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A BACTERIOLOGICAL SURVEY OF CHARLOTTETOWN HARBOUR AND THE HILLSBOROUGH RIVER PRINCE EDWARD ISLAND

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Atlantic Region

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A BACTERIOLOGICAL SURVEY OF CHARLOTTETOWN HARBOUR AND THE HILLSBOROUGH RIVER PRINCE EDWARD ISLAND

BY

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FOREWORD

This report is the result of a joint investigation conducted by the Environmental Protection Service and the Prince Edward Island Department of the Environment.

Without the exceptional cooperation and assistance provided by the Prince Edward Island Department of Environment, this report would not have been possible. The authors, however, are completely responsible for the interpretation of the data and the conclusions of this report.

ABSTRACT

This report contains the results of a sanitary and bacteriological investigation conducted during the May - September period 1975 on the Hillsborough River and Charlottetown Harbour area of Prince Edward Island. Approximately 900 samples were collected and analyzed for fecal coliform bacteria at 121 sampling stations.

The Hillsborough River area between the Johnson River and Mt. Stewart showed evidence of periodic contamination below Mt. Stewart in the vicinity of the Pisquid River and careful pre-season monitoring should continue near the present closure line (7-4). The Hillsborough River between the highway bridge and the Johnson River showed considerable improvement in bacteriological water quality over pre-treatment plant conditions on most sampling days. On July 29 following a hurricane and high rainfall (0.95 inches) water quality in this area was extremely poor. This was attributed to a power failure and high flows at the Charlottetown sewage treatment plant. The Harbour and Bay area between the Hillsborough Bridge and Governor's Island also on most days showed greatly improved water quality conditions over previous survey results. This improvement is attributed to the installation of the Charlottetown sewage treatment plant. On August 13, following 0.82 inches of rain, bacteriological water quality deteriorated in the Harbour and Harbour entrance. Bacteriological water quality at the mouth of Hyde Creek also deteriorated and was attributed to sewage from the lagoon for the Village of Cornwall.

RÉSUMÉ

Le présent rapport expose les résultats d'une enquête sanitaire et bactériologique tenue de mai à septembre 1975 sur la rivière Hillsborough et dans la zone du havre de Charlottetown, à l'île du Prince-Édouard. Près de 900 échantillons d'eau prélevés à 121 stations ont fait l'bojet d'une analyse pour déterminer la concentration de bactéries coliformes d'origine fécale.

La zone de la rivière Hillsborough s'étendant entre la rivière Johnson et Mt. Stewart a manifesté un état de contamination périodique en aval de Mt. Stewart, dans le voisinage de la rivière Pisquid. Il y a lieu de poursuivre une surveillance présaisonière près de la limite actuelle de la zone interdite (7-4). La plupart du temps, la qualité bactériologique de la rivière Hillsborough, entre le pont de la grand-route et la rivière Johnson, s'est révélée nettement supérieure à ce qu'elle était avant la mise en usage de l'usine d'épuration. Le 29 juillet, à la suite d'un ouragan accompagné d'une forte précipitation (0, 95 po), la qualité de l'eau dans cette région s'était grandement détériorée. On a attribué la situation à une panne d'électricité accompagnée d'un fort débit enregistré à l'usine d'épuration de Charlottetown. Les techniciens ont également noté, la plupart du temps, une amélioration considérable de la qualité de l'eau par rapport aux résultats des enquêtes antérieures dans la région du havre et de la baie, entre le pont de Hillsborough et l'île Governor. Ce progrès serait attribuable à la mise en usage de l'usine d'épuration de Charlottetown. Le 13 août, à la suite d'une précipitation de 0, 82 po de pluie, les conditions bactériologiques de l'eau se sont détériorées dans le havre et à l'entrée de celui-ci. La situation bactérienne de l'eau s'est également détériorée à l'embouchure du ruisseau Hyde et cela semblait dû à un déversement d'eaux usées provenant de la fosse de stabilisation du village de Cornwall.

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1.0 INTRODUCTION

From May to September 1975, Environmental Protection Service conducted bacteriological water pollution surveys in the estuarine areas near Charlottetown, Prince Edward Island to provide data for a review of the shellfish closure regulations that are enforced there. The survey covered all of the Hillsborough (East) River, and Charlottetown Harbour and part of the North and West Rivers as well as a portion of Hillsborough Bay (Figure 1).

Shellfish (mainly oysters) are abundant throughout much of this area, and until recently there was evidence of fecal pollution. Raw sewage from the City of Charlottetown was discharged at several locations along the waterfront and as previous surveys have illustrated (Reid et al 1964, Silliphant 1967) high levels of pollution indicator bacteria can be detected in Charlottetown harbour. With rising tides, large sectors of the East, North, and West Rivers were affected while at falling tides pollutants entered Hillsborough Bay. As a result, shellfishing is prohibited in a large area as defined in Schedule F of the Prince Edward Island Fishery Regulations, closure 7-2 (Figure 1).

In 1974, a municipal sewage treatment plant was constructed at Charlottetown. This plant receives the domestic wastes from Charlottetown and two adjacent communities, Sherwood and Parkdale. The chlorinated effluent is discharged to the harbour in the main channel east of the Highway 1 causeway. The resulting change in bacteriological water quality in the area will be discussed.

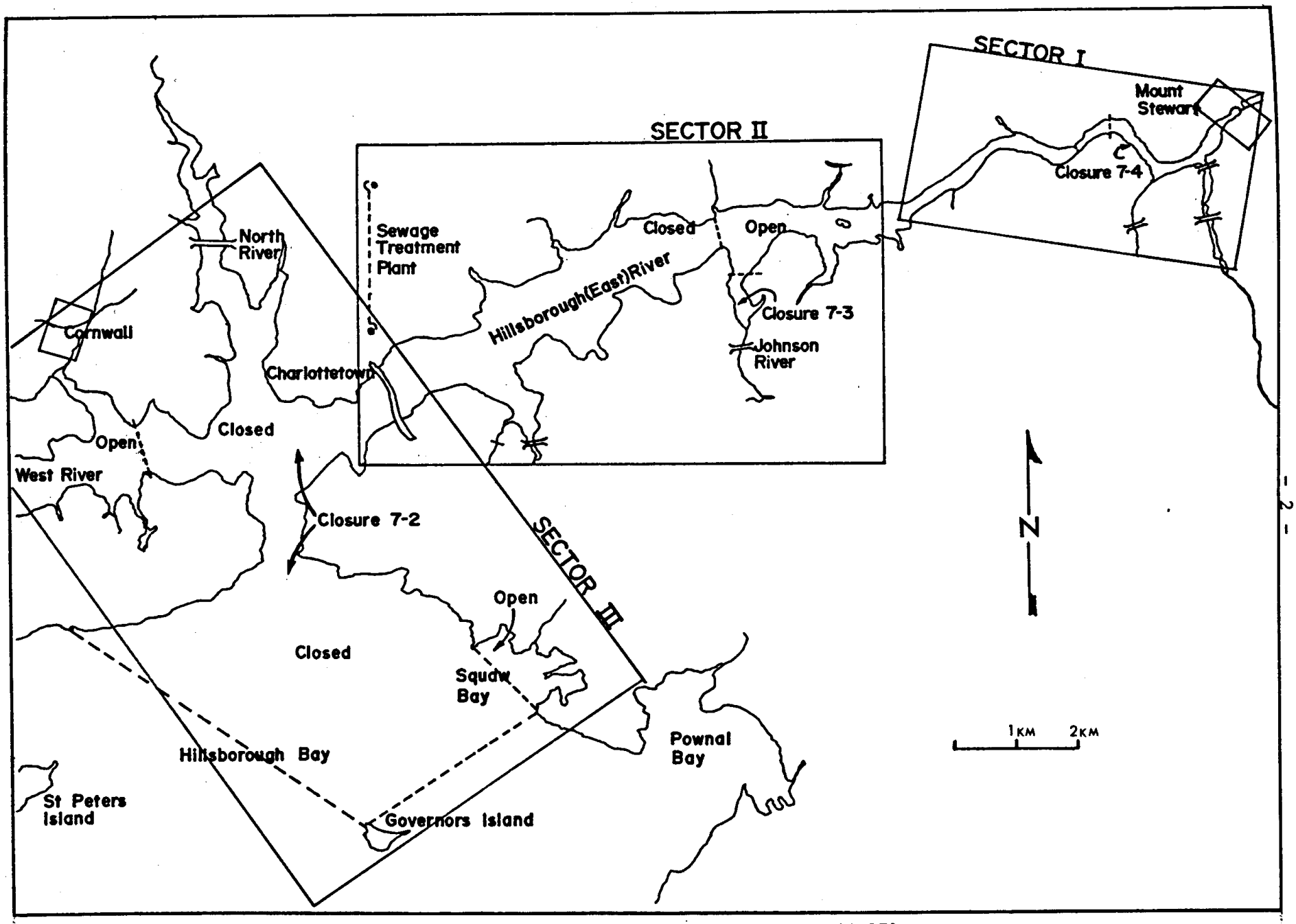


FIGURE 1· MAP OF THE STUDY AREA SHOWING SURVEY SECTORS AND SHELLFISH CLOSURES.

There are two additional closures in the surveyed area, both in the East River (Figure 1). Fecal contamination and the resulting shellfish closure (7-4) in the upstream section of the river near Mount Stewart has in previous surveys (Cullen, 1967a, 1967b, 1968, 1969) been linked to untreated effluent from this community. At the present time, however, the wastes from Mount Stewart are discharged to a lagoon. For the remaining closure (7-3) in the Johnston River, municipal sewage is not a factor and there have been no major changes in this area.

The survey data are presented by sector as shown in Figure 1. Sector I includes the East River upstream from Glenfinnan Island. Sector II is that part of the East River between Glenfinnan Island and the Causeway at Charlottetown, while remaining area, Charlottetown Harbour and Hillsborough Bay is called Sector III.

In 1964, Reid et al conducted a bacteriological survey of the area covered in the present study. The closure lines enforced at that time differed from the current lines in two ways; Hillsborough Bay was an open area and the northern most closure (7-4) line was located close to Mount Stewart just upstream from the Pisquid River. Reid's report recommended the present closure lines which encompasses a portion of Hillsborough Bay. Further surveys were conducted in the Mount Stewart sector by McLaughlin in 1966 and Cullen in 1967. Cullen (1967) recommended an extension in the closure (7-4) to the present closure line below the Pisquid River.

Silliphant (1967) surveyed Charlottetown Harbour and recommended no change in the existing closure (7-2) lines. Additional bacteriological surveys were conducted on the Mount Stewart sector by Cullen, 1967b, 1968, 1969 and a sanitary survey was completed by Baxter (1970). No closure changes were recommended as a result of these surveys. After the installation of a sewage lagoon and collection system for Mount Stewart, Baxter (1971) conducted a bacteriological survey of the Upper East River sector, and recommended no change in the existing closure (7-4). Baxter, 1972 conducted a bacteriological survey of the Johnson River closure (7-3) and of the eastern limits of closure (7-2). No closure changes resulted from these latter surveys.

Sanitary surveys of shellfish growing waters, including bacteriological water quality surveys are routinely carried out by EPS. The objective of these surveys is to determine if direct harvesting of shellfish is acceptable. The principal concern is the potential occurrence of disease-causing organisms that may be accumulated by shellfish if domestic sewage or wastes of domestic and wild animals reach their environment.

To assess the degree of fecal pollution in water the fecal coliform "Most Probable Number " (MPN) test is currently used in the Canadian Shellfish Sanitation Program. Water is considered acceptable if the median of the test results at a sampling station does not exceed 14 per 100 ml. Before areas are designated contaminated or approved, however, all factors that have a bearing on potential contamination levels are considered in addition to the bacteriological results.

2 MATERIALS AND METHODS

2.1 Sample Collection

Surface water samples were collected in sterile glass bottles (100 ml) using a rod-sampling device to lower the bottles to a depth of about 2 feet. For depth samples, rubber deflated bulbs were fitted with a piece of rubber hose and closed by a glass sealed tube. This assembly was sterilized in the field, placed in a metal holder and lowered to the desired depth. By releasing a brass messenger, the glass tube was smashed and the sample obtained.

All samples were stored in an insulated container, processed in a mobile laboratory and were on test two to three hours after collection.

2.2 Bacteriological Analyses

Fecal coliform tests were performed on all samples using the Most Probable Number (MPN) technique (APHA 1970). Three 5-tube MPN series were innoculated with appropriate aliquots of sample (decimal dilutions). In the first stage of the procedure, Bacto-Lauryl-Tryptose Broth was used as growth medium. The tubes were incubated at 35°C for about 48 hours, or if gas formation was detectable sooner, for 24 hours. Gas-positive cultures were then transferred to Bacto-EC medium and incubated at 44.5°C in a circulating water bath. Gas formation after 24 hours constituted the confirming stage of the test. Coliform isolates were typed by the procedure given in Appendix C.

2.3 Additional Data

Salinity and temperature was measured in situ using a YSI model 33 salinometer. Rainfall and wind records for Charlottetown were obtained from the Provincial Department of Agriculture, and the Atmospheric Environment Service, Environment Canada.

The speed and direction of currents in East River and Charlottetown Harbour were observed using metal drogues suspended from wooden floats.

3 SANITARY CONDITIONS

3.1 Sector I

In previous surveys, the village of Mount Stewart was identified as the most significant source of fecal contamination affecting the upstream sector of the East River. This waste is now discharged to a lagoon located near the southeast bank of the river. On inspection the lagoon was virtually dry; there appears to be seepage to a marshy area and subsequently to the East River. There are two lift stations, one on each side of the bridge.

Upstream from Mount Stewart, there are extensive marshy areas providing a resting place for water fowl. There is little human habitation in this closure and none near the water.

Downstream from Mount Stewart, the East River winds through low lying lands with marshy areas near the banks in several locations. On the northern shore, the communities of Tracadie and Scotchfort are located within the small discharge area, but do not form a source of pollution to the East River.

On the southern shore, there is virtually no habitation near the river. Clarks Brook and the Pisquid River each drain a fairly large area. Much of the land is wooded and mixed with farmland in the downstream sectors. There are marshy areas along the bank of the Pisquid River, but behind these, the land is used for farming and rises steeply on both sides of the river. There are several farms located near the water in the upstream portions of the river.

3.2 Sector II

On both sides of the river a highway runs approximately 1.2 kilometers from the river bank. Farms and residences are scattered along this road although very few are near the river. A number of small creeks, which are tidal about half their course, drain this area.

Somewhat larger areas are drained by the Johnson and Glenfinnan Rivers and there are many farms in the area. The Johnson River is currently under closure 7-3 (Figure 1). There are no sources of fecal contamination along this river other than those associated with farming. The upstream portion of the Johnson River is, however, somewhat more populated than the Glenfinnan River.

On the downstream portion of Sector I near the Hillsborough Causeway, human habitation is close to the river's edge. On the south shore, the community of Bunbury is served by septic tank disposal systems. There is also a number of farms located near the river. The Charlottetown municipal sewage treatment plant began operation early in 1975. The system provides treatment for the Charlottetown, Sherwood and Parkdale areas.

The effluent is discharged via a submerged outfall which is 610 meters long and terminates at the northern edge of the river channel in 9 meters of water. The plant has a capacity of 5 million gallons per day (MGD) and provides primary treatment with chlorine disinfection by settling and anaerobic sludge digestion (Appendix Figure A-1). The collection system includes three lift stations: one serving the Parkdale-Sherwood area, a second located at Dorchester Street and a third at the Navy quay.

During the study period the treatment plant effluent was consistently well chlorinated on most days (Appendix Table A-1), as indicated by plant records. However, on July 29 during a period of heavy rainfall, a power failure occurred and raw sewage was discharged via the lift stations for a number of hours. Also, on August 13 the Navy quay pumping station was not operating and plant flows reached 4.6 MGD.

3.3 Sector III

This sector described clockwise at the causeway borders a densely populated area containing a number of minor and major potential sources of fecal pollution. South of the causeway, residential areas of Rosebank and Southport border Charlottetown harbour.

There is a concentration of homes and recreational properties near Keppoch Point, but further east along Hillsborough Bay, permanent residences are located a good distance from the water and a limited number of cottages do not appear to pose a significant hazard.

The western shore of Hillsborough Bay rises fairly steep close to shore. Much of this area is farmland. No significant contamination sources were observed. On the western shore of the area between Hillsborough Bay and Charlottetown Harbour is located the historic site, Fort Amherst; north of this area a number of houses are located close to the water.

Only a small section of the west river was included in the survey. The south shore of this sector consists of farmland interspersed with wooded areas.

On the northern shore, Hyde Creek enters West River after passing through the village of Cornwall. Sewage from Cornwall is discharged to a single cell lagoon and then enters Hyde Creek without disinfection. At the present time, a second lagoon is under construction.

The upstream regions of West River and North River have not been contaminated. The community of North River west of the North River Causeway is served by septic tanks. A trailer park north of the highway discharges its sewage to a package treatment plant and subsequently to the North River (chlorinated). On the east shore of North River, an untreated effluent is contributed by a home for the aged.

The remainder of the area is occupied by Charlottetown and untreated sanitary sewage is not discharged here. The two lift stations in this sector form a potential source of pollution but are closely monitored. As with any municipal area, significant levels of indicator bacteria would be introduced with stormwater.

4.0 CURRENTS, TIDES AND RAINFALL

The survey was conducted during an unusually dry summer. Many of the sampling days were preceeded by little or no rainfall. Nevertheless, some representation of conditions following rainfall were obtained the day following May 6 and 7 (2.56 inches/48 hrs.), July 28 (0.95 inches/24 hrs.) and August 12 (0.82 inches/24 hrs.) (see Appendix Table B-1). Temperature and salinity results are given in Appendix Tables B 2-4 .

The mean tide differential at Charlottetown is 1.8 meters. During the survey period, differences between high and low ranged from 0.5 meters to 3 meters and the corresponding differences in the strength of tidal currents prevailed. The movement of surface waters in the vicinity of the Charlottetown sewage treatment plant outfall were traced by the use of drifters on three occassions during the survey period. Wind data during the drift observation periods are given in Appendix Table B-5.

Observations on current patterns in the vicinity of the waste treatment plant were made on three days using drogues set at a 3 meter depth. During the rising tide on July 30, drogues placed at the causeway moved up the East River, a distance of 2.7-3.0 kilometers in 90 minutes for an average speed of 1 knot (Appendix Figure B-1). On August 7, drifters on a rising tide moved up the East River a distance of 4.3-5.0 kilometers in 165 minutes for a speed of 0.8-1.0 knots (Appendix Figure B-2). These drift patterns indicate that on the rising tide,wastes discharged from the treatment plant move fairly rapidly up the East River. There is some suggestion of an eddying effect under certain conditions in the area between the bridge and the plant.

On July 23, on the falling tide, drogues moved 4.5 kilometers to Fort Amherst in 145 minutes for a speed of 1.3 knots (Appendix Figure B-3). Thus on the falling tide, it is apparent that material discharged at the treatment plant moves quickly out of the harbour into Hillsborough Bay. The bottom topography also suggests this general current pattern.

5.0 BACTERIOLOGICAL RESULTS

5.1 Sector I

This sector was sampled on five days at 39 stations. The results of fecal coliform analyses on these samples are given in Appendix Table C-1. The distribution of median fecal coliform levels for the Mount Stewart area (closure 7-4) are given in Figure 2. Median levels within the present closure are generally in excess of 14/100 ml. and median levels at station 3- - 32 outside the existing closure are also above 14. The distribution of maximum counts (see Figure 3) for the most part are in excess of 43 MPN/100 ml within the closure and also at station 36,35,32,30,25 and 24 outside the current closure. Maximum counts in excess of 2400 MPN/100 ml occur between Cranberry Wharf and the closure line at two stations, and 1.6 kilometers below Cranberry Wharf at two stations.

Distribution of fecal coliform counts on three days are given in Figure 4. Twice during the survey period particularly high counts in the closure were restricted to the mouth and the area adjacent to the Pisquid River.

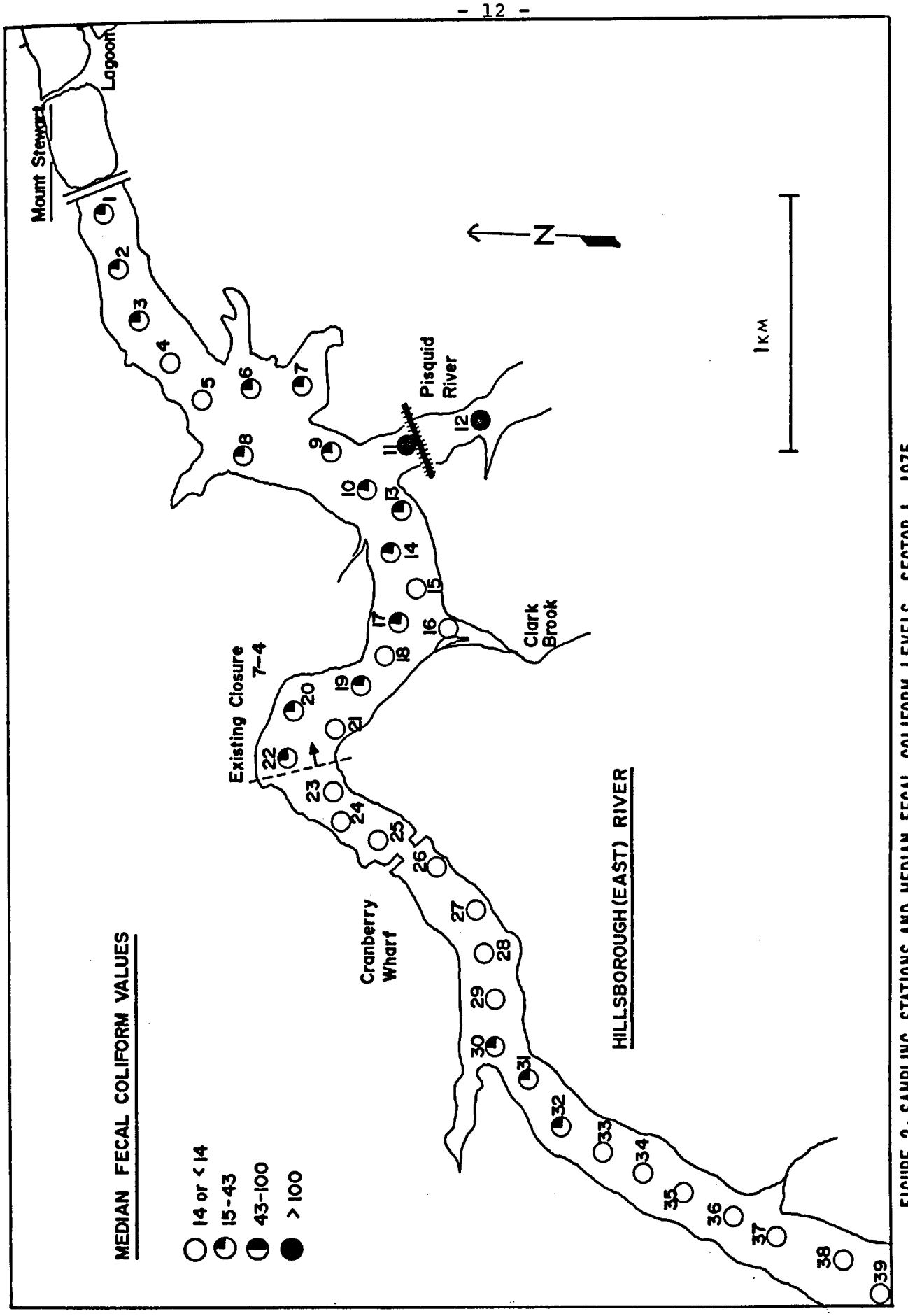


FIGURE 2. SAMPLING STATIONS AND MEDIAN FECAL COLIFORM LEVELS, SECTOR 1, 1975.

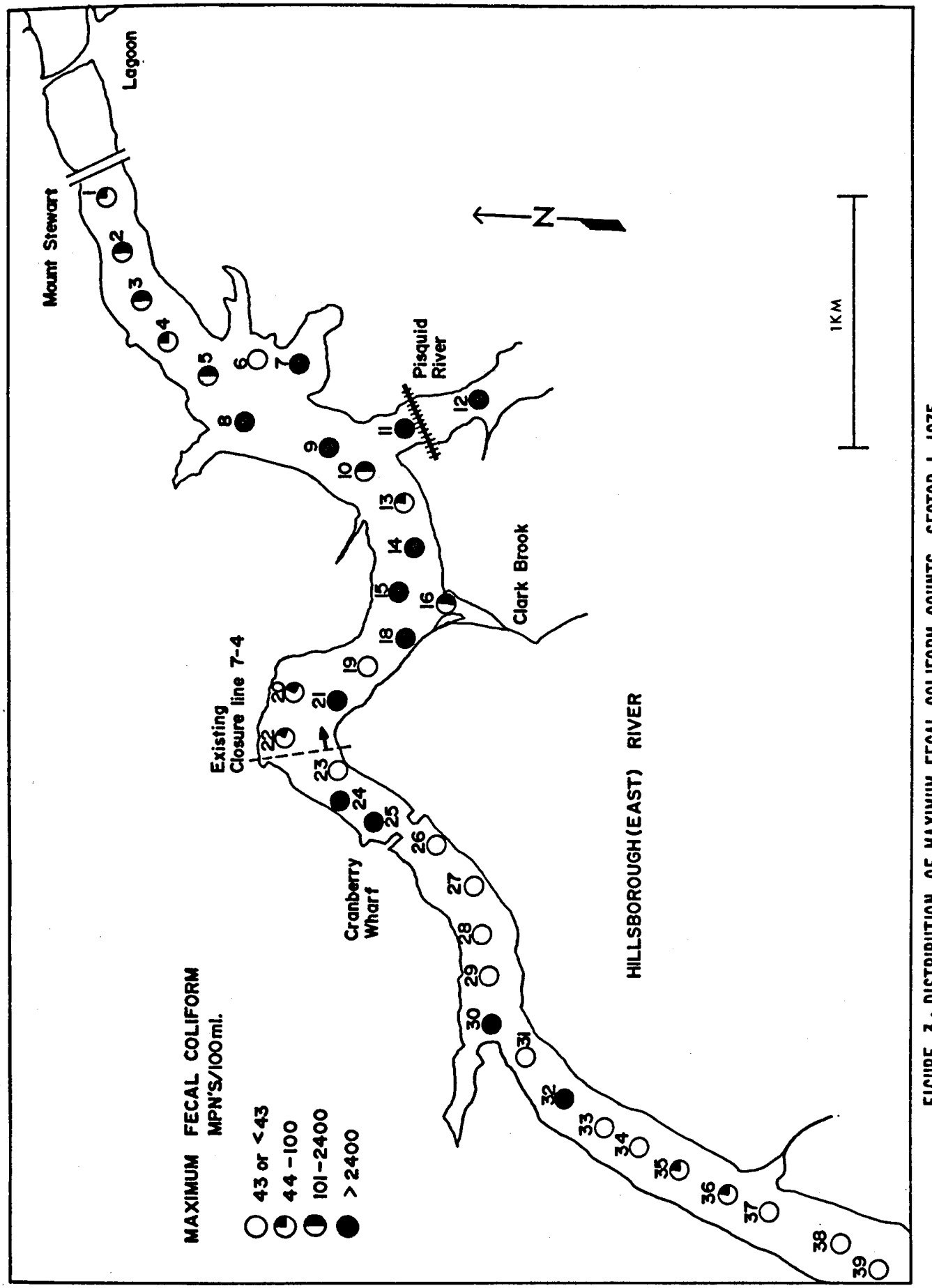


FIGURE 3 - DISTRIBUTION OF MAXIMUM FECAL COLIFORM COUNTS, SECTOR 1, 1975.

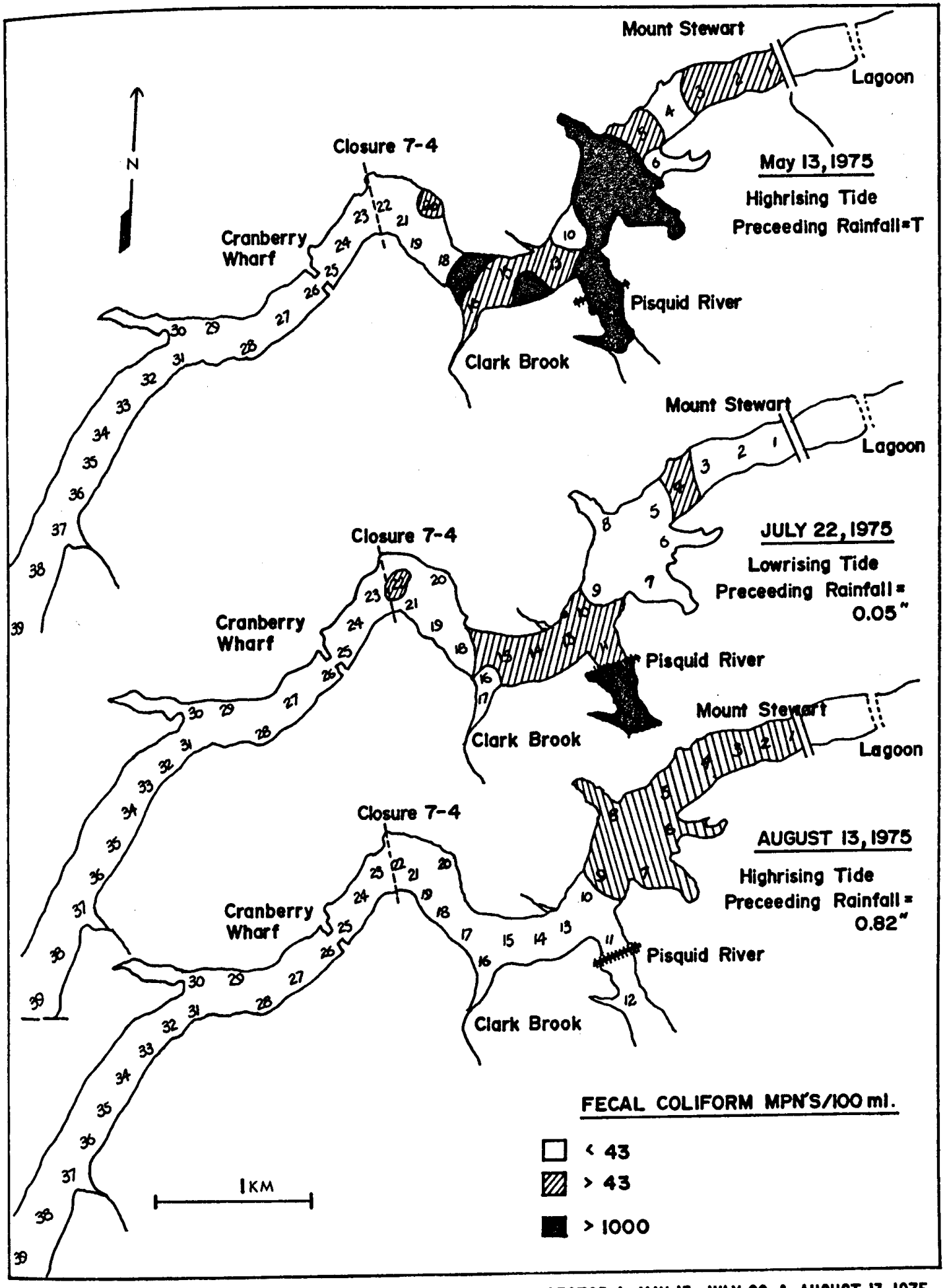


FIGURE 4 · DISTRIBUTION OF FECAL COLIFORM COUNTS, SECTOR 1, MAY 13, JULY 22 & AUGUST 13, 1975

On both occasions this condition was noted on rising tides after periods of little or no rainfall. Similar high counts did not occur, however, after significant rainfall ie. August 13 (Figure 5).

Additional water samples were collected by Provincial Authorities on the East River above Mount Stewart and on the Pisquid River in October and November (Appendix Table C-5). The results of the East River samples show consistent low levels of fecal contamination. Fecal coliform counts ranged between 2-130 MPN/100 ml with a median of 33 MPN. The Pisquid River 3.5-4 kilometers above the mouth had fecal coliform levels ranged from 79 to 2400 MPN/100 ml with a median of 390 MPN.

In general, the area below station 36 has consistently acceptable water quality under all environmental conditions reflected in the survey data.

5.2 Sector II

This sector was sampled on five days at 22 stations and a total of 198 samples were analysed. The results of these analyses are listed in Appendix Table c-2. Median fecal coliform levels throughout most of this sector are below 14. Medians in excess of 14 occur only at a few stations in the immediate vicinity of the treatment plant outfall (See Figure 5).

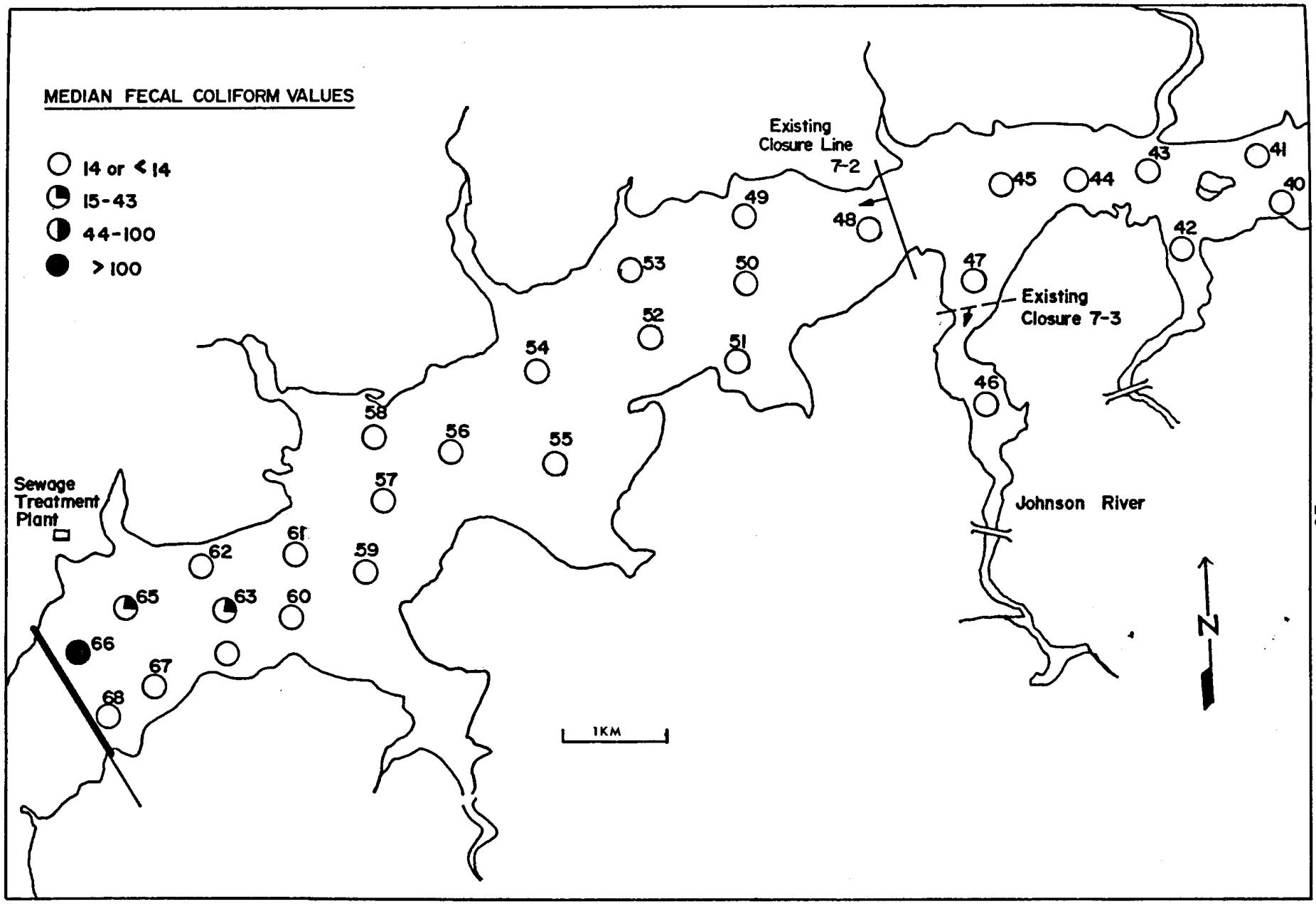


FIGURE 5- SAMPLING STATIONS AND MEDIAN FECAL COLIFORM LEVELS, SECTOR 2, 1975.

The distribution of maximum counts is given in Figure 6. These maximum counts represent conditions which occurred only on a single day (July 29). During July 29, fecal coliform counts were in excess of 1000 MPN/100 ml at almost every station south of the mouth of the Johnston River. This data represents conditions following a treatment plant failure during a period of heavy rainfall. A power failure in the early morning hours of July 29 resulted in the bypassing of raw sewage for approximately 5 hours.

Fecal coliform counts in excess of 43 MPN/100 ml on August 13 and July 22 however, are limited to the area between the sewage treatment plant outfall and Currys Point (approximately 4 kilometers east of the Causeway) (Figures 7 & 8).

The results of time series sampling at the discharge site (station 66) is given in Figure 9. At this site, surface fecal coliforms counts ranged from 23-2400 + MPN/100 ml with medians of 79 on the falling tide and 2400 + on the rising tide. At a depth of 4 meters, fecal coliform counts ranged from 2 to 550 MPN/100 ml with medians of 49 on the falling tide and 150 on the rising tide. Fecal coliform levels were lower at depth and counts on the surface and at depth tended to be lower on the falling tide and higher on the rising tide. Counts at both depths tended, also to be lower during the slack water period.

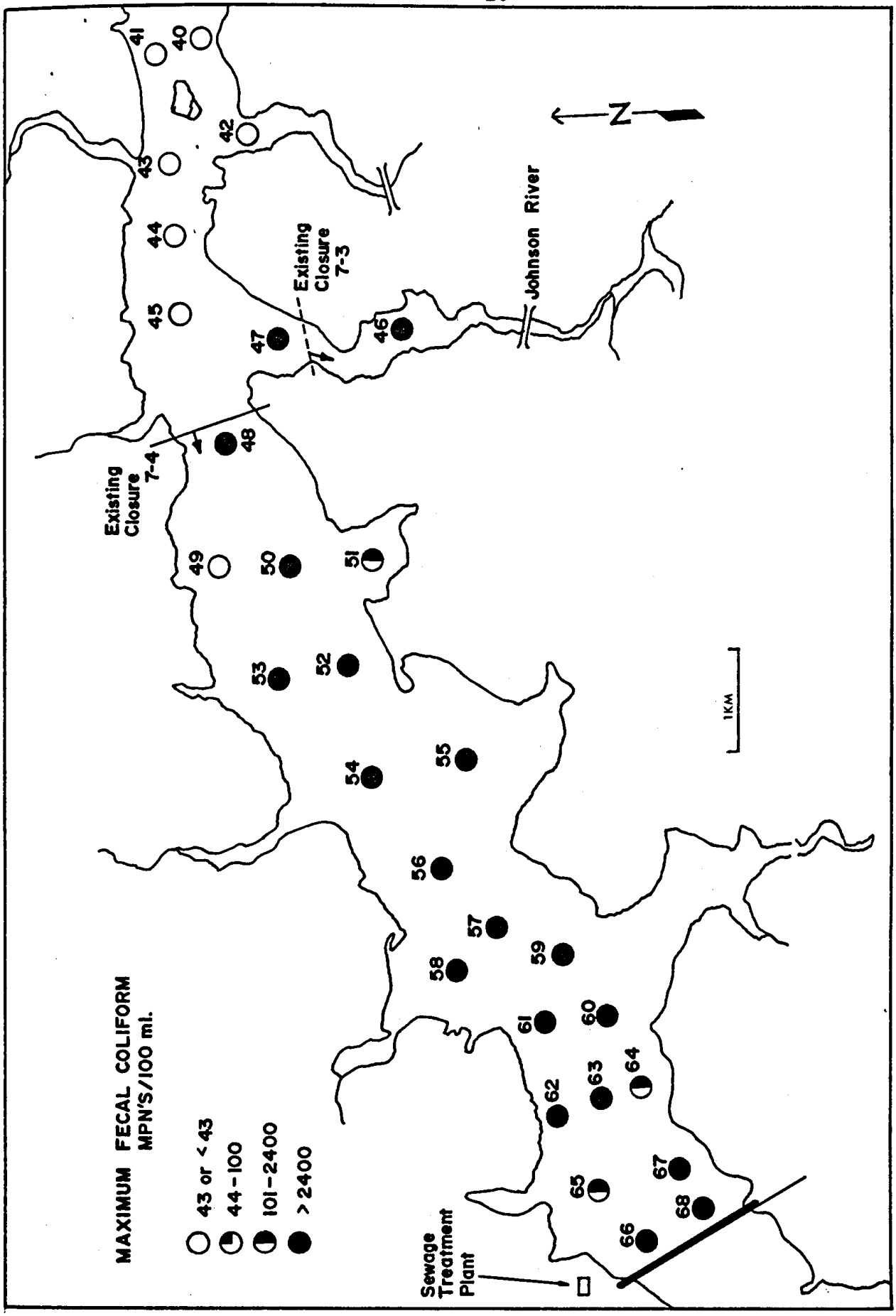


FIGURE 6 - DISTRIBUTION OF MAXIMUM FECAL COLIFORM COUNTS, SECTOR 2, 1975.

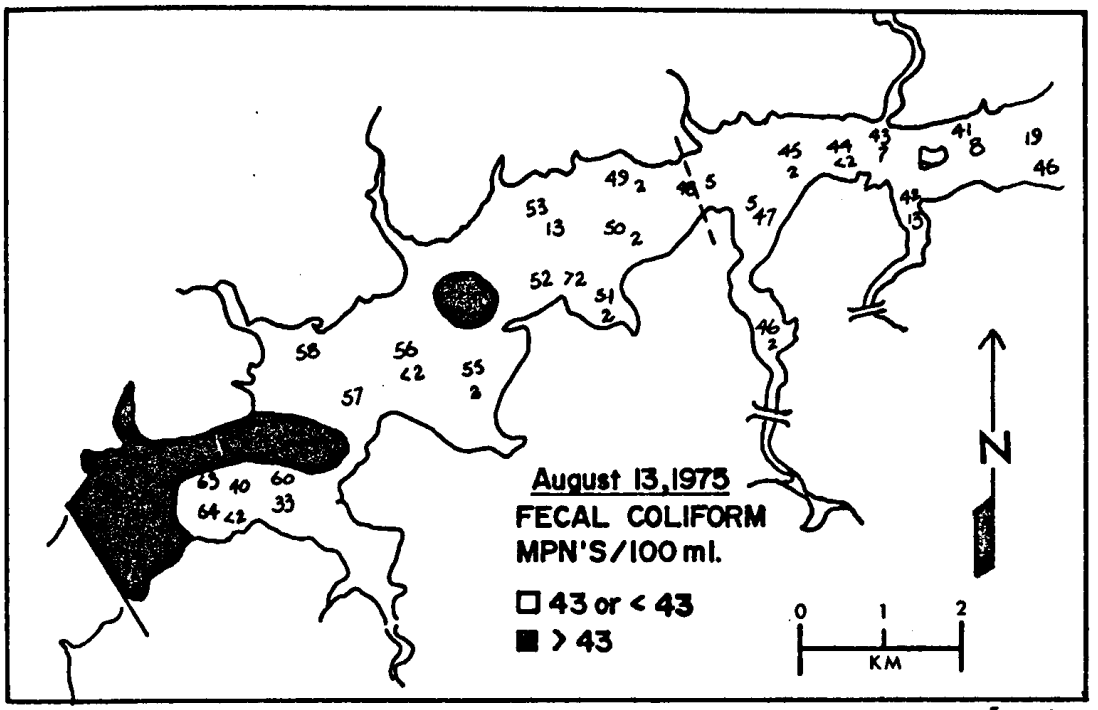


FIGURE 7· DISTRIBUTION OF FECAL COLIFORM COUNTS, SECTOR 2, AUGUST 13, 1975.

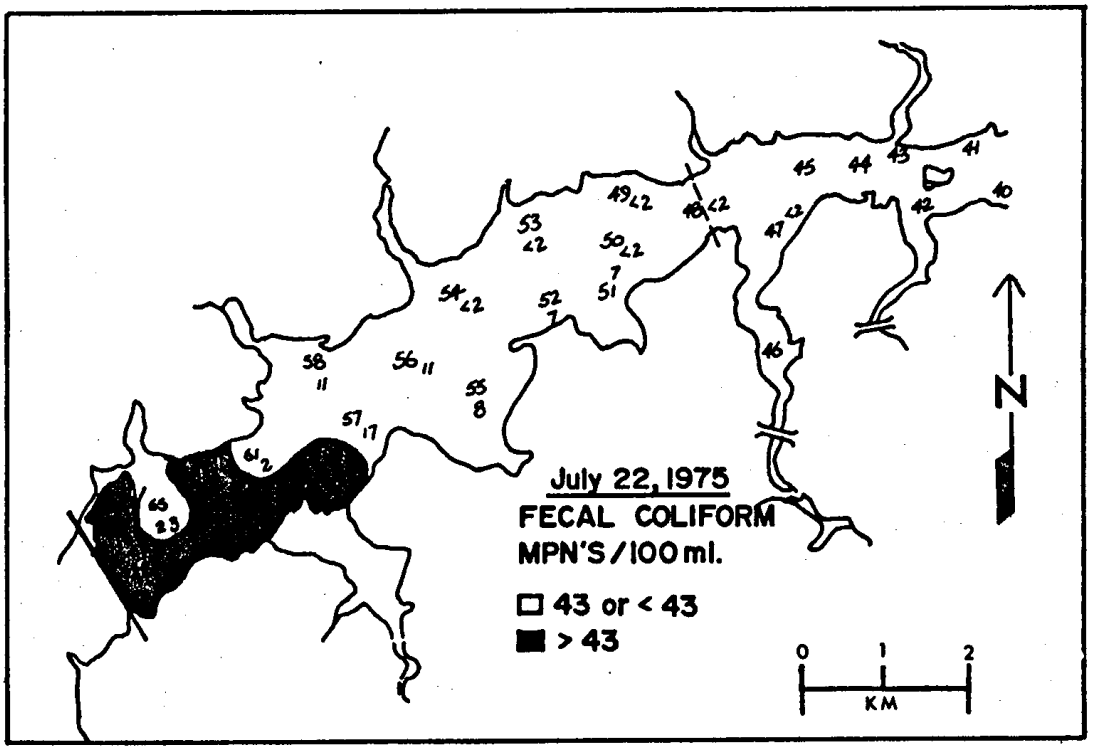


FIGURE 8· DISTRIBUTION OF FECAL COLIFORM COUNTS, SECTOR 2, JULY 22, 1975.

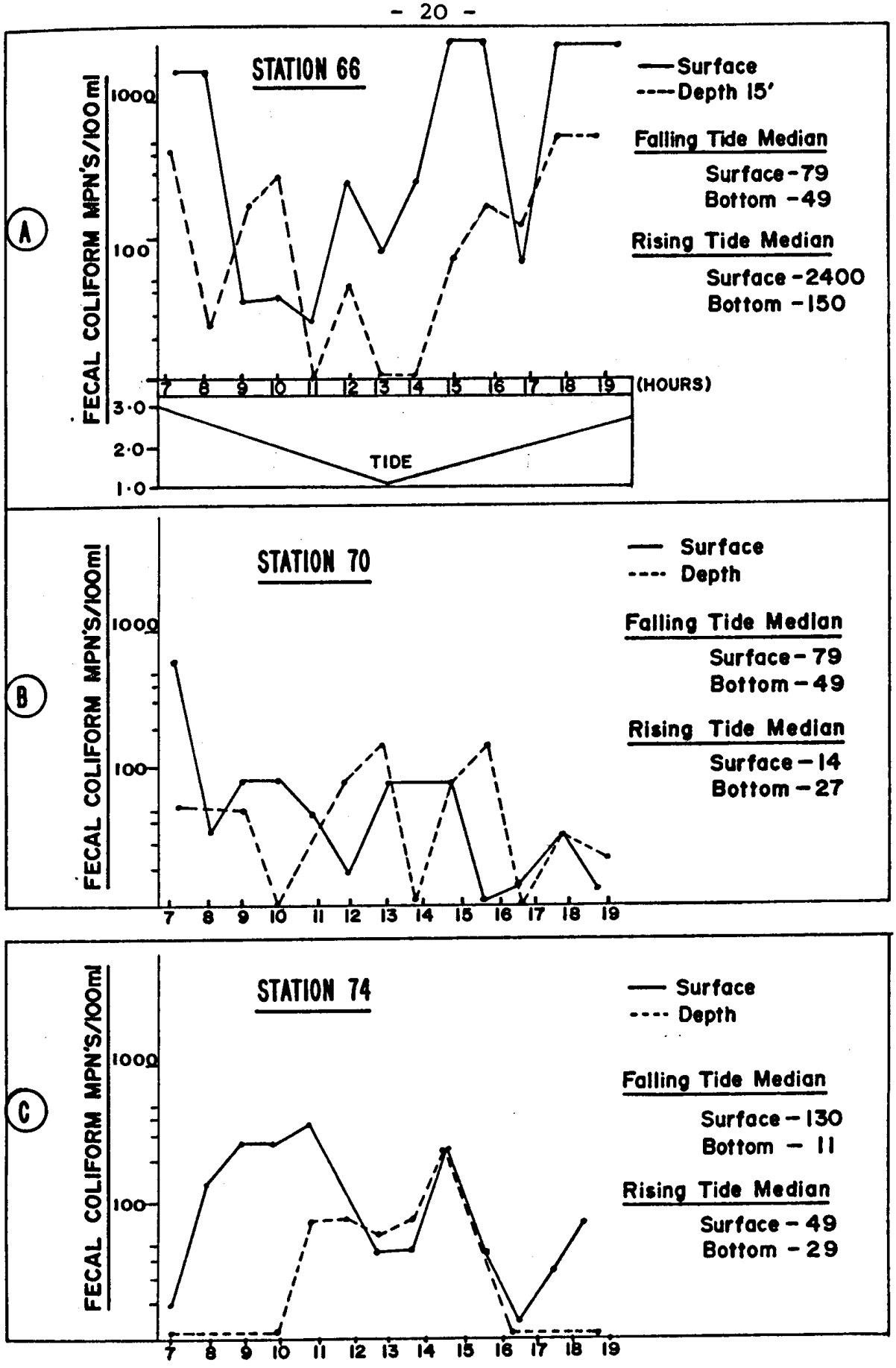


FIGURE 9· TIME SERIES SAMPLING RESULTS JUNE 5, 1975; SURFACE AND SUBSURFACE FECAL COLIFORM COUNTS: (A) STATION 66 (B) STATION 70 (C) STATION 74.

5.3 Sector III

Samples were collected at fifty-two stations on 8-11 days and a total of 280 samples were analysed for fecal coliform bacteria (Appendix Table C-3, C-4). The distribution of median counts are given in Figure 10. Median counts were below 14 at most stations. Exceptions to this occurred in the vicinity of the waterfront (stations 72-75), at one station (88) in the North River and in two stations in Hillsborough Bay. The median at all these stations, however, were less than 43. The distribution of maximum fecal coliform counts (See Figure 11) show MPN's in excess of 43 in the waterfront area west of the Causeway, in the York River, in the Hyde Creek area (West River) and in and outside the harbour entrance. Daily data, (Figure 12) shows that during good plant operation and no rainfall, high fecal coliform levels are restricted to the waterfront region of the harbour ie. September 3. After a high rainfall (August 13) counts increased throughout the eastern side of the harbour and extended out the harbour entrance into Hillsborough Bay. On this day, according to the field notes of E.P.S. personnel, the Navy quay pumping station was not operating for a period of time and the treatment plant flow was 4.6 MGD.

Data from July 29, following a power failure at the treatment plant and high rainfall indicates significant contamination throughout the portion of the harbour sampled including the North and West Rivers (See Figure 13). Unfortunately, a sampling on this day did not include the harbour entrance of Hillsborough Bay, although the distribution of counts similar to those observed on August 13 could be expected, in these latter areas, at least on the falling tide.

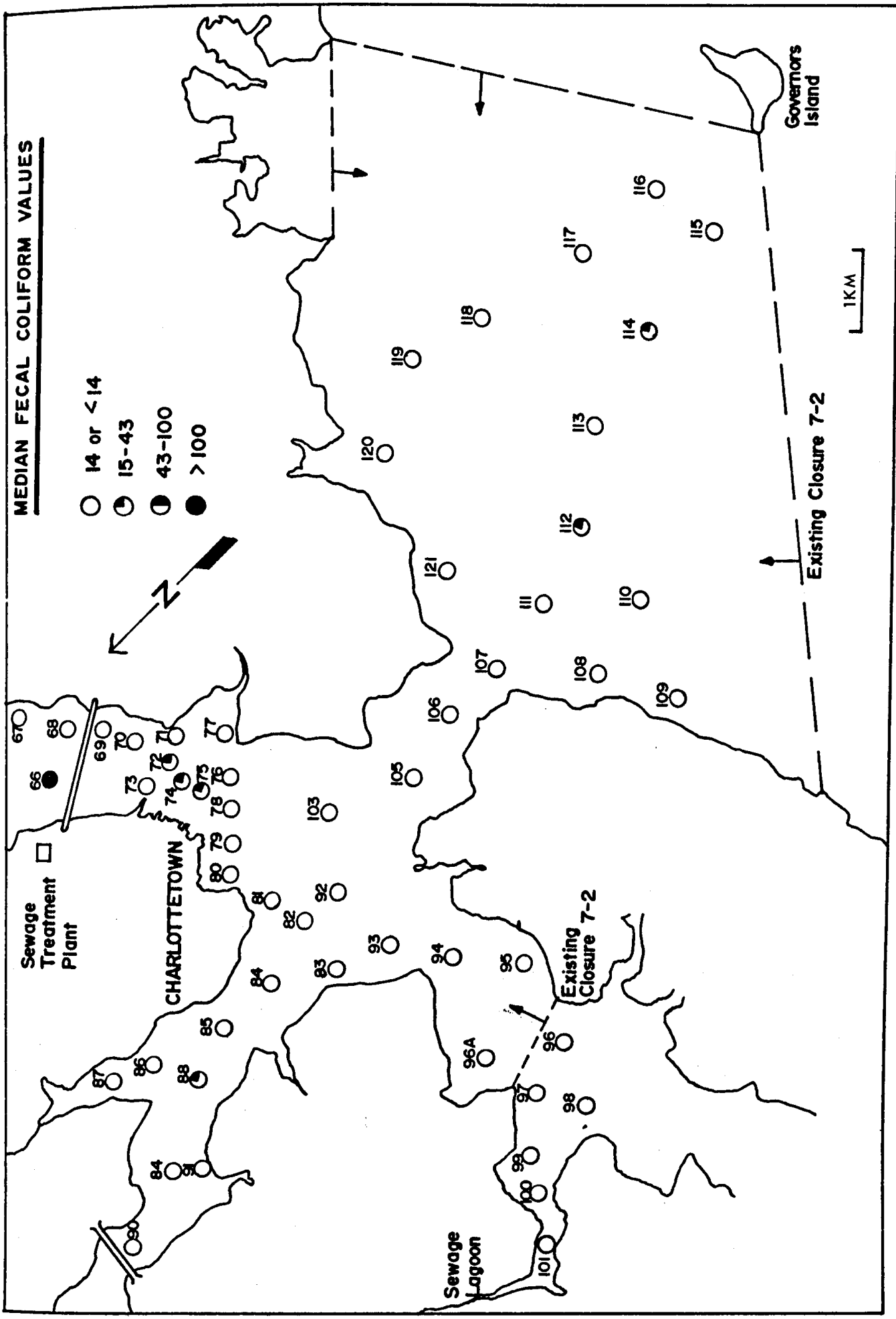


FIGURE 10 · SAMPLING STATIONS AND MEDIAN FECAL COLIFORM LEVELS, SECTOR 3, 1975.

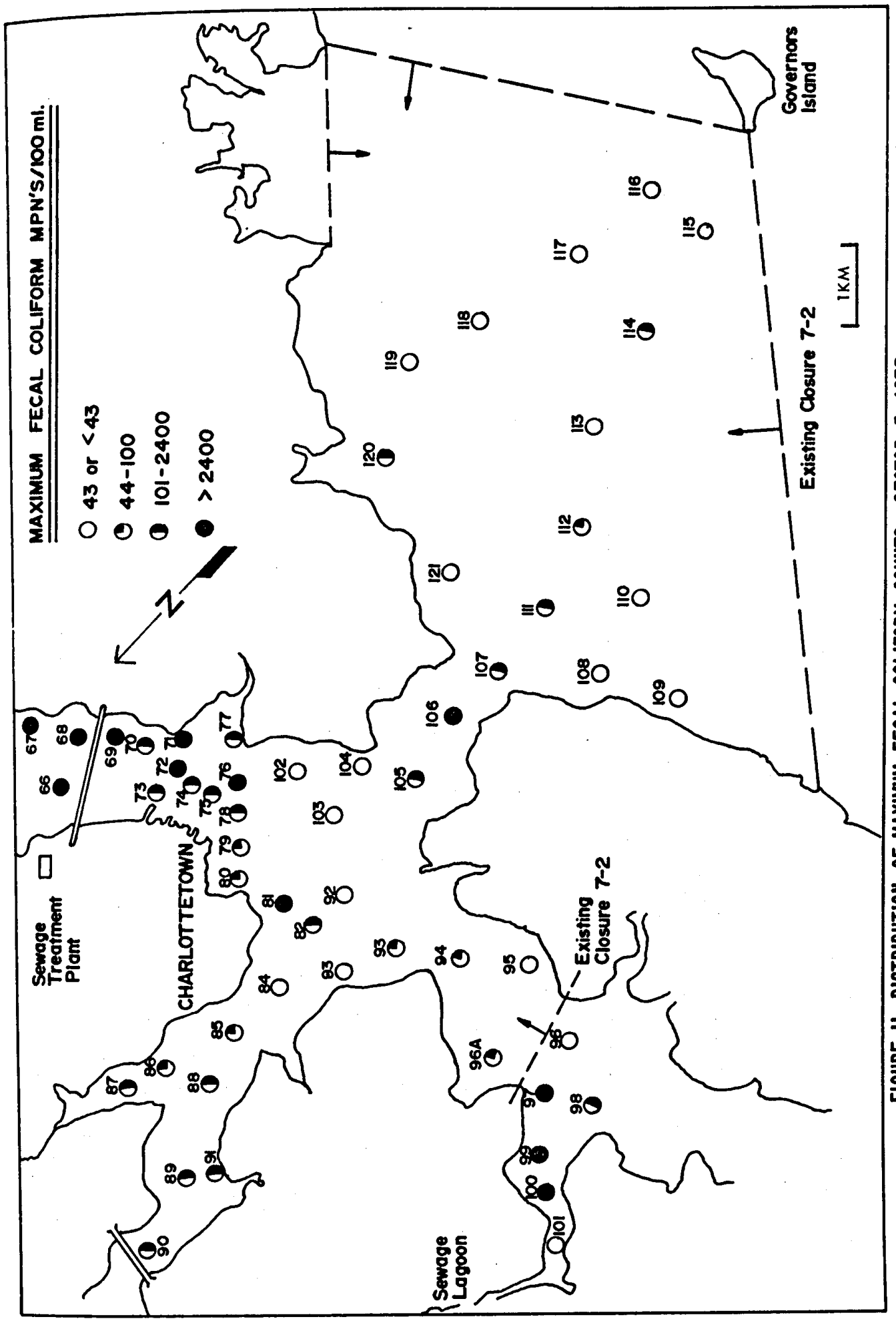
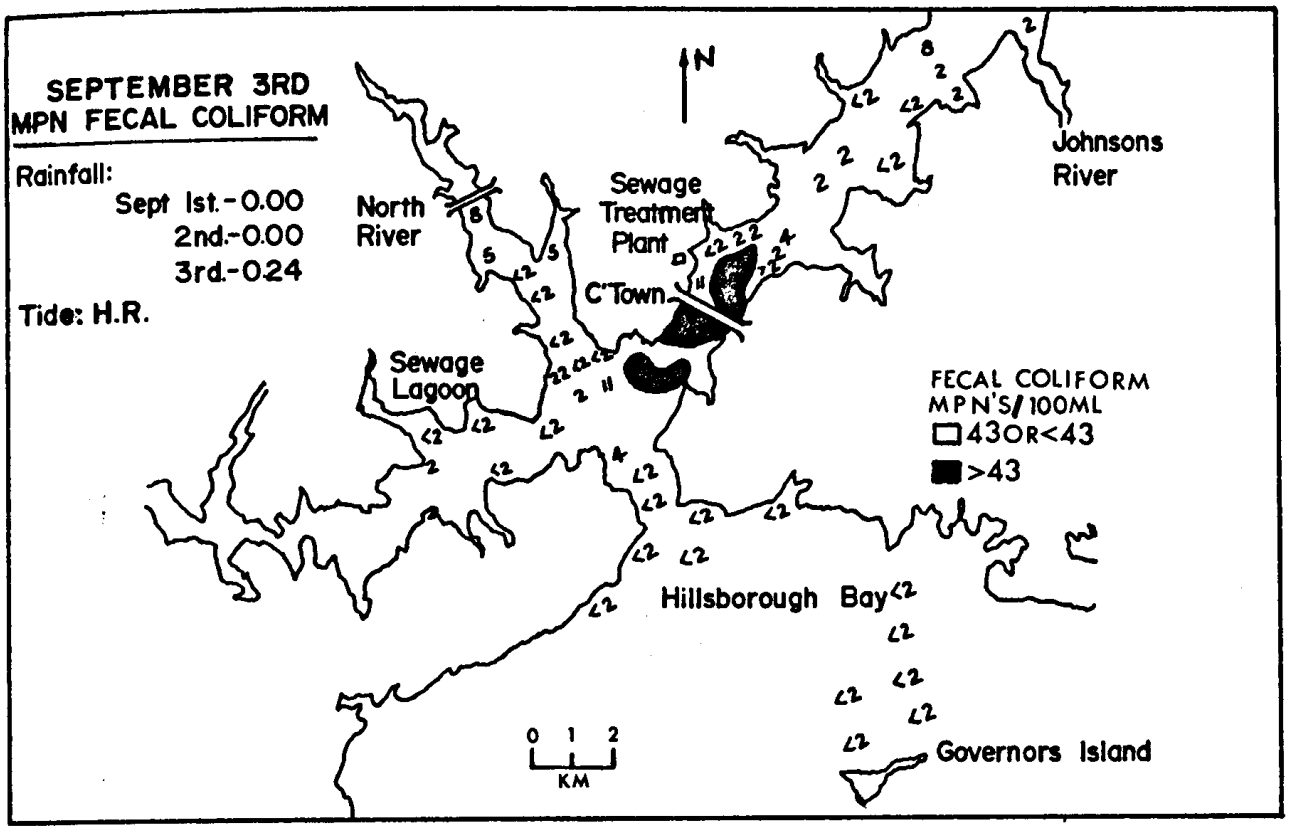


FIGURE 11 - DISTRIBUTION OF MAXIMUM FECAL COLIFORM COUNTS, SECTOR 3, 1975.



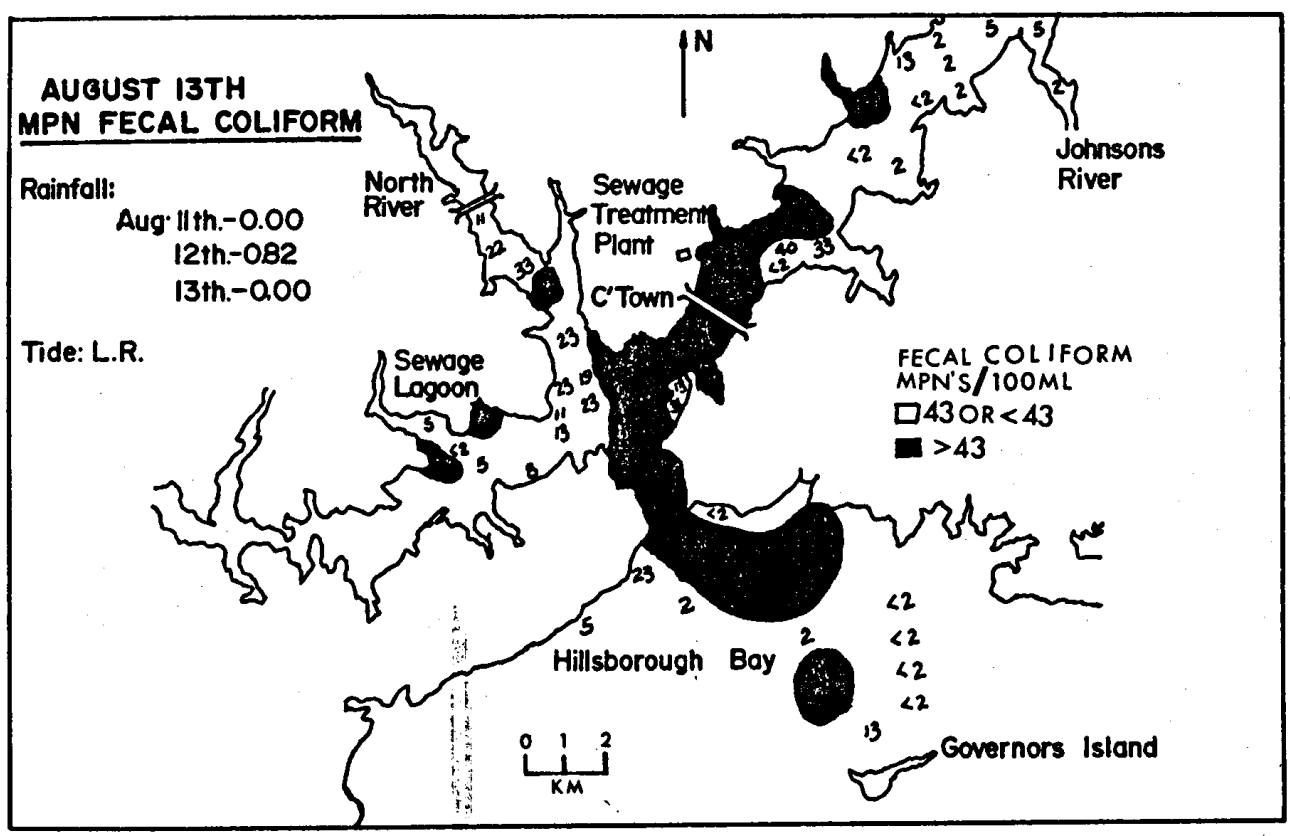


FIGURE 12 · DISTRIBUTION OF FECAL COLIFORM COUNTS SECTOR 3 :
(A) SEPTEMBER 3 AND, (B) AUGUST 13, 1975.

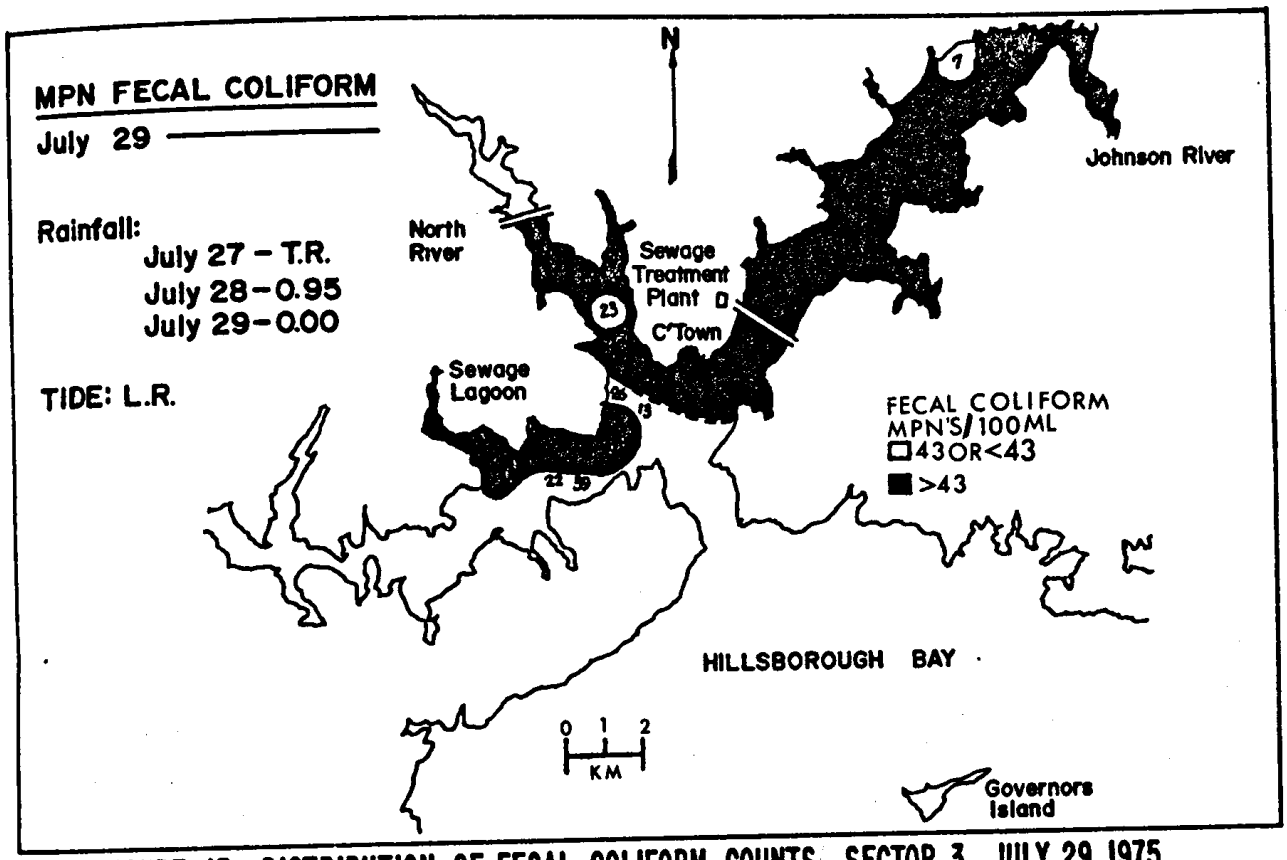


FIGURE 13 · DISTRIBUTION OF FECAL COLIFORM COUNTS, SECTOR 3, JULY 29, 1975.

Time-series sampling was completed on one day at stations 70 and 74, east of the Hillsborough Causeway (Figure 9). Median counts at the surface and at depth (3 meters) were 79 and 49 respectively during the falling tide. On the rising tide, median counts at the surface and at depth were 49 and 27, respectively. Levels were more uniform than those observed at station 66 (Sector II) and only once exceeded 150 MPN/100 ml. Time-series sampling at station 74 showed median fecal coliform MPN's of 130 and 11 for surface and depth samples respectively, during the falling tide. On the rising tide, surface and depth samples had median levels of 49 and 29, respectively at both stations 70 and 74. Time-series sampling results indicated that median surface levels were higher than those at depth and surface counts were higher on the falling tide.

6.0 DISCUSSION

6.1 Sector I

Waters within the present Mount Stewart closure (7-4) are clearly contaminated according to shellfish growing area standards. Occasionally, unacceptable fecal coliform levels are also observed below the closure line for a distance of nearly 2.5 kilometers. The two major potential sources of contamination entering this are are the village of Mount Stewart and runoff from agricultural activities.

Mount Stewart has been pointed out as the major cause for the current closure in numerous reports (Cullen 1968, Baxter 1971), and the installation of waste treatment facilities for the village resulted largely from concern over the possible contamination of the shellfish resource.

Data from this sector collected prior to the installation of treatment at Mount Stewart has been plotted in Figure 14. By comparing this with our present survey results (Figures 3 & 6), it appears that there is little, if any difference, in the water quality below Mount Stewart before and after installation of waste treatment facilities. It is interesting to note, however, that the lagoon at Mount Stewart was essentially empty during the survey period. It would appear that either fecal wastes are not reaching the lagoon or the liquid portion rapidly leaves the lagoon, via seepage and evaporation. During the survey period, there were high fecal coliform levels below Mount Stewart near the mouth of the Pisquid River on several days with no previous history of significant rainfall. Sampling results from the East River above Mount Stewart suggest a consistent low level of fecal contamination. Results from the Pisquid River do indicate significant fecal contamination entering the upstream portion of the River originating from several farms and the associated livestock and manure piles. Data on this river was collected under relatively low runoff conditions and do not reflect water quality conditions after high rainfall. The high counts below Mount Stewart observed during the survey period were not runoff induced and probably originate from fecal sources on the Pisquid River and/or from the Village of Mount Stewart.

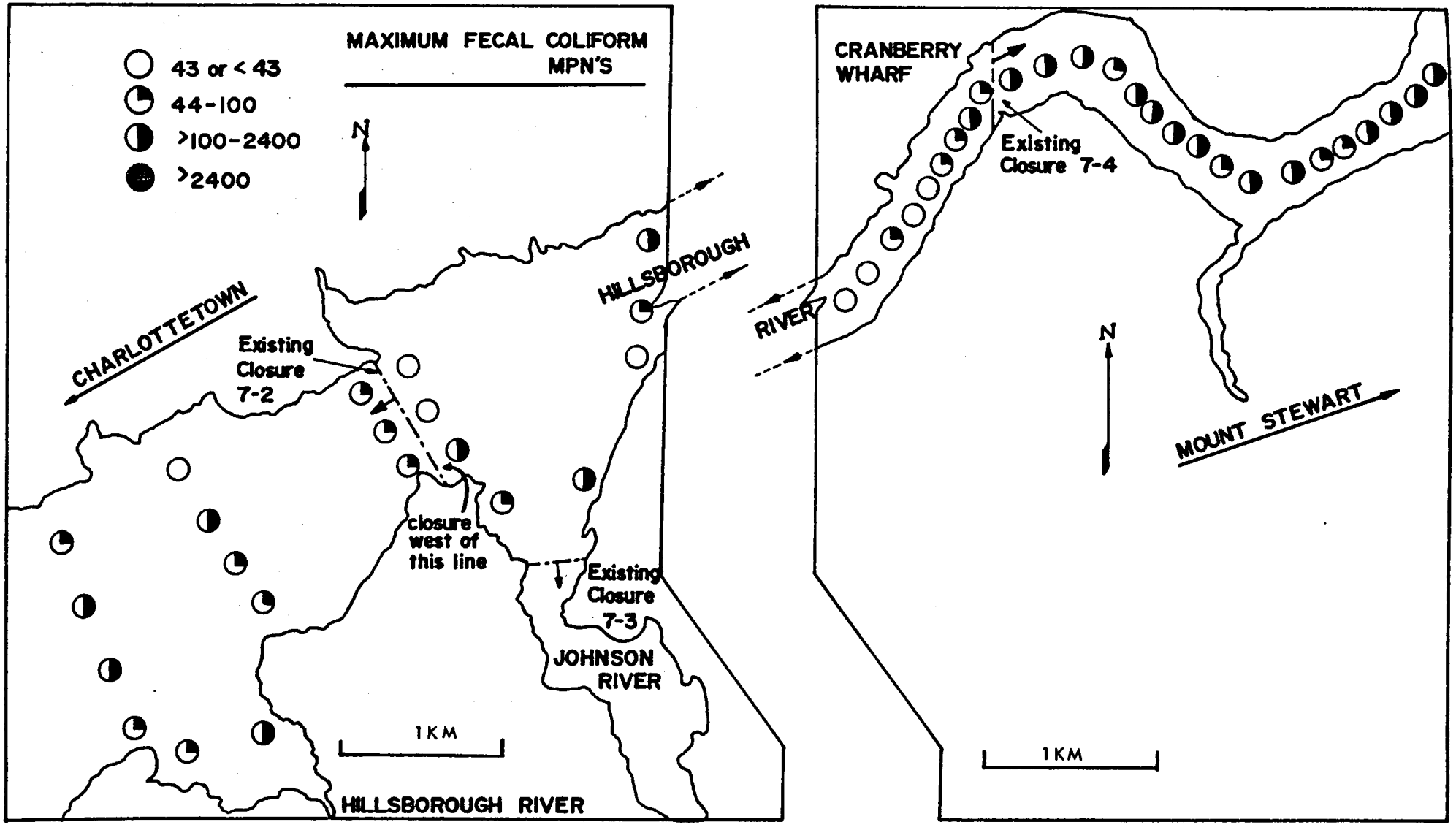


FIGURE 14 · DISTRIBUTION OF MAXIMUM FECAL COLIFORM COUNTS, SECTORS 1 AND 2 IN 1967-1969 PRIOR TO THE INSTALLATION OF SEWAGE TREATMENT FACILITIES AT MOUNT STEWART.

6.2 Sector II

The Glenfinnan Island portion of this sector had acceptable water quality conditions throughout the duration of the present survey. Although the data is representative of high (.95 and 0.82") rainfall conditions on two occasions these days do not represent high runoff conditions due to the praticularly dry soil conditions, thus the effect of landwash is not reflected well in the present data for this sector.

The sewage treatment plant under the normal operating conditions, represented during the survey period,does not adversely influence water quality more than 4 kilometers from the Hillsborough Causeway (Figure 8). The remaining 6 kilometers to the existing closure line (7-2) meets acceptable bacteriological standards for an approved growing area, during periods of good plant operation. However, with a failure in the treatment plant, the entire sector is contaminated as far as the Johnson River. Judging from the estimated current speeds indicated from drift observations, 5-6 hours on the rising tide. Thus acceptable water quality is clearly conditional upon the functioning for the Charlottetown sewage treatment facility, and the sector does not meet approved standards under the worst conditions.

6.3 Sector III

Water quality in Charlottetown Harbour has improved significantly on the average over pre-sewage treatment plant conditions (See Figure 15 A & B). Comparing 1964 median fecal coliform data for the Harbour with data from the present survey, a significant difference can be seen. In 1964, median levels in excess of 1000 were widespread throughout the Harbour. In 1975, median levels exceeded 1000 only at one station immediately over the sewage plant outfall site. Under the worst conditions, (ie. a treatment plant failure), water quality in the harbour rapidly deteriorates. This is apparent from the data on both July 29 and August 13. On both of these days, the treatment plant was subject to high flow conditions as indicated by rainfall data of the previous day. This situation combined with plant malfunctions such as the power failure on July 29 results in bypassing of raw sewage to the harbour and/or reduced treatment and disinfection efficiency.

From the drift data, it is apparent that upon plant malfunction, fecal contamination will be transported rapidly out the harbour mouth into Hillsborough Bay on the falling tide. Judging from estimated current speed, one falling tide could bring fecal wastes at least half the distance to Governors Island depending upon wind conditions.

The fecal wastes from the village of Cornwall also poses a threat in the presently approved area of the West River adjacent to Hyde Creek.

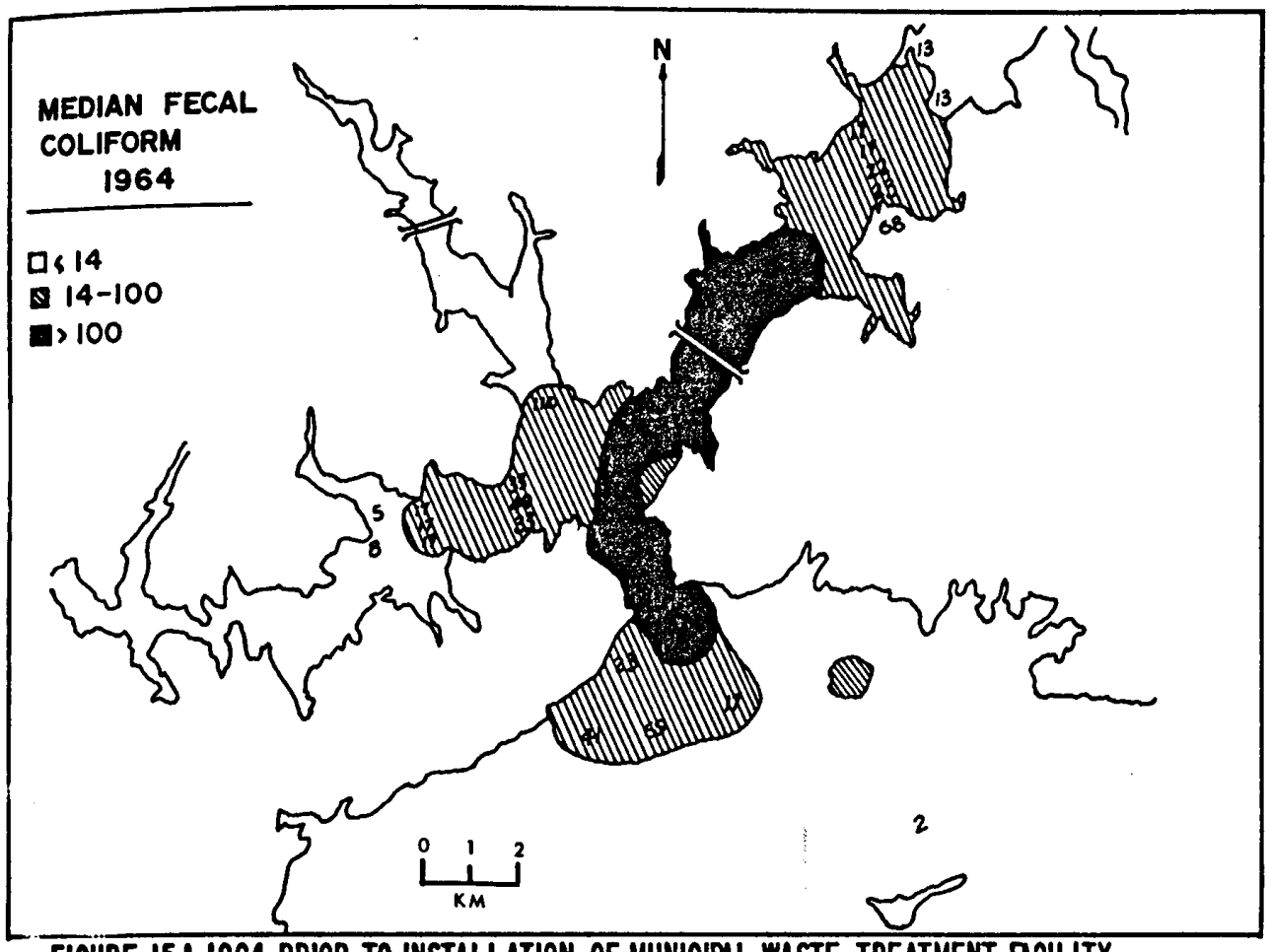


FIGURE 15A·1964 PRIOR TO INSTALLATION OF MUNICIPAL WASTE TREATMENT FACILITY.

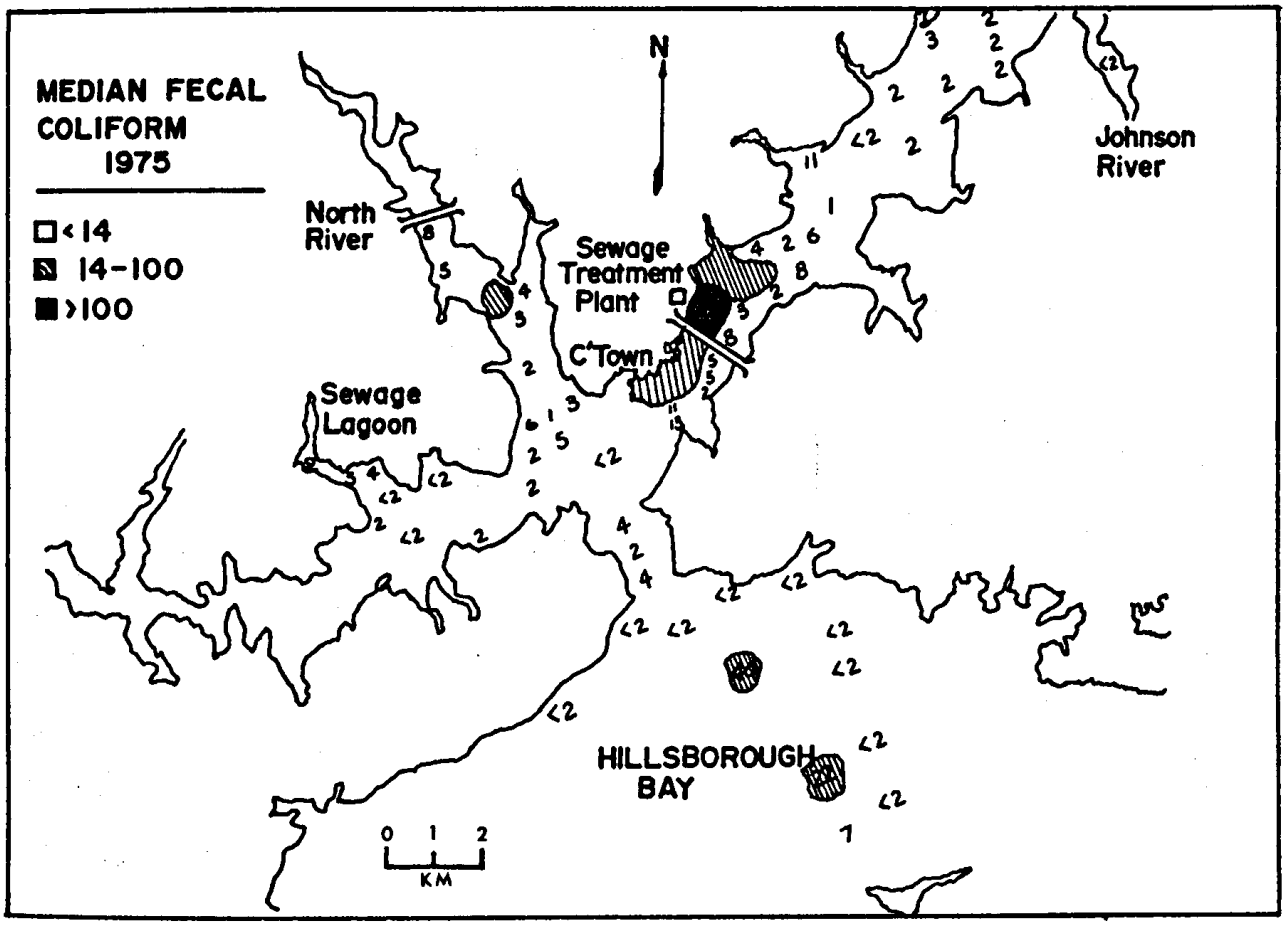


FIGURE 15B·1975 AFTER INSTALLATION OF CHARLOTTETOWN MUNICIPAL WASTE TREATMENT FACILITY.

On July 29 following rainfall, fecal levels were far beyond acceptable limits in Hyde Creek. The Cornwall system is presently being improved by the addition of a second cell to the lagoon system. It is possible that the construction at the site during the survey period contributed to the observed contamination problem, however, the system has never had any provision for disinfection and is a threat to the shellfish growing waters at least until the new system is installed and the effluent treated.

In Hillsborough Bay, the area seaward of a line drawn between Squaw Pt. and Bacon Point meets bacteriological standards for an approved shellfish growing area. Less than 10% of the counts exceeded 43 MPN/100 ml in the samples taken from this area.

The area north of a line between Lobster Point and Holland Cove and Bacon Point is dependant probably in large part on the operation of the Charlottetown sewage treatment plant.

7 CONCLUSIONS

After review of the preceeding survey data and the results of previous surveillance activities in the Charlottetown Harbour and East River area, the following conclusions have been reached:

1. The area upstream of Station 32, below the closure 7-4 on the East River does not meet the bacteriological water quality criteria for an approved area. Fecal contamination is present in the area below the present closure line only occasionally. The above mentioned sector could be conditionally approved if shellstock monitoring is completed annually prior to and during the harvesting season.

2. The Glenfinnan Island area between below Station 32 and the landward limit closure 7-2, meets the criteria for an approved shellfish growing area.

3. The Johnston River, closure 7-3, should be extended to include Station 47.

4. The area between Curry's Point and the present East River closure line of closure 7-4 meets the criteria for a conditionally approved growing area. Water quantity in this sector is dependent upon the adequate operation of the Charlottetown sewage treatment plant. As the effective operation of the plant appears to also be dependent upon flow conditions, the probable frequency of storm events significant enough to affect plant operation may make the application of the conditionally approved status on this sector impractical.

However, if deemed practical and if adequate administrative procedures can be developed to close this growing area upon treatment plant malfunctions within an acceptable time period, this sector can be classified as conditionally approved. If the previous conditions, all or in part, cannot be met, this sector must remain prohibited to harvesting of shellfish according to the existing regulations.

5. The area of Hillsborough Bay seaward of a line drawn between Squaw Point and Bacon Point meets the bacteriological criteria for an approved shellfish growing area.

6. The water quality in the sector between the above line drawn between Lobster Point and Holland Cove is dependent upon the operation of the Charlottetown Sewage Treatment Plant and meets the criteria for a conditionally approved area, if adequate administrative procedures can be established and if deemed practical. If these conditions are not met, this sector must remain prohibited to the harvesting of shellfish.

7. The current boundary of closure 7-2 in the West River should be extended to include the mouth of Hyde Creek.

8 RECOMMENDATIONS OF THE MARITIME STANDING COMMITTEE ON SHELLFISH

1. The existing closure P.E.I. 7-4, East River, should remain in effect unchanged, but routinely subjected to preseason stock monitoring in the Cranberry wharf sector.

2. The existing closure P.E.I. 7-3, Johnson River, should remain in effect unchanged.

3. Closure P.E.I. 7-2, Charlottetown Harbour should be reduced in Hillsborough Bay as shown in Figure 16 of this report.

4. No closure should be implemented in Hyde Creek until additional survey work has been completed. This work should be completed prior to the end of July, 1976.

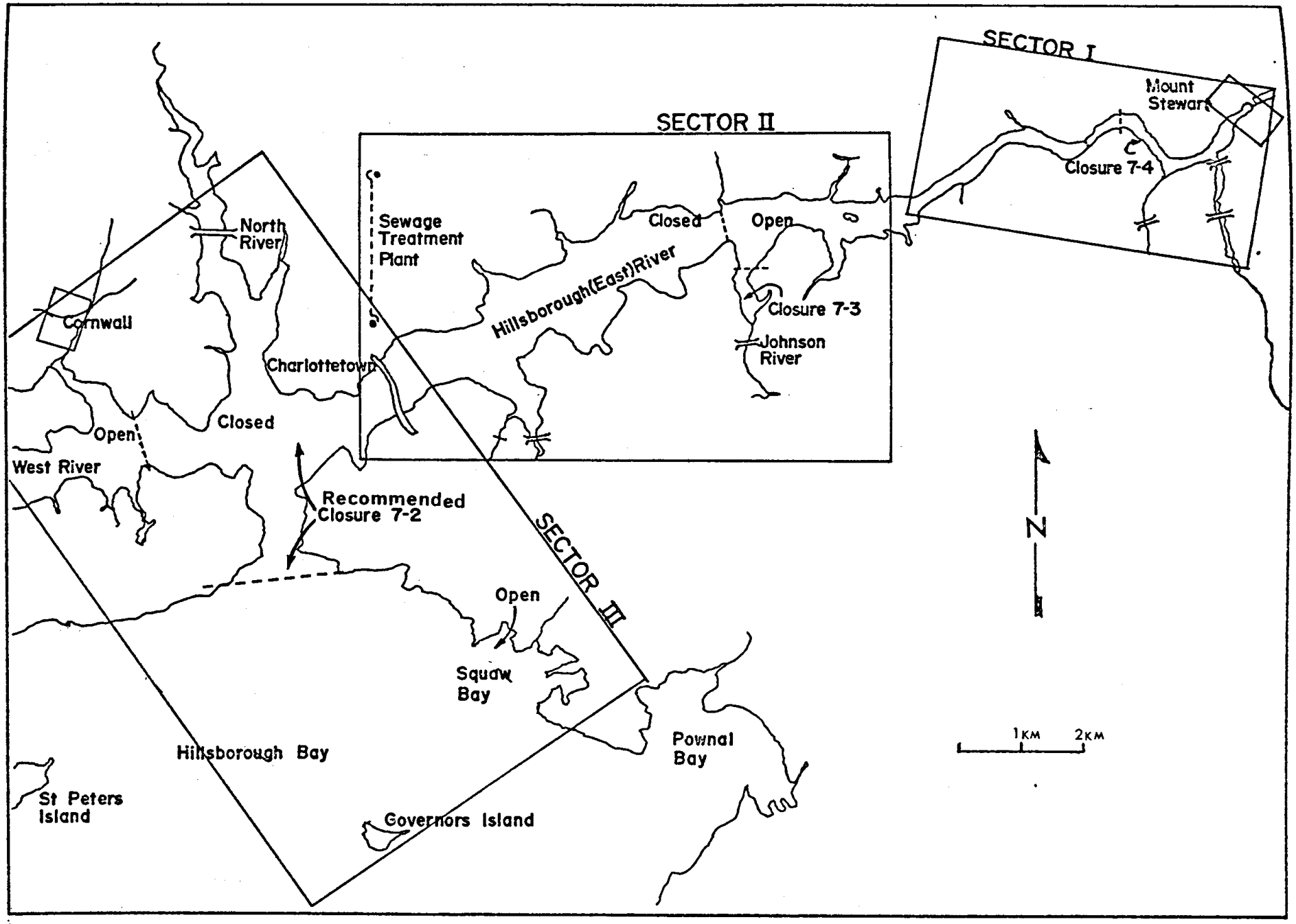


FIGURE 16 MAP OF THE STUDY AREA SHOWING SURVEY SECTORS AND SHELLFISH CLOSURES.

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ACKNOWLEDGEMENTS

The authors wish to acknowledge the excellent cooperation and assistance provided by the Environmental Control Commission of Prince Edward Island and specifically Mr. C. Murphy of that office. Field assistance was provided by Mr. K. McNeill and Mr. K. Burdet. The help of the members of the Microbiology Section in the organization of the field activities and in the preparation of the report is also gratefully acknowledged.

APPENDIX A

SCHEME OF OPERATIONS: SEWAGE TREATMENT PLANT – CHARLOTTETOWN.

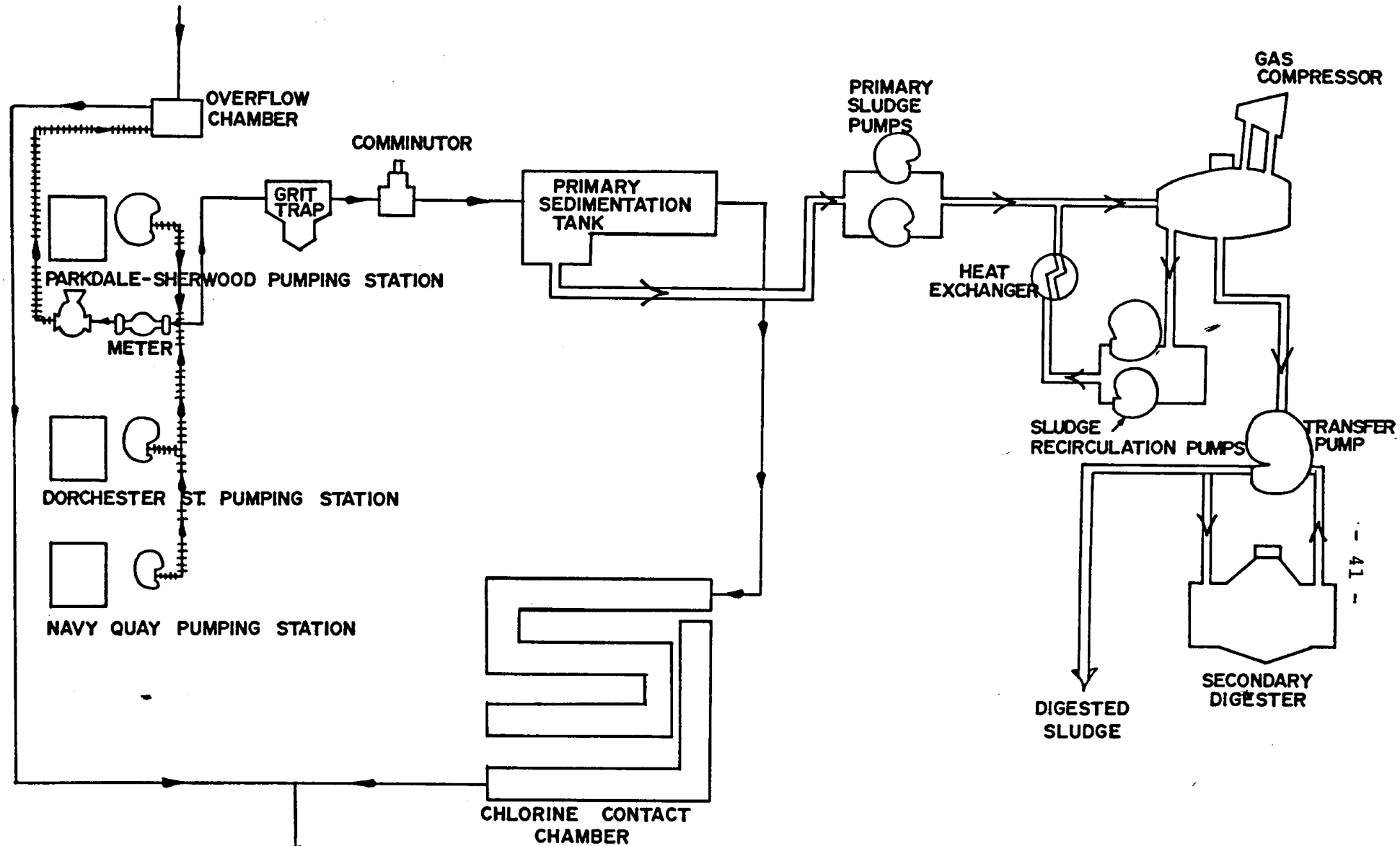


FIGURE A-1 · SCHEMATIC DIAGRAM OF CHARLOTTETOWN SEWAGE TREATMENT FACILITY.

TABLE A-1 EFFLUENT BACTERIOLOGICAL RESULTS AND RESIDUAL CHLORINE RECORDS FOR THE CHARLOTTETOWN SEWAGE TREATMENT PLANT, MAY - SEPTEMBER, 1975

DATE		TIME	RESIDUAL CHLORINE ppm	FC/MPN/100 ml PRE CHLORINATION	POST CHLORINATION
June	5	1500			2400+
		1600			2400+
		1700			2400+
		1800			2400+
		1900			2400+
July	8			130×10^5	<20
	9			130×10^7	9
	15			70×10^6	<2
	16			79×10^6	4
	22			26×10^6	2
	23	0230	0.5		
	24	0800	1.0+		
	25	2130	1.0+		
	26	1300	0.75		
	27	1330	0.9		
	28	1000	1.0		
		2130	1.0		
	29	1430	1.0	240×10^5	2400+
		2000	1.0		
	30	1330	0.5		
		2130	0.7		
	31	0830	0.8		
		2130	0.75		
Aug.	1	0830	0.05		
		1900	0.75		
	2	0830	0.05		
		1400	0.9		
	3	0830	0.1		
	4	0830	0.2	350×10^5	<2
		2100	0.75		
	5	0930	0.5		

TABLE A-1 (Cont'd)

DATE	TIME	RESIDUAL CHLORINE ppm	FC/MPN/100 ml PRE CHLORINATION	POST CHLORINATION
Aug. 5	1615	0.3		
6	0745	0.65		
	2030	0.5		
7	0830	0		
	2115	0.1		
8	1115	0.3		
	2330	0.1		
9	1300	0.75		
10	1130	0.4		
11	1130	1.0+		
	2100	0.2		
12	1330	0.1		
	2030	0.05		
13	0730	0.3		
14	0745	0.1		
15	0800	0.6		
16	0800	0.9		
17	0830	0.8		
18	0815	1.0		
	2045	1.0+		
19	0800	1.0		
	2000	1.0+		
20	0745	1.5		
	2015	0.75		
21	0900	0.6		
	2000	0		
22	0915	0.3		
	2100	0		
23	00	0.5		
24	1345	0.6		
25	0930	1.5		
	2130	0		
26	1330	0.3		
	2130	0.1		

TABLE A-1 (Cont'd)

DATE	TIME	RESIDUAL CHLORINE ppm	FC/MPN/100 ml PRE CHLORINATION	FC/MPN/100 ml POST CHLORINATION
Aug. 27	0730	0.5		
	2130	0.1		
28	0730	0.9		
	2130	0		
29	0730	0.6		
	1830	0		
30	0915	0.9		
31	0930	0		
Sept. 1	0800	1.2		
	1930	0		
2	1015	0.6		
3	0830	0.8	55×10^5	<2
	1900	0.9		
4	0745	1.5		
	2000	0.3		
5	0800	1.5		
6	0915	1.2		
7	1400	0.9		
8	0900	0.5		
	2100	0		
9	2130	0		
10	0800	0.5		

APPENDIX B

TABLE B-1

PRECIPITATION DATA, CHARLOTTETOWN
ATMOSPHERIC ENVIRONMENT SERVICE
ENVIRONMENT CANADA, CHARLOTTETOWN, P.E.I.
MAY - SEPTEMBER, 1975

	MAY		JUNE		JULY		AUGUST		SEPTEMBER	
DAY	RAIN INCHES	SAMPLING SECTORS	RAIN INCHES	SAMPLING SECTORS	RAIN INCHES	SAMPLING SECTORS	RAIN INCHES	SAMPLING SECTORS	RAIN INCHES	SAMPLING SECTORS
1	0		0.21		0		0		0	
2	0		0		0		Trace		0	
3	0.12		0		0.07		0		0.24	2 3
4	0.05		0		0		0	2 3	0.27	
5	0.05		0		0.36		6	1	0	
6	0.81		0.75		0		0		0.01	
7	0.43		0.02		0	2 3	Trace		Trace	
8	0.01	1	0.36		0		0		Trace	
9	0		0.15		0		0		0.04	
10	0		0		Trace		0			
11	0		0		0		0			
12	0	2 3	0		0		0.82			
13	Trace	1	0				0	1 2 3		
14	0		0		0		0			
15	0		0		0.17		Trace			
16	0.08		0		0		0			
17	0		0		0		Trace			
18	0		0.02		Trace		0.31			
19	0		0.01		0		0.02			
20	0.21	2 3	0		0		Trace			
21	0	3	0		0.05		0			
22	0.14		0.01		Trace	1 2 3	0.51			
23	0		0		0		0			
24	0		0		0		0			
25	0		0		0.17		0			
26	0.04		0		0.03		0			
27	0.26		0		Trace		Trace			
28	0.07		0		0.95	3	0			
29	Trace		0.10		0		0			
30	0		0		0		0			
31	0.17				0		0			

TABLE B-2 SALINITY AND TEMPERATURE RESULTS, SECTOR 1, 1975

STATION	MAY 8		MAY 13		JUNE 16		AUGUST 5	
	SAL. o/oo	TEMP. °C	SAL. o/oo	TEMP. °C	SAL. o/oo	TEMP. °C	SAL. o/oo	TEMP. °C
1	5.5	5.0	4.5	12.0	9.9	14.9	18.0	16.2
10	2.5	5.0	6.0	12.0	11.8	17.5	-	-
26	6.0	5.0	10.0	12.0	12.8	17.5	21.5	17.0
38	8.0	5.0	16.5	11.0	16.2	18.0	22.0	17.0

TABLE B-3 SALINITY AND TEMPERATURE RESULTS, SECTOR 2, 1975

STATION	MAY 12		MAY 20		MAY 27		JULY 7	
	SAL. o/oo	TEMP. °C	SAL. o/oo	TEMP. °C	SAL. o/oo	TEMP. °C	SAL. o/oo	TEMP. °C
46	19.0	9.0	-	-	20.9	12.2	24.2	18.0
54	20.0	8.0	-	-	24.8	11.0	22.2	19.0
58	11.0	7.0	23.0	13.0	25.0	11.0	23.0	19.0
60	19.0	6.0	22.0	12.0	25.0	11.0	23.0	19.0
65	21.0	4.0	21.0	11.0	25.5	11.0	22.9	17.0

TABLE B-4 SALINITY AND TEMPERATURE RESULTS, SECTOR 3, 1975

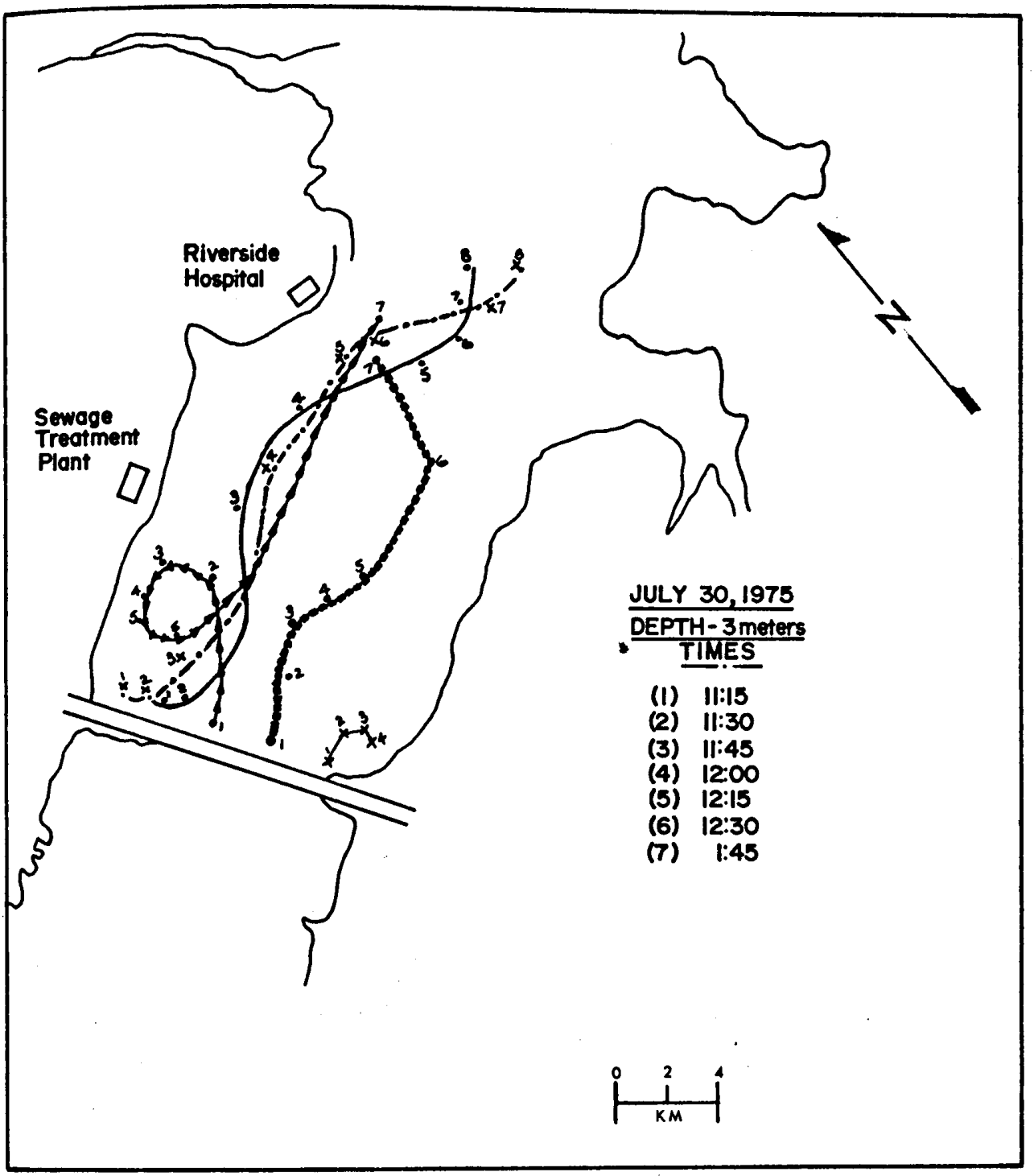
STATION	MAY 12		MAY 20		MAY 21		MAY 27		JULY 7	
	SAL. o/oo	TEMP. °C	SAL. o/oo	TEMP. °C	SAL. o/oo	TEMP. °C	SAL. o/oo	TEMP. °C	SAL. o/oo	TEMP. °C
84	19.0	7.0	19.0	13.0	24.0	11.0	24.9	10.0	21.9	16.4
95	20.0	6.0	20.0	12.0	24.0	11.0	24.9	10.0	19.4	17.1
103	21.0	6.0	22.0	11.0	23.0	11.0	26.8	9.0	25.0	14.2
111	18.0	5.0	21.0	11.0	26.0	8.0	26.5	9.2	17.4	15.0

TABLE B-5 WIND SPEED AND DIRECTION DATA, CHARLOTTETOWN - ATMOSPHERIC ENVIRONMENT SERVICE, ENVIRONMENT CANADA, CHARLOTTETOWN, P.E.I. JULY - AUGUST, 1975

DATE	TIME (HRS.)	SPEED (KNOTS)	DIRECTION	
July 23	0800	5	222°	SSW
	0900	6	200°	SSW
	1000	7	193°	SSW
	1100	10	210°	SSW
	1200	12	183°	SSW
	1300	14	208°	SSW
	1400	14	348°	SWW
July 29	0000	15	230°	SWW
	0100	14	210°	SSW
	0200	13	222°	SSW
	0300	10	220°	SSW
	0400	10	242°	SWW
	0500	10	242°	SWW
	0600	13	233°	SWW
	0700	6	230°	SWW
	0800	10	223°	SSW
	0900	15	223°	SSW
	1000	15	210°	SSW
	1100	13	218°	SSW
	1200	15	200°	SSW
	1300	15	210°	SSW
	1400	15	190°	SSW
	1500	15	210°	SSW
	1600	12	200°	SSW
	1700	14	190°	SSW
	1800	15	220°	SSW
July 30	0800	7	270°	W
	0900	13	240°	SWW
	1000	10	270°	W
	1100	14	260°	SWW
	1200	13	240°	SWW
	1300	15	260°	SWW
	1400	14	273°	NWW
August 7	0800	10	20°	NNE
	0900	10	20°	NNE
	1000	8	20°	NNE
	1100	10	350°	NNW
	1200	10	360°	N
	1300	12	360°	N
	1400	12	360°	N

TABLE B-5 (CONT'D)

DATE	TIME (HRS.)	SPEED (KNOTS)	DIRECTION	
August 13	0000	5	240°	SWW
	0100	4	225°	SWW
	0200	0	0°	0
	0300	5	270°	W
	0400	0	0°	0
	0500	0	0°	0
	0600	5	270°	W
	0700	5	270°	W
	0800	5	320°	NNW
	0900	10	330°	NNW
	1000	10	330°	NNW
	1100	10	330°	NNW
	1200	10	350°	NNW
	1300	10	350°	NNW
	1400	10	360°	N
	1500	4	360°	N
	1600	5	20°	NNE
	1700	0	0°	0
	1800	0	0°	0



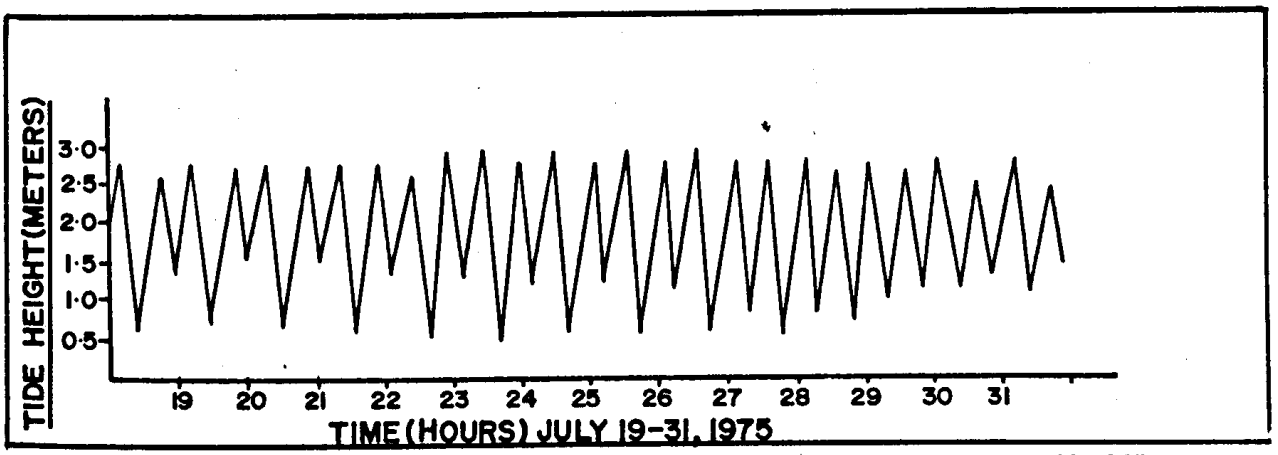
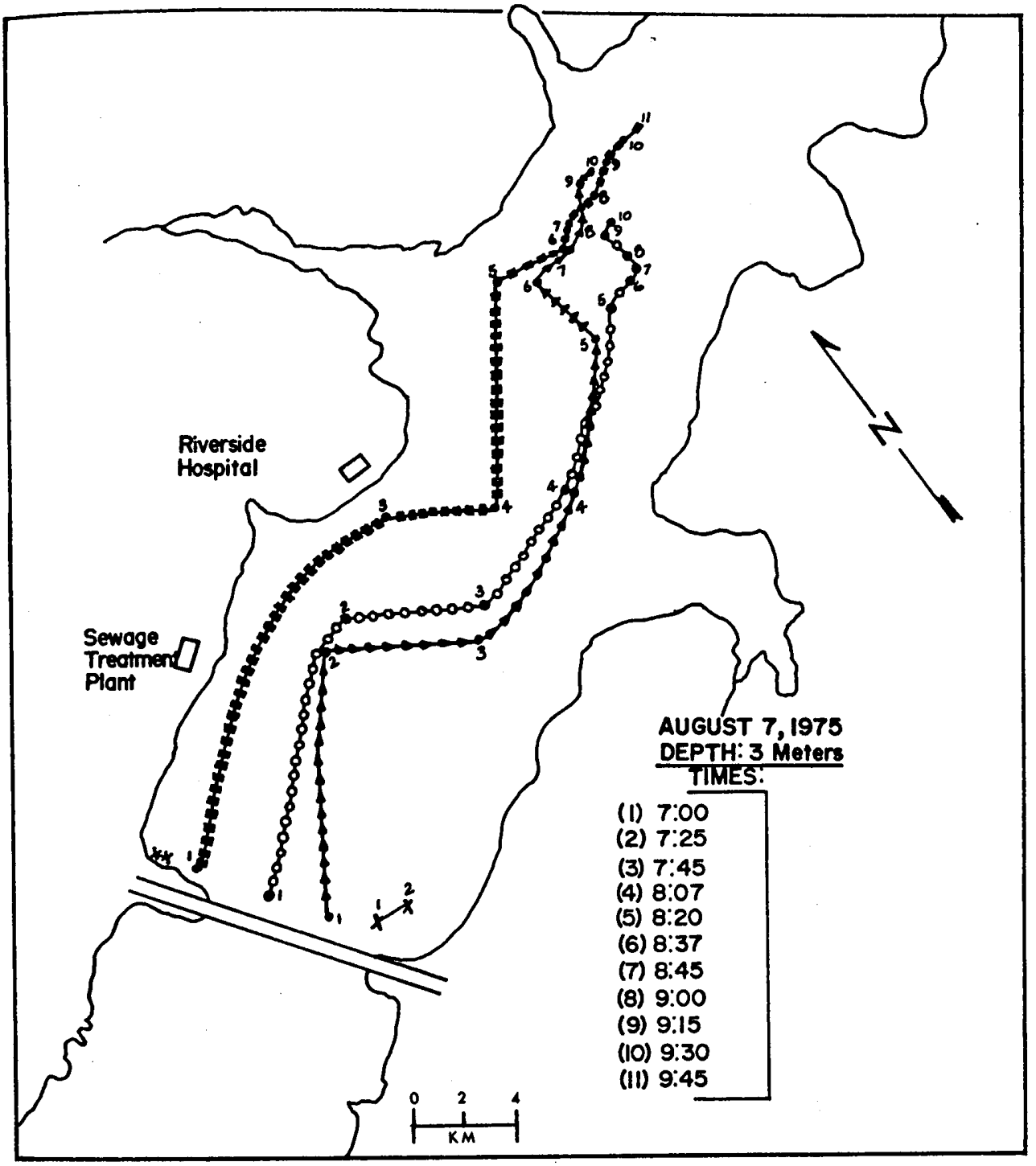


FIGURE B-1 · MOVEMENT OF DROGUES, CHARLOTTETOWN HARBOUR, JULY 30, 1973.



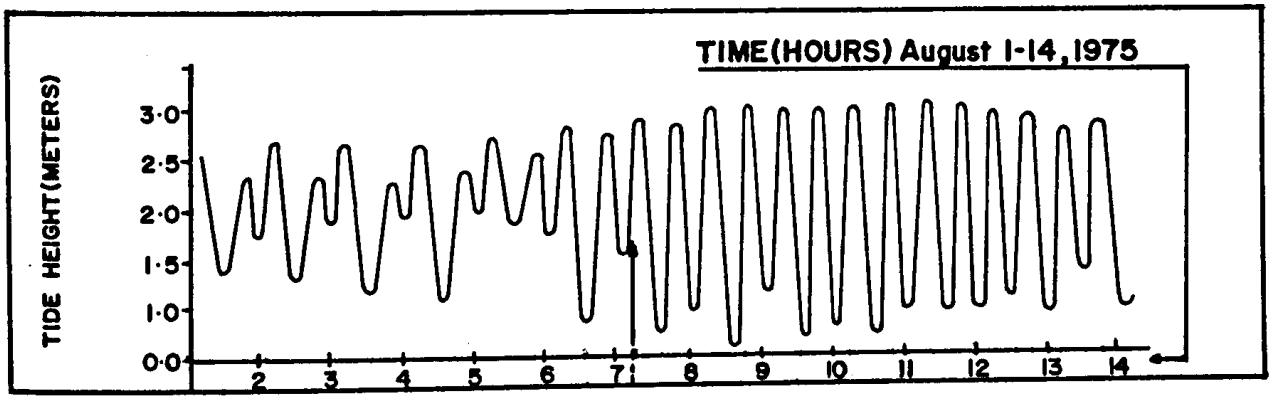


FIGURE B·2 · MOVEMENT OF DROGUES, CHARLOTTETOWN HARBOUR, AUGUST 7, 1975.

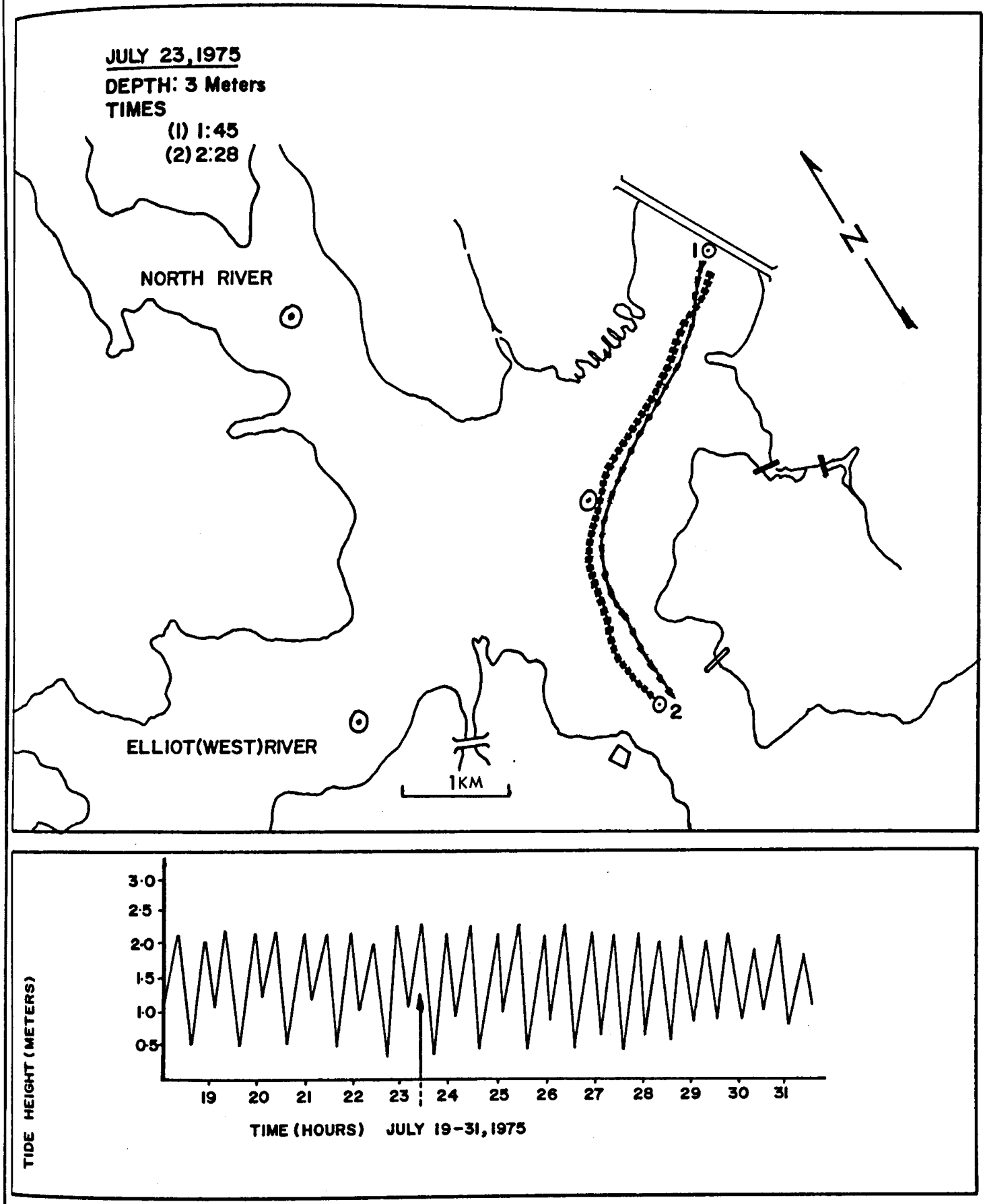


FIGURE B·3· MOVEMENT OF DROGUES, CHARLOTTETOWN HARBOUR, JULY 23, 1975.

APPENDIX C

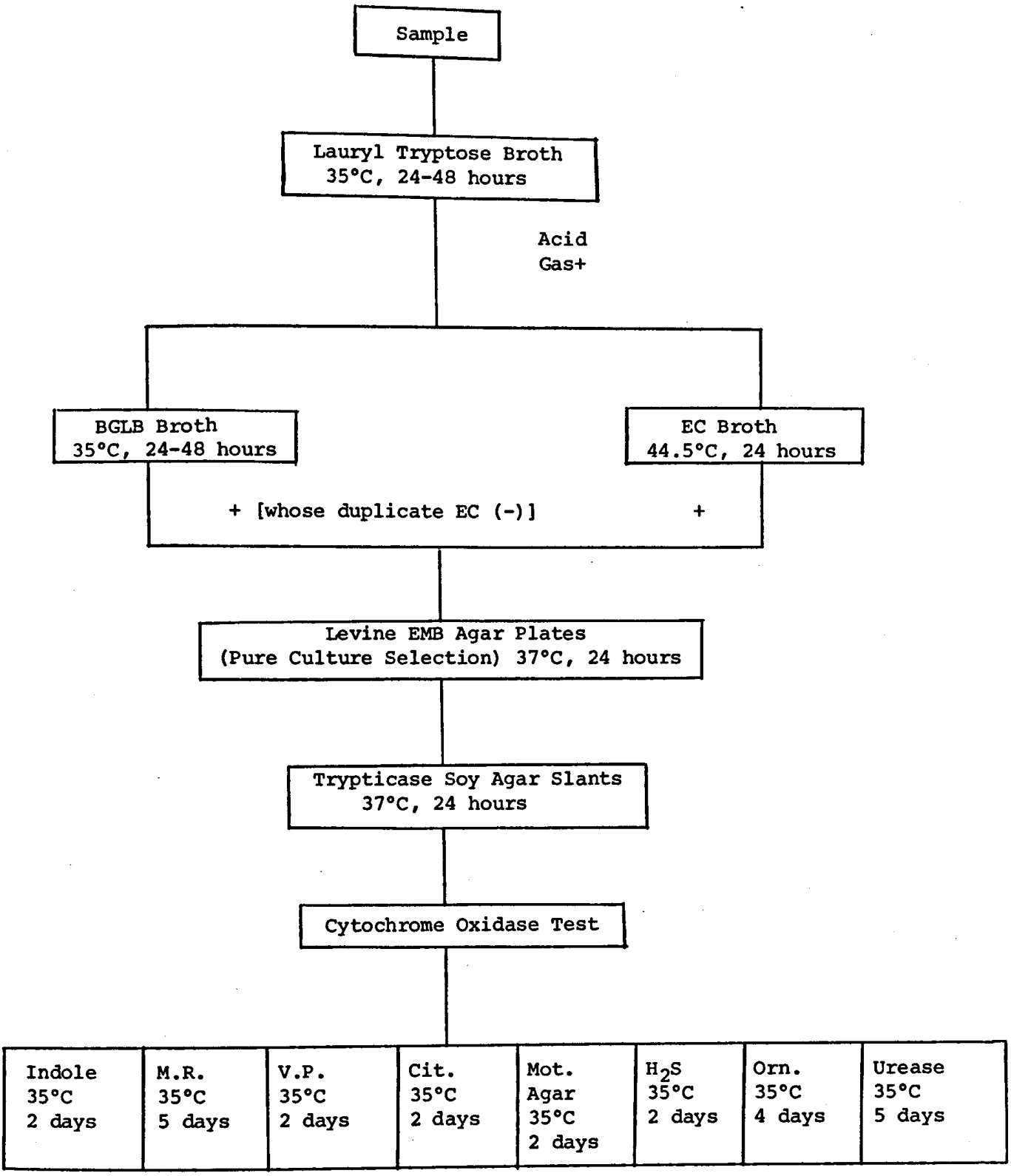


FIGURE C-1 COLIFORM GROUP ISOLATION AND IDENTIFICATION PROCEDURE

TABLE C-1 FECAL COLIFORM RESULTS, SECTOR 1, EAST RIVER - MT. STEWART, MAY - SEPTEMBER, 1975

STATION NO.	FECAL COLIFORM MPN/100 ML							
DATE	MAY 8	MAY 13	JUNE 16	JULY 22	AUG 5	AUG 13		
TIME	1000-	800-900	1000-1200	830-930	930-1030	1300-1400	MEDIAN	
TIDE	H.R.	H.R.	L.F.	L.R.	H.F.	H.R.		MAX.
1	-	79	23	8	24	49	24	79
2	-	350	22	5	17		20	350
3	-	79	17	13	210	140	79	210
4	14	8	23	95	14	-	14	95
5	8	180	5	11	-	130	11	180
6	5	13	23	-	27	-	25	27
7	<2	2400+	11	-	59	-	35	2400+
8	23	2400+	5	17	23	-	23	2400+
9	7	2400+	5	17	42	46	30	2400+
10	-	38	13	540	4	-	26	540
11	-	2400+	2	540	50	-	300	2400+
12	-	2400	-	1600	4	23	800	2400+
13	70	70	4	46	36	23	40	70
14	13	2400+	23	240	16	-	23	2400+
15	14	95	11	240	2400+	-	95	2400+
16	13	280	6	17	12	12	13	280
17	17	2400+	5	220	-	23	23	2400+
18	11	38	8	33	13	-	13	38
19	34	36	5	23	2400+	33	34	2400+
20	23	59	F	2	19	-	19	59
21	26	23	4	13	2400+	-	23	2400+
22	23	31	4	49	4	11	18	49
23	13	19	5	2	<2	-	5	19
24	17	6	8	4	2400+	22	12	2400+
25	130	13	8	13	2400+	-	13	2400+
26	-	36	8	8	8	23	8	2400+
27	-	17	<2	7	4	-	6	17
28	33	24	2	2	<2	23	12	24
29	11	8	8	5	22		8	22
30	-	19	5	17	2400+	-	18	2400+
31	23	19	<2	13	17	7	15	23
32	46	24	<2	11	2400+	-	18	2400+
33	33	41	<2	5	21	13	7	41
34	8	11	<2	2	2	-	2	11

TABLE C-1 (Cont'd)

STATION NO.	FECAL COLIFORM MPN/100 ML							
DATE	MAY 8	MAY 13	JUNE 16	JULY 22	AUG 5	AUG 13		
TIME	1000-	800-900	1000-1200	830-930	930-1030	1300-1400	MEDIAN	
TIDE	H.R.	H.R.	L.F.	L.R.	H.F.	H.R.		MAX.
35	49	2	5	2	<2	5	4	49
36	70	35	<2	5	12	-	8	70
37	23	2	33	2	<2	22	12	33
38	-	9	2	5	2	8	5	9
39	-	-	<2	-	5	11	5	11
40	-	-	<2	-	9	14	9	14
41	-	-	<2	-	<2	8	<2	8
42	-	-	8	-	12	13	12	13
43	-	-	23	-	<2	7	7	23
44	-	-	2	-	8	<2	2	8
45	-	-	<2	-	<2	2	<2	2

TABLE C-2 FECAL COLIFORM RESULTS, SECTOR 2, GLENFINNAN ISLAND, EAST RIVER, MAY - SEPTEMBER, 1975

STATION NO.	FECAL COLIFORM MPN/100 ML										
DATE	MAY 12	MAY 20	MAY 27	JULY 7	JULY 22	JULY 29	AUG 4	AUG 13	SEPT 3		
TIME	8:00-11:00	8:00-9:00	7:30-11:30	8:30-11:00	12:30-1500	1:00-4:00	12:00-13:30	12:30-1330	12:30-16:30	MEDIAN	
TIDE	H.R.	H.F.	H.R.	H.F.	H.F.-L.F.	H.R.	L.F.	L.R.	L.F.		MAX
46	<2	-	<2	<2	-	2400+	-	2	-	<2	2400+
47	<2	2	11	<2	<2	2400+	<2	5	2	2	2400+
48	5	<2	17	<2	<2	2400+	<2	5	<2	<2	2400+
49	<2	<2	5	5	<2	7	<2	2	8	2	8
50	13	2	49	<2	<2	2400+	<2	2	2	2	2400+
51	2	<2	7	<2	7	920	<2	2	2	2	920
52	<2	<2	11	2	7	2400+	<2	<2	<2	2	2400+
53	<2	2	6	4	<2	2400+	<2	13	-	3	2400+
54	<2	<2	14	<2	<2	2400+	2	49	<2	2	2400+
55	<2	<2	13	2	8	2400+	5	2	<2	2	2400+
56	<2	<2	27	<2	11	2400+	<2	<2	2	<2	2400+
57	<2	<2	70	<2	17	2400+	<2	-	2	1	2400+
58	2	2	13	2	11	2400+	11	-	-	11	2400+
59	7	<2	6	<2	79	2400+	2	79	4	6	2400+
60	8	<2	17	<2	240	2400+	<2	33	2	8	2400+
61	2	2	23	2	2	2400+	<2	130	2	2	2400+
62	4	4	11	2	70	2400+	<2	-	2	4	2400+
63	<2	<2	49	<2	240	2400+	<2	40	79	40	2400+
64	<2	2	11	2	79	130	2	<2	22	2	130
65	5	<2	22	49	23	1600	<2	220	<2	23	1600
66	2	<2	14	2400+	130	2400+	<2	540	11	130	2400+
67	4	<2	2	<2	220	2400+	<2		49	3	2400+
68	5	2	8	<2	240	2400+	<2	540	49	8	2400+

TABLE C-3 FECAL COLIFORM RESULTS, SECTOR 3, CHARLOTTETOWN HARBOUR, MAY - SEPTEMBER, 1975

STATION NO.	FECAL COLIFORM MPN/100 ML												
DATE	MAY 12	MAY 20	MAY 21	MAY 27	JULY 7	JULY 22	JULY 28	JULY 29	AUG 4	AUG 13	SEPT 3	MEDIAN	
TIME	8-11 AM	900-1200	800-900	730-1130	830-1100	1230-300	900-1030	1300-1600	1230-1330	900-1100	730-1000		
TIDE	H.R.	H.F.	H.F.	H.R.	H.F.	H.F.-L.F.	L.R.	L.R.	L.F./H.F.	L	H.R.		MAX.
69	2	<2	5	23	5	170	-	HR2400+	<2	-	130	5	2400+
70	<2	<2	79	5	<2	170	-	540	2	-	31	5	540
71	<2	<2	2	5	<2	13	-	2400+	<2	-	33	2	2400+
72	<2	<2	8	22	240	170	-	-	<2	110	23	22	2400+
73	<2	<2	14	7	540	49	-	110	4	-	49	14	540
74	17	2	8	17	5	130	-	240	2	-	46	17	240
75	22	<2	13	17	49	110	-	170	<2	350	33	28	350
76	2	7	6	8	14	350	-	2400+	8	70	130	11	2400+
77	<2	<2	4	27	-	130	-	170	5	13	33	13	170
78	5	<2	13	140	<2	170	-	130	5 HF	-	130	13	170
79	4	2	<2	22	2	13	-	-	79	-	2	3	79
80	2	<2	2	17	4	17	-	-	79	33	< 2	4	79
81	<2	2400+	2	4	<2	-	<2	79	9	49	< 2	3	2400+
82	2	11	140	<2	<2	-	<2	170	<2	17	< 2	1	170
83	<2	4	33	7	<2	-	2	26	4	23	22	6	33
84	-	-	-	-	-	-	<2	95	2	33	< 2	2	33
85	2	4	<2	22	<2	-	<2	33	<2	49	< 2	3	49
86	-	-	-	-	-	-	4	280	<2	-	5	4	280
87	-	-	-	-	-	-	2	-	<2	-			
88	-	-	-	-	-	-	<2	130	<2	33	< 2	17	130
89	-	-	-	-	-	-	4	240	5	22	5	5	240
90	-	-	-	-	-	-	-	280	<2	11	8	10	280
91	-	-	-	-	-	-	-	140	2	-	-	-	-
92	5	5	4	2	<2	-	-	13	<2	23	11	5	23

TABLE C-3 (Cont'd)

STATION NO.	FECAL COLIFORM MPN/100 ML												
DATE	MAY 12	MAY 20	MAY 21	MAY 27	JULY 7	JULY 22	JULY 28	JULY 29	AUG 4	AUG 13	SEPT 3	MEDIAN	
TIME	8-11 AM	900-1200	800-900	730-1130	830-1100	1230-300	900-1030	1300-1600	1230-1330	900-1100	730-1000		
TIDE	H.R.	H.F.	H.F.	H.R.	H.F.	H.F.-L.F.	L.R.	L.R.	L.F./H.F.	L	H.R.		MAX.
93	<2	<2	2	5	<2	-	<2	49	<2	11	2	2	49
94	<2	<2	4	<2	2	-	<2	79	2	13	<2	2	79
95	<2	<2	4	4	<2	-	<2	33	<2	8	<2	2	33
96	-	-	-	-	-	-	<2	22	<2	5	<2	<2	22
96A	-	-	-	-	-	-	<2	-	-	46	<2	<2	46
97	-	-	-	-	-	-	<2	2400+	<2	<2	<2	<2	2400+
98	-	-	-	-	-	-	<2	49	<2	140	2	2	140
99	-	-	-	-	-	-	<2	2400+	2	5	-	4	2400+
100	-	-	-	-	-	-	<2	2400+	5	-	-	5	2400+
101	-	-	-	-	-	-	9	31	8	-	-	9	31
102	-	-	-	-	-	-	-	-	-	31	33	-	-
103	<2	<2	<2	23	<2	-	-	-	<2	110	31	<2	31
104	-	-	-	-	-	-	-	-	-	79	33	-	-
105	2	<2	6	33	<2	-	-	-	<2	1600	4	4	1600
106	<2	2	2	49	<2	-	-	-	<2	2400+	<2	2	2400+
107	2	<2	5	<2	5	-	-	-	<2	540	<2	4	540
108	<2	<2	8	<2	<2	-	-	-	<2	23	<2	<2	23
109	<2	<2	<2	<2	<2	-	-	-	<2	5	<2	<2	5
110	-	-	-	-	-	-	-	-	<2	2	-	-	-
111	<2	<2	7	7	<2	-	-	-	<2	920	<2	<2	920
112	-	-	-	-	-	-	-	-	<2	79	-	40	79

TABLE C-3 (Cont'd)

STATION NO.	FECAL COLIFORM MPN/100 ML												
DATE	MAY 12	MAY 20	MAY 21	MAY 27	JULY 7	JULY 22	JULY 28	JULY 29	AUG 4	AUG 13	SEPT 3		
TIME	8-11 AM	900-1200	800-900	730-1130	830-1100	1230-300	900-1030	1300-1600	1230-1330	900-1100	730-1000	MEDIAN	
TIDE	H.R.	H.F.	H.F.	H.R.	H.F.	H.F.-L.F.	L.R.	L.R.	L.F./H.F.	1	h.r.		MAX.
113	-	-	-	-	-	-	-	-	<2	2	-	1	2
114	-	-	-	-	-	-	-	-	<2	170	<2	22	170
115	-	-	-	-	-	-	-	-	-	13	2	7	13
116	-	-	-	-	-	-	-	-	<2	<2	<2	<2	<2
117	-	-	-	-	-	-	-	-	-	<2	<2	<2	<2
118	-	-	-	-	-	-	-	-	<2	<2	<2	<2	<2
119	-	-	-	-	-	-	-	-	<2	<2	<2	<2	-
120	2	2	2	2	2	-	-	-	<2	140	<2	<2	140
121	<2	<2	2	<2	2	-	-	-	<2	8	<2	<2	8

TABLE C-4 FECAL COLIFORM RESULTS, SUBSURFACE SAMPLES, SECTORS 1-3, MAY - SEPTEMBER, 1975

STATION	DEPTH METER	DEPTH SAMPLES FECAL COLIFORM MPN/100 ml							
		MAY 12	MAY 13	MAY 20	MAY 21	MAY 27	JUNE 16	JULY 22	AUGUST 4
1	2	-	2400+	-	-	-	-	-	-
10	2	-	2400+	-	-	-	-	-	-
26	3	-	4	-	-	-	-	-	-
38	4	-	5	-	-	-	<2	-	-
46	2	<2	-	-	-	2	<2	2	-
54	2	2	-	-	-	170	-	<2	-
58	2	2	-	-	-	-	-	70	-
60	2	-	-	<2	-	-	-	240	-
65	4	<2	-	-	-	350	-	79	-
84	4	-	-	-	22	-	-	-	<2
95	4	-	-	<2	7	-	-	-	<2
103	4	-	-	-	4	-	-	-	-
111	5	2	-	<2	17	<2	-	-	<2

TABLE C-5 BACTERIOLOGICAL DATA FOR THE EAST RIVER ABOVE MT. STEWART AND THE PISQUID RIVER, OCTOBER AND NOVEMBER, 1975

STATION	LOCATION	FECAL COLIFORM MPN/100 ml				
		DATE*				
		10/21/75*	10/28/75	11/3/75	11/5/75	11/8/75
A	Pisquid River 4.0 kilometers above mouth	430	-	2400+	350	240
B	Pisquid River 3.05 kilometers above mouth	-	-	79	m -	23
C	East River at Cherry Hill	79	2	130	33	2
D	East River 1.5 kilometers above Mt. Stewart	-	7	33	110	-
E	East River above Dam at Mt. Stewart	79	46	11	17	<2

* Rainfall the day previous sampling: October 20, 15.8 mm; October 28, 0 mm; November 3, 3.1 mm; November 5, TR