46

DREDGING WATER QUALITY PROBLEMS IN THE GREAT LAKES

VOLUME 6

APPENDIX B - SAMPLING SURVEYS WITHOUT SEPARATE REPORT

U.S. ARMY CORPS OF ENGINEERS
ESSAYONS
BUFFALO DISTRICT

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The present report presents the results of a study conducted by the Corps of Engineers with cooperation of the Federal Water Pollution Control Administration to evaluate the effects of water quality of current dredging practices including the disposal of dredged material in unconfined open water areas of the Great Lakes, as well as to develop the most practical methods for management of pollution problems that may be identified as resulting from dredging operations on the Lakes. The investigations conducted during the study included contruction and operation of diked areas, treatment

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of the dredged material, modifications to dredge equipment and in dredging operations, functional studies of the effects on lake ecology of open-lake disposal, surveys of possible alterate disposal areas at 37 Great Lakes harbors and connecting channels, and an economic evaluation of benefits which might accrue from improved Great Lakes water quality.

Appendix B

SAMPLING SURVEYS WITHOUT SEPERATE REPORT

In many instances, a sampling survey report was prepared for a number of projects as one group, and separating the individual projects was not feasible. Also, in certain cases, only data was submitted without comment or discussion by the sampling agency. This appendix is an inventory of those sampling surveys where individual projects were treated as a group or where only data was submitted.

Inventory of Sampling Surveys Without Separate Report

Project	Year	Sampling Agency[a]	Appendix No.
Lake Superior:			
Grand Marais Harbor, Michigan	1968	DTL	B4
Little Lake Harbor, Michigan	1968	DTL	B4
White Fish Point Harbor, Michigan	1968	DTL	B4
Lake Michigan:			
Charlevoix Harbor, Michigan	1968	DTL	B4
Frankfort Harbor, Michigan	1967	FWPCA	B2
	1968	FWPCA	B1
Grand Haven Harbor, Michigan	1967	FWPCA	B2
	1968	FWPCA	B1
Holland Harbor, Michigan	1967	FWPCA	B2
	1968	FWPCA	B1
Kenosha Harbor, Wisconsin	1967	FWPCA	B3
Kewaunee Harbor, Wisconsin	1967	FWPCA	B3
Leland Harbor, Michigan	1968	DTL	B4
Ludington Harbor, Michigan	1967	FWPCA	B2
Manistee Harbor, Michigan	1967	FWPCA	B2
Manistique Harbor, Michigan	1967	FWPCA	B1
Manitowac Harbor, Wisconsin	1967	FWPCA	B3
Muskegon Harbor, Michigan	1967	FWPCA	B2
	1968	FWPCA	B1
Pentwater Harbor, Michigan	1967	FWPCA	B2
Portage Lake Harbor, Michigan	1968	DTL	B4
Racine Harbor, Wisconsin	1967	FWPCA	B3
Saugatuck Harbor, Michigan	1967	FWPCA	B2
Sheboygan Harbor, Wisconsin	1967	FWPCA	B3
South Haven Harbor, Michigan	1967	FWPCA	B2
St. Joseph Harbor, Michigan	1967	FWPCA	B2
(and Benton Harbor)	1968	FWPCA	B1

Table Cont.

Project	Year	Sampling Agency[a]	Appendix No.
Sturgeon Bay Ship Canal, Wisconsin	1967	FWPCA	B3
Traverse City Harbor, Michigan	1968	DTL	B4
White Lake Harbor, Michigan	1967	FWPCA	B2
Lake Huron and Connecting Channels:			
Alpena Harbor, Michigan	1967	FWPCA	B2
Au Sable Harbor, Michigan	1967	FWPCA	B2
Bayport Harbor, Michigan	1968	DTL	B4
Black River, Michigan	1968	DTL	B4
Caseville Harbor, Michigan	1968	DTL	B4
Cheboygan Harbor, Michigan	1967	FWPCA	B2
Clinton River, Michigan	1968	DTL	B4
Detroit River, Michigan	1968	FWPCA	B1
Hammond Bay Harbor, Michigan	1968	DTL	B4
Harbor Beach Harbor, Michigan	1968	FWPCA	B1
Harrisville Harbor, Michigan	1968	DTL	B4
Lake St. Clair, Michigan	1967	FWPCA	B2
Port Austin Harbor, Michigan	1968	DTL	B4
Port Sanilac Harbor, Michigan	1968	DTL	B4
Rouge River, Michigan	1968	FWPCA	B1
Sebewaing River, Michigan	1968	DTL	B4
The Inland Route, Michigan	1968	DTL	B4
Lake Erie:			
Ashtabula Harbor, Ohio	1967	BD	B5
Bolles Harbor, Michigan	1968	DTL	B4
Conneaut Harbor, Ohio	1967	BD	B5
East Outer Channel, Detroit River	1968	FWPCA	B1
Erie Harbor, Pennsylvania	1967	BD	B5
Fairport Harbor, Ohio	1967	BD	B5
Huron Harbor, Ohio	1967	BD	B5
Lorain Harbor, Ohio	1967	BD	B5
Monroe Harbor, Michigan	1968	DTL	B4
Port Clinton Harbor, Ohio	1968	DTL	B4
Sandusky Harbor, Ohio	1967	BD	B5
Lake Ontario:			
Little Sodus Bay Harbor, New York	1967	BD	B5
Oswego Harbor, New York	1967	BD	B5
Rochester Harbor, New York	1967	BD	B5

a - Agency abbreviations: DTL - Detroit Testing Laboratory, Detroit, Michigan; FWPCA - Federal Water Pollution Control Administration; BD - Buffalo District, Corps of Engineers.

APPENDIX B1

1968 DREDGING STUDY, LAKE HURON BASIN OFFICE
LHBO 31-A

SAMPLING SURVEYS FOR:

FRANKFORT HARBOR, MICHIGAN
GRAND HAVEN HARBOR, MICHIGAN
HOLLAND HARBOR, MICHIGAN
MANISTEE HARBOR, MICHIGAN
MUSKEGON HARBOR, MICHIGAN
ST. JOSEPH HARBOR, MICHIGAN (and BENTON HARBOR)
DETROIT RIVER, MICHIGAN
HARBOR BEACH HARBOR, MICHIGAN
ROUGE RIVER, MICHIGAN
EAST OUTER CHANNEL, DETROIT RIVER

OCTOBER 1968

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION
LAKE HURON BASIN OFFICE
U.S. NAVAL AIR STATION
GROSSE ILE, MICHIGAN
48138

1968 Dredging Report
FWPCA, DPO
List of Tables

1968 Dredging Report
FWPCA, DBO
List of Figures

PURPOSE

The "1968 Dredging Study" was conducted to provide information supplemental to two reports produced by Detroit Program Office: "Pilot Study of Rouge River - 1967" and "Michigan Harbors & Navigation Channels - Bottom Sediment Analysis - 1967." These reports will provide background information for the Corps of Engineers' report on the "Disposal of Great Lakes Dredgings."

SCOPE

The results of the study include benthos sampling in the Rouge River and in the vicinity of Grassy Island, core sampling in several Rouge River docking areas, and water quality measurements upriver and downriver from the dumping grounds and in the Grassy Island wells.

The results of the analysis of bottom sediments collected from nine Michigan Harbors is given. The sediment quality of each harbor is evaluated based on these results.

ORGANIZATION

The "1968 Dredging Study" was a cooperative effort of the Detroit District of the Corps of Engineers and the Detroit Program Office of the Federal Water Pollution Control Administration.

REMARK

1. Biological studies in the Rouge River indicate that the bottom sediments are grossly polluted and support a meager benthic community of oligochaetes. Corps of Engineers dredging operations in the Rouge River apparently had little effect on this already debased aquatic life.

2. Changes in water quality and benthic populations in the area of Grassy Island could not be attributed to the disposal operation.

3. Further study should be conducted in those Michigan harbors designated as "polluted" to determine the depth and areal extent of the polluted materials.

4. In a laboratory study of open water spoil disposal, Detroit River bottom sediment samples were deposited into proportional volumes of receiving water. Some evidence of water quality degradation remained 24 hours after dumping.

I. INVESTIGATION PROCEDURES AND DATA

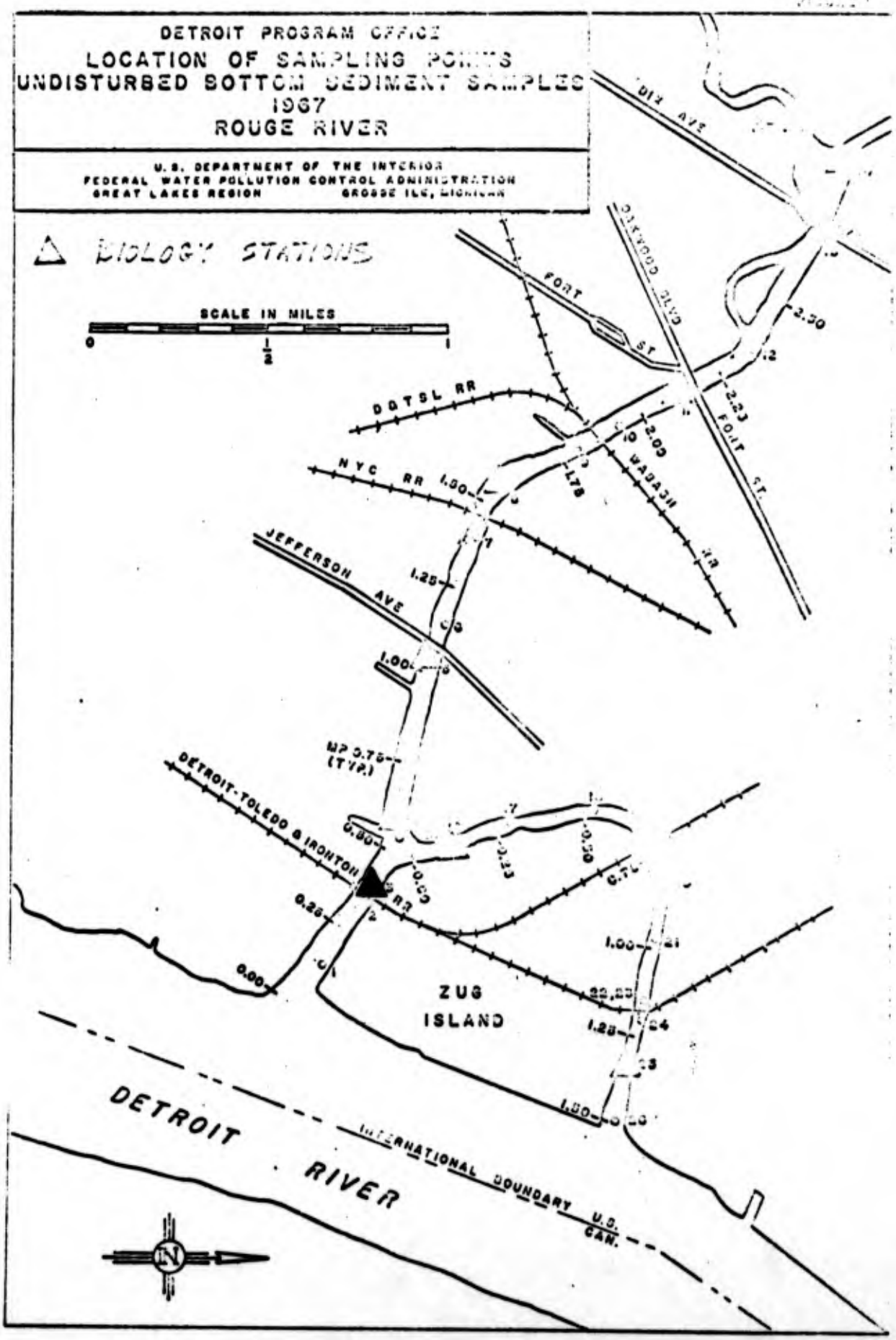
A. Dredging Site - Rouge River

Benthos Sampling

The benthic organisms of the Rouge River were sampled on June 7, 1968 before dredging operations began; and on August 2, 1968 during the peak of the Corps of Engineers dredging activities. The primary dredging activity up to August 2 was conducted in the areas indicated in Figure 2 .

Three samples were collected across the width of the river at each of ten cross sections indicated in Figure 1 . The samples were collected with a 1/4 square-foot Eckman dredge, preserved in a formalin - rose bengal solution and returned to the laboratory for population counts. Because of the large number of sludgeworms in some of the samples, aliquots were counted and an appropriate factor applied to estimate the number of organisms per square foot.

The grossly polluted Rouge River supported a meager benthic community consisting of the sludgeworms Limnodrilus sp. and Tubifex tubifex. These two sludgeworms comprised virtually 99.9% of the benthic population during both sampling periods. (Tables 1 and 2) Bottom sediment constituents, supporting these populations varied widely. Asphalt, oil, grease, sewage, wood pulp, and iron oxide were among the man-made materials noted in the bottom sediments.


DETROIT PROGRAM OFFICE
LOCATION OF SAMPLING POINTS
UNDISTURBED BOTTOM SEDIMENT SAMPLES
1967
ROUGE RIVER
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION
GROSSE ILE, MICHIGAN
BIOLOGY STATIONS
SCALE IN MILES
0
1/2
1
DIX AVE
FORT ST
OAKWOOD BLVD
DGTSL RR
NYC RR
WABASH RR
JEFFERSON AVE
DETROIT-TOLEDO & IRONTON RR
ZUG ISLAND
DETROIT RIVER
INTERNATIONAL BOUNDARY U.S. CAN.
N
2.30
2.23
2.09
1.78
1.50
1.25
1.00
0.80
0.50
0.28
0.00

DETROIT PROGRAM OFFICE

LOCATION OF [illegible]

ROUGE RIVER

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

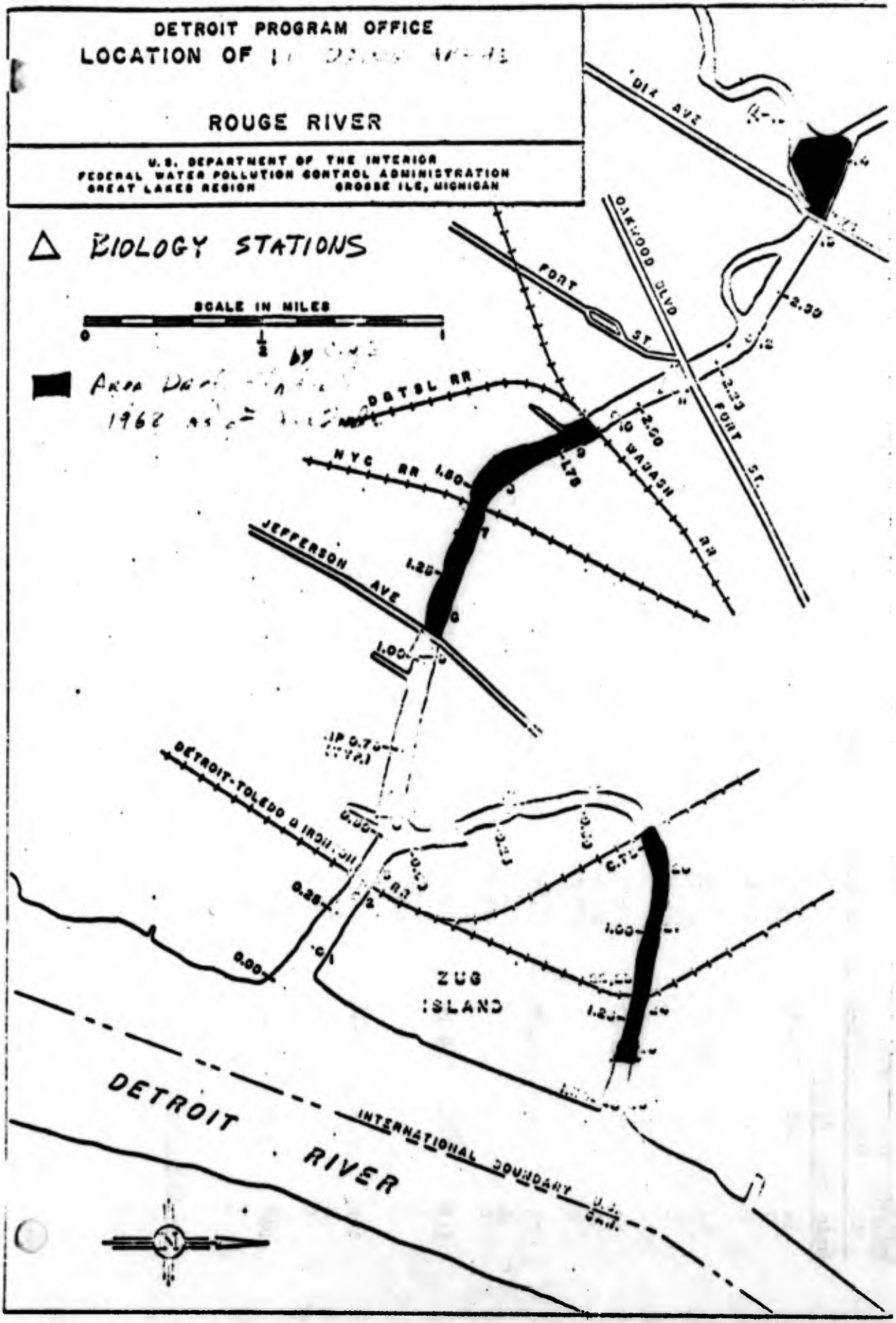


Table -

Rouge River Pilot Study
Bottom Fauna Survey - 6/7/68

FWPCA, DRO

Station No.	Mile Point	Corps Designation	Lab. No.	Sediment Description	Bottom Fauna per sq. foot	
Main Rouge River						
3A	.40	25-29	23629	Grey sludge, pulp, wood chips	Tubificidae	200
B			23630	Odor: Ch, Ds	"	2,880
C			23631		"	690
4A	.55	24-27	23626	Grey sludge	"	46,800
B			23627	Odor: Ch	"	19,600
C			23628		"	7,000
5A	1.05	21-23	23623	Grey sludge, oil	"	1,690
B			23624	Odor: strong Ch	"	1,840
C			23625		"	4,750
8A	1.57	15-26	23620	Dark grey sludge, clay	"	1,000
B			23621	Odor: Ch	"	2,460
C			23622		"	14,400
11A	2.14	9-19	23617	Grey sludge, detritus	"	25,200
B			23618	Odor: Ch	"	13,900
C			23619		"	12,500
14A	2.94	2-18	23614	Dark grey sludge, detritus	"	780
B			23615	Odor: Ch	"	4,370
C			23616		"	2,200
R1A	3.06	-	23611	Grey sludge, sand	"	32,500
B			23612	Odor: Ch	"	110
C			23613		"	130
Old Channel						
16A	.12	34	23638	Pulp, wood chips, sludge	"	< 10
B			23639	Odor: Ch, Cm	"	40
C			23640			4,000

Table 1 (Cont'd)

Rouge River Pilot Study
Bottom Fauna Survey - 6/7/68

FWPCA, DPO

Station No.	Mile Point	Corps Designation	Lab. No.	Sediment Description	Bottom Fauna per sq. foot	
Old Channel						
19A	.70	38-21	23635	Sludge, sand, trash, clay, Anacharis sp.	Tubificidae	11,300
B			23636	Odor: Ch	"	570
C			23637			17,400
25A	1.32	45-21	23632	Sludge, clay, trash, Anacharis sp.	"	6,300*
B			23633	Odor: Ch	"	66,600
C			23634		"	13,200

*St. 25A also had 16 Glossiphonia heteroclita and 56 Valvata sp./sq. ft.

Table 2
House River Pilot Study
Bottom Fauna Survey - 8/8/62

FWPCA, DPO

Station No.	Mile Point	Corps Designation	Lab. No.	Sediment Description	[illegible]	[illegible]
Main Rouge River						
3A	.40	25-29	31604	Grey sludge, wood chips	"	5,360
B			31605	Odor: Ch, Ds	"	[illegible]
C			31606		"	[illegible]
4A	.55	24-27	31607	Grey sludge, clay	"	[illegible]
B			31608	Odor: Ds	"	[illegible]
C			31609		"	[illegible]
5A	1.05	21-23	31610	Grey sludge, sand, gravel, clay	"	[illegible]
B			31611	Odor: Ch, Ds	"	[illegible]
C			31612		"	[illegible]
6A	1.37	15-26	31613	Grey sludge, debris, asphalt	"	[illegible]
B			31614	Odor: Strong Ch	"	[illegible]
C			31615		"	[illegible]
11A	2.14	9-19	31616	Grey sludge, debris	"	[illegible]
B			31617	Odor: Ch, Ds	"	[illegible]
C			31618		"	[illegible]
14A	2.94	8-17	31619	Grey sludge, debris	"	[illegible]
B			31620	Odor: Ch	"	[illegible]
C			31621		"	[illegible]
15A	3.16	-	31622	Sand, sludge	"	[illegible]
B			31623	Odor: Strong Ch	"	[illegible]
C			31624		"	[illegible]

Table 2 (Cont'd)
Rouge River Pilot Study
Bottom Fauna Survey - 2/26/

FWPCA, DPO

Station No.	Mile Point	Corps Designation	Lab No.	Sediment Description	Bottom Fauna	Sta. Total
Old Channel						
16A	.12	34	31622	Pulp, wood chips, sludge		
B			31623	Odor: Ds, Cm	"	
C			3162[illegible]		"	*
19A	.70	33-21	31626	Grey sludge, sand, clay	"	
B			31627	Odor: Ds	"	
C			31628	Limnodrilus sp.		
25A	1.32	45-21	31629	Grey sludge		
B			31630	Odor: Ds, Ch	"	
C			31631	Limnodrilus sp.		

*Sta. 16C also had 36 Glossiphonia heteroclita and 4 Physa sp. [illegible]

Core Sampling

In 1966, the Detroit Program Office utilized a core sampling device in obtaining samples of the bottom materials buried beneath the surface of the river bed. The equipment consisted of a 1-inch diameter pipe (see Figure 4 .) which was pushed or driven into the river bottom to the desired depth. A protruding tip could be inserted as the instrument was being pushed through the surface sediments and withdrawn as it passed through the sediments to be sampled. The device was used with varied degrees of success depending on the nature of the sediments to be collected.

Dunbar and Sullivan Dredging Company applied to the U.S. Corps of Engineers for a Federal permit to dredge at seven locations on the Rouge River shown in Figure 3 . The shoal areas at these docking facilities were sampled with the device. Attempts to obtain a core sample at Scott Paper Company were unsuccessful. The sample from this location was collected with a Peterson dredge.

Samples were analyzed in segments to determine the variation of the parameters with depth. The gross descriptions and analytical results are given in Table 3 . The samples are numbered from bottom segment to top as follows: E1, E2, E3 etc. The bottom segment of the core is indicated "bot." next to lab number.

Table 3
1968 Analytical Results
Bottom Sediment Core Samples
Detroit & Rouge River

FWPCA, DCO

SAMPLE NO.	AREA	Water Depth (Ft.)	Sample DEPTH (FT)	COLLECT DATE	LAB. NO.	GROSS DESCRIPTION (Description: Odor)
A	International Salt	21	24 to 27	7-17-68	29761	Black sludge, trace oil; Ch
B*	Marathon Oil Co.	21	24 to 27	7-17-68	29762	Dark gray sludge (clay), some coal, trace oil;Ch
B-1	Marathon Oil Co.	18	19 to 23	7-25-68	30561 Bot	Dark gray sludge (clay), some coal, trace oil: Ch
B-2	Marathon Oil Co.		19 to 23	7-25-68	30562 Top	Black sludge, trace oil; Ch
C*	Sun Oil Co.	21	24 to 27	7-17-68	29763	Black sludge, trace oil; Ch
C-1	Sun Oil Co.	17	18to20.5	7-26-68	30563 Bot	Black sludge; Ch
C-2	Sun Oil Co.		18to20.5	7-26-68	30564	Black sludge; Ch
C-3	Sun Oil Co.		18to20.5	7-26-68	30565	Black & brown sludge; Ch
C-4	Sun Oil Co.		18to20.5	7-26-68	30566	Dark brown sludge; Ch
C-5	Sun Oil Co.		18to20.5	7-26-68	30567	Dark brown sludge; Ch
C-6	Sun Oil Co.		18to20.5	7-26-68	30568 Top	Black sludge; Ch
D-1	Allied Chemical	17	18to21.5	8-8-68	32571 Bot	Gray sludge (part clay);D,C,A,Ch
D-2	Allied Chemical		18to21.5	8-8-68	32572	Gray sludge (part clay); D,A,Ch
D-3	Allied Chemical		18to21.5	8-8-68	32573	Gray sludge (part clay); D,C,A,Ch
D-4	Allied Chemical		18to21.5	8-8-68	32574 Top	Gray sludge (clay); C,D,A
E-1	Detroit Marine Term	23	24.5to28	8-5-68	32565 Bot	Black & gray sludge; Ds
E-2	Detroit Marine Term.		24.5to28	8-5-68	32566	Black & gray sludge; Ds
E-3	Detroit Marine Term		24.5to28	8-5-68	32567	Black & gray sludge; Ds
E-4	Detroit Marine Term		24.5to28	8-5-68	32568 Top	Black & gray sludge; soft; Ds
F	Scott Paper	19	Surface (PetersonDr.)	7-26-68	30574	Black sludge w. wood fibers, Ch

Table 3
1968 Analytical Results
Bottom Sediment Core Samples
Detroit & Rouge River

FWPCA, DPO

SAMPLE NO.	IMMED. DO DEM Mg/Kg Wet Basis	COD Mg/Kg Wet Basis	PHENOLS µg/Kg Wet Basis	TOTAL PO_4 Mg/Kg Wet Basis	TOT. SOL. PO_4 Mg/Kg Wet Basis	NITRATE NO_3-N Mg/Kg Wet Basis	NITRITE NO_2-N Mg/Kg Wet Basis	AMMONIA NH_3-N Mg/Kg Wet Basis	ORGANIC NITROGEN Mg/Kg Wet Basis	IRON Mg/Kg Wet Basis	OIL & GREASE Mg/Kg Dry Basis	TOTAL SOLIDS % Wet Basis	VOL SOLIDS % Dry Basis	BOD Mg/Kg Wet Basis
A	260	50,000	870	3000				120	86	40,000	19000	30.3	17.9	
E*	90	61,000	460	3000				320	1.6	33,000	3000	72.4	4.7	
B-1	30	67,000	880	1800		140		140	76	-		75.9	3	
B-2	510	100,000	1600	1800		130		130	130	-		43.5	12.4	
C*	510	70,000	430	1800				55	64	25,000	6000	50.2	7.6	
C-1				4500						86000	65,000	46.1	15.8	
C-2				4400						71000	41,000	46.5	15.2	
C-3				4000						66000	51,000	41.1	13.2	
C-4				3800						66000	52,000	42.7	14.8	
C-5				4000						63000	50,000	42.2	14.2	
C-6				3100						49000	41,000	39.2	9.9	
D-1				1400						21,000	780	74.7	4.6	
D-2				1300						17,000		54.1	10.0	
D-3				1000						15,000		69.3	-	
D-4				1600						15,000	17,000	54.5	-	
E-1				4200						46,000	30,000	47.4	17.2	
E-2				-						-	40,000	52.2	16.7	
E-3				-						-	17,000	47.6	18.0	
E-4				-						-	31,000	34.8	17.7	
F				1100						15000	25,000	24.4	28.7	

Table 3
1968 Analytical Results
Bottom Sediment Core Samples
Detroit & Rouge River

FWPCA, DPO

SAMPLE NO.	AREA	Water Depth (Ft.)	Sample DEPTH (FT)	COLLECT DATE	LAB. NO.	GROSS DESCRIPTION
G-1	Detroit Lime Co.	15.5	17.5to21	7-26-68	30569 Bot	Black & brown sludge, trace sand; Ch
G-2	Detroit Lime Co.		17.5to21	7-26-68	30570	Black & brown sludge, trace gravel; Ch
G-3	Detroit Lime Co.		17.5to21	7-26-68	30571	Greenish brown sludge & sand; Ch, Df, D
G-4	Detroit Lime Co.		17.5to21	7-26-68	30572	Greenish brown sand & sludge; Ch, Df, D
G-5	Detroit Lime Co.		17.5to21	7-26-68	30573 Top	Greenish brown sand w. sludge, tr.oil, Ch, Df, D
H 1	Nicholson Term	15	16'-21.5	8-8-68	32569 Bot	Gray sludge(clay); E (slight)
H 2	Nicholson Term		16'-21.5	8-8-68	32570 Top	Gray sludge (clay); E (slight)

Table 3

1968 Analytical Results
Bottom Sediment Core Samples
Detroit & Rouge River

SAMPLE NO.	IMMED. DO DEM Mg/Kg Wet Basis	COD Mg/Kg Wet Basis	PHENOLS µg/Kg Wet Basis	TOTAL PO_4 Mg/Kg Wet Basis	TOT. SOL. PO_4 Mg/Kg Wet Basis	NITRATE NO_3-N Mg/Kg Wet Basis	NITRITE NO_2-N Mg/Kg Wet Basis	AMMONIA NH_3-N Mg/Kg Wet Basis	ORGANIC NITROGEN Mg/Kg Wet Basis	[illegible] Mg/Kg [illegible] Basis	OIL & GREASE Mg/Kg Dry Basis	TOTAL SOLIDS % Wet Basis	VOL SOLIDS % Dry Basis	BOD Mg/Kg Wet Basis
G-1				5800						5000	33,000	58.4	15.6	
G-2				6000						6000	33,000	61.6	13.9	
G-3				860						1700	2,500	69.2	8.1	
G-4				1000						1400	-	63.8	7.7	
G-5				820						1800	1,000	55.1	6.7	
H-1				750						19,000	600	75.3	2.4	
H-2				1100						21,000	550	75.3	1.1	

15

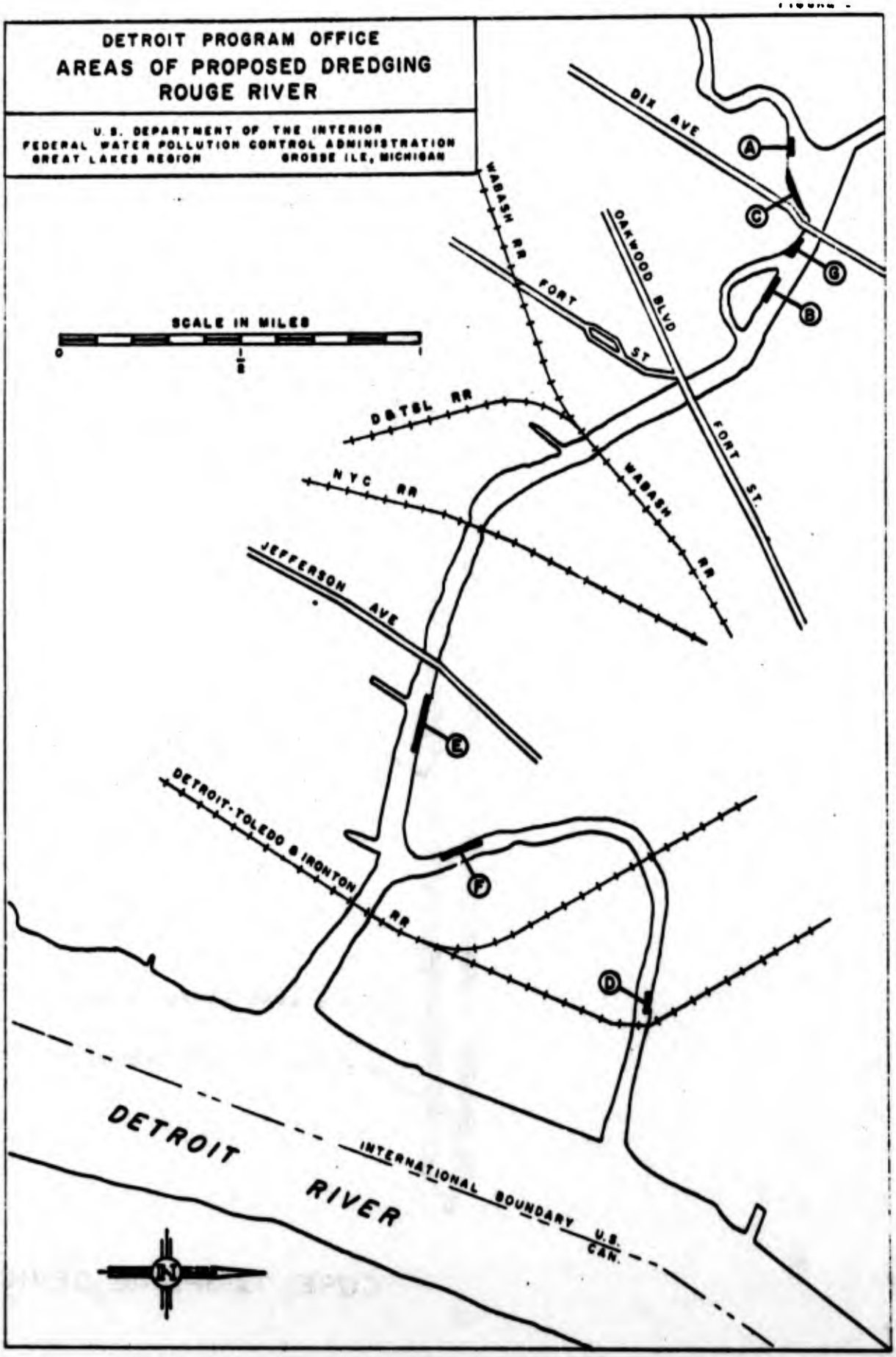

DETROIT PROGRAM OFFICE
AREAS OF PROPOSED DREDGING
ROUGE RIVER
U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN
SCALE IN MILES
0
1
DIX AVE
WABASH RR
FORT ST
OAKWOOD BLVD
D&TSL RR
NYC RR
WABASH RR
FORT ST.
JEFFERSON AVE
DETROIT-TOLEDO & IRONTON RR
A
B
C
D
E
F
G
DETROIT RIVER
INTERNATIONAL BOUNDARY U.S. CAN.
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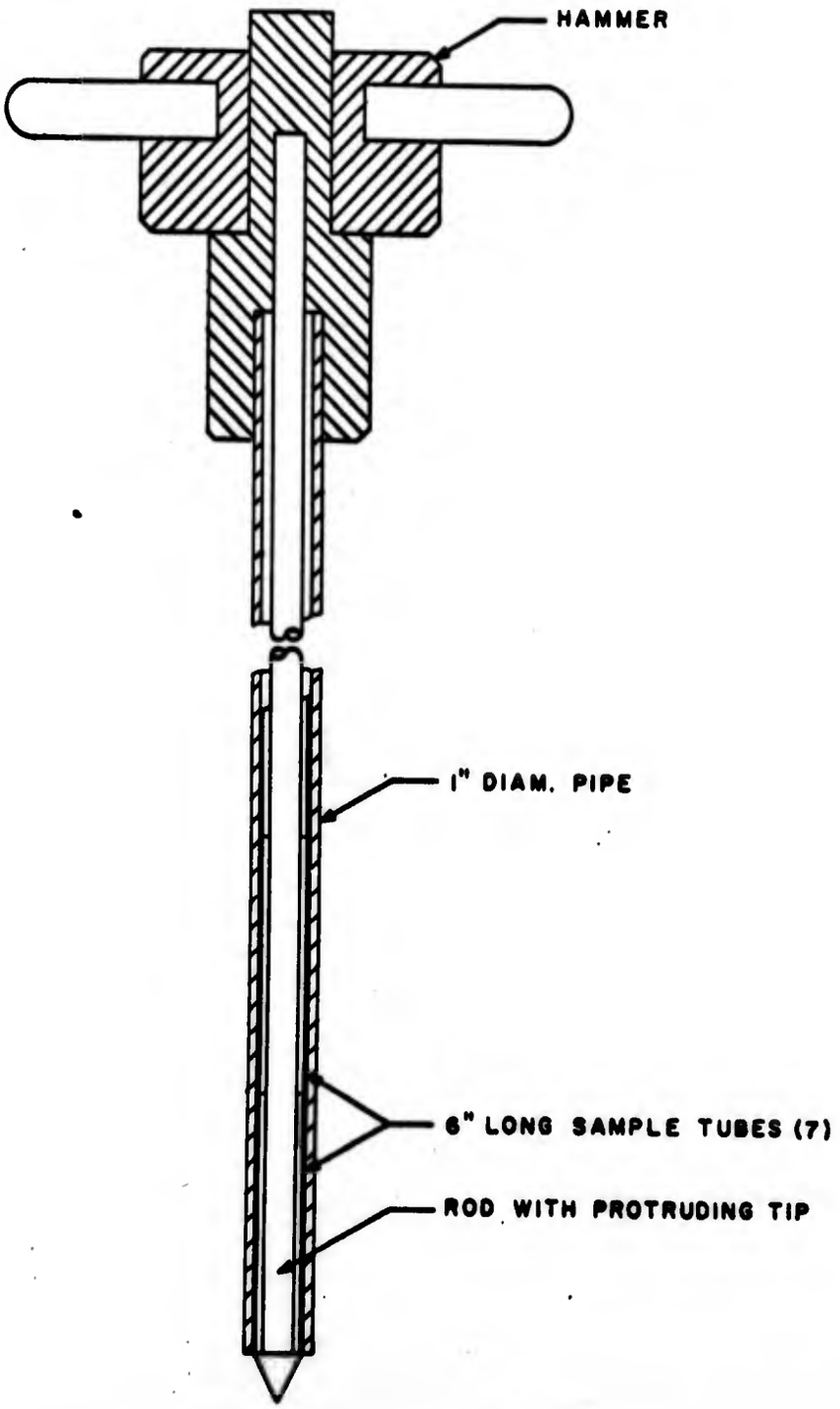
FIGURE 4



CORE SAMPLING DEVICE

B. Dumping Grounds - Grassy Island

Effect of Dumping Ground on Detroit River Water Quality

Seven stations in the vicinity of Grassy Island were sampled in 1968 to detect the pollutional effect of the dumping ground on Detroit River water quality. As shown in Figure 5 , stations PS-68-1, PS-68-2, and PS-68-3 are located upriver from the island; and PS-68-4, PS-68-5, and PS-68-6 are downriver from the dumping ground. Samples collected from PS-68-7 depict the quality of water pumped on to the dredge and mixed with the dredged material at the unloading dock to facilitate pump-off operations.

Each of these stations were sampled on July 8 and 9 before dredging operations began and on August 6, 7, and 13 after the commencement of the dredging of the Rouge. The results of the analyses are given in Table 4 .

Benthos Sampling

The Grassy Island area of the Detroit River was sampled for benthos once prior to the dumping of Rouge River dredgings on the island and once after the deposition of sludge behind the dikes. The samples were collected with a 2/3 square foot Petersen dredge and preserved in a formalin - rose bengal solution.

The stations in the vicinity of Grassy Island are shown in Figure 6 and the analytical results in Table 5 & 6. The Investigation found a bottom fauna community indicative of polluted waters. Although a few intolerant scuds and a burrowing mayfly were found, 98% of the total benthic population consisted of the pollution tolerant sludgeworms.

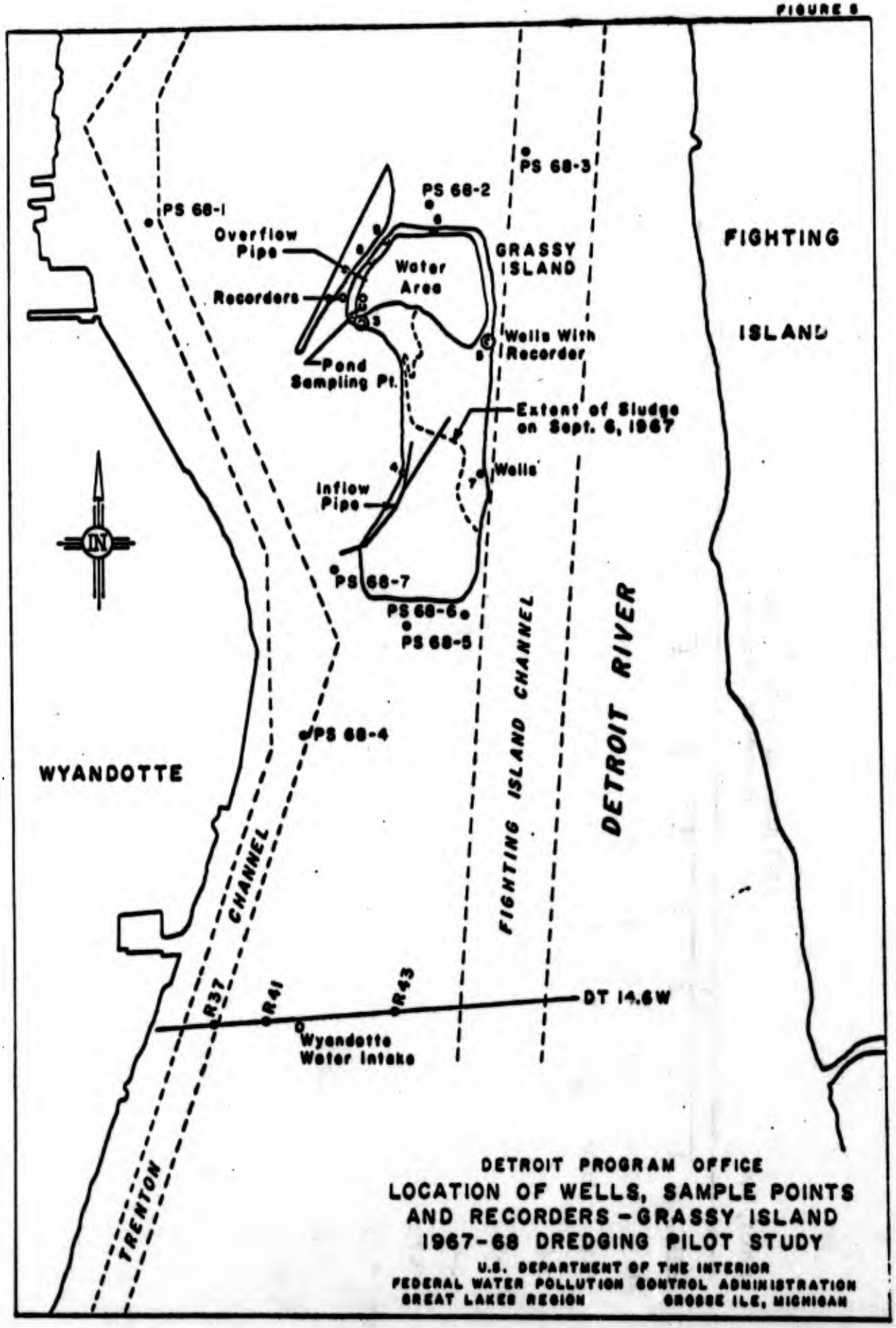
[illegible]

Five of the wells installed in the Grassy Island dike in 1967 were sampled twice in 1968 before the dredging operations began. Well 9 was sampled once.

The sampling procedure was the same as that used in 1967. Each well was pumped the day before the samples were to be collected. On the sampling day, the coliform samples were first collected with a J. T. bacteriological sampler and then the chemical samples were collected with a Kemmerer depth sampling device. The location of the wells are shown in Figure 5 and the results of the analysis are listed in Table 4 .

The condition of wells 3, 4, 5, and 7 appeared unchanged from 1967. However, alterations in the northwest side of the dike had apparently changed the wells in that area such that there was increased free flow of water between the Detroit River and wells 8 and 9.

FIGURE 5



DETROIT PROGRAM OFFICE

LOCATION OF WELLS, SAMPLE POINTS AND RECORDERS - GRASSY ISLAND 1967-68 DREDGING PILOT STUDY

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

FWPCA, DPO

TABLE 4
1968 SAMPLING RESULTS - GRASSY ISLAND AREA
Parameter: Temperature (°C)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	7.0	8.0	7.0	7.0	7.0	7.0							
5-14	10.0	8.0	7.5	8.0	10.0	-							
7-8							19.5	19.5	19.5	19.5	19.0	19.5	19.5
7-9							20.0	20.0	19.5	20.0	20.0	20.0	20.0
8-6							23.0	23.5	22.5	23.5	24.0	24.0	23.5
8-7							23.0	23.0	22.5	23.0	23.0	23.0	23.0
8-13							22.0	22.0	22.0	22.0	22.0	22.0	22.0
Avg.	8.5	8.0	7.0	7.5	8.5	7.0	21.5	21.5	21.0	21.5	21.5	21.5	21.5

TABLE 4
1968 SAMPLING RESULTS - GRASSY ISLAND AREA
FWPCA, DPO
Parameter: pH S.U.

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	7.2	8.2	7.6	7.5	7.6	7.7							
5-14	7.2	8.0	7.4	7.2	7.2	-							
7-8							8.5	8.6	8.5	8.5	8.5	8.6	8.5
7-9							7.9	8.2	8.2	8.0	8.0	8.2	8.0
8-6							8.0	8.1	8.2	8.0	8.0	8.0	8.1
8-7							8.1	8.2	8.3	8.2	8.1	8.0	8.3
8-13							7.8	8.0	7.8	7.7	7.9	7.9	7.9
Avg.	7.2	8.1	7.5	7.4	7.4	7.7	8.0	8.2	8.2	8.1	8.1	8.1	8.2

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Conductivity (umhos/cm)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	1700	2400	1300	2900	900	240							
5-14	1200	2600	1100	3000	900	-							
7-8							220	220	210	220	220	220	220
7-9							220	220	220	220	220	220	220
8-6							220	220	220	230	220	220	220
8-7							220	220	220	220	220	230	210
8-13							250	250	250	250	250	250	240
Avg.	1400	2500	1200	3000	900	240	230	230	220	230	230	230	220

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

Parameter: Alkalinity (mg/l)

FMCA, DNO

Date	Wells					
	3	4	5	7	8	9
4-30	400	720	680	760	300	130
5-14	210	650	660	660	310	-

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Chlorides (mg/l)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	80	66	72	170	38	12							
5-14	42	20	80	150	30	-							
7-8							11	10	9	11	10	10	10
7-9							11	10	10	10	10	10	10
8-6							9	9	9	10	6	9	10
8-7							9	9	8	9	9	10	9
8-13							11	10	13	10	10	11	10
Avg.	61	43	76	160	34	12	10	10	10	10	9	10	10

FWPCA, DPO

TABLE 4
1968 SAMPLING RESULTS - GRASSY ISLAND AREA
Parameter: Phenols (ug/1)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	3	1	2	2	3	23							
5-14	-	3	3	1	1	-							
7-8							8	2	5	7	3	3	5
7-9							7	4	6	6	7	4	4
8-6							7	5	7	8	6	5	6
8-7							8	4	5	4	2	1	2
8-13							8	6	6	6	3	5	6
Avg.	3	2	2	2	2	23	8	4	6	6	4	4	5

TABLE 4
1968 SAMPLING RESULTS - GRASSY ISLAND AREA
Parameter: DO (mg/l)

FWPCA, DPO

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	2.3	.3	< .1	9.2	2.3	9.4							
5-14	4.4	2.2	1.7	3.8	2.8	-							
7-8							9.3	9.6	9.1	9.2	8.9	9.1	9.0
7-9							8.9	9.2	9.1	9.0	8.7	9.0	8.6
8-6							8.4	8.4	8.5	8.0	8.0	8.0	8.3
8-7							8.2	8.1	8.5	8.3	7.0	7.5	8.0
8-13							7.9	8.0	8.0	7.7	7.3	7.4	7.6
Avg.	3.3	1.3	.9	6.5	2.5	9.4	8.5	8.6	8.6	8.4	8.0	8.2	8.3

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: BOD (mg/l)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	17	4	6	8	2	8							
5-14	7	8	7	6	4	-							
7-8							2	3	2	3	3	3	2
7-9							3	2	2	3	2	2	5
8-7							3	2	1	1	2	2	1
Avg.	12	6	6	7	3	8	3	2	2	2	2	2	3

TABLE 4
1968 SAMPLING RESULTS - GRASSY ISLAND AREA
Parameter: COD (mg/l)

FWPCA, DPO

	Wells						PS-68 - Stations						
Date	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	230	260	80	200	55	58							
5-14	44	330	86	140	71	-							
7-8							8	11	11	9	13	14	14
7-9							2	1	3	10	16	11	73
8-6							47	37	9	32	10	43	40
8-7							28	4	12	1	10	13	3
8-13							8	11	10	1	7	9	37
Avg.	140	300	83	170	63	58	18	13	8	11	11	18	33

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Total Phosphates (mg/l)

	Wells						PS-68 - Stations						
Date	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	4.7	1.3	1.9	4.4	.43	1.9							
5-14	.41	2.2	.73	2.9	.54	-							
7-8							.20	.17	.08	.15	.20	.16	.19
7-9							.18	.25	.09	.31	.28	.17	.18
8-6							.22	.23	.15	.31	.31	.32	.26
8-7							.26	.31	.13	.25	.31	.29	.25
8-13							.21	.29	.20	.19	.38	.32	.40
Avg.	4.4	1.8	1.3	3.6	.48	1.9	.21	.25	.13	.24	.29	.25	.25

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

Parameter: Total Sol. Phosphates (mg/l)

FWPCA, DPO

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	.03	.05	.04	.06	.04	.12							
5-14	.04	.04	.03	.10	.05	-							
7-8							.18	.15	.08	.15	.4	.15	.15
7-9							.14	.21	.07	.20	.18	.15	.14
8-6							.20	.22	.13	.20	.23	.22	.22
8-7							.20	.21	.09	.20	.24	.22	.23
8-13							.23	.26	.19	.24	.26	.31	.30
Avg.	.04	.04	.04	.08	.04	.13	.19	.21	.11	.20	.19	.21	.21

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Nitrates (mg/l)

	Wells						PS-68 - Stations						
Date	3	4	5	7	8	9	1	2	3	4	5	6	7
4 30	4.7	1.3	.5	1.9	.4	1.6							
5-14	.8	1.6	.4	.7	.2	-							
7-8							.4	.3	.4	.5	.4	.4	.5
7-9							.2	.2	.2	.2	.2	.2	.2
8-6							.1	.2	.2	.2	.1	.2	.1
8-7							.1	.1	.2	.2	.1	.1	.1
8-13							< .1	.1	< .1	.1	.2	.2	.2
Avg.	2.0	1.4	.45	1.3	.3	1.6	.2	.2	.2	.2	.2	.2	.2

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Nitrites (mg/l)

Date	3	4	5	7	8	9
4-30	.04	< .01	< .01	.04	.01	.02
5-14	.03	.01	.01	.04	.02	-

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

EWPCA, DPO

Parameter: Ammonia (mg/l)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	2.6	-	4.4	3.8	2.2	.88							
5-14	1.3	.68	4.4	3.4	2.0								
7-8							.21	.06	.13	.24	.12	-	.13
7-9							.16	.06	< .05	.19	.19	.10	.12
8-6							.18	.19	.14	.18	.16	.19	.17
8-7							.25	.19	.28	.08	.23	.24	.18
8-13													

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Organic-N (mg/l)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	.20	-	.12	.29	.24	.46							
5-14	< .05	.19	.12	.43	.06	-							
7-8							< .05	.06	< .05	< .05	< .05	-	< .05
7-9							< .05	.10	.16	< .05	< .05	< .05	< .05
8-6							< .05	.08	.08	.12	.05	.05	.09
8-7							.13	.05	.10	.06	.18	.06	.11
8-13													

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Total Coliform (MF/100 ml)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	1300	400	1400	1000	1200	14,000							
5-14	420	> 160	80	60	150	-							
7-0							23,000	5,800	3,900	17,000	9,200	7,500	15,000
7-2							2,000	1,400	1,400	3,800	21,000	7,000	23,000
8-6							61,000	43,000	250,000	110,000	120,000	110,000	71,000
8-7							> 200,000	>140,000	73,000	> 10,000	>160,000	>140,000	>190,000
8-13							350,000	370,000	220,000	190,000	380,000	470,000	260,000

TABLE 4
1968 SAMPLING RESULTS - GRASSY ISLAND AREA
Parameter: Fecal Coliform (MF/100 ml)

FWPCA, DPO

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	10	< 10	< 10	< 10	10	220							
5-14	10	10	< 10	< 5	< 5	-							
7-8							970	350	420	880	720	620	890
7-9							40	20	40	160	720	420	1,300
8-6							2200	1900	2600	3700	4300	4700	1,100
8-7							30,000 >	2,500	5700	22,000	25,000	19,000	25,000
8-13							29,000	13,000	18,000	18,000	24,000	31,000	27,000

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Fecal Strep (MF/100 ml)

Date	PS-68 - Stations						
	1	2	3	4	5	6	7
7-8	50	5	15	50	10	25	15
7-9	10	< 1	10	30	10	10	90
8-6	80	52	38	10	20	80	140
8-7	220	110	70	210	290	180	310
8-13	230	78	130	190	150	160	130

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

Parameter: Total Solids (mg/l)

FWPCA, DPO

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	5000	4100	1300	5000	1200	2600							
5-14	1200	4500	1300	4100	1000	-							
7-8							140	180	150	160	140	140	170
7-9							180	160	150	170	150	160	190
8-6							160	160	160	180	170	190	160
8-7							120	150	120	340	150	140	130
8-13							170	170	190	190	240	180	180
Avg.							150	160	150	210	160	170	170

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Dissolved Solids (mg/l)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	2600	3100	550	2800	830	1900							
5-14	1000	2700	950	2900	620	-							
7-8							120	130	140	120	110	130	140
7-9							160	140	130	150	130	140	160
8-6							150	130	130	130	130	150	130
8-7							99	140	90	320	60	120	110
8-13							160	140	180	170	160	150	170
Avg.							140	140	130	180	120	140	140

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Suspended Solids (mg/l)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	2200	1000	760	2200	330	650							
5-14	160	1800	380	1200	400	-							
7-8							20	53	19	44	33	17	23
7-9							16	16	22	20	22	13	29
8-6							13	31	21	49	39	47	31
8-7							22	12	34	18	90	24	19
8-13							9	33	12	16	80	34	18
Avg.							16	29	21	29	52	28	25

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Total Volatile Solids (mg/l)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	770	930	450	940	270	340							
5-14	250	340	350	700	200	-							
7-8							32	43	35	37	26	24	34
7-9							42	78	81	71	80	71	83
8-6							87	94	110	110	100	120	110
8-7							49	100	93	59	77	64	82
8-13							43	43	45	57	46	45	43
Avg.							50	71	72	67	65	65	70

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

Parameter: Vol. Susp. Solids (mg/l)

FWPCA, DPO

Date	Wells 3	4	5	7	8	9	PS-68 - Stations 1	2	3	4	5	6	7
4-30	240	120	92	230	32	66							
5-14	19	130	29	84	45	-							
7-8							4	6	3	20	7	4	9
7-9							9	7	10	6	3	4	8
8-6							5	6	9	14	6	8	9
8-7							14	7	16	7	15	8	4
8-13							2	12	10	9	11	7	10
Avg.							6	7	9	11	8	6	8

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Iron (mg/l)

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	130	43	23	60	8.9	20							
5-14	11	79	16	36	12	-							
7-8							.35	.79	.31	.50	.58	.46	.43
7-9							.36	.33	.29	.58	.57	.39	.50
8-6							.35	.34	.26	1.1	1.2	1.3	.63
8-7							.37	.69	.29	.37	.69	.64	.41
8-13							.47	.39	.29	.39	1.8	.94	.50
Avg.							.38	.50	.28	.58	.94	.62	.49

TABLE 4

1968 SAMPLING RESULTS - GRASSY ISLAND AREA

FWPCA, DPO

Parameter: Oil & Grease (mg/l)

Date	3	4		7	8	9
4-30	7	8	4	9	6	5
5-14	2	5	3	3	3	-

TABLE 4
1968 SAMPLING RESULTS - GRASSY ISLAND AREA
Parameter: Turbidity (JCU)

FWPCA, DPO

Date	Wells						PS-68 - Stations						
	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	110	340	310	300	90	170							
5-14	85	290	140	320	85	-							
7-8							6	25	6	7	9	8	15
7-9							6	7	6	7	9	7	8
8-6							6	6	6	25	25	25	15
8-7							6	15	6	6	15	15	18
8-13							7	8	6	6	40	20	7
Avg.							6	12	6	10	19	15	12

TABLE 4
1968 SAMPLING RESULTS - GRASSY ISLAND AREA
FWPCA, DPO
Parameter: Sulphate (mg/l)

	Wells						PS-68 - Stations						
Date	3	4	5	7	8	9	1	2	3	4	5	6	7
4-30	840	1500	240	1300	240	37							
5-14	440		190		180								
7-8							17	16	15	16	16	16	16
7-9							20	19	18	19	19	19	19
8-6							16	16	16	17	17	18	17
8-7							18	18	16	17	18	17	16
8-13							17	16	16	16	17	17	16
Avg.							17	17	16	17	17	17	16

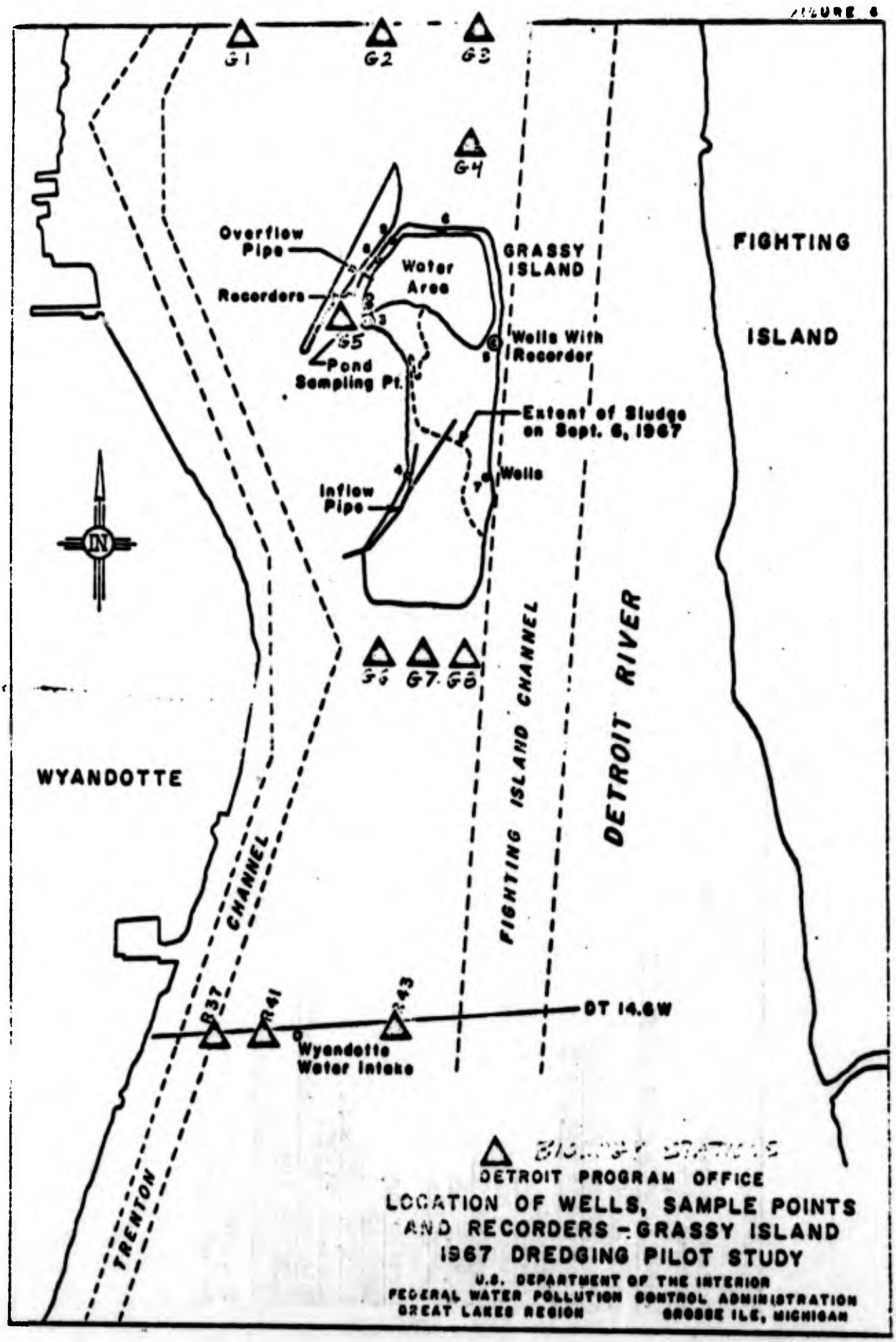


FIGURE 6
G1
G2
G3
G4
Overflow Pipe
Recorders
Water Area
GRASSY ISLAND
FIGHTING ISLAND
Wells With Recorder
G5
Pond Sampling Pt.
Extent of Sludge on Sept. 6, 1967
Wells
Inflow Pipe
N
G6
G7
G8
WYANDOTTE
TRENTON CHANNEL
FIGHTING ISLAND CHANNEL
DETROIT RIVER
R37
R41
R43
DT 14.6W
Wyandotte Water Intake
BIOLOGY STATIONS
DETROIT PROGRAM OFFICE
LOCATION OF WELLS, SAMPLE POINTS AND RECORDERS - GRASSY ISLAND 1967 DREDGING PILOT STUDY
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION
GROSSE ILE, MICHIGAN

Table 5

Rouge River Pilot Study
Bottom Fauna near Grassy Island
5/31/68

Station No.	G-1	G-2	G-3	G-4	G-5	G-6
Lab. No.	22511	22510	22509	22508	22507	22506
Sediment Descrip.	Sand, sludge	Sand, sludge	Sand, gravel	Sand, sludge	Sand, sludge	Sand, sludge
Sediment Odor	Ds	Ch	-	-	-	Ds
Bottom Organisms per Square Foot:						
Tubificidae	7,160	1,940	39	5,617	88	112
Glossiphonia heteroclita	17	8	-	17	-	-
Glossiphonia complanata	6	-	-	-		
Physa sp.	2	9	2	5	-	-
Gyraulus sp.	-	2	-			
Helisoma sp.	-	2	-	-	-	-
Campeloma sp.	-	2	-	-	-	-
Bithinia sp.	2	5	2	2	-	-
Valvata sp.	35	12	-	5	3	-
Unionidae	-	-	-	-	-	-
Pisidium sp.	21	77	3	27	-	-
Sphaerium sp.	5	-	2	-	-	-
Gammarus fasciatus	-	-	2	-	-	-
Hyalella azteca	-	2	-	-	-	-
Chironomus (Cryptochironomus) sp.	-	2	-	-	-	-
Hexagenia limbata	-	-	-	-	-	-
Potomogeton pectinatus	present	present	-	present	-	-
Total No./Sq. Ft.	7,248	2,061	50	5,673	91	112
No. of Kinds	8	11	6	6	2	1

Table 5 (Cont'd)
Rouge River Pilot Study
Bottom Fauna near Grassy Island
5/31/68

Station No.	G-7	G-8	DT 14.6-R37	DT 14.6-R41	DT14.6-R43
Lab. No.	22505	22504	22502	22501	22503
Sediment Descrip.	Sand, sludge	Sand, sludge	Sand, sludge	Sand, sludge	Sand, gravel
Sediment Odor	Ds	Ds, Ch	-	-	-
Bottom Organisms per Square Foot:					
Tubificidae	2,790	417	187	3,320	17
Glossiphonia heteroclita	6	-	2	-	-
Glossiphonia complanata	-	-	-	-	-
Physa sp.	-	-	8	-	-
Gyraulus sp.	-	-	-	-	-
Helisoma sp.	-	-	-	-	-
Campeloma sp.	-	-	-	-	-
Bithinia sp.	-	-	18	-	-
Valvata sp.	2	-	2	-	-
Unionidae	-	-	2	-	-
Pisidium sp.	2	-	8	12	-
Sphaerium sp.	6	-	17	23	-
Gammarus fasciatus	-	-	-	-	-
Hyalella azteca	-	-	-	-	-
Chironomus (Cryptochironomus) sp.	-	-	-	-	-
Hexagenia limbata	-	-	2	-	-
Potomogeton pectinatus	present	-	-	present	-
Total No./Sq. Ft.	2,806	417	246	3,355	17
No. of Kinds	5	1	9	3	1

Table 6
Rouge River Pilot Study
Bottom Fauna near Grassy Island
8/20/68

Station No.	G-1	G-2	G-3	G-4	G-5	G-6
Lab. No.	34581	34582	34583	34584	34585	34586
Sediment Descrip.	Sand, sludge	Sand, sludge	Sand, sludge	Sand, sludge	Sand, sludge	Sand, sludge
Sediment Odor	Ch	Ch	Ch	Ch	Ch, strong	-
Bottom Organisms per Square Foot:						
Tubificidae	170	340	60	570	210	920
Glossiphonia heteroclita	17	50	2	5	14	3
Glossiphonia complanata	-	8	-	-	-	-
Placobdella sp.	-	2	-	-	-	-
Dugesia sp.	-	-	18	-	-	-
Physa sp.	-	9	3	-	2	-
Bithinia sp.	-	9	8	-	-	-
Valvata sp.	-	8	5	-	5	-
Helisoma sp.	-	2	-	-	-	-
Pleurocera sp.	-	-	8	-	-	-
Goniobasis sp.	-	-	5	-	-	-
Pisidium sp.	-	2	3	2	-	-
Sphaerium sp.	-	2	23	-	3	-
Gammarus fasciatus	-	-	-	-	-	-
Hyalella azteca	-	-	2	-	-	-
Chironomus (Cryptochironomus) sp.	-	-	3	-	-	-
Procladius sp.	-	-	-	-	2	-
Potomogeton sp.	present	present	present	-	-	-
Total No./Sq. Ft.	187	432	140	577	236	923
No. of Kinds	2	10	12	3	6	2

Table 6 (Cont'd)
Rouge River Pilot Study
Bottom Fauna near Grassy Island
8/20/68

Station No.	G-7	G-8	DT 14.6-R37	DT14.6-R41	DT14.6-R43
Lab. No.	34587	34588	34589	34590	34591
Sediment Descrip.	Sand, sludge	Sand, sludge	Sand, sludge	Sand, sludge	Sand, sludge
Sediment Odor	Ch	Ch	Ch	Ch	Ch
Bottom Organisms per Square Foot:					
Tubificidae	950	7,800	16	1666	380
Glossiphonia heteroclita	6	2	1	3	-
Glossiphonia complanata	-	-	-	-	-
Placobdella sp.	3	-	-	2	-
Dugesia sp.	3	-	2	-	-
Pyhsa sp.	12	2	-	4	-
Bithinia sp.	-	-	13	1	-
Valvata sp.	15	8	-	1	-
Helisoma sp.	-	-	-	-	-
Pleurocera sp.	-	-	-	-	-
Goniobasis sp.	-	-	-	-	-
Pisidium sp.	50	2	2	6	8
Sphaerium sp.	5	6	2	1	-
Gammarus fasciatus	-	-	1	-	-
Hyalella azteca	-	-	-	-	-
Chironomus (Cryptochironomus) sp.	-	-	-	-	-
Procladius sp.	-	-	-	-	-
Potomogeton sp.	present	-	-	present	present
Total No./Sq. Ft.	1044	7820	37	1678	388
No. of Kinds	8	6	7	8	2

C. Other Harbors

Bottom sediment samples from nine Michigan Harbors were received by the Detroit Program Office Laboratory from the Corps of Engineers in 1968. Three different sampling methods were employed. Samples from the Detroit River were collected with a Petersen dredge. A scuba diver collected the samples from Harbor Beach. All other bottom samples were collected directly from the hopper dredge (HAINS) intake chute in a metal bucket suspended from a rope. The samples were transported to the laboratory in plastic jars and were preserved in ice.

Most samples delivered to the FWPCA laboratory were analyzed for COD, total solids and volatile solids. Other tests were performed as time and the laboratory work load permitted.

The harbors sampled, the gross descriptions and the analytical results are listed in Table 7 . The explanation of the bottom material description is given on page 64 . The qualitative odor description and code is shown in Table 10 .

Table 7
Bottom Sediment Sample Analysis
Michigan Harbors
1968

FWPCA, DPO

SAMPLE NO.	HARBOR	DREDGE	COLLECT DATE	LAB. NO.	GROSS DESCRIPTION (Description; odor; depth)
1	Grand Haven	HAINS	5-13-68	20750	Black sludge, some fine sand, a sludgeworm; E,Ds
2	Grand Haven	HAINS	5-13-68	20751	Black sludge, some fine sand, a sludgeworm; E,Ds
3	St. Joseph	HAINS	5-15-68	20752	Brown to dark gray medium sand, trace sludge, gravel and pebbles; fishy odor.
4	St. Joseph	HAINS	5-15-68	20753	Brown medium sand, trace dark gray sludge; fishy odor & Ep
5	St. Joseph	HAINS	5-17-68	20754	Dark gray to brown medium sand, trace sludge & pebbles; E, Ds
6	St. Joseph	HAINS	5-17-68	20755	Dark gray to brown medium sand trace sludge and gravel; sludgeworms; E, Ds
7	St. Joseph	HAINS	5-20-68	21750	Gray to brown sludge, some sand, trace pebbles; E
8	Benton Harbor	HAINS	5-20-68	21751	Brown sand, some sludge, sludgeworm, bloodworm, some duckweed; E
9	Holland	HAINS	5-23-68	21752	Brown fine sand; slight fishy odor
10	Holland	HAINS	5-23-68	21753	Brown fine sand, a sludgeworm; slight fishy odor
11	Muskegon	HAINS	5-24-68	21754	Brown fine sand; slight fishy odor
12	Muskegon	HAINS	5-24-68	21755	Brown fine sand; slight fishy odor
13	Grand Haven	HAINS	5-27-68	22750	Dark brown to black sludge & ooze, some oil sludgeworms, bloodworms; Ch
14	Grand Haven	HAINS	5-27-68	22751	Dark brown to black sludge and ooze, some oil, sludgeworms; Ch
15	Muskegon	HAINS	5-29-68	22752	Brown sand; fishy odor
16	Muskegon	HAINS	5-29-68	22753	Brown sand; fishy odor
17	Manistee River	HAINS	6-24-68	26750	Medium brown sand; slight Ch and DF
18	Manistee River	HAINS	6-24-68	26751	Sand & gravel with a few stones and shells; Ep, G, and E; slight trace of oil
19	Manistee	HAINS	6/26/68	26752	Brown sand; E
20	Manistee	HAINS	6/26/68	26753	Brown sand; E, E & Ep
21	Manistee	HAINS	6/26/68	26754	Gravel & dark brown sand w. sludge; E, slightly S
22	Manistee	HAINS	6/26/68	26755	Dark brown sand w. sludge; E, slightly S
23	Manistee	HAINS	7/1 /68	27750	Dark brown sand, (red clay); E
24	Manistee	HAINS	7/1 /68	27751	Dark brown sand, sludge; E

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Table 7
Bottom Sediment Sample Analysis
Michigan Harbors
1968

SAMPLE NO.	IMMED. DO DEM Mg/Kg Wet Basis	COD Mg/Kg Wet Basis	PHENOLS µg/Kg Wet Basis	TOTAL PO_4 Mg/Kg Wet Basis	TOT. SOL. PO_4 Mg/Kg Wet Basis	NITRATE NO_3-N Mg/Kg Wet	NITRITE NO_2 [illegible] g/Kg t Basis	AMMONIA [illegible] N Mg/Kg Wet Basis	O[illegible] N Mg/Kg Wet Basis	IRON Mg/Kg Wet Basis	OIL & GREASE Mg/Kg Dry Basis	TOTAL SOLIDS % Wet Basis	VOL SOLIDS % Dry Basis	BOD Mg/Kg Wet Basis
1		46,000	< 190					190	200	6600		43.4	6.9	
2		47,000	< 190					200	76	6700		44.2	7.9	
3		11,000								6000		74.7	2.6	
4		9,400								4400		78.4	.7	
5		8,400								4200		75.7	1.3	
6		7,300								4000		78.6	1.0	
7		27,000										67.3	4.2	
8		37,000										70.6	2.8	
9		< 200										83.6	.2	
10		480										82.7	.2	
11		790										82.6	.2	
12		790										[illegible]	.2	
13		53,000										26.4	29.6	
14		42,000										31.6	11.9	
15		1,100										82.2	.4	
16		1,200										80.7	.3	
17	6.	4,800	210	230				25	7.4		490	82.0	.4	
18	6.	5,500	200	320				21	9.2		93	77.1	2.4	
19	5.	1,300	< 150	240				28	5.4		150	88.0	.3	
20	< 3.	830	< 150	120				16	11.0		250	87.6	.1	
21		23,000	< 150	290				62	65.0		440	64.2	3.1	
22		-	< 150	400				53	5.6		930	53.8	4.9	
23	3	12,000	170	280				4.0	12.0		470	85.8	1.5	
24	5	14,000	210	270				5.2	5.8		380	84.6	1.3	

Table 7
Bottom Sediment Sample Analysis
Michigan Harbors
1968

FWPCA, DPO

SAMPLE NO.	HARBOR	DREDGE	COLLECT DATE	LAB. NO.	GROSS DESCRIPTION (Description: odor; depth)
25	Manistee	HAINS	7/3/68	27752	Medium brown sand, some gravel; E, DF
26	Manistee	HAINS	7/3/68	27753	Light sand; E, DF
27	Detroit River - L. Erie		7/10/68	28750	Dark grey sludge; some oil, sludgeworms; Ch & C
28	Detroit River - L. Erie		7/10/68	28751	Grey sludge, sludgeworms, some oil; D, Ep, Cs
29	Detroit River - L. Erie		7/10/68	28752	Grey sludge, sludgeworms; C & Ch
30	Detroit River - L. Erie		7/10/68	28753	Dark grey sludge, sludgeworms; C & Ch
31	Detroit River - L. Erie		7/10/68	28754	Dark grey sludge, sludgeworms; C & Ch
32	Frankfort	HAINS	7/10/68	28755	Light brown sand, no odor
33	Frankfort	HAINS	7/10/68	28756	Light brown sand, no odor
34	Frankfort	HAINS	7/12/68	28757	Medium brown sand; DF
35	Frankfort	HAINS	7/12/68	28758	Dark brown sand; M, G
36	Detroit River - L. Erie	-	7/15/68	29750	Dark gray sludge; Ch, E
37	Detroit River - L. Erie	-	7/15/68	29751	Dark gray sludge, tr. oil; Ch, M, Bs, E
38	Detroit River - L. Erie	-	7/15/68	29752	Brown gray sludge; slight odor
39	Detroit River - L. Erie	-	7/15/68	29753	Dark gray sludge, tr. oil; Ch, E, Bs, Ep
40	Detroit River - L. Erie	-	7/15/68	29754	Dark gray sludge, tr. oil; Ch, E, Bs
41	Detroit River - L. Erie	-	8/26/68	35750	Gray sludge, trace sand; Ch, M
42	Detroit River - L. Erie	-	8/26/68	35751	Gray sandy sludge; Ch, Mm
43	Detroit River - L. Erie	-	8/26/68	35752	Gray sandy sludge; E, Cc
44	Detroit River - L. Erie	-	8/26/68	35753	Grey sludge, some sand; Ep, Ch, E
45	Detroit River - L. Erie	-	8/26/68	35754	Gray sandy sludge, some gravel; Df, E, Ep
46	Detroit River - L. Erie	-	8/26/68	35755	Gray sludge, trace sand; Ch, E, Bs
47	Harbor Beach		8/27/68	35756	Dark gray sludge, some sand; Ep, E; 15' - 16'
48	Harbor Beach		8/27/68	35757	Dark gray sandy sludge; Ep, E; 18.8' - 19.8'
49	Harbor Beach		8/27/68	35758	Dark gray sandy sludge; Ep, E; 19.8' - 20.8'
50	Harbor Beach		8/27/68	35759	Dark gray sandy sludge; Ep, E; 17.2' - 18.2'
51	Harbor Beach		8/27/68	35760	Dark gray sandy sludge; Ep, E; 21.5' - 22.5'
52	Harbor Beach		8/27/68	35761	Dark grey sludge, some sand; Ep, E; 21.8' - 22.8'
53	Harbor Beach		8/27/68	35762	Dark gray sludge, some sand; Ep, E; 18.2' - 19.2'
54	Harbor Beach		8/27/68	35763	Dark gray sandy sludge; Ep, E; 22.1' - 23.1'
55	Harbor Beach		8/27/68	35764	Dark gray sandy sludge; Bs, E; 20.3' - 21.3'
56	Harbor Beach		8/27/68	35765	Black sandy sludge, some gravel; Cs,D,Ds; 1.5' - 2.5'

Table 7
Bottom Sediment Sample Analysis
Michigan Harbors
1968

FWPCA, DPO

SAMPLE NO.	IMMED. DO DEM Mg/Kg Wet Basis	COD Mg/Kg Wet Basis	PHENOLS µg/Kg Wet Basis	TOTAL PO_4 Mg/Kg Wet Basis	TOT. SOL. PO_4 Mg/Kg Wet Basis	NITRATE NO_3-N Mg/Kg Wet Basis	NITRITE NO_2-N Mg/Kg Wet Basis	AMMONIA NH_3-N Mg/Kg Wet Basis	ORGANIC NITROGEN Mg/Kg Wet Basis	IRON Mg/Kg Wet Basis	OIL & GREASE Mg/Kg Dry Basis	TOTAL SOLIDS % Wet Basis	VOL SOLIDS % Dry Basis	BOD Mg/Kg Wet Basis
25	5	650	130	240				3.2	1.8		800	41.3	2.9	
26	3	350	280	230				2.6	.80		270	[illegible]	1.1	
27	120	62,000	650	2400		2.2		140	78	2000	11,[illegible]	[illegible]	[illegible]	
28	150	52,000	830	2500		2.0		130	1.8	1400	[illegible]	40.1	11.2	
29	120	56,000	970	2900		1.2		130	91	1700	17,000	40.1	13.0	
30	120	46,000	760	1600		2.7		92	73	1700	16,000	45.[illegible]	10.1	
31	240	42,000	760	2600		2.2		110	160	1500	17,[illegible]	[illegible]	[illegible]	
32	< 2	200	330	120				1.4	-		[illegible]	[illegible]	[illegible]	
33	< 2	130	220	150				6.1	1.0	[illegible]	[illegible]	[illegible]	[illegible]	
34	2	13,000	160	-				12	[illegible]			81.	[illegible]	
35	120	56,000	270	-				110	110			[illegible]	3.5	
36	140	57,000	770	-				1[illegible]	110	-	6,600	11.[illegible]	7.8	
37	150	57,000	610	-				12	120	-	11,000	[illegible]	8.6	
38	30	52,000	190	-				6.0	150	-	620	[illegible]	6.3	
39	110	38,000	160	-				6.0	70	-	6,500	1.[illegible]	5.4	
40	90	45,000	340	-				6.4	180	-	3,800	[illegible]	5.1	
41	140	50,000	<150	1400						11,000	4,100	[illegible]	[illegible]	
42	170	66,000	210	1500						15,000	9,200	[illegible]	[illegible]	
43	180	59,000	280	2200						11,000		[illegible]	[illegible]	
44	160	53,000	290	1600						12,000	8,700	[illegible]	[illegible]	
45	100	31,000	180	1100						12,000	2,100	[illegible]	[illegible]	
46	180	49,000	270	1700						13,000		[illegible]	[illegible]	
47		20,000	370	2200						8,100		[illegible]	[illegible]	
48		30,000	< 170	600						17,000		[illegible]	7.4	
49		30,000	210	700						10,000		[illegible]	[illegible]	
50		33,000	< 170	800						9,000		[illegible]	[illegible]	
51		31,000	< 170	800						11,000		[illegible]	[illegible]	
52		31,000	310	700						10,000		39.0	[illegible]	
53		31,000	< 170	800						8,000		29.5	[illegible]	
54		28,000	< 170	800						9,300		33.3	[illegible]	
55		29,000	< 170	1.00						9,700		[illegible]	[illegible]	
56		31,000	< 170	1100						7,700		[illegible]	[illegible]	

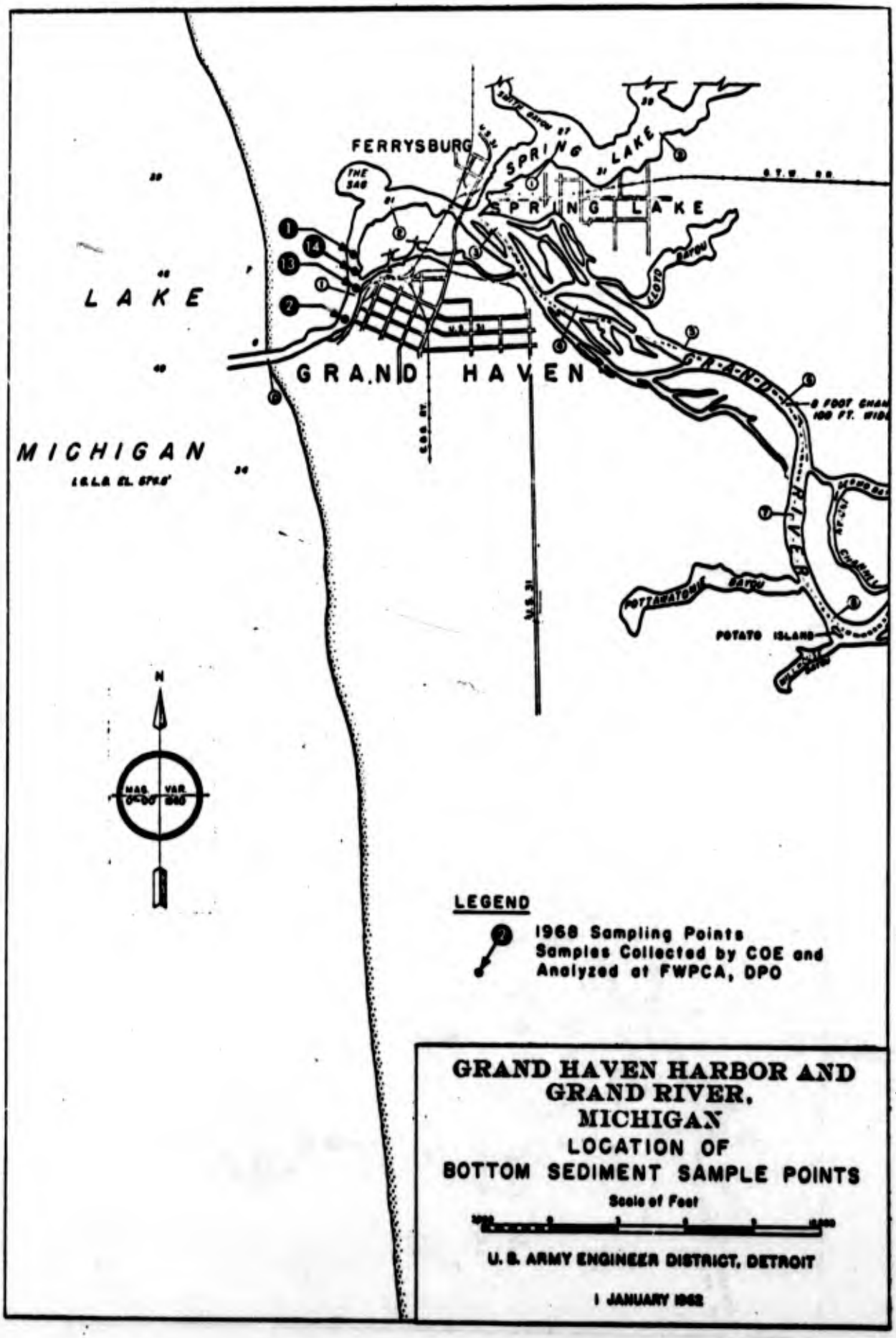
Table 7
Bottom Sediment Sample Analysis
Michigan Harbors
1968

FWPCA, DPO

SAMPLE NO.	HARBOR	DREDGE	COLLECT DATE	LAB. NO.	GROSS DESCRIPTION (Description; odor; depth)
57	Harbor Beach		8/27/68	35766	Black sandy sludge, some gravel; Cs,D,Ds; 1.5' - 2.5'
58	Harbor Beach		8/27/68	35767	Black sand, with gravel and sludge; E,M,Mm; 0.5'-1.5'

Table 7
Bottom Sediment Sample Analysis
Michigan Harbors
1968

SAMPLE NO.	IMMED. DO DEM Mg/Kg Wet Basis	COD Mg/Kg Wet Basis	PHENOLS µg/Kg Wet Basis	TOTAL PO_4 Mg/Kg Wet Basis	TOT. SOL. PO_4 Mg/Kg Wet Basis	NITRATE NO_3-N Mg/Kg Wet Basis	NITRITE NO_2-N Mg/Kg Wet Basis	AMMONIA NH_3-N Mg/Kg Wet Basis	ORGANIC NITROGEN Mg/Kg Wet Basis	IRON Mg/Kg Wet Basis	OIL & GREASE Mg/Kg Dry Basis	TOTAL SOLIDS % Wet Basis	VOL SOLIDS % Dry Basis	BOD Mg/Kg Wet Basis
57		140,000	1200	600						5,800		40.2	21.6	
58		24,000	380	800						13,000		72.2	4.3	


FERRYSBURG
SPRING LAKE
SPRING LAKE
LAKE
MICHIGAN
GRAND HAVEN
LOST BAYOU
POTTAWATOMIE BAYOU
POTATO ISLAND
N
LEGEND
1968 Sampling Points
Samples Collected by COE and
Analyzed at FWPCA, DPO
GRAND HAVEN HARBOR AND
GRAND RIVER,
MICHIGAN
LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS
Scale of Feet
U. S. ARMY ENGINEER DISTRICT, DETROIT
1 JANUARY 1968

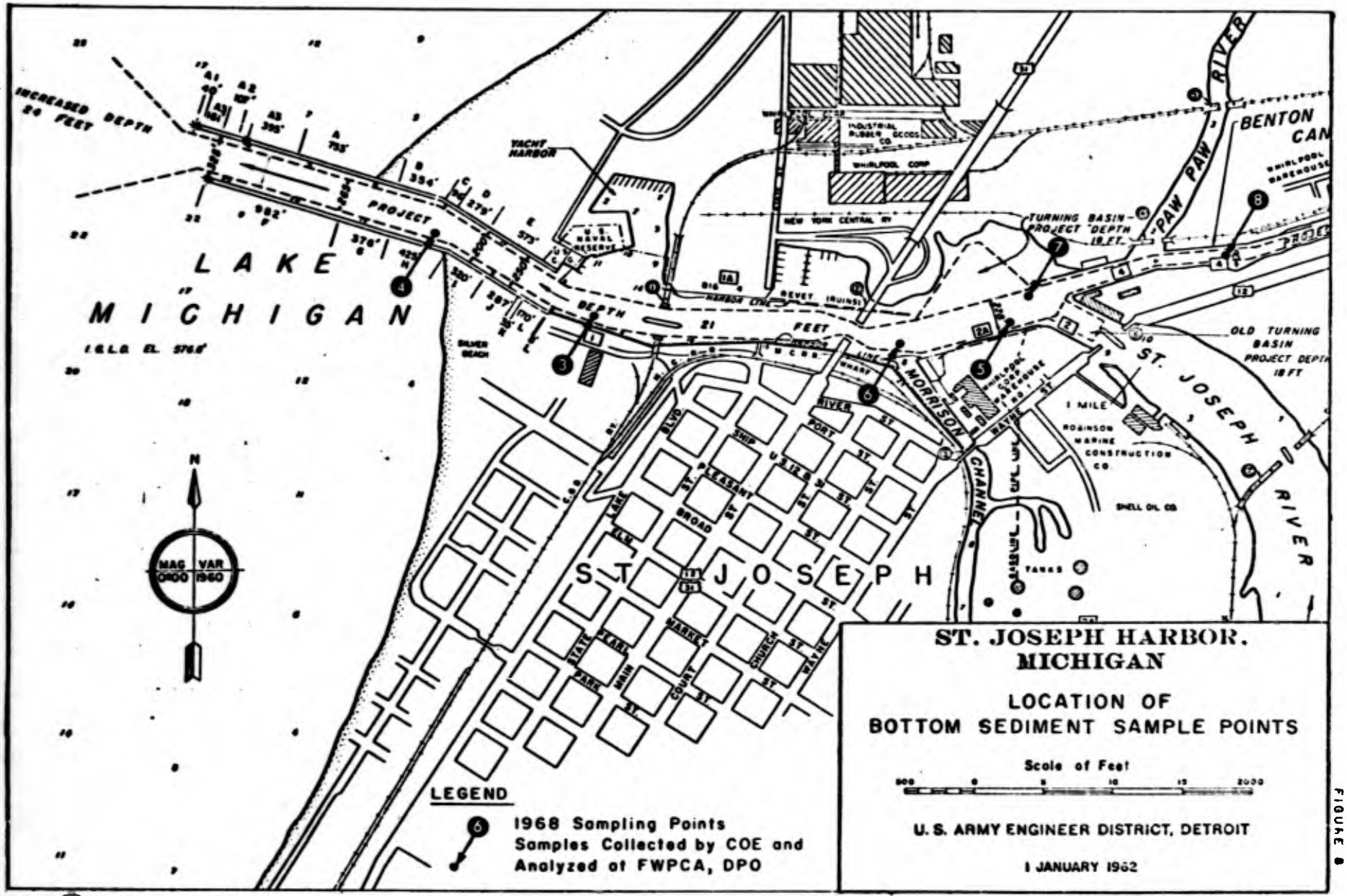
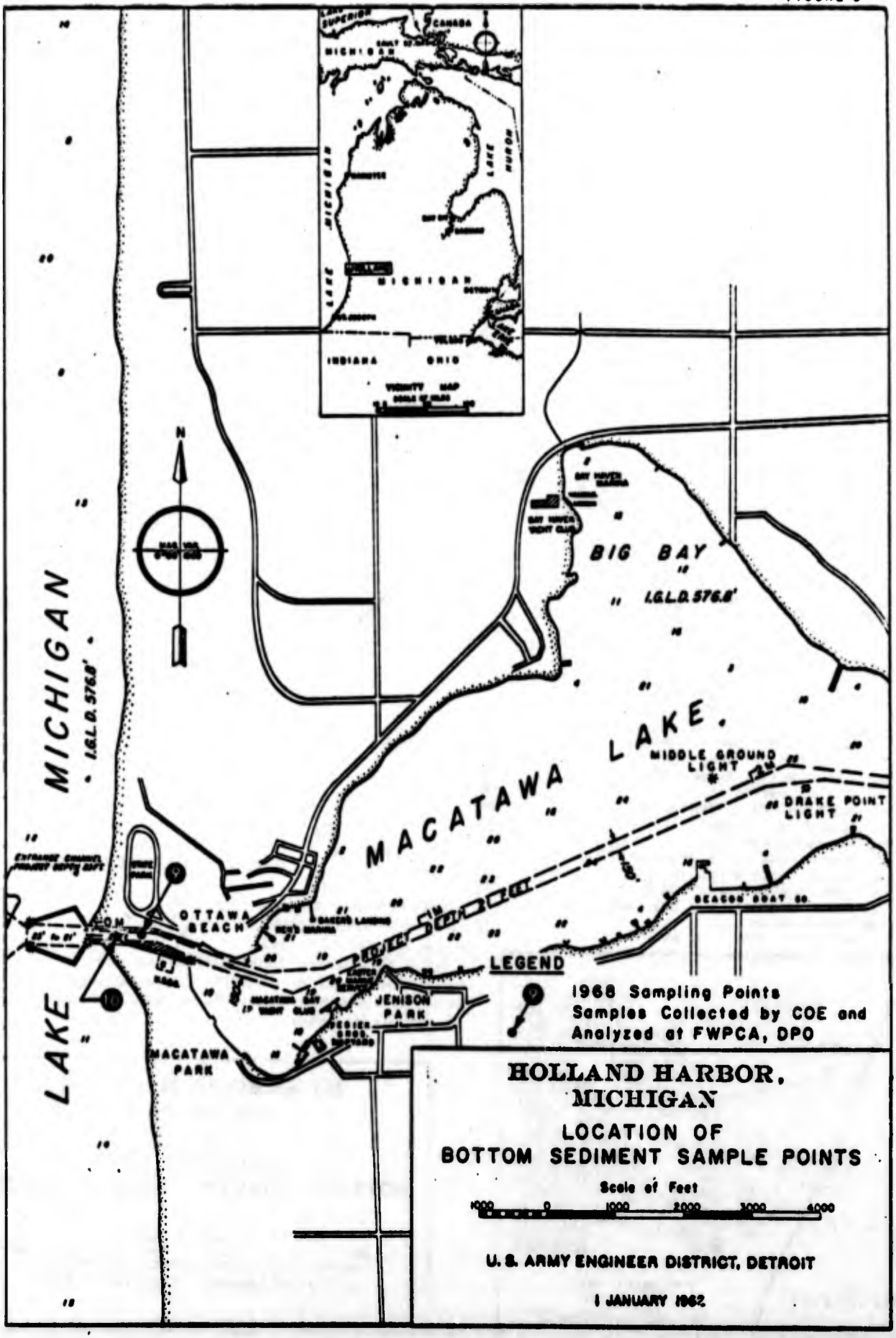
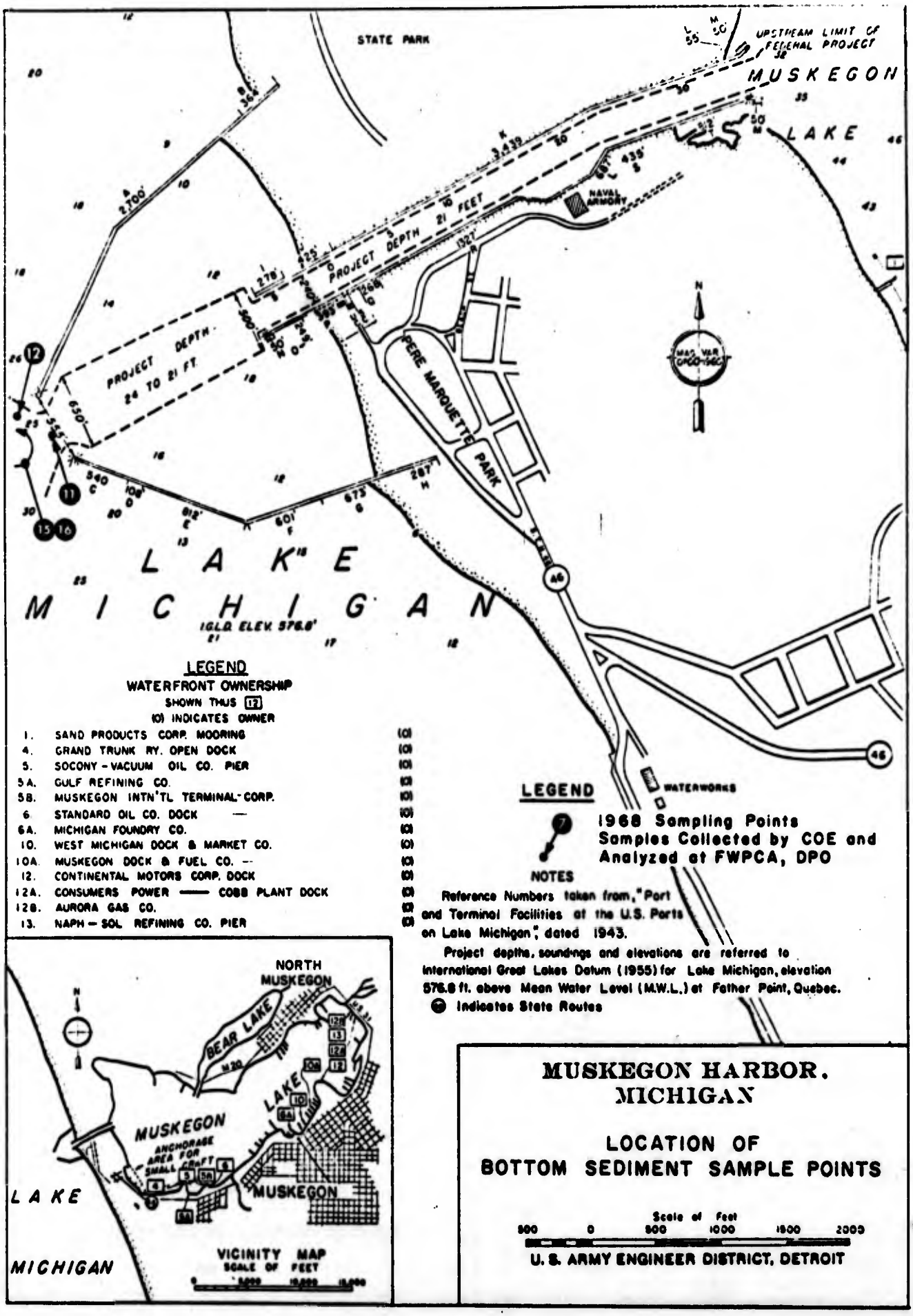

LAKE
MICHIGAN
I.G.L.D. EL. 576.8'
INCREASED DEPTH 24 FEET
PROJECT
YACHT HARBOR
DEPTH 21 FEET
HARBOR LINE
REVET (RUINS)
U.S. NAVAL RESERVE
NEW YORK CENTRAL RY
TURNING BASIN - PROJECT DEPTH 18 FT.
PAW PAW RIVER
BENTON CAN
OLD TURNING BASIN PROJECT DEPTH 18 FT
ST. JOSEPH RIVER
MORRISON CHANNEL
WHIRLPOOL CORP WAREHOUSE
ROBINSON MARINE CONSTRUCTION CO.
SHELL OIL CO.
TANKS
1 MILE
SILVER BEACH
S T J O S E P H
MAG VAR 0900 1960
N
LEGEND
1968 Sampling Points
Samples Collected by COE and Analyzed at FWPCA, DPO
ST. JOSEPH HARBOR, MICHIGAN
LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS
Scale of Feet
500 0 5 10 15 2000
U.S. ARMY ENGINEER DISTRICT, DETROIT
1 JANUARY 1962

FIGURE 8

FIGURE 9


LAKE MICHIGAN
I.G.L.D. 576.8'
BIG BAY
I.G.L.D. 576.8'
LAKE MACATAWA
MIDDLE GROUND LIGHT
DRAKE POINT LIGHT
OTTAWA BEACH
JENISON PARK
MACATAWA PARK
BEACON BOAT CO.
N
LEGEND
1968 Sampling Points
Samples Collected by COE and Analyzed at FWPCA, DPO
HOLLAND HARBOR, MICHIGAN
LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS
Scale of Feet
1000 0 1000 2000 3000 4000
U. S. ARMY ENGINEER DISTRICT, DETROIT
1 JANUARY 1962


STATE PARK
UPSTREAM LIMIT OF FEDERAL PROJECT
MUSKEGON LAKE
NAVAL ARMORY
PROJECT DEPTH 21 FEET
PROJECT DEPTH 24 TO 21 FT
PERE MARQUETTE PARK
WATERWORKS
LAKE MICHIGAN
IGLD ELEV. 576.8'
LEGEND
WATERFRONT OWNERSHIP
SHOWN THUS (12)
(O) INDICATES OWNER
1. SAND PRODUCTS CORP. MOORING (O)
4. GRAND TRUNK RY. OPEN DOCK (O)
5. SOCONY - VACUUM OIL CO. PIER (O)
5A. GULF REFINING CO. (O)
5B. MUSKEGON INTN'TL TERMINAL CORP. (O)
6. STANDARD OIL CO. DOCK (O)
6A. MICHIGAN FOUNDRY CO. (O)
10. WEST MICHIGAN DOCK & MARKET CO. (O)
10A. MUSKEGON DOCK & FUEL CO. (O)
12. CONTINENTAL MOTORS CORP. DOCK (O)
12A. CONSUMERS POWER — COBB PLANT DOCK (O)
12B. AURORA GAS CO. (O)
13. NAPH - SOL REFINING CO. PIER (O)
LEGEND
1968 Sampling Points
Samples Collected by COE and Analyzed at FWPCA, DPO
NOTES
Reference Numbers taken from, "Port and Terminal Facilities at the U.S. Ports on Lake Michigan", dated 1943.
Project depths, soundings and elevations are referred to International Great Lakes Datum (1955) for Lake Michigan, elevation 576.8 ft. above Mean Water Level (M.W.L.) at Father Point, Quebec.
Indicates State Routes
NORTH MUSKEGON
BEAR LAKE
LAKE MUSKEGON
MUSKEGON
ANCHORAGE AREA FOR SMALL CRAFT
LAKE MICHIGAN
VICINITY MAP
SCALE OF FEET
MUSKEGON HARBOR, MICHIGAN
LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS
Scale of Feet
500 0 500 1000 1500 2000
U. S. ARMY ENGINEER DISTRICT, DETROIT

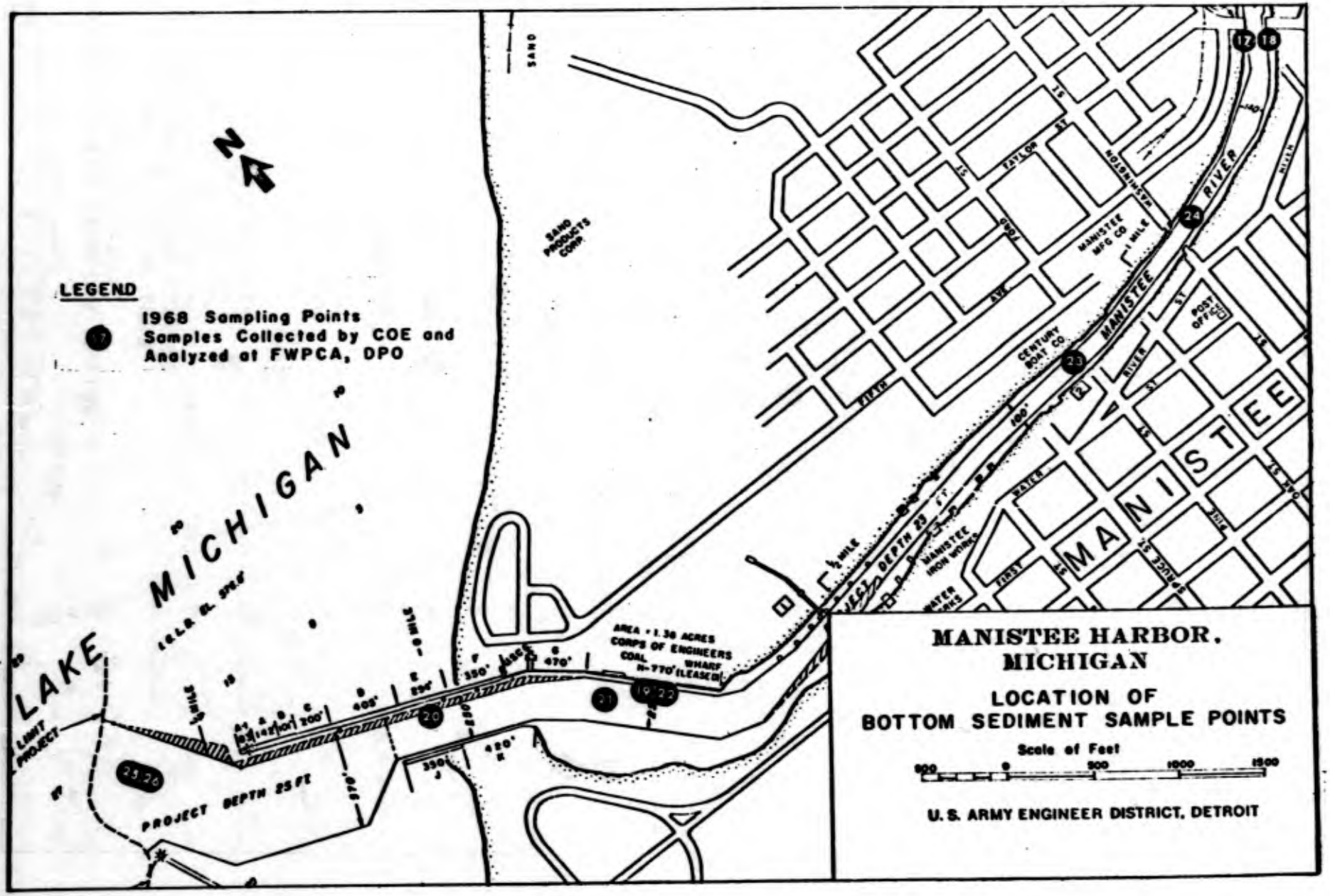

LEGEND
1968 Sampling Points
Samples Collected by COE and
Analyzed at FWPCA, DPO
LAKE MICHIGAN
MANISTEE
MANISTEE RIVER
SAND PRODUCTS CORP.
MANISTEE MFG CO
CENTURY BOAT CO
POST OFFICE
MANISTEE IRON WORKS
AREA = 1.36 ACRES
CORPS OF ENGINEERS
COAL WHARF
N-770' (LEASED)
PROJECT DEPTH 25 FT
DEPTH 23
MANISTEE HARBOR,
MICHIGAN
LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS
Scale of Feet
500 0 500 1000 1500
U. S. ARMY ENGINEER DISTRICT, DETROIT

FIGURE 12

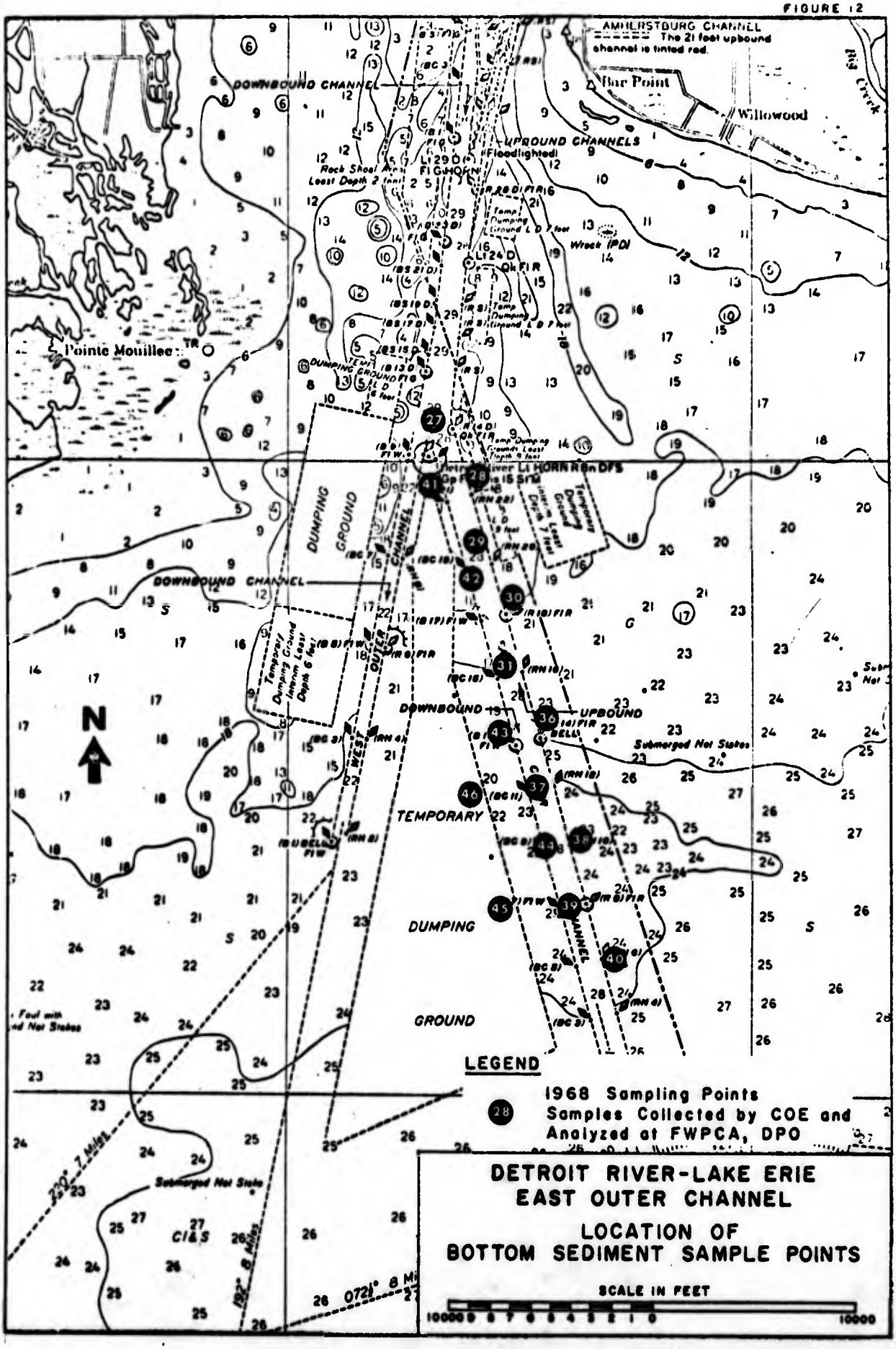
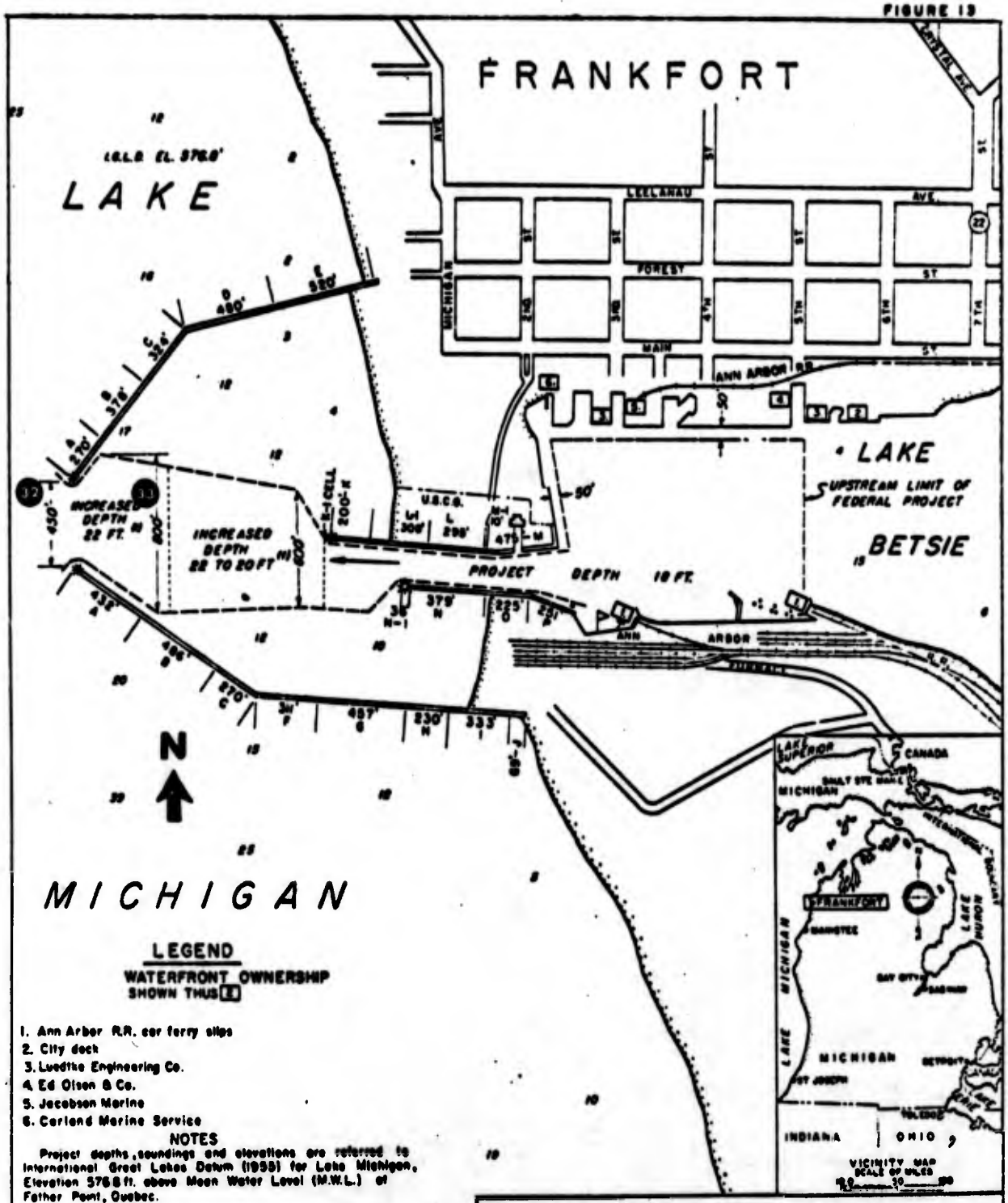

AMHERSTBURG CHANNEL
The 21 foot upbound channel is tinted red.
DOWNBOUND CHANNEL
UPBOUND CHANNELS
Floodlighted
Bar Point
Willowood
Big Creek
Rock Shoal Area Least Depth 2 feet
FIG HORN
Wreck (PD)
Pointe Mouillee
DUMPING GROUND
Temporary Dumping Ground Depth 6 feet
Temporary Dumping Ground Depth 7 feet
DOWNBOUND
UPBOUND
Submerged Net Stakes
TEMPORARY
DUMPING GROUND
Submerged Net Stakes
Cl&S
N
LEGEND
1968 Sampling Points
Samples Collected by COE and Analyzed at FWPCA, DPO
DETROIT RIVER-LAKE ERIE
EAST OUTER CHANNEL
LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS
SCALE IN FEET
10000 0 5 7 6 5 4 3 2 1 0 10000

FIGURE 13



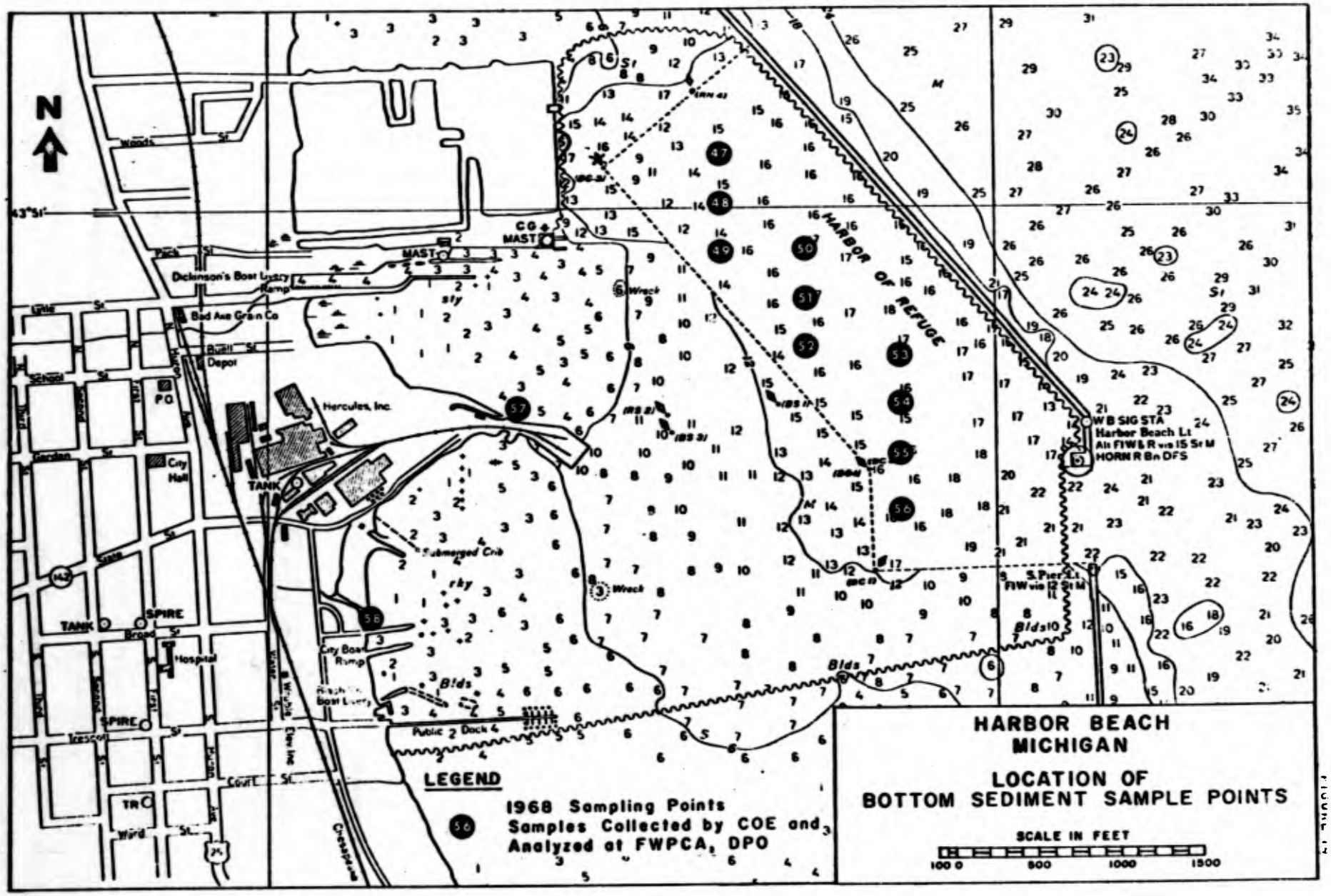
FRANKFORT HARBOR, MICHIGAN

LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS

Scale of Feet

500 0 500 1000 1500

U. S. ARMY ENGINEER DISTRICT, DETROIT


N
HARBOR OF REFUGE
CG MAST
MAST
Dickinson's Boat Livery Ramp
Bad Axe Grain Co
Depot
P.O.
City Hall
TANK
SPIRE
Hospital
Hercules, Inc.
Submerged Crib
City Boat Ramp
Public Dock
Bldg
Wreck
WB SIG STA
Harbor Beach Lt
Alt FlW & R vis 15 St M
HORN R Bn DFS
S. Pier Lt
FlW vis 12 St M
Court St.
Ward St.
Crosstown
LEGEND
1968 Sampling Points
Samples Collected by COE and Analyzed at FWPCA, DPO
HARBOR BEACH
MICHIGAN
LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS
SCALE IN FEET
100 0
500
1000
1500

II. CONCLUSIONS

A. Dredging Site

Benthos Sampling

Sludgeworms Limnodrilus sp. and Tubifex tubifex comprised 99.9% of the benthic population found during both sampling periods. sludgeworm populations of June 7 and August 2 are presented in bar graphs in Figures 15 and 16 respectively. Although sludgeworm standing crops changed at some stations between sampling periods, dredging operations seemingly had little effect.

Station 25, at the mouth of the Old Channel of the Rouge River, supported a huge quantity of tubificids, (66-108 thousand sq. foot). This concentration of sludgeworms is probably encouraged by the settling of organic materials on the bottom of the Rouge River from upstream combined sewer discharges along the Michigan side of the Detroit River. On the other hand, Stations 5 and 8 on the main stem of the lower Rouge River, had noticeably more tar and oils in the sediments and fewer sludgeworms. The Corps of Engineers dredging operations in the Rouge River apparently had little effect on the already debased aquatic life in that river.

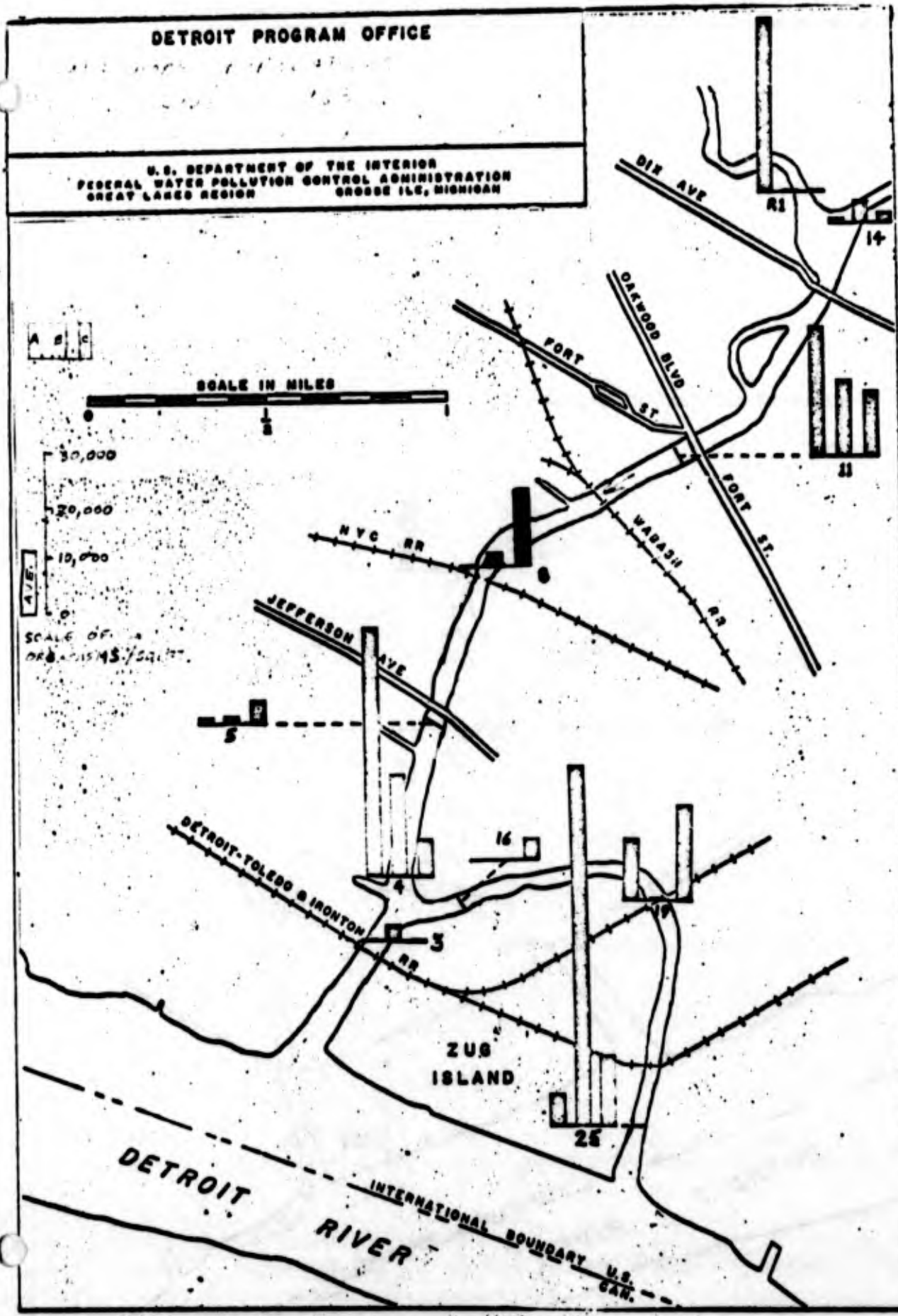
Core Sampling

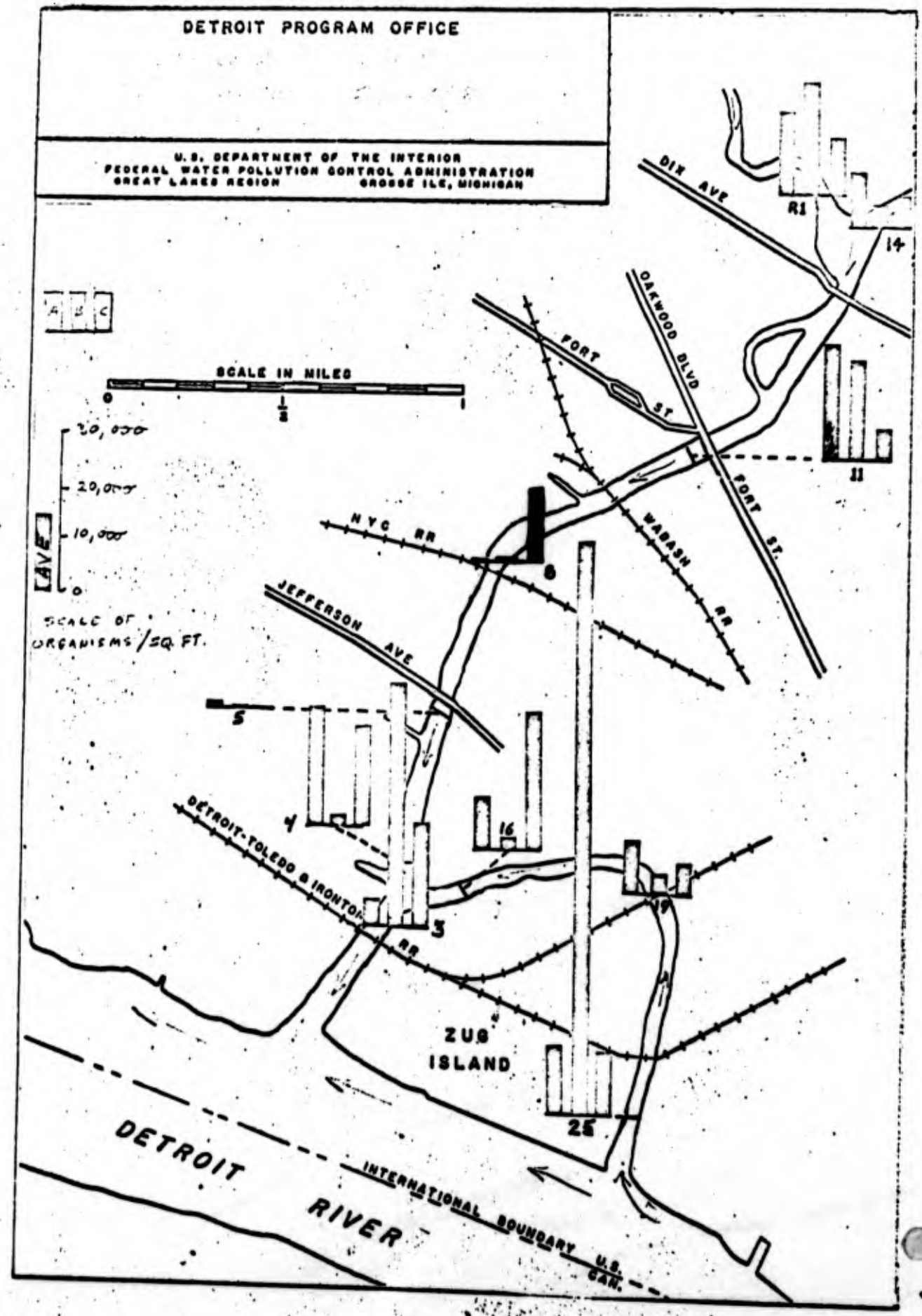
Most of the subsurface sediments collected from the Rouge with the core sampling device exhibited characteristics similar to the polluted surface materials sampled from the river in 1967 with the Petersen dredge. Most of the samples contained moderate to high levels of BOD, COD, phenols, total phosphate, iron, oil and volatile

solids. The concentrations of certain pollutants in samples A*, B-1, C*, D-1, G-3, G-4, and G-5 were somewhat lower. The volatile solids concentration in these particular sediments ranged from 5.6 - 8.1% dry basis.

The twenty subsurface core samples were collected from Areas A (1 sample), B (3 samples), C (7 samples), E (4 samples), and G (5 samples) along the main stem of the Rouge from the turning basin to its confluence with the Old Channel. Ten bottom sediment samples (Samples No. 5-14) were collected with a Petersen dredge along the same stretch of the river in 1967. Analytical results are compared in the following table:

Parameter	Core Samples Areas A, B, C, E, G		Petersen Dredge Samples Sample Points 5 to 14	
	Range	Average	Range	Average
Total PO_4 (mg/kg wet)	820-6000	3200	1700-5000	3200
Iron (mg/kg wet)	14000-86000	47,000	39000-59000	44000
Oil & Grease (mg/kg dry)	3000-65000	31,000	30000-60000	40000
Volatile Solid (% dry)	3-18.6	12.6	11-19	16


DETROIT PROGRAM OFFICE
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION
GROSSE ILE, MICHIGAN
SCALE IN MILES
30,000
20,000
10,000
0
AVE.
SCALE OF
DIX AVE
OAKWOOD BLVD
FORT ST
FORT ST.
NYC RR
WABASH RR
JEFFERSON AVE
DETROIT-TOLEDO & IRONTON RR
ZUG ISLAND
DETROIT RIVER
INTERNATIONAL BOUNDARY U.S. CAN.
A1
14
11
5
16
4
3
19
25


DETROIT PROGRAM OFFICE
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION
GROSSE ILE, MICHIGAN
A
B
C
SCALE IN MILES
0
1/2
1
20,000
10,000
0
AVE
SCALE OF ORGANISMS/SQ FT.
DIX AVE
R1
14
OAKWOOD BLVD
FORT ST
FORT ST.
11
NYC RR
WABASH RR
8
JEFFERSON AVE
5
4
16
DETROIT-TOLEDO & IRONTON
RR
3
ZUG ISLAND
25
DETROIT RIVER
INTERNATIONAL BOUNDARY U.S. CAN.

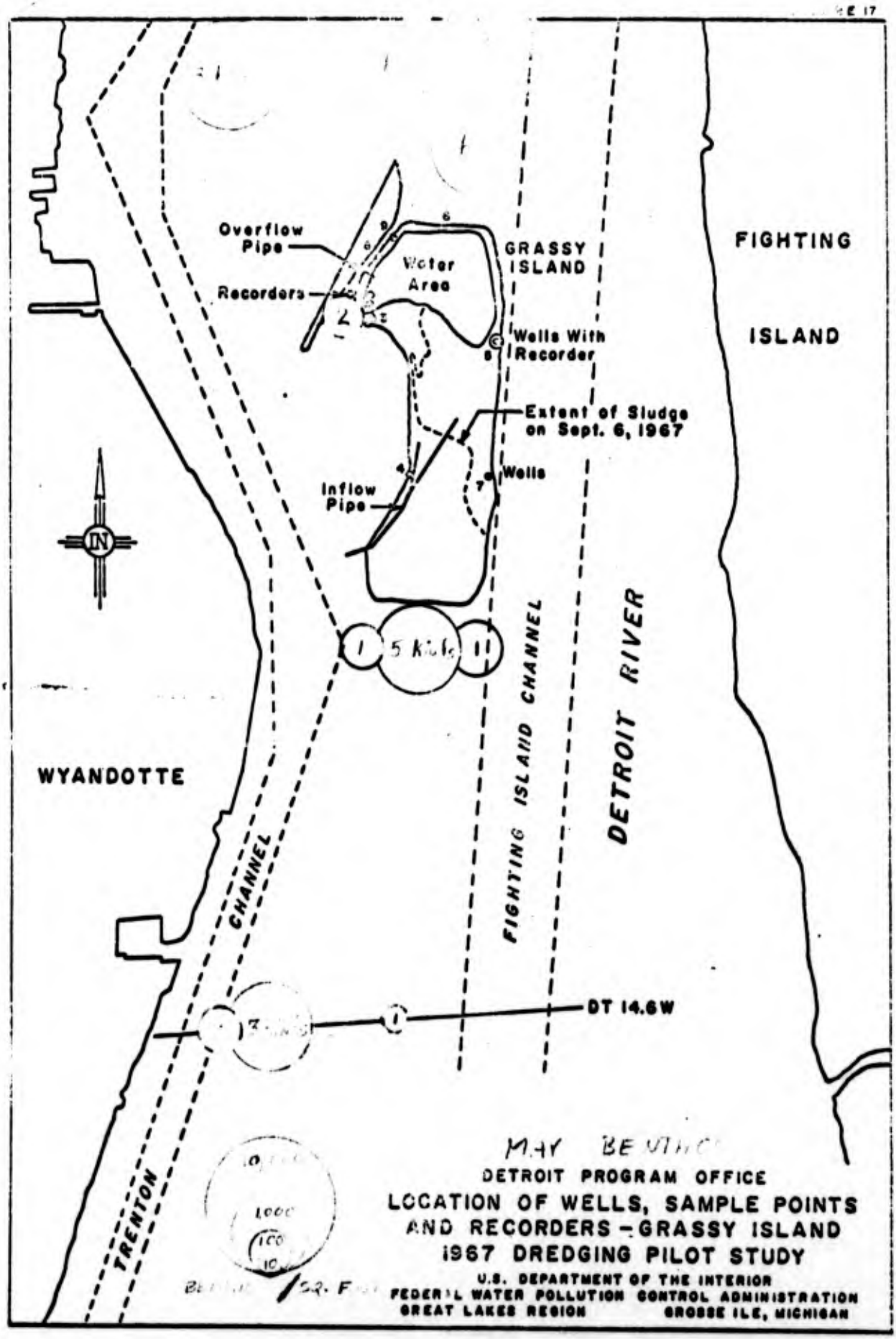
F. Dumping Grounds

Effect of Dumping Ground on Detroit River Water Quality

No water quality degradation of the Detroit River by disposal operations was detected by analysis of samples collected around Grassy Island. The water quality of the river upriver from the island was found similar to that directly downriver from the dumping grounds.

Benthos Sampling

The Grassy Island investigation found a bottom fauna community indicative of polluted waters. Although, a few intolerant scuds and a burrowing mayfly were found, 90% of the total benthic population consisted of the pollution tolerant sludgeworms. The number of individuals varied widely between stations in the Detroit River (Figures 17 & 18). Both upstream and downstream standing crops of benthic organisms varied, but community composition around the island changed very little. The same species of benthic organisms were predominant before and after dumping operations. The variety of organisms only changed from an average of 5 in May, to 6 in August. Dike construction and sludge deposition activities on Grassy Island did not appear to alter the benthic fauna community significantly. Present disposal methods employed at Grassy Island appears to have contained the polluted sediments and spared the native aquatic life. The protection of the bottom organisms near Grassy Island is important because they provide food for the support of fish and waterfowl in the Detroit River.

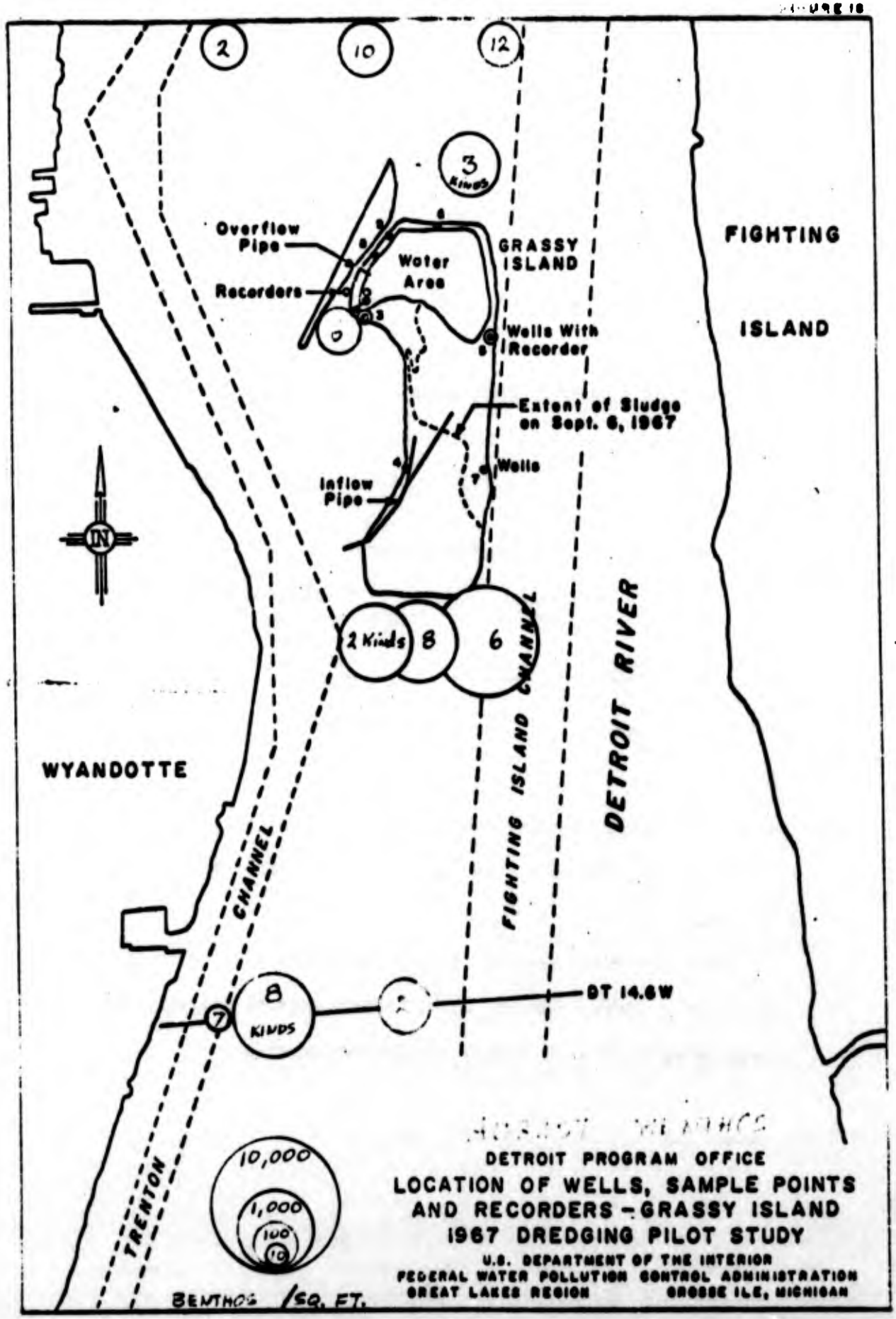


MAY BE UTIL

DETROIT PROGRAM OFFICE

LOCATION OF WELLS, SAMPLE POINTS AND RECORDERS - GRASSY ISLAND 1967 DREDGING PILOT STUDY

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


2
10
12
3 Kinds
Overflow Pipe
Recorders
Water Area
GRASSY ISLAND
FIGHTING ISLAND
Wells With Recorder
Extent of Sludge on Sept. 6, 1967
Wells
Inflow Pipe
IN
2 Kinds
8
6
WYANDOTTE
CHANNEL
FIGHTING ISLAND CHANNEL
DETROIT RIVER
8 KINDS
DT 14.6W
TRENTON
10,000
1,000
100
10
BENTHOS /SQ. FT.
DETROIT PROGRAM OFFICE
LOCATION OF WELLS, SAMPLE POINTS AND RECORDERS - GRASSY ISLAND
1967 DREDGING PILOT STUDY
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION
GROSSE ILE, MICHIGAN

Well Sampling

The two samples collected from the wells before the 1968 dredging activity were grossly polluted as in 1967 during disposal activities. However, it is again expected that many of the pollutional characteristics are imparted to the water by surrounding soils and that the well water is not necessarily representative of the seepage flow.

A few differences in analytical results are notable. The concentrations of phenol and total soluble phosphate found in 1968 were significantly lower than those determined in 1967 as shown below.

Average Values

	Phenols (ug/l)		Total Soluble Phosphate (mg/l)	
Well	1967	1968	1967	1968
3	12	3	.46	.04
4	9	2	.13	.04
5	10	2	.17	.04
7	9	2	.27	.08

Even at the higher concentrations the pollutional load of the seepage flow is not significant in view of the low estimated seepage rate of less than .2 cfs.

Lower bacteria densities were also determined prior to dredging operations in 1968. However, lower bacteriological activity and growth is expected at the lower sample temperatures.

C. Other Harbors

Over 900 analyses were performed on 173 bottom sediment samples delivered to the Detroit Program Office laboratory by the Corps of Engineers in 1967 and 1968. The quality of the bottom sediments collected from each area has been evaluated based on the results of these tests, the gross appearance of the material, and its odor. The evaluation includes only those areas for which samples were received. Portions of eighteen Michigan harbors and navigation channels are designated as "polluted" or "unpolluted" in Table . The table lists the harbors, area sampled, number of samples received from each area, the number of analysis performed on these samples, and a preliminary evaluation of the area.

Probably any of the harbors listed would have some areas of organic deposits and further analysis of all the harbors would be necessary to give a complete picture of harbor conditions. However, it is suggested that the Corps of Engineers conduct further study in those harbors designated as "polluted" to determine the depth and areal extent of the polluted material.

Status of Michigan Harbors and
Analysis of Dredged Bottom Sediments
FWPCA - Detroit Program Office
1967 & 1968

Harbor	Corps of Engineers Cross Section	No. Samples	No. Analyses	Evaluation	Remarks
Grand Haven	40+00 to 88+00	5	20	Polluted	Sludge; volatile solids 6.9 to 29.6% dry basis, COD 42,000 to 53,000 mg/kg wet basis
South Haven	Bar area to 3+50E	4	6	Unpolluted	Sand; volatile solids < 1 to 3% dry basis
	Turning Basin (26+00 to 37+00)	6	36	Polluted	Sludge; average volatile solids = 12% dry basis
St. Joseph	Bar area to 17+90W	3	8	Unpolluted	Sand; low volatile & low oil & grease
	17+90W to Benton Harbor Canal	30	134	Polluted & Unpolluted	Sand & sludge; varied results
Pentwater	Bar area to 3+20E	15	23	Unpolluted	Sand; low concentrations of all pollutants
Holland	Bar area to 7+00	22	10	Unpolluted	Sand; low volatile solids & COD
	273+00 to 307+00	9	29	Polluted	Sand & sludge; volatile solids = 9-15% dry basis
Saugatuck	7+00 to 9+00	1	2	Unpolluted	Sand
Muskegon	Bar area to 28+00	7	60	Unpolluted	Sand; low concentration of all pollutants
White Lake	Bar area to 5+00	2	8	Unpolluted	Sand

Status of Michigan Harbors and
Analysis of Dredged Bottom Sediments
FWPCA - Detroit Program Office
1967 & 1968

Harbor	Corps of Engineers Cross Section	No. Samples	No. Analyses	Evaluation	Remarks
Ludington	Bar area to 16+00E	4	51	Unpolluted	Sand
Manistee	Bar area to 46+00	15	108	Unpolluted	Sand, some sludge; low concentrations of most pollutants
Manistique	7+30	3	37	Unpolluted	Gravel & pebbles some sludge; low IDOD
Frankfort	Bar area to 2+00E	4	44	Unpolluted	Sand; low to medium volatile solids low IDOD, other factors low
	13+00E to 24+00E	2	26	Polluted	Sludge; organic concentration high, odor
Lake St. Clair	60+00 to 84+00	2	26	Unpolluted	Sludge; medium volatile solids; low oils
Au Sable	19+60	3	22	Unpolluted	Sand; low volatile solids, & oil & grease
Cheboygan	15+00 to 49+00	3	39	Unpolluted	Sand; some sludge
Alpena	1+00 to 38+00	3	34	Unpolluted	Sand; low to medium volatile solids, low oil and grease
Harbor Beach	Harbor of Refuge	12	72	Polluted	Sandy sludge; high COD; medium to high volatile solids
Detroit R. - Lake Erie	0+00 to 270+00	16	136	Polluted	Sludge; medium to high volatile solids, high COD & oil; more polluted 0+00 to 120+00

III. APPENDIX

A. Simulated Open Water Spoil Disposal Tests

A study was performed in the laboratory to simulate the dumping of bottom sediment by a hopper dredge or scow in dump grounds. For the study the following assumptions were made:

1. The ground depth was 15 feet (5 yards)
2. The length of dump per scow - 600 feet (200 yards)
3. The width of dump per scow - 90 feet (30 yards)

Therefore the volume of water influenced by dumping is 30,000 cubic yards of water. Assume 1000 yards of bottom sediment is dumped, therefore ratio of bottom sediment to water is 1 to 30. Using 3 gallon jugs containing 10,000 cc of water volume of bottom sediment needed is 333 cc.

To measure the effect of bottom sediments on river water, five bottom sediment samples from the Detroit River were used in the study. Six - 3 gallon jugs of water were collected from the Detroit River, R77. For 5 of the jugs, a measured amount of bottom sediment was added and a sample taken after 15 minutes and 24 hours to measure the effect. To the other jug no bottom sediment was added, samples were taken to be used for comparison with the bottom sediment plus water mixture.

For each bottom sediment the following procedure was used.

1. 333 cc of bottom sediment was measured in beaker.
2. 333 cc of water from a jug was added and then the contents was mixed thoroughly.
3. The mixture was then dumped into the 3 gallon jug.
4. After 15 minutes without disturbing the jugs, a sample was siphoned in a 1/2 gallon glass bottle and analysis were conducted.
5. After 24 hours without disturbing the jugs, a sample was siphoned in a 1/2 gallon glass bottle and analysis were conducted.

Water quality measurement results for aliquots collected (from the jugs) 15 minutes and 24 hours after the deposition of the bottom material are given in Table 9. The characteristics of each sludge deposited are given (under samples 36 through 40) in Table 7. Bottom sediments were added as follows:

Water	Bottom Sediment	
Laboratory No.	Sample No.	Laboratory No.
29755	#36	29750
29756	#37	29751
29757	#38	29752
29758	#39	29753
29759	#40	29754
29760	No sediment added	

The average of the analysis of the five samples contaminated with sediment is given for comparison with the control sample (29760).

The five bottom sediment samples collected from Lake Erie with a Petersen dredge were moderately polluted sludges containing medium levels of COD and volatile solids. Immediate DO demand, phenols, ammonia nitrogen and organic nitrogen results varied from low to medium.

The physical conditions of the laboratory test were different in many respects from those which exist at the designated dumping grounds in Lake Erie. The quiescent condition in the laboratory provided for better settling than would have been possible in the lake. However, under natural conditions the lake water at the dumping grounds would have dispersed and mixed with other water whereas the laboratory receiving water were not so dispersed. In

addition, the dissolved oxygen relationships were unnatural in the laboratory with the absence of turbulence and sunlight.

Evidence of the deposition of the sludge remained in the water for at least 24 hours as reflected in increased levels of conductivity, iron and turbidity for all five sludges deposited. Some, but not all of the water samples tested, also showed increases in phenol, total phosphate, total soluble phosphate, ammonia nitrogen, and organic nitrogen after 24 hours.

Although this test did not represent actual conditions existing in the lake, it does show that the dumping of polluted dredgings in the open water does degrade water quality. Such water quality degradation often becomes immeasurable in the lake after a short time due to dilution and pollution from other sources.

Table 9
Effects of Open Water Spoil Disposal
On Water Quality
Detroit River Station R77 (DT 3.9)
July 15-16, 1968
(mg/l unless noted)

Lab Number	Conductivity (umhos/cm)		Phenols (ug/l)		Dissolved Oxygen		BOD	
	15 min.	24 hrs.	15 min.	24 hrs.	15 min.	24 hrs.	15 min.	24 hrs.
29755	240	260	12	2	5.0	5.1	9	3
29756	280	300	17	2	3.2	5.4	18	4
29757	230	250	4	11	5.2	5.6	13	4
29758	240	260	5	2	3.4	4.4	8	3
29759	240	250	5	4	4.2	5.2	9	4
Average	250	360	8	4	4.2	5.1	11	3
29760	220	240	2	2	8.6	6.8	1	1

Table 9
Effects of Open Water Spoil Disposal
On Water Quality
Detroit River Station R77 (DT 3.9)
July 15-16, 1968
(mg/l unless noted)

Lab Number	Total PO_4		Total Sol. PO_4		Ammonia-N		Organic-N	
	15 min.	24 hrs.	15 min.	24 hrs.	15 min.	24 hrs.	15 min.	24 hrs.
29755	2.9	.21	.48	.18	1.1	-	.96	-
29756	4.1	.18	.32	.16	3.5	2.8	1.2	.11
29757	1.6	.47	.71	.28	.64	.43	1.8	.41
29758	3.8	.16	1.1	.08	1.5	1.2	.07	< .05
29759	2.4	.16	.83	.10	1.0	.75	.77	< .05
Average	3.0	.24	.69	.16	1.5	1.3	.96	.15
29760	.11	.16	.09	.09	< .05	< .05	-	< .05

Table 9
Effects of Open Water Spoil Disposal
On Water Quality
Detroit River Station R77 (DT 3.9)
July 15-16, 1968
(mg/l unless noted)

Lab Number	Total Coliform (MF/100 ml)		Iron		Sulfate		Turbidity (J.C.U.)	
	15 min.	24 hrs.	15 min.	24 hrs.	15 min.	24 hrs.	15 min.	24 hrs.
29755	25,000	33,000	3[illegible]	1.0	18	19	400	30
29756	49,000	42,000	44	2.7	17	17	370	45
29757	53,000	32,000	52	4.3	18	18	300	180
29758	31,000	11,000	44	1.3	18	17	400	35
29759	33,000	14,000	3[illegible]	1.2	18	18	380	30
Average			42	2.1	18	17	370	64
29760			.27	.27	-	16	6	5

Table 9
Effects of Open Water Spoil Disposal
On Water Quality
Detroit River Station R77 (DT 3.9)
July 15-16, 1968
(mg/l unless noted)

Lab Number	Nitrate		COD	
	15 min.	24 hrs.	15 min.	24 hrs.
29755	.3	.2	160	290
29756	.4	.2	200	140
29757	.2	.1	180	220
29758	2.5	.2	130	< 1
29759	.4	.3	110	< 1
Average	.8	.2	160	110
29760	.2	.3	36	< 1

B. Description of Bottom Materials & Odors

Description of Bottom Material

The descriptions of bottom materials are listed in Table

The sediments were classified as follows:

Ooze: soft, fine, decaying organic material.

Sludge: (clay, silt, mud or organic material): non-gritty material of natural or unnatural origin.

Sand: gritty particles up to 1/25" in diameter

Gravel: 1/25" to 1/4"

Pebbles: 1/4" to 2"

Stones: 2" to 10"

Table
Qualitative Descriptions of Odors*
FWPCA, DRO, 1966

Code	Nature of Odor	Description (Such as Odors of:)
A	Aromatic (spicy)	camphor, cloves, lavender, lemon
Ac	cucumber	Synura
B	Balsamic (flowery)	geranium, violet, vanilla
Bg	geranium	Asterionella
Bn	nasturtium	Aphanizomenon
Bs	sweetish	Coelosphaerium
Bv	violet	Mallomonas
C	Chemical	industrial wastes or treatment chemicals
Cs	chlorinous	free chlorine
Ch	hydrocarbon	oil refinery wastes
Cm	medicinal	phenol and iodoform
Cs	sulfuretted	hydrogen sulfide
D	Disagreeable	(pronounced, unpleasant)
Df	fishy	Uroglenopsis, Dinobryon
Dp	pigpen	Anabaena
Ds	septic	stale sewage
E	Earthy	damp earth
Ep	peaty	peat
G	Grassy	crushed grass
M	Musty	decomposing straw
Mm	moldy	damp cellar
V	Vegetable	root vegetables

*Standard Methods of Examination of Water & Wastewater, 11th Edition, p. 255

C. Laboratory Methods

The methods employed in the laboratory are the same as those described in the "Rouge River Pilot Study - 1967" and "Michigan Harbors and Navigation Channels - Bottom Sediment Analysis - 1967."

APPENDIX B2

MICHIGAN HARBORS & NAVIGATION CHANNELS
BOTTOM SEDIMENT ANALYSIS
1967

SAMPLING SURVEYS FOR:

FRANKFORT HARBOR, MICHIGAN
GRAND HAVEN HARBOR, MICHIGAN
HOLLAND HARBOR, MICHIGAN
LUDINGTON HARBOR MICHIGAN
MANISTEE HARBOR, MICHIGAN
MANISTIQUE HARBOR, MICHIGAN
MUSKEGON HARBOR, MICHIGAN
PENTWATER HARBOR, MICHIGAN
SAUGATUCK HARBOR, MICHIGAN
SOUTH HAVEN HARBOR, MICHIGAN
ST. JOSEPH HARBOR, MICHIGAN (and BENTON HARBOR)
WHITE LAKE HARBOR, MICHIGAN
ALPENA HARBOR, MICHIGAN
AU SABLE HARBOR, MICHIGAN
CHEBOYGAN HARBOR, MICHIGAN
LAKE ST. CLAIR MICHIGAN

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

CORPS OF ENGINEERS

U S ARMY

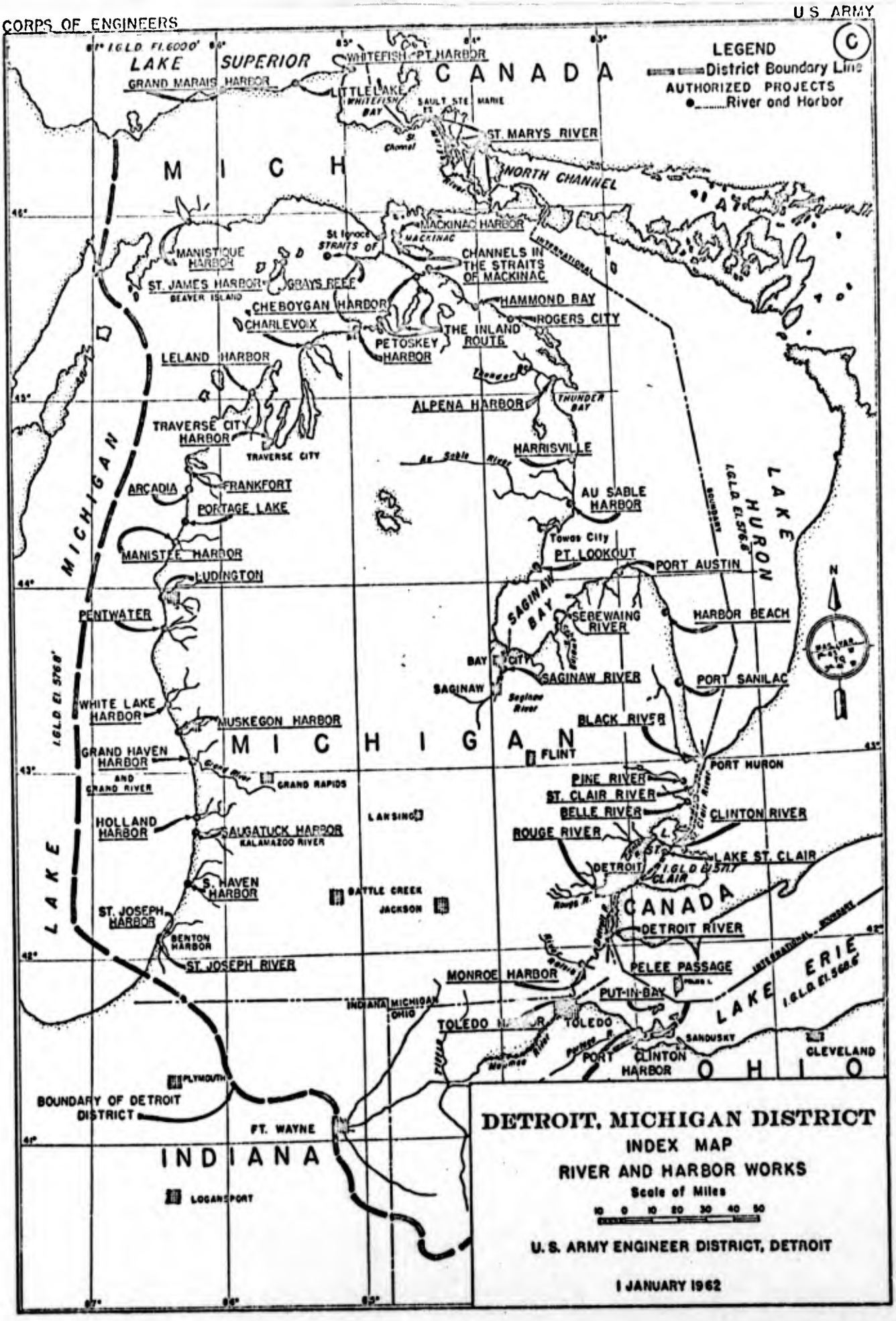


TABLE OF CONTENTS

TABLES

Dredging Study - 1967
Michigan Harbors and Navigation Channels

PURPOSE

The study was conducted to determine the characteristics of the bottom sediments dredged from Michigan harbors and navigation channels by the Detroit District of the U.S. Army Corps of Engineers.

SCOPE

The results of the analyses depict the characteristics of sediments dredged from particular points located in seventeen Michigan harbors and navigation channels. The samples collected do not necessarily represent the major portion of the bottom sediments dredged from a particular project area.

PROCEDURE

The Corps of Engineers and the Federal Water Pollution Control Administration conducted a cooperative survey of seventeen Michigan harbors and channels dredged by the Detroit District in 1967. Bottom sediment samples were collected by Corps of Engineers' personnel from three Corps dredges: TOMPKINS (scow), HAINS (hopper) and the HOFFMAN (hopper). The samples were analyzed by the Federal Water Pollution Control Administration laboratory at Grosse Ile, Michigan.

In April, 1967, representatives of the FWPCA (Detroit Program Office) and the Corps of Engineers (Detroit District) visited the HAINS and the TOMPKINS to observe the dredging operation and initiate the sampling program. The purpose of the study, the sample collection procedure, and the delivery requirements were explained to the master of each dredge.

An average of five samples were analyzed each week at the FWPCA laboratory. Every effort was made to collect these limited number of samples in the most polluted areas of each harbor.

During the early weeks of the study, Corps of Engineers' personnel picked up the samples early in the morning of the collection day and transported them by automobile to the FWPCA laboratory. When the dredge moved to more distant harbors, prompt delivery of the sample by automobile became more difficult and shipment by air more effective.

The bottom sediments were collected directly from the hopper dredge intake chute in a metal bucket suspended from a rope. The bottom sediment samples were taken directly from the scow of the TOMPKINS during the loading operation. The samples were then poured into one-quart glass jars and delivered or shipped to the FWPCA laboratory for analysis. When delivery was delayed, the samples were analyzed for parameters which are not significantly affected by storage: total solids, volatile solids, suspended solids, oil and grease, iron, total phosphate, and total soluble phosphate. Analysis of the bottom sediments begun 5 to 10 hours after collection also included the following parameters: immediate dissolved oxygen demand, COD, phenols, nitrate, nitrite, ammonia, organic nitrogen, and BOD. All samples transported by automobile were preserved in ice. Uniced samples were transported by air freight to the laboratory from Manistique, Frankfort, Cheboygan and Alpena. Bottom sediments of similar nature from the same harbor were composited when it was found that the analysis of the individual samples would overload the laboratory facilities. Complete analysis of every sample delivered was beyond the capacity of the

FWPCA laboratory. However, a gross description is provided for all samples received.

Most of the samples had settled out in transit to form two fractions: a sediment and supernatent. In all cases only the settled material was analyzed.

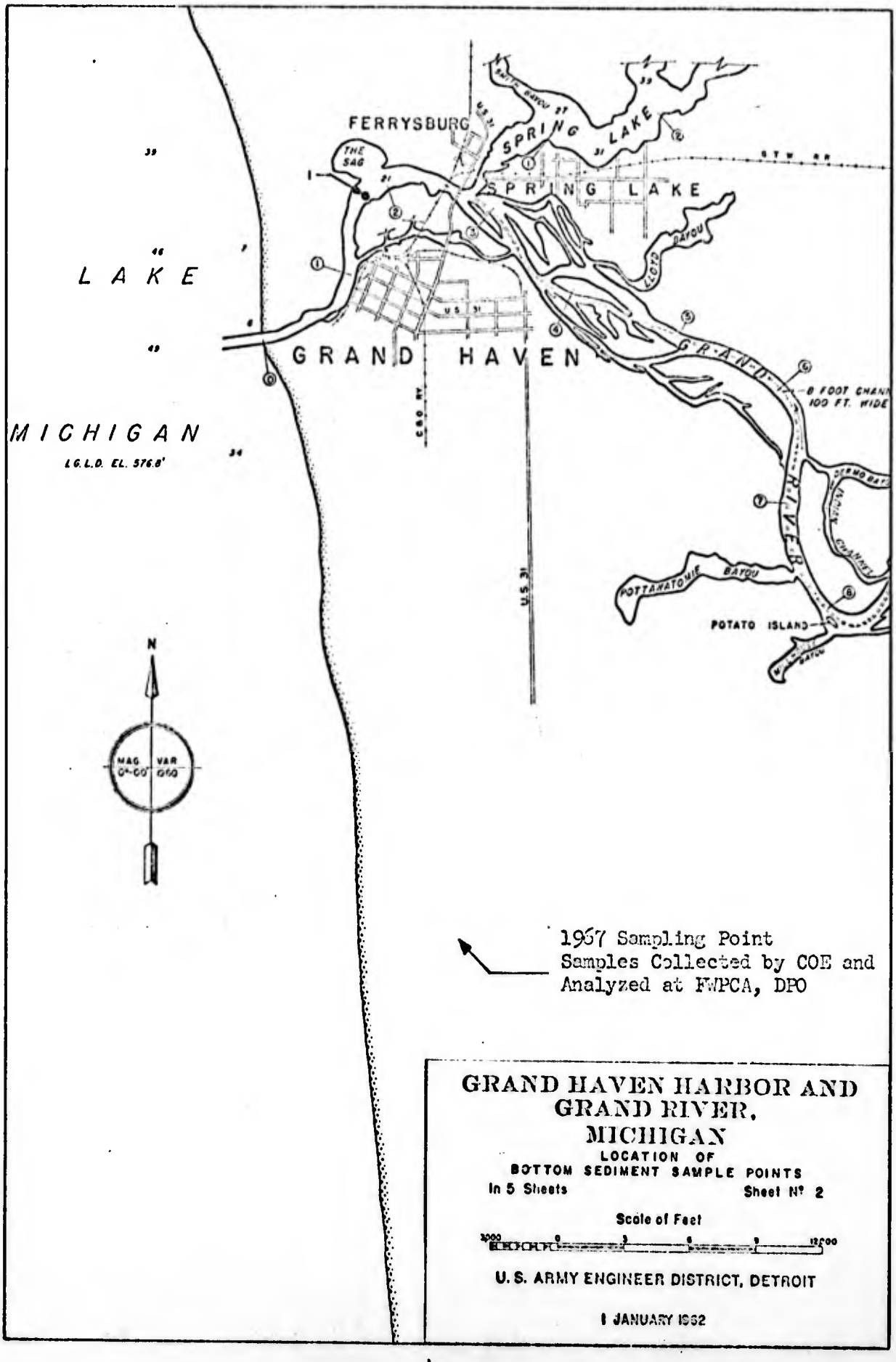
RESULTS

The location of the 1967 sampling points (numbered 1 to 115) are shown in the series of maps of the Corps of Engineer (Detroit District) project areas. The gross description, odor, and analytical results of these samples are given in Table 2. The material description and the odor description are explained in pages 21 and 22.

Samples designated with a C (eg. 7C) are composites of three samples collected between the depths indicated. One exception is sample 83C which is a composite of three samples collected at cross sections 7+00, 8+00, and 9+00 in the Kalamazoo River (Saugatuck Harbor). Some samples (numbers: 1, 2, 3, 4, 5, 6, 12, 54C, 55C, 88, 92) were designated as being collected in the "bar area" or "turning basin" with no exact station location given. The locations of these samples are indicated by arrows (↗) in the appropriate maps.

Those results reported on a wet basis indicate the weight of a substance per unit weight of the wet bottom sediments. Similarily, those reported on a dry basis indicate concentrations in the moisture-free solids. Concentrations expressed on a wet basis can be reported on a dry basis by applying the following formula:

$$\text{mg/kg dry basis} = \frac{\text{mg/kg wet basis}}{\%\ \text{total solids}} \times 100$$



1967 Sampling Point
Samples Collected by COE and Analyzed at FWPCA, DPO

GRAND HAVEN HARBOR AND GRAND RIVER, MICHIGAN

LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS

In 5 Sheets Sheet Nº 2

Scale of Feet

3000 0 3 6 9 12000

U. S. ARMY ENGINEER DISTRICT, DETROIT

1 JANUARY 1962

1967 Sampling Point
Samples Collected by COE and
Analyzed at FWPCA, DPO

LEGEND

WATERFRONT OWNERSHIP
SHOWN THUS [x]
(O) Indicates Owner
(L) Indicates Lessee

1. Board of Public Works (O)
2. Mich Shore Lumber & Supply Co. (O)
2A. Mich Shore Lumber & Suppy Co. (L)
5. South Haven Terminal Dock Co. (O)

INDEX TO BRID--
SHOWN THUS

1. Dyckman Ave.

NOTES

Reference Numbers taken from "Port and Terminal Facilities of the U.S. Ports on Lake Michigan" dated 1943.

Project depths, soundings and elevations are referred to International Great Lakes Datum (1955) for Lake Michigan, elevation 576.8ft. above Mean Water Level (M.W.L.) at Father Point, Quebec

(31) Indicates State Route

SOUTH HAVEN HARBOR, MICHIGAN

LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS

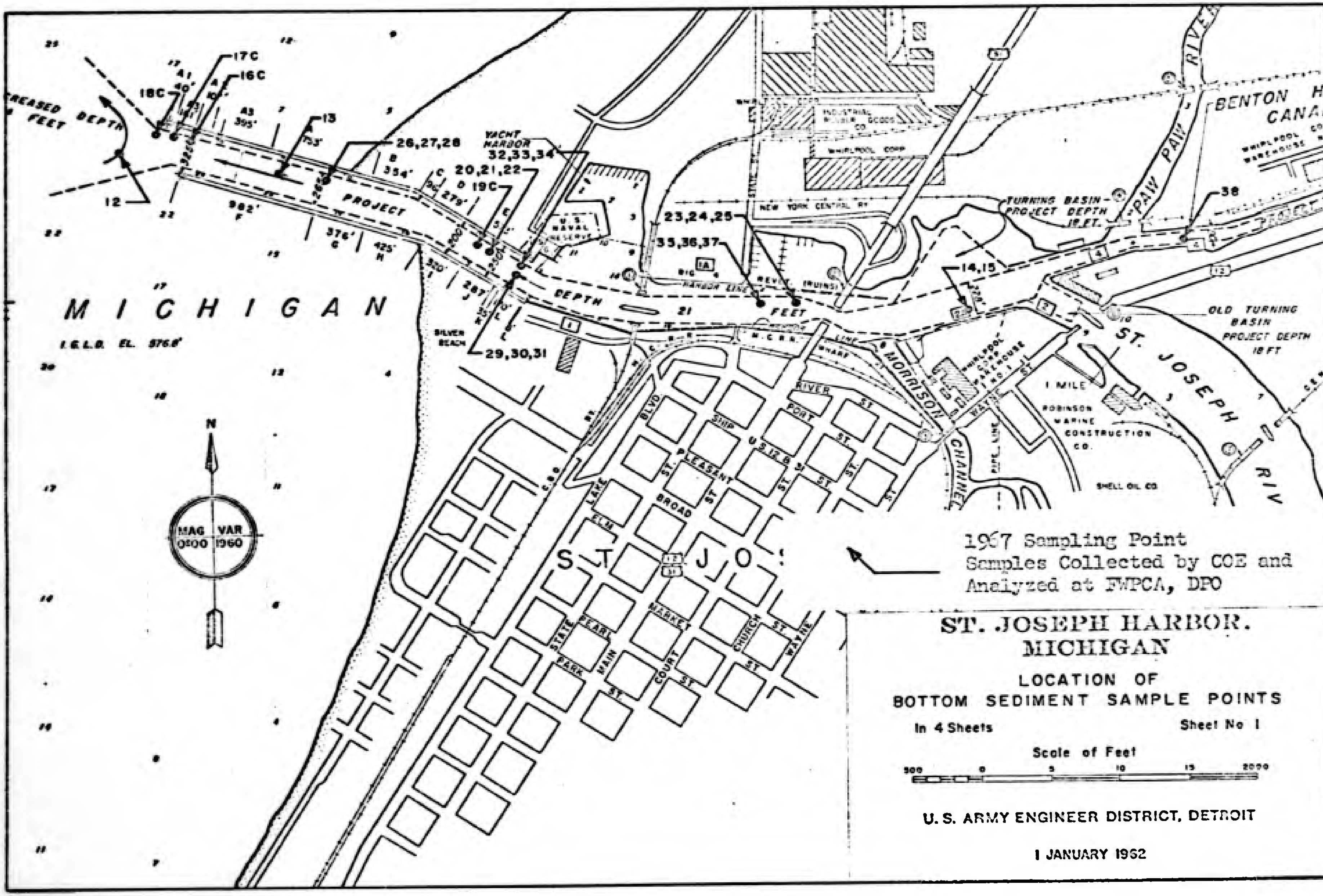
In 2 Sheets Sheet No. 1

Scale of Feet

500 0 5 10 1500

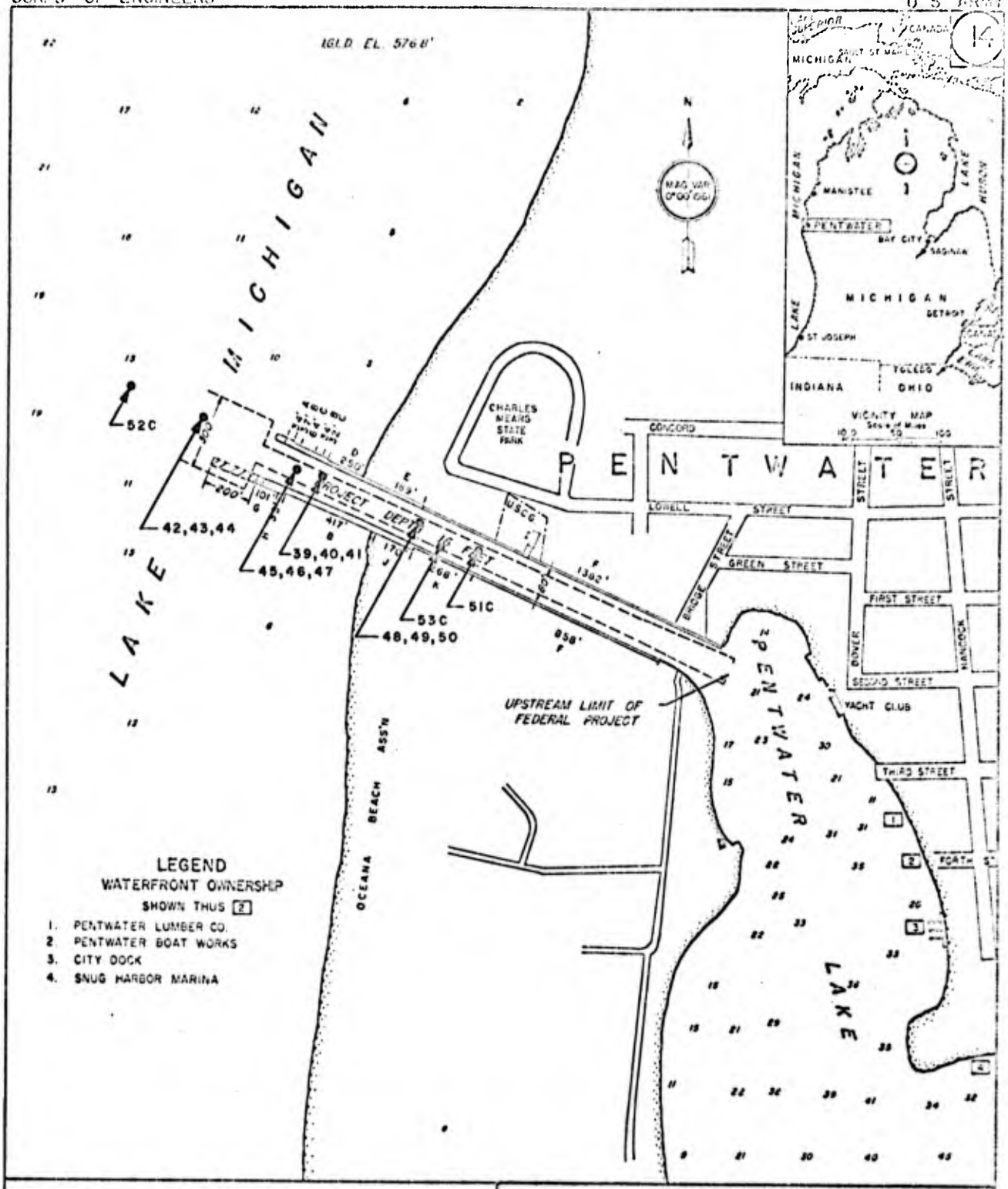
U. S. ARMY ENGINEER DISTRICT, DETROIT

1 JANUARY 1962



1967 Sampling Point
Samples Collected by COE and
Analyzed at FWPCA, DPO
ST. JOSEPH HARBOR.
MICHIGAN
LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS
In 4 Sheets
Sheet No 1
Scale of Feet
U. S. ARMY ENGINEER DISTRICT, DETROIT
1 JANUARY 1962
MICHIGAN
ST. JOSEPH RIV
PAW PAW RIVER
BENTON H
CANAL
MORRISON CHANNEL
PROJECT DEPTH 21 FEET
OLD TURNING BASIN PROJECT DEPTH 18 FT
TURNING BASIN PROJECT DEPTH 18 FT.
YACHT HARBOR
SILVER BEACH
NEW YORK CENTRAL RY
INDUSTRIAL RUBBER GOODS CO
WHIRLPOOL CORP
ROBINSON MARINE CONSTRUCTION CO.
SHELL OIL CO
MAG VAR 0°00 1960
12
13
14,15
16C
17C
18C
19C
20,21,22
23,24,25
26,27,28
29,30,31
32,33,34
35,36,37
38

CORPS OF ENGINEERS U. S. ARMY



LEGEND
WATERFRONT OWNERSHIP
SHOWN THUS [2]

1. PENTWATER LUMBER CO.
2. PENTWATER BOAT WORKS
3. CITY DOCK
4. SNUG HARBOR MARINA

NOTE: Work remaining to be done shown thus: ////

Project depths, soundings and elevations are referred to International Great Lakes Datum (1955) for Lake Michigan, elevation 576.8 ft above Mean Water Level (M.W.L.) at Father Point, Quebec.

1957 Sampling Point
Samples Collected by COE and
Analyzed at FWPCA, DPO

PENTWATER HARBOR, MICHIGAN

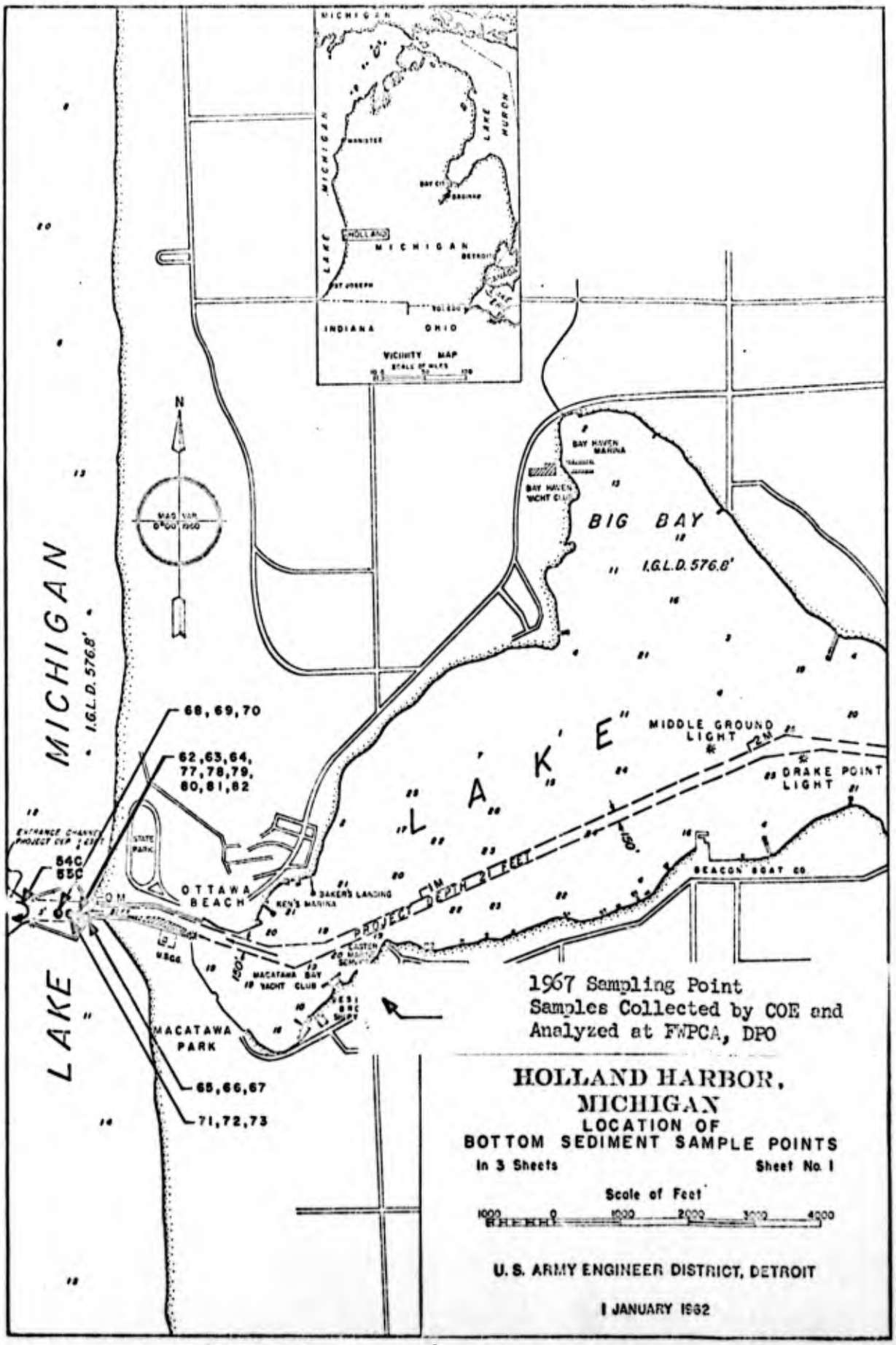
LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS

Scale of Feet

500 0 500 1000

U. S. ARMY ENGINEER DISTRICT, DETROIT

1 JANUARY 1962


MICHIGAN
LAKE MICHIGAN
LAKE HURON
HOLLAND
MICHIGAN
INDIANA
OHIO
VICINITY MAP
N
MICHIGAN
I.G.L.D. 576.8'
LAKE MICHIGAN
BAY HAVEN MARINA
BAY HAVEN YACHT CLUB
BIG BAY
I.G.L.D. 576.8'
68, 69, 70
62, 63, 64, 77, 78, 79, 80, 81, 82
MIDDLE GROUND LIGHT
DRAKE POINT LIGHT
LAKE
ENTRANCE CHANNEL PROJECT DEP. 21 FEET
STATE PARK
84C
85C
OTTAWA BEACH
BAKER'S LANDING
KEN'S MARINA
BEACON BOAT CO
PROJECT DEPTH 21 FEET
150'
USCG
MACATAWA BAY YACHT CLUB
MACATAWA PARK
65, 66, 67
71, 72, 73
1967 Sampling Point
Samples Collected by COE and
Analyzed at FWPCA, DPO
HOLLAND HARBOR,
MICHIGAN
LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS
In 3 Sheets
Sheet No. 1
Scale of Feet
1000 0 1000 2000 3000 4000
U. S. ARMY ENGINEER DISTRICT, DETROIT
1 JANUARY 1962

1967 Sampling Point
Samples Collected by COE and
Analyzed at FWPCA, DPO

LEGEND

WATERFRONT OWNERSHIP
SHOWN THUS [4]
(O) INDICATES OWNER
(L) INDICATES LESSEE

2.	AURORA GAS CO.	(L)
3.	HARRINGTON COAL DOCK	(O)
3A.	PENN—DIXIE CEMENT CORP.	(O)
7.	MUNICIPAL COAL DOCK	(O)
7A.	BREWER'S CITY COAL DOCK	(L)

Hachured Area Denotes Work Authorized But Not Constructed.

HOLLAND HARBOR, MICHIGAN

LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS

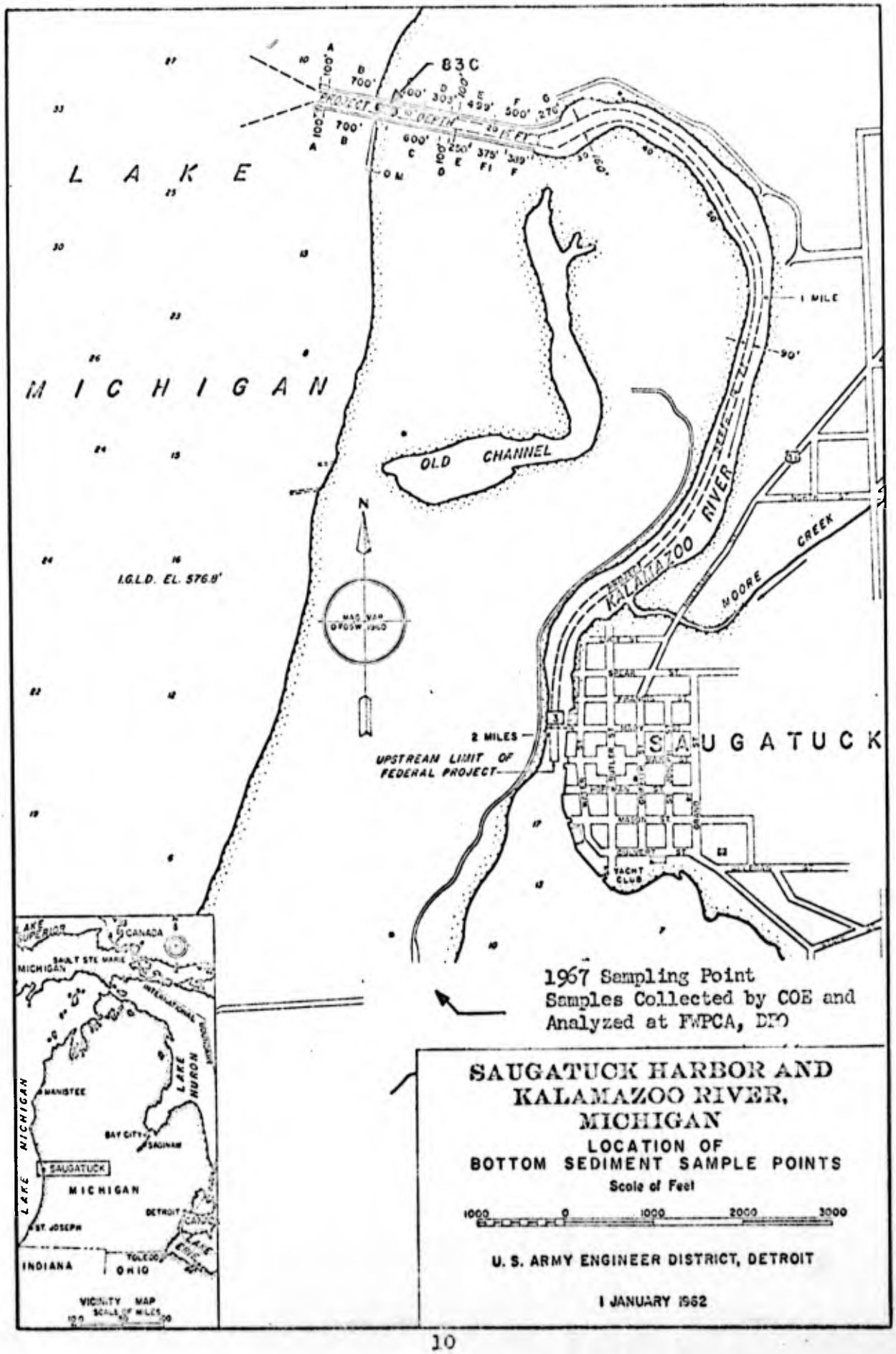
In 3 Sheets — Sheet No. 1

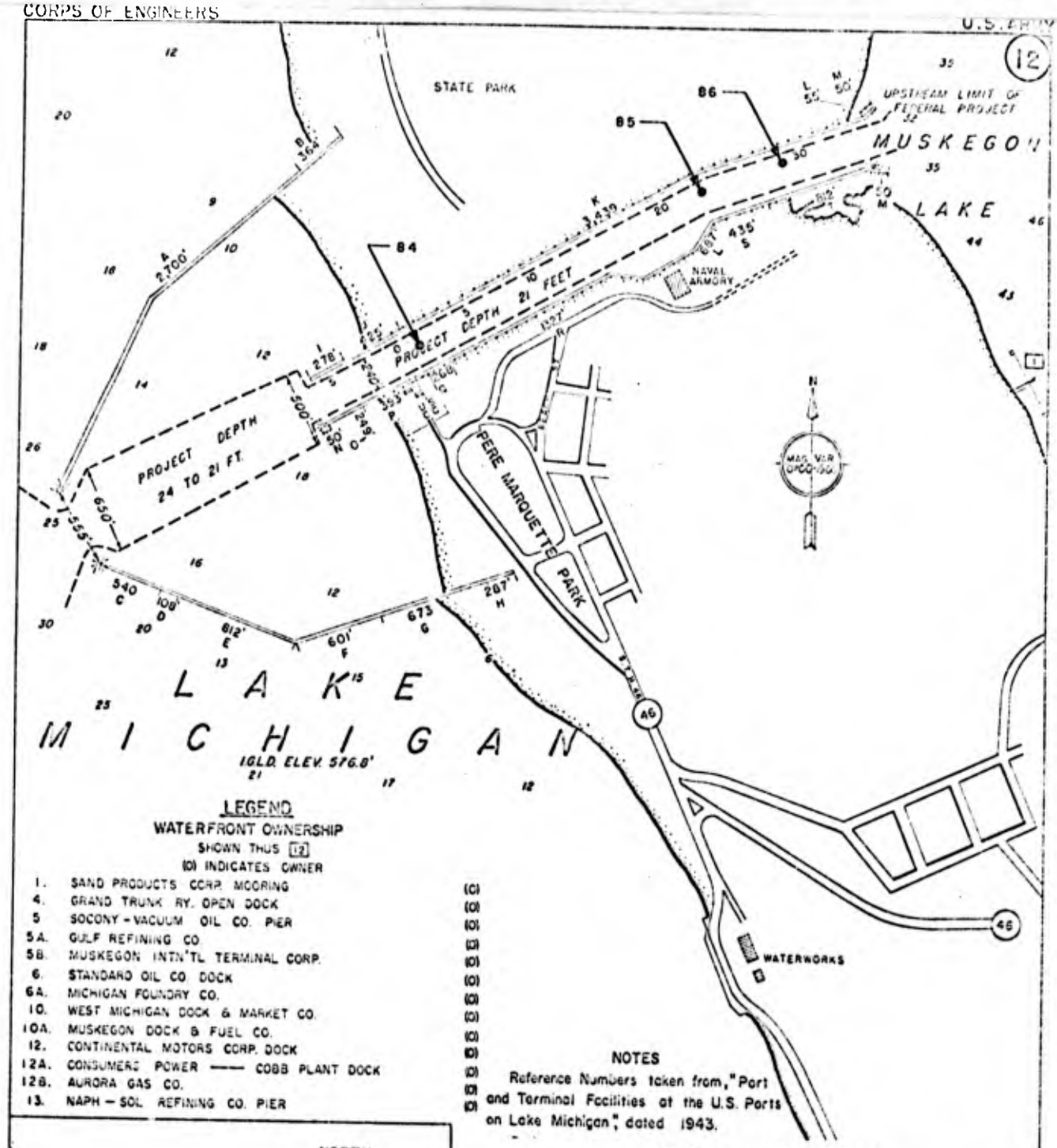
Scale of Feet

1000 0 1000 2000 3000 4000

U. S. ARMY ENGINEER DISTRICT, DETROIT

1 JANUARY 1962


83C
LAKE
MICHIGAN
OLD CHANNEL
KALAMAZOO RIVER
MOORE CREEK
1 MILE
2 MILES
UPSTREAM LIMIT OF FEDERAL PROJECT
I.G.L.D. EL. 576.8'
SAUGATUCK
YACHT CLUB
1967 Sampling Point
Samples Collected by COE and
Analyzed at FWPCA, DPO
SAUGATUCK HARBOR AND
KALAMAZOO RIVER,
MICHIGAN
LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS
Scale of Feet
1000 0 1000 2000 3000
U. S. ARMY ENGINEER DISTRICT, DETROIT
1 JANUARY 1962
LAKE SUPERIOR
CANADA
MICHIGAN
LAKE HURON
LAKE MICHIGAN
MANISTEE
BAY CITY
SAGINAW
SAUGATUCK
MICHIGAN
DETROIT
ST. JOSEPH
LAKE ERIE
INDIANA
TOLEDO
OHIO
VICINITY MAP



LEGEND

WATERFRONT OWNERSHIP

SHOWN THUS [12]

(0) INDICATES OWNER

1. SAND PRODUCTS CORP. MOORING
4. GRAND TRUNK RY. OPEN DOCK
5 SOCONY-VACUUM OIL CO. PIER
5A. GULF REFINING CO.
5B. MUSKEGON INTN'TL TERMINAL CORP.
6. STANDARD OIL CO. DOCK
6A. MICHIGAN FOUNDRY CO.
10. WEST MICHIGAN DOCK & MARKET CO.
10A. MUSKEGON DOCK & FUEL CO.
12. CONTINENTAL MOTORS CORP. DOCK
12A. CONSUMERS POWER —— COBB PLANT DOCK
12B. AURORA GAS CO.
13. NAPH-SOL REFINING CO. PIER

NOTES

Reference Numbers taken from, "Port and Terminal Facilities at the U.S. Ports on Lake Michigan", dated 1943.

1967 Sampling Point Samples Collected by COE and Analyzed at FWPCA, DFO

MUSKEGON HARBOR, MICHIGAN

LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS

In 3 Sheets

Sheet No.1

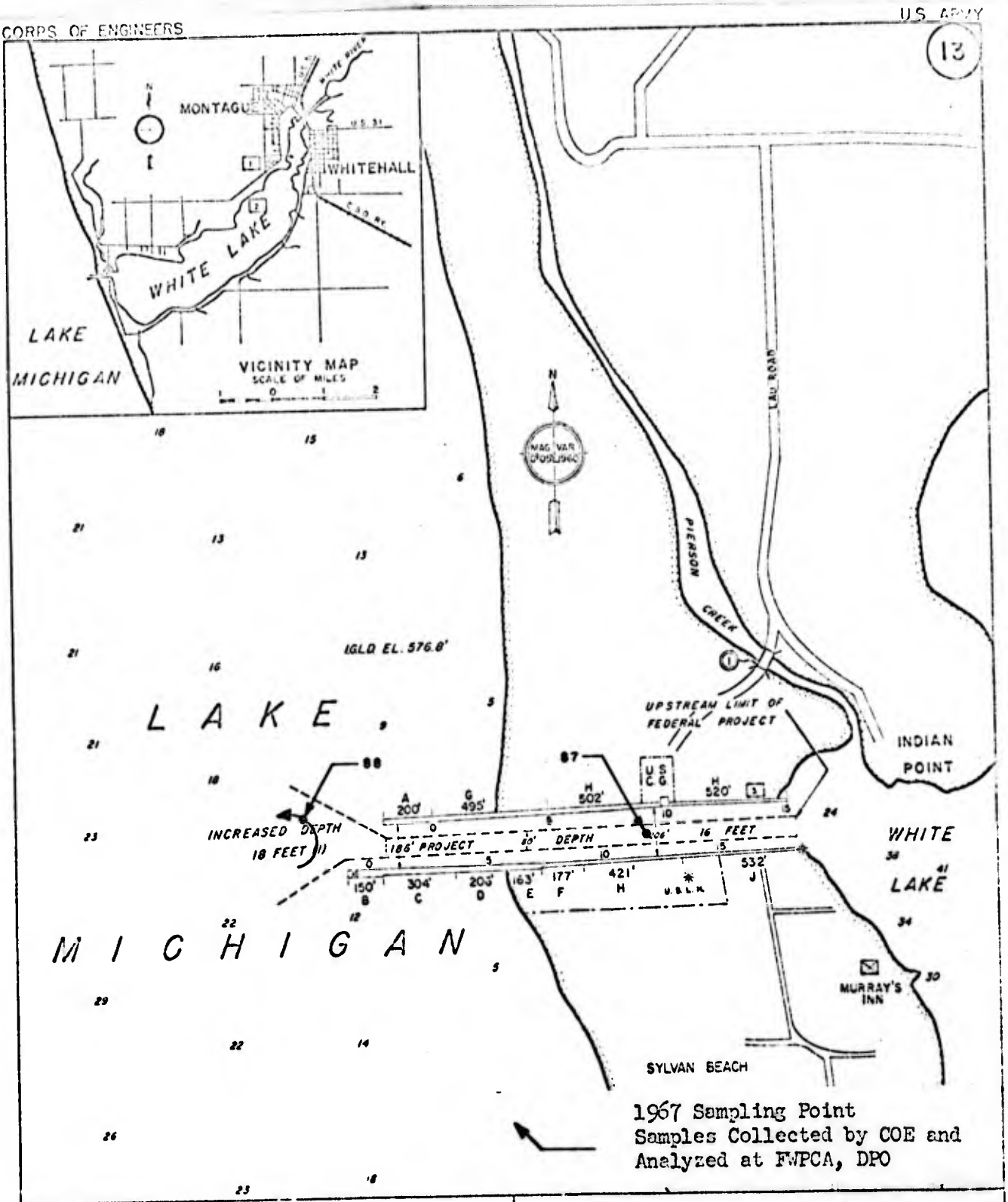
Scale of Feet

500 0 500 1000 1500 2000

U. S. ARMY ENGINEER DISTRICT, DETROIT

1 JANUARY 1962

13



LEGEND

WATERFRONT OWNERSHIP

SHOWN THUS [2]

(O) INDICATES OWNER

1. WHITE LAKE DOCK & FUEL CO. DOCK (O)
2. HOOKER ELECTRO-CHEMICAL CO. DOCK (O)
3. GROVER BROS. FISHERIES (O)

INDEX TO BRIDGES

SHOWN THUS ○

1. LAU ROAD BRIDGE

Project depths, sounding and elevations are referred to International Great Lakes Datum (1955) for Lake Michigan, elevation 576.8ft. above Mean Water Level (M.W.L.) at Father Point, Quebec.

WHITE LAKE HARBOR, MICHIGAN

LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS

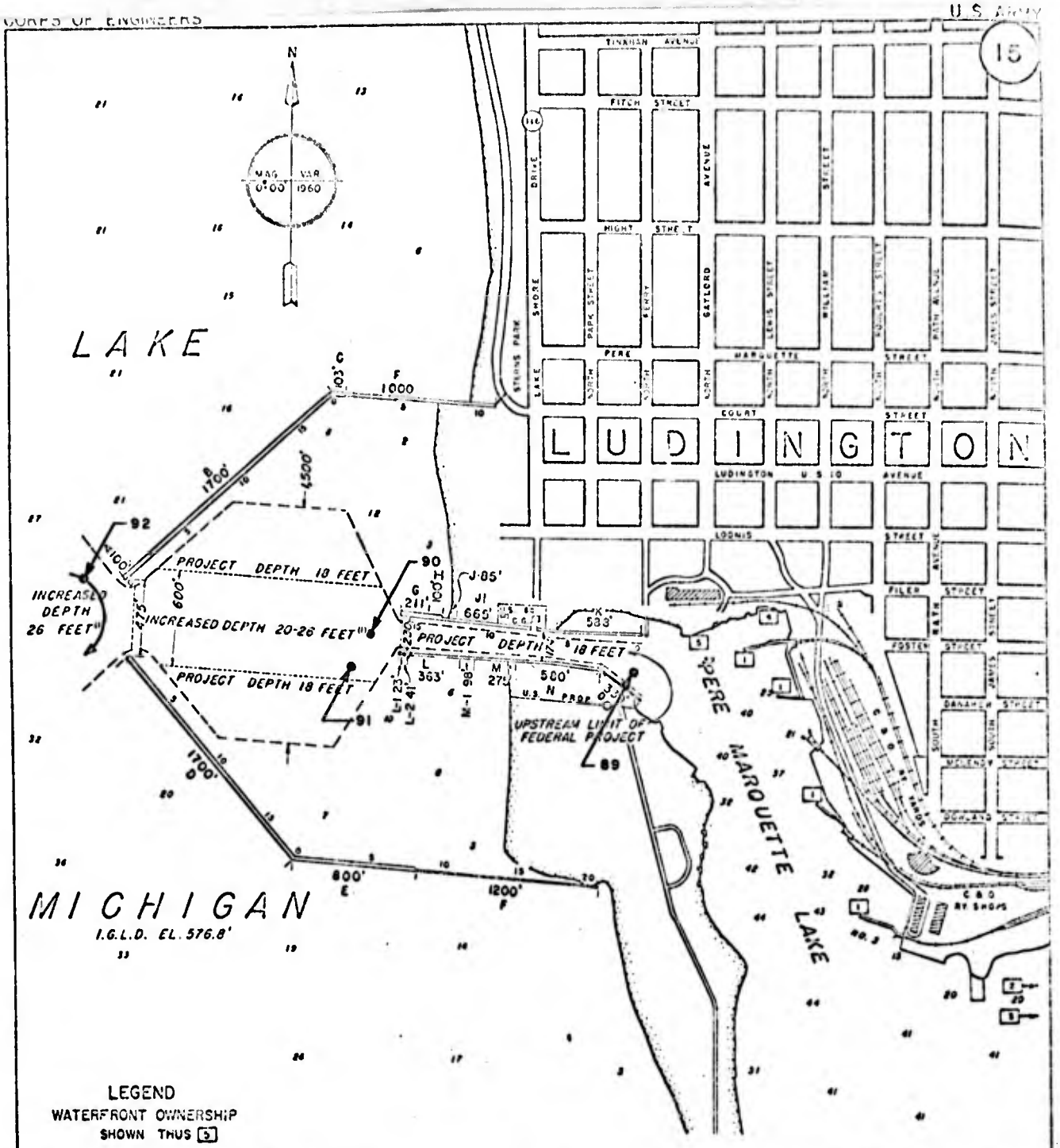
In 2 Sheets Sheet No 1

Scale of Feet

500 0 500 1000

U. S. ARMY ENGINEER DISTRICT, DETROIT

1 JANUARY 1962



LEGEND

WATERFRONT OWNERSHIP SHOWN THUS [5]

1 PERE MARQUETTE RAILWAY CAR FERRY SLIPS

2 ABRAHAMSON NERHEIM CO.

3 DOW CHEMICAL CO.

4 CHARLES PETERSON INC.

5 MARQUETTE MFG. CO.

1967 Sampling Point
Samples Collected by COE and Analyzed at FWPCA, DPO

NOTES:

Reference numbers taken from, "Port and Terminal Facilities of the U.S. Ports On Lake Michigan", Dated 1943.

Project depths, soundings and elevations are referred to International Great Lakes Datum (1955) for Lake Michigan, elevation 576.8 ft. above Mean Water Level (M.W.L.) at Father Point, Quebec.

(1) Authority R.& H. Act March 4, 1915.

O Indicates State Routes

LUDINGTON HARBOR, MICHIGAN

LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS

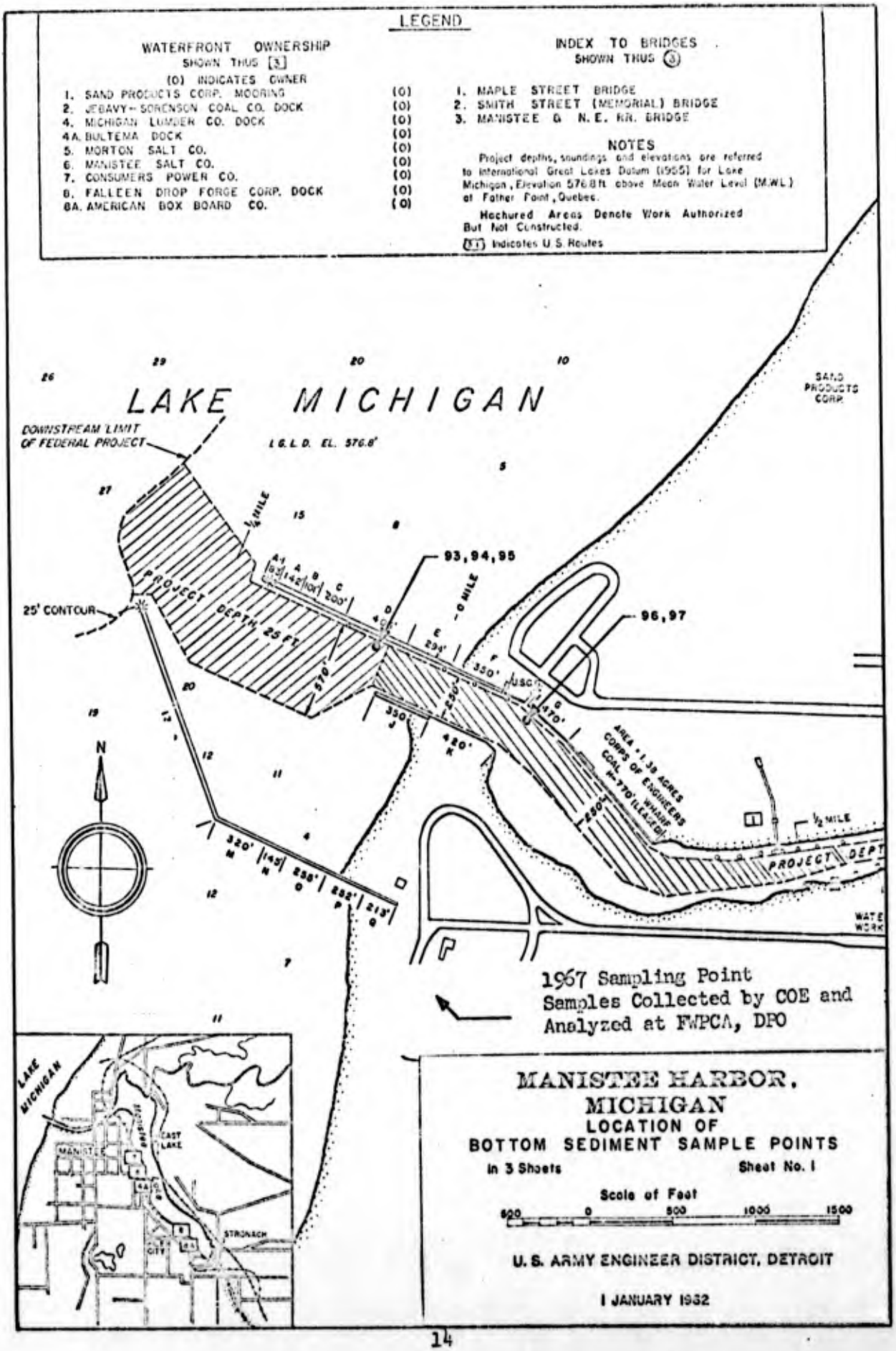
In 3 Sheets Sheet No. 1

Scale of Feet

500 0 5 10 15 2000

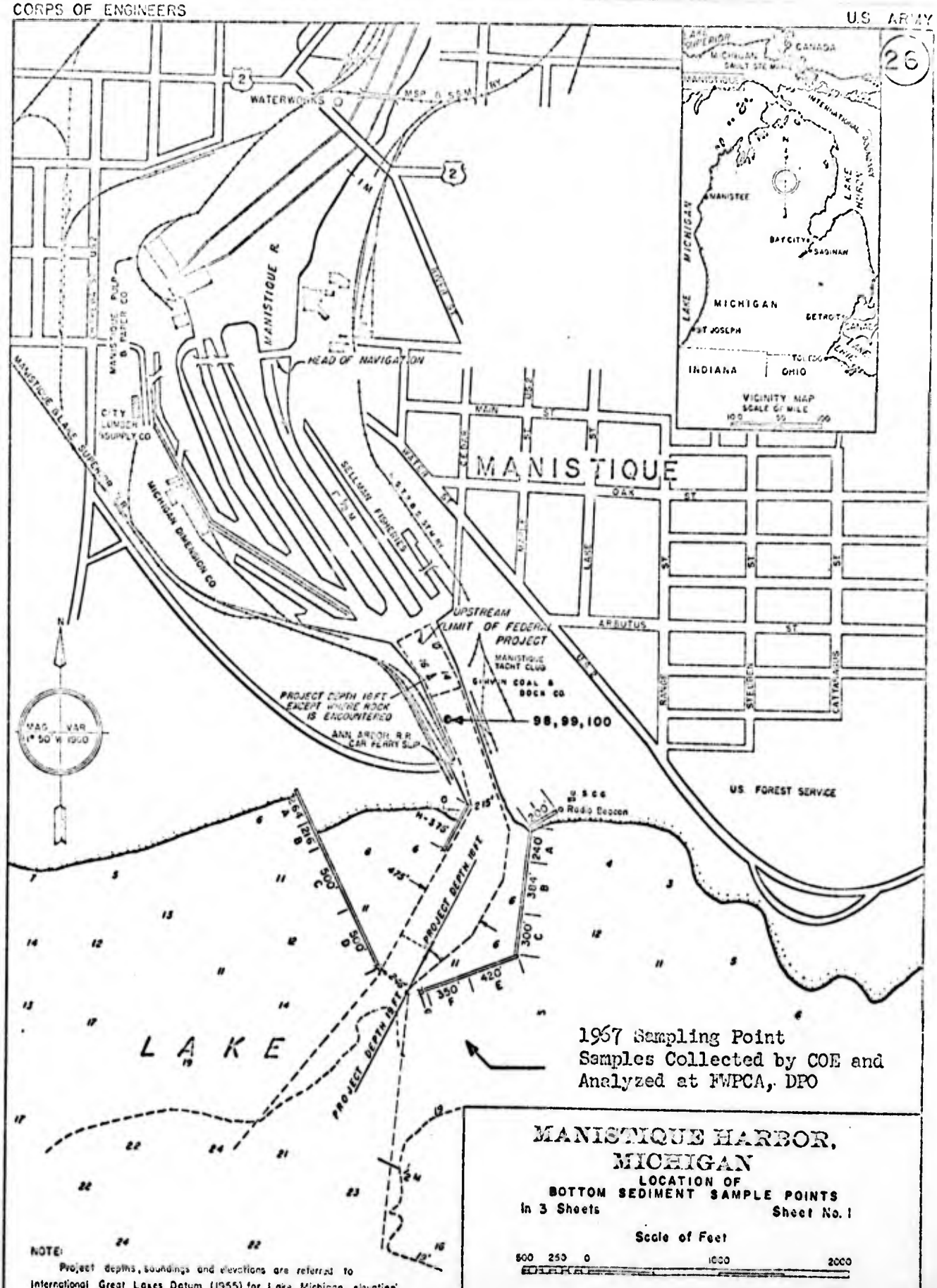
U. S. ARMY ENGINEER DISTRICT, DETROIT

1 JANUARY 1962


LEGEND
WATERFRONT OWNERSHIP
SHOWN THUS [3]
(O) INDICATES OWNER
1. SAND PRODUCTS CORP. MOORING (O)
2. JEBAVY-SORENSON COAL CO. DOCK (O)
4. MICHIGAN LUMBER CO. DOCK (O)
4A. BULTEMA DOCK (O)
5. MORTON SALT CO. (O)
6. MANISTEE SALT CO. (O)
7. CONSUMERS POWER CO. (O)
8. FALLEEN DROP FORGE CORP. DOCK (O)
8A. AMERICAN BOX BOARD CO. (O)
INDEX TO BRIDGES
SHOWN THUS (3)
1. MAPLE STREET BRIDGE
2. SMITH STREET (MEMORIAL) BRIDGE
3. MANISTEE & N.E. RR. BRIDGE
NOTES
Project depths, soundings and elevations are referred to International Great Lakes Datum (1955) for Lake Michigan, Elevation 576.8 ft. above Mean Water Level (M.W.L.) at Father Point, Quebec.
Hachured Areas Denote Work Authorized But Not Constructed.
(31) Indicates U.S. Routes
LAKE MICHIGAN
DOWNSTREAM LIMIT OF FEDERAL PROJECT
L.G.L.D. EL. 576.8'
SAND PRODUCTS CORP.
93,94,95
96,97
25' CONTOUR
PROJECT DEPTH 25 FT.
1/4 MILE
1/2 MILE
AREA = 1.38 ACRES
CORPS OF ENGINEERS WHARF
COAL #-770' (LEASED)
PROJECT DEPT
WATER WORKS
N
1967 Sampling Point
Samples Collected by COE and
Analyzed at FWPCA, DPO
LAKE MICHIGAN
MANISTEE
EAST LAKE
STRONACH
MANISTEE HARBOR,
MICHIGAN
LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS
In 3 Sheets
Sheet No. 1
Scale of Feet
500 0 500 1000 1500
U.S. ARMY ENGINEER DISTRICT, DETROIT
1 JANUARY 1962

CORPS OF ENGINEERS

U.S. ARMY



MANISTIQUE HARBOR, MICHIGAN

LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS

In 3 Sheets — Sheet No. 1

Scale of Feet

500 250 0 1000 2000

U. S. ARMY ENGINEER DISTRICT, DETROIT

1 JANUARY 1962

NOTE:

Project depths, soundings and elevations are referred to International Great Lakes Datum (1955) for Lake Michigan, elevation 576.8 ft. above Mean Water Level (M.W.L.) at Father Point, Quebec.

CORPS OF ENGINEERS

U.S. ARMY

LEGEND

WATERFRONT OWNERSHIP SHOWN THUS [2]

1. Ann Arbor R.R. car ferry slips
2. City dock
3. Luedtke Engineering Co.
4. Ed Olson & Co.
5. Jacobson Marine
6. Garland Marine Service

NOTES

Project depths, soundings and elevations are referred to International Great Lakes Datum (1955) for Lake Michigan, Elevation 576.8 ft. above Mean Water Level (M.W.L.) at Father Point, Quebec.

(22) Indicates State Route

(1) Authority R&H Act March 4, 1915

1967 Sampling Point
Samples Collected by COE and Analyzed at FWPCA, DPO

FRANKFORT HARBOR, MICHIGAN

LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS

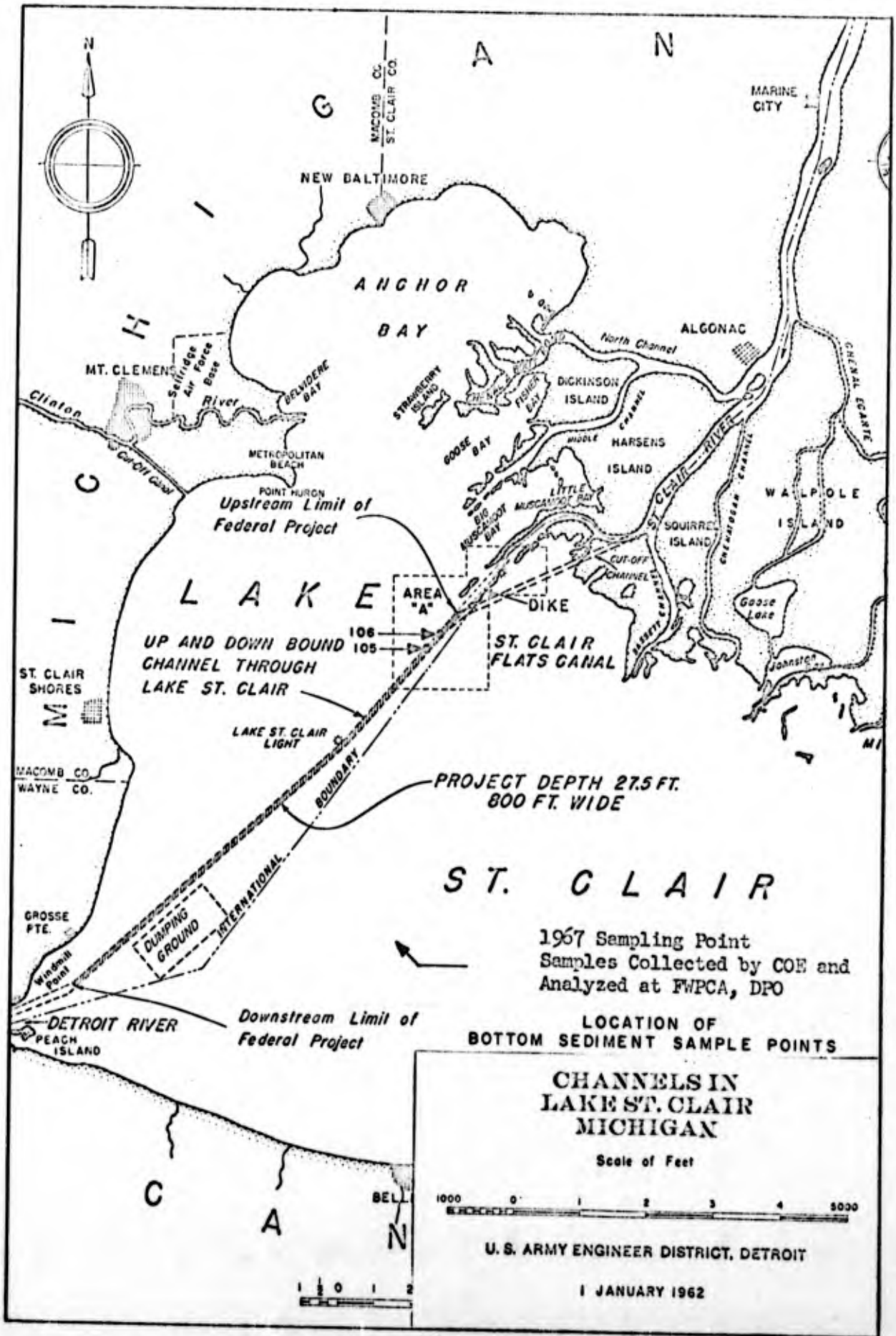
In 3 Sheets — Sheet No. 1

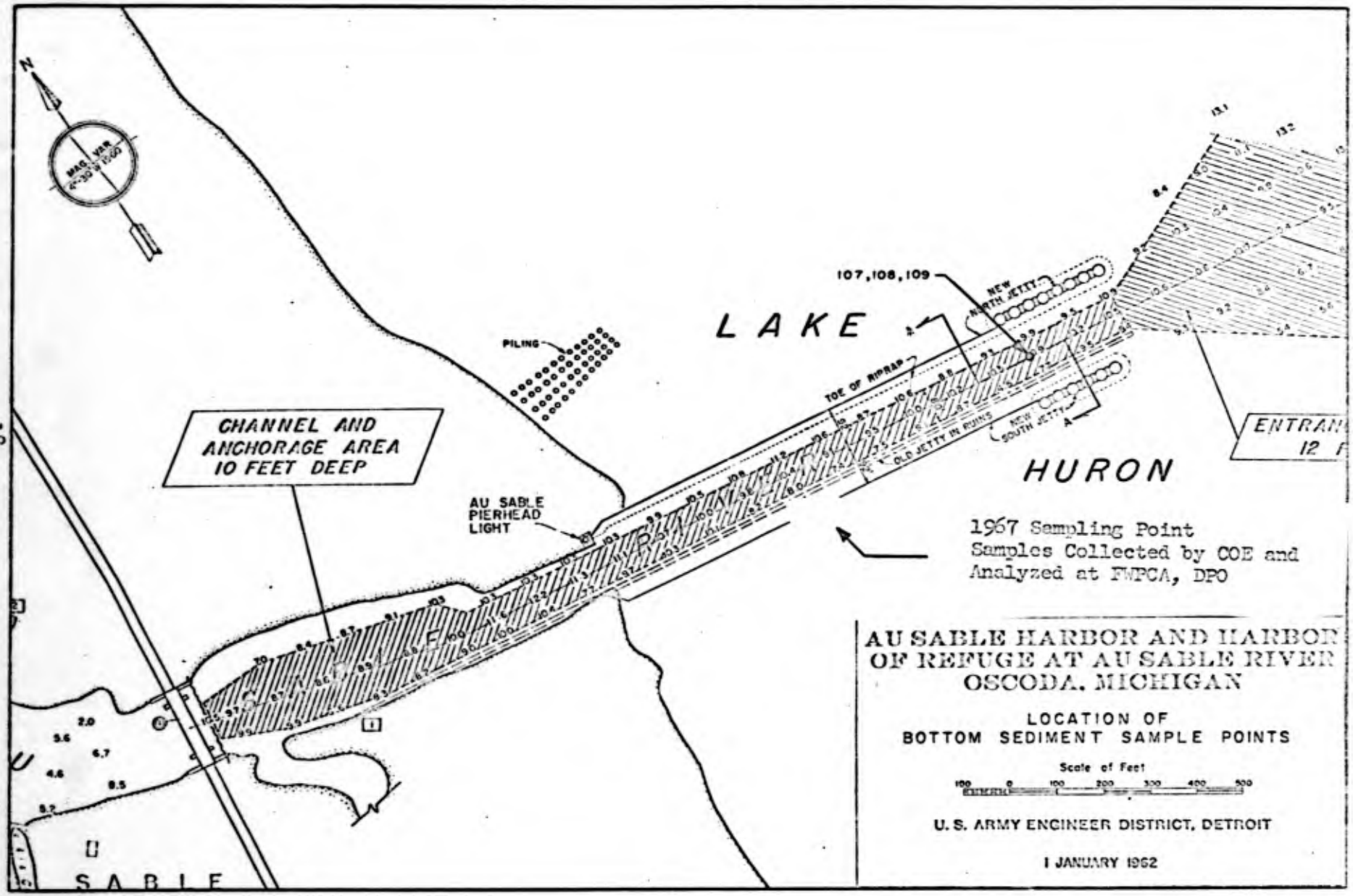
Scale of Feet

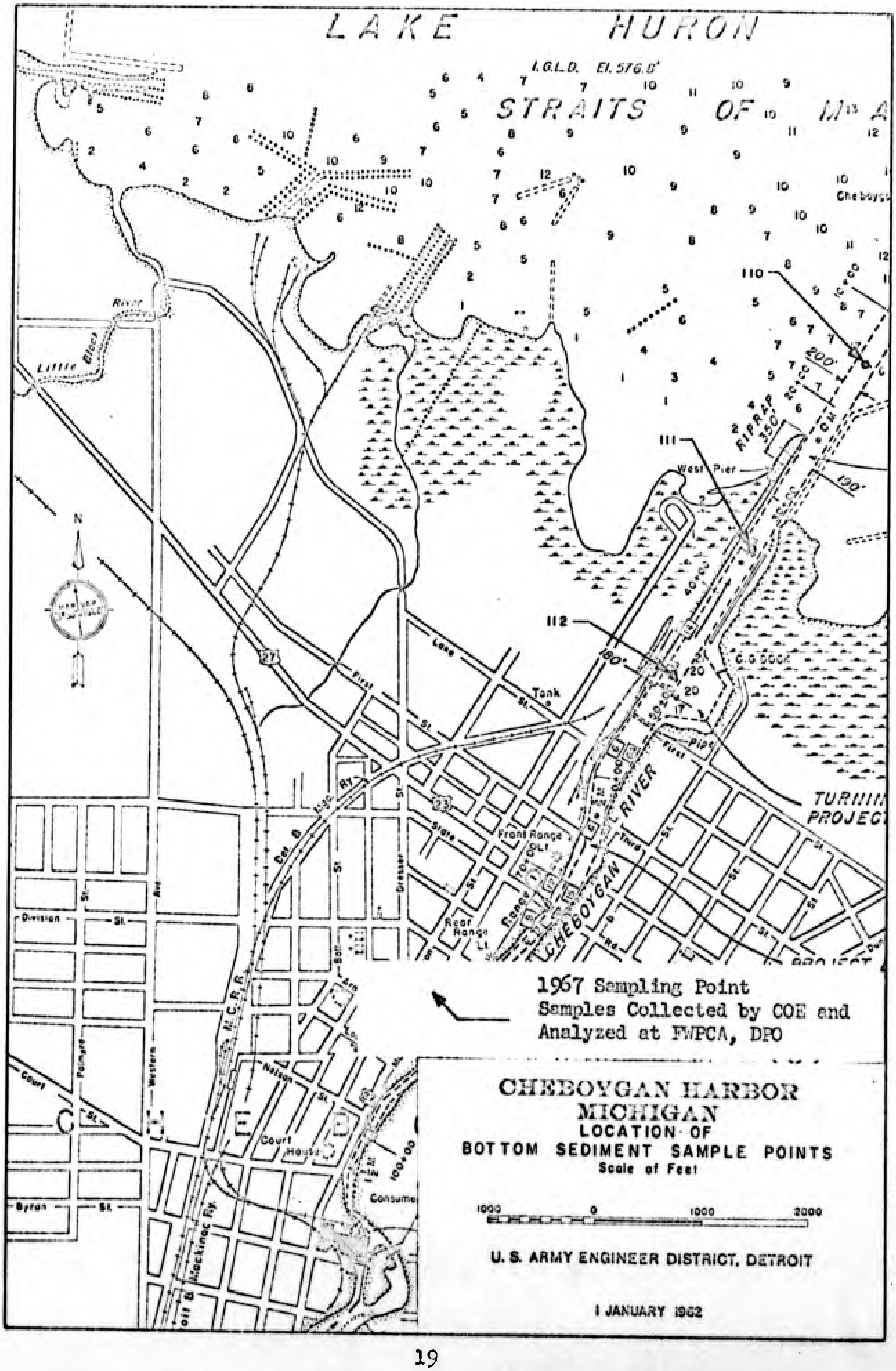
500 0 500 1000 1500

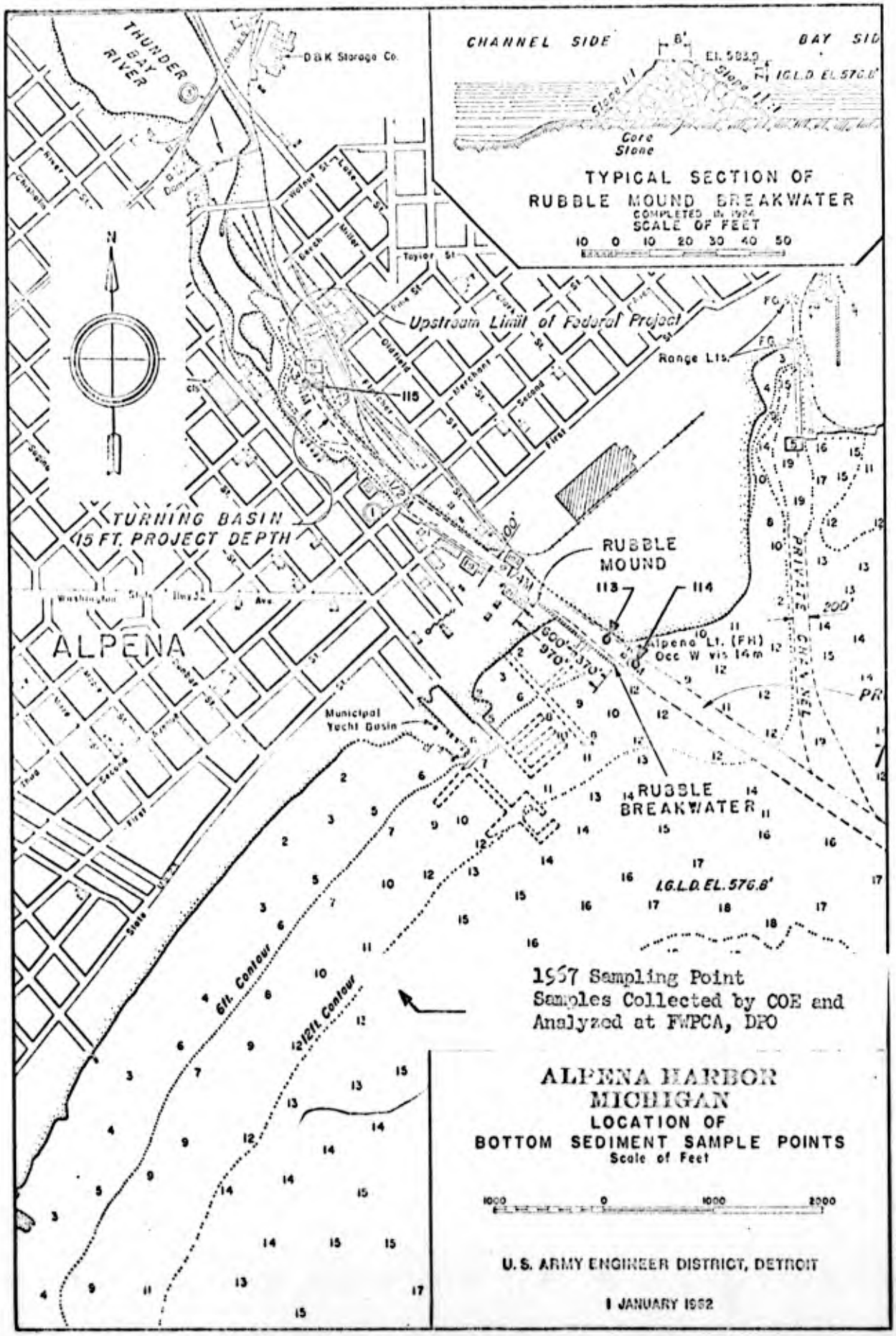
U. S. ARMY ENGINEER DISTRICT, DETROIT

1 JANUARY 1962


MACOMB CO.
ST. CLAIR CO.
NEW BALTIMORE
MARINE CITY
ANCHOR BAY
ALGONAC
North Channel
MT. CLEMENS
Selfridge Air Force Base
Clinton River
BELVIDERE BAY
STRAWBERRY ISLAND
DICKINSON ISLAND
FISHER BAY
GOOSE BAY
MIDDLE CHANNEL
HARSENS ISLAND
METROPOLITAN BEACH
Cut-Off Canal
POINT HURON
Upstream Limit of Federal Project
LITTLE MUSCAMOOT BAY
BIG MUSCAMOOT BAY
ST. CLAIR RIVER
SQUIRREL ISLAND
CHENOBOSH CHANNEL
WALPOLE ISLAND
CUT-OFF CHANNEL
LAKE ST. CLAIR
AREA "A"
DIKE
106
105
UP AND DOWN BOUND CHANNEL THROUGH LAKE ST. CLAIR
ST. CLAIR FLATS CANAL
Goose Lake
Johnston
ST. CLAIR SHORES
LAKE ST. CLAIR LIGHT
MACOMB CO.
WAYNE CO.
BOUNDARY
PROJECT DEPTH 27.5 FT.
800 FT. WIDE
INTERNATIONAL
DUMPING GROUND
GROSSE PTE.
Windmill Point
DETROIT RIVER
PEACH ISLAND
Downstream Limit of Federal Project
ST. CLAIR
1967 Sampling Point
Samples Collected by COE and Analyzed at FWPCA, DPO
LOCATION OF BOTTOM SEDIMENT SAMPLE POINTS
CHANNELS IN LAKE ST. CLAIR MICHIGAN
Scale of Feet
1000 0 1 2 3 4 5000
U. S. ARMY ENGINEER DISTRICT, DETROIT
1 JANUARY 1962


LAKE
HURON
CHANNEL AND
ANCHORAGE AREA
10 FEET DEEP
PILING
TOE OF RIPRAP
NEW
NORTH JETTY
NEW
SOUTH JETTY
OLD JETTY IN RUINS
AU SABLE
PIERHEAD
LIGHT
107,108,109
ENTRAN
12 F
1967 Sampling Point
Samples Collected by COE and
Analyzed at FWPCA, DPO
AU SABLE HARBOR AND HARBOR
OF REFUGE AT AU SABLE RIVER
OSCODA, MICHIGAN
LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS
Scale of Feet
100 0 100 200 300 400 500
U. S. ARMY ENGINEER DISTRICT, DETROIT
1 JANUARY 1962
SABLE


LAKE HURON
I.G.L.D. El. 576.8'
STRAITS OF
Little Black River
West Pier
RIPRAP 350'
200'
190'
180'
110
111
112
C.G. DOCK
Tank
Lake St.
First St.
State St.
Front Range Lt.
Rear Range Lt.
CHEBOYGAN RIVER
TURNING
PROJECT
Division St.
Court St.
Byron St.
Nelson St.
Court House
Consumers
Western
Palmyra
Dresser
1967 Sampling Point
Samples Collected by COE and
Analyzed at FWPCA, DPO
CHEBOYGAN HARBOR
MICHIGAN
LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS
Scale of Feet
1000 0 1000 2000
U. S. ARMY ENGINEER DISTRICT, DETROIT
1 JANUARY 1962


THUNDER BAY RIVER
D & K Storage Co.
CHANNEL SIDE
BAY SIDE
El. 583.0
I.G.L.D. EL. 576.8'
Slope 1:1
Slope 1:1
Core Stone
TYPICAL SECTION OF
RUBBLE MOUND BREAKWATER
COMPLETED IN 1924
SCALE OF FEET
10 0 10 20 30 40 50
N
Upstream Limit of Federal Project
Range Lts.
115
TURNING BASIN
15 FT. PROJECT DEPTH
RUBBLE MOUND
118
114
ALPENA
Alpena Lt. (FH)
Occ W vis 14m
Municipal Yacht Basin
RUBBLE BREAKWATER
I.G.L.D. EL. 576.8'
6ft. Contour
12ft. Contour
1957 Sampling Point
Samples Collected by COE and
Analyzed at FWPCA, DPO
ALPENA HARBOR
MICHIGAN
LOCATION OF
BOTTOM SEDIMENT SAMPLE POINTS
Scale of Feet
1000 0 1000 2000
U.S. ARMY ENGINEER DISTRICT, DETROIT
1 JANUARY 1962

Description of Bottom Material

The descriptions of bottom materials are listed in Table 2. The sediments were classified as follows:

Ooze: soft, fine, decaying organic material.

Sludge: (clay, silt, mud or organic material): non-gritty material of natural or unnatural origin.

Sand: gritty particles up to 1/25" in diameter

Gravel: 1/25" to 1/4"

Pebbles: 1/4" to 2"

Stones: 2" to 10"

Table 1
Qualitative Descriptions of Odors*
FWPCA, DPO, 1967

Code	Nature of Odor	Description (Such as Odors of:)
A	Aromatic (spicy)	camphor, cloves, lavender, lemon
Ac	cucumber	Synura
B	Balsamic (flowery)	geranium, violet, vanilla
Bg	geranium	Asterionella
Bn	nasturtium	Aphanizomenon
Bs	sweetish	Coelosphaerium
Bv	violet	Mallomonas
C	Chemical	industrial wastes or treatment chemicals
Cc	chlorinous	free chlorine
Ch	hydrocarbon	oil refinery wastes
Cm	medicinal	phenol and iodoform
Cs	sulfuretted	hydrogen sulfide
D	Disagreeable	(pronounced, unpleasant)
Df	fishy	Uroglenopsis, Dinobryon
Dp	pigpen	Anabaena
Ds	septic	stale sewage
E	Earthy	damp earth
Ep	peaty	peat
G	Grassy	crushed grass
M	Musty	decomposing straw
Mm	moldy	damp cellar
V	Vegetable	root vegetables

*Standard Methods of Examination of Water & Wastewater, 11th Edition, p. 25

Bottom Sediment Sample Analysis
Michigan Harbors
1967

FWPCA, DPO

Table 2

SAMPLE NO.	HARBOR	DREDGE	COLLECT DATE	LAB. NO.	GROSS DESCRIPTION (Description; Odor*; Depth)
1	Grand Haven	HAINS	4-14	15790	Dark sludge
2	South Haven	HAINS		16790	Dark sludge
3	"	HAINS		16791	Dark sludge
4	"	HAINS		16792	Dark sludge
5	"	HAINS		16793	Dark sludge
6	"	HAINS	4-19	16794	Clean sand
7C	"	TOMPKINS	5-25	21757	Dark sludge; G,D,C_s; 20.5'to 21'
8C	"	TOMPKINS	5-27	21760	Dark sludge and sand; G, E, C_s; 18.5' to 21'
9C	"	TOMPKINS	5-29	22751	Light and dark sand; slight C_s, E; 17' to 21'
10C	"	TOMPKINS	5-31	22754	Light and dark sand; C_s, E, G,; 20' to 23'
11C	"	TOMPKINS	6-1	22757	Light & dark sand; C_s, E,; 20.5'to 23'
12	St. Joseph	HAINS	4-27	17790	Clean sand
13	"	"	5-1	18790	Dark sand and sludge
14	"	"	5-2	18791	Dark sludge
15	"	"	5-2	18792	Dark sludge
16C	"	TOMPKINS	6-3	22763	Dark sand & sludge; E, G; 28' to 30'
17C	"	"	6-5	23751	Light sand; E; 23' to 26'
18C	"	"	6-6	23754	Light clean sand; E, C_s; 23' to 26'
19C	"	"	6-7	23760	Dark sludge; G, C_h; 19' to 21'
20	"	"	6-8	23790	Dark sludge - 16.5'
21	"	"	6-8	23791	Dark sludge C_h ; 18'
22	"	"	6-8	23792	Dark - sludge; 21'
23	"	"	6-9	23781	Black sand; o odor; 19'
24	"	"	6-9		Black sand; no odor; 20.5'
25	"	"	6-9		Black sand; no odor; 22'
26	"	"	6-10	23780	Black sandy sludge; C_h, D_s; 16'
27	"	"	6-10		Black sandy sludge C_h, D_s; 18'
28	"	"	6-10		Black sandy sludge; C_h, D_s; 20'
29	"	"	6-12	24755	Black sandy sludge C_h, D_s; 16'
30	"	"	6-12		Black sandy sludge C_h, D_s; 18'
31	"	"	6-12		Black sandy sludge C_h, D_s; 20'
32	"	"	6-13	24754	Black sandy sludge C_h ; 16'

*For odor description, see page

Bottom Sediment, Sample Analysis
Michigan Harbors
1957

FWPCA, DIO

Table 2 (Cont.)

SAMPLE NO.	IMMED. DO DEM Mg/Kg Wet Basis	COD Mg/Kg Wet Basis	PHENOLS µg/Kg Wet Basis	TOTAL PO_4 Mg/Kg Wet Basis	TOT. SOL. PO_4 Mg/Kg Wet Basis	NITRATE NO_3-N Mg/Kg Wet Basis	NITRITE NO_2-N Mg/Kg Wet Basis	AMMONIA NH_3-N Mg/Kg Wet Basis	ORGANIC NITROGEN Mg/Kg Wet Basis	IRON Mg/Kg Wa. Basis	OIL & GREASE Mg/Kg Dry Basis	TOTAL SOLIDS % Wet Basis	VOL SOLIDS % Dry Basis	BOD Mg/Kg Wet Basis
1				70	4					13,000	1000	32	14	
2				180	10					19,000	2000	30	15	
3				120	70					17,000	2000	31	13	
4				110	4					12,000	2000	20	10	
5				230	20					13,000	1000	31	14	
6														
7B				850	4					4,600	700	67	4	
8C				1600	2					8,500	2000	43	9	
9B												80	1	
10B												69	3	
11C												90	<1	
12														
13												-		
14				160	20					12,000	1000	32	10	
15				150	5					13,000	1000	36	10	
16B												63	4	
17B												77	1	
18C				1600	2					15,000	3000	80	<1	
19B				2500	3					13,000	7000	39	15	
20	2000		1200	2100	1	30	.1	400		15,000	30,000	43	13	2000
21				1700	2					8,500	8000	38	3	
22	2000		750	2000	1	40	.1	400		4,500	20,000	40	16	2200
23				1200	30					15,000	4,000	58	4	
24														
25														
26				1800	60					7,600	10,000	35	17	
27														
28														
29				1300	70					10,000	20,000	41	18	
30														
31														
32				750	90					8,800	10,000	42	18	

Bottom Sediment Samples Analysis
Michigan Harbors
1967

FWPCA, DPO

Table 2 (Cont.)

SAMPLE NO.	HARBOR	DREDGE	COLLECT DATE	LAB. NO.	GROSS DESCRIPTION (Description; Odor*; Depth)
33	St. Joseph	TOMPKINS	6-13		Black sandy sludge; C_h; 18'
34	"	"	6-13		Black sandy sludge; C_h; 20'
35	"	"	6-14	24750	Black sand sludge; slight D_s; 19'
36	"	"	6-14		Black sand & sludge; slight D_s; 21'
37	"	"	6-14	24751	Black sand & sludge; slight D_s; 23'
38	Benton Harbor	HAINS	5-8	19793	Dark sludge
39	Pentwater	TOMPKINS	5-16	20750	Clean sand; - 13'
40	"	"	5-16		Clean sand; - 15'
41	"	"	5-16		Clean sand; no odor; 16'
42	"	"	5-17	20751	Clean sand; no odor; 14'
43	"	"	5-17		Clean sand; no odor; 15'
44	"	"	5-17		Clean sand; no odor; 16'
45	"	"	5-18	20752	Clean sand; no odor; 13.5'
46	"	"	5-18		Clean sand; no odor; 14.5'
47	"	"	5-18		Clean sand; no odor; 16'
48	"	"	5-19	20753	Clean sand; no odor; 15'
49	"	"	5-19		Clean sand; no odor; 16'
50	"	"	5-19		Clean sand; no odor; 17'
51C	"	"	5-20	20751a	Clean sand; no odor; 14' to 16'
52C	"	"	5-21	21751	Clean sand; no odor; 14' to 16'
53C	"	"	5-23	21754	Clean sand; no odor; 13' to 14'
54C	Holland	HAINS	6-6	23757	Light sand
55C	"	"	6-8	23763	Light sand; no odor
56	"	"	6-9	23782	Black sand & sludge little odor
57	"	"	6-9		Black sand & sludge little odor
58	"	"	6-9		Black sand & sludge little odor
59	"	"	6-14	24752	Black sand & sludge little odor
60	"	"	6-14		Black sand & sludge little odor
61	"	"	6-14	24753	Black sand & sludge little odor
62	"	TOMPKINS	6-15		Light gray sand; odor C_s; 20'
63	"	"	6-15		Light gray sand; odor C_s; 21'
64	"	"	6-15		Light grayish brown sand; odor C_s; 22'

*For odor description, see page

Bottom Sediment Sample Analysis
Michigan Harbors
1967

FWPCA, DPO

Table 2 (Cont.)

SAMPLE NO.	IMMED. DO DEM Mg/Kg Wet Basis	COD Mg/Kg Wet Basis	PHENOLS µg/Kg Wet Basis	TOTAL PO_4 Mg/Kg Wet Basis	TOT. SOL. PO_4 Mg/Kg Wet Basis	NITRATE NO_3-N Mg/Kg Wet Basis	NITRITE NO_2-N Mg/Kg Wet Basis	AMMONIA NH_3-N Mg/Kg Wet Basis	ORGANIC NITROGEN Mg/Kg Wet Basis	IRON Mg/Kg Wet Basis	OIL & GREASE Mg/Kg Dry Basis	TOTAL SOLIDS % Wet Basis	VOL SOLIDS % Dry Basis	BOD Mg/Kg Wet Basis
33														
34														
35	70		310	570	60	40	< 0.05	300		4,100	6000	45	10	3000
36														
37	80		690	780	30	50	0.8	500		7,100	6000	58	8	2600
38				60	5					14,000	2000	33	14	
39												77	< 1	
40														
41														
42												75	< 1	
43														
44														
45												76	< 1	
46														
47														
48	< 3		410	< 80		< 1	< .05	< 1	< 1		200	78	< 1	30
49														
50												81	< 1	
51C												78	< 1	
52C												79	< 1	
53C												79	< 1	
54C												79	< 1	
55C												79	< 1	
56				910	30					7,300	5000	32	15	
57														
58														
59	40		560	570	40	90	0.1	40		6,000	4000	48	8	3000
60														
61	100		810	670	30	30	0.30	300		5,100	7000	36	13	3000
62														
63														
64														

Bottom Sediment Sample Analysis
Michigan Harbors
1967

FWPCA, DPO

Table 2 (Cont.)

SAMPLE NO.	HARBOR	DREDGE	COLLECT DATE	LAB. NO.	GROSS DESCRIPTION (Description; Odor*; Depth)
65	Holland	TOMPKINS	6-16		Light brown sand; odor C_s; 20'
66	"	"	6-16		Light brown sand; odor C_s; 21'
67	"	"	6-16		Light brown sand; odor C_s; 22'
68	"	"	6-17		Light brown sand; odor none; 22'
69	"	"	6-17		Light gray sand; odor D_s; 23'
70	"	"	6-17		Gray sand & black water; odor D; 24'
71	"	"	6-19		Light sand; odor D_s; 22'
72	"	"	6-19		Light gray sand; odor D_s; 23'
73	"	"	6-19		Light sand; no odor; 24'
74	"	"	6-19		Dark gray sludge trace sand; odor D_s
75	"	"	6-19		Dark gray sludge trace sand; odor D_s
76	"	"	6-19		Dark gray sludge trace sand; odor D_s
77	"	"	6-20		Light gray sand; odor C_s; 22'
78	"	"	6-20		Light brown sand; odor C_s; 23'
79	"	"	6-20		Light gray sand; odor C_s; 24'
80	"	"	6-21		Light gray sand; odor C_s; 17'
81	"	"	6-21		Light gray sand; odor C_s; 19'
82	"	"	6-21		Light gray sand; odor C_s; 21'
83C	Saugatuck	TOMPKINS	6-8	22760	Light sand; no odor
84	Muskegon	HAINS	7-12	28750	Coarse sand, some seaweed; D_f
85	"	"	7-12	28751	Coarse sand; E, slight D_s
86	"	"	7-12	28752	Coarse sand; E, slight D_s
87	White Lake	"	7-6	27750	Clean sand (insufficient sample); no odor; 27'
88	"	"	7-6	27751	Clean sand (insufficient sample); no odor; 29'
89	Ludington	"	7-20	29771	Sand, trace black charcoal
90	"	"	7-20	29772	Sand, some sludge
91	"	"	7-20	29773	Sand, some sludge
92	"	"	7-20	29774	Clean sand
93	Manistee	TOMPKINS	6-28		Light brown sand odor C_s; 22'
94	"	"	6-28		Light brown sand; no odor; 23'
95	"	"	6-28		Light brown sand; trace organic matter & oil;-; 25'
96	"	"	6-29	26750	Clean sand

*For odor description, see page

Bottom Sediment Sample Analysis
Michigan Harbors
1967

FWPCA, DPO

Table 2 (Cont.)

SAMPLE NO.	IMMED. DO DEM Mg/Kg Wet Basis	COD Mg/Kg Wet Basis	PHENOLS µg/Kg Wet Basis	TOTAL PO_4 Mg/Kg Wet Basis	TOT. SOL. PO_4 Mg/Kg Wet Basis	NITRATE NO_3-N Mg/Kg Wet Basis	NITRITE NO_2-N Mg/Kg Wet Basis	AMMONIA NH_3-N Mg/Kg Wet Basis	ORGANIC NITROGEN Mg/Kg Wet Basis	IRON Mg/Kg Wa. Basis	OIL & GREASE Mg/Kg Dry Basis	TOTAL SOLIDS % Wet Basis	VOL SOLIDS % Dry Basis	BOD Mg/Kg Wet Basis
65														
66														
67														
68														
69														
70														
71														
72														
73														
74														
75														
76														
77														
78														
79														
80														
81														
82														
83C												80	< 1	
84	< 3		< 190	240	.5	< 8	< 0.05	6	7	1,600	400	80	< 1	110
85	10		< 190	170	.3	< 8	< 0.05	4	3	1,700	100	80	< 1	38
86	10		< 190	240	.6	< 8	< 0.05	10	3	1,200	200	81	< 1	45
87	< 3					-						77	< 1	47
88	< 3					-			< 1			78	< 1	39
89	< 3		< 190	130	1	< 8	< 0.05	20	< 1	1,900	200	78	< 1	68
90	< 3		< 190	120	3	< 8	.1	20	2	1,400	300	83	< 1	67
91	< 3			190	2	< 8	.2	20	< 1	1,600	200	82	< 1	67
92	6		< 190	190	2	< 8	.1	20	3	1,400	300	78	< 1	67
93														
94														
95														
96	< 3		880	310	.8	< 8	.1	200	9	1,000	200	81	< 1	27

Bottom Sediment Sample Analysis
Michigan Harbors
1967

FWPCA, DPO

Table 2 (Cont.)

SAMPLE NO.	HARBOR	DREDGE	COLLECT DATE	LAB. NO.	GROSS DESCRIPTION (Description; Odor*; Depth)
97	Manistee	TOMPKINS	6-29	33751	Sand, some sludge
98	Manistique	"	8-3	31771	Gravelpebbles; D_s, M_m; 16'
99	"	"	8-3	31772	Gravelpebbles; C_h, D_s, C_s; 17'
100	"	"	8-3	31773	Sludge some coarse sand; D, M_m, C_s; 18'
101	Frankfort	HAINS	8-10	32750	Thin sludge; E
102	"	"	8-10	32751	Thin sludge; C_h, M_m, C_s
103	"	"	8-10	32552	Dark sand; strong E, M_m
104	"	"	8-10	32753	Dark sand; sludge worms; E, M_m
105	Lake St. Clair	HOFFMAN	8-11	32754	Thin, gray sludge; E, D_s
106	"	"	8-11	32755	Thin, gray sludge; E, D_s
107	Au Sable	TOMPKINS	8-17	33750	Gray brown sand; odorless; 10'
108	"	"	8-17	33751	Gray brown sand; odorless; 11'
109	"	"	8-17	33752	Gray brown sand; odorless; 12'
110	Cheboygan	HAINS	8-17	33753	Sand; some sludge; C_s
111	"	"	8-17	33754	Sand; some sludge; C_s
112	"	"	8-17	33755	Sludge & sand C_s
113	Alpena	"	8-24	34750	Sand; little sludge; twigs; E
114	"	"	8-24	34751	Sand; little sludge; twigs; E, slight C_s
115	"	"	8-24	34752	Sand; little sludge; twigs; E, slight C_s

For odor description see page

Bottom Sediment Sample Analysis
Michigan Harbors
1967

FWPCA, DPO

Table 2 (Cont.)

SAMPLE NO.	IMMED. DO DEM Mg/Kg Wet Basis	COD Mg/Kg Wet Basis	PHENOLS µg/Kg Wet Basis	TOTAL PO_4 Mg/Kg Wet Basis	TOT. SOL. PO_4 Mg/Kg Wet Basis	NITRATE NO_3-N Mg/Kg Wet Basis	NITRITE NO_2-N Mg/Kg Wet Basis	AMMONIA NH_3-N Mg/Kg Wet Basis	ORGANIC NITROGEN Mg/Kg Wet Basis	IRON Mg/Kg We. Basis	OIL & GREASE Mg/Kg Dry Basis	TOTAL SOLIDS % Wet Basis	VOL SOLIDS % Dry Basis	BOD Mg/Kg Wet Basis
97	< 3		380	170	1.0	< 8	.2	-	-	650	400	80	< 1	45
98*	9		< 190	190	.8	8	< .05	6	20		900	45	7	790
99*	8		< 190	110	.6	20	< .05	6	30		9000	73	3	1200
100	10		< 190	200	.6	20	< .05	20	60	2,100	2000	68	5	1500
101	90		< 190	480	20	40	.1	30	100	4,800	5000	24	20	890
102	80		1300	520	6	20	.2	100	80	3,400	5000	21	19	2500
103	10		< 190	230	1	10	.1	20	-	1,900	500	77	1	820
104	3		190	590	1	< 8	.08	20	20	1,500	400	77	8	760
105	40		< 190	470	< .6	8	.1	80	40	780	800	62	5	140
106	90		< 190	400	1	9	.1	10	40	930	2000	55	7	2100
107	3		< 190	120	.6	-	< .05	10	8	1,800	800	83	< 1	52
108				120	1	-				1,600		83	< 1	
109				130	< .6	-				1,700		84	< 1	
110	20		190	240	< .6	< 8	.03	20	5	1,700	500	81	1	160
111	10		190	240	< .6	< 8	.06	60	50	3,500	400	82	5	96
112	30		< 190	470	.6	20	.06	20	4	5,000	500	78	3	160
113		100	< 190	< 80	2	< 8	.10	30	30	1,400	700	73	5	
114		79	< 190	110	2	< 8	.03	20	1		700	74	6	
115		20	400	90	1	< 8	.06	10	2		500	82	2	

*Material consisted mostly of gravel & pebbles; only the fine material forced through a #10 screen was analyzed.

AVERAGES OF ANALYTICAL RESULTS

The results listed in Table 2 were grouped according to area and the nature of the bottom samples. Most of the bottom sediments collected from a particular harbor were of the same nature, that is, either sand or sludge. However, at South Haven, St. Joseph, Holland and Frankfort, sand was found in the outer channels and bar areas while sludge was found in the inner channel or turning basin.

The average analytical results for each harbor, navigation channel or portion thereof are listed in Table 3. The samples which are included in each average and a preliminary evaluation of the bottom materials collected from each area are also indicated in the table.

Table 3
Averages of Analytical Results
Michigan Harbors and Navigation Channels
FWPCA, DPO, 1967

Code No.	Channel or Harbor	Area	Type of Material	Sample Numbers
*A	Grand Haven		sludge	1
B1	South Haven	outer channel & bar	sand	6,9C,10C,11C
*B2	"	turning basin	sludge	2,3,4,5,7C,8C
**C1	St. Joseph	outer channel & bar	sand	12,17C,18C
C2	"	outer channel	sand and sludge	13,16C
*C3	"	inner channel	sludge	14,15,19C,20,21,22,26-37
C4	"	inner channel	sand	23,24,25
D	Benton Harbor		sludge	38
**E	Pentwater		sand	39-53C
**F1	Holland	outer channel & bar	sand	54C,55C,62-82
*F2	"	inner channel at turning basin	sand and sludge	56-61, 74-76
**G	Saugatuck		sand	83C
**H	Muskegon		coarse sand	84-86
**I	White Lake		sand	87,88
**J	Ludington		sand	89-92
**K	Manistee		sand	93-97
L	Manistique		gravel, pebbles	98-100
M1	Frankfort	outer channel	sand	103,104
*M2	"	inner channel and turning basin	thin sludge	101,102
N	Lake St. Clair		thin sludge	105,106
P	Au Sable		sand	107-109
Q	Cheboygan		sand; some sludge	110-112
R	Alpena		sand, little sludge	113-115

*Highly polluted bottom materials
**Good quality bottom materials

Table 3 (Cont.)

FWPCA, DPO, 1967 Average Values

SAMPLE NO.	IMMED. DO DEM Mg/Kg Wet Basis	COD Mg/Kg Wet Basis	PHENOLS µg/Kg Wet Basis	TOTAL PO_4 Mg/Kg Wet Basis	TOT. SOL PO_4 Mg/Kg Wet Basis	NITRATE NO_3-N Mg/Kg Wet Basis	NITRITE NO_2-N Mg/Kg Wet Basis	AMMONIA NH_3-N Mg/Kg Wet Basis	ORGANIC NITROGEN Mg/Kg Wet Basis	IRON Mg/Kg Wet Basis	OIL & GREASE Mg/Kg Dry Basis	TOTAL SOLIDS % Wet Basis	VOL SOLIDS % Dry Basis	BOD Mg/Kg Wet Basis
A				70	4					13,000	1000	32	14	
B1												76	2	
B2				490	20					12,000	2000	38	12	
C1				1600	2					15,000	3000	72	< 1	
C2												63	4	
C3	1000		740	1300	30	40	.3	400		9,400	10,000	41	13	2900
C4				1200	30					15,000	4,000	50	4	
D				60	5							77	< 1	
E	< 3		410	< 80		< 1	< .05	< 1	< 1		200	78	< 1	30
F1												79	< 1	
F2	70		690	720	30	60	.2	170		6,100	5,000	39	12	3000
G												80	< 1	
H	8		< 190	220	.5	< 8	< .05	7	4	1,500	200	80	< 1	64
I	< 3								< 1			78	< 1	43
J	4		< 190	160	2	< 8	.1	20	2	1,600	300	80	< 1	72
K	< 3		630	240	.9	< 8	.2	200	9	830	300	81	< 1	36
L#	9		< 190	170	.7	16	< .05	10	40	2,100	4,000	62	5	1200
M1	7		< 190	410	1	9	.09	20	20	1,700	500	77	5	790
M2	90		750	500	10	30	.2	70	90	4,100	5,000	23	20	1700
N	70		< 190	440	.8	9	.1	50	40	860	1,000	59	6	1100
P	3		< 190	120	.7	9	< .05	30	30	1,200	1,000	67	4	760
Q	20		< 190	320	< .6	12	.07	40	20	3,400	500	80	3	140
R		66	290	93	2	< 8	.08	20	10	1,400	600	76	4	

#Material, consisted mostly of gravel & pebbles; only the fine material forced through #10 screen was analyzed.

III. APPENDIX

Laboratory Procedure

Bottom sediment samples were analyzed according to the Chicago Program Office (FWPCA) procedures and Standard Methods for the Examination of Water and Wastewater, 12th Edition, 1965.

Parameters not run according to the Chicago Program Office procedures are: IDOD, BOD, NO_2, NH_3-N and Organic-Nitrogen. However, the first three of these parameters were run according to "Standard Methods" with modifications and the NH_3-N and Organic-Nitrogen analyses were run according to published procedures.

The following is a condensed procedure for each of these parameters which were run by the Detroit Program Office, FWPCA. Chicago procedures are not listed.

A limited number of precision tests were run on all parameters except BOD, to provide a base for the number of significant figures to which each test is reported.

Immediate Dissolved Oxygen Demand (IDOD)
and BOD (5-day) Determinations
Using a Dissolved Oxygen Analyzer (D.O. probe)

1. Prepare dilution water at 20°C and measure its oxygen content.
2. Weigh 5-10 grams of sample and siphon in dilution water to fill the BOD bottle.
3. Let stand exactly 15 minutes.
4. Measure oxygen content and report as IDOD based on 10 or 5 grams at 20°C.
5. In addition to the 5-10 gram sample prepare dilutions containing 1 gram and .5 gram of sample. Determine dissolved oxygen content after 15 minutes.

Use the 15 minute oxygen concentrations as initial oxygen content for BOD.

6. Measure oxygen content after five days incubation at 20°C.

Nitrite - Nitrogen (Manual Determination)

1. Weigh 5 grams of sample into 150 ml beaker. Add 50 ml nitrite-free water, and let stand overnight.
2. Filter through membrane filter and analyze according to "Standard Methods."

Determination of Ammonia and Organic Nitrogen following Phenol Analysis Using Cupric Sulfate as Catalyst

Ammonia - Nitrogen (Manual Determination)

1. Place 10 grams of sample into a 1000 ml distilling flask. Add 550 ml phenol-free distilled water and 10 ml of 10% $Cu\text{-}SO_4\text{-}H_3PO_4$ solution.
2. Distill over phenol.
3. To the residue in flask, add 5 ml of NAOH (250 g/liter), a few glass beads, and enough water to make 250 ml approximately.
4. Distill over NH_3 in bottles. (Boric Acid is used only for extremely high concentrations).
5. Measure the volume and save for nesslerization.

Organic Nitrogen

1. Add 10-50 ml $K_2SO_4\text{-}H_2SO_4$ solution to the residue from ammonia determination; digest until fumes are acid to litmus paper.
2. Cool; add distilled water to volume of about 250 ml.
3. Add 50% solution of NaOH containing thiosulfate, the volume of which is equal to the amount of $K_2SO_4\text{-}H_2SO_4$ added in Step 1.

4. Distill over NH_3 into bottle. Measure volume and save for nesslerization.

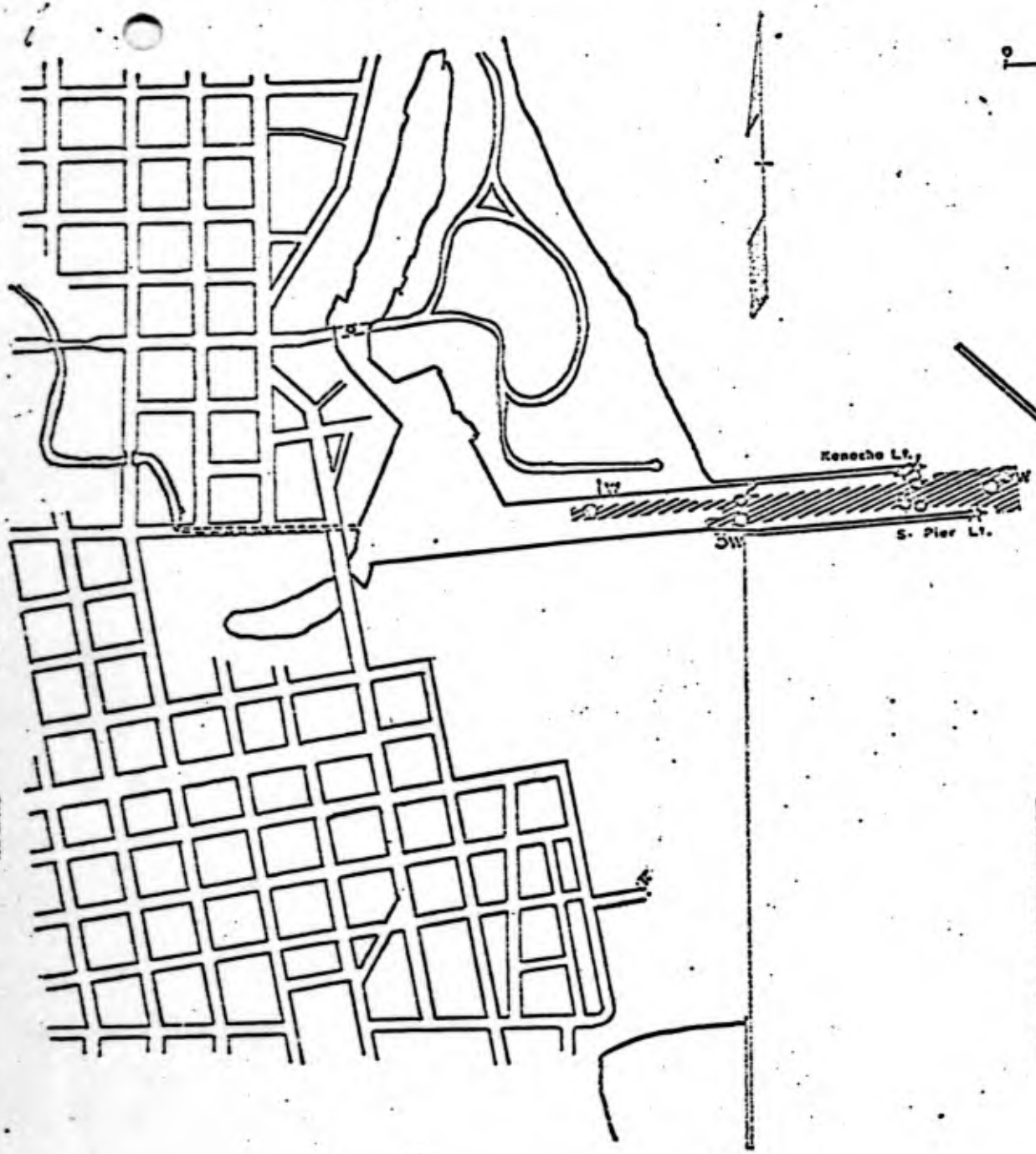
5. Nesslerize NH_3 and organic samples according to "Standard Methods."

APPENDIX B3

WISCONSIN HARBORS
BOTTOM SEDIMENT ANALYSES
1967

KENOSHA HARBOR, WISCONSIN
KEWAUNEE HARBOR, WISCONSIN
MANITOWAC HARBOR, WISCONSIN
RACINE HARBOR, WISCONSIN
SHEBOYGAN HARBOR, WISCONSIN
STURGEON BAY SHIP CANAL, WISCONSIN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION
CHICAGO PROGRAM OFFICE
CHICAGO, ILLINOIS



0 1000 2000

SCALE - (Feet)

DREDGING AREA

o^{1w} WATER AND MUD SAMPLE

o^{4} MUD SAMPLE ONLY

SAMPLES COLLECTED
5-3-67

CHICAGO PROGRAM OFFICE CALUMET AREA SURVEILLANCE UNIT
KENOSHA HARBOR DREDGING SAMPLING STATIONS
U.S. DEPARTMENT OF THE INTERIOR FEDERAL WATER POLLUTION CONTROL ADMIN. Great Lakes Region Chicago, Illinois

FIELD OBSERVATIONS ON BOTTOM SAMPLES
KENOSHA HARBOR MAY 3, 1967

Sample		Water Depth
1W	Brown clay, some sand, no odor	20 ft.
2	Brown clean sand, no odor	22 "
3W	Dark brown oily silt and clay; sludge worms noted; slight petrol odor	23 "
4	Light brown sand, some silt, slight fish odor	22 "
5	Light brown sand, some silt, no odor	21 "
6W	Light brown sand with some black specks, no odor	25 "

RESULTS OF ANALYSIS OF BOTTOM MUD SAMPLES
COLLECTED IN KENOSHA HARBOR MAY 3, 1967

Station	% Tot. Solids	% Vol. Solids	Phosphates		Nitrogens			
			Total PO_4(mg/g)	Sol.PO_4(mg/g)	NO_3-N(mg/g)	NH_3-N(mg/g)	Tot.Kjeldahl(mg/g)	Phenc
1W	46.8	18.9	1.20	0.010	0.003	0.078	0.94	1.0
2	78.5	7.1	0.67	0.003	0.002	0.020	0.20	0.3
3W	35.8	22.3	1.15	0.003	0.003	0.066	1.40	1.3
4	68.8	17.5	1.14	0.004	0.002	0.025	0.61	0.2
5	67.5	8.0	0.88	0.003	0.002	0.035	0.45	0.27
6W	76.9	14.5	0.87	0.002	0.002	0.014	0.56	0.3

The bottom samples were analyzed after well-mixing and the results are reported as "WET." "DRIED" results can be calculated by dividing the "WET" results by the decimal fraction of the "% Total Solids."

RESULTS OF ANALYSES OF WATER SAMPLES
COLLECTED IN KENOSHA HARBOR MAY 3, 1967

Station	Temp. °C	pH	Conductivity	Turbidity	Alkalinity (total) mg/l	DO mg/l	Chlorides mg/l	Sulphate mg/l
1W	10	7.3	395	16.0	98	5.65	22	43
3W	9	7.6	355	17.5	149	6.50	20	39
6W	8	7.8	295	3.5	65	9.90	12	24
Inner Harbor Basin Criteria*	Max.29.4	7.5-9.0	-	-	-	Min. 65% sat.	16	35

* Criteria adopted for Calumet Area used for comparison purposes only.

RESULTS OF ANALYSES OF WATER SAMPLES
COLLECTED IN KENOSHA HARBOR MAY 3, 1967

Station	Phosphates		Nitrogen			Dis.Solids	Susp.Solids	Phenolics	Cya
	Total mg/l	Sol. mg/l	NO_3-N(mg/l)	NH_3-N(mg/l)	Org.N(mg/l)	mg/l	mg/l	ug/l	m
1W	0.40	0.25	0.54	0.21	0.64	243	26	20	N
3W	0.32	0.21	0.47	0.17	0.52	218	21	19	N
6W	0.23	0.15	0.22	0.12	0.47	183	10	15	N
Inner Harbor Basin Criteria	Max 0.10	-		Max 0.12		Max 230		Max 5	Max

NF - None found within sensitivity of the test.

CORPS OF ENGINEERS U. S. ARMY

3--19

PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM 579.8 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC, I. G. L. D. (1955) (INTERNATIONAL GREAT LAKES DATUM)

RACINE HARBOR
WISCONSIN

III B SHEETS SHEET NO. 1

SCALE OF FEET

CORPS OF ENGINEERS CHICAGO, ILL.

Table 11

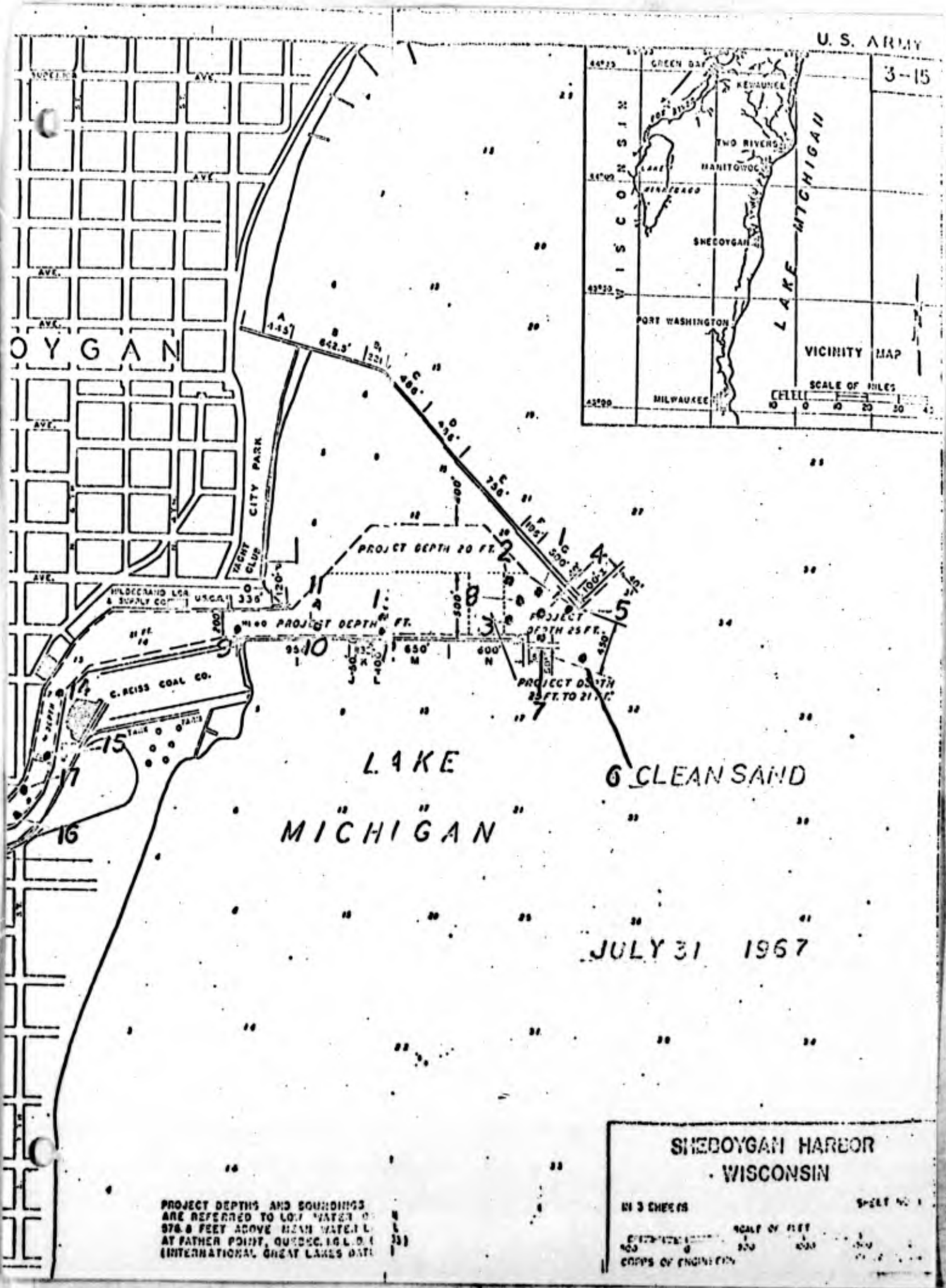
ANALYSES OF BOTTOM SEDIMENTS
Racine Harbor
June 5, 1967

Sample No.	1		2		3		4		5	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
% T. Solids	74.1		72.5		72.1		74.1		59.0	
% T. Vol. Solids		19.5		16.9		7.9		10.8		20.3
NH_3-N	22	30	52	72	3	4.2	5	6.7	222	376
NO_3-N	0.40	0.54	0.60	0.83	0.30	4.2	0.40	5.4	2.0	3.4
Org-N	259	350	483	666	131	182	164	221	1098	1860
T. Sol. PO_4	1	1.4	8	11	1	1.4	2	2.7	20	34
T. PO_4	754	1015	754	1040	637	883	377	509	1130	1920
Phenol (µg/kg)	81	109	486	670	13	18	27	36	162	274
Oil & Grease	4400	5940	6600	9100	4900	6790	1700	2290	6500	11010
T. Fe	4100	5540	5400	7450	3200	4400	3200	4320	5900	10000
Sulfide	11	15	49	68	5	6.9	11	15	56	95
Cu	*	*	*	*	*	*	*	*	15	25
Cd	*	*	*	*	*	*	*	*	*	*
Ni	8.0	11	8.0	11	6.0	8.3	*	*	8.0	14
Zn	37	50	42	58	23	32	263	354	58	98
Pb	*	*	*	*	*	*	*	*	*	*
Cr	4.0	5.4	11	15	4.0	5.5	*	*	8.0	14
COD	5900	7950	26200	36200	5530	7660	4800	6470	44200	75000

Table 11

ANALYSES OF BOTTOM SEDIMENTS
Racine Harbor
June 5, 1967

Sample No.	6		7		8		9			
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
% T. Solids	60.2		55.8		48.7		45.1			
% T. Vol. Solids		4.1		22.8		23.6		10.7		
NH_3-N	87	128	164	294	144	296	159	352		
NO_3-N	2.0	2.9	2.0	3.6	2.0	4.1	1.0	2.2		
Org-N	609	892	976	1750	1436	2950	143	317		
T. Sol. PO_4	3	4.4	3	5.4	41	84	32	71		
T. PO_4	1140	1670	1510	2710	2030	4170	2170	4820		
Phenol (µg/kg)	202	296	337	605	149	306	337	746		
Oil & Grease	7000	10250	7700	13800	7000	14390	10800	23950		
T. Fe	6900	10100	9200	16500	10000	20550	9000	19920		
Sulfide	115	168	60	108	470	965	404	895		
Cu	8.0	12	12	22	20	41	17	38		
Cd	*	*	*	*	*	*	*	*		
Ni	23	34	34	61	38	78	45	100		
Zn	58	85	69	124	106	218	91	202		
Pb	*	*	*	*	49	101	51	113		
Cr	9.0	13	7.0	13	10	21	18	40		
COD	42400	62100	44200	79400	60100	123500	65600	145500		


U.S. ARMY
3-15
VICINITY MAP
SCALE OF MILES
LAKE MICHIGAN
SHEBOYGAN
PORT WASHINGTON
MILWAUKEE
TWO RIVERS
MANITOWOC
KEWAUNEE
GREEN BAY
WISCONSIN
OYGAN
AVE.
CITY PARK
YACHT CLUB
PROJECT DEPTH 20 FT.
PROJECT DEPTH 25 FT.
PROJECT DEPTH 25 FT. TO 21 FT.
C. REISS COAL CO.
LAKE
MICHIGAN
CLEAN SAND
JULY 31 1967
SHEBOYGAN HARBOR
WISCONSIN
SCALE OF FEET
CORPS OF ENGINEERS

ANALYSIS OF DREDGING SAMPLES
SHEBOYGAN HARBOR

Results Expressed in mg/kg on a wet basis

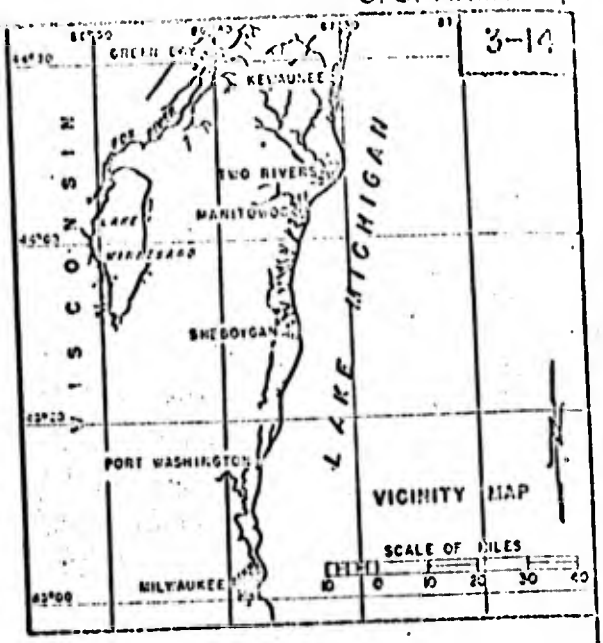
July 31, 1967

Parameter	% Total Solids	% T. Vol. Solids	NH_3-N	NO_3-N	Org-N	T. Sol. PO_4	Total PO_4	Oil and Grease	COD
Station									
1	64.6	3.8	174	73	520	16	680	2,325	11,810
2	64.1	6.8	42	65	320	2.8	575	2,230	3,220
3	59.2	8.9	149	60	711	4.1	784	2,075	22,950
4	72.3	6.9	5.6	50	283	2.0	261	2,250	2,150
5	68.8	7.3	4.2	58	56	1.4	261	3,405	1,791
7	70.8	8.2	8.4	58	22	1.1	157	1,605	1,791
8	51.8	15.0	161	190	639	38	992	1,775	11,810
9	51.1	11.4	214	138	1,096	9.9	1,200	4,825	26,850
10	55.0	11.3	220	238	1,000	15	1,515	17,635	31,550
11	38.2	18.3	245	150	1,475	51	1,098	3,460	36,600
12	66.1	6.2	18	110	302	4.5	575	1,865	3,940
13	43.3	16.9	144	113	1,231	77	1,252	4,975	34,800
14	37.7	16.6	132	108	1,121	37	1,308	3,725	17,200
15	44.1	7.0	165	110	1,435	58	1,410	1,770	47,600
16	53.0	12.1	105	98	2,235	17	1,620	6,380	45,900
17	40.0	17.9	174	80	1,366	14	1,515	1,395	45,900

S OF ENGINEERS

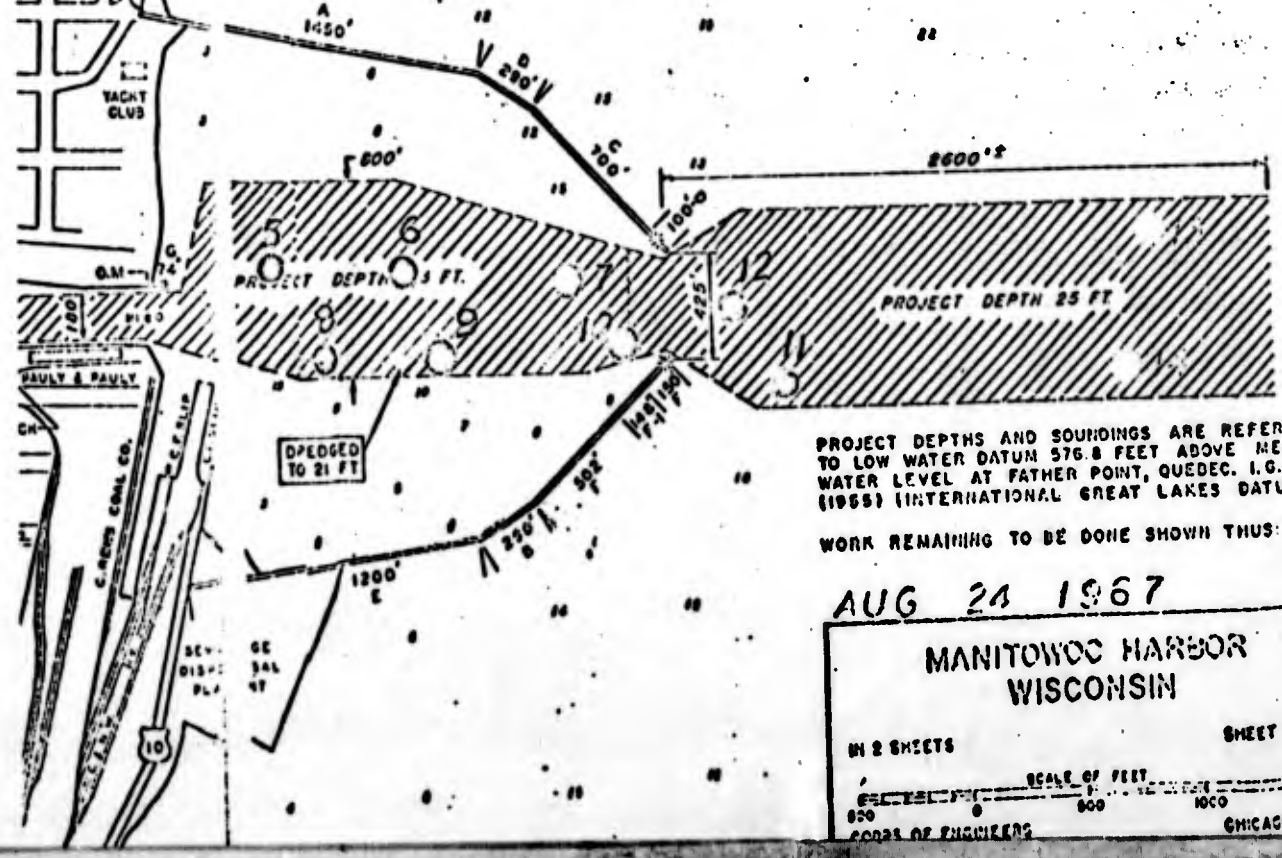
U. S. ARMY

3-14



LAKE

MICHIGAN



PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM 576.8 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC, I.G.L.D. (1955) (INTERNATIONAL GREAT LAKES DATUM)

WORK REMAINING TO BE DONE SHOWN THUS: ▨

AUG 24 1967

MANITOWOC HARBOR
WISCONSIN

IN 2 SHEETS

SHEET NO. 1

SCALE OF FEET

800 0 800 1600 2400

CORPS OF ENGINEERS

CHICAGO, ILL.

MANITOWOC HARBOR - BOTTOM SEDIMENTS - 8/24/67
Results Expressed in mg/kg - Dry Basic

Type of Sample	Bottom Sediments						
Stations	1	2	3	4	5	6	7
Parameter							
% Total Solids	57.3	45.6	51.6	48.6	37.1	62.7	61.1
% Volatile "	19.6	21.0	21.0	21.6	19.1	17.7	13.4
C O D	74,600	111,000	89,325	104,780	57,110	33,200	25,550
Total Soluble Phosphorus	7.42	11.7	12.9	11.3	52.0	16.3	9.65
Total Phosphorus	843	1,157	1,230	1,181	1,170	542	257
NH_3 N	213	350	200	250	350	170	37
NO_3 N	5.1	2.2	3.5	9.7	7.5	1.8	4.9
Org -N	1,907	2,620	247	2,450	1,770	813	1,072
Phenol	0.436	0.547	1.13	4.04	1.40	0.061	0.498
Oil and Grease	14,755	13,020	14,740	17,235	17,990	13,365	10,145
Cyanide	NF	NF	0.10	0.24	NF	NF	NF
Sulfide	25.6	12.9	25.5	75.8	NF	1.2	13.2
Total Iron	6,931	10,023	8,984	9,502	7,053	4,205	3,193
cu	NF	8.7	NF	NF	NF	NF	26.
cd	NF	NF	NF	NF	NF	NF	NF
Ni	NF	NF	NF	NF	NF	NF	41
Zn	24	NF	46	49	48	25	NF
Pb	31	35	69	51	45	14	8.8
Cr	NF	NF	NF	NF	NF	4.4	NF

NF = None Found

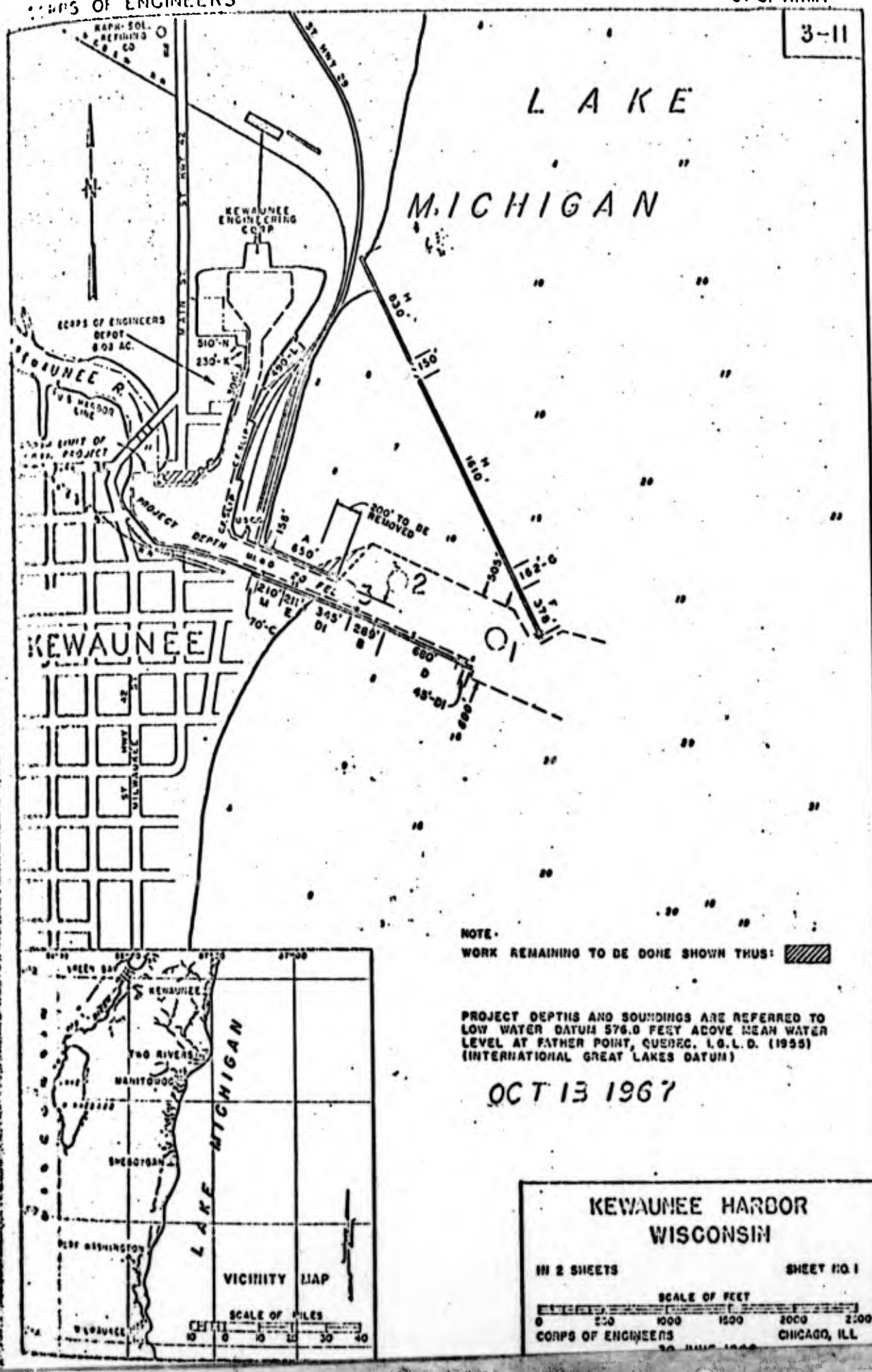
MANITOWOC HARBOR - BOTTOM SEDIMENTS - 8/24/67
Results Expressed in mg/kg - Dry Basic

Type of Sample	Bottom Sediments						
Stations	8	9	10	11	12	14	15
Parameter							Clean Sand
% Total Solids	61.8	47.3	60.3	55.9	62.8	78.9	
% Volatile "	17.2	21.0	16.3	17.6	15.2	9.4	
C O D	24,060	66,800	48,700	57,185	46,165	3,295	
Total Soluble Phosphorus	14.2	23.9	12.6	21.8	6.65	0.840	
Total Phosphorus	567	1,035	550	620	428	154	
NH_3 N	178	423	318	286	212	14	
NO_3 N	3.1	1.7	9.0	3.2	4.6	8.6	
Org -N	1,242	2,317	1,112	1,229	868	181	
Phenol	1.99	3.50	2.16	0.962	0.888	NF	
Oil and Grease	2,645	3,265	2,735	2,675	1,195	360	
Cyanide	NF	NF	NF	NF	NF	NF	
Sulfide	14.9	32.5	9.1	15.0	7.6	4.7	
Total Iron	3,312	2,554	4,294	5,594	4,092	2,113	
cu	NF	NF	NF	NF	NF	12	
cd	NF	NF	NF	NF	NF	NF	
Ni	NF	NF	NF	NF	NF	16	
Zn	NF	NF	NF	NF	NF	NF	
Pb	17	13	20	18	10	23	
Cr	NF	7.1	NF	7.3	NF	6.1	

NF = None Found

...PS OF ENGINEERS U. S. ARMY

3-11



KEWAUNEE HARBOR
WISCONSIN

IN 2 SHEETS SHEET NO. 1

SCALE OF FEET
0 500 1000 1500 2000 2500

CORPS OF ENGINEERS CHICAGO, ILL

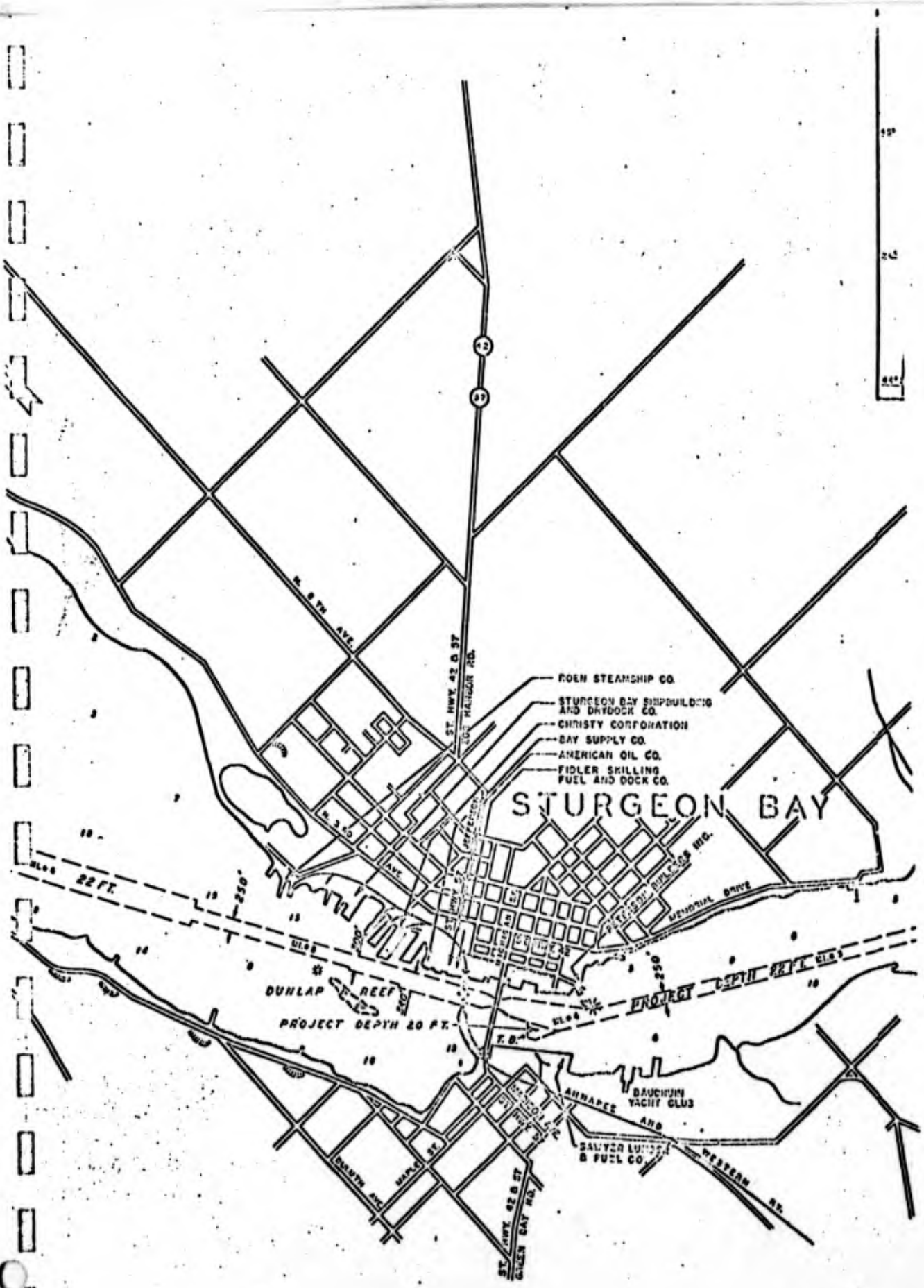
Chicago Program Office, FWPCA

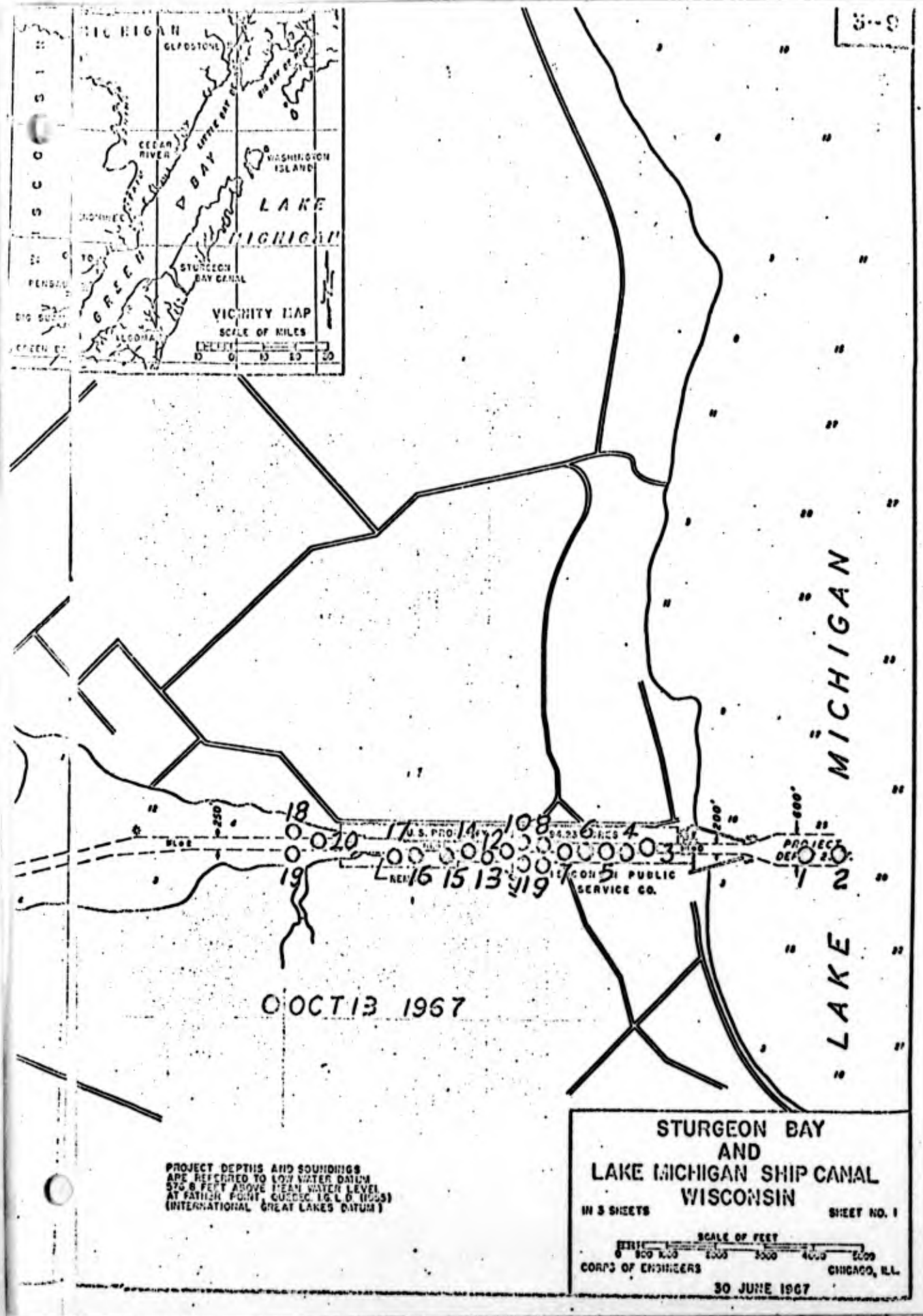
Ref: WIS WL-26B
4/29/68
Chemistry

KEWAUNEE HARBOR-BOTTOM SEDIMENTS
October 12, 1967
Results expressed in mg/kg - Dry basis

Type of Sample	Bottom Sediments		
Station	1	2	3
CPO No.	1004	1005	1006
% Total Solids	45.2	35.8	49.5
% Volatile Solids	11.2	8.1	5.7
COD	127,500	111,095	78,095
T. Sol. Phosphorus	6.38	2.10	9.14
Total Phosphorus	937	2,970	955
NH_3-N	354	238	263
NO_3-N	2.2	2.2	1.8
Org.-N	2,206	2,802	1,957
Phenol	2.68	2.07	2.59
Oil & Grease	2,320	2,440	1,820
Cyanide	NF	0.254	0.283
Sulfide	66	75	239
Total Iron	2,640	26,250	10,190
Cu	*	*	*
Cd	*	*	*
Ni	*	25	*
Zn	*	*	*
Pb	27	*	30
Cr	*	*	*

* Not detected at sensitivity of test


ROEN STEAMSHIP CO.
STURGEON BAY SHIPBUILDING AND DRYDOCK CO.
CHRISTY CORPORATION
BAY SUPPLY CO.
AMERICAN OIL CO.
FIDLER SKILLING FUEL AND DOCK CO.
STURGEON BAY
N. 8TH AVE.
ST. HWY. 42 & 57
GREEN BAY RD.
22 FT.
250'
DUNLAP REEF
PROJECT DEPTH 20 FT.
MEMORIAL DRIVE
BAUCHMAN YACHT CLUB
ANNAPEE AVE
WESTERN AVE.
DUBUQUE AVE.
MAPLE ST.


VICINITY MAP
SCALE OF MILES
0 0 5 10 20
CEDAR RIVER
LITTLE BAY DE NOC
BAY
WASHINGTON ISLAND
LAKE MICHIGAN
STURGEON BAY CANAL
GREEN BAY
ALGOMA
GLADSTONE
U.S. PROJECT
PUBLIC SERVICE CO.
LAKE MICHIGAN
OCT 13 1967
PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM 579.8 FEET ABOVE MEAN WATER LEVEL AT FATISH POINT, QUEBEC (G.L.D. 1955) (INTERNATIONAL GREAT LAKES DATUM)
STURGEON BAY AND LAKE MICHIGAN SHIP CANAL WISCONSIN
IN 3 SHEETS
SHEET NO. 1
SCALE OF FEET
0 500 1000 2000 3000 4000 5000
CORPS OF ENGINEERS
CHICAGO, ILL.
30 JUNE 1967

Chicago Program Office, FWPCA

Ref: WIS WI-26B
4/30/68
Chemistry

STURGEON BAY - BOTTOM SEDIMENTS
Oct. 12-13, 1967
Results expressed in mg/kg - Dry basis

Type of Sample	Bottom Sediments				
Station	1	2	3	4	5
CPO No.	984	985	986	987	988
% Total Solids	59.2	74.2	38.7	35.6	37.3
% Volatile Solids	3.0	1.2	8.6	9.1	8.4
COD	29,765	7,205	106,930	110,680	99,265
Total Sol. Phosphorus	3.49	1.13	3.60	4.43	5.72
Total Phosphorus	289	196	646	778	764
NH_3-N	167	36	687	396	404
NO_3-N	5.6	8.5	12	13	10
Org-N	1,743	180	2,783	3,376	2,770
Phenol	0.021	0.042	0.601	0.522	1.43
Oil & Grease	1,182	438	2,584	2,388	3,619
Cyanide	0.05	0.03	0.08	0.14	0.13
Sulfide	104	38	103	90	123
Total Iron	2,758	2,116	4,868	6,890	7,575
Cu	*	*	*	*	*
Cd	*	*	*	*	*
Ni	*	*	*	*	*
Zn	*	*	*	*	*
Pb **	11	8.6	44	37	26
Cr	*	*	*	*	*

* Not detected at sensitivity of test

** Lead analyzed by polarographic techniques and by atomic absorption

Chicago Program Office, FWPCA

Ref: WIS WI-26D
4/30/68
Chemistry

STURGEON BAY - BOTTOM SEDIMENTS
Oct. 12-13, 1967
Results expressed in mg/kg - Dry basis

Type of Sample	Bottom Sediments				
Station	6	7	8	9	10
CPO No.	989	990	991	992	993
% Total Solids	32.0	30.8	36.7	26.7	36.6
% Volatile Solids	10.0	9.6	9.2	10.0	6.8
COD	115,705	138,215	138,655	155,000	121,720
Total Sol. Phosphorus	8.63	25.3	4.29	32.0	6.02
Total Phosphorus	754	840	753	1,025	731
NH_3-N	589	520	145	694	245
NO_3-N	5.3	11	16	25	13
Org-N	3,733	4,188	3,806	4,046	3,572
Phenol	0.088	2.39	1.45	2.11	3.99
Oil & Grease	4,940	4,773	136	5,112	3,689
Cyanide	0.16	0.16	0.14	0.07	0.33
Sulfide	175	428	250	416	174
Total Iron	7,066	5,708	8,387	9,408	7,721
Cu	*	*	*	*	*
Cd	*	*	*	*	*
Ni	*	*	*	*	*
Zn	*	*	*	*	*
Pb **	30	49	26	49	36
Cr	*	*	*	*	*

* Not detected at sensitivity of test
** Lead analyzed by polarographic techniques and by atomic absorption

Chicago Program Office, FWPCA

Ref: WIS WI-268
4/30/68
Chemistry

STURGEON BAY - BOTTOM SEDIMENTS
Oct. 12-13, 1967
Results expressed in mg/kg - Dry basis

Type of Sample	Bottom Sediments				
Station	11	12	13	14	15
CPO No.	994	995	996	997	998
% Total Solids	27.4	29.2	28.2	27.5	25.6
% Volatile Solids	11.3	9.3	27.4	9.6	11.8
COD	179,210	150,000	169,215	176,400	163,970
Total Sol. Phosphorus	21.3	14.0	18.2	13.6	22.0
Total Phosphorus	976	796	948	1,131	1,011
NH_3-N	598	411	745	471	707
NO_3-N	7.3	6.8	2.4	20	20
Org-N	5,081	4,555	5,340	4,656	4,902
Phenol	2.63	3.17	2.05	3.02	1.22
Oil & Grease	3,923	3,596	6,418	6,618	5,977
Cyanide	0.18	0.17	0.28	0.29	0.20
Sulfide	467	404	333	364	238
Total Iron	10,088	9,678	8,908	11,876	10,547
Cu	*	*	*	*	*
Cd	*	*	*	*	*
Ni	*	*	34	*	*
Zn	*	*	*	*	*
Pb**	44	48	67	29	43
Cr	*	*	*	*	*

* Not detected at sensitivity of test
** Lead analyzed by polarographic techniques and by atomic absorption

Chicago Program Office, FWPCA

Ref: WIS WL-26B
4/30/68
Chemistry

STURGEON BAY - BOTTOM SEDIMENTS
Oct. 12-13, 1967
Results expressed in mg/kg - Dry basis

Type of Sample	Bottom Sediments				
Station	16	17	18	19	20
CPO No.	999	1,000	1,001	1,002	1,003
% Total Solids	25.3	26.1	25.6	25.5	26.6
% Volatile Solids	10.7	10.6	26.6	26.7	26.2
COD	176,085	160,000	181,760	194,895	174,925
Total Sol. Phosphorus	10.1	10.9	14.1	12.8	11.2
Total Phosphorus	919	936	1,113	980	1,104
NH_3-N	474	571	484	642	523
NO_3-N	25	11	13	23	15
Org-N	5,834	4,989	4,762	5,201	5,526
Phenol	2.29	3.06	3.37	2.52	3.00
Oil & Grease	4,269	5,575	3,906	4,686	4,286
Cyanide	0.20	0.19	0.31	0.27	0.30
Sulfide	296	226	434	318	417
Total Iron	12,166	11,548	12,266	10,588	9,444
Cu	*	*	*	*	*
Cd	*	*	*	*	*
Ni	*	*	*	*	*
Zn	*	*	*	*	*
Pb **	63	61	59	59	53
Cr	*	*	*	*	*

* Not detected at sensitivity of test
** Lead analyzed by polarographic techniques and by atomic absorption

DREDGING AND WATER QUALITY PROBLEMS

IN

THE GREAT LAKES

APPENDIX B4

Detroit District Sampling Data.

Harrisville Harbor, Mich.
Hammond Bay Harbor, "
Inland Route, "
White Fish Point, "
Little Lake Harbor, "
Grand Marais Harbor, "
Charlevoix Harbor, "
Traverse City Harbor, "
Leland Harbor, "
Portage Lake Harbor, "
Clinton River, "
Black River, "
Port Sanilac Harbor, "
Port Austin Harbor, "
Caseville Harbor, "
Bayport Harbor, "
Sebewaing River, "
Port Clinton Harbor, Ohio
Bolles Harbor, Mich.
Monroe Harbor, Mich.

THE DETROIT TESTING LABORATORY, INC.

DEPARTMENT OF THE ARMY

DETROIT DISTRICT, CORPS OF ENGINEERS

P. O. Box 1027

DETROIT, MICHIGAN 48231

Attn: Mr. Frank Dzwonkiewicz

DTL #709110A

CONTRACT # DACW-35-68-C-0008

Work Requested:

The client requested that the DETROIT TESTING LABORATORY obtain bottom sediment samples from various locations in Michigan and Ohio.

Perform the following tests on the sample obtained:

1. % Passing #20 Sieve
2. Identify Residue
3. Total Coliform
4. Total and Volatile Solids
5. Total Phosphates
6. Total Nitrogen as:
   - A. NO_3 Nitrate
   - B. NO_2 Nitrite
   - C. NH_3 Ammonia
   - D. Organic
7. Immediate Dissolved Oxygen
8. Chemical Oxygen Demand

DESCRIPTION OF SAMPLING LOCATIONS

1.	Harrisville in front of marina	9 1/2 ft.
2.	Harrisville 50 yds off breakwater	13 "
3.	Hammond Bay diagonal from wall to ramp	11 "
4.	Hammond Bay end of East Breakwall	13 "
5.	Inland Route, Outlet of Mullet Lake, past Gulf Marina	8 "
6.	Inland Route, Burt Lake inlet halfway between markers #71 & 73	4 1/2 "
7.	Inland Route, Burt Lake outlet mouth	6 1/2 "
8.	Inland Route, Downstream from I-75 Bridge near marker #58	7 1/2 "
9.	Inland Route, Hay Lake 1/3 down from mouth	4 1/2 "
10.	Inland Route, Crooked Lake off of Oden Island between marker #85 & 87	4 1/2 "
11.	White Fish Point, 25 yds from breakwall in front of fishery	13 "
12.	White Fish Point, end of north breakwall	12 "
13.	Little Lake, end of north breakwall	8 "
14.	Little Lake, inner mouth of Little Lake inlet	12 "
15.	Grand Marais, mouth of inlet to Lake Superior	18 "
16.	Grand Marais mouth of inlet to west Bay	"
17.	Charlevoix inlet at mouth of Round Lake	18 "
18.	Charlevoix inlet at mouth of Lake Michigan	20 "
19.	Traverse City at mouth of Breakwater	18 "
20.	Traverse City Halfway between breakwwater and marina	13 "
21.	Leland, North end of harbor near breakwall	14 "

	Depth	
22. Leland, mouth of stream in harbor	8	ft.
23. Portage Lake inlet to Portage Lake mouth	14	"
24. Portage Lake inlet to Portage Lake mouth	14	"
25. Clinton River mouth at Lake St. Clair	9	"
26. Clinton River at bend in river downstream from island	12	"
27. Clinton River at Jefferson Avenue Bridge	10	"
28. Clinton River south road bend	10	"
29. Clinton near ft. of Irwin St.	8	"
30. Clinton at Dickinson Avenue Bridge	9	"
31. Black River, Port Huron near Grand Trunk RR	12	"
32. Black River, Port Huron near foot of Washington St.	8	"
33. Port Sanilac in middle of harbor in front of marina	11	"
34. Port Sanilac at mouth of harbor	13	"
35. Port Austin just out in front of stream mouth	11	"
36. Port Austin end of breakwall		
37. Caseville in River just before breakwall		
38. Caseville, at end of breakwall	11	"
39. Bayport Station #10	6 1/2	"
40. Bayport Station #50	6 1/2	"
41. Sebewaing near Railroad Bridge, approx. 3/4 from mouth	8	"

	Depth	
42. Sebewaing 3/8 mile from mouth	9	Ft.
43. Sebewaing at mouth of river	7	"
44. Port Clinton at foot of Madison St.	15	"
45. Port Clinton at mouth of river	18	"
46. Bolles Harbor near Ashland marina in stream	10	"
47. Bolles Harbor near end of earth breakwater		

Sample #	Coliform (org/cm)	C. O. D. (mg/l)
1	95	7.1
2	84	6.2
3	348	10.8
4	16	1.3
5	0	2.0
6	840	6.5
7	0	1.8
8	784	12.5
9	122	8.5
10	1264	55.5
11	0	3.1
12	4	2.5
13	0	2.5
14	0	0
15	0	0
16	0	1.8
17	80	4.6
18	100	5.0
19	170	6.5
20	20	3.2

Sample #	Coliform (org/cm)	C. O. D. (mg/l)
21	1580	61.8
22	900	10.3
23	130	6.5
24	90	4.8
25	50	2.5
26	220	6.5
27	190	8.3
28	660	15.6
29	35	8.3
30	15	5.5
31	15	6.8
32	25	4.2
33	485	16.3
34	60	8.8
35	0	4.6
36	15	4.5
37	305	12.2
38	515	21.8
39	155	16.3
40	35	10.1

Sample #	Coliform (org/cm)	C. O. D. (mg/l)
41	0	2.8
42	15	4.2
43	30	6.2
44	78	8.5
45	109	8.5
46	10	2.8
47	21	4.1

Results: (continued)

Sample #	Total Phosphate wet basis mg/g	Nitrite wet basis mg/g	Nitrate wet basis mg/g
1	.025	.0003	.0005
2	.015	.0007	.0008
3	.045	.0006	.0004
4	.020	.0006	.0004
5	.022	.0006	.0004
6	.012	.0007	.0008
7	.011	.0009	.0005
8	.049	.0006	.0003
9	.067	.0007	.0007
10	.025	.0008	.0001
11	.012	.0006	.0008
12	.009	.0006	.0010
13	.023	.0003	.0008
14	.016	.0003	.0007
15	.034	.0002	.0008
16	.022	.0002	.0034
17	.014	.0003	.0019
18	.012	.0003	.0027
19	.006	.0002	.0002
20	.004	.0001	.0002

Results: (continued)

Sample #	Total Phosphate wet basis mg/g	Nitrite/N wet basis mg/g	Nitrate/N wet basis mg/g
21	.002	.0007	.0003
22	.029	.0004	.0004
23	.007	.0001	.0003
24	.008	.0004	.0003
25	.272	.002	.0006
26	.323	.002	.0005
27	.368	.002	.0001
28	.357	.002	.0001
29	.248	.002	.0011
30	.268	.002	.0004
31	.025	.0014	.0002
32	.020	.0002	.0008
33	.020	.0003	.0004
34	.023	.0003	.0007
35	.024	.0003	.0007
36	.032	.0003	.0005
37	.180	.0008	.0004
38	.030	.0005	.0003
39	.061	.0005	.0008
40	.022	.0006	.0007

Results: (continued)

Sample #	Total Phosphate wet basis mg/g	Nitrite /N wet basis mg/g	Nitrate /N wet basis mg/g
41	.027	.0005	.0002
42	.012	.0005	.0005
43	.014	.0008	.0009
44	.006	.0005	.0006
45	.013	.0005	.0006
46	.012	.0005	.0009
47	.009	.0005	.0009

Results: (continued)

Sample #	Volatile Solids (Dry Basis) Loss %	Nitrogen Ammonia (Wet Basis) mg/g	Nitrogen Organic (Wet Basis) mg/g
1	16.7	0.098	1.07
2	4.34	0.0364	0.193
3	23.7	0.0728	0.667
4	8.9	---	0.048
5	35.0	0.0196	0.078
6	36.7	0.0308	1.20
7	4.00	0.0154	0.388
8	4.85	0.0336	0.260
9	41.5	0.0308	1.20
10	23.5	0.0308	0.669
11	1.55	0.0364	0.370
12	5.06	0.014	0.586
13	0.182	0.007	0.066
14	0.223	0.014	0.042
15	0.233	---	0.132
16	0.314	---	0.048
17	5.93	0.0098	0.141
18	3.25	---	0.039
19	6.87	0.0154	0.201
20	24.1	0.035	0.771

Results: (continued)

Sample #	Volatile Solids (Dry Basis) Loss %	Nitrogen Ammonia (Wet Basis) mg/g	Nitrogen Organic (Wet Basis) mg/g
21	21.8	0.014	0.314
22	3.50	0.0210	0.182
23	1.50	0.007	0.188
24	1.22	0.007	0.105
25	11.3	0.070	0.97
26	17.5	0.074	0.80
27	17.0	0.108	1.15
28	17.0	0.108	1.01
29	17.2	0.140	1.16
30	13.3	0.162	1.20
31	14.0	0.143	0.93
32	2.94	---	0.180
33	12.4	0.087	0.109
34	8.5	---	0.092
35	3.12	---	0.308
36	4.30	---	0.014
37	11.2	0.042	0.272
38	4.25	0.022	0.292
39	23.6	0.031	0.96
40	5.75	0.028	0.650
41	5.85	0.014	0.406

Results: (continued)

Sample #	Volatile Solids (Dry Basis) Loss %	Nitrogen Ammonia (Wet Basis) mg/g	Nitrogen Organic (Wet Basis) mg/g
42	15.2	0.042	0.392
43	22.2	0.062	1.19
44	10.8	0.028	1.03
45	11.4	0.028	0.94
46	13.8	0.084	1.03
47	14.6	0.028	0.84

Sample #	SiO_2	FeO	Al_2O_3	CaO	MgO	K_2O & Na2 O
1	50 - 60%	1.40	6.00	9.2	4.5	1.5
2	" "	0.40	2.0	5.0	2.0	1.5
3	" "	1.40	5.50	10.00	4.0	1.5
4	" "	0.50	2.0	8.0	2.00	1.5
5	" "	1.5	4.50	10.5	4.00	1.5
6	" "	0.4	4.50	10.5	4.00	1.5
7	" "	0.5	6.50	6.0	1.5	1.5
8	" "	0.5	6.50	11.0	3.0	1.5
9	" "	0.5	2.50	11.0	2.0	1.5
10	" "	0.5	5.50	10.0	4.0	1.5
11	94.00	0.3	3.00	0.30	0.15	2.5
12	94.00	0.3	3.00	0.30	0.15	0.1
13	94.00	0.3	3.00	0.25	0.15	0.1
14	95.00	0.50	2.00	0.25	0.15	1.70
15	93.00	0.50	2.50	1.00	0.15	2.20
16	91.00	0.50	3.00	1.50	0.25	2.20
17	85.00	0.50	5.00	5.50	2.00	2.50
18	89.00	0.50	3.50	5.00	0.25	1.70
19	85.00	0.40	5.00	6.00	1.00	2.00
20	84.00	1.00	6.00	6.00	0.40	2.50

Sample #	SiO_2	FeO	Al_2O_3	CaO	MgO	K_2O & Na_2O
21	87.00	1.00	2.50	6.00	0.40	2.50
22	88.00	0.50	5.00	4.50	0.40	2.50
23	89.00	1.50	2.00	5.00	0.40	2.00
24	95.00	0.50	2.00	0.25	0.25	2.50
25	50 - 60	3.00	10.00	5.00	3.50	2.00
26	" "	1.50	8.00	3.50	2.15	3.00
27	" "	4.50	12.00	7.00	3.25	2.50
28	" "	4.60	12.50	5.50	3.00	2.50
29	" "	4.50	12.00	6.00	3.00	2.50
30	" "	4.50	12.00	6.00	3.00	2.50
31	" "	4.50	12.00	6.00	3.00	2.50
32	" "	4.50	10.00	6.00	2.50	2.50
33	" "	2.00	5.50	5.00	3.00	3.00
34	" "	1.50	6.00	5.00	3.00	2.75
35	" "	1.50	5.00	10.00	2.80	2.90
36	" "	1.50	6.00	5.50	3.00	3.00
37	" "	1.50	5.50	6.00	2.75	2.50
38	" "	1.50	6.00	4.50	3.00	2.75
39	" "	3.00	11.00	4.00	4.50	3.00
40	" "	1.50	5.50	11.00	2.50	3.00

Sample #	SiO_2	FeO	Al_2O_3	CaO	MgO	K_2O & Na_2O
41	50 - 60	1.50	5.50	4.00	3.00	3.00
42	" "	2.50	9.00	8.00	4.00	3.00
43	" "	2.50	12.00	10.00	4.25	3.00
44	" "	2.50	12.00	10.00	4.25	3.00
45	" "	3.00	12.00	10.00	4.25	3.00
46	" "	2.50	12.00	6.00	3.50	3.00
47	" "	2.50	11.00	10.00	3.50	3.00

Sample #	D. O. ppm	Sample #	D. O. ppm
1	7.60	22	9.41
2	7.80	23	7.54
3	8.10	24	7.54
4	8.10	25	8.96
5	7.90	26	6.96
6	7.80	27	8.30
7	8.40	28	7.63
8	8.60	29	7.18
9	8.33	30	7.63
10	8.00	31	8.66
11	9.14	32	9.12
12	9.03	33	9.51
13	7.99	34	9.60
14	7.77	35	8.84
15	8.24	36	8.82
16	8.24	37	8.60
17	7.48	38	9.10
18	7.48	39	9.07
19		40	9.04
20		41	8.95
21	9.41	42	8.92
		43	8.81

Sample #	D. O. ppm	Sample #	D. O. ppm
44	9.35	46	9.13
45	9.57	47	9.92

Sample #	% Passing #20 Sieve	Sample #	% Passing #20 Sieve
1	100.00	22	96.00
2	98.57	23	97.39
3	93.46	24	99.05
4	71.93	25	100.00
5	89.53	26	100.00
6	100.00	27	100.00
7	100.00	28	100.00
8	93.77	29	100.00
9	100.00	30	100.00
10	100.00	31	100.00
11	100.00	32	89.05
12	98.20	33	100.00
13	99.56	34	64.43
14	97.21	35	100.00
15	97.67	36	35.03
16	90.54	37	84.84
17	67.40	38	98.95
18	77.76	39	100.00
19	97.52	40	100.00
20	97.95	41	94.20
21	98.02	42	100.00

Sample #	% Passing #20 Sieve	% T.S.	Sample #	% Passing #20 Sieve
43	100.00		44	97.53
44.		89.2		
45	98.39	88.6	46	100.00
47	100.00			

Sample #	SiO_2	FeO	Al_2O_3	CaO	MgO	K_2O & Na_2O
41	50 - 60	1.50	5.50	4.00	3.00	3.00
42	" "	2.50	9.00	8.00	4.00	3.00
43	" "	2.50	12.00	10.00	4.25	3.00
44	" "	2.50	12.00	10.00	4.25	3.00
45	" "	3.00	12.00	10.00	4.25	3.00
46	" "	2.50	12.00	6.00	3.50	3.00
47	" "	2.50	11.00	10.00	3.50	3.00

Note: The results reported for the identification of the residue are semi-quantitative only, therefore, in many cases the total amount of all components including loss on ignition may be below or exceed 100.00%.

THE DETROIT TESTING LABORATORY, INC.

Caulton Ray, Jr.
Mgr. Chemistry Dept.

CR:rw

Additional Sampling Data
Port Clinton Harbor, Ohio
Mud Samples-18 July 1968[a]

Station	Depth (ft)	Temp °C	COD	Total Fe	Oil and Grease	% Solids	Volatile Solids	Kjedahl Nitrogen
48	11	22.5	9.40	10.6	1.08	71.27	29.54	.84
49	11	24.5	12.44	16.6	7.36	59.27	51.11	1.75
50	14	25.5	6.78	12.7	.89	67.82	33.17	.82
51	15	26.0	13.98	14.0	1.03	55.54	57.57	1.87

a Parameters reported as mg /g unless otherwise noted

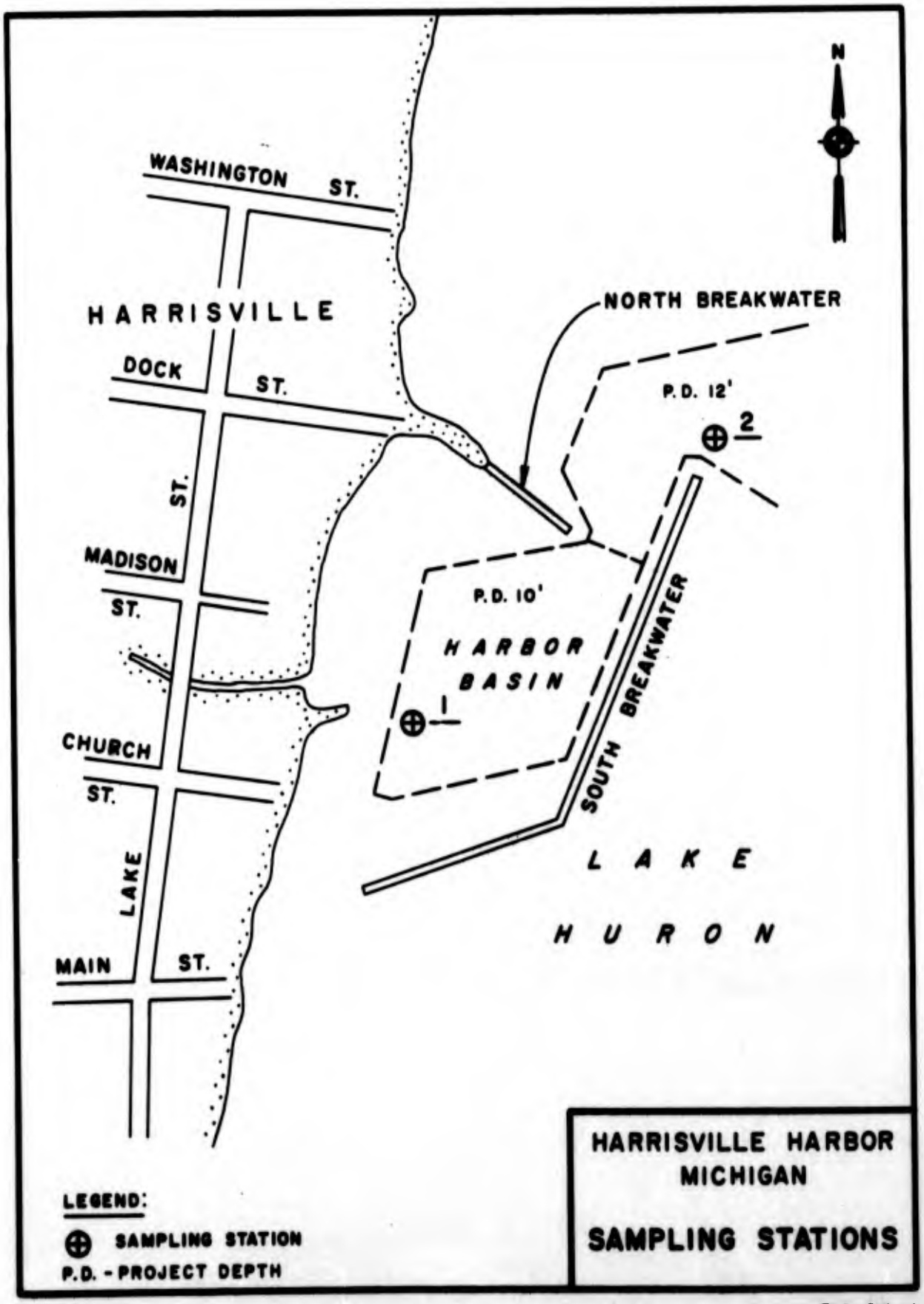

N
WASHINGTON ST.
HARRISVILLE
DOCK ST.
ST.
MADISON ST.
CHURCH ST.
LAKE ST.
MAIN ST.
NORTH BREAKWATER
P.D. 12'
2
P.D. 10'
HARBOR BASIN
1
SOUTH BREAKWATER
LAKE HURON
LEGEND:
SAMPLING STATION
P.D. - PROJECT DEPTH
HARRISVILLE HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-1

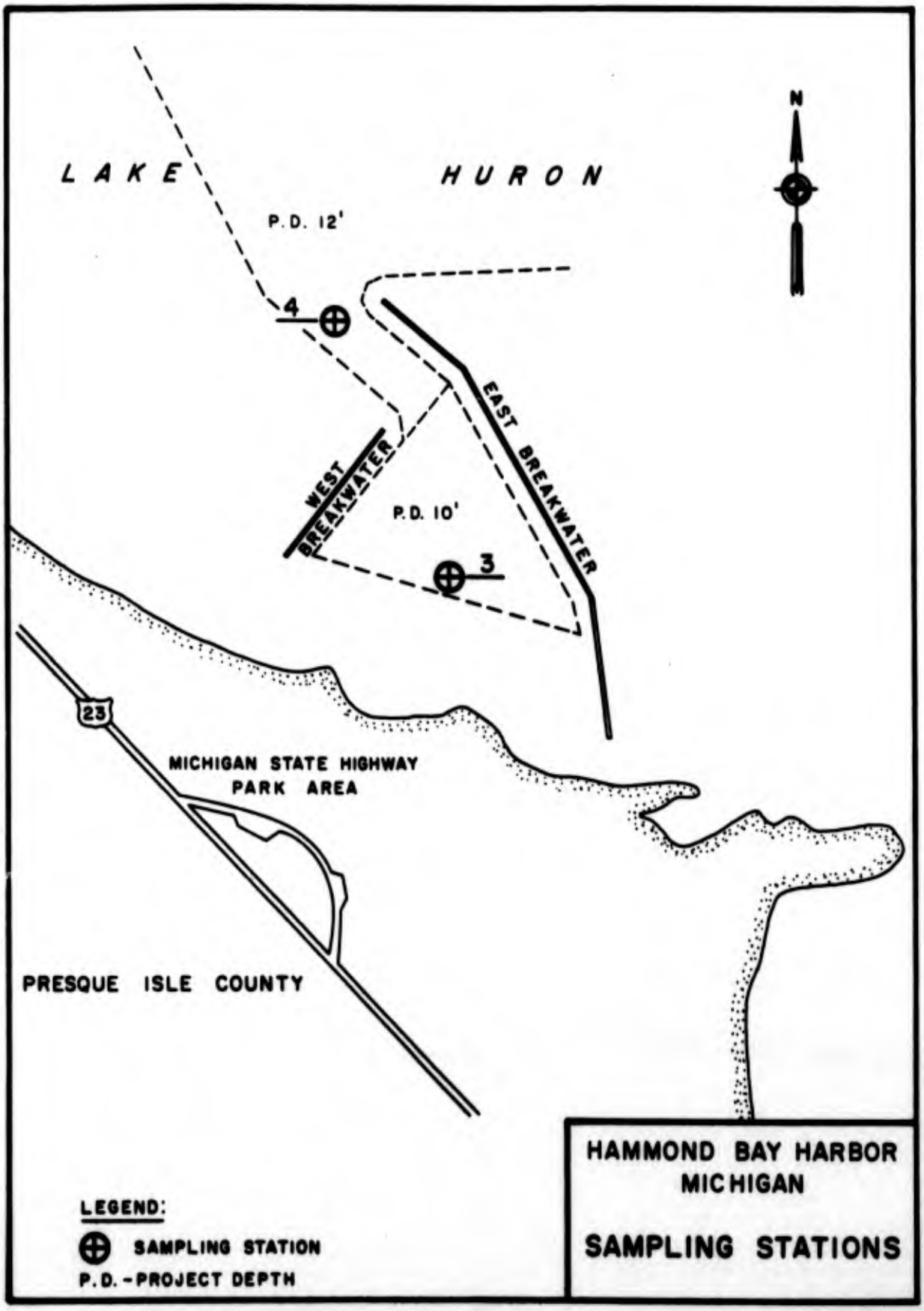

LAKE HURON
N
P.D. 12'
4
EAST BREAKWATER
WEST BREAKWATER
P.D. 10'
3
23
MICHIGAN STATE HIGHWAY
PARK AREA
PRESQUE ISLE COUNTY
LEGEND:
SAMPLING STATION
P.D. - PROJECT DEPTH
HAMMOND BAY HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-2

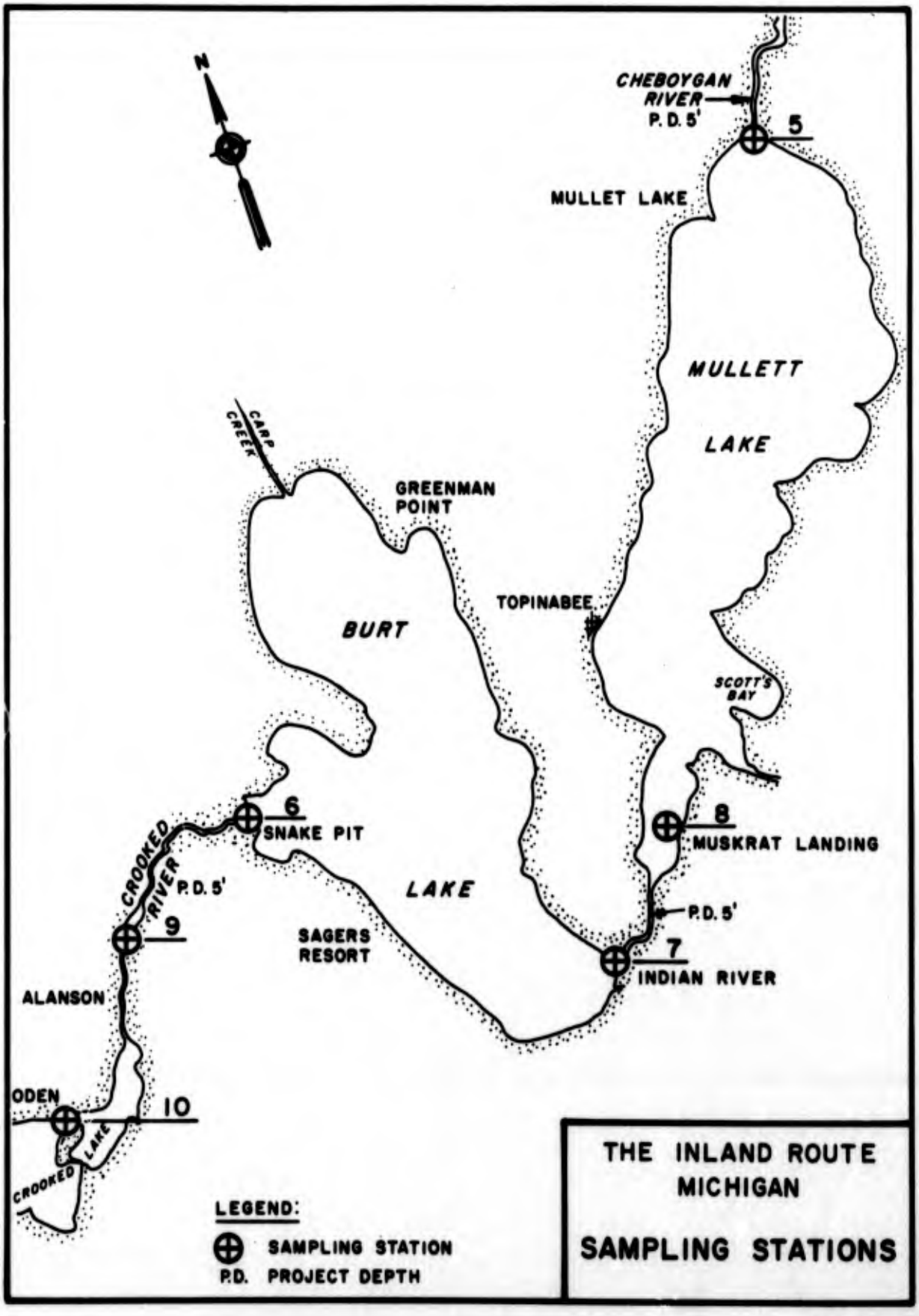

N
CHEBOYGAN RIVER
P.D. 5'
5
MULLET LAKE
MULLETT LAKE
CARP CREEK
GREENMAN POINT
TOPINABEE
BURT
SCOTT'S BAY
6
SNAKE PIT
8
MUSKRAT LANDING
CROOKED RIVER
P.D. 5'
LAKE
P.D. 5'
9
SAGERS RESORT
7
INDIAN RIVER
ALANSON
ODEN
10
CROOKED LAKE
LEGEND:
SAMPLING STATION
P.D. PROJECT DEPTH
THE INLAND ROUTE
MICHIGAN
SAMPLING STATIONS

FIG. B4-3

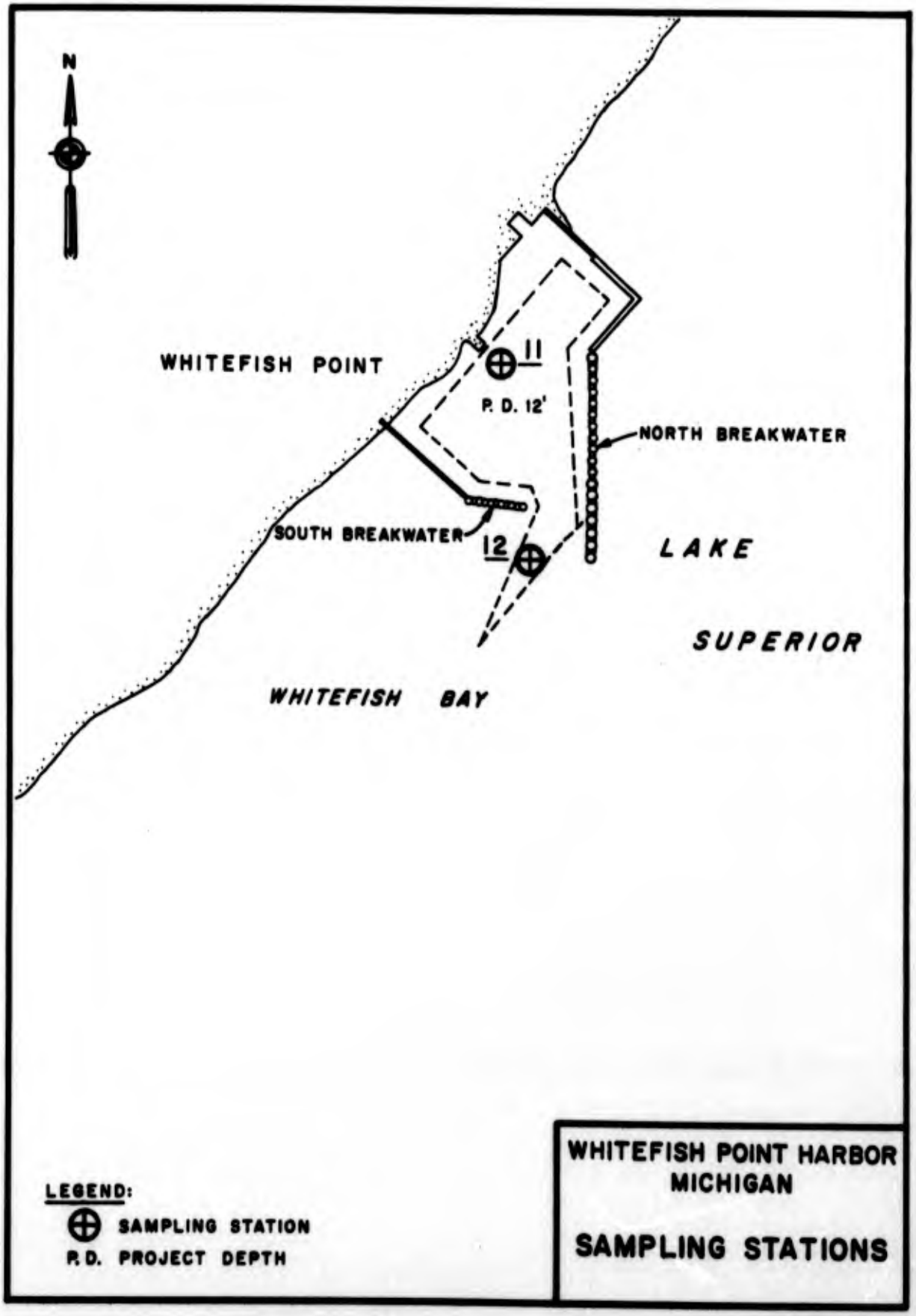

N
WHITEFISH POINT
11
P. D. 12'
NORTH BREAKWATER
SOUTH BREAKWATER
12
LAKE
SUPERIOR
WHITEFISH BAY
LEGEND:
SAMPLING STATION
P.D. PROJECT DEPTH
WHITEFISH POINT HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-4

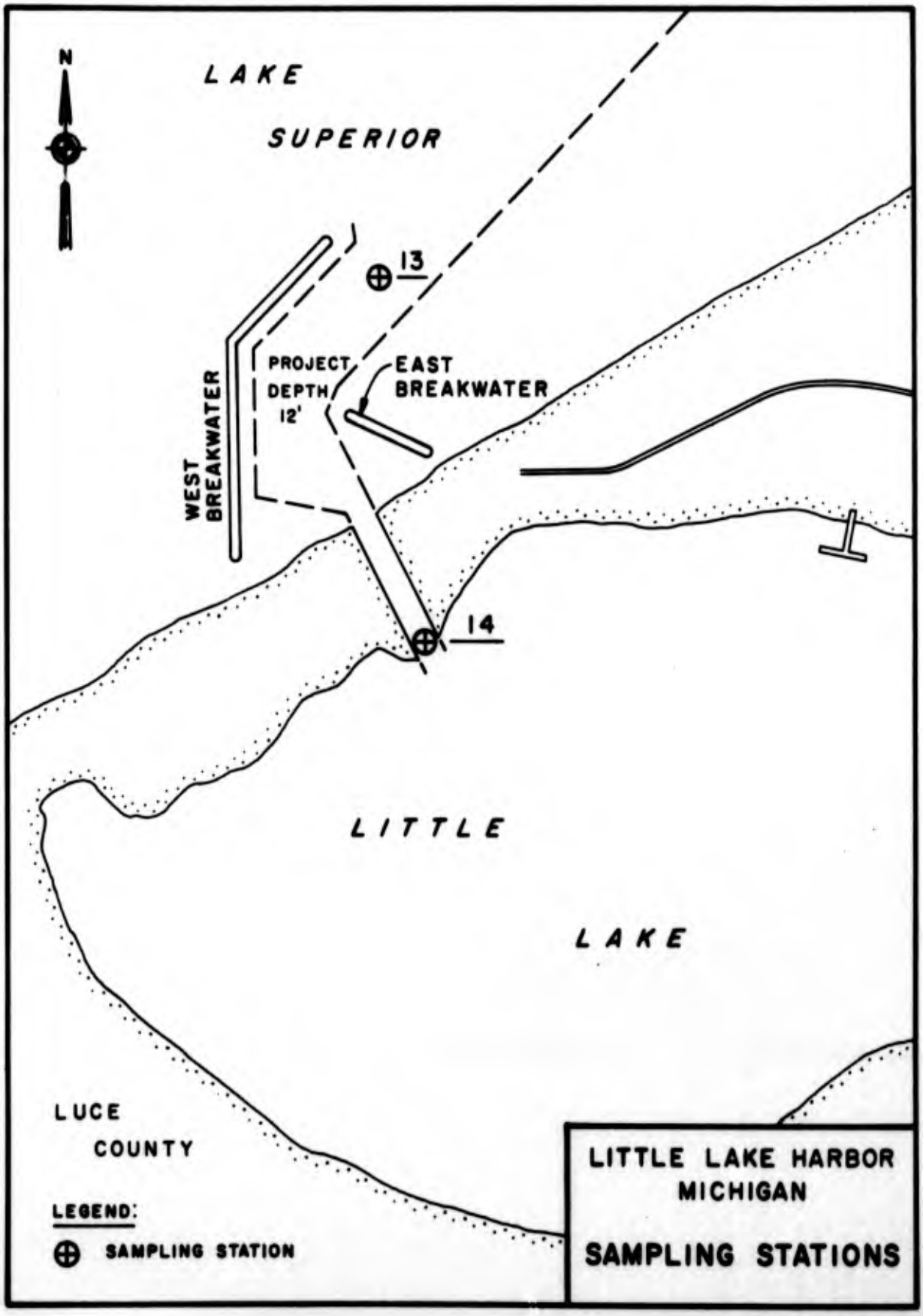

N
LAKE
SUPERIOR
13
PROJECT
DEPTH
12'
EAST
BREAKWATER
WEST
BREAKWATER
14
LITTLE
LAKE
LUCE
COUNTY
LEGEND:
SAMPLING STATION
LITTLE LAKE HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-5

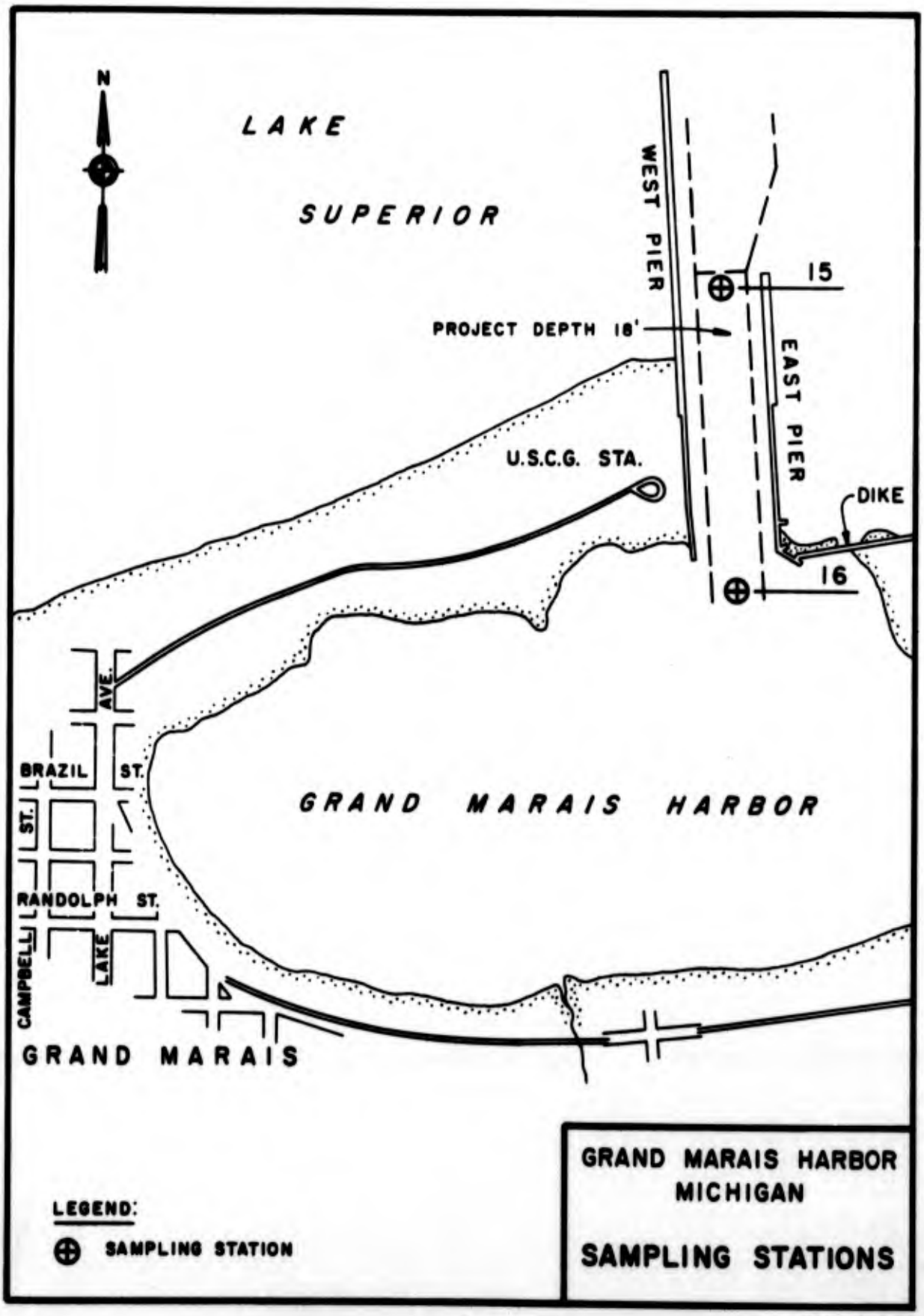

N
LAKE
SUPERIOR
WEST PIER
15
PROJECT DEPTH 18'
EAST PIER
U.S.C.G. STA.
DIKE
16
AVE.
BRAZIL
ST.
ST.
GRAND MARAIS HARBOR
RANDOLPH ST.
CAMPBELL
LAKE
GRAND MARAIS
LEGEND:
SAMPLING STATION
GRAND MARAIS HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-6

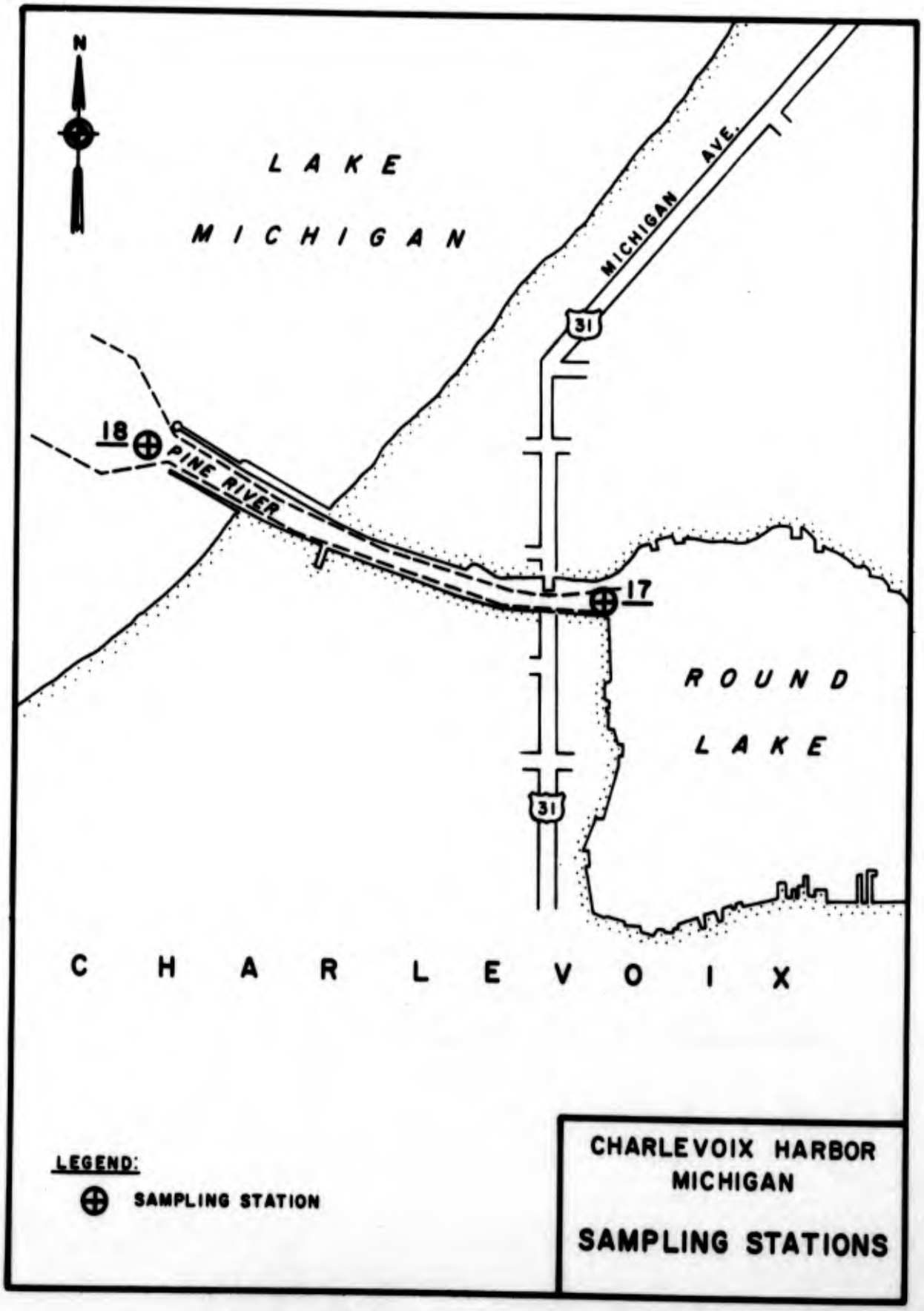

N
LAKE
MICHIGAN
MICHIGAN AVE.
31
18
PINE RIVER
17
ROUND
LAKE
31
CHARLEVOIX
LEGEND:
SAMPLING STATION
CHARLEVOIX HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-7

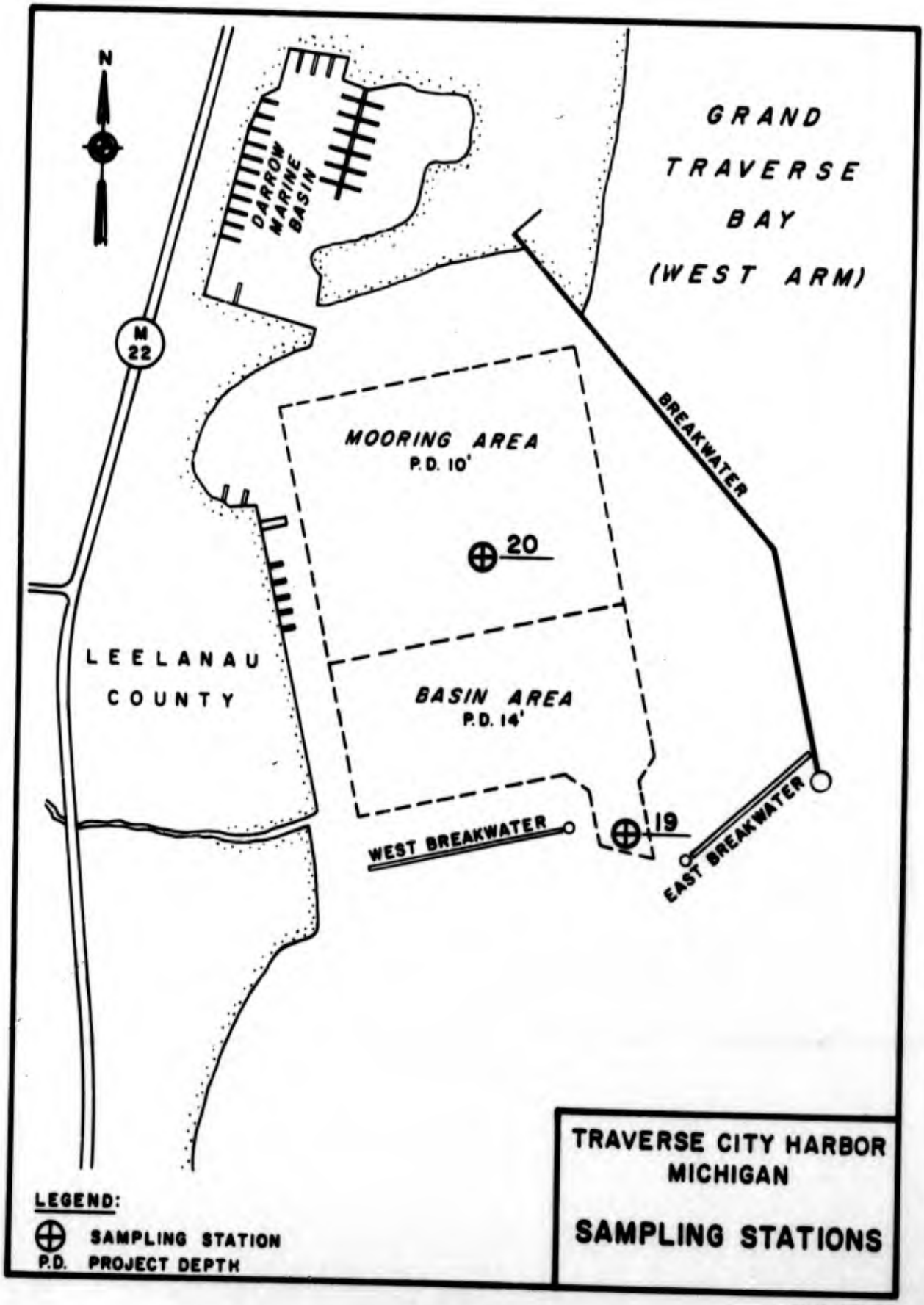

N
DARROW MARINE BASIN
GRAND TRAVERSE BAY (WEST ARM)
M 22
MOORING AREA
P.D. 10'
20
BREAKWATER
LEELANAU COUNTY
BASIN AREA
P.D. 14'
WEST BREAKWATER
19
EAST BREAKWATER
LEGEND:
SAMPLING STATION
P.D. PROJECT DEPTH
TRAVERSE CITY HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-8

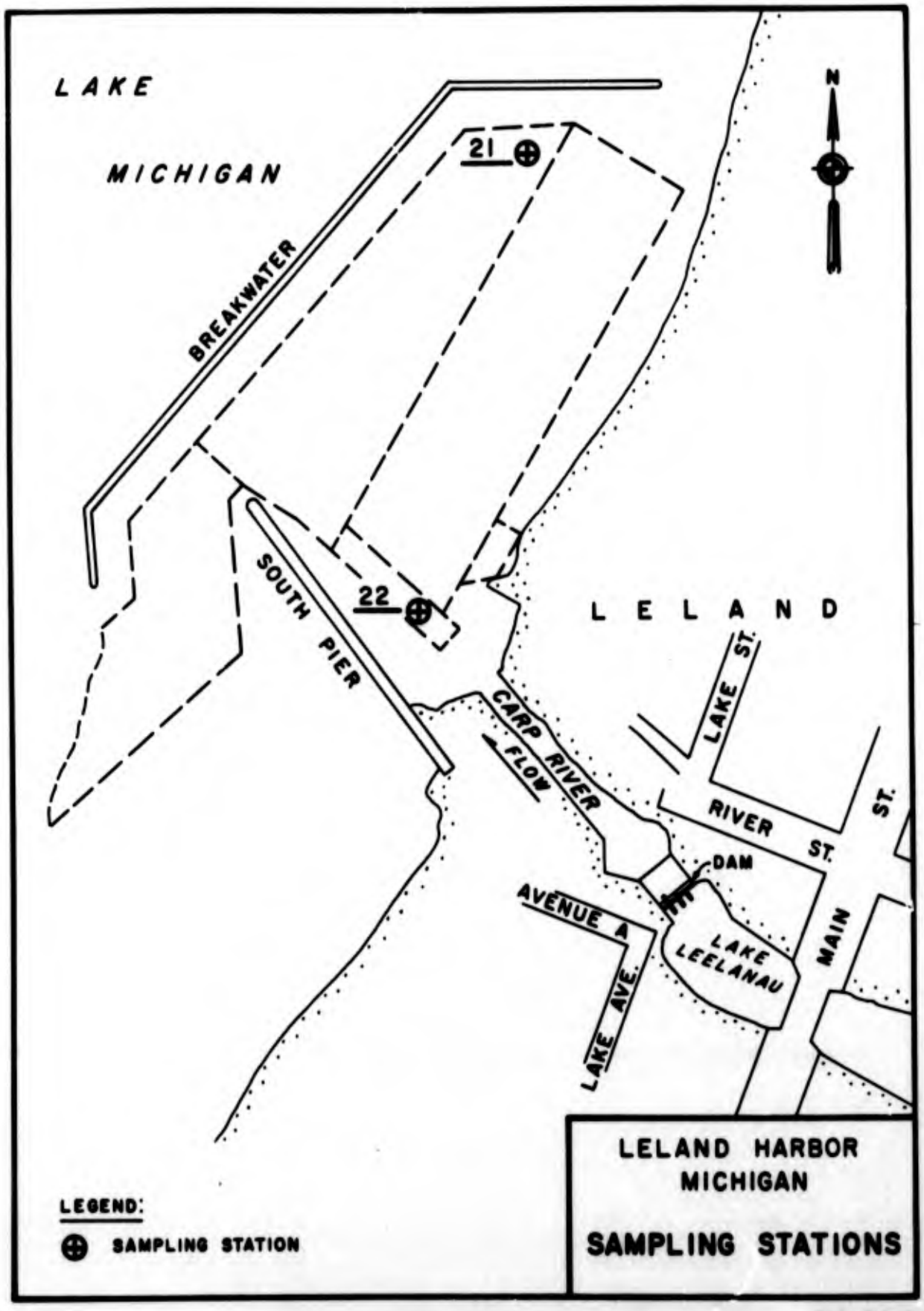

LAKE
MICHIGAN
21
BREAKWATER
22
SOUTH PIER
L E L A N D
LAKE ST.
CARP RIVER
FLOW
RIVER ST.
DAM
AVENUE A
LAKE AVE.
LAKE LEELANAU
MAIN
N
LEGEND:
SAMPLING STATION
LELAND HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-9

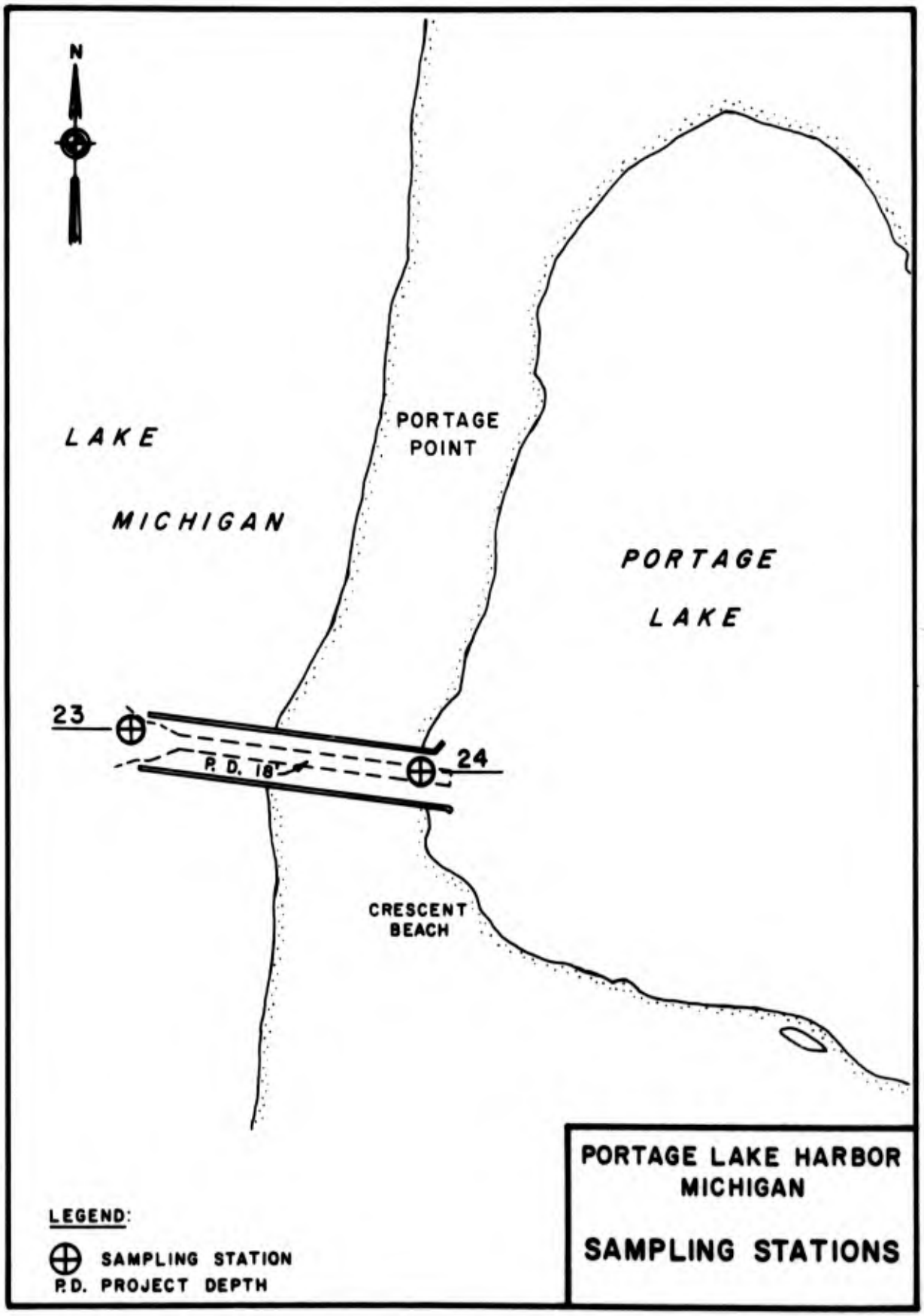

N
LAKE
MICHIGAN
PORTAGE
POINT
PORTAGE
LAKE
23
24
P. D. 18
CRESCENT
BEACH
LEGEND:
SAMPLING STATION
P.D. PROJECT DEPTH
PORTAGE LAKE HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-10

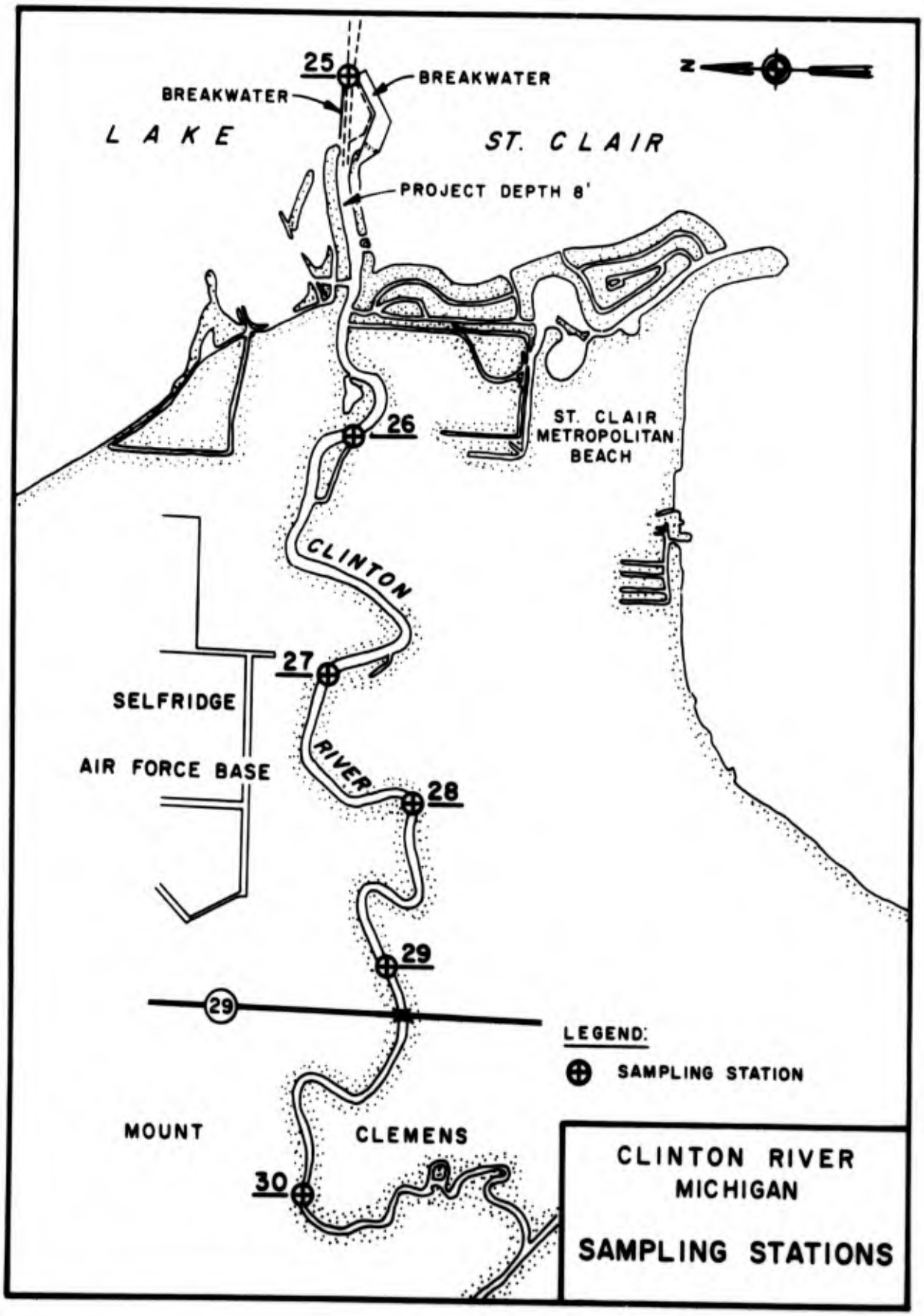

25
BREAKWATER
BREAKWATER
LAKE
ST. CLAIR
PROJECT DEPTH 8'
N
26
ST. CLAIR
METROPOLITAN
BEACH
CLINTON
27
SELFRIDGE
AIR FORCE BASE
RIVER
28
29
29
LEGEND:
SAMPLING STATION
MOUNT
CLEMENS
30
CLINTON RIVER
MICHIGAN
SAMPLING STATIONS

FIG. B4-11

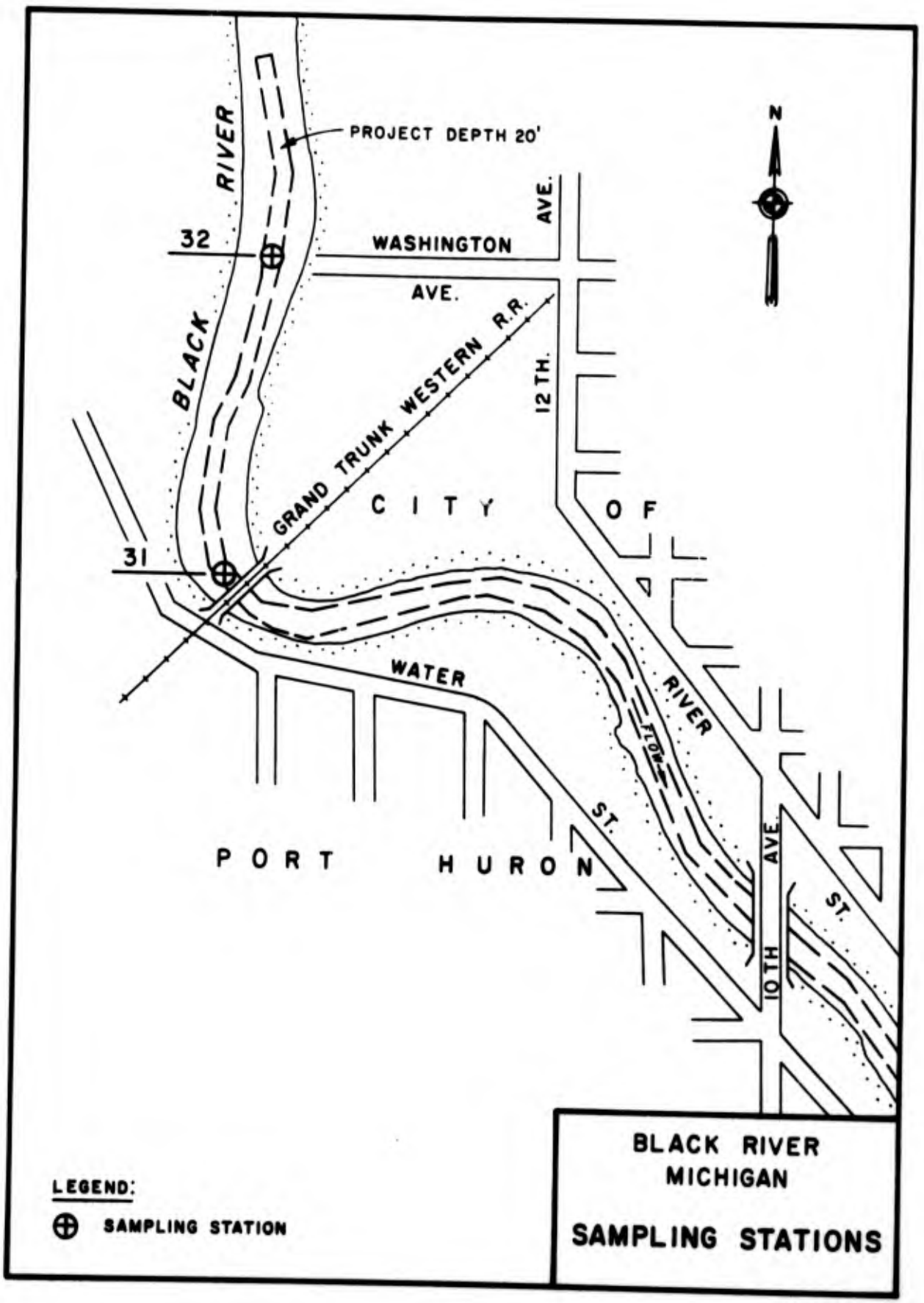

PROJECT DEPTH 20'
BLACK RIVER
32
WASHINGTON AVE.
AVE.
GRAND TRUNK WESTERN R.R.
12 TH.
CITY OF
31
WATER
RIVER
FLOW
ST.
PORT HURON
10 TH AVE.
ST.
N
LEGEND:
SAMPLING STATION
BLACK RIVER
MICHIGAN
SAMPLING STATIONS

FIG. B4-12

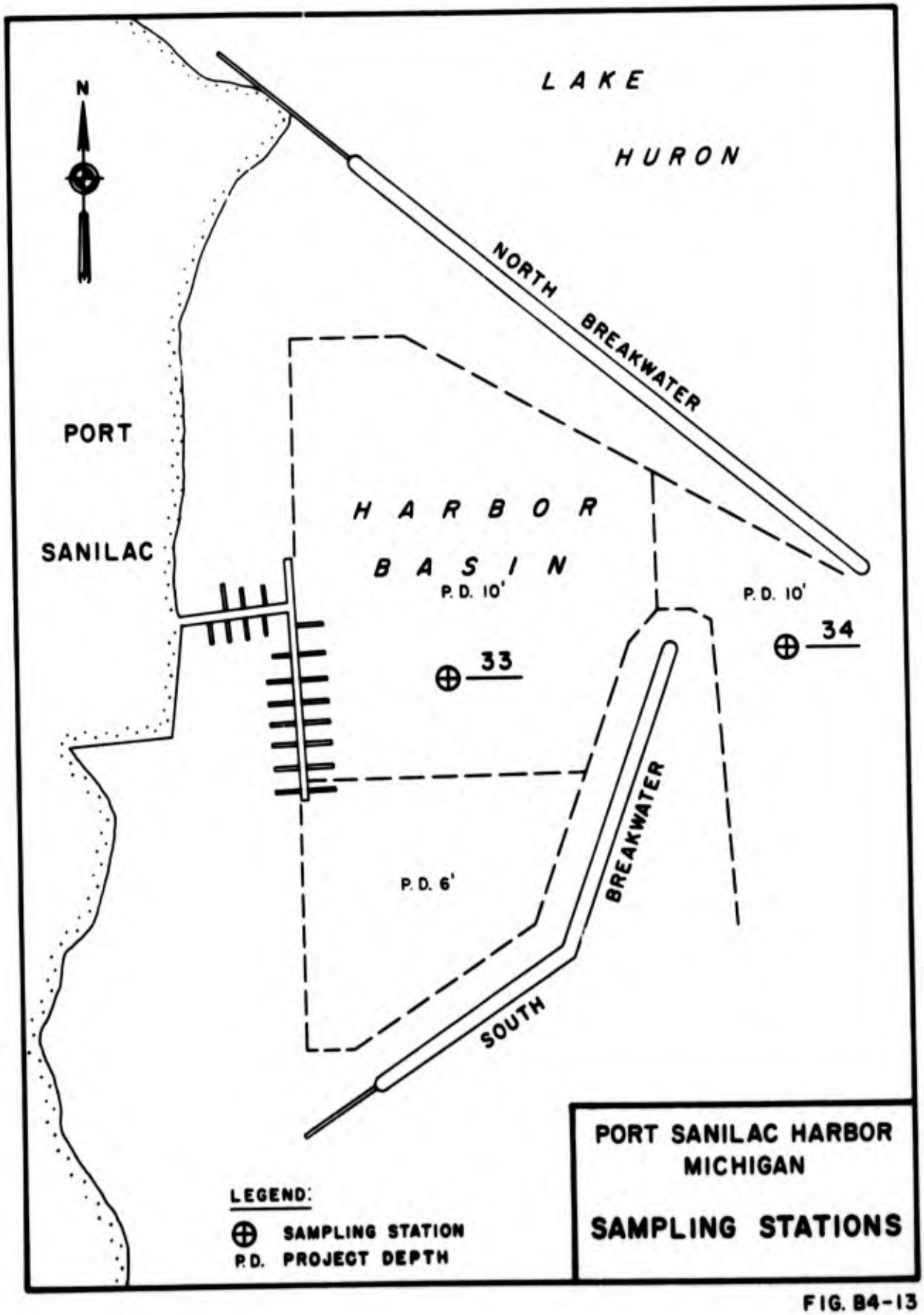

N
LAKE
HURON
NORTH BREAKWATER
PORT
SANILAC
HARBOR
BASIN
P.D. 10'
P.D. 10'
33
34
P.D. 6'
BREAKWATER
SOUTH
LEGEND:
SAMPLING STATION
P.D. PROJECT DEPTH
PORT SANILAC HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-13

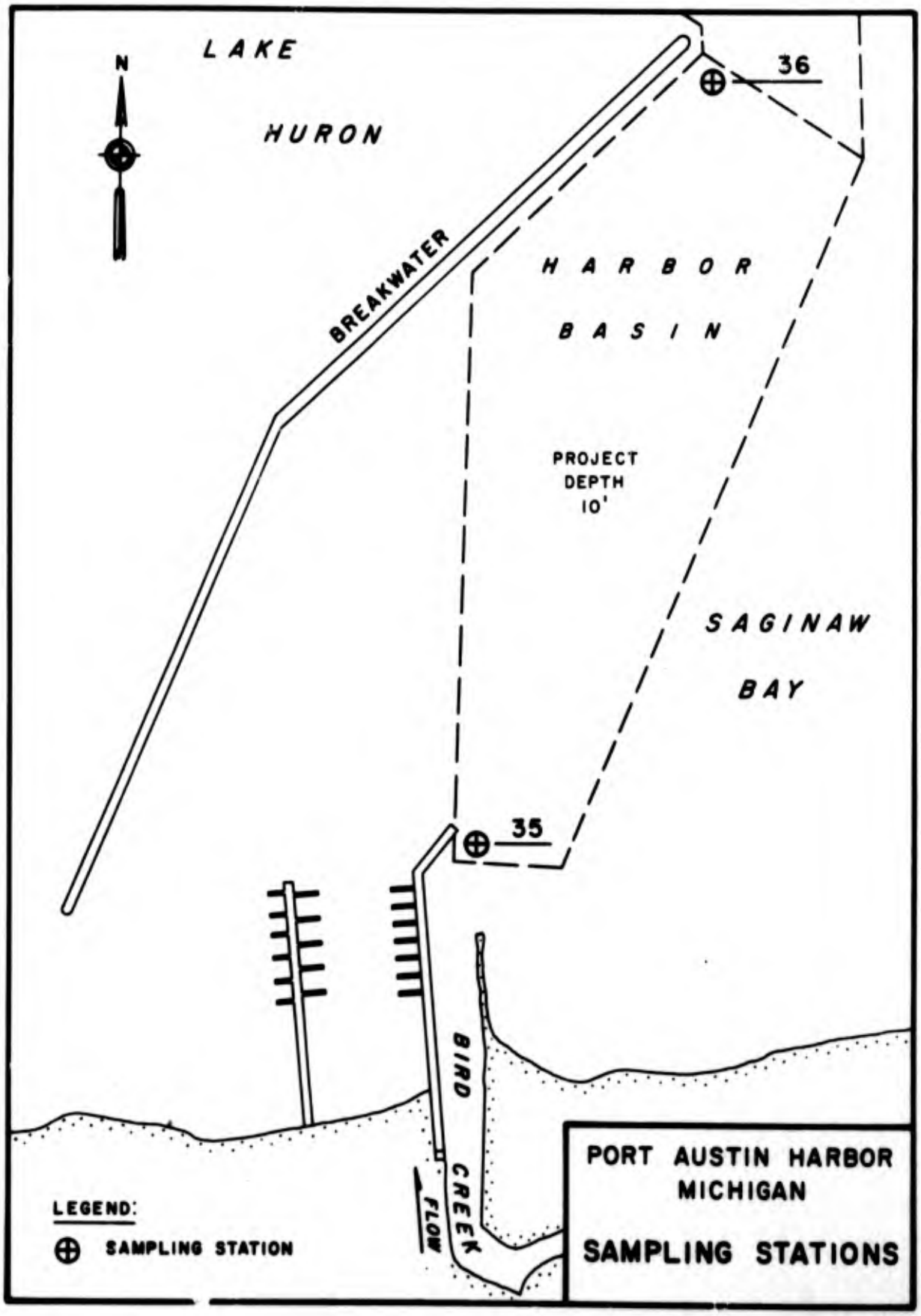

LAKE
HURON
N
36
BREAKWATER
HARBOR
BASIN
PROJECT
DEPTH
10'
SAGINAW
BAY
35
BIRD
CREEK
FLOW
LEGEND:
SAMPLING STATION
PORT AUSTIN HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-14

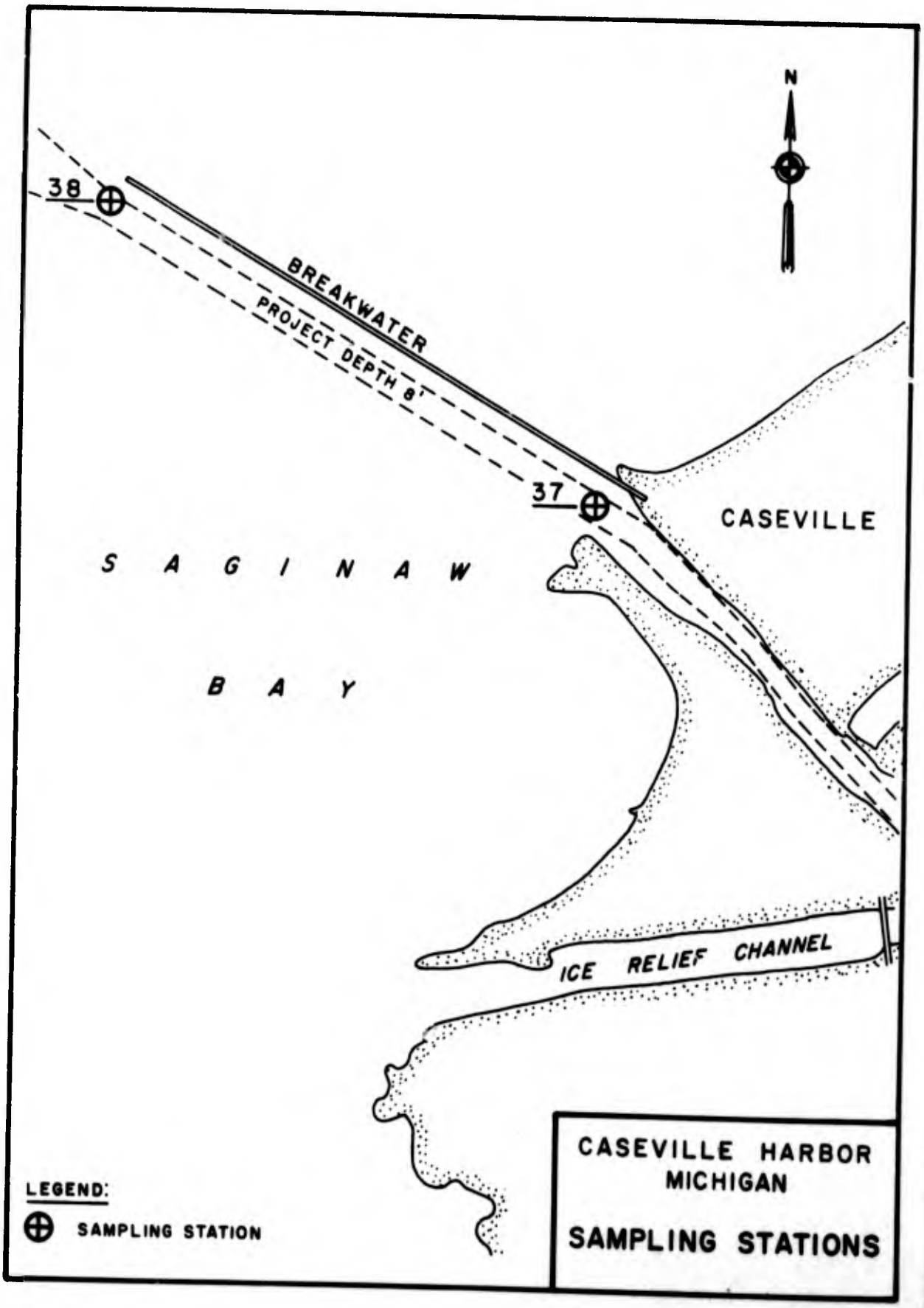

N
38
BREAKWATER
PROJECT DEPTH 8'
37
CASEVILLE
S A G I N A W
B A Y
ICE RELIEF CHANNEL
LEGEND:
SAMPLING STATION
CASEVILLE HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-15

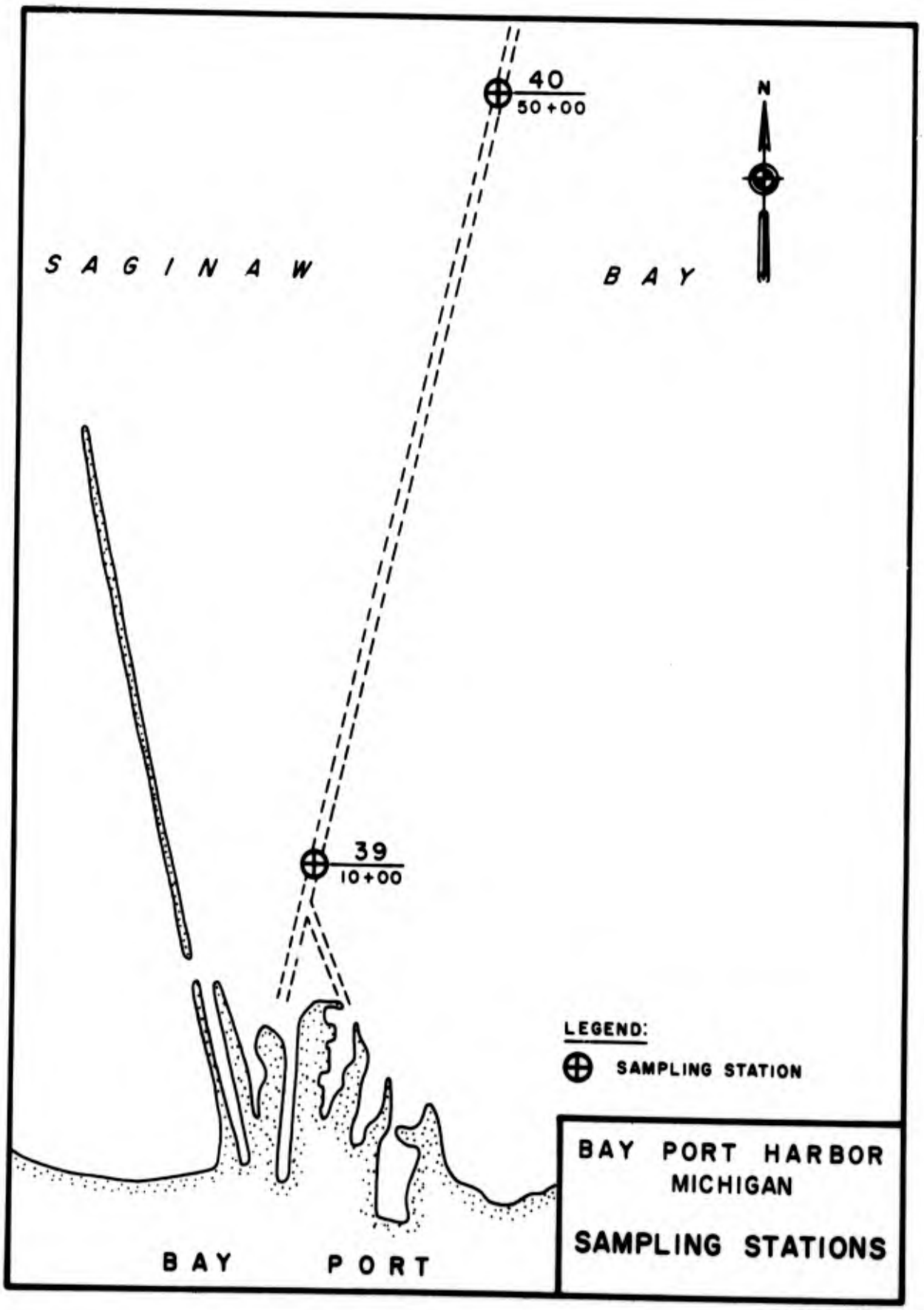

40
50+00
N
SAGINAW
BAY
39
10+00
LEGEND:
SAMPLING STATION
BAY PORT HARBOR
MICHIGAN
SAMPLING STATIONS
BAY
PORT

FIG. B4-16

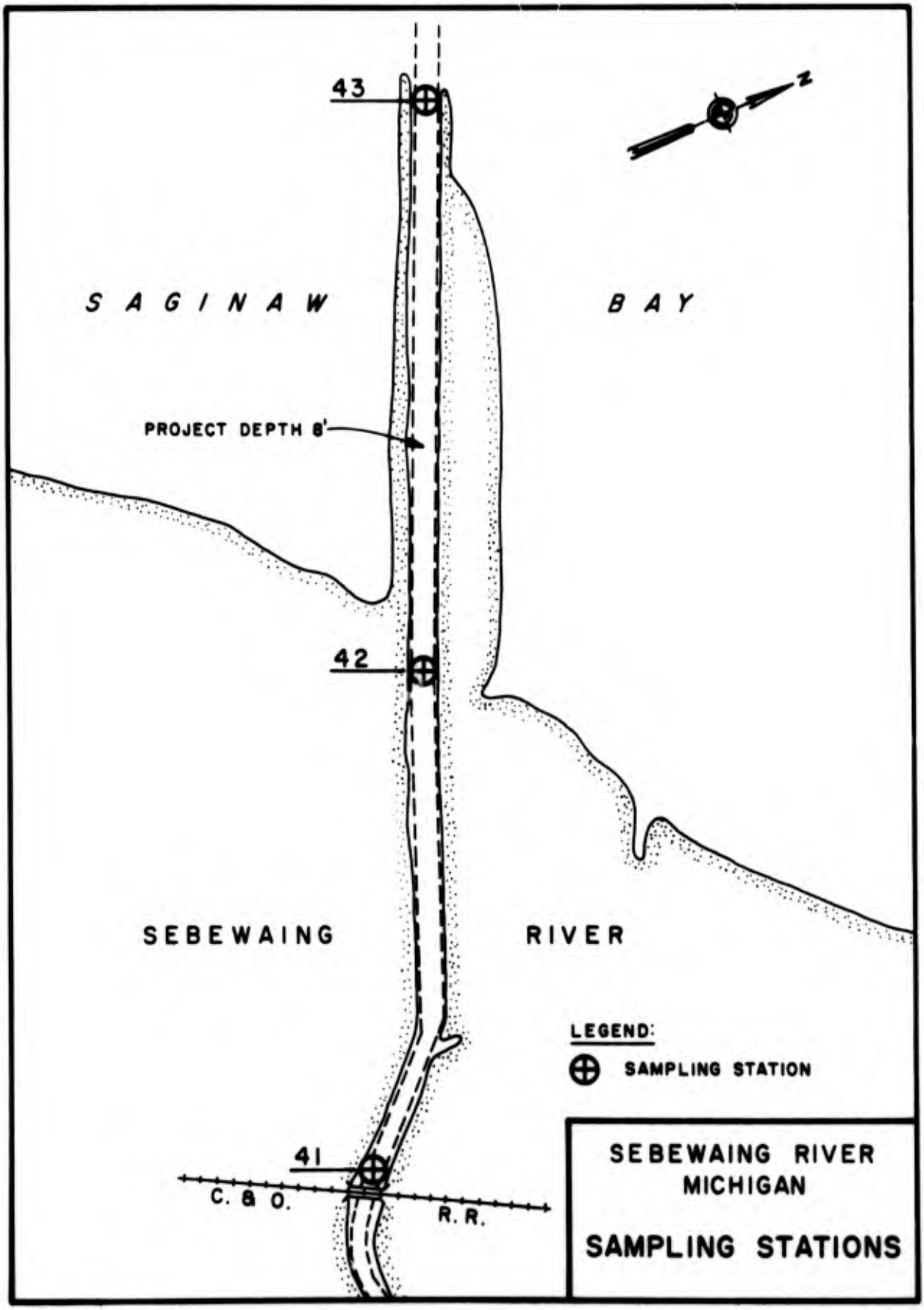

43
N
SAGINAW
BAY
PROJECT DEPTH 8'
42
SEBEWAING
RIVER
LEGEND:
SAMPLING STATION
41
C. & O.
R.R.
SEBEWAING RIVER
MICHIGAN
SAMPLING STATIONS

FIG. B4-17

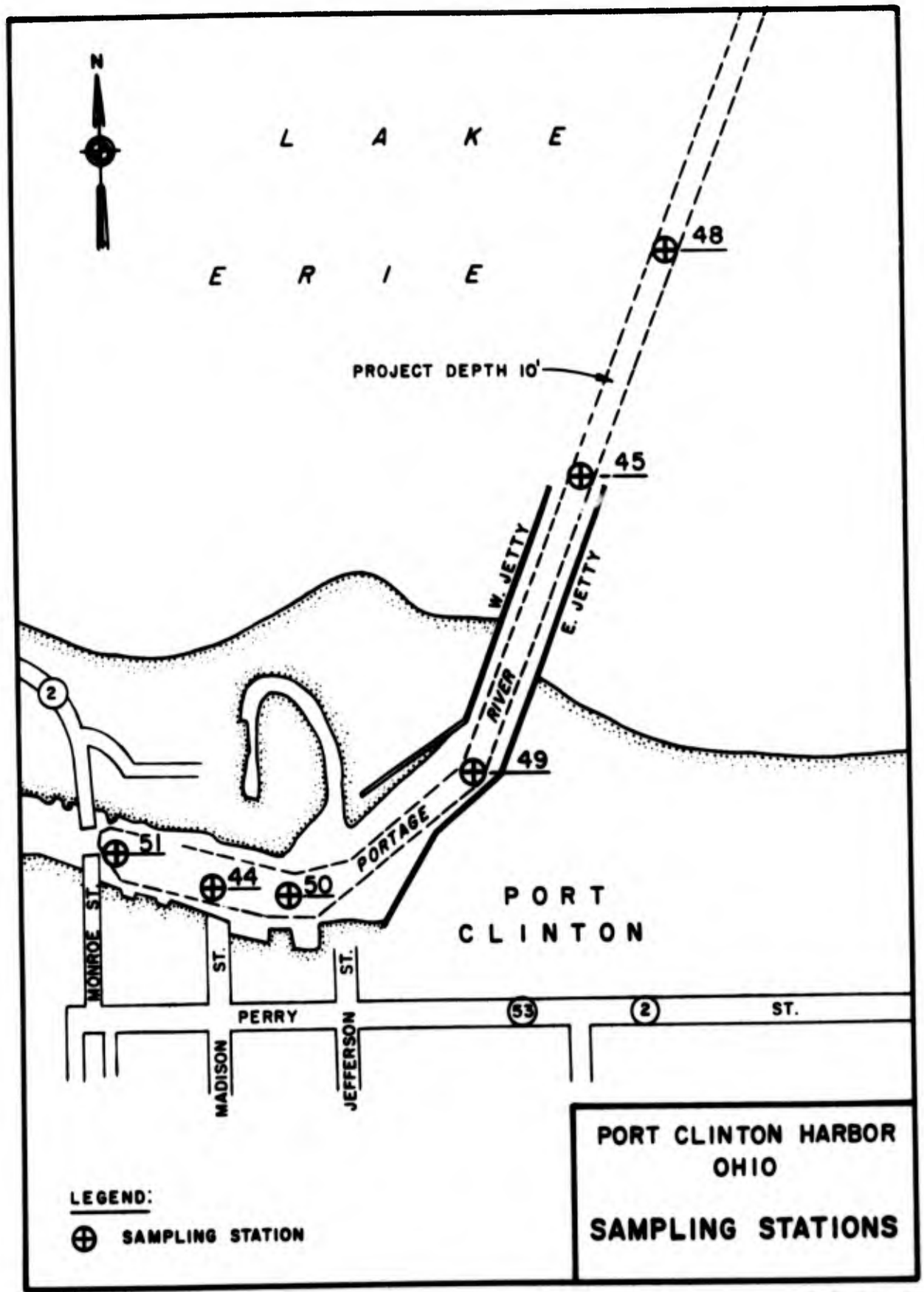

N
L A K E
E R I E
48
PROJECT DEPTH 10'
45
W. JETTY
E. JETTY
RIVER
49
2
PORTAGE
51
44
50
PORT
CLINTON
MONROE ST.
ST.
ST.
PERRY
53
2
ST.
MADISON
JEFFERSON
LEGEND:
SAMPLING STATION
PORT CLINTON HARBOR
OHIO
SAMPLING STATIONS

FIG. B4-18

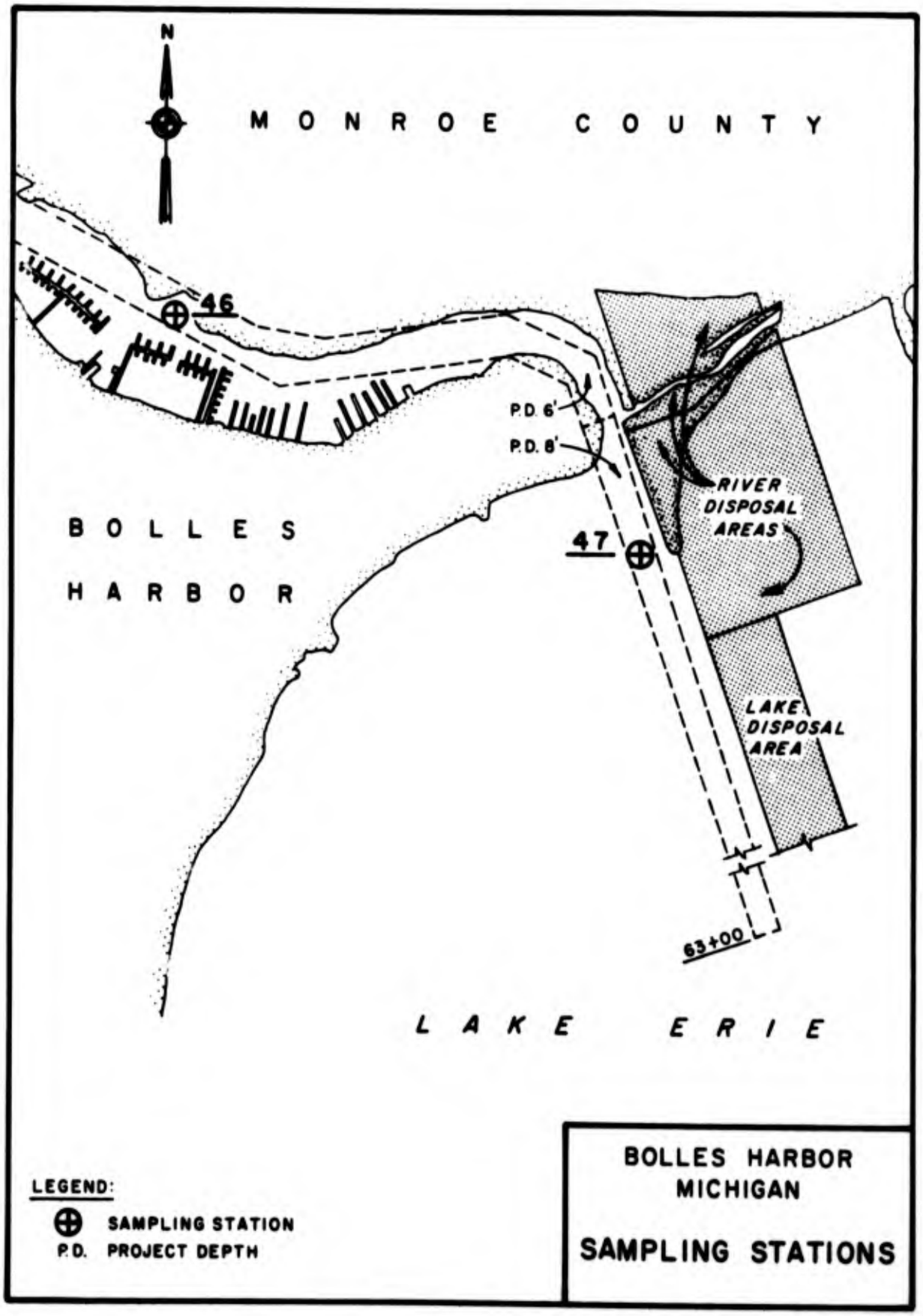

N
MONROE COUNTY
46
P.D. 6'
P.D. 8'
RIVER DISPOSAL AREAS
BOLLES HARBOR
47
LAKE DISPOSAL AREA
63+00
LAKE ERIE
LEGEND:
SAMPLING STATION
P.D. PROJECT DEPTH
BOLLES HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-19

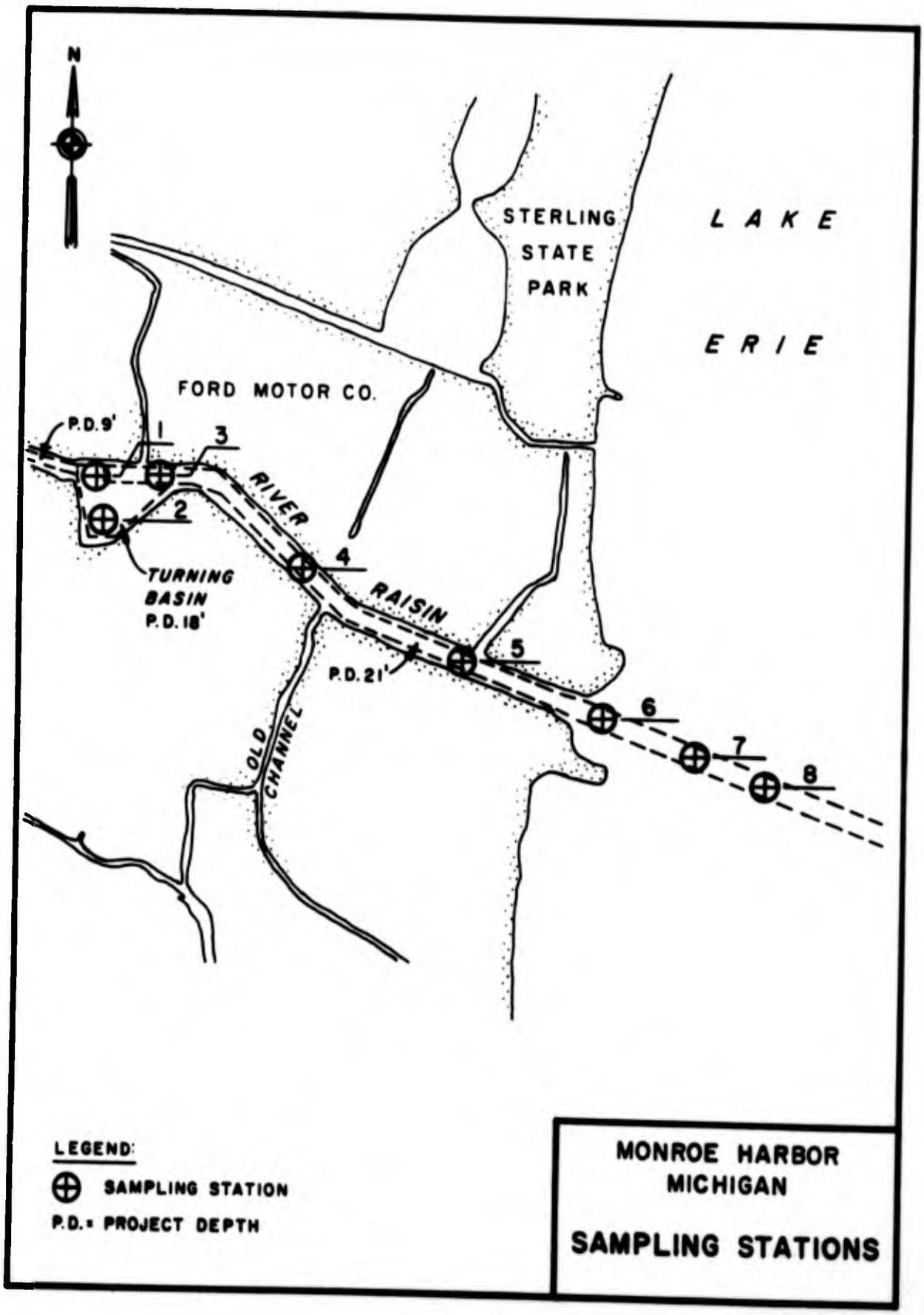

N
STERLING
STATE
PARK
LAKE
ERIE
FORD MOTOR CO.
P.D. 9'
1
3
2
RIVER
4
TURNING
BASIN
P.D. 18'
RAISIN
5
P.D. 21'
6
7
8
OLD
CHANNEL
LEGEND:
SAMPLING STATION
P.D. = PROJECT DEPTH
MONROE HARBOR
MICHIGAN
SAMPLING STATIONS

FIG. B4-20

THE DETROIT TESTING LABORATORY, INC.
12800 NORTHEND AVE. DETROIT, MICH. 48237 • TEL: (313) 398-2100 • TWX 810-232-4848

REPORT NUMBER	CLIENT'S ORDER	DATE REC'D.	REPORT DATE
801027 A	NCESP 68-743	1-4-68	2-29-68

REPORT FOR

U. S. Army Engineering
District, Detroit
Corps of Engineers
P. O. Box 1027
Detroit, Michigan 48231

Attn: Mr. E. A. Smith, Procurement Officer

Work Requested:

The client requested that the DETROIT TESTING LABORATORY supply necessary labor equipment and materials to obtain eight (8) samples of bottom sediments in the Raisin River, vicinity of Monroe, Michigan. Exact spots will be designated by a Government representative but all will be in a two mile stretch from the turning basin downstream, including about 2,000 feet of the channel in Lake Erie, and to perform laboratory tests on above samples per P.O.#NCESP-68-743. Furnish copies of report in quadruplicate.

Note: See attached Map for sampling locations.

(continued)

continued:

Results:

Sample #	% Passing #20 Sieve	% Total Solids	% Volatile Solids Loss	% Total Solids Dried	% Volatile Solids Loss-Dried
		Air Dried	Air Dried	105°	105°
1	97.5	67.0	3.5	67.0	4.2
2	99.6	32.5	18.0	30.0	18.8
3	99.5	52.8	9.40	47.0	9.60
4	98.3	52.5	8.2	47.0	8.20
5	98.5	27.3	19.4	22.0	19.5
6	99.8	32.6	16.5	31.0	16.4
7	99.7	30.0	16.0	33.0	15.5
8	99.9	30.1	16.7	29.0	17.6

(continued)

Results: (continued)

Sample #	Total Phosphate wet Basis mg/g	Ammonia mg/g	Nitrogen wet Basis Organic mg/g	Nitrite mg/g	Nitrate mg/g
1	0.22	0	0.126	0.002	0.005
2	0.20	0	1.10	0.002	0.013
3	0.32	0	0.672	0.002	0.008
4	0.32	0	0.560	0.002	0.021
5	0.36	0	0.781	0.0007	0.005
6	0.13	0	0.714	0.0008	0.015
7	0.13	0	0.840	0.002	0.013
8	0.43	0.012	0.998	0.002	0.015

(continued)

Results: (continued)

Sample #	SiO_2 %	FeO %	Al_2O_3 %	CaO %	MgO %	MnO_3 %	SO_3 %
1	87.3	1.43	0.15	4.5	0.33	0.09	0.092
2	59.2	3.99	3.31	7.1	1.35	0.63	0.75
3	77.0	1.60	0.90	6.1	1.86	0.24	0.33
4	77.0	2.10	0.70	5.9	1.67	0.09	0.37
5	62.0	4.48	3.50	8.1	1.80	0.24	0.54
6	64.6	3.84	2.91	8.1	1.90	0.48	0.70
7	65.0	3.84	3.26	7.5	1.20	0.79	0.71
8	61.4	3.84	3.41	7.6	1.50	0.79	0.54

(continued)

Results;(continued)

Sample #	C.O.D.	Coliform Org/ml
1	30	200
2	35	180
3	40	200
4	35	160
5	20	170
6	20	150
7	18	140
8	10	140

(continued)

Results: (continued)

Sample #	D. O.	Depth
1	6.14	18 ft.
2	6.14	18 ft.
3	6.14	21 ft.
4	5.82	24 ft.
5	4.96	23 ft.
6	4.96	23 ft.
7	4.96	21 ft.
8	4.96	22 ft.

THE DETROIT TESTING LABORATORY, INC.

Caulton Ray, Jr.
Mgr. Chemistry Dept.

CR:rw

APPENDIX B5

OTHER SAMPLING DATA

FOR HARBORS IN

THE BUFFALO DISTRICT

U. S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

DREDGING AND WATER QUALITY PROBLEMS
IN
THE GREAT LAKES

APPENDIX B5

OTHER SAMPLING DATA
FOR HARBORS IN
THE BUFFALO DISTRICT

TABLE OF CONTENTS

Table B5-1

Oswego Harbor, New York

Bottom Sediment Chemistry 1968[a]

Station #	Date	% Solids	% Water	% Volatile Solids	% Silica	pH	BOD	COD	Oil and Grease	Cl Demand	Total-N Kjedahl
Pre-Dredge 2	6/18	59.16	40.83	4.76	79.2	6.65	1,352	13,240	1,228	5,910	1,271
Pre-Dredge 14	6/18	49.91	50.10	5.15	91.7	6.65	2,730	73,361	1,519	8,537	2,039
Pre-Dredge 15	6/18	61.91	38.08	5.45	93.5	6.20	1,630	76,373	1,334	4,200	1,063
Pre-Dredge 17	6/18	64.70	35.25	2.34	60.5	7.35	1,050	33,013	961	896	502
Pre-Dredge 183	6/18	74.84	25.15	1.18	89.3	6.60	553	27,687	270	1,337	431
Inflow Dredge	7/1	55.00	45.00	6.82	74.8	5.90	3,255	63,454	2,864	13,091	2,187
Outflow Dredge	7/1	73.21	26.78	.70	90.5	7.80	112	3,252	94.5	273	102
Post-Dredge 2	7/30	50.54	49.45	12.77	69.7	6.65	2,980	165,110	2,360	11,880	2,703
Post-Dredge 2	8/28	62.77	37.22	4.66	80.6	6.80	1,020	58,743	90.9	6,060	1,189
Post-Dredge 14	8/28	54.07	44.92	7.55	79.6	7.10	3,400	65,950	54.2	7,024	1,942
Post-Dredge 15	7/30	56.22	43.77	8.40	77.5	6.60	3,087	122,940	932	6,227	1,515
Post-Dredge 15	8/28	67.40	32.59	6.84	75.8	6.85	1,280	86,246	576	3,324	904
Post-Dredge 17	7/30	71.98	28.01	11.71	73.5	7.20	972	33,172	42.5	1,029	543
Post-Dredge 17	8/28	55.56	44.43	7.80	73.1	6.50	1,830	96,530	2,820	5,290	2,175
Post-Dredge 183	7/30	69.01	30.98	2.25	68.8	6.95	870	8,219	674	4,200	754
Post-Dredge 183	8/28	82.22	17.77	1.41	88.3	7.50	46	12,102	58.8	1,820	832

a Chemical parameters reported as mg/kg dry weight analysis

Table B5-2

Oswego Harbor, New York

Water Chemistry Dredging Study 1968[a]

Station #	Date	pH	Cond. (μmhos/cm)	DO	BOD	Alk	Cl	NH_3-N	NO_3-N	ORG-N	S-PO_4	T-PO_4	Suspended Solids	Volatile Solids	COD
Pre-Dredge 2	6/6	8.4	530	12.1	4.7	108		.03	.17	.41	.23	.26	12		
Pre-Dredge 2	6/6	8.2	560	11.4	2.7	108			.19	.28	.11	.21	7	5	
Pre-Dredge 11	6/6	8.2	720	9.1	2.7	118		.03<	.35	.30	.25	.50	3	3	
Pre-Dredge 13	6/6	8.2	380	9.2	3.9	116		.03<	.34	.58	.23	.38	10	5	
Pre-Dredge 13	6/6	8.4	750	14.2	2.2	98		.03<	.10	.08	.14	.30	12		
Pre-Dredge 15	6/6	8.4	400	13.9	2.7	100		.06	.10	.41	.17	.35	3	2	
Pre-Dredge 15	6/6	8.1	480	11.2	2.7	108		.03<	.15	.55	.24	.55	12	10	
Pre-Dredge 17	6/6	8.1	920	9.0	4.4	122			.39	.60	.26	.46	11	7	
Pre-Dredge 17	6/6	8.1	940	8.8	6.2	126		.05	.41	.51	.28	.49	24	23	
Pre-Dredge 183	6/6	8.5	340	15.5	5.3	98		.03<	.12	.20	.08	.09	3		
Pre-Dredge 183	6/6	8.2	380	14.1	1.7	96		.03<	.20	.22	.04	.05	5	4	
Inflow Dredge	7/1	8.1	430		2.4	108	50.1	.10	1.98	.13	.72	10.7		427	90
Outflow Dredge	7/1	8.1	434		1.7	106	48.0	.06	2.36	.17	.57	3.30		275	41
Dur-Dredge 14-1	7/1	7.8	840	12.4	1.0	111	163.5	.14	.48	.46	.30	.40			
Dur-Dredge 14-1	7/1	8.4	360		< 1	98	28.1	.06	.22	.08	.08	.081			
Dur-Dredge 17	7/1	8.0	840		1.9	108	168.7	.46	.58	.58	.37	.48	19,900	2,160	
Dur-Dredge 17	7/1	7.9	840	9.3	1.2	112	159.4	.10	.62	.50	.37	.42	40,400	3,440	
Dur-Dredge 183	7/1	8.2	450	12.0	1.4	98	56.7	.07	.25	.30	.11	.13			
Dur-Dredge 183	7/1	8.0	380	12.5	1.1	100	27.7	.02	.28	.30	.08	.11			
Inflow Dredge	7/1	6.9	640		52.0	540		.05		2.16	1.66	663.00			1,700
Outflow Dredge	7/1	7.0	640		37.0	538		.74		1.92	2.54	526.50			2,300
Post-Dredge 2	7/30	8.1	390	7.5	1.5	92	34.4				.21	.25			
Post-Dredge 2	7/30	8.0	410		2.8	102	58.6				.29	.62			
Post-Dredge 11	7/30	8.0	700	6.8	1.7	106	158.3				.20	.34			
Post-Dredge 11	7/30	8.0	710		1.5	104	162.4				.21	.37			
Post-Dredge 14	7/30	8.0	490	7.2	1.3	36	57.6				.13	.29			
Post-Dredge 14	7/30	8.0	490		2.4	62	54.5				.18	.29			
Post-Dredge 15	7/30	8.2	350	7.7	1.5	94	27.3				.12	.21			
Post-Dredge 15	7/30	8.2	320	7.7	2.1	94	28.8				.12	.21			
Post-Dredge 17	7/30	8.0	1100	5.6	1.4	132	282.7	.32		.21	.20	.50			

(Table continued on next page)

Table B5-2 (Cont'd)

Oswego Harbor, New York

Water Chemistry Dredging Study 1968[a]

Station #		Date	pH	Cond. (μmhos/cm)	DO	BOD	Alk	Cl	NH_3-N	NO_3-N	ORG-N	S-PO_4	T-PO_4
Post-Dredge	17	7/30	7.9	1140		2.1	118	295.5	.10		.48	.29	.54
Post-Dredge	183	7/30	8.4	310	9.2	2.1	92	30.7	.01		.23	.08	.10
Post-Dredge	183	7/30	8.4	320	9.2	.6	90	30.7	.11		.24	.08	.12
Post-Dredge	2	8/28	8.3	840		1.4	104	186.0	.05		.53		
Post-Dredge	2	8/28	8.3	910		2.4	106	235.1	.10		.58		
Post-Dredge	14	8/28	8.6	720	10.3	2.4	104	179.9	.05		.50	.26	.34
Post-Dredge	14	8/28	8.5	1240	8.7	3.4	112	327.1	.05		.09	.45	.51
Post-Dredge	15	8/28	8.6	640		1.5	98	110.4			.42		
Post-Dredge	15	8/28	8.4	440		.8	96	53.7			.30		
Post-Dredge	17	8/28	8.6	1400	9.2	3.4	116	383.3	.10		.62	.48	.58
Post-Dredge	17	8/28	8.6	1200	9.3	3.3	112	347.5	.07		.86		
Post-Dredge	183	8/28	8.4	310	9.2	2.1	92	30.7	.01		.23	.08	.10
Post-Dredge	183	8/28	8.4	320	9.2	.6	90	30.7	.11		.24	.08	.12

a All values in mg/l except where noted.

Table B5-3

Oswego Harbor, New York

Benthic Fauna 6/6/1968[a]

Station #	Amphipoda	Oligochaeta	Hirundineae	Isopoda	Chironomidae	Gastropoda	Sphaeriidae	Total
2		748			6	2		756
13	73	278		1	15	26		393
15		2454				36	4	2494
17	23		1	1		3720	2	3747
183		73			2	16		91

a All values in organisms /m^2

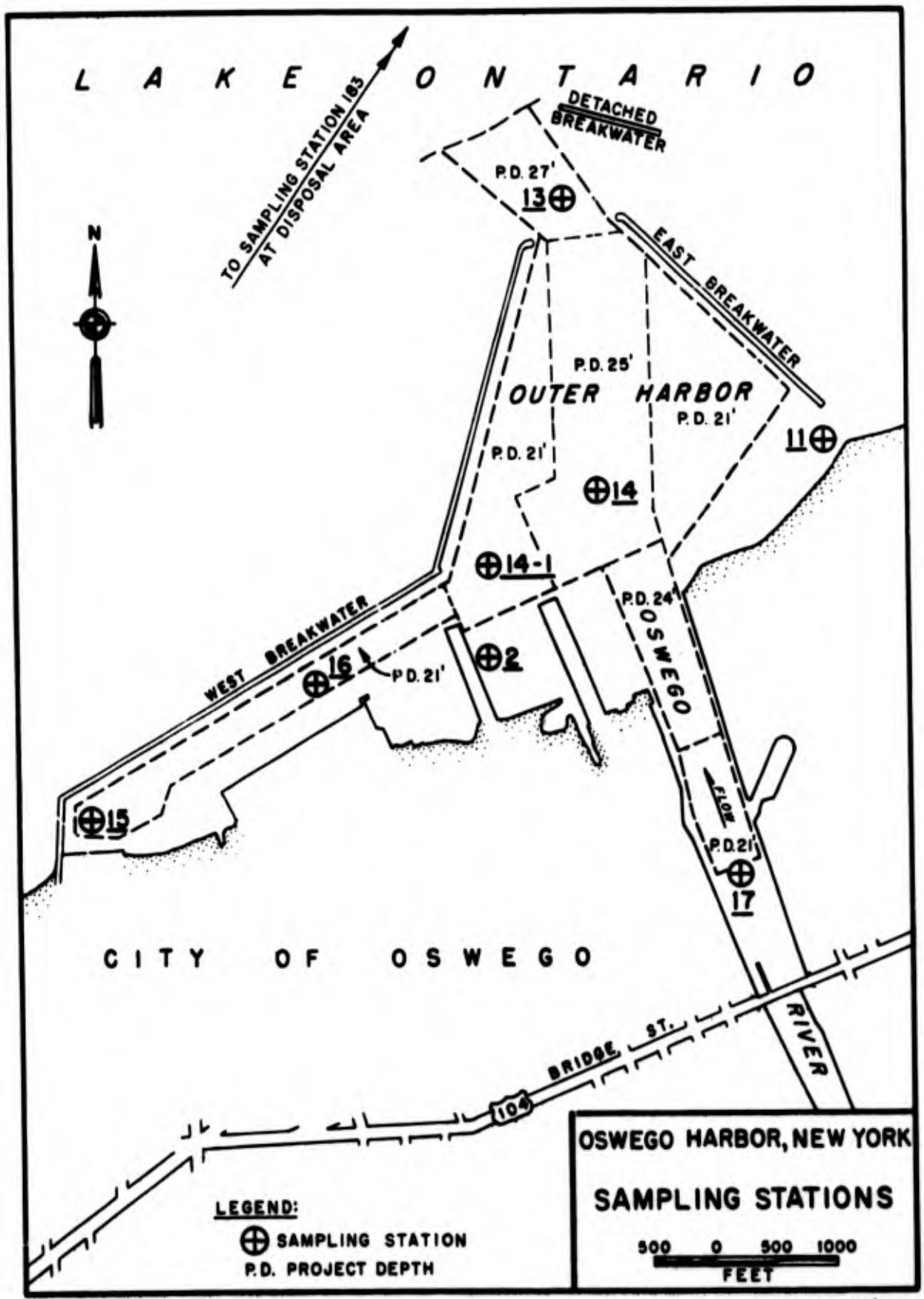

LAKE ONTARIO
TO SAMPLING STATION 183 AT DISPOSAL AREA
DETACHED BREAKWATER
P.D. 27'
13
N
EAST BREAKWATER
P.D. 25'
OUTER HARBOR
P.D. 21'
P.D. 21'
11
14
14-1
P.D. 24'
OSWEGO
WEST BREAKWATER
16
P.D. 21'
2
15
FLOW
P.D. 21'
17
CITY OF OSWEGO
BRIDGE ST.
104
RIVER
LEGEND:
SAMPLING STATION
P.D. PROJECT DEPTH
OSWEGO HARBOR, NEW YORK
SAMPLING STATIONS
500 0 500 1000
FEET

FIG. B5-1

Table B5-4

Little Sodus Bay, New York

Water Chemistry 1968[a]

Station #	Date	pH	Cond. (µmhos/cm)	DO	BOD	Alk	Cl.	NH_3-N	NO_3-N	ORG-N	S-PO_4	T-PO_4	Suspended Solids	Volatile Solids	COD
Pre-Dredge 4	6/5	8.8	354	15.2	13.6	100	27.4	.06	.20	.28	.04	.05	4	2	
Pre-Dredge 4	6/5	8.6	350	12.1	3.4	104	25.3	.05	.14	.29	.06	.06	3	2	
Pre-Dredge 5	6/5	8.1	330	9.5	3.1	106	26.1	.07	.30	.37	.06	.06	6	2	
Pre-Dredge 5	6/5	8.6	334	11.6	3.3	104	24.7	.05	.14	.31	.07	.07	6	3	
Pre-Dredge 176	6/5	8.8	330	15.3	3.1	98	27.9	.06	.17	.28	.07	.09	3	1	
Pre-Dredge 176	6/5	8.6	370	15.3	2.5	100	27.7	.05	.33	.31	.07	.09	4	2	
Pre-Dredge 176	6/5	8.4	312	11.4	1.8			.01	.30	.42			10	3	
Pre-Dredge 176	6/5	8.5	312	11.6	1.8			.01	.07	.17			11	11	
Pre-Dredge 176	6/5	8.5	312	12.1	1.3			.01	.11	.10			4	0	
Pre-Dredge 176	6/5	8.5	312	11.4	1.0			.001	.08	.13			12	12	
Inflow Dredge	6/17	7.6	430		28.0	338	27.0	.87	.75	1.20	.78	76.1	3,192	162	
Outflow Dredge	6/17	7.5	400		22.0	254	27.0	.31	.50	.48	.57	37.1	6,626	346	
Dur-Dredge 4	6/17	8.6	332		2.1	102	26.0	.06	.18	.01	.14	.24	28	12	
Dur-Dredge 176	6/17	8.5	340		4.1	98	26.0	.10	.09	.01	.06	.20	15	7	
Dur-Dredge 176	6/17	8.5	320		5.6	100	26.0	.29	.08	.30	.10	.31	32	20	
PostDredge 4	7/31	8.4	280			96	24.9	.48	.05	3.36	.12	.17	3		
Post Dredge 4	7/31	8.5	304		4.4	86	26.0		.04		.12	.18	8	6	
Post Dredge 5	7/31	8.6	316	8.6	5.6	82	26.2		.04		.12	.17	128	10	
Post Dredge 5	7/31	8.6	316		6.7	88	26.0		.04		.15	.18	60	2	
Post Dredge 6	7/31	8.4	320	9.0	1.4	90	26.7		.04		.09	.16	5	3	
Post Dredge 6	7/31	8.4	320	8.4	2.7	88	26.5		.04		.03	.16	10	2	

a All values in mg/l unless otherwise noted

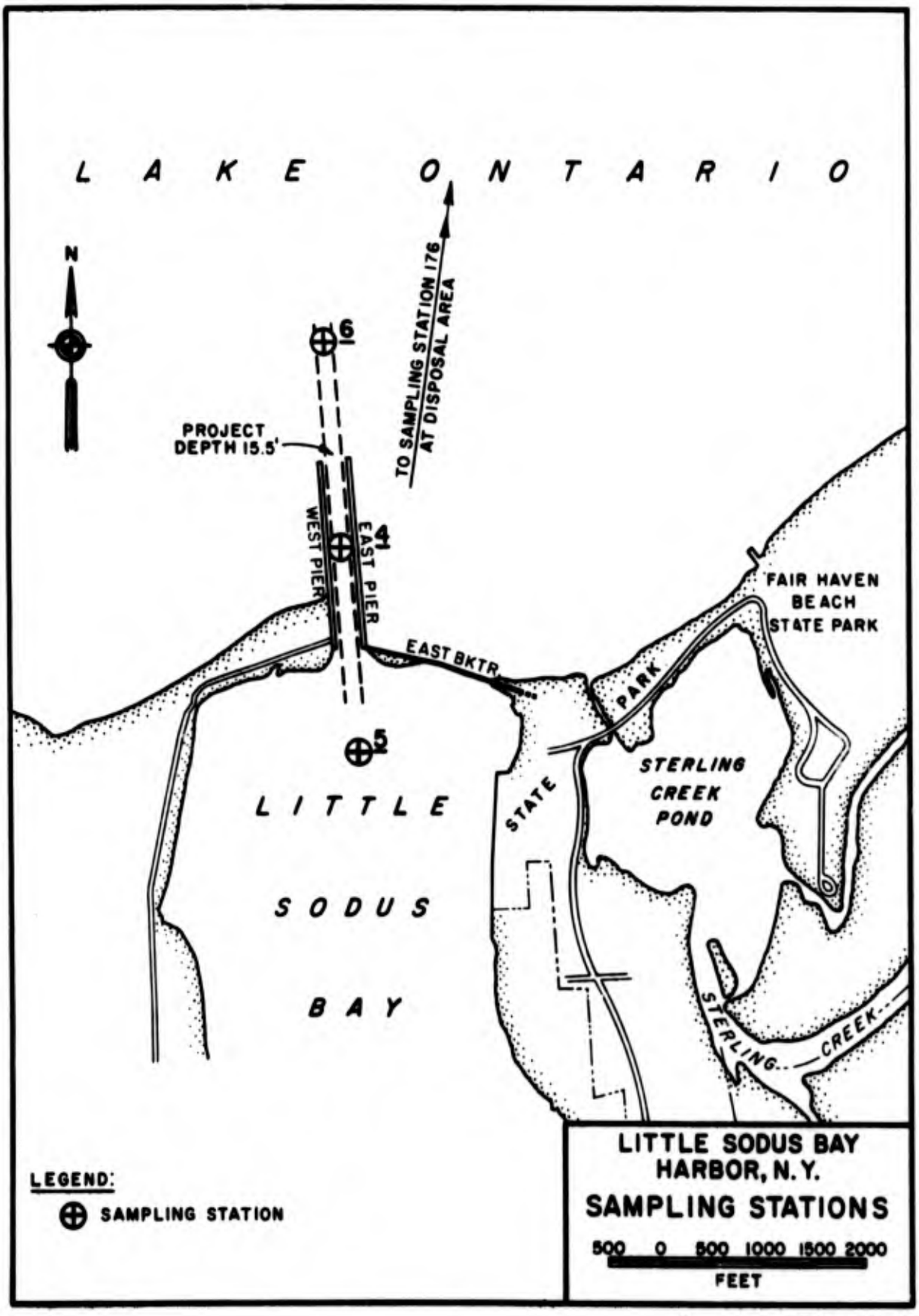

LAKE ONTARIO
N
6
TO SAMPLING STATION 176
AT DISPOSAL AREA
PROJECT
DEPTH 15.5'
WEST PIER
EAST PIER
4
1
FAIR HAVEN
BEACH
STATE PARK
EAST BKTR.
PARK
5
2
LITTLE
SODUS
BAY
STATE
STERLING
CREEK
POND
STERLING
CREEK
LEGEND:
SAMPLING STATION
LITTLE SODUS BAY
HARBOR, N.Y.
SAMPLING STATIONS
500 0 500 1000 1500 2000
FEET

FIG. B5-2

Table B5-5

Rochester Harbor, New York

Water Chemistry Dredging Study 1968[a]

Station #	Date	pH	Cond (μmhos/cm)	DO	BOD	Alk	Cl	NH_3-N	NO_3-N	Org-N	S-PO_4	T-PO_4	Suspended Solids	Volatile Solids	Turbidites[d]	COD
Pre-Dredge 3109	5/10	7.8	700	8.7	8.6	120		.46	1.10		.61	.72	40	16	3.0	
Pre-Dredge 3109	5/10	7.85	700		8.6	120		.16	1.00	.54	.52	.68	53	17	3.8	
Pre-Dredge 3112	5/10	7.7	700	9.2	8.8	120		.15	.94	.23	.35	.66	32	10	10	
PreDredge 3112	5/10	7.8	690		8.7	118		.19	1.08	.41	.58	.81	37	10	10	
Pre-Dredge 3115	5/10	7.7	680	7.8	8.0	126		.33	.84	.92					13.8	
Pre-Dredge 3115	5/10	7.7	640		7.8	124		.11	.80	.92	.79	.89	34	7	13.0	
Pre-Dredge 3157	5/10	7.8	680	5.9	7.8	124		.18	.96	.86	.42	.53	30	8	13.0	
Pre-Dredge 3157	5/10	7.9	500		5.2	106		.07	.22	.32	.13	.33	27	9	3.2	
Disposal Area 146	5/10	8.1	330	12.8	2.4	94		.01	.20	.12	.30	.31	54	3	.6	
Disposal Area 146	5/10	8.1	350	13.3	2.4	90		.03	.22	.19	.10	.15	3	1	.6	
Inflow Dredge	5/27	7.0	880		142.0	704	33.9	4.8	70.0	10.56	1.15	444.6	77,140[c]	11,270[c]		14,830
Outflow Dredge	5/27	7.0	880		136.0	1740	38.4	9.12	84.0	10.08	2.73	1,185.6	169,230[b]	21,820[b]		8,800
Dur-Dredge 3109	5/27	8.0	460		2.8	108	37.9	.12	.46	.42	.38	.44	38	8		
Dur-Dredge 3109	5/27	7.7	484		7.8	112	37.3	.34	.96	.48	.22	1.87	887	64		
Dur-Dredge 3109	5/27	8.1	500		4.0	112	37.3	.12	.41	.42	.17	.45	33	2		
Dur-Dredge 3109	5/27	8.0	500	9.7	4.4	108	37.3	.14	.40	.38	.06	.46	40	9		
Dur-Dredge 3109	5/27	8.2	384		1.8	90	28.3	.04	.23	.25	.03	.11	7	4		
Dur-Dredge 3109	5/27	8.2	364	13.2	1.7	96	28.3	.01	.23	.19	.04	.13	7	4		
Dur-Dredge 3109[1]	5/27	8.1	480		4.7	110	37.9	.08	.45	.17	.17	.47	36	11		
Dur-Dredge 3109[1]	5/27	8.1	500	9.4	6.0	106	37.7	.14	.74	.55	.07	.54	50	5		
Dur-Dredge 3114[1]	5/27	8.0	460	9.7	4.7	110	36.7	.14	.49	.37	.05	.43	37	10		
Dur-Dredge 3114[1]	5/27	8.0	478		4.1	110	36.7	.13	.47	.48	.07	.45	40	10		
Post-Dredge 3114	8/29	7.5	720	.4	32.0	132	108.5	.47		1.44						
Post-Dredge 3114	8/29	7.4	580	.6	7.0	114	77.7	.35		.60						
Disposal Area 146	8/29	8.5	304	9.2	1.2	90	28.4	.01		.32						
Disposal Area 146	8/29	8.3	330	8.7	.2	100	28.1	.04		.23						
Post-Dredge 3109	9/3	6.7	700	2.7	7.8	76	100.2	.23		.72						
Post-Dredge 3109	9/3	7.4	660	.8	4.0	119	73.6	.36		.74						
Post-Dredge 3115	9/3	7.6	700	4.0	6.6	125	100.2	.13		.74						
Post-Dredge 3115	9/3	7.7	460	4.4	2.3	102	43.9	.19		.49						
Post-Dredge 3157	9/3	7.9	460	3.8	1.9	98	51.6	.08		.25						
Post-Dredge 3157	9/3	8.1	390	8.2	1.7	98	36.3	.04		.36						

a. All values in mg/l unless otherwise noted
b 440 ml/hr
c 360 ml/hr
d The Hellige turbidimeter was used to measure turbidity. The units are expressed in mg/l of Silicon dioxide (SiO_2).

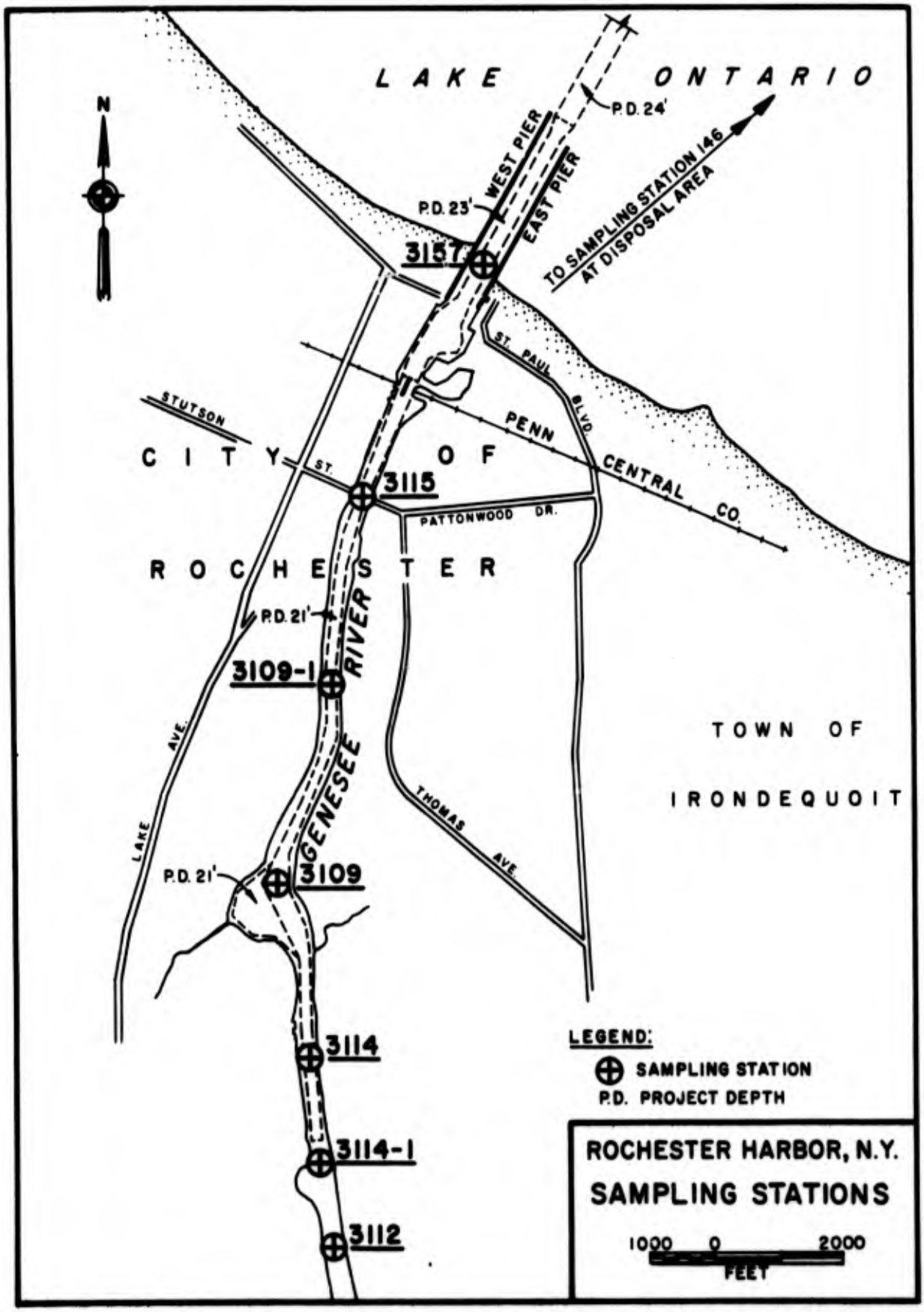

LAKE ONTARIO
N
P.D. 24'
WEST PIER
EAST PIER
TO SAMPLING STATION 146
AT DISPOSAL AREA
P.D. 23'
3157
ST. PAUL BLVD
STUTSON
PENN CENTRAL CO.
CITY OF
ST.
3115
PATTONWOOD DR.
ROCHESTER
P.D. 21'
3109-1
GENESEE RIVER
LAKE AVE.
TOWN OF
IRONDEQUOIT
THOMAS AVE.
P.D. 21'
3109
3114
3114-1
3112
LEGEND:
SAMPLING STATION
P.D. PROJECT DEPTH
ROCHESTER HARBOR, N.Y.
SAMPLING STATIONS
1000 0 2000
FEET

FIG. B5-3

Table B5-6

Conneaut Harbor, Ohio

Bottom Sediment Chemistry 5/6/1968[a]

Station #	Sampler	Depth (ft.)	Temp° C	Total Fe	Cl_2 Demand	Kjel-N	Volatile Solids	% Solids	Oil and Grease	COD	Total P
H 36-10	Core	24	10	33.1	3.7	.8	30	75.72	.59	39.9	.42
H 36-10	Petersen			34	3.3	.8	42	67.60	.74	42.4	.49
H 36-10	Top Core			34	3.4	.9	36	66.01	.81	39.8	.52
H 36-10	Mid Core			29	1.7	.6	27	76.48	.60	29.6	.35
H 36-10	Bottom Core			22.4	2.2	.9	29	79.27	.66	33.8	.45
H 36-11	Core	24.5	9.8	31.5	2.8	.9	38	72.47	1.16	41.2	.37
H 36-11	Petersen			37.9	4.5	1.1	50	62.24	1.07	50.7	.64
H 36-12	Core	29	10.2	33.8	4.3	1.2	40	67.77	1.01	48.4	.44
H 36-12	Petersen			35.1	4.4	1.1	53	60.69	1.15	54.1	.40
H 36-13	Core	29.5	10.8	27.7	4.9	.9	38	70.69	.77	40.6	.40
H 36-13	Petersen			34.3	7.3	1.6	59	58.28	.62	71.7	.52
.30[b]	Core	28	11.5	33.4	6.8	1.7	61	63.15	1.04	61.6	1.00
.30[b]	Petersen			31.5	11.7	2.1	86	57.28	1.44	112.6	.72
.36[b]	Core	25.8	11.5	40.1	3.4	2.0	67	63.00	.84	71.2	.62
.36	Petersen			32.3	9.0	1.9	81	57.60	1.09	112.3	.50
.36	Top Core			32.1	7.6	1.8	81	59.57	.64	104.3	.49
.36	Mid Core			38.6	9.4	1.7	76	57.49	1.90	99.5	.73
.36	Bottom Core			37.2	8.3	1.5	61	65.11	1.14	59.7	.54

a Chemical Parameters Reported as mg/g Day weight analysis
b Conneaut River Stations

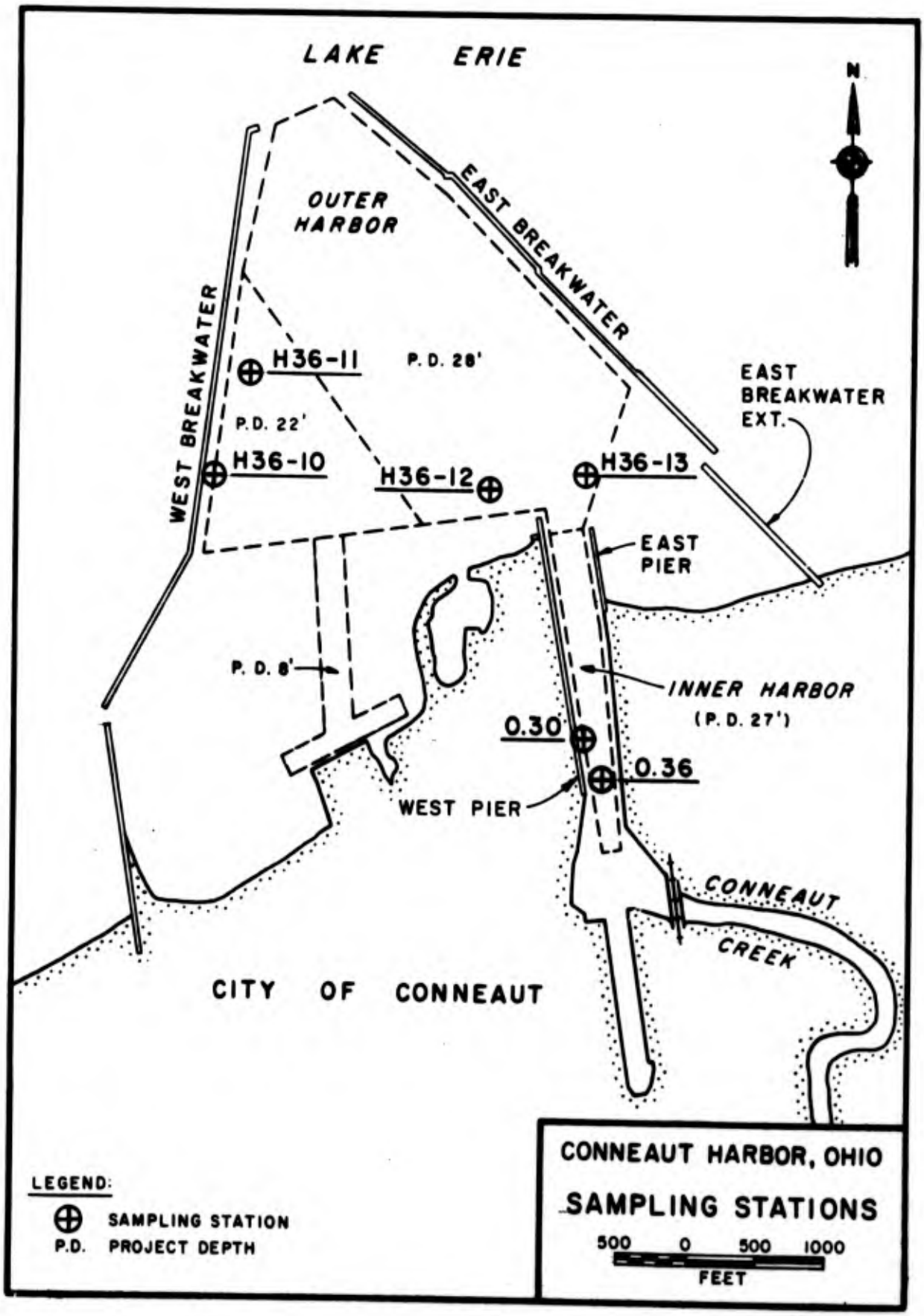

LAKE ERIE
N
OUTER HARBOR
EAST BREAKWATER
WEST BREAKWATER
H36-11
P.D. 28'
P.D. 22'
H36-10
H36-12
H36-13
EAST BREAKWATER EXT.
EAST PIER
P.D. 8'
INNER HARBOR
(P.D. 27')
0.30
0.36
WEST PIER
CONNEAUT CREEK
CITY OF CONNEAUT
LEGEND:
SAMPLING STATION
P.D. PROJECT DEPTH
CONNEAUT HARBOR, OHIO
SAMPLING STATIONS
500 0 500 1000
FEET

FIG. B5-4

Table B5-7

Ashtabula Harbor, Ohio 12/7/1968

Water Chemistry

Station #	Sample Depth (ft.)	Temp°C	DO (mg/l)
L .18	11.0	4.6	12.9
R .18	13.0	4.7	12.9
L .33	11.0	4.6	13.0
R .33	13.0	4.6	12.8
L .55	8.0	4.6	13.0

Botton Sediment Chemistry[a]

Station #	Sample Depth(ft)	Temp°C	Kjel.-N	Total P	Volatile Solids	% Solids	Total Fe	COD	Oil and Grease
L .18	22	3.4	1.21	.12	46.0	60.6	28.0	75.0	2.26
L .33	23	4.4	1.25	.11	47.0	62.9	26.8	55.9	2.63
R .33	26	4.2	1.06	.09	46.0	61.6	22.2	51.8	1.93
L .55	15	4.3	1.07	.13	46.0	64.0	18.6	51.9	2.05

Benthic Fauna[b]

Station #	Oligochaeta Lubificidae	Sphaeriidae
L .18	263,779	86
L .33	73,138	173
R .33	-	-
L .55	303,134	-

a Chemical Parameters of Bottom Sediment Chemistry reported as mg/g Dry weight analysis

b Benthic Fauna reported as organisms /m^2

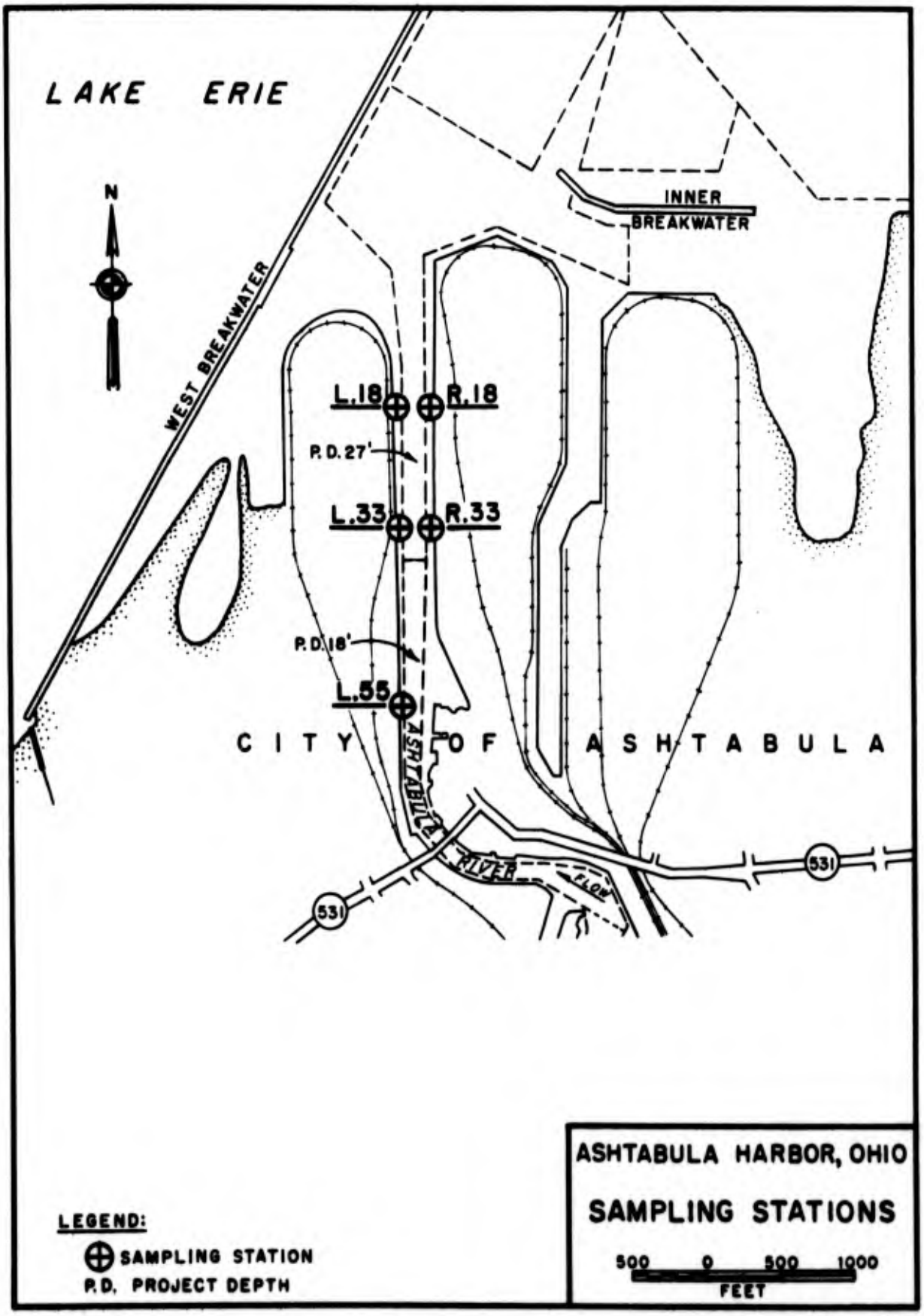

LAKE ERIE
N
WEST BREAKWATER
INNER BREAKWATER
L.18
R.18
P.D. 27'
L.33
R.33
P.D. 18'
L.55
CITY OF ASHTABULA
ASHTABULA RIVER
FLOW
531
531
ASHTABULA HARBOR, OHIO
SAMPLING STATIONS
500 0 500 1000
FEET
LEGEND:
SAMPLING STATION
P.D. PROJECT DEPTH

FIG. B5-5

Table B5-8

Lorain Harbor, Ohio

Water Chemistry 1968

Sta. #	Date	Sample Depth (ft)	Temp°C	DO (mg/l)
2.87	2/14	12	9.0	8.7
2.93	2/14	11	8.5	8.5
2.99	2/14	3	8.5	8.8

Bottom Sediment Chemistry[a]

Sta. #	Date	Sample Depth	Temp°C	NH_3-N	Org-N	NO_3-N	Total N	Total Fe	Total P	COD	BOD	%Solids	Volatile Solids	Oil & Grease	Silica	Cl Demand
2.93	2/14	21	7.5	.20	.9			291.3	1.30	28.2		54.3	66.0	14.0	-	
2.99	2/14	5	8.5	.30	1.8			133.5	1.60	397.0		43.7	86.0	28.4	-	
1	2/17						2.1	42.6	.99	92.0			84.2	2.8	-	9.3
2	2/17						2.3	42.3	1.16	147.6			111.3	2.8	-	9.0
3	2/17						2.4	41.1	.96	131.6			117.3	1.0	-	9.0
b	4/24/67			.47	.99	.01				106.4	7.0	32	57		481.0	
c	5/1/67			.70		.02					9.0	40	79		671.2	

Benthic Fauna[d]

Sta. #	Date	Sample Depth	Oligochaeta Lubificidal	Pulmonata Physa	Hirundinea Helobdella	Norundinea Arhynchobdellida	Diplera Lendipedidal	Total	Pollution Tolerant Sludgeworm
2.93	2/14	21	689					689	
2.99	2/14	5	44,127	108	742	75	21	45,073	
1	2/17								up to 500
2	2/17								46,000
3	2/17								52,000

(Table continued on next page)

Table B5-8 (cont'd)

Lorain Harbor, Ohio

Water Chemistry 1968

Dredge Samples Overflow Slurry[e]

Station #	Alkal	Cond (μmhos/cm)	Cl	Org-N	NH_3-N	NO_3-N	Phenol (μg/l)	Ph
b	130	570	34	21	12	.15	52.3	7.6
c	140	540	36	104	22.2	.18	7.2	7.3

a For Bottom Sediment Chemistry Parameters Reported as mg/g dry weight analysis
b Station in turning basin, Black River
c Station in Black River, exact location unknown
d Benthic Fauna reported as organisms /m^2
e All overflow values mg/l except where noted

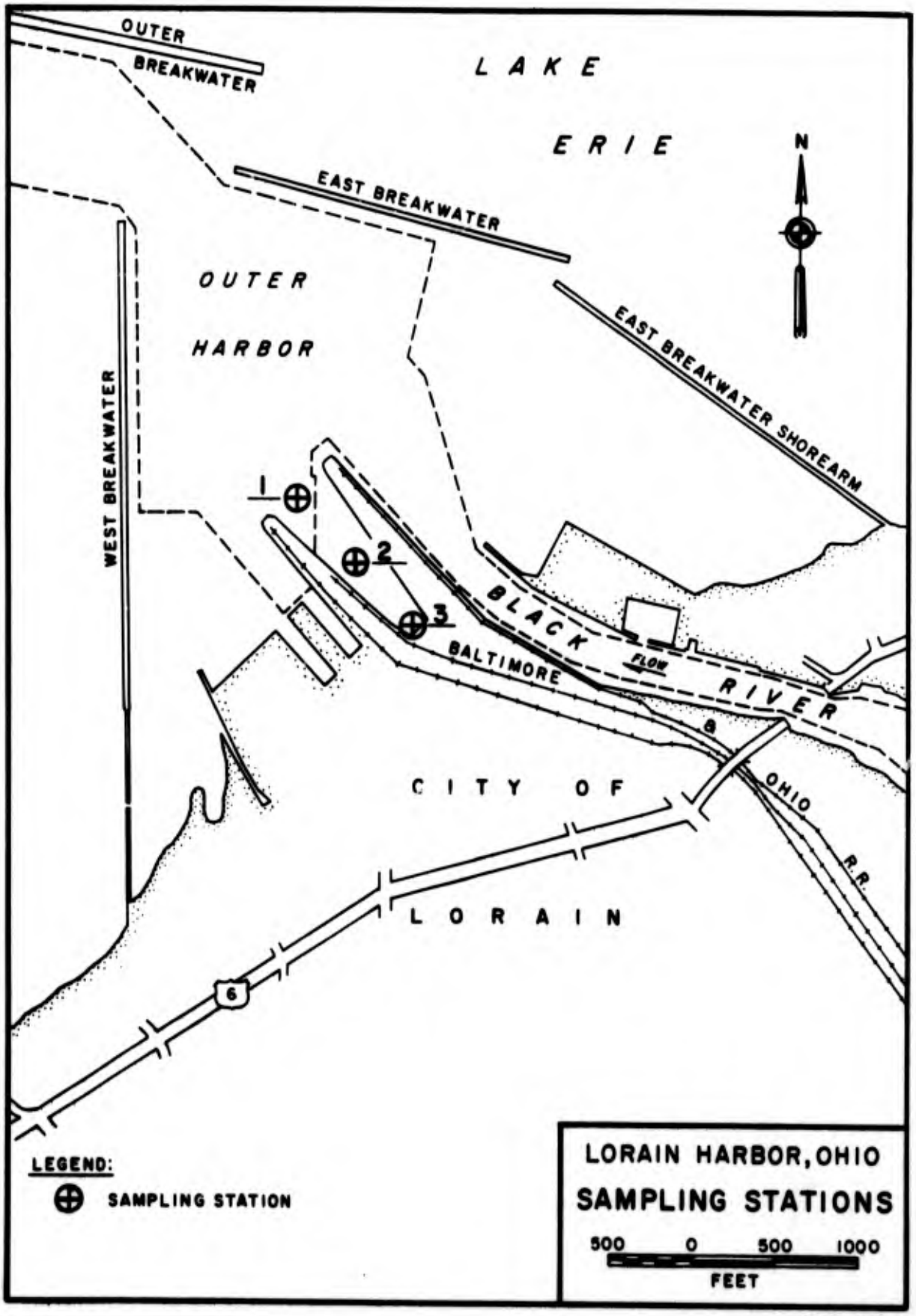

OUTER
BREAKWATER
LAKE
ERIE
N
EAST BREAKWATER
OUTER
HARBOR
EAST BREAKWATER SHOREARM
WEST BREAKWATER
1
2
3
BLACK
FLOW
RIVER
BALTIMORE
8
CITY OF
OHIO
R.R.
LORAIN
6
LEGEND:
SAMPLING STATION
LORAIN HARBOR, OHIO
SAMPLING STATIONS
500 0 500 1000
FEET

FIG. B5-6

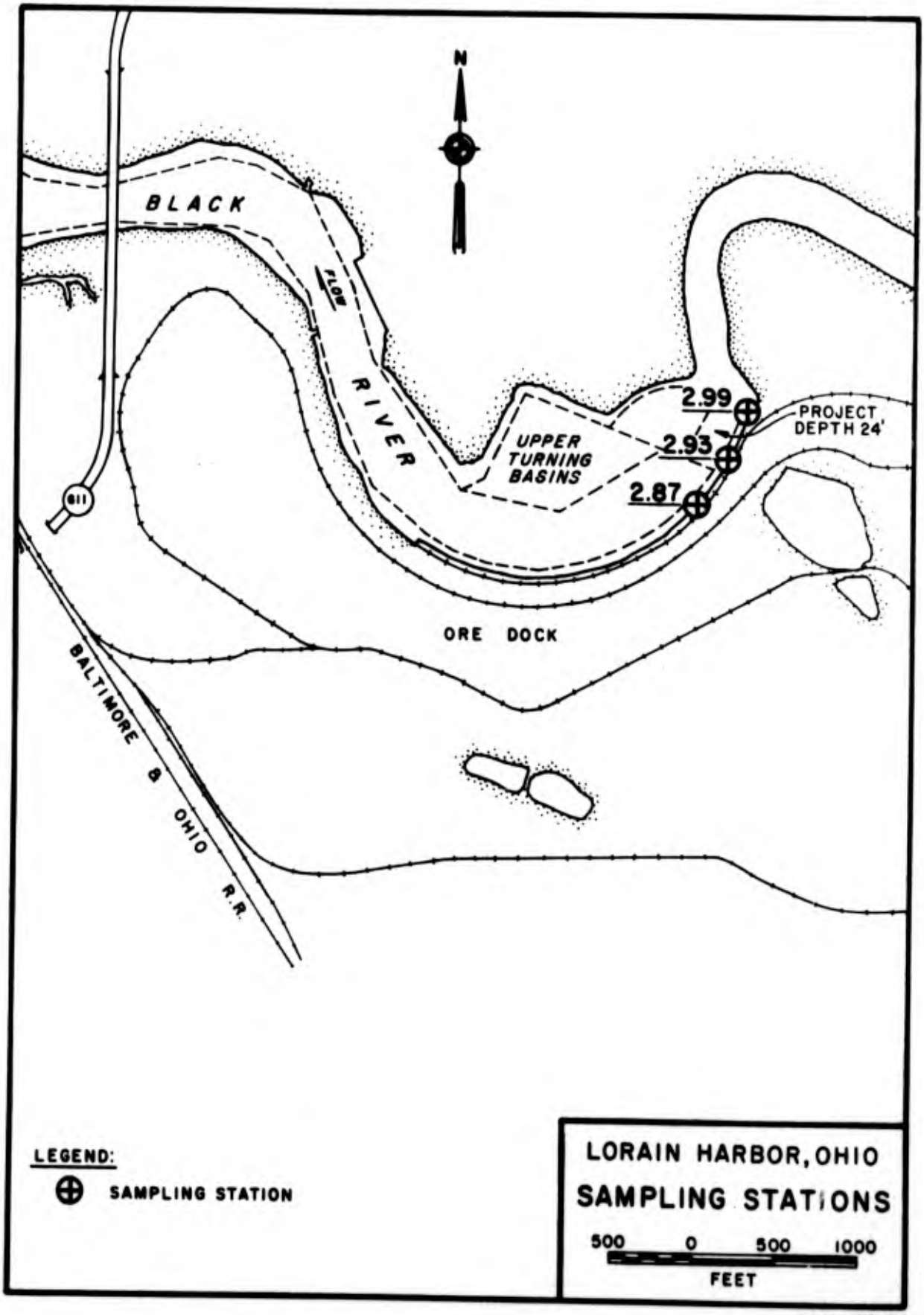

N
BLACK
FLOW
RIVER
2.99
2.93
2.87
PROJECT DEPTH 24'
UPPER TURNING BASINS
611
ORE DOCK
BALTIMORE & OHIO R.R.
LEGEND:
SAMPLING STATION
LORAIN HARBOR, OHIO
SAMPLING STATIONS
500 0 500 1000
FEET

FIG. B5-7

Table B5-9

Hopper Dredge Inflow

Erie Harbor, Pennsylvania [a]

Sample	Temp. °C	Time	Total Coliform (b)	Solids						Kjeldahl Nitrogen			Hydrometer [c] Density 15 min (g/l)	Apparent Sediment Volume 15 min (ml/l)	Total Phosphorus [d]	
				Suspended	Dissolved	Total	Vol.Sus	Vol.Dis.	Total Volatile	Filtered out	Suspended	Total			Suspended	Filtered out
Series [e] 1	1	9/23/67														
1	11.5	0215	542,000	38,247	277	38,524	3,763	93	3,856	7.60	97.40	105.0	43.45	220	32.7	0.03
2	11.0	0330	240,000	67,999	281	68,280	6,231	103	6,334	11.10	197.10	208.2	67.94	390	37.7	0.03
3	11.5	0505	172,000	62,245	281	62,526	6,096	114	6,210	9.30	123.70	133.0	71.10	370	48.7	0.18
4	11.0	0740	79,000	176,487	327	176,814	14,486	138	14,624	17.20	426.20	443.4	173.84	880	42.7	0.11
5	9.5	0800	34,000	168,544	320	168,864	13,896	134	14,030	16.00	387.20	403.2	79.00	870	48.3	0.12
6	10.0	0935	172,000	55,895	275	56,170	2,287	112	2,399	84.60	35.40	120.0	69.52	380	30.0	0.14
Series [f] 2	2	9/24/67														
1	11.0	0205	22,100	214,719	375	215,094	15,088	210	15,298	19.68	489.12	508.8	208.56	950	40.0	0.08
2	10.0	0440	221,000	44,735	302	45,036	4,537	141	4,678	8.46	180.50	189.0	42.66	220	28.3	0.23
3	11.0	0515	70,000	53,050	268	53,318	4,629	113	4,742	8.10	123.90	132.0	57.67	280	29.7	0.18
4	12.0	0740	240,000	172,613	387	173,000	16,330	182	16,512	37.44	538.60	576.0	173.80	760	67.3	0.51
5	12.0	0800	172,000	85,085	333	85,418	8,544	146	8,690	23.28	337.10	360.4	85.16	420	59.7	0.38
6	12.5	1030	542,000	161,829	359	162,188	14,016	180	14,196	37.92	370.10	408.0	161.16	700	88.7	0.34
Series [g] 3	3	9/25/67														
1	12.0	0205	348,000	282,790	580	283,370	21,144	264	21,408	40.60	533.50	574.1	195.92	850	53.7	0.33
2	12.0	0330	109,000	52,564	316	52,880	5,038	126	5,164	15.80	146.20	162.0	60.83	270	43.3	0.23
3		0500	94,000	165,534	360	165,894	13,782	150	13,932	30.70	251.90	282.6	120.08	615	78.3	0.25
4	12.0	0625	94,000	170,390	430	170,820	14,334	174	14,508	31.00	231.80	262.8	170.64	760	84.0	0.31
5	12.5	0740	920,000	152,360	404	152,764	13,316	192	13,508	28.10	348.20	376.3	145.36	700	74.7	0.39
6	12.5	0915	130,000	110,682	406	111,088	10,466	168	10,634	30.50	387.10	417.6	142.20	680	82.7	0.38
Average	11.4		233,394	124,209	349	124,558	10,444	152	10,596	25.41	289.17	314.0	114.94	573	53.6	0.23

a. Solids, Kjeldahl Nitrogen, and Total Phosphorus reported as mg/l
b. Most Probable Number (MPN) / 100ml
c. This table shows dry weight of sediment in one (1) liter of orginal sample.
d. The LEPO chemistry laboratory performed all analyses but does not claim accuracy on unfiltered phosphorus analyses. It was evident early in phosphorus analyses that values were low by perhaps an order of magnitude or more because of incomplete digestion of organic material. The chemistry laboratory, however, was requested to finish the unfiltered phosphorus analyses by the same method, due to time limitations. Future phosphorus analyses of this type are to be done with an improved method. The values for unfiltered phosphorus shown above are presented to provide an indication of probable high content and should in no case be regarded as accurate.
e. Series 1 taken between stations 182 +00 and 196 +00 on Fig. B5-8
f. Series 2, samples 1 through 3 taken between stations 182 +00 and 196 +00, samples 4 through 6 taken between stations 173 +00 and 146 +00 on Fig. B5-8
g. Series 3 taken between stations 418 +00 and 173 +00 on Fig. B5-8

Table B5-10

Hopper Dredge Overflow

Erie Harbor, Pennsylvania [a]

Sample	Temp. °C	Time	Total Coliform (b)	Solids						Kjeldahl Nitrogen			Hydrometer [c] Density 15 min. (g/l)	Apparent Sediment Volume 15 min. (ml/l)	Total Phosphorus [d]	
				Suspended	Dissolved	Total	Vol. Sus.	Vol. Dis.	Total Volatile	Filtered out	Suspended	Total			Filtered out	Suspended
Series [e] 1	8/23/67															
1	12.0	0215	70,000	110,807	295	111,102	8,668	146	8,814	13.30	236.9	250.2	120.08	610	0.01	17.0
2	11.5	0330	49,000	93,066	284	93,350	7,418	137	7,555	12.10	209.9	222.0	85.32	520	0.01	19.7
3	10.5	0505	130,000			150,058			11,606	16.20	351.0	367.2	154.84	790		3.0
4	10.0	0740	23,000	196,694	314	197,008	14,637	151	14,788	12.90	476.7	489.6	195.92	990	0.22	.59
5	10.0	0800	79,000	130,419	291	130,710	10,415	143	10,558	12.60	191.4	204.0	120.08	700	0.10	25.0
6	11.0	0935	70,000	70,668	178	70,846	5,796	132	5,928	8.70	186.3	195.0	74.26	430	0.11	20.0
Series [f] 2	8/24/67															
1	11.0	0205	33,000	112,222	286	112,508	8,346	102	8,448	11.30	271.3	282.6	116.02	480	0.08	19.0
2	11.0	0440	22,100	37,812	296	38,108	3,295	111	3,406	6.15	59.9	66.0	38.71	210	0.05	14.0
3	12.0	0515	46,000	227,749	287	228,036	11,107	107	11,214	11.30	259.9	271.2	158.00	700	0.06	18.7
4	11.0	0740	49,000	151,717	307	152,024	9,648	108	9,756	23.00	319.6	342.6	99.54	520	0.38	34.3
5	12.0	0800	542,000	75,060	300	75,360	6,846	108	6,954	17.80	228.2	246.0	66.36	360	0.29	36.7
6	12.5	1030	79,000	79,421	303	79,924	3,842	115	3,957	18.70	217.5	235.2	83.74	420	0.32	42.0
Series [g] 3	8/25/67															
1	12.0	0205	33,000	98,586	398	98,984	8,796	164	8,960	18.80	137.2	156.0	113.76	350	0.37	31.0
2	12.0	0330	17,000	8,054	266	8,320	806	118	924	5.00	15.4	20.4	7.90	25	0.22	8.3
3		0500	542,000	57,656	334	57,990	5,658	136	5,794	16.70	185.5	202.2	69.32	340	0.25	33.00
4	12.0	0625	22,000	83,616	360	83,976	7,680	168	7,848	21.20	303.3	324.5	91.64	460	0.16	35.7
5	12.5	0740	109,000	58,956	338	59,294	5,690	138	5,828	16.30	154.7	171.0	60.04	310	0.42	44.7
6	12.5	0915	49,000	29,374	322	29,696	2,900	128	3,028	10.30	104.9	115.2	30.02	150	0.26	24.7
Average	11.5		109,122	95,416	303	95,719	7,149	130	7,279	14.02	217.2	231.2	88.09	465	.19	23.74

a. Solids, Kjeldahl Nitrogen, and Total Phosphorus reported as mg/l
b. Most Probable Number (MPN)/100ml
c. This table shows dry weight of sediment in one (1) liter of original sample.
d. The LEPO chemistry laboratory performed all analyses but does not claim accuracy on unfiltered phosphorus analyses. It was evident early in phosphorus analyses that values were low by perhaps an order of magnitude or more because of incomplete digestion of organic material. The chemistry laboratory, however, was requested to finish the unfiltered phosphorus analyses by the same method, due to time limitations. Future phosphorus analyses of this type are to be done with an improved method. The values for unfiltered phosphorus shown above are presented to provide an indication of probable high content and should in no case be regarded as accurate.
e. Series 1 taken between stations 182 +00 and 196 +00 on Fig. B5-8
f. Series 2, samples 1 through 3 taken between stations 182 +00 and 196 +00, samples 4 through 6 taken between stations 173 +00 and 146 +00 on Fig. B5-8
g. Series 3 taken between stations 418 +00 and 173 +00 on Fig. B5-8

Table B5-11

Miscellaneous Data on

Erie Harbor, Pennsylvania

Sediment Chemistry[a]

Location	Date	Total P	Total Fe	Organic N	Kjeldahl Nitrogen	NH_3-N	NO_3-N	% Solids	Volatile Solids	COD	Oil & Grease	BOD_5	Temp° C	Silica
Composite of Station Jkl-1, Jkl-2, Jkl-3	1/2/68	.82			1.90			40.56	.95	125.7	3.98			

Hopper Bin Sediment Chemistry[a]

	Date	Total P	Total Fe	Organic N	Kjeldahl Nitrogen	NH_3-N	NO_3-N	% Solids	Volatile Solids	COD	Oil & Grease	BOD_5	Temp° C	Silica
b	5/26/67	.37	13.2	.37		.05		.70	.19	91.4	.42	1.00	10.0	908.2
b	5/26/67	.46	16.5	.58		.12		.60	.25	32.4	1.31	2.5	11.0	868.0
c	5/26/67	.92	32.7	1.32		.18		.45	.50	78.4	3.08	3.0	10.0	812.0
c	5/26/67	.63	24.6	.95		.13		.58	.35	52.7	1.63	1.9	12.0	864.5

Overflow Slurry Chemistry[a]

	Date				NH_3-N	NO_3-N								
b	5/26/67			85.5	18.0	.20							9.5	
b	5/26/67			218.4	26.4	.23							11.0	
c	5/26/67			347.4	52.2	.15							12.5	
c	5/26/67			112.5	25.8	.18							12.0	

Benthic Fauna[d]

	Date	AMPHITSODA GAMMARUS	ISOPODA ASELLUS	HIRUDINEA HELOBDELLA	HIRUDINEA ARHYNCHOBDELLIDA	OLIGOCHAETA TUBIFICIDEA	TURBELLARIA DUGERIA LIGUMIA	SPHAERIIDAE	DIPTERIA CHIRONOMIDAE	TOTAL
Jkl-1	1/2/68	4	8	8	4	2088	28	8	12	2160
Jkl-3 [e]	1/2/68					Positive		Positive	Positive	

a All chemical parameters are reported as mg/g
b Samples taken between sta. 64+00 and 96+00 as shown on attached map
c Samples taken from same area as Series 3 on table B5-8
d Benthic Fauna reported as organism /m2
e At station Jkl-3 only qualitative analyses were made in addition to the organisms listed as positive, Prosobranchia Valvata, Prosobranchia Amnicula and Argia Sp. (damsal fly) were also present.

Table B5-12

Hopper Dredging (Erie, Pa.)

Hydrometer Density
Specific Gravity

Sample	INFLOW			OVERFLOW		
	0[a]	10 (Seconds)	30	0[a]	10 (Seconds)	30
Series 1 - 5/23/67						
1	1.0275	1.0260	1.023	1.0190	1.018	1.016
2	1.0215	1.021	1.020	1.0270	1.027	1.027
3	1.0225	1.022	1.021	1.0245	1.023	1.020
4	1.0275	1.027	1.026	1.0305	1.030	1.029
5	1.0125	1.012	1.011	1.0190	1.019	1.019
6	1.0220	1.021	1.019	1.0235	1.023	1.022
Series 2 - 5/24/67						
1	1.0330	1.032	1.030	1.0370	1.036	1.034
2	1.0270	1.026	1.024	1.0245	1.024	1.023
3	1.0305	1.035	1.032	1.0250	1.024	1.022
4	1.0275	1.026	1.023	1.0315	1.031	1.030
5	1.0260	1.025	1.023	1.0210	1.021	1.021
6	10.255	1.024	1.021	1.0265	1.026	1.025
Series 3 - 5/25/67						
1	1.0310	1.030	1.028	1.0180	1.017	1.015
2	1.0385	1.037	1.034	1.0050	1.004	1.002
3	1.0190	1.018	1.016	1.0220	1.021	1.019
4	1.0270	1.026	1.024	1.0145	1.014	1.013
5	1.0230	1.022	1.020	1.0380	1.037	1.035
6	1.0225	1.021	1.018	1.0190	1.018	1.016
Average	1.0261	1.0250	1.0229	1.0237	1.0227	1.0215

a Zero second is a straight line calculation from the 10 and 30 second readings.

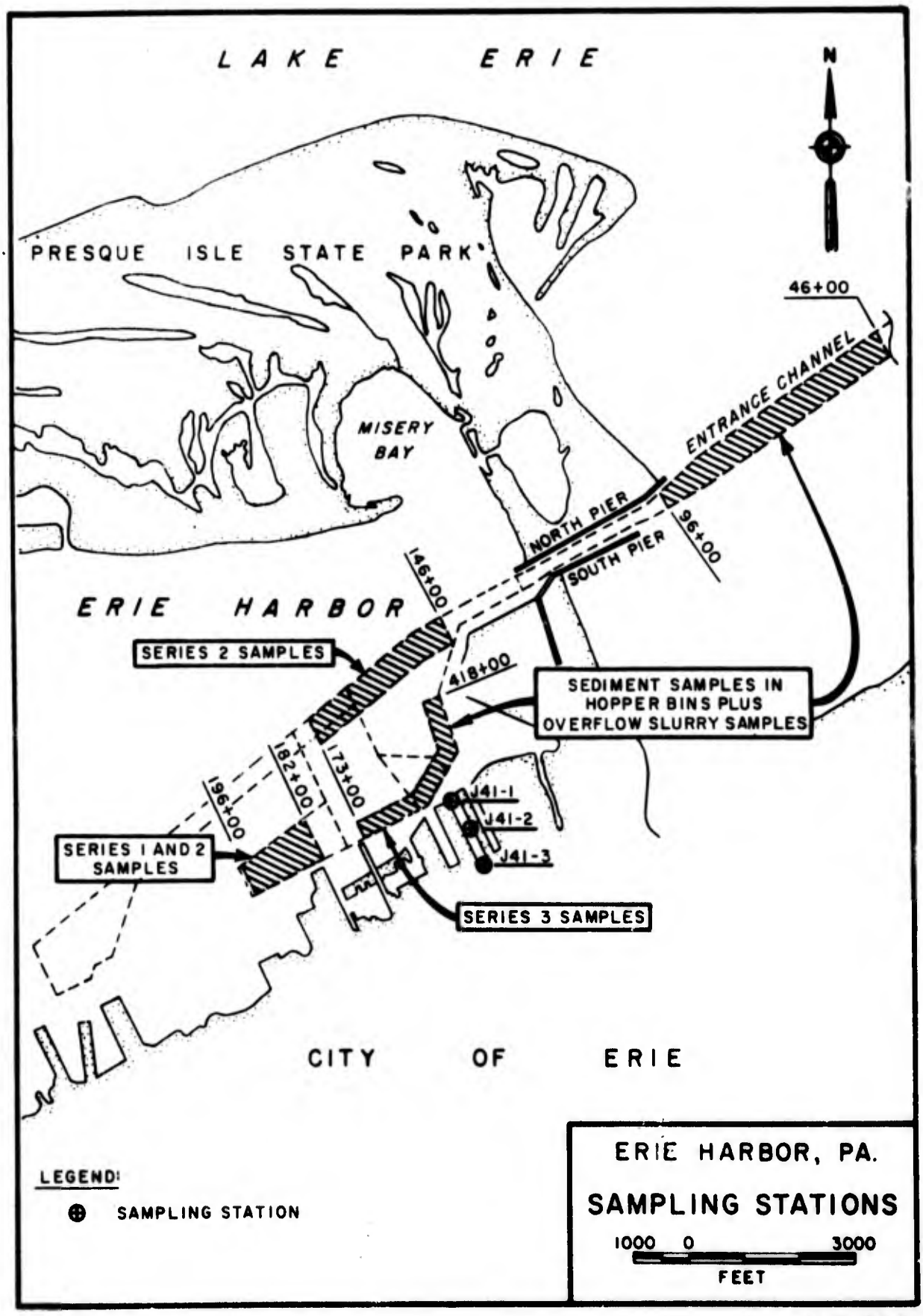

LAKE ERIE
N
PRESQUE ISLE STATE PARK
46+00
ENTRANCE CHANNEL
MISERY BAY
NORTH PIER
SOUTH PIER
96+00
146+00
ERIE HARBOR
SERIES 2 SAMPLES
418+00
SEDIMENT SAMPLES IN HOPPER BINS PLUS OVERFLOW SLURRY SAMPLES
182+00
173+00
196+00
J41-1
J41-2
J41-3
SERIES 1 AND 2 SAMPLES
SERIES 3 SAMPLES
CITY OF ERIE
LEGEND:
SAMPLING STATION
ERIE HARBOR, PA.
SAMPLING STATIONS
1000 0 3000
FEET

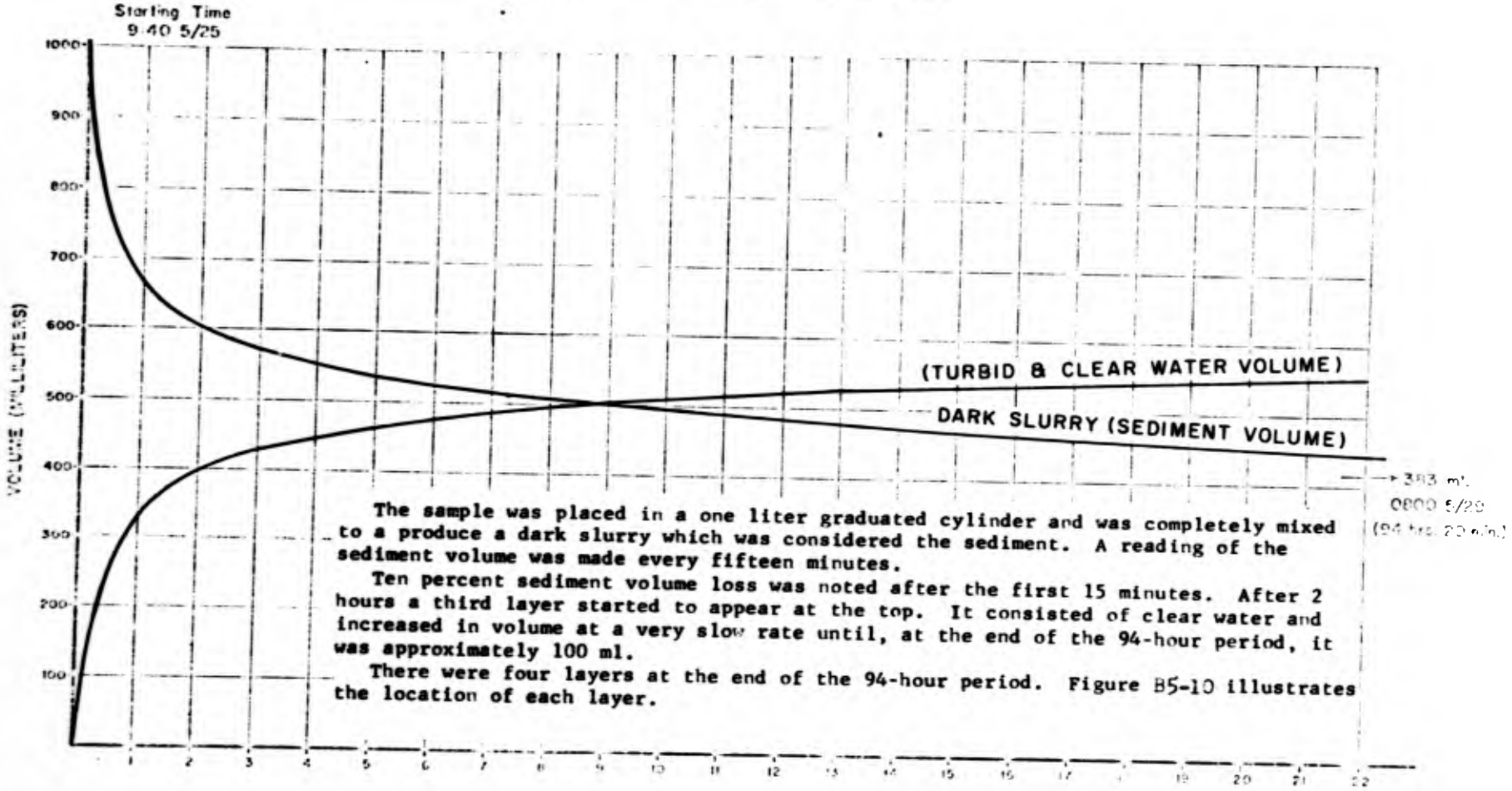
FIG. B5-8

Figure B5-9

Constituent Volume Vs: Time

Intake Sample No. 1 Series No. 2

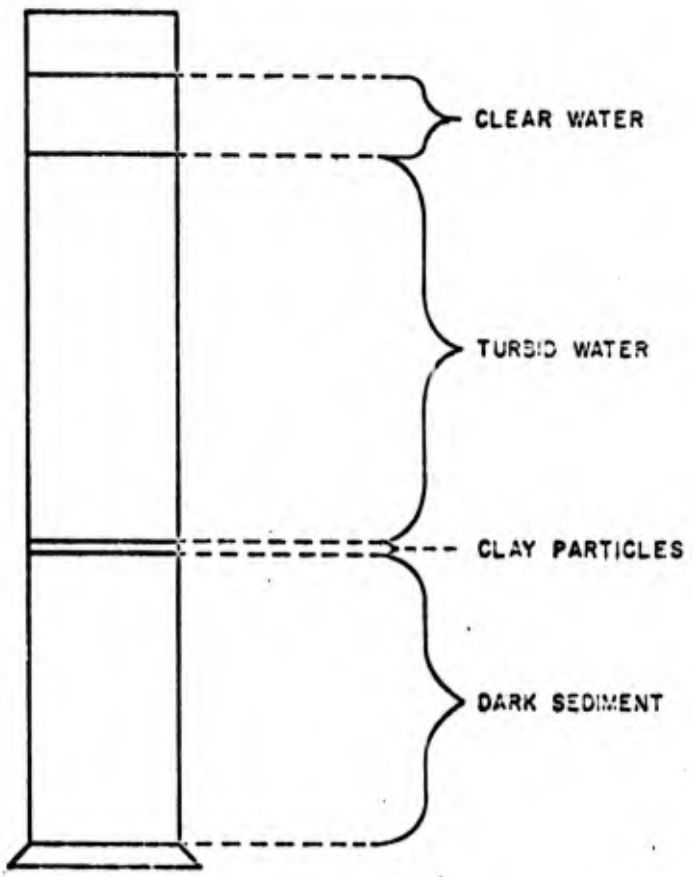
Erie Harbor, Pennsylvania, May 1967



The sample was placed in a one liter graduated cylinder and was completely mixed to a produce a dark slurry which was considered the sediment. A reading of the sediment volume was made every fifteen minutes.

Ten percent sediment volume loss was noted after the first 15 minutes. After 2 hours a third layer started to appear at the top. It consisted of clear water and increased in volume at a very slow rate until, at the end of the 94-hour period, it was approximately 100 ml.

There were four layers at the end of the 94-hour period. Figure B5-10 illustrates the location of each layer.



SAMPLE NO. 1
SERIES NO. 2
DATE 5/24/67
1000 ml. GRADUATED CYLINDER

FIG. B5-10

Table B5-13
Fairport Harbor, Ohio

Bottom Sediment Chemistry 1967[a]

Station #	Date	Time	Secchi[b] Disc	Temp °C Sample	% Solids	Vol. Solids	Total[c] Nitrogen	Org.-N	NH_3-N	Eh[d]	COD	Oil & Grease	Sulfides	Silica	Total P	Total Fe
F26- 1	4/6	0730	7	3	23.53	108.0	3.20	3.14	0.05	242	103.6	2.38	0.47	582.0	2.85	90.1
F26- 1	4/14	0715	5	4	34.28	92.2	2.88	2.86	0.02	366	64.7	6.36	0.35	648.8	3.03	72.9
F27- 6	4/6	0745	7	2	31.71	103.2	2.35	2.33	0.02	144	65.2	1.51	0.26	603.6	2.81	66.9
F27- 6	4/14	0720	7	3.5	36.44	95.4	4.30	4.28	0.02	470	93.6	1.59	0.49	637.2	2.85	64.2
F27- 7	4/6	0800	7		21.46	95.3	1.99	1.96	0.05	241	97.4	2.19	0.39	609.2	5.87	69.4
F27- 7	4/14	0735	8	3.5	46.01	81.7	2.26	2.24	0.02	424	52.5	0.72	0.20	669.2	0.96	61.1
F27-13	4/6	0700	7		29.47	102.2	3.22	3.19	0.03	204	111.4	2.27	0.43	557.2	8.96	61.4
F27-13	4/14	0700	3.5	4	51.27	87.4	4.31	4.29	0.01	494	70.4	2.61	0.20	622.0	2.46	71.4
F27-14	4/5	1000	7	5	73.70	24.6	0.75	0.75	0.01	504	15.0	0.14	0.01	498.8	1.91	28.8
F27-14	4/13	1045	4	3.5	60.06	68.7	3.76	3.75	0.01	169	56.7	1.78	0.13	549.6	2.96	39.0
F27-15	4/5	0930	4.5	8	74.59	18.6	0.33	0.33	0.01	494	9.6	0.11	0.01	794.0	1.09	19.3
F27-15	4/13	1030	3.5	4	75.43	23.2	0.73	0.73	0.01	394	14.1	0.03	0.01	638.8	1.18	23.2
F28- 1	4/6	0930	7	3	28.72	113.1	3.09	3.06	0.02	344	103.5	4.49	0.19	598.4	4.39	107.2
F28- 1	4/13	1315	7	3.5	43.68	92.1	5.16	5.15	0.01	94	66.7	1.69	0.32	634.0	1.85	59.5
F28- 2	4/6	0935	7	3	17.86	149.8	9.87	9.80	0.06	94	137.6	2.97	0.47	540.0	3.30	95.2
F28- 2	4/13	1255	7	4	38.31	90.3	4.08	4.07	0.01	194	77.6	0.42	0.32	612.8	1.54	45.7
F28- 3	4/6	1000	7		77.77	13.5	0.27	0.26	0.01	249	10.9	0.25	0.01	322.0	3.05	22.5
F28- 3	4/13	1245	6	4	38.11	95.0	3.59	3.57	0.02	134	87.7	20.73	0.21	637.2	3.49	65.6
F28- 4	4/6	1020	7	3.5	44.31	92.7	3.01	3.00	0.01	246	82.7	2.51	0.09	569.2	1.83	64.5
F28- 4	4/13	1325	5.5	3.5	45.75	83.3	4.98	4.96	0.02	164	74.3	20.98	0.17	571.6	3.56	44.2
G27- 1	4/5	1240	6	4	32.50	96.2	1.69	1.66	0.03	184	54.2	1.26	0.57	613.4	2.74	66.2
G27- 1	4/14	0820	7	3.5	52.90	94.4	5.26	5.24	0.02	314	64.7	0.96	0.13	600.8	1.97	60.1
G27- 2	4/5	1215	6.5	2	14.42	112.1	4.52	4.44	0.08	254	161.9	3.36	0.64	601.2	1.53	103.3
G27- 2	4/13	1215	8	2	28.93	87.7	4.62	4.60	0.02	144	95.1	0.80	0.37	626.0	2.80	53.2
G27- 3	4/5	1200	7.5	2.5	36.01	48.1	2.27	2.22	0.04	224	73.4	1.47	0.37	590.4	2.47	40.0
G27- 3	4/13	1200	7	3	36.22	92.0	2.89	2.87	0.02	124	74.7	1.66	0.38	644.8	3.06	57.2
G28- 1	4/6	0900	4	2	27.25	102.2	2.00	1.98	0.01	239	72.9	1.87	0.48	563.8	1.91	60.7
G28- 1	4/13	1230	7	3	48.29	53.4	3.25	3.23	0.02	134	54.2	0.21	0.22	626.8	1.68	47.2
Area																
Outside	April 5-6	Average			38.09	84.2	2.75	2.72	0.03		78.5	1.91	0.31	537.0	3.19	61.3
Dump Area	April 13-14	Average			45.40	81.2	3.72	3.70	0.02		67.6	4.32	0.25	622.8	2.38	54.6

(Table continued on next page)

Table B5-13 Cont.

Fairport Harbor, Ohio

Bottom Sediment Chemistry 1967[a]

Station #	Date	Time	Secchi[b] Disc	Temp °C Sample	% Solids	Vol. Solids	Total[c] Nitrogen	Org.-N	NH_3-N	Eh[d]	COD	Oil & Grease	Sulfides	Silica	Total P	Total Fe
F27- 4	4/5	1100	7	4	52.10	77.7	2.56	2.55	0.01		36.2	0.67	0.09	440.8	2.11	37.6
F27- 4	4/13	1115	3	3.5	66.93	86.7	2.97	2.96	0.01	64	47.8	0.63	0.07	430.8	1.11	37.8
F27- 8	4/6	0830	-	-	37.52	90.6	2.00	1.97	0.03	247	71.5	1.88	0.36	542.4	2.16	49.6
F27- 8	4/14	0745	3.5	4	39.19	96.9	2.11	2.09	0.01	444	65.[illegible]	1.07	0.45	523.6	2.83	50.3
F27- 9	4/5	1040	7.5	2	37.05	89.4	2.30	2.13	0.04	94	72.3	0.67	0.28	554.0	2.59	38.8
F27- 9	4/13	1145	7	2.5	41.81	88.9	3.20	3.18	0.02	194	60.7	0.88	0.25	610.1	2.65	61.9
F27-11	4/6	0840	7	3.0	40.68	85.0	1.84	1.82	0.02	144	57.8	0.98	0.21	385.6	3.47	39.1
F27-11	4/14	0800	5.5	3.5	59.11	64.3	1.67	1.66	0.01	494	41.9	0.27	0.10	587.2	1.76	42.6
F27-12	4/5	1030	6	4	63.92	40.5	1.64	1.63	0.01	394	34.6	0.53	0.04	426.0	1.86	32.4
F27-12	4/13	1100	6	3	62.35	85.9	2.52	2.50	0.01	354	58.4	0.69	0.16	568.4	2.50	38.2
Disposal	April 5-6	Average			46.25	76.6	2.07	2.02	0.02		54.4	0.94	0.19	469.7	2.43	43.5
					53.87	84.5	2.49	2.48	0.01		54.8	0.70	0.21	544.0	2.17	46.1
G R -0.5	4/5	0830	1.5	12	30.61	170.7	1.79	1.76	0.02	124	97.1	1.81	0.43	294.8	4.84	59.1
G R -1.0	4/5	0800	1.5	12	35.80	185.0	2.47	2.43	0.04		71.4	0.75	0.12	191.6	3.72	43.0
G R -1.5	4/5	0730	1.5	12	35.92	16.4	9.76	9.74	0.02		186.4	0.64	0.26	315.6	3.70	45.9
F27- 2	4/5	0845	1.3	12	49.01	155.5	1.29	1.29	0.06	204	69.4	0.80	0.24	302.8	3.02	46.7
F27-16	4/5	0900	1.5	6	56.57	155.6	4.90	4.90	0.01	144	115.9	3.52	0.23	449.2	2.62	17.9
F27-17	4/13	1015	1.5	8	65.87	44.5	1.13	1.12	0.01	214	23.5	0.49	0.03	761.6	1.45	23.4
Area Within Break-Water	Average				45.63	121.2	3.56	3.54	0.03		93.9	1.33	0.22	385.9	3.22	39.3

a Chemical parameters reported as mg/g Dry weight analysis

b Average depth at disposal area and vicinity 55 ft., average depth at harbor 24 ft.

c NO_3-N parameter showed at one station which was F28- 2, the value was .01 mg/g

d Eh - Oxidation Reduction Potential recorded in millivolts

Table B5-14

Fairport Harbor, Ohio

Benthic Fauna 1967[a]

Station	Date	Depth (ft.)	Oligochaetae (Sludgeworms)	Diptera		Sphaeriidae (Fingernail Clam)	Hirudinae (leech)	Prosobranchia (Snail - Gill)	Total	Visual Sediment Remarks
				Tendipedidae	Others					
GR-1.5[b]	4/5	13		11	11				22	5 Gammarus sp. in sample 5 unknown + leaves-fishy odor
GR-1.0	4/5	24			16				16	Fine sand-white + black sludge
GR-0.5	4/5	28	16	16					32	Gelatinous sludge-fine sand
F26-1	4/6	60	33			16			49	Organic sludge-65 Isopods
F27-2	4/5	27	33						33	Gelatinous organic sludge
F27-4	4/5	59	1732	49					1781	Sand + organic sludge
F27-6	4/6	61	82	16		16			114	Organic sludge
F27-7	4/6	60	98	16					114	Organic sludge
F27-8	4/6	58	98	33					131	Organic sludge - sl. H_2SO_4
F27-9	4/5	61	65	16		261			342	Organic sludge - sl. H_2SO_4
F27-11	4/5	56	17,794						17,794	Sand-thin overlay of organic sludge
F27-12	4/6	62	2,402						2,402	90% sand-10% organic sludge
F27-13	4/6	52	1,160	212					1,372	Organic sludge
F27-14	4/5	36	294			33			327	Sand-trace of organic sludge
F27-15	4/5	31	No Organisms						0	Fine sand
F27-16	4/5	25	147	33					180	Firm organic sludge
F28-1	4/6	57	229	33			16		278	Organic sludge - sl. H_2SO_4 16 Isopods
F28-2	4/6	56	278	16		180	33	65	572	Organic sludge - sl. H_2SO_4
F28-3	4/6	56	477						477	Sand-thin overlay of organic sludge
F28-4	4/6	47	2,909			16	16		2,941	Organic sludge - sl. H_2SO_4
G27-1	4/5	63	16	261					277	Organic sludge-16 Isopods
G27-2	4/5	65	65			294	16	16	391	Organic sludge-82 Isopods
G27-3	4/5	63	147	196		16			359	Organic sludge - sl. H_2SO_4
G28-1	4/6	63	376	180		16			588	Organic sludge - mod. H_2SO_4 16 Isopods

a Benthic Fauna reported as organisms per square meter
b Grand River

Table B5-15

Fairport Harbor, Ohio

Miscellaneous Data 1967[a]

Hopper Bin Sediment Chemistry

Station	Date	Total Fe	Organic-N	NH_3-N	NO_3-N	% Solids	Volatile Solids	COD	Silica	BOD	Alk	Cond (μmhos/cm)	Cl	Phenol (μg/l)	Ph
b	4/14	42.3		.38		55	92	68.0	555.7	2.3					
c	4/19		[illegible]	.32		50	78	73.9	534.7	2.0					
d	4/20		1.48	.39		59	28		853.3	.8					
e	4/21		1.22	.67		47	73		585.4	1.6					

Overflow Slurry Chemistry

b	4/14		207.0	18.0	.45						230	3,100	1,120		8.0
c	4/19		135.0	9.0	.38						95	4,700	1,620	185.0	8.1
d	4/20		194.4	33.0	8.50						190	2,120	825	48.9	7.4
e	4/21		176.4	20.4	1.38						180	2,880	1,280	83.0	7.8

a. Chemical parameters reported as mg/g
b. No stations indicated on original sampling survey
c. Sampled between stations 38 + 00 and 77 + 00 as shown in Fig. B5-12
d. Sampled between stations 0 + 00 and 23 + 00 as shown in Fig. B5-12
e. Sampled between stations 0 + 00 and 50 + 00 as shown in Fig. B5-12

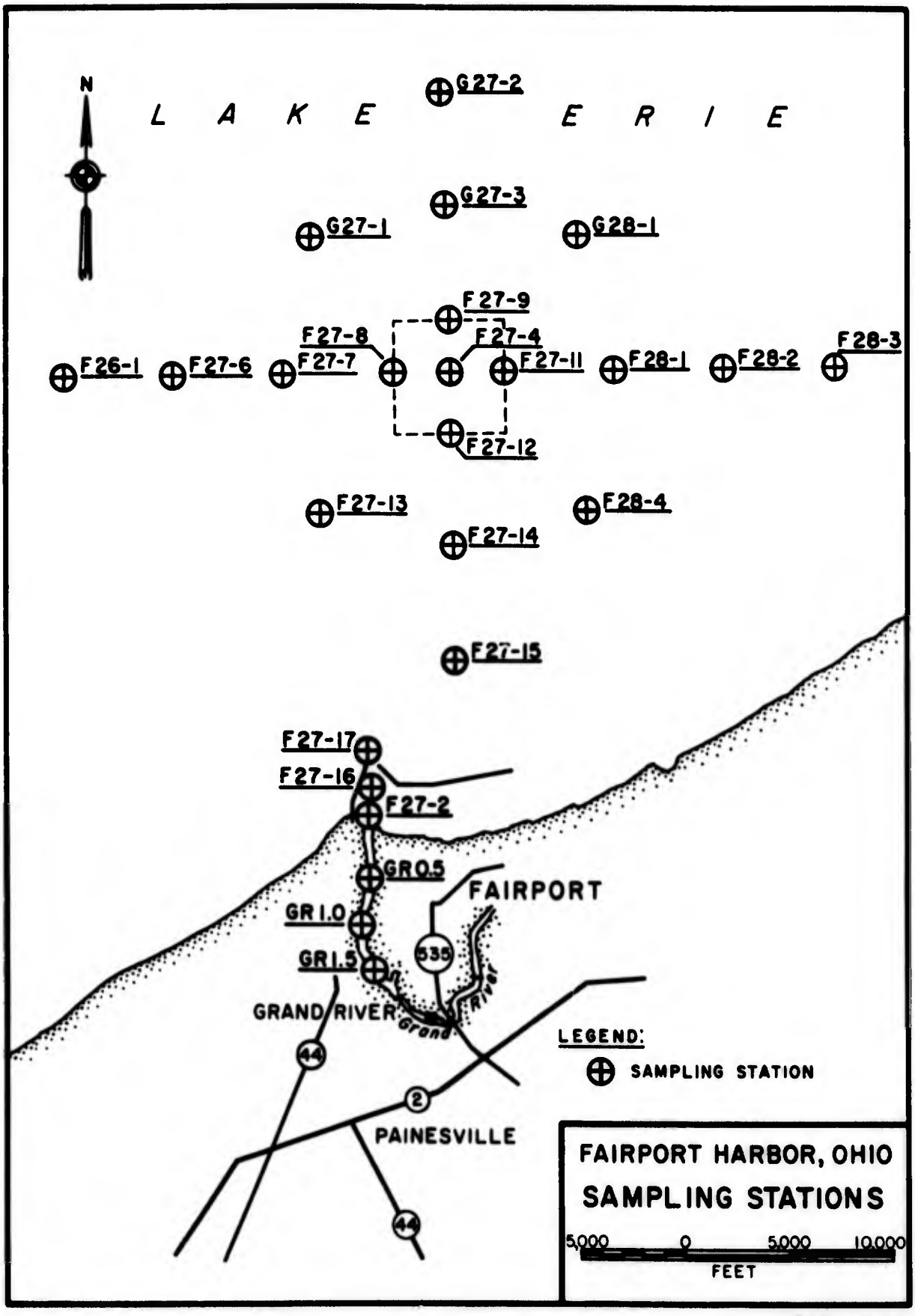

N
LAKE ERIE
G27-2
G27-3
G27-1
G28-1
F27-9
F27-8
F27-4
F26-1
F27-6
F27-7
F27-11
F28-1
F28-2
F28-3
F27-12
F27-13
F28-4
F27-14
F27-15
F27-17
F27-16
F27-2
GR0.5
FAIRPORT
GR1.0
GR1.5
535
GRAND RIVER
Grand River
44
2
PAINESVILLE
LEGEND:
SAMPLING STATION
FAIRPORT HARBOR, OHIO
SAMPLING STATIONS
5,000 0 5,000 10,000
FEET

FIG B5-11

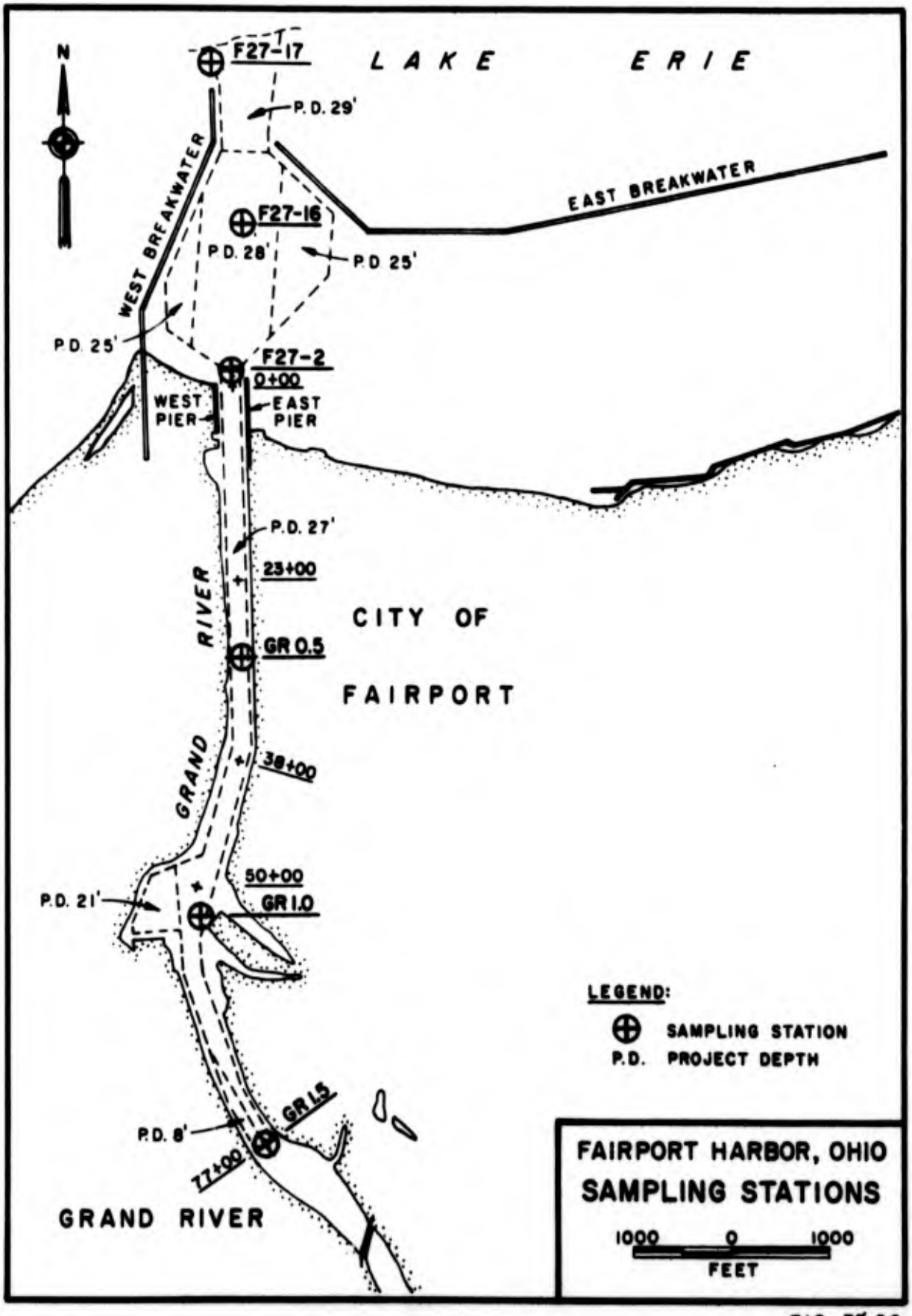

N
F27-17
LAKE ERIE
P.D. 29'
WEST BREAKWATER
EAST BREAKWATER
F27-16
P.D. 28'
P.D. 25'
P.D. 25'
F27-2
0+00
WEST PIER
EAST PIER
P.D. 27'
23+00
RIVER
CITY OF
GR 0.5
FAIRPORT
GRAND
38+00
50+00
P.D. 21'
GR 1.0
LEGEND:
SAMPLING STATION
P.D. PROJECT DEPTH
GR 1.5
P.D. 8'
77+00
GRAND RIVER
FAIRPORT HARBOR, OHIO
SAMPLING STATIONS
1000 0 1000
FEET

FIG. B5-12

Table B5-16

Water and Sediment Chemistry Analysis

Sandusky Harbor, Ohio 1967

Type Sample	Date	Total Coliforms (org/l)	Total P	Soluble P	COD	Cl. Demand (15 min.)	Total Kjel Nitrogen	Total Kjel Filtered	Suspended Solids	Dissolved Solids	Total Solids	Vol. Suspended Solids	Vol. Dissolved Solids	Total Volatile Solids
Dredge Inflow[a]	12/4[c]	17,200	35	.17	17,000	3,400	756	23	279,203	317	279,520	20,833	209	21,042
Dredge Inflow	12/5[d]	23,000	36	.33	19,000	3,500	244	29	282,552	286	282,838	22,961	167	23,128
Dredge Inflow	12/6[e]	130,000	29	.17	21,000	3,900	933	20	304,065	315	304,380	24,780	174	24,954
Dredge Overflow[a]	12/4	13,000	16	.27	8,000	1,800	318	22	107,650	276	107,926	8,951	155	9,106
Dredge Overflow	12/5	33,000	31	.17	11,000	2,200	504	23	150,421	233	150,654	12,754	124	12,878
Dredge Overflow	12/6	130,000	26	.17	12,000	2,700	585	27	178,230	310	178,540	14,478	176	14,654
							Total Kej.				% Solids			
Hopper Sediment[b]	12/4		.58		63.1	12.4	2.34				54.53			78
Hopper Sediment	12/5		.51		64.7	14.3	2.32				54.13			70
Hopper Sediment	12/6		.44		61.3	18.7	2.92				56.10			71

a. Chemical parameters for inflow and overflow are reported as mg/l
b. Chemical parameters for hopper dediment are reported as mg/l
c. Sampling on 12/4 comes from stations 135+00 to 70+00 on Fig. B5-13
d. Sampling on 12/5 comes from stations 135+00 to 105+00 on Fig. B5-13
e. Sampling on 12/6 comes from stations 70+00 to 20+00 on Fig. B5-13

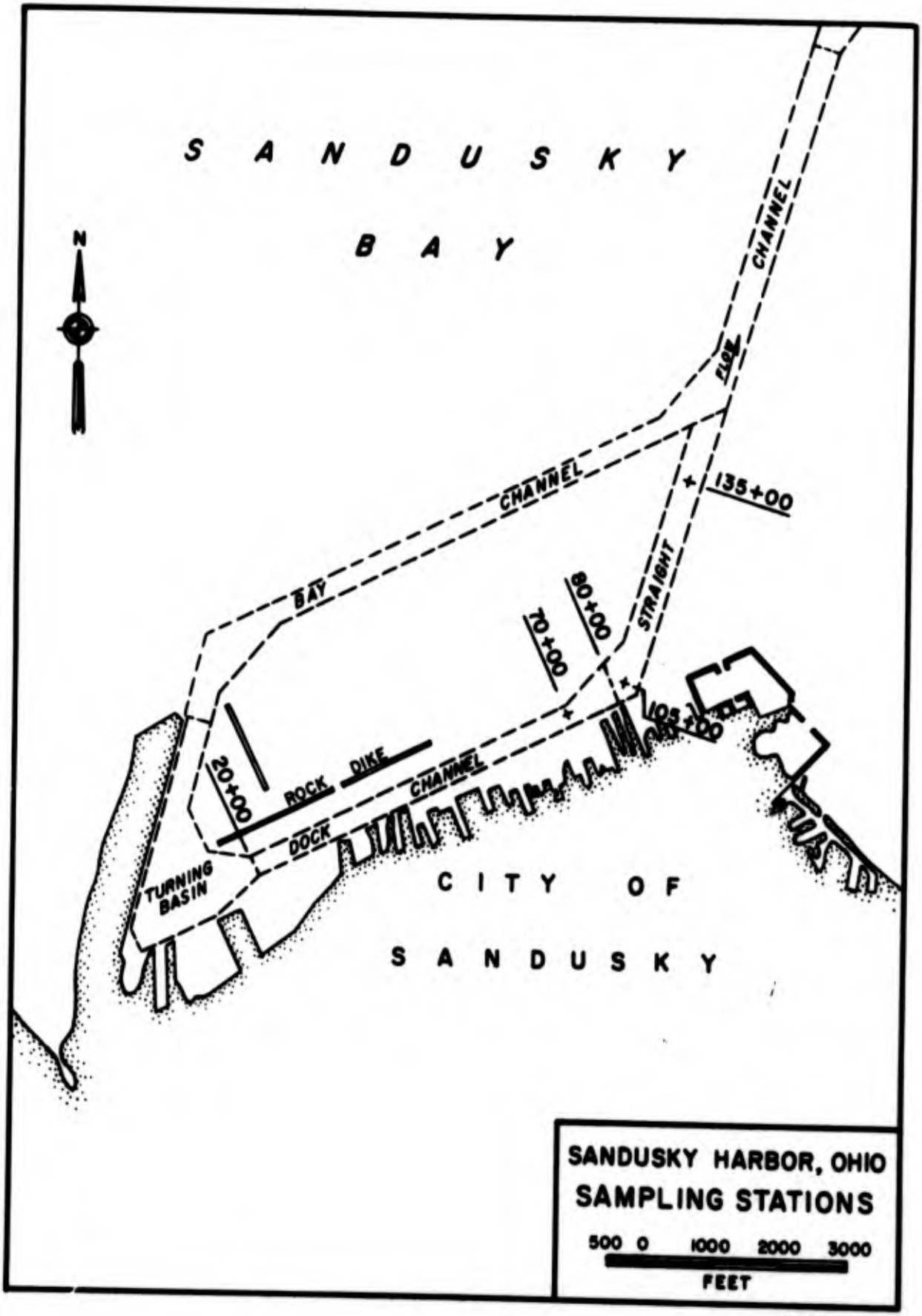

SANDUSKY
BAY
N
FLOE CHANNEL
CHANNEL
135+00
BAY
STRAIGHT
80+00
70+00
105+00
20+00
ROCK DIKE
CHANNEL
DOCK
TURNING BASIN
CITY OF
SANDUSKY
SANDUSKY HARBOR, OHIO
SAMPLING STATIONS
500 0 1000 2000 3000
FEET

FIG. B5-13

Table B5-17

Miscellaneous Harbor Sampling[a]

1967

Harbor	Type Sample	Date	Alk	Cond (umhos/cm)	Dissolved Solids	Total Solids	Cl	Total P	Soluble P	Organic N	NH_3-N	NO_3-N	Phenols (µg/l)	Ph
Huron	Overflow[b]	4/11	480	520			23			99.0	10.8	.18	10.8	7.1
Cleveland	Overflow[b]	3/31	115	540	326	7,105	60	13.87	.16	99.00	12.0	.18	10.5	7.5
Cleveland	Overflow	3/31	90	620	352	45,508	56	25.73	.06	75.00	7.8	.15	12.0	7.4

Harbor	Type Sample	Date	Total Fe	Volatile Solids	Total % Solids	BOD	Silica
Huron	Hopper Sediment[c]	4/11	19.5	35	63	1.2	844.6

a. Maps and sampling stations were not included with these harbors
b. Chemical parameters in mg/l
c. Chemical parameters in mg/g

APPENDIX B5

GLOSSARY

Conductivity:	Conductivity (Cond) indicates the relative concentrations of dissolved ions in a sample. It is reported as micromhos (μmhos) /cm distance between electrodes.
Kjeldahl-Nitrogen:	Includes both ammonia and organic nitrogen, but does not include nitrite and nitrate nitrogen. Measurements are made by the Kjeldahl method.
Phenols:	Phenols are waste products of oil refineries, coke plants, and some chemical producing facilities. Amounts approaching 1 mg/l can impart an objectionable taste to a water following marginal chlorination.
Secchi Disc:	An eight-inch circle with alternate black and white quarters which is used to measure transparency of the water.
Turbidity:	Turbidity in water is caused by the presence of suspended matter, such as clay, silt, finely divided organic matter, plankton, and other microscopic organisms. The turbidities reported in table B2-5 represent the turbidity that would exist if an equivalent amount of Silicon dioxide were present.
Volatile Solids:	Solids that could be suspended or dissolved. When separate from the water they will combust.

APPENDIX B5

LIST OF ABBREVIATIONS

Alkal, Alk	Alkalinity
BOD	Biochemical Oxygen demand
Cl	Chlorine
COD	Chemical Oxygen demand
DO	Dissolved Oxygen
Fe	Iron
NH_3-N	Nitrogen (Ammonia)
NO_3-N	Nitrogen (Nitrate)
Org-N	Nitrogen (Organic)
pH	Phosphorus
P	Hydrogen ion concentration
Silica	Sand (SiO_2)
S-PO_4	Soluble phosphate
T-PO_4	Total phosphate