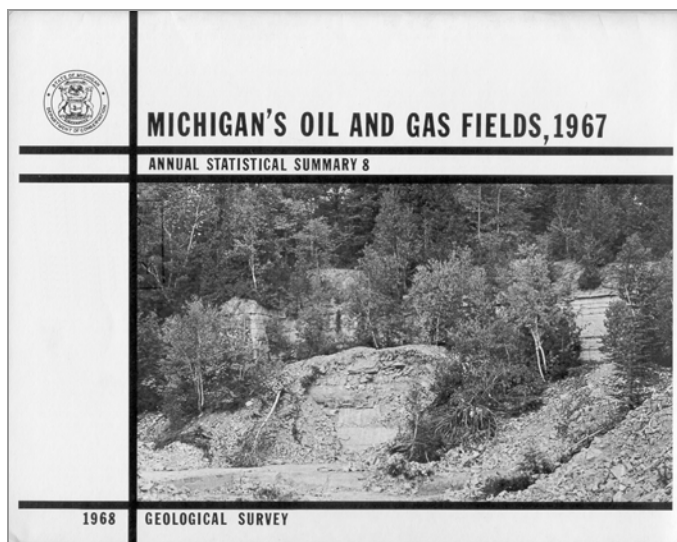




MICHIGAN'S OIL AND GAS FIELDS, 1967

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ACKNOWLEDGMENTS

This publication bring together under one cover many related oil and gas field statistical data not usually found in any other industry or government publication. Oil and gas field data of historical and general interest are included and thus preserved herein for future reference. The summary is, therefore, a source of information most useful in evaluating Michigan's past history and future prospects as an oil and gas province. Furthermore, the gathering, maintenance, and compilation of the many statistical data contained in this summary reflects, in part, the varied functions of the Oil and Gas Section of the Survey.

The contents of this publication result from the joint efforts of the Survey's Oil and Gas Section under the supervision of L. W. Price, geologist in charge. Oil and Gas Section unit supervisors who directed staff members in the gathering and maintenance of the basic records and summarized them for compilation and manuscript preparation are:

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of secretarial and technical staff members of the
Petroleum Geology Unit.

Cover photo by H. O. Sorensen, geologist, Economic
Geology Section. Photo shows exposure of Niagaran
age, Burnt Bluff Group, dolomites near the village of
Drummond, Drummond Island, Chippewa County,
Michigan. These Middle Silurian rocks crop out in an
arcuate band through the Northern Peninsula and are
important sources of limestone and dolomite. Further
south in the basin, Niagaran rocks (generally reefs) are
an important source of oil and gas.

Compiler: G. D. Ells, Petroleum Geology
Lansing, Michigan
May, 1968

MICHIGAN'S OIL AND GAS FIELDS, 1967

Introduction

Over a span of years, oil and gas field activities in a
petroleum province fluctuate. The relative strength of
the activities for a given year as compared with prior
years can be measured by such factors as the number
and size of newly discovered fields and pools, the
amount of exploratory and development drilling, oil and
gas production, and others. In this issue, various facets
of Michigan's 1967 oil and gas field activities are cited
and related to the prior year.

The kinds of data listed herein are derived mainly from
records received and maintained by the Geological
Survey Division. Certain data such as the number of
exploratory and development wells drilled, number of
discoveries, well classifications, and so forth, may differ
from statistical data reported by regional or national
trade journals, or by petroleum industry reporting
services. Differences can be mainly attributed to
methods of gathering and reporting well or drilling data.
The types of data reported in this summary have been
treated uniformly from year to year. The data reflect as
near as possible the actual activities and developments
that should be credited to the past year, 1967.

Comparison of 1967 statistics with those of 1966 show
no large differences or declines in most kinds of oil and
gas field activities, although there is considerable
general decline if compared with 1965. The most active
regions of new field exploration and field development
drilling were St. Clair and Macomb Counties and the
area along the Albion-Pulaski-Scipio oil field trend. In
general, drilling and well completions were distributed,
geographically, about the same as in 1966. New field
discoveries were at about the same level as last year.

Oil and gas production declined a small percentage.
The total value of these products amounted to
\$47,820,112 as compared with \$49,739,074 in 1966.
Domestic LPG production was valued at about
\$3,793,194.

Part 1 of this publication summarizes significant
information on oil and gas field activities, and related
work of the Oil and Gas Section of the Geological
Survey during 1967. Part 2, the green pages, contains
specific information on Michigan's oil and gas fields for
1967. Part 3 contains cumulative records of importance
to the petroleum industry.

***** DRILLING PERMITS *****

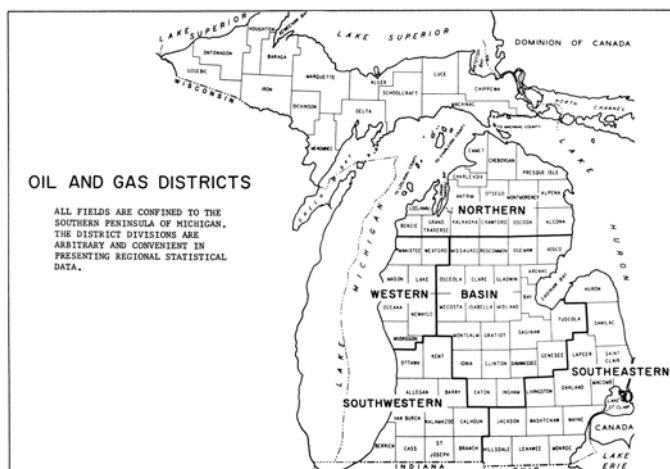
The number of permits issued to drill new holes has
shown a steady decline over the past several years.
Again, fewer permits for oil or gas tests, gas storage
reservoir wells, and other types drilled under permit,
were issued in 1967 by the Regulatory Control Unit.
Part of the decrease is probably due to wider well
spacing and the small areal extent of some 1966 and
1967 new field discoveries.

Of the 405 oil and gas permits issued, 24 were for gas
storage reservoir wells, 198 were for field development
wells, and 183 were for exploratory tests. Included
within the development and exploratory well permit totals
are 8 permits issued to re-open and test wells previously
drilled under other permit numbers. Also, included are 4
permits which were cancelled and terminated due to
failure of operators to commence drilling operations
within six months from the issue date of the permit.

The geographic distribution by district of permits issued
through a 3-year period is shown as follows.

DRILLING PERMITS BY DISTRICT			
DISTRICT	Permits Issued		
	1965	1966	1967
Basin	117	79	91
Northern	7	11	11
Southeastern	247	222	178
Southwestern	63	43	72
Western	60	75	53
Totals	494	430	405

[Oil and Gas Districts (Map)]



The higher figures for the southeastern district reflects the exploration and development activity in the St. Clair-Macomb County area, the area of the Albion-Pulaski-Scipio oil field trend, and gas storage well development in the Howell gas storage field. The fluctuation in permits for gas storage and other types of service wells are shown as follows:

Service Wells	1965	1966	1967
Gas Storage			24
Observation, Brine disposal, etc.			2
	106	7	26

Not included in any of the above figures, were 17 deepening permits. No geological test permits were issued in 1967. Table 2, page 12, shows the distribution of drilling permits by county.

*** WELL COMPLETIONS ***

There were 393 new hole exploratory and development well completions. The figure does not include gas storage reservoir wells, old wells drilled to deeper oil or gas pools, reworks, or others not directly related to exploratory or field development drilling. About one-third of the exploratory wells, directed toward finding new Silurian reefs, were drilled in St. Clair and Macomb Counties. Nearly one-quarter of the field development well completions are also credited to these counties. About one-fifth of all development wells were drilled in the Calhoun County part of the Albion-Pulaski-Scipio oil field trend. More details on well completion results, by county, are shown on Table 2. Exploratory and development well completion results covering a 3-year period are summarized as follows:

EXPLORATORY AND DEVELOPMENT WELL COMPLETIONS

Year	Exploratory			Development			Totals
	Wells			Wells			
	Oil	Gas	Dry	Oil	Gas	Dry	
1965	6	6	189	47	28	102	378
1966	8	3	175	49	42	111	388
1967	7	2	171	69	38	106	393

The fluctuation of drilled footage, including deepening, over a 3-year period is as follows:

Footage Well Class	Amount of Drilled Footage		
	1965	1966	1967
Exploratory	602,682	560,941	539,400
Development	587,457	608,386	686,672
Service	254,403	33,370	88,434
Total	1,444,542	1,202,697	1,314,506

The number and class of well completions according to oil and gas district, and by month of the year, is tabulated on Table 3. Cumulative well completions by county are shown on Table 25, page 64.

*** DISCOVERY WELLS ***

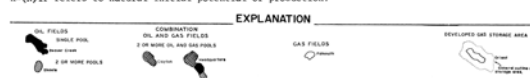
State-wide, the discovery-to-dry hole ratio for new field wildcat wells was 1:20 as compared with 1:17 in 1966. The discovery ratio in St. Clair and Macomb Counties, where about one-third of the exploratory wells were drilled, was also 1:20 although all discoveries in this area were made in St. Clair County.

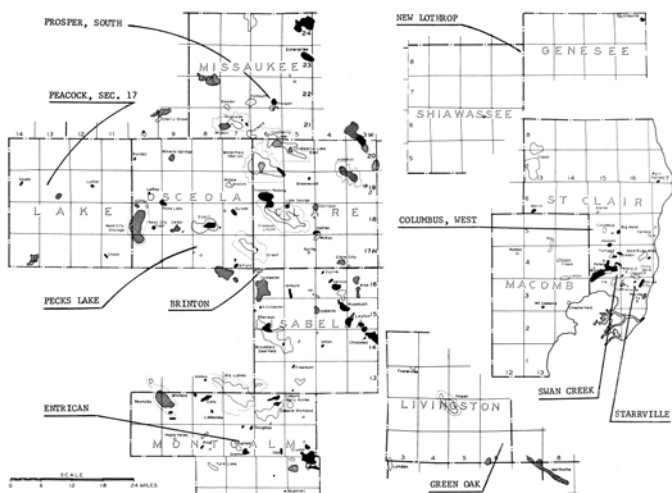
Completion details on all discovery wells credited to 1967 are listed on the next page. All reached total depth during the year, and most were put on production. None of the new oil discoveries appears to have an oil or gas yield greater than a Class E field. The new Columbus West gas field is tentatively designated as Class C, and the new Swan Creek gas field as Class E. These classifications are based on potential yields as defined by the American Association of Petroleum Geologists and are as follows:

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

1967 DISCOVERY WELLS										
Field	County and Location	Operator and Lease	Permit Number	Comp. Date	Depth to Pay	Total Depth	Initial Production m(9)IP t-(C)IP ROPD MC/OPD	Prod. Form.	Basis for Loc.	
NEW FIELDS										
Brinton	Isabella	The Taggart Co.	27025	11-13	4082	4085	P & F60 ^t	Dd.	Sub.	
Columbus, West	St. Clair	A. J. Little No. 1	26746	2-3	3183	3370	8400 ^t	Niag.	Grav.	
Green Oak	Livingston	Sun Oil Co.	26999	9-22	?	5559	P8-9 ^t	Trent. B. R.	Grav.	
New Lothrop	Shelawassee	Harris Oil Co.	26862	6-8	1630	1646	P8 ^t	Berea	Sub.	
Peacock, Sec. 17	12-8N-4E	Carl Wendling No. 1	27095	12-10	2292	2294	P50 ^t	Trav.	Sub.	
Pecks Lake	17-19N-13W	Cook Bros. & Con. Pwr. Co.	26661	7-13	3866	3854	P80 ⁿ	Dd.	Sub.	
Proser, South	18-17N-8W	J. S. Barwick (McClure Oil)	26961	10-8	3796	3807	P75-80 ⁿ	Dd.	Sub.	
Starrville	Missaukee	Woods Oil Co.	26931	7-15	2336	2378	P50 ^t	Niag.	Grav.	
Swan Creek	36-22N-6W	McClure Oil Co.	26984	8-26	2282 ^t	2507	1044 ^t	Niag.	Sub.	
	9-3N-16E	Labuhn-Markel No. 1								
	36-4N-15E	Con. Pwr. Co. & Joint Vent								
	36-4N-15E	Wissman-Draves No. 3								
NEW POOL DISCOVERY										
Entrichon	Montcalm	The NODD	26753	2-16	3312	3336	P3 ^t	Dd.	Sub.	
	21-13N-7W	Elsie Hayer No. 1								

NOTE: t-(C)IP refers to initial potential after acid, sand-fracture, or a combination of well stimulation methods. m-(9)IP refers to natural initial potential or production.





Most new fields were found in established producing regions; none open large, undrilled areas for exploration. The number of oil or gas wells completed in the new fields during 1967, and the cumulative production for the field, can be found in the oil and gas field tables on the green pages.

The New Lothrop field, northeastern Shiawassee County, is the first Berea Sandstone oil pool found in over a decade. Three wells were completed, one to a 20-acre drilling unit, by year's end. Though Berea sandstones have not been prime exploration objectives for many years, this small field should promote more exploration in sparsely drilled Shiawassee and adjacent Genesee County.

The new Peacock field in Lake County on the western side of the basin points up the probabilities of more Traverse limestone pools, and probably deeper production, yet to be found in this sparsely drilled county. Lake County has an area of 577 square miles and a drilled well density of about 1:4 square miles. The few fields which have been found are small and widely scattered, but offer incentive for further exploration.

Pecks Lake, Osceola County, was the first Dundee Limestone discovery of the year but little development drilling was done, probably because of the unsure performance of the discovery well. A well spacing pattern and a 40-acre drilling unit order was established for this field.

Prosper, South was deemed a new field rather than an extension of the original Prosper field which has made nearly 1,700,000 barrels of oil since its discovery in 1942. A well spacing pattern and 40-acre drilling unit was established. Wells are prorated to a 75 BOPD allowable. Three oil wells were completed by year's end and prospects for further development are favorable.

The Brinton field, about 4 miles north of the Cold-water field, Isabella County, raises prospects of another sizeable Dundee oil pool. Though one dry hole and no additional oil wells were completed during 1967, not enough wells have been drilled in the vicinity of the Brinton discovery to give an indication of possible field extent. The Coldwater field to the south covers about

3200 acres and has produced over 21 million barrels of oil since discovery in 1944.

Though 43 exploratory dry holes were drilled in St. Clair County, four new Niagaran reef fields were found. However, only three are credited as 1967 discoveries. The discovery well for the fourth reef field, called Collin, did not reach total depth and final completion during 1967 and is thus not included in 1967 statistics.

The first new reef field discovery of the year, Columbus West, appears to be one of the best finds in recent years. Most of the reef was outlined during the year by the drilling and completion of 12 gas wells and 4 dry holes. Five productive reefs have now been found in Columbus Township. The prospects for additional reef discoveries in this township is greatly enhanced by the size and potential productivity of the new gas field.

The Starrville reef lies about a mile to the west of the southern end of the Marine City field, one of the first (1955) Niagaran reef discoveries in St. Clair County. Two dry development wells were completed during the year, but no additional oil or gas wells. The discovery well produced over 6,000 barrels of oil from discovery date through October 1967. Prospects of a reef-trend paralleling the Marine City field are favorable.

The Swan Creek field appears to be a small pinnacle reef located near the Ira gas storage field. This small semi-isolated reef appears to have been outlined by development drilling. No further producible wells were completed during the year.

Green Oak, the only Trenton-Black River discovery of the year, is located on a part of the Howell anticlinal trend. The well was completed as a small oil well pumping 8 to 10 BOPD, but by year's end production was reported to be down to about 5 BOPD. The Northville, Howell gas storage field, and the Fowlerville Niagaran gas field are located on the Howell anticlinal complex. The Green Oak well, though small, should encourage further exploration of these large faulted, structural features.

Devonian rocks continue to be important drilling objectives from year to year. Devonian formations have produced most of Michigan's oil, and Mississippian rocks have produced most of the gas. An analysis of discoveries through a 3-year period is shown in chart form. New pool discoveries are not included in the chart.

*** OIL AND GAS PRODUCTION ***

No large oil reserves were found and developed during 1967, thus oil production continued to decline a small percentage. Oil production amounted to 13,664,185 barrels as compared with 14,273,099 barrels produced in 1966. Oil production by geologic formation is shown graphically on page 56 Part 3.

Gas production amounted to about 33,241,640 Mcf as compared to 34,120,013 Mcf in 1966.

LPG production stripped from Michigan gas amounted to 1,806,320 barrels. The bulk of this production came from the Albion-Scipio, Belle River Mills, Boyd, and Reed City gas plants. An additional 767,305 barrels were stripped from gas imported into Michigan via pipeline.

ANALYSIS OF DISCOVERY WELLS BY GEOLOGIC SYSTEM				
System	Formation or Pay	Number of Discoveries		
		1965	1966	1967
Pennsylvanian		-	-	-
Mississippian	"Michigan Stray Ss."	1	1	-
	"Berea"	-	-	1
Devonian	Antrim Shale	1	-	-
	"Traverse Lime"	5	3	1
	Dundee	1	1	3
	"Reed City"	1	3	-
	Detroit River	-	-	-
	"Sour Zone"	-	-	-
	Richfield	-	-	-
Silurian	Salina A-1 or A-2	-	-	-
	Niagaran reef*	4	2	3
Ordovician	Trenton-Black River	-	-	1
	Prairie du Chien	-	-	-
Cambrian	(Gas shows reported)	-	-	-

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

Oil and gas production by individual fields or pools is found in Part 2 on the oil and gas field tables. Production by year, geologic formation, and county is shown in the tables in Part 3. Production by month and by geographic district in 1967 is shown on the following charts. See Table 1 for oil and gas production by county in 1967.

OIL AND GAS PRODUCTION BY MONTH		
Month	Production	
	Barrels Oil	MCF Gas
January	1,154,294	3,247,588
February	1,075,568	3,119,834
March	1,183,978	3,152,490
April	1,115,542	2,619,823
May	1,182,262	2,414,101
June	1,119,707	2,133,503
July	1,140,405	2,728,532
August	1,178,572	2,775,451
September	1,120,130	2,421,877
October	1,154,013	2,687,300
November	1,118,597	2,794,179
December	1,121,117	3,146,962
Totals	13,664,185	33,241,640

OIL AND GAS PRODUCTION BY DISTRICT		
District	Production	
	Barrels Oil	MCF Gas
Basin	4,254,529	2,482,992
Northern	35,608	6,951
Southeastern	6,339,441	29,990,566
Southwestern	2,775,972	408,304
Western	258,635	352,827
Totals	13,664,185	33,241,640

*** OIL AND GAS VALUATION ***

The average price paid at the wellhead for Michigan crude was \$2.89 per barrel. The value of this mineral resource amounted to about \$39,455,290 as compared with \$40,912,946 in 1966. The average price of Michigan gas sold at the wellhead was \$.26 per MCF.

The value of this product amounted to about \$8,364,822 as compared to \$8,773,844 in 1966. The value of LPG production from Michigan gas amounted to about \$3,793,194. In addition, LPG's stripped from imported gas was valued at about \$1,611,336.

TABLE 1 -- OIL AND GAS PRODUCTION BY COUNTY IN 1967					
County	Barrels Oil	MCF Gas	County	Barrels Oil	MCF Gas
Allegan	242,343	236,528	Mason	88,044	—
Arenac	273,182	—	Macata	293,217	100,825
Barry	11,007	—	Midland	217,861	—
Bay	321,565	—	Missaukee	447,153	485,868
Berrien	—	—	Monroe	6,056	—
Calhoun	2,314,159	4,347,031	Montcaln	172,769	5,241
Cass	3,081	—	Muskegon	70,511	—
Clare	586,913	167,773	Newaygo	20,723	—
Crawford	182,343	450,656	Oakland	628	—
Genesee	2,219	—	Oceana	74,348	—
Gladwin	352,318	—	Ogemaw	298,341	613,960
Grandt	23,647	1,907	Ontonagon	508,538	197,752
Hillsdale	4,046,027	4,654,604	Oscoda	1,702	—
Huron	2,665	—	Otsego	—	6,951
Ionia	—	—	Ottawa	107,235	153,926
Isabella	250,685	3,839	Rosecommon	169,252	455,171
Jackson	1,602,707	2,374,659	Saginaw	22,626	—
Kalamazoo	33,906	—	Shiawassee	3,650	—
Kent	87,642	17,850	St. Clair	641,555	14,984,222
Lake	5,009	—	Tuscola	74,384	—
Lapeer	64,356	24,772	Van Buren	10,505	—
Leawee	6,358	63,026	Washtenaw	26,589	203,952
Livingston	699	16,488	Wayne	15,214	479,425
Macomb	2,453	2,842,887	Wexford	—	352,827

See Table 23, page 62, for cumulative figures.

Totals: 13,664,185 33,241,640

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

Canadian crude oil imports via pipeline from western Canada oil fields amounted to 8,407,569 barrels as compared with imports of 6,510,132 barrels in 1966. Domestic imports via pipeline from western and mid-western states amounted to 28,853,856 barrels, a decrease from the 32,572,587 barrels imported in 1966. Total imports amounted to 37,250,765 barrels as compared with 39,082,719 barrels imported in 1966.

Crude oil exported to northern Indiana (Ft. Wayne) and Ohio (Cleveland) refineries amounted to 149,463 barrels, a sizeable decrease from the 378,963 barrels reported in 1966.

Gas imports to Michigan markets and gas storage fields via pipelines, primarily from Texas, Louisiana, Oklahoma, and Kansas fields, increased during 1967. Compilations by the Gas Section, Michigan Public Service Commission, show gas imports of 661,345,209 Mcf as compared with 599,174,318 Mcf in 1966. Gas imports by month are:

PIPELINE GAS IMPORTS (in Mcf)	
January	41,700,526
February	34,877,708
March	48,719,131
April	58,464,228
May	63,325,866
June	64,900,589
July	64,267,810
August	69,043,328
September	63,935,094
October	59,768,971
November	46,377,847
December	45,964,111
	661,345,209

*** DEEP TESTS ***

About 22% of exploratory wells bottomed-out in Devonian Traverse limestone, 10% in the Devonian Dundee limestone, 7% in the Reed City zone of Devonian age, 35% in Silurian Niagaran-Clinton age rocks, and about 17% in rocks of Ordovician Trenton-Black River age or older. The balance reached total depth in rocks younger than Devonian in age. No precambrian or basement tests were drilled during the year.

No firm criteria are established for designating exploratory wells as important deep tests. Actual drilled depth is not the determining factor. Selections are most often based on the geologic age of the strata penetrated in reference to the location of the test within the basin, and the relative abundancy of similar tests in the area. Deeper pool tests in designated fields may also qualify as deep tests. Those selected for 1967 are listed on page 15.

*** OIL FIELD BRINE PRODUCTION ***

There were 16 fields producing brine in excess of 2000 barrels per day. These fields and their daily average brine production are shown on the chart below. The fields account for the bulk of the state's total oil field brine production. Most of the brine is returned to the producing formations—mainly the Traverse and Dundee, part is returned to other formations. A small percentage is used on roads for dust control, or returned to oil-waste burning pits. Brine production by individual fields is found in the tables, Part 2. Other brine data is listed on Table 4, page 30, and Table 24, page 63.

MAJOR BRINE PRODUCING FIELDS				
Field	Rank	1967	1966	1965
Coldwater	1	30,415	27,270	29,557
Albion-Scipio Trend	2	8,225	18,845	10,273
Porter	3	8,176	8,239	8,685
Deep River	4	7,635	7,875	7,870
Freeman-Redding	5	5,325	6,640	5,560
McBain	6	6,300	6,180	6,467
Stony Lake	7	2,603	4,154	4,397
Adams, North	8	3,976	3,583	3,262
Vernon	9	2,500	3,400	3,240
Reed City	10	6,039	2,919	3,416
Prosper	11	2,688	2,700	2,750
Gilmore	12	1,875	2,350	2,000
Reynolds	13	1,569	2,297	3,656
Pentwater	14	2,294	2,194	1,926
Clayton	15	1,950	2,098	2,079
Fork	16	2,180	2,025	2,650
Total		93,750	102,759	101,605
State Total (all fields)			144,382	145,102

[Drilling Permits and Well Completions by County]

TABLE 2. DRILLING PERMITS AND WELL COMPLETIONS BY COUNTY, 1967 (Sheet 1 of 2)										
County	Oil and Gas Permits Issued	Does not include reworked wells or old wells drilled deeper						Service Wells		
		Oil and Gas Tests		Oil Wells	Gas Wells	Dry Holes	RWD	GS	Inf.	LPG
		Exploratory	Development							
Alcona	1	1				1				1
Allegan	8	8	4	3		9				12
Antrim	1									
Arenac	2	2								2
Bay	3	2				2				2
Branch	2	3				3				3
Calhoun	51	4	44	13	1	34				48
Clare	2		1			1		1		2
Crawford		1				1				1
Genesee	1		1	1						1
Gladwin	1	1				1				1
Gratiot	2	2				2				2
Hillsdale	20	9	11	5		15				20
Ionia	2	2				2				2
Isabella	4	1	1	1*		1				2
Jackson	12	3	8	2		9				11
Kent	6	6				6				6
Lake	9	6	3	1*		8				9
Lapeer	3	4	4	2		2				4
Lenawee	7	3	10		7	1				13
Livingston	22	2		1*				20		22
Macomb	27	17	7	1		23				24
Mason	13	7	8	1		14				15
Macosta	19	6	14	11		9				20
Midland (A)	5	2	1			3				3
Missaukee	12	1	5	4*		2				6
Monroe	1	1				1				1

TABLE 2. DRILLING PERMITS AND WELL COMPLETIONS BY COUNTY, 1967 (Sheet 2 of 2)										
Montcalm	10	7	5	2		10				12
Muskegon	14	4	12	4		12				16
Newaygo	7	9	1	1		9				10
Oakland	2	2	1	1		2				3
Oceana	10	9	1	1		10				10
Ogemaw	7	1	6	4		3				7
Osceola	14	5	7	3**		9		3		15
Otsego	9		11		10	4				11
Otsewa	4	4				4				4
Roscommon		1				1				1
Saginaw	1	1				1				1
Shiawassee	5	2	2	3*		1				4
St. Clair	82	43	43	4**	20***	62				86
Tuscola	1		2	1		1				2
Van Buren	1	1				1				1
Washtenaw	2	1				1				1
Wayne							2			2
Totals	44 Counties	405	180	213	69	38	287	2	24	420

Does not include reworks resulting in gas wells.

Does not include reworks resulting in oil wells.

Includes 8 new permit numbers issued for previously drilled wells.

Includes 4 permits which were issued and terminated in 1967.

(A) One new oil well completed in Midland County--D & A old hole, cleaned out to TD and recompleted

* New field discovery

** Includes 1 new oil field discovery

*** Includes 2 new gas field discoveries

[Drilling Permits and New Well Completions by District and Month]

TABLE 3. NEW WELL COMPLETIONS BY DISTRICTS, 1967													
CLASSIFICATION OF NEW WELL COMPLETIONS	DISTRICTS					Totals							
	Basin	Northern	Western	Southwestern	Southeastern								
Oil Wells (1)	30	0	7	15	17	69							
Gas Wells (2)	0	10	0	2	26	38							
Gas Storage Wells	4	0	0	0	20	24							
Geological Information Test	0	0	0	0	0	0							
LPG Storage	0	0	0	0	0	0							
Brine Disposal Well	0	0	0	0	2	2							
Dry Holes	52	3	53	57	122	287							
Total Well Completions	86	13	60	74	187	420							
EXPLORATORY WELLS COMPLETED													
Exploratory Tests D & A	30	2	34	26	79	171							
Successful Exploratory Tests*	4	0	1	0	4	9							
Total Exploratory Tests	34	2	35	26	83	180							
DRILLING PERMITS AND NEW WELL COMPLETIONS BY MONTHS, 1967													
CLASSIFICATION OF NEW WELL COMPLETIONS	MONTHS												Totals
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
PERMITS ISSUED	29	35	33	24	30	40	39	40	36	30	26	405	
Oil Wells (1)	10	5	2	4	7	5	4	5	10	3	4	8	69
Gas Wells (2)	5	3	1	1	7	1	5	4	5	4	2	0	38
Gas Storage Wells	0	0	5	6	6	3	2	2	0	0	0	0	24
Geological Information Test	0	0	0	0	0	0	0	0	0	0	0	0	0
LPG Storage	0	0	0	0	0	0	0	0	0	0	0	0	0
Brine Disposal Well	0	0	0	0	0	0	0	0	0	0	0	0	0
Dry Holes	21	22	20	9	27	30	29	36	28	29	24	12	287
Total Well Completions	36	30	28	20	47	39	42	47	43	36	30	22	420
EXPLORATORY WELLS COMPLETED													
Exploratory Tests D & A	12	11	10	3	19	15	18	27	16	18	14	8	171
Successful Exploratory Tests*	0	1	0	0	2	1	2	1	1	1	1	1	9
Total Exploratory Tests	12	12	10	3	19	16	20	28	17	19	15	9	180

(1) Does not include oil wells resulting from rework operations.

(2) Does not include gas wells resulting from rework operations.

* Does not include new pool discoveries.

*** DESCRIPTIVE WELL LOG AND SAMPLE LIBRARY ***

Nearly 500 new well records and well rework records were received by the Regulatory Unit, Oil and Gas Section, during 1967. All were processed, microfilmed, and cataloged by the Petroleum Geology Unit which also processed and published 435 new logs. About 27,000 logs and other well records are available for purchase or use and inspection at Survey offices. More than 8,200 logs were printed and distributed upon request to individuals, oil and gas companies, and other agencies. In addition to individual orders, 40 subscription log orders were mailed each month to individuals, companies, government agencies, and universities.

The Survey acquired and cataloged 83 new sample sets from recently drilled wells. Geological test (core test) sample sets acquired several years ago were also cataloged and added to the sample library. The geological tests include 31 sets for northern Ohio, 305 for northern Indiana, and 844 sets for Michigan. An additional 180 sample sets, mostly from the Albion-Scipio Trend field, were added to the library. The latter sets, consisting primarily of the Trenton-Black River formations, are available for petrographic or insoluble residue studies. Consulting or company geologists borrowed and examined 251 sets of samples during 1967. No charge is made for use or examination of well cuttings.

DEEP TESTS

County	Location	Operator and Lease	Permit Number	System and Formation	Total Depth	Expl. Class	Remarks
Alcona	30-28N-5E	North American Drig. Co. #1 Cranberry Ranch	27060	Dev., D. R.	2318	NPW	
Branch	13-5S-6W	Perry Fork #1 King L. & R.	26954	Ord., P. D. C.	4010	NPW	SO & G
Branch	13-5S-6W	Perry Fork #1 Ratkowski, Tony	26926	Ord., P. D. C.	4020	NPW	
Branch	5-6S-5W	Houseknecht Oil Prod., Inc. #1 Liskey	26719	Camb., Tremp.	4100	NPW	
Hillsdale	32-6S-4W	B. S. & C. Oil Co. #1 Crall, James	27045	Camb., Tremp.	3463	NPS	
Hillsdale	10-5S-2W	McClure Oil Co. #1 Gahard, Gordon	26891	Ord., P. D. C.	4462	NPW	SO & G
Hillsdale	8-6S-4W	Houseknecht Oil Prod., Inc. #1 Marshall G.	26578	Ord., P. D. C.	3892	NPW	SO
Hillsdale	9-6S-4W	Houseknecht Oil Prod., Inc. #1 Marshall R. & T.	27051	Ord., P. D. C.	3691	NPW	
Hillsdale	3-9S-1W	Liberty Petroleum Corp. #1 Horvath J.	27024	Camb., E. C.	3977	NPW	
Hillsdale	27-6S-2W	U. S.-Can Corporation #1 Graham M.	26949	Ord., P. D. C.	4152	NPW	
Ionia	4-9N-8W	An-Son Corporation #1 Dieterman G. & C.	27021	Ord., P. D. C.	6090	NPW	
Ionia	15-7N-8W	An-Son Corporation #1 Essington L. & S.	26990	Ord., P. D. C.	6113	NPW	
Jackson	16-2S-2W	G. S. Swan & Mich. Cons. Gas Co. #1 Fisher W. L.	27084	Ord., P. D. C.	4986	NPW	
Kent	29-9N-10W	An-Son Corporation #1 Parmeter E. & L.	26908	Ord., P. D. C.	6652	NPW	
Kent	2-7N-9W	An-Son Corporation #1 Vingeier A.	26944	Ord., P. D. C.	6393	NPW	
Lake	17-19N-11W	Texaco, Inc. #1 Ellsworth Twp.	26835	Dev., Sylv.	4836	NPW	
Livingston	25-3N-3E	Texaco, Inc. #1 Hills, John E.	27034	Sil., Clinton	4558	NPW	
Newaygo	20-15N-14W	Thunder Hollow Oil & Gas Co. #1 Thompson W. & R.	26662	Ord., P. D. C.	6585	NPW	

DEEPER POOL TESTS 1967

Allegan	15-3N-13W	Harris Oil Co. #1 Brenner-Comans et al	26790	Sil., Niag.	3200	DPT	Monterey
Allegan	9-3N-13W	Harris Oil Co. #1 Svander & Conklin Com.	26864	Sil., Niag.	3132	DPT	Monterey
Gratiot	5-10N-4W	Mich. Cons. Gas Co. #1 Shuttleworth	26779	Dev., Dd.	3287	DPT	Shaver
Necosta	22-13N-10W	Cook Bros. & Mich. Cons. Gas Co. #1 McHugh	27000	Dev., R. C.	3500	DPT	Winfield
Necosta	27-13N-10W	Cook Bros. & Mich. Cons. Gas Co. #1 Sellers G.	26867	Dev., R. C.	3399	DPT	Huber
Newaygo	5-14N-14W	Gordon G. H. #1 Haight E. R.	26893	Dev., D. R.	3400	DPT	Walker
Ottawa	34-7N-13W	Swanson & Babcock #4-A Penske R.	25800	Ord., P. D. C.	5126	DPT	

*** PUBLIC HEARINGS ***

Act No. 61 of the Public Acts of 1939, as amended, provides for hearings on oil and gas matters. Act No. 326 of the Public Acts of 1937, as amended, provides for hearings on matters pertaining to natural dry gas. Hearings on matters of local concern involving the administration of rules and regulations, such as exceptions to spacing orders, or pooling of interests to form drilling units, are conducted by the Supervisor of Wells, the State Geologist. Hearings on matters involving broad policies and practices having field-wide or state-wide application are conducted by the Supervisor of Wells and before the Advisory Board. Oil

and gas hearings held during 1967 are summarized below.

*** NEW PUBLICATIONS ***

Champion, Beverly L., 1967, Oil-Gas Activity Continues Downtrend: Mich. Manufacturer and Financial Rec., V. 119, No. 5, pp. 52, 82.

Ells, Garland D., Compiler, 1967, Michigan's Oil and Gas Fields 1966: Mich. Geol. Survey Ann. Statistical Summ. 6, 64 p.

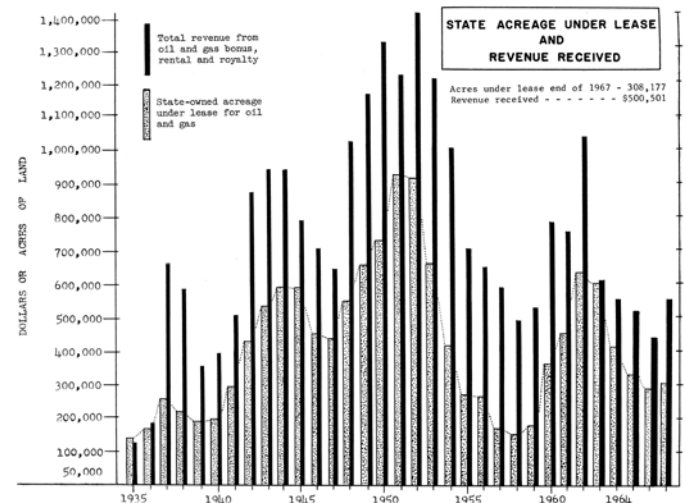
Ells, Garland D., Michigan's Silurian Oil and Gas Pools, 1967: Mich. Geol. Survey Report of Investigations No. 2, 49 p.

Ells, Garland D., and Ives, Robert E., 1967, Developments in Michigan in 1966: Am. Assoc. Petroleum Geologists Bull., V. 51, No. 6, pp. 1039-1044.

Kirkby, Edward E., 1967, Index to Michigan Geological Thesis: Mich. Geol. Survey Circular No. 7, 32 p.

OIL AND GAS HEARINGS													Totals
Hearing Per Month	January	February	March	April	May	June	July	August	September	October	November	December	
Items or Causes Heard	3	3	3	1	0	1	3	4	3	2	3	0	32
Spacing Orders:													
Adopted	2	1	1	1	1	1	1	1	1	1	1	1	7
Amended	1	1	1	1	1	1	1	1	1	1	1	1	10
Abrogated	1	1	1	1	1	1	1	1	1	1	1	1	3
Proration Orders:													
Adopted	1	1	1	1	1	1	1	1	1	1	1	1	1
Amended	1	1	1	1	1	1	1	1	1	1	1	1	2
Abrogated	1	1	1	1	1	1	1	1	1	1	1	1	1
Off-Pattern Permits Issued	4	6	3	1	1	1	3	3	4	3	3	3	28
Pooling to Form Drilling Unit	1	1	1	1	1	1	1	1	1	1	1	1	3
Determine Reservoir Status	1	1	1	1	1	1	1	1	1	1	1	1	5
Unitization of Pool	1	1	1	1	1	1	1	1	1	1	1	1	1
Authorize Air Injection	1	1	1	1	1	1	1	1	1	1	1	1	1
Items heard, no action taken	1	1	1	1	1	1	1	1	1	1	1	1	3
Total Items or Causes	8	6	7	1	1	4	15	7	7	9	9	9	65

[State Acreage Under Lease]



* * MICHIGAN OIL REFINERIES * *

COMPANY	REFINERY LOCATION	NOMINAL CAPACITY* BBLs. DAY
Bay Refining, Division Dow Chemical Company	Bay City	15,000
Crystal Refining Company	Carron City	6,200
Delta Terminal Company (Abandoned 1967)	Rapid River	4,000
Lakeside Refining Company	Kalamazoo	3,500
Leonard Refineries, Inc.		
Leonard Division	Alma	29,000
Roosevelt Division	Mt. Pleasant	7,500
Marathon Oil Company	Detroit	50,000
Naph-Sol Refining Company	Muskegon	10,000
Osceola Refining Company	West Branch	5,000
Petroleum Specialties, Inc.	Flat Rock (Inactive)	6,500
Soco Mobil Oil Company	Trenton	40,700
Total Refinery Capacity		173,400

*Individual refinery operating rates may be less or slightly more than nominal rates shown.

PART 2, OIL AND GAS FIELDS

EXPLANATION

Part 2 brings together general information on Michigan's oil and gas fields, gas storage reservoirs and related items. The tables summarize information relating to oil and gas accumulations which have been designated and named as oil or gas fields.

OIL AND GAS FIELDS. Most fields consist of one pool with oil or gas production coming from a single formation. A few fields have 2 or more separate pools each producing from a different formation or stratigraphic interval and at a different depth. Pools for individual fields are shown under PRODUCING FORMATION OR POOL. The PAY ZONE part of the table generally refers to the discovery well for the specific pool. The PAY THICKNESS shown on the tables does not necessarily indicate net producing pay for the reservoir. The DEEPEST FORMATION TESTED column indicates the deepest total depth and formation penetrated in the field.

LOCATION OF OIL FIELDS, GAS FIELDS, ETC. These tables show the specific locations of the fields and the sections which have or have had producing wells. Miscellaneous wells which produced some oil but were eventually abandoned as dry holes are also included. Miscellaneous wells reporting some gas production are also included.

OIL AND GAS FIELD MAPS. It is not practical to outline and show the names of all the hydrocarbon accumulations that have been designated as a field or pool. In general, the field names shown on the several maps are in agreement with the field names shown on the oil and gas field tables. Certain miscellaneous or single well fields are not shown on the maps but are listed in the tables.

ABANDONED OIL AND GAS FIELDS OR POOLS. Oil and gas fields or pools are considered abandoned when all wells have been plugged to the surface and the equipment has been removed from the area. Fields abandoned during a given year are entered into the abandoned field tables in the following year. Abandoned

oil fields with less than 500 barrels of cumulative oil production are not shown in the tables. Production from fields having less than 500 barrels cumulative production is accounted for in the table summaries. Fields or pools may be re-activated from time to time when new producing wells are drilled.

GAS FIELDS. Many gas fields are listed as "shut in" due to lack of marketing facilities, slow field development, or lack of substantial reserves. Production from fields listed as "Domestic" or "Lease Fuel" is not metered or considered commercial.

GAS STORAGE RESERVOIRS. Most gas storage reservoirs were originally classified as gas fields or pools and upon depletion or near depletion 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.

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.

CASINGHEAD GAS PLANT DATA. These tables indicate the distribution of gross input gas to plants and the resulting net hydrocarbons available for market.

FLUID INJECTION INTO PRODUCING FORMATIONS. A number of fields have secondary recovery projects in operation. In most fields listed in these tables, the injection of oil field brines back into the producing formation is a combination brine disposal and pressure maintenance project.

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 the "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.

WELL COMPLETIONS, PRODUCTION BY COUNTY. These tables show the classifications of completed wells on a county basis, and the cumulative amount of oil and gas produced in individual counties. Tables also indicate the number of dry holes, oil wells, gas wells,

etc., that have been drilled under oil and gas drilling permits in an individual county.

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. 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 prior to 1937 are incomplete. This table shows the reported amount of produced brine and the method of disposal from 1937 to present. Most oil field brine is now 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 in burning pits. Brine production and disposal figures should not be considered entirely accurate.

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

STRATIGRAPHIC SUCCESSION IN MICHIGAN

PALEOZOIC THROUGH RECENT



MICHIGAN DEPARTMENT OF CONSERVATION

Ralph A. MacMullan, Director

GEOLOGICAL SURVEY

Gerald E. Eddy, State Geologist

ACKNOWLEDGEMENT. Compiled with the counsel of colleagues in this department, the U. S. Geological Survey, Michigan's universities, other state Geological Surveys, and geologists within Michigan's oil and gas industry. Dr. Aureal T. Cross, Department of Geology, Michigan State University, identified rocks of Mesozoic age and suggested provisional age assignments.

GEOLOGIC NAMES COMMITTEE

Garland D. Ellis, Chairman, Robert W. Kelley, Secretary;
Harry J. Hardenberg, L. David Johnson, Harry O. Sorensen

INFORMAL TERMS

Principal oil and gas pays, and informal terms used in petroleum exploration and applied to parts of formations or groups in the subsurface.

STRATIGRAPHIC POSITION	INFORMAL TERMS	PAYS
Basal sandstones of Saginaw Fm.	Parna sandstone	
In lower part of Michigan	triple ss. brown lime gray clay ss. gray dol. very sl. } Gas Gas & Oil Gas & Oil	
Marshall Ss.	Calabrate lime	Gas & Oil
Coldwater Sh.	West sand	Gas
	Coldwater red-rock	
In upper part of Elsworth Sh.	"Berea" (Western Michigan)	Oil & Gas
Berea Ss.	Berea sand (Eastern Michigan)	Oil & Gas
Squaw Bay Ls.	Squaw Bay	Oil & Gas
Upper part of Traverse Group in Western Michigan	Traverse formation	
Rogers City Ls.	Traverse zone	Oil & Gas
Dundee Ls.	Stoney Lake zone	Oil & Gas
Dundee Ls. (?) Upper part of Lucas Fm. (?)		
	Kred Clay zone	Oil & Gas
In Lucas Fm.	massive salt brg salt massive anhydrite brg anhydrite Richland zone } Oil & Gas Oil & Gas Oil & Gas	
Amherstburg Fm.	black lime	
Part of Salina	I zone	
Group E Unit	(or Keweenaw zone)	Oil
Divisions of A-2 Carbonate in Western Michigan	A-2 dolomite A-2 lime } Gas Gas	

PLEISTOCENE NOMENCLATURE			
ERA	SYSTEM	SERIES	STAGE
CENOZOIC	QUATERNARY	RECENT	
		PLEISTOCENE	Wisconsin Glaciation
			Mankato Stage (Pl. Huron)
			Cary Stage
			Tazewell Stage
			Sangamon Interglaciation
			Illinoian Glaciation

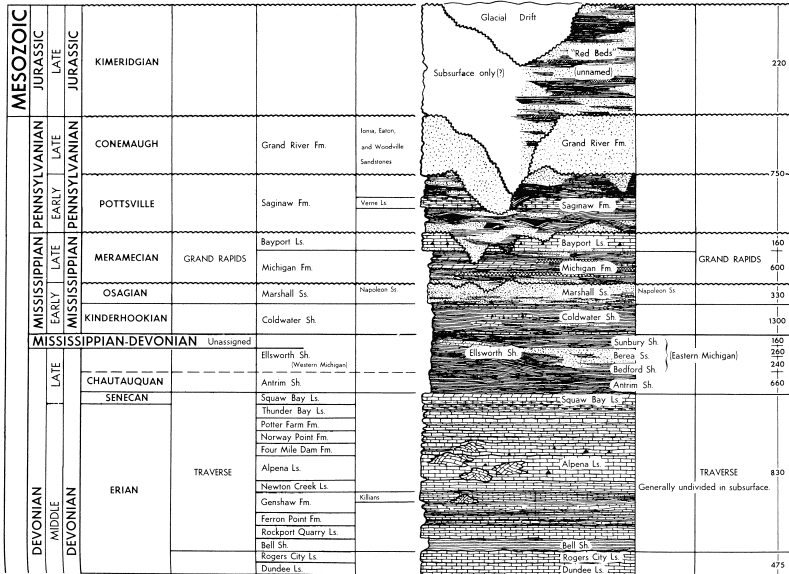
OUTCROP NOMENCLATURE

GEOLOGIC TIME		TIME-STRATIGRAPHIC		ROCK-STRATIGRAPHIC			
ERA	PERIOD	EPOCH	SYSTEM	SERIES	GROUP	FORMATION	MEMBER

SUBSURFACE NOMENCLATURE

ROCK-STRATIGRAPHIC		
FORMATION	MEMBER	GROUP
Approximate maximum thickness, in feet, of rock units in the subsurface. NO SCALE		

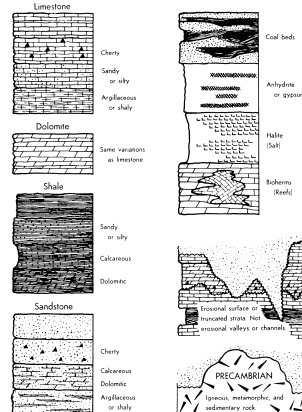
DOMINANT LITHOLOGY



PALEOZOIC				PRECAMBRIAN			
CAMBRIAN	ORDOVICIAN		SILURIAN	DEVELOPMENTAL	SILURIAN	DEVELOPMENTAL	
	EARLY	LATE					EARLY
ULSTERIAN	DETROIT RIVER	MACKINAC BECCIA	Anderdon Fm.	Lucas Fm.	DETROIT RIVER	140	
			Amherstburg Fm.	Amherstburg Fm.	85		
			Sylvania Sh.	Sylvania	80		
			Bois Blanc Fm.	Bois Blanc Fm.	10		
			Garden Island Fm.	Garden Island Fm.	10		
	BASS ISLANDS		Raisin River Dol.		BASS ISLANDS	70	
			Put-in-Bay Dol.				
			St Ignace Dol. (Northern Peninsula)				
			SALINA	Pte. aux Chenes Sh.		SALINA	315
NIAGARAN	Gardiner Dol.		G Unit				
			F Evaporites				
			E Unit				
			D Evaporite				
			C Unit				
	MANISTIQUE		B Evaporite				
			A-2 Carbonate				
			A-2 Evaporite				
			A-1 Carbonate				
			A-1 Evaporite				
BURNT BLUFF		Cordell Dol.		NIAGARA	98		
		Schoorcraft Dol.					
		Hendricks Dol.	Fulton ls.	Generally undivided in subsurface			
		Byron Dol.					
		Lime Island Dol.					
ALEXANDRIAN	CATARACT	Cabot Head Sh.	Cabot Head Sh.	CATARACT	200		
		Mantoulin Dol.	Mantoulin Dol.				
CINCINNATIAN	RICHMOND	Big Hill Fm.					
		Stamington Fm.	Osgood				
		Bay de Noc					
MOHAWKIAN	TRENTON	Bill's Creek Sh.	Cullinwood	RICHMOND	95		
	BLACK RIVER	Gross Quarry Fm.					
		Chandler Falls Fm.					
CHAZYAN	PRAIRIE DU CHIEN	Boya Falls Fm.		TRENTON	100		
ST. CROIXAN	LAKE SUPERIOR	Oreota Dol.		PRAIRIE DU CHIEN	42		
		Trempealeau Fm.	Jordan Sh.				
			St. Lawrence				
		Munsing Fm.	Munsing Fm.				
		Chapel Rock Sh.	Chapel Rock Sh.				
JACOBVILLE		Jacobsville Sh.	Jacobsville Sh.	LAKE SUPERIOR	100		

A-1 Carbonate _____	A-1 dolomite _____	Oil & Gas _____
Upper part of Niagaran Series _____	{ brown Niagaran } { gray Niagaran } { white Niagaran }	Oil & Gas _____
Part of Niagaran Series _____	Clinton shale (Eastern Michigan)	
Trenton Group _____		Oil & Gas _____
Black River Group _____	{ Black River formation } { Black River shale } { Van Wert zone }	Oil & Gas _____
Oneota Dol. _____		Oil _____

EXPLANATION



GEOLOGIC NAMES COMPILATIONS: Harry O. Sorensen, Cambrian and Ordovician; Robert V. Kelley, Early and Middle Silurian; Garland D. Ellis, Late Silurian through Detroit River Group of Devonian age; Harry J. Hardenberg, Dundee Limestone through Traverse Group of Devonian age; L. David Johnson, Antrim Shale through the Pennsylvanian System; F. Wells Terwilliger, glacial geology of the Cenozoic.

CHART 1
1964

Michigan Department of Conservation
Geological Survey Division

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