ENVIRONMENTAL PROTECTION BRANCH
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PACIFIC REGION

SHELLFISH GROWING WATER SANITARY SURVEY OF SALTSPRING ISLAND, BRITISH COLUMBIA, 1977

Regional Program Report: 78-16

by

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ABSTRACT

A sanitary and bacteriological survey of the waters and tidal foreshore of Saltspring Island, British Columbia, was conducted between July 11 and August 19, 1977 by personnel of the Environmental Protection Service, Pacific Region. Additional survey work was carried out by EPS personnel from February 14 to 18, 1978.

The summer bacteriological study was undertaken to evaluate bivalve molluscan growing-water quality in the area. No previous comprehensive studies have been carried out to permit a review of the existing administrative closures as set out in Schedule 1 of the British Columbia Fishery Regulations regarding Contaminated Shellfish Areas. Administrative closures are employed when pollution is suspected but data are unavailable for confirmation. A sanitary survey was performed concurrently to identify and evaluate sources of bacterial contamination to the study area.

The winter survey was carried out to obtain data during a period of heavy precipitation when sewage contamination was expected to be at its worst.

During the summer and winter sampling periods, a total of 1017 marine and 63 freshwater samples were collected and analyzed for fecal coliform levels. Of the 146 marine stations sampled, 25 did not meet the shellfish growing water standard. The survey indicated four new Schedule 1 closures, and modification of five existing closures in the study area was necessary.

RESUME

Le Service de la protection de l'environnement (region du Pacifique) a effectue des etudes sanitaires et bacteriologiques sur les eaux d'estran de l'île Saltspring, en Colombie-Britannique, du 11 juillet au 19 août 1977. Des travaux supplementaires s'y sont egalement deroules du 14 au 18 fevrier de l'annee suivante.

La premiere etude sur la situation bacteriologique visait à determiner la qualite de l'eau où baignent les mollusques bivalves. Aucune etude complete n'avait encore ete faite en vue de reviser l'annexe I des reglements de peche de la Colombie-Britannique. Ceux-ci interdisent provisoirement de pecher les mollusques dans certains secteurs contamines. Les autorites provinciales interdisent la peche dans ces secteurs, de façon temporaire, lorsqu'elles entrevoient une possibilite de contamination. C'est leur seule façon d'agir car elles ne disposent pas des donnees necessaires pour confirmer ou infirmer ces soupçons. Un releve sanitaire a complete l'etude en tentant d'identifier et d'evaluer les sources de contamination bacterienne de cette region.

La deuxieme etude avait pour but de recueillir des donnees pendant une periode de fortes precipitations. On s'attendait alors à ce que la contamination due aux egouts soit à son maximum.

Au total, on a recueilli 1 017 echantillons d'eau de mer et 63 d'eau douce, desquels on a determine le taux de bacteries coliformes d'origine fecale. Il faut mentionner que les echantillons provenant de 25 des 146 stations marines ne repondaient pas aux normes de qualite appropriees a l'exploitation des mollusques. L'etude a demontre la necessite d'interdire la peche aux mollusques dans quatre nouveaux secteurs et de modifier les limites de cinq autres.

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CONCLUSIONS

The bacteriological water quality of most shellfish growing areas around Saltspring Island was good, the exceptions being noted below. Three areas - Fernwood Point to Walker Hook, Booth Inlet and Burgoyne Bay were re-evaluated during the winter season to examine the effect of increased landwash on the water quality. In these specific cases, the water quality was not significantly impaired beyond that which was observed during the summer season. In the case of Burgoyne Bay, water quality improved slightly between summer and winter.

1. The waters and tidal foreshore of Walter Bay were contaminated to such an extent that consumption of bivalve molluscan shellfish from this area may pose a health hazard. The sources of contamination to the bay were not ascertained, although livestock graze near the head of the bay and runoff containing animal fecal material is a probable source.

2. Three stations at the head of Ganges Harbour were contamined to such an extent that consumption of bivalve molluscan shellfish from this area may pose a health hazard.

   Contamination was known to be originating from an antique store beside Ganges Creek, the Esso gasoline station, the Red and White grocery store, the Harbour House Hotel, septic drainage in a storm water culvert, the various marinas, and a common septic discharge from the school complex, Mahon Hall, and the Public Health building.

3. The waters and tidal foreshore of Long Harbour were of acceptable water quality for the purpose of shellfish harvesting. A potential pollution problem exists due to the discharge of untreated sewage from the MVs Queen of Tsawwassen and Queen of Sidney while moored at the Long Harbour ferry terminal.

4. The tidal foreshore waters from Fernwood Point southward to, and including Walker Hook, were of acceptable water quality during both the summer and winter sampling periods. Sewage discharged by the Malaview Estates sewage treatment plant did not appreciably impair the water quality in the intertidal area. During the summer sampling, the outfall pipe was ruptured approximately 58 metres from the shoreline in approximately 1 to 2 metres of water at low tide.

5. All marine stations from Southey Point to Parminter Point were of acceptable water quality for the purpose of shellfish harvesting.

6. The waters and tidal foreshore of Duck Bay were contaminated to the extent that consumption of bivalve molluscan shellfish from this area may pose a health hazard.

   Two potential sources of pollution were evident:
   a) boat moorage in the bay;
   b) a stream entering at the head of the bay, which had septic sludge at its mouth.

7. The waters and tidal foreshore along the eastern shore of Vesuvius Bay were contaminated to the extent that consumption of bivalve molluscan shellfish from this area may pose a health hazard.

   The two major identified sources of pollution to Vesuvius Bay were:
   a) the discharge of septic tank effluent from the Seaside Kitchen,
   b) discharges of raw sewage from the MV Saltspring Queen during those times it is used on the Vesuvius - Crofton crossing.

8. Sample stations at the head of Booth Inlet were contaminated to the extent that consumption of bivalve molluscan shellfish may pose a health hazard. A pond for livestock usage is located near the head of the inlet, but was not discharging during the survey period and the source of contamination remains unidentified.

The outer portion of Booth Inlet was of acceptable growing water quality during both winter and summer sampling.

9. The water quality in the vicinity of Erskine Point met the shellfish growing water standards.

10. The water quality at the head of Burgoyne Bay, overlying the commercial oyster lease on lot 313 exceeded the growing water standard during the summer sampling period. Three freshwater stations entering the bay were not significantly contaminated with fecal material. Homes situated near the beach at the oyster lease did not appear to have septic seepage and the only other identified potential source of contamination to the oyster lease was the discharge of sewage from pleasure craft moored in the bay.

    The winter data that were collected in this area indicated improved water quality conditions relative to summer values, but fecal contamination was still evident. A major rainfall could seriously impair the water quality in this area, although fecal coliform levels in the freshwater inputs were not considered significant.

11. Four of the 17 sample stations in Fulford Harbour exceeded the growing water standard. A small stream on the south side of the harbour impaired water quality in the immediate receiving vicinity. The cause of fecal pollution to this stream was not ascertained. Fulford Creek was the probable cause of contamination at the head of the harbour.

SCHEDULE 1 CLOSURES

1. Walter Bay - Ganges Harbour

The present Area 17-9 closure should be revoked and replaced with the following:

Area 18-5. "The waters and tidal foreshore of Ganges Harbour, Saltspring Island, Area 18, including Walter Bay, lying inside, that is, northwest, of a line drawn from the western tip of Walter Bay spit, to the western end of Goat Island and thence westerly along the axis of the Chain Islands to the shore of Saltspring Island, from the period of October 1 to May 31; the waters and tidal foreshore of Ganges Harbour, Saltspring Island, Area 18, including Walter Bay, lying inside, that is, northwest of a straight line drawn from the western tip of Walter Bay spit, northwest to a point on the northern shore at 123° 29.68'W, 48° 51.49'N, from the period June 1 to September 30."

2. Long Harbour

The present Area 17-10 closure should be revoked and replaced with the following:

Area 18-7. "The waters and tidal foreshore of Long Harbour, Saltspring Island, Area 18, lying within a 1000-foot (304 metres) radius of the ferry landing."

3. Walker Hook - Malaview Estates - Fernwood Point

Given that the outfall pipeline from the Malaview Estates sewage treatment plant has been repaired and has restored the point of effluent discharge to 700 feet (213 metres) from the shoreline at a depth of 44 feet (13.4 metres) below low water, and that the

pollution problem at station 48 is no longer evident, the present Area 17-11 closure should be revoked in its entirety and the area be re-opened to shellfish harvesting; and further, the present Area 17-12 closure should be amended to read:

Area 17-12. "The waters and tidal foreshore of Saltspring Island, Area 17, lying 1500 meters northwest, and 500 meters southeast of the Malaview Estate sewage treatment plant outfall pipe."

4. Duck Bay, Dock Point

The following closure should be added to Schedule 1:

Area 17-21. "The waters and tidal foreshore of Saltspring Island, Area 17, lying inside, that is, eastward, of a straight line drawn due north from the first headland on the south side of Duck Bay (Dock Point) to the opposite shore."

5. Vesuvius Bay

The following closure should be added to Schedule 1:

Area 17-22. "The waters and tidal foreshore of the northern shore of Vesuvius Bay, Saltspring Island, Area 17, from a point onshore 150 meters north of the ferry terminal to a point onshore 500 meters southeast of the ferry terminal."

6. Booth Bay - Booth Inlet

The following closure should be added to Schedule 1:

Area 17-23. "The waters and tidal foreshore of Booth Inlet, Saltspring Island, Area 17, lying eastward of a straight line drawn across the narrowest point of

the Inlet, from a point 123° 32.30'W, 48° 51.89'N; northnorthwest to a point on the opposite shore at 123° 32.35'W, 48° 51.83'N."

7. Burgoyne Bay

The following closure should be added to Schedule 1:

Area 18-6. "The waters and tidal foreshore at the head of Burgoyne Bay, Saltspring Island, Area 18, lying inside, that is, eastward, of a straight line drawn from a point at 123° 31.40'W, 48° 47.36'N on the southern shore, to a point on the opposite shore at 123° 30.65'W, 48° 47.72'N."

8. Fulford Harbour

The present Area 17-8 closure should be revoked and replaced with the following:

Area 18-4. "The waters and tidal foreshore at the head of Fulford Harbour, Saltspring Island, Area 18, lying inside, that is, northward, of a straight line drawn from a point at 123° 27.25'W, 48° 45.92'N on the western shore, to a point at 123° 26.53'W, 48° 46.06'N on the eastern shore."

Schedule 1 closures are shown in Figure 1.

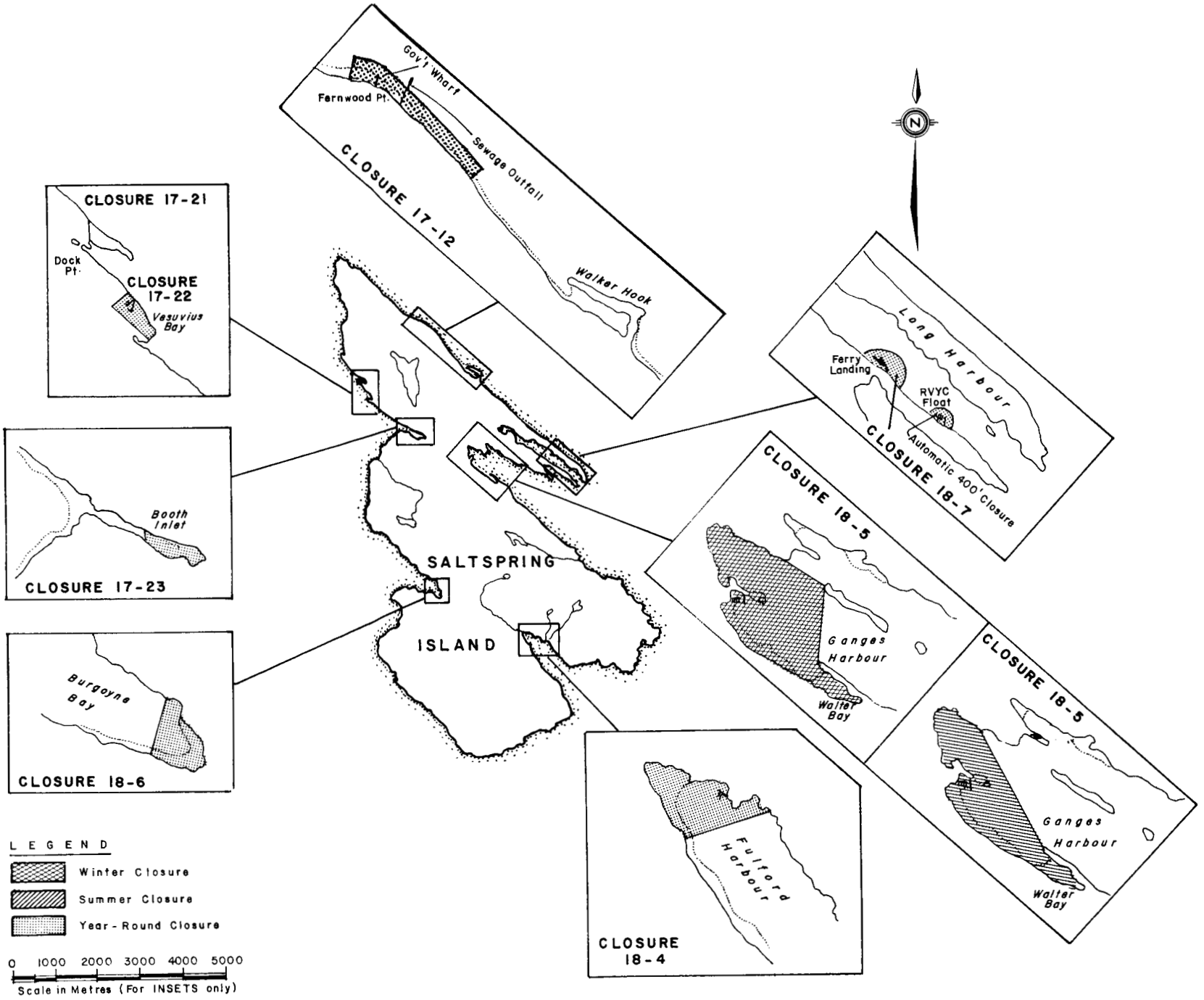

FIGURE I RECOMMENDED SCHEDULE 1 CLOSURE AMENDMENTS AND ADDITIONS

1 INTRODUCTION

The Gulf Islands constitute a popular recreational area in British Columbia. They are sheltered from the Pacific Ocean by Vancouver Island, and support sizeable recreational and commercial fisheries. Of this island group, Saltspring Island is the largest. The 1976 permanent population figure obtained from Statistics Canada was 4410 and this figure almost doubles during the summer months. The tidal foreshore of the island supports a sizeable shellfish resource, which is harvested by both recreational and commercial fishermen. It shelters numerous privately owned wharves, and three provincial government ferry terminals.

The business center is located at Ganges which is situated in the northern part of the island, having a permanent population (1976) of 444. At Ganges, there are two hotels, three restaurants, a department store, two large grocery stores, three gas stations, two marine gas stations, a public high school serving the entire Gulf Islands area, a public health building, a shopping center, and numerous other non-residential establishments.

There are two commercial oyster leases on the island, one on the northeast near Southey Point and the other at the head of Burgoyne Bay. Clams are dug commercially at several locations on the island, the most productive area being Booth Inlet which is also the location of a seaside resort.

Several factors were considered in selecting Saltspring Island as a priority survey area:

i) because of suspected pollution problems, five administrative shellfish harvesting closures had been imposed on certain areas of the island in 1972 which required verification in the form of a detailed bacteriological and sanitary survey (Figure 2);

ii) the remainder of the foreshore had not been previously surveyed;

iii) two commercial oyster leases and several commercial clam areas required classification in accordance with the Canadian Shellfish Safety Program; and

iv) two registered marine discharges required inspection.

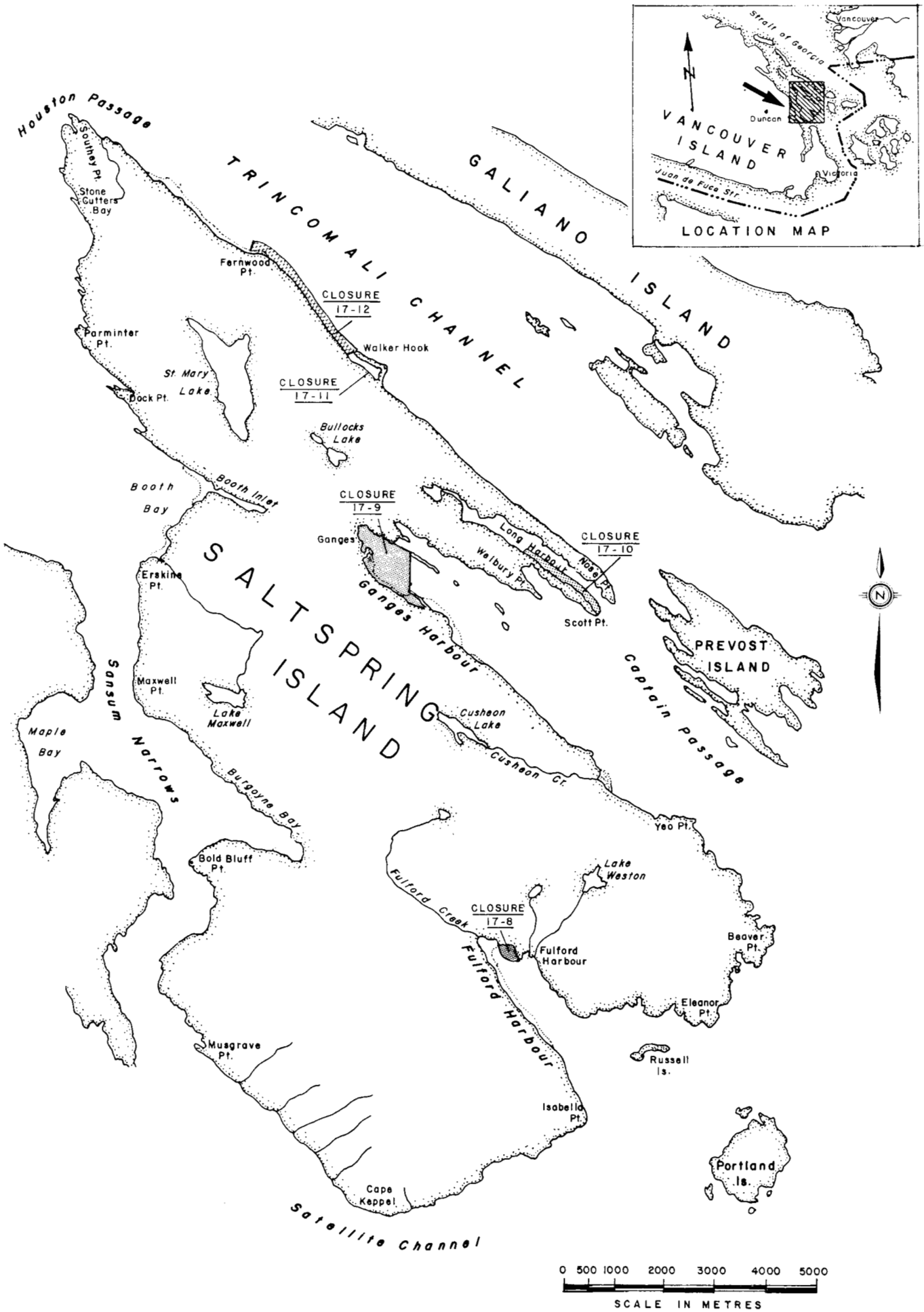

FIGURE 2 EXISTING SCHEDULE I CLOSURES

The survey was scheduled during the summer months to:

i) examine the water quality during a period of increased island population and consequent increased usage of sewage disposal systems; and

ii) evaluate fecal pollution in moorage areas and at wharves resulting from the increased number of boaters.

Additional sampling was conducted during February 1978, to assess the water quality in selected areas of the island. Burgoyne Bay, Walker Hook, Fernwood Point and Booth Inlet were re-examined during this higher precipitation period to determine the influence of increased landwash on the receiving water quality. It was also believed that some pollution sources which were not evident during the summer survey would be more easily revealed during the winter season.

2 MARINE SAMPLE STATION LOCATIONS

Sample station locations and descriptions are presented in Appendix I and are illustrated in Figures 3 and 4. The shellfish resource information used in establishing the stations was obtained from the Fisheries and Marine Service of the Department of Fisheries and the Environment, from the Marine Resources Branch of the Province of British Columbia, and from a visual inspection by Environmental Protection Service personnel carried out by boat at high and low tides.

The following stations were established in areas under Schedule 1 closure: 25 stations (1-25) in Ganges Harbour; 10 (28-37) in Long Harbour in the vicinity of the ferry terminal, the Royal Vancouver Yacht Club Marina, and the head of the harbour; 12 stations (39-50) within Walker Hook with one station (38) as a control, on the eastern side of the hook; 13 stations (51-63) along the stretch of shoreline between Walker Hook and Fernwood Point, eight of which were in close proximity to the outfall from the sewage treatment plant discharge from Malaview Estates; and 17 stations (118-134) in Fulford Harbour, the location of the island's second major ferry terminal.

Two commercial shellfish leases were in operation during the survey; however, no stations were established at Lease 341 near Southey Point because the sanitary survey did not reveal any existing or potential pollution sources. Four stations (114-117) were established over Lease 313 in Burgoyne Bay and 14 (98-111) were set up in Booth Bay and Booth Inlet which support recreational and commercial clam fisheries.

Six stations (92-97) were established in Vesuvius Bay, the location of the island's third ferry terminal.

All remaining stations were situated in areas where a shellfish resource existed in close proximity to residential and/or recreational areas. Of these, the majority were on the northwestern side of the island, between Southey and Dock points.

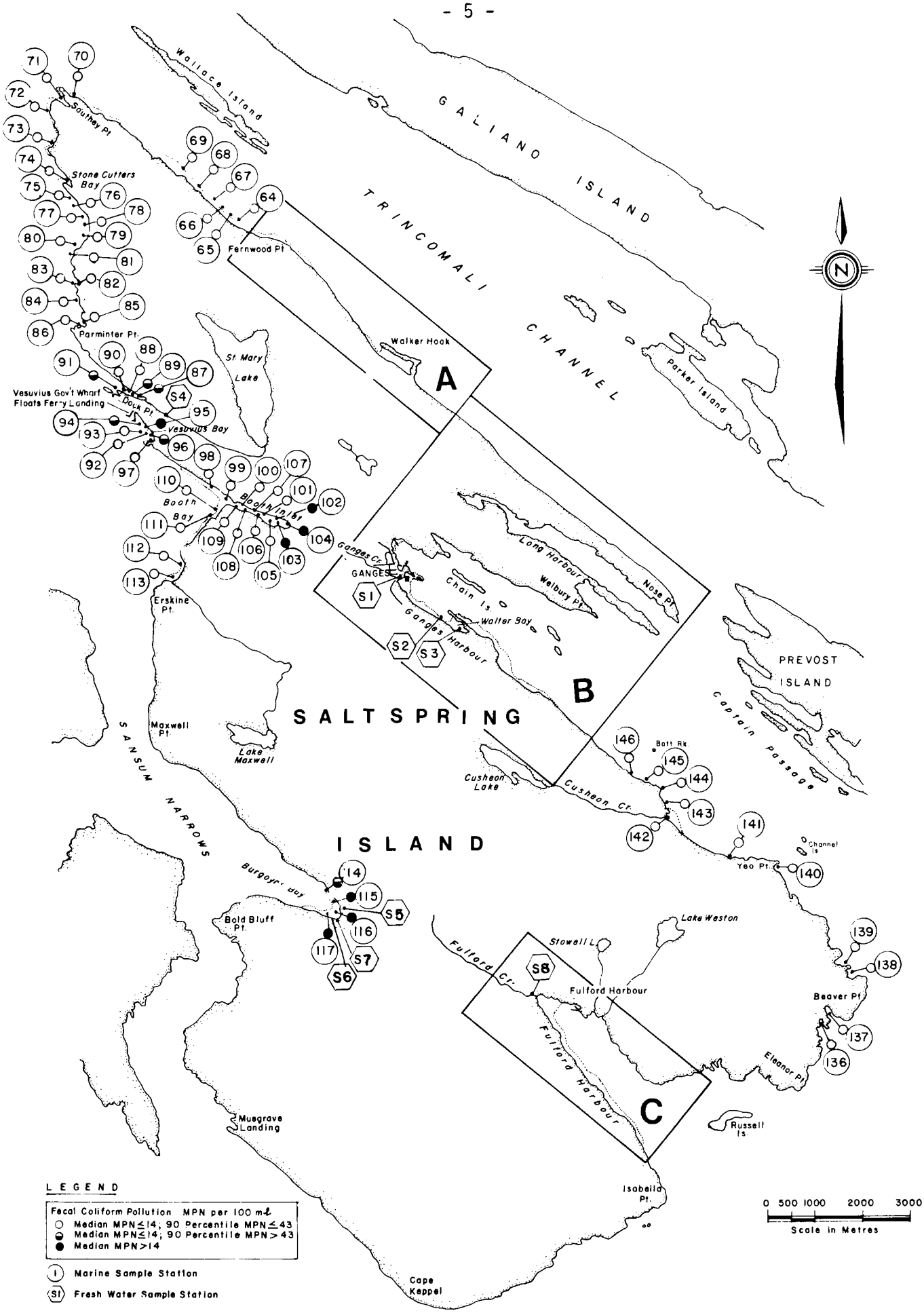

FIGURE 3 MARINE SAMPLE STATION LOCATIONS (Excluding A, B and C) AND FRESHWATER SAMPLE STATION LOCATIONS

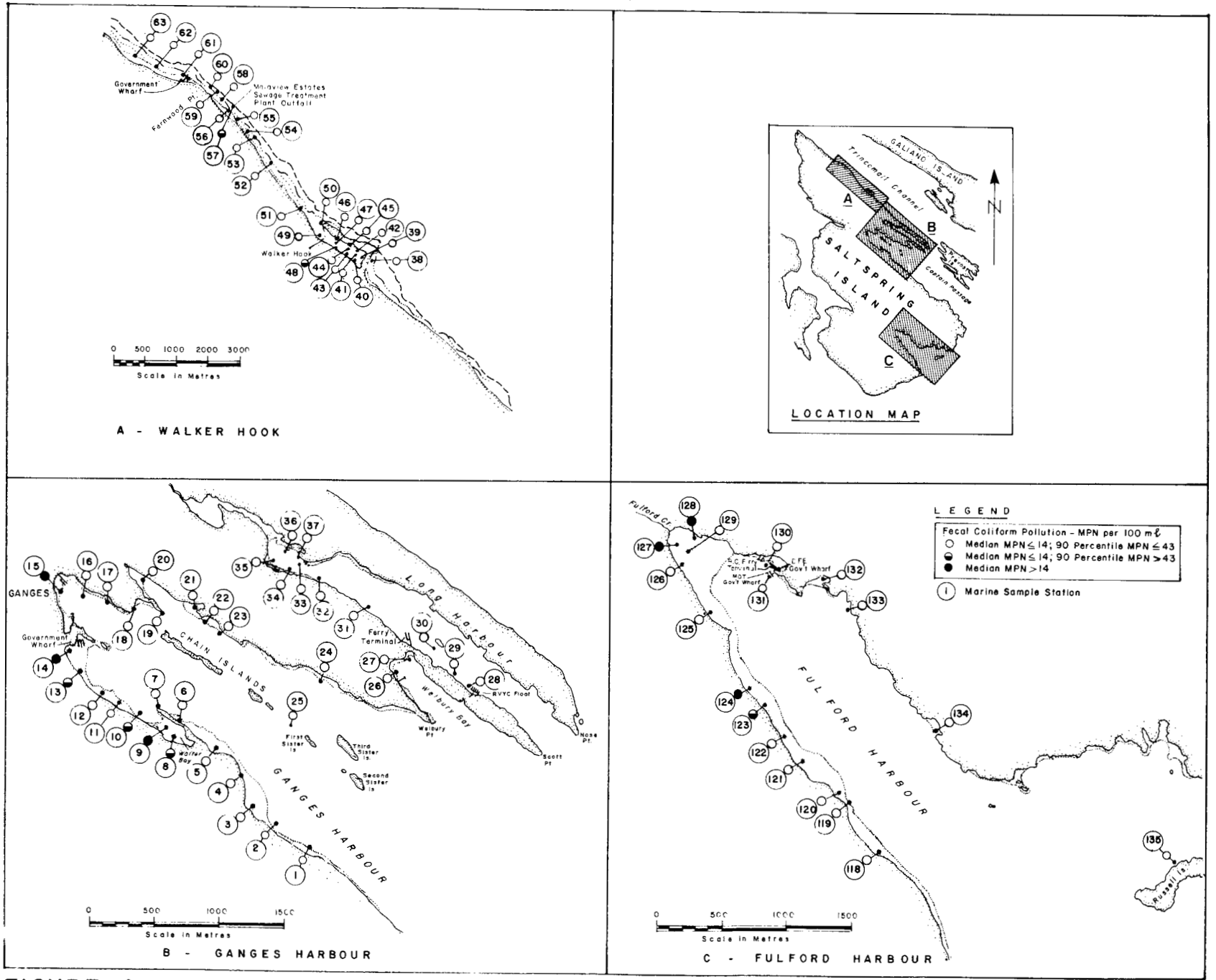

FIGURE 4 MARINE STATION LOCATIONS IN AREAS A, B AND C, SALTSPRING ISLAND

3 FRESHWATER, SEDIMENT, AND MISCELLANEOUS SAMPLING

3.1 Streams, Sediments

Freshwater samples were collected as part of the sanitary investigation into pollution sources from land. Stations (Figure 3) were established in several areas as described in Appendix II. Sludge from the drying stream bed at Dock Point, surface scum at the Fulford Harbour government wharf, sediments from areas in Walker Hook, Ganges Creek and Booth Inlet, and water samples from above and below a stagnant pond in fields used by the Burgoyne Dairy were also sampled. Additional freshwater samples were taken during the February survey and the station locations are described in Appendix X, Table 2.

3.2 Malaview Estates Sewage Treatment Plant

Bacteriological and chemical sampling was carried out as part of a performance evaluation of the sewage treatment plant. Dye studies were also carried out during the summer and winter surveys.

3.3 Shellstock Sampling

Samples of shellfish tissue were collected for bacteriological analysis from suspected pollution areas. Samples of oyster shellstock were collected on August 3 at stations 39 and 46. Littleneck clams were collected on the same day at station 65. On August 15, samples of oysters were collected at stations 36, 74, 87, 99, 115 and 117; and clams were collected at stations 35 and 99. On August 16, geoduck samples were collected near the Malaview Estates outfall, with assistance from the Marine Resources Branch of the Province of British Columbia.

4 FIELD PROCEDURES AND METHODS

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

4.1 Bacteriological Sampling and Analyses

4.1.1 Marine Samples. All water samples for bacteriological analyses were collected in sterile 170 cc wide-mouth glass bottles, approximately 15 to 30 cm below the water surface. The water depth at collection points over shellfish beds did not exceed 2 meters. Samples were collected by boat or on foot. The samples were stored in coolers at temperatures not exceeding 10°C until processed. Analyses were carried out within 3 hours of collection in the mobile microbiology laboratory of the Environmental Protection Service, located on Saltspring Island.

The fecal coliform most probable number (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 14th edition of Standard Methods for the Examination of Water and Wastewater (1). The culture medium used was the A-1 medium, as described by Andrews and Presnell (2). This medium and the method described below were accepted by the Canadian government as the method of choice for the enumeration of fecal coliforms in shellfish growing waters in April, 1977.

The "modified A-1" technique involves the inoculation of a series of dilutions in accordance with the multiple tube fermentation technique. Ten milliliter volumes of sample water were inoculated into each of five double strength tubes of A-1 medium, and 1.0 ml and 0.1 ml volumes were inoculated into five tubes each of single strength medium. The tubes were incubated at 35 $\pm$ 0.5°C in air incubators for 3 hours and then transferred to a water bath at 44.5 $\pm$ 0.2°C and incubated for a further 21 hours for a total of 24 $\pm$ 2 hours. All gassing tubes with growth were considered to be fecal coliform positive. The most probable number for each sample was then determined according to the manner described in Standard Methods.

4.1.2 Shellstock. Shellstock samples were analyzed by the Fish Inspection Laboratory of the Department of Fisheries and the Environment in Victoria, B.C. It was desirable to use at least 12 animals per station, in order to get a representative sample, except in the case of the geoduck analysis when five animals per station were used owing to their relatively great size.

4.1.3 Freshwater Samples. All freshwater samples were collected in 450 cc sterile wide-mouth glass bottles. Samples were collected close to the mouth of streams and analyzed on site. Samples were tested for total coliforms, fecal coliforms, and fecal streptococci using the membrane filtration (MF) method described in Part 909 of the 14th edition of Standard Methods. Media used were m-endo LES, m-FC, and KF streptococcus agars obtained from Difco Laboratories, Detroit, Michigan, U.S.A., for the total coliform, fecal coliform, and fecal streptococcus tests respectively. The membrane filters used were Millipore HC, obtained from Millipore Limited, Mississauga, Ontario.

4.2 Physical and Chemical Testing Equipment and Analyses

4.2.1 Marine Stations. Temperature measurements were made at a depth of 15-30 cm below the water surface, using an immersible Celsius thermometer. An American Optical refractometer, Catalogue No. 10413 which has a resolution to the nearest 0.5 parts per thousand was employed for the salinity determinations. Wind speeds and direction were determined with a Telcor series 210 electronic wind speed/direction indicator.

Tide data used was that for Fulford Harbour.

4.2.2 Freshwater Stations. Temperature readings were made at a depth of 15-30 cm when possible, using a submersible Celsius thermometer. Flow volumes and rates were calculated only during the February survey due to the low flows encountered during the summer sampling (Appendix X).

4.2.3 Malaview Estates Sewage Treatment Plant. Samples of final effluent were analyzed for chemical oxygen demand (COD), non-filterable residue (NFR), total phosphate, and ammonia.

Samples were analyzed by the Chemistry Laboratory, Department of Fisheries and Environment located in West Vancouver according to the procedures described in the latest edition of the EPS-FMS Laboratory Manual (3).

5 RESULTS

In order for an area to be considered bacteriologically safe for the harvesting of bivalve molluscan shellfish, the fecal coliform median MPN of the water must not exceed 14/100 ml and not more than 10% of the samples can exceed an MPN of 43/100 ml for a 15 tube, decimal-dilution test.* Samples are taken from productive resource areas most probably exposed to fecal contamination during unfavorable hydrographic and pollution conditions.

Using this criterion, numerous areas of Saltspring Island did not meet acceptable water quality standards. These areas included Walter Bay, portions of Ganges Harbour, Vesuvius Bay, portions of Booth Inlet, portions of Burgoyne Bay and portions of Fulford Harbour.

Summer bacteriological results for marine stations are summarized in Appendix III, and a list of daily results for these stations are presented in Appendix IV. Bacteriological results for the summer freshwater sampling are summarized in Table 1 and daily results are given in Appendix V. Summer temperature and salinity ranges and means for all marine stations are presented in Appendix VI and tidal and rainfall conditions for July-August 1977, are presented in Appendices VII and VIII, respectively.

Bacteriological and physical data for the February, 1978 sampling period are presented in Appendix X.

5.1 Ganges and Walter Bay (Figure 4B)

Of the 21 stations positioned in Ganges Harbour, six exceeded the growing water standard, and of these six, stations 13, 14 and 15 were in close proximity to identified sewage discharges and were within the 400 foot (120 metre) wharf closures. The concurrent bacteriological study of the water quality at government marinas conducted by the Federal Activities Abatement Group of the Environmental Protection Service determined that at two other stations, one at the entrance of the most shoreward float of the DFE wharf, and one between the shore and the MOT wharf, the water quality was unacceptable for shellfish harvesting.

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*This report expresses the 10 percent limit as a 90 percentile which must not exceed 43/100 ml.

TABLE 1 SUMMARY OF BACTERIOLOGICAL DATA FOR FRESHWATER STATIONS

Sample Station	FC:FS Ratio	Mean Membrane Filtration Count/100 ml		
		Total Coliform	Fecal Coliform	Fecal Streptococci
S1	0.55	1937.3 (3)	337.3 (3)	613.3 (3)
S2	0.31	660 (2)	213 (3)	685 (2)
S3	0.39	2320 (2)	83.5 (4)	215 (4)
S4	1.15	>80 (1)	81 (1)	70 (1)
S5	-	>80 (1)	>80 (1)	>80 (1)
S6	0.11	419 (4)	36.6 (3)	349 (4)
S7	0.18	513.3 (3)	120.6 (3)	656.6 (3)
S8	1.73	1823 (2)	418 (2)	240.5 (2)

This data correlates well with some preliminary data obtained by Ker, Priestman and Associates in December 1974 from Ganges Harbour (4). Fecal coliform levels were high at the head of the harbour; northwest of Walter Bay; in the vicinity of the Ganges Creek mouth and DFE wharf; in the vicinity of the Harbour House Motel; and the Harbour's End Marina. The poor water quality was, however, localized to specific areas of the harbour, and generally speaking the water quality was good during the dry summer season. Water quality may be expected to deteriorate considerably during higher rainfall months.

This harbour is an embayed area, being relatively shallow with little or no current movement. The average tidal range is 2.3 meters. A drift card study in upper Ganges Harbour carried out by the Capital Regional District (5) showed that in light winds blowing on an ebbing tide, climatic conditions which should be favourable to seaward dispersion of sewage, 100% of all drift cards, presumably started near the exit port of a proposed 480 metre sewage pipeline, ended up on the

beaches within 3-4 hours. Thus the removal of contaminated waters from the inner harbour appears to be largely dependent on weak tidal currents.

Presently, in the Ganges Harbour area, most sewage disposal is effected by septic-tank, tile-field systems and, in some cases, by sewage holding tanks which are regularly pumped out by a septic tank service for land disposal. Factors which undermine the effectiveness of these systems in this area include slopes in excess of 15%, a seasonal water table within 4 feet of the surface, a depth-to-rock of less than 4 feet, and poor soil percolation. These can lead to malfunctioning of the treatment systems although there may be other causes, such as infrequent emptying of the tanks. At the time of the survey, there were 13 unsatisfactory sewage treatment systems in Ganges, as identified by the Public Health Unit, one of which was being corrected, according to information received from the Public Health Unit in Ganges.

The confirmed and suspected sources of pollution in Ganges that received our attention during the survey are discussed below.

A dye test revealed that septic seepage from the Funque and Junque Antique Store in Ganges was contaminating Ganges Creek (S1). This creek had moderate fecal coliform and fecal streptococci levels (Table 1). The ratio of fecal coliform/fecal streptococcus was 0.55 suggesting pollution from animal sources was one causative agent for the bacterial contamination observed. Previous samples taken even further upstream in January and September 1973 had fecal coliform MPN counts of 750/100 ml and 5400/100 ml, respectively (4).

Also confirmed faulty by dye testing was the sewage disposal system of the Esso Gasoline Station. Septic seepage from the absorption field reaches the foreshore via a nearby culvert which empties just north of the government wharf (DFE) boat launching ramp.

Sewage disposal system problems were reported at the Red and White Grocery Store which had had seepage contaminating a storm drain; at Mouat's Department Store; and at the Ship 'n Anchor Hotel which had a large amount of septic seepage emanating from its septic tank system. A sediment sample of the foreshore near the Ship n' Anchor Hotel exhibited a fecal coliform MPN of 1.6×10^7/100 g.

The K & R Grocery Store, was having its septic tank pumped out regularly due to an inadequate absorption field.

The elementary and secondary schools, the vocational unit, Mahon Hall, and the School Board-Health Unit office building are serviced by a system of three septic tanks which discharge effluent to the foreshore of Ganges Harbour. The location of septic sludge near the supposed position of the outfall indicated that the combined discharge occurs above the high water mark. Also, a large amount of seepage near the school complex was confirmed septic by a sediment analysis for fecal coliform, which gave >1600 MPN/100 ml.

During the survey, the Harbour House Motel in Ganges was experiencing difficulties with their septic-tank, tile-field system, as well as with their plumbing. A dye test demonstrated that effluent was draining down the surface of the ground to the road where it could have reached the foreshore through a culvert.

Drainage in a storm culvert from Ganges townsite was observed running onto the foreshore. Because of its strong hydrogen sulfide odor (diagnostic of septic discharge), the presence of a grey-white scum in the pipe, and the high flow during a period of dry weather, the drainage was very likely the result of a sewage disposal system mulfunction. The nearby Crest Restaurant, according to the proprietor, previously had a discharge to the drain but this was said to have been corrected.

A potential problem was found at the Gulf Marina Office Building which has a septic tank under the building and its absorption field under a driveway. A dye test for septic seepage was negative; however, the location of this sewage treatment system appears to contravene Sections 6:12 (c) and 6:20 (a) of the Provincial Sewage Disposal Regulations.

Fecal contamination also originated from vessels moored at the Gulf Marina, although there is only occasional overnight use of this marina; the Harbour's End Marina which has a 60-boat capacity, no on-shore washrooms and had two temporary live-aboards; and the Government Wharf, which has a 90-boat capacity, one live-aboard, and shore-based washrooms in an adjacent public park. No seepage was found in the vicinity of these washroom facilities or the associated tile-field.

No noticeable problems were found at the Saltspring Island fish plant on Rainbow Road which utilizes a holding tank system. The tanks are pumped out 2-3 times per week when five people are employed and three times per day during the herring season when 25 persons are employed. This holding tank receives domestic sewage and fish offal, and the pumped-out effluent is discharged onto private property a considerable distance from the sea.

A laundromat on Rainbow Road was reported to be awaiting a permit to discharge sewage laundry effluent to the ground (septic tank system); however, this business was also located a considerable distance from the foreshore.

The remaining three stations inside Ganges Harbour which did not meet the growing-water standard were stations 8, 9, and 10, located in Walter Bay. A stream, S3, entering this bay near station 9 exhibited relatively low fecal coliform counts, with a mean of 83.5/100 ml and an FC:FS ratio of 0.39. This ratio is indicative of animal pollution which would likely contribute to the impairment of stream water quality during periods of high precipitation. Another small creek, S2, entering northwest of the bay's mouth also exhibited fecal counts, with a mean of 213/100 ml and an FC:FS ratio of 0.31, once again indicative of animal pollution.

Livestock at the head of the bay, and discharges from boats moored in the bay are also possible sources of contamination. There is a sizeable geoduck resource on the Ganges Harbour side of the Walter Bay spit near the bay's mouth. The water in the area, at stations 1, 6 and 7, met the water quality standard.

5.2 Long Harbour (Figure 4B)

All stations (28 to 37) in Long Harbour met the shellfish growing water standard, including those in areas presently under closure. The Royal Vancouver Yacht Club marina was accommodating a considerable number of vessels during the survey period. However, despite its onshore washroom facilities, some degree of sewage contamination might be expected in the vicinity of the marina, especially during the summer,

although none was detected. The 400-foot (120 metre) wharf closure appears to be adequately protecting the shellfish resource in the vicinity of the RVYC docks.

Water quality in the vicinity of the ferry terminal met the standard, although it could be impaired as a result of sewage discharges emanating from ferries while at the terminal. A dye test of the Queen of Tsawwassen was conducted while the vessel was loading at the Long Harbour slip. It revealed that effluent from on-board washroom facilities, which were available to the public while at the terminal, discharged directly to the sea. The terminal itself is equipped with two washrooms and a septic-tank, tile-field system. Both the tank and the tile field are covered with asphalt, technically in contravention of Sections 6:20 (b) and (c) of the British Columbia Health Act Sewage Disposal Regulations. However, this system was installed prior to the promulgation of the Regulations and is, therefore, exempt. There were no visible signs of seepage in the area, and the water quality of nearby stations 30 and 31 was not impaired.

At the time of the summer survey, an old derilect ship was moored at the head of Long Harbour and was occasionally occupied. The houseboat was scheduled to be removed in the fall, and water in the vicinity was found to be acceptable for shellfish harvesting. It was no longer moored there in February 1978.

5.3 Walker Hook (Figure 4A)

During the summer survey, all stations within Walker Hook (39 to 50) and station 38 which was established on the southeastern shore of the Walker Hook spit as a control, met the growing water standard, with the exception of station 48. In addition to water samples, sediments at stations 46, 47, and 48 were collected and analyzed. These proved to have low fecal coliform levels of 10/100 g or less except on July 27, when the sediment at station 48 had a slightly elevated fecal coliform MPN of 46/100 g. Oyster samples (Appendix IX) taken at stations 39 and 46 on August 3 did not have excessive levels of fecal coliforms in their tissues.

On July 21, most stations within the Hook showed elevated fecal coliform levels, particularly station 39 which had an MPN in excess of 1600/100 ml. Subsequent sampling did not indicate a recurrence of this event and the source of contamination could not be ascertained. At the time of sampling the winds were light, blowing from the southeast, and the tide was flooding. No rainfall had occurred in the preceding five days precluding the possibility of landwash being responsible.

It is possible that sewage discharged from the Malaview Estates development may have resulted in these higher fecal counts although several factors argue against such an occurrence. Firstly, Trincomali Channel floods in a northwesterly direction which would carry sewage away from Walker Hook. Secondly, although sewage would move southeast towards Walker Hook during the ebb tide, no contaminated water would enter the hook, as the area dries on a low tide. Thirdly, sample stations further towards the sewage outfall had decreasing fecal coliform levels on July 21, suggesting the contamination observed in Walker Hook was more of a localized problem.

The Hedgecock residence on Ross Road had an exposed tile field drainage pipe from which effluent drains in the direction of a small creek bed. This creek which would empty into the Hook close to the location of station 48 was not flowing at the time of the summer survey.

This was re-examined in February (Station FS1) but the leakage did not appear to be contaminating the stream which was then flowing at a rate of 0.05 m^3 sec^{-1} (9.9×10^5 IGPD). This stream was sampled but an analysis of the fecal coliforms level revealed that no significant contamination was present with a mean count of 7/100 ml and a population equivalent of 0.0098.

5.4 Malaview Estates (Figure 4A)

During the summer survey, sample stations 51-59, located immediately northwest of Walker Hook met the shellfish growing water standard with the exception of station 57, which was located directly over the Malaview Estates sewage treatment plant (STP) outfall.

This STP is a Spirogester primary treatment, non-chlorinating plant, a version of the Imhoff Tank which is generally capable of removing 50% of the BOD and 40-60% of suspended matter from raw sewage. The Pollution Control Branch Permit for this plant allows for an average 24 hour discharge of 0.001 m^3 sec^{-1} (21 250 imperial gallons). During the summer survey, the flow rate was estimated at 0.0005 m^3 sec^{-1} (10 000 IGPD). Flow increased to 0.0006 m^3 sec^{-1} (11 800 IGPD) in February and would probably increase further during periods of heavier precipitation from groundwater and inflow from surface runoff.

Work to reduce infiltration had been done between the summer and winter surveys and also since the February survey. The permit also states that the effluent is to be discharged through an outfall 213 meters from the shoreline, and 13.4 meters below low water.

It was found during the summer survey that the effluent had a relatively high fecal coliform concentration (1.02×10^7/100 ml), as determined by membrane filtration technique, despite a reduction of 84% from raw sewage fecal coliform levels. Additional chemical sampling was done at this plant and the results of these analyses are presented in Appendix XI.

A dye test on July 26 indicated that the effluent was being discharged approximately 190 feet from the shoreline into 1 to 2 metres of water at low tide. Investigation by a diver confirmed a break in the outfall pipe at this point.

On July 28, surface samples collected at slack low water from stations 51-60 showed elevated fecal coliform levels, with a value 1600/100 ml in the surface sample at station 57. A trend of higher levels with increasing distance south from the outfall seemed to present itself on that day only, partially because sampling on other days was done on incoming or high slack tides. This suggests that under certain climatic and tidal conditions coupled with a break close to the shore in the pipeline, the effluent may remain near the surface and be moved back to shore by wind action some distance from the outfall.

Float study work done by Willis, Cunliffe & Tait in 1968 (5) at the site of the discharge shows clearly that sewage does not move towards

shore, when it is discharged at the end of the 213 meter unruptured pipeline, but rather moves parallel to the shore approximately 185 to 245 meters offshore. Float data obtained during the worst possible dispersion conditions, i.e., slack tide with only a 0.6 metre change between low and high tides indicates that the effluent remains in an area approximately 380 m northwest of the outfall and 215 m southeast of the outfall. Thus, under normal operating conditions, the shoreline in the vicinity of the outfall would be minimally affected.

Some geoduck sampling was done in August in the vicinity of the outfall and these tissues were of satisfactory bacteriological quality for marketing purposes.

The results of the short monitoring program of the Malaview Estates sewage treatment plant which was conducted by EPS personnel during the February 1978 survey indicated that the plant was meeting the requirements of the PCB permit. The fecal coliform count of the final effluent was somewhat lower (2.9×10^6/100 ml) than those obtained during the July-August 1977 survey. However, the fecal count in the final effluent was slightly higher than the count in the untreated sewage indicating the plant was not effective in reducing bacterial numbers.

The pipeline had been repaired and the February survey found no evidence of contamination in the intertidal area nearby. Stations 52-56 and 58 all exhibited acceptable fecal coliform levels, further supporting the float study data.

5.5 Fernwood Point to Southey Point (Figures 3 and 4A)

Sample stations 60-70 all exhibited acceptable water quality. Stations 59 and 60 were adjacent to the MOT government wharf at Fernwood Point. This wharf is used infrequently as it is in an area unprotected from the easterly winds and the shoreward side requires dredging if it is to be used at low tide. No sewage contamination was evident here, and the shellfish resource was reported as being somewhat depleted along this stretch of coastline due to heavy harvesting.

The oyster lease, lot 341, on the northeastern side of the island was not marked nor were any oyster beds evident. No pollution sources were discovered in this area. A littleneck clam sample taken at station 65 on August 3 was of satisfactory bacteriological quality.

5.6 Southey Point to Parminter Point

All sample stations along this stretch of shoreline (71 to 86) met the water standard. However, three suspect pollution sources were identified: (1) the Peacock weekend residence at the unnamed point west of Southey Point near station 71 which had evidence of septic seepage; (2) the Simpson farmhouse which had a seepage pit adjacent to a dry stream bed near station 74 in Stonecutter's Bay (no seepage was evident but there may be a pollution problem in rainy weather); and (3) a mobile home which apparently had a septic tank and outfall in a small cove near station 82, north of Parminter Point (contact with the owners could not be arranged at the time). There was occasional evidence of some contamination in the receiving waters at station 82, but the levels of fecal coliforms were not high and met the water quality standard.

The Peacock residence and the Simpson farmhouse were re-visited in February to check for pollution problems. No seepage was visible at the Peacock residence but the home appeared to have been unoccupied for quite some time. No seepage was evident at the small stream which was flowing near the Simpson farmhouse seepage pit. A single sample of this stream yielded a fecal coliform count of 50/100 ml.

5.7 Duck Bay, Dock Point (Figure 3)

Of stations 87 to 91, situated in the Duck Bay vicinity, numbers 87, 89 and 91 exceeded the growing-water standard. Two possible causes of pollution were evident:

1) discharges from boats moored in the area - there are reportedly up to 40 boats present on some summer weekends;
2) the stream entering at the head of the bay had septic sludge noted at its mouth. This stream, S4, was sampled on July 14 when it had a coliform count of 81/100 ml and a fecal streptococcus count of

70/100 ml. After this date the stream had dried, making further sampling impossible. The sludge at the mouth was tested on August 16, and had a high fecal coliform level of 2.2×10^4/100 g. Further sampling of the stream in February did not indicate the presence of significant levels of fecal coliforms.

All houses in the bay area were well above the high tide level and no other pollution sources could be identified at the time. The stream drains St. Mary Lake which is a popular tourist area in the summer. The Gulf Island Septic Tank Service which has a permit to discharge to ground in an area north of St. Mary Lake and west of Fernwood Point was investigated and was considered to pose no pollution problems to the lake or the sea. This service is permitted to dispose septic tank sludge and holding tank contents from various locations on Saltspring Island to ground disposal trenches at the rate of 120 000 liters (10 000 Imperial gallons) per month, with an application on file to amend the permit to 600 000 liters per month (50 000 IGPM).

No other examination of potential pollution sources to St. Mary Lake was conducted. In February, the Forrester residence at the head of Duck Bay was checked for a malfunctioning septic-tank, tile-field system. The owner reported that his septic tank had overflowed during the summer but there was no evidence of malfunction in February, and a dye-test of the system was negative.

It is possible that the sewage system malfunction was the cause of contamination observed during the summer survey, although discharges from moored boats is the more probable source.

5.8 Vesuvius Bay (Figure 3)

In Vesuvius Bay, stations 92 to 97 were sampled, and of these, stations 94, 95, and 96 exceeded the water quality standard. Two major sources of pollution were identified. Direct sewage discharges may occur from the ferry while at the terminal for loading and off-loading. The Vesuvius Queen is equipped with holding tanks and should not pose a pollution threat provided good housekeeping is practised. The alternate vessel on this run, the Saltspring Queen, is not equipped with holding

tanks and may discharge sewage directly if the washroom doors do not remain locked while the ferry is at the terminal. The terminal is equipped with a portable toilet which is on a holding-tank, pump-out system with no evident pollution problems. The Seaside Kitchen Restaurant has a direct septic tank discharge to the bay but because this system was in operation before the Sewage Disposal Regulations were promulgated, no PCB permit is required. Some contamination most likely stems from the considerable number of boats using this bay, although there is a 24-hour limit in this area, which is also popular for swimming. A beach investigation revealed no other likely sources of contamination.

The southwestern shoreline of the bay was not adversely affected by these sources of pollution.

5.9 Booth Bay, Booth Inlet (Figure 3)

During the summer survey, stations 98, 99, 110 and 111 were sampled in Booth Bay and all met the growing water standard. Stations 100 to 109 were sampled in Booth Inlet and of these, stations 102, 103, and 104 exceeded the standard at the median level. The source of this contamination could not be ascertained. A creek at the head of the inlet had low fecal coliform levels during both summer and winter investigations. It may be of significance that water at the extreme head of the inlet, where the contamination was discovered, does not appear to drain out to sea at low tides, but rather appears to stagnate. Also, a beach investigation revealed that a house near station 105 had an apparent sink discharge but the owners could not be located at the time, and the type of discharge was not confirmed.

An occupied sailboat was moored near the mouth of Booth Inlet and reportedly is moored there all year. This area is very productive for clams, and there is much digging for these shellfish both recreationally and commercially. The water was of acceptable shellfish growing quality at stations 100, 107, 108 and 109 during both the summer and winter sampling programs.

A sediment sample which was taken from what appeared to be septic seepage near a house close to station 110 on August 15 had a fecal coliform MPN of 130/100 g, but the water quality in this area was acceptable. This fecal coliform level is not extraordinarily high for sediment samples and may indicate a low level source of contamination which, through dilution, would not significantly impair water quality.

5.10 Erskine Point (Figure 3)

Bacterial levels at stations 112 and 113 were elevated but not in excess of the growing water standard. The area is used mainly for swimming; no houses were in the immediate vicinity, and the stream at the beach was not flowing.

5.11 Burgoyne Bay (Figure 3)

During the summer survey, four stations, 114 to 117, were established here to monitor the overlying water quality at the oyster lease on lot 313. All four stations exceeded the growing water standard.

Burgoyne Bay is a popular anchorage for pleasure craft and discharges from these boats might be one source of contamination in the bay. There is a DFE government wharf northwest of the oyster lease which has a 2-hour limit at all times for other than commercial fishing boats during the February-March herring season.

Three freshwater stations were established in this bay in July-August 1977. One sample was taken from an almost dry stream bed (S5) on the north side of the lease, however, the fecal coliform and fecal streptococcus counts were indeterminate (>80/100 ml) and subsequent sampling was impossible as the stream had dried. Additional sampling during February 1978 indicated this stream was not a significant source of contamination with a mean fecal coliform count of 66.8/100 ml and a population equivalent of 0.054.

Freshwater station S6 was established at a flowing creek near some houses on the south side of the lease and S7 samples were taken from a stagnant pond which would flow into S6 during either the summer or

winter sampling periods. This stream was not a significant contributor of fecal contamination to the bay. Similarly, S7 had low fecal coliform levels. Fecal streptococci levels were also very low although the FC:FS ratio obtained during the summer sampling indicated that the major source of contamination to S6 and S7 was from animal fecal matter. Several muskrats reportedly live nearby and the stream feeding the pond drains pastureland although no livestock were using the land during the summer. There were no indications of septic seepage from either residence at the head of the bay during both winter or summer conditions.

The flow in S5 greatly increased during the winter and this stream drains a considerable amount of pastureland. Manure was noted in this stream bed and it is likely that a major rainfall event would cause water quality impairment in the vicinity of this discharge. However, the high fecal counts obtained during the summer study could not be accounted for by freshwater inputs to the bay and moored boats in the bay were suspected to be the chief source of contamination.

Oyster samples were collected on August 15 at stations 115 and 117. These were found to have fecal coliform levels of 70 and 20 MPN/100 g respectively.

5.12 Bold Bluff Point - Isabella Point (Figure 3)

This stretch of coastline was not surveyed because shellfish resources and residential populations were minimal. No problem areas were suspected.

5.13 Fulford Harbour - Russell Island (Figure 4C)

The Fulford Harbour intertidal zone has an extensive shellfish resource, which includes horseclams, littleneck, and butter clams. Stations 118 to 135 were located in this area; of these, stations 123, 124, 127 and 128 were not of acceptable water quality. Some identified and suspected sources of pollution are discussed below.

A small spring-fed stream entering the sea on the south side of the harbour near station 124 proved to have a high fecal coliform count which exceeded 1600/100 ml. The contamination is suspected to originate

from the sewage disposal facilities on the property that the stream crosses, although a dye test was inconclusive. This stream is a suspected contributor to the pollution discovered at stations 123 and 124. However, there was no evidence of seepage on the premises when an inspection was done in February.

Fecal contamination at the head of the harbour, as shown by the unacceptable water quality of stations 127 and 128, is attributable in part, to Fulford Creek. During the summer survey, the mean fecal coliform level was 418/100 ml and this contribution, coupled with the relatively slow flushing action in Fulford Harbour (personal observation) could result in the accumulation of contaminated water at the head of the harbour. The source of contamination at Fulford Creek was not established although the creek does drain a considerable area of pastureland. One operation which was surveyed as a possible contributor was the Burgoyne Dairy. Fecal coliform and fecal streptococcus levels were relatively unchanged both above and below the reported input from the dairy. The ratios of fecal coliform to fecal streptococcus were 1.03 above the dairy and 1.75 below it, suggesting, albeit inconclusively, that the contamination originated from livestock. However, the dairy itself could not be identified by this information as a pollution problem. Landwash from the livestock area drains to a pond which could overflow into Fulford Creek in periods of heavy rainfall. Winter sampling of the creek indicated low fecal coliform levels with a corresponding population equivalent of 0.26.

The waiting-room at the Fulford Harbour B.C. Ferry Corporation terminal is equipped with washrooms, with the sewage treated by an extended aeration treatment plant. There is no chlorination of the effluent. A dye test located the discharge at the high tide level although this plant was reported to have had a tile-field system, not an outfall. This may be indicative of a broken pipeline. The discharge occurs intermittently and no contaminating effect from it was evident at nearby marine station 131.

The DFE wharf adjacent to the terminal was accommodating several live-aboard vessels at the time of the survey. Scum on the nearby shore was sampled on August 4 and was found to have a fecal coliform level in excess of 1600/100 ml. On the outside of this small bay and of the ferry slip there is a MOT wharf at which vessels tie-up for brief periods. Despite the above mentioned confirmed sources of pollution in the vicinity of stations 130 and 131, the water quality there was acceptable. However, in the concurrent small-craft marina study of government wharves, undertaken by the Federal Activities Branch, two sample stations were established within the DFE wharf floats. Both of these stations had high fecal coliform and low fecal streptococcus counts which indicated that human waste was the source. This contamination was localized within the marina.

The water quality at stations 131, 132 and 133 was acceptable; however, several identified and suspected sources of contamination in the area are discussed below.

Some moisture and black sediment was observed above the low-water mark near Nan's Cafe beside the ferry terminal. No dye was observed when the cafe was tested, so the moisture may have originated from another, possibly non-septic, source. An inspection of Nan's Cafe premises was carried out in February but the restaurant was closed for the winter and no evidence of seepage near the tile field was found. A house and guest house near the MOT wharf, east of the terminal but within the existing Schedule 1 1000-foot (308 metre) closure each have a raw sewage discharge to the sea. Only one person was in residence at the time of the survey. A small summer house in the same vicinity has a septic tank with a reported 90-meter offshore outfall which is equipped with a valve such that discharges occur only at high tide.

In July-August 1977, at the mouth of Fulford Harbour on the north side, a houseboat was moored in one of the small coves. Direct discharge may have occurred from the boat but the owner/occupant was not available for an interview. The water quality at nearby station 134 was acceptable. This houseboat had been moved near the head of the Harbour by February and had apparently been the subject of complaints from the shore residents.

Station 135 on Russell Island which is situated at the mouth of Fulford Harbour was of acceptable water quality, although there is reportedly a direct discharge from a home on this island.

5.14 Beaver Point - Batt Rock (Figure 3)

Stations 136 to 146 were all of acceptable water quality. However, the Unger residence, near station 137, had a direct discharge to the foreshore, as the outfall pipe was found to be broken above the low-water level.

Cusheon Creek which drains Cusheon Lake to the sea was sampled near the mouth as well as upstream. Fecal coliform levels at both sampling points were low, whereas fecal streptococcus levels were elevated (660/100 ml and 460/100 ml respectively) indicating animal wastes as the probable pollution source. No fecal coliform counts were picked up at marine station 142, near the mouth of the creek. There was a moderate sized shellfish resource in this area.

REFERENCES

1. Standard Methods for the Examination of Water and Wastewater, 14th edition, American Public Health Association, Washington, D.C., (1975).

2. Andrews, W.H., and M.W. Presnell, "Rapid Recovery of Escherichia coli from Estuarine Water." Applied Microbiology 23:521-523 (1972).

3. Environment Canada, Fisheries Service - Environmental Protection Service Laboratory Manual, Latest edition (1978).

4. Appeal from Pollution Control Permit No. 2049 by the Canadian Scientific Pollution and Environmental Control Society, Supplementary Information. Information supplied by Ker, Priestman and Associates Ltd. (December 1974)

5. Willis, Cunliffe and Tait, Float Study conducted for the Capital Regional District (1968).

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APPENDICES

APPENDIX I

MARINE SAMPLE STATION LOCATIONS

APPENDIX I MARINE SAMPLE STATION LOCATIONS

Sample Station	Latitude (North)	Longitude (West)	Description
1	48° 49.85'	123° 27.60'	In line with light on Second Sister and glass fronted house on Saltspring Island
2	48° 49.90'	123° 27.81'	Off large white house SE Ganges Harbour
3	48° 50.10'	123° 28.12'	Off big brown house near large tree, SE Ganges Harbour
4	48° 50.30'	123° 28.25'	Off brown house with Canadian flag (between Sample Stations 3 and 5)
5	48° 50.45'	123° 28.48'	Off white house with Canadian flag, SE of spit outside Walter Bay, SE Ganges Harbour
6	48° 50.70'	123° 28.84'	Mid-way on outside of Walter Bay spit
7	48° 50.70'	123° 29.03'	Tip of outside of Walter Bay spit
8	48° 50.50'	123° 28.82'	Head of Walter Bay, at centre
9	48° 50.60'	123° 29.08'	Mouth of small stream near a large brown house, west side of Walter Bay
10	48° 50.65'	123° 29.21'	Off small, rickety white boat shed, mouth of Walter Bay
11	48° 50.70'	123° 29.35'	Off red house and red boat-house, NW of mouth of Walter Bay
12	48° 50.80'	123° 29.66'	Off curved, felled tree on small pebble beach
13	48° 50.95'	123° 29.79'	Off group of felled trees opposite marina
14	48° 50.10'	123° 29.89'	Off brown house behind marina
15	48° 51.45'	123° 29.98'	Below hotel, north end of Ganges Harbour
16	48° 51.45'	123° 29.73'	Brown house with green and white sundeck, Ganges Harbour

APPENDIX I MARINE SAMPLE STATION LOCATIONS (continued)

Sample Station	Latitude (North)	Longitude (West)	Description
17	48° 51.40'	123° 29.50'	Green and white house with red roof, Ganges Harbour
18	48° 51.30'	123° 29.29'	Rock wall at middle, edge of Ganges old closure
19	48° 51.30'	123° 29.00'	Off yellow house on small point in Ganges Harbour
20	48° 51.50'	123° 29.19'	Small bay at northern most part of Ganges Harbour
21	48° 51.35'	123° 28.69'	In notch just north of Sample Station 22
22	48° 51.25'	123° 28.59'	Off yellow house, onshore from Goat Is.
23	48° 51.20'	123° 28.45'	East of rock outcropping, off white house with red roof and yellow stained railings, onshore from Goat Island
24	48° 51.90'	123° 27.51'	Fisheries boundary marker on northern shore of Ganges Harbour, in line with First Sister Island
25	48° 50.60'	123° 27.82'	Midway between Deadman and First Sister islands
26	48° 50.95'	123° 26.80'	Off white beach cottage, NW head of Welbury Bay
27	48° 50.05'	123° 26.65'	Off ferry terminal sign, at head of Welbury Bay
28	48° 50.85'	123° 26.10'	Off western end of dock at RVYC
29	48° 50.95'	123° 26.24'	Off private wharf approximately 270 m west of Yacht Club wharf
30	48° 51.10'	123° 26.50'	Mid-channel off beacon approximately 180 m east of ferry terminal
31	48° 51.35'	123° 27.09'	Mid-channel of "Do not Dump" sign approx. 180 m west of ferry dock

APPENDIX I MARINE SAMPLE STATION LOCATIONS (continued)

Sample Station	Latitude (North)	Longitude (West)	Description
32	48° 51.55'	123° 27.57'	Off brown house (middle in group of 3)
33	48° 51.60'	123° 27.73'	Mid-channel between point and wharf with white railing
34	48° 51.60'	123° 27.86'	Offshore next to modified A-frame boathouse, South side of Long Harbour
35	48° 51.60'	123° 27.97'	Off brown house with log retaining wall, south side of Long Harbour
36	48° 51.70'	123° 27.80'	Brown house with dock at NW end of Long Harbour (last house)
37	48° 51.70'	123° 27.72'	Off white house with large view window
38	48° 53.40'	123° 29.52'	Middle of beach on the west side of the head of Walker Hook
39	48° 53.45'	123° 29.63'	Head of Walker Hook
40	48° 53.40'	123° 29.74'	100 metres NW of SE corner (just past marsh grass), south side of Walker Hook
41	48° 53.45'	123° 29.69'	Middle of head of Walker Hook, 100 yards from SE shore
42	48° 53.50'	123° 29.63'	Opposite shore in line with Sample Stations 40 and 41
43	48° 53.50'	123° 29.86'	At rocky outcropping and dead branches across from bare patch
44	48° 53.55'	123° 29.81'	Middle of Walker Hook, almost out from flat rock on Hook
45	48° 53.55'	123° 29.81'	At flat rock, halfway along Hook
46	48° 53.60'	123° 29.99'	SE of Hook tip across from white house with red roof
47	48° 53.60'	123° 30.05'	At middle of Walker Hook out from white house

APPENDIX I MARINE SAMPLE STATION LOCATIONS (continued)

Sample Station	Latitude (North)	Longitude (West)	Description
48	48° 53.60'	123° 30.08'	Off white house, Walker Hook
49	48° 53.64'	123° 30.16'	Small float at red house
50	48° 53.75'	123° 30.19'	Tip of Walker Hook
51	48° 53.90'	123° 30.40'	White house past tall fir, tip of Walker Hook
52	48° 54.20'	123° 30.85'	Cluster of three houses
53	48° 54.50'	123° 31.11'	Off boathouse and ramp below houses
54	48° 54.70'	123° 31.38'	Brown house with big windows and white roof trim, large arbutus
55	48° 54.70'	123° 31.45'	180 m SE of outfall at old staircase
56	48° 54.70'	123° 31.50'	Onshore at outfall
57	48° 54.75'	123° 31.45'	Plume of Malaview outfall
58	48° 54.75'	123° 31.52'	NW of outfall, off large white house
59	48° 54.75'	123° 31.59'	180 m NW of house being built
60	48° 54.75'	123° 31.59'	Off rickety old dock near Fernwood Road
61	48° 55.00'	123° 32.15'	Off white house with green trim approx. 105 m NW of Fernwood wharf
62	48° 55.10'	123° 32.45'	Off dead tree approximately 210 m NW of wharf just in from 1st (pink) buoy
63	48° 55.15'	123° 32.60'	Off house with brown wood siding and green trim on sundeck, stone wall on beach
64	48° 55.25'	123° 32.85'	Off road leading to beach
65	48° 55.35'	123° 33.00'	Off yellow house with green roof and large anchorage buoy
66	48° 55.40'	123° 33.10'	Off large white house with big windows and shake roof; large grass yard
67	48° 55.50'	123° 33.20'	Off large rock outcropping in front of large brown house

APPENDIX I MARINE SAMPLE STATION LOCATIONS (continued)

Sample Station	Latitude (North)	Longitude (West)	Description
68	48° 55.55'	123° 33.30'	Off yellow house with white trim NW of house with blue flag
69	48° 55.70'	123° 33.55'	Off pink house with shake roof
70	48° 55.65'	123° 35.45'	Just south of Southey Point; off beach with a large steel buoy
71	48° 56.55'	123° 35.55'	Off yellow and brown house at head of small bay on the west side of Southey Point
72	48° 56.30'	123° 35.80'	By the small anchorage buoy and past 2nd beacon at the sandy beach SE of Southey Point
73	48° 56.05'	123° 35.75'	Off turquoise house with boat ramp
74	48° 55.65'	123° 35.51'	Off pinky-brown house with green roof, head of Stonecutter's Bay
75	48° 55.45'	123° 35.39'	Off the white swimming float SW of Stonecutter's Bay
76	48° 55.35'	123° 35.29'	White house with small green porch and shed to left
77	48° 55.20'	123° 35.15'	Off A-frame with lots of windows in front, in little bay
78	48° 54.95'	123° 35.22'	Beige house with Canadian flag in front (on a separate pole)
79	48° 54.90'	123° 35.29'	Off cement wall
80	48° 54.90'	123° 35.35'	Off green wharf south of Sample Station 79
81	48° 54.80'	123° 35.40'	Off boathouse in the small cove SE of Sample Station 80 (large brown house on the hill to left)
82	48° 54.50'	123° 35.39'	Small cove SE of Sample Station 81
83	48° 54.50'	123° 35.32'	Head of cove

APPENDIX I MARINE SAMPLE STATION LOCATIONS (continued)

Sample Station	Latitude (North)	Longitude (West)	Description
84	48° 54.25'	123° 35.35'	Small cove SE of Sample Station 82
85	48° 54.00'	123° 35.25'	Small cove SE of Sample Station 84
86	48° 54.00'	123° 35.32'	2nd small cove SE of Sample Station 85
87	48° 53.15'	123° 34.42'	South side at head of Dock Point Bay
88	48° 53.10'	123° 34.39'	Middle at head of Dock Point Bay
89	48° 53.10'	123° 34.44'	North side at head of Dock Point Bay
90	48° 53.10'	123° 34.52'	Off house with stairway on south side of Bay
91	48° 53.45'	123° 34.66'	Off private dock on south side of Bay
92	48° 52.70'	123° 34.28'	Off concrete wall at end of rock spit - Vesuvius Bay
93	48° 52.75'	123° 34.22'	Midway between Sample Stations 92 and 94 - Vesuvius Bay
94	48° 52.80'	123° 34.16'	Across from Sample Station 92, off steps leading to the beach
95	48° 52.75'	123° 34.11'	Off public access stairway leading to Vesuvius Beach
96	48° 52.70'	123° 34.11'	Midway between Sample Stations 95 and 97
97	48° 52.70'	123° 34.18'	South side of Vesuvius Beach (45 m East of concrete wall)
98	48° 52.10'	123° 32.92'	Off grey house with large windows and Canadian flag - Booth Bay
99	48° 52.00'	123° 32.81'	Entrance to Booth Inlet
100	48° 51.95'	123° 32.64'	Mid-channel between almost dead fir tree and grass area on the north of the inlet

APPENDIX I MARINE SAMPLE STATION LOCATIONS (continued)

Sample Station	Latitude (North)	Longitude (West)	Description
101	48° 51.85'	123° 32.23'	Approximately 2/3 of the way across the Inlet from the boathouse mentioned in Sample Station 106
102	48° 51.80'	123° 31.94'	Approximately 2/3 of the way across the Inlet from the dead tree mentioned in Sample Station 103
103	48° 51.75'	123° 31.96'	Approximately 1/3 of the way across the Inlet off a dead tree which had fallen in the water
104	48° 51.75'	123° 31.80'	At the head of the Inlet, off a small wooden bridge
105	48° 51.80'	123° 32.10'	Mid-channel of roadway and small private dock on the south side
106	48° 51.85'	123° 32.10'	Approximately 1/3 of the way across the Inlet off a cedar shake boathouse with a barn-shaped house on the lot above
107	48° 51.85'	123° 32.32'	Mid-channel at entrance to inner Booth Inlet
108	48° 51.90'	123° 32.56'	Across from large, partial A-frame house on south side of Inlet
109	48° 52.00'	123° 32.68'	Across from Sample Station 100, on south side of Inlet, mid-channel between shore and grass area
110	48° 51.90'	123° 33.05'	Off a brown house with big windows, approximately 800' south of wharf - Booth Bay
111	48° 51.90'	123° 33.17'	Off a white house with blue and white awnings west of the resort wharf - Booth Bay

APPENDIX I MARINE SAMPLE STATION LOCATIONS (continued)

Sample Station	Latitude (North)	Longitude (West)	Description
112	48° 51.20'	123° 33.68'	Approximately half-way between the road and the end of Erskine Point beach
113	48° 51.15'	123° 33.80'	NW off road at Erskine Point beach
114	48° 47.45'	123° 31.02'	Off sign, "Oyster Culture, No Trespassing on Beach," at the oyster lease on the north side of Burgoyne Bay
115	48° 47.40'	123° 31.02'	Approximately 45 m SE of Sample Station 114
116	48° 47.35'	123° 31.07'	Off white house with a TV antenna at the head of Burgoyne Bay
117	48° 47.30'	123° 31.10'	Off the road at the head of Burgoyne Bay
118	48° 45.00'	123° 26.28'	Off a house with big windows and a curved fir tree, at the SE end of the harbour
119	48° 45.20'	123° 26.47'	Off a brown house with a red roof and verandah
120	48°45.25'	123° 26.54'	180 m NW of Sample Station 119
121	48° 45.40	123° 26.78'	Off house with a star-shaped roof antenna on chimmney
122	48° 45.50'	123° 26.89'	NW of Sample Station 121 at the end of a rock embankment where the road goes down to the beach
123	48° 45.65'	123° 27.01'	NW of Sample Station 122, off a white house above the road
124	48° 45.70'	123° 27.11'	NW of Sample Station 123 off a cement wall and staircase

APPENDIX I MARINE SAMPLE STATION LOCATIONS (continued)

Sample Station	Latitude (North)	Longitude (West)	Description
125	48° 46.00'	123° 27.38'	NW of Sample Station 124, off a brown house with green trim (on stilts), across from the ferry terminal
126	48° 46.20'	123° 27.56'	NW of Sample Station 125, off the swings at the park
127	48° 46.30'	123° 27.59'	Mouth of Fulford Creek
128	48° 46.35'	123° 27.49	Off the church on the north side of Fulford Harbour
129	48° 46.30'	123° 27.53'	Midway across Fulford Harbour between the church and the boat launch at the park
130	48° 46.20'	123° 27.00'	Off the last ferry pylon at the end of the Government wharf - Fulford Harbour
131	48° 46.15'	123° 26.93'	Off the sewage treatment plant at Fulford Ferry Terminal
132	48° 45.15'	123° 26.66'	At outfall 90 m offshore, off a brown house with white trim
133	48° 45.05'	123° 26.48'	Off an A-frame house with a white, brick chimney
134	48° 45.50'	123° 25.92'	SE end of Fulford Harbour, near mouth
135	48° 45.05'	123° 24.31'	Russell Island
136	48° 46.00'	123° 22.20'	Off a small shack just around the point from Sample Station 137
137	48° 46.15'	123° 22.37'	Small bay south of Beaver Point with a farm in the 1st bay
138	48° 46.50'	123° 22.62'	1st bay NE of Beaver Point
139	48° 46.70'	123° 22.73'	2nd bay NE of Beaver Point
140	48° 47.75'	123° 23.40'	Just around Yeo Point, SW of Sample Station 143

APPENDIX I MARINE SAMPLE STATION LOCATIONS (continued)

Sample Station	Latitude (North)	Longitude (West)	Description
141	48° 47.90'	123° 23.97'	Larger bay, on East side of Yeo Point, near a barn and an old house
142	48° 48.40'	123° 25.28'	Off an old staircase, SW of Sample Station 145
143	48° 48.55'	123° 25.37'	Off a wooden house with turquoise trim, SW of Sample Station 146
144	48° 48.70'	123° 25.46'	In the 3rd small cove, off a sign marked "Foreshore Rights" near a house made of granite chunks
145	48° 48.70'	123° 25.57'	Off a pink house with a dock, in the next cove SW of Sample Station 146
146	48° 48.80'	123° 25.70'	At the white buoy in the cove, off Batt Rock marker

APPENDIX II

FRESHWATER SAMPLES STATION LOCATIONS

APPENDIX II FRESHWATER SAMPLE STATION LOCATIONS

Sample Station	Description
S1	Ganges Harbour - Ganges Creek, taken at mouth.
S2	Ganges Harbour - NW of entrance to Walter Bay next to glass fronted house; sampled at mouth.
S3	Ganges Harbour - stream entering Walter Bay next to large brown house with vine-covered fir tree; sampled at mouth.
S4	Dock Point - stream entering at the head of Duck Bay sampled at Sunset Drive.
S5	Burgoyne Bay - mouth of stream on northern side of bay below bridge crossing.
S6	Burgoyne Bay - mouth of creek at head of bay flowing between the houses.
S7	Burgoyne Bay - small stagnant pool which drains into S6.
S8	Fulford Creek at mouth.

APPENDIX III

SUMMARY OF BACTERIOLOGICAL RESULTS FOR MARINE STATIONS

APPENDIX III SUMMARY OF BACTERIOLOGICAL RESULTS FOR MARINE STATIONS

Sample Station	Number of Samples	MPN Range	Fecal MPN/100 ml	
			Median	90th Percentile
1	6	< 2 - 2	< 2	2
2	6	< 2 - 5	< 2	3.2
3	6	< 2 - 13	4.5	10
4	8	< 2 - 7.9	2	17.4
5	7	< 2 - 33	2	19
6	6	< 2 - 17	4	11.6
7	6	< 2 - 13	6	10
8	8	< 2 - 350	6.5	88.4
9	8	< 2 - 94	15.5	58
10	9	< 2 - 540	11	180
11	9	< 2 - 79	8	19.6
12	10	2 - 79	7.5	23
13	9	< 2 - 170	13	46.7
14	7	2 - 240	31	149
15	6	< 2 - 79	23	61
16	10	< 2 - 8	< 2	5
17	7	< 2 - 2	< 2	< 2
18	11	< 2 - 130	2	21.4
19	6	< 2 - 5	< 2	3.2
20	6	< 2 - 23	< 2	10.4
21	6	< 2 - 13	4.5	9.4
22	6	< 2 - 8	< 2	4.4
23	6	< 2 - 5	< 2	3.2
24	6	< 2 - 5	< 2	3.2
25	6	< 2 - <2	< 2	< 2
26	6	< 2 - 23	< 2	12.2
27	6	< 2 - <2	< 2	< 2
28	9	< 2 - 33	2	9.6
29	6	< 2 - 2	< 2	2
30	6	< 2 - 2	< 2	< 2

APPENDIX III SUMMARY OF BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (continued)

Sample Station	Number of Samples	MPN Range	Fecal MPN/100 ml	
			Median	90th Percentile
31	6	< 2 - <2	< 2	< 2
32	6	< 2 - 5	< 2	3.2
33	6	< 2 - 8	2	4.4
34	6	< 2 - 8	2	5.6
35	10	< 2 - 49	6.5	33
36	6	< 2 - 5	< 2	4.4
37	6	< 2 - 5	2	3.2
38	6	< 2 - 5	< 2	3.2
39	10	2 - >1600	5	23
40	10	< 2 - 130	4.5	33
41	6	< 2 - 22	3.5	11.8
42	6	< 2 - 11	< 2	5.6
43	10	< 2 - 46	2	23
44	6	< 2 - 23	< 2	17
45	6	< 2 - 8	2	6.2
46	6	< 2 - 23	2	12.2
47	6	< 2 - 33	2	14.4
48	10	< 2 - 130	7.5	94
49	6	< 2 - 8	2	6.2
50	6	< 2 - 4	< 2	2.8
51	6	< 2 - 9	< 2	4.8
52	11	< 2 - 350	2	15.7
53	11	< 2 - 110	2	7
54	13	< 2 - 190	< 2	23.1
55	6	< 2 - 23	< 2	17
56	10	< 2 - 17	< 2	5
57	6	< 2 - >1600	< 2	650.2
58	6	< 2 - 8	< 2	7.4
59	6	< 2 - 2	< 2	< 2
60	6	< 2 - 17	< 2	8

APPENDIX III SUMMARY OF BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (continued)

Sample Station	Number of Samples	MPN Range	Fecal MPN/100 ml	
			Median	90th Percentile
61	6	< 2 - 8	2	4.4
62	6	< 2 - 2	< 2	< 2
63	6	< 2 - 2	< 2	< 2
64	7	< 2 - 130	2	40.4
65	7	< 2 - 49	< 2	16.1
66	6	< 2 - 33	2	14.4
67	6	< 2 - 12	3.5	7.8
68	6	< 2 - 13	< 2	6.4
69	6	< 2 - 2	2	2
70	6	< 2 - 2	< 2	< 2
71	6	< 2 - 5	< 2	5
72	6	< 2 - <2	< 2	< 2
73	6	< 2 - <2	< 2	< 2
74	6	< 2 - 2	< 2	< 2
75	5	< 2 - 5	< 2	5
76	5	< 2 - 5	< 2	3.5
77	5	< 2 - <2	< 2	< 2
78	5	< 2 - 2	< 2	2
79	5	< 2 - <2	< 2	< 2
80	5	< 2 - <2	< 2	< 2
81	5	< 2 - 2	< 2	2
82	4	< 2 - <2	< 2	< 2
83	5	< 2 - 8	2	5
84	5	< 2 - 8	< 2	5
85	5	< 2 - <2	< 2	< 2
86	5	< 2 - 5	< 2	3.5
87	6	< 2 - 220	8	94.6
88	5	< 2 - <2	< 2	< 2
89	7	< 2 - 240	2	121
90	6	< 2 - 14	< 2	6.8

APPENDIX III SUMMARY OF BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (continued)

Sample Station	Number of Samples	MPN Range	Fecal MPN/100 ml	
			Median	90th Percentile
91	8	< 2 - 540	< 2	109.6
92	6	< 2 - 22	2	14.2
93	6	< 2 - 4	< 2	2.8
94	8	< 2 - 540	6.5	196
95	6	2 - 920	23	446
96	6	< 2 - 110	12	63.8
97	6	2 - 79	10.5	39.4
98	5	< 2 - 8	2	6.5
99	5	< 2 - 2	< 2	2
100	2	2 - 23	5	14
101	5	< 2 - 8	5	8
102	5	5 - 49	22	41
103	5	9 - 79	33	56
104	5	2 - 130	70	104.5
105	5	5 - 8	5	7
106	5	< 2 - 11	7	9.5
107	5	< 2 - 11	4	8
108	5	< 2 - 8	2	8
109	5	< 2 - 13	5	10.5
110	6	< 2 - 31	2	17.2
111	7	< 2 - 17	< 2	6.5
112	7	< 2 - 79	2	27.2
113	7	< 2 - 49	< 2	37.8
114	8	< 2 - 110	12.5	78
115	8	< 2 - 240	20	84.8
116	6	5 - 79	31.5	61
117	6	7 - 170	33	115.4
118	6	< 2 - 11	2	6.8
119	6	< 2 - 13	6.5	11.8
120	6	< 2 - 8	2	5.6

APPENDIX III SUMMARY OF BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (continued)

Sample Station	Number of Samples	MPN Range	Fecal MPN/100 ml Median	Fecal MPN/100 ml 90th Percentile
121	6	< 2 - 13	6.5	11.8
122	11	< 2 - 79	2	21.5
123	6	< 2 - 79	9	59.2
124	6	4 - 140	15	103.4
125	6	< 2 - 13	3.5	13
126	12	< 2 - 49	12.5	31.6
127	6	33 - 350	185	350
128	6	4 - 110	19.5	63.8
129	6	< 2 - 13	5	10
130	6	< 2 - 8	< 2	6.2
131	6	2 - 11	2	11
132	6	< 2 - 2	< 2	2
133	6	< 2 - 23	2	15.8
134	5	< 2 - 11	4	8
135	4	< 2 - 2	< 2	2
136	6	< 2 - 2	< 2	< 2
137	7	< 2 - 8	< 2	8
138	2	< 2 - <2	< 2	< 2
139	2	< 2 - <2	< 2	< 2
140	6	< 2 - <2	< 2	< 2
141	6	< 2 - 33	2	14.4
142	6	< 2 - 2	< 2	< 2
143	6	< 2 - 5	< 2	3.2
144	6	< 2 - 2	< 2	< 2
145	6	< 2 - <2	< 2	< 2
146	6	< 2 - 2	< 2	2

APPENDIX IV

DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
1	July 20/77	0843	< 2
	21	0800	< 2
	22	0908	< 2
	25	1058	< 2
	26	1420	2
	27	1340	2
2	July 12/77	1615	< 2
	13	1355	< 2
	14	1720	5
	15	0950	< 2
	18	1620	2
	19	1005	2
3	July 12/77	1615	< 2
	13	1400	< 2
	15	0955	2
	18	1625	8
	19	1010	7
	Aug. 12/77	0840	13
4	July 13/77	1610	79
	15	1010	2
	18	1630	< 2
	19	1020	2
	Aug. 12/77	0850	2
	16	0950	< 2
	17	1035	< 2
	19	1100	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
5	July 12/77	1625	13
	13	1615	5
	15	1007	< 2
	18	1635	< 2
	19	1025	2
	Aug. 16/77	-	2
	17	1030	33
6	July 12/77	1630	4
	13	1620	17
	15	1013	< 2
	18	1640	8
	19	1030	2
	Aug. 17/77	1025	4
7	July 12/77	1635	13
	13	1625	8
	15	1015	< 2
	18	1640	2
	19	1035	7
	Aug. 17/77	1020	5
8	July 13/77	1630	< 2
	18	1650	< 2
	19	1040	8
	Aug. 12/77	0900	350
	17	1020	8
	18	1055	5
	19	1050	23

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
9	July 13/77	1635	2
	15	1025	< 2
	18	1655	49
	19	1045	23
	Aug. 12/77	0905	8
	16	0915	94
	17	0915	23
10	July 12/77	1635	< 2
	13	1640	33
	15	1025	8
	18	1710	11
	19	1050	7
	Aug. 16/77	0925	2
	17	1010	540
	18	1050	140
	19	1050	46
11	July 12/77	1640	< 2
	13	1645	79
	15	1030	4
	19	1055	8
	Aug. 16/77	0930	5
	17	1115	8
	18	1050	13
	19	1045	8

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
12	July 13/77	1650	8
	15	1030	7
	18	1720	5
	19	1100	11
	Aug. 12/77	0910	2
	16	0905	8
	17	1010	7
	18	1045	79
	19	1030	23
13	July 13/77	1655	2
	18	1725	33
	19	1105	13
	Aug. 12/77	0915	13
	16	0900	8
	17	1005	17
	18	1040	23
	19	1025	170
14	July 13/77	1655	5
	18	1730	2
	Aug. 12/77	0920	6
	16	0850	110
	17	1000	240
	18	1035	70
	19	1025	31

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
15	July 13/77	1735	49
	15	0905	2
	18	1550	33
	19	0905	5
	20	0812	13
	Aug. 12/77	0930	79
16	July 12/77	1525	5
	13	1730	< 2
	14	1715	5
	15	0910	8
	18	1235	< 2
	19	0915	< 2
	20	0816	< 2
	Aug. 16/77	1025	2
	17	1100	< 2
	18	1115	5
17	July 12/77	1530	< 2
	13	1725	< 2
	14	1710	< 2
	15	0910	2
	18	1230	< 2
	19	0920	< 2
	20	0821	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
18	July 12/77	1535	< 2
	13	1720	130
	14	1705	23
	15	0915	4
	18	1222	< 2
	19	0925	7
	20	0828	4
	Aug. 16/77	1015	2
	17	1055	2
	18	1100	< 2
	19	1105	< 2
19	July 12/77	1535	< 2
	13	1720	130
	14	1700	23
	15	0920	4
	18	1217	< 2
	19	0925	7
	20	-	4
20	July 12/77	1540	< 2
	13	1715	23
	15	0925	2
	18	1212	< 2
	19	0935	< 2
	Aug. 12/77	0935	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
21	July 13/77	1715	< 2
	15	0930	< 2
	19	0940	< 2
	Aug. 16/77	1005	13
	17	1045	7
	18	1105	7
22	July 12/77	1550	< 2
	13	1710	< 2
	14	1650	< 2
	15	0935	8
	18	1203	< 2
	19	0945	< 2
23	July 12/77	1550	< 2
	13	1705	< 2
	14	1650	2
	15	0940	5
	18	1200	< 2
	19	0950	< 2
24	July 13/77	1725	5
	14	1640	< 2
	15	0915	< 2
	18	1152	< 2
	19	1014	< 2
	Aug. 12/77	0950	2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
25	July 12/77	1605	< 2
	13	1410	< 2
	14	1725	< 2
	15	0905	< 2
	18	1610	< 2
	19	0955	< 2
26	July 13/77	1715	< 2
	14	1630	23
	15	1005	< 2
	18	1143	5
	19	1006	< 2
	Aug. 12/77	1000	< 2
27	July 13/77	1710	< 2
	14	1625	< 2
	15	1005	< 2
	18	1138	< 2
	19	1002	< 2
	Aug. 12/77	1005	< 2
28	July 13/77	1655	2
	14	1615	7
	15	0955	33
	18	1127	< 2
	19	0951	< 2
	Aug. 12/77	1020	< 2
	16	1340	7
	17	1630	< 2
	18	1415	4

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
29	July 13/77	1650	< 2
	14	1615	< 2
	15	0955	2
	18	1123	2
	19	0947	< 2
	Aug. 12/77	1020	2
30	July 13/77	1645	< 2
	14	1610	< 2
	15	0950	< 2
	18	1119	2
	19	0944	< 2
	Aug. 12/77	1025	< 2
31	July 13/77	1640	< 2
	14	1605	< 2
	15	0945	< 2
	18	1115	< 2
	19	0940	< 2
	Aug. 12/77	1030	< 2
32	July 13/77	1635	< 2
	14	1600	< 2
	15	0945	< 2
	18	1110	< 2
	19	0935	< 2
	Aug. 12/77	1040	5

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
33	July 13/77	1630	< 2
	14	1600	< 2
	15	0943	2
	18	1103	< 2
	19	0932	2
	Aug. 12/77	1045	8
34	July 13/77	1625	2
	14	1550	< 2
	15	0935	4
	18	1055	< 2
	19	0920	2
	Aug. 12/77	1120	8
35	July 13/77	1620	33
	14	1550	49
	15	0935	< 2
	18	1052	< 2
	19	0922	< 2
	Aug. 12	1100	5
	16	1425	11
	17	1505	< 2
	18	1435	8
	19	1435	8
36	July 13/77	1615	5
	14	1545	< 2
	16	0930	< 2
	18	1045	2
	19	0927	< 2
	Aug. 12/77	1050	4

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
37	July 13/77	1627	2
	14	1555	< 2
	15	0940	2
	18	1100	< 2
	19	0930	2
	Aug. 12/77	1050	5
38	July 20/77	0930	< 2
	21	0820	5
	22	0910	< 2
	25	1440	< 2
	26	1430	< 2
	27	1525	< 2
39	July 20/77	0845	2
	21	0810	>1600
	22	0945	5
	25	1420	23
	26	1420	2
	27	1530	5
	Aug. 15/77	2000	2
	17	0900	5
	18	0945	17
	19	0945	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
40	July 20/77	0850	4
	21	0828	130
	22	0935	2
	25	1431	2
	26	1440	< 2
	27	1532	5
	Aug. 15	2005	17
	17	0905	33
	18	0950	23
	19	0940	2
41	July 20/77	0855	5
	21	0835	22
	22	0940	5
	25	1433	< 2
	26	1440	< 2
	27	1533	< 2
42	July 20/77	0855	< 2
	21	0840	11
	22	0940	< 2
	25	1446	2
	26	1445	< 2
	27	1535	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
43	July 20/77	0900	2
	21	0845	46
	22	0935	17
	25	1451	< 2
	26	1450	< 2
	27	1536	< 2
	Aug. 15/77	2005	23
	17	0905	8
	18	0950	< 2
	19	0946	< 2
44	July 20/77	0900	13
	21	0845	23
	22	0930	< 2
	25	1453	< 2
	26	1450	< 2
	27	1537	< 2
45	July 20/77	0905	5
	21	0840	2
	22	0930	8
	25	1454	< 2
	26	1450	2
	27	1540	< 2
46	July 20/77	0905	5
	21	0855	23
	22	0930	2
	25	1502	< 2
	26	1505	< 2
	27	1541	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
47	July 20/77	0910	2
	21	0900	33
	22	0925	2
	25	1501	< 2
	26	1505	2
	27	1542	2
48	July 20/77	0910	2
	21	0905	130
	22	0925	17
	25	1458	2
	26	1455	2
	27	1543	2
	Aug. 15/77	2010	94
	17	0910	23
	18	0950	< 2
	19	0945	13
49	July 20/77	0915	< 2
	21	0910	2
	22	0920	2
	25	1505	8
	26	1510	2
	27	1545	5
50	July 20/77	0920	< 2
	21	0915	4
	22	0915	< 2
	25	1508	< 2
	26	1510	< 2
	27	1545	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
51	July 20/77	0940	< 2
	21	1016	< 2
	22	1103	< 2
	25	1514	2
	26	1515	< 2
	28	0815	9
52	July 20/77	0945	2
	21	1023	< 2
	22	1122	17
	25	1518	4
	26	1520	< 2
	28	0820	350
	Aug. 3 /77	1500	2
	5	1335	2
	8	1140	4
	9	1010	< 2
	10	1025	< 2
53	July 20/77	0950	7
	21	1028	2
	22	1128	7
	25	1521	< 2
	26	1525	< 2
	28	0823	110
	Aug. 3 /77	1431	< 2
	5	1405	5
	8	1145	2
	9	1015	< 2
	10	1025	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
54	July 20/77	0955	< 2
	21	1034	170
	22	1135	7
	25	1524	< 2
	26	1530	< 2
	28	0825	27
	29	1045	< 2
	Aug. 2/77	1025	4
	3	1420	< 2
	5	1345	14
	8	1150	< 2
	9	1020	2
	10	1030	< 2
55	July 20/77	1025	< 2
	21	1037	23
	22	1138	< 2
	25	1526	< 2
	26	1530	< 2
	28	0828	13
56	July 20/77	1020	< 2
	21	1040	17
	22	1142	< 2
	25	1528	< 2
	26	1530	2
	Aug. 3/77	1405	< 2
	5	1353	< 2
	8	1155	< 2
	9	1028	5
	10	1030	2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
57	July 20/77	1015	< 2
	21	1346	17
	22	1147	< 2
	25	1530	< 2
	26	1530	< 2
	28	0830	> 1600
Depth Sample	July 21/77		> 1600
58	July 20/77	1030	< 2
	21	1044	2
	22	1150	< 2
	25	1531	< 2
	26	1535	7
	28	0835	8
59	July 20/77	1030	< 2
	21	1047	< 2
	22	1154	< 2
	25	1532	< 2
	26	1535	2
	27	0836	< 2
60	July 20/77	1035	< 2
	21	1050	< 2
	22	1158	< 2
	25	1534	< 2
	26	1540	< 2
	27	0837	17

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
61	July 28/77	0845	< 2
	29	0930	2
	Aug. 2/77	1035	< 2
	3	0928	8
	4	1223	2
	5	0920	< 2
62	July 28/77	0845	2
	29	0935	< 2
	Aug. 2	1035	< 2
	3	0930	< 2
	4	1225	2
	5	0925	< 2
63	July 28/77	0850	2
	29	0935	< 2
	Aug. 2/77	1040	< 2
	3	0935	< 2
	4	1230	< 2
	5	0928	< 2
64	July 28/77	0853	130
	29	0940	2
	Aug. 2/77	1045	2
	3	0938	< 2
	4	1235	2
	5	0935	< 2
	8	1200	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
65	July 28/77	0855	49
	29	0945	< 2
	Aug. 2/77	1050	< 2
	3	0945	< 2
	4	1238	2
	5	0940	< 2
	8	1205	< 2
66	July 28/77	0900	33
	29	0948	< 2
	Aug. 2/77	1055	< 2
	3	0950	2
	4	1242	2
	5	0945	2
67	July 28/77	0905	12
	29	0950	< 2
	Aug. 2/77	1105	5
	3	0954	5
	4	1247	2
	5	0948	2
68	July 28/77	-	13
	29	0955	< 2
	Aug. 2/77	1107	< 2
	3	1000	< 2
	4	1252	< 2
	5	0953	2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
69	July 28/77	0915	< 2
	29	1000	< 2
	Aug. 2/77	1112	2
	3	1005	< 2
	4	1258	2
	5	0957	< 2
70	July 28/77	-	< 2
	29	1005	< 2
	Aug. 2/77	1120	< 2
	3	1010	< 2
	4	1305	2
	5	1005	< 2
71	July 28/77	-	< 2
	29	1010	5
	Aug. 2/77	1125	< 2
	3	1020	5
	4	1313	< 2
	5	1017	< 2
72	July 28/77	-	< 2
	29	1020	< 2
	Aug. 2/77	1135	< 2
	3	1030	< 2
	4	1320	< 2
	5	1025	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
73	July 28/77	-	< 2
	29	1025	< 2
	Aug. 2/77	1140	< 2
	3	1035	< 2
	4	1325	< 2
	5	1030	< 2
74	July 28/77	-	< 2
	29	1030	2
	Aug. 2/77	1145	< 2
	3	1040	< 2
	4	1330	< 2
	5	1035	< 2
75	Aug. 8/77	1225	< 2
	9	1235	< 2
	10	1235	< 2
	11	1420	5
	12	1000	5
76	Aug. 8/77	1230	5
	9	1230	< 2
	10	1230	< 2
	11	1620	< 2
	12	0955	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
77	Aug. 8/77	1240	< 2
	9	1225	< 2
	10	1225	< 2
	11	1615	< 2
	12	0955	< 2
78	Aug. 8/77	1245	< 2
	9	1225	< 2
	10	1225	< 2
	11	1610	< 2
	12	0950	2
79	Aug. 8/77	1250	< 2
	9	1220	< 2
	10	1220	< 2
	11	1610	< 2
	12	0950	< 2
80	Aug. 8/77	1250	< 2
	9	1215	< 2
	10	1215	< 2
	11	1605	< 2
	12	1605	< 2
81	Aug. 8/77	1300	< 2
	9	1210	2
	10	1210	< 2
	11	1600	2
	12	0940	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
82	Aug. 8/77	1305	< 2
	9	1200	< 2
	11	1600	< 2
	15	1645	< 2
83	Aug. 9/77	1200	2
	10	1225	8
	11	1550	2
	15	1645	< 2
	17	0900	< 2
84	Aug. 8/77	1310	< 2
	9	1145	8
	10	1200	< 2
	11	1450	< 2
	15	1655	< 2
85	Aug. 9/77	1150	< 2
	10	1155	< 2
	11	1542	< 2
	15	1700	< 2
	17	1155	< 2
86	Aug. 9/77	1155	2
	10	1155	< 2
	11	1545	2
	15	1715	< 2
	17	1150	5

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
87	Aug. 8/77	1325	< 2
	11	1535	< 2
	15	1730	8
	17	0910	220
	18	1510	11
	19	1440	8
88	Aug. 8/77	1325	< 2
	9	1135	< 2
	10	1145	< 2
	11	1535	< 2
	15	1725	< 2
89	Aug. 8/77	1325	< 2
	11	1530	< 2
	15	1725	70
	16	1010	2
	17	0915	240
	18	1515	2
	19	1445	21
90	Aug. 8/77	1330	< 2
	9	1135	< 2
	10	1140	2
	11	1530	< 2
	15	1730	< 2
	17	1530	14

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
91	Aug. 8/77	1335	< 2
	9	1130	< 2
	10	1135	< 2
	11	1525	< 2
	15	1735	540
	17	1535	< 2
	18	1500	2
	19	1430	2
92	Aug. 8/77	1640	< 2
	9	1120	< 2
	10	1120	2
	11	1515	< 2
	12	0930	9
	15	1750	22
93	Aug. 8/77	1645	< 2
	9	1123	2
	10	1125	< 2
	11	1515	< 2
	12	0930	4
	15	1745	< 2
94	Aug. 8/77	1645	540
	9	1125	2
	10	1125	< 2
	11	1520	22
	12	0930	5
	15	1745	8
	16	1545	110
	18	1145	5

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
95	Aug. 9/77	1205	9
	10	1020	2
	11	0920	13
	12	1400	33
	15	1755	920
	17	1520	130
96	Aug. 9/77	1210	17
	10	1025	< 2
	11	0920	< 2
	12	1400	33
	15	1750	110
	17	1515	7
97	Aug. 9/77	1212	8
	10	1030	2
	11	0925	13
	12	1355	8
	15	1745	79
	17	1515	13
98	Aug. 8/77	1635	< 2
	9	1115	2
	10	1115	5
	11	1510	8
	15	1800	2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
99	Aug. 8/77	1630	2
	9	1110	< 2
	10	1110	< 2
	11	1505	< 2
	15	1605	< 2
100	Aug. 15/77	1815	23
	16	0740	4
	17	0820	5
	18	0910	5
	19	0910	2
101	Aug. 15/77	1800	8
	16	0730	< 2
	17	0810	8
	18	0900	5
	19	0905	2
102	Aug. 15/77	1750	5
	16	0720	33
	17	0805	22
	18	0855	49
	19	0900	17
103	Aug. 15/77	1750	79
	16	0720	9
	17	0805	33
	18	0855	33
	19	0900	17

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
104	Aug. 15/77	1745	2
	16	0720	79
	17	0800	49
	18	0855	130
	19	0900	70
105	Aug. 15/77	1755	8
	16	0725	6
	17	0810	5
	18	0900	5
	19	0900	5
106	Aug. 15/77	1800	7
	16	0730	8
	17	0810	2
	18	0900	11
	19	0905	< 2
107	Aug. 15/77	1805	< 2
	16	0730	11
	17	0815	5
	18	0900	4
	19	0905	< 2
108	Aug. 15/77	1810	< 2
	16	0735	8
	17	0815	8
	18	0905	2
	19	0905	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
109	Aug. 15/77	1620	< 2
	16	0735	2
	17	0815	8
	18	0905	13
	19	0910	5
110	Aug. 8/77	1625	< 2
	9	1105	< 2
	10	1105	< 2
	11	1500	8
	12	0920	2
	15	1810	31
111	Aug. 8/77	1620	< 2
	9	1100	< 2
	10	1100	< 2
	11	1500	17
	12	0915	< 2
	15	1815	2
	17	1025	< 2
112	Aug. 9/77	1115	2
	10	0945	< 2
	11	0956	2
	12	1430	< 2
	15	1710	79
	17	1445	< 2
	19	1415	5

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
113	Aug. 9/77	1110	< 2
	10	0940	< 2
	11	0945	< 2
	12	1435	49
	15	1715	5
	17	1440	33
	19	1410	< 2
114	Aug. 8/77	1540	< 2
	10	1735	17
	11	1430	5
	15	1620	8
	16	0900	23
	17	0945	< 2
	18	0900	110
	19	1320	70
115	Aug. 8/77	1545	< 2
	10	1740	240
	11	1430	7
	15	1620	8
	16	0900	17
	17	0950	23
	18	0905	46
	19	1325	46
116	Aug. 8/77	1550	5
	10	1745	79
	11	1435	2
	15	1635	46
	16	0855	17
	18	0920	49

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
117	Aug. 8/77	1555	33
	10	1750	170
	11	1440	8
	15	1630	79
	16	0855	7
	18	0915	33
118	July 28/77	-	< 2
	Aug. 2	1115	11
	3	0920	2
	4	0935	4
	5	1045	2
	8	1730	< 2
119	July 28/77	-	2
	Aug. 2	1112	< 2
	3	0845	11
	4	0932	13
	5	1043	11
	8	1725	< 2
120	July 28/77	-	< 2
	Aug. 2	1110	4
	3	0915	2
	4	0930	2
	5	1040	8
	8	1720	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
121	July 28/77	-	< 2
	Aug. 2	1102	8
	3	0905	11
	4	0927	13
	5	1037	5
	8	1715	< 2
122	July 28/77	1710	2
	Aug. 2	1100	< 2
	3	0900	8
	4	0925	23
	5	1035	2
	8	1715	79
	11	1105	< 2
	12	1345	5
	16	0930	2
	17	1520	< 2
	18	1120	2
123	July 28/77	1715	2
	Aug. 2	1055	5
	3	0855	13
	4	0925	46
	5	1030	79
	8	1710	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
124	July 28/77	1720	79
	Aug. 2	1050	4
	3	0855	4
	4	0920	13
	5	1030	17
	8	1705	140
125	July 28/77	1725	< 2
	Aug. 2	1045	< 2
	3	0845	13
	4	0915	13
	5	1025	5
	8	1705	2
126	July 28/77	1735	7
	Aug. 3	0840	8
	4	0910	26
	5	1020	22
	8	1700	8
	10	1600	49
	11	1425	2
	12	1335	17
	16	0920	23
	17	1445	< 2
	18	1110	33
	19	1340	5

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
127	July 28/77	1745	33
	Aug. 3	0830	350
	4	0900	70
	5	1015	130
	8	1650	350
	10	1550	240
128	July 28/77	1750	4
	Aug. 3	0830	110
	4	0905	22
	5	1015	17
	8	1655	8
	10	1555	33
129	July 28/77	1751	< 2
	Aug. 3	0835	8
	4	0910	8
	5	1017	13
	8	1655	< 2
	10	1600	2
130	Aug. 2/77	1135	5
	3	1025	< 2
	4	1015	< 2
	5	1112	8
	8	1810	< 2
	10	1605	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
131	Aug. 2/77	1132	2
	3	1025	2
	4	1015	11
	5	1110	2
	8	1805	11
	10	1610	2
132	July 28/77	-	< 2
	Aug. 2	1130	< 2
	3	1010	2
	4	1010	< 2
	5	1105	< 2
	8	1800	2
133	July 28/77	-	< 2
	Aug. 2	1125	2
	3	1005	2
	4	1005	< 2
	5	1100	23
	8	1755	11
134	Aug. 3/77	0955	< 2
	4	1000	< 2
	5	1050	5
	8	1750	11
	10	1620	4

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
135	Aug. 3/77	0945	< 2
	4	0950	< 2
	8	1740	2
	10	1630	< 2
136	July 20/77	1056	< 2
	21	0912	< 2
	25	1152	< 2
	26	1510	2
	27	1430	< 2
	Aug. 3	1135	< 2
137	July 20/77	1055	< 2
	21	0905	< 2
	22	1001	< 2
	25	1146	< 2
	26	1505	8
	27	-	8
	Aug. 3	1130	2
138	July 20/77	1035	< 2
	21	0854	< 2
139	July 20/77	1030	< 2
	21	0847	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
140	July 20/77	1010	< 2
	21	0837	< 2
	22	0949	< 2
	25	1135	< 2
	26	1456	< 2
	27	1415	< 2
141	July 20/77	0950	< 2
	21	0832	2
	22	0943	< 2
	25	1128	2
	26	1450	33
	27	1410	< 2
142	July 20/77	0945	< 2
	21	0825	< 2
	22	0935	< 2
	25	1210	< 2
	26	1445	< 2
	27	1405	< 2
143	July 20/77	0937	< 2
	21	0821	5
	22	0931	< 2
	25	1120	< 2
	26	1440	2
	27	1405	< 2

APPENDIX IV DAILY BACTERIOLOGICAL RESULTS FOR MARINE STATIONS (cont.)

Sample Station No.	Date of Collection	Time of Collection	Fecal Coliform MPN/100 ml
144	July 20/77	0930	< 2
	21	0815	< 2
	22	0926	2
	25	1115	< 2
	26	1440	< 2
	27	1400	< 2
145	July 20/77	0921	< 2
	21	0812	< 2
	22	0922	< 2
	25	1112	< 2
	26	1435	< 2
	27	1359	< 2
146	July 20/77	0917	< 2
	21	0809	< 2
	22	0918	2
	25	1108	< 2
	26	1430	< 2
	27	1350	2

APPENDIX V

BACTERIOLOGICAL RESULTS FOR FRESHWATER STATIONS

APPENDIX V BACTERIOLOGICAL RESULTS FOR FRESHWATER STATIONS

Sample Station	Date of Sampling	Total Coliform/100 ml	Fecal Coliform/100 ml	Fecal Strep/100 ml
S1	July 14	4	12	20
	15	3200	490	620
	18	2600	510	1200
S2	July 14	N.C.[1]	249	>80
	15	840	300	1020
	18	480	90	350
S3	July 14	>80	84	140
	15	440	50	60
	Aug. 19	4200	160	170
	19 upstream	3100	40	490
S4	July 14	>80	81	70
S5	July 14	>80	>80	>80
S6	July 14	86	12	66
	Aug. 9	950	77	410
	10	630	21	620
	18	10	<10	300
S7	July 14	TNTC[2]	142	TNTC
	Aug. 9	550	190	1300
	10	390	<10	330
	18	600	30	340
S8	July 14	46	6	1
	Aug. 18 upstream of Dairy	5400	730	710
	18 downstream of Dairy	3600	830	480

[1]N.C. - No count
[2]TNTC - Too numerous to count

APPENDIX VI

SUMMARY OF TEMPERATURE AND SALINITY DATA FOR MARINE STATIONS

APPENDIX VI SUMMARY OF TEMPERATURE AND SALINITY DATA FOR MARINE STATIONS

Sample Station	Temperature (°C)			Salinity (ppt)		
	No. of samples	Range	Mean	No. of samples	Range	Mean
1	5	13.0 - 15.5	14.4	4	26.0 - 28.1	21.8
2	3	12.5 - 15.5	14.3	2	28.9 - 29.5	29.2
3	3	14.5 - 19.0	17.0	3	26.5 - 29.4	28.3
4	4	14.5 - 19.0	17.1	6	25.5 - 29.4	27.9
5	3	15.5 - 18.5	17.0	3	27.5 - 29.8	28.8
6	3	15.0 - 18.0	16.5	3	27.5 - 29.7	28.7
7	3	15.0 - 19.0	16.3	3	28.0 - 29.3	28.9
8	5	14.5 - 20.0	17.5	6	27.0 - 29.7	28.2
9	5	15.0 - 20.5	18.0	5	25.5 - 29.8	27.7
10	5	15.0 - 19.5	17.4	6	25.5 - 29.3	27.7
11	5	15.5 - 20.0	17.5	6	25.0 - 29.7	27.9
12	6	15.5 - 20.0	17.3	7	25.5 - 29.3	27.7
13	6	15.0 - 19.5	17.3	7	25.5 - 29.3	27.6
14	5	16.5 - 19.5	18.2	6	25.5 - 29.5	27.5
15	3	13.5 - 18.5	16.5	3	26.5 - 29.0	28.2
16	6	13.5 - 18.0	16.0	5	25.5 - 29.5	28.0
17	3	14.0 - 16.0	14.6	3	29.5 - 29.5	29.5
18	6	14.5 - 19.0	16.6	6	25.5 - 29.7	27.9
19	3	13.5 - 15.5	14.6	2	29.5 - 29.9	29.7
20	3	13.0 - 17.5	15.2	3	27.0 - 30.1	28.8
21	4	13.0 - 17.0	14.8	4	26.0 - 29.1	27.6
22	3	13.5 - 17.0	15.0	2	29.5 - 29.7	29.6
23	3	13.5 - 15.5	14.5	2	29.1 - 29.7	29.4
24	4	14.5 - 19.0	15.9	2	27.5 - 30.1	28.8
25	4	12.5 - 14.5	13.9	2	29.4 - 29.5	29.4
26	4	14.0 - 20.0	17.1	2	27.0 - 29.9	28.5

APPENDIX VI SUMMARY OF TEMPERATURE AND SALINITY DATA FOR MARINE STATIONS (continued)

Sample Station	Temperature (°C)			Salinity (ppt)		
	No. of samples	Range	Mean	No. of samples	Range	Mean
27	4	14.0 - 19.0	16.3	2	27.2 - 27.5	27.4
28	7	14.0 - 21.5	17.6	5	25.5 - 29.7	27.5
29	4	14.5 - 19.0	16.0	2	27.0 - 29.5	28.3
30	4	15.0 - 18.5	16.1	2	27.5 - 29.5	28.5
31	4	15.0 - 18.5	16.3	2	27.5 - 29.8	28.7
32	4	16.5 - 20.5	17.9	2	27.5 - 29.4	28.5
33	4	16.0 - 20.0	17.6	2	26.3 - 27.0	26.6
34	4	16.5 - 20.5	18.3	2	27.5 - 29.5	28.5
35	7	16.5 - 23.5	20.1	6	25.5 - 29.5	27.5
36	4	16.5 - 19.5	17.9	2	27.0 - 29.5	28.3
37	4	16.0 - 20.0	18.0	2	27.5 - 29.4	28.5
38	6	14.0 - 18.0	16.2	5	26.0 - 28.0	26.8
39	9	15.0 - 20.0	17.3	9	26.5 - 28.0	27.0
40	9	15.0 - 20.5	18.2	9	27.0 - 28.0	27.3
41	6	14.5 - 18.5	16.8	5	27.0 - 28.1	27.4
42	6	15.0 - 23.0	18.7	5	27.3 - 28.0	27.9
43	9	14.5 - 19.5	16.9	9	26.8 - 28.0	27.3
44	6	14.0 - 18.0	15.8	5	26.3 - 28.0	27.4
45	6	14.5 - 21.5	17.7	5	27.3 - 28.0	27.6
46	6	13.5 - 19.5	15.7	5	26.0 - 28.0	27.4
47	6	14.5 - 17.0	15.7	5	25.8 - 28.0	27.5
48	9	14.5 - 24.0	18.4	9	26.5 - 28.0	27.4
49	6	14.0 - 18.5	15.3	5	26.4 - 28.0	27.3
50	6	13.5 - 15.0	14.3	5	26.5 - 28.0	27.3
51	6	13.5 - 16.0	14.9	5	26.0 - 28.0	27.1
52	11	13.0 - 19.0	16.1	10	25.0 - 28.0	26.7

APPENDIX VI SUMMARY OF TEMPERATURE AND SALINITY DATA FOR MARINE STATIONS (continued)

Sample Station	Temperature (°C) No. of samples	Range	Mean	Salinity (ppt) No. of samples	Range	Mean
53	11	14.0 - 18.5	16.1	10	25.0 - 27.6	26.7
54	13	14.0 - 19.5	16.2	12	25.5 - 28.0	26.7
55	6	14.0 - 16.0	15.3	5	26.8 - 28.0	27.4
56	10	14.0 - 19.0	16.7	9	25.5 - 28.0	26.6
57	5	14.5 - 16.0	15.1	5	26.0 - 28.0	26.8
58	6	13.5 - 16.0	14.9	5	26.9 - 28.0	27.2
59	6	13.5 - 16.0	15.1	5	26.7 - 28.0	27.3
60	6	14.5 - 16.0	15.3	5	27.0 - 28.0	27.5
61	6	15.0 - 16.5	15.7	6	24.5 - 28.0	26.4
62	6	15.0 - 16.5	15.9	6	25.0 - 28.0	26.5
63	6	15.0 - 16.5	15.8	6	25.0 - 28.0	26.3
64	7	15.5 - 18.5	16.4	7	25.0 - 28.0	26.4
65	7	15.5 - 18.0	16.3	7	25.0 - 28.0	26.4
66	6	15.5 - 16.5	15.9	6	26.0 - 28.0	26.4
67	6	16.0 - 17.0	16.3	6	25.5 - 27.0	26.5
68	5	15.0 - 17.0	16.0	6	25.5 - 27.0	26.5
69	6	15.0 - 16.4	15.6	6	25.5 - 28.0	26.4
70	6	15.0 - 17.0	15.8	6	25.5 - 28.0	26.3
71	6	15.5 - 19.0	17.5	6	25.0 - 27.0	25.8
72	6	15.5 - 20.5	18.0	6	25.5 - 27.0	25.8
73	5	16.0 - 20.0	17.5	6	25.5 - 27.0	26.0
74	6	16.0 - 21.0	18.0	6	25.5 - 27.0	26.3
75	5	19.0 - 21.0	20.6	5	24.5 - 25.5	24.8
76	5	20.0 - 22.0	21.0	5	24.5 - 26.0	25.1
77	5	20.5 - 22.0	21.2	5	24.5 - 26.0	25.0
78	5	21.0 - 22.5	21.6	5	24.5 - 25.5	24.9

APPENDIX VI SUMMARY OF TEMPERATURE AND SALINITY DATA FOR MARINE STATIONS (continued)

Sample Station	Temperature (°C) No. of samples	Range	Mean	Salinity (ppt) No. of samples	Range	Mean
79	5	21.0 - 22.0	21.4	5	24.5 - 26.0	24.9
80	5	19.5 - 22.5	21.0	5	24.5 - 26.0	25.2
81	5	20.0 - 21.5	21.0	5	24.5 - 25.5	25.1
82	4	21.5 - 24.5	22.5	4	25.5 - 26.0	25.6
83	5	21.0 - 23.5	22.4	5	24.5 - 26.0	25.6
84	5	21.0 - 22.5	21.7	5	25.0 - 25.5	25.3
85	5	21.0 - 24.0	22.3	5	24.5 - 26.0	25.4
86	5	21.5 - 24.5	22.3	5	24.5 - 26.0	25.4
87	8	19.5 - 25.0	22.2	6	24.5 - 26.5	25.7
88	5	21.0 - 24.5	22.5	5	25.5 - 26.0	25.6
89	7	19.5 - 24.0	21.9	6	24.5 - 26.5	25.7
90	6	21.0 - 24.0	22.4	6	25.0 - 27.0	25.8
91	8	19.0 - 23.0	21.4	7	25.5 - 27.0	25.7
92	6	21.0 - 22.5	21.4	6	25.5 - 26.5	26.0
93	6	21.0 - 23.0	21.7	6	25.5 - 26.5	26.0
94	8	20.5 - 27.0	22.4	8	24.5 - 26.0	27.5
95	7	21.5 - 26.5	23.9	6	26.0 - 26.5	26.3
96	7	21.0 - 26.0	23.6	6	25.5 - 27.5	26.2
97	7	21.0 - 24.5	23.3	6	25.5 - 27.0	26.2
98	5	20.5 - 25.0	22.4	5	25.5 - 26.5	26.0
99	5	20.0 - 22.5	21.3	5	25.5 - 26.0	25.7
100	5	17.5 - 24.0	20.3	5	25.5 - 27.0	26.2
101	5	17.5 - 23.5	20.4	5	26.0 - 27.0	26.5
102	5	18.0 - 27.0	21.7	5	26.0 - 26.5	26.4
103	5	18.0 - 25.5	21.3	5	26.0 - 27.0	26.4
104	5	17.5 - 28.0	21.4	5	26.5 - 27.5	26.8

APPENDIX VI SUMMARY OF TEMPERATURE AND SALINITY DATA FOR MARINE STATIONS (continued)

Sample Station	Temperature (°C)			Salinity (ppt)		
	No. of samples	Range	Mean	No. of samples	Range	Mean
105	5	18.0 - 24.0	20.7	5	25.5 - 26.5	26.2
106	5	17.5 - 22.5	20.1	5	26.0 - 27.0	26.5
107	5	17.5 - 23.0	20.1	5	26.0 - 27.0	26.3
108	5	17.5 - 22.0	19.9	5	26.0 - 27.0	26.2
109	5	17.5 - 22.5	20.0	5	25.5 - 27.0	26.3
110	6	19.5 - 23.5	21.5	6	25.5 - 27.0	26.1
111	7	19.0 - 23.5	21.4	7	25.0 - 27.0	25.9
112	8	20.5 - 27.0	23.1	8	25.5 - 27.5	26.3
113	8	19.5 - 30.0	23.5	8	25.0 - 27.0	26.3
114	8	16.0 - 21.5	19.6	8	25.0 - 27.5	26.4
115	8	16.5 - 22.5	19.8	8	25.0 - 27.5	26.5
116	6	19.0 - 26.0	22.1	6	24.5 - 27.0	26.5
117	6	19.0 - 27.0	22.2	6	25.0 - 28.0	26.4
118	5	13.5 - 17.0	14.7	6	27.5 - 29.5	28.3
119	5	14.0 - 17.0	15.0	6	27.5 - 30.0	28.3
120	5	13.5 - 18.0	15.3	6	27.5 - 29.5	28.3
121	5	13.0 - 18.0	15.1	6	27.5 - 29.5	28.3
122	10	13.5 - 21.5	17.2	11	26.0 - 29.5	28.0
123	4	14.5 - 18.0	16.1	6	27.5 - 29.5	28.5
124	4	14.5 - 18.0	16.0	6	27.5 - 29.5	28.3
125	4	14.0 - 18.0	16.0	6	27.5 - 29.5	28.4
126	10	14.0 - 26.5	19.4	12	26.0 - 29.0	27.9
127	5	15.0 - 25.0	19.0	6	26.5 - 28.5	27.7
128	4	14.0 - 21.5	17.6	6	26.5 - 28.5	27.9
129	4	13.5 - 21.0	17.4	6	27.0 - 28.5	27.8
130	5	14.0 - 18.0	15.9	6	26.5 - 29.5	27.8

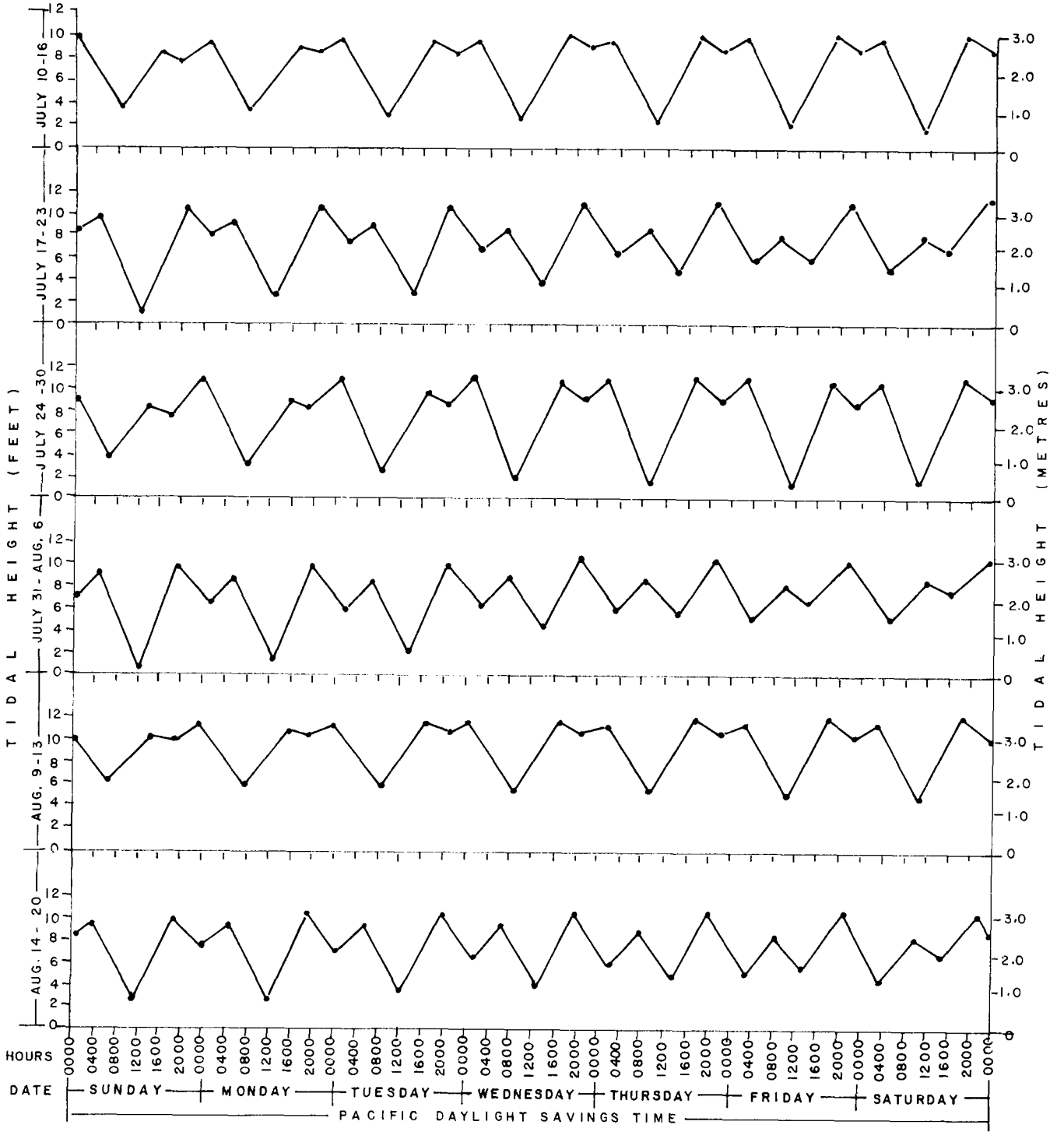
APPENDIX VI SUMMARY OF TEMPERATURE AND SALINITY DATA FOR MARINE STATIONS (continued)

Sample Station	Temperature (°C) No. of samples	Range	Mean	Salinity (ppt) No. of samples	Range	Mean
131	5	13.5 - 17.5	15.3	6	27.0 - 29.5	27.9
132	5	14.0 - 19.0	15.6	6	27.5 - 30.0	28.3
133	5	13.5 - 18.0	14.9	6	27.5 - 29.5	28.7
134	4	13.5 - 19.5	16.1	5	27.5 - 28.0	27.6
135	3	12.5 - 17.0	15.2	4	27.0 - 28.5	27.5
136	6	12.5 - 16.5	14.2	4	24.0 - 28.0	26.4
137	7	12.0 - 16.0	14.0	5	24.0 - 29.0	27.2
138	2	12.0 - 12.5	12.3	N.T.*	N.T.	N.T.
139	2	12.0 - 13.0	12.5	N.T.	N.T.	N.T.
140	6	12.0 - 14.0	13.1	4	25.5 - 29.1	27.7
141	6	12.5 - 15.0	13.8	4	27.0 - 28.5	28.9
142	5	12.5 - 14.0	13.6	4	26.5 - 28.2	27.7
143	5	12.5 - 15.5	14.0	4	27.0 - 28.2	27.3
144	5	13.0 - 14.0	13.8	4	26.0 - 28.1	27.0
145	5	12.0 - 14.0	13.5	4	27.0 - 28.2	27.5
146	5	12.5 - 14.5	13.8	4	27.0 - 28.1	27.5

*N.T. - not taken

APPENDIX VII

FULFORD HARBOUR, SALTSPRING ISLAND - TIDAL HEIGHT GRAPH
July 10 - August 20, 1977



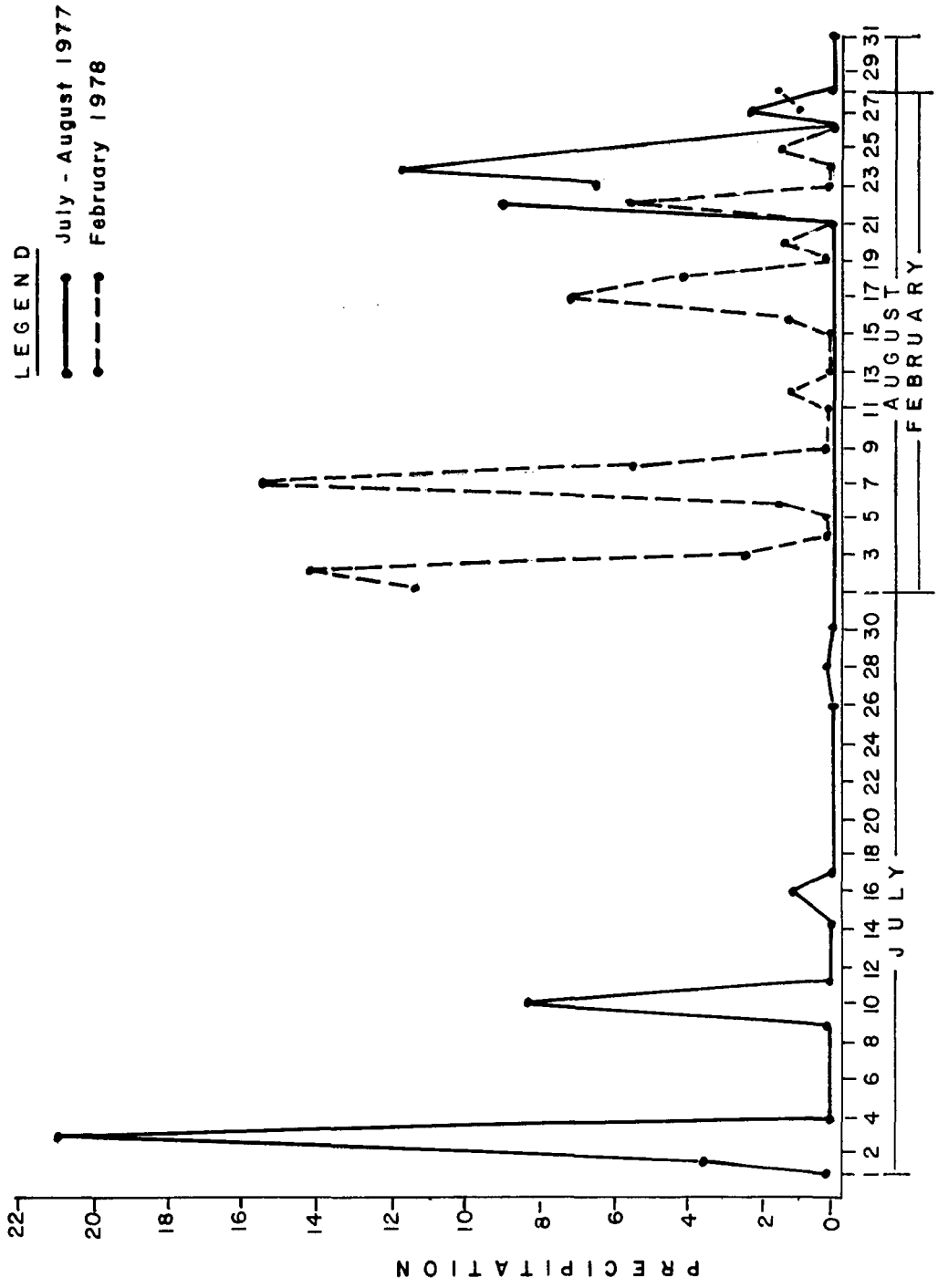
APPENDIX VII

FULFORD HARBOUR, SALTSPRING ISLAND - TIDAL HEIGHT GRAPH - July 10 - August 20, 1977

Note: *This is a diagrammatic figure only. The tidal heights should not be considered accurate as this figure does not represent the sinusoidal action of the tides.*

APPENDIX VIII

TOTAL PRECIPITATION, ST. MARY LAKE RAINFALL STATION -
SUMMER AND WINTER SURVEYS - SALTSPRING ISLAND, B.C.



APPENDIX VIII
TOTAL PRECIPITATION, ST. MARY'S LAKE RAINFALL STATION - SUMMER AND WINTER SURVEYS - SALTSPRING ISLAND, B. C.

APPENDIX IX

SUMMARY OF BACTERIOLOGICAL ANALYSIS OF SHELLSTOCK, 1977

APPENDIX IX SUMMARY OF BACTERIOLOGICAL ANALYSIS OF SHELLSTOCK, 1977

Station No.	Shellstock	Date Sampled	Date Inspected	Confirmed Coliform MPN/100 g	Fecal Coliform MPN/100 g
39	oyster	August 3	August 4	2400	220
46	oyster	August 3	August 4	20	< 20
65	littleneck clam	August 3	August 4	130	80
36	oyster	August 15	August 16	490	230
35	clam	August 15	August 16	790	170
99	clam	August 15	August 16	490	220
74	oyster	August 15	August 16	330	230
87	oyster	August 15	August 16	490	330
115	oyster	August 15	August 16	330	70
117	oyster	August 15	August 16	230	20
99	oyster	August 15	August 16	3500	490
Vicinity Malaview Estates	geoduck	August 16	August 17	1300	20

APPENDIX X

SUMMARY OF WINTER (February 1978) DATA

a. Comparison of Summer and Winter Data (1977-78) for Marine Stations on Saltspring Island
b. Location of Winter (February 1978) Freshwater Sampling Sites, Saltspring Island and Summarized Results
c. Daily Bacteriological Results for Freshwater Stations
d. Daily Bacteriological Results for Marine Stations
e. Sampling Times and Tidal Conditions, Fulford Harbour, Saltspring Island, February 1978

APPENDIX X a) Comparison of Summer and Winter Data (1977-78) for Marine Stations on Saltspring Island

Sample Station		Number of Samples	MPN Range	Fecal MPN/100 ml Median	Fecal MPN/100 ml 90th Percentile
			Walker Hook		
41	Summer	6	< 2 - 22	3.5	11.8
	Winter	5	< 2 - 5	< 2	3.5
49	Summer	6	< 2 - 8	2	6.2
	Winter	5	< 2 - 17	2	9.5
			Malaview Estates Coastline		
52	Summer	11	< 2 - 350	2	15.7
	Winter	5	< 2 - 2	2	2
53	Summer	11	< 2 - 110	2	7
	Winter	5	< 2 - 5	< 2	3.5
54	Summer	13	< 2 - 190	< 2	23.1
	Winter	5	< 2 - 130	2	7.5
55	Summer	6	< 2 - 23	< 2	17
	Winter	5	< 2- 2	< 2	2
56	Summer	10	< 2 - 17	< 2	5
	Winter	5	< 2 - 11	5	9.5
58	Summer	6	< 2 - 8	< 2	7.4
	Winter	5	< 2 - 8	2	5
			Booth Inlet		
100	Summer	2	2 - 23	5	14
	Winter	5	< 2 - 13	5	10
107	Summer	5	< 2 - 11	4	8
	Winter	5	< 2 - 8	2	8
108	Summer	5	< 2 - 8	2	8
	Winter	5	< 2 - 5	2	3.5
109	Summer	5	< 2 - 13	5	10.5
	Winter	5	< 2 - 13	2	9
			Burgoyne Bay		
114	Summer	8	< 2 - 110	12.5	78
	Winter	5	2 - 33	11	23
115	Summer	8	< 2 - 240	20	84.8
	Winter	5	4 - 49	8	30
116	Summer	6	5 - 79	31.5	61
	Winter	5	2 - 8	8	8
117	Summer	6	7 - 170	33	115.4
	Winter	5	< 2 - 46	7	29.5

APPENDIX X b) Location of Winter (February, 1978) Freshwater Sampling Sites, Saltspring Island, and Summarized Results

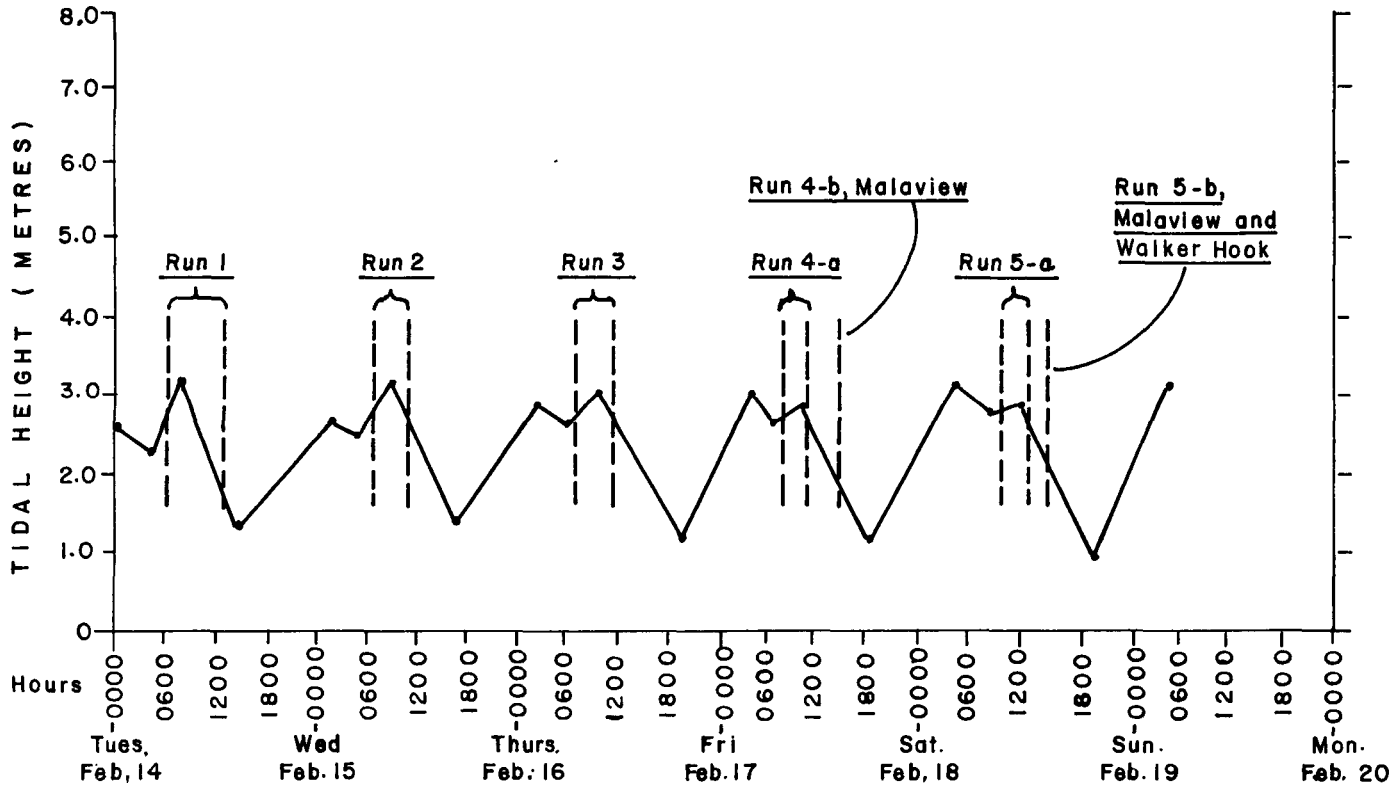
Station Number	Location Description	Winter Flow Data m /sec	Mean Fecal Coliform Count/100 ml	No. of Samples	Population Equivalent
FS1	stream entering Walker Hook	0.052	7.0	2	0.0098
FS2	stream entering at head of Booth Inlet	0.076	7.5	2	0.015
FS3	confluence of 2 streams, entering Duck Bay	0.57	10.5	2	0.16
FS4	large pond at head of Booth Inlet	not gauged	0	1	-
FS5	ditchwater draining into Stonecutter's Bay	low flow, not gauged	50	1	-
S4	larger of the 2 streams in S6, sampled at Sunset Drive; corresponds to S4 of summer survey	0.51	12.5	2	0.17
S5	As summer survey	0.030	66.8	5	0.054
S6	As summer survey	0.057	7.6	5	0.012
S7	As summer survey	0.031	33.6	5	0.028
S8	Fulford Creek at bridge	0.91	10.5	2	0.26
Raw Sewage	Malaview Estates S.T.P.	0.0006	1.85 x 10		31.1
Effluent Sewage	Malavew Estates S.T.P.	0.0006	2.91 x 10		48.9

APPENDIX X c) Daily Bacteriological Results for Freshwater Stations

Sample Number	Date '78	Fecal Coliform	Fecal Streptoccoci
FS1	Feb. 15	10	28
	16	4	5
FS2	Feb. 15	2	3
	16	13	98
FS3	Feb. 15	17	250
	16	4	12
FS4	Feb. 16	0	44
FS5	Feb. 16	50	-
S4	Feb. 15	15	64
	16	10	80
S5	Feb. 14	40	<10
	15	16	9
	16	23	20
	17	9	17
	18	246	298
S6	Feb. 14	10	<10
	15	14	1
	16	4	2
	17	7	3
	18	8	< 2
S7	Feb. 14	20	20
	15	14	5
	16	22	5
	17	8	14
	18	104	92
S8	Feb. 15	15	120
	16	6	61

APPENDIX X d) Daily Bacteriological Results for Marine Stations

Sample Station	Date (February 1978)				
	14	15	16	17	18
41	5	<2	< 2	< 2	<2
49	<2	2	< 2	17	2
52	<2	2	< 2	2	2
53	5	2	< 2	<2	< 2
54	2	< 2	2	13	< 2
55	<2	< 2	< 2	2	2
56	5	11	< 2	<2	8
58	2	8	< 2	2	2
100	<2	7	5	13	2
107	2	8	2	2	8
108	2	2	5	<2	< 2
109	2	2	5	13	2
114	2	11	13	7	33
115	5	49	4	8	11
116	<2	8	8	2	8
117	13	46	2	<2	7



(e)

SAMPLING TIMES AND TIDAL CONDITIONS, FULFORD HARBOUR, SALTSPRING ISLAND - February 1978

APPENDIX XI

MALAVIEW ESTATES SEWAGE TREATMENT PLANT EVALUATION
SALTSPRING ISLAND SHELLFISH WATER QUALITY SURVEY

by

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1 INTRODUCTION

An evaluation of the Malaview Estates Sewage Treatment Plant (STP) was conducted by the author in conjunction with a Shellfish Growing Water Sanitary Survey of Saltspring Island, carried out by personnel of the Environmental Protection Service.

The purpose of this evaluation was to assess the effects of the Malaview Estates STP discharge on the bacteriological water quality of the adjacent foreshore areas.

Malaview Estates is a 85 lot subdivision, comprising at present approximately 52 houses, located on the north side of Saltspring Island between Walker Hook and Fernwood Point.

The Malaview Estates Sewage Treatment Plant is a "Spirogester" primary treatment plant, a version of the Imhoff Tank. The Spirogester is divided into three compartments: sedimentation, digestion and scum chambers. Sedimentation of settleable solids occurs in the sedimentation chamber allowing them to pass through a slot into the digestion chamber where they are digested anaerobically. Gases generated in the digestion chamber escape through the scum chamber. A gas trap prevents gas from the digestion chamber entering the sedimentation chamber. Flowrates for this plant are estimated using a 60° V-notch weir. Imhoff tanks are generally capable of removing 50% of the raw sewage BOD_5 and 40-60% of the suspended matter.

The Pollution Control Permit of this plant allows an average 24 hour discharge of 21 250 Imperial gallons per day (0.0009 m^3/sec). During the survey the flow rate was estimated at 10 000 Imperial gpd (0.0004 m^3/sec). However, flows could be expected to increase during periods of heavy precipitation due to infiltration from groundwater, and inflow from surface runoff. The Pollution Control Permit also states that the effluent is discharged through an outfall terminating 700 feet (213 metres) from the shoreline and 44 feet (13 metres) below the water.

2 PROCEDURES

Sewage treatment plant effluent 24 hour composite samples were collected using an ISCO Continuous sampler. Samples were collected from July 25 to 29, were separated in the proper container, preserved as required, and stored at 4°C. Samples collected on July 26, 27 and 28 were submitted to the Environmental Protection Service Laboratory, West Vancouver on July 29 for chemical analysis. The samples collected on July 29 were submitted on August 2, 1977.

Samples for bacteriological analyses were collected in sterile 340 cc wide-mouthed bottles and submitted to the EPS mobile laboratory, located during the survey at Welbury Point, Saltspring Island. The total and fecal coliform concentrations were determined using the membrane filtration technique.

3 RESULTS AND DISCUSSION

The results of the chemical analyses of the effluent composite samples are presented in Table 1. The BOD_5 results have been omitted due to poor reliability, i.e., length of storage and presence of air in the sample bottles. Due to intermittent and low flows a representative raw sewage sample could not be obtained.

The results of bacteriological analyses of the raw sewage and effluent samples are presented in Table 2. The results indicate that the treatment plant reduced total coliforms from a mean of 9.3×10^7 to 2.68×10^7 MF/100 ml (71%) and reduced fecal coliforms from a mean of 6.3×10^7 to 1.02×10^7 (84%).

Using a standard total coliform contribution of 1.6 x 10" total coliforms/person/day* and the flow estimate of 0.0004 m^3/sec (10 000 Imperial gpd) yields a population equivalent for the Malaview Estates STP effluent of 76.1.

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* U.S. Public Health Publication, No. 33

TABLE 1 MALAVIEW ESTATES SEWAGE TREATMENT PLANT

Date of Collection	Effluent Sample COD (mg/l)	NFR (mg/l)	Analytical Results* TPO (mg/l P)	NH_3 (mg/l N)
July 26, 1977	400	93	8.6	30
July 27, 1977	410	96	8.8	34
July 28, 1977	430	130	8.9	33
July 29, 1977	360	110	8.2	38
AVERAGE	425	107	8.6	34

*24 Hour Composite samples.

TABLE 2 MALAVIEW ESTATES SEWAGE TREATMENT PLANT
BACTERIOLOGICAL RESULTS*

Location	Date	Time	Total Confirmed Coliform MF/100 ml	Fecal Coliform MF/100 ml
Raw Sewage	July 25	1055	2.01×10^8	$< 10^6$
		1425	$< 10^6$	$< 10^6$
	July 26	1000	6.4×10^7	4.8×10^7
		1400	2.7×10^7	1.4×10^6
	July 27	0830	2.5×10^7	8.1×10^6
		1430	1.3×10^7	8.1×10^6
	July 28	1030	3.57×10^8	3.75×10^8
		1400	1.4×10^7	1.4×10^6
	July 29	1030	4.4×10^7	$< 10^6$
		MEAN	9.3×10^7	6.3×10^7
Effluent	July 25	1055	2.4×10^7	6.0×10^7
		1425	$< 10^6$	$< 10^6$
	July 26	1000	10^7	1.5×10^7
		1400	1.9×10^7	6.5×10^6
	July 27	0830	2.5×10^7	1.2×10^7
		1430	2.7×10^7	6.3×10^6
	July 28	1030	2.7×10^7	8.1×10^6
		1400	3.7×10^7	1.7×10^7
	July 29	1030	2.6×10^7	1.1×10^7
		MEAN	2.68×10^7	1.02×10^7

*Grab samples only.

3.1 Outfall

A solution of fluorescein dye was added to the effluent on July 26 to determine the exact location of the end of the outfall. The test indicated that the sewage effluent was being discharged approximately 58 metres from the shoreline into 1-2 metres of water at low tide. Further investigation by a diver indicated that the outfall was broken at this point, allowing effluent to be discharged into shallow water.

4 CONCLUSIONS

The Malaview STP effluent exhibited a relatively high fecal coliform concentration (1.02×10^7 MF/100 ml). Combining this information with the fact that the outfall line is broken at a point near the low water level and that the tide tends to move water along the shoreline during flooding and ebbing, it can be concluded that this discharge would tend to adversely affect the bacteriological water quality of the foreshore area for a considerable distance north and south of the outfall.

5 RECOMMENDATIONS

1. The outfall should be repaired and restore the discharge depth to 13 metres of water.

2. Consideration should be given to increasing the length of the outfall into deeper water to increase dilution.

   The Rawn Palmer Formula for Sewage Dispersion predicts a dilution at the shoreline from the outfall of 8700 (for 213 metre outfall). Based on the average flow and fecal coliform data obtained during the survey the calculation predicts a fecal coliform concentration of 1160 MF/100 ml at the shoreline nearest the outfall. This is far in excess of the Shellfish Water Quality standard of 14 MPN/100 ml.