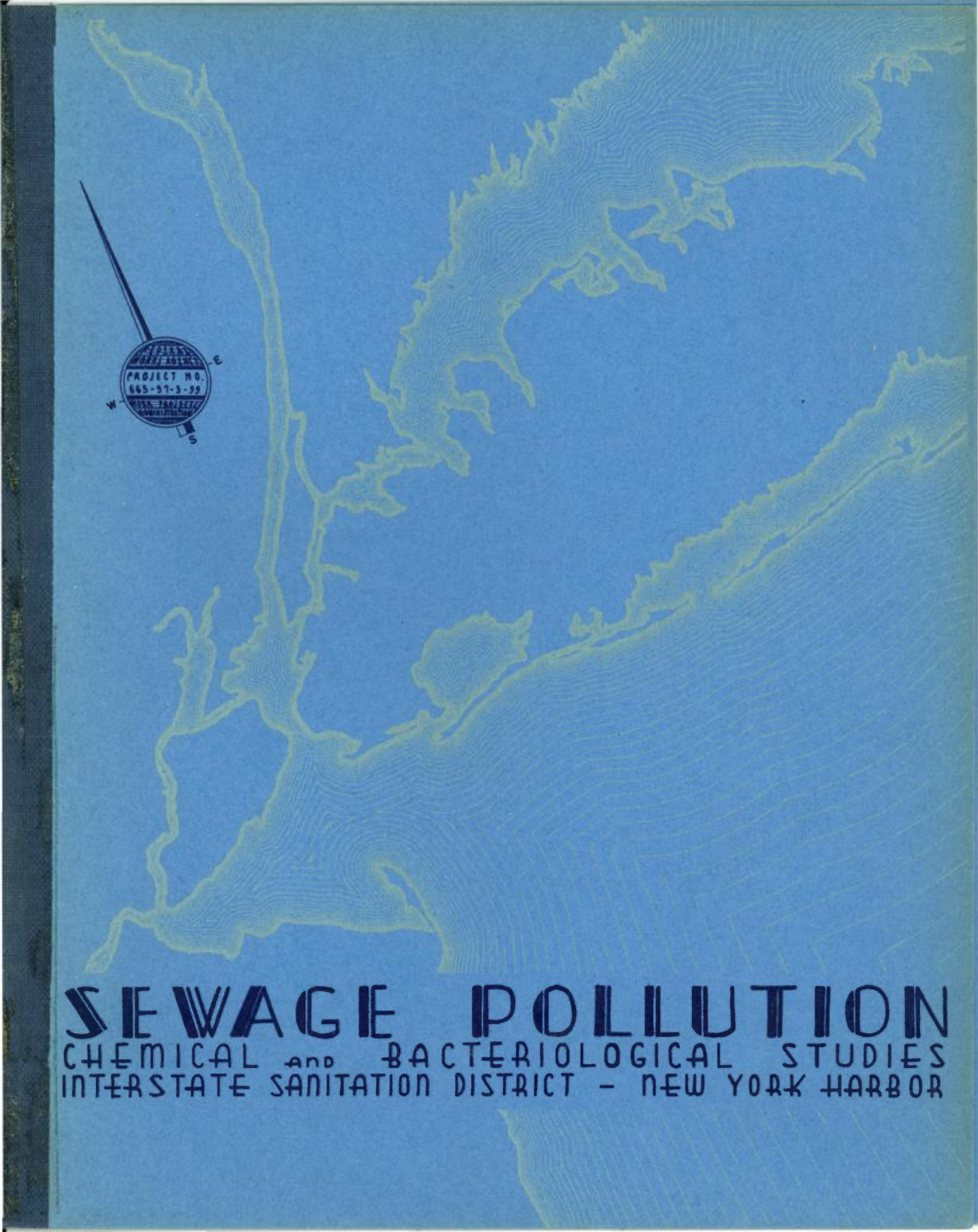

SEWAGE POLLUTION

CHEMICAL and BACTERIOLOGICAL STUDIES

INTERSTATE SANITATION DISTRICT - NEW YORK HARBOR

CHEMICAL AND BACTERIOLOGICAL ANALYSES OF THE WATER IN THE NATURAL WATERWAYS OF THE INTERSTATE SANITATION DISTRICT

1937 - 1938

F E D E R A L W O R K S A G E N C Y

WORKS PROJECTS ADMINISTRATION
For the City of New York

Report of Official Project No. 465-97-3-131

Sponsored By.

THE INTERSTATE SANITATION COMMISSION
60 Hudson Street, New York, N.Y.

A p r i l 1939

THE INTERSTATE SANITATION COMMISSION

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465-97-3-131

Chester G. Wigley, C.E.	Engineer in Charge
Maurice J. Schwarz,	Jr. Engineer
Antonio Giglio,	Drafting Supervisor

CHEMICAL AND BACTERIOLOGICAL ANALYSES OF THE WATER IN THE NATURAL WATERWAYS OF THE INTERSTATE SANITATION DISTRICT

1937 - 1938

PREFACE

The Interstate Sanitation Commission was formed for the purpose of abating pollution in New York Harbor and the adjacent waters. As the program of abatement of pollution was undertaken, it became obvious that a comprehensive survey of the conditions existing in the waters of the Interstate Sanitation District should be known. Among the many uses which such knowledge could be placed is that of furnishing a basis upon which to measure the degree of improvement resulting from the accomplishment of the program.

To this end, the Work Projects Administration undertook a project of taking samples and analyzing the waters throughout the Interstate Sanitation District.

This report concerns itself with the samples and the chemical analyses and bacteriological determinations made during 1938. This information should be valuable not only to this Commission but also to many persons and agencies interested in the character of the waters of New York Bay.

The original project was co-sponsored by the United States Public Health Service. Their co-sponsorship, advice and cooperation has been sincerely appreciated as has been the cooperation of Colonel Somervell and his assistants, as well as the Supervisor and men employed on the Water Pollution Survey.

Seth G. Hess

Chief Engineer - Executive Secretary

Interstate Sanitation Commission

F O R E W O R D

All of the work done on this Project (465-97-3-131) is for the use of the recently established Interstate Sanitation Commission. To this Commission has been assigned the difficult task of bringing about improved conditions in the waters of New York Harbor and the more extensive Interstate Sanitation District, as to the discharge of polluting material into them. It may be said that this task is comparable to the fabled "Twelve Labors of Hercules." It is not an easy matter to coordinate and standardize the efforts of some eighty-five municipalities for a single purpose.

Basic data relative to the sources and degree of pollution in the waters of the Interstate Sanitation District and information of economic importance that would have been of value to the Commission, has been far from adequate. For these reasons, this project has been engaged in collecting and compiling information that would be of value to the Sponsor, The Interstate Sanitation Commission and the Co-Sponsor, The United States Public Health Service. This work will bring technical data for the Commission's files up-to-date.

Recently there has been a very great change in the attitude of municipal officials towards the improvement of the waterways adjoining their cities. In the past, sewage and other wastes have been dumped into the streams or tidal estuaries without compunction, and little or no attempt made to alleviate foul conditions. At the present time, there is a much better attitude evinced, showing on the part of the municipalities a desire to at least maintain adjoining waterways in such a condition that they will not seriously affect the use of the waters by their own citizens or neighboring cities, as well as to improve their own environment.

C. C. Wigley C.E.

C. C. Wigley
Engineer in Charge

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ILLUSTRATIONS

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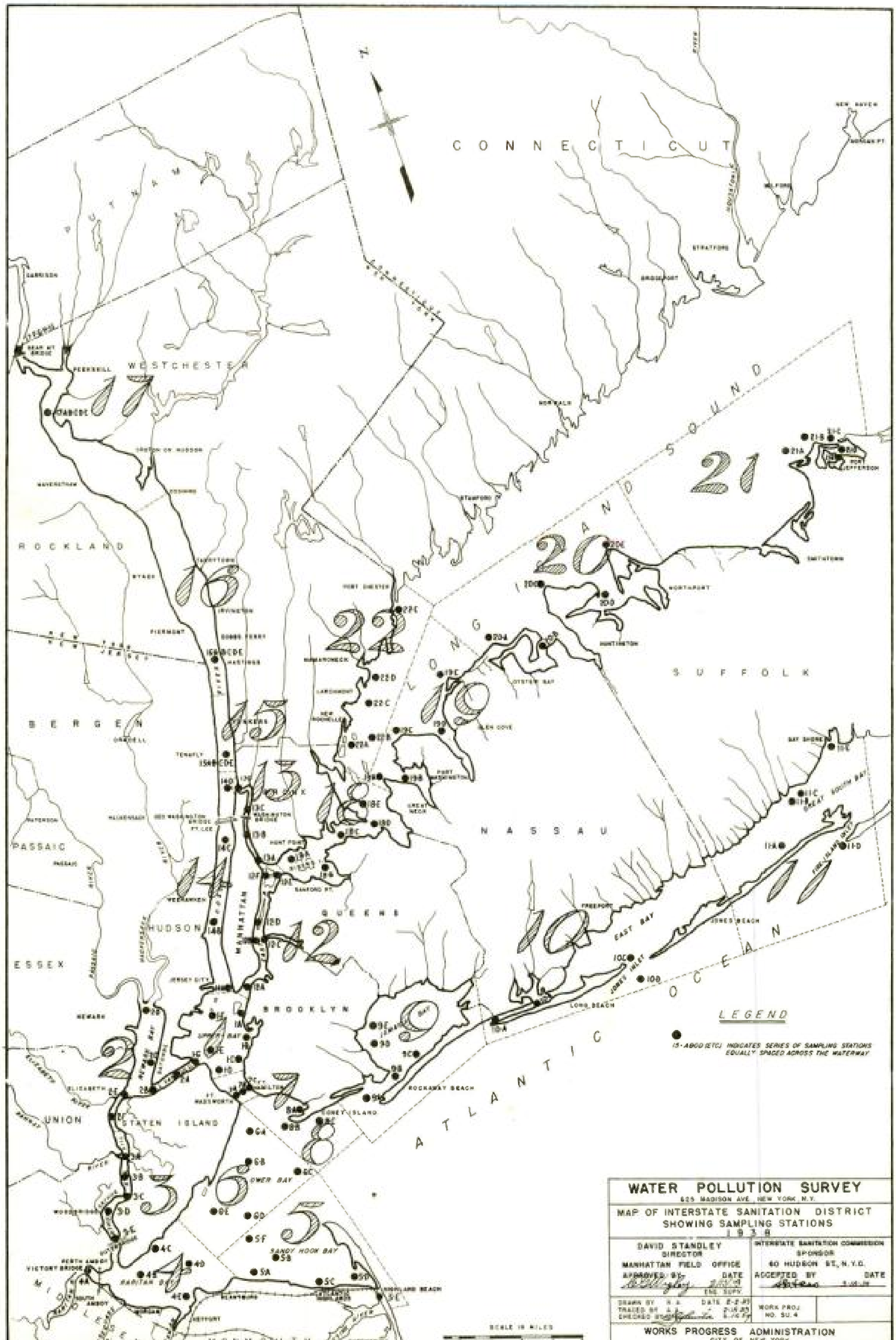
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QUEENS
NASSAU
SUFFOLK
MONMOUTH
LONG ISLAND SOUND
ATLANTIC OCEAN
LEGEND
15-ABCD(ETC) INDICATES SERIES OF SAMPLING STATIONS EQUALLY SPACED ACROSS THE WATERWAY
SCALE IN MILES
WATER POLLUTION SURVEY
625 MADISON AVE., NEW YORK, N.Y.
MAP OF INTERSTATE SANITATION DISTRICT
SHOWING SAMPLING STATIONS
1938
DAVID STANDLEY
DIRECTOR
MANHATTAN FIELD OFFICE
APPROVED BY
DATE
ENG. SUPV.
INTERSTATE SANITATION COMMISSION
SPONSOR
60 HUDSON ST., N.Y.C.
ACCEPTED BY
DATE
WORK PROJ
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WORKS PROGRESS ADMINISTRATION
CITY OF NEW YORK
OFFICIAL PROJECT NO. 465-97-3-131

FIG. 1

I N T R O D U C T I O N

REASONS FOR MAKING THE STUDY

A major part of the work program of this Project has been the collection and analysis of samples of water taken from the various waterways of the Interstate Sanitation District. Some work had been done in this connection in 1937 but, due to the lack of equipment, was limited to the taking of samples for the determination of dissolved oxygen. The work done in 1937 was somewhat unsatisfactory due to the fact that the method of collecting the samples was not performed in the manner required by the standard methods of the American Public Health Association for water and sewage analyses. In 1937 the Project did not have a proper sample collector, and the samples were collected in glass stoppered bottles, weighted with lead sinkers. In making dissolved oxygen determinations the method of obtaining the sample is of prime importance for obtaining accurate results.

SCOPE OF THE WORK

The work of the Project in 1938 included the taking of samples for the determination of the dissolved oxygen, the determination of the total thirty-seven degree count of bacteria and the determination of the number of coliform organisms present. Some work was also done in the collection of samples for the determination of the biochemical oxygen demand of the various waterways. In addition to the above mentioned tests which were made in various sections of the Interstate Sanitation District, a special study was made of the waters of Jamaica Bay. This work was mainly a long continued program of tests for the determination of the number of coliform group of intestinal bacteria present in various parts of the waters of Jamaica Bay.

PLAN OF OPERATIONS

A program for doing the chemical and bacteriological work was prepared in advance of the working season. For the purpose of carrying out the program the Interstate Sanitation District waterways were divided into twenty-two sections. The general plan included the taking of bacteriological samples during the month of June, visiting each of the twenty-two sections and the collection of dissolved oxygen samples in the same areas several times during the latter half of July, during August, and the first part of September, when the waters are warm.

DESCRIPTION OF SAMPLING SECTIONS

The extent of the territory embraced in the Interstate Sanitation District was defined in the Tri-State Compact of 1936. This District was divided by the Commission into twenty-two sections, arranged with the objective of obtaining an adequate number of samples in any section in a single day. As it was desired to make an intensive study of Jamaica Bay (Section #9) in order to determine the effects of chlorination, this section was divided into five subsidiary areas.

Three or more sampling points were located in each section or area. In selecting these points consideration was given to (a) the location of sampling points used by other agencies, (b) the location of outfalls from sewage treatment plants, and (c) the navigability of the waters by motor boat.

Following is a description of the sections of the District:

Section 1 - Upper Bay; from the Battery south to The Narrows and west to the mouth of Kill Van Kull.

Section 2 - Newark Bay; Kill Van Kull channel and entrance to Arthur Kill channel.

Section 3 - Arthur Kill channel.

Section 4 - Raritan Bay; from Raritan River entrance to Princess Bay, and from Princess Bay to Conaskonk Point.

Section 5 - Sandy Hook Bay; from Conaskonk Point to Highland Beach.

Section 6 - Lower Bay; from Princess Bay to Fort Wadsworth.

Section 7 - Narrows.

Section 8 - Gravesend Bay and Coney Island from Fort Hamilton to Manhattan Beach.

Section 9 - Jamaica Bay. This section was divided into five areas. Area No. 1 was located in Rockaway Inlet; Area No. 2 along the bridge connecting Barren Island and Rockaway, near Jacob Riis Park; Area No. 3 was located near the draw span between Broad Channel and Rockaway Beach; Area No. 4 in Island Channel, at Mill Basin, and Area No. 5, southeast of the City dock, Canarsie.

Section 10- Hempstead Bay, East Rockaway Inlet and Jones Inlet.

Section 11- Great South Bay and Fire Island Inlet.

Section 12- East River; from Pier 8 to 106th Street and West of Wards Island.

Section 13- Harlem River, north to 215th Street.

Section 14- Lower Hudson River, from Pier "A" in Manhattan north to Dyckman Street.

Section 15- Hudson River at Yonkers.

Section 16- Hudson River from Hastings north to Ossining.

Section 17- Hudson River from Ossining north to Bear Mountain Bridge.

Section 18- Includ[illegible] the waters around Rikers Island east to the Stepping Stones, Long Island Sound.

Section 19 - Long Island Sound from Hewlett Point to Mattinicock Point, including Manhasset Bay.

Section 20 - Long Island Sound; from Oak Neck Point, east to Eaton's Point, including Oyster Bay.

Section 21 - Long Island Sound east as far as Port Jefferson, including Port Jefferson Harbor.

Section 22 - Long Island Sound from the northeastern point of City Island northeast to Port Chester.

DESCRIPTION OF SAMPLING POINTS.- A description of the sampling points in each section, revised as of August 10, 1938, follows:

SECTION NO. 1 - UPPER NEW YORK BAY

1A - Buttermilk Channel, southerly approach, adjacent to Light and Bell Buoy No. 30.

1B - In Bay Ridge Channel at Gowanus Bay, adjacent to Light and Bell Buoy No. 7.

1C - In Bay Ridge Channel north of Owl's Head Park, Bay Ridge, 400 feet west of center of Long Island Railroad Float Bridges.

1D - Off Tompkinsville, adjacent to Light and Bell Buoy No. 25.

1E - Off Robbins Reef Lighthouse, 600 feet northeast of Light Buoy No. 27, in Passaic Valley Sewage Dispersion area.

1F - Lehigh Valley Railroad channel, southeast of Bedloe Island, midway between Can Buoy No. 1 and Bell and Light Buoy No. 2.

1G - Off New Brighton mouth of Kill an Kull, 100 feet northwest of Can Buoy No. 3.

SECTION NO. 2 - KILL VAN KULL - NEWARK BAY - ARTHUR KILL

2A - Kill Van Kull mid-channel opposite Central Railroad of New Jersey Piers in Bayonne.

2B - Kill Van Kull mid-channel at Bayonne Bridge, Bergen Point.

2C - Newark Bay mid-channel, 100 feet west of Nun Buoy No. 4.

Section No. 2 (Continued)

2D - Newark Bay mid-channel, 50 feet south of center of draw of Lehigh Valley R.R. Bridge.

2E - Arthur Kill center entrance of channel off center of Elizabethport Recreation Pier.

2F - Arthur Kill north of center pier of B. & O. R.R. Bridge, adjacent to Joint Meeting outfall.

SECTION NO. 3 - ARTHUR KILL

3A - Mid-channel of Arthur Kill at the mouth of the Rahway River.

3B - Mid-channel of Arthur Kill, between Chrome Works in Cartaret and the south mouth of Fresh Kills.

3C - Mid-channel at Rossville, midway between Can Buoy No. 5 and Bell and Light Buoy No. 4a.

3D - Off Boynton Beach mid-channel, 100 feet west of Light Buoy No. 6.

3E - At Outerbridge Crossing in mid-channel, directly under center of span.

SECTION NO. 4 - RARITAN BAY - RARITAN RIVER - PRINCESS BAY

4A - Raritan River at Victory Bridge Perth South Amboy, directly under center of draw span.

4B - Raritan Bay channel to Princess Bay, midway between Bell and Light Buoy No. 13 and Nun Buoy No. 38.

4C - Princess Bay channel to Arthur Kill, midway between Nun Buoy No. 30 and Can Buoy No. 9.

4D - On a line between Conaskonk Point and Huguenot Beach, adjacent to Bell and Light Buoy No. 5.

4E - Mouth of channel into Matawan Creek, adjacent to Light Buoy No. 7.

SECTION NO. 5 - SANDY HOOK BAY - LOWER BAY - SHREWSBURY RIVER

5A - At intersection of range line Point Comfort Beacon - Waachaak Light and Old Orchard Shoal Light - Elmtree Beacon, approximately 1,200 yards north of Mill Creek, Port Monmouth, N.J.

Section No. 5 (Continued)

5B - At intersection of range line West Bank Light - Conover Beacon and the stack on Sandy Hook just north of Horseshoe Cove and the tank at Shoal Harbor, approximately 2,200 yards north of Conover Beacon at Leonardo, N. J.

5C - 20 yards east of outer end of Atlantic Highlands Pier.

5D - Channel entrance to Shrewsbury River, adjacent to Bell and Light Buoy No. 2.

5E - Center of Channel at railroad bridge over Shrewsbury River, located 100 feet north of concrete bridge of Highway No. 36, between Highlands and Highland Beach.

5F - Lower Bay in Raritan Bay Channel, 100 feet south of Light and Bell Buoy No. 10.

SECTION NO. 6 - LOWER BAY

6A - Northwest of Hoffman Island, adjacent to Nun Buoy No. 2.

6B - Approximately 1,700 yards southeast of Midland Beach, adjacent to Bell Buoy.

6C - Adjacent to West Bank Light located in Swash Channel.

6D - Adjacent to Old Orchard Shoal Light.

6E - Adjacent to Great Kills Light, 1,500 yards off south of Crooks Island.

SECTION NO. 7 - THE NARROWS

7A - The westerly quarter point of a line between the Fort Lafayette and Fort Wadsworth landing docks.

7B - Mid-stream on a line between Fort Lafayette and Fort Wadsworth landing docks, The Narrows.

7C - The easterly quarter point on a line between the Fort Wadsworth and Fort Lafayette landing docks.

SECTION NO. 8 - GRAVESEND BAY - ATLANTIC OCEAN AT CONEY ISLAND

8A - Gravesend Bay at mouth of Coney Island Creek in mid-channel, on a line between Norton Point flagpole and huge gas tank in Gravesend adjacent to Coney Island Creek.

8B - South of Norton Point, adjacent to Light and Bell Buoy No. 12.

8C - Atlantic Ocean, 200 feet south of end of Steeplechase Pier at Coney Island.

SECTION NO. 9 - JAMAICA BAY

Sampling points for dissolved oxygen tests are located as follows:

9A - Rockaway Inlet, midway between the light on the east end of Manhattan Beach and Rockaway Point, approximately 300 feet east of the Coney Island outlet pipe.

9B - Rockaway Inlet, under center of bridge from Barren Island to Rockaway.

9C - Beach Channel, east of and adjacent to the center of draw span of causeway from Broad Channel Beach to Rockaway Beach.

9D - Island Channel at Mill Basin midway between Light Buoy No. 39 and Nun Buoy No. 12.

9E - 400 feet southeast of end of City dock, Canarsie.

Sampling points for bacteriological work are the following:

Area No. 1 - Five sampling points on a straight line between the light on the east end of Manhattan Beach and Rockaway Point.

Area No. 2 - Five sampling points alongside the bridge connecting Barren Island and Rockaway near Jacob Riis Park.

Area No. 3 - Three sampling points alongside the draw span between Broad Channel and Rockaway.

Area No. 4 - Three sampling points in Island Channel at Mill Basin.

Area No. 5 - Three sampling points in line, off City dock, Canarsie.

SECTION NO. 10 - HEMPSTEAD BAY

10A - East Rockaway Inlet, immediately west of center of draw span of Far Rockaway - Atlantic Beach Bridge.

10B - Main channel immediately west of center of Island Park - Long Beach R.R. Bridge.

10C - Jones Inlet, 200 yards east of north point of Point Lookout at inner end of the inlet.

10D - Atlantic Ocean at Jones Inlet, 300 yards off shore in main channel as closely as possible on line with the cupola and the Coast Guard Lookout Tower, at Lookout Point on Long Beach.

SECTION NO. 11 - GREAT SOUTH BAY

11A - Approximately 200 yards north of the easterly end of Cedar Island.

11B - Entrance to Santapogue River, 250 yards east of Fleet Point.

11C - Mouth of the Carll River on line between Fleet and Sampawan Points.

11D - Fire Island Inlet, about 300 yards south of the tip of Democrat Point.

11E - Great Cove, 100 yards south of Watchogue Creek Light, Bay Shore, on line with Light Buoy No. 14.

SECTION NO. 12 - EAST RIVER

12A - Mouth of river mid-channel off Pier 8, Brooklyn.

12B - One-third the distance from the foot of East 23rd Street, Manhattan to Brooklyn.

12C - Center of Newtown Creek channel on the Brooklyn pierhead line,

Section No. 12 (Continued)

12D - One-fourth the distance from the foot of East 42nd Street, Manhattan to Queens... (middle of west channel.)

12E - Hell Gate, east of Wards Island mid-stream under the New York connecting railroad bridge.

12F - Harlem River west of Wards Island mid-stream opposite the foot of East 106th Street, Manhattan.

SECTION NO. 13 - HARLEM RIVER

13A - Mid-stream north of the central pier of the Willis Avenue drawbridge.

13B - Mid-stream north of the central pier of the 155th Street drawbridge.

13C - Mid-stream opposite the Consolidated Shipbuilding Plant and Sherman Creek.

SECTION NO. 14 - LOWER HUDSON RIVER

14A - One-third the distance from Pier "A" in Manhattan to the Central Railroad of New Jersey slips at Communipaw.

14B - One-third the distance from the Manhattan shore at West 42nd Street to the New Jersey shore opposite.

14C - One-fourth the distance from the Manhattan shore at West 155th Street to the New Jersey shore opposite.

14D - One-fourth the distance from the central pier of the New York Central Railroad Bridge over Spuyten Duyvil Creek to the New Jersey shore opposite.

SECTION NO. 15 - HUDSON RIVER, traversing at right angles to center line of river at five equally spaced points north of Mt. St. Vincent - at the New York City-Yonkers boundary line.

15A - Beginning the traverse near the easterly side, approximately one-sixth the width of the river from the New York shore.

Section No. 15 (Continued)

15E - Being located five-sixths the distance to the New Jersey shore.

SECTION NO. 16 - HUDSON RIVER, traversing at right angles to center line of river at five equally spaced points from the New York-New Jersey State boundary line.

16A - Beginning the traverse near the easterly side, approximately one-sixth the width of the river off shore.

SECTION NO. 17 - HUDSON RIVER, traversing at right angles to center line of river at five equally spaced points on a line from a cupola in Verplanck on the east side of the river to a stack in Tomkins Cove on the west side of the river.

17A - Beginning the traverse near the easterly side approximately one-sixth the width of the river from the Westchester shore.

17E - Being located on the traverse, one-sixth the width of the river from the Rockland County shore.

F)
G)
H)- Are located on a traverse across the
I) river at Bear Mountain Bridge.
J)

17F - Being approximately one-sixth the width of the river off the east shore.

17J - Being one-sixth the width of the river off the Rockland County shore.

SECTION NO. 18 - EAST RIVER - LONG ISLAND SOUND

18A - East River, north channel, one-third the distance from Barotto Point to the dock on Rikers Island.

18B - East River near Flushing Bay, 500 feet due west from College Point ferry slip.

18C - East River one-third the distance from Whitestone Point to the Bronx shore.

Section No. 18 (Continued)

18D - East River at Throgg's Neck, midway between the two forts at the narrowest point.

18E - Long Island Sound, one-half mile north of the Stepping Stones Lighthouse.

SECTION NO. 19 - LONG ISLAND SOUND

19A - Off Hewlett Point, adjacent to Can Buoy No. 29.

19B - Manhasset Bay southeast of Plum Point, adjacent to Can Buoy No. 3.

19C - Off Prospect Point, adjacent to Bell Buoy No. 23.

19D - Hempstead Harbor off Mott Point adjacent to Bell Buoy No. 4.

19E - Off Mattinicock Point, adjacent to Bell and Light Buoy.

SECTION NO. 20 - LONG ISLAND SOUND

20A - Off Oak Neck Point, adjacent to Can Buoy No. 19.

20B - Oyster Bay Harbor off Seawanhaka, adjacent to Nun Buoy No. 2a.

20C - Off Lloyd Point, adjacent to Light and Bell Buoy No. 15.

20D - Huntington Bay off East Fort Point, adjacent to Nun Buoy No. 8.

20E - Off Eaton's Point, approximately 2,000 yards north of the northerly point of the shore line, adjacent to Can Buoy No. 13.

SECTION NO. 21 - LONG ISLAND SOUND

21A - Approximately 1,000 yards north of Crane Neck Point on Smithtown Bay.

21B - Off Oldfield Point, adjacent to Gong Buoy No. 11a

21C - Entrance to Port Jefferson Harbor, adjacent to Bell Buoy located west of Mt. Misery shoals.

Section No. 21 (Continued)

21D - In Port Jefferson Harbor, adjacent to Light and Bell Buoy No. 1 at inner end of channel.

21E - In mid-channel at entrance to Setauket Harbor, which is a part of Port Jefferson Harbor.

SECTION NO. 22 - LONG ISLAND SOUND

22A - Channel into Pelham Bay, midway between Twin Island and High Island.

22B - Off Sands Point, adjacent to Execution Rock Light.

22C - Channel into Echo Bay, Larchmont, adjacent to Nun Buoy No. 4.

22D - Mamaroneck Harbor, approximately 100 yards south of Light Buoy No. 42.

22E - Port Chester Harbor in channel adjacent to Light Buoy at tip of Byram Point.

FACILITIES USED - During the 1938 season two laboratories were in constant use. One of these, the main laboratory of the Project, was provided by the Interstate Sanitation Commission, and was in the quarters occupied by the Commission on the fourth floor of the Western Union Building at 60 Hudson Street, New York City. Some fixtures were installed by the Commission, others by the Project. The final result was a laboratory quite adequate for the work, but overcrowded because part of the space was used by the clerical and supervisory staff. As this location is very remote from Jamaica Bay, where a large part of the program was carried on, it was decided to establish field headquarters at the Coney Island Sewage Treatment Plant, Avenue "Z" and Knapp Street, Brooklyn. This laboratory is well equipped for the analysis of water and sewage, and space and equipment were placed at the disposal of this survey by the Department of Public Works.

In addition to the afore mentioned laboratories, the laboratory at Stable "I", Brighton 3rd Street and Canal Avenue, Brooklyn, was made available, and used on one or two occasions. This laboratory was until recently the main laboratory of the Department of Public Works.

Some materials and supplies for dissolved oxygen and biochemical oxygen demand work were in stock when the field work began, but there was practically nothing in the way of bacteriological equipment; this shortage was relieved by borrowing. Help in this emergency came from several sources - from the Interstate Sanitation Commission; from the Department of Public Works and the Department of Health of New York City, and from Dr. Buchbinder of Columbia University, former head of the bacteriological laboratory of the Air Pollution Survey. These contributions, eked out by such stores as were already available, made it possible to begin work on schedule. Towards the end of the season, supplies which had been ordered long in advance began to arrive.

No boat trips were planned from July 1 to July 11 in order to allow time for cleaning up laboratory bacteriological work and arranging dissolved oxygen equipment and making up standard solutions. Plans called for dissolved oxygen sampling and analysis to start on July 11, using one (1) boat up to July 18 and using two (2) boats during the remainder of July and throughout August.

In regard to the frequency of sampling the various sections, one day was to be allotted to each section from No. 1 to No. 19 inclusive, during June. Programs for July and August were so arranged that each section would be sampled three times, at intervals of about two weeks between successive visits.

An early estimate of the work to be accomplished during the 1938 season was:

	2500	samples for dissolved oxygen determinations
	5000	bacteriological samples
Total	7500	samples

These tests were to be supplemented by determinations of biochemical oxygen demand to the extent permitted by time and available facilities Color and turbidity were to be determined only at such points in the District where the appearance of the sample was obviously not normal.

Despite the difficulties encountered in obtaining supplies, the Jamaica Bay boat squad started operations on May 9, a week in advance of the date that had been set. This pre-schedule work was intended to familiarize the men with details of the procedure, prior to the adopted program. This work was continued on a three-day-week basis, as planned, without serious interruption or mishap up to and including August 23rd. At this critical stage of the program the boat was suspended by an inspector of the Works Progress Administration (August 24th.) Every effort was made to obtain another boat and resume operations, but this proved impossible until September 27, when the "Sweetheart" was assigned to finish this program. Following is the summary for Jamaica Bay coliform sampling:

WPA Boat	722	samples
"Sweetheart"	53	"
	775	"

The "Sweetheart" was placed in service as the second boat of the Project on June 6, and a third boat, the "Spray," was added on July 18, both as scheduled. The number of samples collected by each boat is shown in Table No. 2. Table No. 1 gives the hours contracted for and the number of hours the boats were used.

TABLE NO. 1 - OPERATION OF BOAT "SWEETHEART" - 1938

Month	Contracted Hours	Hours Consumed
June	176	126
July	120	106
August	176	148.5
September	112	53

Time lost = 25.8% of total time contracted for.

OPERATION OF BOAT "SPRAY" - 1938

Month	Contracted Hours	Hours Consumed
July	68	63.5
August	150	148
September	72	72

Time lost = 2.2% of total time contracted for.

"Hours Consumed" includes standby time; the hourly rate for the latter did not include charge for fuel and oil. Considerable time was lost due to breakdowns, inspections and bad weather, with breakdowns predominating.

In addition to the boat work, a start was made on shore line sampling and analysis of sludge, early in the season.

The following is a summary of the number of samples collected for the season:

TABLE NO. 2.

	D.O.	B.O.D.	Coliform	Total Count	Sludge
Jamaica Bay Boat	-	-	722	-	-
"Sweetheart"	359	58	244	82	-
"Spray"	521	25	59	41	-
Shoreline	-	-	-	-	28
	880	83	1,025	123	28

There was a break in sampling for biochemical oxygen demand, coliform density and total count after July 28, due to the fact that insufficient dissolved oxygen samples were

being collected prior to that date. Bacteriological work, although of minor importance in comparison with D.O. tests, was crippling the program. Departure of boats was being delayed while awaiting fresh bacteriological supplies, and field work was terminated at an earlier hour than normally required, to permit bacteriological samples to be returned to the laboratory before closing time. To remedy this situation, it was decided to stop all bacteriological work. This work was resumed later in the season, but only as an adjunct to the other work, and subordinate to the rest of the program.

Adequate control of supplies used on the boats was a problem of major importance. Squad leaders were instructed to keep proper records and to report regularly all breakage, and physical inventories of supplies on board the boats were taken at the end of each week. This count was rechecked by the squad leader taking charge of operations on the following week.

Laboratory work during the period of field work consisted of preparation of bacteriological supplies; incubation and examination of bacteriological samples; preparation of reagents; and standardization of solutions. Work on computation included the determination of most probable numbers of coliform group density; determination of oxygen solubility, percent sea water, and percent saturation, from the dissolved oxygen field data. Before field work had ended, employees had started to tabulate data, and to correlate them to predicted and observed tides, rainfall and other variables.

The safety record of the Project was excellent, as no accident of any significance occurred. During the period of field work, from May 9 to September 30 inclusive, a total of 13,889 man-hours were charged to the Project, and no employee lost any time due to injury. A maintenance worker in the laboratory suffered minor cuts from broken glassware on two occasions and received first aid. On two other occasions, members of the technical staff were injured by somewhat deeper cuts, once in the laboratory and once in the field; these men received medical attention - that is, their wounds were cleaned and bandaged - and then returned to work. Furthermore, no loss of time could be attributed to ill health as a result of the work.

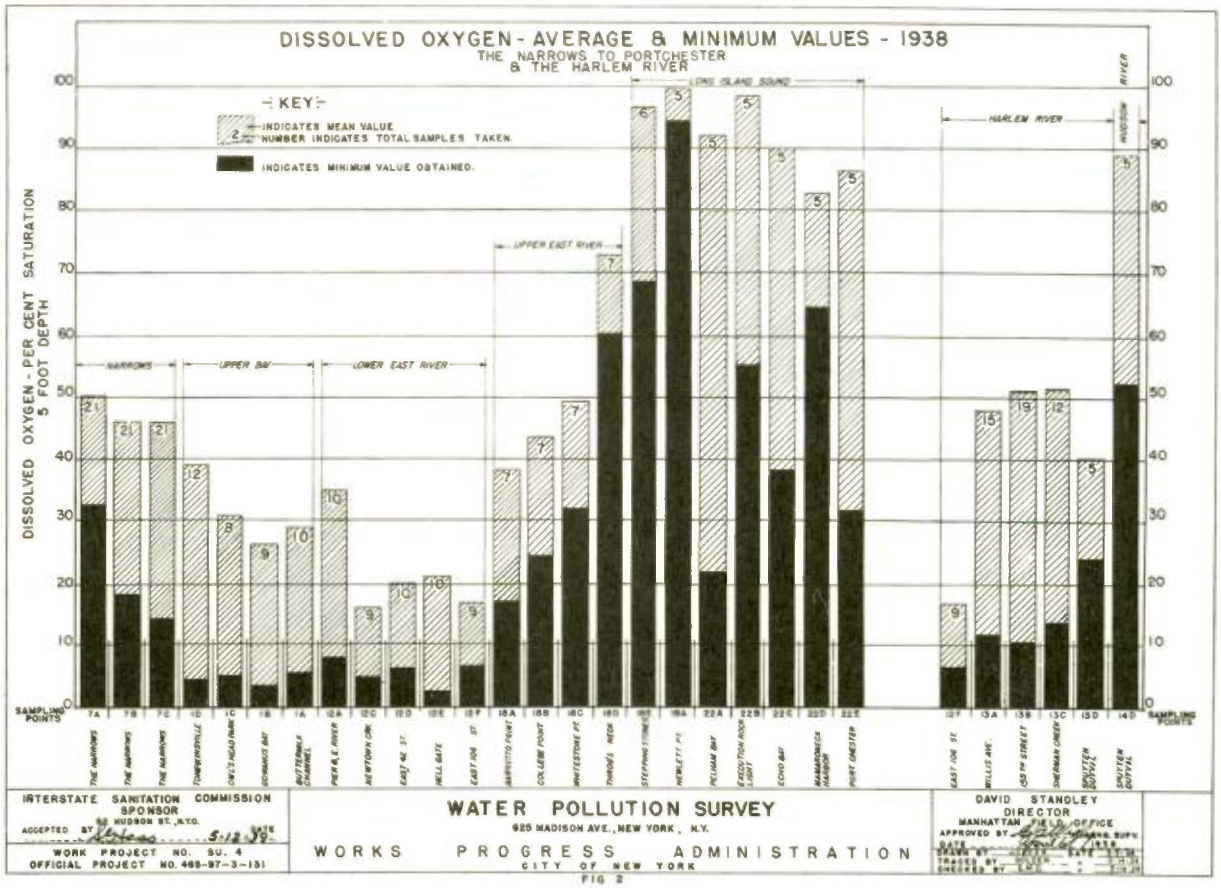
DISSOLVED OXYGEN - AVERAGE & MINIMUM VALUES - 1938
THE NARROWS TO PORTCHESTER
& THE HARLEM RIVER
KEY
INDICATES MEAN VALUE
NUMBER INDICATES TOTAL SAMPLES TAKEN.
INDICATES MINIMUM VALUE OBTAINED.
DISSOLVED OXYGEN - PER CENT SATURATION
5 FOOT DEPTH
NARROWS
UPPER BAY
LOWER EAST RIVER
UPPER EAST RIVER
LONG ISLAND SOUND
HARLEM RIVER
HUDSON RIVER
SAMPLING POINTS
THE NARROWS
TOMPKINSVILLE
OWL'S HEAD PARK
GOWANUS BAY
BUTTERMILK CHANNEL
PIER A, E. RIVER
NEWTOWN CR.
EAST 46 ST.
HELL GATE
EAST 104 ST.
BARRETTO POINT
COLLEGE POINT
WHITESTONE PT.
THROG'S NECK
STEPPING STONE
HEWLETT PT.
PELHAM BAY
EXECUTION ROCK LIGHT
ECHO BAY
MAMARONECK HARBOR
PORT CHESTER
EAST 106 ST.
WILLIS AVE.
138 TH STREET
SHERMAN CREEK
SPUYTEN DUYVIL
SPUYTEN DUYVIL
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FIG 2

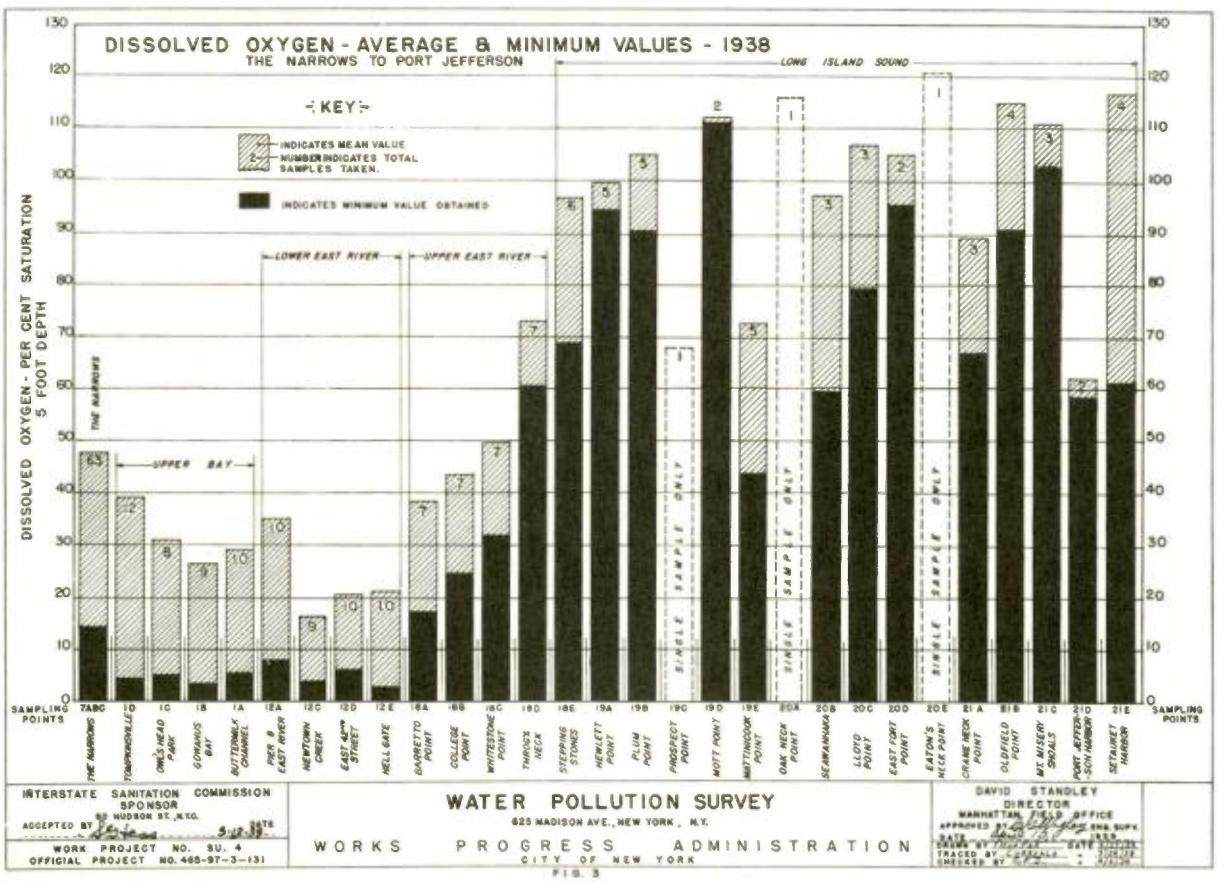
DISSOLVED OXYGEN - AVERAGE & MINIMUM VALUES - 1938
THE NARROWS TO PORT JEFFERSON
LONG ISLAND SOUND
KEY
INDICATES MEAN VALUE
NUMBER INDICATES TOTAL SAMPLES TAKEN.
INDICATES MINIMUM VALUE OBTAINED
DISSOLVED OXYGEN - PER CENT SATURATION
5 FOOT DEPTH
LOWER EAST RIVER
UPPER EAST RIVER
UPPER BAY
THE NARROWS
SINGLE SAMPLE ONLY
SAMPLING POINTS
7ABC THE NARROWS
1D TOMPKINSVILLE
1C OWL'S HEAD PARK
1B GOWANUS BAY
1A BUTTERMILK CHANNEL
12A PIER A, EAST RIVER
12C NEWTOWN CREEK
12D EAST 46TH STREET
12E HELL GATE
18A BARRETTO POINT
18B COLLEGE POINT
18C WHITESTONE POINT
18D THROG'S NECK
18E STEPPING STONES
19A HEWLETT POINT
19B PLUM POINT
19C PROSPECT POINT
19D MOTT POINT
19E MATTINICOCK POINT
20A OAK NECK POINT
20B SEAMANHAKA
20C LLOYD POINT
20D EAST FORT POINT
20E EATON'S NECK POINT
21A CRANE NECK POINT
21B OLDFIELD POINT
21C MT. MISERY SHOALS
21D PORT JEFFERSON HARBOR
21E SETAUKET HARBOR
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FIG. 3

DISCUSSION AND COMPARISON OF ANALYTICAL DATA

DISSOLVED OXYGEN DATA.- In the twenty-two (22) sampling areas into which the Interstate Sanitation District had been divided, 868 samples of water were taken by boat crews and tested to determine the per cent saturation of dissolved oxygen during the summer of 1938. The sampling points, methods of analysis and other details of the work have been described in the preceding pages of this report.

In making the dissolved oxygen tests, the results are sometimes so high as to be abnormal. These may be due to personal errors, effect of rainstorms, the lag in releasing oxygen after a sudden change in temperature or several other causes. For this reason, it was decided to retain all values for dissolved oxygen of 125 per cent saturation or less, and to reject all higher percentages as being of questionable value. The total number of results rejected for this cause was 38 or 4.4 per cent of the total.

Table No. 3* lists the individual dissolved oxygen results by sections and sampling points of the Interstate Sanitation District. For each section, the samples collected at all sampling points are listed separately, with the "salinity" (per cent sea water) and "D.O."(dissolved oxygen-per cent saturation). A summary, giving the average and minimum values of these tests for 1938, is given for each section in Table No. 4*, and a summary of the results for 1937 is given in Table No. 5*.

RESULTS OBTAINED IN 1938.- In sixteen (16) of the twenty-two (22) sections, average values for saturation of dissolved oxygen were above 50 per cent. In this group seven (7) sections had minimum dissolved oxygen values also above 50 per cent saturation. These sections were numbers: 5; 10; 11; 16; 17; 20 and 21. In the same group, nine (9) sections had minimum values below 50 per cent saturation, these being sections: 4; 6; 8; 9; 14; 15; 18; 19 and 22.

Five (5) other sections of the District had average values between 30 and 50 per cent saturation, and minimum values below 30 per cent saturation. These were sections number : 1; 2; 3; 7 and 13. In one (1) section, No. 12, both average and minimum values were less than 30 per cent saturation.

* See appendix

TABLE NO. 4 -- SUMMARY OF DISSOLVED OXYGEN TESTS - 1938

SECTION NO.	LOCATION	NO. OF ANALYSES	AVERAGE D.O.	MINIMUM D.O.
1	Upper New York Bay	73	33.5	3.5
2	Kill van Kull; Newark Bay; Arthur Kill	59	40.2	4.8
3	Arthur Kill	36	39.6	8.5
4	Raritan Bay; Raritan River; Princess Bay	27	81.9	41.4
5	Sandy Hook Bay; Lower Bay; Shrewsbury River	27	90.7	78.6
6	Lower Bay	29	55.7	19.6
7	The Narrows	63	47.6	14.3
8	Gravesend Bay; Atlantic Ocean at Coney Island	36	65.3	5.7
9	Jamaica Bay	37	81.3	45.4
10	Hempstead Bay	6	114.	102.
11	Great South Bay	3	109.	100.
12	Lower East River	58	22.8	2.6
13	Harlem River	51	49.4	10.6
14	Lower Hudson River	22	67.0	35.4
15	Hudson River at Mt. St. Vincent	106	77.8	48.2
16	Hudson River at N.Y.-N.J. State Line	49	91.0	81.7
17	Hudson River at Verplanck and at Bear Mt. Bridge	45	91.9	84.0
18	East River; Long Island Sound	34	59.0	17.1
19	Long Island Sound	18	93.2	43.8
20	Long Island Sound	10	106.	59.5
21	Long Island Sound	16	99.5	58.7
22	Long Island Sound	25	89.9	22.0

RESULTS OBTAINED IN 1937.- For the purpose of making broad general comparisons of data easily, a summary of the 1937 data is given below. This matter is discussed in considerable detail in later pages of this report. The use of data here presented only might lead to erroneous deductions, because of differences in methods and locations used in 1937 and 1938.

TABLE NO. 6. - SUMMARY OF DISSOLVED OXYGEN TESTS - 1937

SECTION NO.	LOCATION	NO. OF ANALYSES	AVERAGE D.O.	MINIMUM D.O
1	Upper New York Bay	60	44.9	0
2	Kill van Kull; Newark Bay; Arthur Kill	9	55.4	43.
3	Arthur Kill	5	40.	22.
4	Raritan Bay; Raritan River; Princess Bay	17	77.1	48.
5	Sandy Hook Bay; Lower Bay; Shrewsbury River	10	95.3	80.
6	Lower Bay	24	69.2	53.
7	The Narrows	97	53.9	24.
8	Gravesend Bay; Atlantic Ocean	53	56.8	0
9	Jamaica Bay	68	83.3	2.
10	Off Long Beach and Jones Beach	3	108.	99.
11	Great South Bay	0	-	-
12	Lower East River	46	19.6	3.
13	Harlem River	34	24.5	1.
14	Lower Hudson River	55	41.7	20.
15	Hudson River at Mt.St.Vincent	16	56.2	29.
16	Hudson River north of Ossining	28	76.5	46.
17	Hudson River - Croton Point and Bear Mt. Bridge	11	73.9	66.
18	East River; Long Island Sound	286	38.7	0

TABLE NO. 5. - (Continued)

SECTION NO.	LOCATION	NO. OF ANALYSES	AVERAGE D.O.	MINIMUM D.O.
19	Long Island Sound	12	72.8	42.
20	Long Island Sound	0	-	-
21	Long Island Sound	0	-	-
22	Long Island Sound; Pelham Bay	22	71.	44.

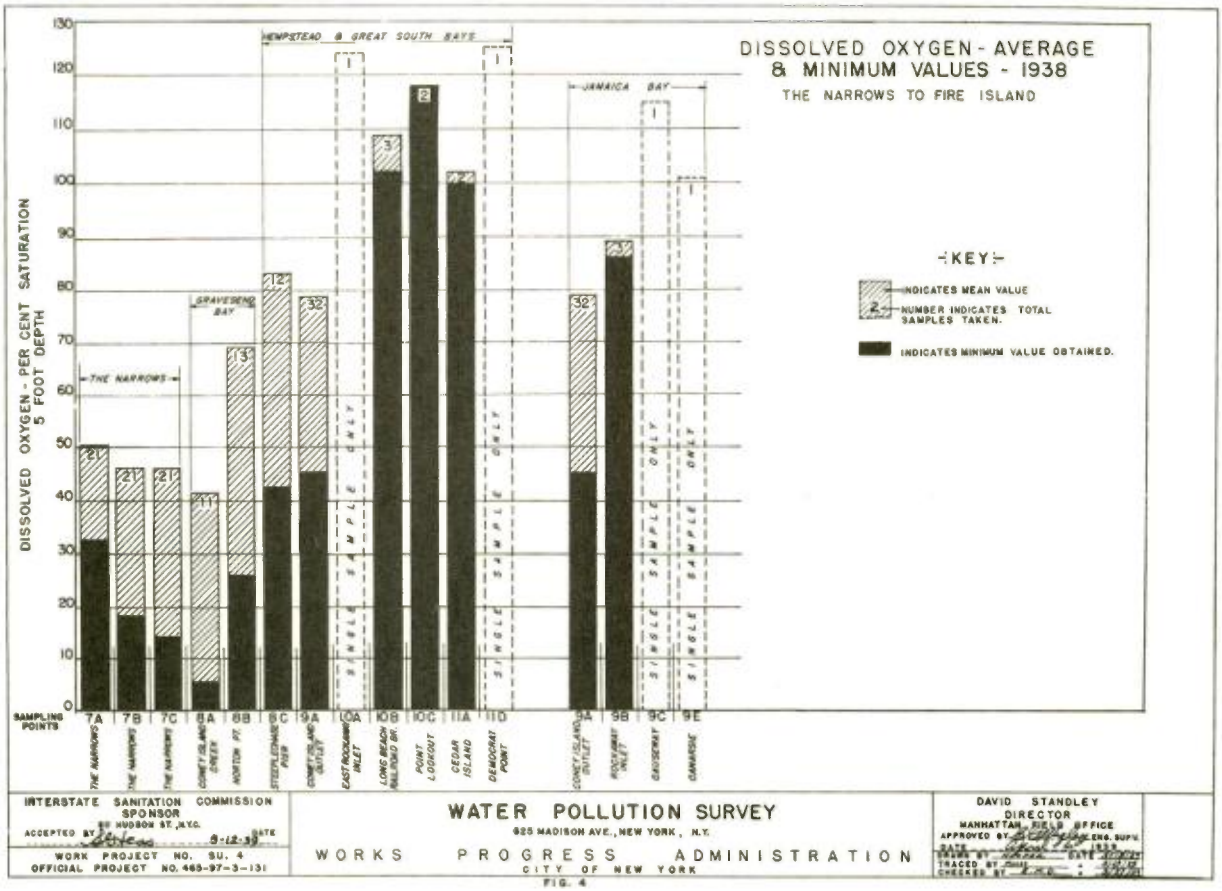

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FIG. 4

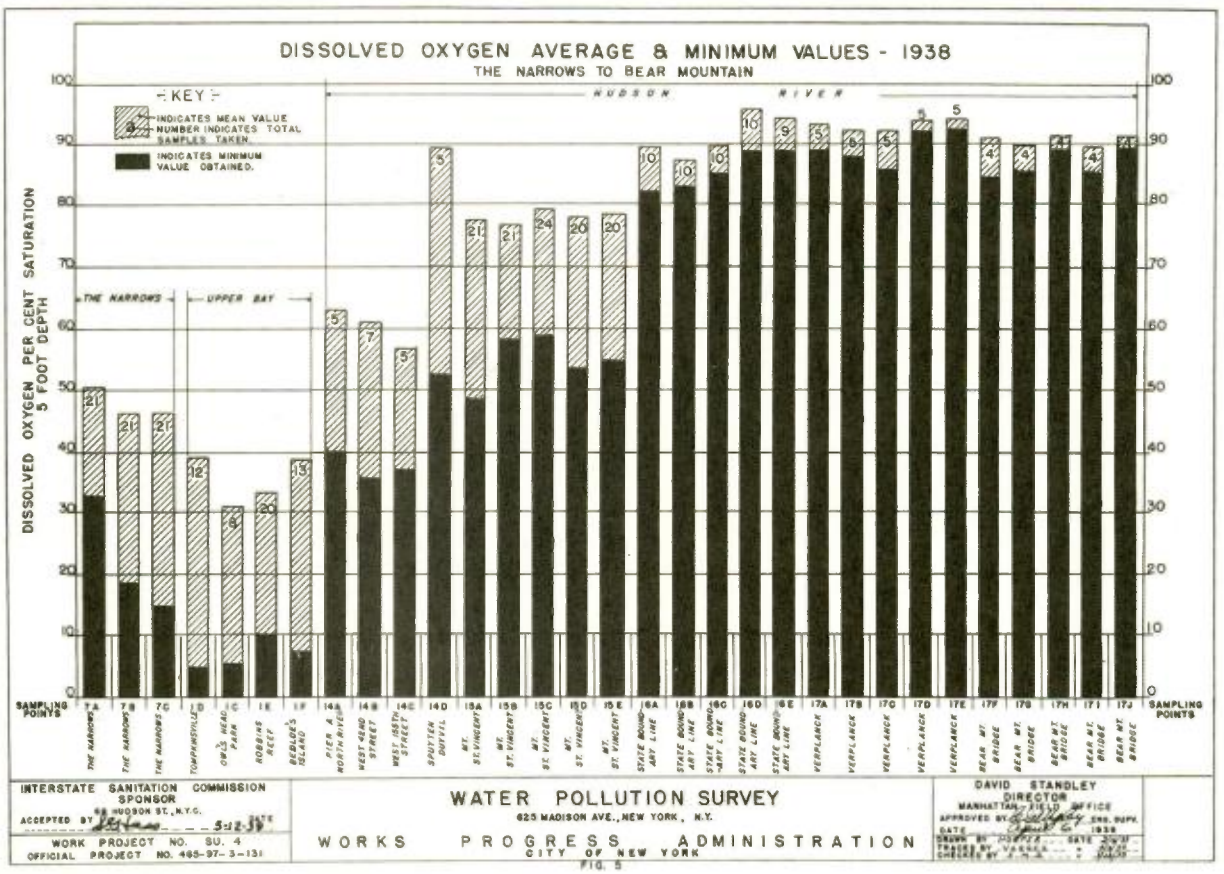

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FIG. 5

COMPARISON OF DISSOLVED OXYGEN DATA BY SECTIONS AND POINTS

The minimum and average values for each sampling point are compared graphically in Figures 2 to 8. These show the variations in the saturation of dissolved oxygen along routes of connecting water ways, such as :

(1) From The Narrows through the Upper Bay and East River to Long Island Sound along the Westchester County Shore. This chart also shows the same data for the Harlem River including sampling points in the East and Hudson Rivers.

(2) From The Narrows through the Upper Bay and East River to Long Island Sound along the North Shore of Long Island.

(3) From The Narrows through the Lower Bay to the Atlantic Ocean along the South Shore of Long Island.

(4) From The Narrows through the Upper Bay and Hudson River to Bear Mountain.

(5) From the Upper Bay through the Kill van Kull and Arthur Kill to Raritan Bay.

(6) From The Narrows through the Lower Bay along the South Shore of Staten Island to Raritan Bay.

(7) From Raritan Bay along the New Jersey coast line through Sandy Hook Bay.

By means of these charts, anyone can readily perceive the great difference between the dissolved oxygen saturation values in the most badly polluted areas, and in the comparatively less polluted waters of Long Island Sound and the Atlantic Ocean.

SECTION 1. - UPPER NEW YORK BAY

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	10	29	6
B	9	26	4
C	9	31	5
D	12	39	5
E	20	33	10
F	13	39	7

An average value of 33.5 per cent was obtained for the six (6) sampling points. The mean dissolved oxygen values for each of the three (3) points near the Brooklyn Shore (A, B and C) are somewhat lower than the means for the three (3) points further west (D, E and F). The minimum dissolved oxygen values do not show any significant difference between any of the six (6) points. What might be considered as of some significance, is the fact that no samples at A, B or C gave dissolved oxygen values above 50 per cent saturation. At Points A, B and C, there is more polluting material present than in the rest of the section. The samples of water taken at Station B, indicated the presence of more serious pollution at this point than at the other sampling points in the Upper Bay. Sampling points 1D, 1E and 1F are in the westerly portion of the Upper Harbor. Samples taken at Point E showed greater pollution than at D and F. The mean value for the dissolved oxygen samples at Point E was lower than at the other two (2) points. Furthermore, there was at Point E a larger percentage of samples with dissolved oxygen values below 30 per cent and a smaller percentage of samples with dissolved oxygen values above 50 per cent saturation, than at D or F.

SECTION 2. - KILL VAN KULL, NEWARK BAY AND ARTHUR KILL

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	12	37	10
B	12	42	10
C	11	42	5
D	11	44	7
E	10	37	5
F	3	32	23

The samples taken at the six (6) sampling points in this section yielded an average dissolved oxygen saturation value of 40.2 per cent. The average value for each of the six (6) points did not show any very great difference. At Points B, C and D, the samples indicate that there was somewhat less pollution than at Points A and E, as measured by the mean values for dissolved oxygen, the percentage of samples with dissolved oxygen less than 30 per cent and the percentage of samples with dissolved oxygen above 50 per cent. The range in the minimum values does not appear to have any special significance. No definite conclusions can be drawn relative to the degree of pollution at F, as only three (3) samples were collected at that point. One unexpected characteristic of this set of samples was the low values for dissolved oxygen saturation found in Newark Bay, as much of the sewage, from municipalities that are situated in the drainage area, is conveyed by the Passaic Valley Trunk Sewer into Upper New York Bay.

The open and shallow waters of Newark Bay may account for the slightly better conditions found at Points C and D. Point B is located at the westerly end of Kill van Kull, where the latter connects with Newark Bay. There are no large sewer outlets near this point, and the current attains a maximum velocity of 2.7 knots. These conditions might be the reason for the slightly more favorable results obtained.

An explanation of the higher pollution indicated at Points A and E, is that the former is located within Kill van Kull into which the polluted waters of New York Harbor enter at certain stages of the tide, and Point E is at the north end of Arthur Kill, in the vicinity of important sewer outlets, and considerable industrial pollution.

SECTION 3. - ARTHUR KILL

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	7	30	9
B	11	35	13
C	11	44	15
D	7	50	19

Samples collected at the four (4) sampling points in this section gave an average dissolved oxygen of 39.6 per cent. No samples for dissolved oxygen were collected at Point 3-E.

Comparisons of the data collected at Points A, B, C and D, all of them located in Arthur Kill, show a consistent improvement in conditions in the sequence stated. At all of these points, samples were taken in which the dissolved oxygen was below 30 per cent. Point A was the only point in this section at which none of the samples exceeded 50 per cent saturation.

If we compare the data obtained in Section 3 with the dissolved oxygen values observed in the previous section at Points 2-E and 2-F, which are also in Arthur Kill, we find that proceeding south thus, the average value varies from 37 per cent at 2-E to 32 per cent at 2-F, dropping further to 30 per cent at the low point 3-A. South of this point, the dissolved oxygen values rise to 35 per cent at point 3-B, to 44 per cent at 3-C and to 50 per cent at Point 3-D.

The improved conditions in the southerly portion of Arthur Kill are no doubt due to the fact that sewage treatment plants were recently placedin operation for the Joint Sewer Outlet and the Rahway Valley Sewer systems, and for several municipalities situated on the lower portion of the Raritan River.

Arthur Kill carries a considerable load of industrial waste, and the indication of maximum pollution at Point 3-A seems normal.

SECTION 4. -RARITAN BAY

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	6	59	41
B	5	97	66
C	5	90	49
D	6	96	64
E	5	69	52

The average dissolved oxygen value for the twenty-seven (27) samples taken in this section was 81.9 per cent. None of these samples were below 30 per cent saturation, and at three (3) points (B, D and E), all samples were above 50 per cent saturation. At Point D, five (5) out of six (6) samples exceeded 80 per cent saturation. Of the five (5) points here considered, the lowest average value was found at Point 4-A.

Considering the points in relation to each other, these results seem consistent. Points B and D are in open water. Point E is inshore, but there are only two (2) sewer outfalls in this vicinity. On the other hand, Point C is close to the South Shore of Staten Island where there are several sewer outlets, and Point A is in the mouth of the Raritan River, near several sewer outlets.

The rather high per cent of dissolved oxygen saturation values found here are probably due to the construction of sewage treatment plants at municipalities along the Raritan River, at Perth Amboy and at other places. These works have reduced considerably the amount of pollution from that which formerly was discharged into this area. Higher values are also induced by the natural aeration and oxidation of the organic matter by wave action, sedimentation and dilution in Raritan Bay. The presence of algae which was noted at the time some of these samples were taken might also have affected the test somewhat.

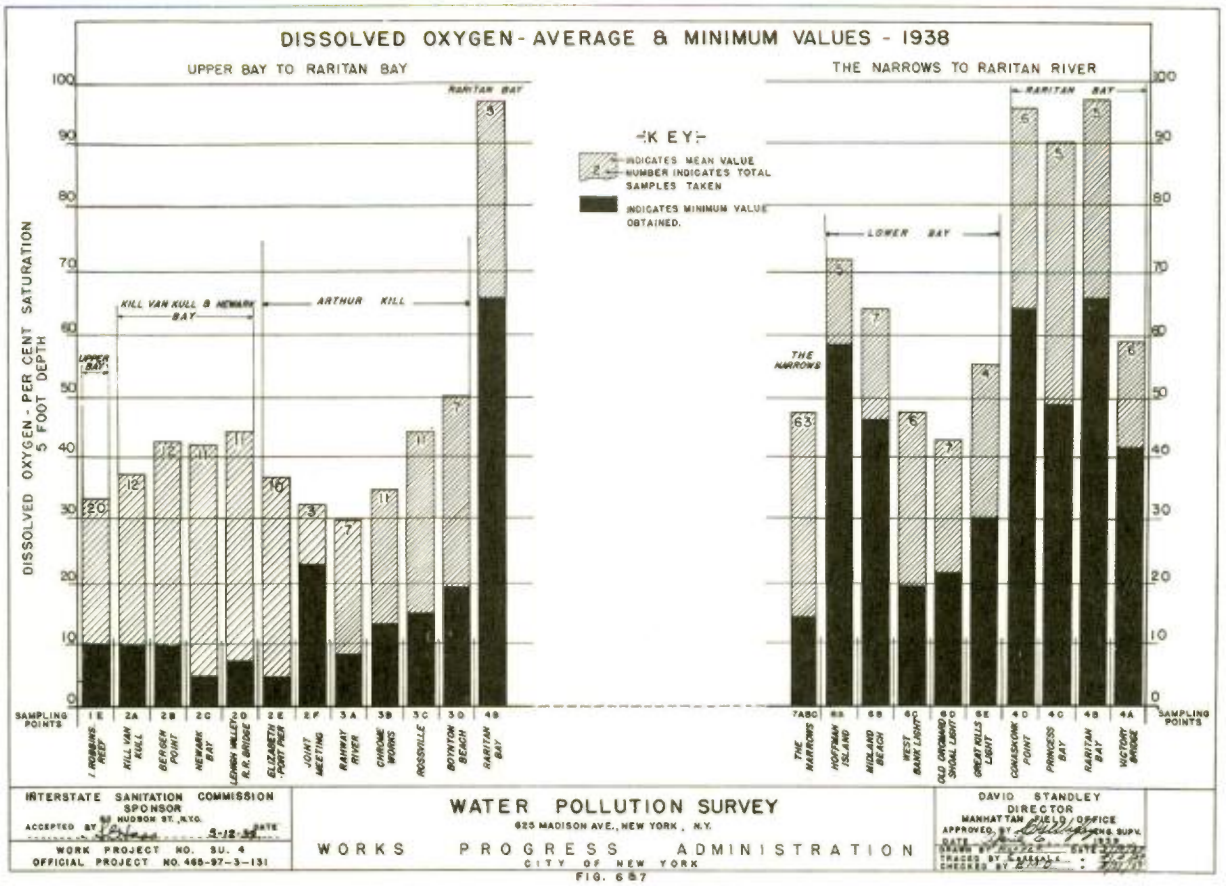

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FIG. 6&7

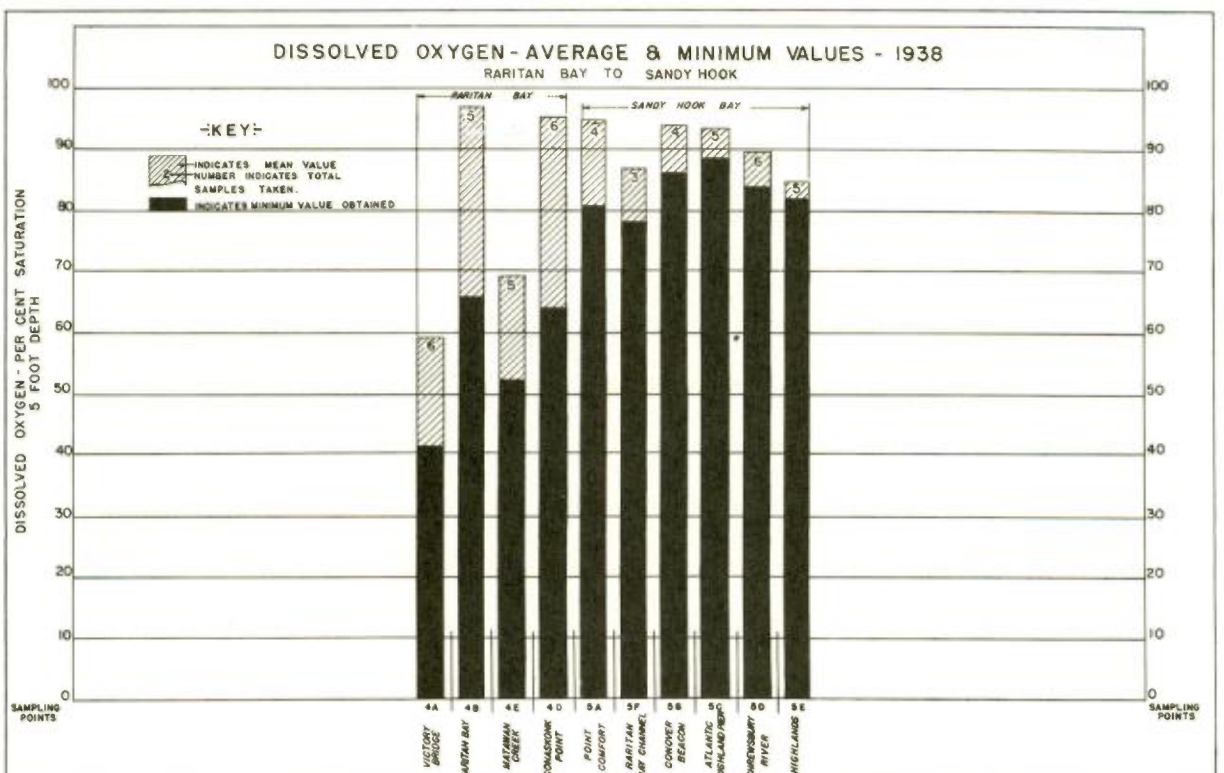

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FIG. 8

SECTION 5. - SANDY HOOK BAY

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	4	95	81
B	4	94	86
C	5	94	88
D	6	90	84
E	5	85	82
F	3	87	79

An overall average dissolved oxygen value of 90.7 per cent was obtained from the samples taken in this section. All of the twenty-seven (27) samples were well above 50 per cent saturation. Only one (1) of the samples was below 80 per cent saturation. The mean dissolved oxygen values at Points A, B and C, were somewhat higher than the means at Points D, E and F.

The high dissolved oxygen values for this section seem normal, considering the distance of the points from large sources of pollution of the Metropolitan Area, and their proximity to the Atlantic Ocean. Point E had the lowest mean dissolved oxygen of any of the six (6) points, but because of the small differences and the few samples taken, it may be of no special significance.

SECTION 6. - LOWER BAY

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	5	72	59
B	7	64	46
C	6	48	20
D	7	43	22
E	4	56	30

The twenty-nine (29) samples collected in this section showed a general average dissolved oxygen of 55.7 per cent of saturation. At Points B and E, no samples were below 30 per cent, and at Point A, all samples were above 50 per cent saturation. Considering mean values for dissolved oxygen and percentage breakdown of results, conditions were poorest at Points C and D.

All points in this section are offshore. The inferior conditions at Point C may be due to the fact that tidal

currents carry the more highly polluted water from The Narrows to these points. It is not immediately evident why Point 6-D, although fairly close to Point 5-F, shows much poorer dissolved oxygen results on all counts, but may be due to the course of the channel and tidal currents. Another factor involved is the fact that the seven (7) samples from Point 6-D were collected in July and August, whereas the three (3) samples collected at Point 5-F were collected in September.

SECTION 7. - THE NARROWS

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	21	50	33
B	21	46	18
C	21	46	14

The average dissolved oxygen for all the samples taken in this section was 47.6 per cent. Twenty-one (21) samples at Point A showed better dissolved oxygen results than at Points B and C, as the mean value was slightly higher and the minimum value was considerably higher. Furthermore, no sample at Point A showed less than 30 per cent saturation and the percentage of samples having 50 per cent saturation or more was higher than at Points B and C. The samples taken at Points B and C indicated that there was very little difference in the amount of pollution at these two (2) points.

These results seem consistent, as Point A is nearest to the Staten Island shore, from which a much smaller quantity of sewage and trade wastes is discharged than from the Brooklyn side of these waters. Point B is in the main channel and Point C is near the Brooklyn side.

Another cause for the difference found between Point A as compared with Points B and C, is the fact that sewage tends to follow the shore line from which it is discharged unless it is conveyed into the main water channels by means of long submerged pipe lines. Conditions similar to the preceding may also be noted in connection with the analyses made in other sections of the District.

SECTION 8. - GRAVESEND BAY AND ATLANTIC OCEAN

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	11	41	6
B	13	69	27
C	12	83	43

The mean dissolved oxygen of 65.3 per cent for the samples from this section, has no real significance, as the amount of pollution varies quite widely. It is therefore, natural that the mean values for each of these sampling points should differ widely from one another.

Conditions were markedly better at Point C than at A or B. Point C had the highest mean and minimum values for dissolved oxygen. None of the samples were below 30 per cent saturation. The worst conditions prevailed at Point A. At this point, the mean and minimum dissolved oxygen values were the lowest for the section. The percentage of samples below 30 per cent saturation was higher than at the other two (2) points, and the percentage of samples showing above 50 per cent saturation was lower.

These sampling points are located in an area where the dilution by sea water becomes an important factor. The results appear to be consistent with their location.

Point C is in the Atlantic Ocean, 200 feet south of the end of Steeplechase Pier, at Coney Island. Although the mean dissolved oxygen at this point is fairly high, it is not as high nor are the individual tests as free from lower values as might be expected. A minimum value of 43 per cent was obtained in each of two (2) tests made at low tide on July 26th. The next lowest values found at this point were 72 per cent on July 14th and 76 per cent on August 3rd.

Point B is off Norton Point, and in the path of the ebb flow of the diluted pollution from Gravesend Bay and The Narrows.

Point A is in Gravesend Bay and shows the effect of pollution from the shore and also from Coney Island Creek.

SECTION 9. - JAMAICA BAY

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	32	79	45
B	3	89	86
C	1	-	*115
D	-	-	-
E	1	-	*101

* Single Sample

The average dissolved oxygen of 81.3 per cent is probably not representative of the actual conditions in Jamaica Bay. This is due to the fact that 35 of the 37 samples were taken from the inlet connecting the Ocean

with Jamaica Bay, at Points A and B. Only two (2) of the samples were taken within Jamaica Bay and one (1) each at Points C and E. These samples seem to be inordinately high.

The lowest values for the mean and minimum dissolved oxygen saturation were found at Point A. Thirty-two (32) samples were collected at this point, which is in Rockaway Inlet. The sampling point is also near the outlet from the Coney Island Sewage Treatment Plant, from which approximately twenty million gallons of treated sewage effluent is discharged each day. Wide differences in the saturation values would be expected due to the change in direction of the tidal flow at this point about every six (6) hours.

SECTION 10. - HEMPSTEAD BAY AND EAST BAY

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	1	-	*124
B	3	109	102
C	2	118	118
D	-	-	-

* Single sample

An average dissolved oxygen of 114 per cent was obtained for this section.

The dissolved oxygen of each of the six (6) samples obtained exceeded 100 per cent saturation. Due to the small number of samples, the average value should not be given too great a significance. As far as they go, these samples indicate a relatively unpolluted condition as compared with the sections previously discussed.

SECTION 11. - GREAT SOUTH BAY

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	2	102	100
B	-	-	-
C	-	-	-
D	1	-	*125
E	-	-	-

* Single sample

Three (3) samples each exceeded 100 per cent saturation and averaged 109 per cent. What was said in reference to the preceding section samples, applies here also. Such a small number of samples were collected that the results

should be used with caution. The samples indicate that very little polluting material is present at Jones Beach Inlet.

SECTION 12. - LOWER EAST RIVER

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	10	35	8
B	10	26	13
C	9	16	4
D	10	20	6
E	10	21	3
F	9	17	7

This section had an average dissolved oxygen of 22.8 per cent, and all of the samples showed less than 50 per cent saturation. These facts indicate that the degree of pollution in this section exceeds that found in any other area from which samples were taken.

At Points C and F, all samples were below 30 per cent saturation, and the mean values were the lowest for the section. The sequence of the other points, placed in the order of decreasing pollution, is D, E, B and A.

Point C is in the center of Newtown Creek Channel. It is not surprising that samples taken here should show results somewhat lower than samples from the East River itself. Conditions in Newtown Creek have been notoriously bad for years. The large number of sewer outlets in the East River, discharging both from Manhattan and Long Island, explains the high degree of pollution indicated at Point F.

Sampling Points D and B are somewhat removed from Point C and are in the main channel of the East River where the effect of the full diluting capacity of the river flow would be indicated.

The somewhat better conditions found at Point E as compared with samples taken at Point F, are probably due to discharge of the treated sewage from the Ward's Island Sewage Treatment Plant.

The data indicates that the East River receives increasing quantities of polluting material from the Upper Bay to Ward's Island, with the lowest values for dissolved oxygen in the general vicinity of the Harlem River. It will be of considerable interest to see the effect produced

on this badly polluted waterway when both the Ward's Island and Tallman's Island Sewage Treatment Plants are in operation during the summer of 1939.

SECTION 13. - HARLEM RIVER

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	15	48	12
B	19	51	11
C	12	52	14
*D	5	41	24

* Sampling Point D was discontinued during the season.

The mean dissolved oxygen for this section was 49.4 per cent. The data indicate that conditions at Points B and C are generally somewhat better than at Point A.

The results for the section appear somewhat erratic at first glance. However, about half of all the results upon which the averages are calculated were obtained near the end of the season, on September 26th.

The tidal flow through the Harlem River varies considerably during the summer and this fact probably tends to make the mean value of tests at various points approach a common value. The Harlem River is in reality a strait connecting the Hudson River with the East River. Therefore, the tidal movements and currents are somewhat different than are found in a tidal river. Any change in the relative water levels of the Hudson River during heavy run-off from inland, or of the East River due to Northeast storms, will cause variations in the direction and force of the current in the Harlem River.

SECTION 14. - LOWER HUDSON RIVER

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	5	63	40
B	7	61	35
C	5	57	37
D	5	89	52

The mean dissolved oxygen for all the samples in this section was 67.0 per cent and all samples ran above 30 per cent saturation.

Sampling Point A is at the mouth of the Hudson River.

just north of Battery Park. The test made at this point indicates a somewhat better condition of the water than was found at the mouth of the East River. The mean value of dissolved oxygen was 63 per cent and the minimum value found was 40 per cent. Comparable figures for Point 12-A, at the lower end of the East River, are respectively 35 per cent and 8 per cent of saturation. Samples taken at Point 14-B, about opposite West 42nd Street, and Point 14-C, opposite West 155th Street, gave results very similar to those at Point 14-A.

At the time samples were taken, there was apparently little difference between the amount of pollution encountered at these three (3) points. This is to be expected, as they are all located in an area which receives large amounts of sewage, which is transported by the tides up the river as well as in the other direction. This sewage is discharged into the Hudson River from both New York and New Jersey.

Sampling Point D, at Spuyten Duyvil, appears to be in better condition as both the mean and minimum dissolved oxygen are considerably higher. It would seem that the tidal flow at the time the samples were taken did not carry as much of the polluting material to Point D as to Point C. Apparently, the conditions at Point D are affected more by the flow of the Hudson above this point, than by the pollution discharged below it, in the vicinity of New York City.

SECTION 15. - HUDSON RIVER OPPOSITE MOUNT ST. VINCENT

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	21	77	48
B	21	77	58
C	24	79	59
D	20	78	53
E	20	78	55

The mean dissolved oxygen for this section was 77.8 per cent saturation. This is consistent, in comparison with the mean value of 67.0 per cent for the preceding Section 14, the Lower Hudson River.

At Points B, C, D and E, all samples were above 50 per cent saturation. At Point A, only one (1) sample out of twenty-one (21), was below 50 per cent saturation.

The locations of the sampling points in Section 15

differ from those discussed in the preceding Section 14, as they are in an east and west line across the Hudson River at Mount St. Vincent. The samples, therefore, give a cross-section of the river from the New York to the New Jersey Shore. In Section 14, the sample points were located in a south to north line proceeding up the river. These points are down stream from the City of Yonkers, from which is discharged not only the sewage of that city, but also sewage from other sections of Westchester County.

SECTION 16. - HUDSON RIVER AT HASTINGS

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	10	89	82
B	10	87	83
C	10	90	85
D	10	95	88
E	9	94	89

The average dissolved oxygen for this section was 91.0 per cent. This average indicates that much less sewage is entering this section. This is consistent with the facts, as the location is further removed from the large centers of population. Samples taken in this section further indicate that the flood tidal flow in the Hudson does not carry polluting matter very far.

Every sample in this section exceeded 80 per cent saturation. The mean and minimum values for Points D and E exceeded the values for the other points of the section.

This is consistent with the known facts, as Point E is nearest the New Jersey Shore and Point D is adjacent to Point E. A large number of sewer outlets, both above and below Hastings, are on the New York Shore, whereas there are very few on the New Jersey side.

SECTION 17. - HUDSON RIVER AT VERPLANCK AND BEAR MOUNTAIN

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	5	93	89
B	5	92	88
C	5	92	85
D	5	94	92
E	5	94	92
F	4	91	84
G	4	90	85
H	4	91	89
I	4	90	85
J	4	91	89

The sampling points for this section are located along two (2) lines, one (1) at Verplanck and the other at Bear Mountain. At each of these places, five (5) samples were taken across the river from the easterly side to the West Shore of the Hudson River. The mean and minimum values for dissolved oxygen do not vary greatly in these two (2) areas.

The mean dissolved oxygen value for the entire section was 91.9 per cent. The mean value for Points A, B, C, D and E of the Verplanck traverse was 92.9 per cent. The mean for Points F, G, H, I and J of the Bear Mountain traverse was 90.4 per cent. Every sample exceeded 80 per cent saturation.

These results appear somewhat inconsistent, as a higher dissolved oxygen would be expected at the upstream points. An explanation of this may be that all points were not sampled uniformly. On September 23rd, three (3) samples were taken at each point, but on August 26th, two (2) samples were taken at Points A, B, C, D and E, and one (1) sample at Points F, G, H, I and J.

SECTION 13. - UPPER EAST RIVER AND LONG ISLAND SOUND

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	7	38	17
B	7	43	25
C	7	50	32
D	7	73	61
E	6	97	69

This section includes the northerly end of the East River. It adjoins and is directly north of Section 12 which has been previously discussed.

An average dissolved oxygen of 59.0 per cent for all the samples was obtained in this section.

At Point C, no samples were below 30 per cent saturation, and at Points D and E, all samples were above 50 per cent saturation. The five (5) points may be arranged definitely in the order A, B, C, D and E, showing the improvement in conditions as the diluting waters of Long Island Sound become effective. Conditions at Point 13-A are distinctly better than at Point 12-E in the previously discussed section.

These results are entirely normal showing an increase

in dissolved oxygen when proceeding from Manhattan to Long Island Sound. At Stepping Stones (Point 18-E) the water is approaching saturation with oxygen.

These samples taken together with those of Sections 12 and 13, make an interesting study of the waters of the East River. They show in a characteristic way, the beneficent changes which nature itself produces in attempting to counteract and overcome the careless and poor methods used by human beings in disposing of their filth and refuse.

SECTION 19. - LONG ISLAND SOUND

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	5	100	94
B	5	105	90
C	1	-	*68
D	2	112	111
E	5	72	44

* Single sample

The mean for this section was 93.2 per cent saturation. Note should be taken of the fact that all samples were obtained on a single day, August 10th.

All samples at Points A and B were above 80 per cent saturation. Two (2) samples were collected at Point D, and these were also above 80 per cent saturation. All samples at Point E were above 30 per cent saturation. Results were inconclusive for Point C. Only five (5) samples were collected at this point, all of them on August 10th, and four (4) of these results were rejected, as they were over 125 per cent saturation. The fifth sample, 68 per cent saturation, is reported herewith.

Evidently, no serious pollution problem exists at A and B. Although there is some evidence of pollution at Point E, it would be preferable to reserve judgment, as all samples were collected within a short time interval on one (1) day, and for comparative purposes they may be misleading.

SECTION 20. - LONG ISLAND SOUND

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	1	-	*116
B	3	97	60
C	3	107	79
D	2	105	96
E	1	-	*121

* Single sample

The mean dissolved oxygen for this section was 106 per cent.

All samples exceeded 50 per cent saturation. Single samples obtained at Points A and E do not permit a valid comparison with the results for the other points. The results for the remaining points are meager, but they suggest that conditions at D are somewhat better than at B.

Point D is in Huntington Bay and Point B is in Oyster Bay Harbor.

SECTION 21. - LONG ISLAND SOUND

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	3	89	67
B	4	115	91
C	3	111	103
D	2	62	59
E	4	102	61

This section had an average dissolved oxygen of 99.5 per cent.

All samples in this section exceeded 50 per cent saturation, and at Points B and C, each of the samples exceeded 80 per cent saturation. In general, conditions at Points B and C were better than at Point A, and conditions were worst at Point D. Results for Point E cannot be readily classified with respect to the other points.

These results are generally consistent. Points B and C are in Long Island Sound opposite a sparsely settled area. Point D, on the other hand, is in Port Jefferson Harbor, which receives some pollution from Port Jefferson and possibly from other communities.

SECTION 22. - LONG ISLAND SOUND

Sampling Point	No. of Samples	Mean Dissolved Oxygen	Minimum Dissolved Oxygen
A	5	92	22
B	5	99	56
C	5	90	38
D	5	83	65
E	5	86	32

The average dissolved oxygen for this section was 89.9 per cent.

At Points B and D, all samples were above 50 per cent saturation. Four (4) of the five (5) samples at Point A were above 80 per cent; the fifth showed 22.0 per cent saturation. The wide variation in values at several of these points cannot at this time be fairly discussed. Possibly they are due to tidal currents which might be traced if it were possible to collect a much larger number of samples from the area. Conditions were in general most satisfactory at Point B which is in open water, adjacent to Execution Rock Light.

COMPARISON OF DISSOLVED OXYGEN RESULTS IN WATERWAYS OF THE DISTRICT

The conditions prevailing in the various waterways of the Interstate Sanitation District may be summarized as follows:

HUDSON RIVER.- In the Lower Hudson River (Section 14) below George Washington Bridge about 40 per cent of the dissolved oxygen samples were under 50 per cent saturation. At Spuyten Duyvil, all the samples exceeded 50 per cent saturation. Continuing up the river, 99 per cent of the samples at Mount Saint Vincent (Section 15) exceeded 50 per cent saturation. Further improvement was noted at Hastings (Section 16) and at Verplanck and Bear Mountain (both in Section 17) as every sample collected in these two (2) sections exceeded 80 per cent saturation. The mean values for the sections in the Hudson River range from 67.0 per cent in Section 14 to 91.9 per cent in Section 17.

EAST RIVER AND HARLEM RIVER.- As previously stated, a greater degree of pollution was found in the Lower East River (Section 12) than in any other part of the District. In this section, the average and minimum values for dissolved oxygen were both lower, respectively, than in any other section; every sample was below 50 per cent saturation and 72 per cent of the samples were below 30 per cent saturation. Conditions were found to be decidedly better in the Upper East River (Section 18). At three (3) of the sampling points, about 40 per cent of the samples were above 50 per cent saturation, and at one point, all samples exceeded 50 per cent saturation. Section 18 also includes one (1) sampling point in Long Island Sound.

In the Harlem River (Section 13) the mean and minimum values for dissolved oxygen were intermediate between these respective values for the Lower East River and the Upper East River. The mean values for Sections 12, 13 and 18, were 22.8, 49.4 and 59.0 per cent , respectively. The condition of the Harlem River was somewhat worse than the condition of the Hudson River in the vicinity of Spuyten Duyvil.

LONG ISLAND SOUND.- Two (2) of the four (4) sampling sections in the Sound (Sections 19 and 22) are adjacent to the Upper East River. In Section 22, along the Westchester County Shore, the mean and minimum values were the lowest found in any of these four (4) sections.

Only one (1) sample in Section 22 was below 30 per cent saturation, and 88 per cent of the samples exceeded 50 per cent saturation. In Section 19, along the Nassau County Shore, the mean and minimum values were slightly higher than in the previously discussed section. No samples were under 30 per cent saturation and 89 per cent of the samples were above 50 per cent saturation. The shore line of Section 20 is in Nassau and Suffolk Counties, whereas that of Section 21 is confined to Suffolk County. The respective mean and minimum values for Sections 20 and 21 were approximately the same. Every sample collected in these two (2) sections exceeded 50 per cent saturation. The mean values for dissolved oxygen saturation for Long Island Sound ranged from 89.9 per cent in Section 22 to 106 per cent in Section 20.

HEMPSTEAD BAY, EAST BAY, AND GREAT SOUTH BAY.- Section 10 comprises Hempstead Bay and East Bay. Great South Bay is in Section 11. Nine (9) samples were collected in these waterways and every sample exceeded 100 per cent saturation.

JAMAICA BAY.- Inadequate sampling precludes any valid discussion of the Bay as a whole. The mean value of 32 samples collected in Rockaway Inlet was 79.0 per cent saturation. None of these samples was below 30 per cent saturation and 97 per cent of them were above 50 per cent saturation.

UPPER NEW YORK BAY, THE NARROWS, THE KILLS AND NEWARK BAY.- The greatest degree of pollution in this group of waterways was found in Upper New York Bay (Section 1). Here, the mean and minimum dissolved oxygen values were the lowest (33.5 and 3.5 per cent, respectively). The percentage of samples below 30 per cent saturation was greatest and the percentage of samples above 50 per cent saturation was lowest in this section.

A lesser degree of pollution was found in The Kills and Newark Bay (Sections 2 and 3). Both Sections 2 and 3 had mean values close to 40 per cent saturation, and in each section, 22 per cent of the samples were below 30 per cent saturation. The percentages of samples above 50 per cent saturation were 19 and 36 in Section 3 and Section 2, respectively. The least degree of pollution in this group was found in The Narrows (Section 7). Here the mean and minimum values were the highest; the percentage of samples below 30 per cent saturation was lowest, and the percentage of samples above 50 per cent saturation was a maximum. Mean values for this group range from 33.5 per cent for Section 1 to 47.6 per cent for Section 7.

GRAVESEND BAY, LOWER NEW YORK BAY, RARITAN BAY, AND SANDY HOOK BAY. - Due to the difference in the natural conditions affecting the dilution of polluting material in Section 8, it cannot be readily classified with respect to other sections in this group. Water collected at the sampling point within Gravesend Bay (Point 8-A) showed greater pollution than at any other sampling point in the group. The respective mean and minimum values were lower than those for the other sampling points in the section and the percentage of samples above 50 per cent saturation was lower.

Consistently better conditions were noted in the Lower Bay (Section 6), and a further improvement was observed in Raritan Bay (Section 4). In the latter section, no samples were below 30 per cent saturation and 89 per cent of the samples were above 50 per cent saturation. Still better conditions were observed in Sandy Hook Bay (Section 5). The respective mean and minimum values were the highest of any of the sections of this group and all samples exceeded 50 per cent saturation. Mean values for Sections 8, 6, 4, and 5 were 65.3, 55.7, 81.9, and 90.7 per cent, respectively.

S U M M A R Y

The maximum pollution was observed in the East River and Harlem River. Pollution of about the same order of magnitude, but within a narrower range for mean values was noted in the Upper Bay, The Narrows, The Kills and Newark Bay. Further decrease in the amount of pollution was found in Gravesend Bay, the Lower Bay, Raritan Bay and Sandy Hook Bay. The Hudson River was next in order of increasing values.for dissolved oxygen. The most satisfactory conditions were found in Long Island Sound, Hempstead Bay, East Bay and Great South Bay.

In practically all cases, a consistent betterment was evident in proceeding from Manhattan to the more remote and less densely populated parts of the Interstate Sanitation District.

RELATIONSHIP OF DISSOLVED OXYGEN VALUES TO DISTANCES FROM THE BATTERY

The Battery has been taken as the starting point of the following study because of its well known central location with relation to adjoining waterways.

The shortest distances by water from The Battery to each sampling point have been used in making the chart. The distances have been taken from the United States Coast and Geodetic Survey maps following navigable waterways having depths of four feet or more at mean low tide. These distances are tabulated in Table No. 6 for ready reference.

The accompanying Figure 9 is presented for the purpose of showing the great difference in the amount of the dissolved oxygen content in the waters near New York City as compared with the relatively unpolluted waters of the Atlantic Ocean, Long Island Sound and the Hudson River. The most distant points on the chart are about thirty miles from The Battery.

The heavy line indicates the general trend relative to the variation in the per cent of saturation of dissolved oxygen with reference to the distances of the sampling points from The Battery. This curve reflects the average conditions found at the various fixed sampling points. The values which were used to obtain the average value at any given distance often varied over a wide range. This would be anticipated because of the very different degrees of pollution found in New York Harbor.

The broken line shows the normal condition relative to the dissolved oxygen content if no polluting material were discharged into any of the waterways. The purpose of the chart is to bring out in a very general way the serious depletion of the dissolved oxygen in New York Harbor waters.

It will be noted that for the first five miles the curve dips downward from 49% to 30% saturation. This part of the curve reflects the low dissolved oxygen values in the East River, Hudson River, and in the Kills west of Staten Island. From this point the curve rises steadily and with fair uniformity until at thirty miles the average value of dissolved oxygen is one hundred per cent . Even at twenty miles from The Battery most of the values are between 90 and 100% of saturation.

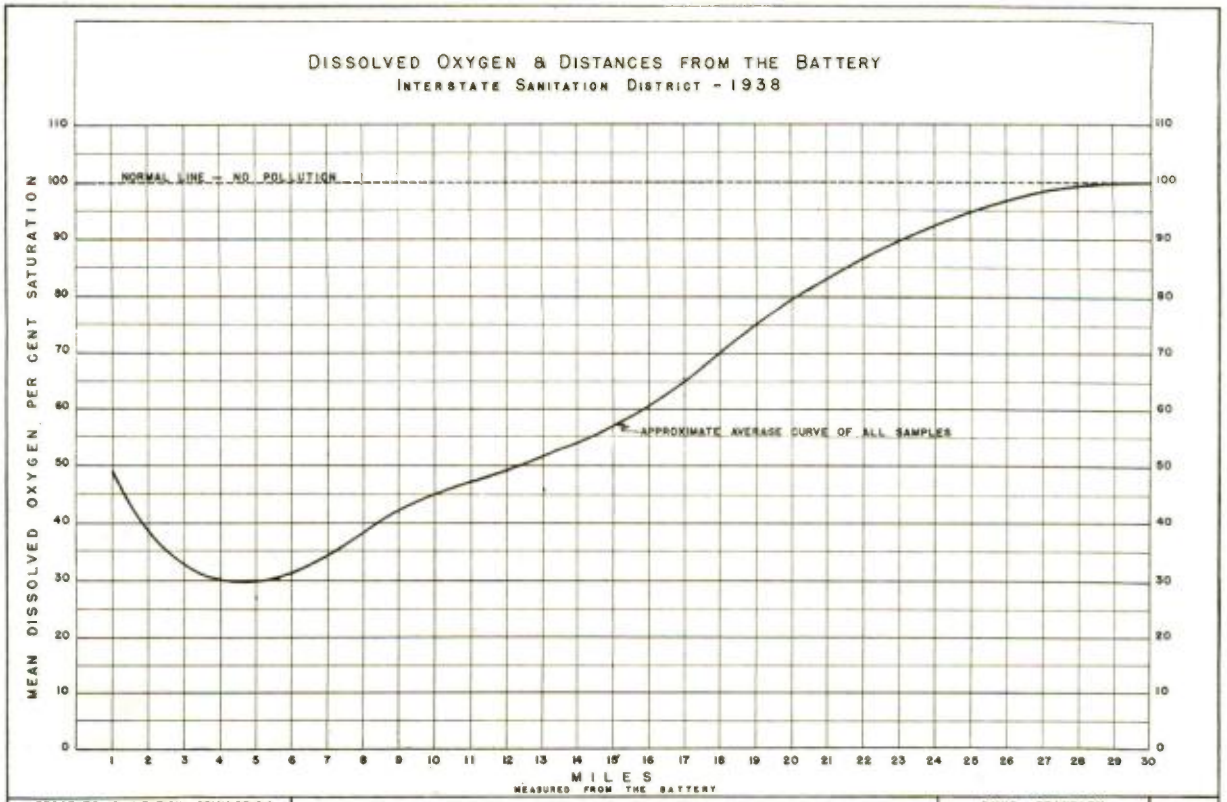
DISSOLVED OXYGEN & DISTANCES FROM THE BATTERY
INTERSTATE SANITATION DISTRICT - 1938
MEAN DISSOLVED OXYGEN PER CENT SATURATION
NORMAL LINE - NO POLLUTION
APPROXIMATE AVERAGE CURVE OF ALL SAMPLES
MILES
MEASURED FROM THE BATTERY
INTERSTATE SANITATION COMMISSION
SPONSOR
60 HUDSON ST. N.Y.C.
ACCEPTED BY
DATE
WORK PROJECT NO. SU-1
OFFICIAL PROJECT NO. 665-97-3-99
WATER POLLUTION SURVEY
625 MADISON AVE. NEW YORK, N.Y.
WORKS PROGRESS ADMINISTRATION
CITY OF NEW YORK
DAVID STANDLEY
DIRECTOR
MANHATTAN FIELD OFFICE

FIG. 9

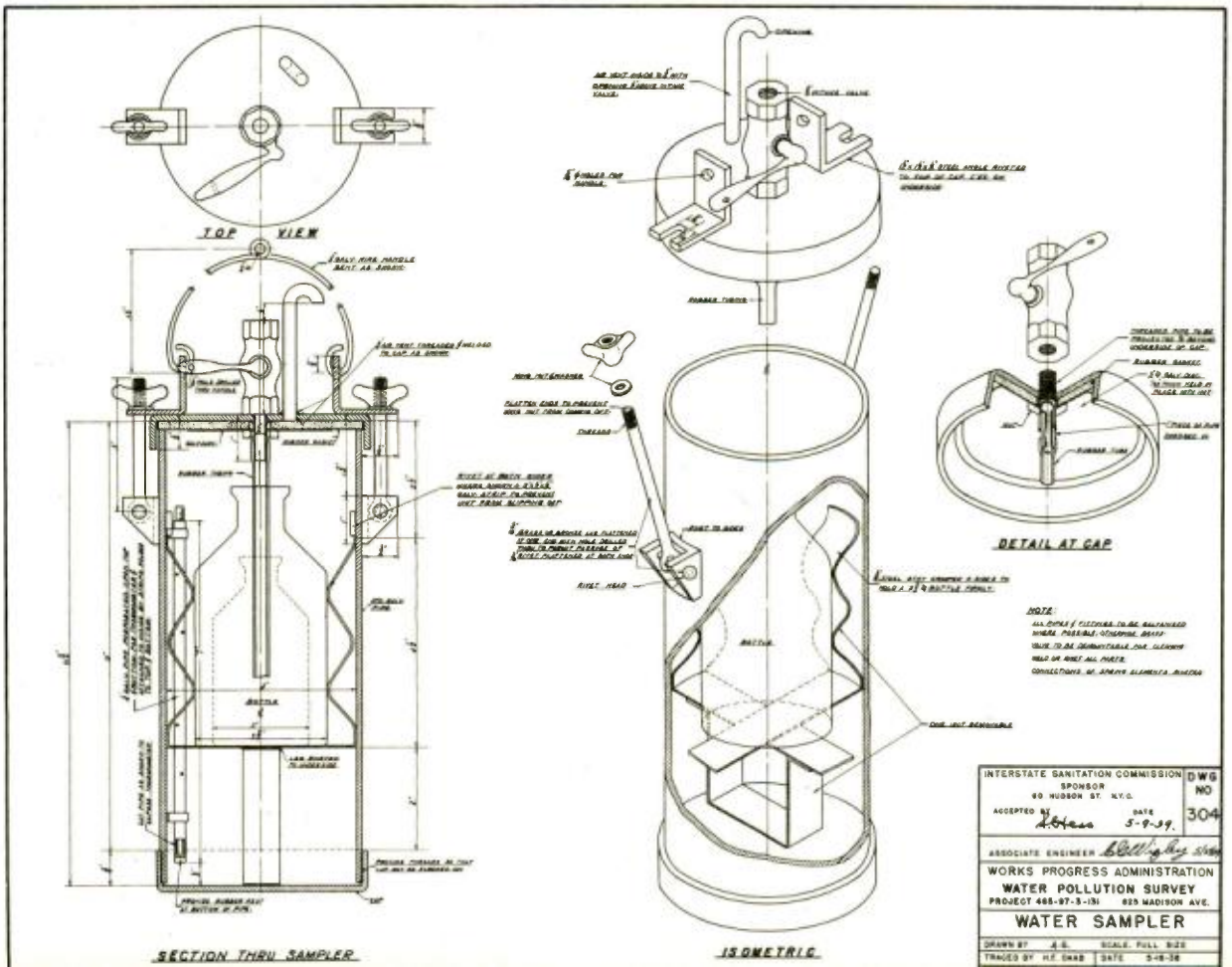
TOP VIEW
SECTION THRU SAMPLER
ISOMETRIC
DETAIL AT CAP
NOTE:
INTERSTATE SANITATION COMMISSION
SPONSOR
60 HUDSON ST. N.Y.C.
ACCEPTED BY A. Haas
DATE 5-9-39.
DWG NO 304
ASSOCIATE ENGINEER
WORKS PROGRESS ADMINISTRATION
WATER POLLUTION SURVEY
PROJECT 665-97-3-131 625 MADISON AVE.
WATER SAMPLER
DRAWN BY A.G. SCALE: FULL SIZE
TRACED BY H.F. SHAB DATE 5-8-39

TABLE NUMBER 6
SHORTEST DISTANCES IN MILES FROM THE BATTERY
TO SAMPLING POINTS VIA WATER ROUTES

1-A - 2.1	5-A - 17.8	10-A - 25.5	15-A,B,C,D,E - 15.9
1-B - 3.0	5-B - 18.5	10-B - 29.7	
1-C - 4.2	5-C - 19.5	10-C - 35.3	16-A,B,C,D,E - 21.9
1-D - 5.0	5-D - 19.9	10-D - 34.7	
1-E - 4.0	5-E - 21.9		17-A,B,C,D,E - 40.5
1-F - 1.9	5-F - 15.4	11-A - 48.9	17-F,G,H,I,J - 46.0
1-G - 5.1		11-B - 50.3	
	6-A - 8.6	11-C - 51.0	18-A - 11.2
2-A - 6.5	6-B - 10.1	11-D - 48.4	18-B - 12.8
2-B - 8.1	6-C - 11.6	11-E - 55.2	18-C - 14.8
2-C - 10.1	6-D - 13.0		18-D - 16.5
2-D - 12.8	6-E - 14.3	12-A - 0.8	18-E - 18.3
2-E - 10.0		12-B - 4.3	
2-F - 11.2	7-A - 6.3	12-C - 4.3	19-A - 19.8
	7-B - 6.8	12-D - 5.3	19-B - 21.6
3-A - 14.5	7-C - 6.8	12-E - 8.8	19-C - 23.0
3-B - 16.0		12-F - 8.4	19-D - 26.4
3-C - 17.0	8-A - 10.1		19-E - 28.1
3-D - 19.2	8-B - 9.9	13-A - 9.4	
3-E - 20.7	8-C - 11.4	13-B - 11.2	20-A - 31.8
		13-C - 13.4	20-B - 36.0
4-A - 22.7	9-A - 14.1	13-D - 15.7	20-C - 36.9
4-B - 20.4	9-B - 16.3		20-D - 40.1
4-C - 18.5	9-C - 19.9	14-A - 0.4	20-E - 41.7
4-D - 17.9	9-D - 19.1	14-B - 4.4	
4-E - 20.0	9-E - 20.6	14-C - 9.9	21-A - 54.1
		14-D - 13.7	21-B - 55.7
			21-C - 57.9
			21-D - 58.1
			21-E - 58.6
			22-A - 21.2
			22-B - 22.4
			22-C - 24.6
			22-D - 26.1
			22-E - 31.4

DISSOLVED OXYGEN IN 1937 AND 1938

A comparison of the results obtained from year to year may be employed in determining whether the conditions at any location are improving or growing worse. Such comparisons are of particular interest where a physical change in conditions has taken place, due to such factors as the operation of new sewage treatment plants, or the construction of additional sewer outfalls for residential or industrial sewage. Unwarranted conclusions must be guarded against, as there are a number of variables that control the dissolved oxygen saturation in the New York Harbor waters. Records which have been kept for approximately twenty years show considerable variation from year to year, but such variations should not be considered as being significant until they are found in successive years.

The geographical distribution of dissolved oxygen sampling in 1937 and 1938 is shown on Maps No. 11 and 12. The average and minimum values for each section and sampling point are compared graphically in Charts No. 9 to 17, inclusive.

When comparing the dissolved oxygen figures for 1937 and 1938, consideration should be given to the principal known factors which may have operated differently in the two surveys. Mention has been made elsewhere, of the different methods used in sampling and analysis during 1937 and 1938. In 1937, samples were taken somewhat at random in weighted glass stoppered bottles or by means of a gear pump and were tested by the Winkler method. In 1938, samples were taken at selected stations, with a well designed sampling apparatus and analyzed by the Rideal-Stewart modification of the Winkler method.

Precautions were taken in 1938 to maintain standard conditions with respect to reagents, and to check and recheck all calculations; the extent to which these precautions were taken in 1937 is not known. Both surveys started in mid-July; the 1937 sampling period continued to October 19th, whereas in 1938, sampling was concluded on September 30th. June, July, September and October of 1937 were about normal with respect to temperature and rainfall. August was marked by heavy rains, and in October the water temperature had dropped to such an extent as to affect the results. In 1938, June, July and September were excessively, rainy, while August was abnormally dry. The comparative weather data are as follows:

		June	July	Aug.	Sept.	Oct.
Normal (inches)		3.33	4.24	4.33	3.39	3.53
Rainfall "	1937	3.07	4.41	7.92	4.04	4.12
" "	1938	7.59	6.41	1.99	8.77	--
Normal °F		68.8	73.8	73.1	66.8	56.3
Mean Temp. "	1937	70.6	75.4	75.7	65.2	54.6
" " "	1938	69.0	75.1	76.3	64.9	--

The mean air temperatures for the first four months, June to September, inclusive, were:

Year	Temperature	Per Cent
Normal	70.63	100.0
1937	71.73	101.6
1938	71.33	101.0

On the basis of mean temperatures, therefore, no great difference in the values for dissolved oxygen would be expected in 1937 and 1938. The effect of using a proper sampler would be to give lower dissolved oxygen results, by avoiding aeration during the sampling. The substitution of the Rideal-Stewart method for the Winkler method would also tend to give lower dissolved oxygen figures. These considerations should be kept in mind when comparing the figures for 1937 and 1938.

SECTION 1. - UPPER NEW YORK BAY

	1937	1938
No. of Samples	60	73
Mean Dissolved Oxygen	44.9 per cent	33.5 per cent
Minimum Dissolved Oxygen	0 " "	4. " "
	Per Cent of Samples	
Under 30% D. O.	3.	40.
30.0-49.9% D. O. inclusive	62.	44.
50% and over D. O.	35.	16.

The different methods used during 1937 probably account for the main differences in these two sets of results.

Low dissolved oxygen values were reported during July 1938. After August 1st, the oxygen values rose in this section despite warm and dry weather. This might have been

due to the increased run off from the Hudson River.

At Points 1-B and 1-E, the mean values were lower in 1938 than in 1937, and the percentage of samples running below 30 per cent saturation was greater. Moreover, the percentage of samples at Point 1-E, showing above 50 per cent saturation, was less in 1938. The 1938 figures show a definite drop in saturation values at these two points.

SECTION 2. - KILL VAN KULL, NEWARK BAY AND ARTHUR KILL

	1937	1938
No. of Samples	9	59
Mean Dissolved Oxygen	55.4 per cent	40.2 per cent
Minimum " "	43. " "	5. " "
	Per Cent of Samples	
Under 30% D. O.	0	22.
30.0-49.9% D. O. inclusive	22.	42.
50% and over D. O.	78.	36.

Of the nine (9) samples obtained in 1937, only one (1) was taken at a 1938 sampling point: the rest were more or less scattered. A comparison based on these figures may be regarded as of doubtful value.

SECTION 3. - ARTHUR KILL

	1937	1938
No. of Samples	5	36
Mean Dissolved Oxygen	40. per cent	39.6 per cent
Minimum " "	22. " "	9. " "
	Per cent of Samples	
Under 30% D. O.	40.	22.
30.0-49.9% D. O. inclusive	20.	58.
50% and over D. O.	40.	19.

As in the case of Section 2, no adequate comparison can be made, as none of the 1937 samples were collected at a sampling point used in 1938.

SECTION 4. - RARITAN BAY

	1937	1938
No. of Samples	17	27
Mean Dissolved Oxygen	77.1 per cent	81.9 per cent
Minimum " "	48. " "	41. " "
	Per Cent of Samples	
Under 30% D. O.	0	0
30.0-49.9% D. O. inclusive	6.	11.
50% and over D. O.	94.	89.

The 1937 and 1938 results are similar in most respects and the data disclose no evidence of material change in the condition of Raritan Bay.

SECTION 5. - SANDY HOOK BAY

	1937	1938
No. of Samples	10	27
Mean Dissolved Oxygen	95.3 per cent	90.7 per cent
Minimum " "	80. " "	79. " "
	Per Cent of Samples	
Under 30% D. O.	0	0
30.0-49.9% D. O. inclusive	0	0
50% and over D. O.	100.	100.

As in the preceding section, the results for the two years may be taken as essentially the same, keeping in mind the small number of samples in 1937. There is no conclusive evidence of material change.

SECTION 6. - LOWER BAY

	1937	1938
No. of Samples	24	29
Mean Dissolved Oxygen	69.2 per cent	55.7 per cent
Minimum " "	53. " "	20. " "
	Per Cent of Samples	
Under 30% D. O.	0	31.
30.0-49.9% D. O. inclusive	0	14.
50% and over D. O.	100.	66.

The 1938 average is pulled down by points C, D and E, which were not included in the 1937 survey. Each of these points gave results at least half of which were not over 50 per cent. The 1938 average for the two points A and B is 67.3 per cent (12 samples) and the 1937 average for the same two points (8 samples) is 68.4 per cent, a difference which, all things considered, may be regarded as of doubtful significance.

SECTION 7. - THE NARROWS

	1937	1938
No. of Samples	97	63
Mean Dissolved Oxygen	53.9 per cent	47.6 per cent
Minimum "	24. "	14. "
	Per Cent of Samples	
Under 30% D. O.	2.	6.
30.0-49.9% D. O. inclusive	28.	38.
50% and over D. O.	70.	56.

It will be noted that the mean value for 1938 shows a drop of about 6 per cent from the 1937 value. This decrease may have been caused by the differences in methods of sampling and analysis. Another possible explanation is the difference in the dates on which samples were collected in the two years, as shown below:

1937	No. of Samples	1938	No. of Samples
July 12	6	July 13	12
July 21	4	July 22	3
August (entire Mo.)	0	July 27	9
Sept. 10	5	August 4	6
Sept. 14	5	August 12	33
Sept. 17	10		
Sept. 21	10		
Sept. 23	10		
Sept. 30	3		
October 1	5		
October 6	10		
October 7	10		
October 13	8		
October 14	8		
October 19	3		
Total	97 Samples	Total	63 Samples

In 1938, 24 samples were collected in July, and 39 in August - a total of 63 samples for the season. In 1937, 10 samples were collected in July and none was collected in August. The balance of 87 samples were collected in September and October - 43 and 44 samples, respectively.

All of the 1938 samples in this section were collected when the water was warm, whereas 90 per cent of the 1937 samples were taken during the cooler weather in September and October.

SECTION 8. - GRAVESEND BAY AND ATLANTIC OCEAN

	1937	1938
No. of Samples	53	36
Mean Dissolved Oxygen	56.8 per cent	65.3 per cent
Minimum " "	0. " "	6. " "
	Per Cent of Samples	
Under 30% D.O.	17.	11.
30.0-49.9% D.O. inclusive	17.	25.
50% and over D.O.	66.	64.

Of the fifty-three (53) samples obtained in 1937, only seventeen (17) were collected at sampling points included in the 1938 survey. The balance of the 1937 samples were collected within Coney Island Creek, within Gravesend Bay and at points in the Atlantic Ocean, and none of these samples can be compared fairly with the samples taken in 1938. The above-mentioned seventeen (17) samples taken in 1937 at comparable points, consisted of four (4) samples at Point A and thirteen (13) samples at Point B.

The analyses of samples taken at Point A, at the mouth of Coney Island Creek, in 1937 and 1938, were as follows:

	1937	1938
No. of Samples	4	11
Mean Dissolved Oxygen	46. per cent	41. per cent
	Per Cent of Samples	
Under 30% D.O.	0.	27.
50% and over D.O.	25.	18.

The seeming increase of pollution in 1938 may be ex-

plained by the different methods of sampling and analysis and also by the different dates of sampling as indicated below:

SAMPLING POINT A

1937	No. of Samples	1938	No. of Samples
		July 14	3
July 21	1		
		July 26	2
		August 3	2
		August 18	4
Sept. 10	1		
October 1	1		
October 6	1		
Total	4 Samples	Total	11 Samples

The following results were obtained at Point B, off Norton Point:

	1937	1938
No. of Samples	13	13
Mean Dissolved Oxygen	70. per cent	69. per cent
	Per Cent of Samples	
Under 30% D.O.	0.	8.
50% and over D.O.	100.	84.

The months in which these samples were taken did not correspond in the two surveys and were as follows:

1937	No. of Samples	1938	No. of Samples
		July	6
		August	7
Sept.	7		
October	6		
Total	13 Samples	Total	13 Samples

Although there is no basis for a direct comparison, there is no indication of any marked change in conditions at this point for the two years.

SECTION 9. - JAMAICA BAY

	1937	1938
No. of Samples	67	37
Mean Dissolved Oxygen	79.2 per cent	81.3 per cent
Minimum " "	2. " "	45. " "
	Per Cent of Samples	
Under 30% D.O.	6.	0.
30.0-49.9% D.O. inclusive	9.	3.
50% and over D.O.	85.	97.

The results for 1938 showed an increase in the average value of about 2 per cent above the 1937 figure. The 1938 results further suggest improved conditions, as none of the samples was below 30 per cent saturation, and a larger percentage of samples were above 50 per cent saturation.

However, it should be pointed out that in 1938, 32 of the 37 samples were collected at Point A in Rockaway Inlet. In 1937, 35 samples were taken at this point and 32 samples at other points in the section.

A more trustworthy comparison is afforded by the data for Point A alone, as given below:

	1937	1938
No. of Samples	35	32
Mean Dissolved Oxygen	86. per cent	79. per cent
Minimum " "	64. " "	45. " "
	Per Cent of Samples	
Under 30% D.O.	0	0.
30.0-49.9% D.O. inclusive	3.	3.
50% and over D.O.	97.	97.

In 1937, the 35 samples at this point were collected between September 16 and October 13. The 32 samples collected here the following year were taken in July and August. As in several preceding cases, the decrease in dissolved oxygen values in 1938 may have been due to differences in methods or dates of sampling, or to both causes.

SECTION 10. - HEMPSTEAD BAY AND EAST BAY

	1937	1938
No. of Samples	3	6
Mean Dissolved Oxygen	108. per cent	114. per cent
Minimum " "	99. " "	102. " "
	Per Cent of Samples	
50% and over D.O.	100.	100.

The data obtained in this section are meager for both 1937 and 1938, but they indicate that the waters of the area were in good condition. There was no evidence of any material difference between the samples collected in these two years.

SECTION 11. - GREAT SOUTH BAY

This section was not sampled in 1937.

SECTION 12. - LOWER EAST RIVER

	1937	1938
No. of Samples	46	58
Mean Dissolved Oxygen	19.6 per cent	22.8 per cent
Minimum " "	3. " "	3. " "
	Per Cent of Samples	
Under 30% D.O.	87.	72.
30.0-49.9% D.O. inclusive	11.	28.
50% and over D.O.	2.	0.

A superficial examination of these data suggests a slightly improved condition in 1938. It should be noted, however, that only 57 per cent of the 1937 samples were collected at sampling points corresponding to the 1938 stations. The comparable data, collected at Points B, D, E and F, are given below:

SAMPLING POINT B (EAST 23rd STREET)

	1937	1938
No. of Samples	7	10
Mean Dissolved Oxygen	19. per cent	26. per cent
	Per Cent of Samples	
Under 30% D.O.	100.	50.

These data suggest that there has been a definite improvement at this point since 1937. A more detailed comparison is given below:

1937		Dissolved Oxygen		1938		Dissolved Oxygen	
				July	22	13.	per cent
				August	5	14.	" "
				"	5	17.	" "
				"	5	15.	" "
August	10	17.	per cent				
"	11	15.	" "				
				"	12	39.	" "
				"	12	33.	" "
				"	12	34.	" "
				"	12	35.	" "
"	24	22.	" "				
"	25	20.	" "				
"	31	7.	" "				
				September	2	23.	" "
				"	2	35.	" "
September	10	24.	" "				
"	14	29.	" "				

The above results seem to indicate that some of the sea water reaching this area in 1938 carried a smaller amount of polluting material than was the case in 1937. The differences noted are not large enough to be of great significance.

SAMPLING POINT D (EAST 42nd STREET)

	1937	1938
No. of Samples	9	10
Mean Dissolved Oxygen	20. per cent	20. per cent
	Per Cent of Samples	
Under 30% D.O.	89.	90.

The degree of pollution at this point was apparently the same in 1937 and 1938.

SAMPLING POINT E (HELL GATE)

	1937	1938
No. of Samples	4	10
Mean Dissolved Oxygen	21. per cent	21. per cent
	Per Cent of Samples	
Under 30% D.O.	100.	80.

Apparently, there was a slight degree of improvement at this point in 1938 but the small number of samples in 1937 does not warrant further comparison of the two years.

SAMPLING POINT F (EAST 106th STREET)

	1937	1938
No. of Samples	7	9
Mean Dissolved Oxygen	12. per cent	17. per cent
	Per Cent of Samples	
Under 30% D.O.	100.	100.

Although the mean value for 1938 was higher than the 1937 value, the change is of doubtful significance, as all of the samples were below 30 per cent saturation each year.

The data for Points B, D, E and F show that conditions were about the same or possibly slightly better in 1938, as compared with 1937. The increase in mean dissolved oxygen for the entire section in 1938 may have been due to the difference in sampling points, or the fact that the Ward's Island Sewage Treatment Plant was operating during 1938.

SECTION 13. - HARLEM RIVER

	1937	1938
No. of Samples	34	51
Mean Dissolved Oxygen	24.5 per cent	49.4 per cent
Minimum " "	1. " "	11. " "
	Per Cent of Samples	
Under 30% D.O.	56.	29.
30.0-49.9% D.O. inclusive	41.	24.
50% and over D.O.	3.	47.

These results at first glance indicate a marked improvement in conditions in 1938, as the mean value was double the value obtained in 1937. Furthermore, in 1938 the minimum value was higher, the per cent of samples under 30 per cent saturation was much lower, and the per cent of samples above 50 per cent saturation was much higher, than in 1937.

More than eighty (80) per cent of the 1937 samples were obtained at sampling points used in 1938. Following are the data for each of these points.

SAMPLING POINT A (WILLIS AVENUE)

	1937	1938
No. of Samples	12	15
Mean Dissolved Oxygen	9. per cent	48. per cent
	Per Cent of Samples	
Under 30% D.O.	100.	33.
50% and over D.O.	0.	47.

These figures standing by themselves would indicate a marked improvement in 1938. Following are the results obtained on each day's sampling at Point A.

1937	Dissolved Oxygen	1938	Dissolved Oxygen
		July 25	13. per cent
August 7	11. per cent		
" 7	14. " "		
		August 8	12. " "
		" 8	12. " "
" 10	1. " "		
" 11	2. " "		
" 18	16. " "		
" 18	7. " "		
" 24	5. " "		
" 24	6. " "		
" 25	14. " "	" 25	44. " "
" 25	15. " "	" 25	47. " "
" 31	6. " "		
		September 6	31. " "
		" 6	29. " "
		" 6	17. " "
NOTE: This date, the 26th occurred after the so called hurricane that caused considerable damage along the coasts of Long Island and New England.		" 26	88. " "
		" 26	86. " "
		" 26	79. " "
		" 26	79. " "
		" 26	62. " "
		" 26	60. " "
		" 26	66. " "

In comparing these data, it would seem advisable to exclude the results for September 26, 1938, which are very much higher than the values obtained during the summer. These high values are probably due to the cooler weather prevailing in September and to abnormally heavy rainfall and high winds prior to September 26th. From 11:00 A.M. on September 19th to 2:00 P.M. on September 21st, an interval of 51 hours, the rainfall exceeded 7 inches. On September 21st, the wind attained a velocity of 70 miles per hour, a maximum for the month since 1912, and the barometer dropped to 28.72 inches, the lowest for September since 1882. The effects of the storm on the waters of the Harlem River are further reflected in the low salinity observed on September 26th; the per cent of sea water ranged from 3 to 51 on this day, compared with a range of 51 to 75 per cent during the other days of sampling.

Excluding the data for September 26th, the conditions in 1938 still appear to be somewhat better than 1937. This improvement is probably due to the diversion of considerable quantities of sewage from the Harlem River to Ward's Island Sewage Treatment Plant.

SAMPLING POINT B (155th STREET)

	1937	1938
No. of Samples	5	19
Mean Dissolved Oxygen	27. per cent	51. per cent
	Per Cent of Samples	
Under 30% D.O.	40.	31.
50% and over D.O.	0	53.

Conditions at this point also appear to be better in 1938. The daily results are listed below.

1937		Dissolved Oxygen		1938		Dissolved Oxygen	
				July	25	12.	per cent
				August	8	11.	" "
				"	8	13.	" "
August	10	36.	per cent				
"	11	49.	" "				
"	24	7.	" "				
"	25	42.	" "	"	25	63.	" "
				"	25	59.	" "
"	31	3.	" "				
				September	6	19.	" "
				"	6	43.	" "
				"	6	16.	" "
				"	6	44.	" "
				"	6	34.	" "
				"	6	24.	" "
See note relative to this date on page 197.				"	26	92.	" "
				"	26	93.	" "
				"	26	94.	" "
				"	26	89.	" "
				"	26	69.	" "
				"	26	66.	" "
				"	26	66.	" "
				"	26	67.	" "

The high value for mean dissolved oxygen obtained in 1938 is due in large part to the high results obtained on September 26th. However, the five (5) samples of 1937 were all collected in August and may be compared with four (4) samples collected in August out of a total of nineteen (19) samples for 1938. The August samples give mean values of 27. and 37. per cent for 1937 and 1938, respectively, and while the data are meager, they tend to confirm the evidence of improved conditions in 1938.

SAMPLING POINT C (OPPOSITE SHERMAN CREEK)

	1937	1938
No. of Samples	6	12
Mean Dissolved Oxygen	26. per cent	52. per cent
	Per Cent of Samples	
Under 30% D.O.	33.	25.
50% and over D.O.	0	50.

Again, there is evidence of decreased pollution in

1938. All of the 1937 samples were collected in August, and these are compared below with the August, 1938 samples.

1937		Dissolved Oxygen		1938		Dissolved Oxygen	
				August	8	14.	per cent
				"	8	21.	" "
August	10	41.	per cent				
"	11	42.	" "				
"	18	1.	" "				
"	24	33.	" "				
"	25	39.	" "	"	25	61.	" "
				"	25	66.	" "
"	31	1.	" "				
Mean D.O.		26.	per cent	Mean D.O.		41.	per cent

The number of samples is small, but the data, as far as they go, again indicate a better condition of the waterway in 1938 than in 1937.

* SAMPLING POINT D (SPUYTEN DUYVIL)

	1937	1938
No. of Samples	5	5
Mean Dissolved Oxygen	33. per cent	41. per cent
	Per Cent of Samples	
Under 30% D.O.	20.	20.
50% and over D.O.	20.	20.

* This sampling point was discontinued during the 1938 season.

All of the 1937 samples and four (4) of the five (5) samples in 1938 were collected in August. The mean value for August 1938 alone was 39. per cent, indicating a slightly better condition than in the preceding year.

These facts point to a lesser degree of pollution in 1938 at Points A, B, C and D, with the least improvement shown at Point D. This is consistent with the known facts. The decrease of pollution, due to diversion of sewage to Ward's Island, would affect points in the Easterly portion of the Harlem River. It would also have a minimum effect on Point D, at Spuyten Duyvil, as conditions here are largely influenced by the character of the Hudson River water.

SECTION 14. - LOWER HUDSON RIVER

	1937	1938
No. of Samples	55	22
Mean Dissolved Oxygen	41.7 per cent	67.0 per cent
Minimum " "	20. " "	35. " "
	Per Cent of Samples	
Under 30% D.O.	22.	0
30.0-49.9% D.O. inclusive	34.	32.
50% and over D.O.	44.	68.

Half of the samples in 1937 were collected at sampling points used in 1938. The data for these points (A, B and D) are given below:

SAMPLING POINT A (PIER A, NORTH RIVER)

	1937	1938
No. of Samples	9	5
Mean Dissolved Oxygen	43. per cent	63. per cent
	Per Cent of Samples	
Under 30% D.O.	22.	0
50% and over D.O.	33.	60.

These data indicate that the dissolved oxygen values were higher in 1938. Following are the results for each day's sampling:

1937		Dissolved Oxygen	1938		Dissolved Oxygen
			July	25	81. per cent
			"	25	59. " "
			August	8	40. " "
August	10	34. per cent			
"	11	29. " "			
"	18	47. " "			
			"	22	48. " "
"	24	38. " "			
"	25	36. " "			
"	31	26. " "			
			September	22	88. " "
October	18	56. " "			
"	19	59. " "			
"	19	61. " "			

Excluding the results for October, 1937 and September, 1938, there is still some indication of higher values in 1938.

SAMPLING POINT B (WEST 42nd STREET)

	1937	1938
No. of Samples	6	7
Mean Dissolved Oxygen	30. per cent	61. per cent
	Per Cent of Samples	
Under 30% D.O.	67.	0
50% and over D.O.	0	57.

The above data considered by themselves indicate a much better condition in 1938. This point was sampled as follows:

1937		Dissolved Oxygen	1938		Dissolved Oxygen
			July	25	79. per cent
			"	25	75. " "
			August	8	46. " "
			"	8	55. " "
August	10	21. per cent			
"	11	32. " "			
"	18	44. " "			
			"	22	42. " "
"	24	26. " "			
"	25	26. " "	"	25	35. " "
"	31	29. " "			
			September	22	95. " "

All of the 1937 sampling at this point was done in August. Three (3) of the 1938 samples were collected in July and September and yielded high values. Comparing results for August, 1937 with August, 1938, the mean values were 30. and 45. per cent, respectively. This again confirms the apparent improvement in 1938.

SAMPLING POINT D (SPUYTEN DUYVIL)

	1937	1938
No. of Samples	13	5
Mean Dissolved Oxygen	47. per cent	89. per cent
	Per Cent of Samples	
Under 30% D.O.	23.	0
50% and over D.O.	38.	100.

These figures suggest a decided improvement for 1938, but this assumption should be accepted with reservations, due to the relatively small number of samples in 1938. All of the 1937 samples and four (4) of the five (5) samples in 1938 were collected in August.

SECTION 15. - HUDSON RIVER OPPOSITE MOUNT ST. VINCENT

	1937	1938
No. of Samples	16	106
Mean Dissolved Oxygen	56.2 per cent	77.8 per cent
Minimum " "	29. " "	48. " "
	Per Cent of Samples	
Under 30% D.O.	12.	0
30.0-49.9% D.O. inclusive	19.	1.
50% and over D.O.	69.	99.

Ten (10) of the 1937 samples were collected near Point B; the balance of the samples for that year were taken at miscellaneous locations. In 1938, twenty-one (21) samples were obtained at Point B. As the sampling at this point was performed in August of each year, these data are comparable.

SAMPLING POINT B

	1937	1938
No. of samples	10	21
Mean Dissolved Oxygen	54. per cent	77. per cent
	Per Cent of Samples	
Under 30% D.O.	10.	0
50% and over D.O.	60.	100.

These data again indicate improved conditions in 1938.

SECTION 16. - HUDSON RIVER AT HASTINGS

	1937	1938
No. of Samples	28	49
Mean Dissolved Oxygen	76.5 per cent	91.0 per cent
Minimum Dissolved Oxygen	46. " "	82. " "
	Per Cent of Samples	
Under 30% D. O.	0	0
30.0-49.9% D. O. inclusive	7.	0
50% and over D. O.	93.	100.

The mean value for all samples taken in this area was considerably higher in 1938, but results for the two years are not directly comparable, as less than one-fourth of the 1937 samples were collected at a 1938 sampling point. Following are the comparable data for samples taken at Point A in 1937 and 1938:

SAMPLING POINT A

	1937	1938
No. of Samples	6	10
Mean Dissolved Oxygen	74. per cent	89. per cent
	Per Cent of Samples	
50% and over D. O.	83.	100.

These data parallel the results for the entire section and show an increase in dissolved oxygen for 1938. The six (6) samples for 1937 were collected on four (4) days in August; the ten (10) samples for 1938 were all taken on August 10th.

SECTION 17. - HUDSON RIVER AT VERPLANCK AND BEAR MOUNTAIN

	1937	1938
No. of Samples	11	45
Mean Dissolved Oxygen	73.9 per cent	91.9 per cent
Minimum Dissolved Oxygen	66. " "	84. " "
	Per cent of Samples	
Under 30% D. O.	0	0
30.0-49.9% D. O. inclusive	0	0
50% and over D. O.	100.	100.

The mean value for this section was higher in 1938. The only comparable samples were taken at Point J; two out of the total of eleven samples were collected here in 1937, and four out of forty-five, in 1938. The mean values at Point J were 71. and 91. per cent in 1937 and 1938, respectively.

All the comparable data for the Hudson River show higher values for dissolved oxygen in 1938. The mean values which might be compared fairly for each year and the percentage increase for 1938 are summarized below.

Point	1937	1938	Per cent Increase Over 1937
14A	43.	63.	46.
14B	*30.	*45.	50.
14D	47.	89.	89.
15B	54.	77.	42.
16A	74.	89.	20.
17J	71.	91.	28.

*August only

It will be noted that the per cent increase for 1938 is a maximum at Point 14D, opposity Spuyten Duyvil Creek. Whether this can be attributed in part to the operation of the Ward's Island Sewage Treatment Plant, to reduced operation at local manufacturing plants or to some other condition connected with the surveys is an open question.

SECTION 18. - UPPER EAST RIVER AND LONG ISLAND SOUND

	1937	1938
No. of Samples	287	34
Mean Dissolved Oxygen	38.7 per cent	59.0 per cent
Minimum Dissolved Oxygen	0 " "	17.1 " "
	Per cent of Samples	
Under 30% D. O.	20.	20.
30.0-49.9% D. O. inclusive	54	15.
50% and over D. O.	26.	65.

Mean and minimum values were higher in 1938 and there was also a larger percentage of samples above 50 per cent saturation. As approximately one third of the 1937 samples were collected at miscellaneous sampling points which were

not used in 1938, a better comparison may be obtained from the data for individual sampling points. Samples were collected in both years at Points A, B, C and D, but no samples were collected at Point E in 1937.

SAMPLING POINT A (BARRETTO POINT)

	1937	1938
No. of Samples	11	7
Mean Dissolved Oxygen	29. per cent	38. per cent
	Per Cent of Samples	
Under 30% D.O.	55.	57.
50% and over D.O.	18.	43.

These results indicate a somewhat higher dissolved oxygen in 1938. Following are the values obtained on each day's sampling.

1937		Dissolved Oxygen	1938		Dissolved Oxygen
July	22	62. per cent			
"	28	9. " "			
"	31	8. " "			
August	6	37. " "			
"	7	43. " "			
			August	9	17. per cent
			"	9	22. " "
"	11	14. " "			
			"	22	27. " "
			"	22	21. " "
"	25	31. " "			
September	1	27. " "			
"	8	20. " "			
"	10	22. " "			
"	14	51. " "			
			September	27	58. " "
			"	27	59. " "
			"	27	64. " "

The August samples gave somewhat lower values in 1938. In September, the 1938 values were higher, but results obtained late in the season are of doubtful significance. No definite conclusions can be drawn regarding

comparative conditions for 1937 and 1938 at this point.

SAMPLING POINT B (COLLEGE POINT)

	1937	1938
No. of Samples	10	7
Mean Dissolved Oxygen	35. per cent	43. per cent
	Per cent of Samples	
Under 30% D. O.	50.	43.
50% and over D. O.	10.	43.

At this sampling point, conditions were apparently somewhat better in 1938. The values for each sample are listed below.

1937		Dissolved Oxygen		1938		Dissolved Oxygen	
July	22	14.	per cent	August	9	25.	per cent
"	28	42.	" "	"	9	27.	" "
"	31	66.	" "	"	22	46.	" "
				"	22	29.	" "
August	6	29.	" "				
"	11	28.	" "				
"	11	37.	" "	September	27	54.	" "
"	25	28.	" "	"	27	64.	" "
				"	27	62.	" "
September	1	23.	" "				
"	8	38.	" "				
"	8	46.	" "				

The mean values for August, 1937 and August, 1938 were 31. and 32. per cent, respectively, showing conditions to be practically the same in each year.

SAMPLING POINT C (WHITESTONE POINT)

	1937	1938
No. of Samples	10	7
Mean Dissolved Oxygen	41. per cent	50. per cent
	Per cent of Samples	
Under 30% D. O.	10.	0
50% and over D. O.	20.	43.

Again, there seems to be some evidence of improvement in 1938. Adequate comparison is not possible, however, as the 1938 samples were collected in August and September, whereas only one of the 1937 samples was collected in August. All the other 1937 samples were obtained in July and September.

SAMPLING POINT D (THROGGS NECK)

	1937	1938
No. of Samples	163	7
Mean Dissolved Oxygen	43. per cent	73. per cent
	Per cent of Samples	
Under 30% D. O.	7.	0
50% and over D. O.	23.	100.

The wide disparity in the number of samples makes direct comparison meaningless.

It now seems evident that a complete and satisfactory comparison of the 1937 and 1938 data for this section cannot be made. The following entries are taken from the 1937 field sheets:

"High suspendeds"
"Probable nitrites"
"Particles over whole bay"
"Stale sewage"
"Very high suspendeds and organics"
"Nitrate"
"Organic matter"
"Probably interference high suspendeds"

It appears from the above that some of the 1937 results are of doubtful reliability, as the unmodified Winkler method was used at all times.

SECTION 19. - LONG ISLAND SOUND

	1937	1938
No. of Samples	13	18
Mean Dissolved Oxygen	67.5 per cent	93.2 per cent
Minimum " "	42. " "	44. " "
	Per Cent of Samples	
Under 30% D.O.	0	0
30.0-49.9% D.O. inclusive	15.	11.
50% and over D.O.	85.	89.

What at first appears to be a marked increase in dissolved oxygen in this section in 1938 is not substantiated on further analysis. The minimum values were nearly the same in each year, and there was little difference in the percentages of samples within the three groupings. As only two (2) of the 1937 samples were obtained at sampling points used in 1938, further comparison of the results for the two years would be without value. There appears to be no evidence of serious pollution in either 1937 or 1938.

SECTION 20. - LONG ISLAND SOUND

No samples were taken from this section in 1937.

SECTION 21. - LONG ISLAND SOUND

No samples were taken from this section in 1937.

SECTION 22. - LONG ISLAND SOUND

	1937	1938
No. of Samples	24	25
Mean Dissolved Oxygen	76.1 per cent	89.9 per cent
Minimum " "	44. " "	22. " "
	Per Cent of Samples	
Under 30% D.O.	0	4.
30.0-49.9% D.O. inclusive	13.	8.
50% and over D.O.	87.	88.

The mean value of samples collected from this section was higher in 1938, but there was no material difference in the results for the two years when consideration is given

to the different methods employed. Nearly 90 per cent of the 1937 samples were collected at Point A and data for this sampling point are compared below.

SAMPLING POINT A (CHANNEL INTO PELHAM BAY)

	1937	1938
No. of Samples	21	5
Mean Dissolved Oxygen	76. per cent	92. per cent
	Per Cent of Samples	
Under 30% D.O.	0	20.
50% and over D.O.	86.	80.

Although the mean value was higher in 1938, the percentage of samples under 30 per cent saturation was greater, and the percentage of samples above 50 per cent saturation was less, in that year. The relatively small number of samples in 1938 does not warrant further comparison. The 1937 field sheets for this point contain the following remarks:

"High suspendeds - Probable nitrites"
"High suspendeds"

This tends to cast some doubt on the reliability of the 1937 data, as the Winkler method was in use during this period.

SLUDGE ANALYSES

In the spring of 1938, before starting regular field operations, 28 samples of sludge were obtained. These were collected from the bottom of the Hudson River, near the east shore, in the area extending from Pier 25 to Pier 37, adjacent to the outfall of the Canal Street Sewage Screening Plant. The samples were obtained by lowering a pail from a convenient pier, until it touched bottom; then dragging the pail until it scraped up a sufficiently large sample. Moisture, total solids and volatile solids were determined in the laboratory by evaporating to dryness, followed by ignition, as outlined in Standard Methods. The results are reported in Table No. 22; "volatile" and "ash" were computed as percentages of dry solids, and not of the original sample. "Volatile" corresponds roughly to organic solids, and "ash", to inorganic solids.

Nearly all of the samples were characterized by a volatile solid content between 10 and 20 per cent, with the odor generally described as either hydrogen sulfide or earthly. The former odor is indicative of anaerobic decomposition. Four of the samples contained in excess of 20 per cent of volatile solids; the odor of 3 of these samples was described as earthly, and the remaining one, as sour.

TABLE 7

RESULTS OF SLUDGE ANALYSES: SEASON OF 1938

(Samples from Hudson River, near Canal Street)

SAMPLE NUMBER	DATE	PIER NUMBER	DEPTH FEET	CHARACTER OF SAMPLE	REACTION	ODOR	PER CENT MOISTURE	SOLIDS DRY BASIS	
								VOLATILE	ASHES
1	3/12	25	22	Hard, lumpy	Acid	Earthy	67.2	10.4	89.6
2	3/12	25	32	Black slime	Acid	H_2S	75.8	15.1	84.9
3	3/12	25	34	Black slime	Acid	H_2S	72.5	15.8	84.2
4	3/12	25	42	---	Alk.	Earthy	97.6	21.7	78.3
5	3/12	25	32	Black slime	Acid	H_2S	73.3	14.1	85.9
6		25	28	Black slime	Alk.	Earthy	81.4	13.0	87.0
7		25	35	---	Acid	H_2S	75.1	13.5	86.5
8		26	30	Black slime	Acid	H_2S	70.4	14.8	85.2
9		26	35	Black slime	Acid	H_2S	74.4	13.0	87.0
10		26	20	Sandy, rather compact, some slime	Acid	H_2S	74.5	17.1	82.9
11		26	40	Black slime	Acid	H_2S	72.9	15.5	84.5
12		26	40	Slime and clayey lumps	Acid	H_2S	76.9	12.7	87.3
13	4/11	32	28	Hard bottom scrapings, little slime	Alk.	Earthy	77.3	12.7	87.3
14	4/11	32		Firm, lumpy, little slime; live oyster	Acid	Oyster	78.1	12.4	87.6
15	4/11	32		Black slime	Acid	Sour	70.7	12.3	87.7
16	4/11	32		Black slime	Acid	Sour	77.8	13.1	86.9
17	4/12	34		Black slime	Acid	Sour	74.9	15.0	85.0
18	4/12	34		Lumpy scrapings, little slime	Acid	Earthy	71.7	37.8	62.2

TABLE 7 (Cont'd)

RESULTS OF SLUDGE ANALYSES: SEASON OF 1938

(Samples from Hudson River, near Canal Street)

SAMPLE NUMBER	DATE	PIER NUMBER	DEPTH FEET	CHARACTER OF SAMPLE	REACTION	ODOR	PER CENT MOISTURE	SOLIDS DRY BASIS	
								VOLATILE	ASH
19	4/12	34		Lumpy scrapings, little slime	Acid	Earthy	74.3	23.0	77.0
20	4/12	34	30	Black Slime	Acid	Sour	75.3	13.6	86.4
21	4/13	36	18	Heavy black slime	Acid	Dank	75.2	12.9	87.1
22	4/13	36	24	Light and dark slime mixed	Acid	Sour	77.9	13.3	86.7
23	4/13	36	32	Slime and ashes	Acid	Sour	75.0	19.4	80.6
24	4/13	36	14	Slime, sticks, stones, ashes	Acid	H_2S*	51.0	12.2	87.8
25	4/14	37	25	Slime mixed with debris	Acid	Sour	76.9	19.0	81.0
26	4/14	37	25	Heavy black slime, silt, cinders	Acid	Sour	67.2	42.5	57.5
27	4/14	37	30	Black and gray slime mixed	Acid	Sour	74.9	12.3	87.7
28	4/14	37	8	Black and gray, oily slime	Acid	Sewage	75.0	15.0	85.0

*Sample No. 24 was the only sample having different hot and cold odors; the cold odor: wet ashes; hot odors: H_2S.

The odor reported as "Sour" in the table was the sour smell of stale sewage.

BACTERIOLOGICAL TESTS

COLIFORM DATA.- Samples for the determination of coliform group density were collected in 19 sections of the Interstate Sanitation District, and were examined as described previously in this report, under "Details of Bacteriological Methods". The results of these tests are listed in Table 8, and the intensity of sampling at the various locations is shown on Map 13.

Following are the results for each section and for the various sampling points therein:

SECTION 1.- UPPER NEW YORK BAY

The M.P.N. for each point of this section is relatively high. This may be considered fairly conclusive evidence of a high degree of contamination from sewage and is in general accordance with the low values for dissolved oxygen that were obtained here.

These results are not in complete agreement with the dissolved oxygen results for the individual points as the coliform data indicated less pollution near the Brooklyn shore whereas the dissolved oxygen data indicated the opposite. This discrepancy may be due to the fact that the same number of coliform samples were not collected at all points.

TABLE 8
COLIFORM GROUP DENSITY

Section	Location	Most Probable Numbers Per 100 ml. Minimum	Maximum	Mean	No. of Samples	Days of Sampling
1	Upper New York Bay	2,300	70,000 plus	47,200	28	5
2	Kill van Kull, Newark Bay, Arthur Kill	6,200	70,000 plus	52,300	27	4
3	Arthur Kill	230	70,000	11,400	16	3
4	Raritan Bay	60	6,200	2,200	4	1
5	Sandy Hook Bay	* 0	210	100	5	1
6	Lower Bay	230	70,000 plus	35,700	10	2
7	The Narrows	2,300	70,000 plus	36,700	21	3
8	Gravesend Bay; Atlantic Ocean	130	70,000	41,000	17	3
9	Jamaica Bay	* 0	700,000 plus	39,000	720	48
10	Hempstead Bay and East Bay	* 0	* 0	* 0	5	2
11	Great South Bay	* 0	60	12	5	2
12	Lower East River	620	70,000	36,100	20	3
13	Harlem River	13,000	70,000 plus	59,400	14	2
14	Lower Hudson River	2,300	70,000	17,800	17	3
15	Hudson River at Mt. St. Vincent	-	-	-	0	-
16	Hudson River North of Ossining	-	-	-	0	-
17	Hudson River (Verplanck and Bear Mountain Bridge)	200	70,000 plus	14,400	20	2
18	East River; Long Island Sound	230	24,000	9,100	10	1
19	Long Island Sound	* 0	620	150	9	1
20	Long Island Sound	* 0	230	60	5	1
21	Long Island Sound	* 0	230	60	6	1
22	Long Island Sound	-	-	-	0	-

* Zero in 1 milliliter

TABLE 9:
COLIFORM GROUP DENSITY
SECTION 1 - UPPER NEW YORK BAY

SAMPLING POINTS	1A	1B	1C	1D	1E	1F
	Buttermilk Channel B.B. #30	Bay Ridge Channel at Gowanus Bay L.B.B.#7	Bay Ridge Channel No.Owl's Head Park	Tompkinsville L.B.B.#5	Robbins Reef Light L.B. #27	Bedloe's Is. Bet. Can Buoy #1 and B.L.B. #2
	2,300	24,000	6,200	70,000	6,200	70,000
	70,000	70,000+	70,000	6,200	6,200	2,300
		24,000	70,000+	6,200	70,000+	70,000
				70,000	24,000	70,000+
				70,000+	70,000	70,000
				24,000	70,000+	70,000+
					70,000	
					70,000+	
MEAN VALUES	36,200	39,300	48,700	41,100	48,300	58,700

S U M M A R Y

No. of Samples - 28
Mean Density - 47,200
Minimum " - 2,300
Maximum " - 70,000+

SECTION 2. - KILL VAN KULL, NEWARK BAY AND ARTHUR KILL

The data in Table 25 indicate that the waters of this section are badly polluted. On the first stage of the flood tide, the polluted waters of the Upper Bay, which have just received the polluted waters of the Lower Hudson River and the East River find their way into Kill van Kull and Newark Bay. On the ebb tide, the waters of Newark Bay flow out through Kill van Kull into the Upper Bay and for a time may flow northward. For the balance of the ebb tide period, the Newark Bay waters flow through Kill van Kull southward into The Narrows and out to the Lower Bay. Because of the location of this section, much of the waters flow back and forth without receiving any great dilution from the ocean.

The coliform results partly confirm the conclusions drawn from the dissolved oxygen data. There is evidence of a high degree of pollution in Newark Bay, (Points C and D) with conditions somewhat worse at point E.

TABLE 10.
COLIFORM GROUP DENSITY
SECTION 2 - KILL VAN KULL - NEWARK BAY - ARTHUR KILL

SAMPLING POINTS	2A	2B	2C	2D	2E
	Kill van Kull opposite C.R. R.N.J. Piers in Bayonne	Kill van Kull at Bayonne Bridge, Bergen Point	Newark Bay: 100 feet west Nun Buoy #4	Newark Bay: 50 feet so. Lehigh Valley R.R.Bridge	Arthur Kill Elizabethport Recreation Pier
	70,000	70,000	70,000	70,000	70,000
	24,000	24,000	24,000	24,000	70,000
	24,000	24,000	24,000	70,000	70,000+
	6,200	70,000	24,000	70,000+	
	70,000	70,000+	24,000		
	70,000+	70,000	70,000+		
	70,000+	70,000+			
MEAN VALUES	47,700	56,900	39,300	58,500	70,000

S U M M A R Y

No. of Samples	-	27
Mean Density	-	52,300
Minimum Density	-	6,200
Maximum "	-	70,000+

SECTION 3. - ARTHUR KILL

The coliform data for this section, given in Table 26, are rather meagre but are in agreement with the dissolved oxygen data, showing a consistent improvement of the water in proceeding from Point A to Point D.

TABLE 11
COLIFORM GROUP DENSITY
SECTION 3 - ARTHUR KILL

SAMPLING POINTS	3A	3B	3C	3D
	Mid-channel, mouth of Rahway River	Between Chrome Wks. in Carteret & south mouth of Fresh Kills	Rossville between Can Buoy #5 & Bell & Light B. #4a	Off Boynton Beach 100 feet west Light Buoy #6
	24,000	6,200	2,100	230
	6,200	2,300	24,000	2,300
	6,200	6,200	2,300	2,300
	70,000	13,000	2,300	
		13,000		
MEAN VALUES	26,600	8,100	7,700	1,600

S U M M A R Y

No. of Samples	-	16
Mean Density	-	11,400
Minimum Density	-	230
Maximum Density	-	70,000

SECTION 4 - RARITAN BAY

The data are not in sufficient quantity to form a reliable index, but as far as they go, they confirm the conclusions drawn from the dissolved oxygen analyses. This section is relatively free from pollution, and as previously concluded, the minimum of pollution is at Points B and D. Table 12 shows the results of tests made in this section.

TABLE 12.
COLIFORM GROUP DENSITY
SECTION 4 - RARITAN BAY - RARITAN RIVER - PRINCESS BAY

SAMPLING POINTS			
4A	4B	4C	4D
Raritan River Victory Bridge Perth-South Amboy	Raritan Bay Midway Between Bell and Light Buoy #13 & Nun Buoy #38	Princess Bay midway between Nun Buoy #30 & Can Buoy #9	Between Conaskonk Point and Huguenot Beach Bell & Light Buoy #5
6,200	230	2,300	60

S U M M A R Y

No. of Samples - 4
Mean Density - 2,200
Minimum Density - 60
Maximum Density - 6,200

SECTION 5 - SANDY HOOK BAY

Only one sample was collected at each of 5 sampling points. The data are in agreement with the high dissolved oxygen values, pointing to only a slight degree of pollution in this section. The results of these tests are given below in Table 13.

TABLE 13.
COLIFORM GROUP DENSITY
SECTION 5 - SANDY HOOK BAY - LOWER BAY - SHREWSBURY RIVER

SAMPLING POINTS				
5A	5B	5C	5D	5E
About 1200 yds. north of Mill Creek, Mouth, N.J.	About 2200 yds. north of Conover Beacon, Leonardo, N.J.	20 yards east of Atlantic Highlands Pier	Shrewsbury River Bell and Light Buoy No. 2	100 feet north of concrete bridge of Highway #36 between Highlands & Highland beach
210	0	60	0	210

S U M M A R Y

No. of Samples - 5
Mean Density - 100
Minimum Density - 0
Maximum Density - 210

SECTION 6. - LOWER BAY

Owing to the small number of samples and the wide difference between minimum and maximum values for each point, the mean values are of doubtful significance. These divergent data are the result of sampling on different days and at different stages of the tide.

TABLE 14.
COLIFORM GROUP DENSITY
SECTION 6 - LOWER BAY

SAMPLING POINTS	6A	6B	6C	6D	6E
	Northwest of Hoffman Island Nun Buoy #2	About 1700 yards S.E. Midland Beach at Bell Buoy	West Bank Light in Swash Channel	Old Orchard Shoal Light	Great Kills Light 1500 yds. south of Crooks Island
	2,300	230	2,300	2,300	230
	70,000+	70,000+	70,000	70,000	70,000
MEAN VALUES	36,200	35,100	36,200	36,200	35,100

S U M M A R Y

No. of Samples	-	10
Mean Density	-	35,700
Minimum Density	-	230
Maximum "	-	70,000+

SECTION 7. - THE NARROWS

These data confirm the dissolved oxygen data, indicating fairly heavy pollution in this section. However, they are inconsistent to the extent that the coliform results show maximum pollution at Point A, whereas the dissolved oxygen data give evidence of minimum pollution at that point.

TABLE .15.
COLIFORM GROUP DENSITY
SECTION 7 - THE NARROWS

SAMPLING POINTS:	7A	7B	7C
	2,300	24,000	24,000
	6,200	24,000	2,300
	6,200	70,000	2,300
	70,000+	24,000	70,000
	70,000+	70,000	24,000
	70,000+	24,000	24,000
	70,000	24,000	70,000
MEAN VALUES	42,100	37,100	30,900

S U M M A R Y

No. of Samples	-	21
Mean Density	-	36,700
Minimum Density	-	2,300
Maximum "	-	70,000+

SECTION 8. - GRAVESEND BAY AND ATLANTIC OCEAN

The high coliform density at Point A is in conformity with the low dissolved oxygen value. Both data indicate maximum pollution for this section at Point A.

At Point C, in the Atlantic Ocean, the high coliform density seems to confirm the somewhat unexpected results for dissolved oxygen. The mean value for dissolved oxygen at this point was rather low, and some of the individual tests were decidedly low. These facts suggest the probable influence of water currents near Point C.

TABLE 16.
COLIFORM GROUP DENSITY
SECTION 8 - GRAVESEND BAY - ATLANTIC OCEAN AT CONEY ISLAND

SAMPLING POINTS:	8A	8B	8C
	Gravesend Bay Mouth of Coney Island Creek	South of Norton Point L.B. Buoy #12	Atlantic Ocean 200 feet south of Steeplechase Pier, Coney Island
	24,000	6,200	130
	24,000	2,300	70,000+
	70,000+	70,000+	2,100
	70,000+	2,300	70,000
	70,000+	70,000	70,000
	70,000+	6,200	
MEAN VALUES	54,700	26,200	42,400

S U M M A R Y

No. of Samples	-	17
Mean Density	-	41,000
Minimum Density	-	130
Maximum "	-	70,000

SECTION 9. - JAMAICA BAY

During the 1938 season, a total of 775 coliform samples were collected in Jamaica Bay. This work was done at the request and with the cooperation of the Department of Sanitation and the Department of Health, City of New York. This work was undertaken for the purpose of obtaining information as to the efficiency of the disinfection of the sewage that is discharged into Jamaica Bay. The work was carried on from May 9th to September 30th.

SECTION 10. - HEMPSTEAD BAY AND EAST BAY

Four samples collected at four different sampling points showed zero values for the coliform density. These

results tend to confirm the freedom from pollution in this section, which was indicated by the dissolved oxygen results.

TABLE 17
COLIFORM GROUP DENSITY
SECTION 10 - HEMPSTEAD BAY AND EAST BAY

SAMPLING POINTS			
10A	10B	10C	10D
E.Rockaway Inlet west of center of Far Rockaway-Atlantic Beach Bridge	Mid-channel west of center of Island Park Long Beach R.R. Bridge	Jones Inlet 200 yards east of north point of Point Lookout	Atlantic Ocean at Jones Inlet 300 yards off shore
* 0	* 0	* 0	* 0

* Zero in 1 milliliter

S U M M A R Y

No. of Samples - 4
Mean Density - * 0

SECTION 11. - GREAT SOUTH BAY

Out of five samples taken in this section, four showed zero values, while the fifth showed 60 coliform per 100 ml. This is in agreement with the general absence of pollution shown by the dissolved oxygen analyses.

TABLE 18
COLIFORM GROUP DENSITY
SECTION 11 - GREAT SOUTH BAY

SAMPLING POINTS			
11A	11B	11C	11D
200 yards north of Cedar Island	Entrance to Santapogue River, 250 yds. east of Fleet Point.	Mouth of Carll River.	Fire Island Inlet 300 yards south of Democrat Point
* 0	* 0	* 0	* 0 60
MEAN VALUES			
-	-	-	30

* Zero in 1 milliliter

S U M M A R Y

No. of Samples - 5
Mean Density - 12
Minimum Density - * 0
Maximum Density - 60

SECTION 12. - LOWER EAST RIVER

Twenty samples were collected in this section on three different sampling days. The highest coliform values were found at the entrance to Newtown Creek and amounted to 70,000 per 100 ml. The lowest values were found close to Ward's Island, opposite East 106th Street, and amounted to 11,700 per 100 ml. The mean value for all samples collected in these five miles of the East River amounted to 36,100 per 100 ml.

The results are in general accord with the dissolved oxygen data, showing a high degree of pollution for the entire section, with the worst conditions prevailing at Point C, in Newtown Creek Channel. The results of these tests for the other points vary somewhat from their sequence as determined from the dissolved oxygen data. This is probably due to the comparatively small number of samples.

TABLE 19.
COLIFORM GROUP DENSITY
SECTION 12 - EAST RIVER

SAMPLING POINTS	12A	12B	12C	12D	12E	12F
	Mid-channel off Pier 8, Brooklyn	Foot of East 23rd St. 1/3 distance to Brooklyn	Center of Newtown Creek channel on Brooklyn pierhead line	Foot of E. 42nd St. 1/4 distance to Queens	Hell Gate E. of Ward's Is. under R.R. bridge	Harlem River W. of Ward's Is. opp. ft. of E. 106th Street
	24,000	70,000+	70,000+	24,000	70,000	6,200
	62,000	70,000+	70,000	70,000	620	24,000
	6,200	2,300	70,000	24,000	24,000	5,000
				24,000	6,200	
MEAN VALUES	30,700	47,400	70,000	35,500	25,200	11,700

S U M M A R Y

No. of Samples	-	20
Mean Density	-	36,100
Minimum Density	-	620
Maximum "	-	70,000+

SECTION 13. - HARLEM RIVER

The coliform data indicate that this sampling section is the most highly polluted in the District. The dissolved oxygen data accorded this doubtful distinction to Section 12. This lack of agreement may be traced to the fact, that as previously stated, about half the dissolved oxygen samples in this section were collected late in September. For this reason, the coliform data, although meagre, may give a more correct picture of the conditions in this section.

TABLE . 20.
COLIFORM GROUP DENSITY
SECTION 13 - HARLEM RIVER

SAMPLING POINTS	13A	13B	13C	* 13D
	Midstream north of Willis Ave. drawbridge	Midstream north of 155th St. drawbridge	Midstream opposite Consolidated Shipbuilding Plant and Sherman Creek	Spuyten Duyvil east of the railroad bridge
	13,000	70,000	70,000	70,000
	70,000	24,000	70,000	70,000
	70,000+	70,000+	70,000	70,000
		24,000	70,000+	
MEAN VALUES	51,000	47,000	70,000	70,000

* Sampling Point D was discontinued during the season.

S U M M A R Y

No. of Samples	-	14
Mean Density	-	59,400
Minimum Density	-	13,000
Maximum "	-	70,000+

SECTION 14. - LOWER HUDSON RIVER

The coliform results indicate a fairly large amount of pollution in the section, and confirm the dissolved oxygen results in this respect. The single sample obtained at Point E is probably not representative of conditions at that location.

TABLE 21
COLIFORM GROUP DENSITY
SECTION 14 - LOWER HUDSON RIVER

SAMPLING POINTS	14A	14B	14C	14D	14E
	Pier A 1/3 distance to C.R.R. N.J. Communipaw	W. 42nd St. 1/3 distance to N.J. shore	W. 155th ¼ distance to N.J. shore	Spuyten Duyvil Creek ¼ distance to N.J. shore	Opposite Mount St. Vincent ¼ distance to N.J. shore
	6,200	24,000	24,000	24,000	70,000
	6,200	6,200	24,000	24,000	
	2,300	24,000	24,000	6,200	
	13,000	13,000	5,000	6,200	
MEAN VALUES	6,900	16,800	19,300	15,100	* 70,000

* Single sample

S U M M A R Y

No. of Samples	-	17
Mean Density	-	17,800
Minimum Density	-	2,300
Maximum "	-	70,000

SECTION 15. - HUDSON RIVER OPPOSITE MOUNT ST. VINCENT

No coliform samples were collected in this section in 1938.

SECTION 16. - HUDSON RIVER AT HASTINGS

No coliform samples were collected in this section in 1938.

SECTION 17. - HUDSON RIVER AT VERPLANCK AND BEAR MOUNTAIN

Twenty samples were collected in this section of the Hudson River, at Verplanck and at Bear Mountain Bridge, on two different days, yielding an average value for the section of 14,400 coliform organisms per 100 ml. This would indicate a fairly high degree of pollution and is not in complete agreement with the dissolved oxygen data. Less significance may be attached to the Bear Mountain data, as only a single sample was collected at each point (F,G,H,I and J).

At Verplanck, however, three samples were taken at each point (A,B,C,D and E); these samples were picked up on the same days as the dissolved oxygen samples. Please note that values of 70,000 plus were obtained, once at Point B and once at Point C. These values are out of line with the other values for Verplanck, which are fairly consistent. The explanation may be that these two extremely high values were due to some local and temporary contamination.

TABLE 22.
COLIFORM GROUP DENSITY
SECTION 17 - HUDSON RIVER AT VERPLANCK & BEAR MT. BRIDGE

Traverse at right angles to center line of river

AT VERPLANCK

SAMPLING POINTS	17A	17B	17C	17D	17E
	200	70,000+	70,000+	5,000	950
	2,300	13,000	2,300	6,200	6,200
	6,200	6,200	6,200	6,200	24,000
MEAN VALUES	2,900	29,700	26,200	5,800	10,400

AT BEAR MOUNTAIN

SAMPLING POINTS	17F	17G	17H	17I	17J
	24,000	2,300	6,200	24,000	6,200
MEAN VALUES	*24,000	* 2,300	* 6,200	*24,000	* 6,200

* Single sample

S U M M A R Y

No. of Samples	-	20
Mean density	-	14,400
Minimum Density	-	200
Maximum "	-	70,000+

SECTION 17. - HUDSON RIVER AT VERPLANCK AND BEAR MOUNTAIN

Twenty samples were collected in this section of the Hudson River, at Verplanck and at Bear Mountain Bridge, on two different days, yielding an average value for the section of 14,400 coliform organisms per 100 ml. This would indicate a fairly high degree of pollution and is not in complete agreement with the dissolved oxygen data. Less significance may be attached to the Bear Mountain data, as only a single sample was collected at each point (F,G,H,I and J).

At Verplanck, however, three samples were taken at each point (A,B,C,D and E); these samples were picked up on the same days as the dissolved oxygen samples. Please note that values of 70,000 plus were obtained, once at Point B and once at Point C. These values are out of line with the other values for Verplanck, which are fairly consistent. The explanation may be that these two extremely high values were due to some local and temporary contamination.

TABLE 22.
COLIFORM GROUP DENSITY
SECTION 17 - HUDSON RIVER AT VERPLANCK & BEAR MT. BRIDGE

Traverse at right angles to center line of river

AT VERPLANCK

SAMPLING POINTS	17A	17B	17C	17D	17E
	200	70,000+	70,000+	5,000	950
	2,300	13,000	2,300	6,200	6,200
	6,200	6,200	6,200	6,200	24,000
MEAN VALUES	2,900	29,700	26,200	5,800	10,400

AT BEAR MOUNTAIN

SAMPLING POINTS	17F	17G	17H	17I	17J
	24,000	2,300	6,200	24,000	6,200
MEAN VALUES	*24,000	* 2,300	* 6,200	*24,000	* 6,200

* Single sample

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No. of Samples	-	20
Mean density	-	14,400
Minimum Density	-	200
Maximum "	-	70,000+

TABLE 24.
COLIFORM GROUP DENSITY
SECTION 19 - LONG ISLAND SOUND

SAMPLING POINTS	19A	19B	19C	19D	19E
	Hewlett Point Can Buoy #29	Manhasset Bay south-east of Plum Point Can Buoy #3	Prospect Point Bell Buoy #23	Hempstead Harbor, Mott Point Bell Buoy #4	Mattini-cock Pt. Bell and Light Buoy
	230	620	** 0	** 0	** 0
	230	230	** 0	60	
MEAN VALUES	230	430	** 0	30	* 0

* Single sample
** Zero in 1 milliliter

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No. of Samples	-	9
Mean Density	-	150
Minimum Density	-	* 0
Maximum "	-	620

SECTION 20.- LONG ISLAND SOUND

Only one coliform sample was obtained at each point, but the data, as far as they go, agree with the dissolved oxygen data, showing a general absence of serious pollution in this section.

TABLE 25.
COLIFORM GROUP DENSITY
SECTION 20 - LONG ISLAND SOUND

SAMPLING POINTS	20A	20B	20C	20D	20E
	Oak Neck Point Can Buoy #19	Oyster Bay Harbor off Seawanhaka Nun Buoy #2a	Lloyd Pt. Light and Bell Buoy #15	Huntington Bay, East Fort Point, Nun Buoy #3	Eaton's Point 2000 yds, north of shoreline, Can Buoy #13
	230	60	* 0	* 0	* 0

* Zero in 1 milliliter

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No. of Samples	-	5
Mean Density	-	60
Minimum Density	-	* 0
Maximum "	-	230

SECTION 21.- LONG ISLAND SOUND

Coliform data at Points A, B and C agree with the dissolved oxygen data, showing generally satisfactory conditions. At Point D, the dissolved oxygen data indicated pollution was present at times. The two coliform samples for this point both yielded M.P.N of zero in 1 milliliter; these samples were collected five and one half and six hours after low water, and the dissolved oxygen samples collected with them showed 127 per cent and 126 per cent saturation, respectively.

TABLE 26.
COLIFORM GROUP DENSITY
SECTION 21 - LONG ISLAND SOUND

SAMPLING POINTS	21A	21B	21C	21D	21E
	About 1000 yds. north of Crane Neck Point Smithtown Bay	Oldfield Point, Gong Buoy #11a	Port Jefferson Harbor, adjacent to Bell Buoy, west of Mt. Misery Shoals	Port Jefferson Harbor Light and Bell Buoy #1, inner channel	Setauket Harbor, in Port Jefferson Harbor
	* 0	* 0	230	* 0	-
			130	* 0	-
MEAN VALUES	** 0	** 0	180	** 0	-

* Single sample
** Zero in 1 milliliter

S U M M A R Y

No. of Samples	-	6
Mean Density	-	60
Minimum Density	-	* 0
Maximum "	-	230

RELATIONSHIP OF COLIFORM GROUP DENSITY TO DISTANCES FROM THE BATTERY.- The relationship between coliform group density and distances from The Battery is shown in Tables 27 and 28. In the former, the sections and sampling points are arranged in numerical order. In Table 28, the sampling points and M.P.N. are correlated with the distance of each from The Battery.

It will be seen that in general, the higher values are found near The Battery, and low values in the more remote sections. There are a number of cases that depart from this rule, and these deviations may be due in part to the fact that bacteriological methods cannot attain the precision of chemical methods. In some cases, lack of sufficient number of samples would explain the apparent discrepancies.

TABLE 27.
DISTANCES IN MILES FROM THE BATTERY AND
COLIFORM GROUP DENSITY (M.P.N. - ARITHMETICAL MEAN VALUES)

Sec.	Pt.	Dist.	M.P.N.	Sec.	Pt.	Dist.	M.P.N.
1	A	2.1	36,200	10	A	25.5	* 0
1	B	3.0	39,300	10	B	29.7	* 0
1	C	4.2	48,700	10	C	35.3	* 0
1	D	5.0	41,100	10	D	34.7	* 0
1	E	4.0	48,300				
1	F	1.9	58,700	11	A	48.9	* 0
				11	B	50.3	* 0
2	A	6.5	47,700	11	C	51.0	* 0
2	B	8.1	56,900	11	D	48.4	30
2	C	10.1	39,300				
2	D	12.8	58,500	12	A	0.8	30,700
2	E	10.0	70,000	12	B	4.3	47,400
				12	C	4.3	70,000
3	A	14.5	26,600	12	D	5.3	35,500
3	B	16.0	8,100	12	E	8.8	25,200
3	C	17.0	7,700	12	F	8.4	11,700
3	D	19.2	1,600				
				13	A	9.4	51,000
4	A	22.7	6,200	13	B	11.2	47,000
4	B	20.4	230	13	C	13.4	70,000
4	C	18.5	2,300	13	D	15.7	70,000
4	D	17.9	60				
				14	A	0.4	6,900
5	A	17.8	210	14	B	4.4	16,800
5	B	18.5	* 0	14	C	9.9	19,300
5	C	19.5	60	14	D	13.7	15,100
5	D	19.9	* 0	14	E	15.9	70,000
5	E	21.9	210				
				17	A	40.5	2,900
6	A	8.6	36,200	17	B	40.5	29,700
6	B	10.1	35,100	17	C	40.5	26,200
6	C	11.6	36,200	17	D	40.5	5,800
6	D	13.9	36,200	17	E	40.5	10,400
6	E	14.3	35,100	17	F	46.0	24,000
				17	G	46.0	2,300
7	A	6.8	42,100	17	H	46.0	6,200
7	B	6.8	37,100	17	I	46.0	24,000
7	C	6.8	30,900	17	J	46.0	6,200
8	A	10.1	54,700				
8	B	9.9	26,200				
8	C	11.4	42,400				

* Zero in 1 milliliter

TABLE 27(Cont'd)

DISTANCES IN MILES FROM THE BATTERY AND COLIFORM GROUP DENSITY (M.P.N. - ARITHMETICAL MEAN VALUES)

Sec.	Pt.	Dist.	M.P.N.	Sec.	Pt.	Dist.	M.P.N.
18	A	11.2	13,200	20	A	31.8	230
18	B	12.8	9,600	20	B	36.0	60
18	C	14.8	18,500	20	C	36.9	* 0
18	D	16.5	4,300	20	D	40.1	* 0
18	E	18.3	230	20	E	41.7	* 0
19	A	19.8	230	21	A	54.1	* 0
19	B	21.6	430	21	B	55.7	* 0
19	C	23.0	* 0	21	C	57.9	180
19	D	26.4	30	21	D	58.1	* 0
19	E	28.1	* 0				

* Zero in 1 milliliter

TABLE 28.
DISTANCES IN MILES FROM THE BATTERY AND COLIFORM GROUP DENSITY (M.P.N. - ARITHMETICAL MEAN VALUES)

Dist.	Sec.	Pt.	M.P.N.	Dist.	Sec.	Pt.	M.P.N.
0.4	14	A	6,900	17.8	5	A	210
0.8	12	A	30,700	17.9	4	D	60
1.9	1	F	58,700	18.3	18	E	230
2.1	1	A	36,200	18.5	4	C	2,300
3.0	1	B	39,300	18.5	5	B	* 0
4.0	1	E	48,300	19.3	3	D	1,600
4.2	1	C	48,700	19.5	5	C	60
4.3	12	B	47,400	19.8	19	A	230
4.3	12	C	70,000	19.9	5	D	* 0
4.4	14	B	16,800	20.4	4	B	230
5.0	1	D	41,100	21.6	19	B	430
5.3	12	D	35,500	21.9	5	E	210
6.5	2	A	47,700	22.7	4	A	6,200
6.8	7	A	42,100	23.0	19	C	* 0
6.8	7	B	37,100	25.5	10	A	* 0
6.8	7	C	30,900	26.4	19	D	30
8.1	2	B	56,900	28.1	19	E	* 0
8.4	12	F	11,700	29.7	10	B	* 0
8.6	6	A	36,200	31.8	20	A	230
8.8	12	E	25,200	34.7	10	D	* 0
9.4	13	A	51,000	35.3	10	C	* 0
9.9	8	B	26,200	36.0	20	B	60
9.9	14	C	19,300	36.9	20	C	* 0
10.0	2	E	70,000	40.1	20	D	* 0
10.1	2	C	39,300	40.5	17	A	2,900
10.1	6	B	35,100	40.5	17	B	29,700
10.1	8	A	54,700	40.5	17	C	26,200
11.2	13	B	47,000	40.5	17	D	5,800
11.2	18	A	13,200	40.5	17	E	10,400
11.4	8	C	42,400	41.7	20	E	* 0
11.6	6	C	36,200	46.0	17	F	24,000
12.8	2	D	58,500	46.0	17	G	2,300
12.8	18	B	9,600	46.0	17	H	6,200
13.4	13	C	70,000	46.0	17	I	24,000
13.7	14	D	15,100	46.0	17	J	6,200
13.9	6	D	36,200	48.4	11	D	30
14.3	6	E	35,100	48.9	11	A	* 0
14.5	3	A	26,600	50.3	11	B	* 0
14.8	18	C	18,500	51.0	11	C	* 0
15.7	13	D	70,000	54.1	21	A	* 0
15.9	14	E	70,000	55.7	21	B	* 0
16.0	3	B	8,100	57.9	21	C	180
16.5	18	D	4,300	58.1	21	D	* 0
17.0	3	C	7,700				

* Zero in 1 milliliter

TOTAL 37 DEGREE BACTERIOLOGICAL COUNT DATA

A total of 119 samples for the total 37 degree bacterial count were collected at 59 sampling points located in13 of the 22 sampling sections of the District. In Upper New York Bay, samples were collected on six different sampling days; in The Narrows on three different days; in the Kill van Kull and in Jamaica Bay on two different days. In the other nine sections where samples were taken, they were taken on single sampling days.

Table 29 shows the minimum, maximum and mean values of the total 37 degree bacterial count for those sections of the Interstate Sanitation District where such tests were made.

In comparing the total count data with the coliform data, it should be noted that the former is expressed as number of organisms per milliliter, whereas, the latter is reported as the number in 100 ml. Moreover, the total count is based on a direct count of visible colonies; in the case of the coliform data, the Most Probable Number (M.P.N.) is determined indirectly, using tables based upon the mathematical laws of probability. For this reason, the total bacteriological count is usually considered to have greater precision as regards the number of organisms present, than the coliform determination. The coliform test is valuable as indicating whether or not pollution from human beings is present and also giving a rough idea as to the intensity of such pollution, while the total count may include many bacteria of decay or from the soil.

TABLE 89.
SUMMARY OF TOTAL BACTERIAL COUNT DATA
(37 degree)

Section	LOCATION	Total Count per 1 ml. (Agar at 37°C. for 24 Hrs.)			No of Samples	Days of Sampling
		Minimum	Maximum	Mean		
1	Upper New York Bay	550	1,500,000	127,000	28	6
2	Kill van Kull, Newark Bay. Arthur Kill	5,400	1,300,000	143,000	12	2
3	Arthur Kill	2,600	8,600	5,300	4	1
4	Raritan Bay	--	--	--	0	-
5	Sandy Hook Bay	--	--	--	0	-
6	Lower Bay	1,200	5,600	3,000	5	1
7	The Narrows	850	100,000	13,000	16	3
8	Gravesend Bay; Atlantic	14,000	260,000	62,300	6	1
9	Jamaica Bay	8	14,000	1,900	14	2
10	Hempstead Bay & East Bay	--	--	--	0	-
11	Great South Bay	--	--	--	0	-
12	Lower East River	800	42,000	8,100	8	1
13	Harlem River	29,000	110,000	71,100	4	1
14	Lower Hudson River	400	8,000	3,100	5	1
15	Hudson River at Mt. St. Vincent	--	--	--	0	-
16	Hudson River north of Ossining	--	--	--	0	-
17	Hudson River- Verplanck and Bear Mountain Bridge	2	1,600	740	5	1
18	East River; Long Island Sound	40	350	260	6	1
19	Long Island Sound	10	2,200	450	6	1
20	Long Island Sound	--	--	--	0	-
21	Long Island Sound	--	--	--	0	-
22	Long Island Sound	--	--	--	0	-

The highest total bacterial counts were obtained from samples taken in Upper New York Bay and the Kills (Sections 1 and 2, respectively). Although the Harlem River Section yielded the highest coliform values, it ranks third in the tabulation of mean total count values. In this connection,

it should be noted that only four samples were taken in this section.

The lowest mean value for total count was obtained in Section 18 (Upper East River and Long Island Sound).

No samples were obtained in some of the more distant sections of the District, which presumably would have shown lower results than those listed above because of the small quantity of sewage discharged into or near them after passing through sewage treatment plants.

Not as many bacteriological samples were collected as would be necessary to give a fair picture of the great area of waters in the Interstate Sanitation District. This was due mainly to lack of equipment and personnel to properly carry the work forward. The data which is given in the preceding table relative to the total bacterial count of agar at 37°C. as well as the coliform results discussed in the previous pages, should be used, if at all, with the greatest circumspection. It is our belief that this data has been obtained in insufficient quantities to be in any sense conclusive evidence as to the condition of any of the waters in the Interstate Sanitation District.

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Appendices

Dissolved Oxygen

Data

TABLE 3
DISSOLVED OXYGEN TESTS - 1938
SECTION #1 - UPPER NEW YORK BAY

SAMPLING POINTS	1A		1B		1C		1D		1E		1F	
	Buttermilk Channel B. B. #30		Bay Ridge Chnl. Gowanus Bay B.B. #7		Bay Ridge Chnl. No. Owls Head Park		Tompkinsville B. B. #5		Robbins Reef Light B.B. #27		Bedloes Is. Bet. Can Buoy #1 & B.B. #2	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	63	31.6	67	45.6	71	41.3	91	55.2	79	61.6	71	56.8
	75	34.3	67	48.4	71	46.4	71	56.8	71	41.3	75	55.7
	63	38.4	71	20.1	68	23.0	68	45.7	67	40.3	67	40.1
	71	15.8	63	21.2	72	27.2	64	51.5	67	39.5	63	48.7
	67	18.8	56	36.8	56	44.7	48	58.5	63	49.6	40	51.5
	44	40.2	56	15.5	56	26.4	36	50.7	60	62.0	48	50.0
	52	46.6	60	18.5	56	27.0	64	35.6	41	35.6	40	52.7
	52	35.4	60	28.4	64	5.1	52	34.6	48	49.9	48	35.8
	56	24.9	68	3.5	52	36.3	76	49.5	52	42.1	48	41.5
	68	5.6					60	4.5	48	39.1	72	47.8
							60	12.8	48	30.4	56	7.1
							68	15.0	64	25.4	60	7.8
									60	22.0	64	9.9
									64	10.0		
									76	12.1		
									76	-		
									68	11.9		
									60	12.8		
									84	13.3		
									80	52.0		
									68	12.6		
Total No. Samples	10	10	9	9	9	9	12	12	21	20	13	13
Average Salinity	61		63		63		63		64		58	
Average D.O.		29.0		26.4		30.8		39.2		33.2		38.8
Minimum D.O.		5.6		3.5		5.1		4.5		10.0		7.1

SUMMARY

No. Salinity Tests 74
No. D.O. Analyses 73

Average Salinity 62. per cent
Average D.O. 33.5 per cent
Minimum D.O. 3.5 per cent

TABLE 3.(Cont'd).
DISSOLVED OXYGEN TESTS - 1938
SECTION #2
KILL VAN KULL - NEWARK BAY - ARTHUR KILL

SAMPLING POINTS	2A		2B		2C		2D		2E		2F	
	Kill Van Kull				Newark Bay				Arthur Kill			
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	63	28.5	59	39.0	59	4.8	47	39.4	59	33.0	55	23.1
	63	38.8	59	43.8	63	33.6	51	36.0	59	36.6	55	26.8
	59	41.1	55	48.4	63	40.2	47	45.4	55	44.3	43	46.8
	64	50.2	60	51.7	67	52.7	52	57.3	51	49.2		
	64	52.0	58	51.1	54	56.0	52	56.5	54	57.2		
	59	51.8	58	51.3	54	55.5	54	54.0	54	56.0		
	53	50.6	56	53.0	54	55.4	54	54.7	47	36.9		
	49	34.8	34	57.4	30	49.4	30	78.6	42	35.8		
	55	41.7	46	38.1	42	64.6	42	44.4	33	12.0		
	40	31.8	54	26.6	33	36.0	33	15.2	56	4.8		
	68	9.9	29	38.4	60	14.2	60	7.4				
	68	15.3	68	9.9								
NO. OF SAMPLES	12	12	12	12	11	11	11	11	10	10	3	3
AVERAGE SALINITY	59		53		53		47		51		51	
AVERAGE D. O.		37.2		42.4		42.0		44.4		36.6		32.2
MINIMUM D. O.		9.9		9.9		4.8		7.4		4.8		23.1

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No. Salinity Tests	59	
No. D. O. Analyses	59	
Average Salinity	53	per cent
Average D. O.	40.2	" "
Minimum D. O.	4.8	" "

TABLE 3 (Cont'd)
DISSOLVED OXYGEN TESTS - 1938
SECTION #3
ARTHUR KILL

SAMPLING POINTS	3A		3B		3C		3D	
	Mouth-Rahway River				Off Rossville		Off Boynton Beach	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	55	34.6	58	38.2	66	43.7	66	54.8
	58	41.2	58	43.1	62	51.0	68	66.2
	39	37.8	68	35.0	68	81.2	75	99.9
	39	36.2	65	52.6	68	90.6	47	34.7
	44	40.3	38	42.2	43	41.0	47	32.0
	37	8.5	40	39.7	43	41.7	46	44.7
	60	9.7	39	40.8	48	36.2	68	19.3
			47	38.8	48	37.1		
			37	13.2	40	17.7		
			60	18.2	60	15.2		
			64	19.1	64	30.5		
NUMBER OF TESTS	7	7	11	11	11	11	7	7
AVERAGE SALINITY	47		52		55		60	
AVERAGE D.O.		29.8		34.6		44.2		50.2
MINIMUM D.O.		8.5		13.2		15.2		19.3

S U M M A R Y

No. Salinity Tests	36
No. D.O. Analyses	36
Average Salinity	54. per cent
Average D.O.	39.6 " "
Minimum D.O.	8.5 " "

TABLE 3 (Cont'd)
DISSOLVED OXYGEN TESTS - 1938
SECTION #4
RARITAN BAY - RARITAN RIVER - PRINCESS BAY

SAMPLING POINTS	4A		4B		4C		4D		4E	
	Raritan River		Raritan Bay		Princess Bay		Bell & Light Buoy #5		Light Buoy #7	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	70	41.4	69	124.	69	70.5	73	116.	68	52.6
	70	56.3	70	105.	69	49.0	71	-	60	95.2
	72	53.8	64	-	68	-	73	96.6	64	90.0
	64	104.	64	111.	60	-	60	98.4	57	56.3
	53	47.7	64	79.1	64	115.	68	-	57	52.4
	53	52.4	64	65.9	64	106.	61	102.		
					61	110.	61	95.5		
							57	64.3		
NUMBER OF TESTS	6	6	6	5	7	5	8	6	5	5
AVERAGE SALINITY	64		66		65		66		61	
AVERAGE D. O.		59.3		97.0		90.1		95.5		69.3
MINIMUM D. O.		41.4		65.9		49.0		64.3		52.4

S U M M A R Y

No. Salinity Tests	32	
No. D.O. Analyses	27	
Average Salinity	64	per cent
Average D. O.	81.9	" "
Minimum D. O.	41.4	" "

TABLE 3 (Cont'd)
DISSOLVED OXYGEN TESTS - 1938
SECTION #5
SANDY HOOK BAY - LOWER BAY - SHREWSBURY RIVER

SAMPLING POINTS	5A		5B		5C Off Atlantic Highl'ds Pier		5D Bell & Light Buoy #2		5E		5F	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	76	92.6	76	86.3	76	101.	68	86.8	68	84.6	80	78.6
	76	97.7	76	88.9	72	98.3	72	84.1	68	88.0	80	83.0
	83	107.	79	-	79	87.8	75	94.2	72	84.3	77	99.3
	76	-	79	113.	80	94.0	88	92.7	72	82.2	-	-
	68	80.7	68	89.0	64	87.8	68	85.0	64	85.0	-	-
	-	-	-	-	-	-	64	96.5	-	-	-	-
NO. OF SAMPLES	5	4	5	4	5	5	6	6	5	5	3	3
AVERAGE SALINITY	76		76		74		73		69		79	
AVERAGE D. O.		94.5		94.3		93.8		89.9		84.8		87.0
MINIMUM D. O.		80.7		86.3		87.8		84.1		82.2		78.6

S U M M A R Y

No. Salinity Tests	29	
No. D. O. Analyses	27	
Average Salinity	74	per cent
Average D. O.	90.7	" "
Minimum D. O.	78.6	" "

TABLE 3 (Cont'd)
DISSOLVED OXYGEN TESTS - 1938
SECTION #6
LOWER BAY

SAMPLING POINTS	6A		6B		6C		6D		6E	
	Nun Buoy #2				West Bank Light		Old Orchard Shoal Light		Great Kill Light	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	77	60.0	75	46.2	76	19.6	76	21.6	72	59.7
	73	61.1	75	52.9	74	22.2	74	30.7	75	41.3
	72	77.6	75	50.9	76	26.9	76	22.9	68	91.3
	68	102.	68	89.3	68	76.8	75	21.7	66	30.1
	68	58.5	68	80.8	76	73.7	68	75.5	-	-
	-	-	68	59.7	66	66.3	68	77.0	-	-
	-	-	68	69.0	-	-	63	51.5	-	-
NUMBER OF TESTS	5	5	7	7	6	6	7	7	4	4
AVERAGE SALINITY	72		71		73		71		70	
AVERAGE D. O.		71.8		64.1		47.6		42.9		55.6
MINIMUM D. O.		58.5		46.2		19.6		21.6		30.1

S U M M A R Y

No. Salinity Tests	29	
No. D. O. Analyses	29	
Average Salinity	71	per cent
Average D.O.	55.7	" "
Minimum D.O.	19.6	" "

TABLE 3 (Cont'd)
DISSOLVED OXYGEN TESTS - 1938
SECTION #7
THE NARROWS

SAMPLING POINTS	7A		7B		7C	
	One Fourth West of Ft. Wadsworth		Mid Stream		One Fourth West of Ft. Lafayette	
	S.	D.O.	S.	D.O.	S.	D.O.
	69	54.3	69	58.5	69	53.0
	69	58.2	69	57.8	65	52.3
	65	57.5	65	55.2	65	52.2
	65	55.1	69	58.2	69	53.2
	65	55.2	65	57.8	69	54.2
	65	55.0	69	53.5	65	52.2
	65	53.8	69	56.1	69	53.7
	65	57.6	69	55.3	65	53.5
	63	54.8	66	59.2	66	50.2
	62	55.4	70	52.2	66	45.5
	63	45.4	62	46.2	66	48.1
	48	52.3	48	45.4	56	62.4
	43	43.9	48	35.4	48	39.0
	54	40.5	54	18.4	58	14.3
	52	38.0	54	31.0	58	31.4
	53	43.2	54	38.4	56	32.2
	68	32.5	68	22.3	72	23.2
	76	57.3	76	38.4	76	43.7
	76	59.1	76	49.9	76	41.7
	76	39.7	76	40.3	76	57.5
	76	42.0	76	40.3	76	56.3
NUMBER OF SAMPLES	21	21	21	21	21	21
AVERAGE SALINITY	64		65		66	
AVERAGE D.O.		50.2		46.1		46.1
MINIMUM D. O.		32.5		18.4		14.3

S U M M A R Y

No. Salinity Tests	63	
No. D.O. Analyses	63	
Average Salinity	65	per cent
Average D. O.	47.6	" "
Minimum D.O.	14.3	" "

TABLE 3 (Cont'd)
DISSOLVED OXYGEN TESTS - 1938
SECTION #8
GRAVESEND BAY - ATLANTIC OCEAN AT CONEY ISLAND

SAMPLING POINTS	8A		8B		8C	
	Gravesend Bay		Light & Bell Buoy #12		Off Steeplechase Pier	
	S.	D.O.	S.	D.O.	S.	D.O.
	74	37.8	86	79.5	94	94.5
	78	42.2	86	88.5	90	101.
	70	48.3	78	51.5	90	104.
	70	43.9	82	75.6	90	102.
	72	73.2	80	97.0	90	100.
	60	66.8	68	87.0	84	88.5
	53	27.4	60	89.8	96	75.7
	60	5.7	64	26.6	77	42.7
	81	48.4	60	31.6	62	42.5
	92	23.1	85	69.8	89	95.3
	92	34.5	85	69.2	89	-
	-	-	85	68.2	85	81.4
	-	-	85	65.3	85	72.0
NUMBER OF SAMPLES:	11	11	13	13	13	12
AVERAGE SALINITY	73		77		86	
AVERAGE D.O.		41.0		69.2		83.3
MINIMUM D.O.		5.7		26.6		42.5

S U M M A R Y

No. Salinity Tests	37	
No. D. O. Analyses	36	
Average Salinity	79	per cent
Average D. O.	65.3	" "
Minimum D.O.	5.7	" "

TABLE 3 (Cont'd)
DISSOLVED OXYGEN TESTS - 1938
SECTION #9
JAMAICA BAY

SAMPLING POINTS	9A Entrance to Jamaica Bay		9B Rockaway Bridge		9C Beach Channel		9D Mill Basin		9E Canarsie	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	96	45.4	91	92.5	79	115.	82	-	84	101.
	96	66.4	84	88.8	82	-	87	-	86	-
	96	71.6	79	86.2	-	-	-	-	-	-
	96	77.3	-	-	-	-	-	-	-	-
	92	84.1	-	-	-	-	-	-	-	-
	92	86.0	-	-	-	-	-	-	-	-
	92	86.5	-	-	-	-	-	-	-	-
	92	97.7	-	-	-	-	-	-	-	-
	84	85.5	-	-	-	-	-	-	-	-
	84	81.3	-	-	-	-	-	-	-	-
	92	93.9	-	-	-	-	-	-	-	-
	92	86.0	-	-	-	-	-	-	-	-
	92	90.7	-	-	-	-	-	-	-	-
	84	90.0	-	-	-	-	-	-	-	-
	88	84.6	-	-	-	-	-	-	-	-
	88	84.4	-	-	-	-	-	-	-	-
	88	79.3	-	-	-	-	-	-	-	-
	84	93.6	-	-	-	-	-	-	-	-
	84	80.3	-	-	-	-	-	-	-	-
	84	90.0	-	-	-	-	-	-	-	-
	84	80.5	-	-	-	-	-	-	-	-
	76	71.9	-	-	-	-	-	-	-	-
	76	73.2	-	-	-	-	-	-	-	-
	76	60.0	-	-	-	-	-	-	-	-
	74	71.9	-	-	-	-	-	-	-	-
	74	52.3	-	-	-	-	-	-	-	-
	74	54.3	-	-	-	-	-	-	-	-
	78	57.9	-	-	-	-	-	-	-	-
	74	59.5	-	-	-	-	-	-	-	-
	99	87.3	-	-	-	-	-	-	-	-
	85	102.	-	-	-	-	-	-	-	-
	85	101.	-	-	-	-	-	-	-	-
NO. OF TESTS:	32	32	3	3	2	1	2	0	2	1
AV. SALINITY:	86		85:		81:		85:		85:	
AV. D. O.		79.0		89.2		-		-		-
MIN. D. O.		45.4		86.2	*	115.		-	*	101.

S U M M A R Y

No. Salinity Tests	41	
No. D. O. Analyses	37	
Average Salinity	86	per cent
Average D.O.	81.3	" "
Minimum D.O.	45.4	" "

* Single Sample

TABLE 3 (Cont'd)
DISSOLVED OXYGEN TESTS - 1938
SECTION #10
HEMPSTEAD BAY

SAMPLING POINTS	10A		10B		10C		10D	
	East Rockaway Inlet		Long Beach R.R. Bridge		Jones Inlet			
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	100	-	100	112.	99	-	101	-
	98	124.	92	102.	94	118.	100	-
	-	-	96	112.	94	118.	-	-
NO. OF SAMPLES	2	1	3	3	3	2	2	0
AVERAGE SALINITY	99		96		96		101	
AVERAGE D. O.		-		109.		118.		-
MINIMUM D. O.		*124.		102.		118.		-

S U M M A R Y

No. Salinity Tests	10	
No. D. O. Analyses	6	
Average Salinity	97.	per cent
Average D. O.	114.	" "
Minimum D. O.	102.	" "

* Single Sample

TABLE 3 (Cont'd)
DISSOLVED OXYGEN TESTS - 1938
SECTION #11
GREAT SOUTH BAY

SAMPLING POINTS	11A		11B Entrance to Santapogue River		11C Mouth of Carll River		11D Fire Island Inlet		11E Great Cove	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	83	103.	-	-	-	-	91	125.	-	-
	96	100.	-	-	-	-	91	-	-	-
NO. OF TESTS:	2	2	0	0	0	0	2	1	0	0
AV. SALINITY:	90		-		-		91		-	
AV. D. O.		102.		-		-		-		-
MIN. D. O.		100.		-		-		* 125.		-

S U M M A R Y

No. Salinity Tests	4	
No. D. O. Analyses	3	
Average Salinity	91.	per cent
Average D. O.	109.	" "
Minimum D. O.	100.	" "

* Single Sample

TABLE 3 (Cont'd)
DISSOLVED OXYGEN TESTS - 1938
SECTION #12
LOWER EAST RIVER

SAMPLING POINTS	12A		12B		12C		12D		12E		12F	
	Pier 8 Brooklyn		23rd St. East River		Center Newtown Creek		East River 42nd St.		Hell Gate E. Wards Island		E. 106th St. Harlem River	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	63	34.8	67	23.1	67	8.9	72	13.9	76	20.3	68	21.4
	63	43.6	67	34.8	64	26.4	66	38.7	67	25.2	70	20.8
	66	38.3	66	33.3	66	23.0	66	25.6	74	17.0	80	17.1
	66	38.3	65	39.4	66	21.8	66	25.6	74	15.0	78	17.8
	68	36.1	67	33.8	60	10.9	67	23.4	68	30.3	76	15.1
	66	39.1	67	35.0	63	9.1	64	24.6	69	33.9	74	13.1
	59	24.7	63	14.3	64	3.9	67	20.2	79	29.3	72	20.0
	48	45.3	60	16.6	63	14.4	68	14.6	75	27.8	68	20.0
	52	42.0	56	15.0	72	27.2	68	6.1	76	10.5	72	6.5
	68	8.0	72	12.8	-	-	68	9.8	72	2.6	-	-
NO. OF SAMPLES	10	10	10	10	9	9	10	10	10	10	9	9
AV. SAL.	62		65		65		67		73		73	
AV. D.O.		35.0		25.8		16.2		20.3		21.2		16.9
MIN.D.O.		8.0		12.8		3.9		6.1		2.6		6.5

S U M M A R Y

No. Salinity Tests	58	
No. D. O. Analyses	58	
Average Salinity	67	per cent
Average D. O.	22.8	" "
Minimum D. O.	2.6	" "

TABLE 3 CONT'D.
DISSOLVED OXYGEN TESTS - 1938
SECTION #13
HARLEM RIVER

SAMPLING POINTS	13A		13B		13C		13D	
	Mid Stream N.of Willis Ave. Bridge		Mid Stream N.of 155th St. Bridge		Mid Stream Opposite Cons. Ship Yard		100 Yd. E. Spuyten Duyvil	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	8	87.5	4	92.0	2	96.2	36	40.4
	5	85.9	4	92.9	2	93.5	27	51.6
	19	78.0	3	94.2	4	87.7	33	24.2
	41	78.8	7	89.3	31	65.0	33	39.0
	43	61.9	27	69.3	67	33.2	21	47.5
	47	59.8	31	65.7	67	34.8	-	-
	51	65.7	37	66.0	71	32.6	-	-
	71	30.8	39	66.8	32	61.4	-	-
	71	29.2	75	19.2	72	65.6	-	-
	75	17.0	71	42.8	61	13.9	-	-
	55	44.4	75	16.4	58	20.9	-	-
	51	46.5	71	44.2	48	14.6	-	-
	70	11.9	71	33.8	-	-	-	-
	68	11.8	75	24.4	-	-	-	-
	60	12.8	33	62.5	-	-	-	-
	-	-	36	58.6	-	-	-	-
	-	-	66	10.6	-	-	-	-
	-	-	59	13.0	-	-	-	-
	-	-	51	12.1	-	-	-	-
NO. OF SAMPLES	15	15	19	19	12	12	5	5
AVERAGE SALINITY	49		44		43		30	
AVERAGE D.O.		48.1		51.2		51.6		40.5
MINIMUM D. O.		11.8		10.6		13.9		24.2

S U M M A R Y

No. Salinity Tests	51	
No. D. O. Analyses	51	
Average Salinity	44.	per cent
Average D. O.	49.4	per cent
Minimum D. O.	10.6	per cent

TABLE B CONT'D.
DISSOLVED OXYGEN TESTS - 1938
SECTION #14
LOWER HUDSON RIVER

SAMPLING POINTS	14A		14B		14C		14D	
	Pier "A" Hudson River		West 42nd St. Hudson River		West 155th St. Hudson River		Spuyten Duyvil Hudson River	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	25	87.5	17	94.7	10	37.4	3	92.5
	67	47.5	56	35.4	48	36.8	35	52.4
	63	40.2	72	41.8	33	64.5	15	97.0
	32	80.5	43	46.2	16	90.2	14	94.5
	20	59.0	48	54.9	8	56.9	12	110.
	-	-	12	78.6	-	-	-	-
	-	-	12	74.7	-	-	-	-
NO. OF SAMPLES	5	5	7	7	5	5	5	5
AVERAGE SALINITY	41		37		23		16	
AVERAGE D. O.		62.9		60.9		57.1		89.3
MINIMUM D. O.		40.2		35.4		36.8		52.4

S U M M A R Y

No. Salinity Tests	22	
No. D. O. Analyses	22	
Average Salinity	30	per cent
Average D. O.	67.0	" "
Minimum D. O.	35.4	" "

TABLE 3 CONT'D.
DISSOLVED OXYGEN TESTS - 1938
SECTION #15
HUDSON RIVER

(Traversing at right angles to center line of river at five equally spaced points North of Mt. St. Vincent at New York City-Yonkers Boundary Line.)

SAMPLING POINTS	15A		15B		15C		15D		15E	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	32	80.9	36	66.5	12	91.0	32	65.5	32	69.5
	32	48.2	35	58.0	18	95.0	36	69.1	32	54.5
	32	55.5	32	59.1	12	109.	36	73.7	30	65.6
	32	66.1	32	68.0	35	59.0	32	53.1	32	65.5
	32	75.7	32	74.7	36	67.2	32	67.0	32	77.9
	33	61.5	32	61.6	36	60.8	32	74.5	28	81.0
	32	79.1	32	73.6	32	65.8	32	87.5	32	75.5
	28	76.0	28	84.8	32	61.4	32	78.1	30	88.0
	33	84.1	32	86.5	33	60.6	32	85.8	28	82.4
	28	85.9	20	96.5	32	87.8	29	84.5	30	89.2
	28	94.9	25	92.5	33	78.8	25	89.6	24	86.7
	25	82.7	25	86.5	33	75.6	21	86.2	21	84.2
	25	85.8	25	67.3	29	82.0	21	80.5	17	86.3
	17	81.7	21	78.2	20	88.5	21	82.1	16	85.4
	17	79.5	20	76.5	30	90.5	16	80.9	20	81.0
	21	81.5	16	78.8	21	85.4	16	83.2	20	81.0
	16	80.0	21	78.9	21	82.0	16	78.0	20	76.4
	20	81.0	16	83.0	17	81.1	20	79.8	24	82.4
	20	82.2	20	82.7	20	77.6	21	79.9	16	75.4
	16	78.8	16	71.0	16	80.5	17	76.2	20	76.3
	17	84.0	16	84.0	24	79.0	-	-	-	-
	-	-	-	-	20	76.5	-	-	-	-
	-	-	-	-	24	79.7	-	-	-	-
	-	-	-	-	16	77.7	-	-	-	-
NO. OF SAMPLES	21	21	21	21	24	24	20	20	20	20
AVERAGE SALINITY	26		25		25		26		25	
AVERAGE D. O.		77.4		76.6		78.9		77.7		78.2
MINIMUM D. O.		48.2		58.0		59.0		53.1		54.5

S U M M A R Y

No. Salinity Tests	106	
No. D. O. Analyses	106	
Average Salinity	25	per cent
Average D. O.	77.8	" "
Minimum D. O.	48.2	" "

TABLE 3 CONT'D.
DISSOLVED OXYGEN TESTS - 1938
SECTION #16
HUDSON RIVER

(Traversing at right angles to center line of river at five equally spaced points from the New York-New Jersey State Boundary Line.)

SAMPLING POINTS	16A		16B		16C		16D		16E	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	17	89.2	14	83.5	12	87.0	12	98.2	12	94.7
	17	81.7	12	86.0	17	85.0	12	88.4	12	94.5
	17	85.3	12	82.5	17	88.9	15	93.5	12	93.8
	17	89.0	15	85.7	12	89.5	17	98.0	12	95.0
	12	86.1	17	88.8	12	91.8	12	95.2	12	88.5
	14	90.4	12	84.8	16	88.3	15	97.0	12	91.6
	17	92.2	15	86.4	12	92.2	10	99.9	10	100.
	17	93.9	15	89.3	12	84.7	14	90.6	12	93.0
	17	89.8	15	91.9	12	92.7	12	95.0	16	95.0
	12	95.3	17	90.0	15	96.8	16	96.7	-	-
NO. OF SAMPLES	10	10	10	10	10	10	10	10	9	9
AVERAGE SALINITY	16		14		14		14		12	
AVERAGE D.O.		89.3		86.9		89.7		95.3		94.0
MINIMUM D. O.		81.7		82.5		84.7		88.4		83.5

S U M M A R Y

No. Salinity Tests	49	
No. D. O. Analyses	49	
Average Salinity	14	per cent
Average D. O.	91.0	" "
Minimum D. O.	81.7	" "

TABLE 3 CONT'D.
DISSOLVED OXYGEN TESTS - 1938
SECTION #17
HUDSON RIVER - VERPLANCK - POINTS A to E
HUDSON RIVER - BEAR MT. BRIDGE - POINTS F to J

SAMPLING POINTS	17A		17B		17C		17D		17E	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	4	95.4	4	97.0	4	98.8	4	95.1	4	96.1
	2	95.6	2	94.8	2	96.0	2	94.8	2	92.4
	1	93.5	1	92.0	2	90.2	1	93.9	1	93.6
	8	88.6	8	87.5	8	90.5	8	91.8	8	92.4
	8	89.7	8	89.0	8	85.4	8	93.5	8	95.8
NO. OF SAMPLES	5	5	5	5	5	5	5	5	5	5
AVERAGE SALINITY	5		5		5		5		5	
AVERAGE D. O.		92.5		92.0		92.1		93.8		94.0
MINIMUM D. O.		88.6		87.5		85.4		91.8		92.4

SAMPLING POINTS	17F		17G		17H		17I		17J	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	2	92.6	1	90.2	1	91.0	1	90.5	1	91.5
	2	96.0	1	93.6	1	92.5	1	92.4	1	90.0
	2	90.5	1	89.9	1	92.4	1	91.5	1	93.8
	8	84.0	8	85.4	8	88.7	8	85.1	8	88.6
NO. OF SAMPLES	4	4	4	4	4	4	4	4	4	4
AVERAGE SALINITY	4		3		3		3		3	
AVERAGE D. O.		90.7		89.7		91.1		89.8		90.9
MINIMUM D. O.		84.0		85.4		88.7		85.1		88.6

S U M M A R Y

No. Salinity Tests	45	
No. D. O. Analyses	45	
Average Salinity	4.	per cent
Average D. O.	91.9	per cent
Minimum D. O.	84.0	per cent

TABLE 3 CONT'D.
DISSOLVED OXYGEN TESTS - 1938
SECTION #18
EAST RIVER - LONG ISLAND SOUND

SAMPLING POINTS	18A		18B		18C		18D		18E	
	E. River: North Channel		East River		East River		E. River Throgg's Neck		Long Island Sound	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	47	58.0	53	53.8	61	63.5	65	68.4	65	68.7
	43	59.3	55	63.8	61	61.5	63	73.1	65	93.9
	45	64.2	47	62.0	66	67.9	72	86.6	72	82.3
	82	27.1	77	45.5	83	47.5	84	60.6	82	92.5
	77	21.0	76	28.0	79	31.9	79	62.1	84	121.
	73	17.1	82	24.6	83	36.1	83	90.5	84	118.
	75	22.4	81	26.5	81	38.4	84	69.4	-	-
NO. OF SAMPLES	7	7	7	7	7	7	7	7	6	6
AVERAGE SALINITY	63		67		73		76		75	
AVERAGE D. O.		38.4		43.4		49.5		72.9		96.6
MINIMUM D. O.		17.1		24.6		31.9		60.6		68.7

S U M M A R Y

No. Salinity Tests	34	
No. D. O. Analyses	34	
Average Salinity	71	per cent
Average D. O.	59.0	" "
Minimum D. O.	17.1	" "

TABLE 3 CONT'D.
DISSOLVED OXYGEN TESTS - 1938
SECTION #19
LONG ISLAND SOUND

SAMPLING POINTS	19A		19B		19C		19D		19E	
	Off Hewlett Pt. - Can Buoy #29		Can Buoy #3		Off Prospect Pt. B. B. #23		Off Mott Pt. Bell Buoy #4		Off Matinicock Pt.-Bell & Light Buoy	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	82	94.3	83	90.2	81	-	78	-	85	70.0
	82	104.	84	107.	82	67.8	83	-	84	46.0
	82	104.	81	111.	78	-	78	-	84	43.8
	79	99.0	81	108.	82	-	84	112.	84	92.2
	78	97.5	81	109.	83	-	80	111.	84	110.
NO. OF SAMPLES	5	5	5	5	5	1	5	2	5	5
AVERAGE SALINITY	81		82		81		81		84	
AVERAGE D. O.		99.8		105.		-		112.		72.4
MINIMUM D. O.		94.3		90.2		*67.8		111.		43.8

S U M M A R Y

No. Salinity Tests	25	
No. D. O. Analyses	18	
Average Salinity	82	per cent
Average D. O.	93.2	" "
Minimum D. O.	43.8	" "

* Single Sample

TABLE 3 CONT'D.
DISSOLVED OXYGEN TESTS - 1938
SECTION #20
LONG ISLAND SOUND

SAMPLING POINTS	20A		20B		20C		20D		20E	
	Off Oak Neck Pt. Can Buoy #19		Off Sea-wanhaka Nun Buoy #2A		Off Lloyd Pt. Light & Bell Buoy #15		Off East Fort Pt. Nun Buoy #8		Off Eaton's Pt. Can Buoy #13	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	82	-	81	-	84	123.	83	115.	84	121.
	-	-	82	-	82	-	82	-	82	-
	87	116.	88	118.	-	-	83	95.5	-	-
	87	-	86	114.	86	79.4	-	-	-	-
	-	-	91	59.5	84	118.	-	-	-	-
NO. OF SAMPLES	3	1	5	3	4	3	3	2	2	1
AVERAGE SALINITY	85		86		84		82		83	
AVERAGE D. O.		-		97.1		107.		105.		-
MINIMUM D. O.		* 116.		59.5		79.4		95.5		* 121.

S U M M A R Y

No. Salinity Tests	17	
No. D. O. Analyses	10	
Average Salinity	85	per cent
Average D. O.	106.	" "
Minimum D. O.	59.5	" "

* Single Sample

TABLE 3 CONT'D.
DISSOLVED OXYGEN TESTS - 1938
SECTION #21
LONG ISLAND SOUND

SAMPLING POINTS	21A		21B		21C		21D		21E	
	Smithtown Bay		Off Oldfield Pt. Gong Buoy #11A		Entrance Port Jefferson Harbor		Port Jefferson Harbor - Light & Bell Buoy #2		Entrance Setauket Harbor	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	84	122.	82	-	83	121.	80	-	81	110.
	82	-	82	123.	80	-	80	-	80	123.
	82	-	82	124.	80	-	84	66.0	88	61.2
	84	78.9	84	121.	80	-	86	58.7	88	114.
	87	67.0	87	90.8	84	103.	-	-	-	-
	-	-	-	-	86	108.	-	-	-	-
NO. OF SAMPLES	5	3	5	4	6	3	4	2	4	4
AVERAGE SALINITY	84		83		82		83		84	
AVERAGE D. O.		89.3		115.		111.		62.4		102.
MINIMUM D. O.		67.0		90.8		103.		58.7		61.2

S U M M A R Y

No. Salinity Tests	24	
No. D. O. Analyses	16	
Average Salinity	83	per cent
Average D. O.	99.5	" "
Minimum D. O.	58.7	" "

TABLE 3 CONT'D.6
DISSOLVED OXYGEN TESTS - 1938
SECTION #22
LONG ISLAND SOUND

SAMPLING POINTS	22A		22B		22C		22D		22E	
	Channel into Pelham Bay		Execution Rock Light		Nun Buoy #4		Mamaroneck Harbor		Light Buoy Byram Point	
	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.	S.	D.O.
	69	22.0	71	55.5	73	38.3	80	64.8	76	31.6
	80	95.0	83	97.0	87	84.8	88	116.	88	121.
	78	110.	82	111.	78	113.	78	87.0	86	81.0
	80	120.	82	114.	81	106.	82	71.4	86	94.3
	80	113.	82	115.	85	108.	79	74.3	83	104.
NO. OF SAMPLES	5	5	5	5	5	5	5	5	5	5
AVERAGE SALINITY	77		80		81		82		84	
AVERAGE D.O.		92.0		98.5		90.0		82.7		86.4
MINIMUM D.O.		22.0		55.5		38.3		64.8		31.6

S U M M A R Y

No. Salinity Tests	25	
No. D. O. Analyses	25	
Average Salinity	81	per cent
Average D. O.	89.9	" "
Minimum D. O.	22.0	" "

DESCRIPTION OF A WATER SAMPLE COLLECTOR.- The device described below was used by the Water Pollution Survey, of the U.S. Works Progress Administration, for the collection of samples of water for the determination of the dissolved oxygen content. This work was done for the Interstate Sanitation Commission, which is the Sponsor of this Project.

The work was performed in the various parts of the Interstate Sanitation District, which includes the Hudson River from Peekskill to the Upper New York Harbor, the Lower New York Harbor, Raritan Bay, Arthur Kill, Newark Bay, Kill van Kull, the East River, the Harlem River, and the waters along the North Shore of Long Island as far east as Port Jefferson, and on the South Shore of Long Island to Babylon.

It was found that the description of the apparatus given in the Standard Methods of the American Public Health Association was not in sufficient detail so that the apparatus could be readily assembled. For this reason it was thought that a complete description of the apparatus might be of value to other people who desire to collect samples of water from various depths below the surface, and particularly samples for the determination of the dissolved oxygen.

Upon test it was found that the volume of the air in the sampler with a 125 ml. bottle in place was 1,680 ml. and with a 300 ml. bottle in place was 1,400 ml. Therefore, the requirements of the standard methods for a three-fold displacement of the volume of the sample are amply met with this device. The time required to fill the sampler under a head of approximately two inches was found to be one minute and twenty seconds.

For the purpose of obtaining the temperature of the water a standard thermometer was used. This had an engraved stem from minus 10 degrees Centigrade to plus 110 Centigrade, calibrated for total immersion. Its approximate length was 17-1/2 centimeters. This type of thermometer was selected so that it would be completely within the container and there would be much less likelihood of breakage than when the thermometer projected from the sampling equipment.

Two samplers were in constant use during the summer on separate boats, and functioned very satisfactorily. The only difficulty encountered was due to the fact that in a swiftly-running current on several occasions the sampling device was given a rotating motion, which twisted the trip cord with the lift cord. This was not a serious difficulty as the trip cord was strong enough to be used for lifting the apparatus, and by slacking away on the lift cord the trip cord could be satisfactorily used.

Efforts were made to purchase a similar device from laboratory supply houses, but we were unsuccessful in this endeavor. The apparatus was, therefore, carefully designed and its manufacture was given out to contract. The cost of the samplers averaged $35 each. The specifications for the fabrication of the sample collector will be found in Appendix B, pages 1 to 5.

SPECIFICATIONS COVERING WATER SAMPLER FOR DISSOLVED OXYGEN TESTS

INTENT (1) This specification describes a Water Sampler for the determination of dissolved oxygen.

KIND (2) The Water Sampler is of all metal; in cylinder form; with sealed bottom; a removable clamped on head to which is attached a manually operated service cock for inflow of water with an inner extension for a rubber tube connection; a pipe vent tube for air escape when sampler is filling; angle ears furnishing means for connection of bail and also means for clamping down the head with wing nut bolts which are attached to the ears on sides of cylinder body.

The inside of sampler contains a fixed holder for thermometer and a removable spring member for holding the sampling bottle. The inside of head is fitted with a retained rubber sealing gasket.

SIZE (3) The Water Sampler is to have an inside diameter of 4 inches; an inside depth of approximately 9-1/4 inches.

MATERIAL (4) The Water Sampler shall be constructed of the following materials:

Base and Head of standard 4-inch malleable iron pipe caps.
Body of standard 4-inch wrought iron pipe.
Vent of standard 1/4-inch wrought iron pipe and els.
Ears on body and head, of wrought iron or steel.
Bail of steel wire.
Clamping Bolts of bronze or brass.
Intake service cock of bronze.
Spring of phosphor spring bronze.

DETAIL MANUFACTURE

BASE (5) The base shall be a standard 4-inch malleable iron pipe cap, approximately 4-inches diameter. Cap shall be machined only on the bottom.

BODY (6) (a) The body shall be of standard 4-inch wrot. iron pipe with thread connection to base; the upper end to be machined smooth for a gasket fitting and to give an inside depth of approximately 9-1/4 inches when base is screwed home tight.
NOTE: The use of a 12-inch nipple is most economical for the body.

(b) The thermometer holder shall be a 3/8 inch iron pipe 7 inches long with at least six (6)-1/8 inch holes equally spaced throughout its length: the pipe is to be firmly held to one side of body with clamps, secured by rivets through clamps and body, the rivets upset in countersunk holes and finished smooth or spot welded. The ends of the thermometer holder are to be 1-1/2 inches below top and 1/2 inch from bottom, respectively, of body of receptacle.

(c) A retaining hoop of 1/8" x 1/2" band shall be riveted or welded along the inner circumference of the body, approximately 2 inches from the top, to prevent the spring element from lifting out with sampling bottle. The ends of the hoop shall nearly meet the thermometer holder.

(d) Two ears shall be secured to opposite sides of body for connection of clamping bolts. The ears shall be thoroughly welded around or fastened with two (2) 3/16 inch round head rivets from inside, upset in countersunk holes and finished smooth. The ears shall be of channel shape, 1" x 1" x 1/8" wall, approximately 1 inch long, with lower part of extensions cut back or rounded.

(e) Clamping bolts shall be not less than 5/16" diameter by 3-1/4 inches long, with wing nuts, both to be of brass or bronze. Head end of bolts - with heads removed - secured in ears by 5/32" steel pin bearing with spacers to keep bolt central; the pin bearing of bolts shall be approximately 2 inches from top of body: the thread end of bolts shall be upset to prevent loss of wing nuts.

HEAD (7) (a) The head shall be a standard 4-inch malleable iron pipe cap, machined to an inside diameter of approximately 4-9/16 inches, to provide an easy fit over top of body; an cut-

HEAD (7) (a) (Continued)

side diameter of 5 inches; an inside depth of 3/4 inch at flange with inner head surface machined 1/4 inch for gasket contact at clamping point.

(b) The upper surface of head shall be step-face machined. The center area shall be approximately 1-3/4 inches diameter; the outer area shall extend 1 inch inward from rim, leaving the edge rounding, and giving 7/8 inch width of flat surface for ear attachments. The cap, at center, shall be drilled and tapped for a tight fitting 3/8" brass pipe nipple; also drilled and tapped approximately 1 inch from outer rim, 1/2 inch off center between bail ears, for 1/4 inch vent pipe thread.

(c) Air vent shall be 1/4 inch iron pipe nipple, 3 inches long, topped with a 90° street el., and a 90° straight el., turned so as to give vent opening on underside of assembly; the flange of the straight el. to be cut off horizontally, raising the opening to the line of its inside angle. Air vent opening shall be at a higher point than top opening of inlet cock.

(d) Ears for bail with extensions for engagement of clamping bolts shall be 3/4 inches wide, cut from 1-1/2" x 1-1/2 x 1/8" angle iron. The upright flange shall be drilled to receive the bail. The horizontal flange shall extend over the rim of cap 1/2 inch, with the end slotted to receive the clamping bolt. The tips of the horizontal angle shall be swaged upward, to keep wing nut from sliding off. The ears shall be secured by two 3/16" R.H. iron rivets, extending through from top, and upset in countersunk holes on underside of head and finished smooth.

(e) The bail shall be of not less than 3/16" steel wire with height approximately 4-1/2 inches and 1/2 inch eye loop formed at top center for rope attachment.

HEAD (7) (Continued)

(f) The Intake valve shall be a 3/8" bronze service cock with lever approximately 2-1/2 inches long. The lever shall be bent, to drop the end 1/2 inch below center when valve is closed. A 1/8 inch hole shall be drilled through its width, at end, for trip cord. The service cock shall be connected to the head by a 3/8 inch brass pipe nipple with tight fitting threads. The service cock shall fit tightly against the head. The nipple shall project inside the head approximately 1/2 inch. The connection for rubber tubing shall be a 3/8 inch O.D. brass tube 1 inch long, 1/32 inch wall, with one-half of its length a force fit into the nipple and the outer corner of lower end rounded to receive tubing.

(g) The Gasket on inside of cap shall be 1/8 inch gasket rubber. It shall be pierced for nipple and vent. It shall be held by galvanized steel disc washer 3 inches diameter by 1/32 inch thick; the latter shall be secured by hexagon brass nut turned tight on nipple.

SPRING HOLDER (8) (a) Spring Element for inside of sampler to hold the sampling bottle shall consist of two strips of spring phosphor bronze 3/4 inch wide, 0.015 inch thick, approximately 18 inches long. They shall be formed in rectangular U shapes having a base width of 3-1/2 inches, and the uprights corrugated or fluted crosswise, the outer contours of which shall be practically perpendicular to the base: the depth and width of corrugations shall be determined by the size of the sampling bottle to be used: the ends of spring members shall be inclined outward to contact the walls of Sampler: the two spring members shall be joined at right angles, central to their base, by copper rivets.

(b) A rectangular U base to support the spring element shall be made of 3/4" by 1/16" brass This U support shall be 2" wide; 2" high; with outward horizontal terminals extending the width of, and fastened to the base of one of the spring elements with copper rivets.

With the spring unit in the Sampler, the result required is an easy insertion and erect posture of bottle with tension of spring against bottle

SPRING HOLDER (8) (b) (Continued)

and Sampler walls; at least two points of the corrugations shall contact the sides of bottle.

MATERIALS AND WORKMANSHIP (9) All material used shall be new and of good quality. All construction operations shall be done in workmanlike manner.

FINISH (10) The completely assembled sampler, less all bronze and brass parts and gasket, shall be thoroughly hot dipped galvanized, inside and out. The thread in center of head shall be cleaned with tap after galvanizing, before assembly of service lock.

TIE CHAIN(11) The head of sampler shall be secured to the body by a chain, about 2" in length, and with a tension strength of 100 lbs. It shall be rust proofed and riveted midway between the clamping features, with sufficient slack to permit ease in placement of top.

NOTE 1. A blue print of 5/16/1938, U. S. Works Progress Administration, Water Pollution Survey, entitled "Water Sampler," covers the design and construction practically as described in this specification. (See Plate No.2)

Modifications of material used in the main structure were adopted for the purpose of lessening the cost in manufacture. Its increase in weight over material called for in blue print makes the use of lead disc weights in the bottom, and also their retaining features unnecessary. It was also found desirable to use no washers under the wing nuts

The addition of "Tie Chain" is suggested to prevent loss of lower element when in use.

NOTE 2. A disc of 1/8 inch thick gasket rubber shall be placed in the bottom of sampler, full diameter, as a cushion to protect thermometer bulb.