ENVIRONMENT
CANADA

ENVIRONMENTAL
PROTECTION
SERVICE

1970 SHELLFISH GROWING WATER SANITARY SURVEY

of

LADYSMITH HARBOUR, B. C.

by

T. J. TEVENDALE, P. ENG.
PROJECT ENGINEER
SHELLFISH WATER QUALITY PROGRAM
PACIFIC REGION

SURVEILLANCE REPORT EPS-WP-73-1
MARCH, 1973

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SHELLFISH WATER QUALITY PROGRAM

LADYSMITH HARBOUR SANITARY SURVEY REPORT

OCTOBER - NOVEMBER 1970

SUMMARY

Ladysmith Harbour is one of the main production areas of the commercial oyster industry in the Province of British Columbia. Following sanitary and bacteriological surveys in 1962, 1963 and 1964 almost the entire harbour was closed to the direct marketing of oysters due to bacteriological contamination of the oyster growing waters mainly by the Town of Ladysmith's discharge of raw sewage into the inner harbour. In 1965 the Town of Ladysmith constructed, under permit, an Imhoff type primary treatment plant with an effluent outfall discharging into the outer harbour. A sanitary and bacteriological survey was mounted during October and November 1970 with laboratory assistance provided by Fish Inspection Branch. Its purpose was firstly, to determine if installation of the primary treatment plant and relocation of the outfall had significantly improved the quality of the oyster growing waters to the extent that the oyster areas could be reclassified, and secondly, to assess the need for a higher degree of sewage treatment.

The bacteriological results of the survey show that the discharge of primary treated sewage at the new outfall has decreased bacterial contamination of the inner harbour waters. The sanitary survey disclosed the conversion of the old outfall to the inner harbour into a sewer system overflow, the presence of raw sewage connections to storm sewers and faulty septic tank absorption field installations. It is concluded that with these defects corrected, 120 acres of the existing restricted oyster leases in the inner harbour could be approved for direct marketing. Despite the wet weather experienced during part of the survey, the land wash effect generally was concluded not to be significant.

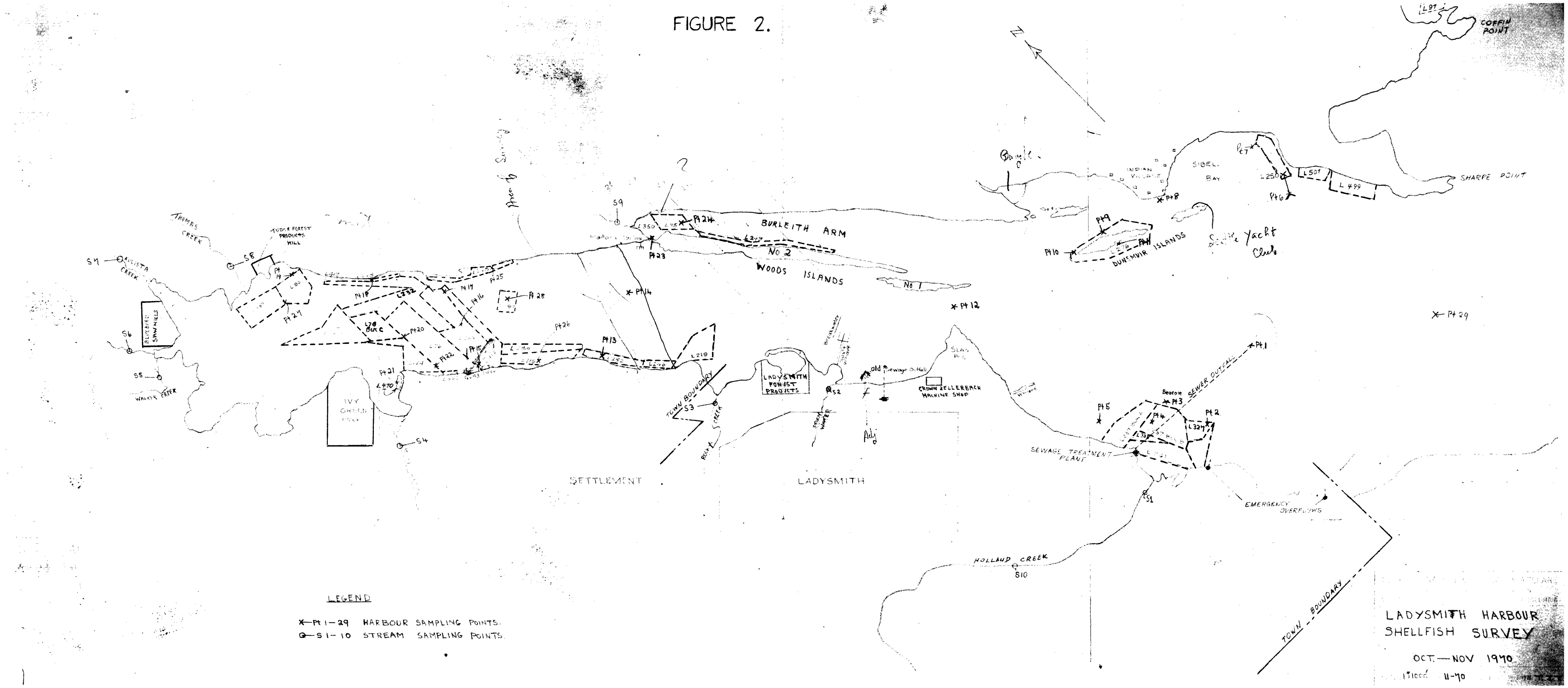
The location of the municipal sewage treatment plant and outfall and the existence of plant by-passes and emergency overflows has enhanced the risk of serious bacteriological contamination of about 40 acres of "restricted" oyster leases in the Holland Bank area. To prevent oysters from these beds being consumed by recreationists or being marketed, it is recommended that this area be closed to shellfish harvesting and the beds depleted.

The bacteriological quality of growing waters overlying commercial oyster leases totalling about 26 acres and Indian lands foreshore (Shell Beach) in the Dunsmuir Island-Sibell Bay area across the harbour from the sewage treatment plant, is influenced by the primary effluent discharged at the outfall. It is recommended that these leases and foreshore be closed to the taking of shellfish. The sewerage improvement works recommended in order to remove oyster-growing area closure restrictions in the outer harbour are specified.

Existing and recommended shellfish growing water classifications are plotted on a chart which accompanies the report (Figure 1).


Dept. of National Health & Welfare
Public Health Engineering Division
Vancouver, British Columbia
FIGURE 1.
LADYSMITH HARBOUR SHELLFISH SURVEY
October - November 1970
Existing and Recommended Shellfish
Growing Water Classification
Legend
A Approved Area
R Restricted Area
P Prohibited Area
Existing Area Boundaries
Recommended Area Boundaries
Scale 1" = 1000'
Date: January 1971
LADYSMITH HARBOUR
PROVISIONAL (See Report Recommendations)
BURLEITH ARM
WOODS ISLANDS
DUNSMUIR ISLANDS
EVENING COVE
VANCOUVER ISLAND
LADYSMITH
STUART CHANNEL
FALSE NARROWS
TRANS-CANADA HIGHWAY
ESPLANADE
FIRST AVENUE
THIRD AVENUE
FIFTH AVENUE
BAYVIEW AVENUE
Holland Creek
HOLLAND BANK
Sharpe Pt.
Wedge Pt.
Slag Pt.
BRENTON ROAD
CHEMAINUS ROAD
Adjoining Chart 3453

FIGURE 2.



LEGEND

✕—Pt 1–29 HARBOUR SAMPLING POINTS.
○—S 1–10 STREAM SAMPLING POINTS.

LADYSMITH HARBOUR
SHELLFISH SURVEY

OCT.—NOV 1970

TABLE 1

LADYSMITH HARBOUR SHELLFISH SURVEY
OCTOBER - NOVEMBER 1970
HARBOUR SAMPLE POINTS - BACTERIOLOGICAL DATA SUMMARY

MEDIAN COLIFORM MPN/100ml

Sample Points	Days 1 - 17		Days 1 - 7 (6 samples)		Days 8 - 17 (9 samples)	
	Total	Fecal	Total	Fecal	Total	Fecal
1 S	11,000	2,100	870	795	24,000	9,300
2	75	23	84	43	43	15
3	150	23	380	93	243	21
4	75	23	93	59	23	14
5	93	9	235	16	43	9
6	33	16	68	43	23	15
7	43	15	33	16	33	15
8	93	16	121	16	59	19
9	93	24	93	23	68	29
10	93	33	166	33	59	41
11	43	9	59	16	93	9
12	43	11	43	9	43	11
13	15	4	33	15	7	<3
14	43	7	69	11	43	4
15	23	4	32	8	9	<3
16	23	7	33	9	14	<3
17	23	9	23	9	23	4
18	9	4	45	3	9	3
19	23	4	151	26	4	<3
20	9	4	43	15	9	<3
21	23	9	43	15	23	7
22	9	4	19	6	4	<3
23	23	4	59	6	23	4
24	15	9	69	29	9	4
25	23	4	43	13	15	3
26	4	<3	23	4	4	<3
27	23	4	43	11	9	<3
28	-	-	-	-	4	<3

TABLE 2

LADYSMITH HARBOUR SHELLFISH SURVEY
OCTOBER - NOVEMBER 1970
HARBOUR SAMPLE POINTS - BACTERIOLOGICAL DATA SUMMARY

MEDIAN COLIFORM MPN/100ml

Sample Points	Percentage of Samples Exceeding A Coliform MPN of 330/100ml (3 tube dilution)		
	Days 1 - 17	Days 1 - 7	Days 8 - 17
2	13	16	11
3	13	16	11
4	7	16	Nil
5	20	50	Nil
6	7	16	Nil
7	Nil	Nil	Nil
8	7	16	Nil
9	Nil	Nil	Nil
10	21	16	25
11	20	16	22
12	14	Nil	22
13	Nil	Nil	Nil
14	Nil	Nil	Nil
15	Nil	Nil	Nil
16	Nil	Nil	Nil
17	Nil	Nil	Nil
18	Nil	Nil	Nil
19	13	33	Nil
20	Nil	Nil	Nil
21	7	Nil	11
22	Nil	Nil	Nil
23	7	16	Nil
24	Nil	Nil	Nil
25	Nil	Nil	Nil
26	Nil	Nil	Nil
27	Nil	Nil	Nil
28	Nil	Nil	Nil
29	16 (6 samples)	-	16

TABLE 3

LADYSMITH HARBOUR SHELLFISH SURVEY
OCTOBER - NOVEMBER 1970
BACTERIOLOGICAL RESULTS OF FRESH WATER STREAMS ENTERING HARBOUR

Stream No.	Day 1		Day 2		Day 3		Day 4		Day 7		Day 8	
	T	F	T	F	T	F	T	F	T	F	T	F
S1	>2,400	>2,400	>2,400	>2,400	4,600	-	1,500	240	430	430	150	93
S2	>2,400	460	>2,400	460	2,400	430	1,500	1,500	90	40	-	-
S3	>2,400	93	>2,400	43	2,400	430	150	9	90	>30	39	4
S4	>2,400	93	>2,400	460	290	290	430	43	90	90	4,600	290
S5	>2,400	150	>2,400	4	9	4	210	23	90	>30	15	4
S6	>2,400	460	>2,400	7	75	23	4,600	43	90	>30	240	9
S7	>2,400	>2,400	>2,400	>2,400	4,600	1,500	11,000	930	1,500	230	4,600	240
S8	>2,400	>2,400	>2,400	>2,400	11,000	4,600	11,000	2,400	9,300	90	11,000	43
S10	-	-	-	-	-	-	-	-	-	-	9	4

T - Confirmed Coliform MPN Index/100 ml
F - Fecal Coliform MPN Index/100 ml

Notes: (1) Stream S2 dried up by Day 8
(2) No samples taken at weekends - i.e. Days 5, 6, 12 and 13.

TABLE 3

LADYSMITH HARBOUR SHELLFISH SURVEY
OCTOBER - NOVEMBER 1970
BACTERIOLOGICAL RESULTS OF FRESH WATER STREAMS ENTERING HARBOUR

Stream No.	Day 9		Day 10		Day 11		Day 14		Day 15		Day 16	
	T	F	T	F	T	F	T	F	T	F	T	F
S1	11,000	430	1,500	140	930	240	4,600	430	2,400	240	930	930
S2	-	-	-	-	-	-	-	-	-	-	-	-
S3	23	4	43	4	430	43	240	4	43	9	93	9
S4	150	93	75	23	1,500	930	2,100	430	430	240	210	43
S5	43	<3	75	4	93	<3	93	9	28	4	21	4
S6	240	4	640	3	930	<3	150	<3	430	3	430	4
S7	2,400	240	2,400	430	2,400	93	1,500	93	1,500	93	930	23
S8	2,400	43	930	23	430	9	750	23	2,400	43	240	23
S10	93	15	4	<3	<3	<3	9	4	9	<3	4	<3

T - Confirmed Coliform MPN Index/100 ml
F - Fecal Coliform MPN Index/100 ml

Notes: (1) Stream S2 dried up by Day 8
(2) No samples taken at weekends - i.e. Days 5, 6, 12 and 13.

TABLE 4

LADYSMITH HARBOUR SHELLFISH SURVEY
OCTOBER - NOVEMBER 1970
STREAM SAMPLE POINTS - BACTERIOLOGICAL DATA SUMMARY

STREAM NO.	STREAM IDENTITY	MEDIAN COLIFORM MPN/100ml		MAXIMUM STREAM FLOW MEASURED cfs
		Total	Fecal	
S-1	Holland Creek	1,500	430	5
S-2	Storm Water	2,400	460	0.5
S-3	Rocky Creek	121	9	1.5
S-4	Bush Creek	430	166	2.5
S-5	Walker Creek	82	4	1.5
S-6	Walker Creek (tributary)	430	5	1.5
S-7	Kuuista Creek	2,400	240	0.5
S-8	Thomas Creek	2,400	43	0.5
S-10	Holland Creek	9	<3	-

TABLE 5

LADYSMITH HARBOUR SHELLFISH SURVEY
OCTOBER - NOVEMBER 1970
CHLORINATION OF SEWAGE TREATMENT PLANT EFFLUENT
COMPARISON OF RECEIVING WATER BACTERIOLOGICAL RESULTS
TOTAL AND FECAL COLIFORM MPN/100ml

Sample Points	Day 12		Day 13		Day 15		Day 16		Day 17	
	T	F	T	F	T	F	T	F	T	F
2	93	7	23	23	137*	38*	93	15	43	7
3	23	9	93	9	144*	85*	9	<3	460	28
4	240	11	43	23	90*	31*	4	<3	43	15
5	43	9	43	23	37*	6*	9	4	240	43
6	240	21	23	23	-	-	4	4	4	<3
7	93	9	23	23	-	-	<3	<3	<3	<3
8	23	23	9	9	-	-	4	<3	<3	<3
9	43	9	43	15	-	-	4	<3	9	4
10	43	4	43	7	-	-	<3	<3	9	<3
11	460	7	9	9	-	-	9	<3	4	<3
12	460	21	93	4	-	-	4	4	75	15
13	23	<3	<3	<3	-	-	43	7	7	7
14	93	7	<3	<3	-	-	43	7	93	9
15	23	9	3	<3	-	-	<3	<3	9	<3
16	4	<3	23	9	-	-	7	<3	23	<3
17	9	<3	9	<3	-	-	4	<3	23	4
18	<3	<3	3	3	-	-	9	4	9	4
19	15	4	4	<3	-	-	23	<3	4	<3
20	9	<3	4	<3	-	-	23	<3	9	<3
21	9	9	460	<3	-	-	43	7	9	<3
22	23	23	4	<3	-	-	4	4	9	4
1(S)N	-	-	-	-	93	43	4,600	2,400	-	-
1(S)E	-	-	-	-	240	43	93	4	-	-
1(S)S	-	-	-	-	1,100	1,100	43	23	-	-
1(S)W	-	-	-	-	240	43	240	23	-	-

0700 hrs. Day 14 - 12% Sodium Hypochlorite to Plant Effluent at 7 ppm (based on 75 gpd for 3,000 population)
0700 hrs. Day 15 - Chlorine increased to 10 ppm
0700 hrs. Day 16 - Chlorine increased to 12 ppm
1200 hrs. Day 16 - Stopped chlorine feed

1(S) N,E,S and W located 300 feet from perimeter of sewage outfall plume.

* Average of 4 sample results.

TABLE 6

LADYSMITH HARBOUR SHELLFISH SURVEY
OCTOBER - NOVEMBER 1970
ELEMENTAL CONDITIONS

Date	Survey Day	Wind MPH	Rainfall Inches	Tidal Conditions At Sampling
October				
9-16			Nil	
17			0.02	
18			0.48	
19			0.26	
20	1	0	0.66	High Slack
21	2	E-S.E.15-33	0.58	No sampling
22	3	SE 20	0.31	Rising
23	4	SE 8 - 25	0.98	Rising
24	5	NW 12 - 18	Nil	Rising
25	6	NW 8 - 10	"	Low Slack - Rising
26	7	NW 4 - 8	"	Rising
27	8	S-S.E. 0 - 6	"	Rising
28	9	NW 5	"	Falling - Mean Slack
29	10	0	"	Mean Slack
30	11	0	"	Falling - Mean Slack
31	12	NW 2	"	Falling - Mean Slack
November				
1	13	NW 5	"	Falling - Mean Slack
2	14	0	"	High Slack
3	15	0	"	High Slack
4	16	N 0 - 4	"	High Slack
5	17	NW 5	"	Rising

TABLE 7

LADYSMITH HARBOUR SHELLFISH SURVEY
OCTOBER - NOVEMBER 1970
SEWAGE TREATMENT PLANT
FIELD TEST RESULTS

Date 1970	RAW SEWAGE BOD_5 (mg/l)	Settleable Solids (ml/l)	pH	Suspended Solids (mg/l)	Sampling Method	PLANT EFFLUENT BOD_5 (mg/l)	Settleable Solids (mg/l)	pH	Suspended Solids (mg/l)	Sampling Method
October										
21	130	5	7.1	-	Grab	180	<0.1	6.8	-	Grab
26	195	10	7.8	-	Grab	142	<0.1	6.5	-	24 hr.composite
27*	228	-	-	234	Grab	195	-	-	76	24 hr. composite
28	290	7.5	7.5	-	Grab	175	1.5	6.7	-	24 hr. composite
29	145	3.5	7.4	-	Grab	135	<0.1	7.2	-	24 hr. composite
30	160	-	-	-	Grab	190	-	-	-	Grab
31	215	12	6.4	-	Grab	160	<0.1	7.0	-	Grab
November 2*	270	-	-	228	Grab	160	-	-	116	24 hr. composite
4*	-	-	-	-	-	160	-	-	147	24 hr. composite

* Samples analyzed by Public Health Engineering Laboratory, Vancouver

Settleable Solids - by Imhoff Cone

TABLE 8

LADYSMITH SEWAGE TREATMENT PLANT
RAW SEWAGE TEST RESULTS
DECEMBER 1970

Date	Analysis *	Approximate Hours of Sampling by 24 hour Automatic Sampler or by Hand											
		2400	0200	0400	0600	08000	1000	1200	1400	1600	1800	2000	2200
December 8	S.S.								28				
	O.C.								38				
9	S.S.					33							
	O.C.					36							
10	S.S.					93							
	O.C.					48							
14	S.S.					65							
	O.C.					46							
15	S.S.					66							
	O.C.					33							
**16	S.S.					50	275	81	90	97	24	93	136
	O.C.					26	28	32	35	38	55	50	61
**17	S.S.	163	143	574	121	60							
	O.C.	63	37	52	67	15							

* S.S. Total Suspended Solids mg/l
O.C. Organic Carbon mg/l
** Dec. 16 (0800) to Dec. 17 (0600) by Automatic sampler. All others by hand.

Samples analyzed by Public Health Engineering Laboratory, Vancouver, B. C.

TABLE 9

LADYSMITH SEWAGE TREATMENT PLANT
PLANT EFFLUENT TEST RESULTS -
DECEMBER 1970

Date 1970	* Analysis	Approximate Hours of Sampling by 24 hour Automatic Sampler or by Hand											
		2400	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200
December													
8	S.S.								25	25	34	22	42
	O.C.								**25 31	37	33	31	48
									**22				
9	S.S.	134	78	66	-	87 **40	113	77	69	70	100	72	53
	O.C.	137	133	96	-	60	91	64	53	57	68	62	49
10	S.S.	78	133	72	37	41							
	O.C.	46	45	47	31	31							
14	S.S.					39	69	62	75	65	64	79	62
	O.C.					24	39	37	39	34	43	45	30
15	S.S.	42	41	75	24	70 **24	76	65	-	-	-	50	67
	O.C	25	24	18	15	26 **21	33	29	-	39	37	29	22
16	S.S.	-	-	31	38	**38							
	O.C.	20	16	16	13	**15							
17	S.S.					**22							
	O.C.					**52							

* S.S. - Total Suspended Solids mg/l
O.C. - Organic Carbon mg/l
** Samples taken by hand

Samples analyzed by Public Health Engineering Laboratory, Vancouver

TABLE 10

LADYSMITH HARBOUR SHELLFISH SURVEY
OCTOBER - NOVEMBER 1970
HARBOUR SAMPLE POINTS - PHYSICAL DATA SUMMARY

Sample Point	o/oo Salinity	J.U. Turbidity	pH	°C Temperature
1S	19.0-27.0	0.6-1.3	7.3-7.7	9.0-11.0
1D	21.5-28.0	0.8-1.6*	7.5-7.7	8.5-11.0
2	21.0-25.0	0.6-1.5	7.6-7.8	9.0-11.0
3	21.0-25.0	0.6-1.3	7.5-7.8	8.0-11.0
4	20.5-24.5	0.1-1.8	7.5-7.7	8.0-11.5
5	22.0-25.0	0.7-2.5	7.5-7.8	9.0-11.5
6	21.0-26.0	0.5-0.9	7.4-7.8	8.0-11.0
7	21.0-26.0	0.5-1.3	7.5-7.8	9.0-11.0
8	21.0-26.0	0.5-0.8	7.6-7.8	9.0-11.0
9	22.0-27.0	0.6-1.5	7.7-7.8	9.0-11.0
10	22.0-28.0	0.5-1.2	7.7-7.8	9.0-11.0
11	21.5-27.0	0.5-1.2	7.6-7.8	9.0-11.0
12	21.5-25.0	0.8-1.8	7.6-7.7	9.5-10.5
13	21.5-25.0	0.7-1.5	7.5-7.7	8.5-11.0
14	18.5-25.0	0.8-1.5	7.6-7.7	9.5-11.0
15	21.5-25.0	0.7-1.2	7.5-7.7	9.0-10.5
16	21.5-25.0	0.6-1.2	7.3-7.7	9.0-10.5
17	21.0-25.0	0.7-1.3	7.4-7.7	8.5-11.0
18	21.0-26.5	0.7-1.2	7.5-7.7	9.0-10.0
19	21.0-26.0	0.8-1.5	7.6-7.7	9.0-10.5
20	17.0-25.0	0.5-2.0	7.5-7.7	9.0-10.5
21	19.5-24.5	0.8-1.9	7.5-7.7	9.0-10.0
22	22.0-25.0	0.6-1.0	7.6-7.7	9.0-11.0
23	22.5-25.0	0.8-1.3	7.6-7.8	8.5-11.0
24	21.5-25.0	0.7-1.5	7.5-7.7	9.0-10.5
25	21.5-25.0	0.5-1.6	7.6-7.8	9.0-10.5
26	21.5-25.0	0.7-2.5	7.5-7.8	8.0-11.0
27	20.0-24.5	0.7-1.5	7.6-7.8	9.0-10.5
28	23.0-25.0	0.7-1.2	7.6	8.5-9.5
29	24.0-24.5	0.6-0.9	-	9.0-10.0

* One high reading of 7.5 neglected

J.U. Jackson Turbidity Units

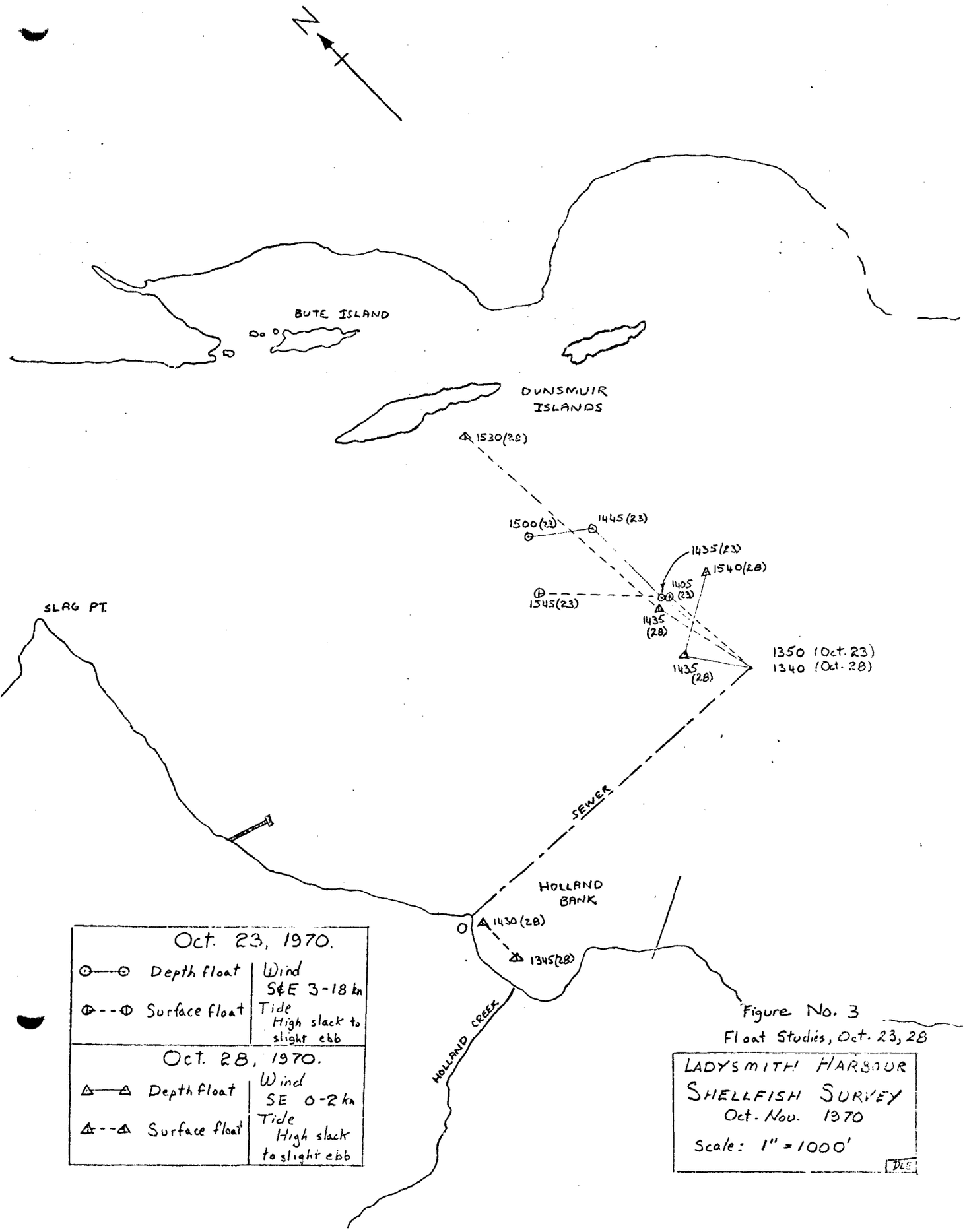


Figure No. 3

Float Studies, Oct. 23, 28

LADYSMITH HARBOUR
SHELLFISH SURVEY
Oct.-Nov. 1970
Scale: 1" = 1000'

DLS

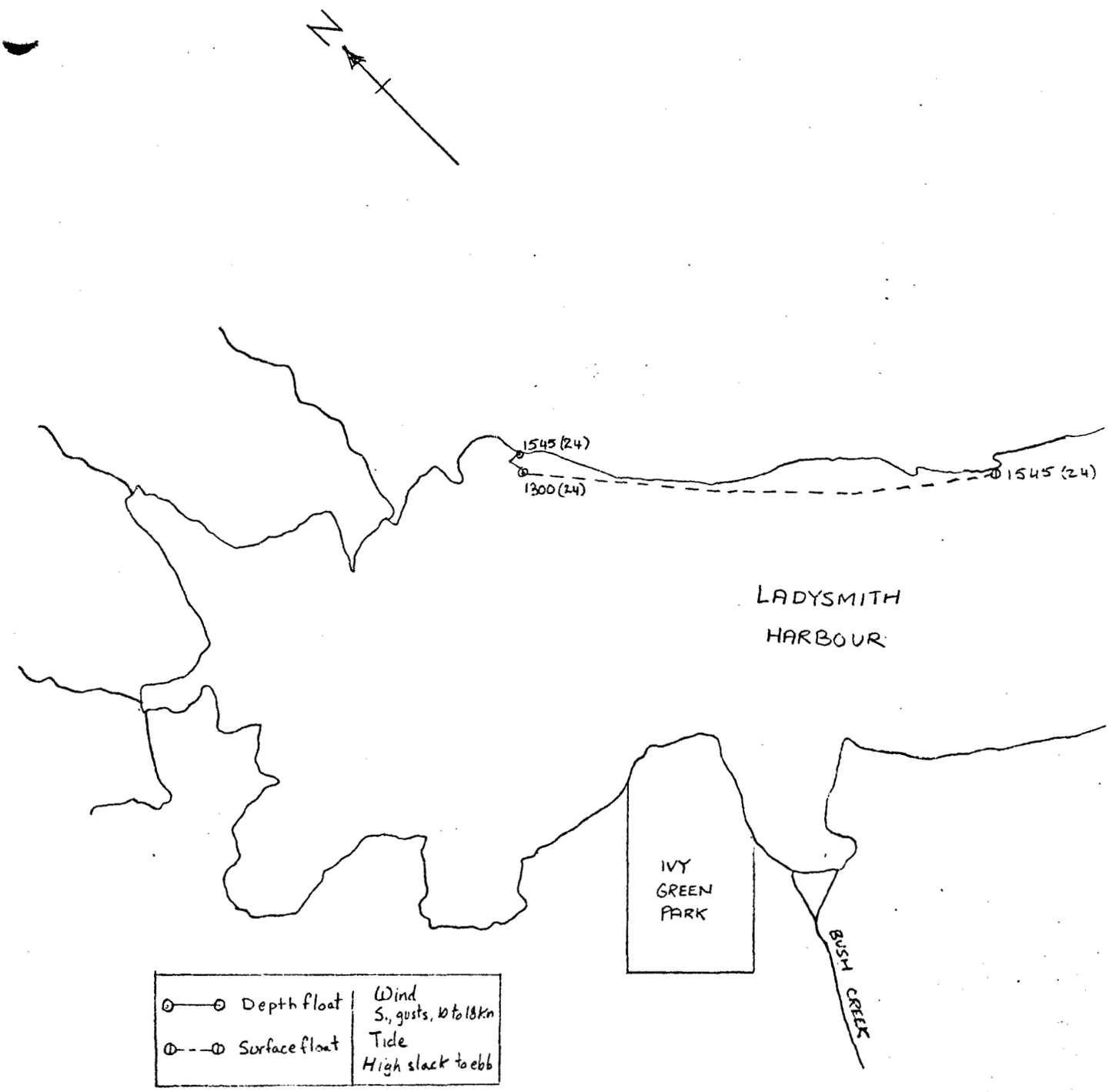


Figure No. 4
Float Study - Oct. 24

LADYSMITH HARBOUR
SHELLFISH SURVEY
Oct. - Nov 1970
Scale: 1" = 1000'
DLE

INTRODUCTION

Ladysmith Harbour is one of the main production areas of the commercial oyster industry in the Province of British Columbia. There are about 40 oyster leases in the harbour and vicinity covering a total of approximately 200 acres. The lease locations are shown on Figure 2. Sanitary surveys were conducted in 1962, 1963 and 1964. The result of these surveys was the classification of the oyster growing waters into "Approved", "Restricted" and "Prohibited" areas. The area demarcations outlined in Figure 1 were established by a Public Notice dated June 18, 1965, signed by the Deputy Minister, Department of Health Services and Hospital Insurance. The main source of pollution was stated to be an estimated daily discharge into the inner harbour of 350,000 gallons of raw sewage from 2,400 persons by the Town of Ladysmith sewage outfall. In 1965 the Town of Ladysmith constructed, under permit, an Imhoff type primary treatment plant at Holland Bank with an outfall extending 2,875 feet into the outer harbour to a depth of 62.5 feet. The sewage collection system area was also expanded and included were most of the establishments within the Town boundary. It is now estimated that a population of 3,000 contributes to the sewerage.

The 1970 survey conducted by Public Health Engineering Division, Department of Health and Welfare, with bacteriological laboratory services provided by Fish Inspection Services Branch, Department of Fisheries, commenced October 20th and was completed November 17th (Days 1 - 17) .

The bacterial criterion for an approved shellfish growing area is a total coliform median MPN of the water which is not to exceed 70 per 100 ml with not more than 10 percent of the samples exceeding an MPN of 330 per 100 ml (where the 9-tube decimal dilution test is used in the analysis of samples) with sampling carried out in

(a) those areas most probably exposed to contamination with human and animal wastes, and

(b) during the most unfavourable hydrographic and pollution conditions.

Previous sanitary and hydrographic surveys had indicated that the most unfavourable conditions existed during the winter, coincident with heavy rainfalls and strong S.E. winds. Those conditions existed from October 18th to October 23rd. The bacteriological data has been presented to reflect the two periods of contrasting conditions which were experienced during the survey. Days 5, 6 and 7 have been included in the unfavourable period to reflect the continuing higher results during the interim change to zero rainfall and N.W. winds.

Tests were performed on raw sewage and treatment plant effluent during, and following the survey and indicate the substantial variation in quality of effluent produced by the plant.

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It will be appreciated that the design and operation of a sewage collection and treatment plant determines one of the most unfavourable pollution conditions. At Ladysmith the following factors are considered to fall within this category. Desludging of the Ladysmith Spiragester tank could increase bacterial pollution in the receiving water. Desludging is carried out by opening a drain valve and drawing down the contents of the tank consisting of digested and freshly settled raw sludge to the outfall. There is no visual or other means of controlling this operation. (The Spiragester was not desludged during the survey period.) There is no emergency holding capacity at the plant. In the case of malfunction in the plant, raw sewage can be diverted directly to the outfall. A 10-inch drain pipe from the "grit chamber" which discharges waste material onto the oyster leases beneath the treatment plant is arranged to act as a treatment plant by-pass. Both sewage lift stations embody overflows. The shoreline sewer overflow at Manhole 60, 1400 feet east of the plant, can discharge raw sewage onto Oyster Lease 261 in the event of blockage, a power outage or control system failure in a single high-lift pneumatic ejector and during down-times for extended repairs to equipment. A second overflow exists in Manhole 52 at the most easterly point of the shoreline sewer and can overflow to the foreshore due to sewer blockage or operational failure of the low-lift single pneumatic ejector. The low-lift station depends on a manual shut down whenever the high-lift station becomes inoperative.

The major factor of concern to the sanitary control of shellfish in Ladysmith Harbour is the conversion in 1965 of the previous raw sewage outfall into the inner harbour to the role of a storm relief sewer to the new Ladysmith sewage collection system.

An attempt was made to evaluate the effect disinfection by chlorine of the existing primary plant effluent might have on the oyster leases in Ladysmith Harbour. It was realized that only an indication would be obtained due to the brief chlorination sampling program that was governed by time and analytical factors.

Methods, Sample Points, Sampling, Field and Laboratory Procedures

(a) Streams

A preliminary reconnaissance of fresh water streams discharging into Ladysmith Harbour established nine possible sources of pollution from hinterland drainage. Sample points were established and identified as S1 to S9 (Figure 2). Only three of the streams, Holland Creek, Rocky Creek and Bush Creek are shown on the Topographic and Hydrographic maps of the area. The other streams were given their local names; S2 was storm water from the Town of Ladysmith which dried up four days after the start of the dry weather; S9 was sampled during the 1964 survey, but it remained dry throughout the present survey; S10, the Town of Ladysmith water intake on Holland Creek was added at Day 8 due to the high coliform counts being obtained at S1 near the mouth of Holland Creek. The S10 sample was obtained from a tap at Sandy Beach Auto Court which supply is piped untreated from S10. Salmon spawning activity was occurring in streams S1, S4, S5 and S6 during the entire survey period.

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The samples for bacteriological analyses were taken in sterilized glass bottles, placed on ice-packs in an insulated picnic cooler and shipped by bus daily to the Fish Inspection Laboratory in Victoria. Stream samples were not taken on Saturdays or Sundays. The time interval between taking the first sample and the arrival of the samples in the Victoria Laboratory was a maximum of six hours. The water samples were tested for confirmed coliform and faecal coliform bacteria by the most probable number (MPN) methods described in the APHA "Recommended Procedures for the Bacteriological Examination of Sea Water and Shellfish", Fourth Edition, 1970, using 3 replicate tubes per decimal sample increment.

Glass bottles containing 2 drops of concentrated nitric acid were used to collect one batch of stream samples for heavy metal analyses. The heavy metals were analyzed by the Department of Fisheries and Forestry Resource Development Laboratory in West Vancouver using Atomic Absorption equipment.

Glass bottles with aluminum foil-lined bottle caps were used to collect samples from Holland Creek, Rocky Creek and Bush Creek for pesticide analysis. These samples were analyzed by the Public Health Engineering Laboratory in Ottawa.

(b) Harbour

At the commencement of the survey, 27 sample points were established throughout the harbour in locations selected to provide most information on the bacterial quality of the water over the oyster growing areas and on the influence of known or possible domestic sewage inputs to the harbour. These sample points were numbered 1 to 27 inclusive. Sample point 28 close to the Depuration Plant water intake was added at Survey Day 7 and Sample Point 29 was added at Survey Day 11 to provide background data on the quality of sea water entering and leaving the harbour. To ensure that samples were obtained from the same locations on each sampling trip, the inshore sampling points were located beside permanent landmarks, the lease samples were taken at painted and flagged lease markers and at other locations where no permanent markers existed, the sample points were marked by buoys. The sample points were located on a harbour chart by taking horizontal sextant fixes on prominent landmarks and plotting the angles with a two-arm transparent protractor. On Survey Day 7, since the discharge boil from the sewer outfall was plainly visible at the surface, it was decided to sample Points 1(S) - surface and 1(D) - depth from the centre of the boil instead of at the location previously determined by the appearance of dye introduced at the sewage treatment plant. The geographical location of sample point 1 changed daily from Day 7 to Day 17 depending on the tidal conditions at the time of sampling.

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The samples for bacteriological analyses were taken in sterilized glass bottles, placed on ice-packs in an insulated picnic cooler and transported by car to the Fish Inspection Laboratory established for the survey at the Fisheries Research Board facility in Nanaimo. The average time intervals between taking the first and last samples and arrival of the samples at the Nanaimo laboratory were 4 hours and 1 hour respectively. The samples were processed on receipt. The water samples were tested for confirmed coliform and faecal coliform bacteria by the most probable number (MPN) methods described in the APHA "Recommended Procedures for the Bacteriological Examination of Sea Water and Shellfish" Fourth Edition, 1970, using 3 replicate tubes per decimal sample increment.

One litre plastic bottles were used to obtain water samples for Salinity, pH and Turbidity determinations. These tests were conducted daily in the Public Health Engineering regional office mobile laboratory parked at Ladysmith using a Beckman RB 3-349 Solubridge with a 0/00 Salinity scale, a Radiometer N 29 pH Meter and a Hach 1860-A Turbidimeter.

All water samples with the exception of those from sample point 1(D) were obtained by immersing the sample bottles upside down about 1 foot below the surface and tilting to fill. The 50-foot depth samples at 1(D) were obtained by filling the sample bottles from a Forst depth sampler. The majority of the water samples were taken from the stern of the Department of Recreation and Conservation, Commercial Fisheries Branch vessel "Marten". Samples from points 20, 21, 23 and 24 and at low tides from points 4, 5, 19, 22 and 27 were taken from Public Health Engineering's 11 foot pneumatic boat. Temperature readings of the samples were taken at the time of sampling using a Precision D.O. Meter thermistor.

Wind velocity and direction were recorded using a Lambrecht anemometer. Rainfall and additional weather information was obtained from the Department of Transport weather station at Cassidy Airport to supplement visual observations. Cassidy Airport is 4 miles north of Ladysmith Harbour.

Float studies were carried out using 1 litre plastic bottles half-filled with water as surface floats and poles with lead weight attachments as depth floats.

(c) Sewage Treatment Plant

During the survey, grab and 24 hour composite raw and treated sewage samples were tested for 5-day Biochemical Oxygen Demand, volumetric Settleable Solids, pH and Suspended Solids. The test methods followed APHA, Part III, "Standard Methods for the Examination of Water and Wastewater", Twelfth Edition, 1965. The BOD_5, pH and Settleable Solids tests were carried out at the mobile laboratory in Ladysmith. The Suspended Solids tests were performed at the Division's laboratory in Vancouver as were the Organic Carbon tests on later submitted samples.

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The composite samples were collected using a 24-hour time clock on a 12-bottle North Hants Automatic Liquid Sampler. The samples in plastic bottles were packed on ice-packs in picnic coolers and shipped by bus to Vancouver. The carbon analyses were performed on a Beckman 915 Total Organic Carbon Analyzer with a 215-A Infra red Analyzer attachment.

During the treated sewage disinfection trial run, chlorine residuals were determined at the mobile laboratory using a Wallace & Tiernan Amperometic Titrator.

RESULTS AND DISCUSSION

The location of the stream and harbour sampling points and the location of the commercial oyster leases are shown in Figure 2.

The physical and bacteriological data obtained from the harbour sampling points during the survey and the weather and tidal conditions at sampling are assembled in Appendix 2. Tables 1 and 2 present this bacteriological data to reflect the two periods of contrasting weather conditions experienced during the survey, and in a format that allows for convenient classification of the growing areas according to the U.S. National Shellfish Sanitation Program Manual of Operations. Table 6 summarizes the weather and tidal conditions. Tables 3 and 4 present the bacteriological data for the fresh water streams entering the harbour.

In the following discussion, the division line between the outer and inner harbour is the constriction between Slag Pt. and Woods Island No. 1. Sample point 12 was located on this line.

In the outer harbour, oysters growing in the Holland Bank area are subject to contamination by domestic sewage from the Town of Ladysmith sewage treatment plant by-passes and sewage lift station overflows, and by faecal pollution present in Holland Creek. On this basis alone, the area should be closed to shellfish harvesting. Additionally, the discharge through the outfall of over 300,000 GPD of primary treated non-disinfected sewage from the plant within 4,000 feet of all of the commercial growing oyster leases at Holland Bank could have a decided effect on the growing water quality.

The bacteriological results from the sample points in this area at a time when the sewage treatment plant was in normally good operating condition and by-passes and emergency overflows not in use, would indicate that the growing water is, indeed, affected by sewage discharged at the outfall and by the faecal contribution from Holland Creek. Referring to Tables 1 and 2, sample points 2, 3, 4 and 5 covering the commercial oyster lease areas at Holland Bank gave results that exceeded the bacteria criterion for an approved shellfish growing area; namely, a total coliform median MPN greater than 70 per 100 ml. The results at 1(S) were high as would be expected by sampling the surface boil from a 62 1/2 foot deep sewage outfall discharge in which considerable suspended solids were easily visible. Median coliform

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results for sample point 1(D) were not presented since the extreme variations from high to low merely showed that the 50-foot depth sample sometimes coincided with the plume from the outfall, depending on tidal conditions.

On the north side of the outer harbour sample points 6, 8, 9, 10 and 11 gave median coliform MPN results that under the worst conditions, Days 1 - 7, either did not meet the maximum 70 per 100 ml or the 10 percent not greater than 330 per 100 ml criteria for an approved growing area. While the samples from point 7 were of approved water quality, it is felt that under certain weather and tidal conditions, the potential for higher coliform counts is too great to allow harvesting from a small portion of Sibell Bay. This has lately been substantiated by high faecal levels in the meat of oysters taken from Sibell Bay.

The direction of floats launched at the sewer outfall (Fig. 3) and the higher median coliform counts at sample points 11 and 12 during the dry weather and calm seas period of the survey (Days 8 - 17), would indicate that the growing water quality is adversely influenced by sewage discharged at the treatment plant outfall. The high coliform counts at sample point 29 on Days 11, 12, and 13 (Appendix 2) obtained on an ebbing tide, are further evidence of the far-reaching effect of the outfall location and the high coliform content of the discharged sewage. The distance between the end of the outfall and point 29 is about 4,000 feet.

In the inner harbour, only at sample points 19, 21 and 23 did the median coliform counts not meet the approved growing water standard, probably due to localized pollution inputs. The higher coliform counts at point 19 could be due to human wastes from the neighbouring sawmill and residence or by human and animal wastes contributed by nearby Thomas Creek (S8). Point 21 will be influenced mainly by the coliform levels in Bush Creek (S4). Points 23 and 24 could be influenced by local faulty sewage disposal facilities and by storm water and raw sewage discharges to the inner harbour from within the Ladysmith municipal area.

The physical characteristics of the harbour water samples are presented in Table 10. During the entire survey and including all samples taken throughout the harbour, the variation extremes were as follows:

Salinity 17-28^{o}/oo, Turbidity 0.1 - 2.5 J.U., pH 7.3-7.8.
Temp 8-11.5^{o}C.

The individual sample point results do not seem to have any particular significance with respect to pollution inputs or oyster growing activity.

In deciding the growing area classification for the harbour, existing and potential sources of domestic and industrial wastes must be considered along with the bacteriological data. The existing classifications based on previous surveys and those recommended by the present survey are shown in Figure 1. It will be noted that the existing "prohibited" area has been retained, due to the waterfront logging and boating activities and the storm water contribution from the populated paved area of the town, and further extended to include the foreshore in the outer harbour subject to contamination by domestic sewage. The existing "restricted" growing area at the head of the harbour has been shown as "provisionally approved". This existing classification was mainly due to the discharge

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of raw sewage from the Town of Ladysmith into the inner harbour via the old outfall. The old outfall is still connected to the Ladysmith sewerage and acts as a storm or emergency overflow. The approval of this growing area is conditional on eliminating sanitary sewer system discharges into the inner harbour. The remainder of the harbour water with a median coliform MPN between 70 and 700 per 100 ml remains in the "restricted" category.

The bacteriological pollution contribution by the streams entering the harbour are shown in Tables 3 and 4. Holland Creek has the largest flow, reported in a previous survey at 100 cfs following heavy rains in winter, and reduced to 0.5 cfs in summer. Sample point S10, the Town of Ladysmith water intake on the creek above the inhabited area is relatively low in coliform organisms compared to sample point S1. The much higher coliform count at S1 even in the dry weather would seem to indicate either a human or animal sewage input to the Creek above the Island Highway. The faecal counts obtained at S2 show the pollution effects of run-off water from a sewered area. Bush Creek in both volume and coliform contribution exceeds Rocky Creek and may account for the occasional high count obtained at Harbour sample point 21. Streams S5 and S6 drain a relatively unpopulated small local area, while streams S7 and S8 drain inhabited hinterland and have understandingly higher coliform counts.

Appendix 3 presents the results of pesticide and metal ion determinations on the fresh water streams entering the harbour. Only the three main streams S1, S3 and S4 were examined for pesticides since they drain the commercially logged forest areas. No organo-phosphorous or organo-chlorine insecticides were detected. All the streams were examined for selected metallic ions and none were present in sufficient concentrations to warrant further attention.

The Town of Ladysmith sewage treatment plant performance test results have been documented in Table 7, 8 and 9. The average suspended solids and BOD_5 removal, considering all samples taken was 55% and 20% respectively. There is a substantial variation in the quality of the effluent produced by the plant.

The results of the plant effluent chlorination study are shown in Table 5 and an evaluation of the results made in Appendix 1.

CONCLUSIONS

1. There has been a change in the water quality of Ladysmith Harbour since the previous reported shellfish survey of 1964, due to the construction by the Town of Ladysmith in 1965 of a primary sewage treatment plant with a deep outfall to the outer harbour. The effects of the change on the oyster growing areas are as follows:

(a) The waters overlying the oyster leases in the Holland Bank area are now subject to contamination by raw and treated sewage from the sewers, the treatment plant and its outfall. Irrespective of the degree of treatment accorded the sewage at the treatment plant, the proposed prohibited classification of these oyster leases is essential unless all of the following safeguards are provided:

(i) Elimination of overflows from the sewer system.

(ii) Installation of duplicate pneumatic ejectors and an auxiliary power source at low and high lift stations, or adequate outage storage capacity.

(iii) Construction of spill holding capacity and/or the installation of duplicate process units at the sewage treatment plant to provide treatment during times of hydraulic overloading and to allow unit maintenance without deterioration of the quality of the treated effluent.

(iv) Removal of raw or inadequately treated sewage treatment plant by-passes or drains discharging to the foreshore.

(v) Appointment of competent certified and continuously available personnel to operate the plant to consistently maintain the quality of the effluent set out in the plant permit.

If these safeguards are implemented, the Holland Bank oyster leases could be placed in a restricted category.

(b) The waters overlying the oyster leases in the Sibell Bay area are influenced by the quality of the effluent discharged at the treatment plant outfall. The survey data indicate a potential health risk if these leases continue to be approved for direct marketing. The provision of secondary treatment and disinfection at the sewage treatment plant to produce an effluent in which the suspended solids does not exceed 30 mg/l and the total coliform MPN does not exceed 1000/100 ml, will permit the Sibell Bay and Dunsmuir Island leases to be approved for direct marketing.

(c) The waters overlying the presently restricted oyster growing areas in the inner harbour have improved in bacteriological quality to the extent that most of the leases could be approved for direct marketing provided the following safeguards are adopted:

(i) Complete elimination of the storm overflow of sanitary sewage via the old sewer outfall.

(ii) Mandatory connection to the sanitary sewer system of properties that lie within the sewered area and the elimination of raw sewage connections to storm sewers such as the Crown Zellerbach Maintenance Workshop.

1. (c) (iii) Confirmation from the Department of Health Services that the septic tank and field absorption systems serving industrial, commercial and residential establishments on or near, the inner harbour shoreline and streams are performing satisfactorily and that an active inspection program has been instituted to maintain operation at a satisfactory level.

The present prohibited area in the inner harbour would remain since it is subject to storm drainage discharges from the Town of Ladysmith and includes the main commercial, fishing and recreational boating facilities. A restricted buffer zone between the existing prohibited area and the proposed approved eastern boundary line across the inner harbour is required, and the location of the boundary line must be at least 1000 feet west of the marinas.

RECOMMENDATIONS

1. The proposed Oyster growing water area classifications for Ladysmith Harbour are dependent on action taken by the Pollution Control Branch, the Town of Ladysmith and the Department of Health Services and Hospital Insurance to limit the pollution input to the harbour. Since this is improbable in the immediate future, we recommend that the following changes be made immediately to the existing classification boundaries (Figure 1)

   "Extend the prohibited area northern boundary line eastward from the southern extremity of Woods Island to intersect a line drawn between Sharpe Point on the north side of the harbour and a point on the south side of the harbour about 6,000 feet southeast of the Ladysmith Sewage Treatment Plant".

   The southern part of the harbour within the boundary lines would be prohibited and the remainder of the harbour would be restricted.
2. If the safeguards outlined in conclusion 1(c) are implemented, the entire inner harbour west of a line drawn between the western extremity of oyster lease 252 on the south side to a point on the north side at least 1000 feet west of Manana Marina can be placed in the approved category.
3. If the safeguards outlined in conclusion 1(a) are implemented, the prohibited area between the existing easterly prohibited line and the prohibited eastern boundary described in the first recommendation can be upgraded to the restricted category.
4. If the upgraded treatment outlined in conclusion 1(b) is implemented, the northern part of the outer harbour can be approved for direct marketing.

APPENDIX I

REPORT SUBMITTED TO POLLUTION CONTROL BRANCH

JANUARY 29, 1971

Pages 1 - 7 Influence of Discharges from Ladysmith Treatment Plant on Oyster Growing Areas in Ladysmith Harbour

Public Health Engineering Division
Room 605, 1110 West Georgia Street
Vancouver 5, British Columbia

January 29, 1971

Mr. W.N. Venables
Director of Pollution Control
Pollution Control Branch
Dept. of Lands, Forests
and Water Resources,
Parliament Buildings
Victoria, B.C.

Attention: Mr. J.E. Dew-Jones

Dear Sir:

We are pleased to provide you with the attached copy of an Appendix to the Ladysmith Harbour Shellfish Survey Report now in preparation.

The Appendix contains all of the information obtained during the Survey that is pertinent to your consideration of the Permit Application from the Town of Ladysmith.

If further details or elucidation of the data is required, please let us know.

Yours very truly,

J.S. Wishart, P.Eng.,
Regional Engineer

c.c. Dr. J.A.Taylor, Dept. of Health Services and Hospital Insurance
Mr. R.G. McMynn, Dept. of Recreation and Conservation
Mr. W.R. Hourston, Regional Director, Dept. of Fisheries and Forestry, Vancouver.

INFLUENCE OF DISCHARGES
FROM LADYSMITH TREATMENT PLANT
ON OYSTER GROWING AREAS IN LADYSMITH HARBOUR

As a result of sanitary surveys conducted in 1962, 1963 and 1964 the oyster growing waters of Ladysmith Harbour were classified into "Approved", "Restricted" and "Prohibited" areas. The existing demarcations outlined in Figure 1 were given in a Public Notice dated June 18, 1965 signed by the Deputy Minister of Health, Department of Health Services and Hospital Insurance. The main source of pollution was stated to be an estimated daily discharge into the inner harbour of 350,000 gallons of raw sewage from 2,400 persons by the Town of Ladysmith sewage outfall. In 1965 the Town of Ladysmith constructed, under permit, an Imhoff type primary treatment plant at Holland Bank with an outfall extending 2,875 ft. into the outer harbour at a depth of 62.5 ft. The sewage collection system area was also expanded and included were most of the establishements within the Town boundary. It is now estimated that a population of 3,000 contributes to the sewage.

In 1966-67 Provincial Health and Canada Fisheries Research Board together conducted a sanitary survey of the growing areas. A survey report was never produced. Interpretation of the bacteriological results of the harbour water samples (Tables 1 and 2) that were obtained in the course of the survey carried out in the fall of 1970 by this office, with laboratory facilities provided by Canada Department of Fisheries, shows that the only existing oyster growing leases adversely affected by sewage discharged from the outfall are those located at Holland Bank, and across the harbour in the Dunsmuir Island and Sibell Bay areas.

The bacterial criterion for an approved shellfish growing area is a total coliform median MPN of the water which is

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not to exceed 70 per 100 ml with not more than 10 per cent of the samples exceeding as MPN of 330 per 100 ml (where the 9 tube decimal dilution test is used in the analysis of samples) with sampling carried out in:

(a) those areas most probably exposed to contamination with human and animal wastes, and

(b) during the most unfavourable hydrographic and pollution conditions.

Previous sanitary and hydrographic surveys had indicated that the most unfavourable conditions existed during the winter, coincident with heavy rainfall and strong S.E. winds. These conditions existed from October 18th to October 23rd. Weather and sea conditions during the survey are shown in Table 6. The bacteriological data (Tables 1 and 2) have been presented to reflect the two periods of contrasting conditions which were experienced during the survey. Days 5, 6 and 7 have been included in the unfavourable period to reflect the continuing higher results during the interim change to zero rainfall and N.W. winds.

Tables 7, 8 and 9 present the results of tests performed on raw sewage and treatment plant effluent during, and following, the survey and indicate the substantial variation in quality of effluent produced by the plant.

It will be appreciated that the design and operation of a sewage collection and treatment plant determines one of the most unfavourable pollution conditions. At Ladysmith the following factors are considered to fall within this category. Desludging of the Ladysmith Spiragester tank could increase bacterial pollution in the receiving water. Desludging is carried out by opening a drain valve and drawing down the contents of the tank consisting of a digested and freshly settled raw sludge to the outfall. There is no visual, or other means of controlling this operation. (The Spiragester

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was not desludged during the survey period). There is no emergency holding capacity at the plant. In the case of malfunction in the plant, raw sewage can be diverted directly to the outfall. A 10-inch drain pipe from the "grit chamber" which discharges waste material onto the oyster leases beneath the treatment plant is arranged to act as a treatment plant by-pass. Both sewage lift stations embody overflows. The shoreline sewer overflow at Manhole 60, 1400 feet east of the plant, can discharge raw sewage onto Oyster Lease 261 in the event of blockage, or power outage or control system failure in the single high-lift pneumatic ejector and during down-times for extended repairs to equipment. A second overflow exists in Manhole 52 at the most easterly point of the shoreline sewer and can overflow to the foreshore due to sewer blockage or operational failure of the low-lift single pneumatic ejector. The low-lift station depends on a manual shut down whenever the high-lift station becomes inoperative.

The major factor of concern to the sanitary control of shellfish in Ladysmith Harbour is the conversion in 1965 of the previous raw sewage outfall into the inner harbour to the role of a storm relief sewer to the new Ladysmith sewage collection system.

An attempt was made to evaluate the effect disinfection by chlorine of the existing primary plant effluent might have on the oyster leases in Ladysmith Harbour. It was realized that only an indication would be obtained due to the brief chlorination sampling program that was governed by time and analytical factors.

Table 5 summarizes the bacteriological results for harbour sampling points (Fig. 2) that were obtained immediately before, during, and following chlorination of the sewage treatment plant effluent. A chlorine solution consisting of 12% sodium

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hypochlorite was drip fed into the effluent weir. Mixing and contact time of about 45 minutes (determined by dye tests) was obtained in the outfall line. Chlorine was added from 0700 hrs. on Day 14 to 1200 hrs. on Day 16. A short interruption in chlorine solution feed occurred prior to 0700 hrs. each morning before carboys were changed. Otherwise the feed was continuous at the dosage noted in Table 5. Chlorine demand tests on a grab sample of plant effluent taken at 1400 hrs. on Day 10 showed total combined chlorine residuals of 0.3 and >1.0 ppm with the addition of 5 and 10 mg/l chlorine respectively and a 60-minute contact time. Bacteriological tests of unchlorinated plant effluent grab samples on Days 11, 14 and 15 gave results of $>24 \times 10^6$, 15×10^6, and 240×10^6 total coliforms MPN/100 ml. One grab sample of chlorinated effluent taken from the weir outlet on Day 15 and allowed a 2-hour contact period before testing gave an MPN of less than 300/100 ml. Sampling times at the outfall varied between 0900 and 1000 hrs. each day during the chlorination period.

The sampling points influenced by sewage discharged at the outfall are Nos. 1(S) to 12 inclusive. It was anticipated that if disinfection was effective, a significant reduction in bacteria counts would be achieved at sample points 1(S) to 5 inclusive. Samples at Point 1(S) were taken in the centre of the visible outfall surface boil, the position of which changed geographically from day to day depending on tidal and weather conditions. From the tabulated bacteriological results for Harbour Sample Point No. 1(S) attached, it can be seen that the total coliform MPN varied from a low of 93 to a high of 110,000/100 ml before, and during chlorination. These extremes in variation are most probably due to the presence and unequal distribution, of the visible suspended solids in the surface boil of sewage from the outfall. Similarly, the variation in results at Points 1(S), N, E, S and W located about 300 ft. from the perimeter of the outfall

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boil are indicative of the direction of flow of outfall sewage dictated by tidal and wind effects at the time of sampling.

The median total coliform MPN for the combined results from sample points 2, 3, 4 and 5 on Days 15 and 16 during chlorination (43/100 ml). This deterioration in the water quality would indicate that continuously effective disinfection of the primary treated sewage was not being obtained, probably due to variations in chlorine demand and suspended solids concentration in the effluent. Effective and continuous disinfection should entail duplication of chlorination equipment, positive mixing prior to a 60-minute average flow contact chamber designed to prevent short circuiting, and control of chlorine dosage in order to give a residual in the discharge from the contact chamber at all times. Evidence of satisfactory compliance should be bacteriological results of effluent samples taken in accordance with an approved sampling program.

The decrease in the median MPN for the combined results of sample points 6, 7, 8, 9, 10, 11 and 12 on Days 12 and 13 compared with chlorination on Day 16 and post chlorination Day 17 (43/100 ml to 4/100 ml), indicates an overall improvement in the bacterial quality of the harbour water in the vicinity of Dunsmuir Island and wibell Bay, due to disinfection of the treatment plant effluent. The greater distance of these areas from the outfall and the opportunity for better dispersion of sewage by tidal action would tend to average out the fluctuations in bacteria levels found at the Holland Bank area. Under certain tidal and weather conditions, however, dilution and dispersion effects could be minimized to that higher bacterial concentrations could reach Dunsmuir Island and Sibell Bay growing waters.

The conclusions that can be made from the study conducted by this office are as follows:

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1. Irrespective of the degree of treatment accorded the sewage at the treatment plant, the proposed prohibited or restricted classificjtion of the oyster leases in the outer harbour will remain unless all of the following safeguards are provided:

   (a) Elimination of overflows from the sewer system.

   (b) Installation of duplicate pneumatic ejectors and an auxiliary power source at low and high lift stations or adequate outage storage capacity.

   (c) Construction of spill holding and/or the installation of duplicate process units at the sewage treatment plant to provide treatment during times of hydraulic overloading and to allow unit maintenance without deterioration of the quality of the treated effluent.

   (d) Removal of raw or inadequately treated sewage treatment plant by-passes or drains discharging to the foreshore.

   (e) Appointment of competent (certificated) and continuously available personnel to operate the plant to consistenly maintain the quality of the effluent set out in the plant permit.

2. Reclassification of oyster leases in the inner harbour from a restricted to an approved category is conditional on the adoption of all of the following safeguards.

   (a) Complete elimination of the storm overflow of sanitary sewage via the old sewer outfall.

   (b) Mandatory connection to the sanitary sewer system of properties that lie within the sewered area and the elimination of raw sewage connections to storm sewers such as the Crown Zellerbach Maintenance Workshop.

   (c) Confirmation from the Department of Health Services that the septic tank and field absorption systems

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serving the commercial and residential establishments on, or near, the inner harbour shoreline are performing satisfactorily and that an active inspection program has been instituted to maintain operation at a satisfactory level.

3. The results of the disinfection study are inconclusive though indicative that the Ladysmith primary effluent can be reduced in bacterial content to the extent that oyster leases in the Dunsmuir Island and Sibell Bay areas can be classified as "Approved".

The following recommendations are made to increase the approved growing areas for oysters and to allow increased utilization of the oysters grown in Ladysmith Harbour.

1. Implementation of the safeguards detailed in the foregoing conclusions, 1 and 2.
2. Provision of secondary treatment and disinfection at the existing Ladysmith Harbour plant to produce an effluent in which the suspended solids does not exceed 30 mg/l and the total coliform MPN does not exceed 1000/100 ml.

If these recommendations are adopted, the inner harbour oyster leases west of the proposed approved demarcation line area "A" shown in Figure 1 can be de-restricted as can the oyster leases in the Dunsmuir Island and Sibell areas.

APPENDIX 2

PHYSICAL AND BACTERIOLOGICAL TEST RESULTS AND ELEMENTAL CONDITIONS AT INDIVIDUAL SAMPLING STATIONS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 1(S)

VEY AY	COLIFORM MPN/100ml T	F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP°C	WIND KNOTS	WEATHER	TIDE
	>24,000	>24,000	—	—	—	—	0	.66" RAIN	High slack
3	240	93	19	1·0	7·6	11	SE. 20	.31" RAIN	Rising
+	1500	1500	—	—	—	—	SE 8-25	.98" RAIN	Rising
5	93	43	24	1·0	7·5	10	NW 12-18	0" SUNNY	Rising
6	93	15	23	0·6	7·7	10	NW 8-10	0" OVERCAST	Low Slack - Rising
4	11,000	11,000	23	1·1	7·3	10·5	NW 4-8	0" FAIR	Rising
8	110,000	110,000	—	—	—	—	S-SE 0-6	0" SUNNY	Rising
9	11,000	2,100	25	1·3	—	—	NW 5	0" SUNNY	Falling - Mean Tide
0	11,000	1500	—	—	—	—	0	0" SUNNY	Mean Slack
1	46,000	2,100	—	—	—	—	0	0" SUNNY	Falling - Mean Slac
12	24,000	24,000	25	0·9	—	9	NW 2	0" CLOUDY	Falling - High to Mea
13	110,000	21,000	24·5	0·9	—	10	NW 5	0" SUNNY	Falling - High to Mea
14	— a	—	—	—	—	—	0	0" SUNNY	High Slack.
15	110,000 a	110,000	—	—	—	—	0	0 SUNNY	High Slack
16	93 a	4	25	1·0	—	10	N. 0-4	0" OVERCAST	High Slack
17	24,000	9,300	—	—	—	—	N.W 5	0" SUNNY	Rising
0									

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 1(D)

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	15	4	—	—	—	—	0	.66" RAIN	High Slack
3	—	—	—	—	—	—	SE 20	.31" RAIN	Rising
4	>24,000	150	21.5	1.6	7.7	11	SE8-25	½" RAIN	Rising
5	43	4	28	4.5	7.5	12	NW12-18	0" SUNNY	Rising
6	23	4	26	1.0	7.6	10	NW8-12	0" OVERCAST	Low Slack - Rising
7	430	93	24	1.2	7.5	10.5	NW4-8	0" FAIR	Rising
8	210	39	—	—	—	—	S.SE 0-6	0" SUNNY	Rising
9	150	43	24	1.6	—	—	NW 5	0" SUNNY	Falling - Mean Ti
10	1,600	150	—	—	—	—	0	0" SUNNY	Mean Slack
11	15	<3	24	0.7	—	10	0	0" SUNNY	Falling - Mean Slac
12	240	93	25	1.5	—	8.5	NW 2	0" CLOUDY	Falling - High to Me
13	43	4	24.5	0.8	—	10	NW 5	0" SUNNY	Falling - High to Me
14	—	—	—	—	—		0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	—	—	—	—	—	—	N. 0-4	0" OVERCAST	High Slack
17	—	—	—	—	—	—	NW 5	0" SUNNY	Rising

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 2

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	230	43	—	—	—	—	0	.66" RAIN	High Slack
3	43	23	21	1·2	7·6	11	S.E. 20	.31" RAIN	Rising
4	460	43	—	—	—	—	SE 8-25	.98" RAIN	Rising
5	93	43	22	1·5	7·6	9·5	NW 12-18	0" SUNNY	Rising
6	75	4	25	0 8	7·8	10	NW 8-12	0" OVERCAST	Low Slack - Rising
7	9 (93)	< 3	23·5	0·6	7·7	10	NW 4-8	0" FAIR	Rising
8	~~210~~ (93)	~~39~~ (93)	—	—	—	—	S.SE 0-6	0" SUNNY	Rising
9	43	4	23·5	1·1	—	—	NW 5	0" SUNNY	Falling - Mean Tide
10	23	9	—	—	—	—	0	0" SUNNY	Mean Slack
11	460	240	24·5	0·8	—	—	0	0" SUNNY	Falling - Mean Slack
12	93	4	24·5	1·1	—	9	NW 2	0" CLOUDY	Falling - High to Mean
13	23	23	24·0	1·5	—	10	NW 5	0" SUNNY	Falling - High to Mean
14	— a	—	—	—	—	—	0	0" SUNNY	High Slack
15	23	23	—	—	—	—	0	0" SUNNY	High Slack
16	93 a	15	24·5	0·9	—	9	N. 0-4	0" OVERCAST	High Slack
17	43	4	—	—	—	—	NW 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 3

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	230	230	–	–	–	–	C	.66" RAIN	High Slack
3	240	93	21	1.1	4.4	11	SE 20	.31" RAIN	Rising
4	150	93	–	–	–	–	SE8-25	.98" RAIN	Rising
5	460	93	25	1.3	4.5	10	NW12-18	0" SUNNY	Rising
6	93	23	24	0.8	4.8	9.5	NW2-10	0" OVERCAST	Low Slack – Rising
4	93	4	23.5	0.6	4.4	10	NW4-8	0" FAIR	Rising
8	23	9	–	–	–	–	S.SE0-6	0" SUNNY	Rising
9	23	23	23	1.2	–	–	NW 5	0" SUNNY	Falling – Mean Tide
0	150	23	–	–	–	–	0	0" SUNNY	Mean Slack
1	240	21	22	1.0	–	8	0	0" SUNNY	Falling – Mean Slack
2	23	9	24.5	1.0	–	9	NW2	0" CLOUDY	Falling – High to Mean
13	93	9	24.5	0.6	–	10	NW 5	0" SUNNY	Falling – High to Mean
4	– a	–	–	–	–	–	0	0" SUNNY	High Slack
5	1502	150	–	–	–	–	0	0" SUNNY	High Slack
16	9 a	<3	24.5	0.4	–	9.5	N. 0-4	0" OVERCAST	High Slack
4	460	28	–	–	–	–	NW 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 4

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	230	230	—	—	—	—	C	.66" RAIN	High Slack
3	43	43	23	1.2	7.6	11.5	SE. 20	.31" RAIN	Rising
4	75	75	-	-	-	-	SE8-25	.98" RAIN	Rising
5	93	23	25	1.8	7.5	9	NW12-18	0" SUNNY	Rising
6	93	23	21	0.1	7.7	8	NW8-12	0" OVERCAST	Low Slack - Rising
7	460	240	22	1.0	7.7	10.5	NW4-8	0" FAIR	Rising
8	23	23	-	-	-	-	S.SE0-6	0" SUNNY	Rising
9	93	93	23	0.9	-	-	NW 5	0" SUNNY	Falling - Mean Tide
10	150	14	-	-	-	-	0	0" SUNNY	Mean Slack
11	23	9	23.5	0.7	-	-	0	0" SUNNY	Falling - Mean Slack
12	240	11	20.5	1.1	-	8.5	NW 2	0" CLOUDY	Falling High to Mean
13	43	23	24	0.9	-	9.5	NW 5	0" SUNNY	Falling - High to Mean
14	—a	—	-	-	-	-	0	0" SUNNY	High Slack
15	15a	< 3	-	-	-	-	0	0" SUNNY	High Slack
16	4a	< 3	24.5	0.8	-	9	N. 0-4	C" OVERCAST	High Slack
17	43	15	—	—	-	—	NW. 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 5.

SURVEY DAY	COLIFORM MPN/100ml T	F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP°C	WIND KNOTS	WEATHER	TIDE
1	43	23	—	—	—	—	C	.66" RAIN	High Slack
3	>2,400	>2,400	22	2·3	4·6	11·5	SE 20	.31" RAIN	Rising
4	430	93	—	—	—	—	SE 8-25	.4" RAIN	Rising
5	43	4	25	1·5	4·5	9	NW 12-18	0" SUNNY	Rising
6	460	9	24	0·8	4·8	9	NW 12-18	C" OVERCAST	Low Slack - Rising
4	23	4	22	1·8	4·6	10	NW 4-8	C" FAIR	Rising
8	15	9	—	—	—	—	S.SEC 6	C" SUNNY	Rising
9	23	9	23·5	2·5	—	—	NW 5	0" SUNNY	Falling - Mean Tide
10	43	9	—	—	—	—	0	0" SUNNY	Mean Slack
11	93	4	23·5	0·8	—	—	0	C" SUNNY	Falling - Mean Slack
12	43	9	24	1·5	—	10	NW 2	0" CLOUDY	Falling High to Mean
13	43	23	24	0·4	—	10	NW 5	C" SUNNY	Falling - High to Mean
14	—	—	—	—	—	—	0	0" SUNNY	High Slack
15	93[a]	4	—	—	—	—	0	C" SUNNY	High Slack
16	9[a]	4	—	—	—	—	N. 0-4	C" OVERCAST	High Slack
17	240	43	—	—	—	—	NW 5	C" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 6

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	93	43	—	—	—	—	0	.66" RAIN	High Slack
3	240	240	21	0.9	7.8	11	SE. 20	.31" RAIN	Rising
4	1100	150	—	—	—	—	SE 8-25	.9E" RAIN	Rising
5	43	43	24	0.8	7.4	11	NW 12-18	0" SUNNY	Rising
6	23	< 3	26	0.5	7.8	10	NW 8-12	0" OVERCAST	Low Slack - Rising
7	21	9	23.5	0.7	7.7	10.5	NW 4-8	0" FAIR	Rising
8	23	9	—	—	—	—	S SE 0-6	0" SUNNY	Rising
9	43	4	24	0.7	—	—	NW 5	0" SUNNY	Falling - Mean Tid.
10	23	23	—	—	—	—	0	0" SUNNY	Mean Slack
11	43	23	24	0.9	—	9.5	C	0" SUNNY	Falling - Mean Slack
12	240	21	24	0.9	—	8	NW 2	0" CLOUDY	Falling High to Mear
13	23	23	24	0.8	—	9.5	NW 5	0" SUNNY	Falling - High to Mear
14	—	—	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	4 [a]	4	—	—	—	—	N. 0-4	0" OVERCAST	High Slack
17	4	< 3	—	—	—	—	NW 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 4

SURVEY DAY	COLIFORM MPN/100ml T	F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	23	23	–	–	–	–	C	.66" RAIN	High Slack
3	240	23	21	10	4.8	11	SE 20	.31" RAIN	Rising
4	43	43	–	–	–	–	SE 8-25	.48" RAIN	Rising
5	43	4	24	1.3	4.5	10	NW 12-18	0" SUNNY	Rising
6	15	4	26	0.5	4.8	9.5	NW 8-12	C" OVERCAST	Low Slack - Rising
4	23	9	24	0.7	4.6	10	NW 4-8	C" FAIR	Rising
8	15	15	–	–	–	–	S SE 0-6	0" SUNNY	Rising
9	43	15	23	11	–	–	NW 5	C" SUNNY	Falling - Mean Tide
10	240	93	–	–	–	–	0	C" SUNNY	Mean Slack
11	93	43	24	0.5	–	–	C	C" SUNNY	Falling Mean Slack
12	93	9	24	0.9	–	9.1	NW 2	0" CLOUDY	Falling High to Mean
13	23	23	23.5	0.8	–	9.5	NW 5	C" SUNNY	Falling High to Mean
14	–	–	–	–	–	–	0	C" SUNNY	High Slack
15	–	–	–	–	–	–	0	C" SUNNY	High Slack
16	<3 a	<3	–	–	–	–	N. C-4	C" OVERCAST	High Slack
17	<3	<3	–	–	–	–	NW 5	C" SUNNY	Rising

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 8

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	43	9	—	—	—	—	C	.66" RAIN	High Slack
3	150	150	21	0·8	7·7	11	SE 20	.31" RAIN	Rising
4	460	240	—	—	—	—	SEB-25	⅛" RAIN	Rising
5	43	23	26	0·8	7·6	10	NW12-18	C" SUNNY	Rising
6	93	<3	26	0·5	7·8	10	NW8-10	C" OVERCAST	Low Slack - Rising
7	240	4	23	0·8	7·7	10	NW4-8	C" FAIR	Rising
8	240	93	—	—	—	—	S.SEO 6	C" SUNNY	Rising
9	240	15	23·5	0·6	—	—	NW 5	C" SUNNY	Falling - Mean Tide
10	150	150	—	—	—	—	C	C" SUNNY	Mean Slack
11	93	23	24	0·8			C	C" SUNNY	Falling Mean Slack
12	23	23	24·5	0·5	—	9·0	NW2	C" CLOUDY	Falling High to Mean
13	9	9	24	0·6	—	10	NW 5	C" SUNNY	Falling High to Mean
14	—	—	—	—	—	—	O	C" SUNNY	High Slack
15	—	—	—	—	—	—	C	C" SUNNY	High Slack
16	4 a	<3	24·5	0·8	—	9·0	N. C-4	C" OVERCAST	High Slack
17	<3	<3	—	—	—	—	NW.5	C" SUNNY	Rising

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 9

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	45	39	—	—	—	—	0	.66" RAIN	High Slack
3	150	150	22	1 5	4·8	11	SE. 20	.31" RAIN	Rising
4	93	93	22	0·4	4·4	10·5	SEE-25	.18" RAIN	Rising
5	240	4	24	1·0	4·4	10	NW12-18	0" SUNNY	Rising
6	93	4	26	0·6	4·8	10	NW8-10	0" OVERCAST	low Slack - Rising
4	43	4	24	1·0	4·4	11	NW4-8	0" FAIR	Rising
8	93	93	—	—	—	—	S SE 0-6	0" SUNNY	Rising
9	93	43	23·5	0·4	—	—	NW 5	0" SUNNY	Falling - Mean Tid
10	240	240	—	—	—	—	0	0" SUNNY	Mean Slack
11	240	43	23·5	0·4	-	10	0	0" SUNNY	Falling - Mean Slack
12	43	9	24	0·8	-	9	NW 2	0" CLOUDY	Falling High to Mear
13	43	15	23·5	0·6	—	10	NW 5	0" SUNNY	Falling - High to Mea
14	—	—	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	4	< 3	—	—	—	—	N. 0-4	0" OVERCAST	High slack
17	9	4	—	—	—	—	NW. 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 10

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C.	WIND KNOTS	WEATHER	TIDE
1	93	93	—	—	—	—	0	.66" RAIN	High Slack
3	240	43	22	1.2	4.4	11	SE. 20	.31" RAIN	Rising
4	93	23	—	—	—	—	SE8-25	.48" RAIN	Rising
5	240	43	28	1.0	4.4	10	NW12-18	0" SUNNY	Rising
6	1100	4	26	0.5	4.8	10	NW8-12	0" OVERCAST	Low Slack - Rising
4	15	4	24.5	0.5	4.4	—	NW4-8	0" FAIR	Rising
8	150	45	—	—	—	—	SSE 0-6	0" SUNNY	Rising
9	45	45	24	0.6	—	—	NW 5	0" SUNNY	Falling - Mean Tid
10	460	460	—	—	—	—	0	0" SUNNY	Mean Slack
11	460	45	24	0.6	—	10	0	0" SUNNY	Falling - Mean Slac
12	43	4	24	0.9	—	9	NW 2	0" CLOUDY	Falling - High to Mea
13	43	4	24.5	0.6	—	10	NW 5	0" SUNNY	Falling - High to Mea
14	—	—	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	<3	<3	—	—	—	—	N. 0-4	0" OVERCAST	High Slack
17	9	<3	—	—	—	—	NW. 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 11

RVEY Y	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	75	75	—	—	—	—	0	.66" RAIN	High Slack
3	460	240	21.5	1.2	7.7	11	S.E. 20	.31" RAIN	Rising
4	93	23	—	—	—	—	SE 8-25	.48" RAIN	Rising
5	43	<3	26	0.5	7.6	10	NW 12-18	0" SUNNY	Rising
6	23	4	27	0.5	7.8	4	NW 8-18	0" OVERCAST	low Slack - Rising
7	23	9	23.5	1.1	7.7	—	NW 4-8	0" FAIR	Rising
8	43	23	—	—	—	—	S.SE 0-6	0" SUNNY	Rising
9	460	11	24	0.6	—	—	NW 5	0" SUNNY	Falling - Mean Tide
10	93	93	—	—	—	—	0	0" SUNNY	Mean Slack
11	240	93	24	0.6	—	—	0	0" SUNNY	Falling - Mean Slack
12	460	4	24.5	0.8	—	—	NW 2	0" CLOUDY	Falling - High to Mean
13	9	9	24.5	0.6	—	9.5	NW 5	0" SUNNY	Falling - High to Mean
14	43	9	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	9	<3	24.5	0.8	—	9	N. 0-4	0" OVERCAST	High slack
17	4	<3	—	—	—	—	NW. 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 12

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	150	28	–	–	–	–	C	.66" RAIN	High Slack
3	93	21	–	–	–	–	SE 20	.31" RAIN	Rising
4	93	93	21.5	1.8	7.7	10.5	SE 8-25	.98" RAIN	Rising
5	23	9	25	0.8	7.7	10	NW 12-18	0" SUNNY	Rising
6	23	9	25	0.8	7.7	10.	NW 0-10	0" OVERCAST	Low Slack – Rising
7	43	7	22	1.2	7.6	10	NW 4-8	0" FAIR	Rising
8	< 3	< 3	–	–	–	–	S SE 0-6	0" SUNNY	Rising
9	43	15	23.5	0.8	–	–	NW 5	0" SUNNY	Falling – Mean Tide
10	43	9	–	–	–	–	C	0" SUNNY	Mean Slack
11	21	11	24	0.9	–	9.5	C	0" SUNNY	Falling – Mean Slack
12	460	21	24.5	1.0	–	10	NW 2	0" CLOUDY	Falling – High to Mean
13	93	4	24	1.1	–	9.5	NW 5	0" SUNNY	Falling – High to Mean
14	460	93	–	–	–	–	0	0" SUNNY	High Slack
15	–	–	–	–	–	–	0	0" SUNNY	High Slack
16	4	4	25	0.9	–	–	N. 0-4	0" OVERCAST	High Slack
17	45	15	–	–	–	–	NW 5	0" SUNNY	Rising.

T – CONFIRMED TOTAL COLIFORMS

F – FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 13

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	15	15	–	–	–	–	0	.66" RAIN	High Slack
3	23	23	22	1.3	7.7	11	S.E. 20	.31" RAIN	Rising
4	93	43	–	–	–	–	SE 8-25	.98" RAIN	Rising
5	43	4	22	1.5	7.5	9	NW 12-18	0" SUNNY	Rising
6	43	15	24	0.7	7.7	9	NW 8-16	0" OVERCAST	Low Slack – Rising
7	23	4	21.5	0.8	7.7	10.5	NW 4-8	0" FAIR	Rising
8	< 3	< 3	–	–	–	–	S SE 0-6	0" SUNNY	Rising
9	4	< 3	23.5	0.8	–	–	NW 5	0" SUNNY	Falling – Mean Tid
10	15	4	–	–	–	–	0	0" SUNNY	Mean Slack
11	< 3	< 3	23.5	0.8	–	–	0	0" SUNNY	Falling – Mean Slack
12	23	< 3	24	1.1	–	8.5	NW 2	0" CLOUDY	Falling High to Mea
13	< 3	< 3	24	0.8	–	9.5	NW 5	0" SUNNY	Falling – High to Mea
14	9	9	–	–	–	–	0	0" SUNNY	High Slack
15	–	–	–	–	–	–	0	0" SUNNY	High Slack
16	43	4	25	0.9	–	–	N. 0-4	0" OVERCAST	High Slack
17	4	4	–	–	–	–	N.W. 5	0" SUNNY	Rising

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 14.

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP°C	WIND KNOTS	WEATHER	TIDE
1	4	4	–	–	–	–	C	.66" RAIN	High Slack
3	93	21	22	1.0	7.6	11	SE. 20	.31" RAIN	Rising
4	43	15	–	–	–	–	SEB-25	¼" RAIN	Rising
5	93	4	24	1.5	7.7	11	NW12-18	C" SUNNY	Rising
6	93	15	24	0.8	7.7	9	NW8-12	C" OVERCAST	Low Slack - Rising
7	4	4	21.5	1.0	7.7	–	NW4-8	C" FAIR	Rising
8	9	4	–	–	–	–	S.SE0-6	0" SUNNY	Rising
9	<3	<3	18.5	0.8	–	–	NW 5	C" SUNNY	Falling - Mean Tid
10	15	4	–	–	–	–	C	C" SUNNY	Mean Slack
11	45	14	24	0.8	–	9.5	0	C" SUNNY	Falling - Mean Slack
12	93	4	24.5	0.9	–	9.5	NW 2	0" CLOUDY	Falling - High to Mea
13	~~43~~ 93	~~3~~ 4	24	0.8	–	9.5	NW 5	0" SUNNY	Falling - High to Mea
14	93	4	–	–	–	–	0	C" SUNNY	High Slack
15	–	–	–	–	–	–	C	C" SUNNY	High Slack
16	43	4	25	0.9	–	9.5	N. 0-4	C" OVERCAST	High Slack
17	93	9	–	–	–	–	NW 5	C" SUNNY	Rising

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 15

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	43	23	—	—	—	—	C	.66" RAIN	High Slack
3	23	9	22	1.2	4.6	10.5	SE 20	.31" RAIN	Rising
4	43	4	—	—	—	—	SEE-25	.48" RAIN	Rising
5	21	4	22	1.1	4.5	9	NW12-18	0" SUNNY	Rising
6	9	9	25	0.8	4.4	10	NW8-12	0" OVERCAST	Low Slack - Rising
4	43	4	21.5	0.8	4.4	—	NW4-8	C" FAIR	Rising
8	9	9	—	—	—	—	S.SE0-6	0" SUNNY	Rising
9	9	9	23	1.0	—	—	NW 5	0" SUNNY	Falling - Mean Tide
10	23	<3	—	—	—	—	C	0" SUNNY	Mean Slack
11	23	<3	24.5	0.8	—	—	0	0" SUNNY	Falling - Mean Slack
12	23	9	25	0.8	—	—	NW 2	0" CLOUDY	Falling - High to Mean
13	3	<3	24	0.4	—	9.5	NW 5	0" SUNNY	Falling - High to Mean
14	4	4	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	C" SUNNY	High Slack
16	<3	<3	25	0.8	—	9	N. 0-4	C" OVERCAST	High Slack
17	9	<3	—	—	—	—	NW. 5	C" SUNNY	Rising

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 16

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	9	9					0	.66" RAIN	High Slack
3	93	93	21.5	1.1	4.3	10.5	S.E. 20	.31" RAIN	Rising
4	23	23	—	—	—	—	SE 8-25	.98" RAIN	Rising
5	240	4	23	1.2	4.4	10	NW 12-18	0" SUNNY	Rising
6	43	9	24	0.8	4.4	10	NW 8-18	0" OVERCAST	low Slack - Rising
7	9	< 3	21.5	0.9	4.4	10.5	NW 4-8	0" FAIR	Rising
8	~~< 3~~ 4	~~< 3~~ 4	—	—	—	—	S.SE 0-6	0" SUNNY	Rising
9	~~93~~ 9	~~43~~ 9	23.5	0.4	—	—	NW 5	0" SUNNY	Falling - Mean Ti
10	9	< 3	—	—	—	—	0	0" SUNNY	Mean Slack
11	14	14	25	0.8	—	10	0	0" SUNNY	Falling - Mean Sla
12	4	< 3	24.5	0.6	—	9	NW 2	0" CLOUDY	Falling - High to Me
13	23	9	24	0.6	—	9	NW 5	0" SUNNY	Falling - High to Me
14	93	4	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	4	< 3	25	0.9	—	9	N. 0-4	0" OVERCAST	High Slack
17	23	< 3	—	—	—	—	NW. 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 14

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	23	9	—	—	—	—	C	.66" RAIN	High Slack
3	93	15	21.5	1.2	7.4	10.5	S.E. 20	.31" RAIN	Rising
4	23	23	—	—	—	—	SE 8-25	.98" RAIN	Rising
5	23	9	24	1.2	7.7	11	NW 12-18	0" SUNNY	Rising
6	93	4	25	0.7	7.7	10	NW 8-12	0" OVERCAST	Low Slack - Rising
7	<3	<3	21	1.0	7.7	10.5	NW 4-8	C" FAIR	Rising
8	<3	<3	—	—	—	—	S SE 0-6	0" SUNNY	Rising
9	43	9	23.5	0.9	—	—	NW 5	0" SUNNY	Falling - Mean Tide
10	23	23	—	—	—	—	C	0" SUNNY	Mean Slack
11	23	9	25	1.3	—	—	0	0" SUNNY	Falling - Mean Slack
12	9	<3	24.5	0.9	—	8.5	NW 2	0" CLOUDY	Falling - High to Mean
13	9	<3	23.5	0.9	—	9	NW 5	0" SUNNY	Falling - High to Mean
14	23	23	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	C" SUNNY	High Slack
16	4	<3	25	0.8	—	9.5	N. 0-4	C" OVERCAST	High Slack
17	23	4	—	—	—	—	NW 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 18

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	<3	<3	—	—	—	—	0	.66" RAIN	High Slack
3	45	43	21	1.2	4.5	10	S.E. 20	.31" RAIN	Rising
4	93	43	—	—	—	—	SE 8-25	.48" RAIN	Rising
5	93	4	23	1.5	4.4	10	NW 12-18	0" SUNNY	Rising
6	14	3	25	0.4	4.4	10	NW 8-12	0" OVERCAST	Low Slack - Rising
4	<3	<3	21	0.4	4.6	—	NW 4-8	0" FAIR	Rising
8	23	<3	—	—	—	—	S.SE 0-6	0" SUNNY	Rising
9	9	4	24	1.2	—	—	NW 5	0" SUNNY	Falling - Mean Tide
10	4	<3	—	—	—	—	0	0" SUNNY	Mean Slack
11	4	<3	—	—	—	—	0	0" SUNNY	Falling - Mean Slack
12	<3	<3	24.5	0.8	—	9	NW 2	0" CLOUDY	Falling - High to Mean
13	3	3	24	0.9	—	9.5	NW 5	0" SUNNY	Falling - High to Mean
14	23	4	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	9	4	26.5	1.0	—	9.5	N. 0-4	0" OVERCAST	High Slack
17	9	4	—	—	—	—	NW 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 19

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	93	43	–	–	–	–	0	.66" RAIN	High Slack
3	1100	460	21	1·2	4·6	10	S.E. 20	.31" RAIN	Rising
4	210	210	–	–	–	–	SE 8-25	.48" RAIN	Rising
5	460	4	23	1·5	4·6	9	NW 12-18	0" SUNNY	Rising
6	23	9	24	0·8	4·7	10	NW 8-12	0" OVERCAST	Low Slack – Rising
4	23	4	21	0·9	4·6	10·5	NW 4-8	0" FAIR	Rising
8	9	9	–	–	–	–	S SE 0-6	0" SUNNY	Rising
9	< 3	< 3	23·5	0·9	–	–	NW 5	0" SUNNY	Falling – Mean Tide
10	23	9	–	–	–	–	0	0" SUNNY	Mean Slack
11	< 3	< 3	24·5	0·9	–	–	0	0" SUNNY	Falling – Mean Slack
12	15	3	24·5	1·1	–	9	NW 2	0" CLOUDY	Falling – High to Mean
13	4	< 3	24·5	1·6	–	–	NW 5	0" SUNNY	Falling – High to Mean
14	4	< 3	–	–	–	–	0	0" SUNNY	High Slack
15	–	–	–	–	–	–	0	0" SUNNY	High Slack
16	23	< 3	26	1·1	–	9·5	N. 0-4	0" OVERCAST	High Slack
17	4	< 3	–	–	–	–	NW 5	0" SUNNY	Rising.

T – CONFIRMED TOTAL COLIFORMS

F – FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 20

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP°C	WIND KNOTS	WEATHER	TIDE
1	23	23	—	—	—	—	0	.66" RAIN	High Slack
3	43	43	22.5	1.0	7.5	10.5	S.E. 20	.31" RAIN	Rising
4	43	7	—	—	—	—	SE8-25	.98" RAIN	Rising
5	43	4	14	1.5	7.6	9	NW12-18	0" SUNNY	Rising
6	43	43	24	0.8	7.7	10	NW8-12	0" OVERCAST	Low Slack - Rising
7	4	4	20.5	0.9	7.6	10	NW4-8	0" FAIR	Rising
8	23	23	—	—	—	—	S.SE0-6	0" SUNNY	Rising
9	4	4	22.5	2.0	—	—	NW 5	0" SUNNY	Falling - Mean Tide
10	9	< 3	—	—	—	—	0	0" SUNNY	Mean Slack
11	4	< 3	23.5	0.9	—	—	0	0" SUNNY	Falling - Mean Slack
12	9	< 3	23.5	0.5	—	—	NW 2	0" CLOUDY	Falling - High to Mean
13	4	< 3	24	0.8	—	—	NW 5	0" SUNNY	Falling - High to Mean
14	< 3	< 3	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	23	< 3	25	1.2	—	—	N. 0-4	0" OVERCAST	High Slack
17	9	< 3	—	—	—	—	NW. 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 21

SURVEY	COLIFORM MPN/100ml		SALINITY	TURBIDITY	pH	SEA	WIND	WEATHER	TIDE
	T	F	°/₀₀	J. Units		TEMP°C	KNOTS		
1	43	43	—	—	—	—	0	.66" RAIN	High Slack
3	93	93	22	1.8	7.6	10	SE 20	.31" RAIN	Rising
4	—	—	—	—	—	—	SE 8-25	1/8" RAIN	Rising
5	9	4	—	—	—	—	NW 14-18	0" SUNNY	Rising
6	43	15	19.5	1.9	7.4	9	NW 5-10	0" OVERCAST	Low Slack - Rising
7	4	<3	21.5	0.8	7.6	—	NW 4-8	0" FAIR	Rising
8	23	23	—	—	—	—	S SE 6	0" SUNNY	Rising
9	23	23	21.5	1.0			NW 5	0" SUNNY	Falling - Mean Tide
10	<3	<3	—	—	—	—	0	0" SUNNY	Mean Slack
11	23	9	23.5	1.2	—	—	0	0" SUNNY	Falling Mean Slack
12	9	9	23.5	0.8	7.5	—	NW 7	0" CLOUDY	Falling - High to Mean
13	460	<3	23.5	0.8	—	9	NW 5	0" SUNNY	Falling - High to Mean
14	39	<3	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	43	4	24.5	1.1	—	—	N. 0-4	0" OVERCAST	High Slack
17	9	<3	—	—	—	—	N 5	0" SUNNY	Rising

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 22

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/₀₀	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	23	23	–	–	–	–	0	.66" RAIN	High Slack
3	43	15	22	0.9	4.6	11	SE 20	.31" RAIN	Rising
4	23	9	–	–	–	–	SE 8-25	.48" RAIN	Rising
5	15	4	23	1.0	4.6	9	NW 12-18	0" SUNNY	Rising
6	9	<3	25	0.9	4.4	10	NW 8-12	0" OVERCAST	Low Slack – Rising
4	4	<3	22	0.8	4.4	–	NW 4-8	0" FAIR	Rising
8	<3	<3	–	–	–	–	S SE 0-6	0" SUNNY	Rising
9	<3	<3	23	0.8	–	–	NW 5	0" SUNNY	Falling – Mean Tide
10	<3	<3	–	–	–	–	0	0" SUNNY	Mean Slack
11	4	4	23	0.6	–	–	0	0" SUNNY	Falling Mean Slack
12	23	23	24	0.9	–	–	NW 2	0" CLOUDY	Falling High to Mean
13	4	<3	24	0.6	–	–	NW 5	0" SUNNY	Falling High to Mean
14	9	<3	–	–	–	–	0	0" SUNNY	High Slack
15	–	–	–	–	–	–	0	0" SUNNY	High Slack
16	4	4	25	0.9	–	9	N. 0-4	0" OVERCAST	High Slack
14	9	4	–	–	–	–	NW 5	0" SUNNY	Rising

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 23

SURVEY	COLIFORM MPN/100ml		SALINITY	TURBIDITY	pH	SEA	WIND	WEATHER	TIDE
	T	F	°/oo.	J. Units		TEMP°C	KNOTS		
1	9	9	—	—	—	—	C	.66" RAIN	High Slack
3	93	11	23	1.0	7.6	11	S.E. 2C	.31" RAIN	Rising
4	460	240	—	—	—	—	SE 8-25	.48" RAIN	Rising
5	43	4	24	1.3	7.7	9.5	NW 12-18	0" SUNNY	Rising
6	75	4	24	0.8	7.8	8.5	NW 8-16	0" OVERCAST	low Slack - Rising
7	4	4	22.5	1.1	7.7	—	NW 4-8	0" FAIR	Rising
8	9	4	—	—	—	—	S.SE 0-6	0" SUNNY	Rising
9	23	4	24	0.8	—	—	NW 5	0" SUNNY	Falling - Mean Tide
10	23	<3	—	—	—	—	0	0" SUNNY	Mean Slack
11	23	23	24	1.2	—	—	0	0" SUNNY	Falling - Mean Slack
12	43	43	25	1.1	—	—	NW 2	0" CLOUDY	Falling High to Mean
13	15	9	24	0.8	—	—	NW 5	0" SUNNY	Falling - High to Mean
14	9	4	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	23	4	25	1.1	—	9	N. 0-4	0" OVERCAST	High Slack
17	<3	<3	—	—	—	—	NW. 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 24

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	93	43	—	—	—	—	C	.66" RAIN	High Slack
3	93	93	22	1.5	7.5	10.5	SE 20	.31" RAIN	Rising
4	43	43	—	—	—	—	SE 8-25	.98" RAIN	Rising
5	93	9	24	1.3	7.7	9.5	NW 12-18	0" SUNNY	Rising
6	9	4	26	0.9	7.7	9	NW 8-10	C" OVERCAST	Low Slack - Rising
7	15	15	21.5	1.0	7.7	10	NW 4-8	0" FAIR	Rising
8	9	4	—	—	—	—	S.SE 0-6	0" SUNNY	Rising
9	23	9	25	1.9	—	—	NW 5	0" SUNNY	Falling - Mean Tide
10	9	9	—	—	—	—	0	0" SUNNY	Mean Slack
11	15	<3	25	1.5	—	—	0	0" SUNNY	Falling - Mean Slack
12	43	43	25	1.2	—	9.5	NW 2	0" CLOUDY	Falling High to Mean
13	4	4	24	0.7	—	10	NW 5	0" SUNNY	Falling - High to Mean
14	9	4	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	23	4	24	1.0	—	9	N. 0-4	0" OVERCAST	High Slack
17	<3	<3	—	—	—	—	NW 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 25

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP°C	WIND KNOTS	WEATHER	TIDE
1	230	93	–	–	–	–	C	.66" RAIN	High Slack
3	43	23	21.5	1.6	4.6	10.5	SE. 20	.31" RAIN	Rising
4	93	43	–	–	–	–	SEE-25	.98" RAIN	Rising
5	43	4	23	1.5	4.4	10.5	NW 14-18	0" SUNNY	Rising
6	23	4	25	0.4	4.8	10	NW 8-12	0" OVERCAST	Low Slack – Rising
4	4	<3	22	0.8	4.4	–	NW 4-8	0" FAIR	Rising
8	9	4	–	–	–	–	S.SE 0-6	0" SUNNY	Rising
9	23	<3	24	0.9	–	–	NW 5	0" SUNNY	Falling – Mean Tide
10	15	3	–	–	–	–	0	0" SUNNY	Mean Slack
11	43	4	25	0.8	–	–	0	0" SUNNY	Falling – Mean Slack
12	43	4	24.5	0.5	–	9	NW 2	0" CLOUDY	Falling · High to Mean
13	23	4	24.5	0.9	–	9.5	NW 5	0" SUNNY	Falling · High to Mean
14	4	<3	–	–	–	–	0	0" SUNNY	High Slack
15	–	–	–	–	–	–	0	0" SUNNY	High Slack
16	9	<3	25	1.0	–	9.5	N. 0-4	0" OVERCAST	High Slack
17	4	<3	–	–	–	–	NW 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 26

SURVEY	COLIFORM MPN/100ml		SALINITY	TURBIDITY	pH	SEA	WIND	WEATHER	TIDE
	T	F	°/oo	J. Units		TEMP°C	KNOTS		
1	23	4	—	—	—	—	0	.66" RAIN	High Slack
3	21	21	22	2.5	7.5	11	S.E 20	.31" RAIN	Rising
4	23	4	—	—	—	—	SE8-25	.48" RAIN	Rising
5	93	4	22	1.4	7.7	9	NW12-18	0" SUNNY	Rising
6	23	9	24	0.8	7.8	9.5	NW8-12	0" OVERCAST	Low Slack - Rising
7	<3	<3	21.5	1.1	7.7	10	NW4-8	0" FAIR	Rising
8	9	9	—	—	—	—	S.SE0-6	0" SUNNY	Rising
9	9	4	24	0.7	—	—	NW 5	0" SUNNY	Falling - Mean Tide
10	4	<3	—	—	—	—	0	0" SUNNY	Mean Slack
11	<3	<3	24	0.8	—	—	0	0" SUNNY	Falling - Mean Slack
12	4	<3	24	1.3	—	8	NW 2	0" CLOUDY	Falling - High to Mean
13	4	<3	24	0.9	—	9.5	NW 5	0" SUNNY	Falling - High to Mean
14	<3	<3	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	<3	<3	25	1.1	—	9	N. 0-4	C" OVERCAST	High Slack
17	4	<3	—	—	—	—	NW 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 24

SURVEY NO.	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/oo	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	15	4	-	-	-	-	C	.66" RAIN	High Slack
3	43	43	23	1.2	4.6	10.5	SE 20	.31" RAIN	Rising
4	240	93	-	-	-	-	SE 8-25	.98" RAIN	Rising
5	93	4	20	1.2	4.6	9	NW 14-18	0" SUNNY	Rising
6	43	15	23	0.4	4.8	10	NW 8-18	0" OVERCAST	low Slack - Rising
4	<3	<3	22	0.8	4.6	10.5	NW 4-8	0" FAIR	Rising
8	4	<3	-	-	-	-	S SE 0-6	0" SUNNY	Rising
9	43	15	23	1.1			NW 5	0" SUNNY	Falling - Mean Tide
10	4	<3	-	-	-	-	0	0" SUNNY	Mean Slack
11	9	4	23.5	1.1	-	-	0	0" SUNNY	Falling - Mean Slack
12	23	<3	24.5	1.0	-	9	NW 2	0" CLOUDY	Falling - High to Mean
13	9	<3	24.5	0.7	-	9.5	NW 5	0" SUNNY	Falling - High to Mean
14	23	<3	-	-	-	-	0	0" SUNNY	High Slack
15	-	-	-	-	-	-	0	0" SUNNY	High Slack
16	23	9	24.5	1.5	-	9.5	N. 0-4	0" OVERCAST	High slack
17	<3	<3	-	-	-	-	NW 5	0" SUNNY	Rising.

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1940

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 28

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/₀₀	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	—	—	—	—	—	—	0	.66" RAIN	High Slack
3	—	—	—	—	—	—	S.E. 20	.31" RAIN	Rising
4	—	—	—	—	—	—	SE 8-25	.98" RAIN	Rising
5	—	—	—	—	—	—	NW 12-18	0" SUNNY	Rising
6	—	—	—	—	—	—	NW 8-18	0" OVERCAST	Low Slack - Rising
7	23	< 3	23	0.8	7.6	—	NW 4-8	0" FAIR	Rising
8	< 3	< 3	—	—	—	—	S.SE 0-6	0" SUNNY	Rising
9	4	4	33.5	1.2	—	—	NW 5	0" SUNNY	Falling - Mean Tide
10	< 3	< 3	—	—	—	—	0	0" SUNNY	Mean Slack
11	9	4	24	0.8	—	9.5	0	0" SUNNY	Falling - Mean Slack
12	4	< 3	24	0.7	—	8.5	NW 2	0" CLOUDY	Falling - High to Mean
13	23	4	24	0.7	—	9.5	NW 5	0" SUNNY	Falling - High to Mean
14	14	14	—	—	—	—	0	0" SUNNY	High Slack
15	—	—	—	—	—	—	0	0" SUNNY	High Slack
16	23	< 3	25	1.0	—	9.5	N. 0-4	0" OVERCAST	High Slack
17	< 3	< 3	—	—	—	—	NW 5	0" SUNNY	Rising

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

LADYSMITH HARBOUR SHELLFISH SURVEY OCT-NOV 1970

TEST RESULTS AND CONDITIONS

HARBOUR SAMPLE POINT NO. 29.

SURVEY DAY	COLIFORM MPN/100ml T	COLIFORM MPN/100ml F	SALINITY °/₀₀	TURBIDITY J. Units	pH	SEA TEMP °C	WIND KNOTS	WEATHER	TIDE
1	—	—	—	—	—	—	0	.66" RAIN	High Slack
3	—	—	—	—	—	—	SE 20	.31" RAIN	Rising
4	—	—	—	—	—	—	SE 8-25	.98" RAIN	Rising
5	—	—	—	—	—	—	NW 12-18	0" SUNNY	Rising
6	—	—	—	—	—	—	NW 8-10	0" OVERCAST	Low Slack - Rising
4	—	—	—	—	—	—	NW 4-8	0" FAIR	Rising
8	—	—	—	—	—	—	S SE 0-6	0" SUNNY	Rising
9	—	—	—	—	—	—	NW 5	0" SUNNY	Falling - Mean Tid
10	—	—	—	—	—	—	0	0" SUNNY	Mean Slack
11	240	93	24	0.8	-	9.5	0	0" SUNNY	Falling - Mean Slack
12	150	45	25	0.9	-	9	NW 2	0" CLOUDY	Falling - High to Mea
13	1100	21	25	0.6	-	10	NW 5	0" SUNNY	Falling - High to Mea
14	—	—	—	—	—	—	0	0" SUNNY	High Slack
15	9	<3	—	—	—	—	0	0" SUNNY	High Slack
16	9	<3	24.5	0.6	-	9	N. 0-4	0" OVERCAST	High Slack
17	<3	<3	—	—	—	—	NW 5	0" SUNNY	Rising

T - CONFIRMED TOTAL COLIFORMS

F - FECAL COLIFORMS

APPENDIX 3

METAL ION AND PESTICIDE ANALYSES OF FRESH WATER STREAMS ENTERING LADYSMITH HARBOUR

APPENDIX 3

File PUBLIC HEALTH ENGINEERING Sample No. 000102

Date Nov 18/70 NOV 18 1970

Analysis Report

Collection: Labelled LADYSMITH HARBOUR - SHELLFISH SURVEY

Collected by T.T. Date Oct 24/70 Time _____

Wit. _____

Remarks 2 drops conc. HNO_3 per bottle.

_____ Init. _____

Received (Lab.) by JDW Nov 18/70 Date _____ Time _____

Wit. _____

Preservation: Field (Method) NONE

for analysis of _____

Preserved by _____ Date _____ Time _____

Wit. _____

Remarks _____

_____ Init. _____

Lab. (Method) _____

for analysis of

Preserved by _____ Date _____ Time _____

Wit. _____

Remarks _____

_____ Init. _____

Analysis Required: Fe, Mn, Zn, Cu, Cr, Sn, Pb, Al, Ni, Cd, Temp

_____ Init. _____

Analysis Results:

	Fe	Mn	Zn ppm	Cu	Cr	Sn	Pb	Al	Ni	Cd
1 Holland Creek	.36	.025	<.003	<.005	<.001	<.1	<.03	.1	<.01	<.01
3 Rocky Creek	.13	.11	<.003	<.005	.015	<.1	<.03	.1	<.01	<.01
4 Brad Creek	.36	.047	<.003	<.005	<.001	<.1	<.03	.03	<.01	<.01
5 Walker Creek	<.012	.025	<.003	<.005	.0025	<.1	<.03	<.01	<.01	<.01
6 " " Trib.	.012	.025	<.003	<.005	.005	<.1	<.03	<.01	<.01	<.01
7 Kuwista	.56	.042	<.005	<.005	.013	<.1	<.03	.1	<.01	<.01
8 Thomas Creek	1.2	.092	.003	<.005	.013	<.1	<.03	.03	<.01	<.01

Analyst _____ Date _____ Wit. _____

MEMORANDUM

JAN - 8 1970

CLASSIFICATION

TO
A

Mr. J.S. Wishart, P. Eng.,
Regional Engineer,
Vancouver 5, 1970

Attention: Mr. T.J. Trevendale

YOUR FILE No.
Votre dossier

OUR FILE No.
Notre dossier

FROM
De

Chemist, Ottawa

DATE Dec. 31, 1970

LD

SUBJECT
Sujet

Pesticide Analysis of Water Samples

Please find attached the results of the above analyses. We have analysed the samples of water you submitted for pesticides, looking specifically for the organo-chlorine insecticides. The method we used would also have detected any significant quantities of some of the organo-phosphorus insecticides. We did not analyse for herbicides, since this is a separate analysis, which would have required a further sample, and, in general, herbicides are not persistent in water.

Location: British Columbia Holland Creek
Rocky Creek
Bush Creek Date Sampled 26/10/70

Identification: Stream Date Received 19/11/70

Submitted by: Mr. T.J. Trevendale
PHE Vancouver

Sample	Pesticide
Holland Creek	None Detected
Rocky Creek	None Detected
Bush Creek	None Detected

Margaret C. Holton.

MCH/jo

M.C. Holton

CGSB – 6GP22B 7540-21-798-6998