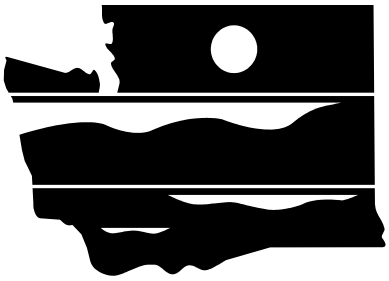

Northport, Washington Air Quality Study:

Phase IV Progress Report

December 1998
Publication No. 98-211

The Department of Ecology is an equal opportunity agency and does not discriminate on the basis of race, creed, color, disability, age, religion, national origin, sex, marital status, disabled veteran's status, Vietnam Era veteran's status or sexual orientation.

If you have special accommodation needs or require this document in alternative format, please contact Tami Dahlgren at (360) 407-6830 (voice) or (360) 407-6006 (TDD only).

Northport, Washington Air Quality Study:

Phase IV Progress Report

Prepared by:

Washington State Department of Ecology
Air Quality Program

Contact Person:
Jon Bennett
(360) 407-6813

December 1998
Publication No. 98-211

Northport, Washington Air Quality Study: Phase IV Progress Report

Background

In the winter of 1992, the Washington State Department of Health, in cooperation with the Washington State Department of Ecology (Ecology), responded to inquiries by residents living in the vicinity of Northport, Washington regarding possible health effects from the Cominco, Ltd. smelter at Trail, British Columbia. The resulting investigations have been reported in Air Monitoring Data and Evaluation of Health Concerns in Areas of Northeast Tri-County, which covers the periods known as Phases I and II, and Northport, Washington Air Quality Study Phase III. The Phase I and Phase II periods were December 15, 1992, through February 13, 1993, and August 10, 1993, through October 30, 1993, respectively. Phase III covers the time period from November 3, 1993, through August 6, 1994.

In October 1995 Cominco, Ltd. proposed to upgrade its lead smelting operation. Both B.C. Environment and Ecology conducted extensive reviews of the proposed technology. Ecology concluded that the technology met U.S. federal and state regulatory requirements and recommended approval to B.C. Environment. Subsequently, B.C. Environment approved the proposal and Cominco, Ltd. installed the new technology. The new process began operation in the spring of 1997 and is expected to reach full production levels sometime in 1999.

Phase IV Study

In response to the changes at the Cominco, Ltd. facility, Ecology is continuing an evaluation of air quality in the Northport area. The Phase IV study began on September 5, 1997, and will continue through December 31, 1998. The purpose of the Phase IV Study is to evaluate any changes in air quality resulting from the implementation of the new smelting process. Phase IV monitoring efforts consists of particulate and metals sampling at the Bennetch Farm site, the Sheep Creek site, and the Northport Elementary School site and meteorology measurements near the Sheep Creek site. Analysis of the data from the three sites will be conducted to determine if changes have occurred in air quality and if the Sheep Creek site is representative of air quality in the area.

This progress report presents data from the first half of the Phase IV Study September 5, 1997, through April 29, 1998. Figure 1 shows the locations of the study sites. The average daily values and standard deviations have been calculated for each data set and are shown with the data in Tables 1 through 4. Appendix A contains a preliminary comparison of the data from the Sheep Creek and Northport School monitoring sites. A final report including analysis and presentation of all the data will be published in the spring of 1999.

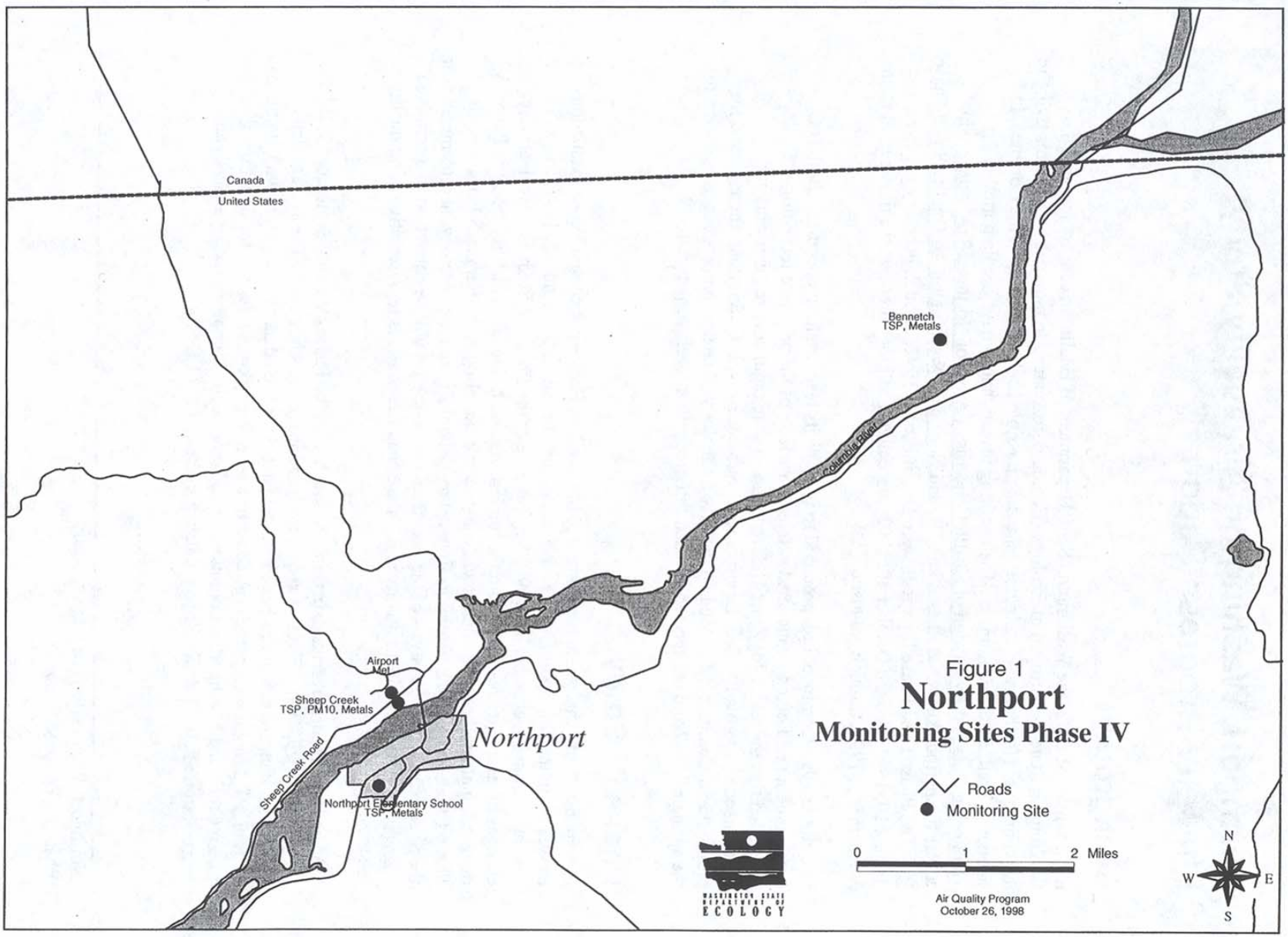
Canada
United States
Bennetch
TSP, Metals
Columbia River
Airport
Met
Sheep Creek
TSP, PM10, Metals
Northport
Sheep Creek Road
Northport Elementary School
TSP, Metals
Figure 1
Northport
Monitoring Sites Phase IV
Roads
Monitoring Site
0
1
2 Miles
Air Quality Program
October 26, 1998
N
W
E
S

Table 1 shows the data set from the Bennetch Farm site for arsenic, cadmium, copper, iron, lead, and zinc. It consists of 28 samples for the period from September 5 through October 27, 1997. Daily averages and standard deviations have been calculated and are presented with the data.

Table 2 shows additional Bennetch Farm data consisting of 16 samples for the period from January 29 through April 29, 1998.

Table 3 shows the data set from six samples taken between September 7 through October 7, 1997, at the Sheep Creek site for arsenic, cadmium, lead, and zinc. This is the continuation of a long-term monitoring effort at Sheep Creek dating from August 1993.

All of the above data sets were provided by Cominco, Ltd. which obtained the samples and performed the analyses.

Two additional data sets cover the period from January 11, 1998 through April 29, 1998. One of these is from an Ecology operated sampler located at the Northport elementary school. The other set is from the Sheep Creek site with the samples obtained by Cominco, Ltd. Both sets of samples were analyzed by Ecology for arsenic, cadmium, lead, and zinc. The Northport elementary school data are shown in Table 4a, data for Sheep Creek are shown in Table 4b.

Concerns have arisen that air quality data from the Sheep Creek site may be questionable because the site meets neither Washington State nor EPA siting criteria. In response, a statistical analysis was conducted comparing the lead and zinc data from the Sheep Creek and Northport School sites. The results of this analysis, which are presented in Appendix A, show that for the 14 data sets analyzed there is no significant difference between measurements. Therefore, the Sheep Creek site data could be representative of air quality in the Northport area. However, the data set was too small to draw a definitive conclusion. Additional data from the rest of Phase IV will be incorporated into this analysis and the above results confirmed when Phase IV is completed.

In addition to the Phase IV Study by Ecology, Cominco, Ltd. will continue to monitor at the Sheep Creek site. Cominco, Ltd. is required under the terms of its approved air permit modification application to monitor for particulate and metals at its Sheep Creek site for a period of one year following the attainment of stable production level with its new lead smelting process. This is anticipated to occur in mid-1999 with a summary report due to BC Environment by no later than December 31, 2000. In the meantime, data generated at the Sheep Creek site during this January 1, 1999, to mid-year 2000 time frame will be provided to Ecology on a monthly basis for subsequent analysis and modeling.

Ecology will also continue its efforts to fine-tune the MM5, CALMET and CALPUFF air quality models for utilization in the Northport study area. These tools should be available in early 1999 at which time the Northport area will be modeled to ascertain the impacts of the Cominco, Ltd. emissions following the imposition of the new treatment technology at that facility. In addition to evaluating the need for further emission reductions at the Cominco, Ltd. facility, the above models will be used to determine pollutant impact "hot spots" and optimum long-term air quality

monitoring site locations. Modeling results and technology will be provided to both BC Environment and Cominco, Ltd. to facilitate air quality and pollutant emissions management.

Table 1: Bennetch 24-hour average TSP data from September 5 through October 27, *Data in ug/m^3 at standard conditions.*

Date	Total Part.	As	Cd	Pb	Zn.
Sep. 5	17 <	< 0.01	< 0.01	0.18	0.56
Sep. 6	13 <	< 0.01	< 0.01	0.06	0.15
Sep. 7	19	0.01	< 0.01	0.23	0.54
Sep. 9	23	0.04	< 0.01	0.16	0.64
Sep. 10	41	0.05	< 0.01	0.18	0.57
Sep. 11	16	< 0.01	< 0.01	0.05	0.01
Sep. 12	8	< 0.01	< 0.01	0.02	0.03
Sep. 13	56	< 0.01	< 0.01	0.16	0.30
Sep. 15	27	< 0.01	< 0.01	0.03	0.09
Sep. 16	5	< 0.01	< 0.01	0.03	0.07
Sep. 18	7	< 0.01	< 0.01	0.06	0.25
Sep. 19	13	< 0.01	< 0.01	0.11	0.17
Sep. 20	18	< 0.01	< 0.01	0.20	0.42
Oct. 1	26	< 0.01	< 0.01	0.19	0.88
Oct. 4	11	< 0.01	< 0.01	< 0.01	-0.03
Oct. 5	12	0.02	< 0.01	< 0.01	0.02
Oct. 7	16	< 0.01	< 0.01	0.10	0.15
Oct. 10	15	0.01	< 0.01	0.02	0.01
Oct. 15	23	0.02	< 0.01	0.14	0.29
Oct. 17	31	0.04	< 0.01	0.14	0.36
Oct. 19	20	0.02	< 0.01	0.10	0.58
Oct. 20	20	< 0.01	< 0.01	0.07	0.41
Oct. 21	25	< 0.01	< 0.01	0.03	0.21
Oct. 22	28	< 0.01	< 0.01	0.05	0.28
Oct. 23	20	< 0.01	< 0.01	< 0.01	0.19
Oct. 24	14	< 0.01	0.02	0.06	0.19
Oct. 26	19	< 0.01	< 0.01	0.42	0.39
Oct 27	18	< 0.01	< 0.01	0.02	0.06
Average	**20**	**0.01**	**0.01**	**0.10**	**0.28**
Std. Deve.	**10**	**0.01**	**0.00**	**0.09**	**0.23**

Table 2: Bennetch 24-hour average TSP data from January 29 through April 29, 1998. Data in ug/m^3 at standard conditions.

Date	Total Part.	As	Cd	Pb	Zn.
Jan. 29	16	0.02	< 0.01	0.19	0.22
Feb. 4	12	0.01	< 0.01	0.29	0.30
Feb. 10	17	0.03	< 0.01	0.23	0.89
Feb.16	9	< 0.01	< 0.01	0.08	0.28
Feb. 22	7	< 0.01	< 0.01	0.07	0.15
Feb. 28	17	0.04	< 0.01	0.12	0.12
Mar. 6	11	< 0.01	< 0.01	< 0.01	0.03
Mar. 12	9	0.01	< 0.01	0.09	0.27
Mar. 18	10	< 0.01	< 0.01	0.3	0.10
Mar. 24	12	0.01	< 0.01	0.08	0.16
Mar. 30	10	< 0.01	< 0.01	< 0.01	0.07
Apr. 5	12	< 0.01	< 0.01	< 0.01	0.02
Apr. 11	7	< 0.01	< 0.01	0.03	0.05
Apr. 17	10	< 0.01	< 0.01	< 0.01	0.06
Apr. 23	22	0.03	< 0.01	0.14	0.36
Apr. 29	50	0.02	< 0.01	< 0.01	0.10
Average	**14**	**0.02**	**0.01**	**0.09**	**0.20**
Std. Deve.	**10**	**0.01**	**0.00**	**0.09**	**0.21**

Table 3: Sheep Creek 24-hour average PM-10 data from September 7 through October 7, 1997. Data in ug/m^3 at standard conditions.

Date	Total Part.	As	Cd	Pb	Zn.
Sep. 7	12	< 0.01	< 0.01	0.08	0.19
Sep. 13	8	< 0.01	< 0.01	0.07	0.10
Sep. 19	6	< 0.01	< 0.01	0.02	0.05
Sep. 25	31	< 0.01	< 0.01	0.12	0.27
Oct. 1	17	< 0.01	< 0.01	0.07	0.30
Oct. 7	9	< 0.01	< 0.01	0.06	0.08
Average	**14**	**0.01**	**0.01**	**0.07**	**0.17**
Std. Deve.	**9**	**0.00**	**0.00**	**0.03**	**0.10**

Table 4a: Northport Elementary School 24-hour average TSP data from January 11 through April 29,1998. Data in ug/m^3 at standard conditions.

Date	Total Part.	As	Cd	Pb	Zn.
Jan. 11	54	< 0.03	< 0.01	0.04	0.09
Feb. 4	32	< 0.03	0.01	0.28	0.31
Feb. 10	76	0.02	0.01	0.16	0.62
Feb. 22	16	< 0.03	< 0.01	< 0.01	0.03
Feb. 28	42	< 0.03	< 0.01	0.06	0.14
Mar. 6	44	< 0.01	< 0.01	0.02	0.04
Mar. 12	48	< 0.03	< 0.01	0.05	0.22
Mar. 18	58	< 0.03	< 0.01	0.03	0.16
Mar. 24	27	< 0.03	< 0.01	0.04	0.12
Mar. 30	50	< 0.03	< 0.01	0.02	0.05
Apr. 5	18	< 0.03	< 0.01	< 0.01	0.02
Apr. 11	20	< 0.03	< 0.01	0.02	0.07
Apr. 17	58	< 0.03	< 0.01	0.02	0.05
Apr. 29	121	< 0.03	< 0.01	0.04	0.11
Average	**47.43**	**0.03**	**0.01**	**0.06**	**0.15**
Std. Deve.	**28.47**	**0.00**	**0.00**	**0.07**	**0.16**

Table 4b: Sheep Creek 24-hour average TSP data from January 11 through April 29, 1998. Data in ug/m^3 at standard conditions.

Date	Total Part.	As	Cd	Pb	Zn.
Jan. 11	83	< 0.03	< 0.01	0.04	0.07
Feb. 4	15	< 0.03	0.01	0.28	0.31
Feb. 10	51	0.02	0.01	0.17	0.66
Feb. 22	9	< 0.03	< 0.01	0.01	0.03
Feb. 28	27	< 0.03	< 0.01	0.08	0.19
Mar. 6	20	< 0.01	< 0.01	0.02	0.04
Mar. 12	44	< 0.03	< 0.01	0.06	0.23
Mar. 18	11	< 0.03	< 0.01	0.03	0.14
Mar. 24	20	< 0.03	< 0.01	0.04	0.13
Mar. 30	21	< 0.03	< 0.01	0.01	0.04
Apr. 5	10	< 0.03	< 0.01	0.01	0.02
Apr. 11	11	< 0.03	< 0.01	0.01	0.05
Apr. 17	20	< 0.03	< 0.01	0.02	0.05
Apr. 29	101	< 0.03	< 0.01	0.04	0.12
Average	**31.64**	**0.03**	**0.01**	**0.06**	**0.15**
Std. Deve.	**28.59**	**0.00**	**0.00**	**0.07**	**0.16**

APPENDIX A - Comparison of Lead and Zinc Measurements Conducted at Two Sites in Northport, Washington

Introduction

In response to concerns over health effects of particulate emissions from the Cominco, Ltd. smelter, located approximately 20 miles up the Columbia River Valley north of Northport, monitoring of various metals in the vicinity of Northport was conducted. After the representativeness of data from one monitoring site, Sheep Creek, was questioned due to siting criteria, an additional site meeting siting criteria was established at Northport Elementary School. A study was conducted to compare both data sets. From January through April of 1998, fourteen twenty-four hour samples were concurrently obtained at each of these sites and analyzed for cadmium, arsenic, lead and zinc. Cadmium and arsenic concentrations were found to be either at or below their respective detection limits at both sites. Lead and zinc were above their detection limits in most of the samples. The purpose of this work is to determine whether site constraints at Sheep Creek resulted in statistically different lead and zinc concentrations from those measured at the Northport Elementary School site.

The approaches employed were exploratory data analysis and computation of p-values for the mean difference, the difference of medians, and the ratio of variances of the two data sets through non-parametric re-randomizations. The approaches are described below.

Exploratory Data Analysis

Figures 1-3 and visual inspection of the data (Table 1) show that the data sets are very similar. Several pairs of data are identical. The interquartile range (in ug/m^3) for lead is 0.01-0.06 at Sheep Creek and 0.02-0.05 at Northport Elementary. The interquartile range for zinc is 0.040.19 at Sheep Creek and 0.05-0.16 at Northport Elementary. Two data points below the detection limit for lead were treated as half of the detection limit (0.005 ug/m^3).

Figure 1 illustrates the distributions of the four data sets. The median for lead in micrograms per cubic meter is 0.035 at both sites, and the difference of the mean of the Sheep Creek data and the mean of the Northport Elementary data (0.0021 ug/m^3) is below the detection limit. The medians for the zinc data are 0.105 and 0.09 ug/m^3 at Sheep Creek and Northport Elementary, respectively. The difference of the means for zinc between the two sites is 0.005 ug/m^3. The zinc data exhibit larger spread than the lead data, and the Sheep creek data exhibit slightly more variability than the Northport Elementary data.

Figure 2 shows only nine points because the remaining five data points are identical to others that were plotted. Similarly, Figure 3 shows only thirteen points since two pairs share the same coordinates. It is evident from inspecting Figures 2 and 3 that both data sets are highly

correlated. The correlation coefficient for lead measurements at the two sites is 0.995, and for zinc it is 0.994.

Non-parametric Resampling

In the approach utilized, one formulates a null hypothesis and an alternate hypothesis. In this case, the null hypothesis is that both sites are measuring the same air mass, and thus should report values that are the essentially the same. Any variability between the values observed at the two sites would have to be explained by the inherent variability of the measurement methodology. The alternate hypothesis is that the observed measurements at the sites are indeed different because the metal particulate loading of the air masses at each of the sites is different.

Non-parametric re-randomization was conducted to obtain the p-values for the chosen test statistics. Resampling Stats software was used to compute the p-values of interest.

Three statistics were chosen: the mean difference and the difference of medians (measures of differences in location) and the ratio of variances (a measure of differences in spread). The p-value for these statistics is the probability, under the null hypothesis, of obtaining values for the statistics at least as favorable to the alternate hypothesis as the observed values. Thus, if the null hypothesis is supported, the slight differences observed between the spread, and location of the data from the two sites can be explained by variations that randomly occur within one data set. If the alternate hypothesis is supported, the differences are significant, and indicative of two different data sets. The p-value is a measure of the support for one or the other hypothesis. Typically, when p-values are larger than 0.05 or 0.10 the alternate hypothesis is rejected.

Results and Conclusion

The observed statistics and the results of the non-parametric analysis are summarized below:

	Lead	Zinc
Mean Difference	0.0002	0.005
Difference of medians	0	0.15
Ratio of Variances	1.04	1.15
p-value for mean differences	0.54	0.50
p-value for difference of medians	0.92	0.25
p-value for ratio of variances	0.38	0.17

The p-values for both lead and zinc are high, and thus do not support the alternate hypothesis. During the fourteen days when monitoring was conducted, there is no significant difference between measurements conducted at Sheep Creek and Northport. The lowest p-value is 0.17, and corresponds to the ratio of variances. Through exploratory analysis the observation was previously made that the zinc values at Sheep Creek exhibited slightly higher variability than that found in the other data.

The results of this analysis show that, even though the Sheep Creek site does not meet EPA/State particulate monitor siting criteria, for this data set the site constraints do not result in statistically different values from that of a nearby site meeting criteria.

Distributions of Lead (Pb) and Zinc (Zn) in ug/m3 at Two Sites in Northport

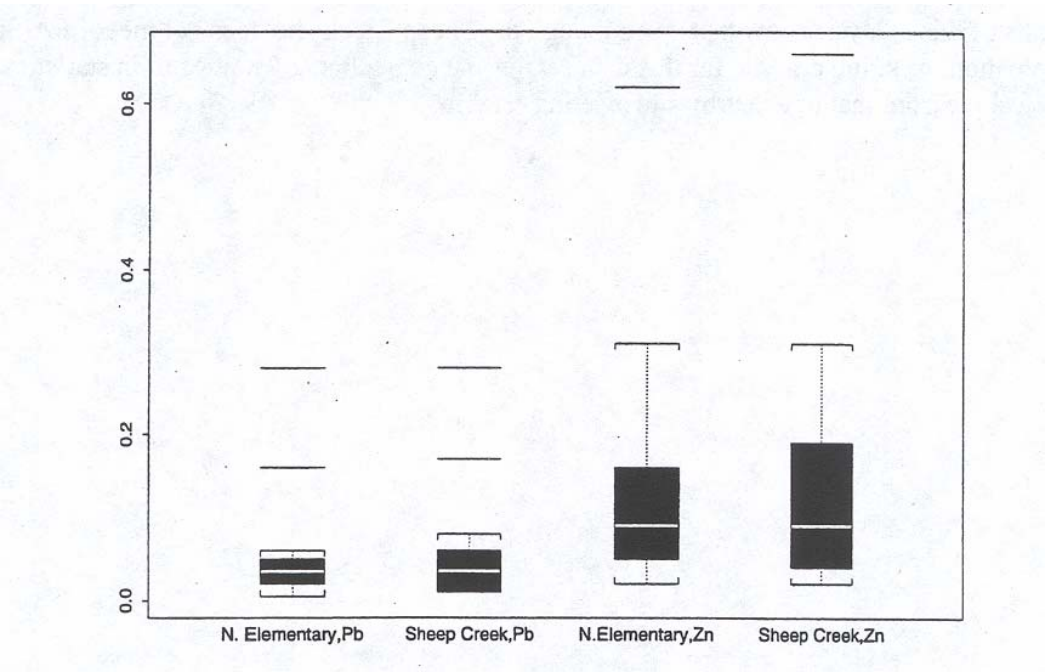

Figure 1. Boxplot of Lead and Zinc Measurements

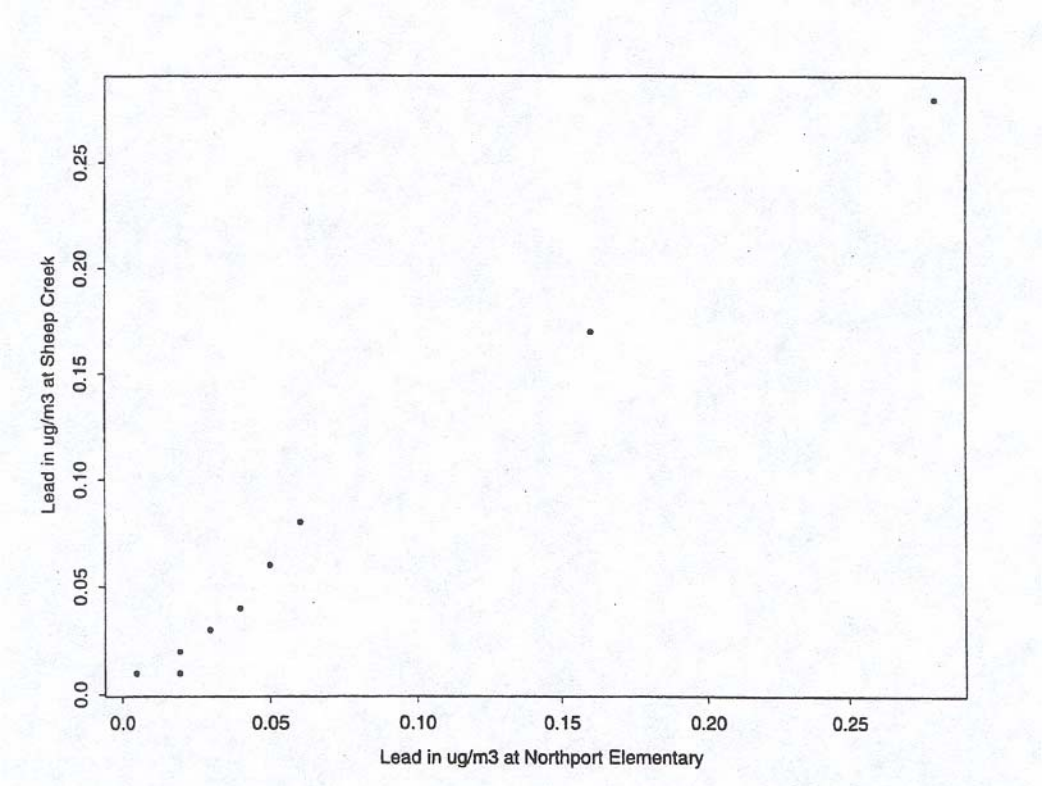

Figure 2. Q-Q Plot of Lead Measurements

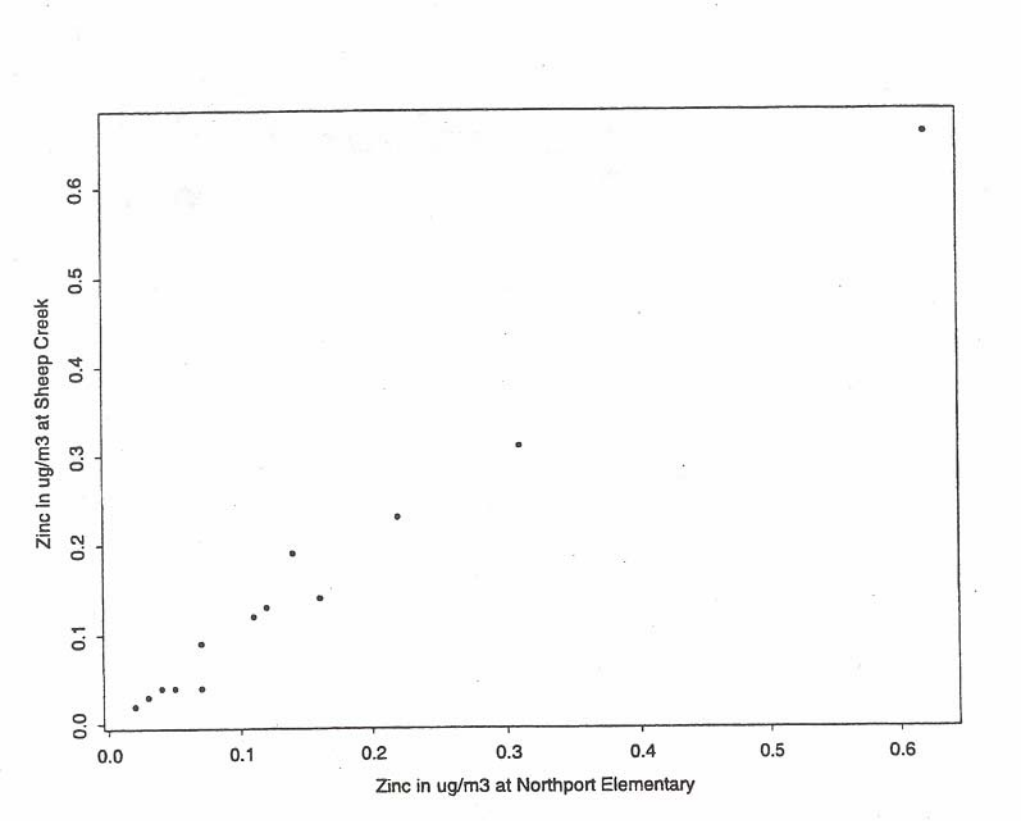

Figure 3. Q-Q Plot of Zinc Measurements

Northport Study Date	SCR, Lead ug/m3	NES, Lead ug/m3	SCR, Zinc UG/M3	NES, Zinc UG/m3
1/11/90	0.04	0.04	0.09	0.07
2/4/98	0.28	0.28	0.31	0.31
2/10/98	0.17	0.16	0.66	0.62
2/22/98	0.01	0.005	0.03	0.03
2/28/98	0.08	0.06	0.19	0.14
3/6/98	0.02	0.02	0.04	0.04
3/12/98	0.06	0.05	0.23	0.22
3/18/98	0.03	0.03	0.14	0.16
3/24/98	0.04	0.04	0.13	0.12
3/30/98	0.01	0.02	0.04	0.05
4/5/98	0.01	0.005	0.02	0.02
4/11/98	0.0	0.02	0.04	0.07
4/17/98	0.01	0.02	0.04	0.07
4/29/98	0.4	0.04	0.12	0.11

SCR = Sheep Creek Site
NES Northport Elementary School

Table 1. Lead and Zinc Data from Two Sites in Northport