The export mechanism is largely a "paper work - credit" type affair involving pipeline transportation. Last year's exports amounted to about 18% of the state's total production. The amount of Michigan produced crude credited to terminals in Indiana, Ohio, Pennsylvania and New York amounted to 2,661,533 barrels in 1973 as compared with 1,013,637 barrels in 1972. All Mobil Oil Corporation crude produced from reef reservoirs in southern Michigan is credited to export. Shell Oil pipeline runs from northern Michigan reef reservoirs go not only to Michigan refineries but to a terminal in Buffalo, New York.

Statewide, 39% of the wildcat wells completed in 1973 resulted in new discoveries as compared with about 32% in 1972, 24% in 1971, 10% in 1970 and 6% in 1969 when the Niagaran reef play began in northern Michigan. In the 15-county Northern District, the discovery-to-exploratory dry-hole ratio was about 1:1 in 1973, 1:2 in 1972, 1:3 in 1971, and 1:3 in 1970. About 60% of the new discoveries were made in this District. In the Western District where the reef play spread in 1972, 9 new reefs were found in Manistee County, 3 in Mason County, and 3 in northwestern Wexford County. Again, all new Niagaran reefs were located by seismic surveys.

Most of the new discoveries are tentatively classified as Class E pools having possible oil and gas recoveries as defined by the Committee on Statistics of Drilling, American Association of Petroleum Geologists. These classes, as follows, are used to give some estimate or measure of reserves found by a discovery well.

- Class A - Over 50 million barrels oil or 300 BCF gas
- Class B - 25-50 million barrels oil or 150-300 BCF gas
- Class C - 10-25 million barrels oil or 60-150 BCF gas
- Class D - 1-10 million barrels oil or 6-60 BCF gas
- Class E - 1 million barrels or less oil or less than 6 BCF gas

Class F - Abandoned as non-profitable

An analysis of discovery wells according to geologic system and an analysis of drilling objectives penetrated by wells completed in 1973 is shown below. The sizeable percentage of wells drilled only to Niagaran rocks, as shown in the latter analysis, reflects the high interest in reef exploration in the northern counties and around the southern edge of the basin.

[Analysis of Discovery Wells by Geologic System]

ANALYSIS OF DISCOVERY WELLS BY GEOLOGIC SYSTEM				
System	Formation or Pay	Number of Discoveries		
		1971	1972	1973
Pennsylvanian		-	-	-
Mississippian	"Michigan Stray Ss."	1	-	-
	"Berea Sandstone"	-	-	-
Devonian	Antrim Shale	-	-	-
	"Traverse Lime"	4	1	-
	Dundee	4	1	-
	"Reed City"	-	-	-
	Detroit River "Sour Zone"	-	1	-
	Richfield	1	-	-
Silurian	Salina A-1 or A-2	-	2	6
	Niagaran reef*	30	53	69
Ordovician	Trenton-Black River	1	-	1
	Prairie du Chien	-	-	-
Cambrian	(Gas shows reported in past years)	-	-	-

*Most reefs also have associated Saline A-1 oil or gas pays.

[Drilling Objectives]

DRILLING OBJECTIVES IN MICHIGAN			
System	Formation or Pay	Percentage	
		1972	1973
Pennsylvanian		-	-
Mississippian	"Michigan Stray Sandstone"	15.0	11.1
	"Berea Sandstone"	-	-
Devonian	Antrim Shale	-	-
	"Traverse Lime"	3.2	1.6
	Dundee	4.6	3.2
	"Reed City"	1.9	1.9
	Detroit River "Sour Zone"-	-	-
	Richfield	4.3	1.4
Silurian	Salina-Niagaran	61.9	74.1
Ordovician	Trenton-Black River	3.2	3.0
	St. Peter Sandstone or	-	-
	Prairie du Chien	4.8	3.0
Cambrian or Precambrian	Undifferentiated	1.2	.8

*** STATE OIL AND GAS REVENUE ***

Public lands in the northern part of the Southern Peninsula have been heavily leased for oil and gas as a result of successful Niagaran reef exploration. At the end of May 1974, State land leased for oil and gas in the Southern Peninsula amounted to 1,416,605 acres, most of it in the northern counties.

The amount of land under lease for oil and gas has varied from year to year, and revenues closely follow the high and low points. Records show a previous high of about 935,000 acres under lease in 1951 and 1952 and then a gradual decline to about 150,000 in 1958. From 1958 the amount increased to about 640,000 in 1962. From 1962 the amount of acres under lease decreased to about 290,000 in 1966. From 1966 leasing increased to its present high level.

At a State oil and gas lease sale held in June 1974, there were 348,405 additional acres offered but only 217,506 acres were leased. The total bid amounted to \$7,131,540.00 and the average bid per acre amounted to \$32.79. The highest bid per acre was \$16,250.00. A record bid of \$1,300,000 was received for an 80-acre parcel in Grand Traverse County.

Total State revenues from royalty, rentals, bonus, and application-assignment fees from 1927 through 1973 amounted to \$46,888,044.11. Revenue figures according to year and source are shown on page 40.

*** WELL RECORDS AND OIL AND GAS MAPS ***

OIL AND GAS WELL RECORDS. Descriptive geological logs and drillers logs are available for over 29,000 oil and gas tests, including exploratory, development, facility and other types of wells. Individual logs may be purchased at small cost from the Geological Survey Division. Electric or radiation logs of any type are not available for distribution or sale.

OIL AND GAS FIELD MAPS. Blueprint copies of county oil and gas field maps are available for every county in the Southern Peninsula. The maps show locations of oil and gas tests but do not show geological data or structural contour lines. County map scales are 1" = 1 mile. Blueprint field maps are available for many oil and gas fields. These maps show well locations, well permit numbers, operators and lease names. They do not show geological data or structural contour lines. Field map scales are mainly 4" = 1 mile. All manuscript maps from which blueprint copies are made are posted on a regular basis. An oil and gas field maps list may be obtained from the Geological Survey upon request.



TABLE 1 DRILLING PERMITS, WELL COMPLETIONS, DRILLED FOOTAGE BY COUNTY, 1973

County	Field Name	Operator and Lease	Permit Number	Depth to P.W.	Total Depth	Initial Production m(D)IP	Initial Production to (T)IP	Producing Formation	Basis For Pool Class	Classification of New Hole Completions									
										Does not include reworked wells or old wells drilled deeper		RESULTS		SERVICE WELLS		TOTAL MLLS DRILLED		TOTAL DRILLED FOOTAGE	
COUNTY	OIL/GAS PERMITS ISSUED	OIL AND GAS TESTS	Completed Explor.	Devel.	Oil Wells	Gas Wells	Dry Holes	Completed G.S.	B.S.W.	Completed	Devel.	Explor.	Devel.	Fac.	Depths				
Alcona	12-31N-SE	Miller Brothers et al	29138	3680	3875		SIOW-Est. 150	Salina	Seis. E										
Alcona	12-31N-SE	Huron Cement Co. #1-12						A-1 Carb.	Seis. E										
Alcona	25-28N-4W	Manelona	29264	6449	6764	F370	+718 Mcr†	Niagara	Seis. E										
Alcona	25-28N-4W	St-Manelona #2-25	29367	3377	3660			1660†	Niagara	Seis. E									
Alcona	2-15-SW	Lee	29166	3172	3329		Est. 20,000†	Niagara	Seis. E										
Alcona	10-15-SW	Harris #1							Seis. E										
Alcona	10-15-SW	Lloyd Koyl #2	29264	3184	3632	F129	+1,914 Mcr†	Niagara	Seis. E										
Alcona	13-15-SW	NGU-Markel-Wood A. Mymachod #1							Seis. E										
Alcona	29-15-7W	Penfield	29389	2676	2806	F200†		Niagara	Seis. E										
Alcona	2-28N-4W	Cotton Pet. Corp.	29247	6390	7010	F396	+532 Mcr†	Niagara	Seis. D										
Alcona	2-28N-4W	Joseph McCusker #1A	29483	7000	7125	F252		Niagara	Seis. E										
Alcona	7-28N-4W	Wood #2-2							Seis. E										
Alcona	7-28N-4W	Frederic Production Co.	29071	6950	7615	+320 Mcr†	04.7 Cond./Mcr†	Niagara	Seis. E										
Alcona	25-28N-4W	St-Frederic #A #1-7							Seis. E										
Alcona	25-28N-4W	Shell Oil Co.	29225	3985	4316	F45	+454 Mcr†	Salina	Seis. D										
Alcona	17-2N-3W	Shell Oil Co.	29208	5844	6123	F360		A-1 Carb.	Seis. E										
Alcona	39-26N-11W	Blair							Seis. E										
Alcona	39-26N-11W	Shell Oil Co.	29349	5815	6413	F61	+475 Cond./Mcr†	Salina-	Seis. E										
Alcona	24-25N-12W	Grant	29409	5720	6135	F641	+6145†	Niagara	Seis. E										
Alcona	24-25N-12W	Pavlis-St-Grant #1-24							Seis. E										
Alcona	29-25N-12W	Shell Oil Co.	29257	5940	6424	F205†		Niagara	Seis. E										
Alcona	29-25N-12W	State-Well #1-29							Seis. E										
Alcona	Grand Traverse Mayfield	Shell Oil Co.	29155	5829	6470	107.4 Cond./Mcr†	+891†	Salina-	Seis. E										
Alcona	3-25N-11W	Schuchert #1-3							Seis. E										
Alcona	Grand Traverse Mayfield	Shell Oil Co.	29242	6508	6783	624 Cond./Mcr†	+829†	Niagara	Seis. E										
Alcona	19-25N-11W	Howard #1-24							Seis. E										
Alcona	Grand Traverse Mayfield	Shell Oil Co.	29385	6329	6630	F312	+110 Mcr†	Niagara	Seis. E										
Alcona	30-25N-11W	Osband #1-30							Seis. E										
Alcona	Grand Traverse Paradise	Shell Oil Co.	29450	6455	6841	1200†		Niagara	Seis. E										
Alcona	18-25N-10W	Eggen #1-18							Seis. E										
Alcona	Grand Traverse Union	Shell Oil Co.	29393*	6118	6494	32.5 Cond./Mcr†	+4615†	Niagara	Seis. E										
Alcona	5-26N-9W	Green-State-Union #1-5							Seis. E										
Alcona	Grand Traverse Union	Anoco Production Co.	29392	6660	6860	76 Cond./Mcr†	+2000†	Niagara	Seis. E										
Alcona	14-26N-9W	Prizy & Schiff #1-14							Seis. E										
Alcona	Grand Traverse Union	Anoco Production Co.	29542	6298	6471	13 Cond./Mcr†	+1100†	Niagara	Seis. E										
Alcona	22-27N-9W	Montgomery #1-18	29100	Unknown	6192	Pay section cemented off		Niagara	Seis. E										
Alcona	Grand Traverse Whitewater	PTD							Seis. E										
Alcona	22-27N-9W	Mobil Oil Corp.	29294	4186	4450	F218		Salina-	Seis. E										
Alcona	12-2N-1E	Meggie Scripper #1							Seis. E										
Alcona	Ingham	Mobil Oil Corp.	29378	4048	4600	F54.6 Hrs.	+122 Mcr†	Niagara	Seis. E										
Alcona	25-2N-1E	Leland Townsend #1							Seis. E										
Alcona	Ingham	Mobil Oil Corp.	29292	3775	4390	F240		Salina-	Seis. E										
Alcona	4-1N-1W	Leo Chick #1							Seis. E										
Alcona	Ingham	Mobil Oil Corp.	29295	3620	3850	F90		Salina-	Seis. E										
Alcona	17-1N-2W	Truffy #1-17							Seis. E										
Alcona	Ingham	White Oak	29158	3970	4155	F236		Salina-	Seis. E										
Alcona	32-2N-2E	H. B. Townsend #1							Seis. E										
Alcona	Kalkaska	Boardman	29437	6570	6980	+117 Mcr†	4 Cond./Mcr†	Niagara	Seis. E										
Alcona	3-26N-6W	State-Boardman #1-3							Seis. E										
Alcona	Kalkaska	Boardman	29381	6477	6975	+566 Mcr†		Niagara	Seis. E										
Alcona	6-26N-6W	Shell Oil Co.	29431	6578	6950	F500		Niagara	Seis. E										
Alcona	Kalkaska	Cold Springs	29169	6564	6970	F173 Cond./Mcr†	+3000†	Salina-	Seis. E										
Alcona	1-28N-6W	Anoco Production Co. #1-1							Seis. E										
Alcona	Kalkaska	Cold Springs	29169	6564	6970	F173 Cond./Mcr†	+3000†	Salina-	Seis. E										
Alcona	12-28N-6W	St-Cold Springs #1-12							Seis. E										
Alcona	Kalkaska	Excelsior	29375	7211	7402	25 Cond./Mcr†	+601†	Niagara	Seis. E										
Alcona	3-27N-6W	Paxson #1-3							Seis. D										
Alcona	Kalkaska	Excelsior	29243	6740	7070	F81 Cond./Mcr†	+7448 Mcr†	Niagara	Seis. D										
Alcona	6-27N-6W	D. E. Wood #1-6							Seis. E										
Alcona	Kalkaska	Excelsior	29366*	7076	7333	F14.4 Cond./Mcr†	+2505†	Niagara	Seis. E										
Alcona	16-27N-6W	Fudge #1-16							Seis. E										
Alcona	Kalkaska	Excelsior	29216	7165	7365	59 Cond./Mcr†	+2678†	Niagara	Seis. E										
Alcona	17-27N-6W	Shell Oil Co.							Seis. E										
Alcona	Kalkaska	Excelsior	29245	6396	6850	F128		Salina-	Seis. E										
Alcona	3-27N-7W	Kalkaska "H" #1-3							Seis. E										
Alcona	Kalkaska	Anoco Production Co.	29124	6572	7077	+835 Mcr†		Niagara	Seis. E										
Alcona	16-27N-7W	Shell Oil Co.	29249	6449	6776	16 BOPH		Niagara	Seis. E										
Alcona	Kalkaska	Northern Mich. Explor.	29239	6380	6852	+447 Mcr†		Salina-	Seis. E										
Alcona	11-27N-5W	Broadwell et al #1-11							Seis. E										
Alcona	Kalkaska	Anoco Production Co.	29263	6372	6968	+220 Mcr†		Niagara	Seis. E										
Alcona	24-27N-5W	St-Kalkaska "F" #1-24							Seis. E										
Alcona	Kalkaska	Anoco Production Co. #1-1							Seis. E										
Alcona	26-27N-5W	St-Kalkaska "G" #1-26							Seis. E										
Alcona	Rapide River	Shell Oil Co.	29422	6719	6986	F39.8 Cond./Mcr†	+1550†	Niagara	Seis. E										
Alcona	35-26N-7W	St-Rapide River #1-35							Seis. E										
Alcona	Manistee	Bear Lake	29395	4786	5035	F99.6 Cond./Mcr†	+4035†	Niagara	Seis. E										
Alcona	23-23N-15W	Manistee	29373	5745	6167	F504		Niagara	Seis. E										
Alcona	11-24N-13W	Manistee	29120	4283	4807	+375 Mcr†		Niagara	Seis. E										
Alcona	1-22N-16W	Manistee							Seis. E										

COUNTY	OIL/GAS PERMITS ISSUED	OIL AND GAS TESTS		RESULTS			SERVICE WELLS		TOTAL MLLS DRILLED		TOTAL DRILLED FOOTAGE		Average Well Depth		
		Completed Explor.	Devel.	Oil Wells	Gas Wells	Dry Holes	Completed G.S.	B.S.W.	Completed	Devel.	Explor.	Devel.		Fac.	Depths
Alcona	1	0	0	0	0	0	0	0	1	0	1	0	1,161	0	111
Alcona	2	1	1	0	1	1	0	0	2	3,875	3,900	0	3888		6200
Alcona	3	1	0	1	0	2	0	0	3	18,599	0	0	0	0	8000
Barry	2	1	0	0	0	0	1	1	2	3,410	0	3,301	3356		3747
Barry	1	2	0	0	0	2	0	0	2	7,494	0	0	0	0	3747
Calhoun	22	11	8	4	4	11	2	0	21	39,013	34,146	3,400	3646		5024
Calhoun	0	2	0	0	0	2	0	0	2	10,048	0	0	0	0	5024
Calhoun	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5024
Calhoun	0	1	0	0	0	1	0	0	1	1,305	0	0	0	0	1305
Calhoun	18	2	1	1	0	2	16	0	19	8,075	5,265	24,431	1988		7372
Calhoun	6	5													

ALPENA COUNTY					
Alpena 12-31N-8E	1973	Gas (A-1 only)			
ANTRIM COUNTY					
Mancelona 25-29N-5W	1973	Oil			
Mancelona 26-29N-5W	1972	Oil			
CRAWFORD COUNTY					
Frederic 2-28N-4W	1973	Oil			
Frederic 7-28N-4W	1973	Oil			
Frederic 10-28N-4W	1971	Oil			
Frederic 13-28N-4W	1972	Gas-Condensate			
Frederic 22-28N-4W	1973	Gas-Condensate			
Frederic 29-28N-4W	1972	Gas-Condensate			
Frederic 29-28N-4W Pool A	1973	Gas-Condensate			
GRAND TRAVERSE COUNTY					
Blair 33-26N-11W	1973	Oil			
Blair 34-26N-11W	1970	Gas-Condensate			
Blair 36-26N-11W	1972	Gas-Condensate			
Grant 24-25N-12W	1973	Gas-Condensate			
Grant 26-25N-12W	1971	Oil			
Grant 29-25N-12W	1973	Oil			
Mayfield 3-25N-11W	1973	Gas-Condensate			
Mayfield 16-25N-11W	1972	Oil			
Mayfield 19-25N-11W	1973	Gas-Condensate			
Mayfield 24-25N-11W	1973	Gas-Condensate			
Mayfield 30-25N-11W	1973	Oil			
Paradise 18-25N-10W	1973	Gas-Condensate			
Union 1-26N-9W	1972	Gas-Condensate			
Union 3-26N-9W	1972	Gas-Condensate			
Union 5-26N-9W	1973	Gas-Condensate			
Union 8-26N-9W	1970	Gas-Condensate			
Union 11-26N-9W	1972	Gas-Condensate			
Union 12-26N-9W	1969	Gas-Condensate			
Union 14-26N-9W	1973	Gas-Condensate			
Union 18-26N-9W	1973	Gas-Condensate			
Whitewater 22-27N-9W	1973	Gas-Condensate			
Whitewater 32-27N-9W	1972	Oil			
Whitewater 34-27N-9W	1972	Oil			
Whitewater 35-27N-9W	1972	Oil			
Whitewater 36-27N-9W	1971	Gas-Condensate			
KALKASKA COUNTY					
Blue Lake 1-28N-5W	1971	Oil			
Blue Lake 12-28N-5W	1971	Oil			
Blue Lake 27-28N-5W	1972	Gas-Condensate			
Blue Lake 28-28N-5W	1970	Gas-Condensate			
Blue Lake 33-28N-5W	1971	Gas-Condensate			
Boardman 3-26N-8W	1973	Gas-Condensate			
Boardman 6-26N-8W	1973	Oil			
Cold Springs 1-28N-6W	1973	Gas-Condensate			
Cold Springs 12-28N-6W	1973	Gas-Condensate			
Cold Springs 19-28N-6W	1971	Oil			
Cold Springs 19-28N-6W Pool A	1973	Oil			
Cold Springs 20-28N-6W	1971	Oil			
Cold Springs 21-28N-6W	1970	Oil			
Cold Springs 25-28N-6W	1971	Gas-Condensate			
Cold Springs 25-28N-6W Pool A	1972	Oil			
Excelsior 3-27N-6W	1973	Gas-Condensate			
Excelsior 6-27N-6W	1973	Gas-Condensate			
Excelsior 7-27N-6W	1973	Gas-Condensate			
Excelsior 9-27N-6W	1972	Gas-Condensate			
Excelsior 17-27N-6W	1973	Gas-Condensate			
Kalkaska 3-27N-7W	1973	Oil			
Kalkaska 3-27N-7W Pool A	1973	Oil			
Kalkaska 5-27N-7W	1970	Oil			
Kalkaska 7-27N-7W	1972	Oil			
Kalkaska 9-27N-7W	1972	Gas-Condensate			
Kalkaska 10-27N-7W	1972	Gas-Condensate			
Kalkaska 12-27N-7W	1972	Oil			
Kalkaska 13-27N-7W	1972	Gas-Condensate			
Kalkaska 16-27N-7W	1973	Oil			
Kalkaska 28-27N-7W	1970	Gas-Condensate			
Kalkaska 28-27N-7W Pool A	1972	Gas-Condensate			
Kalkaska 32-27N-7W	1971	Gas-Condensate			
Kalkaska 11-27N-8W	1973	Oil			
Kalkaska 13-27N-8W	1972	Oil			
Kalkaska 21-27N-8W	1971	Oil			
Kalkaska 24-27N-8W	1973	Oil			
Kalkaska 25-27N-8W	1972	Gas-Condensate			
Kalkaska 26-27N-8W	1973	Gas-Condensate			
Kalkaska 28-27N-8W	1971	Oil			
Kalkaska 33-27N-8W	1972	Gas-Condensate			
Rapid River 24-28N-7W	1970	Oil			
Rapid River 24-28N-7W Pool A	1972	Oil			
Rapid River 27-28N-7W	1972	Oil			
Rapid River 27-28N-7W Pool A	1972	Oil			
Rapid River 32-28N-7W	1973	Oil			
Rapid River 35-28N-7W	1973	Gas-Condensate			
South Boardman Unit Pool A	1971	Gas-Condensate			
South Boardman Unit Pool B	1971	Gas-Condensate			
South Boardman Unit Pool C	1972	Gas-Condensate			
MANISTEE COUNTY					
Bear Lake 23-23N-15W	1973	Gas-Condensate			
Cleon 11-24N-13W	1973	Oil			
Manistee 1-22N-16W	1973	Gas-Condensate			
Maple Grove 2-23N-14W	1973	Gas-Condensate			
Maple Grove 6-23N-14W	1973	Oil			
Maple Grove 9-23N-14W	1973	Gas-Condensate			
Maple Grove 10-23N-14W	1973	Oil			
Maple Grove 16-23N-14W	1973	Oil			
Springdale 25-24N-14W	1972	Oil			
Springdale 28-24N-14W	1973	Oil			
MASON COUNTY					
Hamlin 13-19N-18W	1972	Oil			
Hamlin 13-19N-18W Pool A	1973	Gas-Condensate			
Hamlin 25-19N-18W	1972	Oil			
Victory 7-19N-17W	1973	Gas-Condensate			
Victory 18-19N-17W	1973	Oil			
Victory 19-19N-17W	1972	Oil			
OTSEGO COUNTY					
Bagley 23-30N-3W	1973	Oil			
Bagley 25-30N-3W	1972	Oil			
Bagley 25-30N-3W Pool A	1972	Oil			
Charlton 9-30N-1W	1972	Oil			
Charlton 12-30N-1W	1973	Oil			
Charlton 24-30N-1W	1973	Oil			
Charlton 31-30N-1W	1972	Gas-Condensate			
Charlton 4-31N-1W	1970	Oil			
Charlton 4-31N-1W Pool A	1973	Oil			
Charlton 9-31N-1W	1972	Oil			
Charlton 27-31N-1W	1972	Oil & Condensate			
Charlton 31-31N-1W	1973	Oil			
Chester 15-29N-2W	1970	Gas-Condensate			
Chester 21-29N-2W	1973	Gas-Condensate			
Chester 2-30N-2W	1971	Oil			
Chester 5-30N-2W	1972	Oil			
Chester 6-30N-2W	1973	Oil			
Chester 10-30N-2W	1972	Oil			
Chester 10-30N-2W Pool A	1973	Oil			
Chester 16-30N-2W	1971	Oil			
Chester 18-30N-2W	1971	Oil			
Chester 19-30N-2W	1971	Oil			
Chester 21-30N-2W	1970	Oil			
Chester 30-30N-2W	1973	Oil			
Dover 35-31N-2W	1973	Oil			
Dover 36-31N-2W	1973	Oil			
Hayes 11-29N-4W	1969	Oil			
Hayes 15-29N-4W	1973	Oil			
Hayes 21-29N-4W	1972	Oil			
Hayes 29-29N-4W	1973	Oil			
Hayes 32-29N-4W	1972	Oil			
Otsego Lake 3-29N-3W	1971	Oil			
PRESQUE ISLE COUNTY					
North Allis 29-35N-2E	1969	Oil			
WEXFORD COUNTY					
Wexford 9-24N-12W	1973	Gas-Condensate			
Wexford 9-24N-12W Pool A	1973	Gas-Condensate			
Wexford 10-24N-12W	1972	Gas-Condensate			
Wexford 18-24N-12W	1973	Gas-Condensate			

NOTE: Excelsior 3-27N-6W field also includes an Excelsior 3-27N-6W Pool A. This one-well pool was declared a separate reservoir after public hearings in March, 1974. The discovery well, Shell's Nicklesen #2-3, does not appear on the list of 1974 discoveries, page 9. Also not included in the above list is Charlton 4-31N-1W Pool A. The Pool A discovery well is Shell's State-Charlton #1-5 completed as a development well in 1972.

Reservoir data shows this well to be in a separate reservoir. Both of these pools are listed in Table 2.

PART 2

EXPLANATION

Part 2 brings together general information on Michigan oil and gas fields, gas storage reservoirs, LPG storage facilities, gas plant operations, refinery facilities and other items.

TABLE 2, MICHIGAN OIL AND GAS FIELDS. The symbol on the left margin of the table indicates the official classification of fields and pools at the end of the year. Classifications may be changed as warranted. Official field names are listed alphabetically in the first column and the producing pool, or pools, are shown under the heading Producing Formation or Pool. Most fields consist of one pool with oil or gas production coming from a single reservoir within a formation. Some fields have two or more separate pools, each producing from a different formation or stratigraphic interval and at a different depth. Most multi-pool fields are associated with a common structural feature. Salina-Niagaran reef oil or gas accumulations are mostly single-pool fields. Some, however, have several separate reef reservoirs designated as Pool A, Pool B and so on. Most have been so designated by administrative action following public hearings. Also, a few of the listed fields actually consist of two or more hydrocarbon accumulations which for administrative purposes have been consolidated under one field name.

TABLE 2, MICHIGAN OIL AND GAS FIELDS. The symbol on the left margin of the table indicates the official classification of fields and pools at the end of the year. Classifications may be changed as warranted. Official field names are listed alphabetically in the first column and the producing pool, or pools, are shown under the heading Producing Formation or Pool. Most fields consist of one pool with oil or gas production coming from a single reservoir within a formation. Some fields have two or more separate pools, each producing from a different formation or stratigraphic interval and at a different depth. Most multi-pool fields are associated with a common structural feature. A few of the listed fields actually consist of two or more hydrocarbon accumulations which for administrative purposes have been consolidated under one field name.

Location of fields according to township, range and sections are found at the bottom of the field block. The listed sections are those which have, or have had, producing wells assigned to the field or pool. The geographic location of fields and pools can be found by township and range on the center-spread oil and gas field map. Due to space limitations, all field names are not shown on the map.

The Pay Zone part of the table generally refers to data for the discovery well for the field or pool. The indicated

pay thickness relates to the amount of pay opened or perforated in the discovery well and does not necessarily indicate total net or gross pay for the reservoir.

The Deepest Formation or Pool Tested column indicates the stratigraphically oldest formation penetrated and the deepest total depth reached beneath the field area. Data in these columns are updated periodically.

The Number of Wells column indicates the number of successful field wells drilled in the field to the end of the specified year, the number completed as producing wells during the specified year, the number abandoned during the year and the number of active wells at the end of the specified year.

The Drilled Acres column indicates the total number of acres assigned to the field or pool according to individual well drilling units assigned to each producing well completed in the field or pool. A field may have a 10 or 20-acre drilling unit for one pool and a 40-acre unit for a deeper formation pool. During the development of a field or pool the drilling unit size may change. Subsequent wells are assigned acreage values in accordance with the new unit size. In past years drilling units have been 10, 20 or 40 acres.

Reef reservoirs, especially in the Northern District, have been assigned 40, 80, 160 and 640-acre units. Gas well units, especially for Michigan Stray Sandstone reservoirs, have generally been 160-acre units. Other sizes currently in use for gas wells are 40, 80, 320 and 640-acre units. Changes in drilling units, off-pattern wells, etc. complicate the maintenance of accurate acreage figures during the lifetime of a given field or pool. Though figures cited in the column are not entirely accurate, they do provide as near as possible an indication of the area size of the field. The figures do not indicate the areal extent of the oil or gas reservoir.

Recovery Per Acre Drilled figures for oil pools are derived by dividing the cumulative production figure by the drilled acres figure.

GAS FIELDS. Because of slow field development, small reserves or lack of marketing facilities, some fields are listed as "shut-in" and show no production figures. Other fields, not considered to have commercial size gas accumulations, produce small quantities of unmetered gas which is used for domestic purposes and in some cases, lease fuel.

GAS STORAGE RESERVOIRS. Most gas storage reservoirs were originally classified as gas fields or pools. Upon depletion or near depletion of native gas they were converted to storage reservoirs. Undeveloped gas storage reservoirs are gas pools that have been designated to become storage reservoirs at some future time. The producing sections listed on gas storage reservoir tables do not necessarily relate to current gas storage area or boundaries. The sections or parts of sections listed are those which contained at least one producible oil or gas well assigned to the field or pool prior to conversion to storage operations. Further, the

listed sections do not necessarily relate to potential or future gas storage area or boundary.

LPG STORAGE. Surface and underground storage facilities for liquified petroleum gas.

OIL WELL GAS. This is casinghead gas produced incidental to the production of oil from pools or fields generally classified as oil accumulations.

NATURAL GAS LIQUIDS (CONDENSATE). Natural gas liquids are those portions of reservoir gas which are liquified at the surface in lease separators, field facilities, or gas processing plants. These liquids include but are not limited to: ethane, propane, butanes, pentanes, natural gasoline and condensate. On Table 2 of this report, condensates from Michigan gas-condensate fields are shown under the oil production column.

WELL SAMPLE SETS. Well cuttings for over 9,000 wells are available for inspection at the Geological Survey, Lansing, Michigan. Samples are contained in glass vials arranged in open trays. In addition, several thousand shallow geological test samples are also available for inspection. The Survey does not maintain a core collection. Other sample and core repositories, not connected with the Survey, are located at: Subsurface Laboratory, Department of Geology, The University of Michigan, Ann Arbor, Michigan.

Department of Geology, Wayne State University, Detroit, Michigan.

Department of Geology, Western Michigan University, Kalamazoo, Michigan.

Department of Geology, Michigan State University, East Lansing, Michigan.

Department of Geology, Central Michigan University, Mt. Pleasant, Michigan.

PART 3, CUMULATIVE RECORDS

EXPLANATION

PART 3 contains cumulative statistics principally of oil and gas production, well completions, and oil field brine production and disposal from 1925 through the most recent year-end compilations.

OIL AND GAS PRODUCTION TABLES. Oil and gas production figures for individual years prior to 1960 can be found in issues of "Summary of Operations, Oil and Gas Fields" for 1962 and prior years, and in "Michigan's Oil and Gas Fields" 1963 to present. The tables show the year of the first recorded production from a particular formation, and the yearly and cumulative production totals from 1925 through the most recent year-end compilations. Cumulative oil and gas production by county is shown on a separate table. Refer to Part 1 for county production figures for the past year, and prior issues for previous years.

CUMULATIVE WELL COMPLETIONS. These tables show the cumulative number of yearly completions in a county. Well density figures include field development wells, exploratory wells, and service wells of all types.

DRILLING PERMITS, WELL COMPLETIONS, FIELDS DISCOVERED. These tables show the number of drilling permits issued by year from 1927 through the most recent year-end compilations. Initial classification of well completions by year, the number of new fields or pools discovered, and the number of producible oil or gas wells on a yearly basis are all shown on the same table.

BRINE PRODUCTION AND DISPOSAL. Oil field brine production records other than for individual fields were discontinued in 1968. These tables listed the reported amount of produced brine and the method of disposal from 1937 up to 1967. Most oil field brine is still returned to subsurface formations. Small quantities are used for dust control or ice and snow removal on county roads in local areas. A small amount of brine is also disposed of in burning pits.

SERVICE WELLS. Service wells as listed in this publication are those wells which were drilled to serve some purpose other than the initial production of oil or gas. Oil or gas wells are sometimes converted to salt water disposal, observation, or facility wells in gas storage or pressure maintenance projects. There are several types of service wells:

LPG WELLS. These are wells drilled for underground storage of liquified petroleum gas. In Michigan, these storage reservoirs are in man-made cavities in salt beds. The cavities have been made by dissolving the salt with water and then pumping out the brine.

Gas Storage Wells. These are wells drilled in gas storage reservoirs. They are frequently referred to as facility wells, and are generally used to inject gas into or extract gas from the reservoir. Certain facility wells may sometime in the history of the field be used as salt water disposal wells or observation wells.

Observation Wells. Most observation wells are related to gas storage projects. They are used to observe underground movement of gas, brines, and other fluids, or to observe pressures.

Brine Disposal Wells. These wells are used in the disposal of oil and gas field brines back into some suitable subsurface formation. Brine disposal well permits are issued for these wells.

Injection and Pressure Maintenance Wells. These are wells used in secondary recovery, or pressure maintenance projects. They may be new wells drilled specifically for injection or pressure maintenance, or they may be converted oil or gas wells; their status can change from time to time.

Oil or gas wells are sometimes converted to salt water disposal, observation, facility wells in gas storage reservoirs, or water injection wells used in secondary

recovery or pressure maintenance projects. The types of service wells listed under "Classification of Well Completions" does not include oil or gas wells converted to service wells.

ABBREVIATIONS

A.A.P.G.	American Assoc. Petrol. Geol.	MCFGPD	Thousand Cubic Feet Gas Per Day
A.P.I.	American Petroleum Institute	Mich.	Michigan formation
(A) I.P.	(Acid) Initial Production or Potential	Miss.	Mississippian
A-1 Carb.	A-1 Carbonate	M.S.	Mt. Simon ss.
A-2 Carb.	A-2 Carbonate	NFW	New Field Wildcat
Bbls.	Barrels	(N) I.P.	(Natural) Initial Production or Potential
B.B.	Bois Blanc formation	Niag.	Niagaran
B.D.	Brine Disposal	Nt.	Nontechnical
BDW	Brine Disposal Well	OBS	Observation Well
BOPD	Barrels Oil Per Day	OP	Out Post Well
B.R.	Black River	Ord.	Ordovician
Camb.	Cambrian	OWDD	Old Well Drilled Deeper
"Camb."	Unidentified Cambrian	P.D.C.	Prairie du Chien formation
Cat.	Cataract formation	Penn.	Pennsylvanian
c.f.p.b.	Cubic feet per barrel	Pilot Wtr.	Pilot Water
C.H.	Cabot Head formation	P.M.	Pressure Maintenance
Cinn.	Cincinnatian	Prod. Form.	Producing Formation
Cl.	Clinton formation	R.C.	Reed City formation
Cold.	Coldwater formation	RW	Reworked Well
Compl.	Completion	Rich.	Richfield formation
Coop.	Cooperative	Sag.	Saginaw formation
D & A	Dry and Abandoned	Sal.-Niag.	Salina-Niagaran
Dev.	Devonian	SD	Shut Down
D.R.	Detroit River formation	Seis.	Seismograph
D.R. SZ	Detroit River Sour Zone	SO & G	Show Oil and Gas
Dres.	Dresbach formation	S.P.	St. Peter formation
Dd., DD	Dundee	Stray	Michigan Stray formation
Dd.-R.C.	Dundee-Reed City	Sub.	Subsurface geology
DPT	Deeper Pool Test	SW	Service Well
E.C.	Eau Claire formation	SWD	Salt Water Disposal
Explor.	Exploratory	Sylv.	Sylvania formation
Fran.	Franconia formation	SZ	Sour Zone (in Detroit River)
Geo. Test	Geological Test	Thick.	Thickness
G.O.R.	Gas-Oil Ratio	(T) I.P.	(Treatment) Initial Production or Potential
Grav.	Gravity, Gravimeter	Trav.	Traverse
GS	Gas Storage	Tremp.	Trempealeau formation
GSW	Gas Storage Service Well	Trenton-Blk. River	Trenton-Black River
Gw	Glenwood	Unit.	Unitized
Incs.	Includes		
Inj.	Injection		
L.P.G.	Liquid Petroleum Gas		
Marsh.	Marshall formation		
MCF	Thousand Cubic		

STRATIGRAPHIC SUCCESSION IN MICHIGAN

PALEOZOIC THROUGH RECENT

MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
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