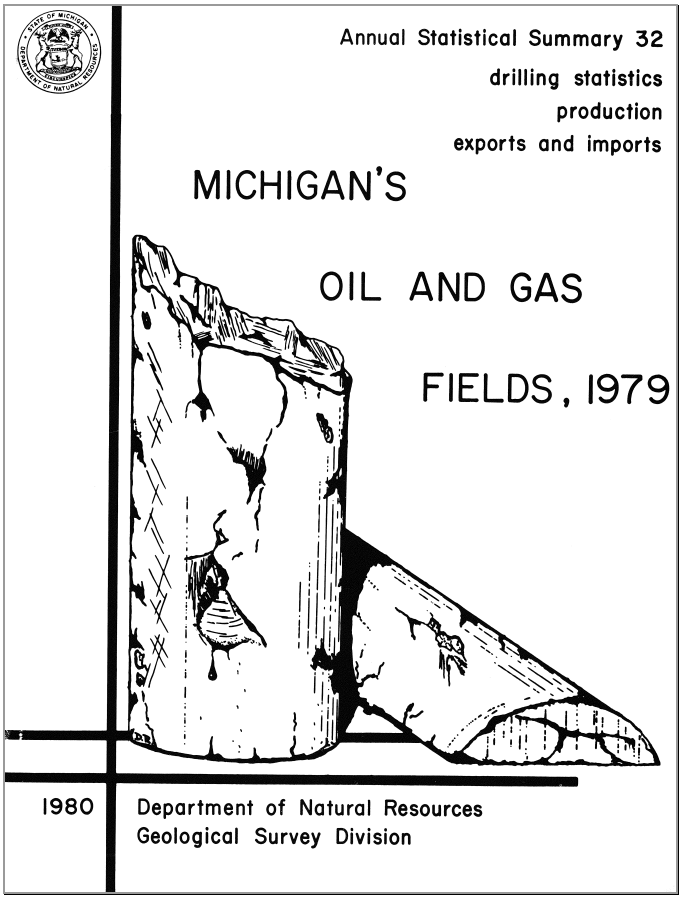

MICHIGAN'S OIL AND GAS FIELDS, 1979

CONTENTS

ACKNOWLEDGEMENTS

The collection and compilation of oil and gas field data into a yearly report is a cooperative effort of the Geological Survey Division's Oil and Gas Section staff personnel who are under the general supervision of James S. Lorenz, Geologist-in-Charge. Additional data were contributed by field office personnel under the supervision of Regional Geologists in DNR Regions II and III. Unit supervisors who provided specific information are:

Samuel L. Alguire, Supervisor, 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.

Floyd L. Layton, Supervisor, Production-Proration Unit. Contribution: All Michigan oil and gas production data, oil and gas valuation figures, import and export figures, LPG and condensate figures, secondary recovery projects (Table 5, Compiler: Arthur D. Matzkanin), and refineries.

Garland D. Ells, Supervisor, Subsurface and Petroleum Geology Unit. Contribution: All general drilling statistics and well completion data, discovery well and deep test data, cumulative records, and all other summary information not specifically provided by other Unit supervisors or by other agencies. Annual Statistical Summary compilation and manuscript preparation by staff members of the Subsurface and Petroleum Geology Unit.

The compilers also acknowledge the assistance of the Interstate Supply personnel, Office of Utilities Operation, Gas Division, Department of Commerce, in providing figures on natural gas imports via interstate pipelines, and the Lands Division, Department of Natural Resources, in providing figures for state revenue derived from various oil and gas transactions.

Michigan oil and gas production figures maintained by the Production-Proration Unit are compiled by the Unit from records obtained from the Michigan Department of Treasury and from records filed by producers and purchasers. All hydrocarbon production figures cited herein are subject to correction as warranted.

Inquiries concerning information contained in this publication should be directed to the appropriate Unit supervisor as noted earlier.

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Lansing, Michigan
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INTRODUCTION

To help foster the development of Michigan's hydrocarbon resources, statistical data have been maintained and published for many years. This issue of the oil and gas field statistical summary brings together information on various facets of Michigan's oil and gas industry activities. Certain indices which show the trend of these activities from year to year are shown in chart form along with figures from prior years. Other charts reflect cumulative data and other historical information useful in oil and gas field evaluation.

The information contained in this oil and gas summary has been treated as uniformly as possible from year to year so that the data reflect accurately the actual figures and other information that should be credited to this year. The data found herein are mainly derived from records maintained by the Oil and Gas Section, Geological Survey Division, Department of Natural Resources.

This publication is essentially divided into three parts. The first summarizes significant statistics on oil and gas field activities and includes numerous other related records kept by the Oil and Gas Section. Part 2 contains specific information on Michigan's oil and gas fields, gas storage fields, and other related subjects. Part 3 contains cumulative records important to the oil and gas industry.

Certain well completion data are furnished to the American Petroleum Institute (API) and the American Association of Petroleum Geologists (AAPG) on a regular basis. Reports citing preliminary oil and gas statistics and production figures are also prepared for the Interstate Oil Compact Commission (IOCC). API publishes the data in monthly and quarterly reports. Year-end printouts of the data are made available to authors of the AAPG yearly Development Papers and to others. Year-end figures published by API are in general agreement with figures for similar categories published in this summary. Oil and gas production data are supplied by request to the United States Bureau of Mines for publication in their minerals yearbook.

Statistical data on Michigan oil and gas activities, derived from outside sources, are also published by the 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 Oil and Gas Journal, Tulsa, Oklahoma.

It should be noted that certain figures for the number of exploratory, development, and service wells drilled and completed, the number of new fields and pools discovered, oil and gas production figures, and other data published in this summary may differ from figures reported by regional or national trade publications or by industry reporting services. The differences in the various statistics are generally minor and are due to methods of gathering and reporting well data, determining cutoff dates for reporting yearly statistics, and the necessity for making projections and estimates for certain types of reports.

Other factors which may result in statistical differences are internal decisions of the Oil and Gas Section regarding final year-end status of completed wells and decisions resulting from public hearings on oil and gas matters. For example, a well originally classified as a development well, and reported as such to one of the above organizations, may later be reclassified as the discovery well for a new pool or field, or a gas well might later be declared an oil well completion on the basis of new evidence. Frequently the changes in well status cannot be readily passed on to these outside organizations so that their records can be updated prior to publication of their final statistics. The discrepancies in year-end figures are almost without exception related to Niagaran reef exploration and development which has formed the largest part of Michigan drilling activities for the past several years.

PART I
1979 STATISTICAL DATA

* * * OIL AND GAS PERMITS * * *

Michigan's oil and gas permit system began in 1927 with the issuance of permit number 1. Since then, permit numbers have been issued in numerically consecutive order. In many cases, wells which has been previously drilled and abandoned have been reopened and reworked under a new permit number. Also, some well locations for which permit numbers were issued but later terminated have been repermitted and assigned new permit numbers. Permits issued under Act 61, P.A. of 1939, as amended are terminated one year after date of issue if actual drilling operations have not begun.

Oil and gas drilling permits issued during 1979 began with permit number 32797 and ended with permit number 33445. The initial classification of wells to be drilled under these permits was as follows:

INITIAL CLASSIFICATION	1977	1978	1979
Exploratory wells	338	311	282
Development wells	296	298	283
Gas storage facility wells	51	74	62
LPG storage facility wells	2	0	5
Brine disposal wells	5	3	5
Water injection wells	0	4	12
	692	690	649

The distribution of oil and gas drilling permits (including terminated permits) according to districts (see oil and gas district map) through a five year period is as follows:

DRILLING PERMITS BY DISTRICT

DISTRICTS	Permits Issued				
	1975	1976	1977	1978	1979
Basin	100	110	135	146	161
Northern	219	221	261	284	271
Southeastern	70	98	111	98	63
Southwestern	108	73	67	47	60
Western	156	143	118	115	94
Totals	653	645	692	690	649

Deepening permits were issued for 29 wells during 1979 as compared with 25 the previous year. Deepening permits issued in 1979 began with number 1942 and ended with number 1970.

[Permits Terminated in 1979]

Permit numbers terminated in 1979

D.P.1938	32405	32617	32685
31478	32430	32618	32686
32028	32449	32632	32687
32100	32491	32641	32696
32118	32493	32652	32698
32166	32504	32653	32709
32172	32539	32657	32710
32206	32572	32664	32717
32270	32588	32666	32737
32290	32599	32668	32772
32315	32606	32669	32776
32333	32608	32676	32785
32359	32609	32677	
32373	32615	32684	

Directionally drilled holes. Environmental and economic considerations have necessitated the drilling of a large number of directional holes since 1972, particularly to help locate Niagaran reefs. During 1979, there were 142 permits issued to drill directional holes. Many of these holes involve using the upper part of a previously drilled hole which, after being initially completed as a dry hole, was plugged back and directionally drilled to a more favorable subsurface location. Only one producing well is allowed per well bore, regardless of the number of holes directionally drilled from the same well bore.

Each new directional hole, even if drilled from the same surface location and using the upper part of a previously drilled well, is treated as a separate test and is assigned its own unique permit number. Each additional hole drilled from the same surface location retains the same well name and number as the original hole, except that the suffix "A", "B", "C" etc., is added to the well number for each successive hole.

Permit numbers issued in 1979 for directional holes

32580	Gd. Traverse County	33169	Otsego County
32587	Otsego County	33172	Presque Isle County
32614	Gd. Traverse County	33175	Otsego County
32699	Manistee County	33176	Otsego County
32797	Gd. Traverse County	33177	Otsego County
32798	Kalkaska County	33178	Otsego County
32800	Manistee County	33179	Otsego County
32820	Otsego County	33186	Calhoun County
32821	Otsego County	33187	Kalkaska County
32822	Calhoun County	33190	Kalkaska County
32824	Macomb County	33198	Presque Isle County
32831	Manistee County	33199	Kalkaska County
32833	Manistee County	33201	Calhoun County
32834	Manistee County	33203	Manistee County
32837	Otsego County	33206	Montmorency County
32838	Manistee County	33209	Presque Isle County
32840	Kalkaska County	33212	Otsego County
32843	Otsego County	33221	Gd. Traverse County
32844	Manistee County	33223	Manistee County
32845	Manistee County	33236	Manistee County
32855	Calhoun County	33245	Otsego County
32857	Manistee County	33247	Otsego County
32863	Livingston County	33249	Kalkaska County
32874	Gd. Traverse County	33254	Presque Isle County
32879	Gd. Traverse County	33258	Jackson County
32884	Gd. Traverse County	33265	Manistee County
32885	Kalkaska County	33267	St. Clair County
32886	Calhoun County	33289	Manistee County
32891	Otsego County	33290	Gd. Traverse County
32893	Manistee County	33297	Kalkaska County
32894	Manistee County	33302	Mason County
32898	Kalkaska County	33305	Eaton County
32899	Manistee County	33308	Otsego County
32903	Kalkaska County	33315	Gd. Traverse County
32905	Kalkaska County	33319	Kalkaska County

32907	Otsego County
32912	Gd. Traverse County
32914	Manistee County
32934	Macomb County
32936	Gd. Traverse County
32937	Eaton County
32939	Presque Isle County
32947	St. Clair County
32957	Manistee County
32962	Manistee County
32967	Calhoun County
32973	Antrim County
32983	Wexford County
33003	Wexford County
33031	Oakland County
33033	Manistee County
33048	Kalkaska County
33049	Cheboygan County
33050	Presque Isle County
33053	Presque Isle County
33057	Oakland County
33063	Gd. Traverse County
33074	Gd. Traverse County
33092	Kalkaska County
33093	Kalkaska County
33094	Kalkaska County
33095	Kalkaska County
33096	Kalkaska County
33100	Oakland County
33106	Presque Isle County
33107	Manistee County
33108	Manistee County
33133	Macomb County
33144	Manistee County
33145	Otsego County
33146	Crawford County
33154	Oceana County
33324	Otsego County
33337	Kalkaska County
33343	Crawford County
33345	Manistee County
33346	Gd. Traverse County
33349	Manistee County
33354	Ingham County
33366	Crawford County
33367	Montmorency County
33375	Montmorency County
33376	Kalkaska County
33379	Gd. Traverse County
33384	Gd. Traverse County
33392	Crawford County
33407	Gd. Traverse County
33411	Manistee County
33412	Kalkaska County
33416	Manistee County
33418	Presque Isle County
33419	Gd. Traverse County
33422	Montmorency County
33423	Otsego County
33429	Kalkaska County
33430	Kalkaska County
33432	Kalkaska County
33433	Kalkaska County
33435	Kalkaska County
33437	Kalkaska County
33438	Kalkaska County
33439	Kalkaska County
33440	Kalkaska County
33441	Kalkaska County
33443	Kalkaska County
33444	Otsego County
33445	Manistee County

Rework applications, transfers of ownership, etc. In addition to issuance of permits for various types of wells covered under Act No. 61, P.A. of 1939, as amended, 195 applications were received and approved for rework operations on existing wells. Letters of termination were sent out for 54 previously issued permits. Transfers of ownership were processed for 131 wells. Corrections of location, well name, or other detail involving specific permits were made for 62 wells, and cancel and transfer of permit were made for 28 others. The surface location as well as the projected bottom-hole location is published for each permitted directionally drilled hole. After the well is drilled and the directional survey is filed, the correct bottom-hole location is determined from the survey record and then published as a correction for the initial projected bottom-hole location. Corrections of this type were published for 110 wells.

Oil and gas hearings. Oil and Gas Section activities included scheduling and preparation for hearings on oil and gas matters and the issuance of orders resulting from these hearings. These activities are summarized as follows:

Advisory Board Hearings held	4
Administrative Hearings held	27
Total Orders issued	27
Total Causes heard	36

Includes:
- 2 changes in well allowables under Special Order 1-78
- 2 spacing and proration orders
- 7 exceptions to spacing orders
- 4 compulsory pooling orders
- 3 causes dismissed
- 3 unitization orders
- 5 secondary recovery by waterflood and pressure maintenance by gas injection
- 1 amendment to spacing and proration order
- 4 abrogations of spacing orders
- 2 spacing orders denied
- 1 amendment to spacing order denied
- 1 conversion to gas storage and exception under spacing order
- 1 exception to General Rules spacing requirements

* * * WELL COMPLETIONS * * *

There were 521 new-hole exploratory and development wells which reached total depth and were considered either completed producers with production casing set, or dry holes during 1979. The 521 wells considered as completed during the past year do not include service wells, old wells drilled to deeper objectives, or reworked wells. Well completion figures for individual counties are shown in Table 1. 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:

EXPLORATORY AND DEVELOPMENT WELL COMPLETIONS

Year	Exploratory Wells			Development Wells			Totals
	Oil	Gas	Dry	Oil	Gas	Dry	
1975	53	17	213	112	21	117	533
1976	30	36	234	90	21	99	510
1977	35	36	230	101	34	111	547
1978	29	25	214	117	32	111	528
1979	42	28	187	131	30	103	521

There were 68 new-hole service well completions in 1979. The figure does not include reworked wells or old wells converted to gas storage facility wells.

SERVICE WELL COMPLETIONS

Year	GS	INJ	LPG	BDW	Totals
1975	37	0	0	1	38
1976	25	13	0	12	50
1977	43	2	1	4	50
1978	60	11	0	3	74
1979	51	13	0	4	68

Major and independent company well completions. Requests are frequently made for statistics on major oil company drilling activities in Michigan. The figures cited for the major companies do not include wells drilled by independents under farmout agreements with a major company or wells drilled by independents but partially supported by dry hole money or some other significant assistance from a major oil company. Independent oil companies, who have drilled most of Michigan's wells, are too numerous to cite individually. All figures cited for majors and independents were derived from inspection of operator names appearing on completion records. On the following chart, in cases where two or more companies were joint operators in a drilling venture, the well completion was attributed to the company whose

name appears first (generally the major interest holder) on the official records. Although there appears to be no single definition of what constitutes a major company, the following companies are frequently cited as belonging in that category: Atlantic-Richfield, Cities Service, Continental Oil Company, Exxon, Getty Oil Company, Gulf Oil Company, Marathon Oil Company, Mobil Oil Corporation, Phillips Petroleum Company, Shell Oil Company, Standard Oil of California, Standard Oil of Indiana, Standard Oil of Ohio, Sun Oil Company, Texaco, Inc., and Union Oil of California. The preceding list is not official nor necessarily complete. A number of these companies or their affiliates drilled wells in Michigan this year.

WELL COMPLETIONS BY MAJORS AND INDEPENDENTS IN 1979

Major Company	Exploratory Oil	Exploratory Gas	Exploratory Dry	Development Oil	Development Gas	Development Dry	Service Wells	Totals
Amoco	5	4	25	8	2	6	0	50
Getty	1	2	0	1	0	0	0	4
Gulf	0	0	1	0	0	0	0	1
Marathon	0	0	0	6	0	2	6	14
Shell	7	6	32	15	4	28	7	99
Sun	0	0	0	19	0	0	0	19
Union	0	0	1	1	0	1	0	3
Sub-totals	13	12	59	50	6	37	13	190
Independents	29	16	128	81	24	66	55	399
Totals	42	28	187	131	30	103	68	589

Total: Exploratory Wells 257; Development Wells 264; Service Wells 68.

Exploratory Wells drilled by Majors 33%.
Exploratory Wells drilled by Independents 67%.

Exploratory Discoveries made by Majors 36%.
Exploratory Discoveries made by Independents 64%.

Development Wells drilled by Majors 35%.
Development Wells drilled by Independents 65%.

Producing Development Wells drilled by Majors 35%.
Producing Development Wells drilled by Independents 65%.

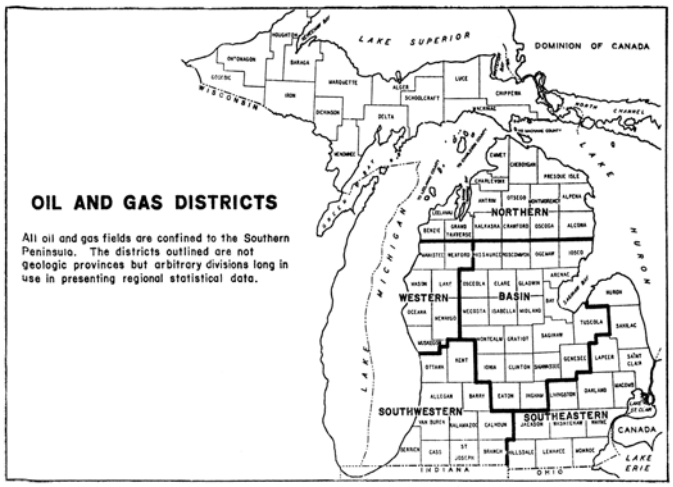
Discovery Success Ratio (Total exploratory wells divided by number of discovery wells)—Majors 1:3; Independents 1:4.

[Well Completions by Districts]

NEW WELL COMPLETIONS BY DISTRICT, 1979

Classification of New Well Completions	Basin 1978	Basin 1979	Northern 1978	Northern 1979	Western 1978	Western 1979	Southwestern 1978	Southwestern 1979	Southeastern 1978	Southeastern 1979	Totals 1978	Totals 1979
Exploratory Wells												
Oil	4	12	15	17	7	4	3	3	0	6	29	42
Gas	2	6	13	11	6	8	3	0	1	3	25	28
D&A	22	27	118	102	27	23	18	17	29	18	214	187
Total	28	45	146	130	40	35	24	20	30	27	268	257
Development Wells												
Oil	45	56	34	26	20	23	11	13	7	13	117	131
Gas	1	3	15	13	8	9	7	1	1	4	32	30
D&A	14	10	40	44	31	30	9	11	17	8	111	103
Total	60	69	89	83	59	62	27	25	25	25	260	264
Service												
WI	9	6	2	6	0	1	0	0	0	0	11	13
BDW	1	3	1	1	1	0	0	0	0	0	3	4
GS	27	24	0	0	5	3	0	0	28	24	60	51
LPG	0	0	0	0	0	0	0	0	0	0	0	0
Total	37	33	3	7	6	4	0	0	28	24	74	68
Total Completions	125	147	238	220	105	101	51	45	83	76	602	589

[Oil and Gas Districts Map]



Drilled footage. The average depth of exploratory wells drilled in Michigan in 1979 was 4,461 feet compared with 4,558 feet in 1978. Development well depths averaged 4,359 feet compared with 4,524 feet in 1978. Service wells drilled in 1979 averaged 2,982 feet as compared with 3,091 feet in 1978. Drilled footage figures and average well depths for specific counties are shown in Table 1.

Total drilled footage figures from the Geological Survey Division records for 1979 and several prior years are as follows:

DRILLED FOOTAGE FIGURES

Well Class	1976	1977	1978	1979
Exploratory	1,448,933	1,474,814	1,220,144	1,146,515
Development	913,530	1,068,429	1,117,482	1,150,710
Service Wells	105,975	91,492	228,768	202,791
Total	2,468,438	2,634,735	2,566,394	2,500,016

Well casing used in 1979 well completions. Periodically, inquiries are made concerning the amount of casing (pipe) used in Michigan wells during a given year. Almost all oil and gas tests drilled in this state utilize rotary drilling techniques and require the setting of surface pipe and an intermediate casing string. A conductor pipe is set on many holes, and all wells completed as producers require a string of production casing. For convenience, casing tallies have been related to a range of casing sizes as shown in the following chart.

	Conductor Pipe	Surface Pipe	Intermediate Pipe	Production Pipe
Casing Size Range Used	13"-20" Dia.	10"-13" Dia.	6"-10" Dia.	4"-6" Dia.
Normal Size Used	16"	11-3/4"	8-5/8"	5-1/2"
Average Weight	75#/ft.	53#/ft.	37#/ft.	19#/ft.
No. feet used (1)	27,715	232,135	1,105,754	1,322,769

(1) Total footage: 2,688,373

GEOLOGICAL SURVEY DIVISION

DNR REGION II FIELD OFFICES
Gaylord (Otsego County)
Cadillac (Wexford County)
Mt. Pleasant (Isabella County)

DNR REGION III FIELD OFFICES
Rose Lake (Clinton County)
Plainwell (Allegan County)
Imlay City (Lapeer County)

Dots show the general location of field offices within the several districts. These districts are arranged for administrative and regulatory purposes. Though frequently called oil-and-gas districts, they should not be confused with those shown below which have been in use for many years in presenting statistical data.

* * * 1979 OIL AND GAS PRODUCTION * * *

Oil and gas production figures are derived from records submitted to the Production-Proration Unit, Oil and Gas Section, Geological Survey Division, Department of Natural Resources and from tax records from the Michigan Department of Treasury. Treasury Department records are primarily concerned with gross production figures needed to calculate revenues. These data are supported by reports required from producing companies and purchasers by the Geological Survey Division.

Delays in reporting and changes in methods of reporting used by producing companies and purchasers result in a continuous correction and refinement of production figures. Consequently all monthly, yearly, or other production figures are subject to correction as warranted.

In an attempt to obtain national uniformity of data as recommended by the Interstate Oil Compact Commission, all annual and cumulative gas production figures for Michigan were converted to a standard base pressure for volumetric measurement of 14.73 pounds per square inch in 1978. This conversion and subsequent adjustment of gas production figures resulted in slight changes in cumulative production volumes in those fields which had been measured at varying pressure bases in prior years.

A no-flare order, enacted as a conservation measure, prohibits the flaring of oil-well gas and requires Salina-Niagaran oil wells in specified counties to be shut-in until a market connection is achieved for the sale of the gas or an exception to the order is granted. Consequently, Special Order No. 3-71, amended, in effect since late 1971, tends to temporarily curtail production from Salina-Niagaran oil wells until gas gathering pipelines are laid and connections made.

Another order, Special Order No. 1-73, deals with spacing and proration of Salina-Niagaran wells in specific counties. This order established basic 80-acre drilling units (either stand-up or lay-down units) for Salina-Niagaran oil and/or gas wells and state-wide proration for Salina-Niagaran oil reservoirs in the specified counties or parts of counties covered by the order. These prudent and justifiable conservation measures effectively prevent waste of millions of cubic feet of valuable and much needed gas that might have been flared in past years, and these measures should ultimately result in more efficient drainage of reef reservoirs and a greater recovery of the liquid hydrocarbons.

OIL AND GAS PRODUCTION BY DISTRICT IN 1979

District	Barrels Oil	MCF Gas
Basin	5,430,832	8,424,845
Northern	16,529,272	94,461,961
Southeastern	1,616,089	10,318,212
Southwestern	1,095,111	4,536,699
Western	9,629,213	41,210,063
Totals	34,746,672	157,293,719

OIL AND GAS PRODUCTION BY MONTH IN 1979

	Barrels Oil	MCF Gas
January	2,930,736	11,992,231
February	2,628,667	12,017,012
March	2,972,379	13,387,671
April	2,821,969	13,005,853
May	3,039,459	13,692,802
June	2,849,858	13,677,723
July	3,038,348	14,586,087
August	2,859,245	14,255,070
September	3,124,414	13,115,573
October	2,928,933	13,564,162
November	2,794,277	11,907,616
December	2,858,640	14,491,058
Totals	34,746,672	157,293,719

[Oil and Gas Production by County]

OIL AND GAS PRODUCTION BY COUNTY IN 1979

County	Barrels Oil	MCF Gas
Allegan	144,968	56,856
Antrim	185,789	756,919
Arenac	189,294	0
Barry	6,162	0
Bay	191,255	0
Benzie	108,355	98,816
Calhoun	817,321	4,353,303
Cass	17,723	0
Cheboygan	3,931	0
Clare	471,295	424,107
Crawford	1,542,332	3,456,516
Eaton	398,985	4,169,961
Genesee	8,996	0
Gladwin	274,100	0
Grand Traverse	4,525,299	47,375,339
Gratiot	9,002	93
Hillsdale	788,418	2,749,854
Ingham	1,233,150	2,603,852
Isabella	207,029	14,417
Jackson	37,605	1,792,859
Kalamazoo	404	0
Kalkaska	3,882,057	27,262,410
Kent	88,077	0
Lake	84,238	0
Lapeer	155,591	0
Lenawee	151	0
Livingston	3,887	1,236,174
Macomb	7,009	2,736,974
Manistee	8,460,019	34,961,685
Mason	211,936	2,035,360
Mecosta	23,346	10,302
Midland	194,782	0
Missaukee	883,227	876,676
Monroe	3,198	0
Montcalm	78,131	0
Montmorency	1,375	0
Muskegon	8,029	0
Newaygo	16,620	0
Oakland	7,128	39,062
Oceana	109,739	0
Ogemaw	645,198	120,255
Osceola	177,799	10,280
Oscoda	732	0
Otsego	6,278,046	15,511,961
Ottawa	6,681	126,540
Presque Isle	1,356	0
Roscommon	352,533	194,902
Saginaw	14,178	0
Shiawassee	13,365	0
St. Clair	604,559	1,710,034
Tuscola	65,117	0
Van Buren	13,775	0
Washtenaw	0	53,255
Wayne	8,543	0
Wexford	738,632	4,213,018
Totals	34,746,672	157,293,719

* * * NATURAL GAS LIQUIDS * * *

The amount of liquids produced from gas-condensate reservoirs associated with northern and western Michigan Silurian reefs decreased during 1979. These liquids, produced from wells classified as gas wells, are included in the yearly oil production totals shown in tabulations in this publication. Wells officially determined to be gas wells are assigned to the Public Service Commission for well connection permits and determination and jurisdiction of gas production rates. There is no restriction on the amount of liquids produced along with the gas. Gas plants operated by Shell Oil Company and Amoco Production Company in Kalkaska County strip natural gas liquids from the gas. The liquids are then sold to another company through the Shell pipeline that terminates at Marysville, Michigan.

An attempt has been made to maintain records of condensate production from the northern reef reservoirs discovered since 1969. Production-Proration Unit records show the following figures for condensate liquids:

CONDENSATE PRODUCTION

Year	Barrels
1969	0
1970	18,946
1971	98,668
1972	125,768
1973	335,041
1974	1,187,498
1975	1,863,338
1976	1,896,870
1977	1,991,330
1978	2,295,263
1979	1,801,928
Total	11,614,650

Gas plant operations are summarized in Table 6. It should be noted that the LPG recovery figures for the Amoco and Shell plants in Kalkaska County include stabilized condensate as well as LPGs.

* * * OIL AND GAS VALUATION * * *

	Average Wellhead Price*		Gross Value*	
Year	Oil per Bbls.	Gas per MCF	Oil	Gas
1969	$ 3.07	$ .26	$ 37,494,318	$ 9,296,332
1970	3.10	.27	36,246,376	10,476,482
1971	3.27	.26	38,858,706	6,775,629
1972	3.20	.31	41,556,432	10,314,222
1973	4.07	.40	59,412,710	17,494,727
1974	8.55	.51	154,746,373	35,181,955
1975	10.74	.63	262,351,653	65,103,875
1976	10.84	.88	329,636,770	120,252,528
1977	10.95	1.10	360,994,743	145,969,976
1978	12.34	1.11	427,881,248	166,920,524
1979	14.94	1.75	524,257,112	279,121,269

*Source: Production-Proration Unit records

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

Michigan refineries import some U.S. domestic and foreign crude oil each year. Overseas foreign sources include Libya and Nigeria. Canadian crude oil brought via pipeline from western Canada oil fields constitutes another important source of imports. Imports by month were reported by refineries as follows:

1979 CRUDE OIL IMPORTS (Bbls.)

	Domestic and Foreign	Canadian	Total
January	2,676,515	534,202	3,210,717
February	2,310,534	870,826	3,181,360
March	2,071,141	1,009,897	3,081,038
April	2,391,424	626,393	3,017,817
May	2,373,874	287,359	2,661,233
June	2,698,890	293,650	2,992,540
July	3,163,746	202,631	3,366,377
August	2,750,567	121,163	2,871,730
September	2,228,178	129,655	2,357,833
October	2,423,965	244,724	2,668,689
November	2,924,019	168,114	3,092,133
December	2,731,865	328,788	3,060,653
Total	30,744,718	4,817,402	35,562,120

Most Michigan produced crude oil goes to Michigan refineries but some is exported. Records provided to the Production-Proration Unit by companies reporting exports of Michigan crude are as follow:

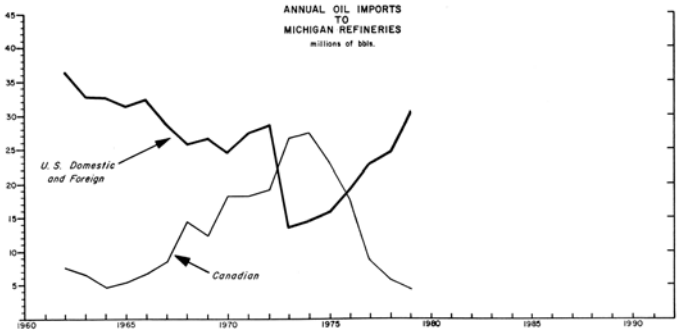
1979 CRUDE OIL EXPORTS (Bbls.)

January	447,718
February	637,661
March	1,051,741
April	593,700
May	727,083
June	551,035
July	735,739
August	307,040
September	621,274
October	712,896
November	480,739
December	530,260
Total	7,396,886

1979 PIPELINE GAS IMPORTS (Mcf)*

January	67,433,456
February	58,459,015
March	76,150,694
April	78,684,100
May	61,086,186
June	58,545,457
July	63,708,449
August	60,876,867
September	58,201,433
October	63,558,588
November	61,125,432
December	59,967,337
Total	767,797,014

*Compiled by Interstate Supply Section, Michigan Public Service Commission



* * * NEW FIELD AND POOL DISCOVERIES * * *

Once again Silurian reefs were the main type of oil and gas trap found this year. All appear to have been located by seismic exploration methods. Most were found along the northern reef trend extending from Mason County to Presque Isle County. Others were found in the southern part of the basin in the Calhoun-Eaton-Ingham County area, and in the Macomb-St. Clair County area of the Southeastern District.

All the new discoveries are tentatively classified as Class E pools having possible oil and gas recoveries as defined by the Committee of Statistics of Drilling, American Association of Petroleum Geologists. These classes, shown below, 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

Michigan wells are initially classified as near as possible according to guidelines established by AAPG and API (AAPG Bulletin, Vol. 58/8, August 1974, pp. 1501-1503). Classifications such as exploratory, development, and the various types of service wells, are made after inspection of appropriate oil and gas maps and noting the location of the test in reference to established fields, dry holes, etc. Gas storage facility wells, water injection wells and other types of service wells are generally designated as such by the operator. The Lahee classification system for designating exploratory or development wells is particularly adaptable to structural traps but does not adapt to all situations involving small reefs such as are found in Michigan. Because of the apparent small areal extent of most reefs as shown by seismic anomalies and the close proximity of one reef to another, especially in the northern and southern reef belts, it has become increasingly difficult to classify with certainty all new well locations as exploratory or development.

Reservoir performance may show that a well previously classified as a development well should actually be considered as being in a separate reservior or pool. Likewise, a so-called discovery well may actually turn out to be a development well to a nearby reef reservoir. Also, a discovery well may be completed as an oil well but at sometime later be reclassified as a gas well and conversely, a gas well may later be reclassified as an oil well. Changes in classification may be the result of action by the regulating agency after enough data has been accumulated on the well or wells, or may result from new data presented at public hearings and the decision of the Supervisor of Wells after thorough consideration of the new data.

[Analysis of Discovery Wells by Geologic System]

ANALYSIS OF DISCOVERY WELLS BY GEOLOGIC SYSTEM

System	Formation or Pay	Number of Discoveries 1977	1978	1979
Pennsylvanian		-	-	-
Mississippian	"Michigan Stray Ss."	-	1	-
	"Berea Sandstone"	-	1	2
Devonian	Antrim Shale	3	-	1
	"Traverse Lime"	1	1	2
	Dundee	-	2	4
	"Reed City"	-	-	-
	Detroit River			
	"Sour Zone"	-	-	2
	Richfield	1	-	1
Silurian	Salina E Zone	-	-	-
	Salina A-1 or A-2	1	2	1
	Niagaran reef	65	47	55
Ordovician	Trenton-Black River	-	-	2
	Prairie du Chien	-	-	-
Cambrian	(Gas shows reported in past years)			

[Drilling Objectives]

DRILLING OBJECTIVES IN MICHIGAN

System	Formation or Pay	Percentage 1977	1978	1979
Pennsylvanian		-	-	-
Mississippian	"Michigan Stray Ss."	7.7	8.9	4.8
	"Berea Sandstone"	-	.2	.8
Devonian	Antrim Shale	.7	-	1.0
	"Traverse Lime"	4.2	2.4	3.4
	Dundee	6.7	5.8	7.1
	"Reed City"	.2	.9	-
	Detroit River "Sour Zone" & Richfield	2.7	7.7	11.0
Silurian	Salina-Niagaran	70.5	69.6	69.1
Ordovician	Trenton-Black River	5.9	3.4	2.6
	St. Peter Ss. or Prairie du Chien	1.1	1.1	.2
Cambrian or Precambrian	Undifferentiated	.3	-	-

* * * STATE OIL AND GAS REVENUE * * *

Total State revenue credited to 1979 and derived from royalty, rental, bonus from lease sales, and application-assignment fees amounted to $26,785,584.81. This figure is derived from these components.

Hydrocarbon royalties	
Oil & Condensate	$15,195,114.46
Gas, Casinghead gas, LPG and Shut-in royalty	9,074,449.82
Subtotal	$24,269,564.28
Rentals	1,100,306.53
Bonus	1,414,667.00
Application-Assignment fees	1,047.00
Subtotal	$2,516,020.53
Total Revenue	$26,785,584.81

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

OIL AND GAS WELL RECORDS. Descriptive geological logs and driller's logs are available for over 33,000 tests, including exploratory, development, facility and other types of wells. Individual well records may be purchased at a nominal 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 oil and gas field maps are available for every county in the Southern Peninsula. The maps show locations of oil and gas test 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 or tracings 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 Division upon request.

[Discovery Well List]

1979 DISCOVERY WELLS

County Location	Field Name	Operator and Lease	Permit Number	Depth to Pay	Total Depth	Initial Production Oil Wells	Initial Production Gas Wells	Producing Formation	Basis for Loc.	AAPG Pool Class
Calhoun 27-1S-4W	Clarence	Reef Petroleum Corp. F. P. Schmidt #1-27	33126	3193	3297	Est. 400 BOPD		Niagaran	Seis.	E
Calhoun 23-1S-5W	Lee	J. O. Mutch D. C. Lutz et al #1-23	33045	3120	3323	175 BOPD +360 Mcf		Salina-Niagaran	Seis.	E
Cheboygan 24-33N-1E	Forest	Shell Oil Co. St.-Forest #2-24A	33049*	3607	3997	Gauge not available		Niagaran	Seis.	E
Cheboygan 34-33N-1E	Forest	Traverse Corporation Nat'l Bank of Detroit #1-34	33015	4158	4490	460 BOPD +300 Mcf		Niagaran	Seis.	E
Eaton 2-1N-4W	Brookfield	Kulka & Schmidt, Inc. Sederlund Unit #1-2	32990	3740	4123	200 BOPD		Niagaran	Seis.	E
Eaton 17-2N-3W	Eaton Rapids 17-2N-3W, Pool A	Amoco Production Co. Getter #3-17	33026	4062	4371		300 Cond./Day +1630 Mcf	Niagaran	Seis.	E
Eaton 32-2N-3W	Eaton Rapids 32-2N-3W, Pool A	Consumers Power Co. Hanks #1-32	32457	3751	3997		858 Mcf	Salina-Niagaran	Seis.	E
Eaton 4-1N-3W	Hamlin 9-1N-3W	Kulka & Schmidt & Mich. Oil Co. Hausch et al Unit #1-4	32937*	3711	3839		SIGW-Gauge not available	Niagaran	Seis.	E
Eaton 15-1N-3W	Hamlin 15-1N-3W	Consumers Power Co. Lawrence-Tomlin #1-15	32458	3608	3825		5076 Mcf	Niagaran	Seis.	E
Eaton 24-1N-6W	Olivet-A-1 Carbonate Pool	Fortuna Oil Co. J. C. Kellogg #3-24	32191	3444	5004		200 Mcf	A-1 Carb.	Acreage	E
Gladwin 36-18N-1W	Buckeye, South-Berea Pool	Wiser Oil Co. Havens #5	32980	2196	2305	10 BOPD +10 BWD		Berea	Acreage	E
Gladwin 34-18N-1E	Hay, Sec. 34	C. W. Kughn Reid #1-34	33180	2210	4130	7 BOPD +85 BWD		Berea	Acreage	E
Grand Traverse 28-26N-11W	Blair 28-26N-11W	North. Mich. Exp. Co. Wedow-St-Blair #1-28	33012	5550	5840	168 BOPD +205 Mcf + 270 BWD		Niagaran	Seis.	E
Grand Traverse 14-26N-10W	East Bay 14-26N-10W	Total Petroleum, Inc. St-East Bay #1-14	33192	6095	6400	241 BOPD +391 Mcf		Salina-Niagaran	Seis.	E
Grand Traverse 22-25N-12W	Grant 22-25N-12W, Pool A	Reef Petroleum Corp. Fryzelka #1-22	32913	5946	6200	365 BOPD +560 Mcf		Niagaran	Seis.	E
Grand Traverse 27-25N-11W	Mayfield 27-25N-11W, Pool A	Shell Oil Co. Hill Estate #3-27A	32912*	6464	6755		60 Cond./Day +3038 Mcf	Niagaran	Seis.	E
Grand Traverse 8-25N-10W	Paradise 8-25N-10W	Delta Oil & Gr. Lks. Niagaran Haight-Rawlings #1-8	33219	6551	6603		SIGW-Gauge not available	Niagaran	Seis.	E
Grand Traverse 17-25N-10W	Paradise 17-25N-10W	Shell Oil Co. Chavalia #1-17	33153	6451	6769	173 BOPD +716 Mcf + 29 BWD		Niagaran	Seis.	E
Grand Traverse 20-26N-10W	Paradise 20-26N-10W, Pool A	Finders Oil & Gas Co. Cunningham #1-20	33101	5786	6087	312 BOPD +600 Mcf + 12 BWD		Niagaran	Seis.	E
Grand Traverse 27-26N-10W	Paradise 27-26N-10W, Pool A	Finders Oil & Gas Co. Cunningham-St-Paradise #1-27	32543	6317	6584		40 Cond./Day +850 Mcf	Niagaran	Seis.	E
Grand Traverse 28-26N-10W	Paradise 28-26N-10W	Finders Oil & Gas Co. Tuller #1-28	33123	6000	6470		30 Cond./Day +600 Mcf	Niagaran	Seis.	E
Grand Traverse 18-26N-9W	Union 18-26N-9W, Pool A	Shell Oil Co. St-Union #3-18A	32773*	6232	6436		117 Cond./Day +3096 Mcf	Niagaran	Seis.	E
Grand Traverse 20-27N-9W	Whitewater 20-27N-9W, Pool A	Shell Oil Co. St-Whitewater #1-20	32438	6149	6360	285 BOPD +495 Mcf		Niagaran	Seis.	E
Grand Traverse 20-27N-9W	Whitewater 20-27N-9W, Pool B	Shell Oil Co. St-Whitewater #2-20	32932	5962	6455	120 BOPD +760 Mcf + 123 BWD		Niagaran	Seis.	E
Ingham 24-2N-2W	Aurelius 24-2N-2W	Petrotech Inc. Akers et al #1-24	32742	3966	4080	250 BOPD		Niagaran	Seis.	E
Ingham 24-2N-2W	Aurelius 24-2N-2W, Pool A	Petrotech Inc. Lyon #1-24	33284	3978	4166		1 Cond./Day +800 Mcf	Salina-Niagaran	Seis.	E
Isabella 14-14N-6W	Broomfield-Traverse Pool	Lewis C. Sibley Harris Diehl #1-A	32955	3173	3190	30 BOPD		Traverse	Acreage	E
Isabella 9-14N-6W	Broomfield-Dundee Pool	Don Yohe Enterprises Lake Isabella Corp. #1-9	33102	3752	3756	15 BOPD +15 BWD		Dundee	Acreage	E
Isabella 24-13N-6W	Rolland-Dundee Pool	Chase Oil Corp. Wonsey #1-24	32931	3560	3755	25 BOPD +25 BWD		Dundee	Acreage	E
Jackson 7-1S-1E	Henrietta	Total Petroleum Inc. Faist-Kelly-Luck #1-7	32714	5060	5653	33 BOPD +74 Mcf + 1 BWD		Trenton	Seis.	E
Kalamazoo 23-1S-11W	Cooper	Petrotech Inc. H. A. Nagel, Jr. #1-23	32639	2308	2870	30 BOPD		B Unit	Seis.	E
Kalkaska 5-28N-5W	Blue Lake 5-28N-5W	Energy Acquisition Corp. St-Hayden #1-5	32538	6630	6793	480 BOPD +500 Mcf		Niagaran	Seis.	E
Kalkaska 13-28N-5W	Blue Lake 13-28N-5W, Pool A	Amoco Production Co. St-Blue Lake "F" #2-13	32960	7014	7193	300 BOPD +297 Mcf		Niagaran	Seis.	E
Kalkaska 19-28N-5W	Blue Lake 19-28N-5W, Pool B	Amoco Production Co. Lachniet-St-Blue Lake Unit #4-19	32532	6970	7280	300 BOPD		Niagaran	Seis.	E
Kalkaska 21-28N-5W	Blue Lake 21-28N-5W	Muskegon Development Co. LaMotte & Batson #2-21	32419	7200	7295		40 Cond./Day +1500 Mcf	Niagaran	Seis.	E
Kalkaska 34-28N-5W	Blue Lake 34-28N-5W	Getty Oil Co. Brown #2-34	32968	7036	7558		24 Cond./Day +800 Mcf	Niagaran	Seis.	E

1979 DISCOVERY WELLS CONTINUED

Kalkaska 24-28N-6W	Cold Springs 24-28N-6W, Pool A	Amoco Production Co. Fawcett-St-Cold Springs "A" #3A-24	33048*	6945	7262	300 BOPD +450 Mcf		Niagaran	Seis.	E
Kalkaska 35-28N-6W	Cold Springs 35-28N-6W	Amoco Production Co. Lockwood-Brammer-St-Cold Springs #1-35	33181	7160	7350		200 Cond./Day +7500 Mcf	Niagaran	Seis.	E
Kalkaska 16-27N-7W	Kalkaska 16-27N-7W, Pool B	Shell Oil Co. Holcomb-St-Kalkaska #1-16	32789*	6695	6858	339 BOPD +477 Mcf		Niagaran	Seis.	E
Kalkaska 12-27N-8W	Kalkaska 12-27N-8W	Amoco Production Co. St-Kalkaska "R" #3-12	33088	6354	6773	200 BOPD +260 Mcf + 50 BWD		Niagaran	Seis.	E
Lapeer 18-9N-9E	Marathon, Dundee Pool	Harris Oil, Inc. Leki #1	33226	2629	3220	80 BOPD +20 Mcf + 10 BWD		Dundee	Acreage	E
Lenawee 14-5S-4E	Newburg	Blunt Drilling Co. Allen #1	22886	3150	4046	40 BOPD +10 BWD		Trenton	Acreage	E
Livingston 2S-2N-3E	Iosco	Amoco Production Co. Patrick Unit #1-2S	32427	3819	4260	278 BOPD +132 BWD		Niagaran	Seis.	E
Macomb 32-5N-14E	Richmond, Sec. 32	Reef Petroleum Corp. Bolen-Belzyt #1-32	32480	3247	3326		1350 Mcf	Niagaran	Seis.	E
Manistee 2-23N-15W	Bear Lake 2-23N-15W, Pool A	Getty Oil Co. Leonard et al #1-2	32949	4420	4715	340 BOPD +200 Mcf		Niagaran	Seis.	E
Manistee 8-23N-15W	Bear Lake 8-23N-15W	Getty Oil Co. Smith #1-8	32996	4354	4575		8 Cond./Day +825 Mcf	Niagaran	Seis.	E
Manistee 19-23N-15W	Bear Lake 19-23N-15W, Pool A	Shell Oil Co. Acker #2-19A	31317*	4227	4372		13 Cond./Day +3548 Mcf	Niagaran	Seis.	E
Manistee 26-24N-13W	Cleon 26-24N-13W, Pool A	Energy Acquisition Corp. Bailey #1-26	32790	5762	5904		20 MMcf	Niagaran	Seis.	E
Manistee 29-24N-13W	Cleon 29-24N-13W, Pool A	Shell Oil Co. St-Cleon #1-29A	32844*	5522	5648		89 Cond./Day +3236 Mcf	Niagaran	Seis.	E
Manistee 2-21N-17W	Filer 2-21N-17W	Aztec Producing Co., Inc. St-Manistee Unit #1-2	32621*	3725	4053		25 Cond./Day +5250 Mcf	Niagaran	Seis.	E
Manistee 33-22N-16W	Manistee 4-21N-16W	Shell Oil Co. Phoenix Petroleum Co. #1-4	32533*	4378	4468		2103 Mcf	Niagaran	Seis.	E
Manistee 23-22N-16W	Manistee 23-22N-16W, Pool A	Shell Oil Co. St-Manistee et al #3-23	32728	4325	4713		18 Cond./Day +3070 Mcf	Niagaran	Seis.	E
Manistee 36-22N-17W	Manistee 36-22N-17W	Aztec Producing Co. St-Manistee Unit #1-36	32708*	3844	4095	680 BOPD +530 Mcf		Niagaran	Seis.	E
Manistee 19-23N-14W	Maple Grove 19-23N-14W, Pool A	Reef Petroleum Corp. Pylkas #1-19	32702	4840	5145	80 BOPD +1250 Mcf		Niagaran	Seis.	E
Manistee 24-23N-16W	Onekama 24-23N-16W	Robinson Energy Corp. Acker #1-24	33033*	4291	4464	160 BOPD +150 Mcf + 7 BWD		Niagaran	Seis.	E
Missaukee 6-24N-6W	Cannon Creek, Det. Rvr. SZ Pool	Dart Oil and Gas Corp. St-Norwich #1-6	32519	4283	4848	65 BOPD +105 Mcf		Detroit River	Acreage	E
Missaukee 36-22N-6W	Prosper, South, Richfield Pool	Powell Petroleum Inc. St-Aetna #1-36	33016	5088	5240	1 BOPD +200 BWD		Richfield	Acreage	E
Oakland 12-5N-11E	Addison 12-5N-11E	Reef Petroleum Corp. Lanphar #1-12	32168	4268	4339	20 BOPD +1.4 MMcf		Niagaran	Seis.	E
Oakland 18-1N-7E	Lyon, Sec. 18	Arbuckle Corp. Friedlaender #1-18	32968	3616	3917	77 BOPD +8.7 MMcf		Niagaran	Seis.	E
Otsego 13-29N-2W	Chester 13-29N-2W	Murrell L. Welch St-Chester #1-13A	32843*	6180	6195		Gas- no gauge	Niagaran	Seis.	E
Otsego 25-30N-2W	Chester, Sec. 25	Amoco Production Co. St-Chester "D" #1-25	32158	1434	1497		205 Mcf +89 BWD	Antrim	Acreage	E
Presque Isle 17-33N-2E	Allis 17-33N-2E	Shell Oil Co. St-Allis #1-17B	32126*	3640	3859	Shut-in Oil Well		Niagaran	Seis.	E
Presque Isle 29-33N-2E	Allis 29-33N-2E	Shell Oil Co. St-Allis #1-29	32616	3771	3968	Shut-in Oil Well		Niagaran	Seis.	E
Presque Isle 7-34N-5E	Belknap 7-34N-5E	Amoco Production Co. Ristow #1-7A	32512	2784	3400		138 Mcf	Niagaran	Seis.	E
Saginaw 26-10N-6E	Birch Run, Sec. 26	Baller and Deshaw Vitany et al #1	32746	2486	2543	10 BOPD		Dundee	Acreage	E
Saginaw 20-9N-3E	Chesaning	Stocker and Sitler Hedrich #1-20	32775	2343	2914	276 BOPD +1000 Mcf		Traverse	Acreage	E
St. Clair 4-5N-15E	Columbus, Sec. 4	Reef Petroleum Corp. Wronski #1-4	32293	3202	3284		850 Mcf	Niagaran	Seis.	E
St. Clair 13-4N-16E	East China, Sec. 13	Petrotech Inc. Detroit Edison Co. #1-13	32711	2428	2490		4.5 MMcf	Niagaran	Seis.	E
Tuscola 25-14N-8E	Akron, East	Southeastern Exploration Co. Baum #1-25	32938	3840	4025	15 BOPD		Richfield	Acreage	E
Wexford 20-24N-12W	Wexford 20-24N-12W	Industrial Natural Gas Corp. St-Kaplan #2-20	32792	6082	6240		90 Cond./Day +2.3 MMcf	Niagaran	Seis.	E

*Directionally drilled hole. Total depth listed is the true vertical depth and not the measured depth. Depths to pay are also true vertical depths.

[Permits, Well Completions, Drilled Footage, Table 1]

TABLE 1 DRILLING PERMITS, WELL COMPLETIONS, DRILLED FOOTAGE BY COUNTY, 1979

COUNTY	OIL/GAS PERMITS ISSUED	OIL AND GAS TESTS Completed	RESULTS			SERVICE WELLS Completed		TOTAL WELLS DRILLED	TOTAL DRILLED FOOTAGE			Average Well Depth
		Explor.	Devel.	Oil Wells	Gas Wells	Dry Holes	G.S.	B.D.W.		Explor.	Devel.	Fac.	
Alcona	1	1	0	0	0	1	0	0	1	3,257	0	0	3257
Allegan	7	2	3	3	0	2	0	0	5	7,015	10,374	187*	3515
Antrim	4	1	2	1	0	2	0	0	3	1,853	13,706	0	5186
Arenac	0	2	0	0	0	2	0	0	2	8,596	0	48*	4322
Bay	3	2	0	0	0	2	0	0	2	6,564	0	0	3282
Berrien	1	0	0	0	0	0	0	0	0	0	0	0	0
Branch	1	1	0	0	0	1	0	0	1	4,633	0	0	4633
Calhoun	30	11	15	7	1	18	0	0	26	36,717	39,432	0	2929
Cass	10	1	2	2	0	1	0	0	3	1,240	1,516	0	919
Cheboygan	6	6	0	2	0	4	0	0	6	23,041	0	0	3840
Chippewa	1	0	0	0	0	0	0	0	0	0	0	0	0
Clare	23	3	12	10	1	4	1	0	16	14,849	61,741	1,548	4884
Clinton	2	2	0	0	0	2	0	0	2	5,620	0	0	2810
Crawford	16	2	7	2	0	7	0	0	9	14,746	30,954	0	5078
Eaton	12	11	3	3	6	5	0	0	14	45,007	11,693	0	4050
Genesee	1	0	1	0	0	1	0	0	1	0	3,202	0	3202
Gladwin	10	2	6	7	0	1	0	1	9	6,435	20,039	4,253*	3414
Grand Traverse	70	44	21	13	9	43	0	0	65	265,971	116,486	0	5884
Gratiot	1	1	0	0	0	1	0	0	1	2,640	0	0	2640
Hillsdale	4	0	5	3	0	2	0	0	5	0	20,441	0	4088
Ingham	7	6	1	2	1	4	0	0	7	22,234	3,735	0	3710
Isabella	8	4	0	3	0	1	0	1	5	14,391	0	3,646	3607
Jackson	12	4	3	2	0	5	0	0	7	16,843	16,914	0	4822
Kalamazoo	2	2	0	1	0	1	0	0	2	5,830	0	0	2915
Kalkaska	62	24	16	11	6	23	0	0	40	148,001	98,154	0	6154
Kent	1	0	0	0	0	0	0	0	0	0	0	0	0
Lapeer	10	1	8	9	0	0	0	0	9	3,220	25,827	0	3227
Lenawee	1	1	0	1	0	0	0	0	1	0	0	0	0
Livingston	5	4	1	1	0	4	0	0	5	17,721	3,980	0	4340
Macomb	10	7	2	0	2	7	1	0	10	19,759	7,286	310	2736
Manistee	74	27	58	24	16	45	0	1(1)	86	116,170	262,800	5,207	4467
Mason	2	2	1	0	0	3	0	0	3	3,000	4,540	0	2513
Mecosta	23	1	1	0	0	2	15	0	17	3,666	2,932	20,282	1581
Midland	4	0	0	0	0	0	0	1	1	0	0	3,800	3800
Missaukee	20	6	22	22	0	6	0	0	28	22,345	101,032	0	4406
Monroe	1	0	0	0	0	0	0	0	0	0	0	0	0
Montcalm	9	0	0	0	0	0	8	0	8	0	0	10,403	1300
Montmorency	15	8	2	0	0	10	0	0	10	37,058	6,636	0	4369
Muskegon	1	0	1	1	0	0	0	0	1	0	2,026	0	2026
Newaygo	5	0	0	0	0	0	3	0	3	0	0	3,546	1182
Oakland	7	3	4	3	2	2	0	0	7	12,300	14,211	0	3787
Oceana	6	1	1	1	0	1	0	0	2	5,065	1,640	0	3353
Ogemaw	14	0	7	6	0	1	0	6(1)	13	0	19,285	16,469	2750
Osceola	1	2	0	0	0	2	0	0	2	8,243	0	0	4122
Otsego	58	17	31	11	8	29	0	7(1)	55	90,664	146,356	26,922	4799
Presque Isle	38	27	4	3	1	27	0	0	31	92,251	13,166	0	3401
Roscommon	8	0	6	6	0	0	0	0	6	0	27,791	0	4632
Saginaw	3	2	1	2	0	1	0	0	3	5,457	2,449	0	2635
Sanilac	0	1	0	0	0	1	0	0	1	2,619	0	0	2619
St. Clair	9	4	2	0	3	3	23	0	29	11,988	7,108	106,170	4320
Tuscola	12	1	9	7	1	2	0	0	10	4,025	41,263	0	4529
Van Buren	8	3	5	3	0	5	0	0	8	3,461	5,813	0	1159
Washtenaw	2	2	0	0	0	2	0	0	2	8,475	0	0	4238
Wayne	2	0	0	0	0	0	0	0	0	0	0	0	0
Wexford	6	5	1	1	1	4	0	0	6	23,545	6,182	0	4955
TOTAL	649	257	264	173	58	290	51	17	589	1,146,515	1,150,710	202,791	

*Includes some facility footage credited to old wells drilled deeper.

(1) Water injection wells involved in secondary recovery operations.

PART 2

EXPLANATION

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

TABLES 2, 3 and 4 list Michigan's oil and gas fields and gas storage reservoirs. 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.

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. Except as provided by special orders covering drilling units, rules promulgated under Act No. 61, P.A. of 1939, as amended, call for a minimum 40-acre unit consisting of a governmental quarter-quarter section of land. Special Order No. 1-73 calls for basic 80-acre drilling units for Salina-Niagaran or deeper tests in specified areas of the state. These 80-acre units are formed by two governmental quarter-quarter sections of land having a common boundary of approximately 1320 feet. In past years drilling units have been 10, 20 or 40 acres for oil wells. A field may have had 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. 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, or a unit size based on seismic and res-servoir data. Reef reservoirs, especially in the northern reef trend, have been assigned 80, 160, 640, or a unit based on seismic data. Changes in drilling units, off-pattern wells, etc., complicate the maintenance of accurate figures during the lifetime of a given field or pool.

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

Gas Fields, Gas-Condensate Fields. Some fields are listed as "shut-in" and show no production figures. In the case of Niagaran reef fields classified as gas-condensate reservoirs, virtually all those listed as shut-in at the end of the year were waiting pipeline construction or gas-handling facilities. Others, mainly small dry-gas reservoirs in shallower formations, are listed as shut-in because of slow field development, small reserves or lack of marketing facilities. Other fields, not considered to have commerical-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. 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 gas storage operations. Further, the listed sections do not necessarily relate to potential or future gas storage area or boundary. The table listing undeveloped gas storage reservoirs has been discontinued.

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 Tables 2 and 3 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 Division, Michigan Department of Natural Resources, Lansing. Samples are contained in glass vials arranged in open trays. In addition, several thousand shallow geological test samples are also available for inspection. The Division does not maintain a core collection. Other sample and core repositories, not connected with the Division, 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.

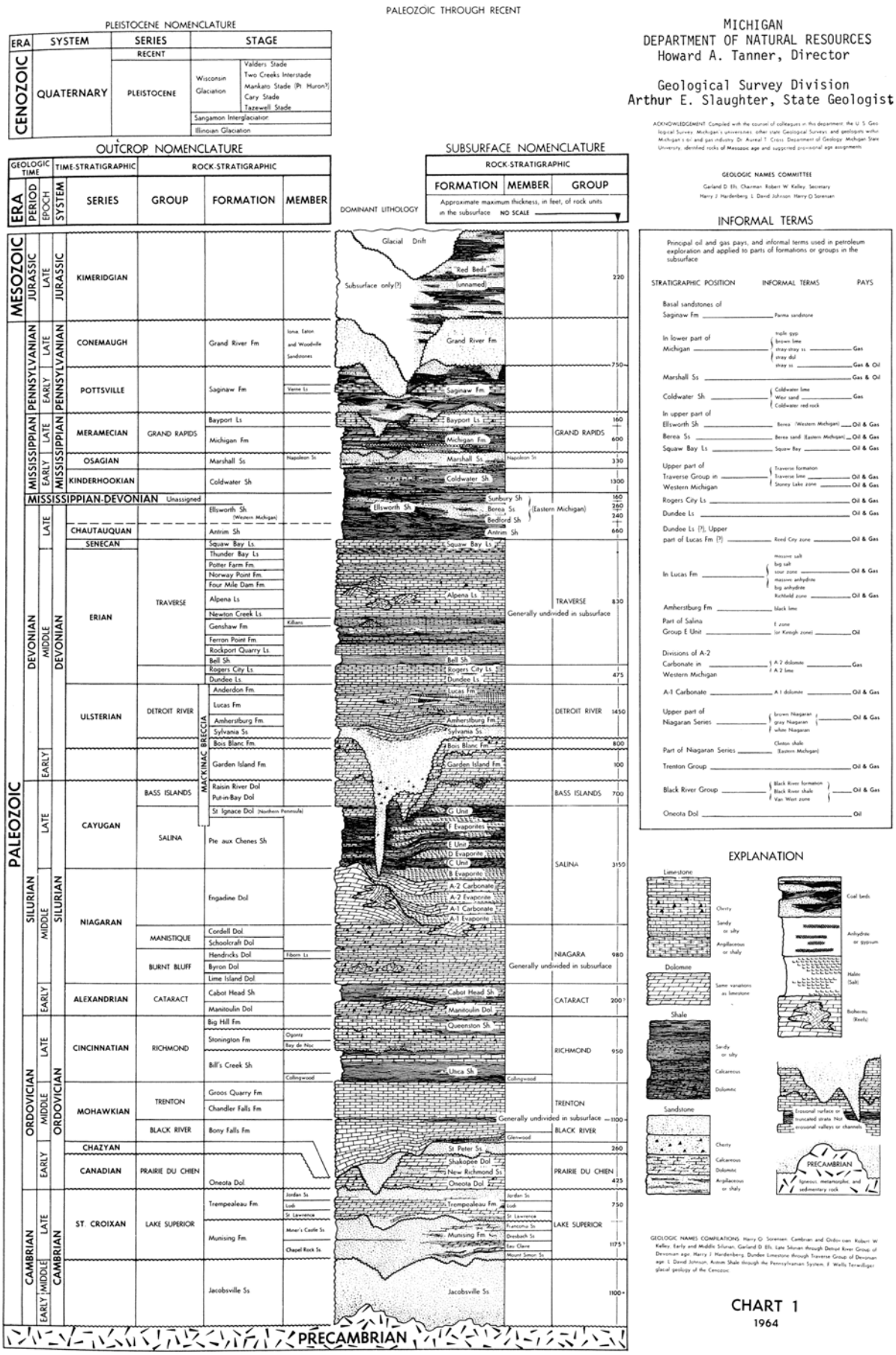
Injection and Pressure Maintenance Wells. These are wells used in secondary recovery, or pressure maintenance projects. They may be new wells drilled specifically for injection or pressure maintenance, or they may be converted oil or gas wells; their status can change from time to time.

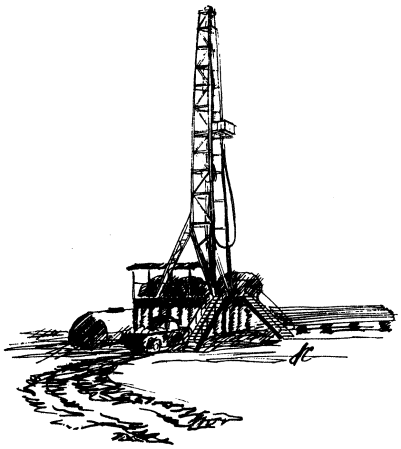
Oil or gas wells are sometimes converted to salt water disposal, observation, facility wells in gas storage reservoirs, or water injection wells used in secondary recovery or pressure maintenance projects. The types of service wells listed under "Classification of Well Completions" do not include oil or gas wells converted to service wells.

ABBREVIATIONS

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

STRATIGRAPHIC SUCCESSION IN MICHIGAN





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