Environment Canada
Environmental Protection

Environnement Canada
Protection de l'environnement

Biochemiological Surveys: Liverpool Bay, Summerville Broad River, Port Mouton and Port Joli, Nova Scotia, Shellfish Area 14, 1973

Surveillance Report EPS 5-AR-74-4
Atlantic Region

ENVIRONMENTAL PROTECTION SERVICE REPORT SERIES

Surveillance reports present the results of monitoring programs carried out by the Environmental Protection Service. These reports will usually be published on a regular basis.

Other categories in the EPS series include such groups as Regulations, Codes and Protocols, Policy and Planning, Technical Appraisal, Technology Development, Surveillance, and Reprints of Published Papers.

Inquiries pertaining to Environmental Protection Service Reports should be directed to the Environmental Protection Service, Department of the Environment, Halifax Nova Scotia, B3J 3E4.

BACTERIOLOGICAL SURVEYS, LIVERPOOL BAY, SUMMERVILLE (BROAD RIVER), PORT MOUTON, AND PORT JOLI, NOVA SCOTIA, SHELLFISH AREA 14, 1973

by

H. R. VANOTTERLOO, M. BAXTER AND J. MACHELL

Microbiology Section
Surveillance and Analysis Division
Environmental Protection Service
Atlantic Region

for the

Water Pollution Control Directorate
Environmental Protection Service
Report EPS-5-AR-74-4
February 1974

ABSTRACT

This report presents the results of bacteriological water quality surveys of Liverpool Bay, Summerville (Broad River), Port Mouton, and Port Joli, four coastal areas in Queens County, Nova Scotia (Shellfish Area NS-14). The surveys were conducted in September and October, 1973 to permit a review of the classification of the areas for the harvesting of shellfish.

The report includes a brief sanitary description of each area and the implications of the bacteriological findings are discussed in terms of criteria for shellfish growing areas.

The principal findings are:

- Liverpool Bay is grossly polluted and evidence of fecal pollution was found outside the present closure line. A new closure line is recommended.
- Because of the recreational use of Summerville Beach, and the fecal contamination of the waters adjacent to Summerville Centre the present seasonal closure of the Broad River Estuary should be modified to a year-round closure.
- Port Mouton and Port Joli are, and should remain, approved shellfish growing areas.

RÉSUMÉ

Ce rapport présente les résultats des études de la qualité bactériologique des eaux de la Baie de Liverpool, Summerville (Broad River), Port Mouton et Port Joli. Ceux-ci sont quatres secteurs côtières dans le Comté de Queens, Nouvelle-Ecosse (Secteur de Pêche Coquillière N.S. - 14). Les études ont été faites aux mois de septembre et d'octobre, 1973 pour permettre une revue de la classification des secteurs pour la pêche coquillière.

Le rapport contient une dèscription sanitaire brève de chaque secteur et les implications des trouvailles bactériologiques sont aussi discutées en termes des critères pour les secteurs de pêche coquillière.

Les trouvailles principales ont été:

- La Baie de Liverpool est grossement polluée et la preuve de pollution fécale a été trouvée en dehors de la présente ligne de clôture. Une nouvelle ligne de clôture est recommendée.
- A cause de l'usage de la plage Summerville pour la récréation, et de la contamination fécale dans les eaux près de Summerville Centre, la présente clôture saisonnière de l'estuaire de Broad River devrait-être étendue à l'année longue.
- Port Mouton et Port Joli sont approuvés comme regions de pêche coquillière.

TABLE OF CONTENTS

		PAGE
ABSTRACT		i
RESUME		ii
TABLE OF CONTENTS		iii
LIST OF FIGURES		iv
LIST OF TABLES		v
1	INTRODUCTION	1
2	METHODS	
	2.1 Sampling	2
	2.2 Bacteriological Analyses	2
	2.3 Additional Data	3
3	LIVERPOOL BAY	
	3.1 Area Description	3
	3.2 Results	4
	3.3 Discussion and Conclusions	5
4	SUMMERVILLE AREA	
	4.1 Area Description	7
	4.2 Results	9
	4.3 Discussion and Conclusions	10
5	PORT MOUTON	
	5.1 Area Description	10
	5.2 Results	11
	5.3 Discussion and Conclusions	13
6	PORT JOLI	
	6.1 Area Description	13
	6.2 Results	14
	6.3 Discussion and Conclusions	16
7	RECOMMENDATIONS	16
REFERENCES		18
ACKNOWLEDGEMENTS		19
APPENDIX I		20
APPENDIX II		29

LIST OF FIGURES

FIGURE		PAGE
1	SAMPLING STATIONS, LIVERPOOL BAY, NOVA SCOTIA	6
2	SAMPLING STATIONS, SUMMERVILLE, NOVA SCOTIA	8
3	SAMPLING STATIONS, PORT MOUTON, NOVA SCOTIA	12
4	SAMPLING STATIONS, PORT JOLI, NOVA SCOTIA	15

APPENDIX FIGURE

1-A	DAILY PRECIPITATION DATA FOR THE SURVEY PERIOD AT WESTERN HEAD, NOVA SCOTIA	23

LIST OF TABLES

APPENDIX TABLE		PAGE
1-A	COLIFORM AND FECAL COLIFORM DATA, 1973, LIVERPOOL BAY, NOVA SCOTIA	20
1-B	DATE AND TIDE AT TIME OF SAMPLING, 1973, LIVERPOOL BAY, NOVA SCOTIA	22
1-C	SALINITY AND TEMPERATURE AT SELECTED STATIONS, 1973, LIVERPOOL BAY, NOVA SCOTIA	22
2-A	COLIFORM AND FECAL COLIFORM DATA, 1973, SUMMERVILLE, NOVA SCOTIA	24
2-B	DATE AND TIDE AT TIME OF SAMPLING, 1973, SUMMERVILLE, NOVA SCOTIA	25
2-C	SALINITY AND TEMPERATURE AT SELECTED STATIONS, 1973, SUMMERVILLE, NOVA SCOTIA	25
3-A	COLIFORM AND FECAL COLIFORM DATA, 1973, PORT MOUTON, NOVA SCOTIA	26
3-B	DATE AND TIDE AT TIME OF SAMPLING, 1973, PORT MOUTON, NOVA SCOTIA	27
3-C	SALINITY AND TEMPERATURE AT SELECTED STATIONS, 1973, PORT MOUTON, NOVA SCOTIA	27
4-A	COLIFORM AND FECAL COLIFORM DATA, 1973, PORT JOLI, NOVA SCOTIA	29
4-B	DATE AND TIDE AT TIME OF SAMPLING, 1973, PORT JOLI, NOVA SCOTIA	29
4-C	SALINITY AND TEMPERATURE AT SELECTED STATIONS, 1973, PORT JOLI, NOVA SCOTIA	29

1 INTRODUCTION

In September and October, 1973, bacteriological water quality surveys were conducted in four coastal areas in Queens County, Nova Scotia: Liverpool Bay, Summerville Beach, Port Mouton, and Port Joli (Shellfish Area NS-14). This report provides an assessment of the fecal pollution within these areas and a review of the resulting restrictions for shellfish harvesting under the Fisheries Act.

At present, shellfishing is prohibited in two of the surveyed areas. These contaminated areas are defined in Schedule G of the Nova Scotia Fisheries Regulations (PC 1970-2189) as follows:

14-4 - Liverpool Bay and the Mersey River, Queens County inside a straight line drawn from Eastern Head to Moose Point.

14-5 - Broad River, Queens County, upstream from a straight line drawn in a northeasterly direction from Broad Head to the school at Summerville Centre, including the Summerville Beach area, from the thirty-first day of May to the thirtieth day of September.

No closure regulations are in force for Port Mouton and Port Joli.

Sanitary conditions in these four areas were investigated in 1969 by Cullen (1) and in 1971 by Culligan (2). Some information from both of these reports is used in the present review.

The four areas are discussed individually in four sections. Bacteriological and other data are included in Appendix I.

The present assessment is part of the continuous review of closure regulations governing shellfish growing areas which is carried out by the Environmental Protection Service in accordance with the procedures described in the National Shellfish Sanitation Program Manual of Operations (3).

The coliform test is the principal bacteriological criterion used in this program although fecal coliform MPN tests provide additional information and are included in this report. With the coliform test, water is considered unacceptable for the harvesting of shellfish when the median of the MPN values exceeds 70 per 100 ml and/or more than ten percent of the results exceed 230 per 100 ml. There is no universally accepted standard for the fecal coliform test but a median of 23 with a 90-percentile of 76 may be used in comparing the two paramaters.

2 METHODS

2.1 Sampling

Water samples were collected in sterile glass bottles using a rod sampling device to lower the bottles to a depth of about two feet. Samples were not iced but were kept in an insulated container and processed in a mobile laboratory less than six hours after collection.

2.2 Bacteriological Analyses

Coliform and fecal coliform tests were performed on all samples using "most probable number" (MPN) techniques. Three or more five-tube MPN series were inoculated with appropriate aliquots of sample (decimal dilutions). In the first stage of the procedure, Bacto Lauryl Tryptose Broth was the growth medium used and 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 transferred to Bacto Brilliant Green Bile Broth (BGB) and Bacto-EC medium. Gas formation in BGB after 24 or 48 hours of incubation at 35°C constituted the confirming stage of the coliform test. For the fecal coliform test, the EC tubes were examined after 24 hours of incubation at 44.5°C. The incubator in this case was a water bath equipped with a stirring device.

2.3 Additional Data

To facilitate interpretation of the bacteriological data, the salinity of selected samples was determined with a hydrometer. Water temperatures were recorded at several stations. The tidal stage was estimated and recorded for each sampling run. In addition, records of daily precipitation at a nearby station of the Atmospheric Environment Service (Western Head) are included.

3 LIVERPOOL AREA

3.1 Area Description

Liverpool Bay is the estuary of the Mersey River (Figure 1). It is a fairly deep bay with depths exceeding ten fathoms, and an average tide amplitude of five feet. The Mersey River originates near the northern border of Queens County and drains a sparsely populated area. The watershed is mainly woodland with little farming activity. Population centres are concentrated in the lower regions of the area near Liverpool Bay. The largest of these is the town of Liverpool with a population of about 4000. Culligan (2) reports that all domestic sewage of the town is discharged to the Mersey River and Liverpool Bay, and the town is the major source of fecal pollution to Liverpool Bay.

Upstream from Liverpool, the village of Milton has a population of about 1200 people. There is no community collection system and outfalls to the river from septic tanks and other private domestic systems were observed by Culligan.(2) At the northern shore of Liverpool Bay, Herring Cove receives discharges from a pulp and paper mill and from the village of Brooklyn (pop. 800). Most of the population is served by septic tanks but sewage from some houses is discharged directly into the Cove. Sanitary facilities at the mill serve some 500

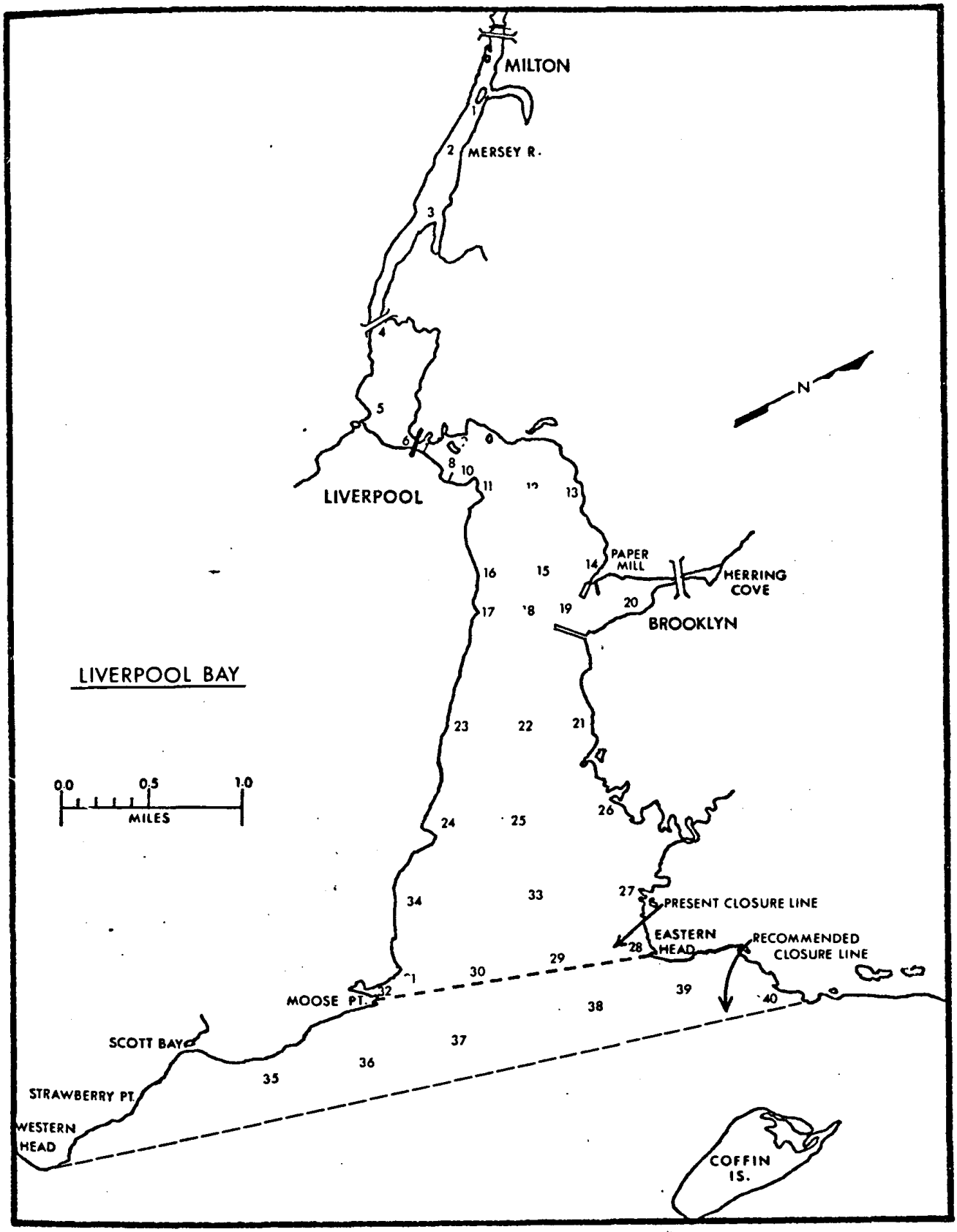

FIGURE 1. SAMPLING STATIONS, LIVERPOOL BAY, NOVA SCOTIA

employees and the wastes are discharged through the main plant sewer (1). Wood fibre and bark are discharged in large volumes and these wastes are deposited on the adjacent shoreline.

On the remaining shoreline of Liverpool Bay, housing developments are located along the main highway. Most of these homes, however, are a good distance from the water and do not constitute significant sources of fecal pollution to the Bay.

3.2 Results

Samples for bacteriological analyses were collected on three days (Sept. 25, Oct. 1 and Oct.10) at forty sampling stations (Figure 1). The results of coliform and fecal coliform MPN tests performed on these samples are listed in Table 1-A of the Appendix. The time of sampling,the salinities,and tide is given in Table 1-B and the temperatures of selected samples are presented in Appendix Table 1-C. Rainfall levels at Western Head for the survey period are presented in Figure 1-A Appendix II.

On all three sampling days, the bacteriological data indicate a consistent pattern. The Mersey River upstream from Liverpool (Stations 1 to 3) is marginally polluted. Coliform MPN values here range from 11 to 180 per 100 ml. Fecal coliform MPN values range between 2 and 64 per 100 ml. The salinity of these samples was less than one ppt at all tidal stages.

At Liverpool, there is a sharp increase in the bacterial densities. From this point to the closure line (Stations 4 to 32, Figure 1), the majority (63%) of coliform MPN's and a significant number (19%) of fecal coliform MPN's exceed 2400 per 100 ml. Of 84 coliform tests performed on samples from this area, 75 (89%) showed MPN's greater than 70 per 100 ml.

Six sampling stations are located outside the closure line. Of these, the three northerly stations (Nos. 38, 39 and 40, near Eastern Head) did not show any evidence of contamination. The highest coliform count at these stations was 46 per 100 ml. The three southerly stations (Nos. 35, 36 and 37, near Moose Point) did show contamination,particularly at falling tides. At these stations, all but one sample contained more than 230 coliforms per 100 ml.

3.3 Discussion and Conclusions

Liverpool Bay is grossly polluted and the need for a continuing closure of the bay is obvious. It is apparent, however, that the contaminated area extends beyond the present closure line. Even in this brief survey, this was indicated by the excessive coliform densities southeast of Moose Point. Very high coliform levels (>2400 per 100 ml.) were found at other stations near the closure line; it is inevitable that, at times, the waters beyond the closure line are significantly affected by the polluted Liverpool Bay water.

The present survey has yielded insufficient data that can be used to determine a new location for a closure line. The available data does indicate, however, that polluted water leaving the Bay affects the southern shore more than the shoreline north of Eastern Head. On the other hand, the northern shores are probably affected under certain tide and wind conditions. An indication of this would be the high coliform density (>2400 per 100 ml.) observed at Station 28 (near Eastern Head) on the rising tide of September 25.

Beyond the closure line, a considerable degree of dilution of the polluted Bay water would take place. However, the volume of coliform contaminated water in

the Bay is large and a fairly wide area would be affected under certain conditions.

It has been estimated that in a northerly direction, water quality is not acceptable for the harvesting of shellfish for approximately one mile beyond Eastern Head. On the opposite shore, the closure should definitely include the area between Moose Point and Scott Bay, and it would be advisable to extend this closure to Western Head (Figure 1).

Coffin Island is located about one mile east of Eastern Head. Its shores would not be expected to be affected to a significant degree by Liverpool Bay waters. Furthermore, there are no shellfish beds at its most exposed western shore. It is not necessary to restrict the shellfish harvesting waters of Coffin Island by including the island in the closure.

In summation, it is suggested that the present closure line be extended as indicated in Figure 1.

4 SUMMERVILLE AREA

4.1 Area Description

Summerville Beach is a wide sand bar at the mouth of the Broad River. Summerville Centre is a small village on the northern shore of the estuary. There is no community sewage collection system. Because of its white sand beach, the area has an appreciable tourist population in summer.

The present seasonal closure (Figure 2) was instituted as a precaution against contamination from bathers and from tourist's mobile homes parked in the beach area in the summer.

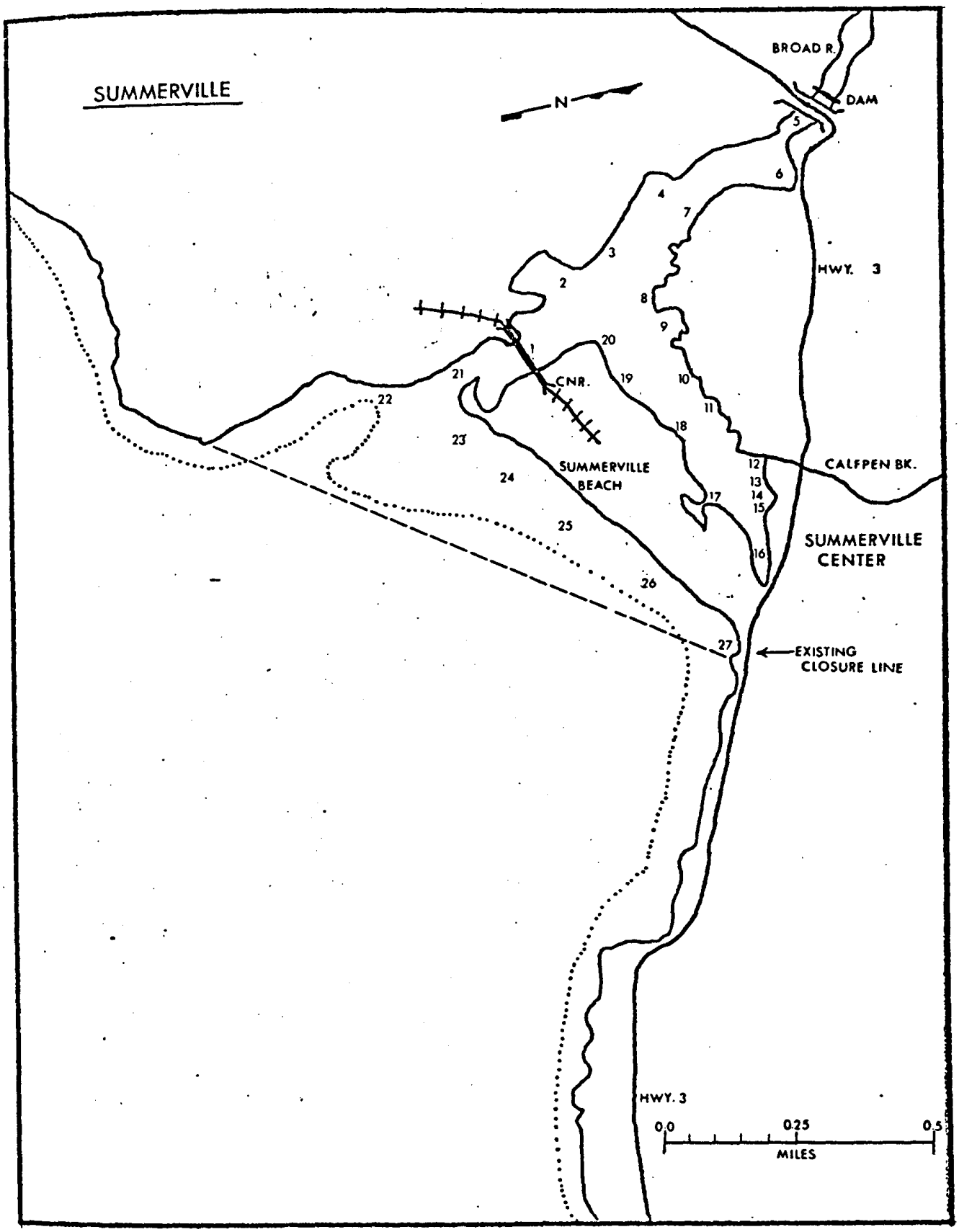

FIGURE 2. SAMPLING STATIONS, SUMMERVILLE, NOVA SCOTIA

4.2 Results

Samples for bacteriological analysis were collected at 27 sampling stations (Figure 2) on four sampling days between September 24 and October 11.

The results of these tests are presented in Table 2-A of the Appendix. The time of sampling and tide is given in Table 2-B. The salinities and temperatures of selected samples are presented in Appendix Table 2-C. Rainfall levels at Western Head were obtained from the Atmospheric Environment Service and are presented in Figure 1-A.

Significant fecal pollution was detected near Summerville Centre on October 11 at high falling tide. At this time, both coliform and fecal coliform densities were high (>230 per 100 ml.) at Stations 14, 15 and 16 along the Summerville Centre waterfront. At the high rising tide of October 2, however, bacterial densities were much lower (<20 per 100 ml.). No results are available for this area on the remaining sampling days as the water depth is too shallow to allow access at low tide.

The water quality of the Broad River appears to be acceptable. No coliform count in the river area (Stations 1-8) exceeded 79 per 100 ml. and all fecal coliform MPN values were 11 or less per 100 ml. At these stations, MPN values on September 24 were somewhat higher than on other sampling days.

Stations 21 to 27 (Figure 2) were selected to represent the water quality status at Summerville Beach. At the time of the survey, the water quality proved to be excellent in this area. No coliform count was greater than 27 per 100 ml and fecal coliforms were hardly detectable (maximum 2 per 100 ml.).

4.3 Discussion

In view of the recreational use of this area, it is regrettable that the bacteriological assessment could not have been conducted in the summertime. Nevertheless, Summerville Centre has been identified as a significant source of fecal pollution even under the favourable circumstances of this survey. The high bacterial densities on October 11 near the town would indicate the need for a year-round closure of this area.

The Broad River does not represent a significant source of fecal pollution to the area. The somewhat higher bacterial densities on September 24 may be attributed to the effects of rainfall (Figure 1-A).

The excellent water quality on the seaward side of the sandbar is not surprising, considering that the area was deserted at the time of the survey. In addition, the beach area is well exposed to the open ocean and any pollutants introduced there would be quickly dispersed. However, the present closure of the Broad River estuary including the beach area was instituted as a precautionary measure and we have no data to show that this action was not warranted.

It is recommended that the existing seasonal closure of this area be modified to include a year-round prohibition to shellfish harvesting based on the existing closure line as shown in Figure 2.

5 PORT MOUTON

5.1 Area Description

The bacteriological surveillance of Port Mouton was limited to the area between Bell Head and the C.W. MacLeod Fish Plant at central Port Mouton. This town is essen-

tially a ribbon development along the southern shore of the surveyed area. There are no community sewage disposal facilities in this area and waste disposal is by privy, septic tank and tile fields or cesspools (2). Domestic sewage is not contributed directly to the seawater, but Cullen (2) expressed the opinion that indirect contamination may be significant.

Port Mouton is a small fishing community along the western shore of the surveyed area, and a number of the houses are located close to the shoreline.

There are two fish plants in this area and both were in operation at the time of the survey. The sanitary facilities at the Nickerson Bros., Ltd., plant in Port Mouton discharge effluent into a septic tank. Process water is chlorinated prior to discharge to salt water. The C.W. MacLeod fish plant at Central Port Mouton is a larger operation. Sanitary wastes as well as process waste are discharged to a package-type extended aeration waste treatment facility. These effluents are then discharged to the harbour (2).

The entire area is classified as an approved shellfish growing area.

5.2 Results

Water samples for bacteriological analyses were collected at 27 sampling stations (Figure 3) on each of three sampling days between September 25 and October 11. The results of these tests are presented in Appendix Table 3-A. The time of sampling and tides is given in Table 3-B. Salinities and temperatures of selected samples are listed in Table 3 -C, while Figure 1-A illustrates the rainfall levels affecting the area at the time of the survey.

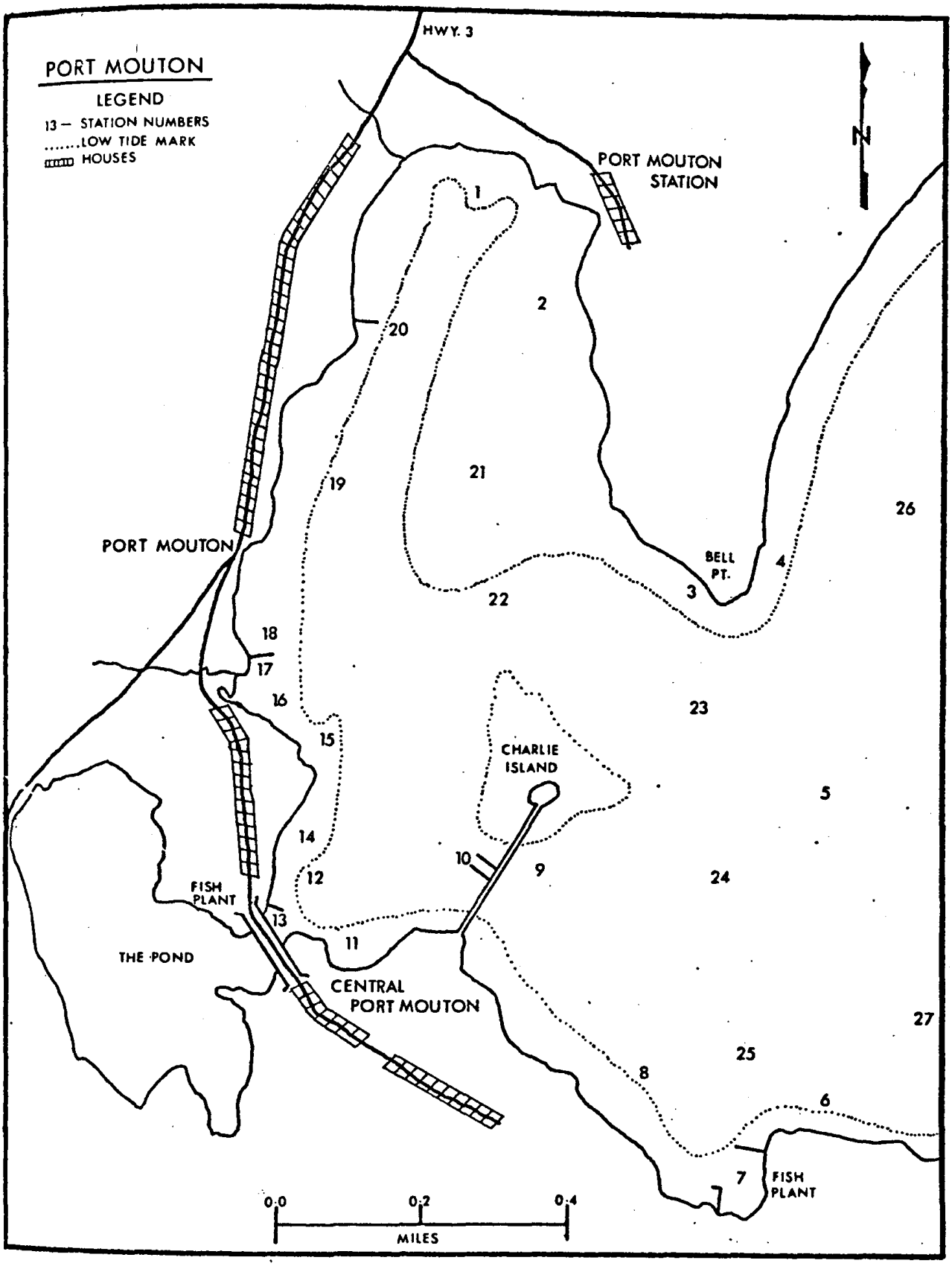

FIGURE 3. SAMPLING STATIONS, PORT MOUTON, NOVA SCOTIA

In general, the water in the surveyed area was of excellent quality. Coliform MPN values at the seaward stations east of Charlie Island did not exceed 5 per 100 ml on any of the sampling days. At the remaining stations, counts exceeding this level were found in only a few samples.

The highest coliform and fecal coliform MPN counts (110 and 46 per 100 ml respectively) were detected at Station 19 (Figure 3) at a high falling tide on October 11. Further south at Station 17, a coliform MPN of 79 per 100 ml was detected on September 25 (low rising tide). No fecal coliforms were detected in this sample.

5.3 Discussion

At every sampling station, the results meet the coliform and fecal coliform standards. They are in fact well below these levels. The area is not totally devoid of fecal contamination, however, as is indicated by the somewhat higher counts near Port Mouton.

There was no precipitation on days preceeding the sampling days. Rainfall may be expected to result in a slight increase in bacterial densities, particularly near Port Mouton. However, even under more adverse climatic conditions, it is unlikely that the coliform densities in waters along the western shores would exceed permissible levels. Therefore, no change is required in the present classification of the entire area as an approved shellfish growing area.

6 PORT JOLI

6.1 Area Description

Port Joli is a wide shallow ocean inlet near the southern border of Queens County. The surrounding area is hilly woodland and is sparsely populated. There are

extensive intertidal flats in the northwestern regions of the inlet. The entire area is protected as a bird sanctuary (Figure 4).

Port Joli is a small fishing village near the northeastern shore. There is no detectable contribution of sanitary wastes from this village to the harbour. Some cottages are situated near the shores but permanent homes are well inland. Further south, the smaller community of St. Catherines River is located at the eastern shore near the deeper parts of the inlet. At the northern shore, a few houses are located along Highway 3 near the point where Douglas Brook enters Port Joli.

6.2 Results

Samples for bacteriological analyses were collected at 24 sampling stations (Figure 4) on three sampling days between September 25 and October 12, 1973. The results of the coliform and fecal coliform MPN tests performed on these samples are listed in Table 4-A of the Appendix. The time of sampling and tide is given in Table 4-B. The salinities and temperatures of selected samples are presented in Appendix Table 4-C, while the rainfall levels for the survey period may be obtained from Figure 1-A.

No coliforms or fecal coliforms were detected in about 50 per cent of the samples while, in the remaining samples, the coliform densities were very low. The highest coliform count (79 per 100 ml) was recorded for the September 25 sample of Station 2 near Douglas Brook. No fecal coliforms were detected in this sample. At 20 out of 24 stations, coliform counts were less than 10 per 100 ml. Fecal coliforms were detected at 11 stations but none of these counts was greater than 8 per 100 ml.

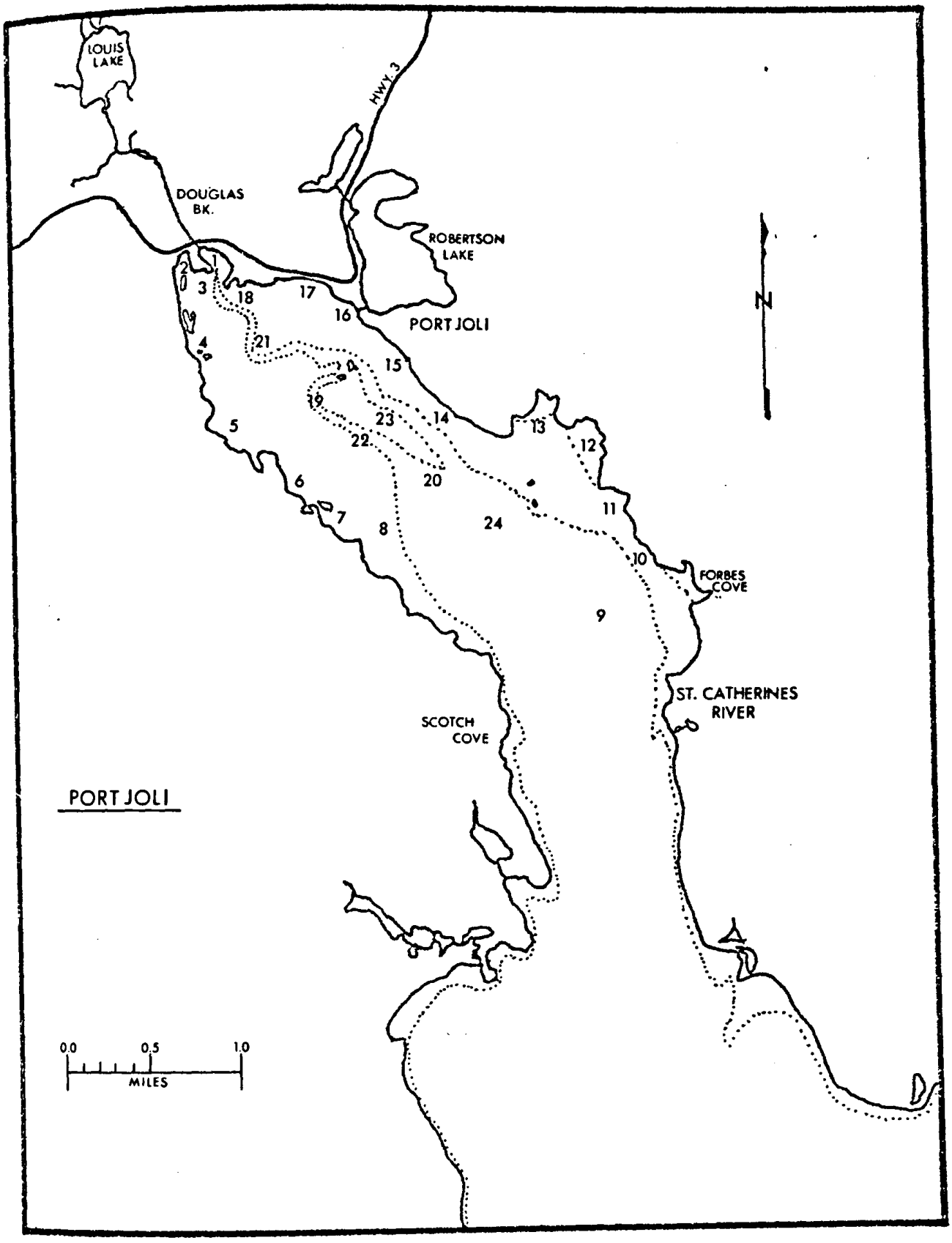

FIGURE 4. SAMPLING STATIONS, PORT JOLI, NOVA SCOTIA

6.3 Discussion

In general, the waters of Port Joli are of good bacteriological quality. The least favourable conditions exist in the northern section near Douglas Brook. This may be attributed to the houses in this area, but more likely the few higher counts detected here on September 25 were the result of the rainfall of September 22 and 23.

We have found no significant fecal pollution in the waters near Port Joli. It is possible that higher levels of indicator bacteria would be detected in summer when the cottages are in use, but it is unlikely that the criteria for shellfish growing waters would not be met.

The use of the area as a bird sanctuary potentially conflicts with its use as a shellfish growing area. No evidence of detrimental effects of the bird population on water quality has been observed.

There appears to be no reason to change the present classification of the area, and we recommend that its "approved" status be continued.

7 RECOMMENDATIONS

1. The description of contaminated area 14-4 in Schedule G of the Nova Scotia Fisheries Regulations, (Item 50, PC 1970-302) should be modified to include the waters of the Mersey River and of Liverpool Bay upstream from a line between Western Head and a point approximately one mile northeast of Eastern Head as specified in Figure 1 of this report.

2. Liverpool Bay should be resurveyed when sewage collection and treatment facilities for the town of Liverpool are in operation.

3. The description of the contaminated area 14-5 in Schedule G of the Nova Scotia Fisheries Regulations, (Item 51, PC 1970-302) should be modified to provide for a year-round closure of the area near Summerville Centre and Summerville Beach as specified in Figure 2 of this report.

4. No change in classification is required for the Port Mouton and Port Joli areas.

REFERENCES:

1. Cullen, D. H., Shellfish Area N. S. 25- Port Joli (Portion of new area N. S. 14). M.S. - Report Division of Public Health Engineering, Department of National Health and Welfare. 1969

2. Culligan, T., Sanitary Survey, Nova Scotia Shellfish Area 14 Port Joli Section (from Liverpool West), Lockport Section. MS. Report No. AR-71-1-2, Division of Public Health Engineering, Department of the Environment. 1971

3. U. S. Department of Health, Education and Welfare, National Shellfish Sanitation Program Manual of Operations, Part I Sanitation of Shellfish Growing Areas, 1968 Revision, Washington.

ACKNOWLEDGEMENT

Essential to the completion of these surveys was the efficient technical assistance provided by Burke Cushing and Mike Gauvin. We greatly appreciate their contributions. The assistance of Dr. R. H. Cook in reviewing the manuscript is also acknowledged.

APPENDIX I

TABLES

TABLE 1-A COLIFORM AND FECAL COLIFORM DATA, 1973; LIVERPOOL BAY, NOVA SCOTIA

STATION NUMBER	COLIFORM MPN's per 100 ml				FECAL COLIFORM MPN's per 100 ml			
	Sept. 25	Oct. 1	Oct. 11	Median	Sept. 9	Oct. 1	Oct. 11	Median
1	11	33	49	33	2	5	7	5
2	8	110	23	23	2	13	13	13
3	180	64	21	64	7	64	11	11
4	920	240	130	240	70	33	49	49
5	>2400	>2400	>2400	>2400	450	>2400	>2400	>2400
6	920	>2400	>2400	>2400	240	1600	>2400	1600
7	>2400	>2400	>2400	>2400	350	350	>2400	350
8	>2400	>2400	>2400	>2400	350	920	1600	920
9	>2400	>2400	>2400	>2400	>2400	1600	>2400	>2400
10	>2400	>2400	>2400	>2400	1600	1600	1600	1600
11	>2400	>2400	>2400	>2400	>2400	>2400	>2400	>2400
12	>2400	>2400	>2400	>2400	1600	920	1600	1600
13	>2400	350	110	350	540	280	70	280
14	>2400	>2400	>2400	>2400	1600	1600	1600	1600
15	>2400	>2400	>2400	>2400	>2400	540	920	920
16	>2400	1600	>2400	>2400	1600	240	240	240
17	>2400	920	540	920	>2400	540	540	540
18	>2400	>2400	>2400	>2400	1600	350	350	350
19	>2400	>2400	>2400	>2400	540	>2400	>2400	>2400
20	>2400	>2400	>2400	>2400	1600	>2400	>2400	>2400
21	>2400	130	11	130	>2400	2	8	8
22	>2400	350	350	350	540	23	240	240
23	>2400	>2400	540	>2400	350	240	17	240
24	>2400	>2400	>2400	>2400	>2400	240	350	350
25	1600	130	17	130	1600	2	9	9
26	>2400	49	7	49	1600	<2	2	2
27	>2400	23	5	23	350	<2	<2	< 2
28	>2400	7	2	7	240	<2	<2	< 2
29	1600	70	350	350	33	>2	240	33
30	1600	>2400	>2400	>2400	70	240	540	240
31	46	920	920	920	17	17	240	17
32	170	1600	920	920	2	95	240	95

TABLE 1-A (cont'd) COLIFORM AND FECAL COLIFORM DATA, 1973; LIVERPOOL BAY, NOVA SCOTIA

STATION NUMBER	COLIFORM MPN's MPN per 100 ml				FECAL COLIFORM MPN's MPN per 100 ml			
	Sept. 25	Oct. 1	Oct. 11	Median	Sept. 9	Oct. 1	Oct. 11	Median
33	-	920	5	462	-	540	2	271
34	-	920	>2400	>1260	-	350	350	350
35	-	240	240	240	-	7	240	123
36	-	48	350	199	-	13	240	126
37	130	1600	>2400	1600	<2	240	920	240
38	17	4	9	7	<2	<2	2	<2
39	-	33	5	19	-	<2	<2	<2
40	-	46	<2	>24	-	<2	<2	<2

TABLE 1-B DATE AND TIDE AT TIME OF SAMPLING, 1973
LIVERPOOL BAY

DATE	TIME	TIDE
Sept. 25	1575 - 1630	Low rising
Oct. 1	1330 - 1515	High falling
Oct. 11	1230 - 1400	Low falling

TABLE 1-C SALINITY AND TEMPERATURE AT SELECTED STATIONS, 1973
LIVERPOOL BAY

STATION	SALINITY (PPT)			WATER TEMPERATURE (C°)		
	Sept. 25	Oct. 1	Oct. 11	Sept. 25	Oct. 1	Oct. 11
4	0.9	0.6	0.6	14.0	13.0	15.5
6	0.9	2.1	-	14.0	13.0	-
18	1.6	-	2.1	13.0	-	16.0
30	29.7	28.5	-	12.5	12.5	-

TABLE 2-A COLIFORM AND FECAL COLIFORM DATA, 1973, SUMMERVILLE BEACH, NOVA SCOTIA

STATION NUMBER	COLIFORM MPN's per 100 ml					FECAL COLIFORM MPN's per 100 ml				
	Sept. 24	Oct. 1	Oct. 2	Oct. 11	Median	Sept. 24	Oct. 1	Oct. 2	Oct. 11	Median
1	13	4	<2	8	6	2	<2	<2	<2	<2
2	17	5	5	12	8	5	<2	5	<2	<3
3	33	17	<2	17	17	8	<2	<2	2	<2
4	41	2	2	4	3	8	<2	<2	<2	<2
5	49	17	2	5	11	11	<2	<2	<2	<2
6	79	13	2	14	13	8	2	<2	<2	<2
7	49	2	7	11	9	8	<2	<2	2	<2
8	33	2	7	11	9	4	<2	5	<2	<3
9	49	4	2	4	4	5	2	<2	<2	<2
10	46	<2	<2	4	<3	11	<2	<2	<2	<2
11	-	-	<2	17	<9	-	-	<2	8	<5
12	-	-	5	95	50	-	-	2	8	5
13	-	-	17	170	93	-	-	17	13	>15
14	-	-	2	>2400	>1200	-	-	<2	920	<461
15	-	-	5	920	462	-	-	2	350	176
16	-	-	13	1600	806	-	-	5	240	122
17	-	-	2	27	14	-	-	<2	5	<3
18	-	-	<2	2	<2	-	-	<2	<2	<2
19	-	-	<2	5	<3	-	-	<2	<2	<2
20	-	-	<2	5	<3	-	-	<2	5	<3
21	17	<2	2	2	2	<2	<2	2	2	<2
22	-	<2	<2	7	<2	-	<2	<2	<2	<2
23	-	2	<2	11	2	-	<2	<2	2	<2
24	-	<2	<2	27	<2	-	<2	<2	<2	<2
25	-	<2	<2	8	<2	-	<2	<2	<2	<2
26	-	<2	<2	9	<2	-	<2	<2	<2	<2
27	-	<2	<2	8	<2	-	<2	<2	<2	<2

TABLE 2-B DATE AND TIDE AT TIME OF SAMPLING, SUMMERVILLE BEACH

DATE	TIME	TIDE
Sept. 24	15:00 - 16:00	Low rising
Oct. 1	16:00 - 16:30	Low falling
Oct. 2	11:00 - 12:00	High rising
Oct. 11	09:00 - 10:00	High falling

TABLE 2-C SALINITY AND TEMPERATURE AT SELECTED STATIONS, SUMMERVILLE BEACH

STATION	SALINITY (PPT)				WATER TEMPERATURE (C°)			
	Sept. 24	Oct. 1	Oct. 2	Oct. 11	Sept. 24	Oct. 1	Oct. 2	Oct. 11
1	26.0	29.8	27.1	21.7	15.0	12.5	13.5	8.5
5	1.5	5.0	4.5	15.9	14.5	13.0	13.0	9.0
21	-	29.8	29.6	26.1	-	12.5	13.0	10.0

TABLE 3-A COLIFORM AND FECAL COLIFORM DATA, 1973; PORT MOUTON, NOVA SCOTIA

STATION NUMBER	COLIFORM MPN's per 100 ml				FECAL COLIFORMS MPN's per 100 ml			
	Sept. 25	Oct. 2	Oct. 11	Median	Sept. 25	Oct. 2	Oct. 11	Median
1	9	<2	11	9	<2	<2	2	<2
2	4	<2	<2	<2	<2	<2	2	<2
3	<2	<2	2	<2	<2	<2	<2	<2
4	<2	<2	2	<2	<2	<2	<2	<2
5	2	<2	2	2	2	<2	<2	<2
6	<2	<2	5	<2	<2	<2	<2	<2
7	<2	8	2	2	<2	6	2	2
8	2	<2	<2	<2	<2	<2	<2	<2
9	<2	<2	2	<2	<2	<2	2	<2
10	17	<2	2	2	<2	<2	2	<2
11	23	2	<2	2	<2	<2	<2	<2
12	13	<2	2	2	<2	<2	<2	<2
13	8	<2	46	8	<2	<2	2	<2
14	8	<2	9	8	<2	<2	2	<2
15	2	<2	< 2	<2	<2	<2	<2	<2
16	<2	<2	2	<2	<2	<2	<2	<2
17	79	<2	2	2	<2	<2	<2	<2
18	8	<2	<2	<2	<2	<2	<2	<2
19	<2	<2	110	<2	<2	<2	46	<2
20	2	2	13	2	<2	<2	2	<2
21	7	<2	2	2	<2	<2	<2	<2
22	2	2	11	2	<2	<2	<2	<2
23	-	<2	2	2	-	<2	<2	<2
24	-	<2	5	3	-	<2	<2	<2
25	-	2	2	2	-	2	2	2
26	-	2	<2	< 2	-	<2	<2	<2
27	-	2	2	2	-	<2	2	2

TABLE 3-B DATE AND TIDE AT TIME OF SAMPLING: 1973, PORT MOUTON, NOVA SCOTIA

DATE	TIME	TIDE
Sept. 25	11:00 - 12:00	Low rising
Oct. 2	12:00 - 13:00	High rising
Oct. 11	10:00 - 11:00	High falling

TABLE 3-C SALINITY AND TEMPERATURE AT SELECTED STATIONS, 1973 PORT MOUTON, NOVA SCOTIA.

STATION NUMBER	SALINITY (PPT)			WATER TEMPERATURE (C°)		
	Sept. 25	Oct. 2	Oct. 11	Sept. 25	Oct. 2	Oct. 11
1	31.1	29.8	29.7	13.0	13.0	10.0
4	31.2	30.1	29.7	12.0	12.0	10.5
13	27.5	29.3	29.0	12.0	13.0	10.5

TABLE 4-A COLIFORM AND FECAL COLIFORM DATA: 1973, PORT JOLI, NOVA SCOTIA.

STATION NUMBER	COLIFORM MPN's per 100 ml				FECAL COLIFORM MPN's per 100 ml			
	Sept. 25	Oct. 10	Oct. 12	Median	Sept. 25	Oct. 10	Oct. 12	Median
1	13	<2	<2	<2	5	<2	<2	<2
2	79	9	9	9	<2	2	2	2
3	21	<2	<2	<2	<2	<2	<2	<2
4	<2	2	<2	<2	<2	2	<2	<2
5	<2	<2	<2	<2	<2	<2	<2	<2
6	8	2	<2	2	<2	2	<2	<2
7	<2	<2	<2	<2	<2	<2	<2	<2
8	<2	<2	<2	<2	<2	<2	<2	<2
9	<2	<2	<2	<2	<2	<2	<2	<2
10	<2	<2	2	<2	<2	<2	<2	<2
11	5	<2	<2	<2	<2	<2	<2	<2
12	5	<2	<2	<2	<2	<2	<2	<2
13	<2	2	2	2	<2	2	<2	<2
14	<2	2	2	2	<2	2	<2	<2
15	5	5	7	5	<2	2	4	2
16	5	<2	2	2	<2	<2	<2	<2
17	8	9	13	9	<2	2	8	2
18	2	2	<2	2	<2	2	<2	<2
19	2	2	5	2	<2	2	2	2
20	<2	2	<2	<2	<2	2	<2	<2
21	-	<2	<2	<2	-	<2	<2	<2
22	-	<2	<2	<2	-	<2	<2	<2
23	-	<2	<2	<2	-	<2	<2	<2
24	-	<2	<2	<2	-	<2	<2	<2

TABLE 4B DATE AND TIDE AT TIME OF SAMPLING: 1973
PORT JOLI, NOVA SCOTIA

DATE	TIME	TIDE
Sept. 25	08:45 - 10:15	High falling
Oct. 10	12:00 - 13:30	Low falling
Oct. 12	09:00 - 10:00	Low rising

TABLE 4-C SALINITY AND TEMPERATURE AT SELECTED STATIONS: 1973
PORT JOLI, NOVA SCOTIA

STATION NUMBER	SALINITY (PPT)			WATER TEMPERATURE (C°)		
	Sept. 25	Oct. 10	Oct. 12	Sept. 25	Oct. 10	Oct. 12
1	1.2	1.5	1.0	11.5	10.0	12.0
5	30.2	29.0	28.6	13.0	12.5	12.5
9	31.5	31.1	30.2	11.0	12.5	13.0

APPENDIX II

FIGURE

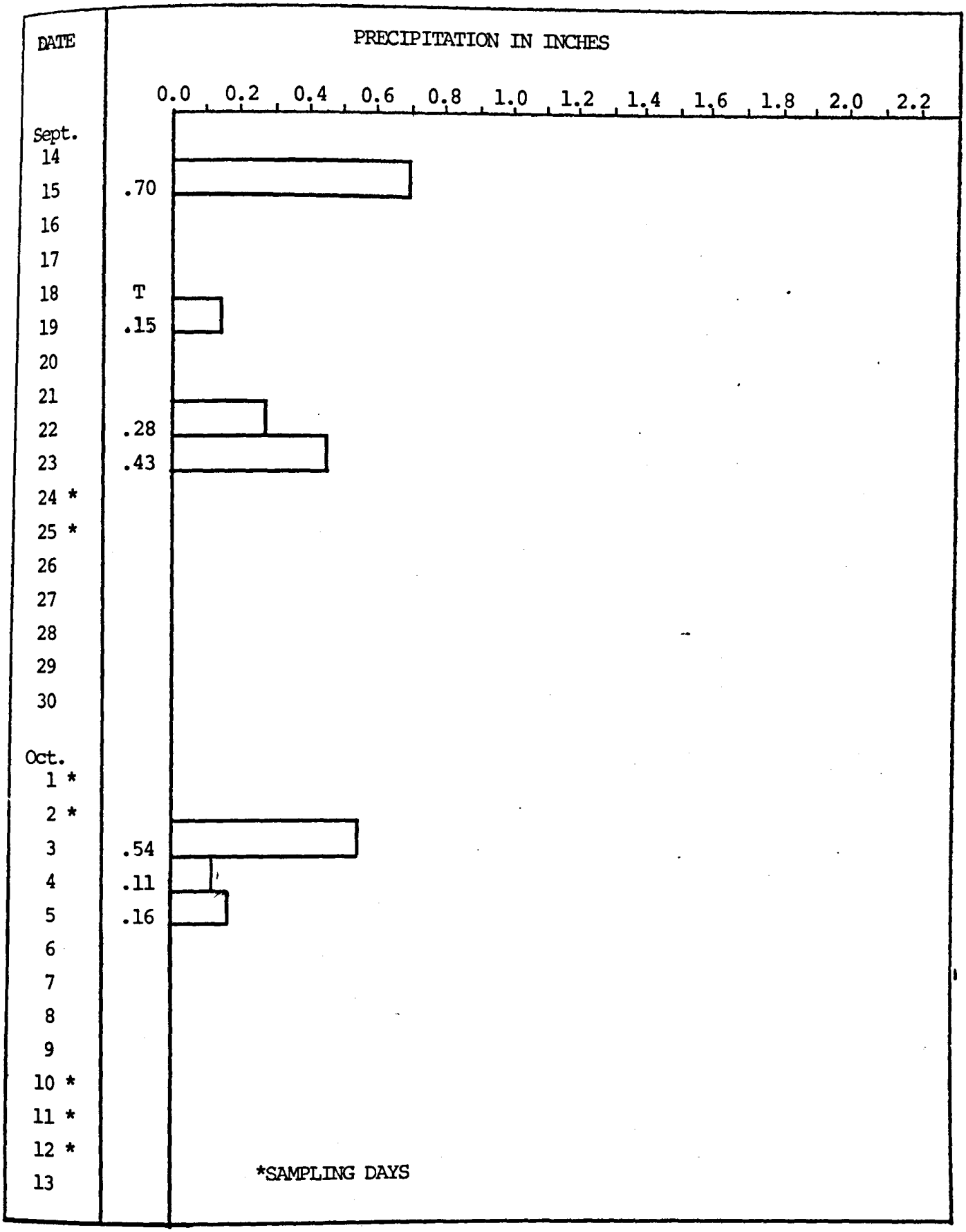

FIGURE 1-A . DAILY PRECIPITATION DATA FOR THE SURVEY PERIOD, AT WESTERN HEAD, NOVA SCOTIA

7012324K