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**THE IMPACT OF THE PROPOSED
FECAL COLIFORM STANDARD
ON
CANADIAN SHELLFISH INDUSTRIES**

**Environmental Impact and Assessment
Report EPS-8-AR-75-7
Atlantic Region**

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THE IMPACT OF THE PROPOSED FECAL COLIFORM
STANDARD ON CANADIAN SHELLFISH INDUSTRIES

BY

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FOR

MICROBIOLOGY SECTION
ENVIRONMENTAL SERVICES BRANCH
ENVIRONMENTAL PROTECTION SERVICE
ATLANTIC REGION

ABSTRACT

The impact of the strict application of the 70 total coliform standard and the 14 and 23 fecal coliform standards on the classification and shellfish resources of 27 shellfish growing areas in the Canadian Atlantic Region, 7 shellfish growing areas in British Columbia and 39 shellfish growing areas in Quebec was evaluated.

Results of the study indicate that strict application of all three coliform standards would decrease the overall acreage of the existing shellfish closures in the three Canadian regions substantially. This is mainly due to the fact that administration of the existing 70 total coliform standard includes an additional safety buffer zone, whereas the true application of the three coliform standards under evaluation did not. The 23 fecal coliform standard was found to be the least restrictive. Both the 70 total coliform and 14 fecal coliform standards decreased the overall acreage of the existing closures studied by approximately the same amount. In most cases, the discrepancies between the existing 70 total coliform standard and the fecal coliform standards occur at the 90 percentile level.

Implementation of the 14 fecal coliform standard would have no major adverse effect on the commercial shellfish industries in Quebec and British Columbia. But they would be detrimental to several important shellfish growing areas in the Maritimes.

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RESUME

L'impact de l'application précise de l'étalon de 70 colibacilles totaux et des étalons de 14 et 23 colibacilles fécaux sur la classification et la ressource coquillière de 27 zones de pêche de la région atlantique, de 7 zones en Colombie-Britannique et de 39 zones au Québec sont évalués dans ce rapport.

Les résultats de l'étude indiquent que l'application précise de tous les étalons diminuerait la superficie des fermetures actuelles dans les trois régions. Ceci est causé par le fait que l'administration de l'étalon de 70 colibacilles totaux comprend une zone de sureté que n'existe pas lors de l'application précise des trois étalons. L'étalon de 23 colibacilles fécaux était le moins sévère. La diminution de la superficie causé par l'application des étalons de 70 colibacilles totaux et de 14 colibacilles fécaux était égales. Dans la majorité des cas, le désaccord entre l'étalon de 70 colibacilles totaux et des étalons de colibacilles fécaux existe au niveau de 90 pourcent.

L'exécution de l'étalon de 14 colibacilles fécaux ne causera pas d'impact majeure sur les pêcheries commerciales de mollusques au Québec et en Colombie-Britannique. Cependant l'impact serait nuisible a plusieurs zones de pêche coquillière importantes dans les provinces maritimes.

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FOREWORD

The impetus for this report was a request from Mr. D. Hunt, Assistant Chief, Division of Shellfish Sanitation FDA, Washington for a Canadian presentation at the 9th National Shellfish Sanitation Workshop, Charleston, South Carolina, on the impact of a water quality standard change on Canadian Shellfish growing areas.

The preparation of this report was coordinated by the Microbiology Section of the Atlantic Regional Office of the Environmental Protection Service at the request of the Chief, Shellfish Water Quality Division, E.P.S. Ottawa.

The intent of this report is to provide a single comprehensive review of the impact of a fecal coliform water quality standard, proposed for adoption by the National Shellfish Sanitation Program, on the shellfish growing waters of British Columbia, Quebec and the Atlantic Provinces. In achieving this purpose, the kind cooperation and assistance of Mr. B.H. Kay, Pacific Region and Mr. C. Blaise, Quebec Region of the Environmental Protection Service, and Dr. R. Lavoie of the Resource Development Branch of the Fisheries and Marine Service, Maritimes Region is gratefully acknowledged.

1 INTRODUCTION

For many years, there have been discussions regarding the application of a fecal coliform standard which would replace the total coliform standard of 70 MPN for approved shellfish growing areas. The major impetus was due to the non-specificity of the coliform group as indicators of fecal pollution. The total coliform group not only measures the fecal contamination present in the water but also includes a varying proportion of organisms which are ubiquitous in nature. The fecal coliform group is a more sensitive index of fecal pollution than the total coliform group in estuarine waters since their presence is generally regarded as indicative of fecal contamination from warm blooded animals.

It should be noted, however, that the terms "fecal coliform" and "E. coli" are not synonymous, and the fidelity of the fecal coliform test in the estimation of E. coli densities varies in different water bodies. In fact, in some cases, the fidelity may be quite low. The percentage recovery of E. coli by the fecal coliform test in shellfish growing waters is usually very high, ranging from 75 to 90 percent (1,2,3), but the test is less specific in nutrient rich waters and in pulp and paper mill wastes. Wastes rich in carbohydrates and other nutrients, tend to be more favourable for the growth of Klebsiella and Enterobacter than E. coli. Some of these Klebsiella and Enterobacter strains are capable of fermenting lactose at 44.5°C. In these waters, the percentage recovery of E. coli by the fecal coliform test can be as low as 15 percent (4). Nevertheless, if we consider all organisms resident in feces of sanitary significance, then the use of the fecal coliform test may be more preferable than the E. coli test. Since it is reported that approximately 10 percent of the fecal coliform flora in feces is

not E. coli (5), and Klebsiella pneumoniae is found in the intestinal tract of 30-40 percent of human and other warm blooded animals, the use of the fecal coliform test will avoid the undesirable risk of excluding some of these fecal contamination occurrences.

Various fecal coliform standards, ranging from 7.8 to 25 MPN per 100 ml, have been proposed for approved shellfish growing waters (1,6-11). At the eighth National Shellfish Sanitation Workshop in 1974, Hunt and Springer (12) recommended the adoption of a median fecal coliform MPN value of 14 per 100 ml of sample with not more than 10 percent of the samples exceeding 43 for a 5-tube, 3 dilution test or 49 for a 3-tube, 3 dilution test as a standard for approved shellfish growing area waters. It was further recommended that the standard be evaluated after an interim period of two years. However, a comparison of the total and fecal coliform counts obtained from Canadian Atlantic shellfish growing area waters by Tennant et al (13,14) and Menon (15) indicate that in the majority of the shellfish growing waters in the Canadian Atlantic Region, fecal coliform constituted 25 to 60 percent of the total coliform flora. A fecal coliform MPN value of 23 per 100 ml was found to be best related to a total coliform MPN of 70 for Canadian Atlantic shellfish growing area waters.

The purpose of this paper is to evaluate the impact of the proposed fecal coliform standard of 14 per 100 ml of sample on the Canadian shellfishing industry. Consequently, comparisons were made between the existing closure lines and the strict theoretical application (based solely on recent bacteriological data) of the 70 total coliform standard and the 14 and 23 fecal coliform standards. Existing closure lines are based on a total coliform MPN value of 70 per 100 ml of sample with not more than 10 percent of the samples exceeding 230 for a 5-tube, 3 dilution test, in addition to, in certain cases, a safety margin or buffer zone. It should be clearly understood that certain

existing closures are not solely based on the application of bacteriological data but are based on a number of sanitary and administrative concerns. Firstly, because of limited resources and the difficulties faced in conducting year round surveys in each shellfish growing area, we include "doubtful quality" growing areas based on the most hazardous environmental conditions expected, proximity to fecal sources, etc. Secondly, because our northern waters are near the habitat range limit for commercial shellfish species, most growing areas are in shallow estuaries which can be very sensitive to runoff and periodic contamination. Thirdly, the location of closure lines may take into consideration the resource utilization and related economic sensitivity of a particular shellfish growing area. Thus, in these cases shellfish growing waters are subjected to more detailed assessment. Lastly, closure lines are set according to easily identified landmarks or monuments for ease of proper enforcement by regulatory officers and location by fishermen.

2 MARITIMES: APPLICATION OF THE THREE COLIFORM STANDARDS

2.1 Analysis

Within the Canadian Atlantic Region, there are presently 211 shellfish growing areas closed to direct harvesting. For the purposes of this presentation, 13 closures from New Brunswick, 7 closures from Nova Scotia and 7 closures from Prince Edward Island (each containing important shellfish resources) were chosen for evaluation with the one total coliform and two fecal coliform standards. Using recent bacteriological data (see Tables 1,2,3 for references) and in accordance with the strict application of the three coliform standards, new closure lines were theoretically determined. The areas, encompassed by the new coliform standards, were then measured with a planimeter from maps of the regions under evaluation.

Since it is the aim of this report to evaluate the impact of adopting the 14 fecal coliform standard on Canadian shellfish resources, 7 of the 27 closures selected were further

evaluated on the basis of their shellfish resources.

For purposes of denoting changes in closure acreage, (+) symbolizes an increase in the existing closure area (more area closed), and (-) symbolizes a decrease in the existing closure area (reopening of area).

2.2 Results

2.2.1 New Brunswick

Of the existing 48 shellfish closures located along the New Brunswick coastline, 13 closures, containing important shellfish resources, were chosen to evaluate the impact of applying the 70 total coliform and the 14 and 23 fecal coliform standards (Table 1).

Upon strict application of the 70 total coliform standard, 5 closure lines remained unchanged, 5 closures were reduced in size by a total of 4,177.74 acres, and 3 closures were increased by a total of 1,171.16 acres. The overall change within the 13 closures produced a total closure area reduction of 3,006.58 acres.

The application of the 14 fecal coliform standard to the same 13 closures produced similar results. Five closures remained unchanged, 5 closures decreased in area by a total of 5,151.94 acres, and 3 closures increased by a total of 706.60 acres. Thus, the net change resulted in a decrease of 4,445.34 acres for the 13 closures.

Strict application of the 23 fecal coliform standard, produced results comparable with the 14 fecal coliform standard, with one exception. Eel River (N.B. 4-2) decreased another 87.25 acres from 135.70 acres as determined by utilizing the 14 fecal coliform standard. The net result upon strict application of the 23 fecal coliform standard was a reduction of 5,066.92 acres from the total 33,555.39 acres presently closed under existing regulations.

In comparison with existing closure lines, application of the 23 fecal coliform standard would theoretically reopen the greatest acreage (5,066.92 acres) followed by the 14 fecal

TABLE 1 NEW BRUNSWICK: VARIATIONS BETWEEN THE EXISTING CLOSURE AND THE STRICT APPLICATION OF THE THREE COLIFORM STANDARDS

SHELLFISH AREA			EXISTING CLOSURE	THEORETICAL CLOSURE BASED ON 70 T.C. OR 10% > 230		ADOPTED CLOSURE BASED ON 14 F.C. OR 10% > 43		COMPARATIVE CLOSURE BASED ON 23 F.C. OR 10% > 76	
NAME	REF.	CODE NO.	TOTAL ACRES	ACRES	%	ACRES	%	ACRES	%
CARAQUET BAY	16.	3-1	6,001.74	-3,453.18	-58	-3,453.18	-58	-3,987.51	-66
SHIPPEGAN HARBOUR	17.	3-2	1,338.80	-318.45	-24	+385.04	+29	+385.04	+29
LAMEQUE BAY	17.	3-3	719.34	-120.90	-17	-120.90	-17	-120.90	-17
MIRAMICHI RIVER	18.	4-1	12,279.01	+254.25	+2	+144.65	+1	+144.65	+1
EEL RIVER	19.	4-2	326.72	-170.14	-52	-135.70	-42	-222.95	-68
BUCTOUCHE RIVER	20.	6-4	1,795.47	0	0	0	0	0	0
COCAGNE R. & HBR.	21.	6-5	1,777.10	+176.91	+10	+176.91	+10	+176.91	+10
LITTLE LEPREAU BAY	22.	9-2	49.59	0	0	0	0	0	0
LEPREAU HARBOUR	22.	10-1	177.94	0	0	0	0	0	0
BEAVER HARBOUR	23.	14-1	608.26	-115.07	-19	-115.07	-19	-115.07	-19
LETANG HARBOUR	24.	14-1	1,625.57	+740.00	+46	-1,327.09	-82	-1,327.09	-82
BLACK BAY & BASIN	24.	14-2	169.90	0	0	0	0	0	0
ST. CROIX RIVER	25.	15-7	6,685.95	0	0	0	0	0	0
DECREASE IN CLOSURE ACREAGE				-4,177.74	-12.5	-5,151.94	-15.4	-5,773.52	-17.2
INCREASE IN CLOSURE ACREAGE				+1,171.16	+3.5	+706.60	2.2	+706.60	2.1
DIFFERENCE				-3,006.58	-9.0	-4,445.34	-13.2	-5,066.92	-15.1
TOTAL ACREAGE CLOSED			33,555.39	30,548.81		29,110.05		28,488.47	

coliform standard at 4,445.34 acres and the 70 total coliform standard at 3,006.58 acres.

2.2.2 Nova Scotia

Around the coastal perimeter of Nova Scotia there presently exist 113 areas closed to harvesting of shellfish. From these, 7 closures containing important shellfish resources, were chosen for evaluation with the 3 coliform standards (Table 2).

Strict application of the 70 total coliform standard influenced 3 of the 4 shellfish closures, chosen from the Annapolis Basin (N.S.-18), by reducing their sizes by a total of 587.79 acres. The Joggins closure (N.S. 18-4) remained unchanged. Little recent total coliform information was available for the remaining 3 closures under discussion (N.S. 7-1, 7-8, 7-10) (Table 2).

Evaluation of the 14 fecal coliform standard with existing regulations would theoretically reduce 2 of the 7 closures by a total of 30.14 acres while the remaining 5 closures would increase by a total of 486.36 acres. Smith Cove (Closure N.S. 18-5) increased in size from 32.15 acres to 105.61. Although this seems like a large increase (229%), compared with other larger closures and their corresponding changes, a 73.46 acre increase is relatively small. The results indicate an overall increase of 456.22 acres for these 7 closures when re-evaluated in accordance with the 14 fecal coliform standard.

Upon application of the 23 fecal coliform standard, 3 of the 7 existing closures decreased in size by 941.35 acres in total, while 1 of the remaining 4 closures increased by 32.14 acres. Three closures, Whycocomagh Bay (N.S. 7-10), Smith Cove (N.S. 18-5) and the Cornwallis area (N.S. 18-2) remained unchanged. The result of changes within the 7 closures was a net reduction of 909.21 acres.

Based on examination of these 7 closures within Nova Scotia, application of the 14 fecal coliform standard produced a net increase of 456.22 acres while the 70 total coliform and 23 fecal coliform standards theoretically produced decreases totalling 587.79 acres and 909.21 acres, respectively.

TABLE 2 NOVA SCOTIA: VARIATIONS BETWEEN THE EXISTING CLOSURE AND THE STRICT APPLICATION OF THE THREE COLIFORM STANDARDS

SHELLFISH AREA			EXISTING CLOSURE	THEORETICAL CLOSURE BASED ON 70 T.C. OR 10% > 230		ADOPTED CLOSURE BASED ON 14 F.C. OR 10% > 43		COMPARATIVE CLOSURE BASED ON 23 F.C. OR 10% > 76	
NAME	REF.	CODE NO.	TOTAL ACRES	ACRES	%	ACRES	%	ACRES	%
NYANZA BAY	26.	7-1	463.79	-	-	+34.06	+7	+32.14	+7
SOUTH BASIN	27.	7-8	197.46	-	-	-9.18	-5	-9.18	-5
WHYCOCOMAGH BAY	26.	7-10	688.80	-	-	+142.35	+21	0	0
ANNAPOLIS RIVER	28.	18-1	4,481.79	-146.94	-3	-20.96	-0.5	-739.31	-17
CORNWALLIS AREA	28.	18-2	794.42	-417.88	-53	+172.2	+22	0	0
THE JOGGINS	28.	18-4	817.38	0	0	+64.29	+8	-192.86	-24
SMITH COVE	28.	18-5	32.15	-22.97	-72	+73.46	+229	0	0
DECREASE IN CLOSURE ACREAGE				-587.79	-9.6	-30.14	-0.4	-941.35	-12.2
INCREASE IN CLOSURE ACREAGE				0	0	+486.36	+6.3	+32.14	+0.4
DIFFERENCE				-587.79	-9.6	+456.22	+5.9	-909.21	-11.8
TOTAL ACREAGE CLOSED			6,125.74 (1) 7,745.79 (2)	5,537.95		8,202.01		6,836.58	

(1) TOTAL OF 18-1, 18-2, 18-4 AND 18-5

(2) TOTAL OF ALL 7 CLOSURES

2.2.3 Prince Edward Island

Along Prince Edward Island's coastline there are 50 areas closed to the harvesting of shellfish. Seven of these closures, representing important shellfish resource areas, were chosen for evaluation with the 3 coliform standards (Table 3).

Strict application of the 70 total coliform standard resulted in a decrease in 4 of the 7 closures for a total reduction of 1,197.80 acres. Of the remaining three closures, Johnston River (P.E.I. 7-4) increased by 114.80 acres while the Hillsborough River (P.E.I. 7-3) and Bedeque Bay (P.E.I. 9-1) remained unchanged. The final consequence of strictly applying the 70 total coliform standard on these 7 particular closures, resulted in a net decrease in closure area of 1,083.00 acres.

With the application of the 14 fecal coliform standard, 3 closures were reduced in size by a total of 1,114.86 acres and 2 closures increased in area by a total of 285.24 acres. Two closures, North Rustico Harbour (P.E.I. 3-4) and Bedeque Bay (P.E.I. 9-1) remained unchanged. Of the 5 closures that were influenced by the 14 fecal coliform standard, 829.62 acres were theoretically reopened from the existing area of 28,425.19 acres already closed to shellfishing under existing regulations.

In comparison, application of the 23 fecal coliform standard also decreased the overall acreage encompassed by the 7 closures. While 2 closures increased in size by 285.24 acres, 4 closures substantially decreased by 1,247.79 acres. This resulted in a net decrease of 962.55 acres for 6 of the 7 closures. Again Bedeque Bay (P.E.I. 9-1) remained unchanged.

Upon comparing the impact of the 3 coliform standards on the 7 existing closures evaluated for Prince Edward Island, each standard decreased the existing total closed acreage by approximately 1,000 acres. The 14 fecal coliform standard which theoretically decreased the least acreage (829.62 acres) did, however, increase two important oyster resource closures; the Johnston River (P.E.I. 7-3) and Hillsborough River (P.E.I. 7-4). These

TABLE 3 PRINCE EDWARD ISLAND: VARIATIONS BETWEEN THE EXISTING CLOSURE AND THE STRICT APPLICATION OF THE THREE COLIFORM STANDARDS

SHELLFISH AREA NAME	REF.	CODE NO.	EXISTING CLOSURE		THEORETICAL CLOSURE BASED ON 70 T.C. OR 10% > 230		ADOPTED CLOSURE BASED ON 14 F.C. OR 10% > 43		COMPARATIVE CLOSURE BASED ON 23 F.C. OR 10% > 76	
			TOTAL ACRES	CHANGE ACRES	%	CHANGE ACRES	%	CHANGE ACRES	%	
ELLIS RIVER	29.	2-4	312.26	-260.21	-81	-270.94	-87	-270.94	-87	
NORTH RUSTICO HARBOUR	30.	3-4	398.13	-190.11	-48	0	0	-132.73	-33	
BRACKLEY BAY	31.	3-7	663.54	-485.74	-73	-485.74	-73	-485.74	-73	
CHARLOTTETOWN HB.	32.	7-2	19,860.46	-261.74	-1	-358.18	-2	-358.18	-2	
JOHNSTON RIVER	33.	7-3*	220.42	+114.80	+52	+114.80	+52	+114.80	+52	
HILLSBOROUGH RIVER	34.	7-4	560.01	0	0	+170.44	+30	+170.44	+30	
BEDEQUE BAY	35.	9-1	6,410.43	0	0	0	0	0	0	
DECREASE IN CLOSURE ACREAGE				-1,197.80	-4.2	-1,114.86	-3.9	-1,247.59	-4.4	
INCREASE IN CLOSURE ACREAGE				+114.80	+0.4	+285.24	+1.0	+285.24	+1.0	
DIFFERENCE				-1,083.00	-3.8	-829.62	-2.9	-962.35	-3.4	
TOTAL ACREAGE CLOSED			28,425.19		27,342.19		27,595.57		27,462.84	
TOTAL ACREAGE CLOSED IN ALL THREE PROVINCES			68,106.32 (1) 69,456.37 (2)		63,428.95		64,907.63		62,787.89	

(1) BASED ON TOTAL OF 24 CLOSURES
(2) BASED ON TOTAL OF 27 CLOSURES

* EXTENDED CLOSURE BASED ON 1 ABNORMALLY HIGH READING (T.C. 1600, F.C. 450)
OUT OF 5 READINGS

two resource regions will be discussed later in detail.

2.3 Summary

The development of theoretical closure lines based on the strict application of three differing bacteriological standards resulted in wide deviations from the existing closure line locations in many cases. Quantitatively, application of the 3 coliform standards on 27 closures within the Maritimes are summarized in Table 4.

TABLE 4 SUMMARY OF VARIATIONS FROM EXISTING CLOSURES UNDER STRICT APPLICATION OF THE THREE COLIFORM STANDARDS

Standard	No. of Closures Evaluation Based on	Existing Area Under Closure (acres)	Total Change (acres)	Percent Change
70 TC	24	68,106.32	-4,677.37	-6.9%
14 FC	27	69,456.37	-4,818.74	-6.9%
23 FC	27	69,456.37	-6,938.48	-10.0%

- signifies a decrease of existing closure area.

As can be seen in Table 4, strict application of all 3 coliform standards decreased the overall acreage closed to shell-fishing by various amounts. This is explainable since administration of the existing 70 total coliform standard, as outlined earlier, includes an additional buffer zone, whereas in this report, the true application of the 3 coliform standards under evaluation did not. However, this does not suggest that these decreases will be completely eroded if buffer zones were added, but indicates that these decreases are maximum values based on strict application of bacteriological standards.

A percentage breakdown of increases and decreases on a provincial basis is presented in Table 5.

Chi square analysis of 24 closures and their observed

TABLE 5 PERCENT CHANGES FROM EXISTING CLOSURE LINES ON A PROVINCIAL BASIS

CHANGE	CHANGES FROM EXISTING CLOSURE LINES		
	70 T.C. % OF TOTAL ACREAGE	14 F.C. (NO. OF CLOSURES)	23 F.C.
NEW BRUNSWICK	CONSTANT	0 (5)	0 (5)
	DECREASE	-9.8 (5)	-13.0 (5)
	INCREASE	3.5 (3)	2.1 (3)
BASED ON 13 CLOSURES			
NOVA SCOTIA	CONSTANT	0 (1)	0 (2)
	DECREASE	-9.6 (3)	-12.2 (3)
	INCREASE	0 (0)	7.0 (2)
(1) BASED ON 4 CLOSURES (2) BASED ON 7 CLOSURES			
P.E.I.	CONSTANT	0 (2)	0 (1)
	DECREASE	-4.2 (4)	-4.4 (4)
	INCREASE	0.4 (1)	1.0 (2)
BASED ON 7 CLOSURES			
ALL THREE PROVINCES	CONSTANT	0 (8)	0 (9)
	DECREASE	-8.8 (12)	-11.5 (12)
	INCREASE	1.9 (4)	1.5 (6)
(1) BASED ON 24 CLOSURES (2) BASED ON 27 CLOSURES			

influence under strict application of the 3 coliform standards indicate that there is no significant relationship between the standards and the observed closure changes beyond that which can be expected by chance (Table 6).

TABLE 6 CHI SQUARE ANALYSIS ON THE EFFECT OF THE THREE COLIFORM STANDARDS ON 24 CLOSURES SHOWING OBSERVED AND PREDICTED () FREQUENCY OCCURENCE, ($\chi^2 = 3.769$; $\chi^2_{.05} = 9.488$, (4D.F))

Change	Standard		
	70 T.C.	14 F.C.	23 F.C.
None	8 (7.6)	7 (7.6)	8 (7.6)
Increase	4 (5.7)	8 (5.7)	5 (5.7)
Decrease	12 (11.5)	9 (10.7)	11 (10.7)

Table 7 lists the individual closures influenced by the 3 coliform standards according to their "percent change" from existing closure acreage.

3 MARITIMES: SHELLFISH RESOURCES AS INFLUENCED BY THE 14 FECAL COLIFORM STANDARD

Since it is the aim of this report to evaluate the impact of adopting the 14 fecal coliform standard over application of the present 70 total coliform standard, only those closures that reveal substantial size changes and contain important shellfish resources (with available information) will be discussed (Table 8).

TABLE 8 CLOSURES CONTAINING IMPORTANT SHELLFISH RESOURCES

<u>Closure</u>		<u>Acres</u>	<u>Change</u>	<u>Percent</u>
Hillsborough (East) River	P.E.I. 7-4	+170.44		+30%
Johnston River	P.E.I. 7-3	+114.80		+52%
Caraquet Bay	N.B. 3-1	-3,453.18		-58%
Cornwallis Area	N.S. 18-2	+172.2		+22%
The Joggins	N.S. 18-4	+64.29		+8%

- signifies a decrease of existing closure area.

+ signifies an increase of existing closure area.

TABLE 7 PERCENT CHANGE FROM EXISTING CLOSURES IN ACCORDANCE WITH THE STRICT APPLICATION OF THE THREE COLIFORM STANDARDS

CLOSURE BASED ON 70 T.C. WITH 10% 230

	CODE NO.	NAME	EXISTING CLOSURE (ACRES)	PERCENT CHANGE
1.	P.E.I. 2-4	Ellis River	312.26	-81
2.	P.E.I. 3-7	Brackley Bay	663.54	-73
3.	N.S. 18-5	Smith Cove	32.15	-72
4.	N.B. 3-1	Caraquet Bay	6,001.74	-58
5.	N.S. 18-2	Cornwallis Area	794.42	-53
6.	P.E.I. 7-3	Johnston River	220.42	+52
7.	N.B. 4-2	Eel River	326.72	-52
8.	P.E.I. 3-4	North Rustico Harbour	398.13	-48
9.	N.B. 14-1	Letang Harbour	1,625.57	+46
10.	N.B. 3-2	Shippegan Harbour	1,338.80	-24
11.	N.B. 13-1	Beaver Harbour	608.26	-19
12.	N.B. 3-3	Lameque Bay	719.34	-17
13.	N.B. 6-5	Cocagne River and Harbour	1,777.10	+10
14.	N.S. 18-1	Annapolis River	4,481.79	- 3
15.	N.B. 4-1	Miramichi River	12,279.01	+ 2
16.	P.E.I. 7-2	Charlottetown Harbour	19,860.40	- 1

CLOSURE BASED ON 14 F.C. WITH 10% 43

	CODE NO.	NAME	EXISTING CLOSURE (ACRES)	PERCENT CHANGE
1.	N.S. 18-5	Smith Cove	32.15	+229
2.	P.E.I. 2-4	Ellis River	312.26	- 87
3.	N.B. 14-1	Letang Harbour	1,625.57	- 82
4.	P.E.I. 3-7	Brackley Bay	663.54	- 73
5.	N.B. 3-1	Caraquet Bay	6,001.74	- 58
6.	P.E.I. 7-3	Johnston River	220.42	- 52
7.	P.E.I. 9-1	Bedeque Bay	6,410.43	+ 49
8.	N.B. 4-2	Eel River	326.72	- 42
9.	P.E.I. 7-4	Hillsborough River	560.01	+ 30
10.	N.B. 3-2	Shippegan Harbour	1,338.80	+ 29
11.	N.S. 18-2	Cornwallis Area	794.42	+ 22
12.	N.S. 7-10	Whycocomagh Bay	688.80	+ 21
13.	N.B. 13-1	Beaver Harbour	608.26	- 19
14.	N.B. 3-3	Lameque Bay	719.34	- 17
15.	N.B. 6-5	Cocagne River and Harbour	1,777.10	+ 10
16.	N.S. 18-4	The Joggins	817.38	+ 8
17.	N.S. 7-1	Nyanza Bay	463.79	+ 7
18.	N.S. 7-8	South Basin	197.46	- 5
19.	P.E.I. 7-2	Charlottetown Harbour	19,860.40	- 2
20.	N.B. 4-1	Miramichi River	12,279.01	+ 1
21.	N.S. 18-1	Annapolis River	4,481.79	- 0.5

CLOSURE BASED ON 23 F.C. WITH 10% 76

	CODE NO.	NAME	EXISTING CLOSURE (ACRES)	PERCENT CHANGE
1.	P.E.I. 2-4	Ellis River	312.26	-87
2.	N.B. 14-1	Letang Harbour	1,625.57	-82
3.	P.E.I. 3-7	Brackley Bay	663.54	-73
4.	N.B. 4-2	Eel River	326.72	-68
5.	N.B. 3-1	Caraquet Bay	6,001.74	-66
6.	P.E.I. 7-3	Johnston River	220.42	+52
7.	P.E.I. 3-4	North Rustico Harbour	398.13	-33
8.	P.E.I. 7-4	Hillsborough River	560.01	+30
9.	N.B. 3-2	Shippegan Harbour	1,338.80	+29
10.	N.S. 18-4	The Joggins	817.38	-24
11.	N.B. 13-1	Beaver Harbour	608.26	-19
12.	N.S. 18-1	Annapolis River	4,481.79	-17
13.	N.B. 3-3	Lameque Bay	719.34	-17
14.	N.B. 6-5	Cocagne River and Harbour	1,777.10	+10
15.	N.S. 7-1	Nyanza Bay	463.79	+ 7
16.	N.S. 7-8	South Basin	197.46	- 5
17.	P.E.I. 7-2	Charlottetown Harbour	19,860.40	- 2
18.	N.B. 4-1	Miramichi River	12,279.01	+ 1

3.1 Hillsborough (East) River

The Hillsborough or East River discharges into Hillsborough Bay, located in South Central Queens County, P.E.I., adjacent to the city of Charlottetown (Figure 1). Two closures presently are in force on the Hillsborough River, one from Charlottetown to the head of Johnston River (P.E.I. 7-2) and one from Scotchford (east of Cranberry Wharf) to the headwaters at Mount Stewart (P.E.I. 7-4) (Figure 2). The latter closure (P.E.I. 7-4), comprising approximately 5 miles of the upper river, contains important oyster resources which are significantly influenced by the strict application of the 14 fecal coliform standard (Figure 3). This new standard would increase the present closure from 560.01 acres to 730.45 acres.

Within this first 560.01 acres there are 24.28 acres of deep water oyster beds (beds below 10 feet deep at low tide) comprising 11.77 percent of the river's total marketable oysters (shell length 3 inches or greater at its longest point). Also restricted within this area is another 28.40 acres of shallow water oyster beds (beds less than 10 feet deep at low tide) containing an unknown quantity of oysters (Table 9).

An extension of the present closure by 170.44 acres or 1.14 miles downstream from its present line will cause a further 48.20 acres of deep water oyster beds to be closed. This additional area alone comprises 50.4 percent of the river's marketable oysters and is potentially valued at \$211,700.00. This does not include the 19.06 acres of shallow water oyster beds about which no resource information presently exists. Thus, strict application of the 14 fecal coliform standard would restrict a total of 72.48 acres on 56.89 percent of the Hillsborough River marketable oyster resources potentially valued at \$285,200.00.

Under Federal Fisheries Regulations the practice of dragging for shellfish is illegal (except by some commercial industries under strict regulations) and since the majority of oyster beds within the Hillsborough River are too deep for tonging,

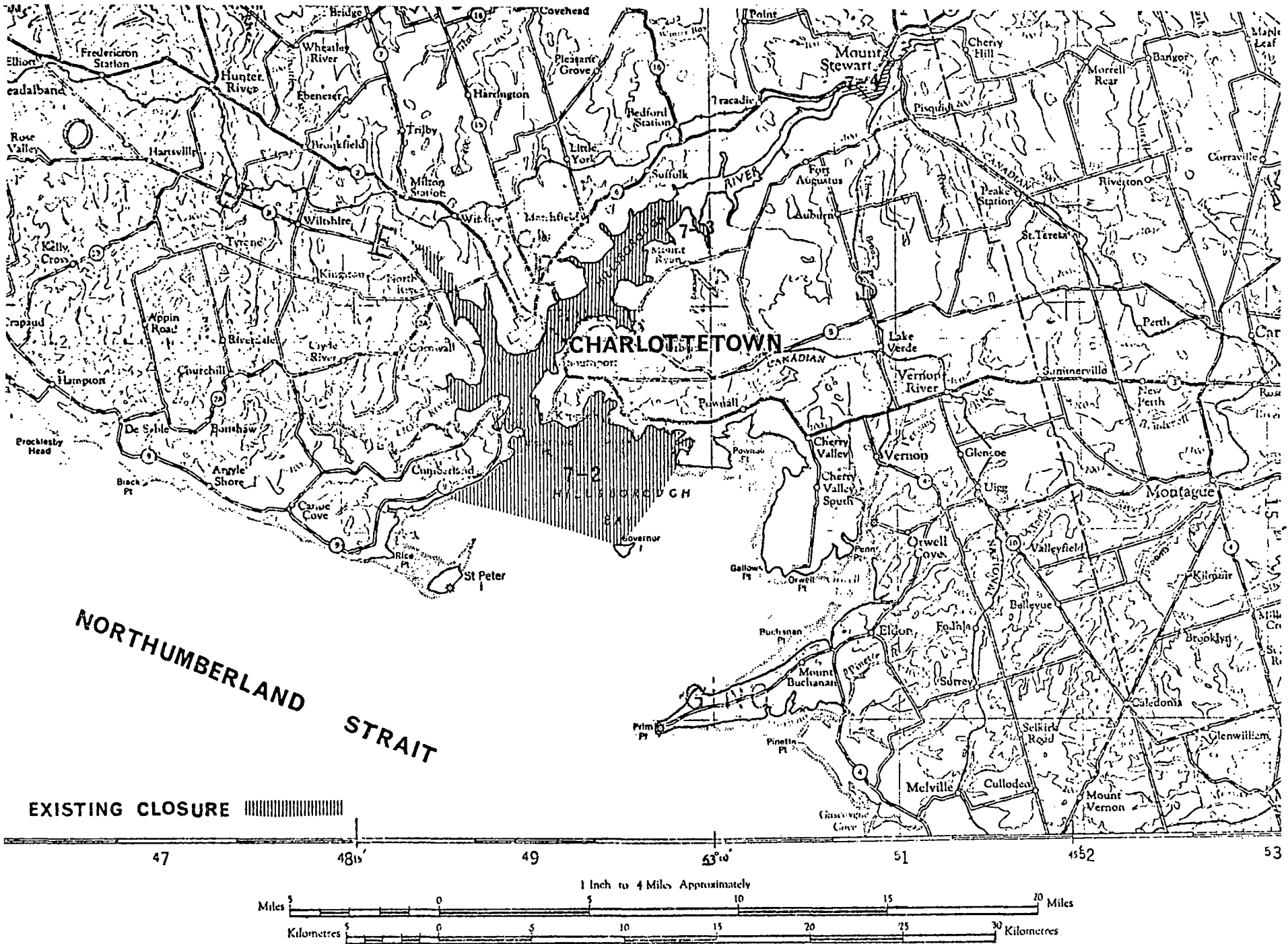


FIGURE 1 LOCATION OF CLOSURES (7-2, 7-3, 7-4) ON HILLSBOROUGH RIVER, P.E.I.

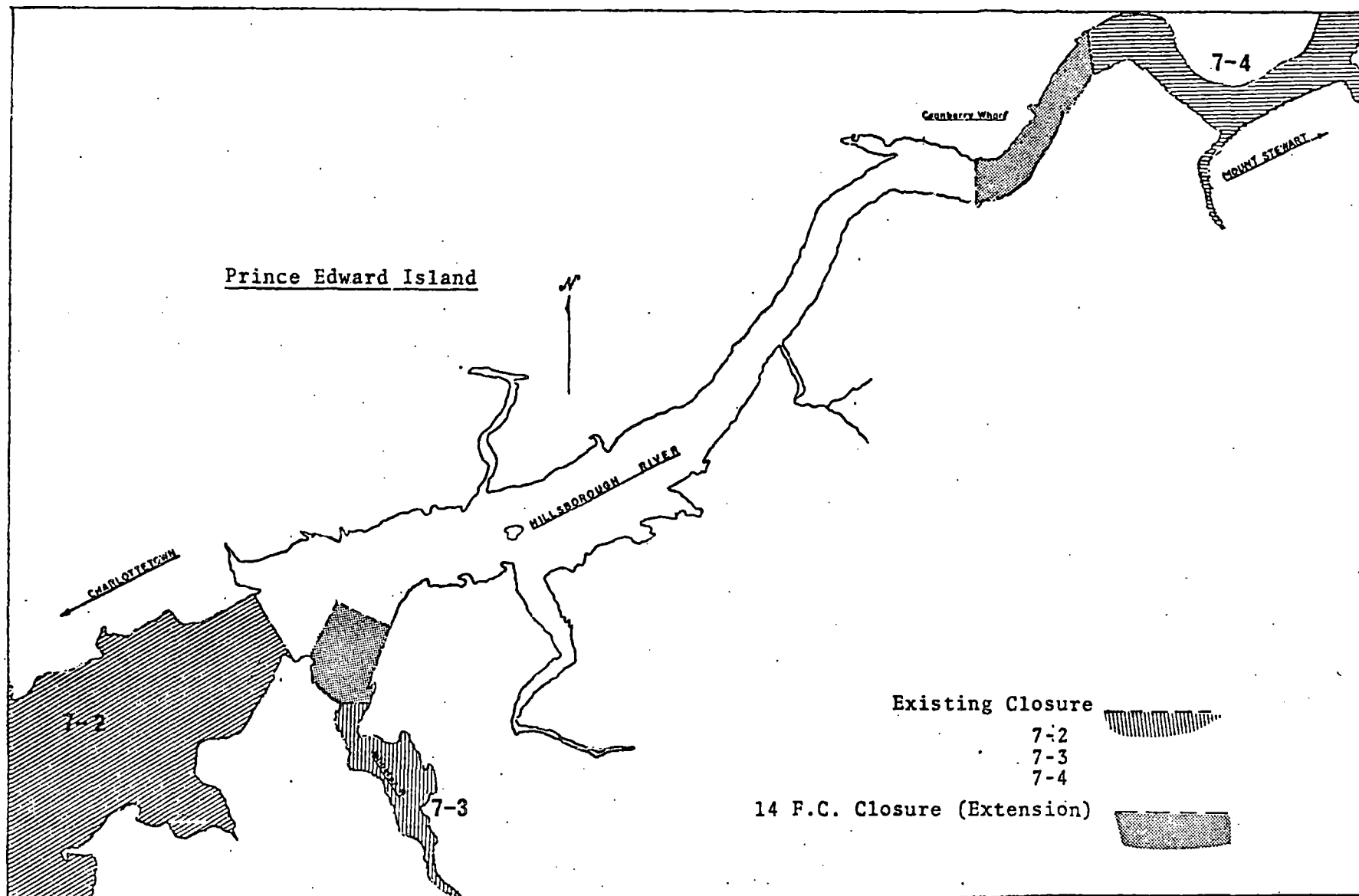


FIGURE 2 LOCATION OF EXISTING CLOSURE LINES (7-2, 7-3, 7-4) AND 14 F.C. CLOSURE LINE EXTENTIONS

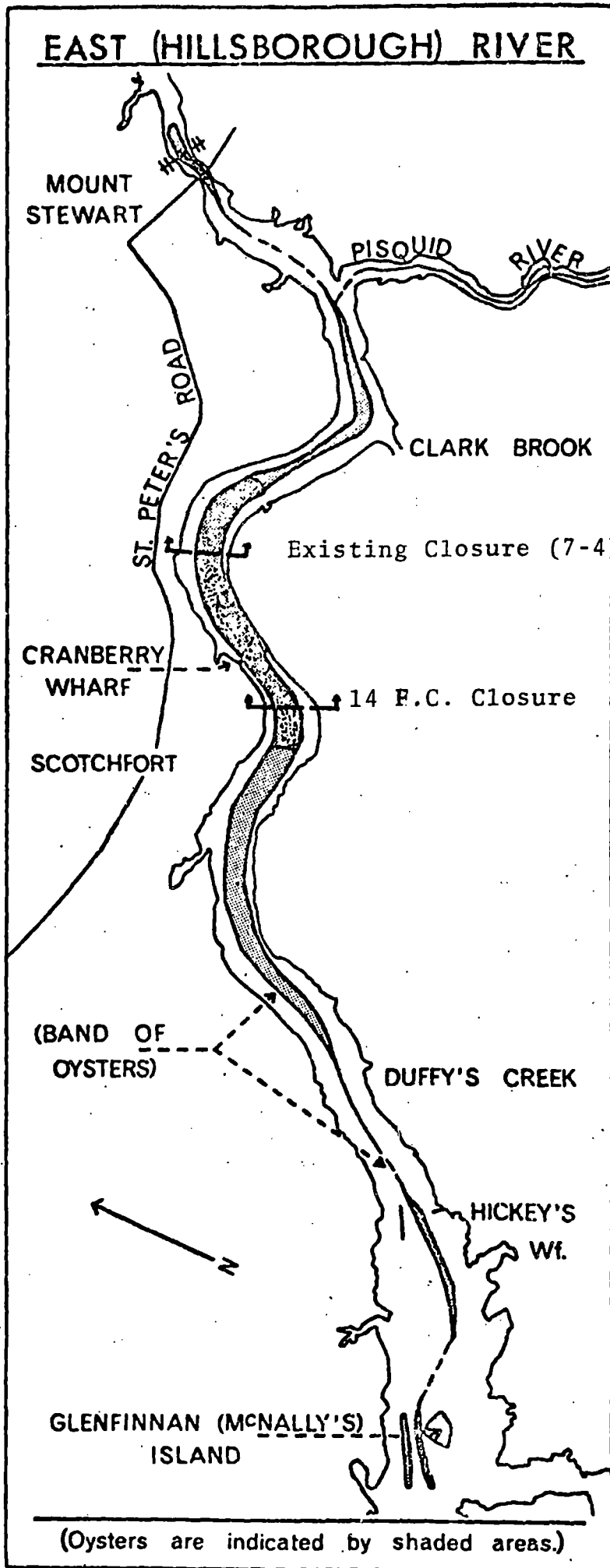


FIGURE 3
LOCATION OF OYSTER BEDS,
HILLSBOROUGH RIVER, P.E.

TABLE 9 HILLSBOROUGH (EAST) RIVER: OYSTER RESOURCES (1)

RIVER SECTION	AREA OF OYSTER BEDS (ACRES)	STANDING CROP (2)		% OF TOTAL RESOURCES
		No. of Boxes @ 500/box	Value (\$,000)	
Major Resources Glenfinnan Island to Mount Stewart (10 Miles)	187.3	24,000	420	100.0
Closed Under Existing Closure (P.E.I. 7-4)	24.28	4,200	73.5	17.5
Additional Section Closed Under 14 F.C. Standard (170.44 acres)	48.20	12,100	211.7	50.4
Total Closure Under 14 F.C. Standard	72.48	16,300	285.2	67.9

18

(1) Source - Resource Development Branch, Fisheries and Marine Services, Environment Canada - Halifax, N.S. - 1974.

(2) Marketable oysters.

much of this oyster population is presently unexploitable. Thus, these deep water oysters can be considered as a brood stock for populating nearby shallow waters either directly or by transplanting by Fishery Officers.

3.2 Johnston River

The Johnston River enters the Hillsborough River approximately 7 miles upstream from Charlottetown, P.E.I. Presently, the entire river is closed (Closure P.E.I. 7-3) to the taking of shellfish but adoption of the 14 fecal coliform standard would extend the present closure line to include much of Walker's Cove at the mouth of the river (Figure 4). This would increase its present closure area of 220.42 acres by another 114.80 acres.

The oyster resources within Johnston River are confined to a narrow channel extending from the center of Hillsborough River down the middle of Johnston River. Under existing closure regulations (P.E.I. 7-3) 65.9 percent of these oyster resources are closed to fishing but with adoption of the 14 fecal coliform standard 100 percent of the resources will be under restriction. On a dollar and cents basis, an additional potential loss of \$32,900.00 would be imposed upon the estimated present resource value in the area under closure of \$63,500.00 (Table 10). Thus, the application of the 14 fecal coliform standard would be detrimental to this area.

3.3 Caraquet Bay

Caraquet Bay is located near the mouth of Chaleur Bay, New Brunswick. Under existing closure 3-1 the southwest and northwest of Caraquet Rivers and the whole southern shore of the Caraquet Bay are closed for direct oyster harvesting (Figure 5).

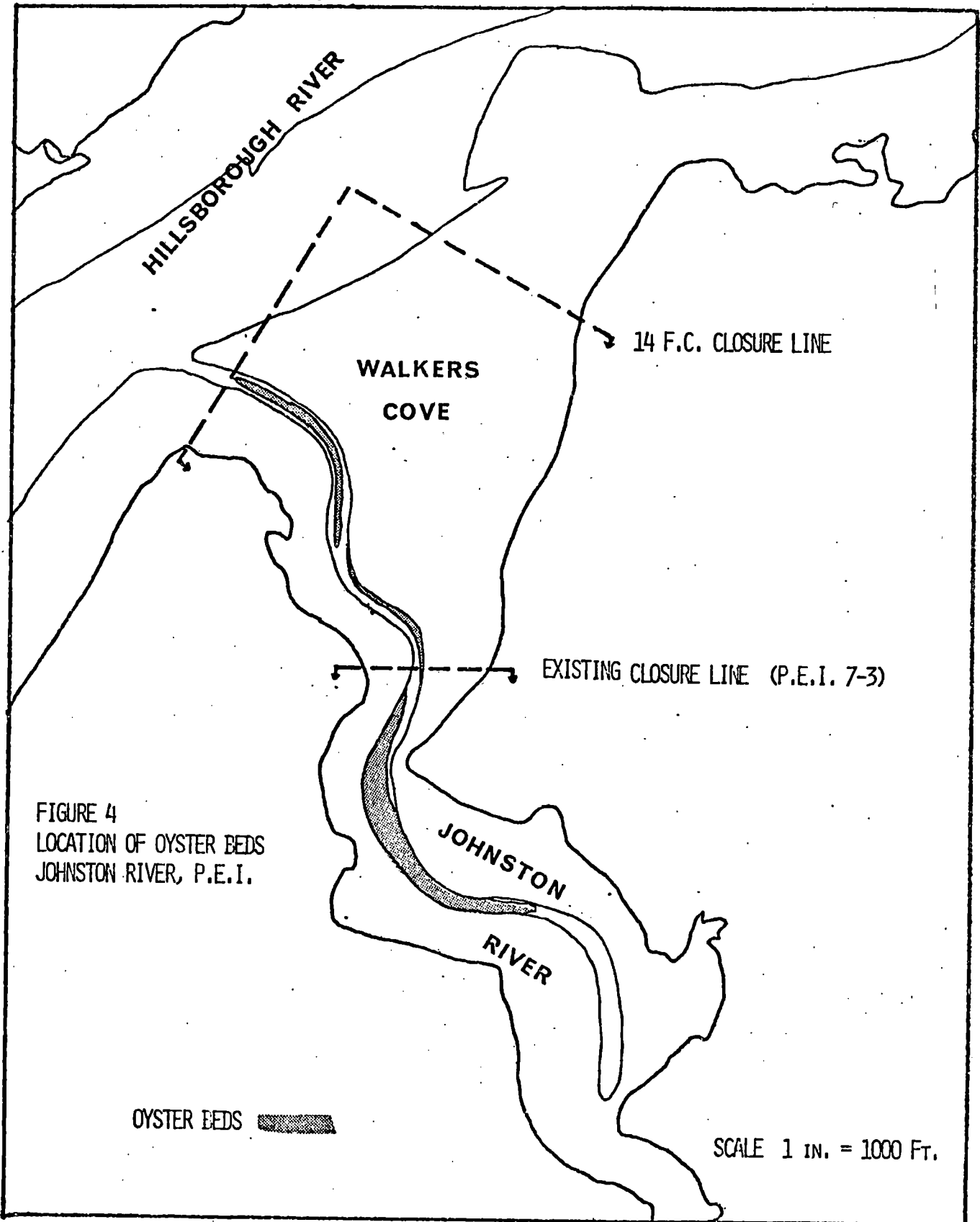


FIGURE 4
LOCATION OF OYSTER BEDS
JOHNSTON RIVER, P.E.I.

OYSTER BEDS 

SCALE 1 IN. = 1000 FT.

TABLE 10 JOHNSTON RIVER: OYSTER RESOURCES (1)

SECTION	AREA OF OYSTER BEDS (ACRES)	STANDING CROP (2)		% OF TOTAL RESOURCES
		No. of Boxes @ 500/box	Value (\$,000)	
Existing Closure	7.27	3,630	63.5	65.9
Additional Area Under 14 F.C. Standard	3.76	1,880	32.9	34.1
Total Closure Under 14 F.C. Standard	11.03	5,510	96.4	100.

(1) Source - Resource Development Branch, Fisheries and Marine Services, Environment Canada - Halifax, N.S. - 1974.

(2) Marketable oysters.

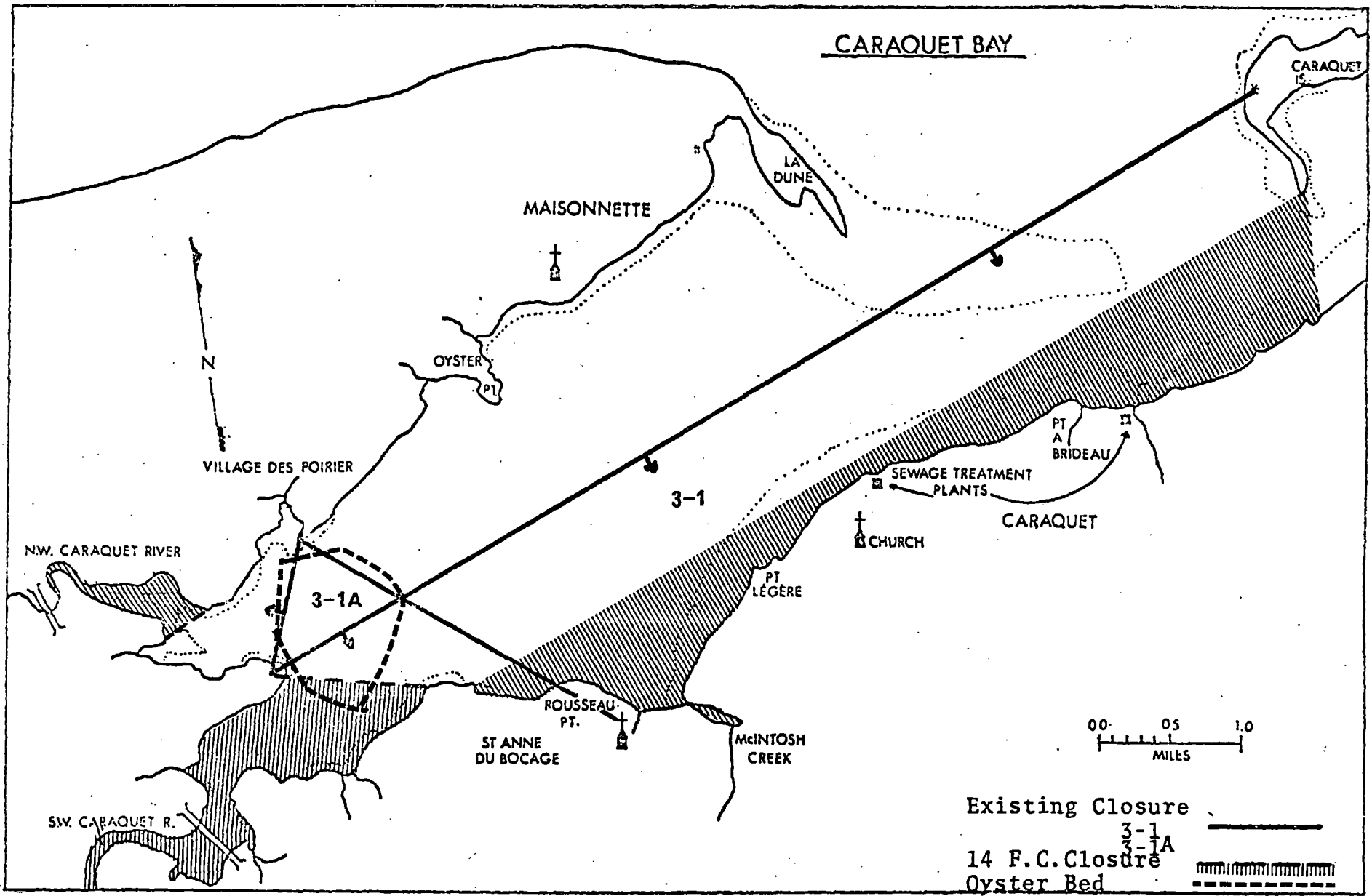


FIGURE 5 LOCATION OF EXISTING CLOSURE LINES, 14 F.C. CLOSURE LINES AND OYSTER BED, CARAQUET BAY, N.B.

TABLE 11 CARAQUET BAY: OYSTER RESOURCES (1)

SECTION	AREA OF OYSTER BEDS (ACRES)	STANDING CROP (2)		% OF TOTAL RESOURCES
		Boxes	Value (\$,000)	
Entire Oyster Bed	592.5	56,700	992.2	100.0
Open Area	250.25	33,000	577.5	58.2
Closed Under Existing Closure	342.25	23,700	414.7	41.8
Area reopened Under 14 F.C. Standard	272.55	19,600	343.0	34.6
Area Remaining Closed Under 14 F.C. Standard	69.70	4,100	71.7	7.2

23

(1) Source - Resource Development Branch, Fisheries and Marine Services, Environment Canada, Halifax, N.S., 1974.

(2) Marketable oysters.

At the head of Caraquet Bay lie 592.5 acres of public oyster beds (indicated by dotted cycle in Figure 5) with a potential value of \$992,200.00 (Table 11). Presently 41.8 percent of the bed is closed year round (N.B. 3-1) with only 58.2 percent of the bed (N.B. 3-1A) opened to direct harvesting from October 1 to December 31. Strict application of the 14 fecal coliform standard would theoretically open another 34.6 percent of the bed for a total of 92.8 percent. It should be noted that the same area that was reopened by the strict application of the 14 fecal coliform standard would also be opened if we strictly apply the 70 total coliform standard. Because Caraquet Bay is frequently subjected to intermittent fecal contamination from a number of pollution sources and the fact that Caraquet Bay oysters have been implicated as the cause of a gastroenteritis outbreak in Quebec during October 1972, it is necessary to enforce an extended closure to protect the public health.

3.4 Cornwallis Area

The Cornwallis closure (N.S. 18-2) located adjacent to H.M.C.S. Cornwallis Naval Training Base, Annapolis Basin, Nova Scotia, encompasses 794.42 acres of which 487.91 acres is intertidal.

Within this intertidal zone, 311.0 acres are known to contain soft shelled clams at a density of 97.5 bushels per acre (clams greater than 1/4 inches in diameter). Estimates for such a population, at \$9.75 per bushel, constitute a potential resource value of \$295,649.00 (Table 12).

Strict application of the 14 fecal coliform standard would expand the Cornwallis closure by another 172.2 acres of which 80.4 acres is intertidal. The extent and density of clams within this new closure area are presently unknown but by using the known density established for the existing closure a rough

TABLE 12 CORNWALLIS AREA: SOFT SHELL CLAM RESOURCES (1)

SECTION	AREA (ACRES)		STANDING CROP (2)	
	CLOSURE	INTERTIDAL ZONE	BUSHELS	VALUE (\$,000)
Existing Closure	794.42	311.0	30,323.0	295.6
Additional Area Under 14 F.C. Standard	172.2	80.4	7,839.0	76.4
Total Closure Under 14 F.C. Standard	966.62	391.4	38,162.0	372.1

(1) Source - Resource Development Branch, Fisheries and Marine Service, Environment Canada, Halifax, N.S., 1974.

(2) Marketable clams.

estimate can be derived. If the entire 80.4 acres of intertidal flats contained soft shell clams in densities of 97.5 bushels per acre, this enlarged closure area could restrict an additional \$76,430.00 worth of resources. Thus, implementation at the 14 fecal coliform standard could increase the present closure (N.S. 18-2) in acreage and restricted resources.

3.5 The Joggins

The Joggins closure (N.S. 18-4) which includes The Raquette is located at the extreme west end of the Annapolis Basin adjacent to the town of Digby, Nova Scotia (Figure 6). This existing closure restricts a total of 817.4 acres from the direct harvesting of soft shell clams (Table 13). The value of potential clam resources restricted within The Raquette and The Joggins closures is estimated at \$224,800.00.

Under the strict application of the 14 fecal coliform standard a total of 64.3 acres will be added to The Raquette and The Joggins closures bringing the total acreage closed under the new standard to 881.7 acres. By extrapolation, using the known densities of clams contained within the existing closure, we can estimate this area to contain approximately \$30,000.00 worth of soft shell clams. Therefore, the adoption of the 14 fecal coliform standard would theoretically increase the present closure by 8 percent in acreage and restrict a potential resource value of \$30,000.00.

3.6 Resource Summary

From the three Maritime Provinces, five closures, representing important shellfish growing areas, were evaluated for the impact on their resources related to the theoretical changes they would incur under strict application of the 14 fecal coliform standard.

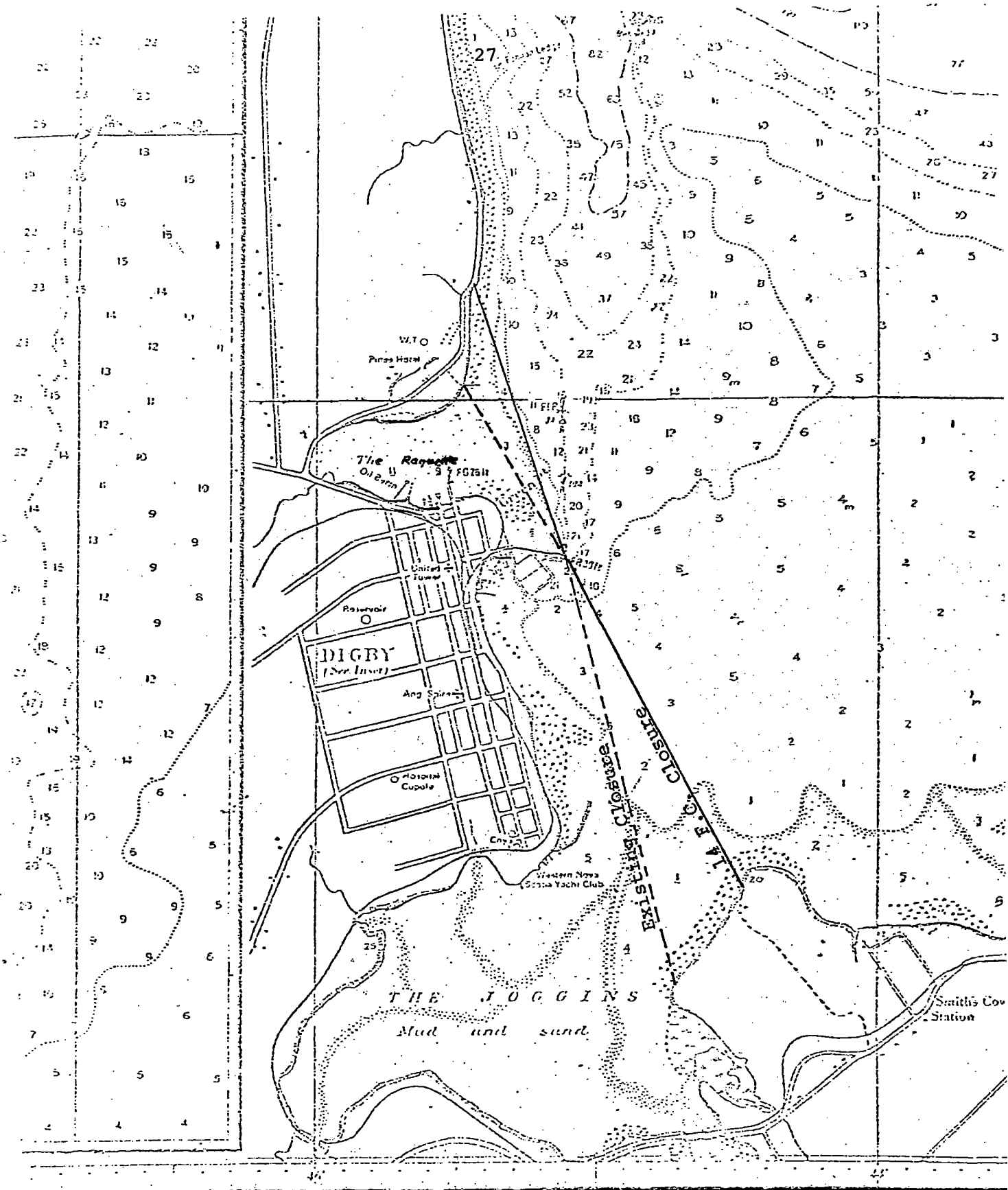


FIGURE 6 Location of closure lines and soft shell clam beds in The Joggins

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TABLE 13 THE JOGGINS AND THE RAQUETTE: SOFT SHELL CLAM RESOURCES (1)

SECTION	CLOSURE	AREA (ACRES)	STANDING CROP (2)	
			BUSHELS	VALUE (\$,000)
Existing Closure	Raquette	54.9	5,054	49.3
	Joggins	762.5	18,000	175.5
	TOTAL	817.4	23,054	224.8
Additional Area Closed Under 14 F.C. Standard	Raquette	21.1	1,757	19.1
	Joggins	43.2	1,328	12.9
	TOTAL	64.3	3,085	30.0
Total Closure under 14 F.C. Standard		881.7	26,139	254.8

(1) Source: Resource Development Branch, Fisheries and Marine Service, Environment Canada, Halifax, N.S., 1974.

(2) Marketable clams.

TABLE 14 RESOURCE SUMMARY

RESOURCE IMPACT OF THE 14 FECAL COLIFORM STANDARD
NEGATIVE IMPACT (INCREASED CLOSURE)

TABLE	AREA	CLOSURE NO	TYPE OF RESOURCE	EXISTING CLOSURE		14 F.C. CLOSURE		DIFFERENCE	
				AREA (Acres)	VALUE	AREA (Acres)	VALUE	AREA (Acres)	VALUE
9	Hillsborough River	P.E.I. 7-4	Oysters	24.28	\$ 73,500.00	72.48	\$ 285,200.00	- 48.20	- \$211,700.00
10	Johnston River	P.E.I. 7-3	Oysters	7.27	63,500.00	11.03	96,400.00	- 3.76	- 32,900.00
12	Cornwallis River	N.S. 18-2	Clams	311.0	295,649.00	391.4	372,079.00	- 80.4	- 76,430.00
13	The Joggins	N.S. 18-4	Clams	817.4	224,800.00	881.7	254,800.00	- 64.3	- 30,000.00
TOTAL				1,159.95	\$654,449.00	1,356.51	\$1,008,479.00	- 196.66	- \$351,030.00

- Signifies a decrease of shellfishing acreage and potential loss of resources.

POSITIVE IMPACT (DECREASED CLOSURE)

11	Caraquet Bay	N.B. 3-1	Oysters	342.25	\$414,700.00	69.70	\$ 71,700.00	+ 272.55	+ \$343,000.00
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+ Signifies an increase of shellfishing acreage and potential gain in resources.

Of the five closures examined, Caraquet Bay (N.B. 3-1, 3-1A) was the only closure to reflect a positive impact under the strict application of the 14 fecal coliform standard (Table 14). This existing closure encompasses a 592.5 acre oyster bed containing a dense population of marketable oysters potentially valued at \$992,200.00. Presently only 58.2 of the bed is open to harvesting but under the 14 fecal coliform standard 92.8 percent would be open.

The remaining four closures all increased in acreage to restrict a further 196.66 acres of important shellfish growing areas (over present closures) estimated in value at \$351,030.00. This figure, added to the value estimated for those areas presently closed under existing regulations, constitutes a potential resource loss of \$1,008.00 theoretically predicted by the strict application of the 14 fecal coliform standard. All these calculations are based on potential shellfish resource that can be utilized by direct harvesting. No compensation has been allocated to those resources that can be used for relaying. To take advantage of these potential resources, studies are presently under way by the Fisheries and Marine Service of Environment Canada, to evaluate the future possibilities of shellfish depuration.

4 BRITISH COLUMBIA

4.1 Impact of Fecal Coliform Standards on Shellfish Growing Areas

The effect of the strict application of the three coliform standards (70 total coliforms, 14 and 23 fecal coliforms) on the classification of 251 individual sampling stations compiled from 7 shellfish growing areas in British Columbia are summarized in Table 15.

TABLE 15 CLASSIFICATION OF THE SAMPLING STATIONS BASED ON STRICT APPLICATION OF THE THREE COLIFORM STANDARDS

70 Total Coliforms	14 Fecal Coliforms		23 Fecal Coliforms	
195A*	175A	20R	186A	9R
56R*	<u>6A</u>	<u>50R</u>	<u>8A</u>	<u>48R</u>
	181A	70R	194A	57R

* A - denoted approved station

R - denotes restricted station

Of the 251 stations examined, 195 stations were approved for direct shellfish harvesting by the existing 70 total coliform standard, whereas 56 stations were restricted. Strict applications of the proposed 14 fecal coliform standard would restrict 20 of the 195 stations approved by the 70 total coliform standard. However, 6 stations which did not meet the 70 coliform standard were acceptable when the 14 fecal coliform standard was used for classification. The application of the 23 fecal coliform standard produced results comparable with the existing 70 total coliform standard. The number of additional approved stations equalled the number of additional restricted stations. Hence the data indicates that the 14 fecal coliform standard is more stringent than the other two standards in classification of individual sampling stations. However, in most cases, the differences arise at the 90 percentile level.

4.2 Comparison of Areal Differences in Closures Based on the Strict Application of the 70 total, 14 and 23 Fecal Coliform Standards

The data presented in Table 16 gives areal closures (in acres) based on the strict application of the three standards. There was no safety buffer zone incorporated into the closure line, nor was data from the sanitary survey considered in determining the line.

TABLE 16 AREA UNDER CLOSURE (ACRES) BASED ON STRICT APPLICATION OF THE THREE BACTERIOLOGICAL STANDARDS.

Survey Area	Acreage under closure using:		
	70 total coliform standard	14 fecal coliform standard	23 fecal coliform standard
Pender Harbour (Area 16-1)	660	630	410
Secret Cove (Area 16-3)	75	80	45
Sargeant Bay (Area 16-4)	60	60	nil
Trail Bay	nil	50	nil
Thetis & Kuper Islands (Area 17-14)	5	120	45
Mud Bay	60	60	nil
Sooke	370	400	360
Total Acreage Closed (Approximate)	1230	1400	860

Examination of the cumulative data presented in Table 16 indicates the 14 fecal standard is the most restrictive, followed by the present 70 total coliform standard, with the 23 fecal standard being the least restrictive.

4.3 Comparison of Areal Differences based on "Administrative Closures"

Obviously in such cases as the one described above, an "administrative closure" would be implemented. This closure would

incorporate information obtained from the sanitary survey with respect to existing and potential pollution sources, and provide an adequate safety zone.

Table 17 presents data on the areal closures in selected survey areas based on an administrative decision, using each of the three standards as supportive data.

TABLE 17 TOTAL AREA UNDER "ADMINISTRATIVE CLOSURE" (ACRES)

	Acreage under closure using:		
	70 total coliform standard	14 fecal coliform standard	23 fecal coliform standard
Pender Harbour	870	790	760
Secret Cove	125	125	125
Thetis & Kuper Islands	7	120	40
Trail Bay	nil	75	nil
Sargeant Bay	60	60	60
Mud Bay	60	60	60
Sooke Harbour & Basin	1365	1400	1395
Totals:	2447	2630	2440

There is essentially no difference in the acreage under closure when one compares the use of the 70 total standard with the 23 fecal standard. Approximately 200 acres are added to the total acreage under closure when the 14 fecal standard is used.

4.4 Impact of the 14 Fecal Coliform Standard on B.C. Commercial Shellfish Areas

The B.C. Commercial shellfish industry harvests 90% of its product from three statistical areas: 60% of the shellfishery is concentrated in Baynes Sound, area 14, with 30% originating from area 15 and 16. The remaining 10% is scattered throughout the province, primarily in Sooke, Ladysmith Harbour, Nanoose Bay etc. Areas 14, 15 and 16 have very few closures mainly due to the absence of significant pollution sources as a result of the limited development in these areas. Thus, implementation of the more

stringent 14 fecal coliform standard would not affect the major producing areas in B.C. The remaining 10% of the producing areas, as well as the prime recreational shellfish areas, would be marginally affected by the implementation of the 14 fecal standard, with approximately 200 acres being added to the areas presently under closure.

5 QUEBEC

5.1 Impact of Fecal Coliform Standards on Restricted Areas

Twenty shellfish growing areas which are presently classified as restricted based on the 70 total coliform standard were chosen for evaluation. The impact of the application of the 14 fecal coliform and 23 fecal coliform standards on the classification and potential shellfish resource of these areas is presented in Table 18 and summarized in Table 19.

It appears that both fecal coliform standards impose less stringent restrictions on these closed areas than the 70 total coliform standard. The implementation of the 14 fecal coliform standard would reopen 7 of the 20 restricted areas for direct harvesting, whereas the implementation of the 23 fecal coliform standard would reopen another 4 of these restricted areas making up a total of 11 areas open for direct harvesting. In terms of potential shellfish resources, the application of the 14 fecal coliform standard would free 67,615* bushels of commercial size Mya arenaria to exploitation, while applying the 23 fecal coliform standard would allow the re-harvesting of 87,182** bushels of presently quarantined shellfish.

5.2 Impact of Fecal Coliform Standards on Open Areas

Table 20 presents the effect of the application of 14 and 23 fecal coliform standards on the classification and resources on 19 existing approved shellfish harvesting areas. The overall impact of the two fecal coliform standards on these areas

* TABLE 1: Total of areas 4,9,10,14 (and an undetermined amount of shellfish resource from areas 1,5, and 18).

** TABLE 2: Total of areas 2,4,8,10,14,17 (and an undetermined amount of shellfish resource from areas 1,5,15 and 18).

TABLE 18 IMPACT OF THE 14 AND 23 FECAL COLIFORM STANDARDS
ON EXISTING RESTRICTED SHELLFISH AREAS IN QUEBEC

LOCATION AND NAME OF AREA (1)	SHELLFISH STOCK (IN BUSHELS)	AREA DESIGNATION ACCORDING TO:					
		FC23 (2)	CLOSURE REASON (3)	EFFECT ON EXISTING CLOSURE (4)	FC14 (2)	CLOSURE REASON (3)	EFFECT ON EXISTING CLOSURE (4)
1. SS74: Cap au Diable	?	0	-	R	0	-	R
2. NS71: Pointe Lebel (N-7.1.2.3)	1,000	0	-	R	R	M	NC
3. NS71: Betsiamites (N-5.1.2)	?	R	P	NC	R	P	NC
4. NS71: St. Anne de Portneuf (N-3.2.2-6)	61,252	0	-	R	0	-	R
5. NS74: Ile-aux- Coudres (Sector B)	?	0	-	R	0	-	R
6. NS74: Baie des Rochers (Sector D)	?	R	MP	NC	R	MP	NC
7. NS74: Baie Ste. Catherine (Sector F)	5,531	R	P	NC	R	P	NC
8. NS74: Tadoussac	1,384	0	-	R	R	P	NC
9. NS74: Baie du Bon Desir	3,089	R	-	R	0	-	R
10. NS74: Anse à la Cave	1,174	0	-	R	0	-	R

TABLE 18 (Cont'd)

LOCATION AND NAME OF AREA	SHELLFISH STOCK (IN BUSHELS)	AREA DESIGNATION ACCORDING TO:					
		FC23 (2)	CLOSURE REASON (3)	EFFECT ON EXISTING CLOSURE (4)	FC14 (2)	CLOSURE REASON (3)	EFFECT ON EXISTING CLOSURE (4)
11. NS74: Baie des Escoumins	1,020	R	MP	NC	R	MP	NC
12. NS74: Anse à Moreau	10,351	R	P	NC	R	P	NC
G72: Barachois de Port Daniel							
13. G-20.2.1	2,100	R	MP	NC	R	MP	NC
14. G-20.2.2	2,100	O	-	R	O	-	R
15. G-20.2.3	?	O	-	R	R	MP	NC
16. G-20.2.4	?	R	P	NC	R	MP	NC
17. G72: St. Omer (G-2.1.2)	17,183	O	-	R	R	P	NC
18. G72: Escuminac (G-1.4)	?	O	-	R	O	-	R
19. G72: Barachois de Malbaie (G-22.4)	7,192	R	P	NC	R	MP	NC
20. G72: Douglastown (G-24.2.3)	8,335	R	P	NC	R	P	NC

(1) St. Lawrence North Shore (NS) and South Shore (SS); Gaspé, and year of survey

(2) O (Open); R (Restricted)

(3) M (Median Value Exceeded); P (Percentile Value Exceeded)

(4) E (Extension required); R (Rescinding required); NC (no change).

TABLE 19 STATUS COMPARISON OF SELECTED TC50 - RESTRICTED QUEBEC SHELLFISH
AREAS WITH FC23 AND FC14 STANDARDS

QUEBEC AREA	NO. SELECTED SHELLFISH AREAS	CORRESPONDING STATUS ACCORDING TO:			
		FC 23		FC 14	
		CLOSED*	OPEN	CLOSED *	OPEN
South Shore	1	0	1	0	1
North Shore	11	5 (2MP, 3P)	6	7 (2 MP, 4P, 1M)	4
Gaspe	8	4 (1MP, 3P)	4	6 (4MP, 2P)	2
All areas	20	9 (3MP, 6P)	11	13 (6MP, 6P 1M)	7
Shellfish Resource (in Bushel)	121,711	34,529	87,182	54,096	67,615

* M (Median Value Exceeded); P (Percentile Value Exceeded);
MP (Both Values Exceeded).

TABLE 20 IMPACT OF THE 14 AND 23 FECAL COLIFORM STANDARDS
ON EXISTING APPROVED SHELLFISH AREAS IN QUEBEC

LOCATION AND NAME OF AREA (1)	SHELLFISH STOCK (IN BUSHELS)	AREA DESIGNATION ACCORDING TO:			
		FC23 (2)	CLOSURE REASON (3)	FC14 (2)	CLOSURE REASON (3)
1. SS74: Le Petit Pélerin	?	0	-	0	-
2. SS74: Pointe St. André	?	0	-	0	-
3. SS74: Ile aux Patins	?	0	-	0	-
4. NS71: Pointe au Boisvert (N-3.2.1)	100,119	0	-	0	-
5. NS71: Baie Laval (N-4.1.)	100,566	0	-	0	-
6. NS71: Baie Blanche (N-4.2)	7,278	0	-	0	-
7. NS71: Ilets à Jérémie (N-4.5)	10,947	0	-	0	-
8. NS71: Bancs des Canadiens (N-4.6.1-2)	?	0	-	0	-
9. NS71: Papinachois (N-5.1.4)	?	0	-	0	-

TABLE 20 (Cont'd)

LOCATION AND NAME OF AREA (1)	SHELLFISH STOCK (IN BUSHEL) (1)	AREA DESIGNATION ACCORDING TO:			
		FC23 (2)	CLOSURE REASON (3)	FC14 (2)	CLOSURE REASON (3)
10. NS71: Pointe aux Outardes (N-6 and N-7.1.1)	84,447	0	-	0	-
11. NS74: Ile-aux- Coudres (Sector A)	?	0	-	0	-
12. NS74: Baie Ste. Catherine (Sector J)	50,201	0	-	0	-
13. NS74: Anse St. Etienne (Saguenay River)	3,848	0	-	0	-
14. NS74: Baie du Moulin a Baude	6,765	0	-	0	-
15. NS74: Petites Bergeronnes	2,672	0	-	0	-
16. NS74: Grandes Bergeronnes	15,702	0	-	0	-
17. NS74: Anse a Thibault, Anse a Pelletier, Ilets Boises	6,333	0	-	0	-
18. NS74: Sault- au-Mouton	238	! 0	-	0	-
19. G72: St. Omer (G-2.2.2)	2,500	0	-	0	-

(1) St. Lawrence North Shore (NS) and South Shore (SS); Gaspe (G), and year of survey.

(2) 0 (open); R (Restricted).

(3) M (Median Value Exceeded); P (Percentile Value Exceeded).

is summarized in Table 21.

TABLE 21 STATUS COMPARISON OF SELECTED TC70 - OPEN
QUEBEC SHELLFISH AREAS WITH FC23 and FC 14 STANDARDS

QUEBEC AREA	NO. SELECTED	CORRESPONDING STATUS ACCORDING TO:			
		FC23		FC14	
		CLOSED	OPEN	CLOSED	OPEN
SOUTH SHORE	3	0	3	0	3
NORTH SHORE	15	0	15	0	15
GASPE	1	0	1	0	1
ALL AREAS	19	0	19	0	19

Comparison of total coliform data with corresponding fecal coliform data for each of these 19 open areas unequivocally demonstrated that these same zones would remain open for harvesting under application of either FC standard. In all cases, median and 90-percentile values for fecal coliform data of these 19 sectors were consistently found to be well below the maximum permissible limits of 14 and 43 respectively. The availability of the shellfish resource present in all areas would thus remain intact and unthreatened for harvesting purposes regardless of which of the two FC standards might be utilized to assess the bacteriological quality of Quebec shellfish growing area waters.

6 CONCLUSIONS

Bacteriological data obtained from shellfish growing areas in the three Canadian Regions - Atlantic, Quebec and Pacific, indicate that the strict application of the 70 total coliform standard and the 14 and 23 fecal coliform standards would decrease the overall acreage of the existing closure substantially. It appears that the discrepancies between the existing total coliform standard and the strict application of the three comparative coliform

standards occurs at the 90 percentile level. In the three Maritime provinces, strict application of any of the three coliform standards under evaluation would decrease the existing closure of the 27 restricted shellfish areas examined considerably. Strict application of either 70 total coliform or 14 fecal coliform standards would reduce the overall acreage of the 27 restricted areas by approximately 7 percent. However, any decreases from existing closure lines obtained under the strict application of any of the three comparative coliform standards might be substantially reduced upon administrative application of the standard because of the incorporation of a safety buffer zone. Since strict application of both the 70 total coliform and the 14 fecal coliform standards would decrease the existing closures approximately the same overall, addition of any buffer zone would apply to both standards about equally. Thus, considering that the existing closure was based on the 70 total coliform standard plus an approximately 7% safety buffer zone and that the application of the 14 fecal coliform standard would fall under the same scrutiny, implementation of the proposed 14 fecal coliform standard would have little or no significant effect on the existing shellfish closures.

Implementation of the 14 fecal coliform standard would have no significant adverse effect on the commercial shellfish industries in Quebec and British Columbia. Instead, a relatively important number (35%) of the existing restricted areas (20) in Quebec would be opened for exploitation. But in the Maritime provinces, implementation of the 14 fecal coliform standard would be detrimental to several important shellfish growing areas (e.g. Hillsborough and Johnston Rivers), by increasing their closure areas and restricting over a half of a million dollars in potential resources.

In summary, it appears that the implementation of the 14 fecal coliform standard has no major adverse effects on Canadian commercial shellfish industries on the whole, other than those few special areas mentioned in the Maritimes. Two of these, the

Hillsborough and Johnston Rivers are being reassessed in this year's shellfish surveillance program. Since the fecal coliform index is a more specific indication of fecal contamination than total coliforms and will provide better health protection in those areas where intermittent bacterial pollution is a problem, it is logical that a fecal coliform index should be used as a standard for assessing shellfish growing area waters in Canada. Therefore, the Canadian shellfish program will adopt the fecal coliform standard of a median MPN value of 14 per 100 ml of sample and not more than 10 percent of the samples exceed 43 per 100 ml as proposed by the National Shellfish Sanitation Workshop in 1974. It should be however emphasized that the adoption of 14 fecal coliform standard does not imply that it is absolute or applicable to all shellfish growing areas. Since the relationships between fecal coliform and total coliform varied greatly in different environmental conditions, it is very difficult if not impossible, to select a fecal coliform number which can be related in all shellfish growing areas to the degree of public health hazard expressed by the 70 total coliform standard. The application of the fecal coliform standard must be closely correlated with the results of a comprehensive sanitary survey and the sanitary survey should be the prime factor in classifying the growing area regardless of bacteriological data. The Canadian Shellfish Program will continue to collect data and develop more rapid and reliable methods and keep in mind that the current proposed fecal coliform standard may change periodically as more advanced technology becomes available. This would be particularly true if a rapid method for enumeration of E. coli is developed.

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