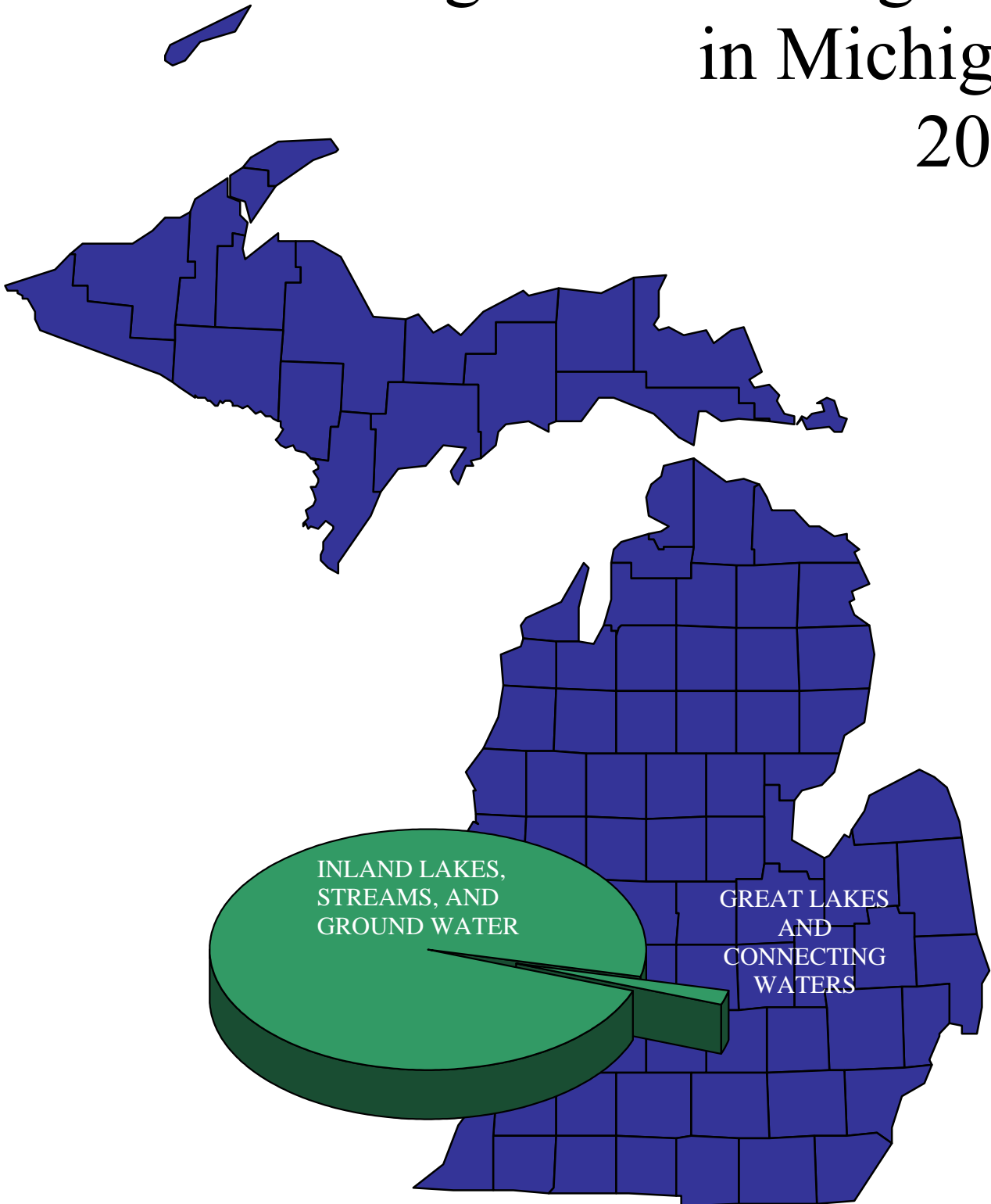


# Water Withdrawals for Agricultural Irrigation in Michigan 2006



# Water Withdrawals for Agricultural Irrigation in Michigan: 2006

## Introduction

This report has been prepared by the Michigan Department of Environmental Quality to summarize agricultural irrigation information estimated in Michigan's Water Use Reporting Program. The overall goal of the program is to establish an environmental baseline and continuing assessment of major water uses in the state, including power generation, industrial, irrigation, and public water supply. This fulfills key requirements of the Great Lakes Charter, a regional agreement signed by the Great Lakes states and Canadian provinces in 1985, and Michigan's water use reporting law (Part 327, Great Lakes Preservation, Natural Resources and Environmental Protection Act, 1994 PA 451, as amended).

Detailed water use information from the states and provinces is maintained by the Great Lakes Commission to facilitate regional policy-making and strengthen the legal defense against unwarranted diversions of Great Lakes water. It also provides essential water use information for state and regional water resources planning to support power generation, industrial, irrigation, and public water supply activities in a manner consistent with sound environmental management.

## Background

The artificial application of irrigation water to grow crops has become a widely practiced agricultural management technique in the Great Lakes Region. Although precipitation is generally sufficient within the Region, the ability to irrigate gives growers greater control over the timing and amount of water applied throughout the growing season. This enables them to increase the soil moisture available for plant growth, provide frost control protection for fruit and specialty crops, and protect against crop loss during periods of climatic stress. Limitations to utilizing irrigation as a management tool include the significant capital and energy costs, labor and maintenance requirements, and the availability of adequate water supplies.

The amount of irrigation water used to irrigate crops depends on a variety of environmental, economic, and legal factors. Perhaps most important is the availability of adequate surface water and ground water sources that can be used without creating water use conflicts among surrounding water users. Since consumptive water loss rates are not only high for agricultural irrigation, but are also concentrated during the summer months of naturally lowered stream flows and lake levels, water supply issues are of primary management concern. The viability of irrigation depends in large part upon a reasonable balancing of shared water rights under common law.

In Michigan, a special provision was enacted in the state water use reporting law in 1996 to develop a methodology for estimating agricultural irrigation water use. The Michigan Department of Environmental Quality, the Michigan Department of Agriculture, and Michigan State University jointly developed an experimental model to estimate agricultural irrigation water use for the period 1997 to 1999. A research team headed by Dr. Joe Ritchie and principal investigators Dr. Jeff Andresen and Dr. Thomas Moen was formed, and the team completed

preliminary work on the estimation model in 1997. Subsequent testing and refinement occurred in 1998, including weather and soils data analyses and a limited field test in St. Joseph County. Since crop and acreage information from individual irrigated farms was necessary to run model simulations, the Michigan Department of Environmental Quality and Michigan Department of Agriculture submitted joint requests to the National Agricultural Statistics Service for access to selected irrigation data from the Census of Agriculture for 1997 and 2002. These requests were approved, subject to extensive security and confidentiality safeguards to ensure that individual reported farm data remained protected from disclosure. Model runs have been completed for the years 1997-2005, and subsequent analyses will be undertaken to estimate agricultural irrigation crop water demand annually. The results for 2006 are summarized in this report.

## Michigan Summary

Agricultural irrigation water use in Michigan is determined by weather conditions, the availability of adequate water supplies, and basic management decisions made by irrigators. For the present study, crop and acreage data for 1,568 Michigan irrigators in the 2002 Census of Agriculture were combined with 2006 weather data and soils information to run a water use estimation model developed for Michigan's Water Use Reporting Program. All farms in the state irrigating 14 or more acres were included in the model analyses (including weighted responses for non-reporting farms). While these farms represented only 36 percent of the 4,413 farms identified as having irrigated crop acreage, they accounted for 99 percent of the irrigated agricultural crop acreage reported in the census.

Crop water demand estimates were made for farms irrigating 452,800 acres in Michigan during 2006. Irrigation water withdrawals for these farms were estimated at 223 million gallons per day (MGD).<sup>\*</sup> This represents 3.0 million acre-inches of water withdrawn for the year. About 65 percent of the agricultural irrigation water withdrawn was from groundwater sources. The remaining 35 percent was withdrawn from surface water sources, primarily from inland lakes and streams. Only 2.5 percent of agricultural irrigation water withdrawals were from the Great Lakes.

Table 1 summarizes water withdrawals for agricultural irrigators in Michigan on a county basis. There were 8 counties that reported no farms irrigating 14 or more acres, and data could not be disclosed for another 28 counties with a small number of irrigated farms. Data for these nondisclosure counties were combined and reported in Table 1 under the categories of "Other LP (Lower Peninsula) Counties" and "Other UP (Upper Peninsula) Counties". The combined irrigated acreage in these counties represents less than six percent of the state total.

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<sup>\*</sup> To be consistent with reporting in other water use categories, agricultural irrigation water withdrawal estimates are calculated by dividing totals by 365 days instead of the actual length of the irrigation season (approximately 120 days). Daily withdrawal rates are significantly larger during this irrigation season.

Saint Joseph County had the largest agricultural irrigation water use in 2006, accounting for 17 percent (38.13 MGD) of the irrigation withdrawals in the state. The next largest water withdrawal counties were Montcalm, Branch, Kalamazoo, and Van Buren. These four counties accounted for an additional 32 percent of the total agricultural irrigation withdrawals and approximately 31 percent of the irrigated acreage statewide. The primary source of water for irrigation in the five largest counties was ground water (73 percent), with the remainder withdrawn from inland surface water sources. No Great Lakes withdrawals were reported.

Table 2 summarizes agricultural irrigation water use by U.S. Geological Survey hydrologic basins in Michigan. There were 7 basins that reported no farms irrigating 14 or more acres, and data could not be disclosed for another 16 basins with a small number of irrigated farms. Data for these nondisclosure watersheds were aggregated in Table 2 under the category of “Other Basins”. The combined irrigated acreage in these basins was one-half percent of the state total.

The largest agricultural irrigation water withdrawals were from the Saint Joseph Watershed (Basin 04050001), which accounted for 42 percent of the total agricultural irrigation withdrawals statewide in 2006. The next largest water withdrawal basins were the Lower Grand (Basin 04050006), the Muskegon (Basin 04060102), the Kalamazoo (Basin 04050003), and the Black-Macatawa (Basin 04050002). Together, these four basins accounted for an additional 34 percent of the total agricultural irrigation withdrawals and 28 percent of the irrigated acreage statewide. Irrigated farms in the five largest watersheds relied primarily on ground water (68 percent), with nearly all of the remaining withdrawals from inland surface water sources. Only one percent of total water withdrawals came from the Great Lakes.

The crops reported under agricultural irrigation in Michigan during 2006 are summarized in Table 3. These crops were classified into 20 categories generally consistent with the survey instrument used for the Federal Agricultural Census. Some modifications were made to simplify the reporting process. Winter and spring wheat, for example, were combined, as were two categories of sorghum. Alfalfa, hay, and silage were similarly reported as one category.

The largest irrigated agricultural crop in Michigan during 2006 was corn grown for grain or seed. This single crop accounted for nearly 40 percent of the total irrigated acreage in the state and 32 percent of the total irrigation water withdrawn. The next four largest irrigated crop categories by acreage were soybeans, vegetables, potatoes, and nursery and greenhouse crops (including sod). Together, these five categories accounted for 84 percent of the total agricultural irrigated acreage in Michigan and 83 percent of the irrigation water withdrawn.

Longer-term trend analysis will be undertaken as agricultural irrigation water use data are compiled or estimated under Michigan’s Water Use Reporting Program. Present trends suggest that the steady expansion of agricultural irrigation in the state over the past 10 years will continue. To determine the overall demand for irrigation water, agricultural and golf course irrigation data will be combined and reported. This information will provide a continuing baseline to ensure the continued protection and wise management of the waters of the Great Lakes Basin.

**Table 1: 2006 Estimated Water Withdrawals for Agricultural Irrigation in Michigan, by County\***

County	2002 Irrigated Farms $\geq$ 14 Acres		2006 Estimated Water Withdrawn (MGD)			
	Number of Farms	Irrigated Acres	Great Lakes	Surface Water	Ground Water	Total
Alcona	(D)	(D)	(D)	(D)	(D)	(D)
Alger	(D)	(D)	(D)	(D)	(D)	(D)
Allegan	78	15,060	0.00	7.74	1.37	9.11
Alpena	(D)	(D)	(D)	(D)	(D)	(D)
Antrim	(D)	(D)	(D)	(D)	(D)	(D)
Arenac	(D)	(D)	(D)	(D)	(D)	(D)
Baraga	(D)	(D)	(D)	(D)	(D)	(D)
Barry	16	2,753	0.00	0.92	0.66	1.58
Bay	27	3,512	0.40	1.78	0.16	2.34
Benzie	9	408	0.00	0.02	0.16	0.18
Berrien	88	18,749	0.00	3.70	4.52	8.22
Branch	88	40,080	0.00	7.36	9.37	16.74
Calhoun	37	10,320	0.00	1.84	3.58	5.42
Cass	64	25,597	0.00	1.89	7.54	9.43
Charlevoix	(D)	(D)	(D)	(D)	(D)	(D)
Cheboygan	(D)	(D)	(D)	(D)	(D)	(D)
Chippewa	4	332	0.08	0.08	0.01	0.17
Clare	(D)	(D)	(D)	(D)	(D)	(D)
Clinton	17	3,166	0.00	1.03	1.21	2.24
Crawford	0	0	0.00	0.00	0.00	0.00
Delta	4	355	0.00	0.16	0.04	0.20
Dickinson	(D)	(D)	(D)	(D)	(D)	(D)
Eaton	11	1,681	0.00	0.72	0.48	1.21
Emmet	(D)	(D)	(D)	(D)	(D)	(D)
Genesee	11	1,251	0.00	0.26	0.46	0.72
Gladwin	(D)	(D)	(D)	(D)	(D)	(D)
Gogebic	0	0	0.00	0.00	0.00	0.00
Grand Traverse	36	1,682	0.05	0.14	0.76	0.95
Gratiot	28	4,987	0.00	1.03	1.54	2.57
Hillsdale	23	4,152	0.00	1.09	1.04	2.13
Houghton	(D)	(D)	(D)	(D)	(D)	(D)
Huron	12	1,634	0.42	0.17	0.37	0.96
Ingham	10	1,451	0.00	0.58	0.58	1.17
Ionia	18	3,186	0.00	0.53	1.59	2.12
Iosco	(D)	(D)	(D)	(D)	(D)	(D)
Iron	(D)	(D)	(D)	(D)	(D)	(D)

2002 Irrigated Farms  $\geq$  14 Acres

## 2006 Estimated Water Withdrawn (MGD)

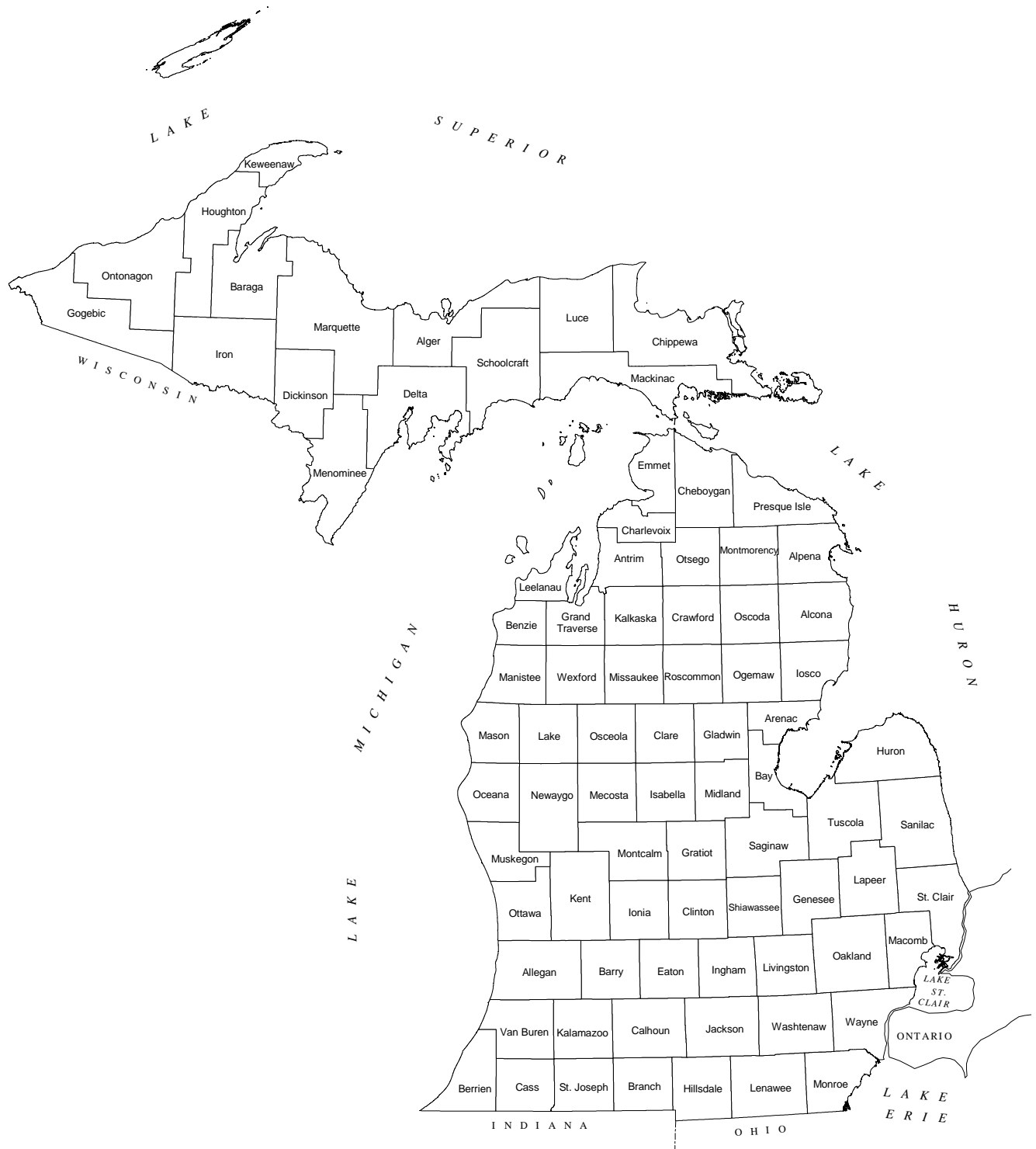
County	Number of Farms	Irrigated Acres	Great Lakes	Surface Water	Ground Water	Total
Isabella	10	3,675	0.00	0.57	1.70	2.27
Jackson	16	4,416	0.00	1.25	1.15	2.40
Kalamazoo	72	29,446	0.00	2.76	10.39	13.15
Kalkaska	(D)	(D)	(D)	(D)	(D)	(D)
Kent	40	8,192	0.00	1.44	3.35	4.79
Keweenaw	0	0	0.00	0.00	0.00	0.00
Lake	0	0	0.00	0.00	0.00	0.00
Lapeer	19	1,787	0.00	0.95	0.17	1.11
Leelanau	21	1,470	0.00	0.04	0.72	0.75
Lenawee	20	4,150	0.00	1.36	0.22	1.58
Livingston	10	1,217	0.00	0.00	0.90	0.90
Luce	(D)	(D)	(D)	(D)	(D)	(D)
Mackinac	(D)	(D)	(D)	(D)	(D)	(D)
Macomb	18	2,769	0.09	1.28	0.46	1.84
Manistee	13	1,635	0.00	0.27	0.63	0.90
Marquette	(D)	(D)	(D)	(D)	(D)	(D)
Mason	19	2,240	0.00	0.24	0.68	0.92
Mecosta	(D)	(D)	(D)	(D)	(D)	(D)
Menominee	(D)	(D)	(D)	(D)	(D)	(D)
Midland	8	1,009	0.00	0.14	0.32	0.46
Missaukee	17	3,113	0.00	0.19	1.05	1.24
Monroe	21	6,225	0.00	2.51	0.88	3.40
Montcalm	76	48,335	0.00	4.90	25.73	30.63
Montmorency	(D)	(D)	(D)	(D)	(D)	(D)
Muskegon	(D)	(D)	(D)	(D)	(D)	(D)
Newaygo	25	6,480	0.00	1.80	1.47	3.28
Oakland	7	457	0.00	0.17	0.17	0.35
Oceana	22	4,132	0.00	0.84	0.84	1.67
Ogemaw	0	0	0.00	0.00	0.00	0.00
Ontonagon	(D)	(D)	(D)	(D)	(D)	(D)
Osceola	8	2,035	0.00	0.32	0.70	1.02
Oscoda	0	0	0.00	0.00	0.00	0.00
Otsego	(D)	(D)	(D)	(D)	(D)	(D)
Ottawa	92	12,539	0.00	2.26	6.43	8.69
Presque Isle	8	1,517	0.00	0.42	0.63	1.05
Roscommon	0	0	0.00	0.00	0.00	0.00
Saginaw	11	3,081	0.00	0.64	1.19	1.84
Saint Clair	11	645	0.00	0.13	0.30	0.43
Saint Joseph	157	104,070	0.00	12.96	25.16	38.13
Sanilac	11	1,042	0.00	0.11	0.63	0.74

County	2002 Irrigated Farms $\geq$ 14 Acres		2006 Estimated Water Withdrawn (MGD)			
	Number of Farms	Irrigated Acres	Great Lakes	Surface Water	Ground Water	Total
Schoolcraft	0	0	0.00	0.00	0.00	0.00
Shiawassee	(D)	(D)	(D)	(D)	(D)	(D)
Tuscola	25	5,707	2.31	0.00	1.36	3.66
Van Buren	102	23,315	0.00	1.68	8.82	10.50
Washtenaw	22	1,756	0.00	0.49	0.60	1.09
Wayne	(D)	(D)	(D)	(D)	(D)	(D)
Wexford	(D)	(D)	(D)	(D)	(D)	(D)
Other LP Counties	91	24,024	2.17	2.11	11.16	15.43
Other UP Counties	15	1,965	0.00	0.74	0.49	1.31
Total	1,568	452,800	5.52	73.61	143.77	222.97

\* This report is provided by the Michigan Department of Environmental Quality and Michigan State University. It was generated using data from the 2002 United States Census of Agriculture.

Note: (D) represents data withheld to avoid disclosing information for individual farms.

# Index Map of Michigan Counties





**Table 2: 2006 Estimated Water Withdrawals for Agricultural Irrigation in Michigan, by Hydrologic Basin\***

Hydrologic Basin Code	2002 Irrigated Farms $\geq$ 14 Acres		2006 Estimated Water Withdrawn (MGD)			
	Number of Farms	Irrigated Acres	Great Lakes	Surface Water	Ground Water	Total
04010302	0	0	0.00	0.00	0.00	0.00
04020101	0	0	0.00	0.00	0.00	0.00
04020102	(D)	(D)	(D)	(D)	(D)	(D)
04020103	(D)	(D)	(D)	(D)	(D)	(D)
04020104	0	0	0.00	0.00	0.00	0.00
04020105	(D)	(D)	(D)	(D)	(D)	(D)
04020201	(D)	(D)	(D)	(D)	(D)	(D)
04020202	(D)	(D)	(D)	(D)	(D)	(D)
04020203	(D)	(D)	(D)	(D)	(D)	(D)
04030106	0	0	0.00	0.00	0.00	0.00
04030107	3	768	0.00	0.49	0.09	0.59
04030108	(D)	(D)	(D)	(D)	(D)	(D)
04030109	(D)	(D)	(D)	(D)	(D)	(D)
04030110	4	490	0.00	0.23	0.07	0.29
04030111	0	0	0.00	0.00	0.00	0.00
04030112	0	0	0.00	0.00	0.00	0.00
04040001	5	406	0.00	0.11	0.14	0.25
04050001	528	237,710	0.00	30.77	63.61	94.38
04050002	122	14,597	0.00	3.38	5.73	9.11
04050003	104	24,941	0.00	8.15	6.15	14.31
04050004	33	6,309	0.00	1.91	2.44	4.36
04050005	34	5,687	0.00	1.04	2.04	3.08
04050006	166	56,493	0.42	7.16	26.70	34.27
04050007	21	3,190	0.00	1.05	1.03	2.07
04060101	53	7,753	0.19	1.24	1.94	3.37
04060102	64	30,171	1.32	3.28	13.83	18.42
04060103	20	3,703	0.00	0.40	1.77	2.17
04060104	27	1,574	0.00	0.09	0.67	0.76
04060105	60	4,808	0.04	0.15	2.80	3.00
04060106	(D)	(D)	(D)	(D)	(D)	(D)
04060107	(D)	(D)	(D)	(D)	(D)	(D)
04070001	(D)	(D)	(D)	(D)	(D)	(D)

Hydrologic Basin Code	2002 Irrigated Farms $\geq$ 14 Acres		2006 Estimated Water Withdrawn (MGD)			
	Number of Farms	Irrigated Acres	Great Lakes	Surface Water	Ground Water	Total
04070002	(D)	(D)	(D)	(D)	(D)	(D)
04070003	6	1,022	0.00	0.28	0.41	0.69
04070004	0	0	0.00	0.00	0.00	0.00
04070005	(D)	(D)	(D)	(D)	(D)	(D)
04070006	(D)	(D)	(D)	(D)	(D)	(D)
04070007	4	463	0.00	0.01	0.24	0.25
04080101	(D)	(D)	(D)	(D)	(D)	(D)
04080102	12	1,651	0.18	0.78	0.09	1.05
04080103	40	6,257	1.80	1.16	1.14	4.11
04080104	(D)	(D)	(D)	(D)	(D)	(D)
04080201	7	721	0.00	0.08	0.14	0.23
04080202	33	8,547	0.00	1.28	3.61	4.89
04080203	17	4,381	0.00	1.51	1.61	3.11
04080204	20	2,608	0.00	0.62	0.95	1.58
04080205	16	2,693	0.93	0.04	0.78	1.75
04080206	6	1,033	0.21	0.09	0.24	0.54
04090001	24	2,418	0.00	0.93	0.64	1.58
04090002	3	182	0.00	0.03	0.07	0.10
04090003	23	3,418	0.09	1.58	0.76	2.43
04090004	10	726	0.03	0.14	0.25	0.43
04090005	24	2,397	0.19	0.51	1.01	1.71
04100001	18	4,250	0.02	1.82	0.70	2.54
04100002	30	6,301	0.00	2.04	0.82	2.87
04100003	3	596	0.00	0.14	0.14	0.28
04100006	7	2,115	0.00	0.66	0.27	0.93
Other Basins	21	2,421	0.09	0.43	0.88	1.47
Total	1,568	452,800	5.52	73.61	143.77	222.97

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Note: (D) represents data withheld to avoid disclosing information for individual farms.

# Index Map of Michigan Hydrologic Basins



**Table 3: 2006 Estimated Water Withdrawals for Irrigated Crops in Michigan, by Crop Type\***

Crop Name	2002 Irrigated Farms ≥ 14 Acres	Irrigated Acres	2006 Estimated Water Withdrawn (MGD)
Corn for Grain or Seed	686	179,925	70.91
Corn for Silage or Green Chop	114	9,899	4.85
Popcorn	6	275	0.13
Soybeans	439	83,996	43.69
Dry Edible Beans (Navy, Black, etc.)	69	13,171	8.48
Wheat	54	5,327	2.60
Oats	18	464	0.23
Rye	11	96	0.05
Barley	3	51	0.03
Sorghum	1	35	0.03
Alfalfa/Hay/Silage	220	17,213	8.33
Potatoes	103	37,928	27.80
Sugar Beets	42	3,771	2.17
Vegetables	336	58,973	25.09
Fruit Trees & Grapevines	192	12,264	5.99
Berries	203	10,841	5.49
Nursery & Greenhouse Crops (includes sod)	140	18,417	17.04
Mint	1	128	0.06
Sunflower	1	16	0.01
Birdsfoot trefoil seed	1	10	0.01
<b>Total</b>		<b>452,800</b>	<b>222.97</b>

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