

LAKE MICHIGAN STUDIES

Special Report Number LM 2

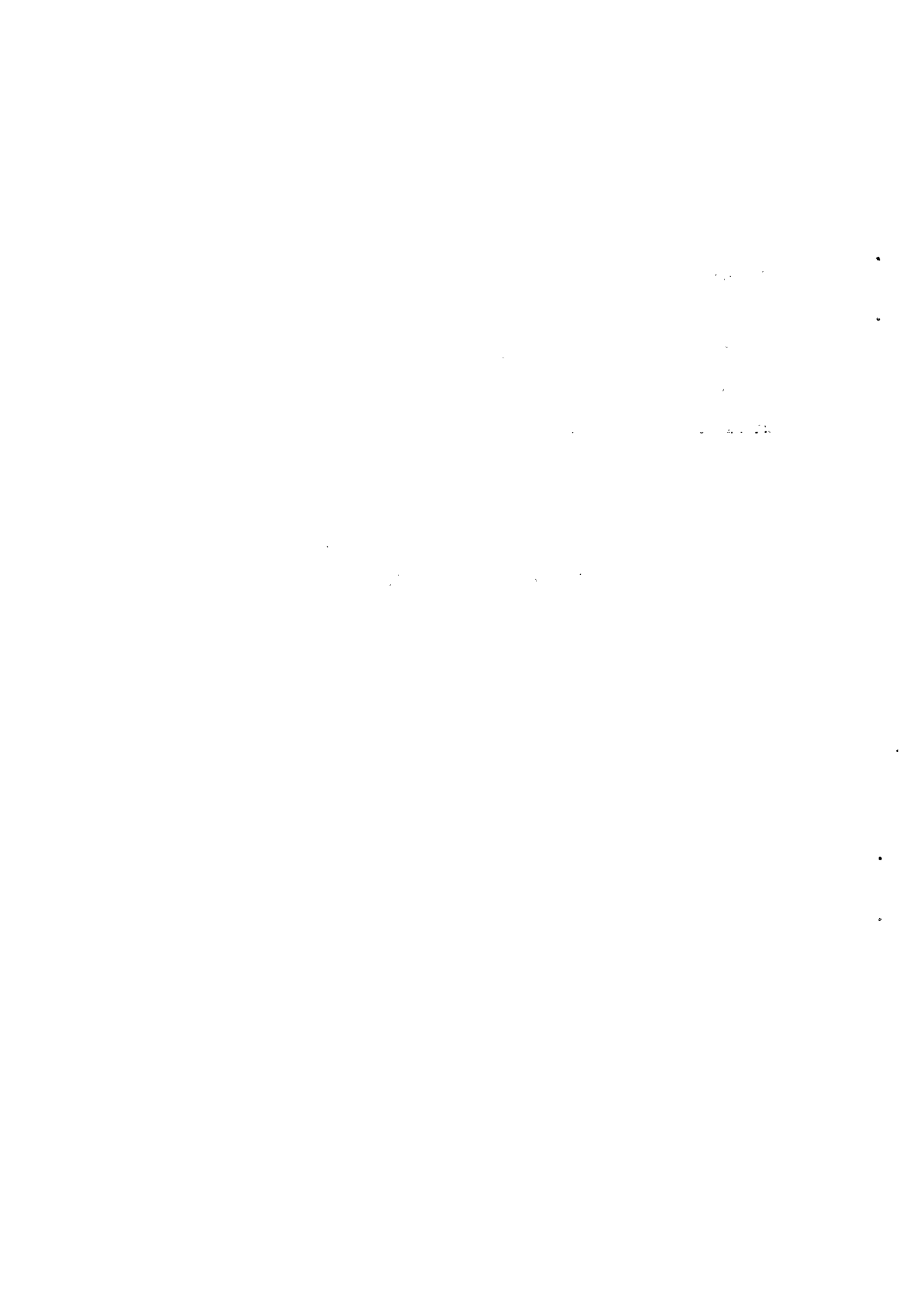
SAMPLING SURVEYS

April, 1963

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Water Supply and Pollution Control
Great Lakes-Illinois River Basins Project

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INTRODUCTION

This report is one of a series covering water quality surveys conducted in Lake Michigan in 1962 by the Great Lakes-Illinois River Basins Project. It presents information on sampling-point locations, summarizes field procedures, and describes apparatus used in carrying out the surveys. Subsequent reports of the series will give details concerning the physical, chemical, biological, microbiological, and radiochemical investigations; will present the findings with respect to each of these aspects of lake water quality; and will draw conclusions regarding the significance of the findings to the problem of preserving lake water quality in the light of existing and potential contaminating influences.

Sampling operations in Lake Michigan began on April 24, 1962 and eight cruises were completed by December 6, 1962. A total of 358 stations were sampled during this period. Return trips were made to some stations (see Table 4) and the total number of station stops or calls was 474.

Three vessels were used during these cruises: the M/V (Motor Vessel) Cisco and M/V Kaho which are owned and operated by the U. S. Bureau of Commercial Fisheries, and the R/V (Research Vessel) Maurice Fitzgerald which is owned and operated by an oceanographic research company, The Geraldines Ltd. of Annapolis, Maryland.

SURVEY SCOPE AND OBJECTIVES

Scope

This Lake Michigan Sampling Survey covered the entire Lake and three harbors: Chicago, Milwaukee, and Racine (see Table 1).

In sampling the Lake, three principal areas of study were selected:

1. The deep-water main body of the Lake.
2. The inshore area (waters adjacent to the shoreline).
3. The waters in and adjacent to principal harbors and tributaries.

At every station, sampling was performed in each zone of the thermal regime and at depths that, in total, represent the vertical profile at that station (see Table 2).

A list of all stations sampled during the period April 24 to December 6, 1962, with types of stations and stops made on each cruise, is presented in Table 4.

Objectives

The primary objective of the Sampling Survey was to obtain scientific and factual data useful in developing information for the complete Lake Michigan Studies.

Some analyses were performed immediately on shipboard; for others, samples were prepared and preserved for more complete analysis at the Project headquarters laboratory (see Table 3).

In addition to sampling and analysis at each station, as many as ten measurements and observations were performed and recorded for study. (See SAMPLING PROCEDURES).

DESCRIPTION OF SAMPLING STATIONS

Extended Range Stations (Figures 1, 2, 3, and 4)

These stations extend throughout the deep-water main body of the Lake and were chosen to coincide with the stations to be used for lake current measurements. Because of special interest and the possibility of greater variability of water quality in the Southern Basin, extra stations were inserted between the proposed current meter locations.

Inshore Stations (Figures 1, 2, 3, and 4)

Inshore stations, also referred to as "along shore" or "shore-line," were located along lines parallel to the shore and respectively one, four, seven, and ten miles out, to provide intensive coverage between shallow waters and deeper regions of the Lake. The density of these stations decreased with distance from shore, e.g., there were fewer ten mile stations than seven mile stations, more four mile stations than seven mile stations, with the greatest number of stations at one mile. Most of the inshore stations were located in the southern half of the Lake, where concentrations of population and industry were greatest, with only scattered stations in other regions of the Lake.

Stations in Harbor and Tributary Areas (Figures 5, 6, and 7)

Racine and Milwaukee Harbors

Within the breakwall, stations were located at approximately quarter-mile intervals along lines parallel to the shore. Stations were placed in increments of one-quarter to one-half mile from shore, depending upon the location of the breakwall. Where necessary, there was an extension of these stations north and south of the breakwall.

Outside the breakwall, stations were located on radii originating from the point at which the main channel flowed through the breakwall, or, in the case of a tributary, on lines radiating from its mouth. Relative placement of these stations was similar to stations within the breakwall. These stations extend a maximum of three miles from shore.

Chicago Harbor

Since the Chicago River normally flows out of, rather than into, Lake Michigan, only a limited number of stations were established in this area. These stations were placed on a line extending two miles north and south of the Chicago River, and extend a maximum of one and one-half miles from shore.

SAMPLING PROCEDURES

Initial Steps

The master of the vessel determines when the ship is on station by conventional navigational procedures. The research vessels are equipped with radar, radio direction finder (RDF), and sextants. As soon as the ship is on station, a bathythermograph (see DESCRIPTION OF FIELD APPARATUS) cast is immediately made. The depth of the water is then determined by the plot on the recording fathometer and checked by the trace on the BT slide. A marker buoy is then cast overboard to mark the sampling point; between drops the vessel is run up to this marker buoy to compensate for drift due to wind and/or current. While the ship is on station, no activities which would discharge waste overside are conducted.

Setting the Sampling Line

The ship's sampling line, a winch-operated oceanographic cable, is rigged with a 15 pound lead weight when line-clamped sampling devices are being used. When dredging is in progress, this weight is not used. The first sampling device is placed about 2 meters above this bottom weight. This weight prevents the sampling gear from bottoming and serves to keep the line taut, as well as serving as a stabilizer to prevent the line from whipping. The sampling line is led over a pulley having a circumference of 1 meter. By reading a revolution counter on the pulley wheel, the amount of line let out or retrieved can be determined. This enables sampling personnel to determine where to clamp the sampling devices to maintain the proper relationship with each other and the depth of the water.

Sampling

The various types of sampling devices are actuated serially by messengers which slide down the oceanographic line. Sampling devices for the collection of water samples at the various depths are serially tripped. The first device trips a messenger and also releases a messenger which, in turn, triggers the device next below it on the line. Any number of devices can be triggered, one after another, using these mechanisms. Generally the oceanographic line is held in contact with the fingers and as each messenger triggers the next lower sampling device on the line, a shock is transmitted up the line. When the number of shocks corresponds to the number of sampling devices on the line, that particular phase of the sampling is over and the winch is reversed and the string of sampling devices is retrieved. Each

sampler is removed from the line, in the reverse order to which it went on, as it is brought up to the sampling platform. These numbered devices are carefully removed and placed in racks according to number.

To collect the multiple samples necessary at a station, several drops are necessary; between drops the vessel is realigned with the reference buoy. Drops at a typical station might be in this order: polyvinyl chloride water bottles of six-liter capacity for chemical analyses; Nansen bottles with reversing thermometers for chemical samples and accurate temperature measurement; bacteriological samplers of the J-Z type; a vertical plankton tow net; and, finally, dredging for bottom sediments and organisms using a bottom sampling device. (For further information about sampling devices mentioned, see DESCRIPTION OF FIELD APPARATUS).

Measurements and Observations

While sampling is in progress, the following measurements and observations are also made:

A bathythermograph is let down to the bottom from the other side of the vessel to determine the vertical temperature profile, as previously described.

A secchi disk is lowered and raised to determine the limit of visibility. On the first cruise, a hydrophotometer was also available for light penetration measurements.

Air temperature was taken in °F.

Wind speed is measured with an anemometer when available.

Wind direction, cloud cover, sea state, visibility and general weather conditions are recorded.

Time on Station

The length of time required at each station is determined by the depth of that particular station and weather conditions. However, elapsed time seldom exceeds 45 minutes.

Work Performed Between Stations

While the vessel is enroute to the next station, the samples are removed from the various devices and some portions are analyzed aboard ship; the remainder are preserved for analysis at the headquarters laboratory. (See Tables 3-a and 3-b)

DESCRIPTION OF FIELD APPARATUS

Polyvinyl Chloride Water Bottle

This device is made of polyvinyl chloride (PVC); is cylindrical in shape; and collects a six-liter sample. Both ends of the cylinder are open when it is cocked, and the ends are sealed water-tight with contoured rubber cups when actuated. The water is then trapped inside and represents a sample at the depth of sampler. A hose, pinched shut during the sampling operation, is used to withdraw the sample following retrieval. (See Figure 8)

The PVC sampler was used for the collection of samples for all chemical analyses and for samples analyzed for chlorophyll density and plankton algae.

Nansen Bottle

The Nansen bottle (Figure 8) is a reversing bottle fitted with two plug valves and holding from 1100 to 1250 ml (milliliters) of water. The two plug valves, one on each end of the brass or bronze cylinder, are operated synchronously by means of a connecting rod which is fastened to the clamp that secures the bottle to the sampling line. When the bottle is lowered, this clamp at the lower end and the valves are in an open position. In this open position, the water passes through the Nansen bottle. The bottle is held in this open position by a release mechanism which passes around the sampling line. When the messenger from the surface travels down the line it strikes the release attached to the Nansen bottle. The bottle falls over and turns through 180° and shuts the valves, which are then held closed by a locking device.

Reversing thermometer frames are attached to the Nansen bottle and reversal of the bottle actuates the reversing thermometer. When the bottle reverses, it releases another messenger attached to the clamp. This second messenger closes the next lower bottle, which releases a third messenger, etc.

Nansen bottles are made from various noncorrosive materials, usually brass or bronze. They are coated with lacquer, are silver plated, or may be lined with some plastic material such as teflon. This lining prevents the metal of the bottle from contaminating the samples.

J-Z Type Bacteriological Sampler (Zo-Bell)

This device, developed by Professor Zo-Bell, is composed of a metal brace which holds a previously sterilized sample container. This container consists of a 250 ml bottle with a rubber stopper through which is placed an open glass tube. On the end of this tube, extending out of the bottle, is a rubber tube that has a sealed glass tube extending from its other end. When the device is actuated, the sealed glass tube is broken and the water enters the bottle. The rubber tubing, which is approximately six inches long, springs away from the metal brace when the glass tube is broken. This feature is to insure against any contamination of the sample by the brace. (See Figure 8)

This sampler was used on all cruises except the first for collecting samples for bacteriological analyses.

Petersen Dredge

The Petersen dredge is widely used for taking samples from hard bottoms such as sand, gravel, marl, clay and similar materials. It weighs from 35 to 70 pounds according to the weights used. The Petersen dredge is generally constructed of iron and is built so that its own weight and the leverage exerted by its closing mechanism bites its way into hard bottoms, deeply enough to secure satisfactory samples.

This dredge incorporates a locking mechanism which is self-releasing when tension on the line is slackened. This tripping device consists of a horizontal locking bar which holds the dredge open until it reaches bottom and the tension is taken off the cable. When tension is reapplied to the cable, leverage is exerted on the jaws by means of cross bars. This motion tends to both close the jaws and force them into the bottom being sampled.

The particular size of Petersen dredge used encloses an area of about 1/10 square meter. Figure 9 shows a sample being emptied from the dredge into a tub.

Vertical Tow Plankton Net

This device consists of a conical shaped, #20 mesh nylon bolting cloth net, 1.5 meters in length, 0.5 meters in diameter at the top, and 0.08 meters diameter at the bottom (see Figure 9). Attached to the bottom is a small metal bucket with large openings in its sides filled with the same fine mesh netting.

When the net is brought up, plankton trapped on the inside surface are washed down into this bucket using a hose on the outside

of the net to prevent contamination of the sample by plankton contained in the wash water. The bucket is removed and the plankton are washed into a sample jar through a stopcock located at its base. (See Figure 9)

Secchi Disk

This is a circular plate 20 centimeters in diameter, the upper surface of which is divided into four equal quadrants, alternately painted black and white. It is lowered on a graduated line and its depths of disappearance and reappearance are averaged and recorded as the limit of visibility.

Reversing Thermometer

The reversing thermometers are also referred to under other names, such as deep-sea thermometers and turn-over thermometers. Various types are made but all operate basically on the same principle, namely that a 180° reversal of the thermometer is accomplished after a required period of adjustment. A column of mercury, whose length is the measure of the temperature at the selected depth, is detached and delivered to the opposite end of the capillary tube. The length of this detached mercury column can not be altered by additions or subtractions until the instrument is brought to the surface and turned back to its original position.

The temperatures were read and recorded to within 1/10 of a degree centigrade. These thermometers are usually operated in pairs and one thermometer compared against the other to eliminate structural and functional errors.

Bathythermograph

The bathythermograph (BT), also called a thermarine recorder (Figure 9), is an instrument which records a graph of water temperature vs depth when lowered or raised through the water. Its thermal element actuates a stylus which scribes a line on a coated slide enclosed in the instrument. The slide is positioned, according to depth, by a pressure-sensing element. The trace scribed on the smoked or gold-plated slide is read by comparing it with a grid individually calibrated for each instrument. It is considered normally accurate within 1/10 of a degree centigrade.



TABLE 1

VESSELS, DATES AND AREAS SAMPLED

<u>Vessel</u>	<u>Inclusive Dates</u>	<u>Cruise Number</u>	<u>Area Sampled</u>
Cisco	April 24-May 7	1	Entire Lake. 32 extended range and 4 along shore stations.
Cisco	June 5-June 18	2	East side and northern quarter, including Green Bay. 24 extended range and 5 along shore stations.
Cisco	July 17-July 30	3	Southern half. 30 extended range and 1 along shore station.
Cisco	Aug. 29-Sept. 9	4	South central to southwest side. 68 along shore and 2 extended range stations.
Cisco	Oct. 10-Oct. 22	5	Southeast side. 65 along shore stations.
Fitzgerald	Oct. 18-Nov. 30	6	South central to southwest side. 130 harbor and 64 along shore stations and 1 extended range station. Harbors sampled were Chicago, Racine and Milwaukee.
Kaho	Oct. 24-Nov. 7	7	Southwest side. 24 along shore and 2 extended range stations.
Kaho	Nov. 28-Dec. 6	8	South central. 22 extended range stations.

Note: A total of 474 station stops were made during this period.

Date	Description	Amount
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927

TABLE 2

SAMPLING DEPTHS

<u>Depth</u>	<u>Type of Station</u>				<u>Extended Range</u>
	<u>Harbor & Tributary</u>	<u>Along shore</u>			
		<u>1 Mi.</u>	<u>4 Mi.</u>	<u>7 Mi.</u>	<u>10 Mi.</u>
0 Meters (Just below surface)		X	X	X	X
5 Meters		X	X	X	X
10 "		X	X	X	X
20 "		X	X	X	X
30 "		X	X	X	X
50 "		X	X	X	X
70 "			X	X	X
100 "				X	X
150 "					X
Mid-depth	X				X

Section 10

Case No.	Case Name	Case Type	Case Status	Case Date	Case Location	Case Description
10-001	John Doe	Arrest	Completed	2023-01-15	New York	Arrested for possession of a controlled substance.
10-002	Jane Smith	Arrest	Pending	2023-02-01	California	Arrested for driving under the influence.
10-003	Michael Brown	Arrest	Completed	2023-03-10	Texas	Arrested for public intoxication.
10-004	Sarah White	Arrest	Completed	2023-04-20	Florida	Arrested for disorderly conduct.
10-005	David Green	Arrest	Completed	2023-05-05	Illinois	Arrested for trespassing.
10-006	Emily Black	Arrest	Completed	2023-06-12	Ohio	Arrested for vandalism.
10-007	Robert King	Arrest	Completed	2023-07-25	Georgia	Arrested for criminal mischief.
10-008	Laura Lee	Arrest	Completed	2023-08-18	Arizona	Arrested for criminal damage to property.
10-009	Christopher Hall	Arrest	Completed	2023-09-03	Colorado	Arrested for criminal mischief.
10-010	Amanda Young	Arrest	Completed	2023-10-14	Connecticut	Arrested for criminal damage to property.

TABLE 3-3

ANALYSIS PERFORMED ON SAMPLES COLLECTED AT EACH TYPE OF STATION AND AT EACH SAMPLING DEPTH

Discipline	Analysis	Shipboard	GLIRBP Lab	Extended Range		Along shore Stations		Harbor Stations
				Station	Station	1 Mi. 4 Mi. 7 Mi. 10 Mi.	Station	
Chemistry	Dissolved Oxygen	X		X	X	X	X	X
	Alkalinity (1)	X		X	X	X	X	X
	Specific Conductivity	X		X	X	X	X	X
	pH	X		X	X	X	X	X
	Turbidity	X		X	X	X	X	X
	Dissolved Solids		X	X	X	X	X	X
	Suspended Solids		X	X	X	X	X	X
	Phenol		X	X	X	X	X	X
	BOD		X	X	X	X	X	X
	COD		X	X	X	X	X	X
	Ammonia Nitrogen		X	X	X	X	X	X
	Organic Nitrogen		X	X	X	X	X	X
	Nitrate Nitrogen		X	X	X	X	X	X
	Nitrite Nitrogen		X	X	X	X	X	X
	Dissolved Total Phosphate		X	X	X	X	X	X
	Chloride		X	X	X	X	X	X
	Sodium		X	X	X	X	X	X
	Potassium		X	X	X	X	X	X
	Calcium		X	X	X	X	X	X
	Magnesium		X	X	X	X	X	X
Silicate		X	X	X	X	X	X	
Sulfate		X	X	X	X	X	X	
Toxic Metals		X	X	X	X	X	X	
Trace Elements		X	X	X	X	X	X	
ABS		X	X	X	X	X	X	

(2)
(2)

(3)
(3)

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities.

2. It then outlines the various methods used to collect and analyze data, including surveys, interviews, and focus groups.

3. The next section describes the results of the data collection process, highlighting key findings and trends.

4. Finally, the document concludes with a summary of the overall findings and recommendations for future research.

5. The following table provides a detailed breakdown of the data collected during the study.

6. The data shows a clear trend of increasing participation in the program over time, with a significant increase in the number of participants in the final year.

7. This increase is likely due to the implementation of the new program, which has been well-received by participants.

8. The data also indicates that the program has had a positive impact on the overall well-being of participants, with a significant increase in self-reported health and happiness.

9. These findings suggest that the program is effective in promoting health and happiness, and should be continued and expanded.

10. The following table provides a detailed breakdown of the data collected during the study.

11. The data shows a clear trend of increasing participation in the program over time, with a significant increase in the number of participants in the final year.

12. This increase is likely due to the implementation of the new program, which has been well-received by participants.

13. The data also indicates that the program has had a positive impact on the overall well-being of participants, with a significant increase in self-reported health and happiness.

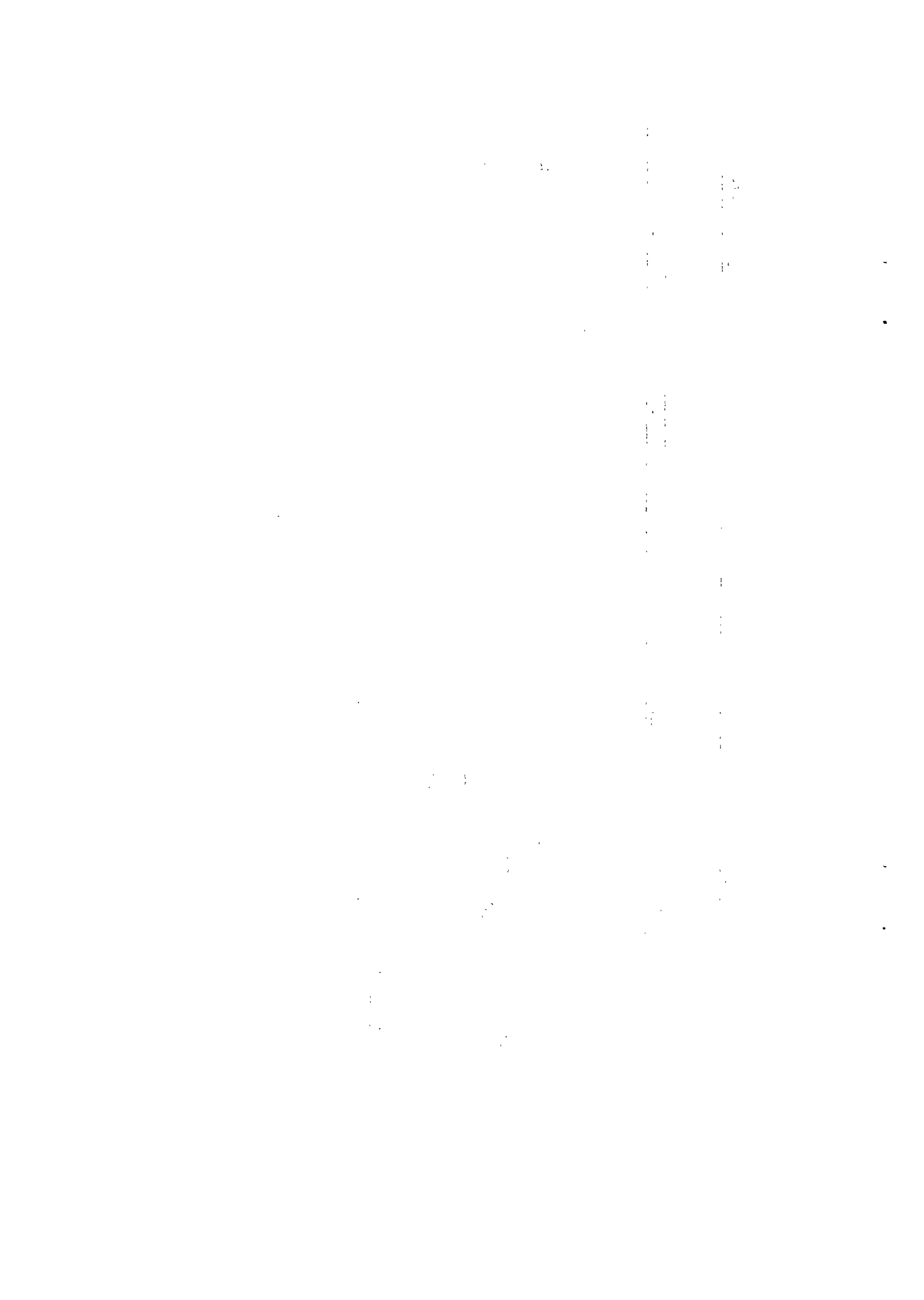


TABLE 3--c

ANALYSES PERFORMED ON SAMPLES COLLECTED AT EACH TYPE OF STATION AND AT EACH SAMPLING DEPTH

Explanatory Notes

- (1) Not accomplished on cruise No. 1.
- (2) All samples analyzed at the GLIRBP Laboratory for BOD and phenol were received in less than 24 hours from time of collection.
- (3) BODs and phenols were not performed on harbor stations extending past the one mile line.
- (4) The only harbor area in which these samples were collected was Milwaukee harbor.
- (5) A vertical plankton tow sample was not collected at stations where oil slicks or high turbidity were observed. This was done to avoid clogging the mesh of the nylon bolting cloth net on which plankton are collected.
- (6) This analysis was done on only a few harbor stations during cruise No. 6, on a trial basis pending analysis of the value of the results.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that this is essential for ensuring transparency and accountability in the organization's operations.

2. The second part of the document outlines the various methods and tools used to collect and analyze data. It highlights the need for consistent data collection procedures and the use of advanced analytical techniques to derive meaningful insights from the data.

3. The third part of the document focuses on the role of technology in data management and analysis. It discusses how modern software solutions can streamline data collection, storage, and analysis processes, thereby improving efficiency and accuracy.

4. The fourth part of the document addresses the challenges associated with data management, such as data quality, security, and privacy. It provides strategies to mitigate these risks and ensure that the data remains reliable and secure throughout its lifecycle.

5. The fifth part of the document concludes by summarizing the key findings and recommendations. It stresses the importance of a data-driven approach in decision-making and the need for continuous monitoring and improvement of data management practices.

TABLE 4-a

Sampling Stations, Cruises #1 through #8 inclusive

Station Location			Type	Cruise and Number of Calls							
Latitude	Longitude	City		1	2	3	4	5	6	7	8
41 38 00	87 17 00		A-1				1		1		
41 39 00	87 10 00		A-1				1		1		
41 39 00	87 23 00		A-1				1		1	1	
41 41 00	87 04 00		A-1				1		1		
41 41 00	87 11 00		A-4				1		1		
41 41 00	87 17 00		A-4				1		1		
41 41 00	87 22 00		A-4				1		1	1	
41 41 00	87 28 00		A-1				1		1	1	
41 43 00	86 58 00		A-1				1				
41 43 00	87 26 00		A-4				1		1	1	
41 44 00	87 03 00		A-4				1				
41 44 00	87 14 00		A-7				1		2		
41 45 00	86 53 00		A-1				1	1			
41 45 00	87 21 00		A-7				1		1	1	
41 45 00	87 31 00		A-1				1		1	1	
41 46 00	87 00 00		E	1		1					1
41 46 00	87 13 00		A-10**						2		
41 46 00	87 13 00		E								1
41 46 00	87 19 00		A-10**						1	1	
41 46 00	87 20 00		E	1		1			1		
41 46 00	87 23 00		E								1
41 46 00	87 27 00		A-4				1		1	1	
41 47 00	86 48 00		A-1					1			
41 47 00	86 56 00		A-4				1				
41 48 00	86 53 00		A-4					1			
41 48 00	87 22 00		A-10				1		1	1	
41 48 00	87 25 00		A-7						1	1	
41 48 00	87 30 00		A-4				1		1	1	
41 49 00	87 34 00		A-1				1		1	1	
41 49 30	87 35 00	Chicago	H						1		
41 50 00	86 44 00		A-1					1			
41 50 00	87 36 00	Chicago	H						1		
41 51 00	86 54 00		A-7					1			
41 51 00	87 32 00		A-4				1		1	1	
41 51 00	87 36 00	Chicago	H						1		

The following table shows the results of the experiment. The first column is the number of trials, the second column is the number of correct responses, and the third column is the percentage of correct responses.

Trial	Correct	Percentage
1	1	100%
2	1	100%
3	1	100%
4	1	100%
5	1	100%
6	1	100%
7	1	100%
8	1	100%
9	1	100%
10	1	100%
11	1	100%
12	1	100%
13	1	100%
14	1	100%
15	1	100%
16	1	100%
17	1	100%
18	1	100%
19	1	100%
20	1	100%
21	1	100%
22	1	100%
23	1	100%
24	1	100%
25	1	100%
26	1	100%
27	1	100%
28	1	100%
29	1	100%
30	1	100%
31	1	100%
32	1	100%
33	1	100%
34	1	100%
35	1	100%
36	1	100%
37	1	100%
38	1	100%
39	1	100%
40	1	100%
41	1	100%
42	1	100%
43	1	100%
44	1	100%
45	1	100%
46	1	100%
47	1	100%
48	1	100%
49	1	100%
50	1	100%
51	1	100%
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53	1	100%
54	1	100%
55	1	100%
56	1	100%
57	1	100%
58	1	100%
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66	1	100%
67	1	100%
68	1	100%
69	1	100%
70	1	100%
71	1	100%
72	1	100%
73	1	100%
74	1	100%
75	1	100%
76	1	100%
77	1	100%
78	1	100%
79	1	100%
80	1	100%
81	1	100%
82	1	100%
83	1	100%
84	1	100%
85	1	100%
86	1	100%
87	1	100%
88	1	100%
89	1	100%
90	1	100%
91	1	100%
92	1	100%
93	1	100%
94	1	100%
95	1	100%
96	1	100%
97	1	100%
98	1	100%
99	1	100%
100	1	100%

100

100

100

100

100

The following table shows the results of the experiment. The first column shows the number of trials, the second column shows the number of correct responses, and the third column shows the percentage of correct responses. The fourth column shows the number of trials that were not completed.

Number of trials	Number of correct responses	Percentage of correct responses	Number of trials not completed
10	8	80%	2
20	15	75%	5
30	22	73%	8
40	28	70%	12
50	35	70%	15
60	42	70%	18
70	48	69%	22
80	55	69%	25
90	62	69%	28
100	70	70%	30

As can be seen from the table, the percentage of correct responses remains relatively constant, around 70%, across all trial numbers. However, the number of trials not completed increases as the number of trials increases, suggesting that the task becomes more difficult as the number of trials increases.

TABLE 4-d

Sampling Stations, Cruises #1 through #8 inclusive

Station Location			Type	Cruise and Number of Calls							
Latitude	Longitude	City		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
42 16 00	87 25 00		E								1
42 16 00	87 48 00		A-1				1				
42 18 00	86 32 00		A-10					1			
42 18 00	87 42 00		A-7				1		1		
42 19 00	86 20 00		A-1					1			
42 20 00	87 48 00		A-1				1		1		
42 21 00	86 23 00		A-4					1			
42 21 00	87 45 00		A-4				1		1		
42 23 00	86 19 00		A-1					1			
42 23 00	86 20 00		E			2					
42 23 00	86 26 00		A-7					1			
42 23 00	86 35 00		E	1		1					1
42 23 00	87 00 00		E	1		1	1				
42 23 00	87 25 00		E	1		1					
42 23 00	87 37 00		A-10				1		1		
42 23 00	87 45 00		E			1					
42 24 00	87 40 00		A-7				1		1		
42 24 00	87 47 00		A-1				1		1		
42 25 00	86 29 00		A-10					1			
42 27 00	86 17 00		A-1					1			
42 28 00	86 20 00		A-4					1			
42 28 00	87 47 00		A-1				1		1		
42 30 00	86 23 00		A-7					1			
42 30 00	86 35 00		E								1
42 30 00	87 44 00		A-4				1				
42 31 00	86 16 00		A-1					1			
42 32 00	86 27 00		A-10					1			
42 32 00	87 47 00		A-1				1		1		
42 33 00	87 37 00		A-10				1				
42 34 00	87 40 00		A-7				1				
42 35 00	86 15 00		A-1					1			
42 36 00	87 48 00		A-1				1		1		
42 37 00	86 18 00		A-4					1			
42 37 00	87 45 00		A-4				1				
42 38 00	86 22 00		A-7					1			

TABLE 4-e

Sampling Stations, Cruises #1 through #8 inclusive

Station Location			Type	Cruise and Number of Calls							
Latitude	Longitude	City		1	2	3	4	5	6	7	8
42 38 00	87 37 00		A-10				1		1		
42 39 00	86 15 00		A-1					1			
42 40 00	86 21 00		A-7					1			
42 40 00	87 40 00		A-7						1		
42 40 00	87 47 00		A-1				1		1		
42 41 00	87 45 00		E				1				
42 42 00	87 43 00		A-4				1		1		
42 42 48	87 46 17	Racine	H						1		
42 42 58	87 45 26	Racine	H						1		
42 43 00	86 14 00		A-1					1			
42 43 00	87 42 00		E			1					
42 43 12	87 46 34	Racine	H						1		
42 43 13	87 44 21	Racine	H						1		
42 43 19	87 45 43	Racine	H						1		
42 43 24	87 46 34	Racine	H						2		
42 43 25	87 46 17	Racine	H						1		
42 43 30	87 45 52	Racine	H						1		
42 43 37	87 46 33	Racine	H						1		
42 43 41	87 46 00	Racine	H						1		
42 43 49	87 46 33	Racine	H						1		
42 43 51	87 46 09	Racine	H						1		
42 43 55	87 46 33	Racine	H						1		
42 43 56	87 46 03	Racine	H						1		
42 44 00	86 15 00		E	1	2	1					
42 44 00	86 17 00		A-4					1			
42 44 00	86 35 00		E	1		1					
42 44 00	87 00 00		E	1							
42 44 00	87 23 00		E	1		1					
42 44 00	87 46 00		A-1				1		1		
42 44 01	87 46 40	Racine	H						1		
42 44 02	87 44 02	Racine	H						1		
42 44 03	87 44 36	Racine	H						1		
42 44 03	87 45 10	Racine	H						1		
42 44 03	87 45 44	Racine	H						1		
42 44 03	87 46 18	Racine	H						1		

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that this is essential for ensuring transparency and accountability in the organization's operations.

2. The second part of the document outlines the various methods and tools used to collect and analyze data. It highlights the need for consistent data collection procedures and the use of advanced analytical techniques to derive meaningful insights from the data.

3. The third part of the document focuses on the role of technology in data management and analysis. It discusses how modern software solutions can streamline data collection, storage, and processing, thereby improving efficiency and reducing the risk of errors.

4. The fourth part of the document addresses the challenges associated with data security and privacy. It stresses the importance of implementing robust security measures to protect sensitive information and ensure compliance with relevant regulations.

5. The fifth part of the document concludes by summarizing the key findings and recommendations. It reiterates the importance of a data-driven approach and encourages the organization to continue investing in data management and analysis capabilities to drive growth and innovation.



TABLE 4-g

Sampling Stations, Cruises #1 through #8 inclusive

Station Location				Cruise and Number of Calls							
<u>Latitude</u>	<u>Longitude</u>	<u>City</u>	<u>Type</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
42 59 00	87 44 00		A-7				1		1		
42 59 00	87 47 00		A-4				1		1		
42 59 04	87 51 12	Milwaukee	H						1		
42 59 13	87 51 56	Milwaukee	H						1		
42 59 15	87 51 22	Milwaukee	H						1		
42 59 22	87 52 09	Milwaukee	H						1		
42 59 26	87 51 33	Milwaukee	H						1		
42 59 30	87 52 28	Milwaukee	H						1		
42 59 36	87 51 43	Milwaukee	H						1		
42 59 41	87 32 34	Milwaukee	H						1		
42 59 43	87 52 46	Milwaukee	H						1		
42 59 46	87 52 55	Milwaukee	H						1		
42 59 48	87 51 10	Milwaukee	H						1		
42 59 57	87 52 05	Milwaukee	H						1		
42 59 57	87 52 57	Milwaukee	H						1		
43 00 00	86 15 00		A-1					1			
43 00 00	87 52 00		A-1				1			1	
43 00 07	87 52 06	Milwaukee	H						1		
43 00 08	87 53 02	Milwaukee	H						1		
43 00 09	87 51 31	Milwaukee	H						1		
43 00 18	87 52 26	Milwaukee	H						1		
43 00 26	87 53 13	Milwaukee	H						1		
43 00 27	87 52 26	Milwaukee	H						1		
43 00 27	87 52 36	Milwaukee	H						1		
43 00 29	87 52 36	Milwaukee	H						1		
43 00 31	87 51 52	Milwaukee	H						1		
43 00 39	87 53 01	Milwaukee	H						1		
43 00 39	87 53 19	Milwaukee	H						1		
43 00 52	87 52 13	Milwaukee	H						1		
43 00 52	87 53 23	Milwaukee	H						1		
43 00 53	87 53 05	Milwaukee	H						1		
43 01 00	86 19 00		A-4					1			
43 01 00	86 22 00		A-7					1			
43 01 00	87 49 00		A-4				1			1	
43 01 01	87 51 08	Milwaukee	H						1		

TABLE 4-h

Sampling Stations, Cruises #1 through #8 inclusive

Station Location				Cruise and Number of Calls							
Latitude	Longitude	City	Type	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
43 01 05	87 53 28	Milwaukee	H						1		
43 01 06	87 53 10	Milwaukee	H						1		
43 01 12	87 51 50	Milwaukee	H						1		
43 01 13	87 52 14	Milwaukee	H						1		
43 01 18	87 53 33	Milwaukee	H						1		
43 01 19	87 53 13	Milwaukee	H						1		
43 01 23	87 52 22	Milwaukee	H						1		
43 01 23	87 52 44	Milwaukee	H						1		
43 01 32	87 53 38	Milwaukee	H						1		
43 01 33	87 53 20	Milwaukee	H						1		
43 01 34	87 52 55	Milwaukee	H						1		
43 01 35	87 52 37	Milwaukee	H						1		
43 01 36	87 52 19	Milwaukee	H						1		
43 01 38	87 51 44	Milwaukee	H						1		
43 01 39	87 52 32	Milwaukee	H						1		
43 01 41	87 51 08	Milwaukee	H						1		
43 01 41	87 52 39	Milwaukee	H						1		
43 01 44	87 53 34	Milwaukee	H						1		
43 01 46	87 52 46	Milwaukee	H						1		
43 01 46	87 53 16	Milwaukee	H						1		
43 01 48	87 52 25	Milwaukee	H						1		
43 01 57	87 52 38	Milwaukee	H						1		
43 01 57	87 53 30	Milwaukee	H						1		
43 01 58	87 53 12	Milwaukee	H						1		
43 02 00	86 26 00		A-10					1			
43 02 03	87 51 55	Milwaukee	H						1		
43 02 10	87 53 26	Milwaukee	H						1		
43 02 11	87 53 07	Milwaukee	H						1		
43 02 17	87 51 25	Milwaukee	H						1		
43 02 20	87 51 21	Milwaukee	H						1		
43 02 22	87 53 22	Milwaukee	H						1		
43 02 24	87 53 03	Milwaukee	H						1		
43 02 31	87 50 55	Milwaukee	H						1		
43 02 35	87 53 18	Milwaukee	H						1		
43 02 39	87 52 48	Milwaukee	H						1		

1. The first part of the document discusses the importance of maintaining accurate records of all transactions.

2. It is essential to ensure that all entries are supported by appropriate documentation.

3. The second part of the document outlines the various methods used to collect and analyze data.

4. These methods include both qualitative and quantitative approaches, each with its own strengths and limitations.

5. The third part of the document provides a detailed overview of the statistical techniques employed.

6. These techniques are used to identify trends, patterns, and correlations within the data set.

7. The fourth part of the document discusses the challenges associated with data collection and analysis.

8. These challenges include issues such as data quality, sample size, and the potential for bias.

9. The fifth part of the document offers practical advice on how to overcome these challenges.

10. This advice includes recommendations for selecting appropriate methods and ensuring the integrity of the data.

11. The sixth part of the document concludes with a summary of the key findings and conclusions.

12. These findings highlight the importance of rigorous data collection and analysis in research.

13. The seventh part of the document provides a list of references for further reading.

14. These references include books, articles, and online resources that provide additional information on the topics discussed.

15. The eighth part of the document contains a glossary of key terms and definitions.

16. This glossary is intended to help readers understand the terminology used throughout the document.

17. The ninth part of the document includes a list of appendices that provide additional data and information.

18. These appendices are organized into sections that correspond to the main text of the document.

19. The tenth part of the document contains a list of figures and tables that illustrate the data and findings.

20. These figures and tables are designed to be clear and easy to interpret, providing a visual representation of the data.

21. The eleventh part of the document includes a list of footnotes that provide additional information on specific points.

22. These footnotes are used to provide context and clarify any potential ambiguities in the text.

23. The twelfth part of the document contains a list of acknowledgments that thank those who provided support and assistance.

24. These acknowledgments are intended to recognize the contributions of individuals and organizations that helped make the research possible.

25. The thirteenth part of the document includes a list of contact information for the author and other relevant parties.

26. This contact information is provided to facilitate communication and further inquiries related to the document.

27. The final part of the document is a list of appendices that provide additional data and information.

TABLE 4-i

Sampling Stations, Cruises #1 through #8 inclusive

Station Location			Type	Cruise and Number of Calls							
Latitude	Longitude	City		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
43 02 39	87 52 59	Milwaukee	H						1		
43 02 43	87 52 03	Milwaukee	H						1		
43 02 47	87 53 12	Milwaukee	H						1		
43 02 50	87 52 54	Milwaukee	H						1		
43 02 59	87 52 39	Milwaukee	H						1		
43 03 00	86 24 00		E	1	1	1					
43 03 00	87 53 09	Milwaukee	H						1		
43 03 02	87 52 00	Milwaukee	H						1		
43 03 06	87 51 47	Milwaukee	H						1		
43 03 25	87 52 14	Milwaukee	H						1		
43 03 29	87 51 30	Milwaukee	H						1		
43 03 52	87 51 13	Milwaukee	H						1		
43 04 00	86 16 00		A-1					1			
43 04 00	87 51 00		A-1				1		1		
43 04 11	87 51 40	Milwaukee	H						1		
43 04 15	87 50 56	Milwaukee	H						1		
43 05 00	87 40 00		A-10				1			1	
43 06 00	86 21 00		A-4					1			
43 06 00	87 45 00		A-7				1		1		
43 07 00	87 49 00		A-4				1		1		
43 08 00	86 18 00		A-1					1			
43 08 00	86 19 00		E	1	1	1					
43 08 00	86 35 00		E	1	1	1					
43 08 00	87 00 00		E	1		1					
43 08 00	87 25 00		E	1		1					
43 08 00	87 52 00		E			1					
43 08 00	87 53 00		A-1				1		1		
43 09 00	86 22 00		A-4					1			
43 09 00	86 26 00		A-7					1			
43 09 00	86 30 00		A-10					1			
43 12 00	86 21 00		A-1					1			
43 12 00	86 26 00		A-4					1			
43 14 00	86 26 00		A-4					1			
43 16 00	86 23 00		A-1					1			
43 17 00	86 28 00		A-4					1			

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that this is crucial for ensuring transparency and accountability in the organization's operations.

2. The second part of the document outlines the various methods and tools used to collect and analyze data. It highlights the need for consistent and reliable data collection processes.

3. The third part of the document describes the different types of data that are collected and how they are used to inform decision-making. It notes that data is used to identify trends, measure performance, and evaluate the effectiveness of various initiatives.

4. The fourth part of the document discusses the challenges associated with data collection and analysis. It identifies common issues such as data quality, data security, and data privacy, and provides strategies to address these challenges.

5. The fifth part of the document outlines the future of data collection and analysis. It discusses emerging technologies and trends that are expected to shape the data landscape in the coming years.

6. The sixth part of the document provides a summary of the key findings and conclusions of the study. It reiterates the importance of data in driving organizational success and the need for a data-driven culture.

7. The seventh part of the document offers recommendations for how organizations can improve their data collection and analysis practices. It suggests implementing robust data governance frameworks and investing in data literacy training for employees.

8. The eighth part of the document provides a list of references and sources used in the study. It includes academic journals, industry reports, and other relevant publications.

TABLE 4-j

Sampling Stations, Cruises #1 through #8 inclusive

Station Location			Type	Cruise and Number of Calls							
Latitude	Longitude	City		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
43 36 00	86 33 00		A-1	1	1	1					
43 36 00	86 47 00		E			1					
43 36 00	87 00 00		E			1					
43 36 00	87 22 00		E	1		1					
43 36 00	87 44 00		E	1		1					
44 04 00	86 33 00		E			1					
44 04 00	86 44 00		E			1					
44 05 00	86 33 00		E	1							
44 05 00	86 44 00		E	1							
44 05 00	87 00 00		E	1		1					
44 05 00	87 20 00		E	1		1					
44 05 00	87 34 00		E	1		1					
44 20 00	87 00 00		E	1							
44 21 00	86 20 00		E	1	1						
44 23 00	86 32 00		E	1							
44 25 00	86 40 00		E	1							
44 32 00	87 27 00		A-1	1							
44 34 00	86 18 00		A-4	1							
44 39 00	86 17 00		E	1	1						
44 41 00	86 30 00		E	1							
44 42 00	87 45 00		A-1		1						
44 43 00	86 44 00		E	1							
44 45 00	87 00 00		E	1							
44 45 00	87 50 00		E		1						
44 47 00	87 14 00		E	1							
44 56 00	86 05 00		E		1						
45 02 00	87 42 00		A-4		1						
44 05 00	87 31 00		E		1						
45 10 00	86 38 00		E		1						
45 13 00	85 40 00		E		1						
45 20 00	85 50 00		E		1						
45 20 00	86 58 00		E		1						
45 21 00	85 20 00		A-4		1						
45 25 00	86 45 00		E		1						
45 31 00	85 25 00		E		1						

Year	Month	Day	Time	Location	Remarks
1911	1	1	10:00	...	...
1911	1	2	10:00	...	...
1911	1	3	10:00	...	...
1911	1	4	10:00	...	...
1911	1	5	10:00	...	...
1911	1	6	10:00	...	...
1911	1	7	10:00	...	...
1911	1	8	10:00	...	...
1911	1	9	10:00	...	...
1911	1	10	10:00	...	...
1911	1	11	10:00	...	...
1911	1	12	10:00	...	...
1911	1	13	10:00	...	...
1911	1	14	10:00	...	...
1911	1	15	10:00	...	...
1911	1	16	10:00	...	...
1911	1	17	10:00	...	...
1911	1	18	10:00	...	...
1911	1	19	10:00	...	...
1911	1	20	10:00	...	...
1911	1	21	10:00	...	...
1911	1	22	10:00	...	...
1911	1	23	10:00	...	...
1911	1	24	10:00	...	...
1911	1	25	10:00	...	...
1911	1	26	10:00	...	...
1911	1	27	10:00	...	...
1911	1	28	10:00	...	...
1911	1	29	10:00	...	...
1911	1	30	10:00	...	...
1911	1	31	10:00	...	...

TABLE 4-k

Sampling Stations, Cruises #1 through #8 inclusive

Station Location			Type	Cruise and Number of Calls							
<u>Latitude</u>	<u>Longitude</u>	<u>City</u>		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
45 32 00	86 10 00		E		1						
45 33 00	87 00 00		E		1						
45 43 00	86 28 00		E		1						
45 44 00	86 08 00		E		1						
45 48 00	84 45 00		E		2						
45 49 00	84 45 00		E		1						
45 53 00	85 36 00		E		1						
45 56 00	86 14 00		A-1		1						

Footnotes

- * A-1, 4, 7, 10 - Along shore approximately 1, 4, 7, or 10 miles out.
 E - Extended Range (deep water)
 H - Harbor
 ** Dual Station, e.g., Extended Range and Along shore

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud. The text notes that records should be kept for a minimum of seven years and should be accessible to authorized personnel at all times.

2. The second part of the document outlines the specific requirements for record-keeping. It states that all transactions must be recorded in a clear and concise manner, using a standardized format. This includes recording the date, amount, and description of each transaction. The text also requires that records be kept in a secure and protected environment, with access restricted to authorized personnel only.

3. The third part of the document discusses the role of internal controls in ensuring the accuracy of records. It notes that internal controls should be designed to prevent errors and fraud, and to ensure that all transactions are properly recorded. The text emphasizes that internal controls should be regularly reviewed and updated to reflect changes in the business environment.

4. The fourth part of the document discusses the importance of training and education for personnel involved in record-keeping. It states that all personnel should receive appropriate training and education to ensure that they are able to perform their duties accurately and efficiently. The text also notes that training should be ongoing and should cover both technical and ethical aspects of record-keeping.

5. The fifth part of the document discusses the importance of regular audits and reviews of records. It states that audits and reviews should be conducted on a regular basis to ensure that records are accurate and complete. The text also notes that audits and reviews should be conducted by independent personnel to ensure objectivity and fairness.

6. The sixth part of the document discusses the importance of transparency and accountability in record-keeping. It states that records should be accessible to all stakeholders and that there should be a clear line of responsibility for the accuracy and integrity of the records. The text also notes that transparency and accountability are essential for building trust and confidence in the financial system.

TABLE 5

Summary of Sampling Stations and Calls

Cruise Number	Type of Station and Number of Calls						Total Sampling Calls
	A-1	A-4	A-7	A-10	E	H	
1	2	2	0	0	32	0	36
2	3	2	0	0	24	0	29
3	1	0	0	0	30	0	31
4	28	23	9	8	2	0	70
5	25	17	13	10	0	0	65
6	23	17	13	11	1	130	195
7	8	11	2	3	2	0	26
8	0	0	0	0	22	0	22
Total	90	72	37	32	113	130	474

The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for ensuring transparency and accountability in financial operations. This section also outlines the various methods and tools used to collect and analyze data, highlighting the need for consistency and precision in data collection.

The second part of the document focuses on the analysis of the collected data. It describes the various statistical techniques and models used to interpret the data, including regression analysis, time series analysis, and hypothesis testing. This section also discusses the challenges associated with data analysis, such as missing data, outliers, and the need for appropriate statistical tests.

The third part of the document discusses the application of the analyzed data to various fields and industries. It highlights the practical implications of the findings and how they can be used to inform decision-making and improve operational efficiency. This section also discusses the potential for future research and the need for continued monitoring and evaluation of the data.

The fourth part of the document provides a summary of the key findings and conclusions. It reiterates the importance of accurate record-keeping and the need for rigorous data analysis. It also discusses the implications of the findings for future research and the need for continued monitoring and evaluation of the data.

The fifth part of the document provides a list of references and sources used in the document. It includes a list of books, articles, and other publications that have been consulted during the research process.