AIR PARTICULATE AND NOISE LEVEL MONITORING PROGRAM

AIRPORT CONSTRUCTION SITE

MOEN ISLAND, TRUK

TRUST TERRITORY OF THE PACIFIC ISLANDS

PART B

CONSTRUCTION

By

William J. Zolan
Russell N. Clayshulte
Stephen J. Winter

UNIVERSITY OF GUAM

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INTRODUCTION

The runway at the Truk International Airport on Moen Island is being lengthened and widened to provide capability for supporting existing and forecast air transportation requirements and for handling medium range jet aircraft without operating restrictions or safety hazards.

This study of air particulate and noise levels was requested by the U. S. Navy in accordance with Amendment No. 3 to Contract No. N62742-78-C-0029, Part B. It is a portion of the second part of a three part monitoring program that consists of:

1. Part A. Pre-Construction Monitoring Program
2. Part B. Construction Monitoring Program
3. Part C. Post-Construction Monitoring Program

Each of these parts is further divided into water, air, noise, and biological monitoring programs. The water, air, and noise monitoring programs are being undertaken by the Water and Energy Research Institute; the biological monitoring program is being undertaken by the University of Guam Marine Laboratory.

OBJECTIVES

The objectives of this study are to determine air particulate and noise levels at selected sites in the airport construction area and to make recommendations for alleviation of adverse conditions.

SCOPE

In order to accomplish the objectives of this study, the Water and Energy Research Institute was directed to:

1. Using the same two air sampling stations and methodology as Part A (pre-construction) of the monitoring program, perform continuous 24-hour sampling for air particulates at each station for three days.
2. Using the methodology as Part A of the monitoring program, collect noise data for 24 hours at each of the following stations:
    a. The three noise monitoring stations established during Part A.

b. One new noise monitoring station in the Mechitiu Village area.

The noise measurements shall be taken on a workday.

3. Compile and summarize the air and noise data using statistical methods when applicable. Compare the data against the baseline established during Part A of the monitoring program.

4. Provide recommendations to reduce excessive air and noise emissions from airport construction activities.

METHODS

Noise Monitoring

The equipment and procedures used in the noise survey were exactly the same as used in the preconstruction survey of June 1978 (Clayshulte, Zolan, and Winter, 1979).* The same three monitoring stations (Weather Station, Mechitiu Quarry, and Pou Bay Causeway) and their respective microphone locations and directions were used as in the June 1978 survey.

Due to complaints about noise, an additional station for a 24-hour survey was selected in Mechitiu Village. This new site was located inland of the village road in the front yard of a home adjacent to a small store and laundromat. Figure 1 shows the approximate location of the site. This site was selected because it had a relatively unobstructed line of sight to the slurry pipeline and the immediate vicinity of the microphone was relatively free from structures and vegetation. Across the road from the site was a single house which was situated between the microphone and pipeline. The line of sight was unobstructed to the west of the house (the direction in which the microphone was pointed was due north). To the east of the house the line of sight to the pipeline was unobstructed for approximately 50 meters until houses and trees began intervening between the pipeline and the microphone. All noise monitoring procedures used at the Mechitiu Village station were the same as those used in the monitoring of the other three sites.

Air Monitoring

Air quality was monitored at the Weather Station and across from Mechitiu Quarry for four 24 hour periods. Three of the 24 hour periods covered work days: Thursday, Friday, and Saturday.

*Copies of this report are available from the Water and Energy Research Institute, University of Guam, UOG Station, Mangilao, Guam 96913.

Sunday completed the remaining monitoring period. The daily data (excluding Sunday) were used to compute a geometric mean for each site. The same high volume air samplers and methods were used in calculating weight of suspended matter per cubic meter air as were used in the June 1978 survey.

RESULTS

Noise Monitoring

Weather Station

The Weather Station noise monitoring station was significantly more noisy during the day than at night with a mean sound pressure level of 59.2 dB(A) during the day versus 47.9 dB(A) at night (Table 1). This differential is due to the work activity inside the Maeda Construction Camp including the running of generators and motors almost constantly during working hours. The large amount of heavy vehicular traffic leaving and entering the camp also contributes significantly to the background and peak intermittent sound levels. Figure 2 shows how the sound levels at the Weather Station site reflect daily work activity. Work starts at 0600. At 1130, there is a lunch break. Noise levels rise again to morning levels in the early afternoon. Work continues until 12 midnight after which sound levels drop approximately 10 dB(A) to 42-45 dB(A). Generator noise is the main factor in maintaining the higher background sound level.

Table 2 shows the peak activity sound levels for various activities common to this study site. A plane taxiing to the terminal area produced the greatest sound level pressure at 106.8 dB(A).

Work inside the construction camp and heavy equipment operation inside and outside the camp produced peak intermittent sound levels of 88 to 94.5 dB(A). The Ldn of 58.1 dB(A) was calculated by adding 10 dB(A) to sound pressure level readings from 2100 to 0500 and averaging them with the mean sound level readings from 0530 to 2030.

Mechitiu Quarry

The Quarry noise monitoring station followed the same pattern as the Weather Station location with elevated sound levels during working hours. Also, the levels were higher than the sound levels measured in the Part A survey (Table 1). As was true at the Weather Station, sound levels have risen about 10 dB(A) during daylight hours and 4 dB(A) during evening hours since June 1978.

Figure 3 shows how daily work activities influence the sound levels. The pattern is similar to that observed at the Weather Station except that, due to continuous slurry pipe operation, the large drop in background noise levels after 12 midnight is not observed. The background noise drops, but only to 55 to 60 dB(A). High background sound levels occur when the rock crushing plant is operating, producing background sound pressure level readings of 70 to 77 dB(A) at the monitoring site. Other quarry operations and equipment engines accounted for peak intermittent sound levels of 86.3 to 96.2 dB(A) (Table 2). The Continental Airline B-727 take off produced the greatest peak intermittent sound pressure level of 109.8 dB(A). The Ldn was 65.0 dB(A) reflecting the impact of the almost continuous slurry pipe operation during night hours.

Pou Bay Causeway

The Pou Bay noise monitoring site also had noise levels higher than those measured during Part A for both day time and night time hours. The increases were less than at the other study sites (Table 2). Daytime sound pressure level readings were lower at the Pou Bay site [mean of 49.7 dB(A)] than at any other site. However the Weather Station had quieter nights than Pou Bay: 47.8 versus 51.0 dB(A).

The primary background sound at Pou Bay is generated by waves breaking on the rocks of the boat landing. The higher values recorded during the June 1979 sampling period are due to the additional sound produced from the suction dredge and pipeline at the other end of the causeway. Figure 4 shows the noise data for Pou Bay plotted versus time of day. The overall range of half hour mean background sound [44.2 to 51.1 dB(A)] is much narrower than that occurring at the other sites.

As in the June 1978 survey, the production of peak intermittent sounds at Pou Bay during the 1979 survey was due to boat docking and passenger unloading at the dock and Tunuk Village activities such as hammering and church bell tolling (Table 2). The suction dredge and pipeline produced peak sound levels of 70 dB(A) or slightly above this figure [highest recorded: 72 dB(A)]. However, most peak intermittent sound from the construction activities at the other end of the causeway produced peak sounds below 65 dB(A). Most half hour peak sounds at this station were produced by boating activity, wave action on the dock, or by persons talking in the area. The Ldn of the Pou Bay site was 54.1 dB(A), 6.0 dB(A) higher than recorded for June 1978.

Mechitiu Village

The Mechitiu noise monitoring station (which was not monitored in the June 1978 survey) is notable for its almost

continuously high background sound level which is produced by the slurry pipeline extending along shore adjacent to the village. The mean sound level for the 24 hour monitoring period was 67.0 dB(A). Daylight hours (0600 to 1730) had a lower mean [65.8 dB(A)] than night hours [68.3 dB(A)] although a test for statistical significance (anova, $p<.05$) revealed no significant difference between night time and daytime sound levels. Figure 5 shows that there is no day/night pattern to the noise level here in contrast to the other sites. The pipeline was frequently (at least seven times/24 hours) turned off or reduced in flow during the 24 hour a day operation but these periods usually lasted no more than 5 to 15 minutes. The longest break came at 8 a.m. when a full half hour of background sound level readings was obtained without pipeline noise. The mean sound level for this half hour was 51.9 dB(A). This indicates that the pipeline operation raises the noise levels 15 to 21 dB(A).

The 166 slow response readings of background sound levels are plotted on probability paper (Figure 6) to show the geometric mean [67 dB(A)] and L_{90} level. The L_{90} level [60 dB(A)] is that sound level which was exceeded 90% of the time. The L_{10} level was 71.5 dB(A) which indicates that the sound level was 71.5 dB or more for 10% of the time. The Ldn for Mechitiu Village was 70.8 dB(A).

The peak sound levels averaged 88.2 dB(A) during the 24 hour period. Table 1 shows that there was essentially no difference in the level of peak sound during the night versus during the day. The pipeline accounted for seven of the peak sound readings. Other notable peak sound producers were plane noise [93 dB(A)], motorbikes [90 to 93 dB(A)], dogs barking [89.8 dB(A)], and dump trucks [89.2 dB(A)]. Other common peak sounds are listed in Table 3.

The frequency of peak sound of 80 dB(A) was almost continuous. When the sound meter was set at peak hold and the needle reset button released, the needle immediately jumped to 80 dB(A) or higher when the pipeline was running at typical operating velocity. The range of peak noise generated by the pipeline under typical operating conditions was 80 to 89.9 dB(A).

Several persons commented to the monitors that noise from the pipeline is disturbing. The noise is apparently more disturbing at night when it keeps children and babies from falling asleep or wakes them up. It should also be pointed out that the sound level meter was set up across the road from the pipeline. Many villagers live along the opposite side of the road, closer to the pipeline (about 15 to 20 meters closer). The sound levels in the open areas between these houses or in back of their homes are probably higher than those recorded in this survey. Unfortunately, the scope of work did not involve the monitoring of noises inside homes or at several locales within the village. However, it is felt that the sound level readings obtained in this survey are fairly characteristic of those levels being experienced outside the home

throughout most of the village.

Table 4 presents weather measurements (courtesy of the Truk Weather Station) taken during the monitoring period. Tables 5 through 8 present the noise monitoring data accumulated for each station.

Air Monitoring

On the basis of the three construction work days and one off day sampled for air particulates, it appears that the concentration of air particulates has roughly doubled since the June 1978 sampling period. Table 9 shows the daily 24 hour air particulate concentrations and geometric mean concentrations for the three work days. The geometric means, 36.4 $\mu g/m^3$ for the Weather Station and 29.8 $\mu g/m^3$ for the Mechitiu Quarry site, are roughly double the previously observed concentrations. The lack of rainfall on the last two days of the monitoring period is believed to have caused the rise in air particulate concentration at the Weather Station. A similar rise was observed in the June 1978 sampling when there was zero rainfall for 24 hours preceding the sampling date.

RECOMMENDATIONS

Noise Levels

Although noise levels have increased significantly at the Weather Station and Mechitiu Quarry, they are not considered to be objectionable. However, it is recommended that noise levels in these areas not be permitted to increase further. The night time noise levels in Mechitiu Village produced by the slurry pipeline are considered to be objectionable. (It is indicated in *Public Health and Welfare Criteria for Noise (1973)* that a Ldn of 70 dB(A) is considered annoying by almost 50% of the persons subject to the noise.) It is recommended that measures be taken to reduce noise levels in this area for at least 8 hours per night. Three suggestions are made:

1. reduce or stop flow through the pipeline

2. insulate or shield the pipeline

3. move the pipeline further from shore [doubling the distance between the sound source and the listener decreases the sound level by 6 dB(A) in an open field situation (Bragdon, 1971)].

If future noise monitoring takes place, it would be useful to add another station in Iras Village.

Air Particulate Levels

Air particulate levels have roughly doubled since pre-construction monitoring has taken place. It has been noted that the highest levels of air particulates occur following a period of at least 24 hours with no rain. It is therefore recommended that roads adjacent to and within the vicinity of the construction area be sprinkled with water as soon as they become dry.

The Trust Territory of the Pacific Islands currently has no air quality standards. The air quality standard for particulate matter in the Territory of Guam is a maximum 24-hour concentration of 150 micrograms/m^3 (GEPA, 1973). This standard is the same as the existing National Secondary Ambient Air Quality Standards.

ACKNOWLEDGMENTS

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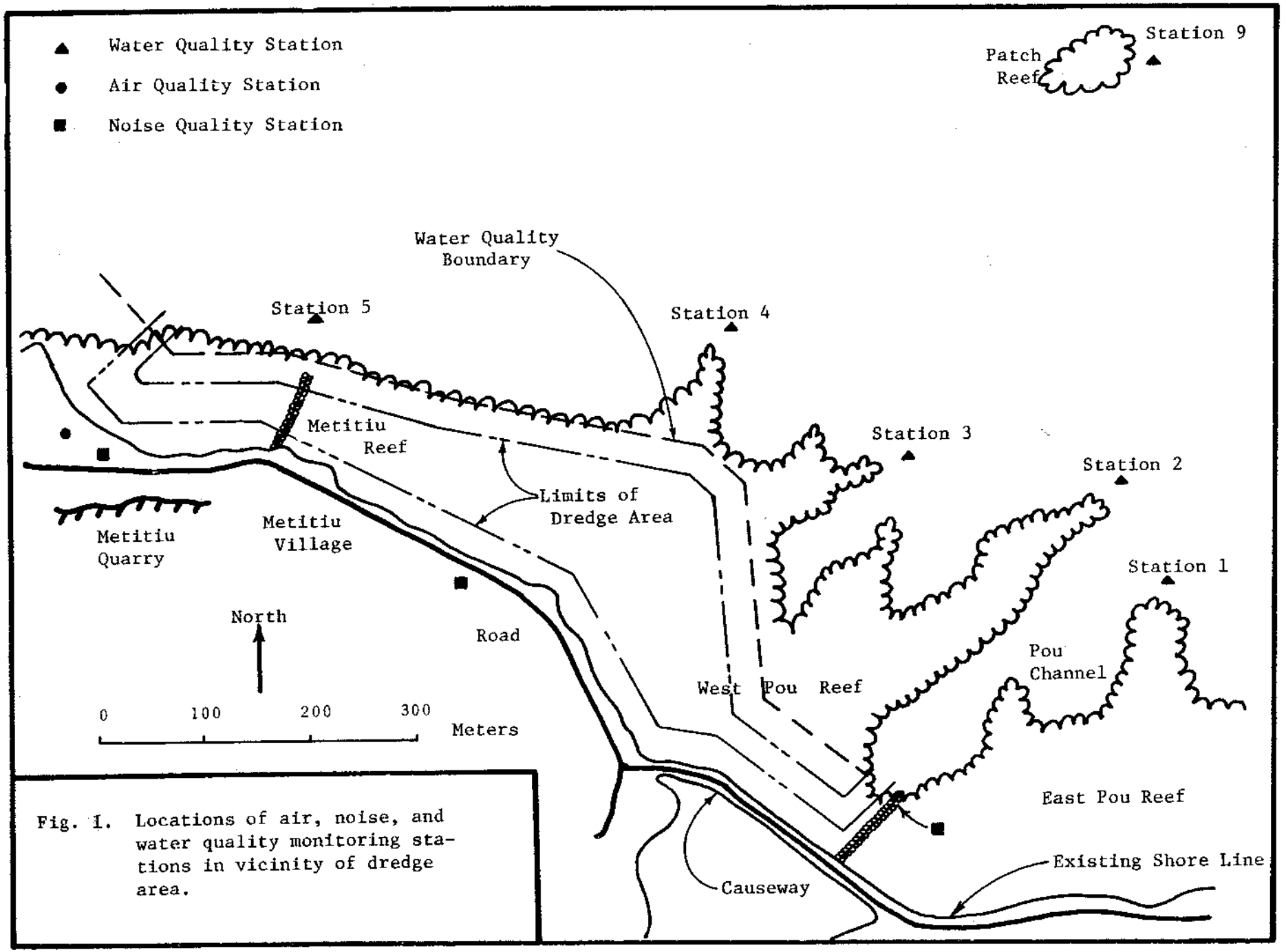

Fig. 1. Locations of air, noise, and water quality monitoring stations in vicinity of dredge area.

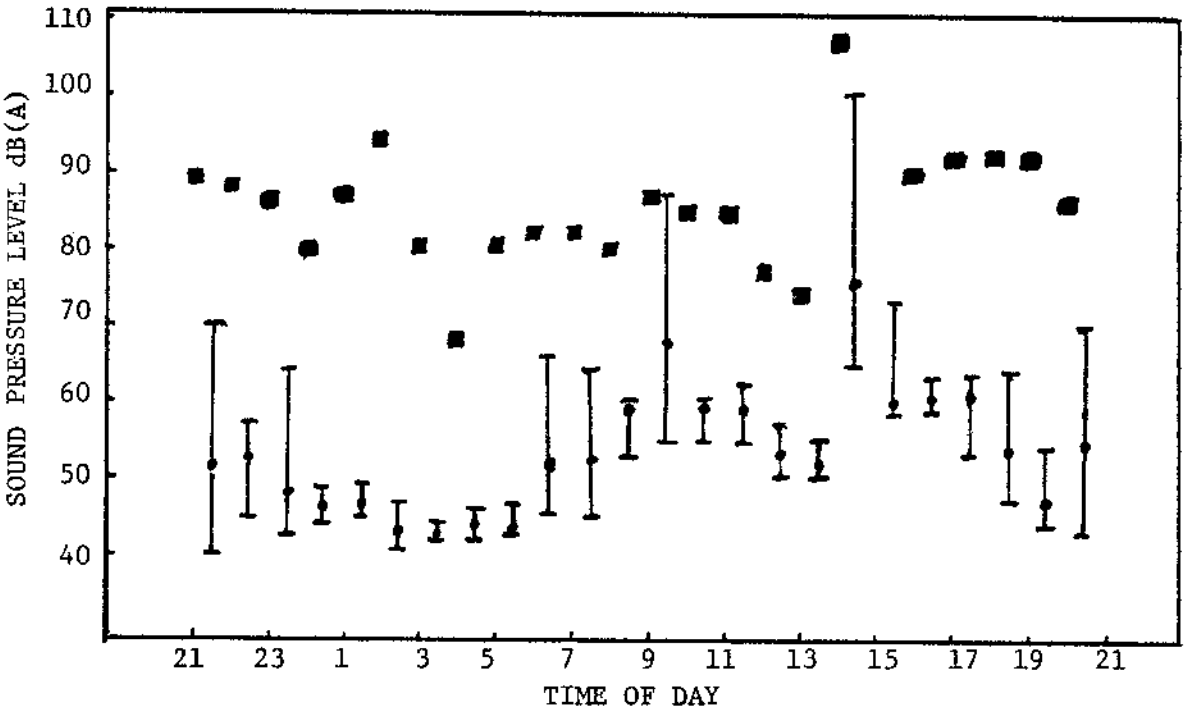

Fig. 2. Half hour mean sound pressure levels (•) and half hour peak noise levels (■) on the grounds of the Truk weather station. The background sound pressure readings (taken every five minutes) were A weighted with the sound meter on slow response.

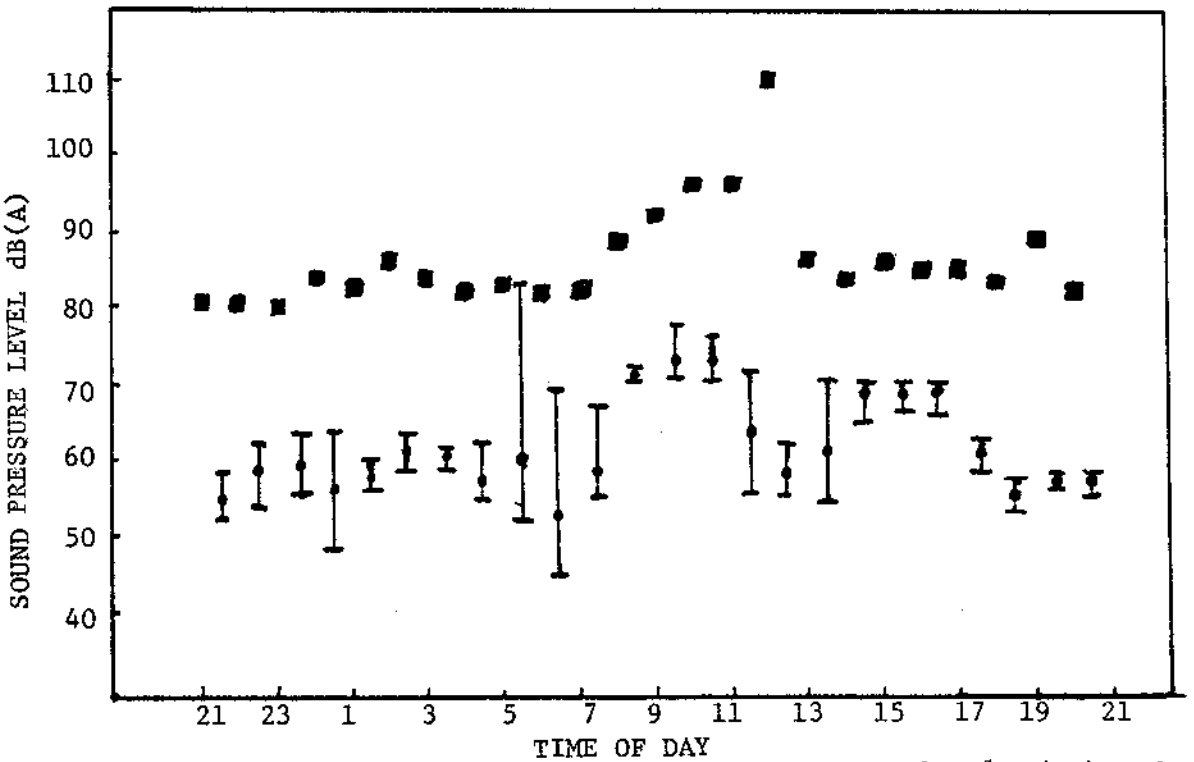

Fig. 3. Half hour mean background sound pressure levels (•) and peak sound levels (■) across from Mechitiu Quarry. The background sound pressure readings (taken every five minutes) were A weighted with the sound meter on slow response.

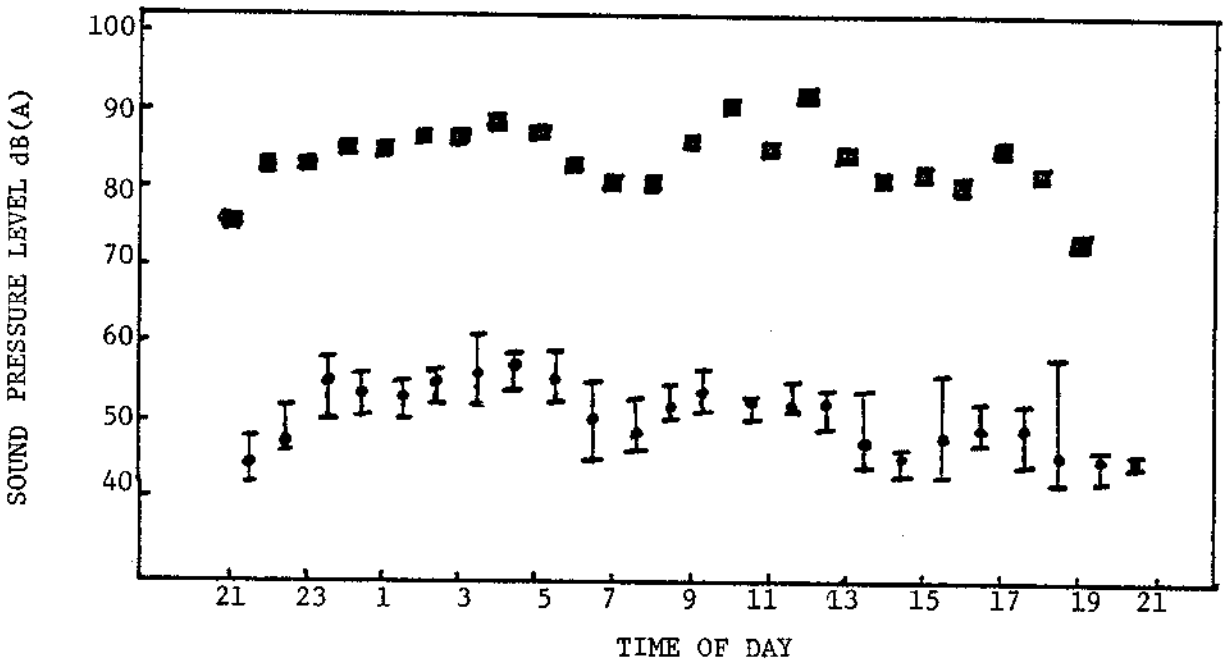

Fig. 4. Half hour mean sound pressure levels (●) and half hour peak sound levels (■) at Pou Bay Causeway. The background sound pressure readings (taken every five minutes) were A weighted with the sound meter on slow response.

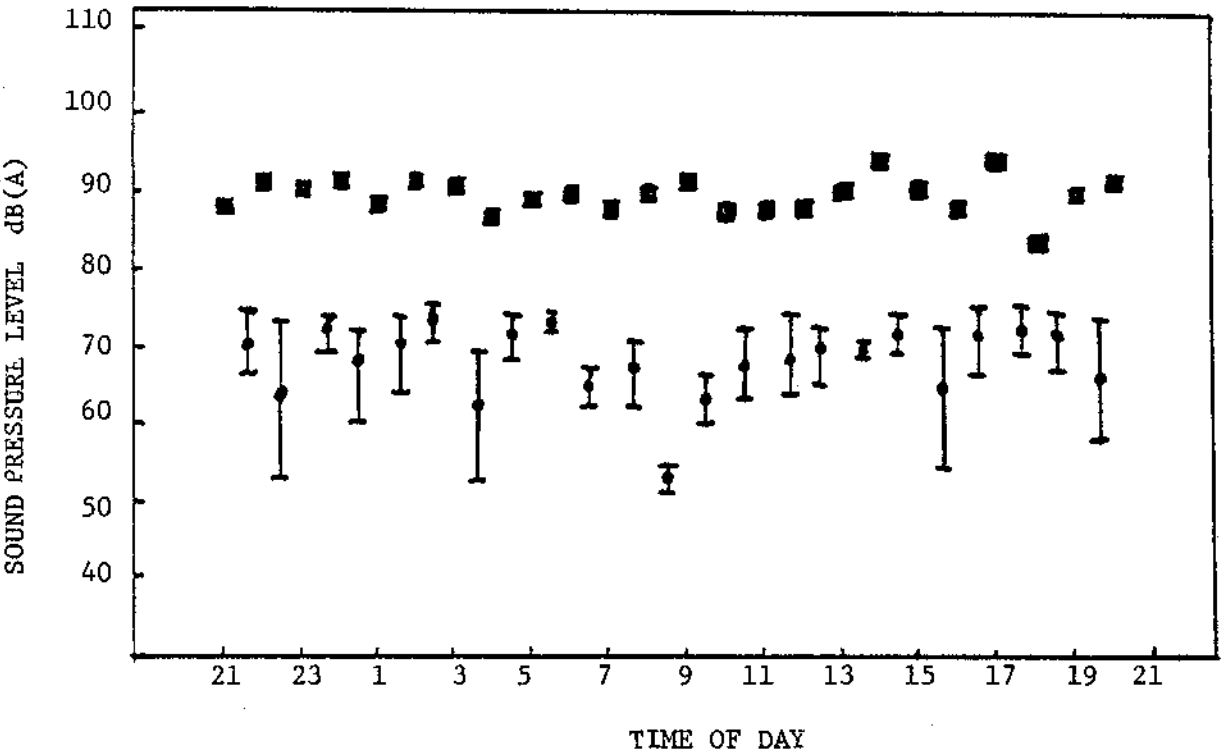

Fig. 5. Half hour mean background sound levels pressure (●) and peak sound levels (■) at Mechitiu Village. The background sound pressure readings (taken every five minutes) were A weighted with the sound meter on slow response.

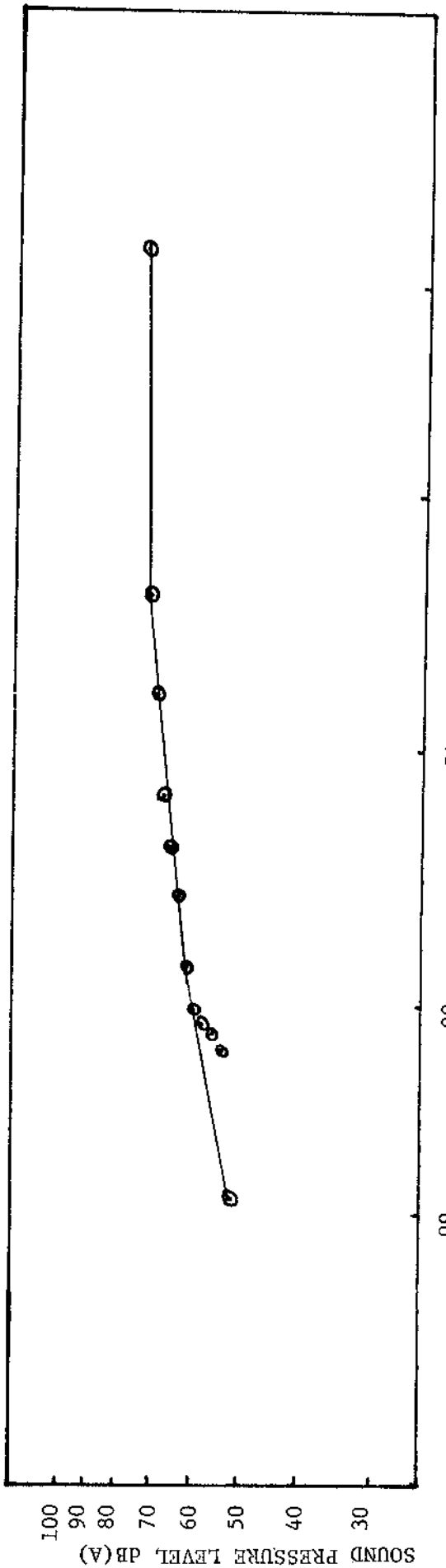

Fig. 6. The plot of the 166 slow response sound pressure level readings (which indicate background sound) at Mechitiu Village. The background sound L_{90}, L_{50}, and L_{10} levels are 60 dB(A), 67 dB(A), and 71.5 dB(A) respectively. The L_{50} level indicates the sound pressure level which is exceeded 50% of time.

Table 1. Mean background sound levels and mean peak sound levels comparing day versus night hours. Daytime is from 0600 to 1730. Night time is from 1800 to 0530. Lower half of Table contains June 1978 mean sound levels.

SITE	PERIOD	MEAN BACKGROUND SOUND LEVEL [dB(A)]	MEAN PEAK SOUND LEVEL [dB(A)]
		June 1979	
#1 - Airport	Day	59.2 ± 6.9	86.5 ± 9.0
	Night	47.8 ± 4.3	84.6 ± 6.9
#2 - Quarry	Day	64.8 ± 6.7	88.8 ± 6.8
	Night	57.8 ± 2.0	82.9 ± 2.6
#3 - Pou Bay	Day	49.7 ± 2.5	83.9 ± 4.0
	Night	51.0 ± 5.1	82.8 ± 4.9
#4 - Mechitiu	Day	65.8 ± 5.2	88.0 ± 3.1
	Night	68.3 ± 3.5	88.5 ± 1.5
		June 1978	
#1 - Airport	Day	46.6 ± 7.4	69.6 ± 15.2
	Night	42.4 ± 1.8	74.0 ± 4.7
#2 - Quarry	Day	54.9 ± 6.2	74.1 + 8.8
	Night	53.2 + 3.8	79.2 ± 4.3
#3 - Pou Bay	Day	41.8 ± 3.7	66.3 ± 19.3
	Night	47.6 ± 9.4	79.6 ± 6.4

Table 2. Activity peak noise levels, background noise levels, and Ldn values for the Weather Station, Mechitiu Quarry, and Pou Bay noise monitoring stations.

WEATHER STATION

	dB(A)
Plane taxing to terminal	106.8
Hammering to change tire, construction camp	94.5
Bulldozer leaving camp	92.5
Large Dump Truck, leaving camp	92.0
Roller leaving camp	92.0
Motorcycle passing	90.0
MCC Dump Truck (muffler defective)	90.0
Payloader leaving construction camp	88.0
Work whistle	86.0
Van passing on access road	80.0
Workers yelling at camp	80.0
Dump Truck (muffler intact)	78.0
Scrapper leaving camp	73.0
Dog barking	72.0
Generator operating at camp	59.0
Mean background sound level 600 a.m. - 530 p.m.	59.2
Mean background sound level 600 p.m. - 530 a.m.	47.8
Mean peak sound level for 24 hours	85.8
Minimum sound level	41.5
Ldn	58.1
Ldn, June 1978	48.7

MECHITIU QUARRY

	dB(A)
Plane taking off from airport	109.8
Rock crusher conveyor belt engine	96.3
Dump Truck (Maeda) horn	96.3
Rock crusher operations	94.0
Bulldozer at quarry	89.3
Payloader operating at quarry	87.0
Drilling operations at quarry	86.3
Dogs Barking	84.5
Small dozer on village road	84.0
Truck door slam	84.0
Motorcycle	82.2
Taxi (car) passing on road	82.2
Bird chirp	72.0
Mean background sound level 600 a.m. - 530 p.m.	64.8
Mean background sound level 600 p.m. - 530 a.m.	47.8
Mean peak sound level for 24 hours	85.8
Minimum sound level	44.5
Ldn	65.0
Ldn June 1978	58.1

POU BAY

	dB(A)
Dog barking, close (20 ft. away)	97.8
Small boat leaving dock	92.3
Plane taking off from airport	91.8
Heavy hammering in Tunuk village	90.5
Gusting wind and wave action	87.4
Small waves but little or no wind	79.0
Church bell in Tunuk	74.0
Suction dredge and pipeline noise	72.0
Dog barking in Tunuk	71.8
Mean background sound level 600 a.m. - 530 p.m.	49.7
Mean background sound level 600 p.m. - 530 a.m.	51.0
Mean peak sound level for 24 hours	83.4
Minimum noise level	42.0
Ldn	54.1
Ldn, June 1978	48.1

Table 3. Activity peak noise levels, background noise levels, and Ldn value for the Mechitiu Village noise monitoring station.

MECHITIU VILLAGE

	dB(A)
Plane taking off from airport	93.0
Motorbike on road	93.0
Police motorbike on road	90.0
Slurry pipeline	89.8
Dog barking	89.8
Dump Truck (Maeda) accelerating	89.2
Stereo playing ("Loud") in nearby house	89.0
Car door slam	88.5
Kids whistling to car from roadside	88.2
Pickup on road (defective muffler)	88.0
Pickup horn	86.5
Rooster crow	82.0
Dump Truck (Maeda), slow and not accelerating	71.0
Mean background sound level 600 a.m. - 530 p.m.	65.8
Mean background sound level 600 p.m. - 530 a.m.	68.3
Mean peak sound level for 24 hours	88.2
Minimum noise level	50.5
Ldn	70.8

Table 4. Average wind direction and speed, air temperature, barometric pressure, total percipitation, and total sunshine for May 29 to June 7, 1979. Wind ranges are read in clockwise direction.

Date	WIND				AIR TEMPERATURE		BAROMETRIC PRESSURE		RAIN	SUNSHINE
	Compass Direction	Range	Speed (kts)	Range	Mean (°C)	Range	Pressure (in Hg.)	Range	Total 24 hr(in)	Total 24 hr (min)
1979										
May 29	11 ± 03	04-12	7.1±3.2	00-12	27.5	24.6-30.4	29.856	.820-.890	0.48	77
May 30	9 ± 03	01-15	6.2±2.3	03-11	27.8	25.4-29.4	29.837	.795-.890	0.11	70
May 31	12 ± 03	08-14	6.1±4.2	00.17	27.9	25.3-30.0	29.824	.795-.865	0.12	61
June 1	8 ± 03	06-12	5.2±2.6	00-11	27.0	25.6-29.9	29.841	.805-.890	0.52	148
June 2	7.6± 03	03-12	7.8±1.8	05-11	28.4	27.1-30.3	29.843	.805-.890	0.00	139
June 3	6.4± 02	02-10	7.7±1.7	04-11	28.4	27.2-30.0	29.853	.810-.895	0.00	255
June 4	6.9± 02	04-12	8.9±2.7	04-16	28.0	27.8-30.1	29.816	.780-.880	0.23	0
June 5	8.1± 04	00-14	8.6±2.9	05-15	28.1	26.1-30.0	29.817	.765-.865	0.04	73
June 6	8.7± 03	03-13	6.7±2.4	03-11	28.1	26.7-30-6	29.829	.795-.850	0.07	112
June 7	7 ± 03*	04-13	7.2±2.8	04-11	28.1	27.0-30.0	29.807	.770-.835	TR.	23

*Calculations are based on one half day.

Table 5. Sound levels recorded at the Weather Station in dB(A) from 0800 May 29, 1979 to 0800 May 30, 1979.

Time Period	No. of Samples	Mean	Standard Deviation	Range	Peak Sound Level
5/29/79:					
0800-0830	7	59.0	2.6	53-60	
0830-0900					87.5
0900-0930	6	67.7	11.1	55-87.5	
0930-1000					85.5
1000-1030	6	58.8	2.0	55-60	
1030-1100					85.0
1100-1130	6	58.8	2.3	55-62	
1130-1200					77.0
1200-1230	6	53.3	2.4	50-57	
1230-1300					74.0
1300-1330	6	52.1	2.0	50-55	
1330-1400					106.8
1400-1430	6	75.8	12.2	65-100	
1430-1500					-- Rain
1500-1530	4	59.7	2.1	58-62.8	
1530-1600					89.5
1600-1630	4	60.7	1.8	58.8-63	
1630-1700					92.0
1700-1730	7	60.1	3.4	53-63.5	
1730-1800					92.5
1800-1830	7	53.9	5.5	47-64	
1830-1900					92.0
1900-1930	7	46.9	3.6	44.54	
1930-2000					86.0
2000-2030	7	54.6	10.5	43-70	
2030-2100					89.4
2100-2130	6	51.7	12.4	43-70	
2130-2200					88.0
2200-2230	6	52.5	5.8	45-57	
2230-2300					86.0
2300-2330	7	48.1	7.3	43-64	
2330-2400					80.0
5/29/79:					
2400-0030	7	46.1	1.6	44-48.5	
0030-0100					87.8
0100-0130	7	47.9	1.5	44.6-49	
0130-0200					94.5
0200-0230	7	42.9	1.6	41.5-46	
0230-0300					80.6
0300-0330	7	42.9	1.1	42-44	
0330-0400					68.2
0400-0430	7	44.1	1.6	42-46	
0430-0500					81.0
0500-0530	7	43.9	1.1	43-46	
0530-0600					82.0
0600-0630	7	52.2	6.9	45.5-66	
0630-0700					82.0
0700-0730	7	52.4	8.5	45-64	
0730-0800					80.0
		$\overline{51.6} \pm 12.7$			

Table 6. Sound levels recorded across from the Mechitiu Quarry in dB(A) from 0900 to 1630 May 30, 1979 and from 0900 June 4 to 0845 June 5, 1979.

Time Period	No. of Samples	Mean	Standard Deviation	Range	Peak Sound Level June 4	Peak Sound Level May 30
6/4/79:						
0900-0930	13	73.5	2.5	70.5-77.5		
0930-1000					96.3	95.9
1000-1030	13	73.0	2.5	70-76		
1030-1100					96.3	83.0
1100-1130	7	63.6	7.7	55.5-71.0		
1130-1200					109.8	90.6
1200-1230	11	58.1	3.0	55-62		
1230-1300					86.2	81.0
1300-1330	13	60.6	5.9	54-69.7		
1330-1400					83.5	85.0
1400-1430	13	68.5	1.6	66-70		
1430-1500					85.0	88.0
1500-1530	13	68.6	1.2	67-70		
1530-1600					85.0	--
1600-1630	13	68.6	1.2	67-70		
1630-1700					85.2	--
1700-1730	7	60.6	2.1	58-62.5		
1730-1800					84.0	--
1800-1830	4	55.4	2.0	53-57.5		
1830-1900					89.0	--
1900-1930	4	57.0	0.4	56.4-57.5		
1930-2000					82.0	--
2000-2030	7	57.0	1.2	55-58		
2030-2100					80.2	--
2100-2130	7	54.7	2.8	52-58.4		
2130-2200					80.0	--
2200-2230	7	58.7	3.0	54-62		
2230-2300					80.5	--
2300-2330	7	59.5	2.2	55.5-63		
2330-2400					83.5	--
6/5/79:						
2400-0030	7	55.9	5.5	48-63		
0030-0100					82.5	--
0100-0130	7	57.5	1.0	56.5-59		
0130-0200					86.0	--
0200-0230	7	60.0	1.4	59-63		
0230-0300					84.3	--
0300-0330	7	60.2	1.6	58.5-61		
0330-0400					81.5	--
0400-0430	7	57.2	3.4	55-62		
0430-0500					83.5	--
0500-0530	7	60.1	10.8	52-83.5		
0530-0600					81.5	--
0600-0630	7	52.7	8.5	44.5-68.5		
0630-0700					82.2	--
0700-0730	7	58.4	3.9	55.5-67		
0730-0800					88.5	--
0800-0830	7	71.2	0.4	70.5-71.6		
0830-0845					92.4	--
		61.3 ± 6.0				

Table 7. Sound level recorded at the end of the boat docking ramp off Pou Bay Causeway. Readings were recorded from 0930 June 6 to 0930 June 7, 1979.

Time Period	No. of Samples	Mean	Standard Deviation	Range	Peak Sound Level
6/6/79:					
0930-1000					90.5
1000-1030	7	52.6	1.8	50.53	
1030-1100					85.2
1100-1130	7	51.4	2.0	50.55	
1130-1200					91.8
1200-1230	7	51.4	2.0	49.54	
1230-1300					84.4
1300-1330	7	47.2	3.4	44-54	
1330-1400					80.5
1400-1430	7	45.2	1.2	43-46	
1430-1500					81.5
1500-1530	6	47.6	4.8	43-56	
1530-1600					80.0
1600-1630	7	48.6	1.9	47-52	
1630-1700					85.0
1700-1730	5	48.8	2.9	44.5-52.5	
1730-1800					81.5
1800-1830	7	45.6	5.7	42-58	
1830-1900					73.0
1900-1930	3	45.3	3.1	42-46	
1930-2000					---
2000-2030	2	44.7	--	44.4-45	
2030-2100					74.8
2100-2130	7	44.2	2.1	42-48	
2130-2200					83.3
2200-2230	7	47.4	2.2	46-52	
2230-2300					83.4
2300-2330	7	55.1	2.5	50-58	
2330-2400					85.0
6/7/79:					
2400-0030	7	53.7	2.0	50.5-56	
0030-0100					84.8
0100-0130	7	53.1	1.7	50-55	
0130-0200					86.5
0200-0230	7	54.4	1.3	53-56	
0230-0300					86.3
0300-0330	7	56.2	3.5	52-61	
0330-0400					87.8
0400-0430	7	57.1	1.5	54-58	
0430-0500					87.4
0500-0530	7	55.2	2.6	52-59	
0530-0600					82.5
0600-0630	7	50.5	3.5	45.5-55	
0630-0700					80.0
0700-0730	7	48.0	2.9	46-52.5	
0730-0800					80.5
0800-0830	7	51.4	1.8	50-54.5	
0830-0900					85.5
0900-0930	7	53.3	2.1	51.56	
		50.4 ± 4.0			

Table 8. Sound levels recorded in Mechitiu Village (in front year of house, east side of laundermat) in dB(A) from 0900 June 5 to 1900 June 6, 1979.

Time Period	No. of Samples	Mean	Standard Deviation	Range	Peak Sound Level
6/5/79:					
0900-0930	7	62.3	2.6	50-65	
0930-1000					86.0
1000-1030	7	66.3	3.0	52-71	
1030-1100					86.5
1100-1130	7	66.8	4.0	62.5-73.4	
1130-1200					86.5
1200-1230	7	68.5	2.3	64-71	
1230-1300					89.0
1300-1330	6	68.3	0.6	67.8-69	
1330-1400					93.0
1400-1430	6	69.9	1.6	68-72.5	
1430-1500					88.8
1500-1530	7	63.6	7.0	53.2-71	
1530-1600					86.5
1600-1630	7	70.4	2.6	65-73.5	
1630-1700					93.0
1700-1730	7	71.2	1.9	68-74	
1730-1800					82.0
1800-1830	7	69.9	2.7	65.5-73	
1830-1900					88.5
1900-1930	7	64.5	5.5	57-72.5	
1930-2000					90.0
2000-2030	7	70.9	2.7	67-73	
2030-2100					87.0
2100-2130	7	69.3	2.6	65.5-72.5	
2130-2200					89.8
2200-2230	7	63.3	8.1	52-72	
2230-2300					89.2
2300-2330	7	70.6	1.6	68.5-72.4	
2330-2400					90.0
6/6/79:					
2400-0030	7	66.9	3.7	59.1-70.5	
0030-0100					87.2
0100-0130	7	69.1	3.3	63.72.5	
0130-0200					89.8
0200-0230	7	71.7	1.1	69.5-72.5	
0230-0300					89.5
0300-0330	7	61.3	6.7	52-68.4	
0330-0400					85.5
0400-0430	7	69.9	2.3	67.4-72.5	
0430-0500					87.5
0500-0530	7	72.4	0.8	71.7-73.5	
0530-0600					88.5
0600-0630	7	63.5	2.0	61-66	
0630-0700					86.3
0700-0730	7	66.1	3.4	61-69.5	
0730-0800					88.0
0800-0830	7	51.9	0.9	50.5-53	
0830-0900					90.0
		67.0 ± 4.5			

Table 9. Air particulate sampling results in micrograms per cubic meter of filtered air ($\mu g/m^3$). The daily sampling period was 24 hours.

DATE	WEATHER STATION	QUARRY
5/31/79	45.5	64.5
6/1/79	38.8	24.8
6/2/79	27.3	16.5
6/3/79	47.7	16.4
Geometric Mean (excluding 6/3/79)	36.4	29.8