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# Shellfish Growing Water Sanitary Survey of Boundary Bay, Mud Bay, and Crescent Beach, British Columbia, 1976

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SHELLFISH GROWING WATER SANITARY SURVEY  
OF  
BOUNDARY BAY, MUD BAY, AND CRESCENT BEACH,  
BRITISH COLUMBIA, 1976

by

B.H. Kay

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## ABSTRACT

A sanitary and bacteriological survey of the intertidal waters of Boundary Bay, Mud Bay, and the Crescent Beach area was conducted between March 22 and May 21, 1976, by personnel of the Environmental Protection Service, Pacific Region.

The bacteriological study was undertaken to evaluate molluscan shellfish growing water quality and permit a review of relevant portions of the existing British Columbia Fisheries Regulations Schedule J Contaminated Shellfish Closure 29-1. A sanitary survey was performed concurrently to identify and evaluate major sources of bacterial contamination to the study area.

During the survey period, 278 marine and 21 freshwater samples were collected and analyzed for fecal coliform levels. A total of 33 marine stations was sampled and, of these, 13 did not meet the shellfish growing water standard.

## RÉSUMÉ

Du 22 mars au 21 mai 1976, le personnel du Service de protection de l'environnement de la région du Pacifique a effectué une étude sanitaire et bactériologique des zones intertidales des baies Boundary et Mud et de la plage Crescent.

L'étude bactériologique visait à évaluer l'état des eaux où se développent crustacés et mollusques en rapport avec les sections pertinentes de l'annexe J du Règlement sur les pêcheries de la Colombie-Britannique (région contaminée 29-1, eaux à crustacés). Une étude sanitaire simultanée avait pour but de découvrir et évaluer les sources les plus importantes de contamination bactérienne dans la zone étudiée.

Durant les deux mois qu'a duré l'enquête, les responsables ont analysé 278 prélèvements d'eau de mer et 21 échantillons d'eau douce afin de connaître la quantité de coliformes fécaux qu'ils contenaient. Treize des 33 stations-témoins ne satisfaisaient pas aux normes s'appliquant aux eaux où se développent les crustacés.

TABLE OF CONTENTS

	PAGE
ABSTRACT	i
RESUME	ii
TABLE OF CONTENTS	iii
LIST OF FIGURES	v
LIST OF TABLES	v
CONCLUSIONS	vi
RECOMMENDATIONS	viii
1 INTRODUCTION	1
2 SAMPLE STATION LOCATIONS	4
3 FIELD PROCEDURES AND METHODS	6
3.1 Bacteriological Sampling and Analyses	6
3.2 Physical and Chemical Testing Equipment and Analysis	7
4 RESULTS	8
4.1 Beach Grove to Mud Bay	12
4.1.1 Third Avenue Pump Station (Beach Grove)	12
4.1.2 12th Avenue Pump Station (Beach Grove)	13
4.1.3 Boundary Bay Airport Pump Station	13
4.1.4 Beharrel Pump Station (P2)	13
4.1.5 Oliver Pump Station (P3)	13
4.2 Crescent Beach	14
4.3 Kwomais Point	17

	PAGE
REFERENCES	19
ACKNOWLEDGEMENTS	20
APPENDIX I      MARINE SAMPLE STATION LOCATION DESCRIPTIONS	21
APPENDIX II     FRESHWATER SAMPLE STATION LOCATION DESCRIPTIONS	23
APPENDIX III    BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES	25
APPENDIX IV    BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR FRESHWATER SAMPLES	73

LIST OF FIGURES

FIGURE		PAGE
1	RECOMMENDED AREA 29-1 SCHEDULE J CLOSURE	ix
2	BOUNDARY BAY AND MUD BAY - SAMPLE STATION LOCATIONS	5
3	TOTAL PRECIPITATION, MARCH 15 - MAY 21, 1976 - DELTA - TSAWWASSEN BEACH	11

LIST OF TABLES

TABLE		PAGE
1	POPULATION STATISTICS - WHITE ROCK, SURREY, DELTA	2
2	SUMMARY OF FECAL COLIFORM MPN DATA FOR MARINE STATIONS	9
3	SUMMARY OF FECAL COLIFORM MPN DATA FOR FRESHWATER STATIONS	10
4	COMPARISON OF FECAL COLIFORM MPN RESULTS FOR SELECTED STATIONS AT CRESCENT BEACH	16
5	BACTERIOLOGICAL RESULTS - SHELLSTOCK SAMPLES	17

## CONCLUSIONS

1. The tidal foreshore waters from Beach Grove to Mud Bay are exposed to fecal contamination to the extent that consumption of molluscan shellfish from this area can constitute a health hazard. Five land drainage pump station discharges were identified as sources of contamination; the 3rd and 12th Avenue pump stations in Beach Grove, the pump station located at the old Boundary Bay Airport, the Beharrel pump station, and the Oliver pump station.
2. The waters of Mud Bay are exposed to fecal contamination to the extent that consumption of molluscan shellfish from this area can constitute a health hazard. The Serpentine and Nicomekl rivers were the significant sources of contamination to this area.
3. The tidal waters between Blackie Spit and the foot of Beecher Street in Crescent Beach are contaminated by fecal pollution to the extent that consumption of molluscan shellfish from this area can constitute a health hazard. The significant sources of contamination were the Serpentine and Nicomekl rivers.
4. The waters between the foot of Beecher Street and the foot of 16th Avenue, near Kwomais Point, were of acceptable shellfish growing water quality during the survey period.
5. The waters of the tidal foreshore in the vicinity of Kwomais Point were of acceptable bacteriological quality during the survey period; however, the area is subject to fecal contamination resulting from (a) the 128th Street sewage lift station emergency overflow discharge, and (b) storm water drainage. Both these pollution sources are discharged through the same outfall at Kwomais Point, thus precluding this area from the recommended reopening of a portion of Crescent Beach, as described in Recommendation No. 1.

High bacterial levels can be expected in the storm water drainage during the "first flush" after a heavy rainfall, with a reduction in levels

concomitant with continued rainfall. Although receiving water quality will be impaired as a result of this initial "first flush", an adequate safety buffer zone has been incorporated into the recommended closure to allow for this situation. However, in the event of an operational or power failure at the lift station, raw sewage can overflow via the storm drain to Kwomas Point. This will occur if the failure lasts longer than 30 minutes, as this is the maximum wet well retention time at this lift station. During such periods of raw sewage overflows, the safety buffer zone for storm water discharges is inadequate, and additional measures as detailed in Recommendation No. 2 must be taken.

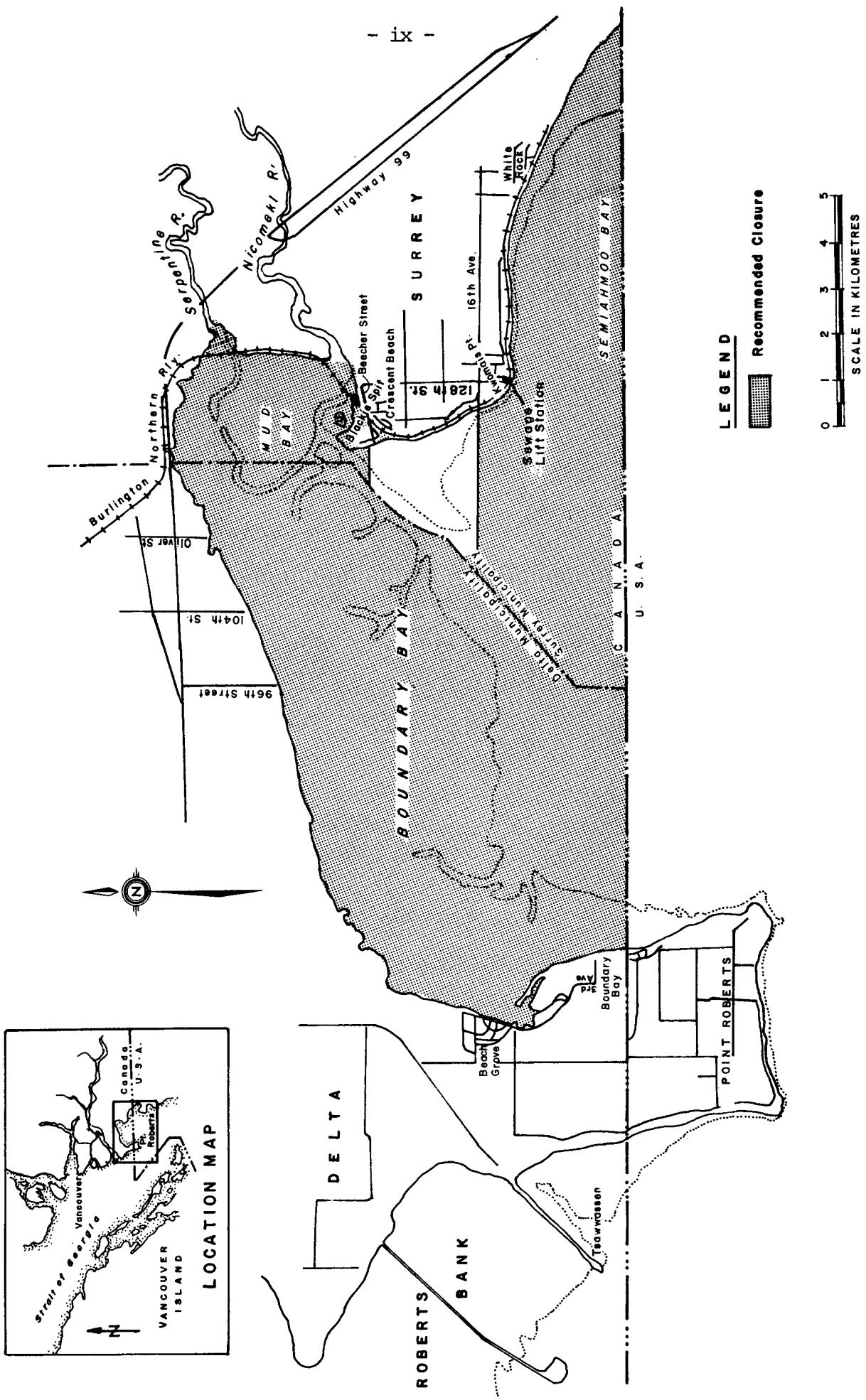
## RECOMMENDATIONS

1. It is recommended that Area 29-1 of the British Columbia Fishery Regulations Schedule J, which reads as follows, "The waters and tidal foreshore of Boundary Bay, Mud Bay, and Semiahmoo Bay, Area 29, lying inside, that is, northerly of the International Boundary Line," be revoked, and substituted with the following closure:

Area 29-1 - "The waters and tidal foreshore of Mud Bay, Boundary Bay, and Semiahmoo Bay lying north of the International Boundary Line and outside of a line drawn due west from the foot of Beecher Street in Crescent Beach to the Delta-Surrey Municipal Boundary, southwest along the boundary, and due east to the foot of 16th Avenue in Ocean Park."

The revised closure is illustrated in Figure 1.

2. It is recommended that the Surrey municipal sewage lift station, located at the southern foot of 128th Street, be equipped with a reliable alarm device to warn of sewage overflows, and further, this device be connected to a 24 hour manned control station, such as a Fire Hall. Overflows not corrected within a 30 minute period must be reported to the Boundary Health Unit so that a public warning can be issued to stop harvesting of molluscan shellfish in those areas not under Schedule J Closure 29-1, for a 14 day purification period after correction of such an occurrence.
3. It is recommended that a sanitary and bacteriological survey of the shellfish growing waters of Semiahmoo Bay be carried out following the completion of the G.V.S.D.D. sewer project and subsequent cessation of the White Rock municipal sewage discharge to the Campbell River. This survey will be scheduled for the winter months, when the worst pollution and hydrographic conditions can be expected. As part of this survey, the buffer zone at Kwomais Point will be re-evaluated, and the bacterial pollution load arising from land drainage pumping stations in Boundary Bay will be re-examined during periods of continuous pumping activity.



## 1 INTRODUCTION

Prior to 1962, the waters of Mud Bay, Boundary Bay, and Crescent Beach were the major commercial oyster producing areas of British Columbia, accounting for over 60% of the total yearly harvest. In the winter of 1962, the Department of National Health and Welfare, Public Health Engineering Division, conducted a bacteriological survey of these growing waters. As a result of the survey, Boundary Bay was classified as "prohibited," when it was found that the winter median total coliform MPNs at sample stations in the main growing areas exceeded 700/100 ml. Several sources of pollution were implicated in causing the high coliform levels, the most notable being the Serpentine and Nicomekl rivers and the Oliver Road land drainage pumping station. The combined discharge of the Serpentine and Nicomekl rivers contained domestic and municipal sewage effluent, as well as agricultural run-off. The Oliver Road pumping station effluent was also contaminated with agricultural run-off and possibly domestic sewage from unsewered homes and/or homes with faulty disposal systems. These sources were becoming increasingly polluted as a result of the rapid urbanization of Surrey and Delta. During the two years following the closure, the majority of oyster leases in Mud Bay were depleted of their shellstock, and marketable oysters have not been commercially harvested since 1962.

In 1972, the area under closure was redefined for inclusion in the shellfish contaminated area "Schedule J" of the amended British Columbia Fishery Regulations, and is presently as follows:

"Area 29-1 - The waters and tidal foreshore of Boundary Bay, Mud Bay, and Semiahmoo Bay, Area 29, lying inside, that is northerly of the International Boundary Line."

Since the initial closure in 1962, considerable residential development has taken place in the Municipalities of White Rock, Surrey, and Delta. Between the years 1961 and 1971, the three municipalities experienced population increases of 60%, 39% and 214%, respectively<sup>1</sup> (Table 1), with a subsequent increase in the demand for domestic

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<sup>1</sup> Statistics Canada

waste disposal facilities.

By the end of 1972, the major domestic and municipal direct discharges of sewage to the Nicomekl and Serpentine rivers, and Boundary Bay, were partially or completely eliminated with the completion of a sewage collection system serving Surrey.

The Municipality of White Rock continued to discharge treated sewage to the Campbell River, with subsequent discharge to Semiahmoo Bay. In early summer, 1973, a preliminary bacteriological re-assessment of the water quality of Semiahmoo Bay and Mud Bay was conducted by personnel of the Shellfish Water Quality Program, Environmental Protection Service (1). The sampling program was not extensive, due to limitations in manpower and resources, but the results did indicate that unacceptable bacterial pollution was being experienced in Semiahmoo Bay as a result of the sewage discharge from the White Rock Municipal sewage treatment plant.

TABLE 1 POPULATION STATISTICS - WHITE ROCK, SURREY, DELTA

	White Rock	Surrey	Delta
1961 <sup>1</sup>	6,453	70,838	14,597
1971 <sup>1</sup>	10,349	98,601	45,860
1976 (est.) <sup>2</sup>	14,000	125,000	69,000

<sup>1</sup> Statistics Canada Census

<sup>2</sup> Municipal estimates

Samples taken along the Crescent Beach shoreline did meet the existing shellfish total coliform growing water standard; however, the presence of fecal contamination in the Serpentine and Nicomekl rivers, and the large expanses of Mud Bay which remained unsurveyed at this time, could not permit any change in the status of this shellfish growing area.

Since 1973, there has been considerable interest shown in the possibility of reactivating some of the oyster leases in Mud Bay for the purpose of growing seed oysters as well as mature oysters of marketable quality. While seed oysters are not sold for consumption and are therefore not of public health concern, mature oysters grown in Mud Bay would require relaying or depuration prior to marketing, if the water quality was still unacceptable. As a result of the renewed interest in Mud Bay as an oyster-producing area, and of requests by the Marine Resources Branch, Province of British Columbia, and the Fisheries and Marine Service, Environment Canada, a bacteriological and sanitary survey of the Mud Bay, Boundary Bay, and Crescent Beach areas was conducted between March 22 and May 21, 1976, by personnel of the Shellfish Water Quality Program, Environmental Protection Service. The purpose of the survey was three-fold:

1. To identify and evaluate pollution sources to Mud Bay, Boundary Bay, and Crescent Beach.
2. To evaluate the shellfish growing water quality in previously unsurveyed areas of Mud Bay, Boundary Bay, and Crescent Beach.
3. To determine whether an improvement had occurred in the water quality of Crescent Beach since 1973.

Semiahmoo Bay was not re-surveyed at this time due to the planned connection of the White Rock sewerage system to the Greater Vancouver Sewerage and Drainage District (G.V.S.D.D.) trunk line, and subsequent cessation of the municipal sewage discharge to the Campbell River. Semiahmoo Bay will be re-surveyed after completion of this project.

## 2 SAMPLE STATION LOCATIONS

Marine sample stations were chosen to assess the extent and degree of contamination to the shellfish growing waters arising from several freshwater inputs to the area.

Seven stations were established between Beach Grove and Mud Bay to evaluate the effects of four land drainage pump stations: the 3rd and 12th Avenue pump stations in Beach Grove, the Beharrel Pump Station, and the Oliver Pump Station at the foot of 112th Street in Delta. Effluent from the 3rd Avenue, Beharrel, and Oliver Pump Stations was sampled concurrently with the marine sampling.

The remaining 26 marine stations were assigned to the Crescent Beach area to assess the effects of contamination arising from the Nicomekl River and onshore sources. Five of these marine stations were duplicated from the 1973 Preliminary Assessment of Boundary Bay, B.C. (1) to determine what changes, if any, had occurred in the water quality during the intervening years. Freshwater samples were taken from the mouths of the Serpentine and Nicomekl rivers concurrent with the marine sampling.

Marine and freshwater sample station locations are illustrated in Figure 2.

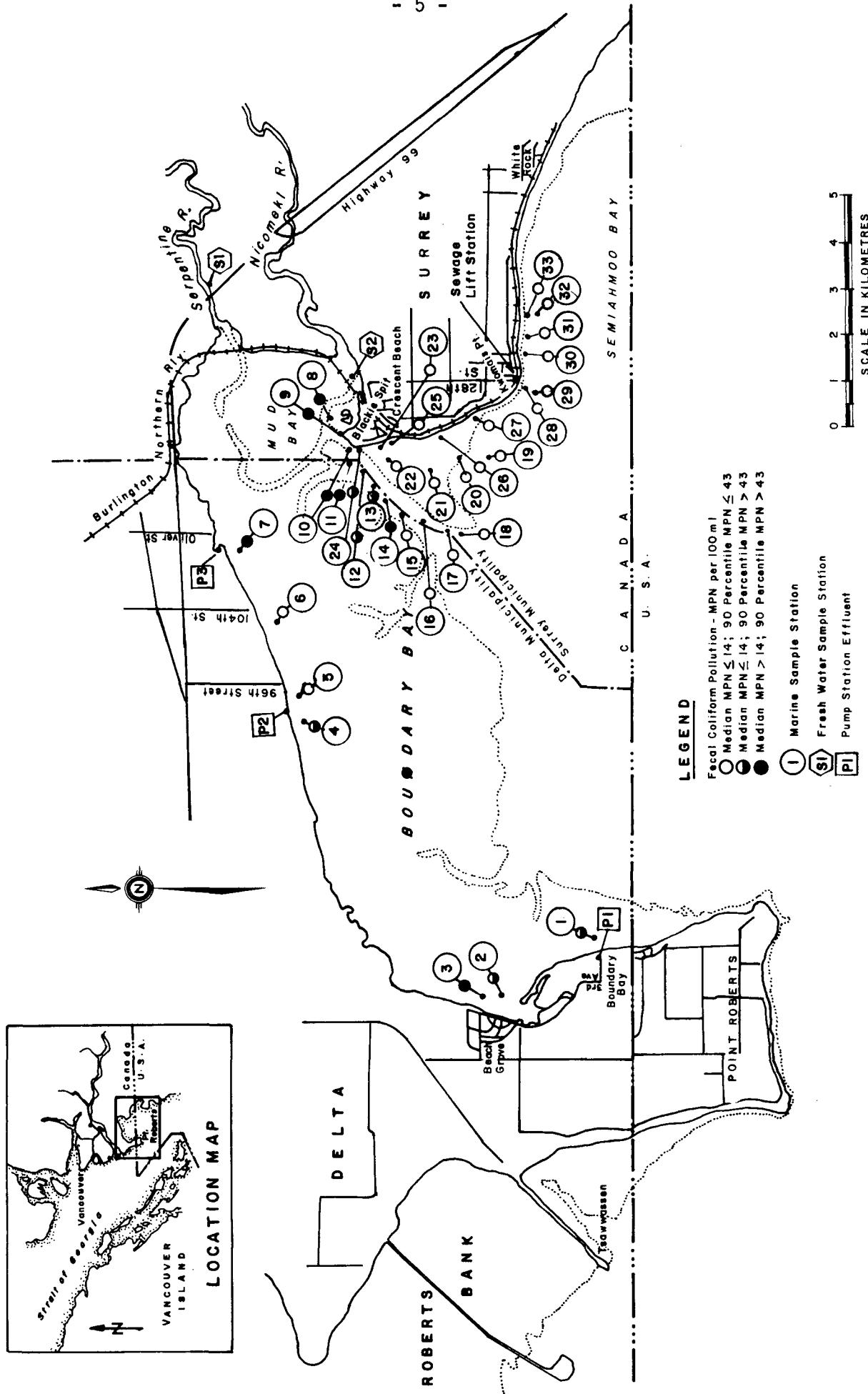


FIGURE 2 BOUNDARY BAY AND MUD BAY - SAMPLE STATION LOCATIONS

### 3 FIELD PROCEDURES AND METHODS

Sampling stations were selected, and a bacteriological and physical water-testing program was developed, to assess the shellfish growing water quality and the source of pollutants.

#### 3.1 Bacteriological Sampling and Analyses

All water samples for bacteriological analyses were collected in sterile 170 or 340 cc wide-mouth bottles, approximately 15 to 30 cm below the water surface. The water depth at collection points over shellfish beds did not exceed 1.2 metres. Samples were collected by boat or on foot, and stored in coolers at temperatures not exceeding 10°C until processed. Analyses were carried out in the Environmental Protection Service Regional bacteriology laboratory in North Vancouver, and were performed within three hours of collection.

The fecal coliform MPN per 100 ml was determined using the multiple tube fermentation technique (at least 3 decimal dilutions of 5 tubes each), as described in Part 407C of the 13th edition of Standard Methods for the Examination of Water and Wastewater (2). Incubation was for  $24 \pm 2$  hours in a water bath equipped with a circulation device, and maintained at  $44.5 \pm 0.2^\circ\text{C}$ . Presumptive culture media used was Bacto-Lauryl Tryptose Broth; fecal coliform determinations were made using Bacto-EC medium.

Shellstock samples were analyzed for fecal coliforms according to the method stated above, with the following preparatory steps. Approximately 250 g of shellstock were aseptically shucked into a sterile, tared blender jar. An equal weight of sterile phosphate-buffered dilution water was added to the jar, and the contents were blended at 14,000 rpm for 90-120 seconds. Immediately after blending, 20 grams of this mixture was added to 80 ml of dilution water, giving a final 1/10 dilution of the original shellstock. The standard MPN test was performed using this dilution. It was desirable to use at least 12 animals per sample, although this was not always possible.

Standard plate counts on the shellstock were performed, as described in Part 406 of Standard Methods.

3.2      Physical and Chemical Testing Equipment and Analysis

Temperature and salinity measurements at marine stations were made at a depth of 15 to 30 cm below the water surface, using an immersible Celcius thermometer and an American Optical refractometer, Catalogue No. 10419. Wind speeds were determined with a Dwyer hand-held wind meter.

Tide data presented is that for Point Atkinson, and the rainfall data was obtained from the Atmospheric Environment Service of Environment Canada, located at Vancouver International Airport.

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## RESULTS

Daily bacteriological, physical, and elemental data for each sample station is presented in Appendices III and IV. Fecal coliform results for marine and freshwater stations are summarized in Tables 2 and 3, respectively.

The results have been interpreted and the growing waters classified based on the following criteria:

In order that an area can be considered bacteriologically safe for the harvesting of shellfish, the fecal coliform median MPN of the water must not exceed 14/100 ml, and not more than 10% of the samples ordinarily exceed an MPN of 43/100 ml for a 5 tube decimal dilution test in those portions of the area most probably exposed to fecal contamination during the most unfavourable hydrographic and pollution conditions.<sup>1</sup>

During the survey, 278 marine and 21 freshwater samples were collected and analyzed for fecal coliform levels. A minimum of six samples was collected for each marine station. The bacteriological results presented in Table 2 show that 20 of the 33 marine stations met the shellfish growing water standard. Of the remaining 13 sample stations which were classified as unacceptable, 7 exceeded the standard at the median level and 6 exceeded the standard at the 90 percentile level. High fecal coliform levels were also found in shellstock samples taken near the mouth of the Nicomekl River.

Rainfall during the survey period (March-May inclusive) totalled 173.0 mm, only 7.14 mm in excess of the average total rainfall reported for these three months (3). Precipitation data is presented graphically in Figure 3. It was difficult to identify any correlation between rainfall and bacteriological results due to the rather inconsistent sampling schedule. Sampling could only be conducted during high tides due to the extensive tidal flats in the area.

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<sup>1</sup> This report expresses the 10 percent limit in terms of a 90 percentile MPN value which must not exceed 43 per 100 ml.

TABLE 2 SUMMARY OF FECAL COLIFORM MPN DATA FOR MARINE STATIONS

Sample Station	Number of Samples	MPN Range	Fecal Coliform	MPN/100 ml
			Median	90 Percentile
1	8	< 2 - 170	6.5	122.0
2	12	< 2 - 240	8.0	142.6
3	8	< 2 - 540	17.0	147.2
4	7	< 2 - 350	2.0	110.6
5	7	< 2 - 79	5.0	31.4
6	7	< 2 - 49	11.0	37.8
7	7	< 2 - 330	23.0	154.3
8	6	23 - 350	205.0	350.0
9	6	5 - 110	59.5	91.4
10	11	2 - 240	23.0	48.7
11	7	2 - 110	22.0	88.3
12	7	< 2 - 94	11.0	83.5
13	9	< 2 - 79	5.0	52.0
14	6	< 2 - 130	21.0	81.4
15	11	< 2 - 49	2.0	21.5
16	6	< 2 - 8	2.0	6.2
17	11	< 2 - 240	< 2.0	22.0
18	10	< 2 - 110	< 2.0	8.0
19	11	< 2 - 49	< 2.0	3.8
20	6	< 2 - 11	< 2.0	7.4
21	6	< 2 - 33	2.0	14.4
22	6	< 2 - 5	2.0	3.2
23	12	< 2 - 79	5.0	28.2
24	7	< 2 - 70	8.0	53.2
25	11	< 2 - 49	< 2.0	7.9
26	6	< 2 - 5	< 2.0	3.2
27	6	< 2 - 23	3.0	12.2
28	11	< 2 - 130	< 2.0	3.8
29	10	< 2 - 79	< 2.0	12.0
30	11	< 2 - 240	2.0	12.4
31	11	< 2 - 110	4.0	30.5
32	11	< 2 - 23	< 2.0	22.3
33	7	< 2 - 130	2.0	16.1

TABLE 3 SUMMARY OF FECAL COLIFORM MPN DATA FOR FRESHWATER STATIONS

Sample Station	Number of Samples	MPN Range	Mean Fecal Coliform MPN/100 ml
P1	3	79 - 350	186.3
P2	3	20 - 240	143.3
P3	4	350 - 1300	885.0
S1	5	170 - 790	422.0
S2	6	130 - 490	305.0

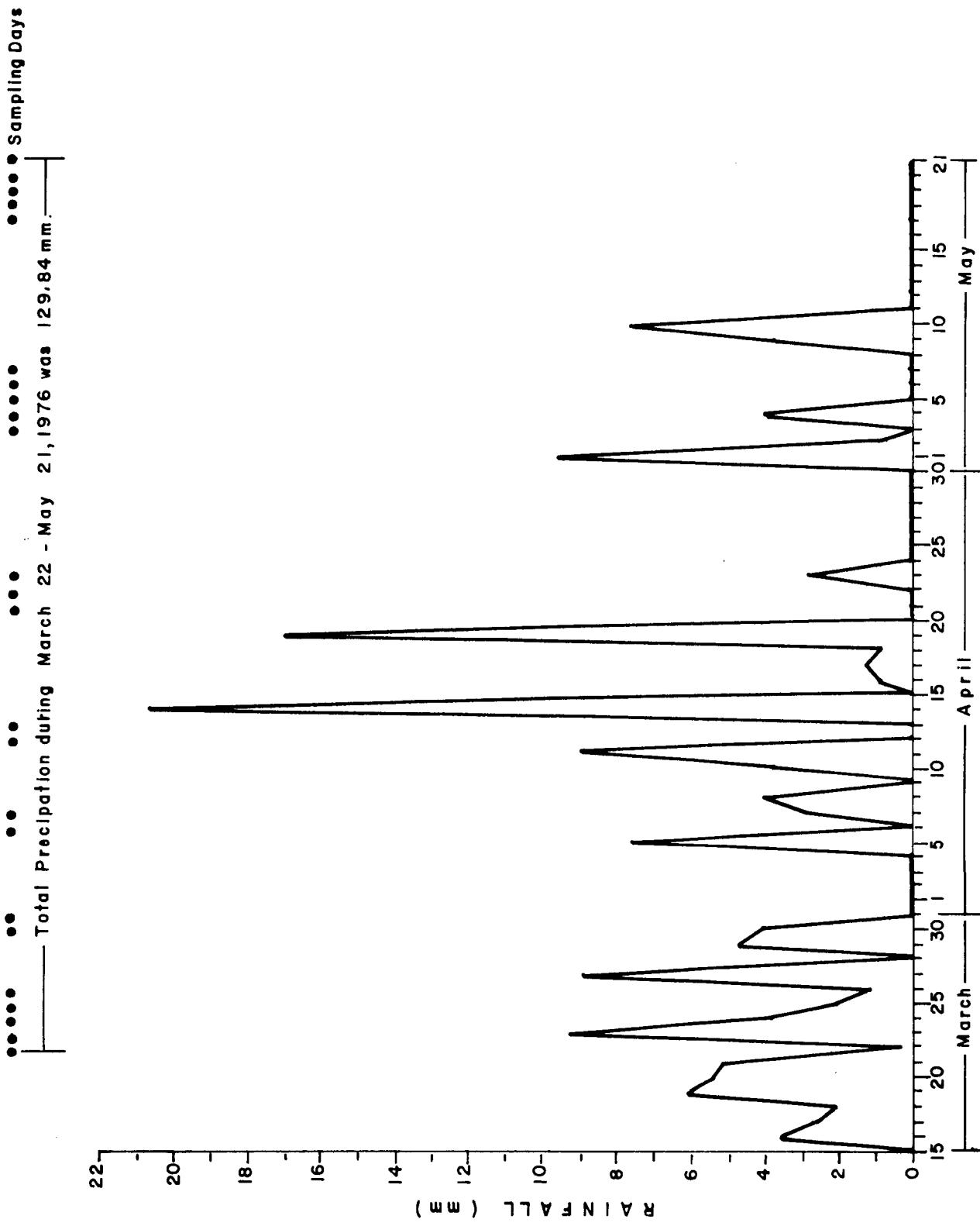


FIGURE 3 TOTAL PRECIPITATION, MARCH 15 - MAY 21, 1976 - DELTA-TSAWASSSEN BEACH

It should be noted that this survey was not scheduled at a time when hydrographic and pollution conditions were expected to be the worst. Heaviest precipitation in this area normally occurs between the months of October and February. However, higher priority survey commitments in other areas of the province prevented a study to be conducted at these times.

#### 4.1 Beach Grove to Mud Bay

Sample stations 1 - 7 were positioned along the dyked shoreline between Beach Grove and Mud Bay, primarily to assess the impact of five drainage pump stations on the receiving water quality. The Fisheries and Marine Service of Environment Canada reports a clam resource of littlenecks, horse clams, cockles, and butter clams west of Mud Bay.

Stations 1, 2, 3, 4, and 7 all exhibited fecal coliform levels which exceeded the growing water standard. Stations 5 and 6 also exhibited evidence of fecal pollution, although the levels were low enough to meet the standard. A comprehensive sampling program was difficult to undertake in this area due to the extensive mud flats and the dangers associated with sampling in areas of quicksand.

During the survey period, the pump stations were not operating at all times and, consequently, sampling of the effluents was irregular. All pumps were reportedly operated by a float system, with high and low level controls. The pumps generally operate only during high tides, with a gravity flow system during low tides. The heaviest pumping activity occurs between November and February, with a virtual shut-down of operation during the summer months.

##### 4.1.1 Third Avenue Pump Station (Beach Grove). This station has a capacity of 606.1 l/sec (8000 Igpm), and reportedly runs steadily during the winter. The area being drained is presently sewered, and the pump effluent should contain no domestic sewage. Contamination results from pastureland and surface run-off. There is one dairy farm in this drainage area. This effluent was sampled three times and exhibited a mean fecal coliform MPN of 186.3/100 ml (P1).

4.1.2     12th Avenue Pump Station (Beach Grove). The capacity of this pump is rated at 1136.4 l/sec (15,000 Igpm). This station drains some farmland and a golfcourse, as well as sewered portions of Beach Grove. The combined drainage area for this pump, and the 3rd Avenue pump, is approximately 2,000 acres; it is anticipated that the 3rd Avenue station drainage will be diverted to the 12th Avenue station by 1981. This station was not sampled due to time constraints.

4.1.3     Boundary Bay Airport Pump Station. This station consists of two pumps, each rated at 606.1 l/sec (8,000 Igpm), which drain pastureland and unsewered residential areas. Facilities at the old airport presently house a driver training center, a mobile home manufacturing plant and a modular home manufacturing enterprise. The former two businesses discharge sewage to holding tanks which are pumped out to tank trucks at regular intervals with subsequent disposal via a regional sewage treatment plant. At the time of printing, the latter business was discharging sewage to the old airport sewage collection system, which is no longer operating satisfactorily. Action was being taken to remedy this situation, presumably through the installation of a holding tank similar to the system described for the other two businesses.

In addition to this problem, health officials have reported the existence of three or four old septic tanks, which, although no longer in use, still contain sewage wastes. It is conceivable that effluent from these sources and the modular home plant may reach the drainage ditch via seepage and leaching and subsequently enter Boundary Bay by way of the pump station.

4.1.4     Beharrel Pump Station (P2). This pump is rated at 1515.2 l/sec (20,000 Igpm), and drains farmland and unsewered residential areas. During the survey, the effluent from this station was sampled three times and exhibited a mean fecal MPN of 143.3/100 ml.

4.1.5     Oliver Pump Station (P3). This station consists of three pumps, each with a capacity of 2651.6 l/sec (35,000 Igpm) and, in conjunction with the Beharrel station, drains farmland and unsewered residential areas. The combined drainage area of the Beharrel and Oliver stations is approximately 10,000 acres, of which one-third is Burn's Bog and the remainder is farmland. Sampling of the Oliver station effluent indicated the presence of significant fecal pollution, with a mean fecal MPN of 885/100 ml over four samplings.

The Variety Farm Training Centre, located on 72nd Street in east Delta, was considered a potential source of fecal contamination to Boundary Bay, having a combined discharge consisting of septic tank, laundry, and raw sewage effluent wastes to a ditch at the rate of 4500 Igpd. However, Delta Municipal officials have stated that this effluent does not reach Boundary Bay via the airport pump station, but rather enters the Fraser River by means of the Crescent Slough. Construction of a two-cell aerated lagoon system to treat the effluent from the Centre is scheduled for August, 1976. The expectation of the Health Department is that there will be no discharge from the lagoon, as transpiration and evaporation are considered sufficient to prevent sewage overflows. The lagoon system is equipped with an emergency overflow discharge to a ditch, as well as emergency truck pump-out facilities.

Numerous faulty disposal systems have been identified by the Boundary Bay Health Unit in east Delta; however, remedial action is difficult due to the poor characteristics of the soil and the high water table.

#### 4.2 Crescent Beach

Sample stations 8 - 27 were located in the Crescent Beach area to assess the growing water quality. The major significant source of contamination to the clam beds at Crescent Beach was the combined discharge of the Nicomekl and Serpentine rivers, as is evidenced by the unacceptable water quality at stations 8 to 14 and 24. The influence of these rivers is reduced by dilution, dispersion, and bacterial die-off to such an extent that acceptable water quality was observed at all stations south of station 14.

The abandoned oyster leases located near the mouth of the Nicomekl River were inaccessible during the survey period due to unfavourable tidal cycles. Sampling was therefore not undertaken; however, there is little doubt that contamination from the Nicomekl and Serpentine rivers would cause the water quality in these areas to exceed the standard.

The bacteriological results for selected marine stations have been compared to results obtained during the 1973 E.P.S. preliminary assessment and to results obtained during the 1975 beach

monitoring program conducted by the Boundary Health Unit. Table 4 presents these results in terms of the fecal coliform growing water standard. Preliminary examination of the results would suggest that water quality has generally deteriorated since 1973. It should be noted, however, that the 1973 bacteriological program was conducted in May - June, during drier conditions, and bacterial levels in the Nicomekl and Serpentine rivers were much lower at that time than was the case during the present survey.

The Health Unit results were compiled from data over 20 samplings during June, July, and August. These results are reasonably compatible with this survey's data, with the exception of station 23, which demonstrated unacceptable shellfish growing water quality during the summer of 1975. In any case, the poor water quality observed suggests that shellfish harvesting from those areas influenced by the Serpentine and Nicomekl rivers should be prohibited during all periods of the year.

Fecal coliform levels in both the Serpentine and Nicomekl rivers were moderate, with mean MPNs of 422/100 ml and 305/100 ml respectively. Upstream sampling done in past years on these two rivers indicates that fecal contamination is present for a considerable distance upstream (unpublished data). These rivers are under considerable tidal influence and, as a result, their levels and discharge rates are controlled by floodgates. It is therefore difficult to estimate the total daily contribution of coliform organisms to the marine environment. Mean daily flows recorded in 1975 for the Nicomekl River were 2.2 m<sup>3</sup>/sec (78.3 cfs), 0.54 m<sup>3</sup>/sec (19.0 cfs), and 0.59 m<sup>3</sup>/sec (21.1 cfs) for the months of March, April, and May, respectively<sup>1</sup>.

No specific pollution sources to the rivers were identified, although pig, beef cattle, fowl, and dairy farms are situated along the course of these waterways and, no doubt, contribute a significant amount

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<sup>1</sup> Water Survey of Canada

TABLE 4 COMPARISON OF FECAL COLIFORM MPN RESULTS FOR  
SELECTED STATIONS AT CRESCENT BEACH

Station	1976 E.P.S. Survey		1975 Health Unit Survey <sup>1</sup>		1973 E.P.S. Survey	
	Median	90 Percentile	Median	90 Percentile	Median	90 Percentile
9	59.5	91.4	-	-	9.4	31.8
10	23.0	48.7	19.0	43.0	2.0	49.0
13	5.0	52.0	-	-	< 2.0	5.9
23	5.0	28.2	23.0	93.0	17.0	30.0
24	8.0	53.2	19.0	43.0	-	-

<sup>1</sup> Fecal densities determined using 9 tube MPN series

of fecal pollution. Municipal sewage discharges to these rivers have been discontinued as a result of connection to the G.V.S.D.D., and the majority of homes in the watershed area are now sewerized.

Two municipal sewage lift stations service approximately 385 properties in Crescent Beach, and pump the sewage to a G.V.S.D.D. pump station which subsequently pumps through a 20" O.D. trunk line, under the Serpentine and Nicomekl rivers to the Annacis Island sewage treatment plant. It is conceivable that an extended pump failure at the pump station, located at Kidd Street and Gilly Avenue, could result in sewage overflowing to a drainage ditch running behind the homes along Gilly Street, and ultimately reaching the beach at Blackie Spit. To date, no such failures have been reported.

The extent of contamination from the Serpentine and Nicomekl rivers also manifests itself in the bacteriological results obtained for shellstock samples (Table 5). With the exception of Station 8 results, data from the shellstock indicates excessive fecal coliform levels. Station 24 exceeded the Fisheries Inspection Branch applied market standard of a fecal coliform MPN level of 230/100 mL. This data should be considered as supportive of the water data, but it may not be representat-

TABLE 5 BACTERIOLOGICAL RESULTS - SHELLSTOCK SAMPLES

Sample Station	Sampling Date	SPC/g	MPN/100 mL	
			Total	Confirmed
8	June 9/76	450	460	20
13	June 10/76	515	1100	210
24	June 11/76	1200	16000	9200
13	June 11/76	325	460	90

ive of the bacteriological quality of all shellstock, as it was difficult to obtain sufficient animals for each sample.

The bacteriological quality of the waters overlying clam beds south of Beecher Street was excellent, and did not appear to be influenced by the Serpentine and Nicomekl rivers. Littleneck clams, horse clams, cockles, and butter clams abound in this area.

#### 4.3 Kwomais Point

The bivalve molluscan resource in the vicinity of Kwomais Point is limited, although littleneck and butter clams are reportedly found here. Sampling in this area continued as far east as the foot of Bergstrom Street, and all sample stations met the fecal coliform growing water standard.

On April 21, 1976, unusually high fecal coliform levels were detected in samples from stations 27 - 33 inclusive. The source of these coliforms was not ascertained, although there are two major possibilities:

1. A moderately heavy rainfall (16.76 mm) occurred on April 19, 1976, which may have resulted in considerable fecal pollution entering the receiving waters by way of a storm drain located at the foot of Stevenson Street (128th Street). However, no sampling was done on April 20, and it is unlikely that contamination entering the water on April 19 would persist for two days at such high levels.

2. Failure of the sewage lift station located at the foot of Stevenson Street could result in the overflow of raw sewage to the storm drain mentioned above. The wet well of this lift station reportedly has a maximum retention time of only 30 minutes prior to any overflow. An alarm located at the site will sound if there is a mechanical failure; however, pump failures resulting from a power outage are not signalled by the alarm, as the alarm is operated on line voltage. An investigation failed to uncover any evidence of a pump or power failure occurring on or about April 21.

There is a high probability of health danger associated with emergency overflow discharges at this lift station, considering the low retention time in the wet well and the inadequate alarm system. Steps are presently being taken to provide a centrally located alarm system, although a completion date was not known.

A second lift station is located at the foot of Greelman Street, and was not of potential danger to the receiving waters. A septic tank - tile field disposal system is to be installed at this station to accommodate any emergency overflows.

REFERENCES

1. Preliminary Assessment of Boundary Bay, B.C., 1973. Unpublished data. Environmental Protection Service.
2. Standard Methods for the Examination of Water and Wastewater, 1971, 13th ed. Amer. Public Health Assoc., New York.
3. Temperature and Precipitation, 1941-1970, British Columbia. Atmospheric Environment, Environment Canada.

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Fisheries and Marine Service of Environment Canada, who provided shellfish resource information.

APPENDIX I

MARINE SAMPLE STATION LOCATION DESCRIPTIONS

APPENDIX I MARINE SAMPLE STATION LOCATION DESCRIPTIONS

Sample Station	Latitude	Longitude	Location
1	49°00'31"	123°01'43"	Offshore 3rd Ave. pump station - Beach Grove
2	49°01'39"	123°02'55"	Offshore Whitcomb Place - Beach Grove
3	49°01'54"	123°02'49"	Foot of 16th Ave. - Beach Grove
4	49°03'55"	122°58'06"	Offshore Beharrel pump station
5	49°04'02"	122°57'25"	Foot of 96th Street, Delta
6	49°04'20"	122°56'00"	Foot of 104th Street, Delta
7	49°04'42"	122°54'55"	Offshore Oliver pump station
8	49°03'45"	122°52'38"	Northern tip of Blackie Spit
9	49°03'35"	122°52'58"	Off Gov't. dock, foot of Wickson Road
10	49°03'24"	122°53'08"	Off life-guard station, Crescent Beach
11	49°03'28"	122°53'24"	Approx. 500 m off station 10, in line with channel marker
12	49°03'20"	122°53'26"	Halfway between station 11 and next channel marker to SW
13	49°03'13"	122°53'37"	At second channel marker
14	49°03'06"	122°53'48"	Approx. 700 m off last residence north Beecher Street
15	49°02'54"	122°54'01"	Off bluff; marked with buoy
16	49°02'44"	122°54'19"	Halfway between station 15 and channel marker at Kwomas Point
17	49°02'29"	122°54'32"	At channel marker off Kwomas Point
18	49°02'18"	122°54'36"	At channel marker past station 17
19	49°01'58"	122°53'16"	Halfway between station 17 and Kwomas Pt.
20	49°02'13"	122°53'22"	Halfway between station 27 and 16
21	49°02'40"	122°53'28"	Halfway between station 26 and 16
22	49°02'59"	122°53'24"	Approx. 300 m off foot of Beecher Street
23	49°03'08"	122°53'06"	At foot of Beecher Street
24	49°03'19"	122°53'10"	Off green house at beach access south of life-guard station
25	49°02'55"	122°53'00"	Approx. 250 m south of station 23
26	49°02'25"	122°52'54"	Approx. 1 km south of station 25 off eroded bluffs
27	49°01'50"	122°52'30"	Off small train bridge
28	49°01'30"	122°52'04"	Kwomas Point
29	49°01'24"	122°52'04"	Approx. 250 m off Kwomas Point
30	49°01'28"	122°51'30"	Approx. 750 m east of station 28
31	49°01'28"	122°51'14"	Approx. 400 m east of station 30 off train signal
32	49°01'20"	122°50'57"	Approx. 200 m offshore of station 33
33	49°01'27"	122°50'57"	Off ravine with culvert, approx. 500 m east of station 31

APPENDIX II

FRESHWATER SAMPLE STATION LOCATION DESCRIPTIONS

APPENDIX II FRESHWATER SAMPLE STATION LOCATION DESCRIPTIONS

Sample Station	Location
P1	Third Ave. (Beach Grove) Pump Station effluent
P2	Beharrel Pump Station effluent
P3	Oliver Pump Station effluent
S1	Serpentine River at Highway 99 Bridge
S2	Nicomekl River at Burlington Railway Crossing

APPENDIX III

BACTERIOLOGICAL ANALYSES RESULTS  
AND SAMPLING CONDITIONS FOR MARINE SAMPLES

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 1

Location: Beach Grove

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
March 23	0950	0600 1020	3.2 3.7	6.0	9.4	SE @ 15	27.5	8
March 24	1220	1145 1905	3.6 1.6	8.0	3.81	SW @ 12	27.5	5
March 25	1045	0835 1330	2.9 3.6	8.0	2.03	S @ 8	27.5	-
March 26	1055	0925 1440	2.7 3.7	8.0	0.51	SE @ 12	27.5	11
March 31	1045	0520 1155	4.2 1.6	8.0	nil	SW @ 12	27.0	<2
April 6	0852	0825 1550	12.3 4.6	9.0	nil	SE @ 10	26.5	110
April 7	1015	0905 1650	11.9 4.9	12.5	2.79	N @ 5-7	27.5	5
May 4	0705	0705 1425	3.8 1.1	12.0	4.06	-	28.5	170

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 2

Location: Beach Grove

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
March 23	1010	0600	3.2	5.0	9.4	SE @ 15	26.5	33
		1020	3.7			-	-	-
March 24	1210	1145	3.6	8.0	3.81	SW @ 9	25.5	17
		1905	1.6			-	-	-
March 25	1025	0835	2.9	8.0	2.03	S @ 9	27.5	11
		1330	3.6			-	-	-
March 26	1035	0925	2.7	8.0	0.51	SE @ 12	27.5	8
		1440	3.7			-	-	-
March 31	1015	0520	4.2	8.0	nil	NW @ 12	26.5	<2
		1155	1.6			-	-	-
April 6	0845	0825	12.3	9.0	nil	SE @ 8	16.0	170
		1550	4.6			-	-	-
April 7	1005	0905	11.9	13.0	2.79	SE @ 2-4	26.5	8
		1650	4.9			-	-	-
May 4	0645	0250	3.3	12.0	4.06	-	29.0	4
		0705	3.8			-	-	-

Continued...

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 2 (Continued)

Location: Beach Grove

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
May 18	1055	0730 1435	3.8 1.0	17.0	nil	S @ 6-9	28.5	240
May 19	1105	0830 1525	3.5 1.3	18.0	nil	W to 10	29.5	7
May 20	0905	0540 0950	2.7 3.2	15.0	nil	-	29.0	<2
May 21	1045	0650 1140	2.4 3.1	-	nil	-	27.5	<2

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 3

Location: Beach Grove

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
March 23	0935	0600 1020	3.2 3.7	5.0	9.4	SE @ 15	21.5	49
March 24	1155	1145 1905	3.1 3.6	8.0	3.81	SW @ 9	24.0	17
March 25	1000	0835 1330	2.9 3.6	8.0	2.03	SW @ 10	27.0	<2
March 26	1015	0925 1440	2.7 3.7	8.0	0.51	SE @ 12	25.5	17
March 31	0945	0520 1155	4.2 1.6	8.0	nil	NW @ 8	26.5	<2
April 6	0830	0825 1550	3.7 1.4	9.0	nil	SE @ 8	26.0	33
April 7	0950	0905 1650	3.6 1.5	11.0	2.79	SW to 6	27.0	8
May 4	0630	0250 0705	3.3 3.8	12.0	4.06	-	27.5	540

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 4

Location: Offshore Beharrel Pump Station

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 6	1030	0825 1550	3.7 1.4	11.0	nil	SW @ 5	23.5	350
April 7	1245	0905 1650	3.6 1.5	15.0	2.79	SW @ 7-9	26.0	2
May 4	0830	0705 1425	3.8 1.1	12.0	4.06	-	27.0	30
May 18	0935	0730 1435	3.8 1.0	16.5	nil	S @ 6-9	25.5	8
May 19	1000	0830 1525	3.5 1.3	17.0	nil	W to 10	30.0	<2
May 20	1105	0950 1620	3.2 1.7	15.0	nil	-	31.5	2
May 21	1015	0650 1140	2.4 3.1	24.5	nil	S to 10	33.5	<2

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 5

Location: Boundary Bay - East Delta

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 6	1010	0825	3.7	9.0	nil	SW @ 5	23.5	79
		1550	1.4					
April 7	1220	0905	3.6	16.0	2.79	SW @ 7	25.5	<2
		1650	1.5					
May 4	0855	0705	3.8	12.0	4.06	-	27.5	8
		1425	1.1					
May 18	0920	0730	3.8	16.0	nil	S @ 6-9	30.5	5
		1435	1.0					
May 19	0945	0830	3.5	16.5	nil	W to 10	30.0	11
		1525	1.3					
May 20	1050	0950	3.2	14.0	nil	-	30.0	<2
		1620	1.7					
May 21	1000	0650	2.4	22.0	nil	S to 10	1100.0	<2
		1140	3.1					

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 6

Location: Boundary Bay - East Delta

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
April 6	1100	0825 1550	3.7 1.4	11.0	nil	SW @ 4	23.0	11
April 7	1145	0905 1650	3.6 1.5	15.0	2.79	nil	23.5	49
May 4	0810	0705 1425	3.8 1.1	12.0	4.06	-	25.0	33
May 18	0845	0730 1435	3.8 1.0	14.5	nil	nil	31.5	13
May 19	0910	0830 1525	3.5 1.3	16.0	nil	W to 10	28.0	< 2
May 20	1035	0950 1620	3.2 1.7	15.0	nil	-	30.5	2
May 21	0920	0650 1140	2.4 3.1	19.5	nil	SE to 5	29.5	8

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 7

Location: Offshore Oliver Pump Station

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
March 23	1040	1020	3.7	6.0	9.4	SE @ 15	21.5	79
		1745	1.4					
April 7	1115	0905	3.6	14.0	2.79	nil	22.5	< 2
		1650	1.5					
May 4	0750	0705	3.8	12.0	4.06	-	18.5	330
		1425	1.1					
May 18	0820	0730	3.8	14.0	nil	nil	24.5	17
		1435	1.0					
May 19	0845	0830	3.5	15.5	nil	W to 10	28.5	2
		1525	1.3					
May 20	1010	0950	3.2	16.0	nil	-	29.0	< 2
		1620	1.7					
May 21	0840	0650	2.4	15.5	nil	SE to 5	27.5	49
		1140	3.1					

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 8

Location: Blackie Spit

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
March 22	1150	0920 1645	4.0 1.2	-	0.31	-	28.5	350
March 23	1135	1020 1745	3.7 1.4	6.0	9.4	SE @ 15	19.0	240
March 24	1050	0745 1145	3.1 3.6	8.0	3.81	SE @ 9	20.5	23
March 25	1200	0835 1330	2.9 3.6	11.0	2.03	S @ 12	11.5	350
March 26	1210	0925 1440	2.7 3.7	8.0	0.51	E @ 12	16.5	170
March 31	1210	1155 1835	1.6 4.1	9.0	nil	SW @ 8	17.5	110

**APPENDIX III**            **BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES**

Sample Station: 9

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
March 22	1125	0920	4.0	-	0.31	-	27.5	11
		1645	1.2					
March 23	1130	1020	3.7	6.0	9.4	SE @ 15	24.0	5
		1745	1.4					
March 24	1040	0745	3.1	7.0	3.81	SW @ 6	25.5	79
		1145	3.6					
March 25	1155	0835	2.9	7.0	2.03	SE @ 8	21.5	110
		1330	3.6					
March 26	1205	0925	2.7	7.0	0.51	E @ 4	22.0	49
		1440	3.7					
March 31	1200	1155	1.6	8.0	nil	SW @ 8	17.5	70
		1835	4.1					

- 35 -

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 10

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
March 22	1115	0920 1645	4.0 1.2	-	0.31	-	27.5	5
March 23	1120	1020 1745	3.7 1.4	6.0	9.4	SE @ 15	27.5	22
March 24	1035	0745 1145	3.1 3.6	8.0	3.81	S @ 14	24.5	36 -
March 25	1150	0835 1330	2.9 3.6	9.0	2.03	S @ 10	24.5	23
March 26	1200	0925 1440	2.7 3.7	8.0	0.51	E @ 10	25.5	33
March 31	1150	0520 1155	4.2 1.6	7.5	nil	SW @ 8	20.0	49
April 6	0925	0825 1550	3.7 1.4	9.5	nil	SW @ 5	27.5	13
April 7	1115	0905 1650	3.6 1.5	14.1	2.79	W @ 5-7	24.5	46

Continued...

## APPENDIX III      BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 10 (Continued)

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
April 21	1315	1010	3.4	12.5	nil	S to 10	23.5	240
		1710	1.6					
April 22	1300	1155	3.3	14.0	nil	S @ 10	28.5	8
		1815	1.9					
April 23	1245	0810	2.4	10.0	3.05	NE to 4	28.0	23
		1330	3.3					

**APPENDIX III**      **BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES**

Sample Station: 11

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 12	1020	0945 1550	1.8 4.1	11.0	nil	nil	21.0	79
April 13	1115	1040 1650	1.4 4.3	12.0	Trace	S @ 6-8	21.5	70
April 21	1030	1010 1710	3.4 1.6	9.5	nil	S to 7	27.0	-
April 22	1035	0720 1155	2.7 3.3	10.0	nil	S @ 6	27.5	2
April 23	0940	0810 1330	2.4 3.3	10.0	3.05	NE to 10	25.5	110
May 3	0930	0630 1350	3.9 1.0	13.5	nil	S @ 5	24.5	22
May 4	0855	0705 1425	3.8 1.1	12.0	4.06	S @ 6	29.5	7

**APPENDIX III**  
**BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES**

Sample Station: 12

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 12	1025	0945 1550	4.5 1.8	10.5	nil	nil	23.5	94
April 13	1120	1040 1650	1.4 4.3	12.0	Trace	S @ 6-8	22.5	79
April 21	1035	1010 1710	3.4 1.6	9.5	nil	S to 10	27.5	-
April 22	1035	0720 1155	2.7 3.3	10.0	nil	S @ 5	28.5	2
April 23	0945	0810 1330	2.4 3.3	10.0	3.05	NE to 10	25.5	7
May 3	0930	0630 1350	3.9 1.0	14.0	nil	S @ 5	25.5	11
May 4	0900	0705 1425	3.8 1.1	12.0	4.06	S @ 6	27.5	< 2

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 13

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
April 12	1030	0945 1550	1.8 4.1	11.0	nil	nil	23.5	49
April 13	1125	1040 1650	1.4 4.3	11.5	trace	S @ 5-7	23.5	79
April 21	1035	1010 1710	3.4 1.6	10.0	nil	S to 10	28.5	< 2
April 22	1040	0720 1155	2.7 3.3	10.0	nil	S to 6	28.5	7
April 23	0945	0810 1330	2.4 3.3	10.0	3.05	NE to 10	27.5	33
May 3	0935	0630 1350	3.9 1.0	12.5	nil	S to 6	28.5	5
May 4	0900	0705 1425	3.8 1.1	12.0	4.06	S @ 6	29.0	< 2

Continued...

## APPENDIX III            BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 13 (Continued)

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
May 6	0900	0855	3.4	-	nil	-	28.0	2
		1610	1.5					
May 7	0900	0605	2.8	-	nil	-	27.5	<2
		1030	3.3					

## APPENDIX III      BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 14

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 12	1035	0945	1.8	10.5	nil	nil	22.5	130
		1550	4.1					
April 13	1130	1040	1.4	12.0	trace	S @ 5	23.5	49
		1650	4.3					
April 21	1040	1010	3.4	9.5	nil	S to 10	28.0	2
		1710	1.6					
April 22	1040	0720	2.7	10.5	nil	S to 6	27.5	9
		1155	3.3					
April 23	0950	0810	2.4	10.0	3.05	NE to 10	27.0	33
		1330	3.3					
May 17	0925	0650	4.1	12.5	nil	S @ 15	28.0	< 2
		1350	0.6					

**APPENDIX III**      **BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES**

Sample Station: 15

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions	Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)				
April 12	1040	0945 1550	1.8 4.1	11.5	nil	S @ 3-5	25.0
April 13	1130	1040 1650	1.4 4.3	12.0	trace	S @ 5-6	24.5
April 21	1040	1010 1710	3.4 1.6	9.5	nil	S to 10	27.5
April 22	1045	0720 1155	2.7 3.3	10.0	nil	S to 6	28.5
April 23	1055	0810 1330	2.4 3.3	10.0	3.05	SE to 10	28.5
May 3	1050	0630 1350	3.9 1.0	14.0	nil	S to 9	27.5
May 4	1000	0705 1425	3.8 1.1	12.5	4.06	E @ 6	29.0
May 5	0910	0800 1510	3.6 1.2	11.5	nil	W to 15	28.5

Continued...

**APPENDIX III**      **BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES**

Sample Station: 15 (Continued)

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
May 6	0945	0855 1610	3.4 1.5	12.5	nil	S to 10	28.0	< 2
May 7	0910	0605 1030	2.8 3.3	13.0	nil	nil	28.5	< 2
May 20	0925	0540 0950	2.7 3.2	11.5	nil	S to 10	28.0	< 2

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 16

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
April 12	1055	0945 1550	1.8 4.1	10.5	nil	S @ 4-5	26.5	8
April 13	1135	1040 1650	1.4 4.3	12.0	trace	S @ 7	24.5	5
April 21	1045	1010 1710	3.4 1.6	9.5	nil	S to 10	27.5	< 2
April 22	1130	0720 1155	2.7 3.3	10.0	nil	S @ 7	29.0	< 2
April 23	1055	0810 1330	2.4 3.3	10.0	3.05	E to 10	29.0	< 2
May 3	1050	0630 1350	3.9 1.0	13.5	nil	S to 8	27.5	2

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 17

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 12	1100	0945	1.8	10.5	nil	S @ 3-4	26.0	13
		1550	4.1					
April 13	1140	1040	1.4	11.5	trace	S @ 6-7	25.5	23
		1650	4.3					
April 21	1045	1010	3.4	9.5	nil	S to 10	27.5	46
		1710	1.6					-
April 22	1135	0720	2.7	10.0	nil	S @ 6	29.0	240
		1155	3.3					
April 23	1050	0810	2.4	10.0	3.05	E @ 8	28.0	<2
		1330	3.3					
May 3	1045	0630	3.9	13.0	nil	S to 9	27.5	5
		1350	1.0					
May 4	1000	0705	3.8	12.0	4.06	E @ 6	29.0	2
		1425	1.1					
May 5	0910	0800	3.6	11.5	nil	W to 15	29.0	<2
		1510	1.2					

Continued...

## APPENDIX III                    BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 17 (Continued)

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
May 6	0945	0855	3.4	12.0	nil	S to 10	29.0	< 2
		1610	1.5					
May 7	0915	0605	2.8	13.0	nil	nil	28.0	< 2
		1030	3.3					
May 20	0930	0540	2.7	11.5	nil	S to 10	27.5	< 2
		0950	3.2					

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 18

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions	Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)				
April 13	1145	1040 1650	1.4 4.3	10.5	trace	S @ 6-8	28.5
April 21	1050	1010 T710	3.4 1.6	9.0	nil	S to 10	27.5
April 22	1140	0720 1155	2.7 3.3	10.0	nil	S @ 8	28.5
April 23	1050	0810 1330	2.4 3.3	10.0	3.05	E @ 8	28.5
May 3	1040	0630 1350	3.9 1.0	13.0	nil	S @ 7	28.5
May 4	0955	0705 1425	3.8 1.1	11.5	4.06	E @ 1	29.0
May 5	0915	0800 1510	3.6 1.2	11.5	nil	W to 15	27.5
May 6	0945	0855 1610	3.4 1.5	11.5	nil	S to 10	28.5

48 -

Continued...

**APPENDIX III**            **BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES**

Sample Station: 18 (Continued)

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
May 7	0915	0605	2.8	13.0	nil	nil	29.0	<2
		1030	3.3					
May 20	0935	0540	2.7	11.5	nil	S to 10	27.0	2
		0950	3.2					

**APPENDIX III**      **BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES**

Sample Station: 19

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 12	1120	0945	1.8	9.5	nil	S @ 3-4	29.0	<2
		1550	4.1					
April 13	1155	1040	1.4	10.0	trace	S @ 6-7	28.5	<2
		1650	4.3					50 -
April 21	1055	1010	3.4	10.0	nil	S @ 5	26.5	49
		1710	1.6					
April 22	1125	0720	2.7	9.5	nil	S @ 6	29.0	<2
		1155	3.3					
April 23	1045	0810	2.4	10.0	3.05	NE to 7	28.0	<2
		1330	3.3					
May 3	1040	0630	3.9	12.0	nil	S @ 6	28.5	<2
		1350	1.0					
May 4	0950	0705	3.8	12.0	4.06	E @ 6	27.5	2
		1425	1.1					
May 5	0920	0800	3.6	11.0	nil	E to 10	28.5	<2
		1510	1.2					

Continued...

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 19 (Continued)

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
May 6	0910	0855	3.4	12.0	nil	E to 10	24.5	< 2
		1610	1.5					
May 7	0925	0605	2.8	13.0	nil	nil	27.0	< 2
		1030	3.3					
May 17	0940	0650	4.1	11.5	nil	S @ 15	28.5	4
		1350	0.6					

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 20

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions	Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)				
April 13	1200	1040 1650	1.4 4.3	10.5	trace	S to 9	29.5
April 21	1135	1010 1710	3.4 1.6	10.0	nil	S @ 5-7	28.0
April 22	1130	0720 1155	2.7 3.3	9.5	nil	S @ 4	29.5
April 23	1000	0810 1330	2.4 3.3	10.0	3.05	E to 14	28.5
May 3	0955	0630 1350	3.9 1.0	12.0	nil	S to 8	29.5
May 4	0915	0705 1425	3.8 1.1	11.5	4.06	S to 8	28.5

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 21

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 21	1140	1010	3.4	10.0	nil	S @ 4-5	28.0	2
		1710	1.6					
April 22	1045	0720	2.7	10.0	nil	S @ 6	28.5	<2
		1155	3.3					
April 23	1000	0810	2.4	10.0	3.05	NE to 10	29.0	-
		1330	3.3					
May 3	0950	0630	3.9	12.0	nil	S @ 6	29.0	<2
		1350	1.0					
May 4	0910	0705	3.8	11.5	4.06	S @ 6	28.0	<2
		1425	1.1					
May 17	0935	0650	4.1	11.5	nil	S @ 15	28.0	33
		1350	0.6					

**APPENDIX III**      **BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES**

Sample Station: 22

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 12	1245	0945 1550	1.8 4.1	-	nil	-	29.0	< 2
April 21	1150	1010 1710	3.4 1.6	11.0	nil	S @ 5	27.5	< 2
April 22	1145	0720 1155	2.7 3.3	11.0	nil	S @ 7	28.5	< 2
April 23	0955	0810 1330	2.4 3.3	10.0	3.05	NE to 10	28.5	5
May 3	0945	0630 1350	3.9 1.0	12.5	nil	S to 6	29.0	2
May 4	0905	0705 1425	3.8 1.1	12.0	4.06	S @ 6	27.5	< 2

- 54 -

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 23

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
March 22	1105	0920 1645	4.0 1.2	-	0.31	-	27.5	9
March 23	1120	1020 1745	3.7 1.4	6.0	9.4	SE @ 15	27.5	9
March 24	1030	0745 1145	3.1 3.6	7.0	3.81	SW @ 10	26.5	33
March 25	1145	0835 1330	2.9 3.6	9.0	2.03	S @ 10	24.5	5
March 26	1155	0925 1440	2.7 3.7	9.0	0.51	E @ 10	27.5	2
March 31	1140	0520 1155	4.2 1.6	8.0	nil	SW @ 8	22.0	79
April 6	0915	0825 1550	3.7 1.4	9.5	nil	SW @ 5	28.0	8
April 7	1340	0905 1650	3.6 1.5	11.5	2.79	W @ 6	28.5	5

Continued...

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 23 (Continued)

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
April 21	1250	1010	3.4	14.5	nil	S to 10	24.5	5
		1710	1.6					
April 22	1245	1155	3.3	15.5	nil	S @ 10	25.5	2
		1815	1.9					
April 23	1230	0810	2.4	11.5	3.05	NE to 4	27.0	<2
		1330	3.3					
May 4	0955	0705	3.8	13.0	4.06	E to 4	28.0	2
		1425	1.1					

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 24

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 12	1330	0945	1.8	16.5	nil	SW @ 8-10	27.0	46
		1550	4.1			-		
April 13	1315	1040	1.4	-	trace	-	25.5	5
		1650	4.3					
April 21	1310	1010	3.4	15.0	nil	S to 10	26.5	<2
		1710	1.6					
April 22	1250	1155	3.3	14.5	nil	S @ 10	29.0	2
		1815	1.9					
April 23	1235	0810	2.4	10.5	3.05	NE to 4	27.0	70
		1330	3.3					
May 3	1215	0630	3.9	15.5	nil	S @ 5	27.5	17
		1350	1.0					
May 4	1030	0705	3.8	12.5	4.06	E to 4	29.0	8
		1425	1.1					

**APPENDIX III**            **BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES**

Sample Station: 25

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 12	1240	0945	1.8	-	nil	-	29.0	< 2
		1550	4.1					
April 13	1325	1040	1.4	-	trace	-	28.5	< 2
		1650	4.3					
April 21	1300	1010	3.4	16.0	nil	S to 10	27.5	-
		1710	1.6					
April 22	1245	1155	3.3	14.5	nil	S @ 10	26.5	8
		1815	1.9					
April 23	1225	0810	2.4	12.0	3.05	NE to 4	23.5	49
		1330	3.3					
May 3	1205	0630	3.9	18.5	nil	S @ 5	27.5	< 2
		1350	1.0					
May 4	1040	0705	3.8	13.0	4.06	E to 4	28.0	7
		1425	1.1					
May 5	1020	0800	3.6	12.5	nil	W to 15	27.5	4
		1510	1.2					

Continued...

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 25 (Continued)

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
May 6	1010	0855	3.4	15.0	nil	S to 10	24.5	2
		1610	1.5					
May 7	0840	0605	2.8	15.0	nil	nil	28.0	-
		1030	3.3					59
May 20	1155	0950	3.2	17.0	nil	S to 16	27.0	< 2
		1620	1.7					< 2

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 26

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
April 12	1230	0945	1.8	11	nil	SW @ 5	29.5	< 2
		1550	4.1					
April 13	1330	1040	1.4	-	trace	-	29.5	5
		1650	4.3					60
April 21	1145	1010	3.4	10	nil	S @ 5	28.5	< 2
		1710	1.6					
April 22	1050	0720	2.7	10	nil	S @ 4	28.5	< 2
		1155	3.3					
April 23	-	-	-	-	3.05	-	28.5	< 2
May 3	1000	0630	3.9	12	nil	S to 5	28.5	< 2
		1350	1.0					

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 27

Location: Crescent Beach

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
April 12	1215	0945	1.8	11.0	nil	SE @ 5	29.5	<2
		1550	4.1					
April 21	1130	1010	3.4	10.0	nil	SE @ 5	28.5	23
		1710	1.6					61
April 22	1055	0720	2.7	9.5	nil	SE @ 5	28.5	-
		1155	3.3					2
April 23	1020	0810	2.4	10.0	3.05	SE @ 5	27.5	
		1330	3.3					
May 3	1005	0630	3.9	12.5	nil	nil	28.0	4
		1350	1.0					
May 4	0920	0705	3.8	11.5	4.06	S to 8	28.0	5
		1425	1.1					

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 28

Location: Kwoma's Point

Date (1976)	Sample Time	Tide Conditions	Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)				
April 12	1140	0945 1550	1.8 4.1	10.0	nil	SW @ 5	28.5
April 13	1235	1040 1650	1.4 4.3	11.0	trace	SE @ 7	29.5
April 21	1105	1010 1710	3.4 1.6	10.0	nil	nil	62
April 22	1105	0720 1155	2.7 3.3	10.0	nil	S to 5	25.5
April 23	1025	0810 1330	2.4 3.3	10.0	3.05	E to 7	130
May 3	1010	0630 1350	3.9 1.0	12.0	nil	S @ 4	28.0
May 4	0925	0705 1425	3.8 1.1	11.5	4.06	S to 8	< 2
May 5	0925	0800 1510	3.6 1.2	11.0	nil	W to 15	28.0

Continued... .

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 28 (Continued)

Location: Kwomaia Point

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
May 6	0915	0855	3.4	12.0	nil	E to S	28.0	2
		1610	1.5					
May 7	0945	0605	2.8	12.5	nil	SW to S	28.5	< 2
		1030	3.3					-
May 20	0950	0540	2.4	12.5	nil	S to SW	26.5	63
		0950	3.2					-

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 29

Location: Kwomaia Point

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 13	1230	1040 1650	1.4 4.3	9.0	trace	S @ 8	29.5	< 2
April 21	1125	1010 1710	3.4 1.6	10.0	nil	S @ 5	25.5	79
April 22	1120	0720 1155	2.7 3.3	10.0	nil	S @ 6	27.5	- 64 -
April 23	1040	0810 1330	2.4 3.3	10.0	3.05	E to 8	28.5	5
May 3	1030	0630 1350	3.9 1.0	12.0	nil	S to 7	28.5	< 2
May 4	0945	0705 1425	3.8 1.1	11.5	4.06	E @ 6	29.0	< 2
May 5	0940	0800 1510	3.6 1.2	11.0	nil	W to 1.5	29.0	< 2
May 6	0935	0855 1610	3.4 1.5	12.0	nil	S to 10	28.5	< 2

Continued...

APPENDIX III                    BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 29 (Continued)

Location: Kwoma's Point

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
May 7	0945	0605	2.8	13.0	nil	SW to 8	29.0	< 2
		1030	3.3					
May 20	1005	0950	3.2	12.0	nil	S to 10	27.0	< 2
		1620	1.7					

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 30

Location: Kwoma's Point

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 12	1145	0945 1550	1.8 4.1	10.5	nil	SW @ 6	29.0	< 2
April 13	1215	1040 1650	1.4 4.3	9.5	trace	S @ 8	29.5	-
April 21	1110	1010 1710	3.4 1.6	10.0	nil	nil	25.5	240
April 22	1110	0720 1155	2.7 3.3	10.0	nil	S @ 5	27.5	2
April 23	1025	0810 1330	2.4 3.3	10.5	3.05	E to 8	28.5	2
May 3	1015	0630 1350	3.9 1.0	12.0	nil	S @ 4	28.0	4
May 4	0930	0705 1425	3.8 1.1	11.0	4.06	E @ 6	28.5	13
May 5	0930	0800 1510	3.6 1.2	11.0	nil	W to 15	28.0	2

Continued...

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 30 (Continued)

Location: Kwomais Point

Date (1976)	Sample Time	Tide Conditions	Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)				
May 6	0920	0855 1610	3.4 1.5	12.5	nil	E to 5	4
May 7	0935	0605 1030	2.8 3.3	12.5	nil	SW to 6	<2
May 20	0955	0950 1620	3.2 1.7	13.0	nil	S to 10	67
							-
							7

**APPENDIX III**      **BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES**

Sample Station: 31

Location: Kwo Mai Point

Date (1976)	Sample Time	Tide Conditions	Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
	Time	Height (m)					
April 12	1150	0945 1550	10.8 4.1	10.5	nil	SW @ 7	29.5 <2
April 13	1220	1040 1650	1.4 4.3	10.0	trace	S @ 7	29.5 <2
April 21	1115	1010 1710	3.4 1.6	10.5	nil	nil	68 -
April 22	1110	0720 1155	2.7 3.3	10.5	nil	S @ 4	24.5 110
April 23	1030	0810 1330	2.4 3.3	10.5	3.05	E to 8	27.0 28.5
May 3	1020	0630 1350	3.9 1.0	12.0	nil	S to 6	28.5 <2
May 4	0935	0705 1425	3.8 1.1	11.5	4.06	E @ 6	28.5 8
May 5	0930	0800 1510	3.6 1.2	11.0	nil	W to 15	28.5 4

Continued...

## APPENDIX III BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 31 (Continued)

Location: Kwomaia Point

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 mL
		Time	Height (m)					
May 6	0925	0855 1610	3.4 1.5	12.5	nil	E to S	27.0	< 2
May 7	0940	0605 1030	2.8 3.3	12.5	nil	SW to S	28.0	-
May 20	1000	0950 1620	3.2 1.7	12.5	nil	S to 10	27.5	8

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 32

Location: Kwomais Point

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 12	1150	0945 1550	1.8 4.1	10.5	nil	SW @ 7	29.0	< 2
April 13	1220	1040 1650	1.4 4.3	10.0	trace	S @ 7	29.5	< 2
April 21	1115	1010 1710	3.4 1.6	10.5	nil	nil	25.5	70
April 22	1110	0720 1155	2.7 3.3	10.5	nil	S @ 4	27.0	-
April 23	1030	0810 1330	2.4 3.3	10.0	3.05	E to 8	29.0	7
May 3	1020	0630 1350	3.9 1.0	12.0	nil	S to 6	28.5	2
May 4	0940	0705 1425	3.8 1.1	11.5	4.06	E @ 6	27.5	< 2
May 5	0935	0800 1510	3.6 1.2	11.0	nil	W to 15	27.5	2

Continued...

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 32 (Continued)

Location: Kwomaia Point

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
May 6	0930	0855	3.4	11.5	nil	S to 7	28.0	< 2
		1610	1.5					
May 7	0940	0605	2.8	12.5	nil	SW to 8	28.5	< 2
		1030	3.3					
May 20	0900	0540	2.7	12.5	nil	S to 10	27.0	8
		0920	3.2					

## APPENDIX III

## BACTERIOLOGICAL ANALYSES RESULTS AND SAMPLING CONDITIONS FOR MARINE SAMPLES

Sample Station: 33

Location: Kwoma's Point

Date (1976)	Sample Time	Tide Conditions		Water Temp. (°C)	Total Precip. (mm)	Wind (knots)	Salinity (ppt)	Fecal Coliform MPN/100 ml
		Time	Height (m)					
April 13	1225	1040 1650	1.4 4.3	9.5	trace	S @ 8	29.5	< 2
April 21	1120	1010 1710	3.4 1.6	10.0	nil	S @ 5	26.5	23
April 22	1115	0720 1155	2.7 3.3	10.0	nil	S @ 5	27.5	- 72 -
April 23	1035	0810 1330	2.4 3.3	10.0	3.05	E to 8	28.5	8
May 3	1025	0630 1350	3.9 1.0	12.0	nil	S to 9	29.0	< 2
May 4	0940	0705 1425	3.8 1.1	11.5	4.06	E @ 6	28.5	< 2
May 5	0935	0800 1510	3.6 1.2	10.5	nil	W to 15	28.5	< 2

APPENDIX IV

BACTERIOLOGICAL ANALYSES RESULTS  
AND SAMPLING CONDITIONS FOR FRESHWATER SAMPLES

## APPENDIX IV BACTERIOLOGICAL ANALYSES AND SAMPLING CONDITIONS FOR FRESHWATER SAMPLES

Sample Station: P1                          Location: Third Ave. (Beach Grove) Pump Station effluent

Date (1976)	Time of Collection	Temperature (°C)	Total Precipitation (mm)	Salinity (ppt)	Fecal Coliform (MPN/100 mL)
March 25	1045	10.0	2.03	0.0	130
April 17	1015	14.0	2.79	0.0	79
May 18	1215	19.0	nil	1.5	350

## APPENDIX IV BACTERIOLOGICAL ANALYSES AND SAMPLING CONDITIONS FOR FRESHWATER SAMPLES

Sample Station:	P2	Location: Beharrel Pump Station effluent			
Date (1976)	Time of Collection	Temperature (°C)	Total Precipitation (mm)	Salinity (ppt)	Fecal Coliform (MPN/100 mL)
April 6	1140	10.0	nil	10.5	170
April 7	1300	13.0	2.79	18.5	20
May 18*	1055	14.0	nil	32.5	240

\* not pumping - ditch sample

## APPENDIX IV BACTERIOLOGICAL ANALYSES AND SAMPLING CONDITIONS FOR FRESHWATER SAMPLES

Sample Station:	P3	Location:	Oliver Pump Station effluent		
Date (1976)	Time of Collection	Temperature (°C)	Total Precipitation (mm)	Salinity (ppt)	Fecal Coliform (MPN/100 mL)
April 6	1115	10.5	nil	10.5	350
April 7	1130	9.0	2.79	2.5	790
May 18*	0930	13.0	nil	21.5	1300
May 21	1200	15.0	nil	12.0	1100

\* not pumping - ditch sample

## APPENDIX IV BACTERIOLOGICAL ANALYSES AND SAMPLING CONDITIONS FOR FRESHWATER SAMPLES

Sample Station: S1 Location: Serpentine River at Highway 99 bridge

Date (1976)	Time of Collection	Temperature (°C)	Total Precipitation (mm)	Salinity (ppt)	Fecal Coliform (MPN/100 mL)
March 23	1105	6.0	9.4	0.0	170
March 24	1005	7.0	3.81	5.5	790
March 25	1225	8.0	2.03	0.0	330
March 26	1130	10.0	0.51	0.0	490
March 31	1125	8.0	nil	2.5	330

## APPENDIX IV

## BACTERIOLOGICAL ANALYSES AND SAMPLING CONDITIONS FOR FRESHWATER SAMPLES

Sample Station: S2      Location: Nicomekl River at Burlington Railway Crossing

Date (1976)	Time of Collection	Temperature (°C)	Total Precipitation (mm)	Salinity (ppt)	Fecal Coliform (MPN/100 mL)
March 22	1315	-	0.31	18.5	220
March 23	1145	6.0	9.4	5.5	330
March 24	1105	7.0	3.81	9.5	330
March 25	1210	8.0	2.03	9.5	490
March 26	1220	7.0	0.51	14.5	330
March 31	1220	9.0	nil	9.5	130