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DEPARTMENT OF THE ENVIRONMENT
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC REGION

A FIELD SURVEY OF
WATER AND SEDIMENT QUALITY AT
SELECTED SITES IN PACIFIC RIM NATIONAL PARK

MANUSCRIPT REPORT 84-1

By

Peter K. Krahn

June 1984

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INTRODUCTION

In response to a request by Pacific Rim National Park Wardens in April 1984, a water quality and sediment survey of selected sites was made in and adjacent to park boundaries. These sites included: 1) the current development of the Tofino Golf Course and streams flowing adjacent to it; 2) the creek passing through the Esowista Indian Reserve and leachate from the reservation septic field; 3) the Tofino/Ucluelet sanitary landfill which discharges leachate directly to Sandhill Creek which flows to Long Beach.

Water samples were tested for metals, nutrients, and fecal coliform bacteria. Sediment samples were tested for metals.

The wardens also requested instruction in field monitoring techniques and recommendations for an appropriate water quality field kit. This was provided to them.

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1.0 SUMMARY

The Tofino Golf Course development has not affected the water quality or bottom of the small creek flowing adjacent to it however there is a severe erosion problem caused by improper ditching in the area between the golf course and the Tofino Airport. The ditches were cut through a shallow topsoil layer into underlying sand which easily erodes under the heavy rainfall experienced in the Pacific Rim area. The eroded sand and mud has silted in the stream bed to the culvert at the Tofino highway and covered a significant portion of the spawning gravel used by cutthroat trout (see plates 1-4). The shallowness of the ditches allows the drainage water to warm significantly. A temperature of 26°C was measured at one test site.

1.1 Water Chemistry

Manganese was the only metal which exceeded (but not significantly) the level considered acceptable for aquatic life at the Tofino Airport/Golf Course site. Nutrients, C.O.D., hardness, alkalinity, dissolved oxygen and pH were all at acceptable levels.

There does not appear to be any fecal pollution of the golf course stream as fecal coliform tests were less than 1/100 mL.

The septic field at the Esowista Indian Reserve appeared to be saturated and not operating properly. Replicate samples of effluent discharging to Long Beach were tested for fecal coliform bacteria and were measured at 460,000/100 mL, and 800,000/100 mL. This field has been closed and effluent is being transported by tanker to Tofino for disposal while an improved system is being designed and built (see Appendix I).

Leachate from the Tofino/Ucluelet landfill flows directly into Sandhill Creek which discharges to Long Beach. Leachate flow is continuous during the wet season and may become stagnant during dry weather. The stagnated leachate was tested in August 1982 and found to be high in various heavy metals including chromium, copper, manganese, zinc, aluminum and iron. Extremely high values were also obtained for chemical oxygen

demand (804 mg/L), hardness (969 mg/L) and ammonia (302 mg/L). The stagnant leachate was bioassayed and found to be accutely toxic to rainbow trout underyearlings with 100% mortality in 10 to 20 minutes at 100% concentration (Appendix III).

During periods of high runoff, chromium, manganese, aluminum and iron were above levels considered acceptable for aquatic life and chemical oxygen demand was also high at 290 mg/L (Appendix IV).

A bioassay of the flowing leachate was found to be non toxic to rainbow trout underyearlings after 96 hours. The fish did show severe stress at the 0.17 hour mark and stress at the 0.33 hour mark of the test (Appendix VI). The leachate has affected the stream by keeping the bottom devoid of growth at the confluence with Sandhill Creek and promoting thick algal growth which in some locations blocks the stream.

The dissolved oxygen in Sandhill Creek is depressed from 9.0 mg/L down to 7.0 mg/L for 20 to 40 meters downstream of confluence with the leachate.

There is little documentation on the aquatic life or flow patterns in these streams. Park wardens have now been instructed in field monitoring techniques and will periodically monitor these sites and record flow, temperature, pH, dissolved oxygen and hardness.

1.2 Sediments

Metals in sediments were sampled at seven locations in and bordering Pacific Rim Park. Two samples of sand from the southern end of Long Beach and one sample of stream sediment from the Tofino Airport/Golf Course ditch were considered to be from areas relatively uncontaminated by human activity. Four samples were taken from sites where contamination was expected.

The beach sand at the discharge from the Esowista Indian Reserve had the highest values for 13 of the 24 elements analysed. Cadmium at 1.3 ppm was 2 to 4 times the level found in uncontaminated sand. Average

Canadian levels for cadmium are 0.1-0.63 ppm and average world levels for Cadmium are 0.20-2.0 ppm. Cadmium found in all samples were within the normal range.

Mercury (0.111 ppm), lead (6.0 ppm) and zinc (85.2 ppm) levels in the Tofino/Ucluelet landfill leachate ditch sediment were two to three times background levels. Mercury was in a range where further monitoring is warranted to ensure that concentrations do not exceed 1.000 ppm at which point significant bioaccumulation can occur (3). Lead was within the range considered normal for British Columbia sediment (5).

1.3 Recommendations

1.3.1 Further erosion of the golf course drainage ditches and silting of the adjacent stream should be prevented. The ditch erosion could be stopped by proper sloping and seeding of the ditch banks. Silting of the stream could be reduced or prevented by construction of settling ponds which would allow eroded sediment to settle before discharging to the creek. The ponds could be incorporated into the landscape of the golf course perimeter.

1.3.2 The Esowista septic field is being replaced and no further recommendations are necessary.

1.3.3 The Tofino/Ucluelet landfill leachate should not discharge directly to Sandhill Creek. Improvements are necessary as the ditch does not allow sufficient treatment to reduce metals, nutrients, and chemical oxygen demand to acceptable levels. A sign at the highway entrance to the landfill should be erected to inform the public of the types of wastes which may be dumped there, as there is potential for direct discharge of a toxic waste to Sandhill Creek.

1.3.4 Further regular monitoring of all the streams and landfill leachate flows, pH, dissolved oxygen, temperature and alkalinity could be

done by park personnel. Quarterly samples for metals and nutrients and chemical oxygen demand of the leachate should be made for one year to establish basic background data. All the data should be reported to Mr. D. Ellis, Sr. Engineer, Federal Activities , EPS, Kapilano 100, West Vancouver.

1.3.5 Posting of the streams discharging to the beach as "Unfit for Drinking Water" has been recommended by the B.C. Department of Health and has been implemented by parks personnel.

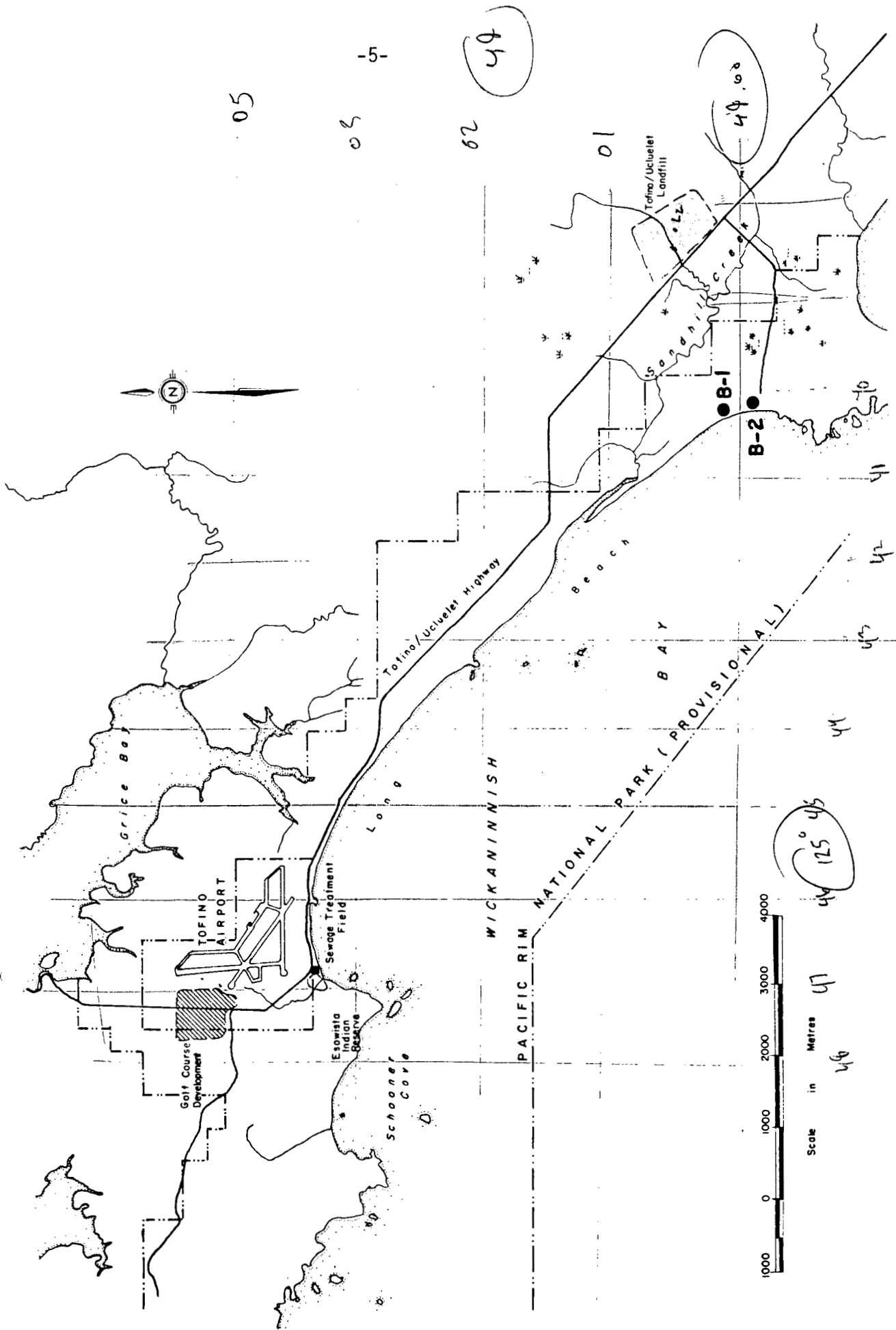


FIGURE 1 TOFINO GOLF COURSE, ESOWISTA INDIAN RESERVE, AND TOFINO / UCLUELET LANDFILL, PACIFIC RIM NATIONAL PARK

2.0 TOFINO GOLF COURSE DEVELOPMENT

Substantial amounts of topsoil have been moved to facilitate the golf course development at the Tofino airport. Some drainage ditching has been done in the course and in the bog area adjacent to the airport runways #10 and #15. All the ditches were cut through the shallow topsoil layer into subsurface sand and drain into a creek which discharges to the beach. Heavy rainfall (up to 2.74 m. from January to June 1984) creates high runoff and severe erosion of the drainage ditch banks which were not properly sloped or protected with gravel or vegetation. Plates 1-4 show how the sand has washed into the ditches and how sand and mud has covered the gravel beds in the stream. The gravel beds are necessary as spawning beds for cutthroat trout. Several fish (in spawning colors) were observed at the culvert where the Tofino highway crosses the stream. The culvert has acted temporarily as a barrier to movement of the silt, as the gravel beds downstream were still free of sand. If the bank erosion is allowed to continue the sand will progress downstream and destroy the remaining spawning beds.

2.1 High Temperature Ditch Water

A water temperature of 26°C was measured in the drainage ditch prior to discharge to the stream. These high temperatures result from a lack of cover and the shallowness of the ditch. During the high runoff the stream flow was sufficient to lower the ditch water temperature to 11°C. It is not known if summer flows would be detrimental to trout fry due to warm water temperatures. Further monitoring of flow and water conditions would determine this.

2.2 Water Chemistry

A water sample collected in June 1984 to be analyzed for dissolved metals was contaminated in the laboratory, however total metals were analysed from a separate sample. Manganese was measured at 0.172 mg/L

or 0.072 mg/L above the acceptable level. Most metals were below the detectable limits or within ranges acceptable to aquatic life.

Nutrients, C.O.D., hardness, and alkalinity were all low and well within acceptable limits. Dissolved oxygen and pH were also at levels acceptable to aquatic life.

2.3 Coliform Bacteria

Fecal coliform bacteria were measured at three sites near the Tofino Golf Course development. The values ranged from 1/100 mL before and after passing through the golf course to 20-180/100 mL after passing next to the Esowista Indian reserve and discharging to Long Beach. These levels are acceptable for primary contact recreational water.

TABLE 1 FECAL COLIFORM MEASUREMENTS AT THE TOFINO GOLF COURSE DEVELOPMENT

SAMPLE SITE	DATE SAMPLED	FECAL COLIFORM/100 ml
G1 North end of runway #15	84 06 05	< 1
	84 06 05	< 1
G2 Prior to the Esowista Indian Reserve	84 06 05	< 1
G3 After the Esowista	84 06 05	20
G4 Indian Reserve before discharge to the beach	84 06 05	180

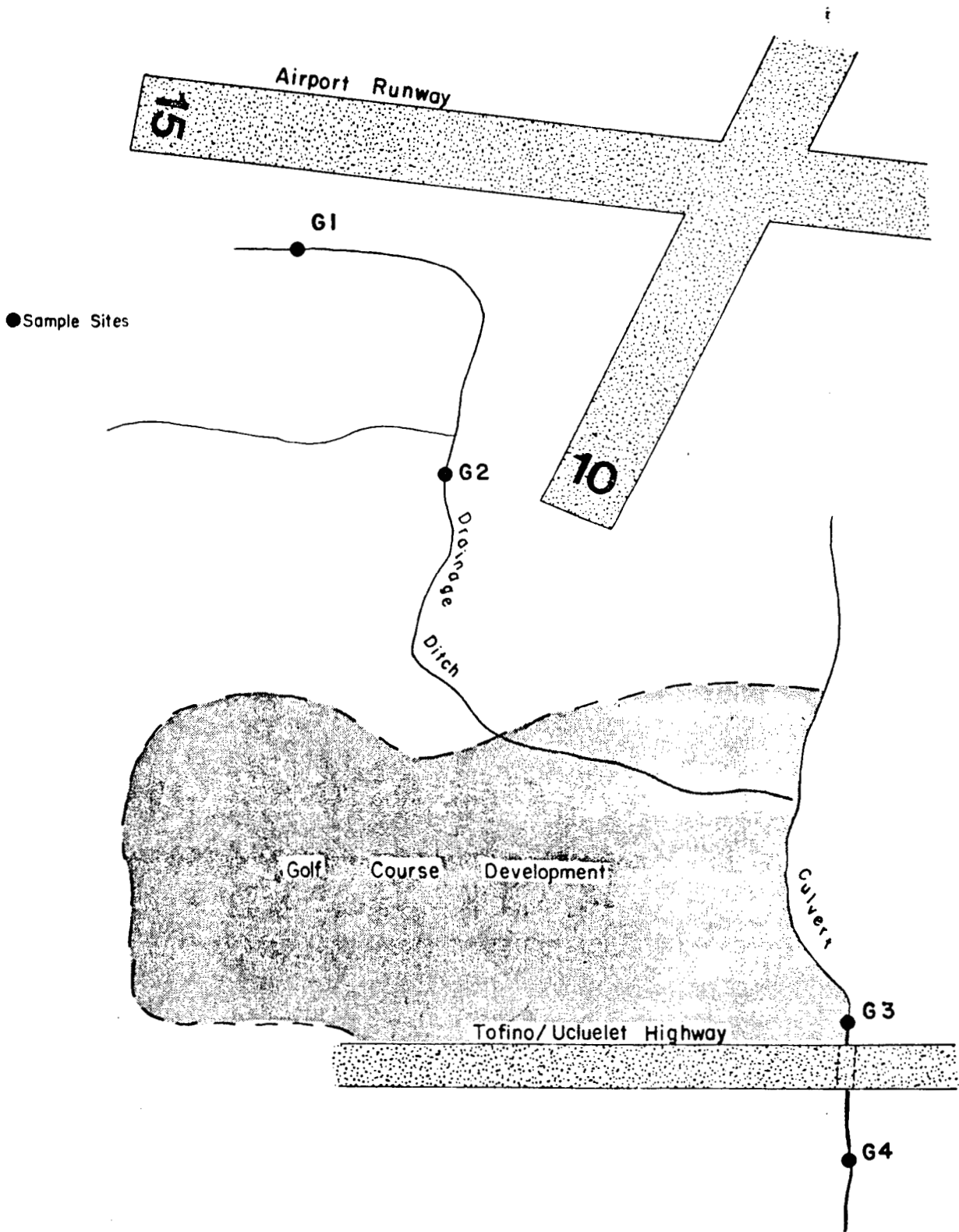


FIGURE 2 LOCATION OF SAMPLE SITES FOR TOFINO GOLF COURSE DEVELOPMENT



Plate #1: Beginning of the Airport/Golf Course Ditch near the northeast end of Runway #15. Note the eroded banks and silted bottom.

Plate #2: Drainage ditch near Runway #10. EPS summer student demonstrates field tests for Park Wardens and Fisheries Officer. Note severe erosion of the banks.





Plate #3: Parks Warden performing field test. Water temperature here = 26°C. Note the lack of cover and severe erosion.



Plate #4: Spawning bed for cutthroat Trout and stream bank covered with silt and mud from upstream ditches. Tofino Highway Culvert.

2.4 Field Data for Airport/Golf Course Stream

Location: North east end of runway #10, on the north west side of the Tofino Golf Course.

Field Tests: Date ; June 4, 1984
Temperature ; 26°C
pH ; 6.4
Dissolved Oxygen; 9.0 mg/L

Observations: Extensive erosion of the banks has resulted in the silting of the stream. This area was originally bog and the ditches were cut to drain the area.

Location: North east end of runway #15, on the northwest side of the Tofino Golf Course.

Field Tests: Date ; June 5, 1984
Temperature ; 14°C
pH ; 5.5
Dissolved Oxygen; 10.0 mg/L

Observations: Extensive erosion of the ditch banks.

3.0 DISCHARGE OF LEACHATE FROM THE ESOWISTA INDIAN RESERVE SEWAGE TREATMENT FIELD

Fecal coliform bacteria were measured in leachate discharging to the beach from the Esowista Indian Reserve sewage lagoon. This was expected to be contaminated, based on previous tests by the British Columbia Health Department. The following results were obtained.

TABLE 2 FECAL COLIFORM MONITORING RESULTS FROM THE ESOWISTA INDIAN RESERVE

SITE	SAMPLING AGENCY	DATE	COLIFORM/100 mL	
			FECAL	TOTAL
E6	B.C. Ministry of Health	Feb. 6/84	> 2400	> 2400
E6		Feb. 6/84	920	> 2400
E6	E.P.S.	June 5/84	8.3×10^5	
E6		June 5/84	4.6×10^5	

An interim report (see Appendix I) was submitted recommending further discharge of effluent be discontinued. These recommendations have been followed and redesign of the waste treatment system is underway. Waste sewage is being trucked to Tofino for disposal.

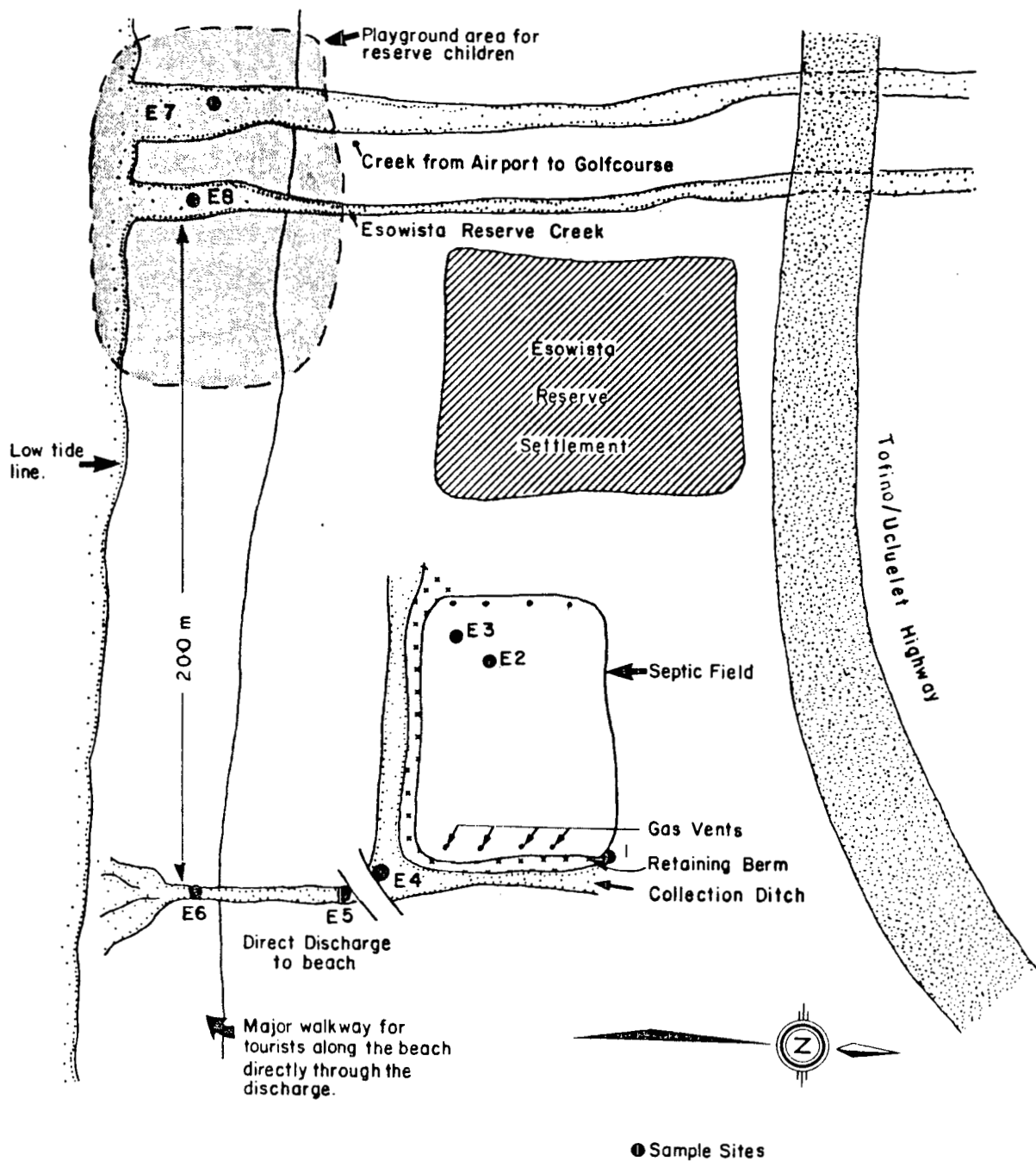


FIGURE 3 BEACH STREAM AND SEPTIC FIELD DISCHARGES TO LONG BEACH AT THE ESOWISTA INDIAN RESERVE

4.0 LEACHATE FROM THE TOFINO/UCLUELET LANDFILL DISCHARGING TO SANDHILL CREEK (Site L2)

Sandhill Creek is a salmon spawning stream which lies adjacent to the Tofino/Ucluelet sanitary landfill. A ditch dug to collect leachate from the landfill discharges directly to Sandhill Creek. The flow of leachate in the ditch may become stagnant during dry weather allowing the leachate to become concentrated.

Certain contaminants measured in the leachate in August 1982 and June 1984 were above acceptable limits for aquatic life (1).

The August 1982 samples of leachate were taken during dry weather when flow was stagnant. Concentrations above acceptable limits for aquatic life were measured for chromium, copper, manganese, nickel, phosphorus, lead, zinc, aluminum, iron, magnesium, sodium, nitrogen (as ammonia), hardness, chemical oxygen demand and zero dissolved oxygen (1). The samples taken in June 1984 were after a prolonged wet period of near record rainfall and continuous leachate flow. A dilution factor was apparent as only chromium, manganese, aluminum, iron, and chemical oxygen demand were above acceptable levels (see Table 3).

4.1 Aluminum

Aluminum in background waters was 2-10 times higher than the 0.10 mg/L normally considered acceptable. ⁽¹⁾ Stagnant leachate concentrations were up to 43 mg/L but only 0.15 to 0.27 mg/L during high flow.

4.2 Iron

Iron was at normal levels in background waters but 10 to 100 times the acceptable level in stagnant water, and 1-10 times during high flow.

4.3 Dissolved Oxygen

Dissolved oxygen was zero in the stagnant leachate tested in 1982 and was not measureable using a Hach Chemical Kit, in the samples tested in

TABLE 3 CONTAMINANTS ABOVE ACCEPTABLE LEVELS IN THE TOFINO/UCLUELET LANDFILL LEACHATE (mg/L) (Site L2)

PARAMETER	*ACCEPTABLE LEVEL (mg/L)	AUGUST, 1982		JUNE 4, 1982	
		Dissolved	Total	Dissolved	Total
Chromium	0.05	0.016	0.078	< 0.005	0.051
Copper	0.005	0.005	0.072		
Manganese	0.10	0.106	3.80	0.164	1.290
Nickel	0.025	0.035	0.055		
Phosphorus	0.020	0.065	3.92		
Lead	0.03 - 0.77	< 0.02	0.075		
Zinc	0.20 - 0.49	0.005	1.12		
Aluminum	0.10	< 0.05	41.0	0.15	0.27
Iron	1.00	13.6	102	1.07	15.30
Magnesium	50.0	127	146		
Sodium	500.0	815	577		
Alkalinity	30 - 130	3100	3100		
Nitrogen (NH ₃)	0.02	302			
Hardness	100.0		969		
C.O.D.	0 - 75		804		290
Dissolved Oxygen	5.0	0.0		**0.0,6.1	

*Reference #1

**High dissolved heavy metals may have interfered with the Hach Kit test.

June 1984. The high dissolved metals may have interfered with the Hach Kit Chemicals method as laboratory tests gave dissolved oxygen as 5.1 to 6.1 mg/L. Field tests indicate that a measurable drop in dissolved oxygen occurred after the landfill leachate entered Sandhill Creek.

TABLE 4 DISSOLVED OXYGEN IN SANDHILL CREEK

SITE	LOCATION	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/l)
L1	20 m Upstream	10.0	9.0
L2	Landfill Leachate	11.0	0.0*
L3	20 m Downstream	11.0	7.0
L4	At the Beach	13.0	11.0

*Leachate contaminants may have interfered with field analysis technique.

4.4 Chemical Oxygen Demand

Chemical oxygen demand was extremely high in the stagnant leachate (840 mg/L) and exceeded the acceptable levels of (0-75 mg/L) during high flow by four times.

4.5 Alkalinity (as CaCO₃)

Alkalinity = 3100 mg/L exceeded the normal range of 30-130 mg/L and was likely due to high ammonia concentrations and dissolved metals such as calcium and magnesium.

4.6 Bioassay

A bioassay of the August 1982 leachate sample showed acute toxicity to rainbow trout underyearlings with 100% mortality in 10 to 20 minutes (Appendix III). The June 1984 sample was not toxic to rainbow trout underyearlings at 100% concentration over 96 hours. The leachate

changed from a black liquid at the landfill site to a clear liquid at the ditch discharge as a result of dilution and some decomposition via aeration and biological/chemical oxidation.

4.7 Nutrients, Nitrogen (NH₃, NO₃⁻), Phosphorus

Nitrogen as ammonia in the stagnant leachate was extremely high at 302 mg/L while the nitrate form was below detectable limits. This indicates that urea, fecal and organic matter in the landfill has undergone bacterial decomposition and hydrolysis to the ammonia form. The ammonia is available at discharge as fertilizer for plant matter. This would promote the growth of large amounts of algae which in some areas filled the creek downstream of confluence with the leachate ditch.

Phosphorus was high in the 1982 measurements but relatively low in the June 1984 tests.

4.8 Coliform Bacteria

Fecal coliform bacteria concentrations in Sandhill Creek (Site L1) were at normal levels for natural waters. The landfill leachate exceeded the 200/100 mL level for primary contact water but was diluted to acceptable levels at its confluence with Sandhill Creek.

TABLE 5 FECAL COLIFORM IN LEACHATE FROM THE TOFINO/UCLUELET LANDFILL AND SANDHILL CREEK

SAMPLE SITE	DATE SAMPLED	FECAL COLIFORM/100 mL
L1 Sandhill Creek 20 m upstream of leachate	84 06 05	10
	"	20
L2 Landfill leachate to Sandhill Creek	"	250
	"	290
L3 Sandhill Creek 20 m downstream of leachate	"	20
	"	50

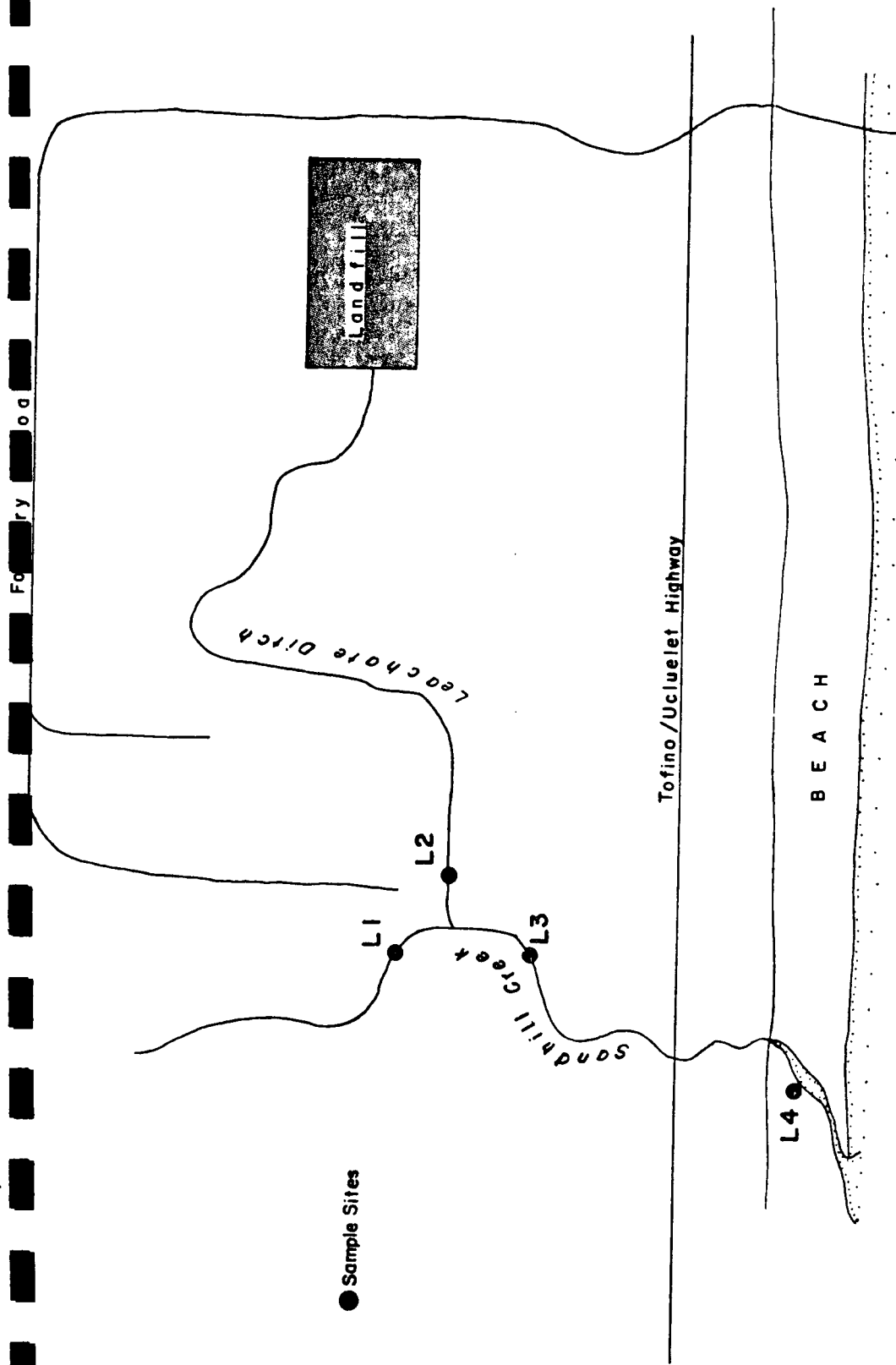


FIGURE 4 TOFINO / UCLUELET LANDFILL LEACHATE TO SANDHILL CREEK

Fecal coliform sources would likely come from domestic wastes including large amounts of disposable diapers visible at the dumpsites. It is recommended that the water in Sandhill Creek discharging to the beach be posted unfit for drinking.

4.9 Potential Problems from the Landfill Leachate

The leachate could be hazardous if after a prolonged dry period the effluent became concentrated and was washed into Sandhill Creek by a sudden storm flush. The high chemical oxygen demand, low dissolved oxygen and high metals concentrations could present a shock load if creek flow is not great enough to provide sufficient dilution. Such a situation might occur during late summer salmon runs but has not yet been observed or documented. It is therefore recommended that stream and leachate parameters such as pH, dissolved oxygen, temperature and flow be monitored on a monthly basis. (Possibly by regular patrols of Parks or Fisheries Officers).

Salmon are known to spawn in the stream and it is not known how long the fry reside in the creek or if cutthroat trout also use the stream to spawn. This should be determined.

4.10 Posting of the Landfill

There was no sign or poster at the entrance to the landfill as to what kind of waste should not be dumped there. It is recommended that such a sign be erected at the highway entrance to inform the public and reduce the risk of highly toxic wastes being dumped and leaching directly into Sandhill Creek.

4.11 Visible Affects of Landfill Leachate on Sandhill Creek

There was no observable plant growth on the bottom of the leachate ditch or Sandhill Creek for several square meters around the confluence. There was a large amount of yellow/orange slime algae on the perimeter of the barren section and downstream for 20 meters. The slime algae was so thick as to block the stream in several locations. Normal stream vegetation appeared 40 m downstream.



Plate #5: Sandhill Creek, 20 m upstream of confluence with the leachate ditch from the Tofino/Ucluelet Landfill.

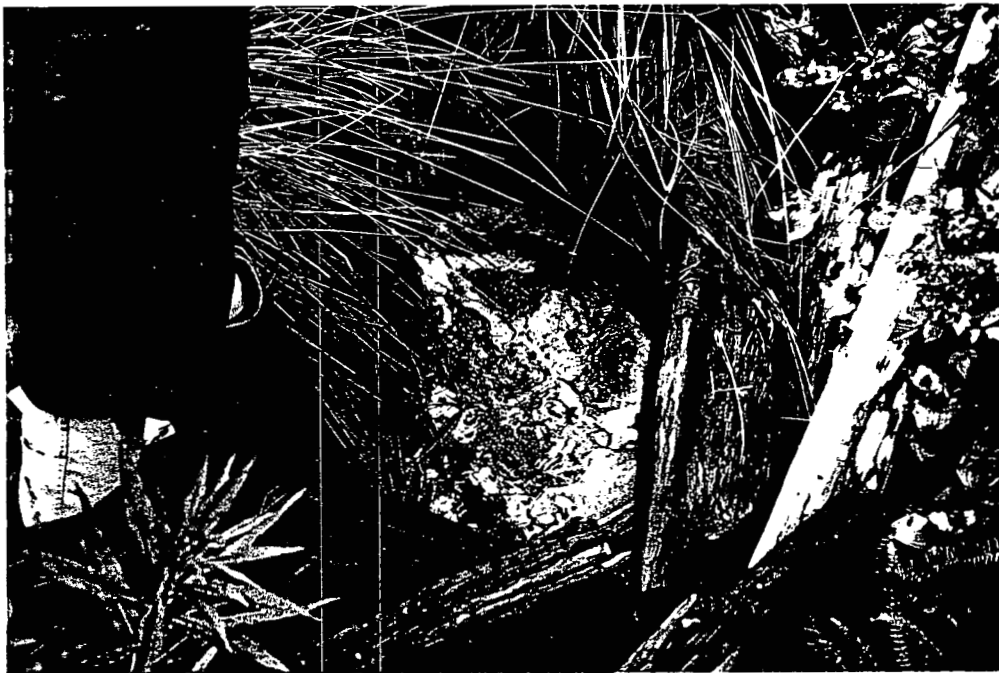


Plate #6: Landfill leachate just prior to confluence with Sandhill Creek.

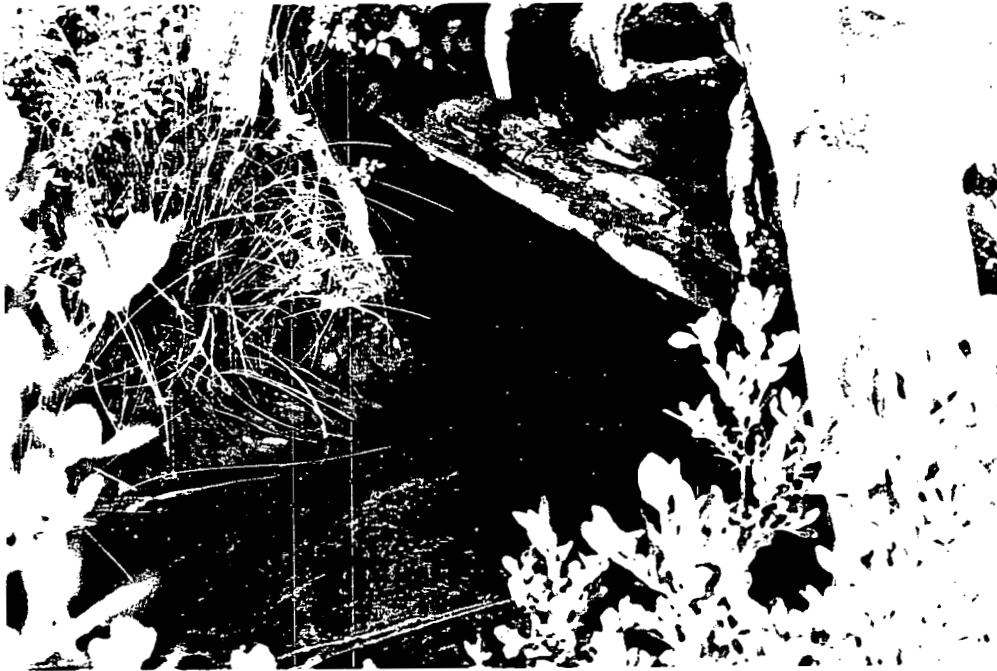


Plate #7: Leachate entering Sandhill Creek. Notice the bare stream bottom and filamentous orange and yellow slime. The stream bottom was devoid of growth for several square meters.

5.0 HEAVY METALS IN SEDIMENT

Sediments were sampled at seven locations in and bordering Pacific Rim Park. Two beach sand samples from the north end of Long Beach and one ditch sediment sample near the north end of runway #15 at the Tofino Airport were considered to be relatively uncontaminated by human activity. Four samples were taken from sites where contamination was expected.

5.1 Beach Sand adjacent to the Esowista Indian Reserve

Beach sand at the Esowista Indian Reserve had the highest readings in 13 of the 24 elements analysed. Values were 0.3 to 1.2 times the mean of all the samples tested and 2.25 times the samples considered uncontaminated.

The highest levels of cadmium, chromium, manganese, nickel, phosphorus, strontium, titanium, vanadium, iron, silica, calcium, and magnesium were detected at this site. Cadmium (at 1.3 ppm) was found to be 2 to 4 times the level found in uncontaminated sand (0.30 to 0.60 ppm). The elevated cadmium is likely due to its wide spread use in household materials such as automobiles, household electrical equipment, plastics and ceramics which would be in use in the households of the Esowista reserve (6). As discharge of effluent is discontinued at this site the levels would be expected to decline to near normal background levels. The reported background levels for cadmium is 0.20-2.0 ppm worldwide and 0.01 to 0.63 for Canada (4). Cadmium levels found in all the samples are within normal ranges.

5.2 Metals in Sediment of the Tofino/Ucluelet Landfill Leachate Ditch

The Tofino/Ucluelet landfill leachate had the highest levels of barium, mercury, copper, lead and zinc. Mercury (0.111 ppm), lead (6.0 ppm), and zinc (85.2 ppm) were two to three times background levels and mercury appeared to be higher (at 0.60 ppm) in sediment downstream of

the confluence with Sandhill Creek. According to Garrett et al (3) mercury levels between 0.100 and 1.000 ppm are difficult to attribute to natural or manmade sources but as Appendix V shows the mercury concentration is a factor of 10 greater in the areas of extensive human activity. As the leachate ditch concentrations are at least four times as high as other sediments tested, the landfill is indicated as the source of mercury. Mercury levels above 1.000 ppm are considered worthy of further investigation for sources as significant bio-accumulation may occur. In this case biannual or annual sampling should be performed to ensure that levels do not increase above this point.

Lead was well within the 10 to 11 ppm range considered normal for background levels in British Columbia (5). The landfill ditch sediment value of 6.0 ppm was more than double the level in other sediments indicating the landfill as the source.

Arsenic was above detectable limits in only one sample of beach sand and below detectable limits in all other samples. Aluminum, sodium, calcium, iron and silicon were highest in beach sand, likely due to the influence of salt water.

BIBLIOGRAPHY

- 1) Clark, M.J.R., "A Compilation of Water Quality Criteria", Province of British Columbia, Waste Management Branch, May 1980.
- 2) Metcalf and Eddy, Inc., "Wastewater Engineering: Treatment, Disposal, Reuse, McGraw--Hill Book Company, Montreal, 1979.
- 3) Garrett, C.L., MacLeod, L.A., Sneddon, H.J., "Mercury in British Columbia and Yukon Environments. Summary of Data to January 1, 1979", Environment Canada, Environmental Protection Service, Pacific Region, Regional Program Report 80-4.
- 4) "An Overview Paper on Cadmium in the Marine Environment in Relation to the OCDA Regulatory Limits", OCDA Program, HQ, March 1983.
- 5) Matt, K.J., "Lead Contamination of Some Agricultural Soils in Western Canada", Environmental Science and Technology, Vol. 5, #12, Dec. 1971.
- 6) Yap, N.T., "Cadmium: The Everyday Toxic Metal", Infoetox, Vol. 1, No. 1, 1984, pg. 11.

APPENDICES

APPENDIX I

INTERIM REPORT RE: DISCHARGE OF SEPTIC FIELD LEACHATE
- ESOWISTA INDIAN RESERVE TO LONG BEACH,
PACIFIC RIM NATIONAL PARK

John Millen

Peter Krahn
Project Engineer

SECURITY - CLASSIFICATION - DE SÉCURITÉ
OUR FILE - N / RÉFÉRENCE
YOUR FILE - V / RÉFÉRENCE 4523-70/P7
DATE June 28, 1984

Discharge of Septic Field Leachate - Esowista Indian Reserve to

Long Beach, Pacific Rim National Park

In response to a request from the Pacific Rim Park's Warden, I inspected and sampled several streams in the vicinity of the Tofino Airport and Esowista Indian Reserve which discharge to the park beaches. Water parameters were measured on site and grab samples for metals, nutrients, bioassay and bacteriology were taken from the streams.

The park warden, Mr. Max Elder, indicated that the septic field servicing the Esowista Reserve did not appear to be operating properly and an inspection was made of the site. See Figure #1.

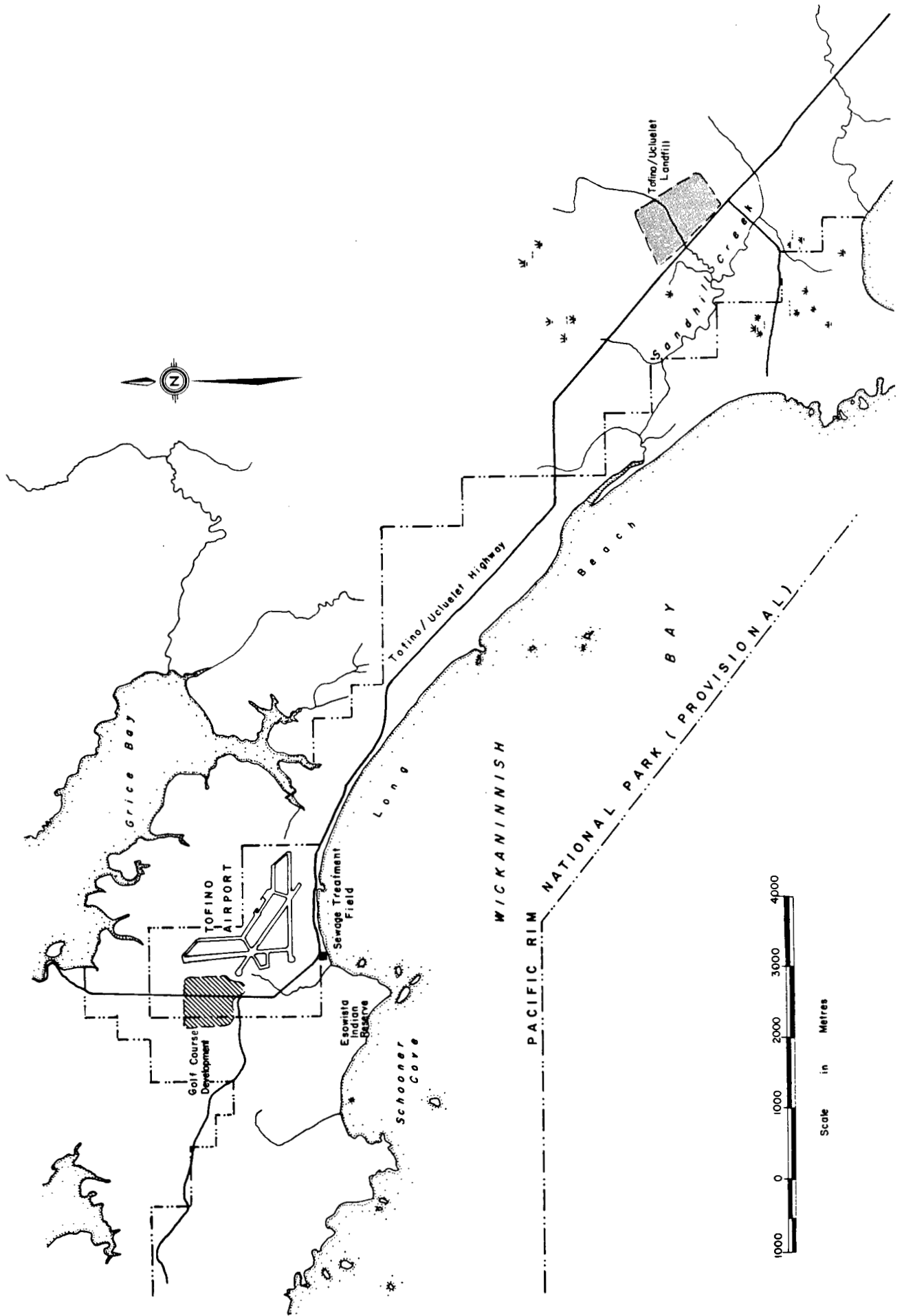


FIGURE 1 TOFINO GOLF COURSE, ESOWISTA INDIAN RESERVE, AND TOFINO / UCLUELET LANDFILL, PACIFIC RIM NATIONAL PARK

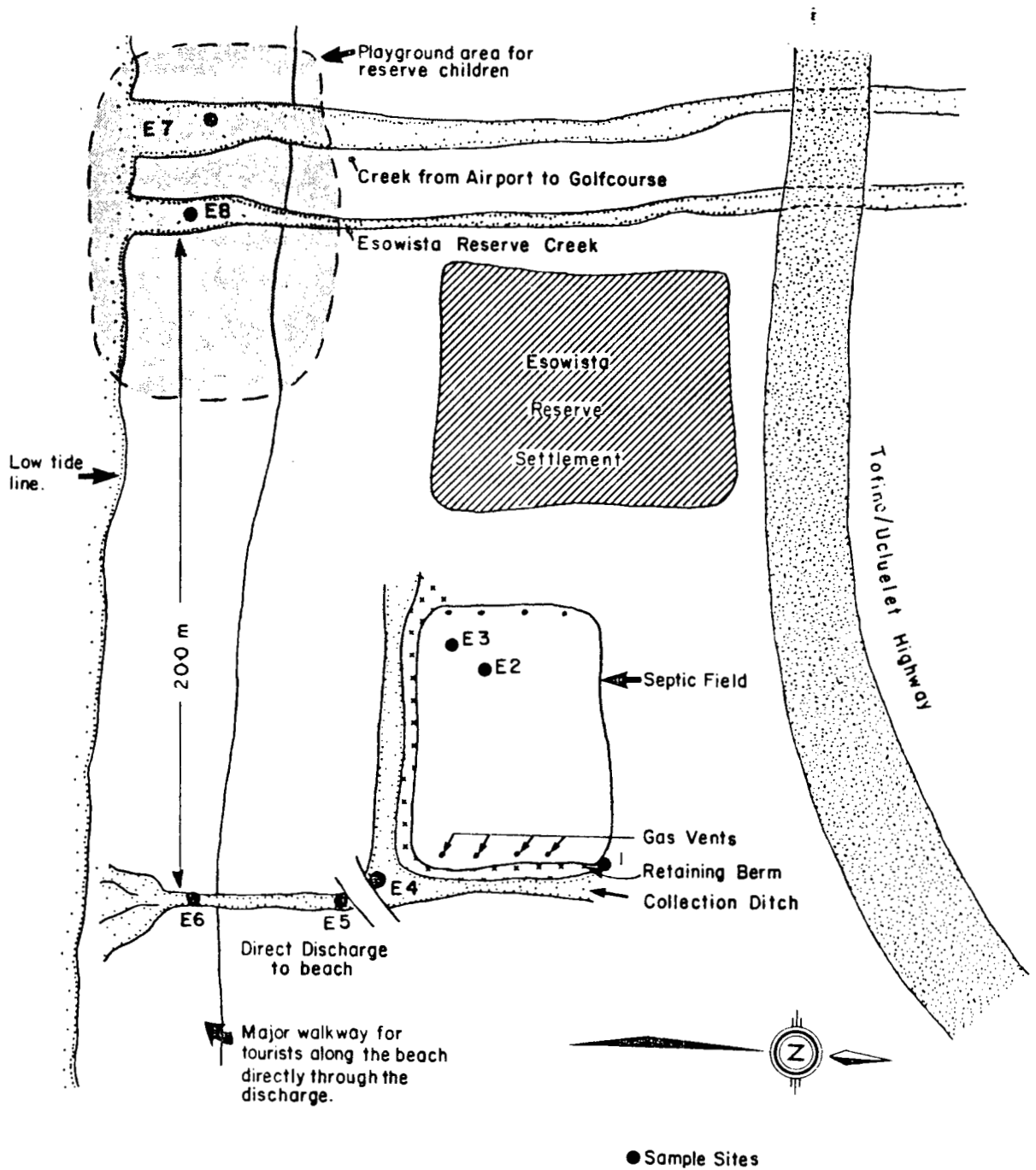


FIGURE 2 BEACH STREAM AND SEPTIC FIELD DISCHARGES TO LONG BEACH AT THE ESOWISTA INDIAN RESERVE



Plate #1 shows the field which is approximately 12 m x 20 m and is dug in sand which has silted in. There was a shallow surface pond and a narrow 1 m berm around the perimeter with a shallow collection ditch on the beach side of the perimeter.



Plates #2, #3 show the surface water of the pond which gave a septic smell and contained slime, foam and gas bubbles typical of anaerobic conditions.

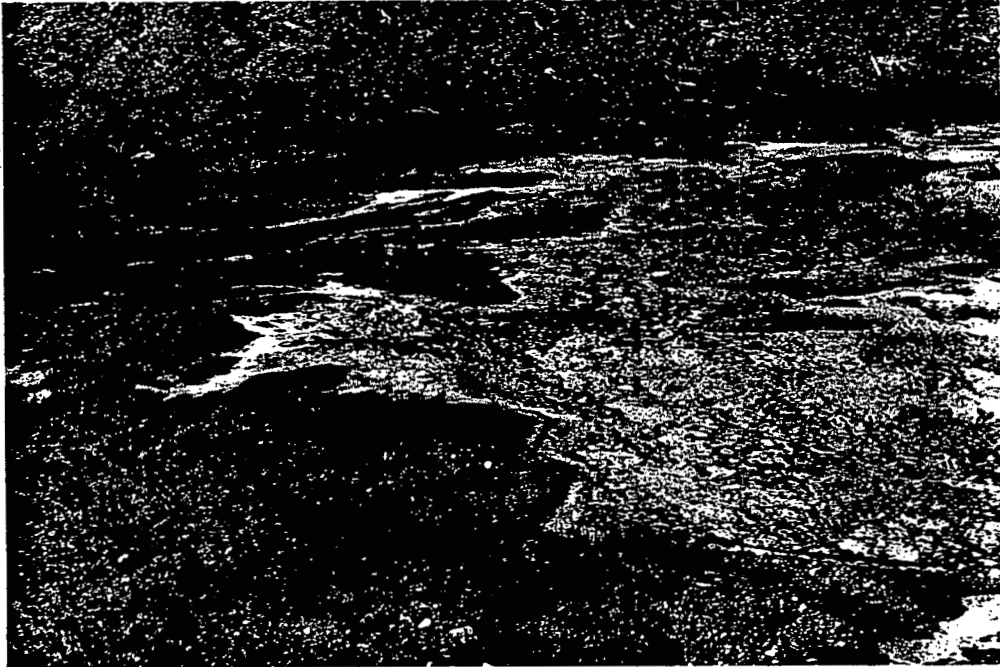


Plate #3



Plate #4 shows the drainage collection ditch is silted in and only a small fraction of one of the two drainage pipes is still open.

Plate #5 shows the leachate on the discharge side of the berm which flows to the beach.



Plate #6 shows the beach discharge at extreme low tide with park visitors walking barefoot across the outflow. Walking along the beach is the major activity in the area and at higher tides people are required to walk directly through the stained area shown in the photograph. The effluent sampled here had pH=5.5, temp.=15°C, and no measureable dissolved oxygen. The Fecal Coliform count of replicate samples were 460 000/100 mL and 830 000/100 mL. This exceeds the 200/100 ml level for primary contact recreational water set by B.C. Health and indicates that further discharge should be stopped as soon as possible.



Plate #7 shows Native children from the reserve playing on the beach in and around the two streams that drain from Tofino Airport and above and through the Esowista Reserve. On the three separate occasions the site was visited the children were present playing on the beach approximately 200 m away from the lagoon discharge. Above the highway the Esowista stream fecal coliform grab samples was less than 1/100 mL while below the reserve the results were 20 and 180/100 mL.

Recommendations

The British Columbia Health Department has sampled the streams in the area and has recommended that they be posted "Unfit for Drinking Water" and signs have been requisitioned by the park.

The major attraction of Pacific Rim National Park is beach combing and walking along the sand. As this is a high traffic area and direct public contact with the streams was observed it is recommended that the beach discharge from the Esowista Indian Reserve be discontinued as soon as possible and better treatment be provided for the reserve wastes.

cc. Max Elder, Head Warden,
Pacific Rim National Park.

Rick Kussat, Contaminants Group
EPS

- 1) Clark, M.J.R., "A Compilation of Water Quality Criteria" Province of British Columbia, Waste Management Branch, May, 1980.

MEMORANDUM

NOTE DE SERVICE

108 141

SECURITY - CLASSIFICATION - DE SÉCURITÉ
OUR FILE - N / RÉFÉRENCE 4523-70/P7
YOUR FILE - V / RÉFÉRENCE
DATE June 12, 1984

Peter Krahn

Bert Kooi
Senior Microbiologist Technician

Pacific Rim Water Samples

Analyses determined for fecal coliforms per 100ml of sample.

<u>Sample Site</u>	<u>Date Sampled</u>	<u>Fecal Coliform/100ml</u>
Sandhill Creek upstream	84 06 05	20
Sandhill Creek upstream	84 06 05	10
Sandhill Creek downstream	84 06 05	20
Sandhill Creek downstream	84 06 05	50
Landfill Leachate	84 06 05	290
Landfill Leachate	84 06 05	250
North end of runway	84 06 05	L1
North end of runway	84 06 05	L1
Iswista above Hwy.	84 06 05	L1
Tofino Golf Course and Beach	84 06 05	20
Tofino Golf Course and Beach	84 06 05	180
Es ⁹ wista Lagoon	84 06 05	8.3 x 10 ⁵
Es ⁹ wista Lagoon	84 06 05	4.6 x 10 ⁵

If any additional information is required, please contact me at 985-6713.

B. Kooi

B. Kooi

APPENDIX II FIELD DATA FOR TOFINO/UCLUELET LANDFILL LEACHATES

Location: Sandhill Creek 20 m upstream of confluence with landfill leachate (see Figure 3).

Date: June 5, 1984, 10:25

Field Tests: Flow ; 0.04 m³/s
pH ; 5.5
Temperature ; 10.0°C
Dissolved Oxygen; 9.0 mg/L

Observations: Water is clear with dark tannin color. The bottom is covered with green grasses, some algae, green to light brown.

Location: Effluent from landfill.

Date: June 5, 1984, 10:25

Field Tests: Flow ; 0.024 m³/s
pH ; 5.5
Temperature ; 11.0°C
Dissolved Oxygen; 0.0 mg/L

Observations: Leachate is clear but the bottom is covered in grey algae and slime. No green growth is visible.

Location: Sandhill Creek 20 m downstream of confluence with landfill leachate ditch.

Date: June 5, 1984, 09:55

Field Tests: Flow ; 0.04 m³/s
pH ; 5.5
Temperature ; 11.0°C
Dissolved Oxygen; 7.0 mg/L

Observations: Large amounts of yellow/orange algae and slime. Completely blocking stream in some locations.

Location: Sandhill Creek at the beach.

Date: June 5, 1984, 11:30

Field Tests: Flow ; 0.24 m³/s
pH ; 6.9
Temperature ; 13.0°C
Dissolved Oxygen; 11.0 mg/L

Observations: Creek flows west along the beach, sandy bottom, no biota.

APPENDIX III AUGUST 1982 DATA FOR THE TOFINO/UCLUELET LANDFILL LEACHATE AND SANDHILL CREEK

TEST	MAXIMUM ACCEPTABLE VALUE ¹ (mg/L)	STREAM DISSOLVED (mg/L)	STREAM TOTAL REPLICATES (mg/L)	LANDFILL DISS. REPLICATES (mg/L)	LANDFILL TOTAL REPLICATES (mg/L)
As	0.10	< 0.05	< 0.06	0.05	< 0.06
B	5.00	0.017	< 0.001	2.42	2.51
Ba	1.00	< 0.005	0.009	0.135	0.372
Be	1.10	< 0.001	< 0.001	< 0.001	< 0.001
Cd	0.0012	< 0.002	< 0.002	< 0.002	< 0.002
Co	1.32	< 0.005	< 0.006	0.016	0.075
Cr	0.05	< 0.005	< 0.006	0.016	0.073
Cu	0.005	< 0.005	< 0.006	0.005	0.069
Hg	0.10	< 0.05	< 0.06	0.05	0.006
Mn	0.10	< 0.09	0.103	2.14	3.80
Mo	0.50	< 0.005	< 0.006	< 0.005	0.015
Ni	0.024	< 0.02	< 0.02	0.04	0.05
P	0.020	< 0.05	0.07	0.31	3.85
Pb	0.77	< 0.02	< 0.02	< 0.02	0.07
Sb	0.20	< 0.05	< 0.06	< 0.05	< 0.06
Se	0.005	< 0.05	< 0.06	< 0.05	0.06
Sn		0.01	< 0.01	0.05	0.02
Sr	75.0	0.025	0.028	1.58	1.88
Ti	2.0	0.013	0.046	0.007	1.50
V	2.0	< 0.01	< 0.01	< 0.01	0.11
Zn	0.49	0.003	0.002	0.005	1.12
Al	0.10	0.24	0.88	< 0.05	39.2
Fe	1.0	1.01	2.07	13.7	101
Si		2.50	3.40	7.2	54
Cu		3.00	3.6	179	239
Mg	50.0	2.80	3.2	127	146
Na	500.0	18.4	19.1	815	578
Alkalinity (pheno)	15.0				
Alkalinity (total)	130.0	4.0		3100	
CO ₂	6.0				
NH ₃	0.02	0.042		302	
N.F.R.	25.0				
Color					
Cl	0.002				
D.O.	5.0	6.6	0.0	0.0	
Hardness (total)	100.0	19.2 19.2		970 963	
		22.6 22.5		1000 993	
pH	5.0 - 10.0	6.1		7.1	
T.O.D.	0.0 - 75.0	45.0		840	
S		< 0.05		0.32	
Cond.					
T.O.C.					
T.I.C.					
O & G					

APPENDIX III AUGUST 1982 DATA FOR TOFINO/UCLUELET LANDFILL LEACHATE AND SANDHILL CREEK

TEST	LEGAL SAMPLE 820717-9 (mg/L)	LEGAL SAMPLE 820717-10 (mg/L)	LEGAL SAMPLE 820717-11 (mg/L)	LEGAL SAMPLE 820717-12 (mg/L)
As				
B				
Ba				
Be				
Cd				
Co				
Cr				
Cu	< 0.005	< 0.005	< 0.006	0.074
Hg				
Mn	0.09	2.11	0.11	3.8
Mo				
Ni				
P	< 0.05	0.31	0.06	4.01
Pb	< 0.02	< 0.02	< 0.02	0.08
Sb				
Se				
Sn				
Sr				
Ti	0.013	0.006	0.046	1.68
V				
Zn	0.004	0.004	0.003	1.11
Al	0.240	< 0.05	0.87	43.0
Fe	1.01	13.6	2.33	103.0
Si				

Bioassay Results EPS Laboratory, August 5, 1982

Sample #820654

At 100% of the LT₅₀ was greater than 0.17 hours (10 minutes) but less than 0.33 hours (20 minutes) of exposure to Rainbow Trout underyearlings.

APPENDIX IV JUNE 1984 DATA FOR TOFINO/UCLUELET LANDFILL LEACHATE, SANDHILL CREEK, TOFINO GOLF COURSE

TEST	SANDHILL CREEK, 20 m UPSTREAM L1		LANDFILL LEACHATE L2		SANDHILL CREEK, 20 m DOWNSTREAM L3		AIRPORT/GOLF COURSE DITCH L4
	Diss. (mg/L)	Total (mg/L)	Diss. (mg/L)	Total (mg/L)	Diss. (mg/L)	Total (mg/L)	Total (mg/L)
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	0.009	0.01	< 0.001	0.137	0.028	0.031	< 0.001
Ba	0.002	0.003	0.004	0.028	0.005	0.005	0.005
Be	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Co	< 0.005	< 0.005	< 0.005	0.011	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	0.051	< 0.005	< 0.005	< 0.005
Cu	< 0.005	< 0.005	< 0.005	< 0.005	0.015	< 0.008	< 0.005
Hg		< 0.00005		< 0.00005		< 0.00005	< 0.00005
Mn	0.019	0.017	0.164	1.290	0.130	0.129	0.172
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005	0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	0.21	< 0.05	< 0.05	< 0.05
Pb	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	0.02	< 0.01	0.01
Sr	< 0.008	0.008	0.029	0.22	0.024	0.027	0.031
Ti	< 0.007	0.007	0.005	0.01	0.009	0.009	0.007
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	< 0.002	< 0.002	< 0.002	0.09	0.032	0.017	0.02
Al	0.30	0.34	0.15	0.27	1.17	0.51	0.20
Fe	0.606	1.87	1.07	15.30	1.71	1.84	1.33
Si	2.9	2.50	4.30	4.30	3.10	2.70	3.70
Cu	1.0	1.00	2.70	34.90	3.90	3.80	2.70
Mg	0.8	0.80	0.90	6.10	1.3	1.3	0.90
Na	5.7	5.70	4.90	38.80	8.30	8.6	5.0
Alkalinity (pheno)	Nil	Nil	Nil	Nil	Nil		Nil
Alkalinity (total)	Nil			82.0	8.0		8.0
CO ₂							
NO ₃ ⁻	< 0.01			< 0.01	< 0.01		< 0.01
Hardness Ca,Mg Total	5.84 8.64	5.79 11.10	10.4 13.5	112 144	15.1 24.9	14.7 21.1	10.2 14.1
pH	5.1		6.1		5.7		6.0
C.O.D.	-	< 20.0	290			45	< 20
Conductivity umho/cm	48.7		512			87.3	52.2
T.O.C.		14.0		110.0		21.0	3.0
T.I.C.		3.0		29.0		6.0	4.0
O & G	3.0		3.0		< 2.0		< 2.0

APPENDIX V JUNE 1984 SEDIMENT DATA FOR TOFINO/UCLUELET LANDFILL LEACHATE, BEACH SAND, TOFINO AIRPORT/GOLF COURSE SEDIMENT

SITE METAL	#1 (ppm)	#2 (ppm)	#3 (ppm)	#4 (ppm)	#5 (ppm)	#6 (ppm)	#7 (ppm)
As	9.0	< 8.0	< 8.0	< 8.0	SAMPLE	< 8.0	< 8.0
Ba	23.2	19.6	18.1	40.3	WAS	61.7	44.0
Be	0.4	0.2	< 0.2	0.2	LOST	< 0.20	< 0.20
Cd	0.6	0.3	1.3	0.7		0.70	< 0.30
Co	12.6	13.2	17.7	12.8		14.5	9.30
Hg	0.024	0.024	0.16	0.025		0.111	0.064
Cr	21.6	19.2	48.8	29.8		33.5	39.6
Cu	6.6	7.0	9.8	8.9		15.7	6.2
Mn	322.0	283.0	542	259		346	230.0
Mo	< 0.8	0.8	< 0.8	< 0.8		< 0.8	< 0.8
Ni	12.0	10.0	18.0	15.0		13.0	8.0
P	423.0	408.0	760.0	349.0		567.0	154.0
Pb	< 3.0	< 3.0	< 3.0	< 3.0		6.0	< 3.0
Sn	12.0	9.0	< 2.0	10.0		6.0	9.0
Sr	54.3	43.9	132.0	37.2		48.4	33.6
Ti	2 380.	1 880	3 630	2 050		1 140.0	1740.0
V	80.0	68.0	219	73		84.0	104.0
Zn	26.6	24.9	40.0	31.6		85.2	32.0
Al	19 500	17 300	24 900	16 100		24 200	26 900
Fe	18 300	16 300	39 500	18 400		22 700	26 600
Si	1 350	1 390	2 290	980		1 670	1 2800
Ca	19 200	16 000	30 000	5 010		6 310	3 560
Mg	6 300	5 690	7 750	4 030		5 430	5 390
Na	1 420	1 580	650	340		460	300

Site #1 - Uncontaminated beach sand on Long Beach, south end of parking lot. B1, Figure 1.

Site #2 - Uncontaminated beach sand on Long Beach, 200 m south of parking lot. B2, Figure 1.

Site #3 - Contaminated beach sand at Esowista Indian Reserve. E6.

Site #4 - Ditch sand at the north end of runway #15, Tofino Airport. G1.

Site #5 - Sandhill Creek sediment 20 m upstream of confluence with landfill leachate ditch. L1.

Site #6 - Landfill leachate ditch sediment. L2.

Site #7 - Sandhill Creek sediment, 20 m downstream of confluence with landfill leachate ditch. L3.

APPENDIX VI BIOASSAY RESULTS FOR LEACHATE FROM THE TOFINO UCLUELET LANDFILL AND SANDHILL CREEK

SAMPLE #	820654		840656		840657		840658	
pH	7.4		6.4		5.5		6.0	
Temperature	15 ± 1 °C		15 ± 1 °C		15 ± 1 °C		15 ± 1 °C	
Loading Density	C		C		C		C	
Avg. Weight	C		C		C		C	
Concentration	100 %		100 %		100 %		100 %	
Test Amount kg	30	30	30	30	30	30	30	30
Dissolved Oxygen mg/L		10.2	6.8	11.8	9.8	11.6	8.6	11.6
Number of Fish	10	10	10	10	10	10	10	10
CUMULATIVE MORTALITY								
0.0 hours	0	0	0	0	0	0	0	0
0.08 "	0 SS	0	0 SS	0	0	0	0	0
0.17 "	0 SS	0	0 SS	0	0	0	0	0
0.33 "	9	0	0	0	0	0	0	0
0.67 "	10	0	0	0	0	0	0	0
1.33 "	T	T	0	0	0	0	0	0
2.67 "			0	0	0	0	0	0
4 hours			0	0	0	0	0	0
48 "			0	0	0	0	0	0
2 "			0	0	0	0	0	0
6 "			0	0	0	0	0	0
pH (final)	7.7	6.4	7.6	6.7	6.4	6.8	7.2	6.8
Dissolved Oxygen mg/l	8.8	10.1	6.4	9.8	9.7	9.8	7.2	9.8
Conductivity umho			400		38		69	

S = Stress, SS = Severe Stress, T = Test Terminated, C = Control Test

820654 - Stagnant Landfill Leachate, L2

840656 - Flowing Landfill Leachate, L2

840657 - Sandhill Creek 20 m Upstream of Landfill, L1

840658 - Sandhill Creek 20 m Downstream of Landfill, L3