Report on Water Pollution

in the

LAKE HURON BASIN

IMMEDIATE
POLLUTION CONTROL
NEEDS

UNITED STATES DEPARTMENT OF THE INTERIOR

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

GREAT LAKES REGION

MARCH 1967

REPORT ON WATER POLLUTION

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IMMEDIATE POLLUTION CONTROL NEEDS

U.S. DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
Great Lakes Region
Detroit Program Office
Grosse Ile, Michigan

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I. Introduction

Purpose:

The purpose of this report is to define present water quality in the Lake Huron Basin, list known sources of pollution, and outline remedial measures that are of immediate importance.

Scope:

The water quality control needs and costs are taken from field investigations by the Lake Huron Program Office of the Great Lakes-Illinois River Basins Project, as well as from information obtained by the Michigan Water Resources Commission, The Michigan Department of Public Health, and other sources.

The "Guidelines for Establishing Water Quality Standards for Interstate Waters" considers international waters as subject to interstate standards. Lake Huron and the St. Marys River fall within this definition. Those waste sources known to contribute to interstate waters directly or through tributaries, thereto, are shown on Figures 4 through 13.

Canadian waste sources are not included in this report.

Authority:

The study of the Lake Huron Basin is a part of the Great Lakes-Illinois River Basins Project, a comprehensive water pollution control study authorized by the Federal Water Pollution Control Act of 1956 as amended (33 USC 466 et seq) Sec. 3a and Sec. 5f.

II. Summary of Immediate Pollution Control Needs

The following table is a summary of immediate pollution control needs. The basis for the major needs are documented elsewhere in this report. Other needs are based on the principal that septic tank systems in urban areas constitute a health hazard. Collection systems with lagoons or secondary treatment are then required to protect the health of the inhabitants and the present recreational uses throughout the tributary systems of the Huron Basin. The priority is that assigned by this office after review of available information from various sources.

The priorities are as follows:

1. Area immediately affected is interstate waters.
2. Intrastate waters - major problem.
3. Intrastate waters - minor problem.
4. Intrastate waters - small community or industry.

The Michigan Water Resources Commission is the agency responsible for implementing pollution control action in the State of Michigan (see page 59).

MUNICIPAL WASTE TREATMENT
(by basin)

Location	County	Needs	Priority
UPPER LAKE HURON			
Upper Peninsula (Figure 4)			
Sault Ste. Marie	Chippewa	Expand to secondary; improve collection	1
St. Ignace	Mackinac	Expand to secondary	1
Mackinac Island	Mackinac	Secondary treatment	1
Brimley	Chippewa	Collection system; lagoon	1
Detour Village	Chippewa	Collection system; lagoon	1
Rudyard	Chippewa	Collection system; lagoon	2
Trout Lake T.	Chippewa	Collection system; lagoon	2

MUNICIPAL WASTE TREATMENT (cont.)
(by basin)

Location	County	Needs	Priority
UPPER LAKE HURON			
Cheboygan River (Figure 5)			
Cheboygan	Cheboygan	Secondary & improve collection system	1
Indian River	Cheboygan	Collection system & lagoon	4
Onaway	Presque Isle	Collection system & lagoon	3
Vanderbilt	Otsego	Collection system & lagoon	4
Wolverine	Cheboygan	Collection system & lagoon	4
Thunder Bay River (Figure 6)			
Alpena	Alpena	Expand to secondary; improve collection	1
Hillman	Montmorency	Collection system & lagoon	4
Au Sable River (Figure 7)			
Gaylord	Otsego	Expand secondary; improve collection	2
Grayling	Crawford	Expand to secondary; improve collection	2
Oscoda & Au Sable	Iosco	Improve collection & build lagoon	1
Roscommon	Roscommon	Expand to secondary	2
Other Upper Lake Huron Areas (Figures 5,6,7)			
Mackinaw City (F.5)	Emmet	Expand to secondary	1
Rogers City (F.6)	Presque Isle	Expand to secondary; improve collection	1
Harrisville (F.7)	Alcona	Collection system & lagoon	1
Mikado (F.7)	Alcona	Collection system & lagoon	3

MUNICIPAL WASTE TREATMENT (cont.)
(by basin)

Location	County	Needs	Priority
SAGINAW BAY			
West Saginaw Bay (Figure 8)			
Au Gres	Arenac	Collection system & lagoon	1
East Tawas	Iosca	Expand to secondary; improve collection	1
Linwood	Bay	Lagoon	1
Omer	Arenac	Collection system & lagoon	3
Rose City	Ogemaw	Collection system & lagoon	3
Standish	Arenac	Improve collection system	3
Sterling	Arenac	Collection system & lagoon	3
Tawas City	Iosca	Expand secondary; improve collection	1
Turner	Arenac	Collection system & lagoon	4
West Branch	Ogemaw	Expand to secondary	3
Saginaw River (Figure 9)			
Bay City	Bay	Connect to Bay City Metro	1
Buena Vista	Saginaw	Connect to Saginaw Metro	1
Carrollton	Saginaw	Expand to secondary	1
Essexville	Bay	Connect to Bay City Metro	1
Saginaw	Saginaw	Connect to Saginaw Metro	1
Zilwaukee	Saginaw	Expand to secondary	1
Bay City Metro	Bay	Interceptor & secondary	1
Saginaw Metro	Saginaw	Interceptor & secondary	1
Tittabawassee River (Figure 10)			
Alma	Gratiot	Expand to secondary	2
Barryton	Mecosta	Collection system & lagoon	4
Beaverton	Gladwin	Collection system & lagoon	3
Clare	Clare	Expand to secondary; improve collection	2
Coleman	Midland	Collection system & lagoon	3
Farwell	Clare	Collection system & lagoon	4

MUNICIPAL WASTE TREATMENT (cont.)
(by basin)

Location	County	Needs	Priority
SAGINAW BAY			
Tittabawassee River (Figure 10)			
Gladwin	Gladwin	Expand to secondary; improve collection	2
Harrison	Clare	Collection system & lagoon	3
Midland	Midland	Expand secondary & improve collection	2
Mt. Pleasant	Isabella	Expand to secondary & improve collection	2
Remus	Mecosta	Collection system & lagoon	3
Shepherd	Isabella	Improve collection system	3
St. Louis	Gratiot	Expand to secondary	2
Saginaw River			
Shiawassee River (Figure 11)			
Argentine	Genesee	Connect to Genesee Co. Metro 3	2
Breckenridge	Gratiot	Collection system & lagoon	2
Byron	Genesee	Collection system & lagoon	4
Caledonia T.	Shiawassee	Secondary & collection system	2
Chesaning	Saginaw	Expand to secondary; improve collection	2
Corunna	Shiawassee	Expand to secondary; improve collection	2
Durand	Shiawassee	Expand secondary; improve collection	2
Fenton	Genesee	Connect to Genesee Co. Metro 3	2
Hemlock	Saginaw	Collection system & lagoon	4
Henderson	Shiawassee	Collection system & lagoon	4
Howell	Livingston	Improve collection system	3
Ithaca	Gratiot	Lagoon; improve collection	3
Linden	Genesee	Connect to Genesee Co. Metro 3	2
Merrill	Saginaw	Collection system & lagoon	3
Oakley	Saginaw	Collection system & lagoon	4
Owosso	Shiawassee	Expand to secondary; improve collection	2
St. Charles	Saginaw	Collection system & lagoon	2
Genesee Co. Metro 3			
Linden	Genesee	Secondary; collection; interceptor	2

MUNICIPAL WASTE TREATMENT (cont.)
(by basin)

Location	County	Needs	Priority
Saginaw River			
Flint River (Figure 12)			
Birch Run	Saginaw	Collection system & lagoon	3
Clifford	Lapeer	Collection system & lagoon	4
Clio	Genesee	Connect to Genesee Co. Metro 2	2
Columbiaville	Lapeer	Collection system & lagoon	3
Davison	Genesee	Connect to Genesee Co. Metro 1	2
Flint	Genesee	Connect to Genesee Co. Metro 1	2
Flushing	Genesee	Connect to Genesee Co. Metro 2	2
Goodrich	Genesee	Connect to Genesee Co. Metro 4	2
Grand Blanc	Genesee	Connect to Genesee Co. Metro 1	2
Grand Blanc T.	Genesee	Connect to Genesee Co. Metro 1	2
Lennon	Genesee	Collection system & lagoon	2
Montrose	Genesee	Connect to Genesee Co. Metro 2	2
Mt. Morris	Genesee	Connect to Genesee Co. Metro 2	2
New Lothrup	Shiawassee	Collection system & lagoon	3
North Branch	Lapeer	Collection system & lagoon	3
Ortonville	Oakland	Collection system & lagoon	3
Otisville	Genesee	Connect to Genesee Co. Metro 4	2
Swartz Creek	Genesee	Connect to Genesee Co. Metro 1	2
Genesee Co.			
Metro 1			
Flint	Genesee	Expand secondary; interceptor system	2
Metro 2			
Montrose	Genesee	Secondary & improve collection	2
Metro 4			
Otisville	Genesee	Collection & lagoon	2
Metro 5			
Goodrich	Genesee	Collection & lagoon	2
Metro 6			
Montrose-Flushing	Genesee	Interceptor system	2

MUNICIPAL WASTE TREATMENT (cont.)
(by basin)

Location	County	Needs	Priority
Saginaw River			
Cass River (Figure 13)			
Bridgeport	Saginaw	Connect to Saginaw Metro	2
Kingston	Tuscola	Collection system & lagoon	2
Mayville	Tuscola	Collection system & lagoon	4
Millington	Tuscola	Collection system & lagoon	3
Ubly	Huron	Collection system & lagoon	3
East Saginaw Bay (Figure 8)			
Akron	Tuscola	Collection system & lagoon	4
Caseville	Huron	Collection system & lagoon	1
Elkton	Huron	Collection system & lagoon	2
Fairgrove	Tuscola	Collection system & lagoon	4
Kinde	Huron	Collection system & lagoon	4
Pigeon	Huron	Collection system & lagoon	3
Port Austin	Huron	Collection system & lagoon	1
Sebewaing	Huron	Collection system & lagoon	1
Unionville	Tuscola	Collection system & lagoon	4
LOWER LAKE HURON (Figure 14)			
Lexington	Sanilac	Improve collection system	1

INDUSTRIAL WASTE TREATMENT

Industry	Location	County	Needs	Priority
SAGINAW BAY				
West Saginaw Bay (Figure 8)				
Kraft Foods Co., Inc.	Pinconning	Bay	Establish adequacy of treatment	1
Saginaw River (Figure 9)				
Bay Refining Co.	Bay City	Bay	Establish adequacy of treatment for oil wastes	1
Tittabawassee River (Figure 10)				
Remus Coop. Creamery Co.	Remus	Mecosta	Improve treatment	2
Dow Chemical Co.	Midland	Midland	Establish adequacy of treatment for brine wastes	2
Michigan Chemical Corp.	St. Louis	Gratiot	Establish adequacy of treatment	2
Shiawassee River (Figure 11)				
Ford Motor Co.	Owosso	Shiawassee	Improve treatment reliability	2
Peet, G.M. Packing Co.	Chesaning	Saginaw	Improve treatment	2
Flint River (Figure 12)				
Vogt Packing Co.	Grand Blanc	Genesee	Establish adequacy of treatment	2
Cass River (Figure 13)				
Nestles Co., Inc.	Ubly	Huron	Establish adequacy of treatment	2

INDUSTRIAL WASTE TREATMENT (cont.)

Industry	Location	County	Needs	Priority
East Saginaw Bay (Figure 8)				
Active Industries	Elkton	Huron	Better control to eliminate oil spills	2
Fairmont Foods Co.	Bad Axe	Huron	Establish adequacy of treatment	2
Michigan Brewery, Inc.	Sebewaing	Huron	Evaluate waste effects	1
Michigan Producers Dairy Co.	Sebewaing	Huron	Improve treatment	1
LOWER LAKE HURON (Figure 14)				
Hercules, Inc.	Harbor Beach	Huron	Establish adequacy of treatment	2

In addition, the necessity for adequate disinfection of sugar beet wastes has been indicated by preliminary studies of Salmonella sp. concentrations in these wastes.

Flow Regulation

The Michigan Water Resources Commission should investigate the practice of low flow augmentation in the Flint River and the Cass River above Frankenmuth for quality control, and recommend to local basin agencies procedures for implementation.

Other Pollution Control Practices

The Michigan Water Resources Commission should require local authorities to provide for onshore disposal of vessel wastes at lake ports and marinas - and for the control of waste disposal from all classes of vessels, including pleasure craft that operate in Michigan waters.

Institutional Practices

-- State of Michigan should adopt standards for both inter- and intrastate streams as currently scheduled by the Water Resources Commission.

-- The Michigan Water Resources Commission, Federal Water Pollution Control Administration, and local watershed agencies, should investigate the waste collection and disposal on a broader basis, especially in the Saginaw River Basin.

-- The Michigan Water Resources Commission should have a larger staff in order to update stream survey reports and to survey those industrial waste sources not presently classified as adequate.

-- The Michigan Department of Public Health should provide for more testing of waste treatment plant effluents, especially for nutrient concentrations and nitrogeneous oxygen-demanding material.

Research

-- The Federal Water Pollution Control Administration and educational institutions should conduct research and pilot plant studies to determine more effective means of reducing nutrients, especially phosphates, from various sizes of treatment plants.

-- Research by educational groups, Federal Water Pollution Control Administration, and other organizations is needed to determine more effective means of reducing all oxygen-demanding wastes, especially the nitrogenous stage.

-- The Federal Water Pollution Control Administration and educational institutions should study the effect of nutrients on algal growth to assess more completely the effect on a stream of a highly-treated organic waste.

-- Research should be conducted by industrial groups and others towards the use of other than phosphate compounds as binders in synthetic detergents.

-- Research should be conducted by the Federal Water Pollution Control Administration to develop advanced treatment methods which are needed in areas where secondary effluent will overload a stream.

III. Immediate Control Needs

In the Michigan area of the Lake Huron Basin there are 56 municipal waste sources of which 8 have no treatment, 25 primary treatment, and 23 secondary treatment. These waste sources are from a population of 582,000 generating 727,000 PE before treatment, and 256,000 PE after treatment, or a 65% removal. From an October 1965 survey, it was determined there were at least 960 miles of combined sewers. The Saginaw Basin has 89% of the population served in the Lake Huron Basin, with an overall PE removal of 67%. There is a large difference in degrees of removal, with the Flint and Cass Rivers being all secondary and 92-94% PE removal, while the 22-mile reach of the Saginaw River has all primary treatment and 34% PE removal. The Tittabawassee and Shiawassee Rivers have half primary and half secondary treatment, which give 54-56% PE removal. Along the 22-mile section of the Saginaw River, there are 747 miles of combined sewers, or 78% of all the combined sewers in the entire Lake Huron Basin.

There are 50 industrial waste discharges - 47 process wastes and 3 cooling water discharges, with some industries having combinations of both cooling and process discharges. The 47 industrial process wastes discharge 193 MGD of the cooling waters, and Consumers Power on the Saginaw River discharges 500 MGD. Of the entire Lake Huron Basin, the Saginaw Basin receives 88% of the process waste discharges, 169.14 MGD, with 5 industries over 10 MGD on the Saginaw and Tittabawassee Rivers contributing 151.9 MGD or 90% of the Saginaw Basin waste discharges.

The following table summarizes the major waste sources in the basin:

WASTE SOURCES

Basin	None	Municipal P*	Municipal S**	Municipal Total	Industrial P***	Industrial C****	Industrial Total	Total
Saginaw River								
Saginaw R.	0	5	0	5	5	1	6	11
Tittabawassee R.	1	5	3	9	5	0	5	14
Shiawassee R.	1	4	3	8	5	0	5	13
Flint R.	2	0	7	9	9	0	9	18
Cass R.	0	0	4	4	4	0	4	8
	4	14	17	35	28	1	29	64
Other Lake Huron	4	11	6	21	19	2	21	42
Total Lake Huron	8	25	23	56	47	31	50	106

Notes: *Primary
**Secondary
***Process
****Cooling

IV. Costs

The following table of immediate needs costs for pollution control are based on actual construction experience in the Michigan area. Cost figures do not include industrial treatment needs, except when the industrial wastes will be treated by a municipal plant. Secondary treatment may be assumed for all sources, except those where a sewage lagoon is adequate and more economically feasible. In addition to the cost for treatment, the cost for sewers is also tabulated. In certain areas adequate sewers exist; in other areas, all sewers are necessary; and in some metropolitan areas, interceptors must be constructed to transport wastes to a central plant from a number of presently inadequate plants. Secondary treatment is the maximum amount of treatment provided for in this tabulation, even if it is inadequate in terms of stream loadings. The costs are listed both by subbasin and by priority of need as defined previously.

Treatment costs will be financed by Federal, State, or local funds.

Sewer costs will be financed by local funds, except when certain interceptors qualify for Federal funds.

TABLE 1. POLLUTION CONTROL COSTS (thousands of dollars) by SUBBASINS

Basin	Treatment	Sewer	Total
Upper Lake Huron			
Upper Peninsula	679	1,585	2,264
Cheboygan River	288	1,095	1,383
Thunder Bay River	831	1,950	2,781
Au Sable River	1,120	1,130	2,250
Other	199	663	862
Total	3,117	6,423	9,540
Saginaw Bay			
West	800	1,182	1,982
Saginaw River	13,620	33,875	47,495
Tittabawassee River	2,389	8,887	11,276
Shiawassee River	1,711	5,033	6,744
Flint	16,902	16,445	33,347
Cass	225	1,198	1,423
East	546	2,857	3,403
Saginaw River Totals	34,847	65,438	100,285
Saginaw Bay Totals	36,193	69,477	105,670
Lower Lake Huron	-	125	125
Total	-	125	125
Total Lake Huron	39,310	76,025	115,335

POLLUTION CONTROL COSTS (thousands of dollars) by PRIORITY

Priority	Treatment	Sewer	Total
1	16,388	39,578	55,968
2	20,677	26,174	46,851
3	1,590	6,602	8,192
4	655	3,671	4,326
Total	39,310	76,025	115,335

TABLE 1. POLLUTION CONTROL COSTS BY GOVERNMENTAL UNITS
(thousands of dollars)

Location	Priority	Treatment	Sewer	Total
UPPER LAKE HURON				
Upper Peninsula				
Sault Ste. Marie	1	325	400	725
St. Ignace	1	83	-	83
Mackinac Island	1	94	188	282
Brimley	4	19	120	139
Detour Village	1	50	263	313
Rudyard	3	83	454	537
Trout Lake Twp.	4	25	160	185
Cheboygan River				
Cheboygan	1	105	100	205
Indian River	4	38	200	238
Onaway	3	88	475	563
Vanderbilt	4	38	200	238
Wolverine	4	19	120	139
Thunder Bay River				
Alpena	1	800	1,750	2,550
Hillman	4	31	200	231
Au Sable River				
Gaylord	2	398	138	536
Grayling	2	50	225	275
Oscoda & Au Sable	1	263	704	967
Roscommon	2	409	63	472
Other Upper Lake Huron Areas				
Harrisville	1	31	200	231
Mackinac City	1	34	--	34
Mikado	3	31	200	231
Rogers City	1	103	263	366
SAGINAW BAY				
West Saginaw Bay				
Au Gres	1	38	233	271
East Tawas	1	416	213	629
Linwood	1	128	--	128
Omer	3	19	120	139
Rose City	3	25	160	185
Standish	3	--	63	63
Sterling	3	38	200	238
Tawas City	1	60	113	173
Turner	4	13	80	93
West Branch	3	63	--	63

TABLE 1. POLLUTION CONTROL COSTS (cont.)
(thousands of dollars)

Location	Priority	Treatment	Sewer	Total
Saginaw River				
Bay City	1	--	--	--
Buena Vista	1	--	--	--
Carrollton	1	60	--	60
Essexville	1	--	--	--
Saginaw	1	--	--	--
Zilwaukee	1	60	--	60
Bay City Metro	1	4,750	18,250	23,000
Saginaw Metro	1	8,750	15,625	24,375
Tittabawassee River				
Alma	2	166	--	166
Barryton	4	38	200	238
Beaverton	3	125	325	450
Clare	2	106	263	369
Coleman	3	72	405	477
Farwell	4	50	274	324
Gladwin	2	69	138	207
Harrison	3	100	475	575
Midland	2	875	5,000	5,875
Mt. Pleasant	2	625	1,313	1,938
Remus	3	77	431	508
Shepherd	3	--	63	63
St. Louis	2	86	--	86
Shiawassee River				
Argentine	2	--	--	--
Breckenridge	2	88	425	513
Byron	4	38	233	271
Chesaning	2	80	163	243
Corunna	2	80	188	268
Durand	2	38	213	251
Fenton	2	--	--	--
Hemlock	4	50	263	313
Henderson	4	19	120	139
Howell	3	--	138	138
Ithaca	3	200	138	338
Linden	2	--	--	--
Merrill	3	62	352	414
Oakley	4	31	200	231
Owosso	2	500	1,100	1,600
St. Charles	2	125	450	575
Caledonia Twp.	2	400	1,050	1,450

TABLE 1. POLLUTION CONTROL COSTS (cont.)
(thousands of dollars)

Location	Priority	Treatment	Sewer	Total
Flint River				
Birch Run	3	63	325	388
Clifford	4	38	75	113
Clio	2	--	--	--
Columbiaville	3	63	75	138
Davison	2	--	--	--
Flint	2	--	--	--
Flushing	2	--	--	--
Goodrich	2	--	--	--
Grand Blanc	2	--	--	--
Grand Blanc Twp.	2	--	--	--
Lennon	2	19	120	139
Montrose	2	--	--	--
Mt. Morris	2	--	--	--
New Lothrup	3	38	200	238
North Branch	3	125	325	450
Ortonville	3	56	325	381
Otisville	2	--	--	--
Swartz Creek	2	--	--	--
Genesee Metro	2	16,500	15,000	31,500
Cass River				
Bridgeport	2	--	--	--
Kingston	4	38	233	271
Mayville	3	63	325	388
Millington	3	68	315	383
Ubly	3	56	325	381
East Saginaw Bay				
Akron	4	38	233	271
Caseville	1	50	263	313
Elkton	2	63	325	388
Fairgrove	4	44	259	303
Kinde	4	38	238	276
Pigeon	3	75	388	463
Port Austin	1	63	325	388
Sebewaing	1	125	563	688
Unionville	4	50	263	313
LOWER LAKE HURON				
Lexington	1	--	125	125

V. Recent Progress in Pollution Control

The Michigan Water Resources Commission, pursuant to Sections 6 (A) and 6 (3) of Act 245, P.A. 1929, as amended, called various governmental units in the Lake Huron Basin to conferences on raw and inadequately treated sewage discharges. These conferences were conducted July 28-29, 1966 at Saginaw, Michigan, for the Saginaw Bay and Lower Lake Huron Basin units, and December 15-16, 1966 at Traverse City, Michigan, for Lake Huron tributaries in the northern lower peninsula and upper peninsula (northern Lake Huron Basin). The conferences were preliminary in nature, not hearings in the legal sense, held first, to present the problems in water quality known to the Commission and second, to hear from governmental units what the units proposed to do about the problems.

At the Saginaw River Basin (Saginaw-Bay City Area) Conference, the Commission staff presented a summary of the Commission report on the Saginaw River. This report included the results of the 1965 surveys conducted jointly by the Michigan Water Resources Commission and the Federal Water Pollution Control Administration on the Saginaw River. The governmental units of Essexville, Bay City, Zilwaukee, Buena Vista, Carrollton, and Saginaw were heard as a single body, due to the complex interrelationships of the river. As the report had not previously been released, only a few statements and questions were received. Bay City and Saginaw presented statements in agreement with the need for improvement of the water quality in the Saginaw River. The matter was referred to Commission staff for continuing attention. This part of the conference was called, not for the discharge of raw sewage, but for discharge of inadequately treated sewage.

Seven governmental units in the Saginaw River Basin tributaries were called for the discharge of raw and semi-treated sewage to surface waters. The following table lists pertinent data:

Unit	County	Population	Discharge to
St. Charles	Saginaw	1960	Bad River (Shiawassee)
Birch Run	Saginaw	840	Silver Creek (Flint)
Caledonia	Shiawassee	3430	Shiawassee
Breckenridge	Gratiot	1130	Pine River (Tittabawassee) and Beaver Creek (Shiawassee)
Columbiaville	Lapeer	878	Holloway Reservoir (Flint)
Frankenmuth	Saginaw	1762	Cass
Millington	Tuscola	1160	Millington Creek (Cass)

The Commission reviewed on an individual basis reports by the staff and previous actions by the commission. Statements were received from representatives of the units and suggestions made toward the solution of the problem. Progress reports by the units or further staff analysis and recommendations for commission consideration were requested within a certain time period.

Six governmental units in the Saginaw Bay-Lower Lake Huron Basin area were called for discharge of raw, semi-treated or inadequately treated sewage. In addition, two industries dischargeing within the limits of these units were also called. The following table lists pertinent data:

Unit	County	Population	Discharge to
Unionville	Tuscola	629	Wiscoggin Creek (Saginaw Bay)
Sebewaing**	Huron	2030	Sebewaing River (Saginaw Bay)
Pigeon	Huron	1190	Pigeon River (Saginaw Bay)
Elkton**	Huron	1010	Pinnebog River (Saginaw Bay)
Burtchville	St. Clair	1726*	Milwaukee Creek (Lake Huron)
Fort Gratiot	St. Clair	5590*	Lake Huron

* The major portions of the townships are in the Black River (St. Clair River) drainage basin.

** These industries were called:

Unit	Industry	Product	Waste
Elkton	Active Industries	Metal Stamping	Oils
Sebewaing	Michigan Producers Dairy Co.	Milk Processing	Organic

The Commission reviewed staff reports on the problems presented by these areas. Statements of current action and progress were made by the governmental unit and industry officials. The necessity for plans to abate the pollution was stressed and possible sources of technical and financial assistance were mentioned by commission members. Progress reports by the units or further staff analysis and recommendations were requested.

At the December Commission meeting 1966, six governmental units in the Upper Lake Huron Basin area were called under provisions of the Act. The following table lists pertinent data:

Unit	County	Population	Discharge to
Hillman	Montmorency	445	Thunder Bay River
Mikado	Alcona		Pine River (Au Sable)
Rose City	Ogemaw	435	Houghton Creek (Rifle River)
Oscoda	Iosco		Au Sable & Lake Huron
Au Sable	Iosco		Au Sable & Lake Huron
Au Gres	Arenac	584	Au Gres & Lake Huron

With the exception of the township of Mikado, which was unable to send a representative to the meeting, progress reports for future meetings were requested from the various units.

In addition to the above, representatives of the City of Grayling (2015), Crawford County, and the Village of Roscommon (867), Roscommon County, were present to hear and discuss the findings of the report on water quality conditions in the Au Sable River. The conference concluded that affected governmental units would review the report and have representatives attend the March 1967 Commission meeting.

In addition to actions taken pursuant to the amended provisions of the Act, the Water Resources Commission continued legal processes started under the previous Act and other Acts. As of December 31, 1966, the following actions had been taken:

City of Clare

On July 28, 1966, representatives of the City of Clare appeared at a conference to show cause why the city should not be held in default of a stipulation requiring construction of a sewage treatment plant to begin on June 1, 1966. This plant was required to abate unlawful pollution of the Tobacco River (a tributary of the Tittabawassee-Saginaw River system).

The delay in beginning construction and going in default of the stipulation was due to increased construction cost estimates, requiring additional funds. Although the city was technically in default, and a final order of determination could have been issued, the Commission extended the date of construction as requested by the city and approved by both the State and the Federal agencies involved. The date of completion of the project was extended to March 8, 1967.

Village of Breckenridge

A "Notice of Determination and Hearing" was adopted December 15, 1966, to the Village of Breckenridge. This notice defined the specific violation of discharging or permitting the discharge of raw sewage of human origin from within the village without adequate treatment to the Pine River (Tittabawassee) and Beaver Creek (Shiawassee). The Commission had under consideration the adoption of a "Final Order of Determination" with these conditions:

1. Abatement of pollution by June 1, 1969, by construction of necessary facilities.
   a) Submit plans by August 1, 1967.
   b) Commence construction by June 1, 1968.
   c) Complete construction and begin operation by June 1, 1969.
2. Failure to meet any requirement would constitute a default of the entire order.

A hearing was to be held January 19, 1967, to determine if agreement on proposed action could be reached by stipulation, agreed settlement, consent order or default, or if a final order of determination would be necessary.

Township of Trout Lake

The following is a chronological report of the disposition of a minor pollution problem in the Upper Peninsula. The problem involved the hookup of septic tank lines to storm sewers.

April 29, 1965 - A letter of complaint (4/16/65) about the discharge of raw sewage was received by the Michigan Conservation Department. Michigan Water Resources Commission wrote to the Township supervisor. Commission action deferred pending receipt of a reply.

May 27, 1965 - As suggested actions were not taken by Township Board, Commission Staff was directed to request a report from the Township Board within 60 days as to what action has been taken.

August 25-26, 1965 - Information was received that the Chippewa County Health Department served notice on violators to terminate connections by September 15, 1965, and that the Township Board passed a resolution to the effect that it recognized the problem and intended to alleviate it.

September 30, 1966 - Conference called under provisions of the amended Act. The problem was discussed. Township officials, in effect, requested a Notice of Determination from the Commission to assist in removing the few remaining violations. Commission Staff authorize to prepare a Notice of Determination and Hearing against the Township for October 27-28, 1966.

October 27-28, 1966 - Notice of Determination and Hearing adopted establishing hearing date December 15-16, 1966. The Notice cited the Township for violation of the statute and contained a proposed timetable for correction by either on site facilities by June 1, 1967, or construction of collection and treatment facilities on a schedule requiring completion by October 1, 1968.

December 15-16, 1966 - Representatives of Township were present for Statutory Hearing scheduled by Notice of Determination and Hearing adopted at the October meeting. Staff members expressed gratification with progress made. Commission directed that a Final Order of Determination be made for consideration at the January 1967 meeting.

In addition to matters called under Section 6 of the Act, the Commission under Section 5, scheduled at its December 1966 meeting a number of conferences throughout the State to establish water quality criteria. The criteria so established would be applied to intrastate waters in a certain priority, i.e., first, where grant money is involved, beginning with the July 1967 meeting. The following schedule was adopted for 1967, primarily to hold hearings on water quality criteria on interstate waters:

January	-	Formulate proposed water quality criteria for the several uses.
February	-	St. Joseph River and Lake Michigan.
March	-	Lake Huron.
April	-	Southeastern Michigan and Maumee River tributaries.
May	-	Menominee and Montreal Rivers - Lake Superior and St. Marys River.
	-	Adopt implementation and enforcement plan for St. Joseph River, Lake Michigan, and Lake Huron.
June	-	Adopt implementation and enforcement plan for Southeastern Michigan, Maumee River, Montreal River, Lake Superior, and St. Marys River.

The Commission also conducted a Public Hearing for Determination of Optimum Flows in parts of the Tittabawassee River Basin, under Act 20, P.A. 1964. At this hearing, various items studied by the Commission Staff were presented. These included:

1. The flow behavior or range of stream flow variations;
2. The uses being made of the stream flow by riparian owners;
3. And the stream's waste assimilation capacity and its practical ability for domestic use, fish and wildlife habitat, recreation, municipal, and industrial water supply, navigation and water storage capacity.

These reports were studied and statements taken regarding testimony and objections of the interested public. An important statement was the fact that waste assimilation is not a basic consideration in selecting optimum flows. The Water Resources Commission will not accept the construction of a reservoir and releases of water as a substitute for modern up-to-date waste control facilities. The Commission was to review the record and make a decision to adopt a flow and what the flow should be.

Numerous orders were issued relating to specific users of water. These include industrial and commercial establishments discharging waste products of a domestic or industrial nature to both surface and ground wastes of the State. Maximum flows and concentrations of substances were stipulated where necessary.

The Commission Staff evaluated data and published a report on the Saginaw River, Au Sable River, and conducted a study of the Shiawassee River during 1966. The Water Quality Monitoring Program was continued, as was the industrial waste surveys in the Lake Huron Basin.

The Michigan Department of Public Health began a requirement for year-round disinfection of municipal waste treatment plant effluents effective January 1967.

VI. Background

A. Basin Characteristics

Lake Huron, the second largest lake in the Great Lakes, has a water surface area of 23,000 square miles and drainage basin area of 73,600 square miles. It has a length of about 200 miles and a width of about 100 miles. The greatest recorded depth in the lake is 750 feet and the average depth is 195 feet. The lake has a volume of 850 cubic miles.

The Lake Huron Basin has a Michigan drainage area of 25,300 square miles and a shoreline of 769 miles. It includes the eastern half of Michigan between the Straits of Mackinac - St. Marys River to the northern metropolitan area of Detroit.

In 1960, approximately 1.2 million persons lived in the Lake Huron Basin, and it is estimated there will be 2.5 million perosns by the year 2020. Value added by manufacture in 1958 was almost one billion dollars. Bay, Genesee, Saginaw, and Midland counties, which are predominantly in the Saginaw Basin, account for 75% of the Lake Huron Basin population, and 90% of the value added by manufacture.

The major tributaries to the lake are the St. Marys River (Lake Superior), the Straits of Mackinac (Lake Michigan), and the Cheboygan, Thunder Bay, Au Sable, Saginaw (all U.S.), and Saugeen (Canadian) rivers. Saginaw Bay, North Channel, and Georgian Bay are extensions to the lake.

Extending from the western side of Lake Huron in a southwesterly direction is Saginaw Bay. This shallow arm of the lake is 26 miles wide at its entrance, and its minimum width is 13 miles between Sand Point and Point Lookout. The Bay is 51 miles long from the mouth of the Saginaw River, to a line joining Pointe Aux Barques and Au Sable Point, which are on opposite sides of its entrance.

Georgian Bay and North Channel are extensions of the lake on the northeast and north sides (Canadian), respectively. They are nearly land-locked, due to the presence of the Bruce (Saugeen) Peninsula, and Drummond, Cockburn, Manitoulin, and Fitzwilliam Islands.

Georgian Bay is about 115 miles long in a northwest-southeast direction and about 50 miles wide. It contains over 20,000 islands, the largest of which are Lonely, Parry, and Christian. The coastline is very irregular and has many inlets and capes. The largest passage between Georgian Bay and Lake Huron is the Lucas Channel. The depth of the water in the Bay is generally 100 to 300 feet, and the maximum recorded depth is 540 feet near the entrance to Lake Huron. The major tributaries to Georgian Bay are the Wamapitei, French, Magnetawan, Muskoka, Severn, and Maitland rivers. The Mississagi and Spanish Rivers are tributary to North Channel.

St. Marys River

St. Marys River is the connecting waterway between Lake Superior and Lake Huron. Channel width varies from 18,000 feet to 2,000 feet at the falls and has channel depths of 25 to 55 feet. The drop through the falls varies from 18 to 24 feet. Flow (which is regulated) averaged about 73,000 cfs. Man-made works have been constructed since 1797 as aids to navigation and for power development. Below the falls, a series of interconnected lakes and bays forms the river passage to Lake Huron. Three large islands split the flow. The river is first divided into two channels below the Soo - Lake Nicolet (the west channel) and Lake George (the international waters and longer by ten miles to the junction at the end of Sugar Island). Lake Nicolet is divided by Neebish Island into the west and middle channels. St. Joseph Island divides the Lake George flow into the middle and east channels. The middle channel (Munuscong) forms the inter-

national waters to Lake Huron. Except for man-made improvements, these channels are shallow compared to the upper river. The population and industrial centers of the Soo constitute the only waste sources in an otherwise relatively sparsely settled region.

Cheboygan River

The Cheboygan River Basin, with a drainage area of approximately 1550 square miles, lies in the uppermost part of the lower Peninsula. It comprises parts of Emmett, Charlevoix, Cheboygan, Presque Isle, Otsego, and Montmorency counties. The major city is Cheboygan, a commercial fishing port located in a year-round resort area.

The basin, an irregularly shaped circle, with a diameter of about 40 miles, has approximately 23% of its surface area in lakes and swamps. Three of the lakes, Mullett Lake, Burt Lake, and Black Lake, are among the largest inland lakes in the State. The area in the basin is drained primarily by the tributary system. The major tributaries - Maple, Sturgeon, Black, Rainy, and Pigeon rivers - all join the main stem through one of the large inland lakes. The main stem of the river is made up of a short stretch of approximately six miles between Mullett Lake and Lake Huron.

Thunder Bay River

The Thunder Bay Basin, with a drainage area of approximately 1120 square miles, lies in the northeastern part of the lower Peninsula comprising parts of Presque Isle, Montmorency, Otsego, Oscoda, Alcona, and Alpena counties. The largest city in the basin, Alpena, is the biggest Michigan port on Lake Huron. This city, located in a recreation area popular for fishing and for winter sports, is near one of the largest limestone quarries in the world.

The basin, irregular in shape, measures approximately 40 miles long and 34 miles wide, measuring at the longest and widest points. The Thunder Bay River flows mostly easterly to its mouth into Thunder Bay, an arm of Lake Huron. The major tributaries - North Branch, Upper South Branch, and Lower South Branch - drain the northern and southern areas of the basin. Lakes and swamps make up approximately 25 percent of the drainage area, giving this basin the highest percentage of lakes and swamps of any river in the Lower Peninsula.

Au Sable River

The Au Sable Basin, with a drainage area of approximately 2035 square miles, lies in the northeastern part of the lower Peninsula. It comprises parts of Otsego, Crawford, Roscommon, Ogemaw, Oscoda, Montmorency, Alcona, and Iosco counties. The major city, Grayling, is in one of the leading recreational areas of the State of Michigan. With headwaters in southeastern Otsego County, the Au Sable River flows southerly, then easterly, and finally southeasterly to its mouth into Lake Huron.

The basin, irregular in shape, is approximately 80 miles long and approximately 40 miles wide, measuring at the longest and widest parts. The major tributaries include the North Branch, the Middle Branch, and the South Branch, and the Pine River.

Saginaw River

The Saginaw River, in the center of the lower Peninsula, is the largest river basin in Michigan. It comprises a drainage area of approximately 6200 square miles, and includes all or parts of 21 counties. The major population centers in the basin are Flint, Saginaw, Midland, and Bay City. Manufacturing and agriculture are the main industries of the area.

The Saginaw River Basin is characterized, hydrologically, by low relief, low elevation above lake level, and poor natural drainage. The river itself is only about 22 miles long and is formed by the junction of its 4 major tributaries: the Flint, Cass, Shiawassee, and Tittabawassee rivers. The Saginaw River flows in a northerly direction and empties into Saginaw Bay at Bay City. Its width varies between 350 and 1700 feet and averages about 500 feet. There is a shipping channel dredged in the river that extends from Saginaw Bay to the City of Saginaw. It has a minimum depth of 20 feet up to the Sixth Street bridge in Saginaw, and 16 feet thereafter, and a width of 200 feet. Generally, it is narrow at its upstream end and widens as it moves downstream.

The slope of the Saginaw River is very flat averaging a 2-foot drop in 22 miles. This causes the depth, velocity, and discharge of the river to be greatly affected by the height of the water in Saginaw Bay. A sustained southwest wind will cause the level of Saginaw Bay to be lowered. This, in turn, will result in the decreasing of the depth of the river, and also increasing its velocity and discharge. A sustained northeast wind causes the opposite result. The bay rises, the river rises, and the velocity and discharge of the river are lowered. At times, the flow of the river reverses.

The junction of the 4 tributaries to the Saginaw occurs in an area known as the Shiawassee Flats. It is a swampy, level region, with poor drainage and much vegetation. Water motion is very slow and not at all conducive to measurement. At the present time, much of the area is set

aside as a wild fowl sanctuary, with water levels maintained at appropriate levels by means of man-made dikes. This area also acts as a flow regulator, in the sense that it greatly reduces flow peaks as they pass through, and also adds water from bank storage in times of low flow. In these respects, it greatly modifies the expected hydrograph of the Saginaw River.

Tittabawassee River

The Tittabawassee River Basin, with a drainage area of approximately 2515 square miles, lies in about the middle of the Lower Peninsula and west of Saginaw Bay. It comprises parts of Ogemaw, Gladwin, Roscommon, Clare, Mecosta, Isabella, Midland, Bay, Saginaw, Gratiot, and Montcalm counties.

The Dow Chemical Company, one of the largest of its kind in the world, is located in the City of Midland, and obtains most of its water supply from the Tittabawassee River.

With headwaters in the southeastern part of Roscommon County and southwestern part of Ogemaw County, the Tittabawassee River flows southerly to Midland and thence southeasterly to its junction with the Saginaw River near Saginaw. The basin is irregular in shape, with a maximum width and length of approximately 60 miles each, but narrowing to less than 5 miles in width along the lower river. Major tributaries of the Tittabawassee River include Tobacco, Salt, Chippewa, and Pine rivers.

Shiawassee River

The Shiawassee Basin, with a drainage area of approximately 1130 square miles, lies west of the thumb area of the State and southeast of Saginaw Bay. The basin comprises parts of Gratiot, Saginaw, Shiawassee, Genesee, Oakland,

and Livingston counties. The largest city in this basin is Owosso. With headwaters in Oakland County, the Shiawassee flows, generally, in a northerly direction to its mouth into the Saginaw River.

The basin is approximately 60 miles long and 30 miles wide at each end, then narrows at the mid-point to a width of about 5 miles. Major tributaries include North Ore Creek, Bogue Creek, and Bad River; the latter joining the main river near its mouth.

Flint River

The Flint River Basin, with a drainage area of approximately 1450 square miles, lies in the southwestern part of the thumb area of the Lower Peninsula. It comprises parts of Saginaw, Shiawassee, Genesee, Oakland, Lapeer, Sanilac, and Tuscola counties. The major city is Flint, now second only to Detroit in the automobile industry. With widely branching headwaters covering most of western Oakland County, the Flint River flows generally southwesterly, and then northwesterly to its mouth into the Saginaw River.

The basin is irregular in shape, with the greatest length approximately 55 miles, and the greatest width approximately 35 miles, narrowing to about 5 miles in width near the mouth. Major tributaries include the North Branch, the South Branch along with Farmers Creek, Kearsley Creek, Thread Creek, and Misteguay Creek.

Cass River

The Cass River Basin, with a drainage area of approximately 950 square miles, lies in the thumb area of the Lower Peninsula. It comprises parts of Saginaw, Tuscola, Huron, Sanilac, Lapeer and Genesee counties. There

are no major cities or towns in this basin. The Cass River has three branches; the north, south, and east branches, with headwaters in Huron, Sanilac, and Lapeer counties. It flows, generally, in a westerly direction to its mouth into the Saginaw River.

The basin is irregularly shaped, varying in width from about 15 to 35 miles and measuring approximately 55 miles at its longest point. The South Branch, originating in Lapeer and Sanilac counties, flows in a northerly direction, converging with the East Branch in the northwest section of Sanilac County. The East Branch meets the North Branch in Tuscola County, and thus, the main stem of the river is formed. These three branches comprise the major tributaries of the Cass River.

The Au Gres (435 square miles), Rifle (370 square miles), and Kawkawlin (150 square miles) rivers on the west, and the Pigeon River (130 square miles) on the east, are rivers of smaller basins draining into Saginaw Bay. In addition, there are numerous minor rivers and creeks which drain directly into Lake Huron and Saginaw Bay.

B. Present Water Quality

Two stations of the Water Pollution Surveillance System (formerly the National Water Quality Network) are currently in operation on the Lake Huron Basin. These are the St. Marys River at Sault Ste. Marie, Michigan (since 11/9/59), and the St. Clair River at Port Huron, Michigan (since 5/16/60). These sampling stations are located at water intakes for the two cities and samples are collected on a bi-weekly basis and a number of analyses made.

The International Joint Commission (IJC) has made both extensive studies (1951 IJC Report) and annual surveys of the international boundary waters of Lake Huron - the St. Marys River at the entrance to, and the St. Clair River at the outlet from Lake Huron.

The State of Michigan Water Resources Commission (MWRC), in May 1955, initiated a surface water quality monitoring program. The sampling is conducted on a bi-weekly basis near the mouths of river basins, below known major sources of pollution. Nine stations (1966) are in the Lake Huron Basin.

The Lake Huron Program Office of the Federal Water Pollution Control Administration, during 1965, conducted a sampling program on the major tributaries to the lake.

In general, the water quality of Lake Huron may be said to be excellent based on the commonly accepted water quality parameters. There is, however, an increase in the levels of conservative materials during transit of the water through Lake Huron. Localized areas of higher concentrations of pollution occur in the vicinity of harbors and at the mouths of the major tributaries.

The following Table lists the average 1965 concentration for a number of parameters of the waters entering and leaving Lake Huron.

WATER QUALITY AT ENTRANCE TO AND EXIT FROM LAKE HURON

Parameter	St. Marys River	St. Clair River
DO	12.4	11.9
% Saturation	100.6	101.5
BOD	-	2
COD	7	-
Chlorides	1.7	8
Alkalinity	41	77
Hardness	44	104
Total Dissolved Solids	-	110
Coliform (median)	10	20
Coliform (maximum)	3000	190
Coliform (minimum)	1	2

Results in mg/l, except coliform - MFC/100ml.

Lake Huron

In the main body of the lake, the water is of excellent quality in all areas. There appears to be no significant change in the water quality as measured by most of the parameters reported. The DO is uniformly high throughout the lake with an average concentration of 11.5 mg/l. The minimum value measured was 8.1 mg/l, with a maximum of 14.2 mg/l. The BOD_5 was also low, with an average of less than 1 mg/l. An apparent increase of less than 1 mg/l was noted in the range averages progressing through the lake. The total solids concentration appeared relatively uniform throughout the lake, averaging about 110 mg/l, with a slight increase in transit. The chloride levels were low with a lake average of

5 mg/l. The concentration was about 6 mg/l at the Straits and about 2 mg/l in the St. Marys River above the Soo. Georgian Bay-North Channel levels were 3 - 4 mg/l. This level increased to 6 mg/l in southern Lake Huron, with the waters of the St. Clair River in Port Huron having a yearly average of about 8 mg/l

The microbiological quality was also excellent throughout the lake. The median coliform count for all ranges was less than 1 MF/100ml, with range maximums from 5 - 40 MF/100ml.

Fecal coliform and fecal streptococci results were likewise low, as were the one-day 35°C total plate count and the two-day 20°C total plate count.

The water quality of the various inshore, harbor, and tributary areas of Lake Huron, which exhibited differences from the main body of the lake, are presented in the following sections.

St. Marys River

The water entering from Lake Superior is of excellent quality at Range SMU 5.6. A decrease in quality is noted at Range SMD 2.0, below the cities of Sault Ste. Marie. This decrease in quality continues through the eastern passage at Range SMD 8.5E and through the western passage Range SMD 5.3W, although less pronounced. Recovery for certain parameters is indicated after passage through Lakes Nicolet and George by the quality at Ranges SMD 18.1W, 16.9M and 25.0E.

A large increase in phenol concentration was observed between SMU 5.6 and SMD 2.0. Average values rose from 4 to 53 µg/l. This increase was

also observed at SMD 8.5E and appeared to follow the eastern (Canadian) shore downstream. At the lower ranges, the concentration was again low, $< 2 - 3$ mg/l.

A significant increase in the coliform concentration was also observed. Median increased from 10 - 30 MF/100ml at SMU 5.6 to 70 - 7300 MF/100ml at SMD 2.0. A significant increase was noted between the 1965 and 1966 results, especially at the nearshore stations of SMD 2.0 and SMD 5.3W. The higher 1966 coliform concentration at SMD 8.5E were due to a temporary breakdown in the chlorination equipment at the Ontario Water Resources Commission sewage treatment plant. The maximum values for the period after chlorination more closely resembled the 1965 values.

No treatment needs or recommendations are included in this report for pollution sources not in the United States.

Straits of Mackinac

The entering waters from Lake Michigan are of very good quality. Average DO concentration exceeded 11.0 mg/l. The average BOD_5 was 1 mg/l, with a maximum of 3 mg/l. Both total and fecal coliform densities were low, with medians of less than 2 MFC/100ml, and fecal coliform was 5 MFC/100ml.

Cheboygan Harbor-South Channel

The DO concentration was high at all stations with an average of about 11 mg/l. The minimum value was 6.5 in the river, with an average of about 10 mg/l. BOD_5 ranged from 1 - 3 mg/l in the river, and 1 - 2 mg/l at the other stations. Chloride levels in South Channel (the waters from the Straits) were at the same range as in the river with average concentration slightly higher. Total solids and total hardness levels were 50% greater

in the river than in the South Channel waters - solids 190 mg/l vs 120 mg/l, and hardness 160 mg/l vs 110 mg/l. Suspended solids in the river and harbor averaged 10 mg/l compared with an average of 3 mg/l in the South Channel. The total and fecal coliform concentrations showed the effect of the river on the harbor waters. Median and maximum total coliforms were 220 and 1400 in the river (Y500), 48 and 790 in the harbor (H525), and 8 and 27 in the South Channel (H526). Fecal coliform values were respectively 30 and 460, 11 and 120, < 2 and 4, all results in MF/100ml.

Rogers City - Calcite

The following information is based on the results of limited sampling. The DO was high, with an average of 13.0 mg/l, with a less concentration of 12.1 mg/l found in the immediate harbor area. Total solids averaged about 130 mg/l, with the higher values near shore. Chloride concentrations were uniform at 5 mg/l, the average for the lake itself in this area. Suspended solids and volatile suspended solids ranged from 0 - 7 mg/l and 0 - 5 mg/l, with the maximum values near shore. The single total coliform value at the harbor was less than 2 MF/100ml.

Thunder Bay

The DO concentration ranged from an average of 9.8 mg/l in the Thunder Bay River and inner harbor area to 11.1 mg/l in the outer harbor. The low values ranged from 7.8 mg/l in the river to 9.3 mg/l in the outer harbor. BOD_5 concentration ranged from an average of 3 mg/l in the river, to 1 mg/l in the outer harbor. Total solids concentration ranged from an average of 240 mg/l in the river, and 140 in the inner harbor, to 110 in the outer harbor. Suspended solids concentration ranged from an average of 10 mg/l in the river, to 3 mg/l in the outer harbor. Chloride levels at all stations

were low, averaging 5 mg/l, the concentration of the main body of the lake. Total hardness ranged from an average of 190 mg/l in the river, to 94 mg/l in the outer harbor.

Total coliform and fecal coliform density medians were 430 and 130 in the river, 130 and 9 in the inner harbor, and 1 and 1 in the outer harbor. Maximum values were 2700 and 500, 3400 and 270, and 6 and 2, respectively; all results in MF/100ml.

Harrisville Harbor

The DO concentration averaged 11.0 mg/l in the more remote stations, with an average concentration of .5 to 7 mg/l less at the stations in the inner harbor. BOD_5 ranged from 1 - 2 mg/l, except in the inner harbor, where the range was 1 - 6 mg/l, with averages of 2 and 3 mg/l. Total solids averaged 120 mg/l in the outer harbor, with averages of 130 and 170 in the inner harbor stations. Suspended solids averaged 5 mg/l in the outer harbor, with averages of 10 and 35 mg/l near shore. Hardness averaged 96 mg/l in the outer harbor, and 101 and 105 mg/l at the inner harbor stations. Chlorides were at a uniform average of 5 mg/l at all stations.

Median total and fecal coliform densities were less than 2 and less than 1 in the outer harbor, 140 and 11 near the mouth of the harbor, and 19 and 16 at the south end of the harbor. Maximum densities were 7 and less than 2, 290, and 150, and 350 and 131, respectively, in MF/100ml. The station at the south end of the harbor appeared for most parameters to be of the poorer quality of the two inner harbor stations.

Oscoda-Au Sable

DO concentration was high in the outer harbor area averaging 10.9 mg/l. The concentration at the mouth of the harbor and in the Au Sable River was less, averaging 9.3 in the river, and 8.7 at the inner harbor. BOD_5 concentration ranged from 1 - 2 mg/l in the outer stations, with a slightly higher concentration in the river. Total solids ranged from an average of 190 mg/l in the river, and 180 in the inner harbor, averaging 140 mg/l. Suspended solids averaged about 8 mg/l in the river and inner harbor, and about 5 in the outer harbor. Chloride levels were apparently higher than found previously, with an average concentration of about 6 mg/l.

Total and fecal coliform median densities ranged from 4700 and 140 in the river, 460 and 26 in the inner harbor, to about 18 and less than 2 in the outer harbor. Maximum values were 45,000 and 7200, 3500 and 130, 290 and 3, respectively, in MF/100ml. These values indicated recent bacterial contamination of the river and also the immediate harbor.

The high bacteria counts at the mouth of the Au Sable constitute a hazard for total and partial body contact use. Excessive growth of vegetation tends to interfere with the trout fishing on the Au Sable. Expansion and improvements in treatment and collection of wastes at Gaylord, Grayling, Oscoda, Au Sable, and Roscommon, would materially reduce bacteriological and vegetative interferences with recreational water use.

Saginaw Bay

The DO concentration of the main bay ranged from an average of 8.0 mg/l near the mouth of the Saginaw River, to an average of 10.0 mg/l in the outer bay. BOD_5 average concentration decreased from 4 mg/l near the mouth of the river to 2 mg/l in the outer bay. Total solids average concentration decreased

from 690 mg/l to 150 mg/l. Suspended solids average concentration decreased from 27 mg/l to 4 mg/l. Chloride concentrations decreased from 169 mg/l to 11 mg/l. In general, the higher concentration tended toward the eastern shore of the bay. The values in Tawas Bay were generally lower than those in the outer bay range.

Significantly different coliform densities were observed during the chlorination period, from the pre- and post-chlorination period. These densities before chlorination ranged from greater than 10,000 MF/100ml near the mouth of the Saginaw River, and 1500 MF/100ml near Tawas City. During the chlorination period, the median at the mouth of the river was 11 - 100 MF/100ml, with all other areas showing medians of less than 1 or 1 - 10 MF/100ml.

The water quality of the 6 major tributaries to Saginaw Bay, excluding the Saginaw River, showed considerable variation in some parameters, with minor variation in others. Average dissolved oxygen concentration ranged from 8.0 - 10.6 mg/l. A single stream, the Sebewaing showed the maximum DO variation 2.6 - 16.6 mg/l, and also the maximum average concentration. Average BOD_5 concentration ranged from 2 - 5 mg/l. Average chloride concentration ranged from 2 - 142 mg/l. Total hardness averages ranged from 160 - 334 mg/l. Total and fecal coliform medians ranged from 370 - 15,000 MF/100ml and 88 - 480 MF/100ml.

The water quality of the major tributary to the Bay, the Saginaw River, was highly variable. Average DO was 7.1 mg/l, with a range of 3.0 to 13.0 mg/l. Average BOD_5 was 5 mg/l. Average suspended solids was 34 mg/l, with total solids of 890 mg/l. Average chloride concentration was 243 mg/l.

Geometric mean coliform was 53,000 MF/100ml for pre- and post-chlorination period, and 5700 MF/100ml during the chlorination period.

The year-round chlorination required by the Michigan Department of Public Health as of January 1967 is expected to decrease the bacteria levels in the water and the threat to health and recreational use. Better water quality in the Bay will be achieved by construction of additional collection and treatment facilities throughout the drainage basin.

Harbor Beach

The DO concentration average exceeded 11.0 mg/l at all stations. The BOD_5 concentration averaged about 2 mg/l for the other harbor stations, and about 2 mg/l for the inner harbor stations. Total solids average concentration averaged 130 mg/l at the outer harbor stations and 140 mg/l in the inner harbor. Suspended solids averaged 4 mg/l in the outer harbor, and 7 mg/l in the inner harbor. Chloride levels were 8 mg/l in the outer harbor, and about 9 mg/l in the inner harbor -- about 3 - 4 mg/l higher than the values found along the upper Lake Huron shoreline. Total hardness averaged 99 mg/l with some minor variation among the inner and outer harbor stations.

Total and fecal coliform densities revealed significant differences in the water quality of the inner and outer harbor. Median and maximum total coliforms were less than 10 and 22 in the outer harbor, and 66 and 190 in the inner harbor. Median and maximum fecal coliforms were 1 and 2, and 32 and 66, respectively, in MF/100ml.

Port Sanilac

DO concentration averaged 11.7 mg/l in all parts of the harbor. BOD_5 averaged 1 mg/l in the outer area and 1 mg/l within the breakwater. Total solids averaged about 120 mg/l in the outer area, and about 130 within the

breakwater. Suspended solids averaged less than 4 mg/l in the outer harbor, and 13 mg/l within the breakwater. Total hardness was uniform, averaging about 99 mg/l throughout the harbor. Chlorides averaged 6 mg/l in the outer harbor, and 7 mg/l within the breakwater, or about the average concentration of the main lake body in that area.

Total and fecal coliform densities were low, with the exception of the station within the breakwater. The median and maximum values in the outer harbor were 1 and 3 for total coliform, with a maximum fecal value of less than 2. Within the breakwater, the corresponding values were 66 and 154 total and 10 and 18 fecal coliform in MF/100ml.

Port Huron

Average DO concentration in the southern end of Lake Huron averaged 11.0 mg/l. Average BOD_5 concentration ranged from 1 - 2 mg/l, with a maximum value of 3 mg/l. Total solids averaged 110 mg/l, with values near the shores 3 mg/l higher. Suspended solids averaged about 2 mg/l in the main body of the lake, and from 6 - 8 mg/l near the shore. Chlorides were uniform, averaging about 6 mg/l. Total hardness averaged 94 mg/l at all stations.

Total and fecal coliform densities were low throughout the range. Median total and fecal coliform values were 1 and less than 1 MF/100ml. Maximum total coliforms of 11 and 16 MF/100ml were found along the shores with maximums from 2 - 6 found in the offshore waters. Maximum fecal coliform value found was 2 MF/100ml.

WATER USES

The principal water uses of the Michigan tributaries of Lake Huron Basin include:

Municipal Water Supply - Use of surface waters of the river, bay, or lake, as a municipal water source.

Total Body Contact - The complete immersion of the body in water as in swimming.

Partial Body Contact - Partial immersion of the body as in water skiing, wading, and stream fishing.

Fish and Aquatic Life - Habitat for fish and aquatic life and available for fishing.

Wildlife - Available for animal and fowl wildlife use.

Livestock - Used for stock watering of dairy cows, pigs, horses, etc.

Irrigation - Used for watering of agricultural lands, golf courses, parks, etc.

Industrial Water Supply - Use of surface waters for processing and manufacturing.

Cooling Water - Industrial and municipal surface water use for cooling of machinery.

Hydro-power - River waters used for the production of hydroelectric power.

Waste Assimilation - Assimilation of municipal and industrial wastes and wastewater.

Esthetics - The use of water for esthetic enjoyment. Camping, picnicking, and sight-seeing, while not directly water oriented activities, are considerably enhanced by the presence of a relatively clean water course.

Pleasure Boating - Includes canoes, small row boats, power boats, and sailboats.

Commercial Shipping - Use of lakes and streams by steamships and commercial fishing boats.

Table 2 is a description of the river, bay, and lake areas covered by this report, and Figure14 shows their locations in reference to the basins by area. The reach boundaries were based on consideration of changing water quality, observed and reported water uses (See Table 3), and/or certain physical features of the area. These water uses were developed through extraction of material from the Michigan Water Resources Commission reports, Bureau of Recreation reports, Michigan Department of Public Health reports, and the U.S. Public Health Service reports. However, full responsibility for designation of these uses is assumed by this office.

The Lake Huron Basin waters are predominantly used for recreational activities, such as swimming, boating, fishing, water skiing, canoeing, camping, picnicking, hiking, and sight-seeing.

TABLE 2. REACH DESCRIPTIONS

Stream	Description
	St. Marys River Area
St. Marys River	Upper - White Fish Bay to Soo Locks Lower - Soo Locks to Lake Huron
Waiska River	St. Marys River to head
Charlotte River	St. Marys River to head
Little Muniscong River	St. Marys River to head
Big Muniscong River	St. Marys River to head
Gogomain River	St. Marys River to head
	Upper Lake Huron Area
Cheboygan River	Lake Huron to Mullet Lake 6.0 Mile
Indian River	Between Burt and Mullett Lakes
Carp River	Lake Huron to head
Ocqueoc River	Lake Huron to head
Trout River	Lake Huron to head
Swan River	Lake Huron to head
Little Trout River	Lake Huron to head
Grand Lake Outlet	Lake Huron to Grand Lake
Long Lake Creek	Lake Huron to head
Devils River	Lake Huron to head
Black River	Lake Huron to head
Thunder Bay River	Thunder Bay to Hillman (40.75 miles)
Thunder Bay	From north point to south point
Au Sable	Lake Huron to Grayling (60 miles)

TABLE 2. REACH DESCRIPTIONS (cont.)

Lower Lake Huron Area

Stream	Description
New River	Lake Huron to North of Bad Axe
Willow River	Lake Huron to East of Bad Axe
Diamond Creek	Lake Huron to head
Ocka Creek	Lake Huron to head
Rock Falls Creek	Lake Huron to head
Sucker Creek	Lake Huron to head
Elm Creek	Lake Huron to head
White River	Lake Huron to head
Mill Creek	Lake Huron to head
Elk Creek	Lake Huron to head
Indian Creek	Lake Huron to head
Big Creek	Lake Huron to head
Cherry Creek	Lake Huron to head
Bridgehampton	Lake Huron to head
Mill Creek	Lake Huron to West of Lexington
Birch Creek	Lake Huron to South of Lexington

TABLE 2. REACH DESCRIPTIONS (Cont.)

Saginaw Bay Area

Stream	Description
Saginaw Bay	Tawas Bay to Bird Creek
Saginaw River	Saginaw Bay to Saginaw 21.14 M.P.
Quanicassee River	Saginaw Bay to head
Sebewaing River	Saginaw Bay to above Sebewaing
Pigeon River	Saginaw Bay to South of Bad Axe
Pinnebog River	Saginaw Bay to South of Bad Axe
Bird Creek	Saginaw Bay to head
Kawkawlin River (NB)	Saginaw Bay to head
Pinconning River	Saginaw Bay to head
Pine River	Saginaw Bay to head
Rifle River	Saginaw Bay to head
Au Gres River	Saginaw Bay to head
Tawas River	Tawas Bay to Lake Tawas

Saginaw River Basin Tributaries Area

Tittabawassee River	Lower - Saginaw River to Gladwin County Upper - Gladwin County to Roscommon County
Chippewa	Tittabawassee River at Midland to Barryton
Pine	Chippewa River to Alma
Salt River	Mouth of Sanford Lake to North of Mt. Pleasant
Tobacco River	Tittabawassee River to Farwell
Shiawassee River	Saginaw River to Holly
Cass River	Shiawassee River to Ubly
Flint River	Shiawassee River to North Branch

TABLE 3. WATER USE

River & Reach***	Number code for water use*													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
ST. MARYS RIVER AREA														
St. Marys														
Upper	PA	PA	PA	PA	PA	-	-	PA	PA	PA	PA	PA	PA	PA
Lower	-	PA**	PA	PA	PA	-	-	-	-	PA	PA	PA	PA	PA
Waiska	-	-	-	PA	PA	PA	-	-	-	-	PA	PA	PA	-
Charlotte	-	PA	PA	PA	PA	PA	-	-	-	-	-	PA	PA	-
Little Munuscong	-	PA	PA	PA	PA	PA	-	-	-	-	-	PA	PA	-
Big Munuscong	-	PA	PA	PA	PA	PA	-	-	PA	-	PA	PA	PA	-
Gogomain	-	PA	PA	PA	PA	PA	-	-	-	-	-	PA	PA	-
UPPER LAKE HURON AREA														
Cheboygan	-	PA**	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA
Indian	-	PA	PA	PA	PA	-	PA	-	-	-	PA	PA	PA	-
Carp	-	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	-
Ocqueoc	-	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	-

Notes: P - present water use.
A - anticipated water use.
- - no present use.
* - see key, Table 4.
** - use presently affected by pollution.
*** - reach description, Table 2.

TABLE 3. WATER USE

River & Reach***	Number code for water use*													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
						UPPER LAKE HURON AREA								
Trout	-	-	-	PA	PA	-	-	-	-	-	-	PA	PA	-
Swan	-	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	-
Little Trout	-	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	-
Grand Lake Outlet	-	-	-	PA	PA	-	-	-	-	-	-	PA	-	-
Long Lake Creek	-	-	-	PA	PA	-	-	-	-	-	-	PA	-	-
Thunder Bay	PA	PA**	PA	PA	PA	-	-	-	PA	-	PA	PA	PA	PA
Thunder Bay R.	-	PA**	PA	PA**	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA
Devils	-	-	-	PA	PA	-	-	-	-	-	-	PA	-	-
Black	-	-	-	PA	PA	-	-	-	-	-	-	PA	-	-
Au Sable	-	PA**	PA**	PA**	PA	PA	-	-	-	PA	PA	PA**	PA	-
						SAGINAW BAY AREA								
Saginaw Bay	PA	PA**	PA**	PA**	PA	PA	PA	PA	PA	-	PA	PA	PA	PA
Tawas Bay	PA	PA	PA	PA	PA	-	-	-	PA	-	PA	PA	PA	PA

Notes:
P - present water use.
A - anticipated water use.
- - no present use.
* - see key, Table 4.
** - use presently affected by pollution.
*** - reach description, Table 2.

TABLE 3. WATER USE

River & Reach***	Number code for water use*													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SAGINAW BAY AREA														
Tawas	-	PA	PA	PA	PA	-	-	-	-	-	PA	PA	PA	-
Au Gres	-	PA	PA	PA	PA	PA	PA	-	-	-	-	PA	PA	-
Rifle	-	PA	PA	PA	PA	PA	PA	-	-	-	PA	PA	PA	-
Pine	-	PA	PA	PA	PA	PA	PA	-	-	-	PA	PA	PA	-
Pinconning	-	PA	PA**	PA	PA	PA	-	-	-	-	PA	PA	PA	-
Kawkawlin (NB)	-	-	PA**	-	PA	PA	PA	-	-	-	PA	PA	PA	-
Saginaw	-	PA**	PA**	PA**	PA	PA	PA	PA	PA	-	PA	PA**	PA**	PA
Quanicassee	-	-	-	PA	PA	PA	PA	-	-	-	-	PA	PA	-
Sebewaing	-	-	-	PA	PA	PA	PA	-	-	-	PA	PA	PA	PA
Pigeon	-	A	A	PA	PA	PA	PA	-	-	-	-	PA	PA	-
Pinnebog	-	A	A	PA	PA	PA	PA	-	-	-	PA	PA	PA	-
Bird Creek	-	A	A	PA	PA	PA	-	-	-	-	-	PA	PA	PA

Notes:
P - present water use.
A - anticipated water use.
- - no present use.
* - see key, Table 4.
** - use presently affected by pollution.
*** - reach description, Table 2.

TABLE 3 WATER USE

River & Reach***	Number code for water use*													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SAGINAW RIVER BASIN TRIBUTARIES														
Shiawassee	-	-	-	PA	PA	PA	PA	PA	PA	-	PA	PA	PA	-
Flint	PA	-	PA**	PA**	PA	PA	PA	-	-	-	PA	PA**	-	-
Cass	PA	-	-	PA**	PA	PA	PA	PA	PA	-	PA	PA**	PA	-
Tittabawassee - Lower	-	-	-	PA**	PA	PA	PA	PA	PA	PA	PA	PA	-	-
Upper	-	PA	PA	PA	PA	PA	-	-	-	-	-	PA	PA	-
Chippewa	-	PA	PA	PA	PA	PA	-	-	-	PA	PA	PA	PA	-
Pine	-	PA	PA	PA	PA	PA	-	-	-	PA	PA	PA	PA	-
Salt	-	PA	PA	PA	PA	PA	-	-	-	-	PA	PA	-	-
Tobacco	-	PA	PA	PA	PA	PA	-	-	-	-	PA	PA	PA	-
LOWER LAKE HURON AREA														
New River	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Willow	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Diamond Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-

Notes:
P - present water use.
A - anticipated water use.
- - no present use.
* - see key, Table 4.
** - use presently affected by pollution.
*** - reach description, Table 2.

TABLE 3. WATER USE

Municipal Areas	Number code for water use*													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
UPPER LAKE HURON AREA														
Mackinaw City	PA	PA	PA	PA	PA	-	-	-	-	-	PA	PA	PA	PA
Cheboygan	-	PA	PA	PA	PA	-	-	-	-	-	PA	PA	PA	PA
Rogers City	-	PA	PA	PA	PA	-	-	-	-	-	PA	PA	PA	PA
Alpena	PA	PA	PA	PA	PA	-	-	-	PA	-	PA	PA	PA	PA
Harrisville	-	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	PA
Oscoda	-	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	PA
LOWER LAKE HURON AREA														
Port Austin	-	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	-
Port Hope	PA	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	-
Harbor Beach	PA	PA**	PA**	PA**	PA	-	-	PA	PA	-	PA	PA	PA	PA
Port Sanilac	-	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	-
Forrestvilee	-	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	-
Lexington	-	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	-
Lake Port	-	PA	PA	PA	PA	-	-	-	-	-	-	PA	PA	-

Notes:
P - present water use.
A - anticipated water use.
- - no present use.
* - see key, Table 4.
** - use presently affected by pollution.
*** - reach description, Table 2.

TABLE 3. WATER USE

River & Reach***	Number code for water use*													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
LOWER LAKE HURON AREA														
Ocka Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Spring Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Rock Falls Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Sucker Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Elm Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
White Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Mill Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Elk Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Indian Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Big Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Cherry Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Bridgehampton	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Mill Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-
Birch Creek	-	-	-	PA	PA	PA	-	-	-	-	-	PA	-	-

Notes:
P - present water use.
A - anticipated water use.
- - no present use.
* - see key, Table 4.
** - use presently affected by pollution.
*** - reach description, Table 2.

TABLE 4. KEY TO WATER USE CODE

1. Municipal Water Supply
2. Total Body Contact
3. Partial Body Contact
4. Fish and Aquatic Life
5. Wildlife
6. Livestock Watering
7. Irrigation
8. Industrial Water Supply
9. Cooling Water
10. Hydro-power
11. Waste Assimilation
12. Esthetics
13. Pleasure Boating
14. Commercial Shipping

INSTITUTIONAL ORGANIZATIONS FOR WATER POLLUTION CONTROL IN MICHIGAN

The following is a list of Michigan Statutes and a brief explanation of their relationship to water pollution control:

Act 350, P.O. 1865 - Conservation Department directed to protect fish and fisheries.

Act 98, P.A. 1973 - Initiated the supervision of municipal water and sewer facilities by the Michigan Health Department.

Act 17, P.A. 1921 - Conservation Department was granted broad authority to "prevent and guard against pollution of lakes and streams within the State."

Act 61, P.A. 1939 - Director of Conservation was named State Supervisor of Wells (for oil and gas) and authorized "to prevent waste or damage to oil and gas, the fresh, brine, and mineral waters or to life and property."

Act 219, P.A. 1949 - Michigan Health Department's control of plans, construction, operation, and supervision of public water supplies, sewerage and sewage treatment facilities was strengthened.

Act 40, P.A. 1956 - Defines unlawful use of county and intercounty drains for carrying sewage and other wastes. County Drain Commissions are responsible for actions under this law.

Act 306, P.A. 1927 - Authorize local health departments to adopt and enforce regulations controlling installation and operation of private sewage disposal systems.

Act 245, P.A. 1929
Act 117, P.A. 1949)
Act 165, P.A. 1963) Amendments to Act 245, P.A. 1929
Act 405, P.A. 1965)

The Michigan Water Resources Commission by authority of the foregoing Acts, is composed of seven members: the Heads of Department of Health, Conservation, Agriculture and Highways, as well as members representing Industrial Management, Municipalities, and Organized Conservation Groups.

Act 20, P.A. 1964 - Water Resources Commission controls storage and established optimum flows for all legitimate uses on a stream.

The Act creating a Water Resources Commission, prohibited the pollution of any waters of the State and the Great Lakes, designated the commission as the State agency in matters concerning the water resources of the State and provided penalties for the violation of the Act. The Act as amended (1965) is composed of twelve major sections. Sections 1 to 4 create the commission, authorize it to make rules and regulations, to enforce provisions of the Act, and to inspect and investigate matters relating to water pollution. Section 5 details the establishment of standards for waters and effluent discharges, and to prevent any pollution. Section 6 (A) is a broad definition of injurious pollution. Section 6 (B) defines "the discharge of any raw sewage of human origin, directly or indirectly into any of the waters of the State shall be considered prima facie evidence of the violation of Section 6 (A)." In addition any governmental unit is held responsible for the acts of "persons" within its boundaries. Section 6 (C) authorizes townships to issue and sell the necessary bonds to construct treatment works. Section 6 (D) defines any violation of Section 6 as a public nuisance and provides for remedies in addition to those specified for water pollution violations. Sections 7 through 12 provide for the legal rights of accused polluters and penalties for those found to be guilty and for conducting hearings and issuing orders of determination, define certain terms and fulfill the legal requirements of Michigan laws. Two important subsections in this group are Sections 8 (B) requiring the filing of proposed use statements with the commission, before using the waters of the State sewage or waste disposal purposes, and Section 12 exempting certain copper or iron mining operations from the provisions of the Act.

Summary of duties:

The Michigan Water Resources Commission has primary responsibility for controlling pollution in the waters of the State, setting of legal water quality standards, comprehensive water resource planning, and establishing priorities for construction grant programs.

The Michigan Department of Public Health controls construction and operation of public sewage collection and treatment systems and public water supply systems, as well as licensing of operators of water supply and sewage treatment plants.

Water and Related Land Resources Planning in Michigan:

There are three Michigan Departments primarily responsible for the activities relevant to comprehensive water and related resource planning.

Department of Commerce (Office of Economic Expansion, State Resource Planning Division, and the Community Planning Division).

Department of Highways (Office of Planning).

Department of Conservation (Division of Recreation Resource Planning and the Planning Section of the Water Resources Commission), the Michigan Water Resources Commission has been designated by Governor Romney as the State agency to develop a comprehensive water and related land resource plan for Michigan.

An Inter-agency Committee was organized as directed by Governor Romney to "coordinate joint State-Federal programs with local and regional planning of Michigan's water and related land resources."

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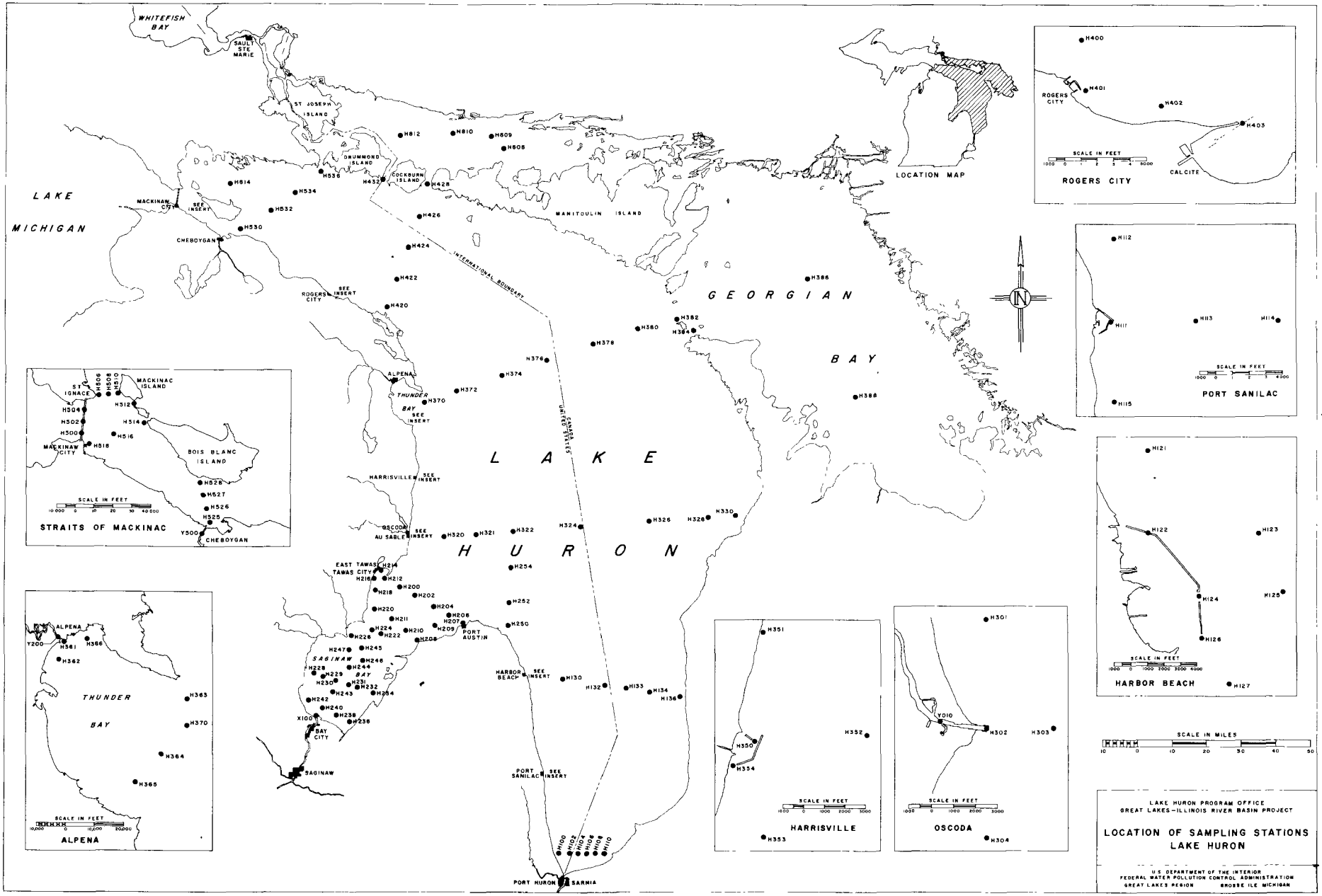
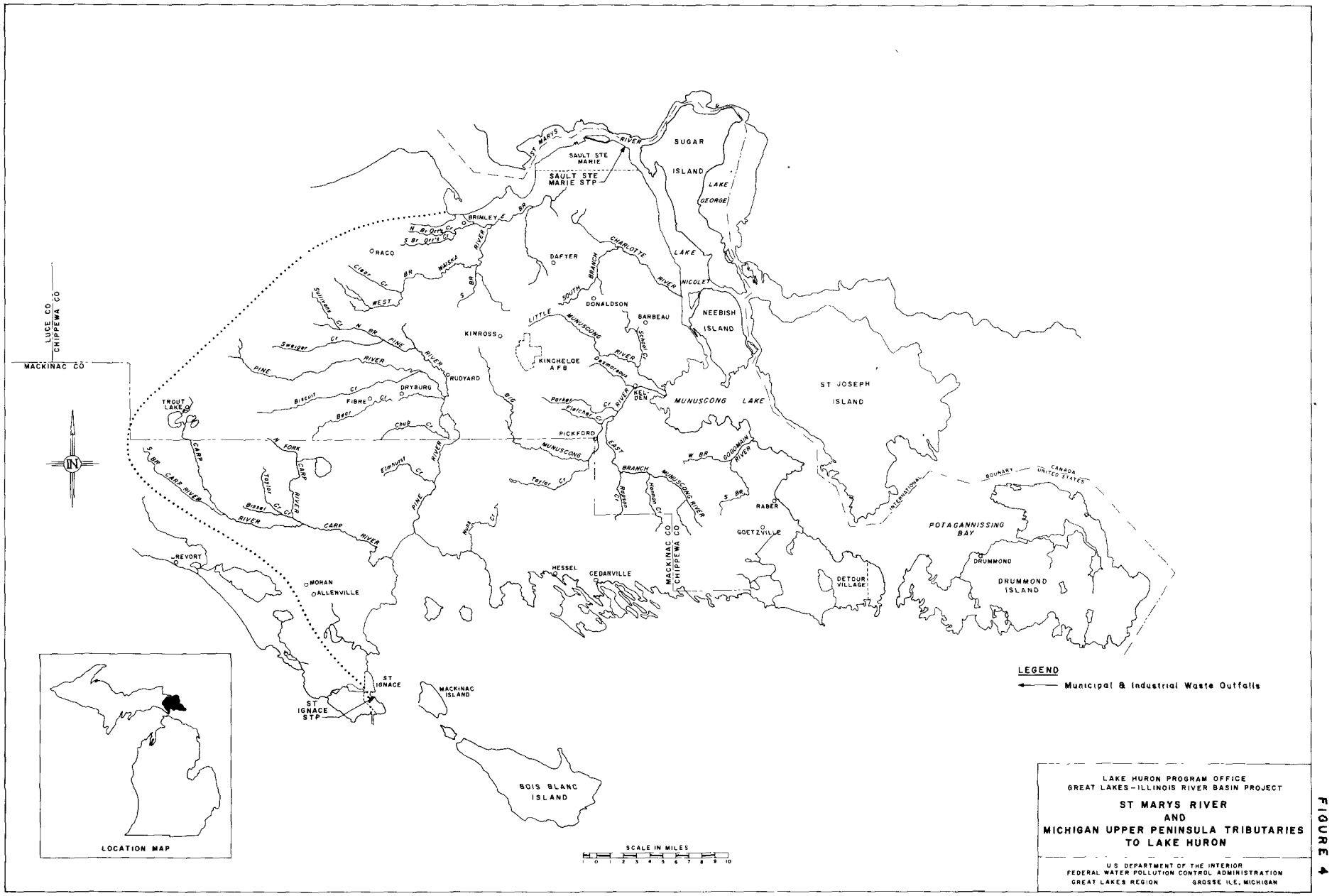


LAKE HURON PROGRAM OFFICE
GREAT LAKES–ILLINOIS RIVER BASIN PROJECT

LOCATION OF SAMPLING STATIONS LAKE HURON

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION — BROSSE ILE MICHIGAN

FIGURE 2



LAKE HURON PROGRAM OFFICE
GREAT LAKES–ILLINOIS RIVER BASIN PROJECT

ST MARYS RIVER AND MICHIGAN UPPER PENINSULA TRIBUTARIES TO LAKE HURON

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN

FIGURE 4

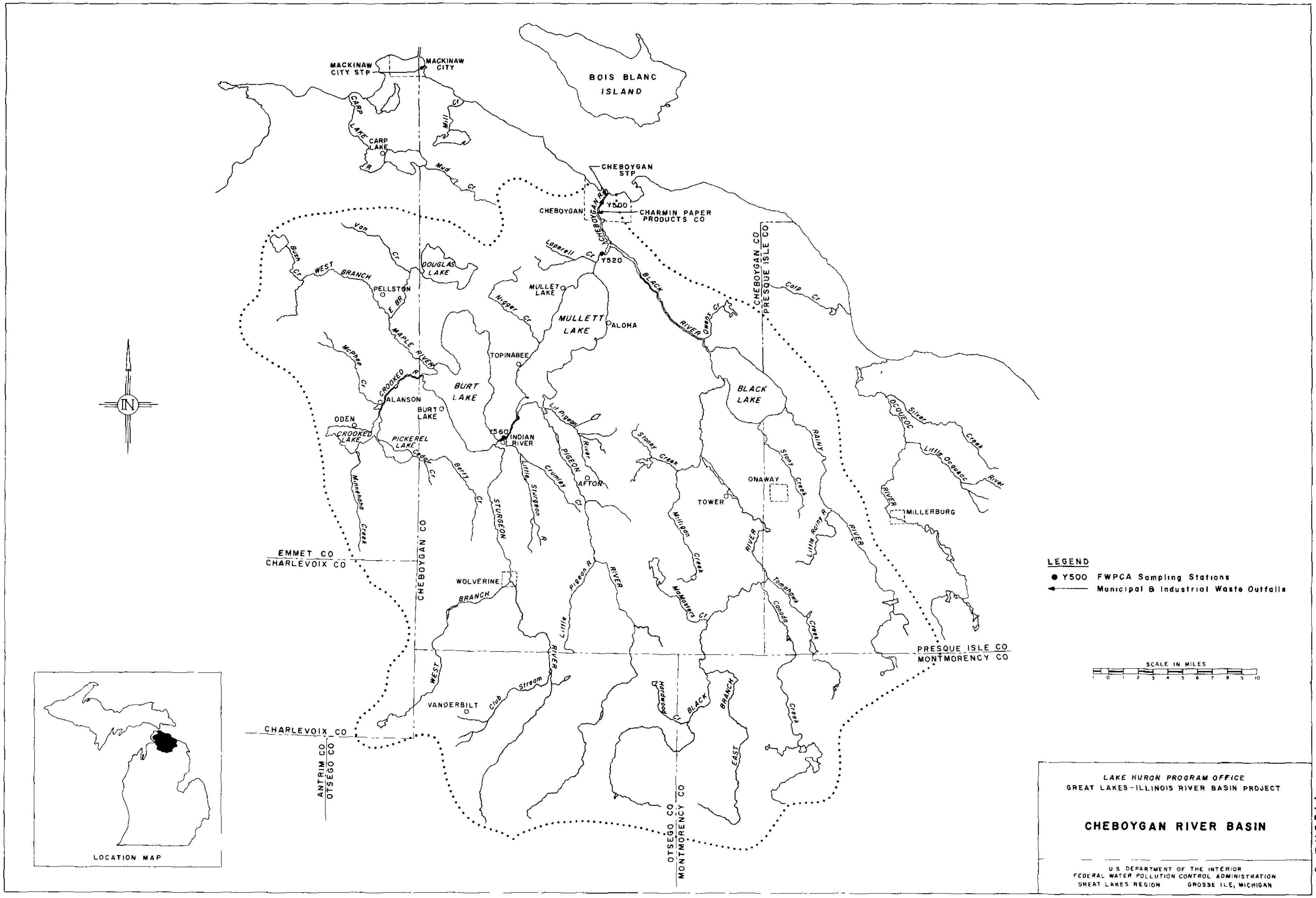


FIGURE 5

LAKE HURON PROGRAM OFFICE
GREAT LAKES-ILLINOIS RIVER BASIN PROJECT

CHEBOYGAN RIVER BASIN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN

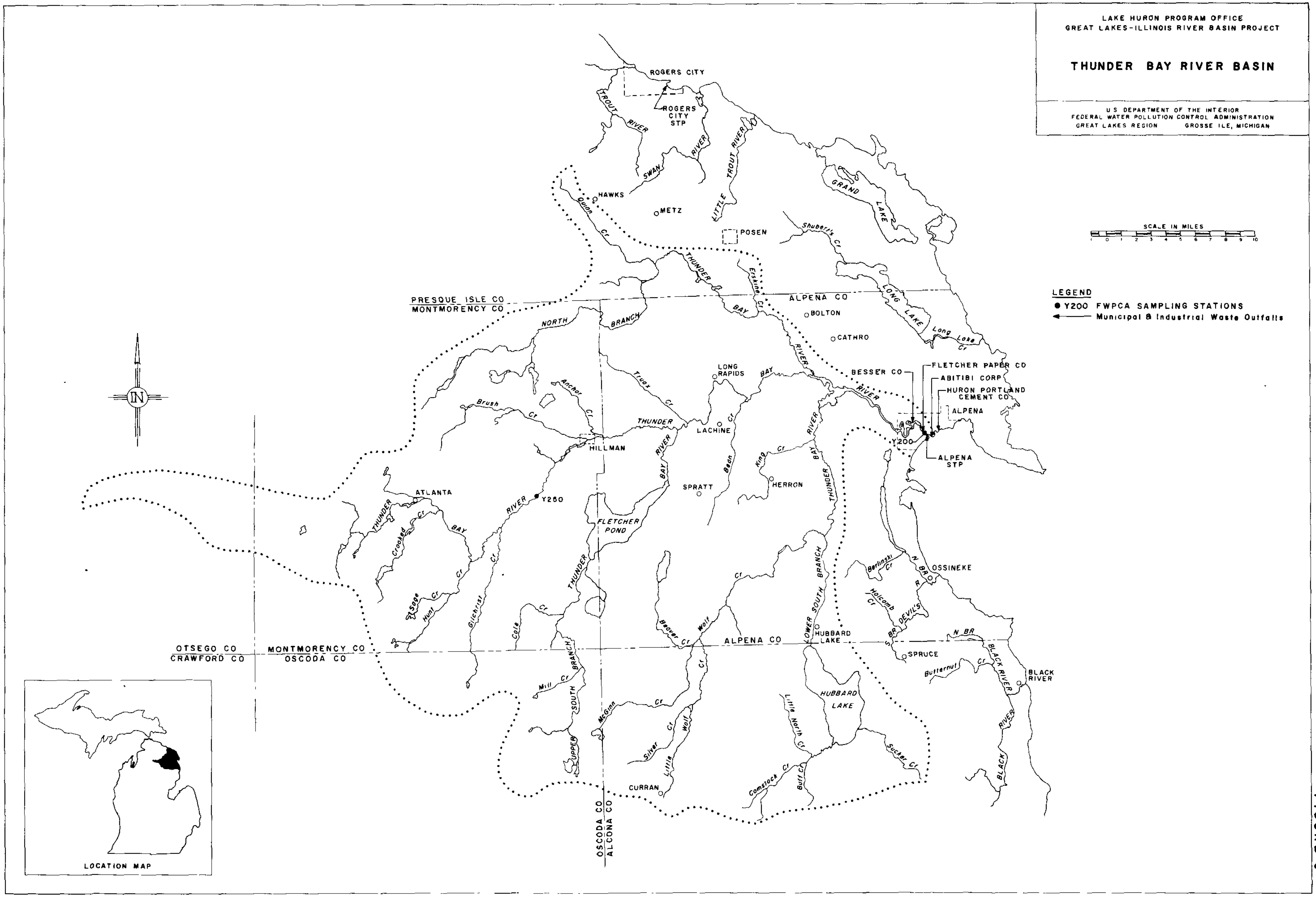

LAKE HURON PROGRAM OFFICE
GREAT LAKES-ILLINOIS RIVER BASIN PROJECT
THUNDER BAY RIVER BASIN
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN
SCALE IN MILES
LEGEND
● Y200 FWPCA SAMPLING STATIONS
Municipal & Industrial Waste Outfalls
ROGERS CITY
ROGERS CITY STP
HAWKS
METZ
POSEN
BOLTON
CATHRO
LONG RAPIDS
LACHINE
SPRATT
HERRON
HILLMAN
ATLANTA
OSSINEKE
HUBBARD LAKE
SPRUCE
BLACK RIVER
CURRAN
ALPENA
ALPENA STP
BESSER CO
FLETCHER PAPER CO
ABITIBI CORP
HURON PORTLAND CEMENT CO
Y200
Y250
PRESQUE ISLE CO
MONTMORENCY CO
ALPENA CO
OTSEGO CO
CRAWFORD CO
OSCODA CO
ALCONA CO
LOCATION MAP

FIGURE 6

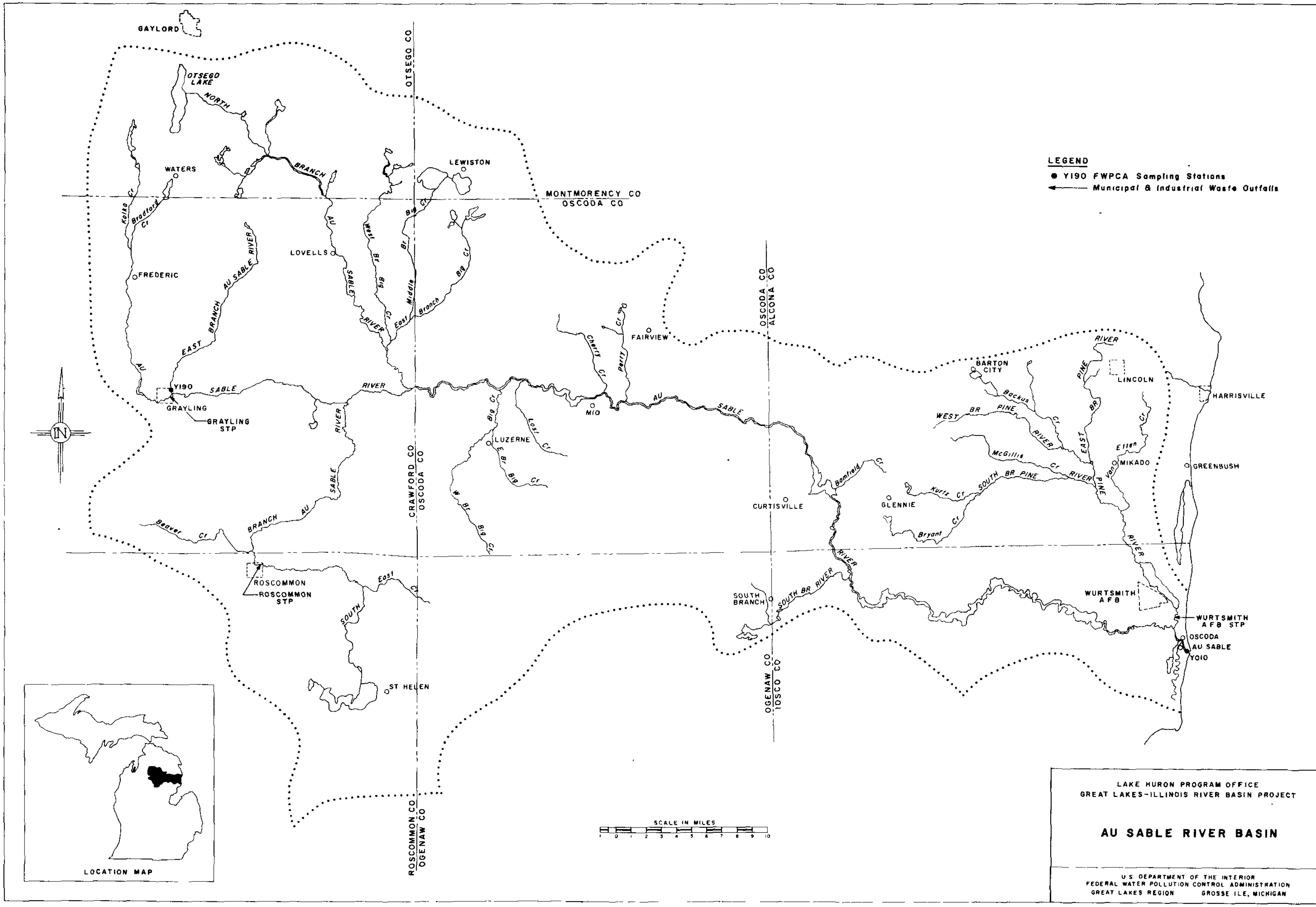


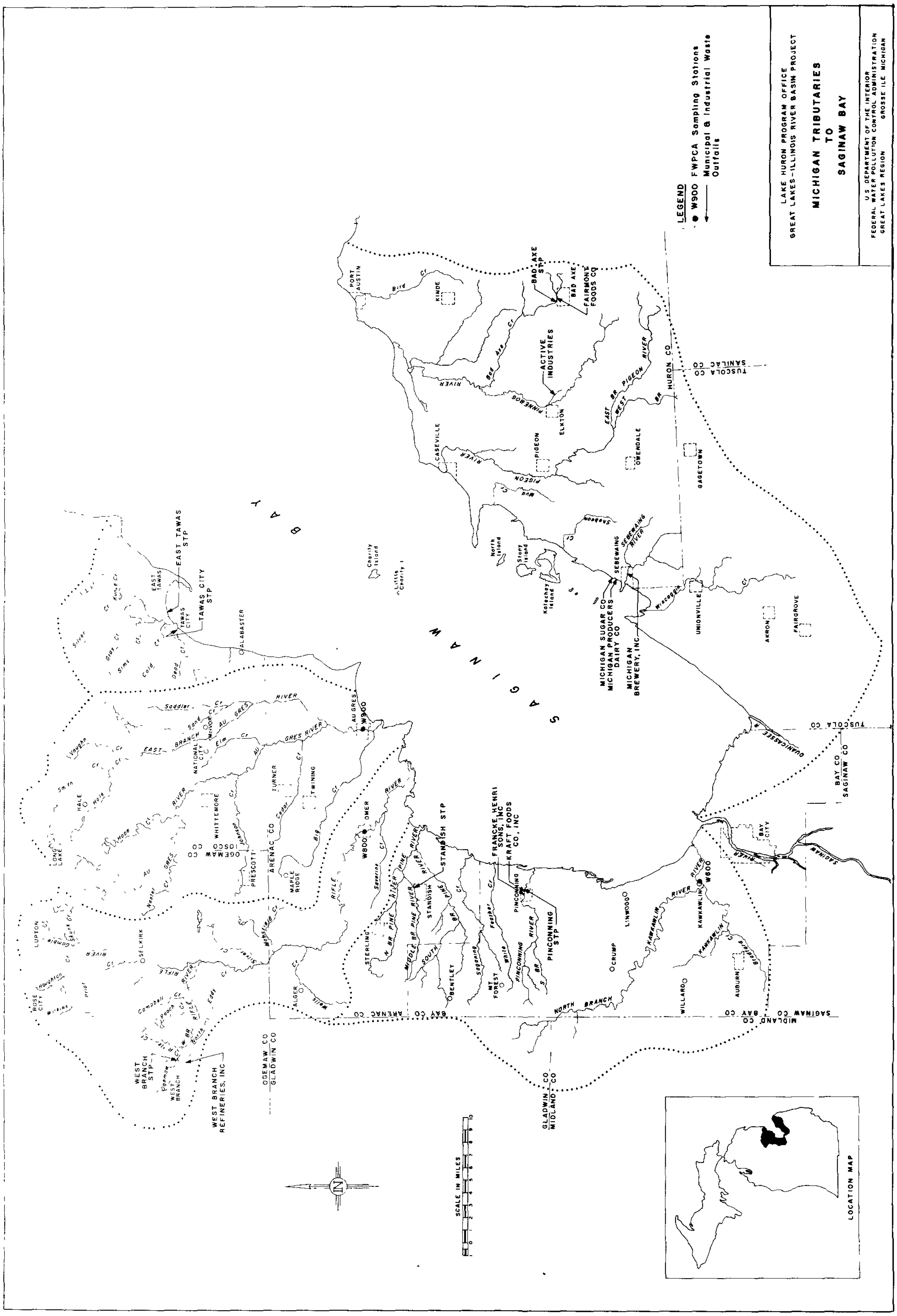
FIGURE 7

LAKE HURON PROGRAM OFFICE
GREAT LAKES-ILLINOIS RIVER BASIN PROJECT

AU SABLE RIVER BASIN

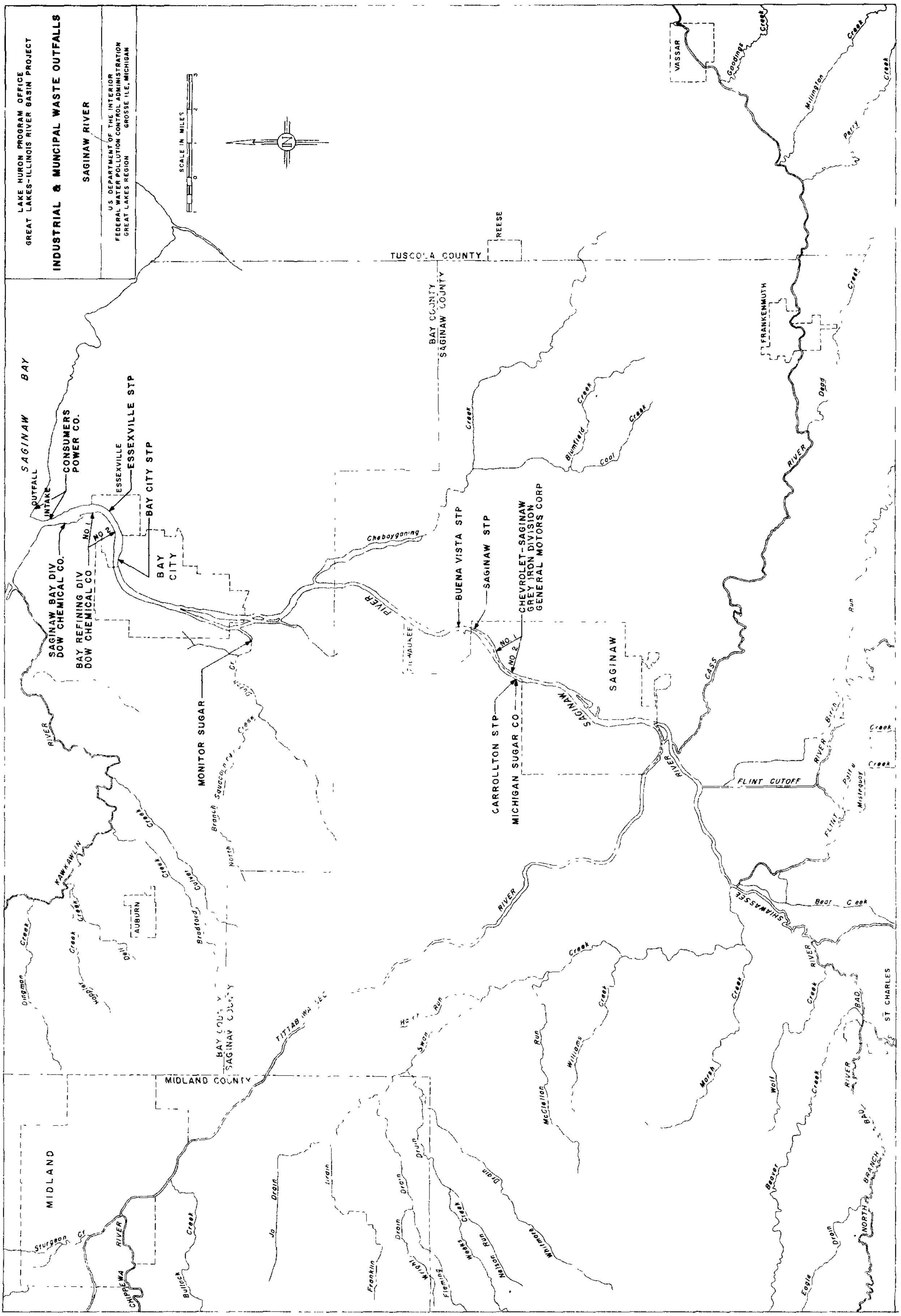
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN

FIGURE 8



LAKE HURON PROGRAM OFFICE
GREAT LAKES-ILLINOIS RIVER BASIN PROJECT
MICHIGAN TRIBUTARIES
TO
SAGINAW BAY
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN
LEGEND
W900 FWPCA Sampling Stations
Municipal & Industrial Waste Outfalls
SAGINAW BAY
LOCATION MAP
SCALE IN MILES
N
BAD AXE STP
FAIRMONT FOODS CO
ACTIVE INDUSTRIES
MICHIGAN SUGAR CO
MICHIGAN PRODUCERS DAIRY CO
MICHIGAN BREWERY, INC.
EAST TAWAS STP
TAWAS CITY STP
STANDISH STP
FRANCKE, HENRI SONS, INC
KRAFT FOODS CO, INC
PINCONNING STP
WEST BRANCH STP
WEST BRANCH REFINERIES, INC
PORT AUSTIN
KINDE
BAD AXE
ELKTON
PIGEON
CASEVILLE
OWENDALE
GAGETOWN
SEBEWAING
UNIONVILLE
AKRON
FAIRGROVE
BAY CITY
KAWKAWLIN
LINWOOD
PINCONNING
STANDISH
OMER
AU GRES
ALABASTER
TAWAS CITY
EAST TAWAS
NATIONAL CITY
WHITTEMORE
PRESCOTT
TURNER
TWINING
MAPLE RIDGE
STERLING
BENTLEY
MT FOREST
CRUMP
WILLARD
AUBURN
ALGER
HALE
LONG LAKE
LUPTON
ROSE CITY
SELKIRK
WEST BRANCH
HURON CO
TUSCOLA CO
SANILAC CO
BAY CO
SAGINAW CO
MIDLAND CO
ARENAC CO
OGEMAW CO
IOSCO CO
GLADWIN CO

FIGURE 9



LAKE HURON PROGRAM OFFICE
GREAT LAKES-ILLINOIS RIVER BASIN PROJECT
INDUSTRIAL & MUNCIPAL WASTE OUTFALLS
SAGINAW RIVER
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN
SCALE IN MILES
SAGINAW BAY
OUTFALL
INTAKE
CONSUMERS POWER CO.
ESSEXVILLE
ESSEXVILLE STP
BAY CITY STP
NO 1
NO 2
SAGINAW BAY DIV DOW CHEMICAL CO.
BAY REFINING DIV DOW CHEMICAL CO
BAY CITY
MONITOR SUGAR
BUENA VISTA STP
SAGINAW STP
CHEVROLET-SAGINAW GREY IRON DIVISION GENERAL MOTORS CORP
CARROLLTON STP
MICHIGAN SUGAR CO.
SAGINAW
SAGINAW RIVER
TUSCOLA COUNTY
REESE
VASSAR
FRANKENMUTH
BAY COUNTY
SAGINAW COUNTY
MIDLAND COUNTY
MIDLAND
AUBURN
ST CHARLES
CASS RIVER
FLINT RIVER
FLINT CUTOFF
SHIAWASSEE RIVER
TITTABAWASSEE RIVER
KAWKAWLIN RIVER
CHIPPEWA RIVER
BAD RIVER
Cheboyganing

FIGURE 10

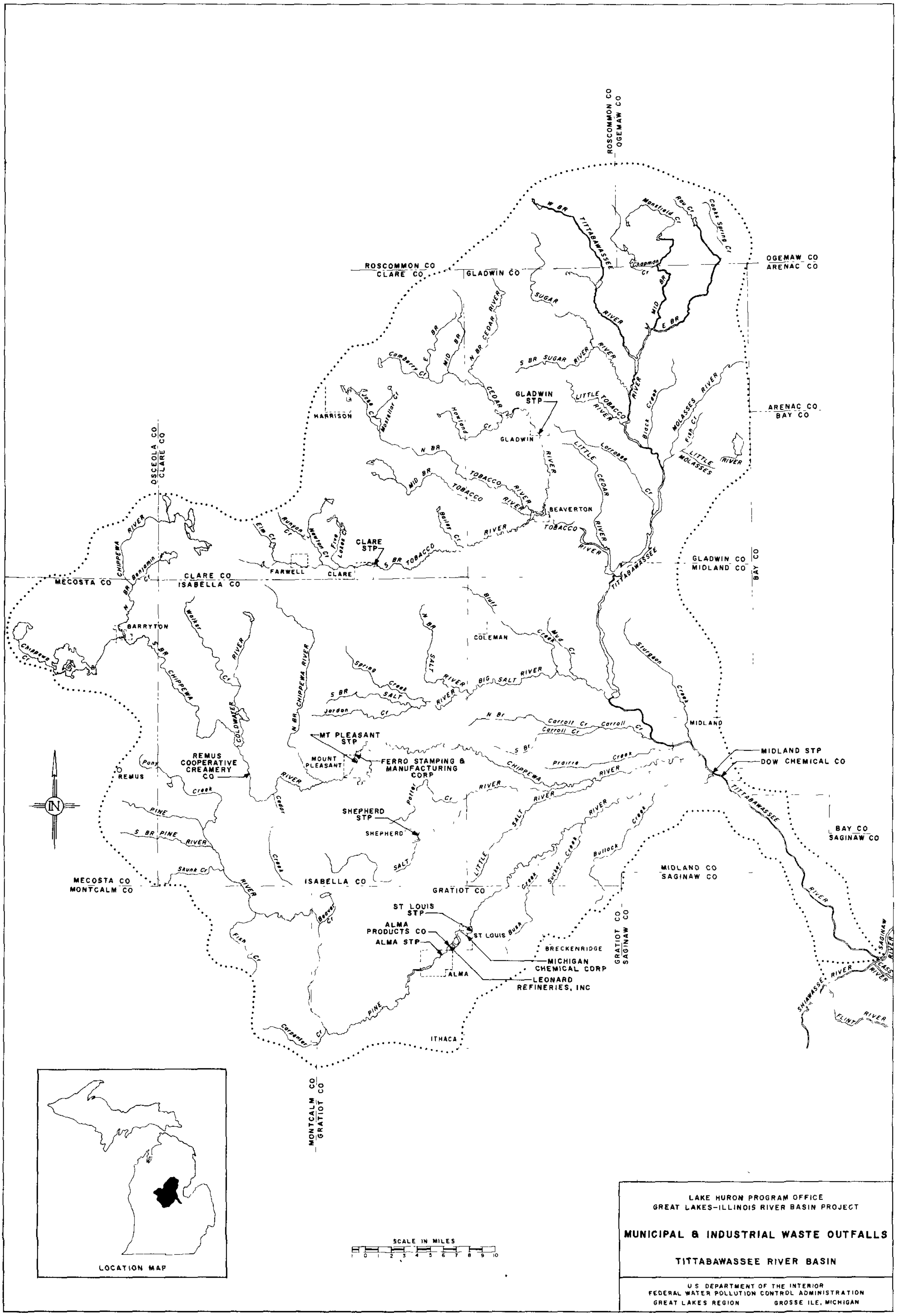
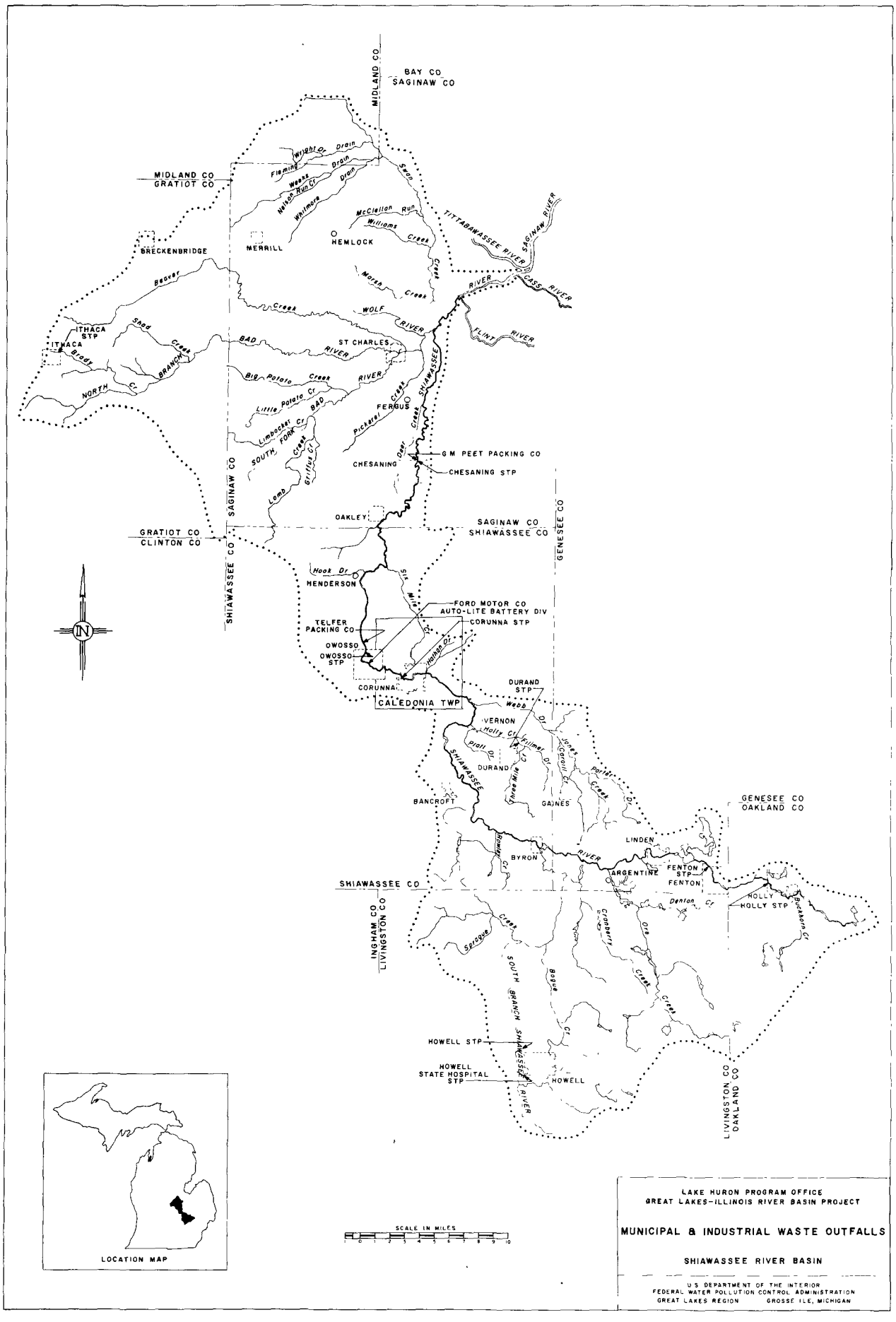

ROSCOMMON CO
OGEMAW CO
OGEMAW CO
ARENAC CO
ROSCOMMON CO
CLARE CO
GLADWIN CO
ARENAC CO
BAY CO
OSCEOLA CO
CLARE CO
GLADWIN CO
MIDLAND CO
BAY CO
CLARE CO
ISABELLA CO
MECOSTA CO
BAY CO
SAGINAW CO
MIDLAND CO
SAGINAW CO
MECOSTA CO
MONTCALM CO
ISABELLA CO
GRATIOT CO
GRATIOT CO
SAGINAW CO
MONTCALM CO
GRATIOT CO
GLADWIN STP
GLADWIN
HARRISON
BEAVERTON
CLARE STP
FARWELL
CLARE
BARRYTON
COLEMAN
MIDLAND
MIDLAND STP
DOW CHEMICAL CO
MT PLEASANT STP
MOUNT PLEASANT
FERRO STAMPING & MANUFACTURING CORP
REMUS COOPERATIVE CREAMERY CO
REMUS
SHEPHERD STP
SHEPHERD
ST LOUIS STP
ALMA PRODUCTS CO
ALMA STP
ST LOUIS
BRECKENRIDGE
MICHIGAN CHEMICAL CORP
LEONARD REFINERIES, INC
ALMA
ITHACA
TITTABAWASSEE RIVER
SUGAR RIVER
TOBACCO RIVER
CEDAR RIVER
CHIPPEWA RIVER
PINE RIVER
SALT RIVER
SAGINAW RIVER
SHIAWASSEE RIVER
FLINT RIVER
CASS RIVER
LOCATION MAP
SCALE IN MILES
0 1 2 3 4 5 6 7 8 9 10
LAKE HURON PROGRAM OFFICE
GREAT LAKES-ILLINOIS RIVER BASIN PROJECT
MUNICIPAL & INDUSTRIAL WASTE OUTFALLS
TITTABAWASSEE RIVER BASIN
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN

FIGURE II



LAKE HURON PROGRAM OFFICE
GREAT LAKES–ILLINOIS RIVER BASIN PROJECT

MUNICIPAL & INDUSTRIAL WASTE OUTFALLS

SHIAWASSEE RIVER BASIN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN

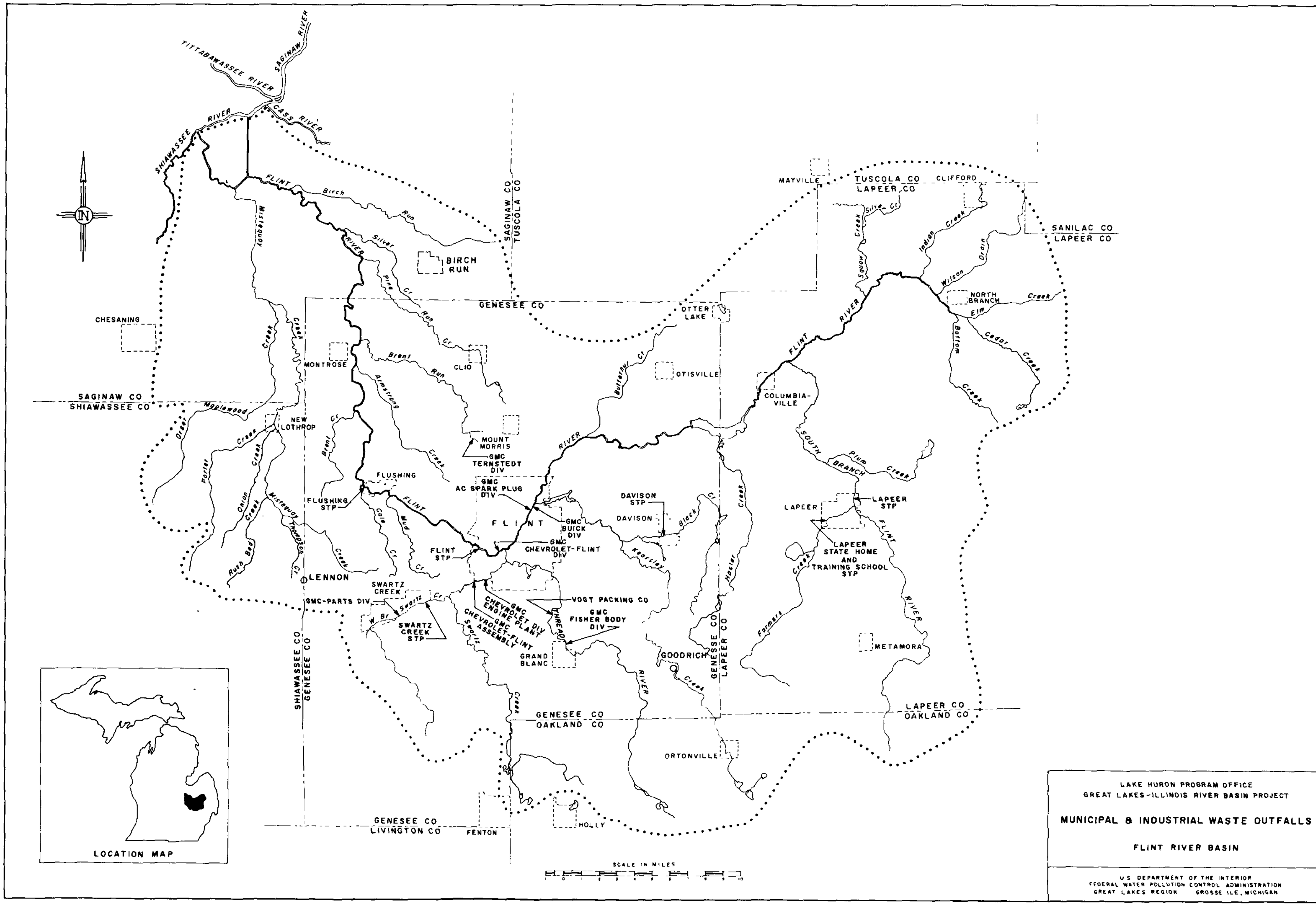

SAGINAW RIVER
TITTABAWASSEE RIVER
CASS RIVER
SHIAWASSEE RIVER
FLINT RIVER
BIRCH RUN
CHESANING
MONTROSE
CLIO
NEW LOTHROP
MOUNT MORRIS
GMC TERNSTEDT DIV
FLUSHING
FLUSHING STP
GMC AC SPARK PLUG DIV
FLINT
GMC BUICK DIV
GMC CHEVROLET-FLINT DIV
FLINT STP
LENNON
SWARTZ CREEK
GMC-PARTS DIV
SWARTZ CREEK STP
GMC CHEVROLET DIV ENGINE PLANT
CHEVROLET-FLINT ASSEMBLY
VOGT PACKING CO
GMC FISHER BODY DIV
GRAND BLANC
DAVISON STP
DAVISON
OTTER LAKE
OTISVILLE
COLUMBIA-VILLE
MAYVILLE
TUSCOLA CO
LAPEER CO
CLIFFORD
SANILAC CO
NORTH BRANCH
LAPEER
LAPEER STP
LAPEER STATE HOME AND TRAINING SCHOOL STP
METAMORA
GOODRICH
ORTONVILLE
HOLLY
FENTON
GENESEE CO
OAKLAND CO
LIVINGTON CO
SAGINAW CO
SHIAWASSEE CO
LOCATION MAP
SCALE IN MILES
LAKE HURON PROGRAM OFFICE
GREAT LAKES-ILLINOIS RIVER BASIN PROJECT
MUNICIPAL & INDUSTRIAL WASTE OUTFALLS
FLINT RIVER BASIN
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN

FIGURE 12

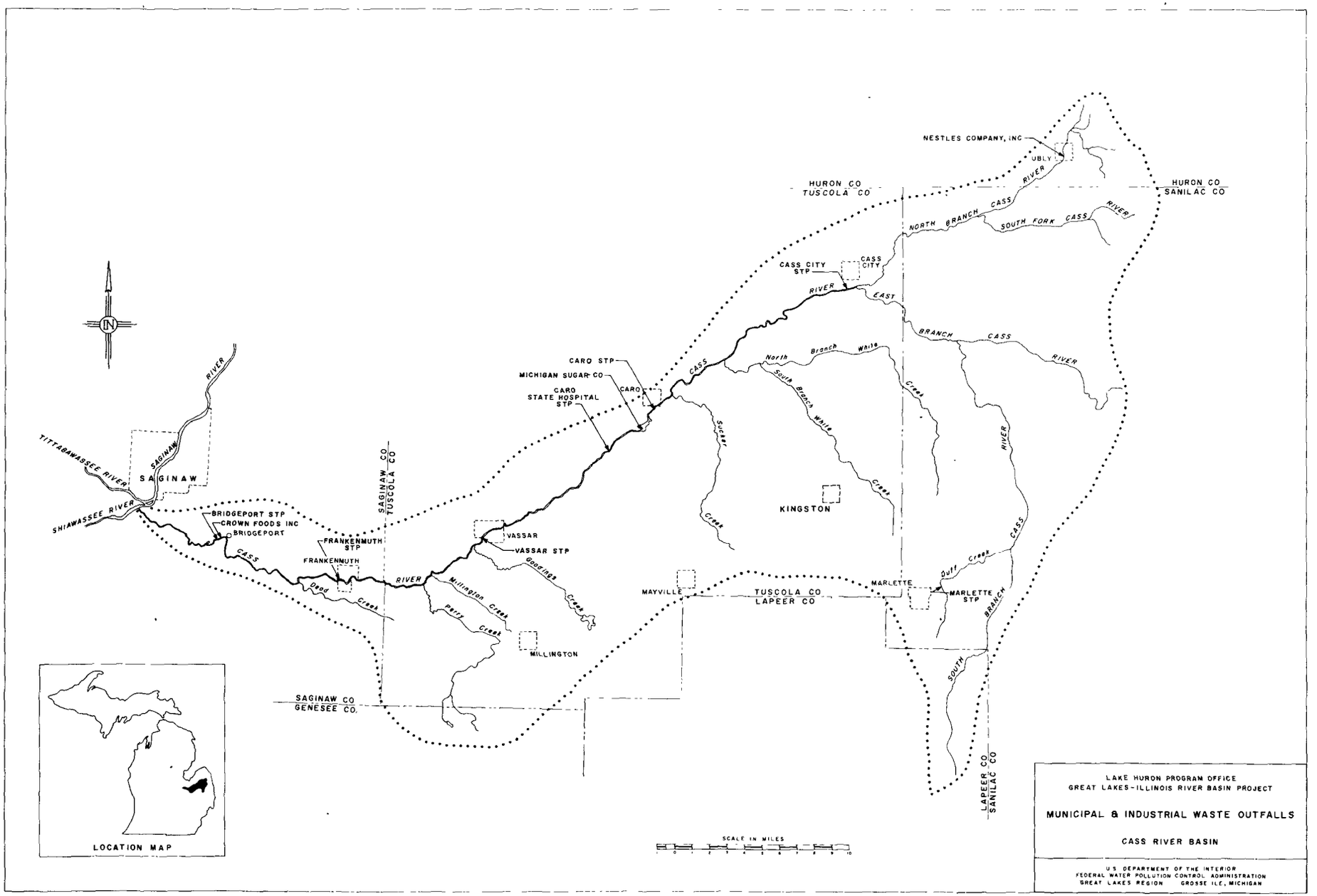
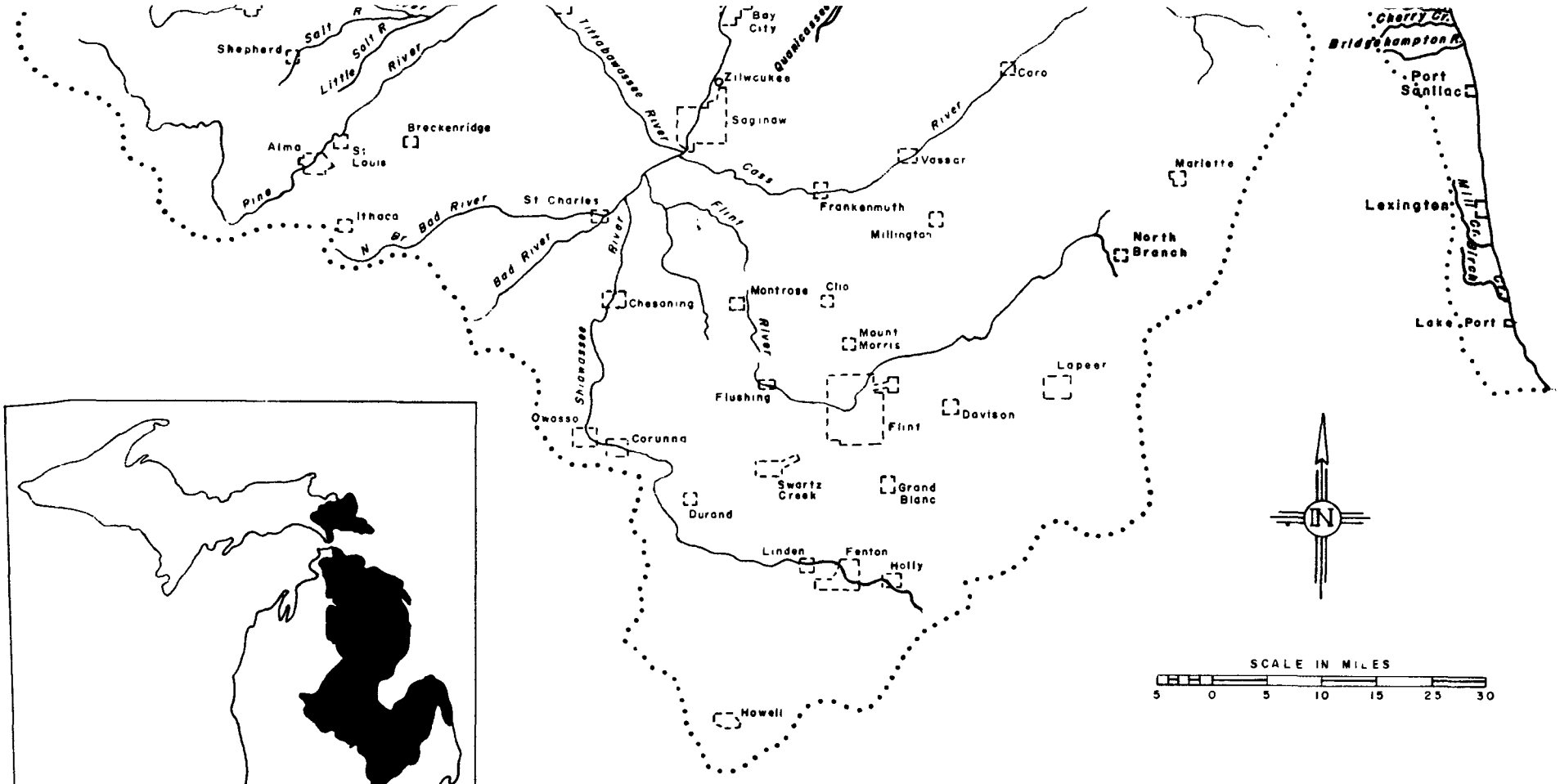

NESTLES COMPANY, INC
UBLY
HURON CO
TUSCOLA CO
HURON CO
SANILAC CO
NORTH BRANCH CASS RIVER
SOUTH FORK CASS RIVER
CASS CITY STP
CASS CITY
EAST BRANCH CASS RIVER
CARO STP
MICHIGAN SUGAR CO
CARO
CARO STATE HOSPITAL STP
CASS RIVER
North Branch Waits Creek
South Branch Waits Creek
Sugar Creek
KINGSTON
TITTABAWASSEE RIVER
SAGINAW
SAGINAW RIVER
SHIAWASSEE RIVER
BRIDGEPORT STP
CROWN FOODS INC
BRIDGEPORT
SAGINAW CO
TUSCOLA CO
FRANKENMUTH STP
FRANKENMUTH
VASSAR
VASSAR STP
CASS RIVER
Goose Creek
Dead Creek
Millington Creek
Perry Creek
MILLINGTON
MAYVILLE
TUSCOLA CO
LAPEER CO
MARLETTE
MARLETTE STP
Gulf Creek
CASS RIVER
SOUTH BRANCH
SAGINAW CO
GENESEE CO.
LAPEER CO
SANILAC CO
LOCATION MAP
SCALE IN MILES
LAKE HURON PROGRAM OFFICE
GREAT LAKES-ILLINOIS RIVER BASIN PROJECT
MUNICIPAL & INDUSTRIAL WASTE OUTFALLS
CASS RIVER BASIN
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN

FIGURE 19



LAKE HURON PROGRAM OFFICE
GREAT LAKES-ILLINOIS RIVER BASIN PROJECT

MICHIGAN TRIBUTARIES OF LAKE HURON BASIN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN

FIGURE 14