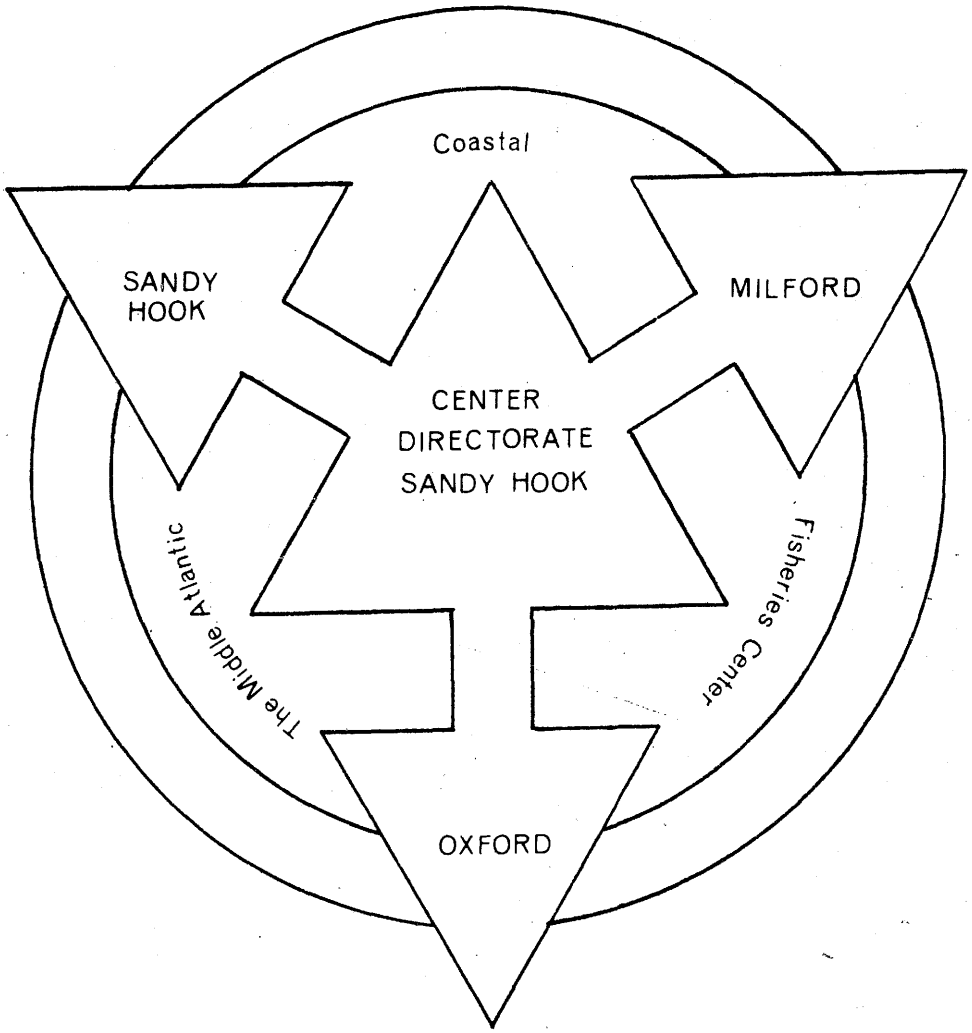
AN ENVIRONMENTAL SURVEY OF EFFECTS OF DREDGING AND SPOIL DISPOSAL, NEW LONDON, CONNECTICUT: 3RD QUARTERLY REPORT

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



Informal Report No. 62

5 May 1975

AN ENVIRONMENTAL SURVEY OF EFFECTS OF DREDGING AND SPOIL DISPOSAL, NEW LONDON, CONNECTICUT: 3rd QUARTERLY REPORT

Submitted by

Ecosystems Investigations
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U. S. Department of Commerce
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to

U. S. Navy, Northern Division, Naval Facilities Engineering Command

U. S. Army, Corps of Engineers

Interagency Scientific Advisory Subcommittee on
Ocean Dredging and Spoiling

5 May 1975

FOREWARD

This report deals with the third three-month period of studies monitoring effects of dredging in the Thames River and spoil disposal at the New London Dumping Ground. Activities and findings of the principal contractor, the Middle Atlantic Coastal Fisheries Center (MACFC), National Marine Fisheries Service, are discussed in detail. All subcontractors' quarterly reports were received by MACFC by 18 April 1975. These documents are summarized in the body of the report, and included as appendices thereto.

Overall goals, schedules and methodologies for the monitoring survey are contained in MACFC Informal Report No. 25-A, "A Proposal for an Environmental Survey of Dredging and Spoil Disposal in the Thames River and New London Dumping Ground" (21 May 1974), and will not be repeated in the quarterly reports. Changes or additions will be described in the pertinent quarterly report but not in subsequent reports.

A tentative schedule for all field activities of the monitoring program was included in the second quarterly report. A summary of the pertinent facts and figures concerning the dredging-disposal operation itself is now being prepared, and will be distributed with the next quarterly report or earlier. Readers should consider this information in analysing the results presented in the quarterly and final reports; survey personnel may wish to consult the schedule in planning further studies. All parties to the operations are again reminded that the stipulation to immediately report any observed violations of the dumping criteria or other impacts judged significant is in effect and an extremely important component of the monitoring and research program.

Reproduction or use of data from these reports must first be approved through MACFC (and through subcontractors if applicable). The following errata have been pointed out in the second quarterly report:

Figures 1 - 3: Dates in legend should read 1974, not 1973.

Figure 3 of Appendix B has been mistakenly inserted between pages 37 and 39 of Appendix D; and Figure 13 of Appendix D between pages 16 and 17 of Appendix B. The sediment phosphorus values reported in Table 4, Appendix D, 2nd Quarterly Report, were suspect. Samples were reanalysed, and revised results are presented at the end of Appendix D of this report.

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APPENDICES:

A. Suspended Material Transport in the Thames River

B. Effects of Dredging in the Thames River on Shellfish Resources and Phytoplankton; Lobster Monitoring and Related Dump Site SCUBA Studies.

C. Physical Oceanography of Dump Site Area

D. Chemical Oceanography of Dump Site Area

E. Demersal Fish Distribution and Abundance

F. Bacteriology

I. UNIVERSITY OF CONNECTICUT SUBTASKS

A. Suspended Material Transport in the Thames River (Appendix A).

Cruises in January and March yielded additional data contributing to the characterization of hydrography and suspended material concentrations in the lower Thames. Results were also reported from a high-resolution survey of dredging effects conducted 29 November 1974. Typical material concentratons for the lower river were found to be ca. 5 mg/l. Grain size distributions remote from the dredging were fairly uniform. The distributions were bimodal, peaking near one to two and ten microns. Particulate organic carbon concentrations averaged 1 mg/l.

The dredging operation had significant impacts on the suspended material characteristics; as in a prior survey, perturbations continued to be limited to within 150m of dredging. Here maximum suspended material concentrations were over 150mg/l, and particulate organic carbon increased to 4 mg/l. The particle distribution became uni-modal with a peak at approximately ten microns - thus the selective removal of fine particles in the dredging area was again documented. Work is near completion on a study of wind effects on suspended materials, and on selection of the optimum hydraulic model for the river's transport characteristics.

In the study of geofungi as possible tracers of suspended sediment movement, analysis was begun on water samples taken in January, February and March 1975. The latter two sampling periods included the dump site area. Identification was completed for fungi collected in November and December 1974. To date overall fungal densities have not correlated

strongly to suspended sediment concentrations or to proximity to dredging.

B. Effects of Dredging in the Thames River on Shellfish Resources and Phytoplankton (Appendix B).

Water samples were taken from six river transects on 2 February 1975 to measure concentrations of six heavy metals. Analyses are complete for the mercury samples; Hg concentrations showed a substantial drop from the July and November 1974 values described in the prior quarterly report. Analysis of Cd, Cr, Cu, Ni and Zn from water samples taken on all cruises had been delayed due to instrument failure, but is now in progress.

Samples of oysters, hard clams and *Pitar* were collected from the Thames River on 1 - 3 March 1975 for inspection of any gross pathology (none was found); and for the continuing analysis of concentration changes in five heavy metals with time and with location in the river. No substantial changes in heavy metals concentrations were detected between samples taken in July 1974, November 1974 and March 1975, although oysters had lower zinc and copper concentrations in the latter two samplings. The only consistent changes in metals values with position in the river were found in the hard clams - copper concentrations increased and nickel decreased upriver. Cu and Zn were much higher in oysters than in hard clams or *Pitar*. Between-species differences were small for the other metals.

C. Lobster Monitoring and Related Dump Site SCUBA Studies (Appendix B).

A dump site dive was made on 7 March 1975. *In situ* observations revealed little newly-dumped material. Considerable burrowing activity by lobsters and rock crabs, and colonization by infauna, was noted in the spoils. No unusual conditions were recorded during the SCUBA observations. Preparations have been made for sonic tracking of disposal area lobsters during the next quarter.

II. NEW YORK OCEAN SCIENCE LABORATORY SUBTASKS

A. Physical Oceanography of Dump Site Area (Appendix C).

The dump site was occupied on 28 February and 6 March 1975 for measurement of physical and chemical characteristics of the water column as affected by single disposal events. On 28 February no barge appeared, so only "background" measurements could be obtained. On 6 March surface and bottom drogues were used to follow the plume of a bargeload of released spoils.

Temperature, salinity and density data from both cruises revealed the water column to be fairly stable; the monitored dump did not appreciably affect these parameters. On both dates the increase in near-bottom turbidity, as measured by beam transmittance and attenuation, indicated some scouring of sediments was taking place. Immediately after the dump, light transmittance at the bottom drogue was roughly halved. Transmittance returned to ambient within ten minutes, however. Transmittance at the surface drogue was relatively constant before, during and after the dump.

Data on current directions, speeds and durations are also presented. Maximum speeds measured were 100 cm/sec in surface waters, and 61 cm/sec at the bottom, both during the February survey. Returns to date from a surface and bottom drifter study have found most of the bottom drifters to be recovered from the Connecticut coast west of New London.

B. Chemical Oceanography of Dump Site Area (Appendix D).

Cruises corresponded to those described above for the Physical Oceanography section, and a joint survey was also conducted with the Sandy Hook Laboratory in January to collect sediments and benthic fauna for chemical analysis. In agreement with the light transmittance studies described above, the water column recovered very quickly from the effects of the 8 March monitored dump. Bottom dissolved oxygen decreased from 80 to 54 percent saturation immediately after the dump, but had returned to ambient within ten minutes. This recovery was faster by a factor of at least four than that found in previous experiments (see 2nd Quarterly Report). Suspended and volatile solids increased, dramatically so in bottom waters, after the dump, but returned to background values within 33 minutes. No significant changes in water column pH or Eh were detected.

Concentrations of nitrogen and phosphorus in seston, reported for August, September and December, show no clear trends over time. Trace metals levels in benthic organisms similarly had no discernable pattern between July and October 1974 and January 1975. Analyses still in progress include sediment nitrogen, phosphorus and chemical oxygen demand, and total organic carbon of water samples. More data will also be forthcoming on the winter seston and benthic organism collections.

C. Demersal Fish Distribution and Abundance (Appendix E)

Fifteen - minute otter trawl tows were made at nine stations, with triplicate tows at two of the stations and duplicate tows at a third, on

18 and 19 February 1975. All fish were identified and enumerated, and samples were preserved for laboratory analysis of length, weight, age, sex, gonad weight and stomach contents. Catches of fish were very small throughout the survey area. Winter flounder was the most abundant species taken, followed by longhorn sculpin and little skate. Gonadal analysis indicated these three species may all have been in spawning condition in February . Polychaete worms, amphipods, mysids and sand shrimp were most conspicuous in their diets. Most species showed little differentiation of year classes, 1973 and 1974 classes predominating.

Trawls on the original dump site (station C 6) itself yielded a small number of fish, the majority winter flounder. Catches at C6 appeared within the range of those collected at "control" stations.

III. MIDDLE ATLANTIC COASTAL FISHERIES CENTER SUBTASKS

A. Benthic Macrofauna Studies

1. Field Activities: The third quarterly cruise to collect macrofauna and sediments from the river and disposal area was conducted between 20 January and 4 February 1975; the fourth cruise began 21 April. Refer to Figures 1 and 2 of Appendix F for locations of stations routinely sampled by MACFC. Visual inspection of all grabs from the winter cruise indicated the following: surficial sediments at C6 and E7 (apparently our station closest to the new disposal point - we're still awaiting coordinates for this point) were completely spoil materials; C7 had approximately 5 cm of spoil over muddy sand, and there may have been some spoil at C5.

2. Laboratory Activities: Fifty-two additional grab samples (three from the June pre-disposal cruise, 18 from September and 31 from January) have been analysed since the prior report. Totals now stand at 38 grabs from 15 June stations, 44 grabs from 16 stations in September, and 31 from 8 stations in January. Numbers of species (S) and individuals (N), Shannon-Weaver species diversities (H') and equitabilities (J') have been calculated for all newly-completed samples. Results are again presented graphically to indicate progressive change (if any) for each faunal parameter at each station analysed. Stations are ordered according to distance from the dumping buoy for the A and C transects (Figures 1-2). As discussed in prior reports, considerations of depth contours and residual drift dictate analysis of these transects for most probable

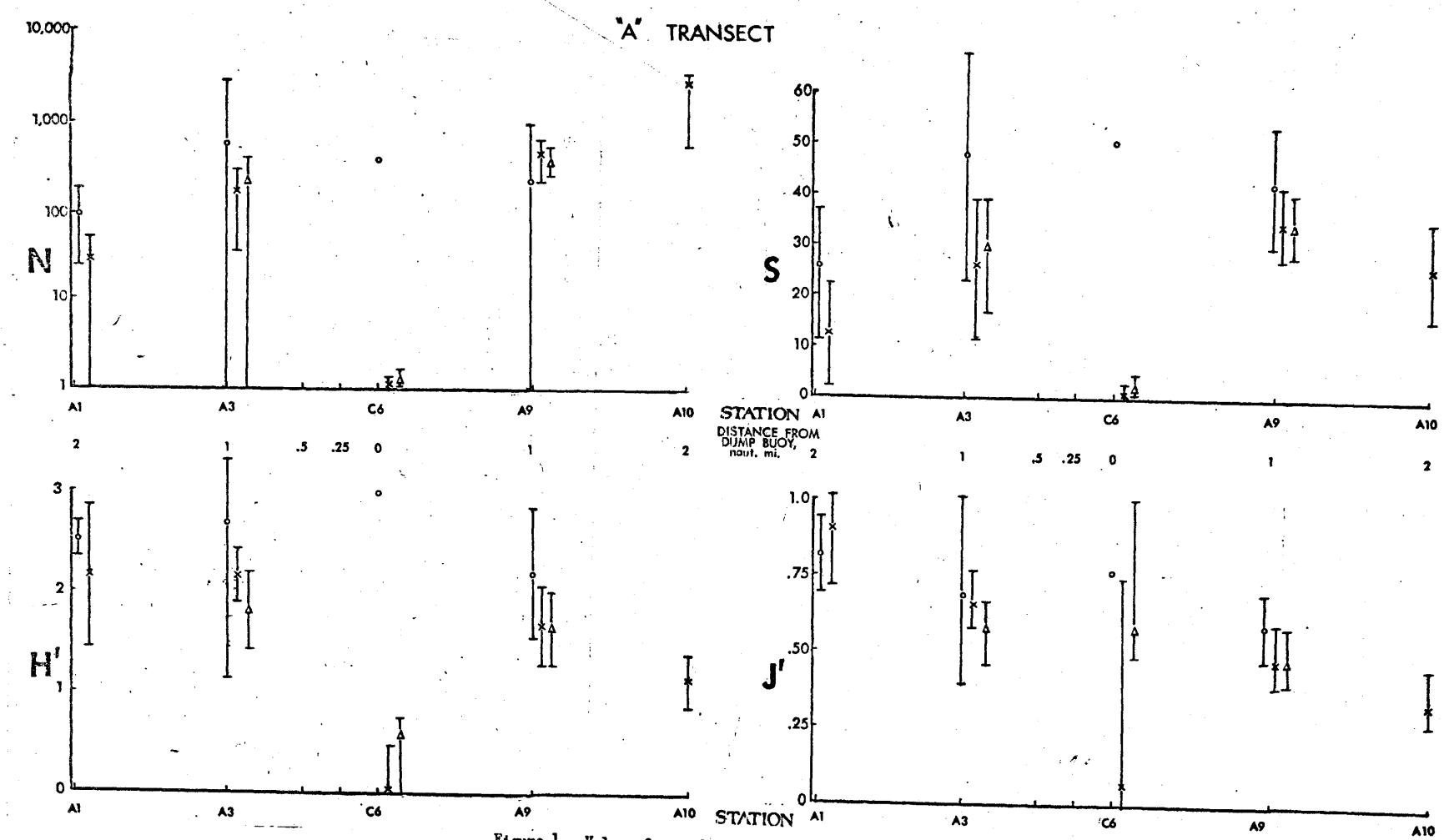


Figure 1. Values for numbers of individuals (N) and species (S), diversity (H') and equitability (J') of macrofauna at selected sts stations. Means and 95% confidence limits indicated where three or more grabs analysed.
June-Jul 1974 - o Sept-Oct 1974 - x Jan-Feb 1975 - Δ

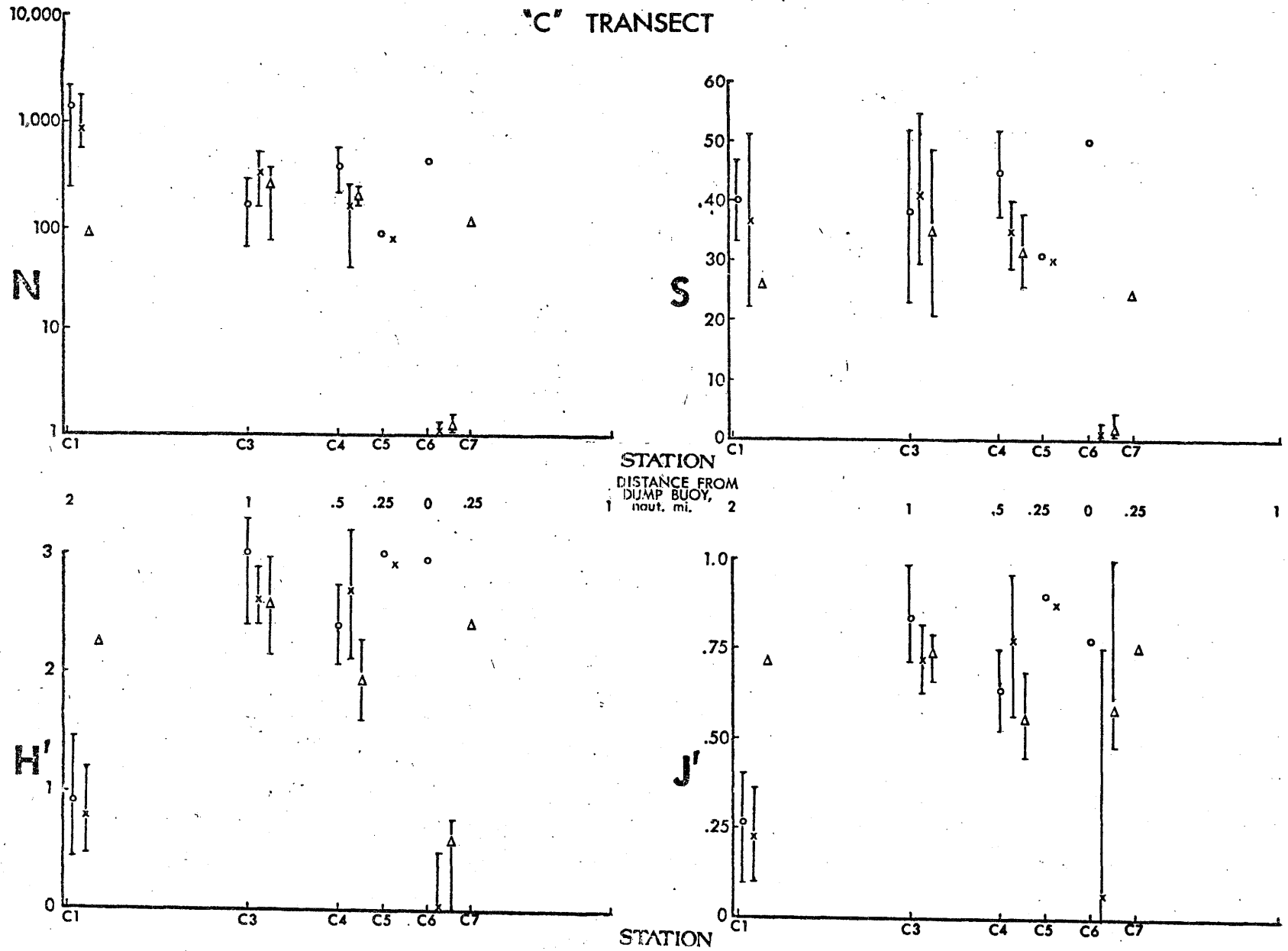


Figure 2. Values for numbers of individuals (N) and species (S), diversity (H') and equitability (J') of macrofauna at selected sts stations. Means and 95% confidence limits indicated where three or more grabs analysed.

June-Jul 1974 = o Sept-Oct 1974 = x Jan-Feb 1975 = Δ

detection of any spoil movement. Comparative data are also given for several other selected stations in Figure 3.

The original dumpsite (C6) contained virtually no macrofauna in January, as in September (a "typical" assemblage had been present in June). January samples from station E7, slightly SSE of the new dump point, showed a faunal condition approaching that of C6. Means for four grabs were fewer than three species and 20 individuals. The large majority of individuals were Nucula proxima, the nut clam. Nucula is abundant in the river as well as the disposal area; these specimens have likely been introduced with the spoils.

Station C7, where a layer of spoils covered the natural substrate in January, still appeared to support a fauna similar to that at stations where no spoil was evident. N, S and H' were all well above those recorded at C6 and E7. Species composition at C7 was also comparable to that at many apparently unimpacted portions of the study area, and was dominated by the ampeliscid amphipods characteristic of many of the stations. No other stations contained such a clearly impovershed fauna as at C6 and E7, although several smaller changes have been noted. Number of individuals at C4 was still significantly lower than in pre-disposal samples, but no further reduction was noted between September and January. At F9, large drops in S, N and H' were found between single grabs from the pre-disposal and September samplings. Stations R4 and R5, near the dredging operation, tended toward reduced N over the same period. A single grab from C1 in January showed reduced S and a large decrease in N from earlier collections.

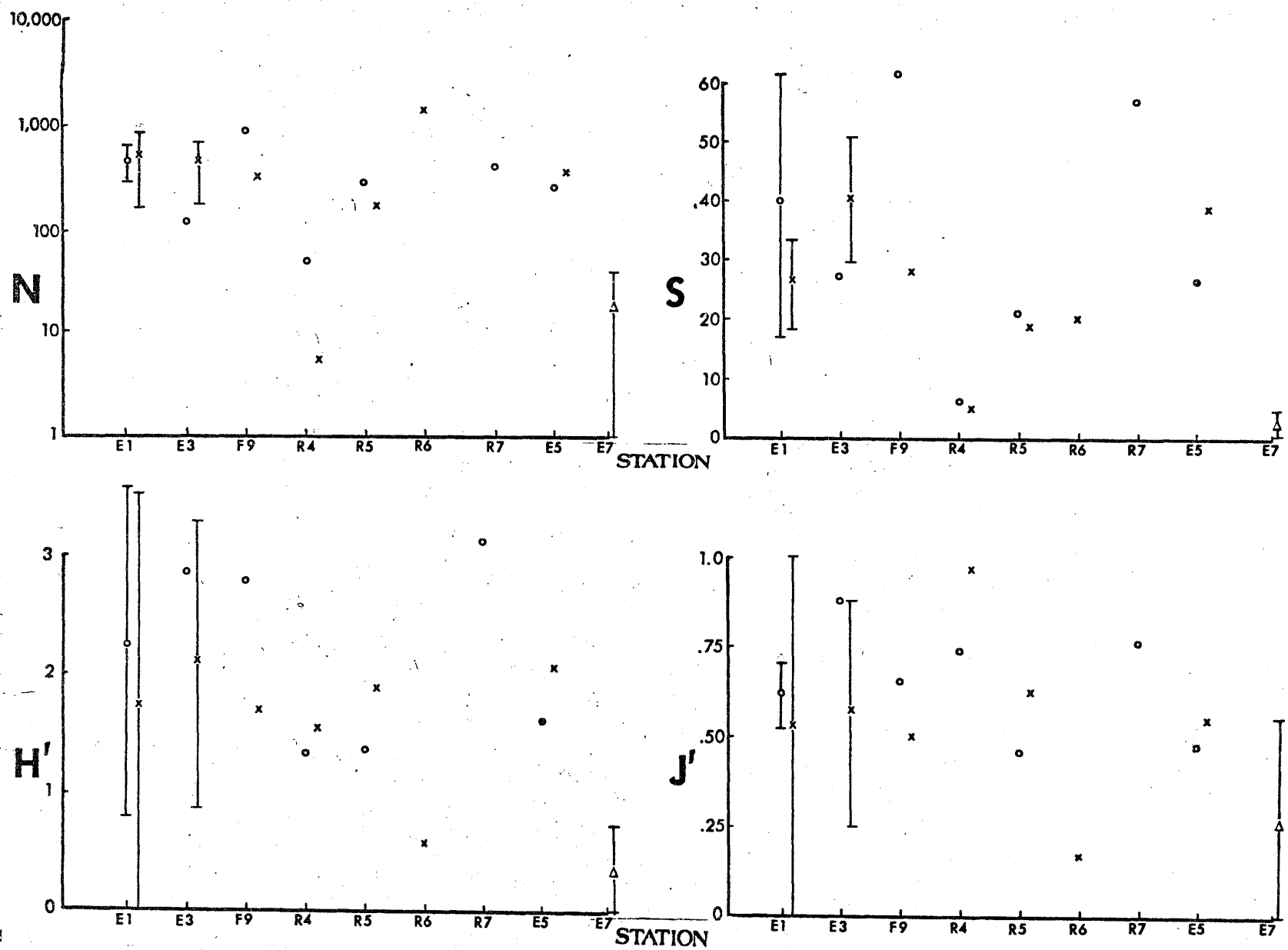


Figure 3. Values for numbers of individuals (N) and species (S), diversity (H') and equitability (J') of macrofauna at selected sts stations. Means and 95% confidence limits indicated where three or more grabs analysed.
June-Jul 1974 - o Sept-Oct 1974 - x Jan-Feb 1975 - Δ

Such changes are not necessarily dump-related; for instance, the smaller numbers at C1 result principally from the reduction in what had been a very dense population of juvenile mussels. Fluctuations of this type may be natural seasonal occurrences. In the absence of large-scale reductions across many taxa, as occurred at C6 and E7, a definitive statement on spoil effects must await comparison of samples collected this June and October with those taken a year earlier. Our conclusion based on samples analysed to date is that no obvious effects of spoiling have been demonstrated outside of those stations in closest proximity to dumping.

B. Sediment Analyses

Duplicate cores from 20 selected stations for each of the first three cruises have been sent to Dr. James Parks of Lehigh University for sediment analysis. Parameters examined are: percent by weight of each of ten grain size classes; mean and median grain diameters; sorting index, skewness and kurtosis; total carbon and carbonate content. This is a more comprehensive analysis than that previously conducted using a rapid sediment analyser. Results have been returned for 33% of the samples to be analysed from cruises I-III. Unfortunately, this does not provide enough data for a meaningful examination of spread of spoils from the disposal site(s). Analyses should be complete for all three cruises, and perhaps for the April 1975 samples as well, for inclusion in the next quarterly report.

C. Sedimentation Rate Studies

Sediment traps were set and retrieved by divers at stations A3, A4 and E3 between 28 February and 5 March 1975. Analyses of sedimentation rates and composition of sedimenting materials are not yet complete.

D. Biological Dive Studies

Between 28 February and 6 March 1975, three steel frames were installed by divers in soft sediments along the A transect. The frames consisted of lengths of 1.9 cm diameter steel reinforcing rod welded to form a square 1 m on a side. Lengths of steel shelving uprights were welded to the corners of the square to serve as legs. The legs were driven approximately 45 cm into the substrate, leaving the square itself about 30 cm above bottom.

Our goal in this experiment is to periodically return to several discrete sites in the disposal area to examine changes in sediment and fauna. If successful, this will avoid much of the variability found in our grab sampling and SCUBA census data, often the result of environmental patchiness and imperfect station finding. Photographs will be taken from each corner of the meter square for documentation of sediment conditions and hopefully for later microscopic enumeration of epifauna and tube-dwelling infauna.

The first three meter squares were set at stations A1, A3 and near A5 (see Appendix F, Figure 2). These sites were chosen on the basis of their similar depths and substrates (according to C&GS Chart #359), with distance

from the dumpsite ostensibly the major variable. If these squares can be relocated during the May 1975 diving operations, additional squares will be deployed at several other sites. Each square has been buoyed and has a 30 m "tail" of anchored polyproplene line, but relocation could still prove difficult. Reinstallation of the large buoys at key stations would aid this experiment.

While setting the meter square slightly south of A5, we observed that the sediment there was largely spoil clays, extending to at least the 45 cm depth to which we drove the square's legs. During the dive, a bargeload of spoil was released between C6 and E7, an estimated 400-600 m east of our position. Surface current was 1-2 knots to the north. Approximately 15 minutes after the barge began to dump, the diver encountered a large turbidity cloud extending from the bottom to ca 4 m above bottom. This observation may indicate the released spoils behave somewhat differently than those observed off New Haven, where essentially no spoil was carried further than 120 m outward after initial impact with the bottom (Gordon, 1974). We will attempt to conduct observations of this type again during the May dives.

E. Caged Organism Experiments

The cages of hard clams hung 12 m below the disposal buoy in October were missing by the time of the 6 March 1975 dive. Cages will be rehung from disposal and control buoys in May. We are considering changing to mussels as the test organism - they may be better suited to the depths and water column characteristics involved, and could perhaps be held in

smaller, lighter cages which would put less strain on the chain attaching them to the buoy's anchor chain.

F. Bacteriology (Appendix F).

Data are presented for pre-dredging densities of fecal coliform bacteria in river and disposal area sediments. Samples were collected from 44 stations between 26 June and 8 July 1974. Collection and analysis is carried out by personnel from the Milford Laboratory, MACFC. Highest fecal coliform counts were found in the river, with three of five stations containing densities in the range of 10,000 - 172,000/ 100 ml sediment. Counts in the disposal area were lower but were still considered "elevated" - 30 of 39 stations had counts of 100 or more fecal coliforms/ 100 ml sediment. Densities did not differ significantly between stations within the spoils area (here the circle of one mile radius from the dump point) and control stations outside this circle. Counts of total aerobic bacteria likewise showed river sediments higher than the spoils or control areas, with no significant differences between the latter two. Another survey of sediments was made on 30 July 1974. Fecal coliform densities at many stations differed considerably from those found on the earlier survey; maximum values were somewhat lower on 30 July. No clear relationship was found between total bacterial densities and fecal coliform counts. Analysis of several bottom water samples revealed no strong correlations of fecal coliform densities to densities in sediments from the same stations. Coliforms were higher at disposal area stations on an ebb than on a flood tide. This indicates that

the Thames River outflow can have an effect on water quality of the disposal area.

Sampling of selected stations has been conducted on a quarterly basis since the pre-dredging survey, most recently on 14-15 April 1975. Results will be included in subsequent reports. In July 1975 another comprehensive survey of sediments will be conducted for comparison with the pre-dredging data.

Literature Cited

Gordon, R. B., 1974. Dispersion of dredge spoil dumped in near-shore waters. Estuarine and Coastal Marine Science 2: 349-358.

IV. ACKNOWLEDGMENTS

This work is supported by the U.S. Navy through contract #74-00001 with MACFC. MACFC has subsequently subcontracted portions of the study to UCONN and NYOSL. Principal investigators for the various subprojects are:

UCONN - Dr. W. F. Bohlen (Suspended Material Transport, Thames River); Dr. S. Y. Feng (Dredging Effects on Shellfish Resources and Phytoplankton, Thames River); Dr. L. Stewart (Dump Site Lobster and Related SCUBA Studies); Mr. J. Cooke (Geofungi).

NYOSL - Dr. J. E. Alexander (Chemical Oceanography of Dump Site); Dr. R. Valenti (Fish Distribution and Abundance); Dr. R. Hollman (Physical Oceanography of Dump Site).

MACFC - Mr. A. Draxler (Sediment Trap Experiments); Dr. J. Graikoski (Microbiology); Mr. R. McGrath (Benthic Macrofauna); Mr. R. Reid (SCUBA Surveys, Cage Experiments, Contract Representative).

APPENDIX A

To: Dr. Robert Reid, Monitoring Project Leader

From: Dr. W. Frank Bohlen, Principal Investigator

Subject: The investigation of suspended material transport in the Thames Estuary: Progress Report for the quarter ending March 31, 1975.

During the quarter ending on March 31, 1975:

1. Field sampling has continued to detail concentration levels and concurrent hydrographic characteristics within the lower Thames River estuary (Table 1).

2. Identification of the fungi associated with the suspended sediments sampled during November and December 1974 was completed. These data have been supplemented by additional samples obtained during January-March 1975 at locations in the lower river and in the vicinity of the dumpsite (Appendix A).

3. A detailed investigation of the impact of the dredging operation on the character of the suspended materials in the Thames estuary was initiated. As indicated in the last quarterly report these analyses had been delayed by instrumentation problems. The resolution of these difficulties permitted completion of the analysis of all samples obtained to date. Primary emphasis during the past quarter has been placed on the development of this data set.

Suspended Material Characteristics and Dredging Effects.

Field sampling and laboratory analyses are being used to detail the by-weight concentration of suspended materials within the study area (Fig. 1) in combination with the grain size distri-

TABLE 1

Survey Summary

January 1, 1975 - March 31, 1975

Date	No. of Stations	Parameters sampled
January 28, 1975	17	water temperature, salinity, suspended solids, transmission, dissolved organic carbon, particulate organic carbon, orthophosphates, turbidity in the vicinity of the dredge-barge
March 3, 1975	21	Same

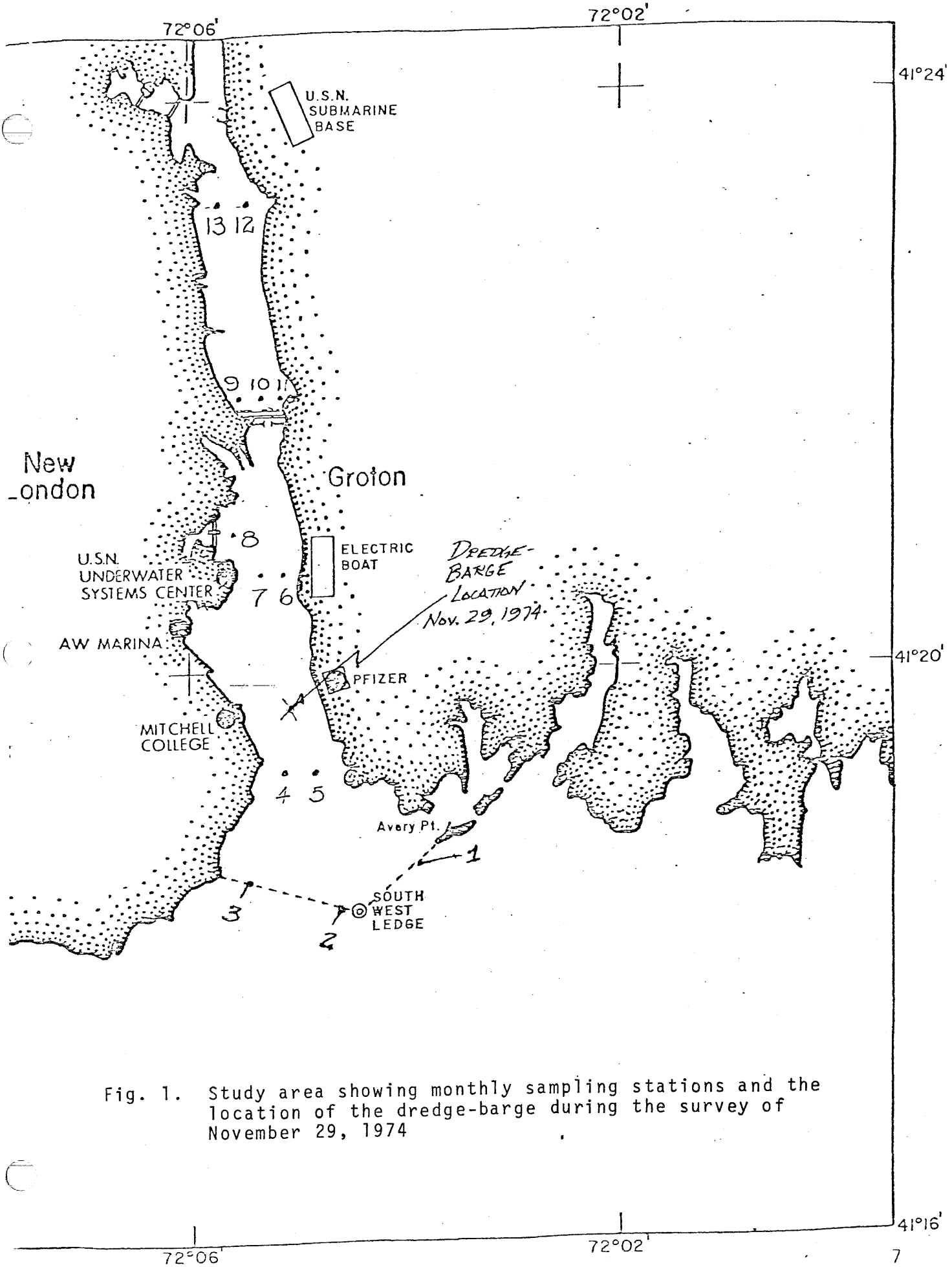


Fig. 1. Study area showing monthly sampling stations and the location of the dredge-barge during the survey of November 29, 1974

bution and organic carbon content of each sample.

Methods

a. By-weight concentration

Drawn water samples obtained using a three liter Van Dorn sampler are returned to the laboratory and filtered within twenty four hours using dried and preweighed 0.45 μ Nuclepore filters mounted in a Millipore vacuum filtration apparatus. All samples are stored in glass containers. Following a wash to remove salts each filter is dried and reweighed to determine the by-weight concentration of suspended particulate material.

b. Grain size distributions

Particle size distributions in selected samples are determined using a Coulter Counter Model T_A. A single aperture tube of 100μm diameter has been used for all measurements to date. Prior to analysis each sample is agitated in an ultrasonic bath to eliminate agglomeration. Initial measurements have sampled a minimum of 100,000 particles. I expect to compare these data with those provided by finite volume sampling during the next quarter.

c. Organic carbon

Samples for the determination of particulate and dissolved organic carbon content were prepared by vacuum filtering fifty to 150 mls (varying as a function of the suspended material concentrations) of each sample using a Reeve Angel glass fiber filter (#934AH; 2.4 cm-0.45μ). Each filter had been precombusted at

400°C for a period of two hours to remove volatile organics. Following the completion of filtration, filters were placed in small aluminum pans and frozen. Three 5 ml aliquots of the filtrate were pipetted into 10 ml glass ampoules which had been pre combusted at 450°C for four hours. The ampoules were individually covered with a small piece of aluminum foil and frozen.

Particulate and dissolved organic carbon were determined by the conversion of organic matter to CO_2 through wet combustion with potassium persulfate, similar to the method developed by Menzel and Vaccaro (1964). The following additions were made to the ampoules containing filtered sample water. 1) 0.2g potassium persulfate ($K_2S_2O_8$) and 6% H_3PO_4 was introduced into the ampoules. 2) Oxygen gas which had been purified by passing through a catalyst tube containing heated (400°C) cupric oxide was bubbled through for 5 mins to remove inorganic carbon components. Ampoules were sealed with a microburner. After sealing the samples were oxidized in a standard laboratory autoclave set at 130°C for a period of four hours.

The resultant CO_2 was analyzed by breaking the top of the ampoules under sealed conditions in a nitrogen atmosphere and carried by a stream of nitrogen gas to an IR analyzer and recorder. The peak heights produced by the CO_2 were corrected for reagent blanks and compared to a standard curve which had been determined by the wet oxidation of known amounts of dextrose ($C_6H_{12}O_6$).

To determine particulate organic carbon the frozen filters were rolled up and placed in precombusted ampoules to which 5 mls

of distilled water was then added. From this point the samples were treated in the same manner as the filtrate.

d. Criticism of method

The wet oxidation method has been criticized for failing to oxidize all the organic carbon present in the sea water sampler (Sharp 1973, Gordon and Sutcliffe 1973). Work by Sharp, Starikova (1970), Skopintsev, et al (1966) and Skopintsev et al (1968) working at low (>2 mg/l) oceanic concentrations using direct combustion method have produced results that are double those found by Menzel & Vaccaro and others using the wet oxidation method. Sharp (1972) concluded that wet oxidation with $K_2S_2O_8$ fails to oxidize organic carbon in the colloidal form.

The efficiency of wet oxidation by $K_2S_2O_8$ has been estimated by dissolving a series of organic compounds of known concentrations in sea water (Menzel and Vaccaro 1964, Fredericks and Hood 1965, Strickland and Parsons 1968). 100% recovery of these compounds occurred in most cases with lower yields for refractory long chain and polycyclic hydrocarbons. Work by P.J. Williams (1969) using a residual ^{14}C method to determine completeness of oxidation concluded that wet oxidation with $K_2S_2O_8$ was effective in oxidizing more than 95% of organic compounds such as sugars, amino acids and fatty acids. These compounds are considered potential food sources and therefore are important biologically, whereas the organics the method fails to oxidize are very resistant to biological breakdown and of little importance bio-

logically.

e. Effects of alterations of technique

Sharp (1973) suggested that the addition of $K_2S_2O_8$ before purging would produce some oxidation at room temp. (up to 28%) which would be removed during the purging procedure. He suggested that the samples first be acidified and purged before the $K_2S_2O_8$ is added, then again quickly purged (~20 sec) after the addition of $K_2S_2O_8$. Experiments conducted by V. Quinn, U.R.I. (personal communication 1974) and by our laboratory have failed to reproduce Sharp's findings.

P.J. Williams (1969) experimented with alterations in $K_2S_2O_8$ and phosphoric acid concentrations, use of nitrogen in place of oxygen for purging and autoclave temps. other than 130°C. He concluded that these alterations did not produce any significant improvements in the extent of oxidation.

It is apparent from the literature that the wet oxidation method using $K_2S_2O_8$ does not measure all the organic carbon present. However, it has been demonstrated that the biologically liable carbon is satisfactorily measured.

Results

The data obtained during the survey of November 29, 1974 present a representative picture of the suspended material field in the lower Thames River and the impact of the dredging operation.

a. Suspended material concentrations

Material concentration levels average approximately 5 mg/l throughout the study area (Fig. 2). Significant perturbations are

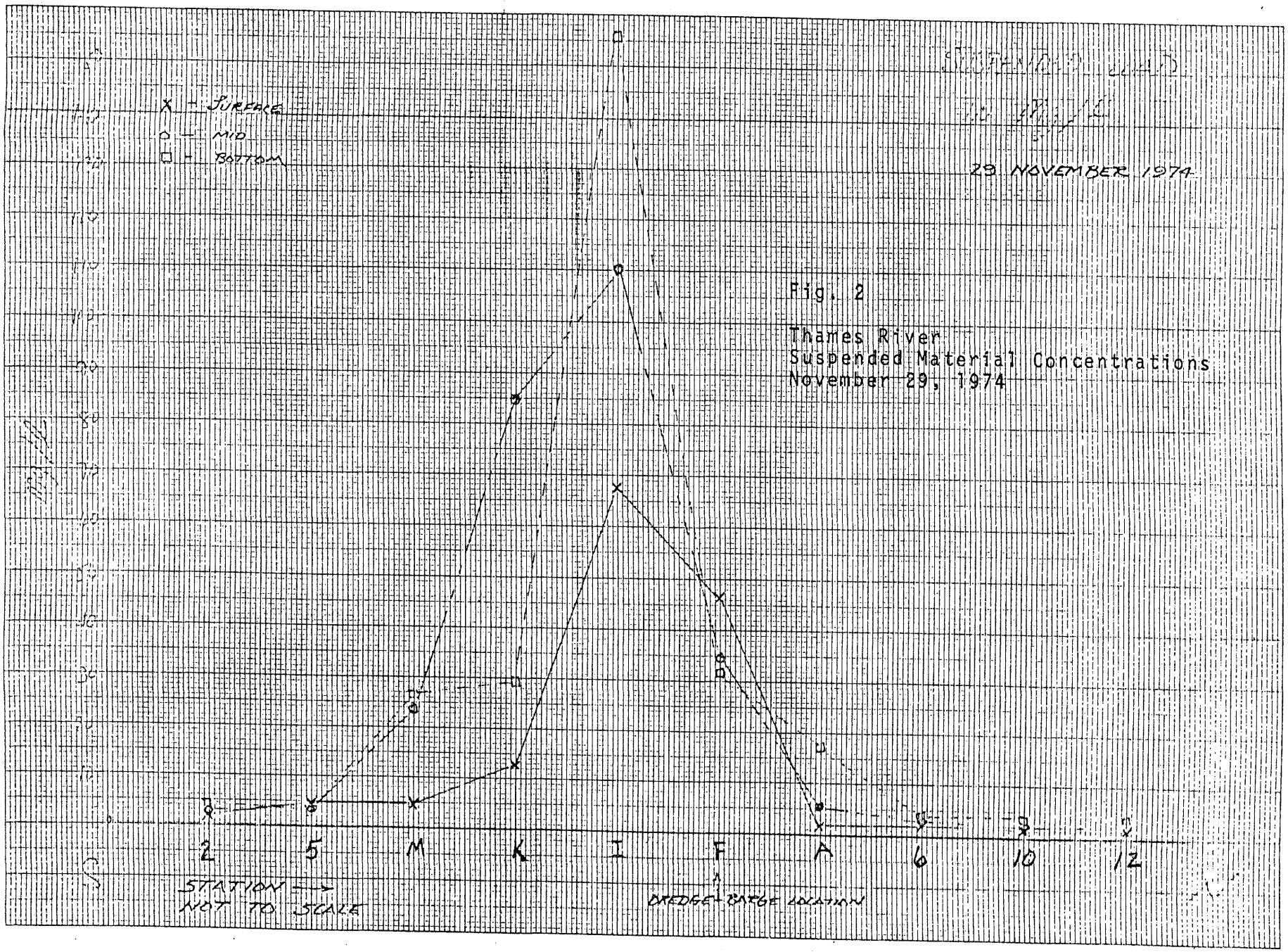


Fig. 2

Thames River
Suspended Material Concentrations
November 29, 1974

observed in the vicinity of the operating dredge and barge (lettered stations Fig. 2). As previously indicated the impact area has a radius of approximately 150m. These data are being used to compute the volume of materials introduced into the water column during the dredging operation and the ultimate fate of the materials. Examination of the symmetry of the impact area suggests that large fraction of these materials rapidly settle out of the water column. An indeterminate fraction however must be distributed over a large area as a function of the velocity field within the estuary. Estimates of the transport routes of these materials will be prepared using a hydraulic model.

b. Grain size distributions

Examination of the particle size distributions of suspended materials along the northern and southern boundaries of the study area (Figs. 3d and 3a respectively) indicates relatively minor variability. Distributions tend to be bi-modal with peaks at one to two microns and approximately ten microns. The data set is still insufficient to permit characterization of seasonal variations in this distribution.

Data obtained in the vicinity of the dredge-barge (Figs. 3b and 3c) indicate an essentially uni-modal distribution with a peak again at approximately ten microns. As previously indicated there appears to have been a selective removal of the finer materials. This phenomenon is being investigated. I expect to complete this study during the next quarter.

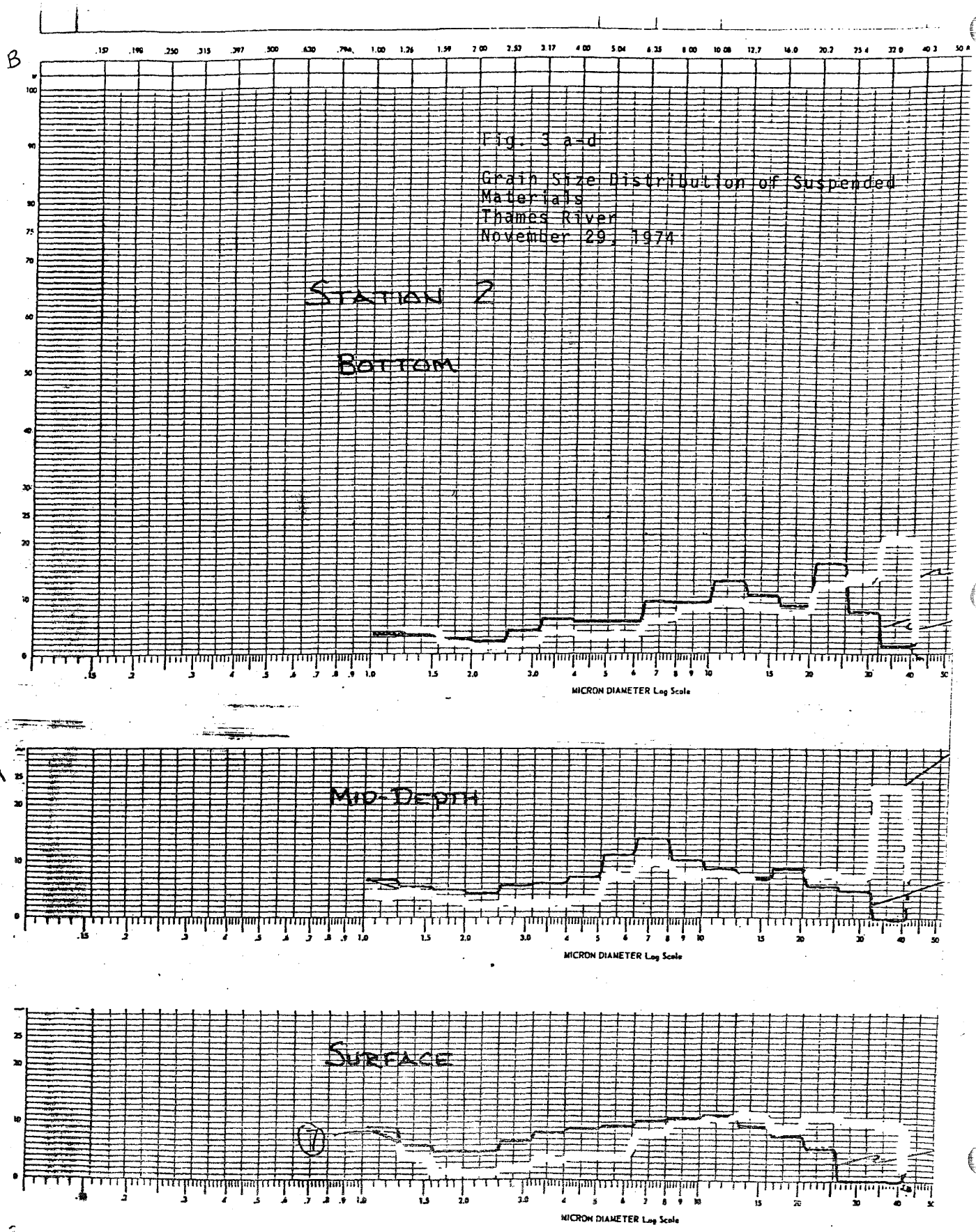
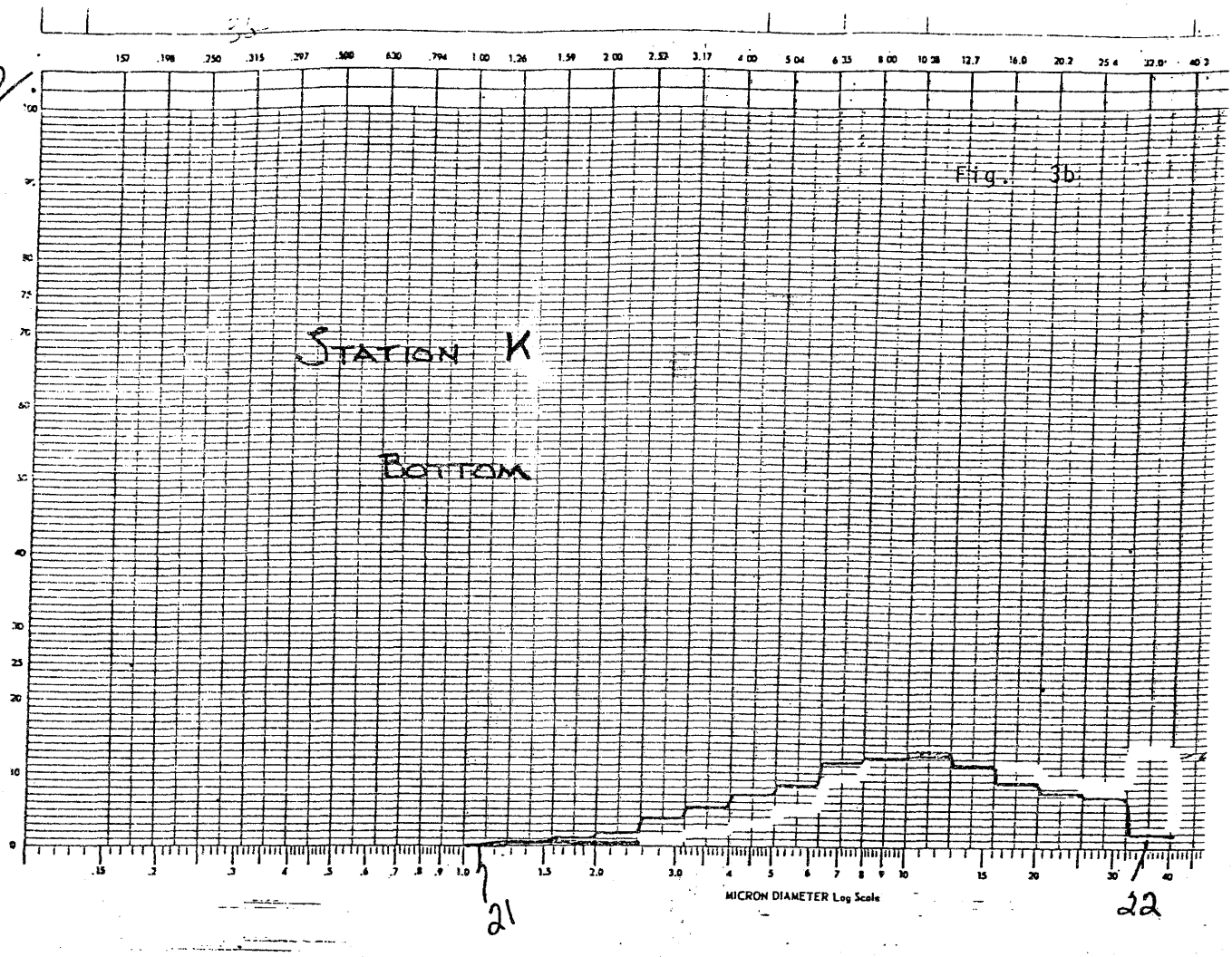
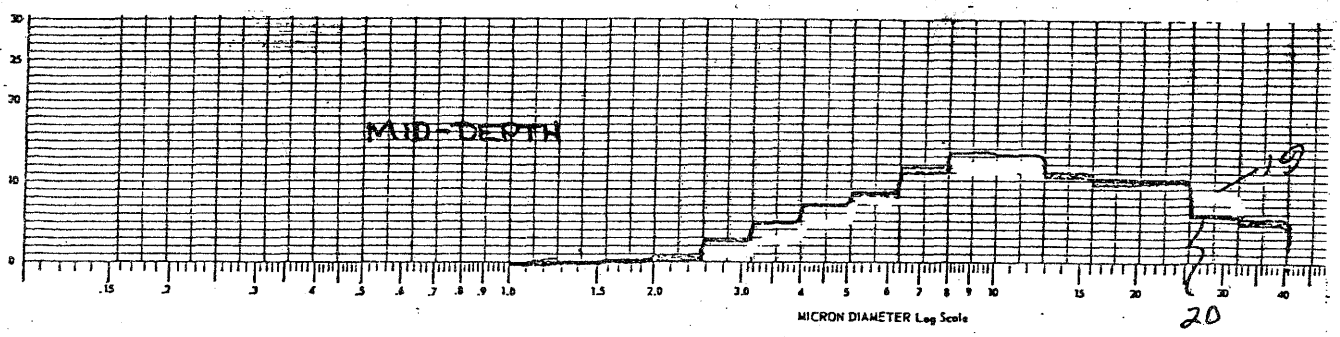
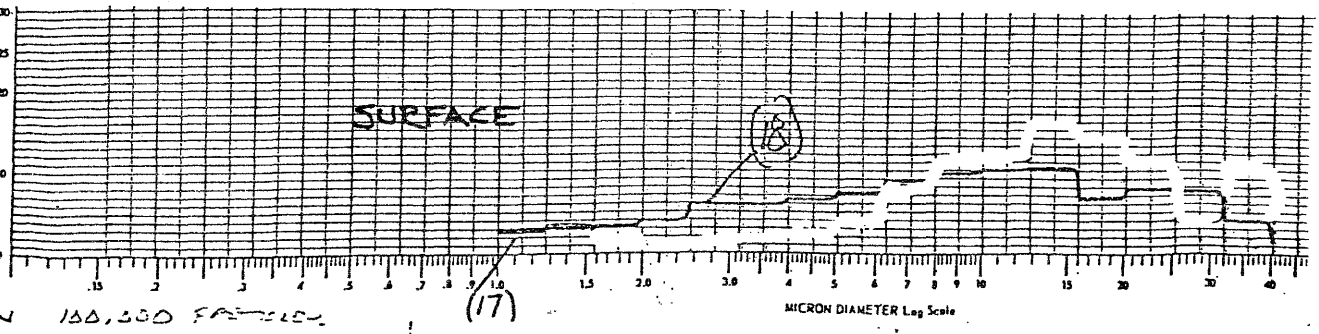


Fig. 3 a-d
Grain Size Distribution of Suspended Materials
Thames River
November 29, 1974
STATION 2
BOTTOM
MID-DEPTH
SURFACE
MICRON DIAMETER Log Scale
MICRON DIAMETER Log Scale
MICRON DIAMETER Log Scale

Fig. 3b







MIN 100,000 PARTICLES

[illegible] FIXED VOLUME OF IF POSSIBLE USE [illegible]

3C

COULTER COUNTER® Model T&TA PARTICLE SIZE ANALYSIS

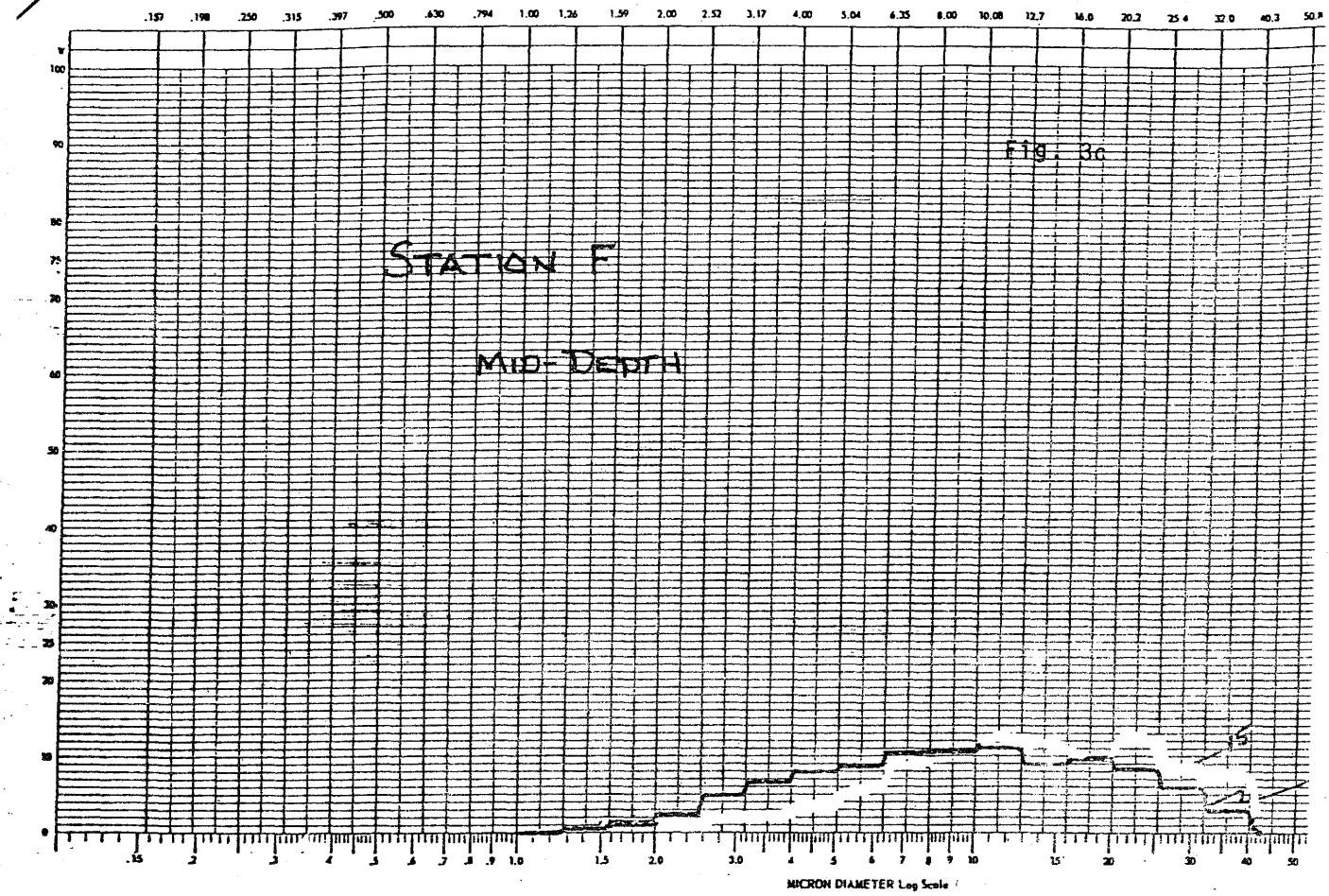
ORGANIZATION

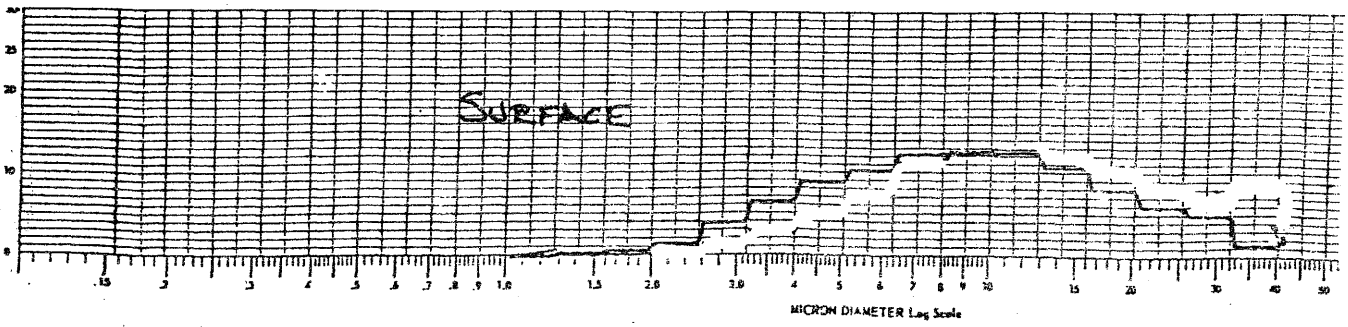
OPERATOR

EQUIPMENT

$k = d\sqrt[3]{2^n}$ FOR MODEL T $\frac{A_2}{A_1} = \left(\frac{d_2}{d_1}\right)^3$ when $W_2 = W_1$ $\frac{A_2}{A_1} = \left(\frac{d_1}{d_2}\right)^3$ FOR MODE

SAMPLE	ELECTROLYTE	DISPERSANT	APER. SIZE	SERIAL		PART DIA.





3d.

Fig. 3d

STATION 13

SURFACE

MICRON DIAMETER Log Scale

MID-DEPTH

MICRON DIAMETER Log Scale

BOTTOM

MICRON DIAMETER Log Scale

c. Organic carbon

Particulate organic carbon concentrations in the areas removed from the dredge location averaged 1 mg/l during the November 1974 survey (Fig. 4). These data are being compared to seasonal data obtained in similar estuarine locations to determine their reliability as indicators of ambient, pre-dredge conditions. The paucity of pre-dredge data within the Thames River precludes accurate impact evaluations at present.

In the vicinity of the dredge-barge particulate organic carbon concentrations increase to 4.0 mg/l. As in the case of total suspended material concentrations, this marked increase is confined to an area having a radius of approximately 150m. More detailed surveys of this impact area are to be accomplished during the next quarter. These data are also to be employed in the determination of the dredging impact on the supply of particulate carbon to the study area.

An examination of the ratio of particulate carbon concentrations to total suspended load (Fig. 5) indicates that the dredging operation supplies materials rich in inorganic constituents. As a result despite the high carbon content the ratio of P.O.C./S.L. shows a marked decrease in the vicinity of the dredge-barge. The implications of these data are being considered in combination with particle size analyses.

Future Work

During the next quarter I expect to complete selection of the

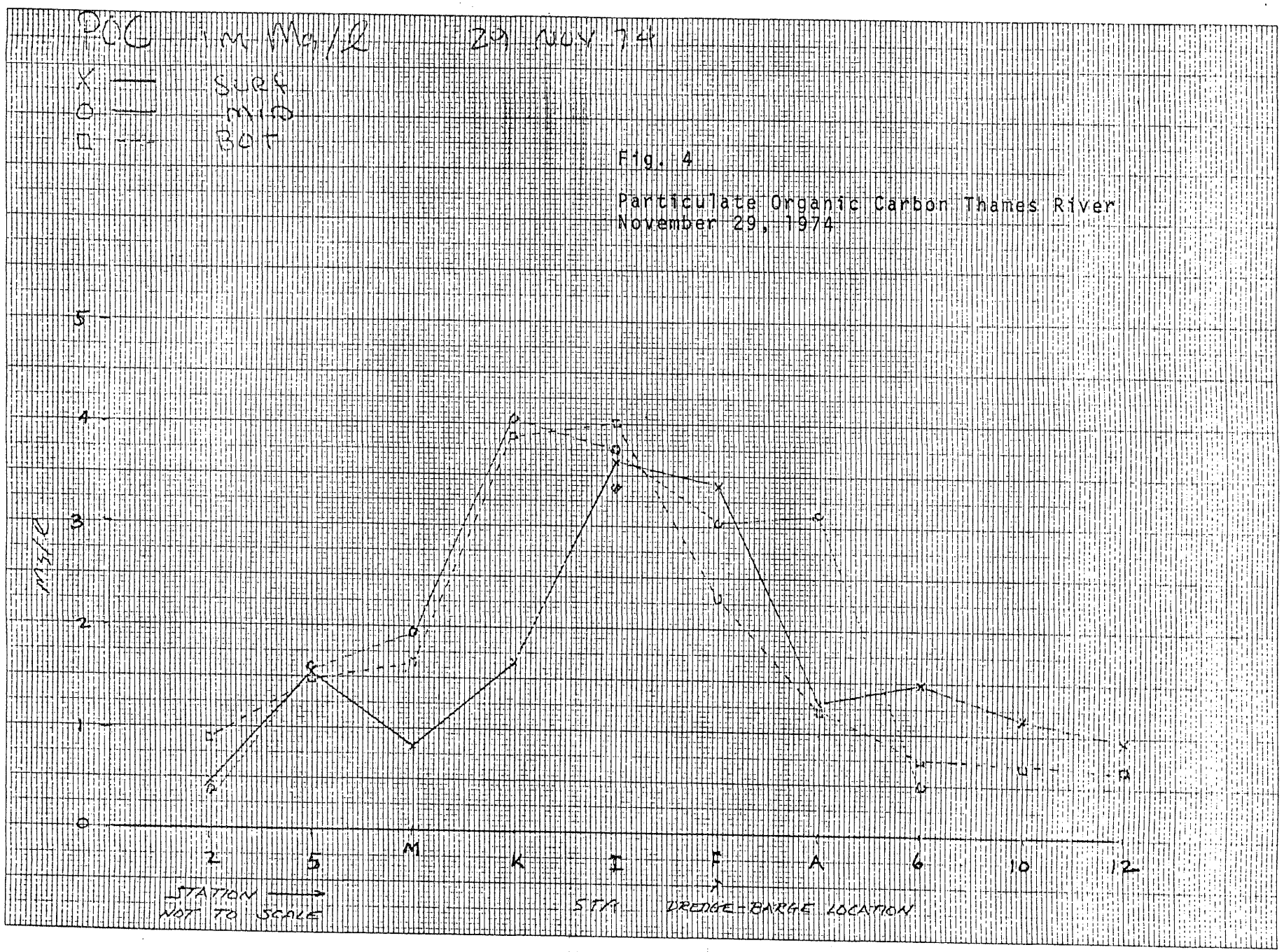


Fig. 4

Particulate Organic Carbon Thames River
November 29, 1974

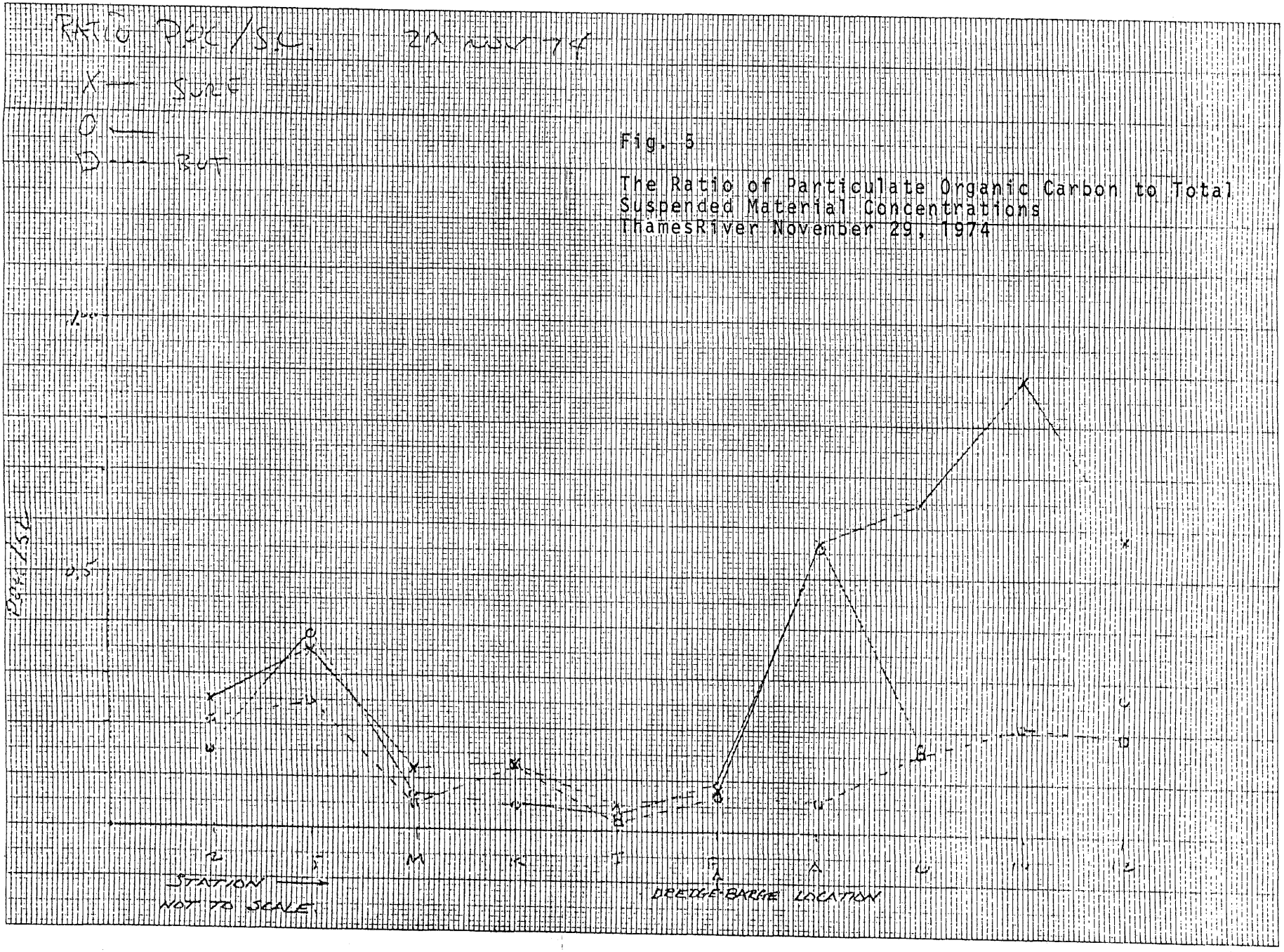


Fig. 5

The Ratio of Particulate Organic Carbon to Total Suspended Material Concentrations
ThamesRiver November 29, 1974

optimum hydraulic model and to begin initial runs to detail the transport field in the lower Thames.

A special effort has been made during the last month to obtain an indication of the effects of wind on the suspended material field in the estuary. I expect to complete this work during the next month and to incorporate this into the transport predictions.

We will obtain a detailed survey in the vicinity of the dredge-barge located along the southern boundary of the study area.

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APPENDIX A

Title: An Investigation of the Effects of Channel Dredging on the Lower Thames River Estuary: Suspended Material Transport Characteristics.

Contract Number: 03-5-043-302.

Quarterly Progress Report - April 1, 1975.

I. INTRODUCTION (Geofungi associated with suspended sediments in the main channel of the Thames River Estuary).

The objectives for the third quarter of this study were: (1) to complete identification of fungi from isolation plates prepared during November and December (1974) and (2) to collect surface and bottom water samples at stations in the river channel and at the dump site during January - March, 1975.

II. METHODS

The materials and methods used are given in the second quarterely report on this study under sampling and analytical procedures. Samples were collected at the stations previously sampled and at the buoy marking the dump site. Water samples were collected on 3 dates during the past quarter: January 8; February 19; and March 20. Samples from station C were collected in December, January and February while the dredges were operating. Samples from station D collected on December 13 were taken from north of the dredge in N.L. Harbor rather than at buoy #2 in the Thames River. Sampling at the dump site was begun on February 19, 1975.

III. RESULTS

The quantity of sediments and the total number of fungal colonies observed for each surface and bottom water sample are given in Table I. Salinity and pH values for the sampled water were within the expected ranges for the dates and times samples were collected and will be taken into account in a later report.

TABLE I.

Number of fungi and amount of sediment from each station sampled.

STATION A: BUOY #2 - New London Harbor (South of New London Light)

DATE	mg/l SEDIMENT Surface	Bottom	TOTAL # OF COLONIES/SAMPLE Surface	Bottom	
10-11-74	6.34	3.80	15/6plates	21/6plates	
11-1-74	lost		8/6 plates	8/6 plates	
12-13-74	4.98	3.76	63/6plates	30/6plates	
1 -08-75	3.29	5.73	28/6plates	29/6plates	
2 -19-75	4.67	2.73	34/6plates	3/6 plates	
3 -20-75	3.75	31.98	plates to be examined		

STATION B: BUOY #6 - New London Harbor

10-11-74	11.68	7.20	29/6plates	23/6plates	
11-01-74	lost		16/6plates	9/6 plates	
12-13-74	0.92	12.55	46/6plates	38/6plates	
1 -08-75	5.73	5.33	40/6plates	16/6plates	
2 -19-75	2.70	3.76	47/6plates	16/6plates	
3 -20-75	3.65	5.18	plates to be examined		

STATION C: (Below dredge in channel - New London Harbor)

10-11-74	not sampled				
11-01-74	lost		12/6plates	15/6plates	Sampled between buoys #8 and #12 (N.L. Harbor).
12-13-74	18.29	11.06	53/6plates	33/6plates	Sampled south of buoy #8 (N.L. Harbor).
1 -08-75	7.76	9.76	39/6plates	22/6plates	Sampled between buoys #6 and #8 (N.L. Harbor).
2-19-75	7.29	1.04	27/5plates	5/6 plates	Sampled ¼ mi. north of New London Light.
3-20-75	not sampled				

TABLE I - continued.

STATION D: Buoy #2 - Thames River (North of Gold Star Memorial Bridge)

DATE	mg/l SEDIMENT Surface	mg/l SEDIMENT Bottom	TOTAL # OF COLONIES/SAMPLE Surface	TOTAL # OF COLONIES/SAMPLE Bottom	
10-11-74	37.36	8.90	21/6plates	26/6plates	
11-01-74	lost		18/6plates	19/6plates	
12-13-74	3.75	6.61	60/6plates	26/6plates	Sample taken north of buoy #12 immediately above dredge (N.L. Harbor).
1 -08-75	1.77	4.37	25/6plates	29/6plates	
2 -19-75	0.20	2.75	50/6plates	17/6plates	
3 -20-75	3.30	4.17	plates to be examined		

DUMP SITE: Samples taken close to marker buoy.

2 -19-75	2.90	5.37	7/6 plates	0/6 plates
3 -20-75	6.34	29.60	plates to be examined	

STATION E: Vixen Ledge (Red Buoy marker).

10-11-74	6.93	23/6plates
11-01-74	lost	18/6plates
12-13-74	4.26	34/6plates
1 -08-75	4.71	23/6plates
2 -19-75	2.79	20/6plates
3 -20-75	7.61	plates to be examined

STATION F: Mumford Cove (West of Channel Marker #5).

10-11-74	7.57	16/6plates
11-01-74	lost	10/6plates
12-13-74	1.85	33/6plates
1 -08-75	4.02	24/6plates
2 -19-75	not sampled	
3 -20-75	5.13	plates to be examined

IV. CONCLUSIONS

The amount of sediment does not appear to correlate directly with the total number of fungi observed from the water samples at any of the stations. However, the possible effects of pH, temperature and salinity on the survival and growth of the fungi have not been considered at this time. Also, correlations that may exist between particular species or groups of fungi and the amount of sediment at a given site have not been made.

Beginning in September (1974) surface and bottom water samples have been taken from stations A, B, C, and D. On the average, a greater number of fungi have been observed from the surface samples than from the bottom samples. Samples taken from station C, areas immediately below the dredge, have produced colony counts in the same range as stations located above the dredges and stations A and B that are further down the channel from the dredges.

V. FUTURE PLANS

Continued monthly sampling of surface and bottom water at the stations in the Thames River Channel and dump site area will be made during the next 3 months. Beginning in June additional analysis of accumulated data will be made.

APPENDIX B

QUARTERLY REPORT

AN INVESTIGATION ON THE EFFECTS OF DREDGING IN THE THAMES RIVER ON SHELLFISH RESOURCES AND PHYTOPLANKTON

(Contract No. 03-5-043-301)

January 1 to March 31, 1975

Submitted to

Sandy Hook Laboratory, Middle Atlantic Coastal Fisheries Center
National Marine Fisheries Service
N. O. A. A.
U. S. Department of Commerce

by

S. Y. FENG
Marine Research Laboratory
University of Connecticut
Noank, Connecticut 06340

March 31, 1975

I. Field Accomplishments:

A. River Studies

Three cruises were made in February and March, 1975. Severe winter weather conditions in our area (ice formation at the upper transects and high wind) as well as a breakdown of hydraulic dredge delayed our regular sampling schedules during this quarter. On February 2, 24 water samples from the six transects were collected for heavy metal analyses and 64 samples were obtained for chlorophyll (a, b and c) determinations. Temperature, salinity and dissolved oxygen measurements were taken also at three depths (surface, mid-depth and bottom) at each station. Twelve samples of Mercenaria mercenaria, 4 samples of Crassostrea virginica and 8 samples of Pitar morrhuana were taken from Thames River on March 1 to 3, 1975.

B. New London Dump Site Studies - Dr. Lance L. Stewart and Robert E. DeGoursey

One trip to the dump site was made on March 7, 1975. Predive fathometer sounding, covering a 200 yd radius of the N.L. Buoy indicated that depths in the vicinity of the Buoy were similar to those recorded in October 1974. Survey of bottom conditions revealed little newly deposited dredge materials and from surface observation of disposal operations, dumping apparently occurred several hundred yds SSE of the Buoy.

On the bottom a high degree of burrowing activities by benthic crustaceans and colonization of the dredge spoil by infauna were noted. Several lobster burrows and depressions excavated by Cancer spp. were also observed. Pandalus montagui, the northern shrimp were encountered for the first time about fragmented pieces of clay spoil. One epibenthic collection was made to obtain P. montagui with a 0.5 X 0.1 meter rectangular net of 1 mm mesh. No unusual conditions were recorded.

Sonic tracking equipment has been prepared for field use and the tagging and monitoring of two lobsters are planned for the spring. Several lobster

burrows discovered during the present survey will permit the use of resident lobsters for sonic tracking experiment. Continued photographic documentation of benthic conditions and associated biota will also be conducted during the next quarter.

II. Results on Laboratory Analyses:

A. Gross Pathological Examination of Shellfish

Ten specimens of the three species of shellfish from each station were dissected. The following anatomical regions were inspected for gross pathological conditions: inner and outer aspects of gills and palps, inner and outer aspects of mantle and pericardial cavity. No discernible abnormalities were noted in the three species of molluscs examined.

B. Heavy Metal Concentrations in *Mercenaria mercenaria*, *Crossostrea virginica* and *Pitar morrhauna*

The concentrations of zinc, copper, cadmium, nickle and mercury in the three species of shellfish collected from the Thames River in July and November 1974 and March 1975 have bee n analyzed with a new atomic absorption spectrophotometer (Instrumentation Laboratory Model 151) which was installed on February 1, 1975. In all 389 *M. mercenaria*, 312 *P. morrhuana* and 102 *C. virginica* grouped into 42, 24 and 12 samples respectively were analyzed. The sampling stations for *M. mercenaria* and *P. morrhuana* were distributed from the mouth (Station A) to about seven miles up river (Station H). The oysters were taken from stations located 8 to 9 miles up river. For all metals, except mercury, the samples were prepared by lyophilization, followed by digestion of 0.4 gm of tissues in 10 ml of concentrated nitric acid at 50°C for 6 hours, before dilution to 25 ml with deionized water. The samples for mercury determination were lyophilized, treated according to the procedure of Hatch and Ott (1968, Anal. Chem., 40, 2085-2087), and measured by the cold vapor atomic absorption spectrophotometry on a Coleman MAS-50 Mercury Analyzer.

The results of metal concentrations are summarized in Table I-V. For the most part the differences among the July, November and March samples were small. The most striking differences were in the concentrations of zinc and copper in C. virginica which were low in November and March compared to the July levels (Tables I and II). For most metals, there was no consistant correlation between the location on the river and the concentrations in the shellfish. However, the copper concentrations in M. mercenaria tended to be higher in the upriver stations, while the concentration of nickle tended to be lower (Tables II and IV).

If there have been any substantial changes in the concentrations of heavy metals during the sampling period, they have so far not been reflected in the concentrations of the shellfish.

C. Heavy Metal Concentrations in Thames River Water Samples

Twenty four water samples were taken on February 2, 1975 at the six transects for determining heavy metal concentrations. With the exception of Hg, the analyses of the other five metals are still incomplete. The mercury concentrations of the water samples were determined by the method of Fitzgerald et al. (1974. Anal. Chem., 43, 1882-1885).

The distribution of mercury in the surface and bottom water at high and low water is shown in Figure 1 and Table VI. There was a substantial drop in the mercury concentration of the February 1975 samples as compared with that of the November and July 1974 samples (see Table II, the Second Quarterly Report). The range of mercury concentrations during this quarter varied from 2 to 10 ng/L, which was the lowest range encountered to date.

Analyses of the other metals in these samples should begin within 2-3 weeks as soon as a new flameless atomizer is delivered.

TABLE I. Zinc Concentrations In Shellfish (μg/gm freeze dry weight)

Station	July 1974	November 1974	March 1975
		Mercenaria mercenaria	
B	182	-	268
C	122	138	181
D	164	368	222
E	147	231	212
F	226	144	226
G	144	168	239
H	236	87	184
Avg.	174	189	219
		Pitar morrhuana	
A	201	178	206
B	-	-	284
C	634	412	390
D	281	546	487
E	-	706	426
F	306	437	-
Avg.-	356	456	359
		Crassostrea virginica	
O-II	19,700	14,700	18,600
O-III	16,900	14,700	12,800
O-VI	21,200	14,400	11,900
O-VII	18,100	13,100	14,700
Avg.	19,000	14,200	14,500

TABLE II. Copper Concentrations in Shellfish (μg/gm freeze dry weight)

Station	July 1974	November 1974	March 1975
		Mercenaria mercenaria	
B	25.6	-	36.8
C	25.0	18.1	15.6
D	25.2	17.2	17.5
E	27.5	24.4	20.3
F	33.7	22.5	22.5
G	29.6	25.6	26.5
H	37.9	27.5	26.8
Avg.	29.2	22.6	23.7
		Pitar morrhuana	
A	22.3	11.9	12.2
B	-	-	14.4
C	19.4	15.9	13.7
D	21.2	13.7	14.7
E	-	23.7	16.2
F	18.1	27.5	-
Avg.	20.2	18.5	14.2
		Crassostrea virginica	
O-II	1500	750	1203
O-III	1218	768	748
O-VI	1405	731	796
O-VII	1275	712	937
Avg.	1350	740	921

TABLE III. Cadmium Concentrations in Shellfish (μg/gm freeze dry weight)

Station	July 1974	November 1974	March 1975
		Mercenaria mercenaria	
B	1.34	-	1.12
C	1.25	1.16	0.97
D	1.16	0.56	1.25
E	1.19	0.84	1.88
F	0.92	0.37	1.09
G	0.92	0.69	1.06
H	0.94	0.31	1.00
Avg.	1.10	0.66	1.20
		Pitar morrhuana	
A	4.48	4.15	3.56
B	-	-	3.99
C	2.38	3.40	3.87
D	3.12	2.47	5.81
E	-	3.00	2.90
F	1.62	2.37	-
Avg.	2.90	3.08	4.03
		Crassostrea virginica	
O-II	5.75	2.56	5.69
O-III	5.31	3.00	4.37
O-VI	-	3.06	6.18
O-VII	8.31	3.81	5.68
Avg.	6.46	3.11	5.48

TABLE IV. Nickle Concentrations in Shellfish (μg/gm freeze dry weight)

Station	July 1974	November 1974	March 1975
		Mercenaria mercenaria	
B	10.24	-	10.24
C	10.50	8.12	5.62
D	8.82	11.49	6.00
E	8.37	9.62	5.75
F	9.12	7.74	4.62
G	6.16	6.24	4.62
H	6.16	7.00	4.24
Avg.	8.51	8.37	5.87
		Pitar morrhuana	
A	7.66	7.12	5.75
B	-	-	5.24
C	7.00	7.37	5.74
D	8.00	8.37	5.12
E	-	8.49	4.25
F	8.00	-	-
Avg.	7.66	7.84	5.22
		Crassostrea virginica	
O-II	6.50	7.00	4.75
O-III	5.75	4.75	4.74
O-VI	5.74	5.00	4.50
O-VII	4.25	4.75	6.75
Avg.	5.56	5.38	5.18

TABLE V. Mercury Concentrations in Shellfish (μg/gm freeze dry weight)

Station	July 1974	November 1974	March 1975
		Mercenaria mercenaria	
B	.304	-	.185
C	.219	.242	.146
D	.277	.221	.195
E	.468	.286	.202
F	.280	.372	.212
G	.307	.254	.320
H	.482	.584	.314
Avg.	.334	.326	.225
		Pitar morrhuana	
A	.260	.206	.204
B	-	-	.261
C	.203	.183	.233
D	.205	.234	.224
E	-	.302	.212
F	-	.118	-
Avg.	.223	.204	.227
		Crassostrea virginica	
O-II	.381	.185	.374
O-III	.368	.233	.356
O-VI	.396	.128	.344
O-VII	.424	.281	.381
Avg.	.392	.207	.364

TABLE VI. Mercury Concentrations in Thames River Water (expressed in ng/L or parts per trillion)

Transect	Tide	2-2-75
I	LW-Surface	8
	Bottom	10
	HW-S	5
	-B	5
II	LW-S	5
	-B	8
	HW-S	6
	-B	3
III	LW-S	5
	-B	4
	HW-S	4
	-B	4
IV	LW-S	4
	-B	3
	HW-S	5
	-B	5
V	LW-S	3
	-B	3
	HW-S	4
	-B	7
VI	LW-S	2
	-B	5
	HW-S	6
	-B	8

Relative standard deviation (R.S.D.) = 8.3% for 1 ng/Hg

APPENDIX C

QUARTERLY REPORT

Physical Oceanography of the New
London Dump Site Area
January through March, 1975

Submitted to

Sandy Hook Laboratory, Middle Atlantic Coastal
Fisheries Center, National Marine Fisheries Service
NOAA/U.S. Dept. Commerce
under Contract No. 03-5-043-305

by

Rudolph Hollman, Ph.D.
New York Ocean Science Laboratory
Montauk, New York

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A. Definitions:

u: east/west velocity component in cm/sec

v: north/south velocity component in cm/sec

R: speed of the current in cm/sec,

$R = [u^2 + v^2]^{1/2}$

θ: direction of the current relative to geographic north,

$\theta = \arctan v/u$.

D(R): virtual distance in kilometers of a half-tidal cycle,

$$D(R) = \int_{1/2 \text{ tidal cycle}} R(t)\, dt$$

t: duration of half tidal cycle in hours

Beam Attenuation coefficient (β): sum of the absorption coefficient and total scattering coefficient and calculated from

$$\beta = (^{-1}/L) \ln (T/100)$$

where T is the beam transmittance in percent and L is the path length in centimeters.

"Extinction" coefficient (k): is defined by the equation:

$$I(z) = I(z=0) \exp -kz$$

where I(z=0) is the total visible light energy (irradiance) incident to the air-sea interface, I(z), is the remaining light energy at the depth z (meters), and -k is the mean total "extinction" coefficient (m^{-1}) for the entire water column.

"Transmission": the degree of daylight penetration in the water (transmission of downwelling irradiance over the visible spectrum) and calculated from:

$$\% \text{ Transmission} = [I(z)/I(z=0)] \times 100\%$$

B. Instrumentation:

Current meters in use are film recording General Oceanics Model 2010.

Temperatures are measured by bathythermograph and surface bucket thermometers.

Beam transmittance measurements are obtained from a Hydro-Products Transmissometer.

Natural light attenuation within the water column is made with an irradiance meter (submarine photometer) manufactured by GM manufacturing, Inc.

C. Cruise Descriptions

1. 28 February 1975

A 3 current meter sub-surface array was installed at the Center Station, C. This station was then sampled 5 times over 4.5 hours to determine background levels in anticipation of a barge release. The results for temperature, salinity, and σ_t are tabulated in Table 1. Transmissometer and submarine photometer results are tabulated in Tables 4 and 5. Unfortunately, no barge releases were made during that day and the surface and bottom drogue tracking experiments were cancelled. Winds were calm throughout the sampling period with visibility greater than 15 miles.

2. 6 March 1975

This cruise was made to complete the drogue tracking experiment cancelled

on 28 February 1975 for lack of a barge release that day.

Three (3) stations were synoptically sampled two (2) times while waiting for a barge release to occur. The results for temperature, salinity, and σ_t are tabulated in Table 1. Two drogues, surface (2m) and bottom (14m just clear of the bottom at the release point) were launched in the wake of the barge at 1220 hours. Water column samples were taken at each drogue during the tracking. The drogues were tracked until background was reached. This experiment was performed during the tail-end of an ebb cycle. The results for temperature, salinity, and σ_t are tabulated in Tables 2 and 3. The transmissometer and submarine photometer results are tabulated in Tables 4 and 5 as well as Tables 6 and 7. A three (3) current meter sub-surface array was installed and operating at the Center Station, C, throughout the sampling period. The visibility was approximately 5 miles with haze, and the winds were from the south at 5 mph increasing to 20-25 mph by the end of the sampling period.

D. Discussion and Comments

The locations of the stations mentioned are shown in Figure 1. Station C was sampled throughout the day on February 28th, while waiting for a barged dump to take place. As can be noted from Table 1, the temperatures and salinities are as expected for that time of the year. Similarly for the data of March 6th. In both cases, the water column is fairly stable. Station W3 was also sampled that day, and shows what may be an intrusion of less saline

water during the ebb tidal cycle. This "lens" of fresher surface water adds greatly to the stability of the water column.

Temperatures and salinities are also within expectation for the cases following the drogues as tabulated in Tables 2 and 3. That is, there is nothing unusual occurring as far as these two variables are concerned.

Corresponding beam transmittance and attenuation coefficients are tabulated in Table 4a and b. The higher values of β (lower transmittance) at 20 m may in part be due to contact of the weight with the bottom causing something of a cloud; nevertheless, values of β increase with depth by a factor of 2, thus indicating that some scouring is occurring. Variations of approximately 6% in transmittance can be expected with time under no dumping conditions at both the surface and bottom; however, variations of over 50% in the average values of β over the water column are noticed. For example, the average value for β at 1200 on 28 February was 0.542, and 1.124 at 1330 hours, an increase of nearly 50%. There is a general agreement between the average beam transmittance attenuation coefficient, β, and the "extinction" coefficient, k, listed in Table 5. Variations in k with time are approximately 34% under no dump conditions (Feb. 28). Values for both β and k are in general lower in the New London Dump Site area than are corresponding values obtained in the western part of Long Island Sound.

From Table 6a it can be seen that the surface waters are comparatively unaffected by the dumped material. Values of β at 5 m (close to level where dis-

charge occurs) are relatively constant throughout the sampling interval. This is also the level (again reasonably constant) where some 20% of the surface light is still found.

Transmittance decreased at the bottom drogue to 50% at 20 m (β = 6.93) close to the time of the dump. Ten minutes later, at 1230 hours, values for transmittance have returned to background. There is no appreciable effect of the dumped material on the attenuation of the natural incident light (Table 7).

Maximum current speeds encountered on the 28th of February and the 6th of March as found from 15 minute averages are shown in Table 8. The moon was near full (new), at perigee, and near the Equator for the 28th of February; however, for the 6th of March, the moon was near quarter, in apogee, and furthest south of the Equator, hence the lower maximum speeds on this date in comparison to the 28th of February.

The resultant current velocities over half-tidal cycles for February 28th and March 6th, are tabulated in Table 9. Again, the higher velocities in February are due to the phase and position of the moon. The higher velocities also yield a higher virtual distance for the tidal cycle.

Of the 21 surface drifters launched at the dump site, only 1 has been returned and that was found at Moriches Inlet on the south shore of Long Island. Of 24 bottom drifters launched, 8 were found along the shores of Connecticut to the west of New London, and 1 from Plum Island to the south.

A copy of the current meter data that have been drawn for August 5th and September 11, 1974 are included as Figures 4 and 5.

The greatest problem we are experiencing, aside from weather, is coordinating the experiments with the dredge operations, particularly the times of the dumps.

Analysis of the data are moving forward as planned.

Table 1: Average temperature, salinity, and σ_t for stations in the New London Dump Site, for 28 February 1975 and 6 March 1975

Cruise	Station	*N	Depth z(m)	T(°C)	S°/oo	σ_t
28 Feb. 75	C	5	0	4.0	29.76	23.65
			15	3.7	30.27	24.08
6 Mar. 75	C	3	0	3.7	29.82	23.73
			15	3.8	30.45	24.22
6 Mar. 75	W1	2	0	3.9	29.47	23.43
			20	4.0	30.17	23.98
6 Mar. 75	W2	2	0	3.9	29.41	23.38
			25	4.0	30.51	24.25
6 Mar. 75	W3	2	0	3.4	28.51	22.71
			25	3.7	30.15	23.99

*Number of observations

Table 2: Observed values of temperature, salinity, & resultant σ_t as a function of depth while following surface drogue, 6 March 1975

	1220 hours			1232 hours			1250 hours			1410 hours		
(1) Z	(2) T	S°/oo	(3) σ_t	(2) T	S°/oo	(3) σ_t	(2) T	S°/oo	(3) σ_t	(2) T	S°/oo	(3) σ_t
0	4.0	29.82	23.70	4.0	29.91	23.77	3.9	29.88	23.75	4.0	29.48	23.43
5	4.0	29.85	23.73	4.0	29.90	23.76	3.9	30.03	23.88	4.0	29.92	23.77
10	4.0	29.89	23.75	4.0	29.88	23.75	4.0	30.19	24.00	4.0	30.33	24.10
15	4.0	30.07	23.90	4.0	30.19	23.99	4.0	30.40	24.16	4.0	30.48	24.22
20	4.0	30.37	24.13	4.0	30.58	24.30	4.0	30.63	24.34	4.0	30.64	24.34

(1) Depth - meters
(2) Temperature - °C
(3) σ_t - gm/cm^3

Table 3: Observed values of temperature, salinity, & resultant σ_t as a function of depth while following bottom drogue, 6 March 1975

	1227 hours			1250 hours			1350 hours		
(1) Z	(2) T	S°/oo	(3) σ_t	(2) T	S°/oo	(3) σ_t	(2) T	S°/oo	(3) σ_t
0	3.4	29.82	23.75	3.4	29.91	23.82	3.4	28.64	22.81
5	3.4	29.87	23.79	3.5	29.95	23.86	3.5	29.31	23.34
10	3.5	29.92	23.83	3.5	30.00	23.89	3.5	29.98	23.87
15	3.5	30.28	24.12	3.5	30.37	24.18	3.5	30.33	24.15
20	3.5	30.65	24.40	3.6	30.74	24.47	3.6	30.67	24.42

(1) Depth - meters
(2) Temperature -°C
(3) σ_t - gm/cm^3

Table 4: Percent Beam Transmittance, T%, and Attenuation Coefficient, $-\beta$, as a function of depth and time at the Center station

a) 28 February 1975

	Time							
	1200		1225		1330		1525	
Depth (m)	T%	$-\beta(m^{-1})$	T%	$-\beta(m^{-1})$	T%	$-\beta(m^{-1})$	T%	$-\beta(m^{-1})$
0	98	0.20	96	0.41	92	0.83	96	0.41
5	96	0.41	91	0.94	92	0.83	92	0.83
10	93	0.73	91	0.94	89	1.17	90	1.05
15	92	0.83	90	1.05	88	1.28	88	1.28
20	-	-	90	1.05	86	1.51	84	1.74

b) 6 March 1975

	Time			
	1140		1150	
Depth (m)	T%	$-\beta(m^{-1})$	T%	$-\beta(m^{-1})$
0	96	0.41	96	0.41
5	97	0.30	96	0.41
10	96	0.41	96	0.41
15	92	0.83	96	0.41
20	86	1.51	90	1.05

Table 5: The depth in meters of the percent of incident light transmitted through the water column and the average "extinction" coefficient, $-\bar{k}$, at the Center station

a) 28 February 1975

Percent	1200	1225	1330	1525
75	0.40	0.65	0.50	0.40
50	0.90	1.40	1.25	1.00
25	2.75	2.50	2.80	1.95
10	4.75	4.30	4.50	3.30
1	10.75	10.00	9.75	7.90
$-\bar{k}$	0.41	0.47	0.45	0.62

b) 6 March 1975

Percent	1140	1150
75	0.20	0.30
50	0.60	1.00
25	1.75	2.70
10	5.60	5.00
1	12.25	11.60
$-\bar{k}$	0.39	0.40

Table 6: Beam Transmittance (T) and Attenuation Coefficient (β) as a function of depth and time while following a drogue planted in the wake of the barge at 1220 hours, 6 March 1975

a) Surface Drogue

Depth (m)	1220 hrs		1240 hrs		1300 hrs		1355 hrs	
	T%	$\beta(m^{-1})$	T%	$\beta(m^{-1})$	T%	$\beta(m^{-1})$	T%	$\beta(m^{-1})$
0	98	0.20	96	0.41	98	0.20	-	-
5	96	0.41	95	0.51	97	0.30	96	0.41
10	94	0.62	95	0.51	96	0.41	97	0.30
15	96	0.41	96	0.41	96	0.41	96	0.41
20	50	6.93	95	0.51	96	0.41	96	0.41

b) Bottom Drogue

Depth (m)	1220 hrs		1230 hrs		1250 hrs		1415 hrs	
	T%	$\beta(m^{-1})$	T%	$\beta(m^{-1})$	T%	$\beta(m^{-1})$	T%	$\beta(m^{-1})$
0	98	0.20	98	0.20	97	0.30	98	0.20
5	96	0.41	96	0.41	95	0.51	97	0.30
10	94	0.62	96	0.41	95	0.51	97	0.30
15	96	0.41	98	0.20	94	0.62	97	0.30
20	50	6.93	96	0.41	-	-	96	0.41

Table 7: The depth in meters of the percent of incident light transmitted through the water column and the average "extinction" coefficient, $-\bar{k}$, while following drogues implanted after a barge dump on 6 March 1975

a) Surface Drogue

	Time			
Percent	1220	1240	1300	1355
75	0.20	0.25	0.20	0.20
50	0.75	1.00	0.50	0.60
25	2.90	2.90	2.80	2.60
10	4.90	6.10	5.70	5.70
1	11.70	12.75	12.80	13.50
$-\bar{k}$	0.38	0.35	0.35	0.33

b) Bottom Drogue

	Time			
Percent	1220	1230	1250	1415
75	0.20	0.40	0.40	0.30
50	0.75	1.00	1.20	0.95
25	2.90	2.90	2.80	2.80
10	4.90	6.20	6.15	5.10
1	11.70	12.95	12.50	12.35
$-\bar{k}$	0.38	0.35	0.35	0.36

Table 8: Maximum speeds over 15 minute averages

Date	Depth	R(cm/sec)	θ(°True)
28 Feb. 1975	Surface	100.0	101
	Mid	59.3	95
	Bottom	61.1	100
6 March 1975	Surface	70.8	93
	Mid	49.0	91
	Bottom	33.6	97

Table 9: The resultant current velocities at Center Buoy stations

	Date	Z(m)	(1) u	(1) v	(1) R	(2) θ	(3) D(R)	(4) t	(1) u	(1) v	(1) R	(2) θ	(3) D(R)	(4) t
Surface	28 II 75	7.5	-3.3	-3.4	4.8	224		0.5	40.2	-21.0	45.4	118	9.1	5.1
	6 III 75	5.5	-	-	-	-	-	-	39.6	-8.0	40.4	101	7.6	5.1
Mid depth	28 II 75	13.5	-	-	-	-	-	-	33.8	-11.4	35.7	109	7.7	5.7
	6 III 75	11.5	-10.9	-4.9	12.0	246	-	0.5	28.6	-4.0	28.9	98	4.7	4.4
Bottom	28 II 75	20.5	-1.2	-4.1	4.3	196		0.5	31.9	-18.6	36.9	120	7.4	5.2
	6 III 75	18.5	-12.8	0.9	12.8	274	0.7	1.5	23.6	-0.5	23.6	91	2.9	3.5

(1) cm/sec
(2) degrees (circular) relative to geographic North
(3) kilometers
(4) hours

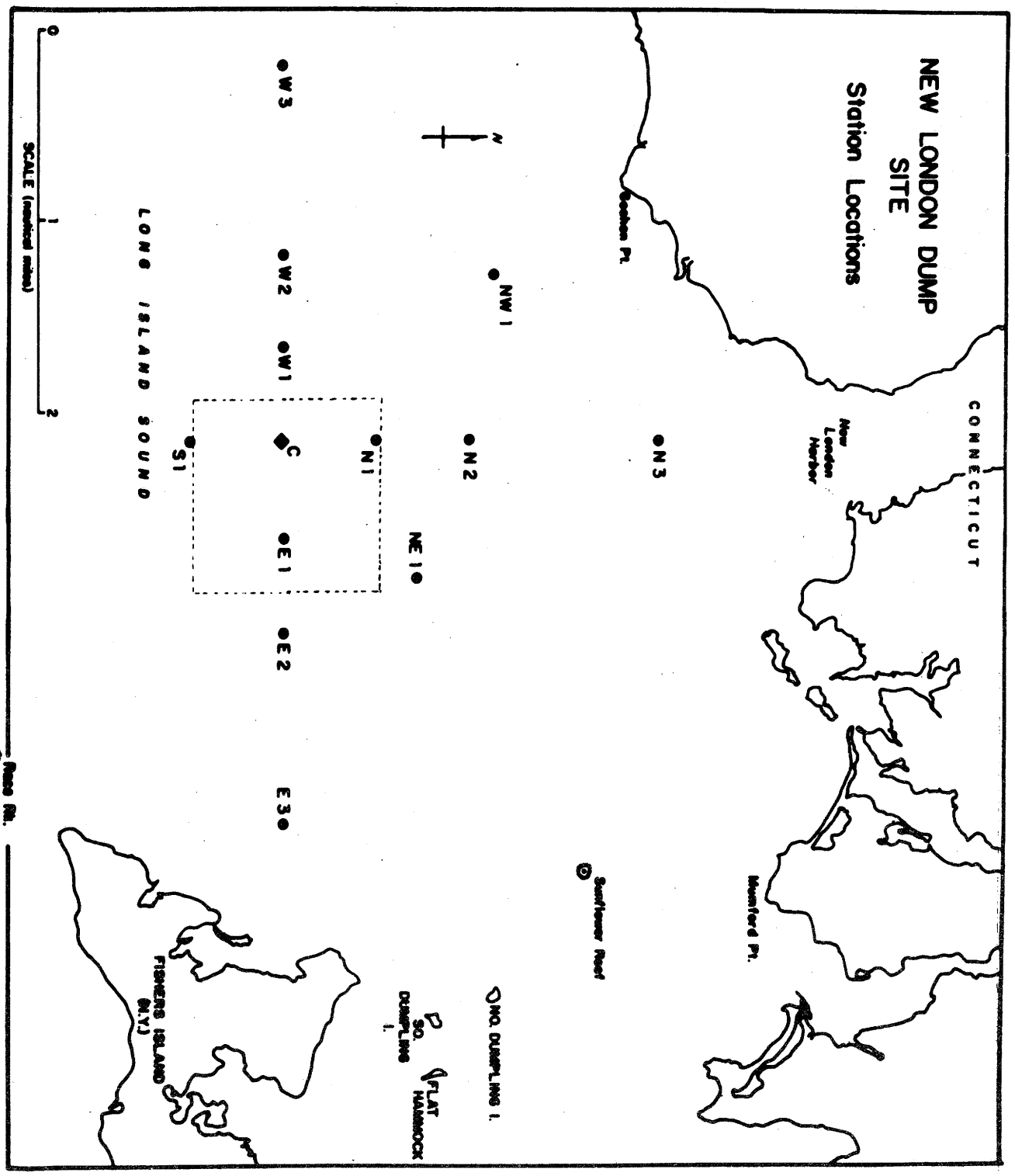

Figure 1: Map of Dump Site (dotted square) and station locations

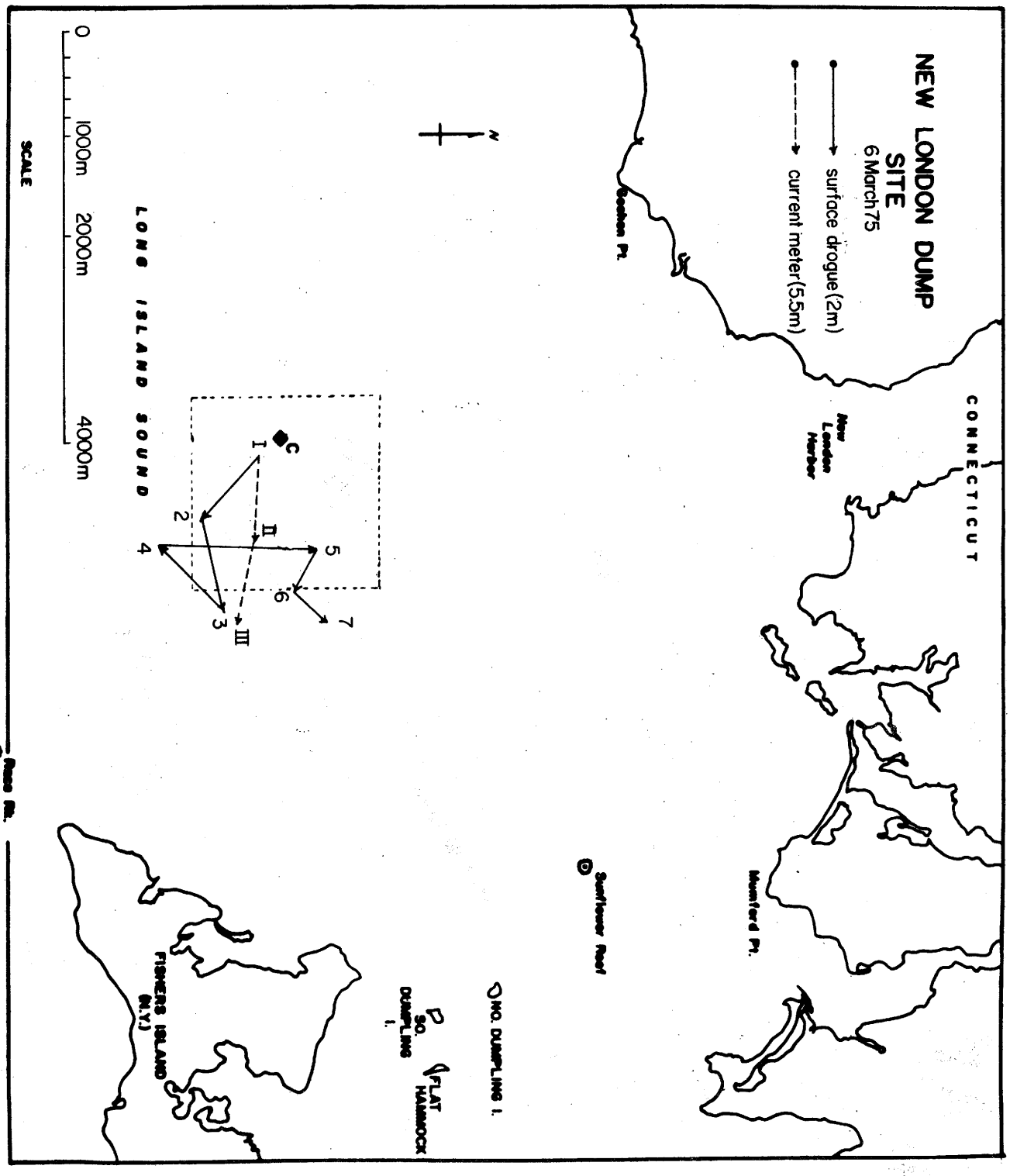

Figure 2: Displacement diagram for surface drogue and corresponding current meter data, 6 March 1975

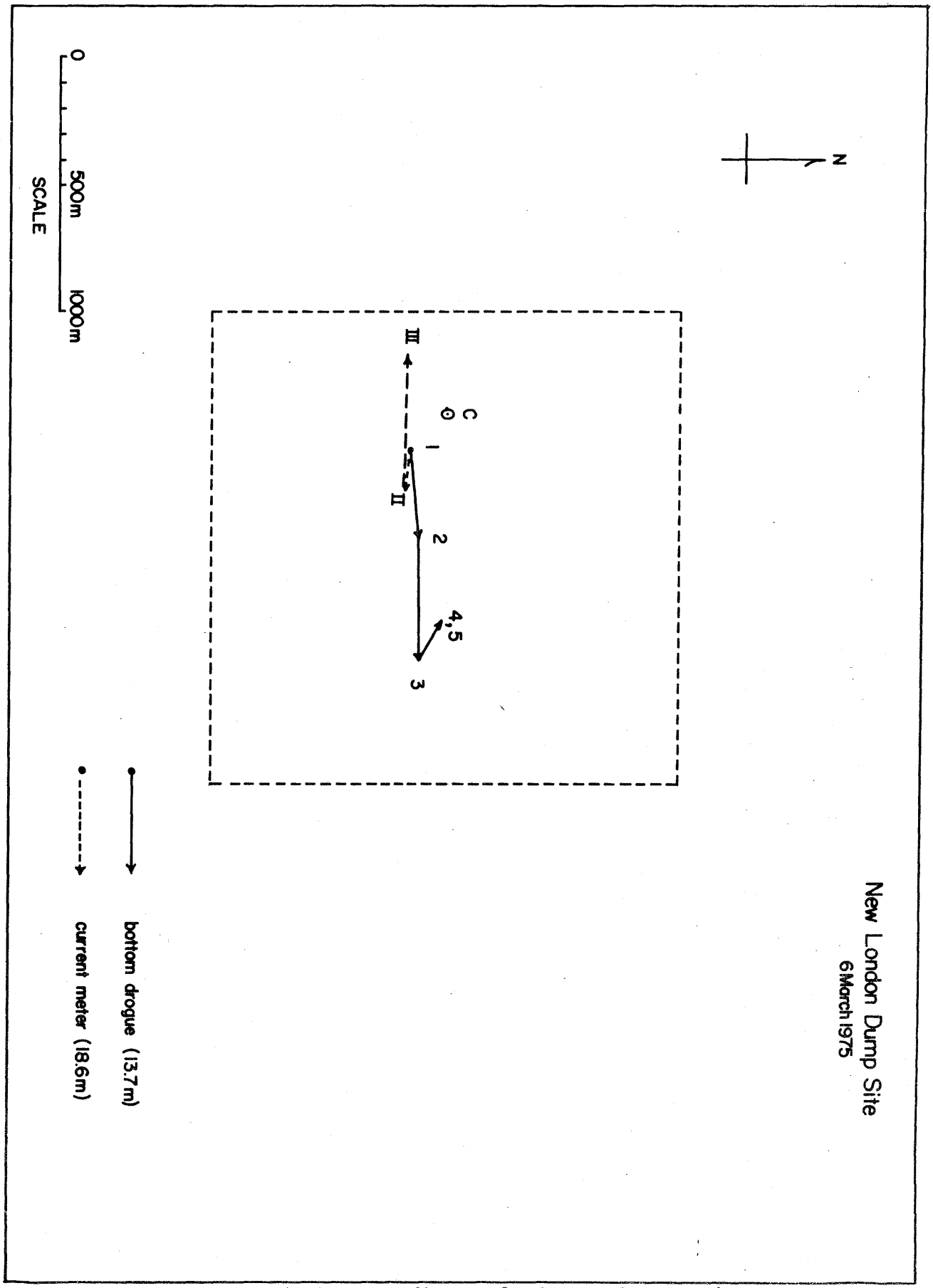

Figure 3: Displacement diagram for bottom drogue and corresponding current meter data, 6 March 1975

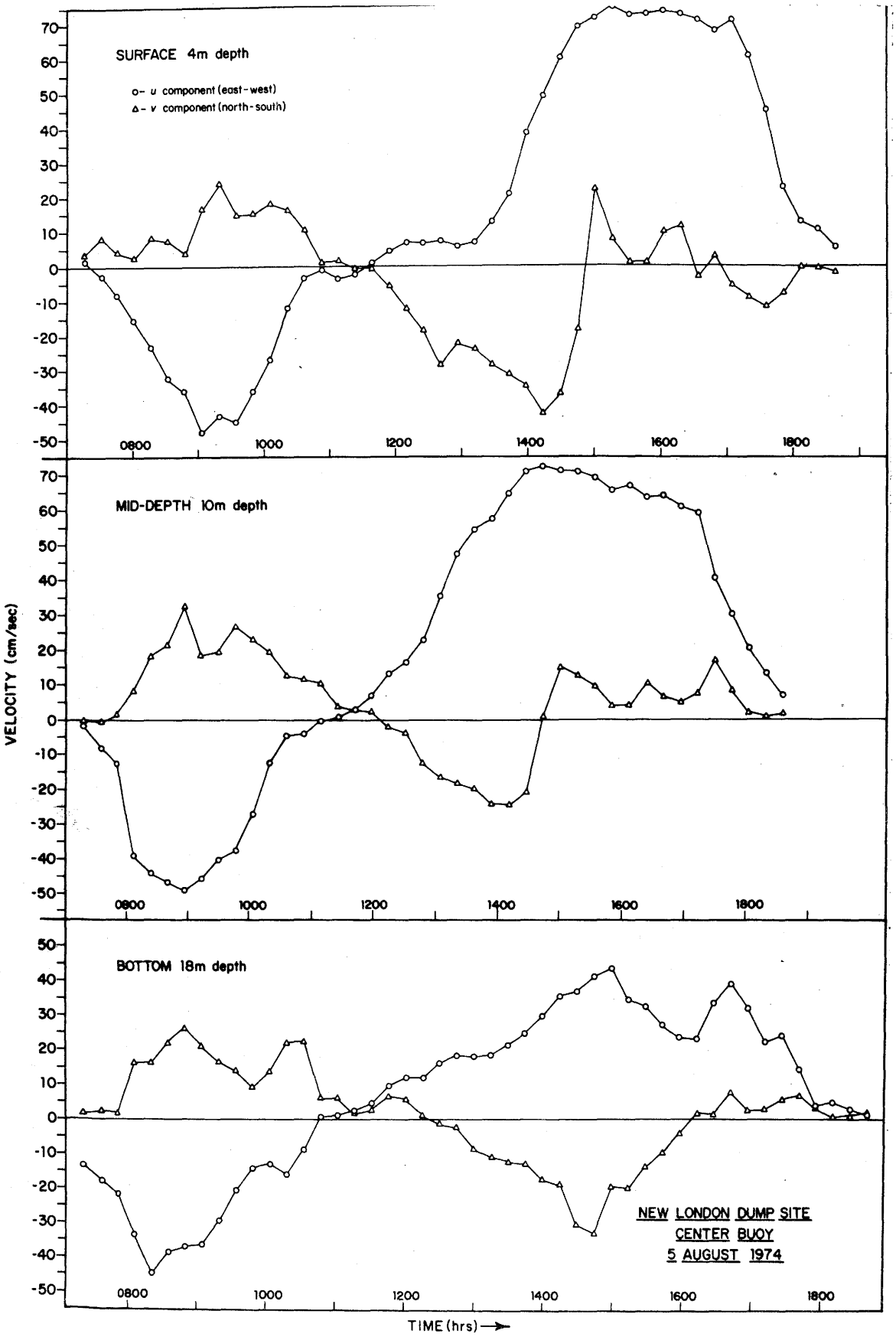

Figure 4: Current meter results for 5 August 1974

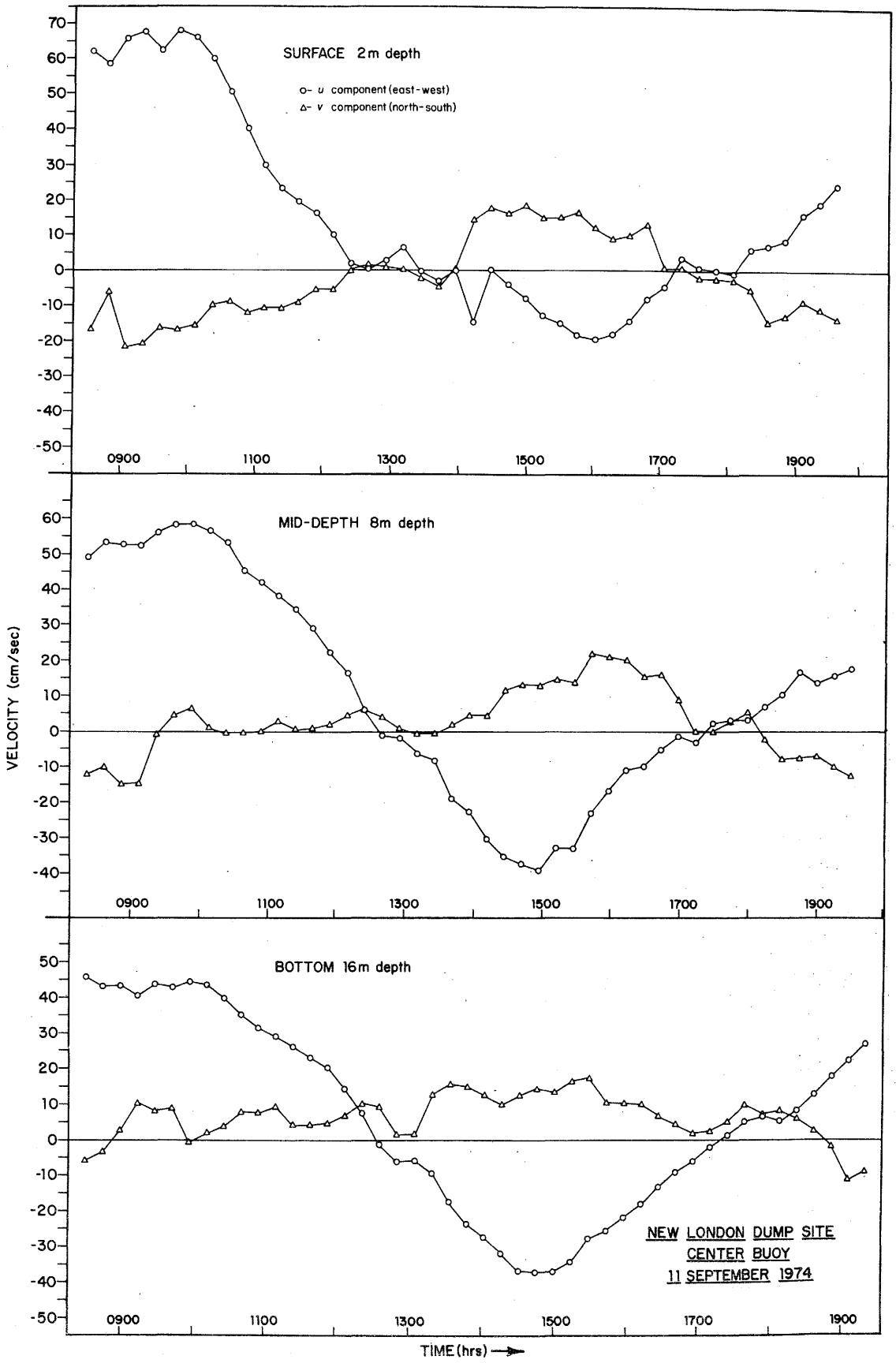

Figure 5: Current meter results for 11 September 1974

APPENDIX D

QUARTERLY REPORT

Chemical Oceanography

of the

New London Dump Site Area

January through March, 1975

Submitted to

Sandy Hook Laboratory

Middle Atlantic Coastal Fisheries Center

National Marine Fisheries Service

NOAA/U.S. Dept. of Commerce

Contract No. 03-5-043-303

by

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Introduction

Previous reports have presented the rationale behind these studies. These reports have also been primarily concerned with the dump site as a total entity. In the winter months experiments were conducted in the water column to determine the fate of the materials contained in a particular plume generated by a dump.

As indicated in our proposal the water column near the dump buoy was to be sampled just prior to a dump. Two drogues were to be planted, one in the surface layer and the other in the bottom immediately following the dump. These drogues were to be tracked and the water column at each drogue sampled at least on an hourly basis.

The quarterly sampling for seston and the benthic organisms was to be accomplished. This report represents the results of the work accomplished through March, 1975.

Methods

Detailed descriptions of both the field and laboratory procedures employed for the collection, on board processing and subsequent laboratory analysis are contained in our October through December, 1974 Quarterly Report.

For the convenience of the reader, Figures 1 and 2 depict the location of the sampling stations in the water column and the sediments respectively.

All of the sampling efforts associated with the winter studies were completed

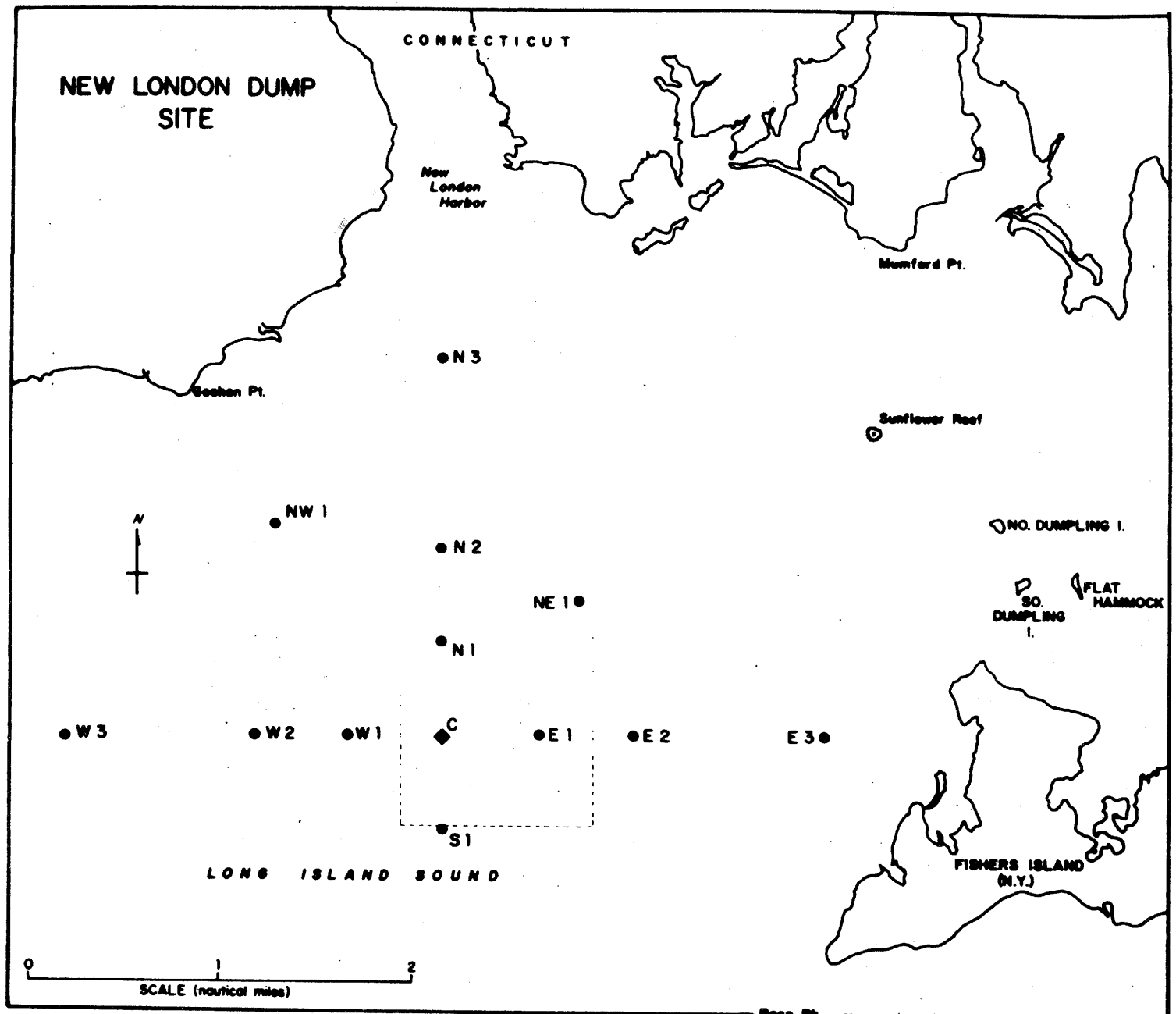


Figure 1. Station locations in the New London Dump Site Area. Water Column

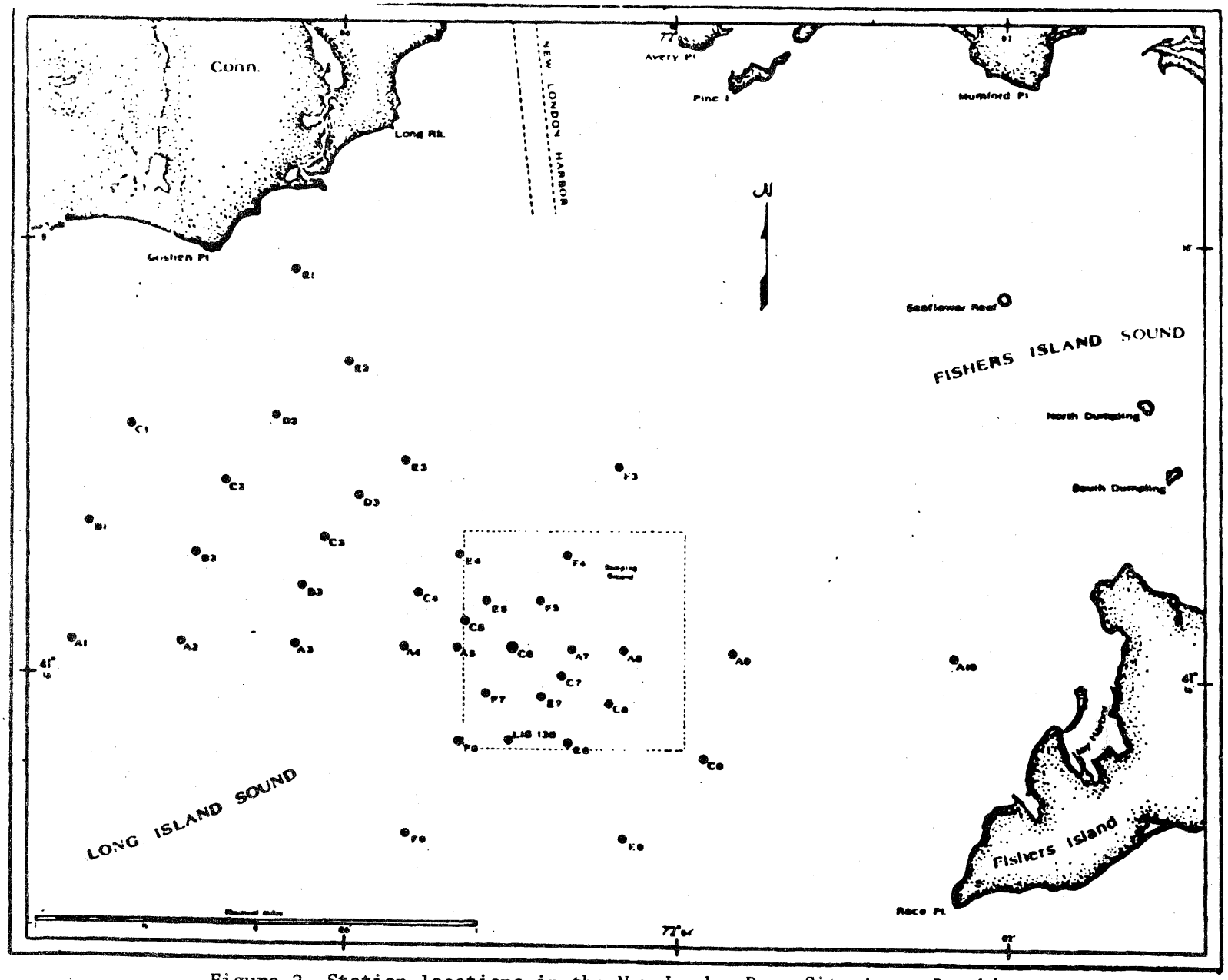


Figure 2. Station locations in the New London Dump Site Area. Benthic.

in January (sediments and benthic biota) and in late February and early March (water column and seston). Cruise reports pertaining to the water column and seston sampling are appended. The benthic sampling efforts were conducted in conjunction with the Sandy Hook Laboratory.

Results

A. Water

1. Dissolved Oxygen. The effect of the released materials on the concentration of dissolved oxygen present in the surface, mid and bottom waters is shown in Figure 3. As shown in the figure oxygen concentration which had decreased to 54 percent in the bottom water had returned to background (approximately 80 percent of saturation) within 10 minutes following the dump. No perturbations were noted in the surface waters. The movement of the surface and bottom drogues is shown in Figure 4a and b.

This "recovery time" is considerably faster (by a factor of at least 4) than was noted in the earlier experiments. This may (or at least in part) be attributed to the sediment particle size as shown in Table 1.

Table 1

Average particle sizes suspended in the bottom waters immediately following the release of barged materials

Particle size	>63μ	<63->3.9μ	<3.9μ
Average, %	24.7	61.8	13.6
Range, %	18.3-31.1	61.2-62.3	7.7-19.4

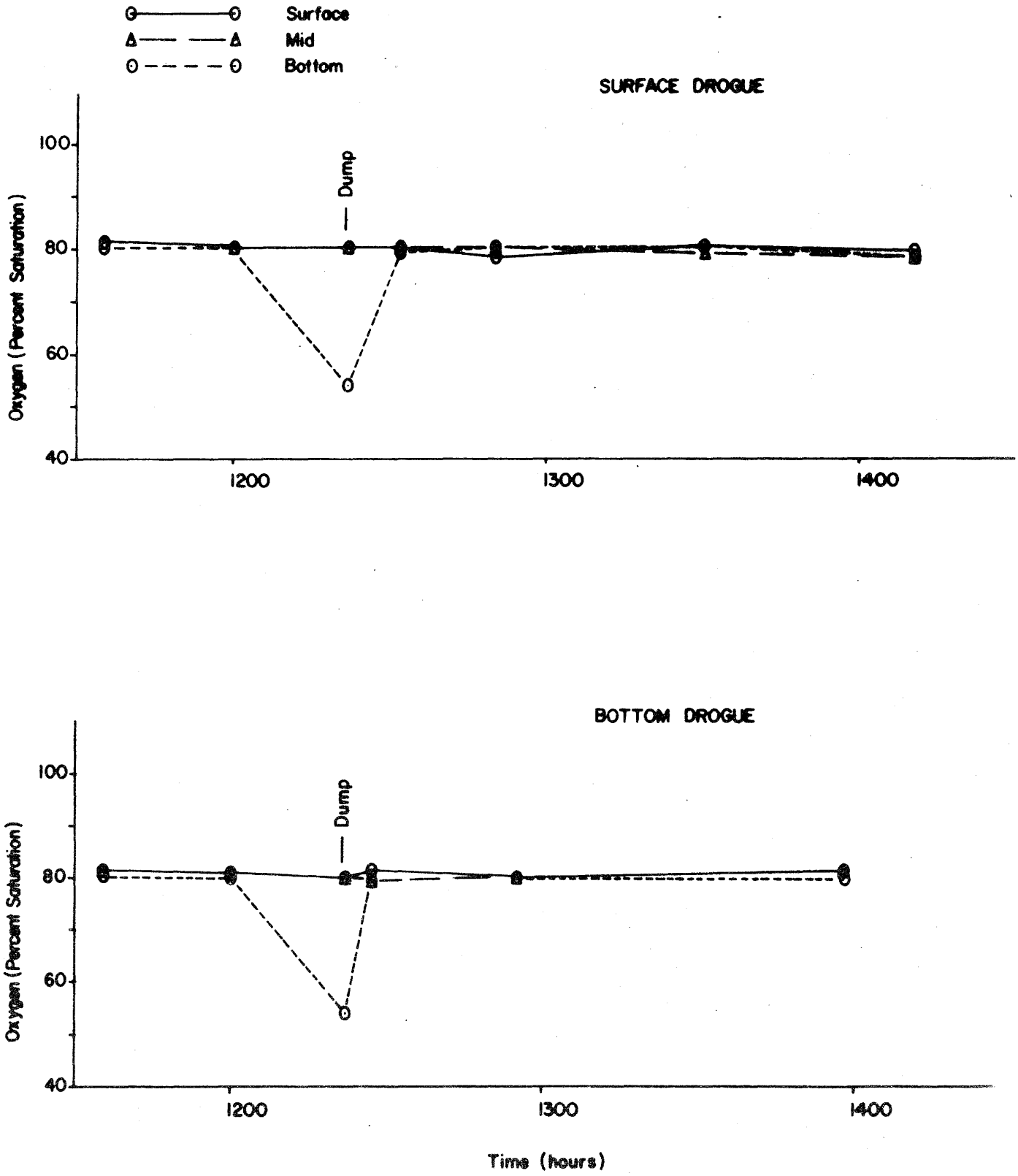


Figure 3. Dissolved oxygen concentration (percent saturation) versus time. 6 March 1975

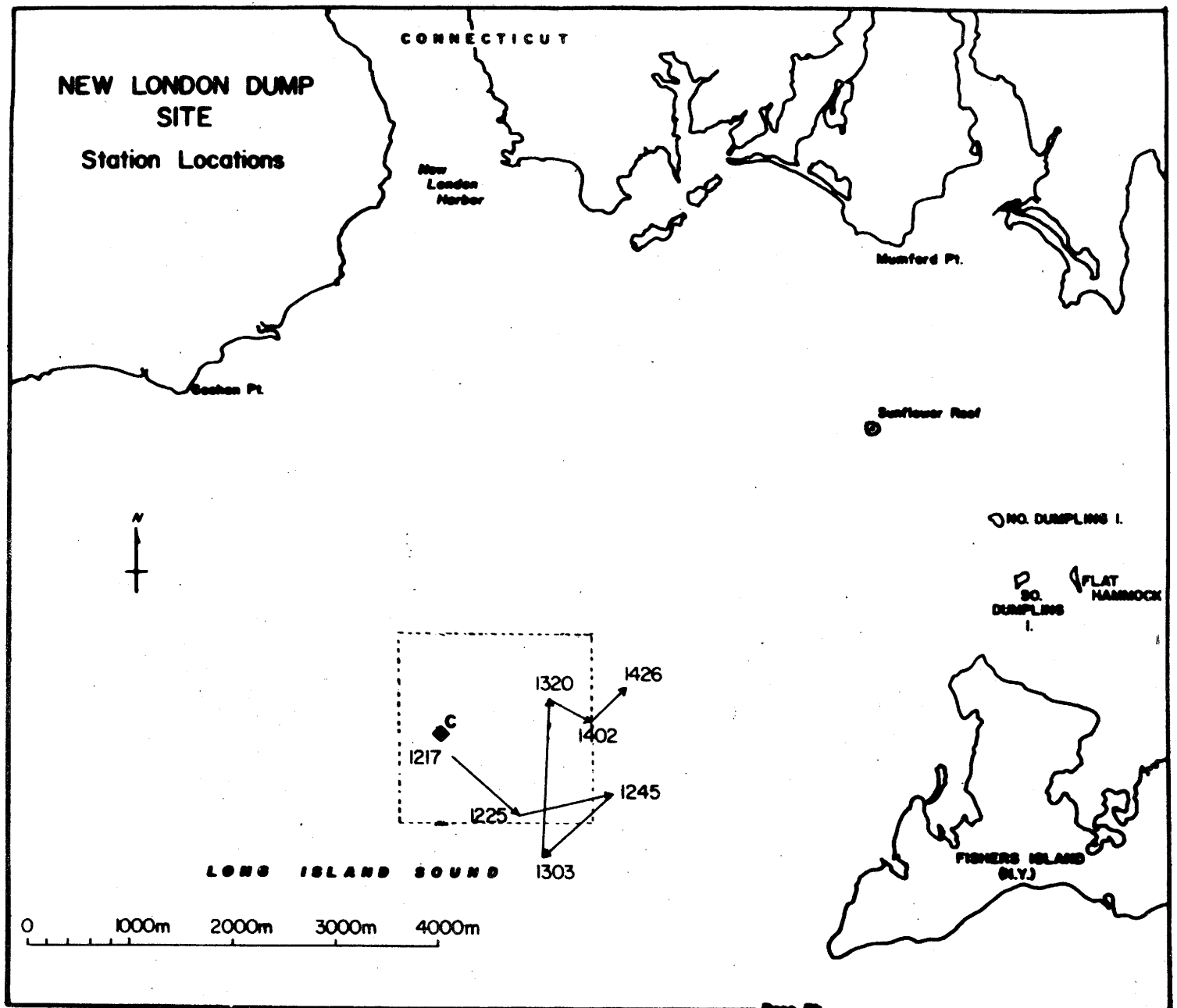


Figure 4a. The direction and distance traveled by the surface drogue. 6 March 1975.

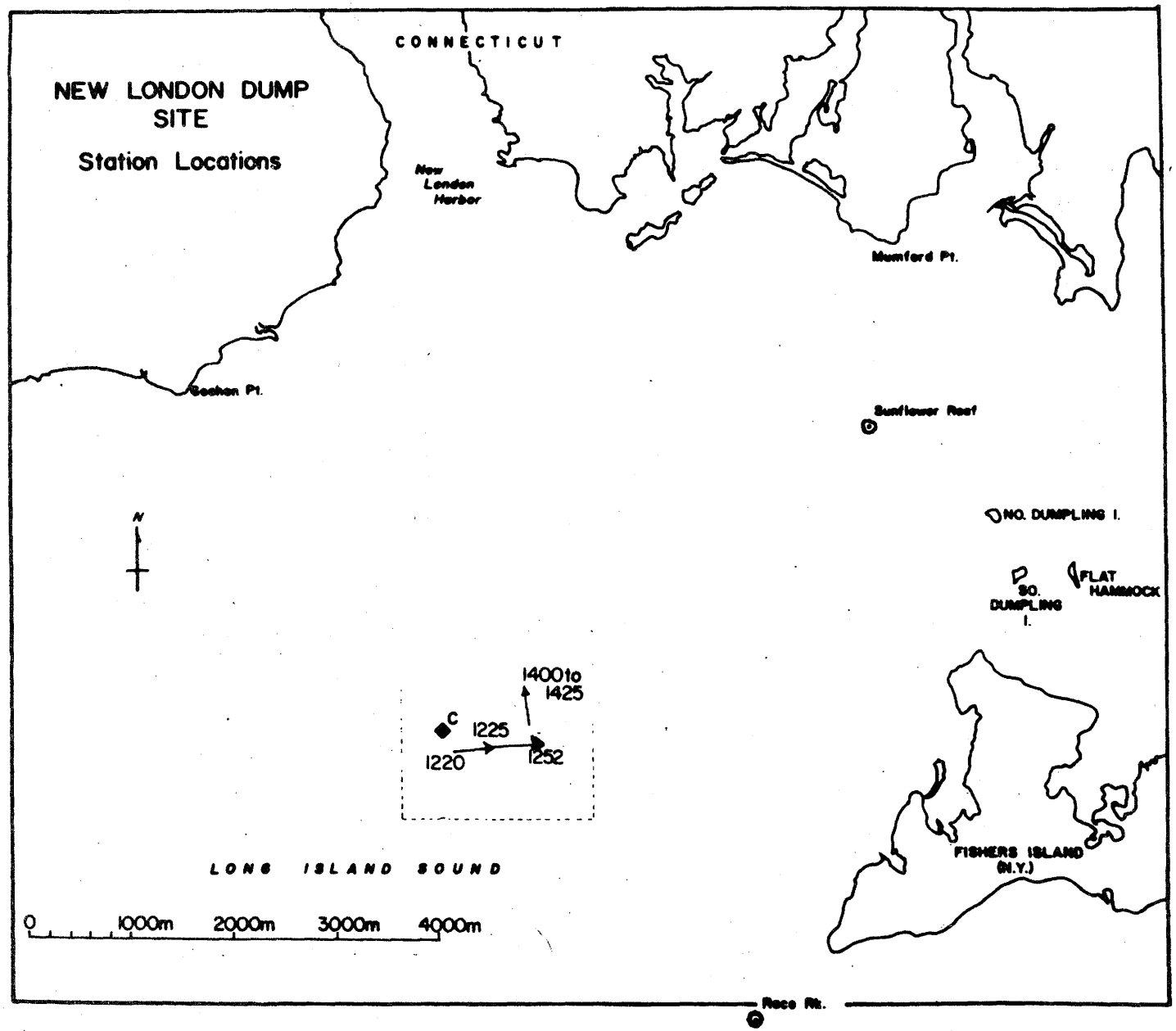


Figure 4b. The direction and distance traveled by the bottom drogue. 6 March 1975.

The background concentrations of oxygen observed in the area during this sampling do not differ markedly from historical data (Riley and Conover, 1956; Alexander, unpub. data).

2. pH. Figure 5 depicts the effect of the released materials upon the pH of the water. No significant changed in the pH of the waters were noted.

3. Eh. As shown in Figure 6, no significant changes in the Eh of the water occurred as a result of dumping activities.

4. Total Organic Carbon. These analyses are incomplete and will be reported on in the next report.

5. Suspended and Volatile Solids. Figures 7a and 7b depict the distribution of suspended and Figure 8 volatile solids following the release of barged materials on 6 March, 1975. The effects were no longer detectable beyond 33 minutes following the release.

B. Organisms and Sediments

Seston and Benthic Organisms. Table 2 lists the Kjeldahl nitrogen and phosphorus content of the seston and selected benthic organisms. For a more meaningful interpretation of the nitrogen and phosphorus data the N/P ratios and the range of these ratios are presented wherever possible.

Although there is a tendency in the range of the N/P ratio to increase with time (seston) the relative consistency of the N/P ratio itself indicates

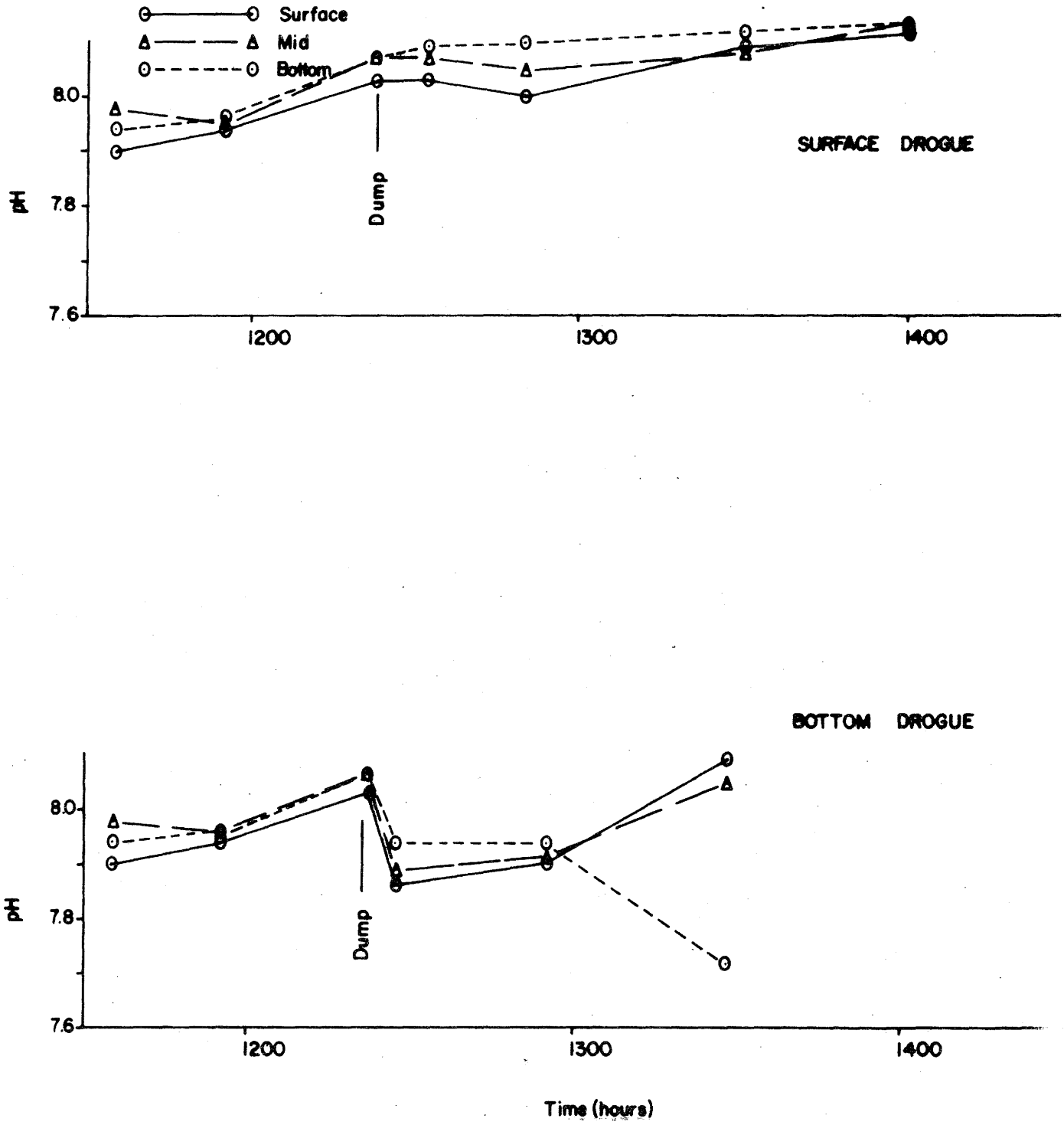
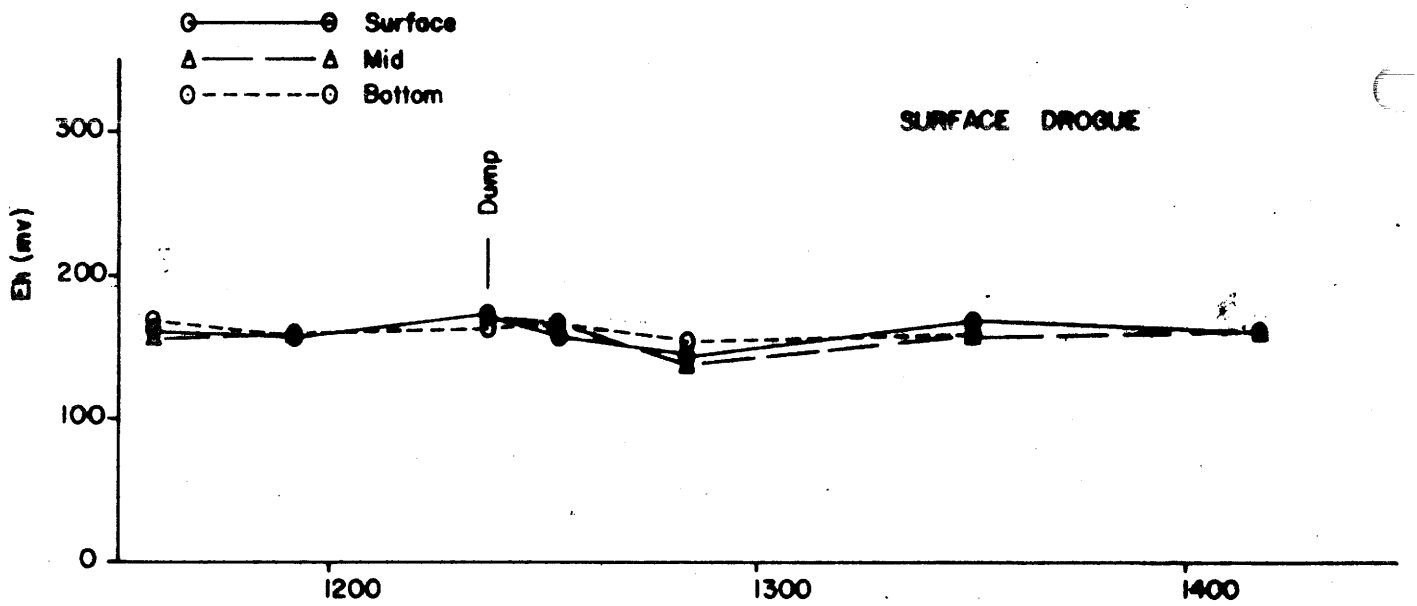


Figure 5. pH versus Time - 6 March 1975



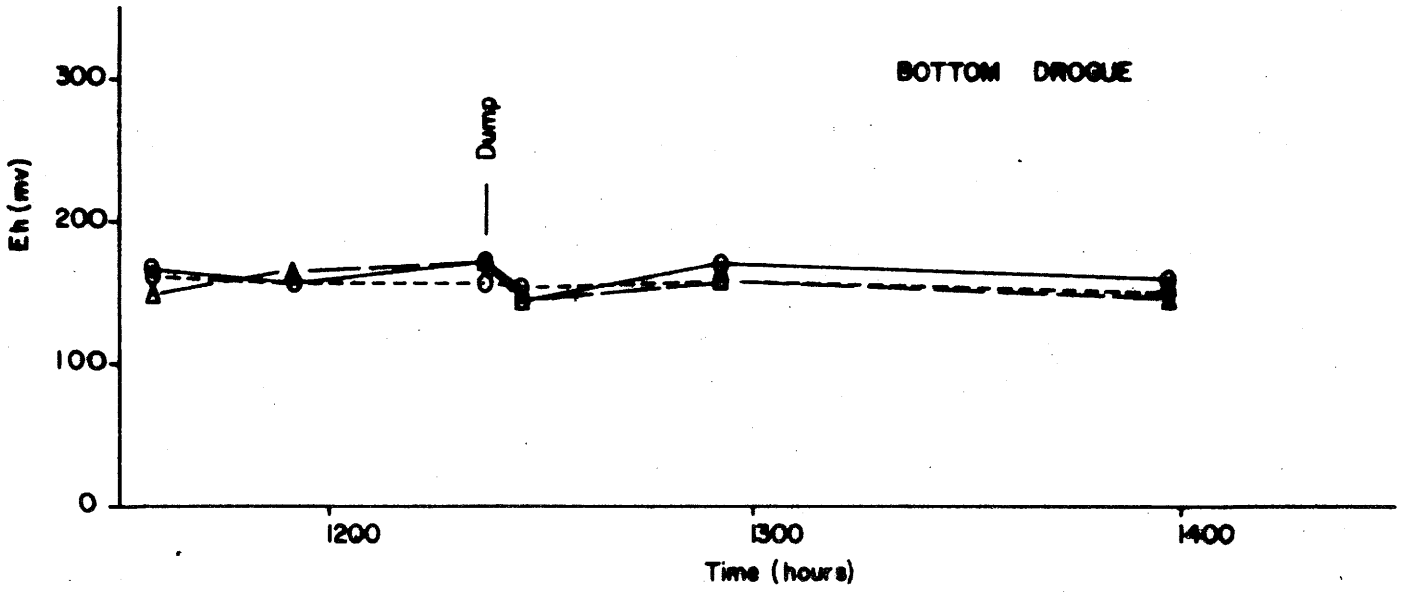


Fig. 6. Eh vs. Time - 6 March 1975

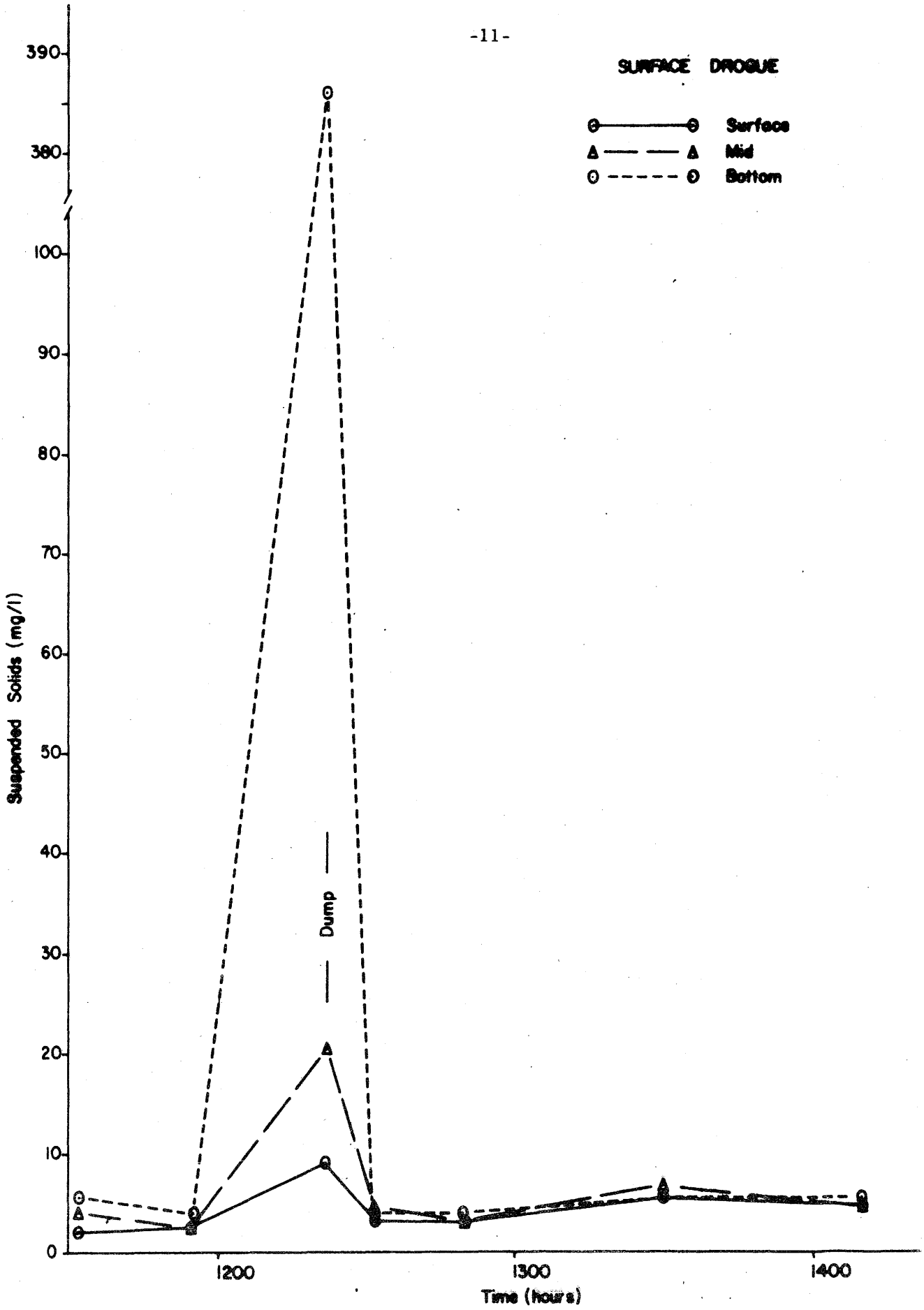


Fig. 7a. Suspended Solids vs. Time
6 March 1975

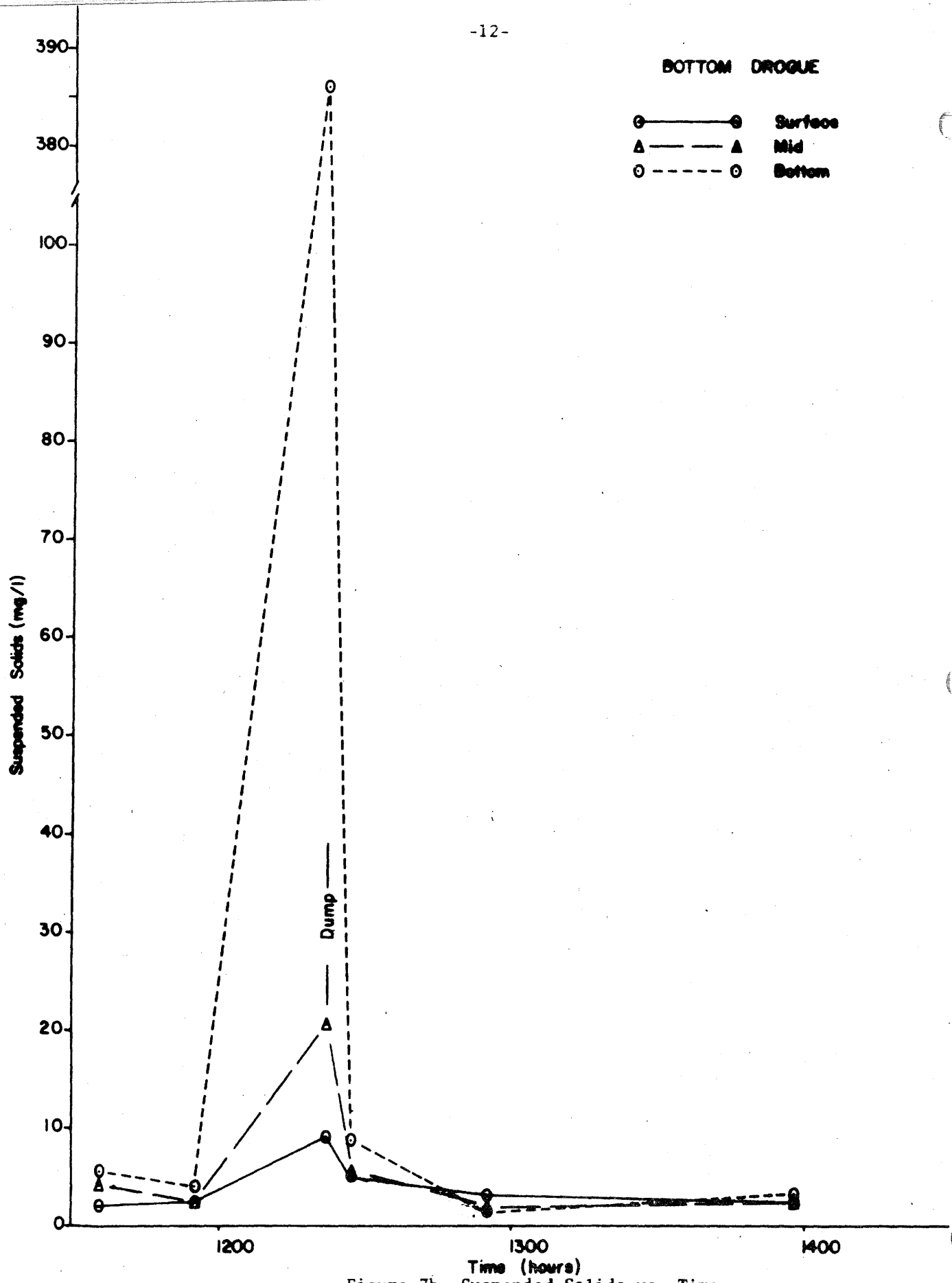


Figure 7b. Suspended Solids vs. Time
6 March 1975

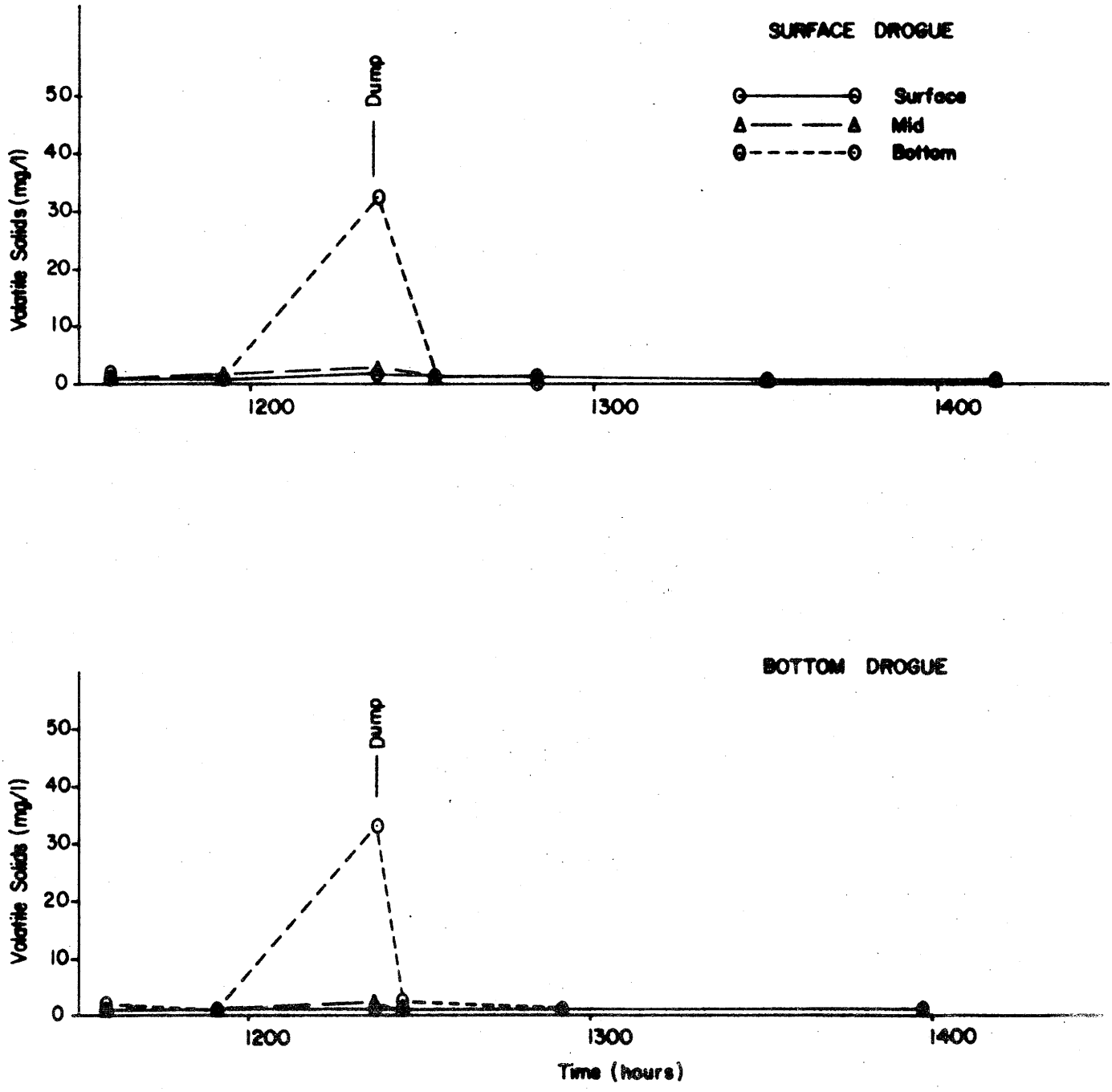


Figure 8. Volatile Solids vs. Time
6 March 1975

Table 2: Kjeldahl Nitrogen and Phosphorus in Benthic Organisms and Seston
New London Dump Area

Sample	Sample Date	Phosphorus %w(dry)		Kjeldahl Nitrogen %w(dry)		N/P Ratio	
		Average[a)]	Range	Average[a)]	Range	Average[a)]	Range
Mytilus	Oct. 1974	0.49	-	11.54	-	23.6	-
Busycon	Oct. 1974	-	-	21.35	-	-	-
Mercenaria	Oct. 1974	0.59	-	8.14	-	13.8	-
Anemone	Oct. 1974	0.35	-	7.45	-	21.2	-
Polychaeta	Oct. 1974	0.58	0.49-0.66	-	-	-	-
Seston	Aug. 1974	0.92	0.85-0.99	12.21	11.02-13.40	13.3	13.0-13.5
Seston	Sept. 1974	0.52	0.39-0.96	6.73	4.59- 8.88	12.9	13.9-30.6
Seston	Dec. 1974	0.57	0.24-1.24	9.92	4.56-11.94	17.4	8.2-49.7

a) When no range is given the average = the value found for a single sample

that the observed changes are due primarily to sampling. The N/P ratios in the benthic organisms are based on single samples.

The analyses of the winter seston and benthic organisms are in progress.

The trace metal content (Table 3) of the benthic organisms show no trends which would indicate that their heavy metal concentration is increasing.

C. Sediments

Analyses for the chemical oxygen demand, Kjeldahl nitrogen and total phosphorus content of the bottom sediments are in progress and will be reported on in the next report. Over 50 percent of these analyses have been completed. Samples for the remaining analyses were received last week from the Sandy Hook Laboratory.

Table 3: Heavy Metals in Benthic Organisms
New London Dump Site, July, Oct. and Jan. Samples
ppm, dry wt.

Organism	Cd July	Cd Oct.	Cd Jan.	Cu July	Cu Oct.	Cu Jan.	Hg July	Hg Oct.	Hg Jan.	Fe July	Fe Oct.	Fe Jan.	Ni July	Ni Oct.	Ni Jan.	Pb July	Pb Oct.	Pb Jan.	Zn July	Zn Oct.	Zn Jan.
Mercenaria																					
Avg.	<2	2.2	0.8	46	17	16	1.4	<0.3	<0.3	840	1950	460	9	13	14	6	18	<5	241	289	289
Range[a)]		1.4-2.8	0.4-1.1	24-147	11-32	10-19	0.3-2.1	<0.3-0.6		380-1780	1280-2700	280-560	5-12	10-16	11-16	<4-13	10-27	<5-5	168-295	149-409	202-414
Cardita																					
Avg.	7	4	4	60	44	32	8	-	-	1000	680	920	8	<5	10	10	19	<5	96	50	110
Range[a)]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Astarte																					
Avg.	<2	-	<1	73	-	38	4	-	<0.3	510	-	1100	7	-	10	<4	-	<10	122	-	170
Range[a)]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polychaeta																					
Avg.	<2	1.1	0.6	52	32	16	1.3	<0.3	<0.3	2700	6550	7070	23	8	7	15	34	10	166	157	158
Range[a)]	-	0.6-2	-	27-77	24-46	-	1.2-1.4	<0.3-0.3		1300-4100	5900-7300	-	10-36	6-9	3-10	12-19	24-45	<5-15	132-200	103-245	137-179
Halichondria																					
Avg.	<2	-	-	26	-	-	0.9	-	-	690	-	-	7	-	-	20	-	-	68	-	-
Range[a)]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cliona																					
Avg.	<2	-	-	30	-	-	< .2	-	-	4400	-	-	<2	-	-	13	-	-	128	-	-
Range[a)]	-	-	-	27-32	-	-	-	-	-	2600-6700	-	-	-	-	-	11-15	-	-	81-174	-	-
Mytilus																					
Avg.	-	2	-	-	21	-	-	0.9	-	-	6140	-	-	15	-	-	36	-	-	225	-
Range[a)]	-	-	-	-	20-21	-	-	-	-	-	5810-6415	-	-	12-18	-	-	32-40	-	-	220-230	-
Busycon																					
Avg.	-	0.8	-	-	33	-	-	<0.3	-	-	50	-	-	2	-	-	4	-	-	72	-
Range[a)]	-	-	-	-	29-36	-	-	-	-	-	<20-80	-	-	<2-2.6	-	-	2-5	-	-	67-78	-
Anemone																					
Avg.	-	1	-	-	9	-2	-	<0.3	-	-	4720	-	-	22	-	-	11	-	-	110	-
Range[a)]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

a) When no range is given the average = the value found for a single sample

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NEW YORK OCEAN SCIENCE LABORATORY
CRUISE REPORT NL-8
New London Dump Site
SR74-48
28 February 1975

I. OBJECTIVES

To continue sampling associated with water quality studies of the New London Dump Site.

II. ACTUAL SCHEDULE

28 February 1975
(Friday)

0855 - Departed Deep Sea Club
1030 - Arrived New London Dump Site
1045 - Implanted current meter array
1145 - Commenced background sampling near center buoy
1630 - Terminated sampling and retrieved current meter array
1645 - Departed New London Dump Site
1830 - Arrived Deep Sea Club

III. VESSELS INVOLVED

R/V Swordfish
R/V Louise
Whaler 19

IV. OPERATIONS

Background water quality sampling initiated after being informed by dredging operation crew that barge releases would be taking place every two to three hours.

However, there were no barge releases throughout the day and sampling was terminated at 1630 hrs. Drogue tracking was not initiated.

V. PROBLEMS

Pumps for filtering apparatus for chemical analysis unable to work off AC generator on *R/V Swordfish*. Filtering completed using shore power at Deep Sea Club.

Unable to get definitive answers from dredge operations crew as to when estimated times of barge releases would take place.

VI. PERSONNEL

H. DeCastro	Captain, *R/V Swordfish*
D. Uttley	Captain, *R/V Louise*
T. White	Chief Scientist
J. Schneidmuller	Technical Aide
H. Dubois	Marine Technician
T. Chiuchiolo	" "
T. Gaines	Technical Aide
S. Gill	Research Assistant
T. Chico	Marine Technician
T. Condit	" "

NEW YORK OCEAN SCIENCE LABORATORY
CRUISE REPORT NL-9
SR74-48
6 March 1975

I. OBJECTIVES

To continue sampling associated with water quality studies of the New London Dump Site.

II. ACTUAL SCHEDULE

6 March 1975
(Thursday)

0705 - Departed Deep Sea Club
0900 - Arrived New London Dump Site
0915 - Implanted current meters at center station
1025 - Commenced sampling stations W3, W2 and C
1150 - Pre-dump sampling initiated stations W1 and C
1215 - Surface and bottom drogues away - Post-dump sampling initiated
1430 - Terminated sampling
1440 - Retrieved drogues, current meters- Departed New London Dump Site
1530 - Arrived Deep Sea Club

III. VESSELS

R/V Swordfish
R/V Louise
Whaler 19

IV. OPERATIONS

Surface drogue tracked by *R/V Louise*. Bottom drogue tracked by *R/V Swordfish*. Drogues were released close to the end of the ebb cycle. Whaler 19 sampled waters for transmissivity and light attenuation.

V. PROBLEMS

A-C generator on *R/V Swordfish* not working properly. Filtering completed at Deep Sea Club using shore power.

VI. PERSONNEL

D. Uttley	Captain, *R/V Louise*
T. Condit	Captain, *R/V Swordfish*
T. White	Chief Scientist
J. Schneidmuller	Technical Aide
H. Dubois	Marine Technician
T. Chiuchiolo	" "
T. Gaines	Technical Aide
S. Gill	Research Assistant
T. Chico	Marine Technician

NEW YORK OCEAN SCIENCE LABORATORY
CRUISE REPORT NL-10
New London Dump Study
Project SR74-48D

I. ACTUAL SCHEDULE

7 March 1975
(Monday)

0530 - Depart Montauk enroute New London Dump Site
0730 - Arrive Station S1 and commence plankton tows
1315 - Complete plankton tows
1430 - Commence background plankton sampling in Block Island Sound
1530 - Arrive Montauk, N.Y.

II. VESSEL INVOLVED

R/V Swordfish

III. SAMPLE LOCATION

Since the waters were isothermal, surface and bottom tows were made at Stations S1, CB, N1, N2, N3, W3, W2, W1, F1, F2, and E3. These tows were made for 20 minutes. While enroute to Montauk, two surface nets were towed simultaneously for 1/2 hour in Block Island Sound.

IV. PERSONNEL

D. Uttley	Captain, *R/V Swordfish*
Dr. J. Alexander	Chief Scientist
Mr. T. Chiuchiolo	Marine Technician
Mr. H. Dubois	Marine Technician

Revised Table 4 for Appendix D, 2nd Quarterly Report
(Note changes in phosphorus data)

Table 4. The chemical oxygen demand, Kjeldahl nitrogen and total phosphorus concentration of the sediments - Composite samples, New London Dump Site.

Station		C.O.D. (mg/kg)		Kjeldahl Nitrogen (mg/kg)		Total Phosphorus (mg/kg)	
		July	October	July	October	July	October
A	1	1670	2020	120	170	287	238
	2	7140	3090	310	230	398	296
	3	15700	10400	660	460	344	488
	4	50700	23100	940	950	691	372
	5	36300	14300	1350	640	426	432
	7	63200	39500	1220	1850	474	472
	8	48400	71100	1020	1440	561	489
	9	20300	6150	380	560	572	567
	10	N.S.	13300	N.S.	360	N.S.	668
B	1	20400	10300	1080	500	272	574
	2	13100	25100	470	640	514	578
	3	29600	13600	1110	780	409	500
C	1	3600	16900	130	950	162	386
	2	3450	3930	130	120	196	368
	3	25300	18400	950	770	536	565
	4	17700	24900	660	930	405	514
	5	42800	29100	1180	1490	517	567
	6	38600	65800	1140	1700	498	677
	7	29700	31500	920	1290	454	661
	8	23800	17300	790	700	518	626
	9	19700	23100	800	1100	487	628
D	1	930	N.S.	50	N.S.	107	N.S.
	2	1390	1630	40	40	138	168
	3	23400	16200	640	680	656	582
E	1	4990	3480	130	120	243	284
	2	6890	19200	280	480	248	608
	3	N.S.	51300	N.S.	840	N.S.	583
	4	21400	35600	750	1570	436	620

Table 4 (cont.)

Station	C.O.D. (mg/kg)		Kjeldahl Nitrogen (mg/kg)		Total Phosphorus (mg/kg)	
	July	October	July	October	July	October
E 5	40400	39500	1310	1180	538	530
7	50500	34400	1600	1300	432	536
8	28900	21300	900	1770	557	522
9	N.S.	17700	N.S.	780	N.S.	428
F 3	36500	15200	900	540	412	533
4	73200	55900	850	1280	467	628
5	52000	71200	1440	2020	527	681
7	81300	51100	3060	1840	769	642
8	20100	15100	810	780	338	385
9	10600	12800	760	720	431	485

APPENDIX E

THIRD QUARTELRY REPORT ON THE DEMERSAL FISH POPULATION OF THE NEW LONDON DREDGED MATERIAL DUMP SITE

April 4, 1975

Submitted:

Dr. Robert J. Valenti
Associate Research Scientist

Trawling operations were conducted on February 18 and 19, to sample the demersal fish populations in the area of the New London Dump Site, in accordance with contract No. SR-74-48-F.

Methodology:

Tows were made using 35' lead rope otter trawl (2" s.m. body, 1" s.m. cod end 1/4" s.m.) at nine stations for a period of fifteen minutes. At stations A2 and C2 triplicate tows were made, while duplicate tows were conducted at Station C6. The remaining stations (A4, A8, A9, E8, E9, F4 and F8) were sampled once with length frequencies taken from stations A8, E8-E9, F-4 and F-8. Bottom temperatures and salinities were measured before each tow at individual stations. This information is represented in Table I. All fish captured were identified and enumerated as indicated in Table II, while a representative sample of each species was kept for laboratory analysis.

Laboratory analysis included measurements of standard length (mm.) and total weight(g) of each fish. Gonads were excised, weighed and examined to determine sex. Stomachs were removed, and contents were identified to the lowest possible taxa and weighed. Ages were calculated by counting annular rings on scales, and/or otoliths. These results are indicated in Tables III-IX.

Results and Discussion:

During the February sampling, a very low occurrence of fish was obtained (Table II). The station with the greatest abundance was A8 where 35 fish were collected. The relative abundance of fish captured indicates winter flounder, *Pseudopleuronectes americanus*, and longhorned sculpin, *Myoxocephalus octodecemspinosus*, to be the most numerous.

Gonadal analysis of fish captured indicates that the winter flounder, *americanus*; the longhorned sculpin, *M. octodecemspinosus*; and the little skate, *Raja erinacea*, to possibly be spawning in the area at this time.

Analysis of otoliths and/or scales revealed few species to have supportive or widely differentiated year classes. The catch of winter flounder, *P. americanus*, is represented by four year classes ranging from 1971 to 1974 (1973 most abundant). The remaining species exemplify primarily 73, and 74 year classes.

The stomach analysis of fish captured reveals polycheates (*Pherusa* sp. *Nereis* sp.), Amphipods (*Phoxocephalus* sp.), and crustaceans (*Neomysis* sp. and *Crangon* sp.) to be the items most consumed by primarily the flounders, skates and longhorned sculpin respectively.

New London Dump Site
18, 19-II-75

TABLE I

Mean Bottom Depth, Temperature and Salinity

Station	Depth(m)	Bottom Temperature(°C)	Bottom Sal.(°/oo)
A2	17	3.5	31.034
A4	19	3.4	30.967
A8	18	4.0	30.969
A9	19.5	3.8	30.923
C2-1	* --	*--	30.920
C6,(T-1)	18	3.4	30.919
C6-T-2	18	3.6	30.886
E8-E9	20	3.4	30.859
F4	10	3.9	30.965
F8	19	3.0	30.743

* No B.T. Recording Available

Table II: Number of Fish Caught Trawling

Stations

Fish	A2-1	A2-2	A2-3	A4	A8	A9	C2-1	C2-2	C2-3	C6-1	C6-2	E8-E9	F4	F8	TOTAL
Pseudopleuronectes americanus					25	12	6	6	1	3	19	1	16	1	90
Urophycis Chuss					2			1		1	1				5
Myoxocephalus octodecempinosus					4	2						1	3	8	18
Raja erinacea					1	2				3	3		1		10
Macrozoarces americanus					1										1
Aloso pseudoharengus					1		1								2
Hemitripterus americanus					1			1							2
Myoxocephalus aenaeus							1						1		2
Pholis gunnellus														1	1
Scophthalmus aquosus						2		1	1						4
Ammodytes sp.							1								1
Menidia menidia							9								9
Osmerus mordax								1							1
Tautogolabrus adspersus									1						1
Trinectes maculatus											1				1

New London Dump Site
Sta. C-2-1
19-11-75

Table III

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	% Empty
Pseudopleuronectes americanus, winter flounder										
74	100%	6	90	14.6	3	0.24%	2	0.16%	59.6% Neomysis	
									14.9 Phoxocephalus sp.	
									9.6 Pectinaria sp.	
									6.4 Gammarus sp.	
									2.1 Ampelisca sp.	
									2.1 Nephtys sp.	
									2.1 Corophium sp.	
									4.2 Ampharetidae	
Myoxocephalus aenaeus, grubby										
---	100%	1	40	2.1						
Alosa pseudoharengus, alewife										
---	100%	1	79	6.46					empty	100%
Ammodytes sp., American sand lance										
---	100%	1	134	6.9					100% copepods	

New London Dump Site (cont'd)
Sta. C-2-1
19-II-75

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	% Empty
Menidia menidia, Atlantic silverside										
74	100 %	9*[1]	83	4.40	2	.585%	2	3.12%	100%Copepods	77.7%

1* (note)-one fish cut in half did not include in average

2* (note)-half of fish had no gonads regarded all 8 in average

New London Dump Site
Sta. C-2-2
18-II-75

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	% Empty
Hemitripterus americanus, sea raven										
73	100%	1	223	381			1	0.79%	33.3% Cancer sp.	
									38.3 Crangon sp.	
									28.3 Digested Fish	
Osmerus mordax , smelt										
74	100 %	1	83	5.5		7.3%		0.59%	empty	100%
Urophycis chuss, red hake										
74	100 %	1	84	7.4		----		----	empty	100%
Pseudopleuronectes americanus , winter flounder										
73	33.3%	2	161	84	1	0.31%	1	0.74%	empty	100%
74	66.6%	4	101	18	2	0.08%	----------		50% digested	
									50% Corophium sp.	

New Londo Dump Site
Sta. C-2
19-II-75

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	% Empty
Scophthalmus aquosus, windowpane flounder										
73	100 %	1	182	140	1	0.43%	----------		empty	100%
Pseudopleuronectes americanus, winter flounder										
74	100 %	1	111	27.8	1	0.18%	----------		empty	100%
Tautogolabrus adspersus, cunner										
73	100 %	1	41	2.09	immature				(rotted away)	

New London Dump Site
C-6-2
19-II-75

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	% Empty
Raja erinacea, little skate										
--	--	3	46	792			3	8.1%	53.4% Nereis	
									9.0 Pherusa sp.	
									13.1 Nemertea sp.	
									2.6 Crangon sp.	
									0.02 Neomysis sp.	
									.42 Brachyura	
									0.2 Shell frag.	
									10.4 digested	
									0.4 fish parts	
									10.6 Polycheate	
Urophycis chuss, red hake										
74	100%	1	114	13.1					100% Crangon	

New London Dump Site
Sta. C-6-1
19-II-75

Table IV

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	% Empty
Raja erinacea, little skate										
-----	-----	3	456.7	574.3	1	1.5%	2	1.7%	82.0% Nereis sp.	
									2.3% Nemertea sp.	
									2.5% Pherusa sp.	
									3.3% Xanthidae	
									10.0% Unidentified	
Pseudopleuronectes americanus, winter flounder										
73	66.7%	2	171.5	101.5	1	0.13%	1	0.51%	65.4% Polycheate	
74	33.3%	1	104	23.4	--	---	1	0.43%	26.3% Nephtys sp.	
									8.3% Lumbirineies sp.	100%
Urophycis chuss, red hake										
74	100%	1	104	8.9	---	----		-----	23.1% Crangon sp.	
									76.9% Nephtys sp.	

New London Dump Site
Sta. C-6-2
19-II-75

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	% Empty
Pseudopleuronectes americanus, winter flounder										
71	6.7%	1	325	830			1	21.7%		33.3%
73	80%	12	162.9	92.6	6	0.23%	6	1.53%	3.3% Echinodermata ?	
74	13.3%	2	110	25.3	1	0.08%	1	0.37%	4.1% Nemertea sp.	
									22.0% Neries sp.	
									.25% Unciola irrorata	
									0.5% Lepiohnotus squaratus	
									17.1% Nephtys	
									0.08% Neomysis sp.	
									41.2% digested	
Trinectes maculatus, hogchoker										
74	100%	1	100	34.7	1	0.35%			empty	100%

New London Dump Site
Sta. A-9
19-II-75

Table V

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	% Empty
Pseudopleuronectes americanus, winter flounder										
72	16.7%	2	226	251	2	0.15%		------	0.82% Neomysis	75%
73	50%	6	160.3	86.83	3	0.30%	3	0.69%	0.82% Corophium sp.	
74	33.3%	4	98	19.5			2	2.35%	24.6% Bivalve	
									Ampelisca viadorium % not calculated	
									73.7% digested	
Myoxocephalus octodecemspinosus, longhorn sculpin										
72	100%	2	238	239	-----		2	1.10%	68% Crangon sp.	
									16% Tautogolabrus adspersus	
									16% rock	
Scophthalmus aquosus, windowpane flounder									empty	50%
72	50%	1	202	183	-----		1	1.4%	63.2% Crangon	
73	50%	1	148	70	-----		1	0.6%	36.8% Neomysis	
Raja erinacea, little skate										
---	---	2	440	680	-----		2	1.4%	86.6% Crangon sp.	
									13.4% Pagurus sp.	

New London Dump Site
Sta. A-8
19-II-75

Table VI

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	# Empty
Hemitripterus americanus, sea raven										
		1	207							
Raja erinacea, little skate										
		1	464							
Myoxocephalus octodecemspinosus, longhorn sculpin										
		4	245							
Pseudopleuronectes americanus, winter flounder										
		25	126							
Macrozoares americanus, ocean pout										
		1	550							
Urophycis chuss, red hake										
		2	79							
Aloso pseudoharengus, alewife										
		1	79							

New London Dump Site
Sta. E8-E9
19-2-75

Table VII

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	# Empty
Pseudopleuronectes americanus, winter flounder										
		1	86							
Myoxocephalus octodecemspinosus, longhorn sculpin										
		1	240							

New London Dump Site
Sta. F-4
12-II-75

Table VIII

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	# Empty
Raja erinacea, little skate										
		1	390							
Myoxocephalus aenaeus, grubby										
		1	104							
Pseudo pleuronectes americanus, winter flounder										
		16	139							
Myoxocephalus octodecemspinosus, longhorn sculpin										
		3	242							

New London Dump Site
Sta. F-8
19-II-75

Table IX

Year Class	% of Sample	N	Mean SL mm	Mean WT g	Males #	Males $\overline{X}$%GW	Females #	Females $\overline{X}$%GW	Stomach Contents % by Weight for all Fishes	# Empty
	Hemitripterus americanus, sea raven									
		1	221							
	Pseudopleuronectes americanus, winter flounder									
		1	115							
	Myoxocephalus octodecemspinosus, longhorn sculpin									
		8	250.75							
	Pholis gunnellus, rock gunnel									
		1	102							

APPENDIX F

MIDDLE ATLANTIC COASTAL FISHERIES CENTER

NATIONAL MARINE FISHERIES SERVICE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Distribution of Fecal Coliforms in Sediments and Water from the Thames River and New London Dumpsite - Long Island Sound

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INTRODUCTION

The following report constitutes data obtained on the distribution of fecal coliform bacteria and total aerobic plate count in the top layer of sediments obtained from the Thames River and the New London, Connecticut, dredge spoil dumping area prior to the commencement of dredging operations in August, 1974. A limited number of water samples were examined for the presence of fecal coliforms. For the initial baseline studies, sampling was conducted in June, July and August of 1974.

Sampling Plan

The three sampling areas designated for the bacterial studies were as follows:

Spoils (Dumping) area - A circular area within a 1-mile radius from the point of dumping designated by the NL buoy in Long Island Sound.

Control area - The area outside the spoils area but within a circle of a 2-mile radius from the NL buoy.

River stations - Areas of the Thames River to be dredged.

Bottom sediments at forty stations located in both the spoils area and control area and five river stations were sampled during four day-cruises in June and July, 1974. These sediment samples were analyzed for total fecal coliforms and total aerobic bacteria. Three weeks later 18 stations within the control and spoils areas and one river station were resampled. Bottom water samples were collected at six stations. These samples were analyzed for total fecal coliforms. In August a spoils station at the

NL buoy (Station C6), three control (spoils interfaces) stations, located one mile from the NL buoy, and one river station were sampled for bottom water once each during flood and ebb tides. These samples were analyzed for total fecal coliform counts.

MATERIALS AND METHODS

Collections and Handling of Samples

Bottom sediments were obtained using a Smith-McIntyre grab. The top centimeter of the sediment surface was removed with a sterile tongue depressor and placed in a sterile 8-oz. French square bottle until full. The samples were then stored in refrigerated ice chests and examined within 24 hours at the laboratory. Each sample represents an approximate 100 cm^2 surface area of the sediment.

Water samples were taken in one-liter sterile plastic bags by means of a sterile polyethylene bag water sampler (Oceanics, Inc.). Water was aseptically transferred to sterile 8-oz. French square bottles and refrigerated for transport to the laboratory. All water samples were analyzed within 24 hours of collection.

Analysis for Fecal Coliform Bacteria

The procedure used for determining total fecal coliform MPN's follows Standard Methods for the Examination of Water and Wastewater (13th edition), modified for the dilution of sediment samples for inoculation of the culture tubes.

RESULTS

The data obtained on the several cruises are presented in Tables 1-4 and plotted on outline maps (Figs. 1-3). The plots on the maps also indicate the

stations sampled during this study. For the convenience of analysis the fecal coliform ranges are grouped in the three areas as follows:

River Stations

	No. of Stations	Fecal Coliform Range
	3	10,000 - 172,000
	2	1,000 - 10,000
Total	5	

Spoils Area

	3	1,000 - 10,000
	13	100 - 1,000
	4	0 - 30
Total	20	

Control Area

	7	1,000 - 10,000
	7	100 - 1,000
	5	0 - 30
Total	19	

The highest fecal coliform counts were obtained in the sediments from the river stations. Three samples had counts in the range of 10,000-172,000 fecal coliforms per 100 ml of sediment. Except for the count in sediment from Station R1, furthest up the river, all counts on the river samples exceeded those obtained from the dumpsite and adjacent areas.

Fecal coliform counts in the top sediments from the dumpsite and adjacent areas were elevated, but lower than those obtained from the river samples. They also exhibited a variance in counts, a factor which would normally be expected.

In examining the grouping of counts, i.e., within the spoils and control areas, no set pattern of distribution was observed. The range of fecal coliform counts in the sediments from each of these areas was quite similar.

Resampling and analyses of sediments from 18 selected stations in the dumpsite area and one river station were made three weeks after the initial survey. These samples yielded fecal coliform counts of which 9 of 19 correlated well, 3 of 19 were comparable and 7 of 19 differed greatly. Considering the difficulty in obtaining sediments from the exact spot at each station during resampling (and the variable distribution of bacteria in sediments) such results would be expected.

Grouping the total aerobic counts in the top sediments from the various stations, as follows, showed no pattern of distribution:

	Number of Stations		
Count Range x 10^5	River	Control	Spoils
1.5 - 6.0	-	4	2
6.1 - 24.0	-	12	13
24.1 - 96.0	-	3	3
93.0 - 650.0	5	-	-

Counts in the river sediments were significantly higher than those obtained from the dumpsite and adjacent areas. Comparison of total counts with the fecal coliform counts did not have a high degree of correlation.

In general, the data would indicate that the fecal coliform and bacterial densities in near-shore sediments were significantly higher than those from the southern section near the center of the dumpsite. This would indicate that significant contamination pressure was exerted by the river outflow.

In the initial survey, sediments were selected for bacterial and coliform analyses. To determine the dispersion of bacteria by dredging operations and the deposition of the spoils into surrounding waters, sediments and their overlaying waters were simultaneously collected and analyzed for fecal coliforms.

Although limited, the data in Table 3 show that no uniform ratios or correlating densities could be established between sediments and the overlaying waters.

To establish any variability in coliform densities in bottom water due to tidal flow, samples were collected from five stations at ebb and flood tides and analyzed for fecal coliforms. The data in Table 4 indicated that higher coliform densities were present in bottom water during ebb rather than flood tide, except at Station R4, the river station. This observation indicated that contamination pressure was exerted by the Thames River to the inshore areas in regard to increased bacterial and fecal coliform densities.

FUTURE STUDIES

Sediments from 7 stations, represented by triangles in Figure 4, will be sampled quarterly to monitor for any increases in fecal coliform and total bacterial densities in the spoils and control areas.

Bottom water and sediment samples will be collected simultaneously at five stations and analyzed to establish any correlation between coliform densities in the sediment and water. The bottom water will be sampled at ebb and flood tides during the spring, summer and winter quarters.

During July sediment samples from all stations in the spoils and control areas, as outlined in Figure 4, will be analyzed for fecal coliforms and total bacterial densities as done in the initial survey.

Table 1. Distribution of total bacterial counts and fecal coliforms in sediments from Thames River-New London Dumpsite - June 26 - July 8, 1974.

Initial Survey

Station	Total Plate Count X 10^4	Fecal Coliforms /100 ml
A1	69	1,300
A2	110	1,720
A3	140	11
A4	140	490
A5	70	240
A6	100	221
A7	72	790
A8	85	460
A9	160	1,410
B1	33	17
B2	26	14
B3	36	2
B4	26	11
B5	15	14
C1	130	172
C2	170	700
C3	160	4,900
C4	150	2,200
C5	95	3,300
C6	17	220
C7	95	330
C8	120	490
C9	93	490
D2	37	221
D3	72	172
D4	91	221
D5	37	130
E1	970	7,900
E2	260	2,400
E3	290	2,210
E4	160	1,090
E5	250	490
E7	310	26
E8	150	109
E9	130	22
F3	140	790
F4	200	460
F5	890	490
F7	170	26
F8	110	172
F9	37	172
R1	2,650	1,300
R2	2,200	4,900
R3	1,080	172,000
R4	6,500	22,100
R5	930	24,000

Table 2. Comparison of Fecal Coliforms in Sediments at Selected Stations before Dredging and Dumping

Initial Survey

Station	Fecal Coliforms/100 ml June 26 - July 8, 1974	July 30, 1974
A2	1,720	330
A3	11	5
A4	490	33
A5	240	330
B2	14	490
B3	2	170
B4	11	49
B5	14	70
C2	700	490
C3	4,900	240
C4	2.200	70
C5	3,300	49
C6	220	79
C7	330	130
C8	490	23
E7	26	0
E8	109	172
F7	26	17
R4	22,100	17,200

Table 3. Distribution of fecal coliforms in sediments and bottom water - from New London Dumpsite - July 29, 1974.

Station	Fecal coliforms/100 ml Sediment	Bottom Water
A2	330	33
C6(N1)	79	0
B3	170	8
C2	490	17
E8	172	0

Table 4. Distribution of Fecal Coliforms in Bottom Water at Ebb Tide and Flood Tide Before Dredging and Dumping

Station	Fecal Coliforms/100 ml	
	Ebb Tide 8/12/74	Flood Tide 8/19/74
A3	8	2
C3	49	5
E3	79	0
C6	2	0
R4	630	790

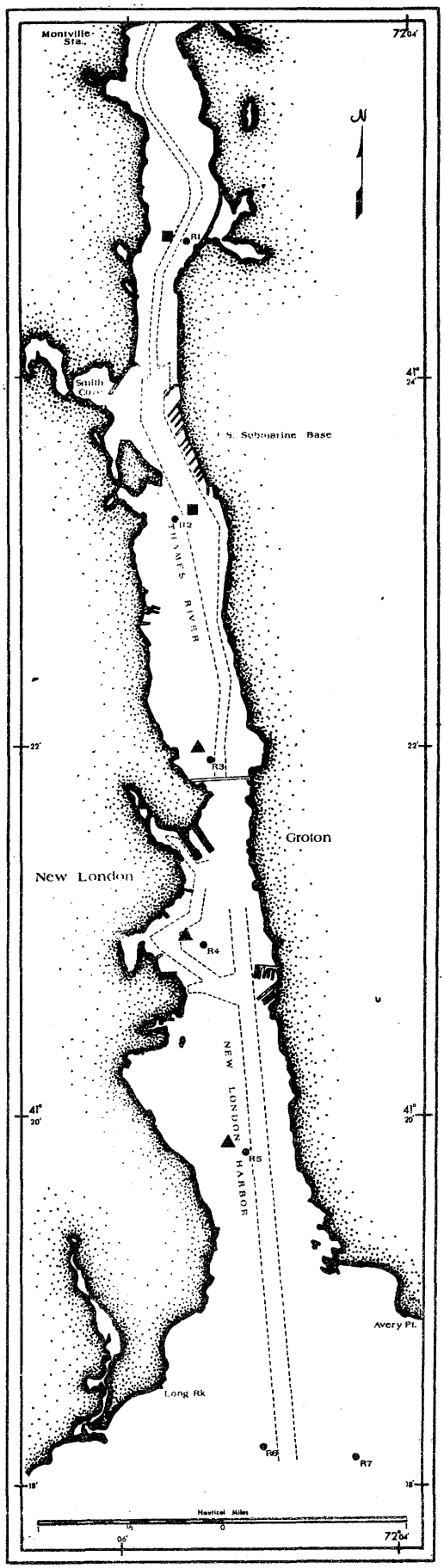

Figure 1 Distribution of fecal coliforms in sediments - Thames River.

FECAL COLIFORMS / 100 ml

■ — 1,000 - 10,000

▲ — 10,000 - 200,000

GPO 954-805

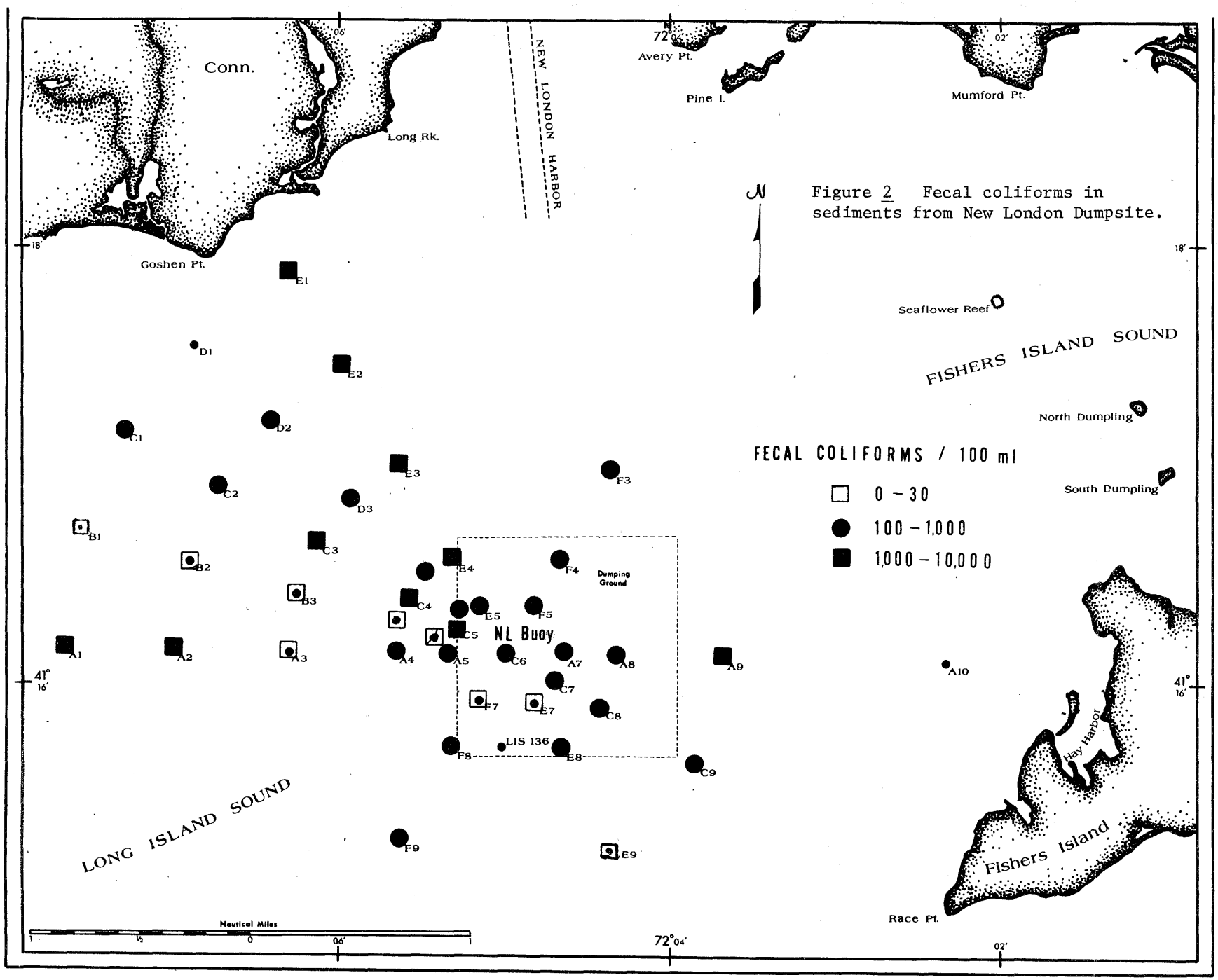

Figure 2 Fecal coliforms in sediments from New London Dumpsite.

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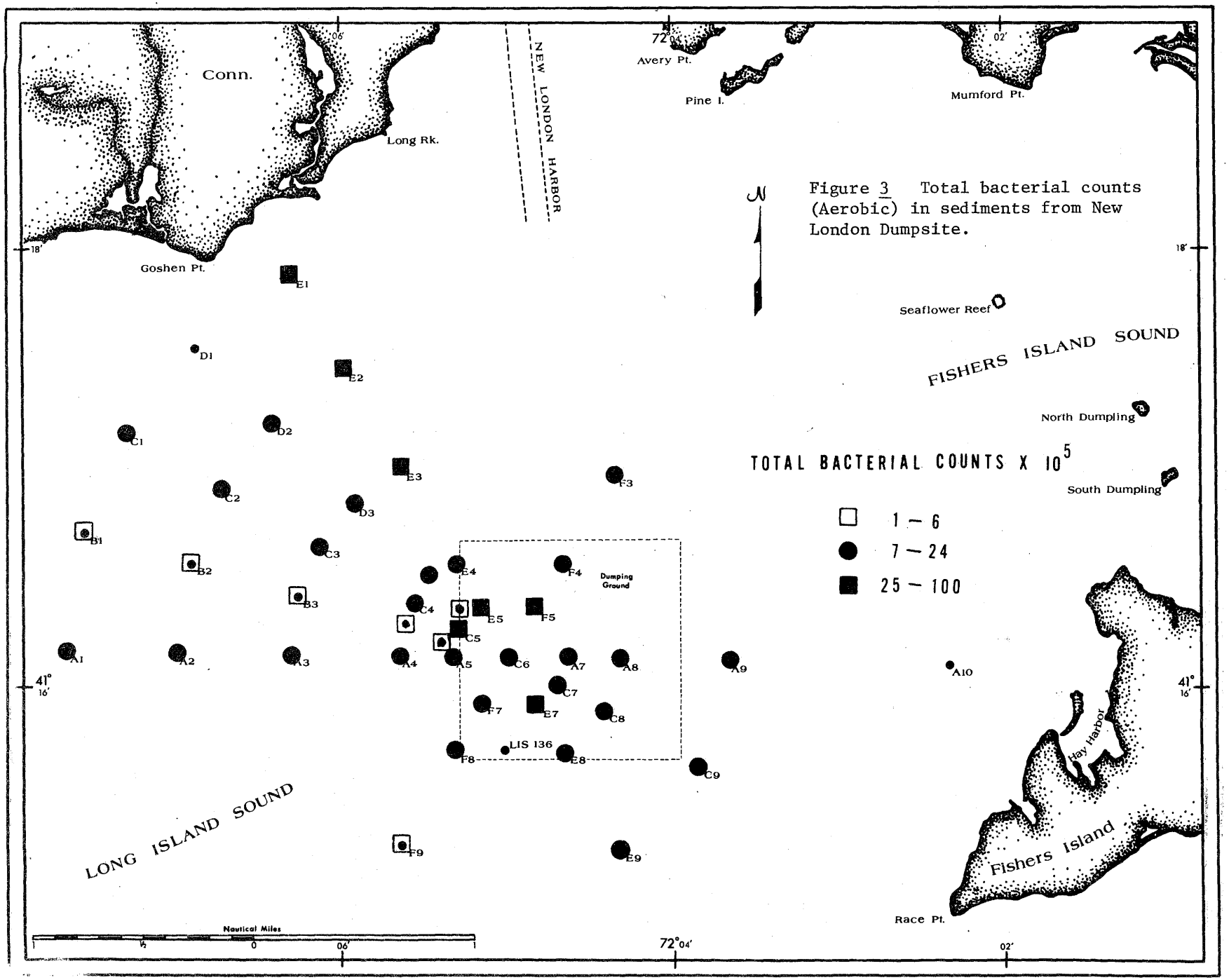

Figure 3 Total bacterial counts (Aerobic) in sediments from New London Dumpsite.

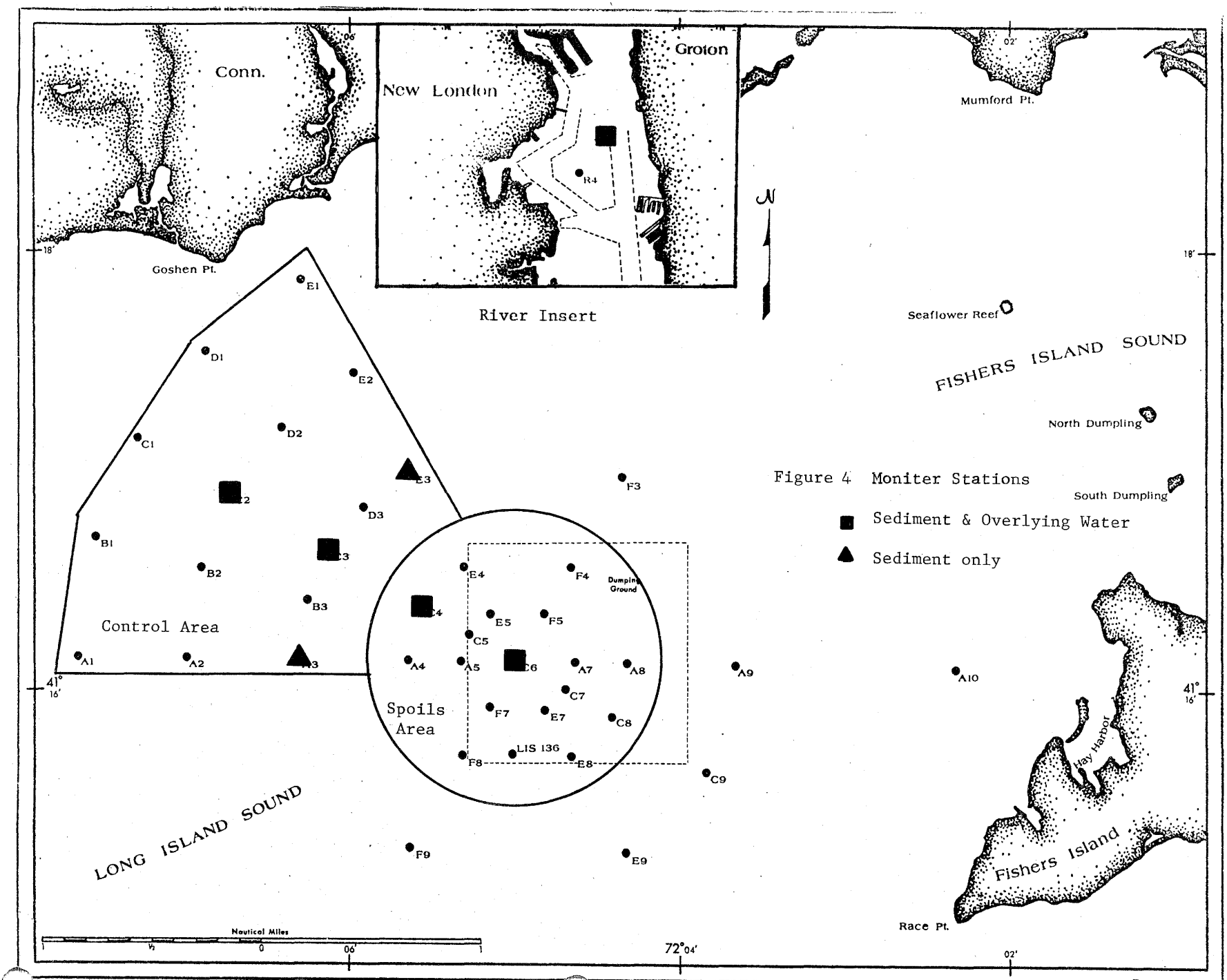

Figure 4 Moniter Stations

■ Sediment & Overlying Water

▲ Sediment only