# EVALUATION OF WATER SUPPLY ALTERNATIVES FOR PINECREST ESTATES

Prepared for

VR559 (Pinecrest) Strata Corporation
c/o 403 - 2324 West 1st Avenue
VANCOUVER, B.C. V6K 1G3

Prepared by

PACIFIC HYDROLOGY CONSULTANTS LTD.
204 - 1929 West Broadway
VANCOUVER, B.C. V6J 1Z3

JULY 16, 1991

E. LIVINGSTON, P. Eng.
A. BADRY

**PACIFIC HYDROLOGY CONSULTANTS LTD.**
CONSULTING GROUNDWATER GEOLOGISTS

204 - 1929 WEST BROADWAY
VANCOUVER, B.C. V6J 1Z3
TELEPHONE: (604) 738-9232

July 16, 1991

VR559 (Pinecrest) Strata Corporation
c/o 403 - 2324 West 1st Avenue
VANCOUVER, B.C. V6K 1G3

Attention: Dr. Joyce Davies and/or
Mr. Ian Barnet

Subject: **Evaluation of Water Supply Alternatives for Pinecrest Estates**

Dear Sirs:

Enclosed herewith is our report concerning the investigation which we recently carried out to evaluate water supply alternatives for the Pinecrest System.

We trust that the report meets with your approval. We would be pleased to further discuss any aspect of the contents of the report.

Yours truly,

PACIFIC HYDROLOGY CONSULTANTS LTD.

E. Livingston

E. Livingston, P. Eng.

# EVALUATION OF WATER SUPPLY ALTERNATIVES FOR PINECREST ESTATES

## TABLE OF CONTENTS



## APPENDICES

## TABLE OF CONTENTS (cont'd)

### FIGURES



### TABLES

## 1.0 SUMMARY AND CONCLUSIONS

1. All evidence is that the existing water distribution and sewage collection systems serving Pinecrest Estates are in good order and are performing in a satisfactory manner.

2. The existing Retta Lake water source seems to be generally satisfactory. It has sufficient capacity and the chemical quality of the water is good. Although the Lake receives runoff from Highway 99, this is not a source of significant contamination. Several steps can be taken to prevent possible problems from human activity along the Highway.

3. Brew Creek and Roe Creek are possible surface water sources for Pinecrest Estates but a change to either of these sources would be quite expensive.

4. The adjacent Black Tusk System is a possible source of water for Pinecrest Estates but little is known about the capacity of the present source and whether there is excess capacity for Pinecrest. The chemical quality of the water is very similar to that from Retta Lake in total mineralization but it is somewhat harder due to differences in various constituents.

5. As far as a groundwater source is concerned, the possibilities are to construct:

   a. a dug well-collector, similar to the one used by Black Tusk, at a site near the Black Tusk well-collector;

   b. a shallow drilled well at a site in the area of the Black Tusk source or in an area south of Pinecrest near Roe Creek.

   Either alternative would require further investigation by actual construction and testing of a well before conclusions could be drawn about the suitability of the source. All things considered, it is difficult to justify such investigation at this time.

## 2.0 RECOMMENDATIONS

1. Continue to use Retta Lake as a water source for the Pinecrest system as at present or, preferably, with simple filtering equipment, particularly in late summer, to remove any organic particles.

2. Equip the present system for monitoring, by installing a water meter at the pumphouse and also a staff gauge in Retta Lake. Read both the water meter and staff gauge weekly in spring, summer and early autumn.

3. Request B.C. Ministry of Transportation and Highways to install sufficient concrete barriers along the Highway to prevent parking near Retta Lake.

4. Post appropriate signs along the east side of Retta Lake stating that the Lake is a community water source and that trespassing is prohibited.

5. Connect the Pinecrest and Black Tusk water systems together with a valved main so that water can be exchanged in the event of fires, breakdowns or other emergencies.

## 3.0 INTRODUCTION

### 3.1 Purpose, Scope and Authorization

The purpose of this report is to discuss the results of Pacific Hydrology's investigation concerning water supply alternatives for Pinecrest Estates, located about 20 kilometres (12 miles) south of Whistler Village, on the west side of Highway 99, a short distance west of Daisy Lake.

The following issues of concern were the motivation for the evaluation of water supply alternatives for the Pinecrest Estates System:

1. The objectionable taste of water from Retta Lake, particularly in late summer.

2. The possibility of lead accumulation in the Lake due to vehicular traffic on Highway 99, particularly in future when the Highway is double-laned.

3. Accumulation of salt in the Lake due to increased road de-icing.

In accordance with Pacific Hydrology's proposal contained in a letter dated September 17, 1990 to VR559 (Pinecrest) Strata Corporation, the investigation covered by this report consisted of:

- assembling and reviewing all available information on geology and groundwater in the subject area;

- geologic and hydrogeologic field reconnaissance on June 28, 1991 by Ed Livingston, P. Eng., of Pacific Hydrology.

The investigation covered by this report was authorized in a telephone call of May 2, 1991 from Mr. Ian Barnet of the Pinecrest Estates Water Committee to Ann Badry, Hydrogeologist of Pacific Hydrology; in a subsequent telephone call of May 31, 1991, Mr. Barnet confirmed that funding was in place for the study.

## 3.2 Background

From Ed Livingston's site visit of June 28, and from several telephone discussions between Mr. Ian Barnet of the Strata Corporation and Ann Badry, Hydrogeologist, of Pacific Hydrology, we understand that the situation concerning water supply for Pinecrest Estates is as follows:

1. The Pinecrest water system, which was constructed in the late 1970's, serves about 75 connections. There are about eight permanent residents in the Pinecrest Development; the remaining homes are occupied on weekends and holidays. There are only a few unoccupied lots in the Development.

2. The source of water for the Pinecrest water system is Retta Lake. The intake consists of a plastic pipe extending into deep water. The water is chlorinated and pumped to a wood stave tank.

3. The distribution system consists of insulated sclair pipe which includes an electric heating cable. Because the area is underlain by bedrock at shallow depth, most of the pipe was placed on the rock and covered with about one-half metre of overburden. The heating cable is activated by temperature sensors to prevent freezing. This system has worked well and there have been no freezing problems since the system was constructed.

4. Pinecrest Estates has a complete sewage collection system, consisting of a storage chamber at each house equipped with a grinder pump discharging to mains which convey the raw sewage to a treatment plant at the south end of the Development. Originally the treated effluent was discharged to a disposal field near the treatment plant but the disposal field did not work well so the effluent is now discharged to a slow-flowing ditch with a vigorous plant growth; this has proved to be quite satisfactory. The drainage is toward Roe Creek to the south of the Community.

5. The Pinecrest Estates Development is joined on the north by the Community of Black Tusk which was developed in the early 1980's. The Black Tusk Village System has about 120 connections; the water distribution system consists of 150 mm (6") diameter mains buried at a depth of about 1.8 m (6 ft), largely in rock because there is very little overburden.

6. The water source for the Black Tusk System is a dug well located quite close to Brew Creek. The well, which consists of a concrete casing extending to a depth about 7.3 m (24 ft), has two 6.1 m (20 ft) collector pipes extending laterally on opposite sides of the main casing near the bottom. The collector-well is equipped with two identical electric pumps which deliver the water to a large concrete tank, from which the water is pumped by a booster pump to the system. The dug well is reported to have been excavated in sand and gravel and the excavation did not reach bedrock.

7. In the planning of Black Tusk Village, the deepest of three 150 mm (6") diameter test wells was drilled to 144.8 m (475 ft). The well produced water but the water quality was reported to be very poor. The casing is in place in the middle of a road but it is full of debris.

8. Mains of the two systems (Pinecrest and Black Tusk) are quite close together at the common boundary but there is no connection between the two systems.

9. There is some concern about the quality of the water in Retta Lake. There have been complaints by Pinecrest Residents about the taste but the main concern is about pollution and contamination, particularly from Highway 99 which runs along the east side of the Lake and is very close to the Lake in one place. Motorists occasionally stop in several places along the Lake and, on at least one occasion, people have been observed swimming in the Lake. However, water samples from the Pinecrest Water System have not shown bacterial pollution.

10. Retta Lake has steep banks and, in most places, deep water is quite close to shore. There are many windfalls in the Lake, some floating and others resting on the bottom. There is some concern that the wood, and some algae clinging to the wood, may have an undesirable effect on the water and may make it corrosive. Removal of part of the wood has been considered.

11. Pinecrest Lake, which lies west of Retta Lake, is used for recreational purposes, particularly for swimming. Sand has been placed along the shore in several places to create beaches. The level of Pinecrest Lake appears to be several metres higher than Retta Lake but the level of Pinecrest Lake falls considerably during late summer. To counteract this, the residents have recently installed a 50 mm (2") diameter polyethylene pipe to bring water by gravity from two small creeks on the hillside west of the railway track. The flow from this pipe was recently measured to be about 2.5 L/sec (35 igpm) but there is some uncertainty about the late summer flow of these creeks.

An area location map showing the relation of the Pinecrest and Black Tusk Communities to the relevant Lakes and Creeks is included as Figure 1 in Appendix A.

## 3.3 Acknowledgements

The cooperation and assistance of various B.C. Government Departments, including B.C. Ministry of Municipal Affairs, Recreation and Culture, B.C. Ministry of Environment (Groundwater Section) and B.C. Ministry of Transportation and Highways were important to our ability to carry out the water supply investigation at Pinecrest Estates, and this is hereby acknowledged with our appreciation. In addition to Pinecrest Residents, Ms. Joyce Davies, M.D., Mr. Ian Barnet, Mr. Doug McDonald and Mr. Jake Abramson, we wish to extend our appreciation to the following individuals who supplied information which was important to the investigation:

- Mr. Len Lemieux, Manager of the Black Tusk Water System;
- Mr. Len Clarkson, R.P.H.I., Environmental Health Officer, Coast Garibaldi Health Unit.

## 4.0 GEOLOGY

Pinecrest Estates is underlain by columnar basalt flows of the Garibaldi Group of late Pleistocene age. Outcrops at the north end of Black Tusk Village show that the basalt overlies a light-coloured schist with steep east-dipping schistocity. This indicates that the basalt under Pinecrest Estates is probably not thick. The basalt forms a flat-topped ridge with steep slopes to Retta Lake on the East and to the B.C. Railway Track on the west. There is very little overburden over the basalt. However, there are several large to very large granitic boulders on top of the basalt surface. These boulders are too large to have been moved by running water; they were certainly brought in by ice, indicating that the basalt flows were in place before the most recent ice in the area, probably about 10,000 years ago.

Surficial deposits of glacial and/or recent sediments are present along Brew and Roe Creeks. The Black Tusk Well shows that the sediments along Brew Creek are at least 7.3 m (24 ft) thick. The large shallow gravel pit near Roe Creek indicates that the situation there may be similar. These deposits are likely to be glacial outwash but may include till and floodplain deposits of the Creeks.

## 5.0 SURFACE WATER HYDROLOGY

The main drainage in the subject area is southward down the Cheakamus River, with part of the water diverted through a long tunnel to an hydroelectric power house on the Squamish River. The main creeks near Pinecrest are Brew Creek to the north and Roe Creek to the south. Both are perennial creeks with Roe Creek much larger than Brew Creek.

The hydrology of Pinecrest and Retta Lakes is not clear but both seem to be partially fed from groundwater. Since Pinecrest Lake is higher by a few metres than Retta Lake, there is probably subsurface flow from Pinecrest Lake to Retta Lake. Retta Lake overflows intermittently at the north end through a small weed-choked area to the Highway and eventually to Brew Creek. Inspection of this outlet indicates that the flow is always very small. The shoreline of Retta Lake indicates that there is very little water level fluctuation and reports of residents tend to confirm this.

The main inflow to Pinecrest and Retta Lakes is from precipitation in the natural drainage area, along with some groundwater inflow from larger groundwater flow systems originating on the west side of the valley. During the dry months, subsurface flow from Pinecrest Lake is sufficient to maintain the level of Retta Lake. Without additional investigation, the hydrology is quite speculative but the important point for this report is that Retta Lake maintains a nearly constant level which is not being lowered by the present rate of withdrawal by the Pinecrest Water System.

## 6.0 GROUNDWATER HYDROLOGY

Under the geologic conditions in the area of Pinecrest Estates and Black Tusk Village, most groundwater is moving through fractures in bedrock. The water moves through large flow systems driven by gravity from the upper mountain slopes, where the flow systems are recharged by precipitation, to the discharge areas in and near the valley bottoms. In moving slowly through rock fractures, the water dissolves minerals so that the water quality changes as it travels from the recharge to the discharge area; depending on the length of flow path, the permeability of the sediments within the path of flow and the chemical makeup of the rock and/or sediments in the path of flow, the change is from a slightly mineralized calcium bicarbonate type water to a more highly mineralized sodium water. Although no chemical analysis is available for the reported poor quality groundwater yielded by the Black Tusk Test Well, the poor quality was probably due to an highly mineralized water containing sodium.

The water in sediments along Brew and Roe Creeks is probably largely underflow from the Creeks but it may also include some water from the large groundwater flow systems mentioned above.

## 7.0 WATER SUPPLY ALTERNATIVES

### 7.1 Existing Retta Lake Source and System

The present Retta Lake source is satisfactory in many ways. The capacity of Retta Lake is unknown but it is more than sufficient for present demands. The chemical quality of the water is excellent, as shown in Table 1 in Appendix B (Page B - 1). The water represented by the February 6, 1990 analysis is a very soft and simple sodium/chloride type water with a very low total mineralization; the low pH and low mineralization indicate a tendency for the water to be corrosive. Apparently the water has an objectionable taste at certain times. All things considered, the unpleasant taste seems likely to be caused by excessive chlorination of the water in the summer, when the organic content may be fairly high.

There is concern by Pinecrest Residents about future contamination and pollution. There are certainly no obvious sources of contamination or pollution on the west side of Retta Lake; the main concern is Highway 99, which runs along the east side and is quite close to the Lake in several places. Possible problems due to the Highway are:

1. Contamination with lead originating from anti-knock compounds in gasoline consumed by automobiles.

2. Contamination with petroleum products, or possibly other materials, in the event of an accident.

3. Contamination during winter months with road salt - probably sodium chloride.

4. Pollution from motorists stopping along the Highway near the Lake.

Lead contamination is no longer a cause for concern, as almost all gasoline is now lead-free. The chance of a petroleum product spill from an accident seems quite remote as there is no particular traffic hazard on the Highway near the Lake. From the configuration of the Highway, it is clear that drainage and runoff from part of the Highway reaches the Lake; however,

the total amount of such runoff is small compared to the volume of the Lake so it would be reduced to extremely low concentration by dilution. For example, if the Lake is assumed to be 350 metres long, 50 metres wide and 5 metres deep, it holds about $10^5$ tonnes of water; if 100 kilograms of salt is applied during one winter to that part of the Highway which drains into the Lake, the salt concentration in the Lake would rise by one mg/L, or about 1/22 of the present concentration in the Lake. This may be the source of at least part of the present sodium chloride content of the Lake. Water with a content of sodium over 20 mg/L may be undesirable for individuals on a salt-free diet, but at 22 mg/L, it certainly cannot be tasted or considered to be a problem for healthy people.

The most likely danger to water quality in Retta Lake comes from activities of motorists stopping along the Highway near the Lake. This hazard is certainly low but obviously the possibility of problems should be reduced. From our inspection, it is apparent that the placing of the usual prefabricated concrete barriers along the Highway, where there is now room to park, would almost eliminate this problem. Signs stating that the Lake is a community water supply should be posted.

There is no evidence of beavers or muskrats in Retta Lake; if any are seen, they should be removed immediately to reduce the possibility of contamination with the parasite **Giardia** which causes giardiasis, popularly known as "Beaver Fever". **Giardia** cysts apparently settle out in still water; therefore, a water intake above the Lake bottom would probably not yield infested water.

In our opinion, the wood in Retta Lake is unlikely to have any perceptible effect on water quality. Much of the wood could be removed but such removal would be quite expensive and would accomplish little. If the taste problem is caused by warm weather growth of algae or other non-pathogenic organisms, the problem can probably be corrected by filtration. A brief discussion of the problem with a manufacturer of such equipment indicates that use of a filter that contains charcoal would remove any organic particles and would also eliminate the unpleasant taste. Such filters are placed in the system to follow the chlorination procedure. The equipment requires no chemicals and it backwashes automatically; the charcoal medium is usually replaced once each year. A rough estiamte of capital cost for such a filter installation is less than $10,000., with a yearly operating cost, mostly replacement of charcoal, of less than $2,000.

## 7.2 Black Tusk System

An obvious possible source for Pinecrest is the Black Tusk System. However, the capacity of the Black Tusk source is not known well enough to be able to say at this time whether it can supply the additional connections of the Pinecrest System. From Ed Livingston's discussion on June 28 with Mr. Lemieux, Manager of the Black Tusk System, we understand that the source well was rated at the time of construction at "35 igpm for 100 days". We do not have data from that test but the well could be re-tested quite easily to determine its present capacity by using the installed pumps. The quality of water from the Black Tusk System is compared with that of Pinecrest's Retta Lake source in Table 1 in Appendix B (Page B - 1). Although the water from the Black Tusk Well is similar to the Retta Lake water in terms of total mineralization, because of differences in the amounts of individual constituents, the water type is different and is much softer. The Black Tusk water is a complex calcium + sodium/bicarbonate + chloride type water.

## 7.3 Brew Creek and Roe Creek

Other possible water sources for the Pinecrest System are Brew Creek, on the north, and Roe Creek, on the south. These are both perennial creeks with more than adequate year-round flow to supply Pinecrest's requirements. Analyses of the chemical quality of the water are not available but there is every reason to expect that water quality is excellent. The distance from either Creek is quite similar but an intake site on Brew Creek could be quite close to the Black Tusk Well where electric power is available. An intake on either Creek would require the following:

1. an intake structure with trash racks, etc.;
2. pumping equipment and electric power;
3. chlorination equipment;
4. a water main from the Creek to the existing system;
5. depending on sediment load in the Creek, a settling basin or other sediment-removal equipment.

## 7.4 Drilled Wells

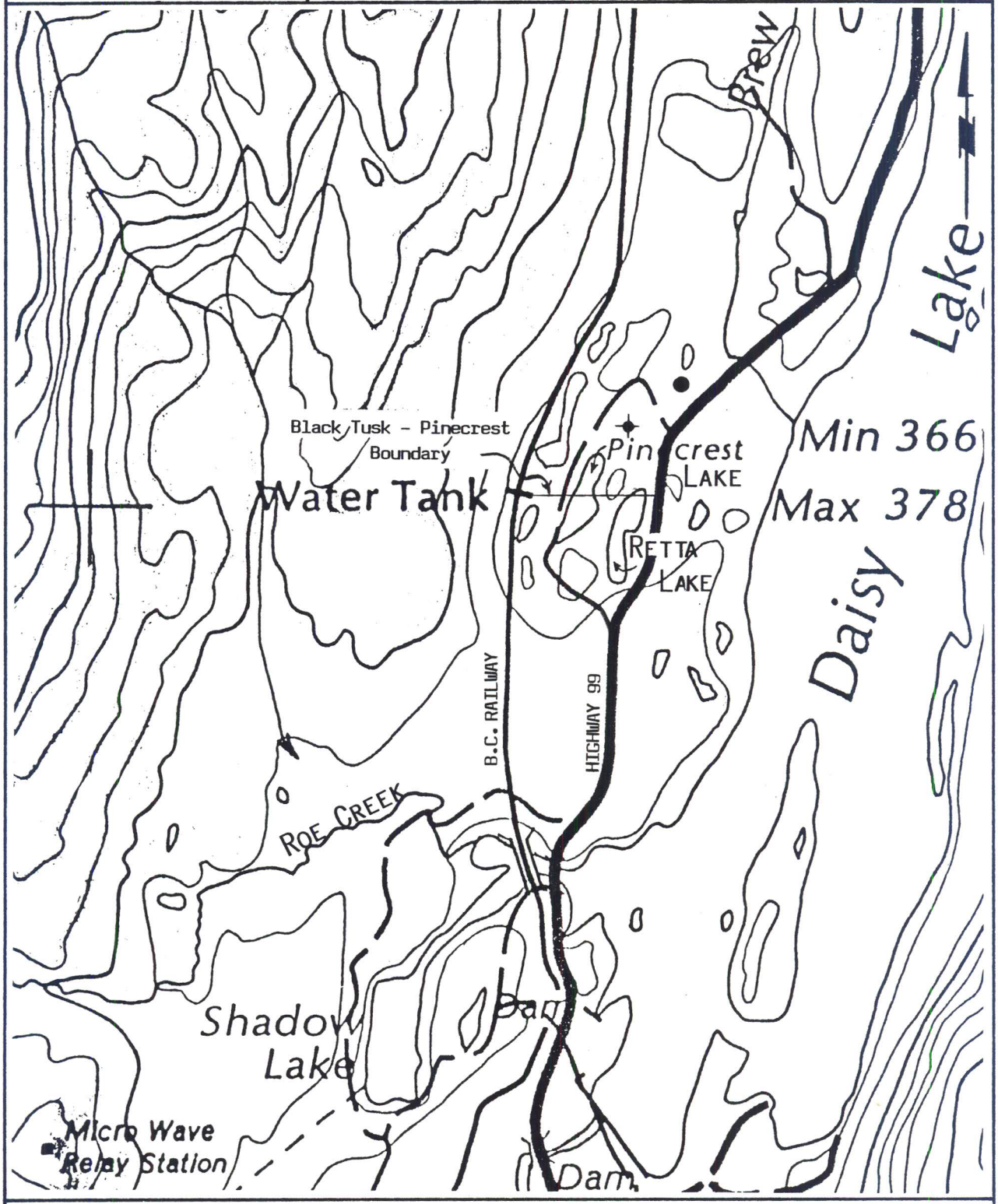
It may be possible to construct a drilled well with a well screen in sand and gravel near Brew Creek or near Roe Creek. Exploration near Roe Creek would obviously have to take into consideration the location of the Pinecrest sewage disposal facility. The feasibility of a drilled well at either location depends, of course, on there being a sufficient thickness of aquifer; the cost of a drilled well would be less than the well-collector at Black Tusk. If successful, a well would be less costly than a creek intake, and related equipment, and chlorination would not be required.

The experience reported for the drilling carried out in early 1982 to explore for a groundwater source for Black Tusk Village shows fairly conclusively that the rocks underlying the Pinecrest area are not an aquifer of interest to supply Pinecrest Estates. According to records on file with Groundwater Section of B.C. Ministry of Environment, three deep test wells were drilled in the rock in the search for a groundwater source for the Black Tusk Vilalge System. The three wells were drilled to depths of 76.2, 136.3 and 144.8 m (250, 447 and 475 ft). The shallowest well had very low capacity. The 136.3 m (447 ft) deep well had a capacity estimated by the driller of 1.5 L/sec (20 igpm) but a comment on the record states "water had a funny bad taste". It seems likely that this is the well which was pointed out by Mr Doug McDonald during Ed Livingston's site visit, although the depth on the record is considerably greater than indicated by Mr. McDonald. The driller's logs show that the three test wells all started in basalt, which varied in thickness from 9.8 to 32.9 m (32 to 108 ft). In any case, the capacities of all three wells are too low to be of any interest as a source for the Pinecrest System and, further, the statement about poor water quality does not encourage other deep drilling in the rock.

# APPENDIX A

## AREA LOCATION MAP

| FIGURE 1 | PINECREST ESTATES AREA LOCATION MAP |
|---|---|




**Notes:**

1. The base map is 1:50,000 scale topographic map, **Garibaldi Park**, enlarged to an approximate scale of 1:30,000.
2. ● ✦ approximate respective location of Black Tusk collector well and test hole.

# APPENDIX B

# WATER QUALITY

**Table 1. Water Quality in the Pinecrest Estates and Black Tusk Water System**

| Parameter | | Pinecrest Estates (1) | Black Tusk (2) | Drinking Water Guidelines (3) |
|---|---|---|---|---|
| **Physical Tests** | | | | |
| pH | | 6.6 | 6.7 | 6.5 - 8.5 |
| Conductivity (umhos/cm) | | 136. | 160. | - |
| Colour (CU) | | 5. | <5. | 15. |
| Turbidity (JTU) | | 0.4 | 0.8 | 5. |
| Total dissolved solids (mg/L) | | - | 102. | 500. |
| Total Hardness (mg/L) | $CaCO_3$ | 9.5 | 50.6 | - |
| **Dissolved Anions** (mg/L) | | | | |
| Alkalinity | $HCO_3$ | 8.4 | 53.7 | - |
| Chloride (diss.) | Cl | 34.5 | 12.9 | 250. |
| Sulfate (diss.) | $SO_4$ | <1.0 | 7.9 | 500. |
| Nitrate and Nitrite (diss.) | N | 0.05 | 0.09 | 10. |
| Fluoride (diss.) | F | <0.10 | <0.10 | 1.5 |
| **Metals** (mg/L) | | | | |
| Calcium | Ca | 2.38 | 16.4 | - |
| Magnesium | Mg | 0.86 | 2.34 | - |
| Sodium (diss.) | Na | 22.1 | 11.7 | - |
| Potassium (diss.) | K | 0.4 | | - |
| Aluminum | Al | <0.10 | <0.10 | |
| Arsenic | As | | <0.001 | 0.05 |
| Barium | Ba | <0.01 | 0.02 | 1.0 |
| Boron (diss.) | B | | 0.05 | 5.0 |
| Cadmium | Cd | <0.0005 | <0.0005 | 0.005 |
| Cobalt | Co | <0.1 | <0.1 | - |
| Chromium | Cr | <0.01 | <0.01 | <0.05 |
| Copper | Cu | 0.05 | 0.38 | 1.0 |
| Iron | Fe | 0.24 | 0.17 | 0.30 |
| Lead | Pb | 0.003 | 0.002 | 0.01 |
| Manganese | Mn | 0.01 | 0.06 | 0.05 |
| Molybdenum | Mo | <0.01 | <0.01 | - |
| Nickel | Ni | <0.05 | <0.05 | - |
| Vanadium | Va | 0.09 | <0.01 | - |
| Zinc | Zn | 0.02 | 0.01 | 5.0 |

**Sources of Information:**

1. Zenon Environmental Inc. Report 03000166, Sample 89021040, February 6, 1990.
2. Zenon Environmental Inc. Report 03020237, Sample 90015104, December 20, 1990.
3. Maximum acceptable concentration as specified by Health & Welfare Canada (1989) and B.C. Ministry of Health (1982).