TECHNICAL REPORT ON SOUND LEVELS IN BRYCE CANYON NATIONAL PARK AND THE NOISE IMPACT OF THE PROPOSED ALTON COAL MINE*

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CONTENTS

Section		Pages
	SUMMARY	1
I.	INTRODUCTION	1
II.	INDIGENOUS SOUND LEVELS IN BRYCE CANYON NATIONAL PARK	3
III.	PRINCIPAL SOURCES OF SOUND FROM THE PROPOSED MINE	20
IV.	ATMOSPHERIC CONDITIONS AFFECTING LONG RANGE SOUND PROPAGATION	26
V.	PREDICTED MINING SOUND LEVELS IN THE PARK	28
VI.	AUDIBILITY OF SOUNDS FROM THE PROPOSED MINING	39
VII.	INTERPRETATION AND CONCLUSIONS	41
	ACKNOWLEDGEMENTS	45
	REFERENCES	46
APPENDIX		
A.	EQUIPMENT LIST	48
B.	INDIGENOUS SOUND LEVELS IN BRYCE CANYON NATIONAL PARK	54
C.	BLASTING DATA	102
D.	ATMOSPHERIC ABSORPTION DATA FOR BRYCE CANYON NATIONAL PARK	106
E.	OCTAVE BAND ANALYSES OF COAL BLAST MEASUREMENTS	136

SUMMARY

At the request of the NPS, the EPA, in cooperation with the Office of Surface Mining (OSM), conducted sound level measurements within Bryce Canyon National Park. In this effort, background sound levels were measured, as well as the sound levels produced by two unconfined air blasts set off south of the Park in a proposed surface coal mining area. Subsequently, EPA, NPS and OSM staff measured the sound levels of blasts from operating surface coal mines in northwest Colorado.

The present report is an account of the levels measured during these monitoring periods. In addition, the report attempts to predict the probable noise impacts of surface coal mining on Bryce Canyon National Park.

Typical background sound levels measured in the Park were found to be extremely low. During the day, in the absence of strong winds, ambient sound levels frequently fall below 20 dBA which is comparable to sound levels in a high quality recording studio.

In higher use areas, during the day, ambient sound levels frequently fall below 30 dBA.

At night, again, in the absence of strong winds, ambient sound levels frequently fall below 20 dBA.

This report is limited to an assessment of only blasting and truck noise expected from the proposed coal development. While several other surface mine noise sources exist which could have an impact on the Park, these sources were not addressed due to time constraints.

Four reference points were selected to estimate the noise levels from blasting and trucks: Two in the proposed mining area (West Alton, East Alton); and two in the Park (Yovimpa Point, Bryce Point).

Blasting noise is likely to be heard at both Park reference points and throughout most of the Park when blasts are detonated in either East or West Alton. Obviously, the most serious noise impacts will occur near Yovimpa Point when mining activities are in the East Alton area. This is also the case for coal truck noise. The coal trucks at East Alton would produce maximum noise levels of 28 to 67 dBA at Yovimpa Point. When compared to the extremely low ambient sound levels, truck noise alone would cause a two to 16 fold increase in the perceived loudness of sound levels in the Park. Blasting noise from East Alton is predicted to be as high as 86 dBA at Yovimpa Point. Once again, comparing these noise levels to the low indigenous sound levels known to exist in the Park, blasting could be perceived as being as much as 64 times louder than the natural background sound levels.

Therefore, both truck noise and blasting will be audible within the Park providing there is no masking from indigenous sounds. An analysis of available wind data (from three different sites and sources) shows similar results for frequency of wind speeds in the area. The wind speed data indicates that wind speeds are ten miles per hour or less from 76% to 84% of the time. A wind speed of ten miles per hour or less has a negligible masking effect. In fact, when wind direction is from the proposed coal field to the Park, a ten mile per hour wind would have the effect of increasing coal mining noise levels in the Park through the well known phenomenon of refraction.

While there are a limited number of existing man-made noise sources in the Park, the impacts are also limited. Existing noise sources are generally confined to small geographical areas such as roads and parking lots. The impact of these sources, however modest, are offset by compensating benefits to Park visitors. Although noise pollution from aircraft is a regrettable intrusion in the Park, at the present time these noise events have a small effect on ambient sound levels in the Park.

The best available data indicates that surface coal mine noise, as projected, would be audible during a major portion of the time within the Park. The EPA and a growing proportion of the scientific community believe that even the detectability of man-made noise in pristine enviroments (such as Bryce Canyon National Park) can be of significant annoyance to people and threaten the intended use and future of significant public lands.

According to the Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) of the National Research Council, for "critical land uses requiring special consideration, the hourly average sound level due to the intruding noise from the coal mine activities should be five dB below the existing background level. The results in this technical report indicate that the CHABA guidelines are exceeded in Bryce Canyon National Park for both parting and overburden blasts.

I. INTRODUCTION

In early June, 1980, the U.S. Environmental Protection Agency (EPA) Region VIII was requested by the National Park Service (NPS) to assist in conducting sound level measurements in Bryce Canyon National Park, Utah. The NPS request came in response to the proposed development of the Alton Coal Field directly south of Bryce Canyon National Park. The sound level measurements were requested as part of the overall environmental assessment on the effects of surface coal mining on unique and significant public lands: Bryce Canyon National Park.

In response to the NPS request, EPA deployed the resources of the Noise Technical Assistance Center (NTAC)* at the University of Colorado to measure natural sound levels at several locations within the Park. The NTAC also measured the sound levels produced by two unconfined blasts set off south of the Park in the proposed mining area by an NPS contractor. After a careful review of the sound level data, weather data and other pertinent and related information, the need for additional sound level measurements was recognized. Analysis of weather data observed at Park Headquarters revealed that weather conditions during the June monitoring period were atypical of normal conditions. Consequently, the EPA found it necessary to undertake additional measurements of sound levels in the Park. Therefore, in August of 1980, a second survey was conducted in an attempt to measure natural sound levels during more typical weather conditions. Unexpectedly, the second survey also included measurements of sound levels produced by three unconfined blasts set off north of the Park by a seismic exploration crew[1].

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*The NTAC at the University of Colorado is funded by the Environmental Protection Agency to provide technical assistance to the Region VIII Noise Control Program in implementing the Quiet Communities Act of 1978.

Another problem identified in the June survey centered on the air blasts detonated and measured under test conditions. Since the type of air blast measured might not have been similar to the type of blasting which would occur under normal mining operations, the need to measure additional surface coal mine blasting was obvious. Therefore, with the cooperation and assistance from staff of both the Office of Surface Mining (OSM) and the NPS, the EPA initiated an effort to monitor blast noise at operating surface coal mines similar to that being proposed at the Alton Coal Field. Specifically, three active surface mines were monitored in the northwestern Colorado area. These mines were: The Energy Fuels Corporation Mine No. 3; the Pittsburgh and Midway Mine; and the Utah International Inc. Trapper Mine.

The present report is an account of our measurements and analysis. Further, the data obtained is used to estimate the probable impact of surface coal mining noise on Bryce Canyon National Park. Sections I through VII are aimed at a wider audience than the appendices, which contain many details and are intended for persons with specialized interests.

The present study was performed under several limiting conditions, one of which was time. If time would have permitted, the sound level survey of the Park would have been extended and more actual blasting measurements would have been pursued. Furthermore, this report is limited only to the probable effects of blasting and truck noise associated with surface coal mining. There are several other sources of noise associated with surface coal mining which were not assessed due to time constraints. The present report, however, does attempt to identify these other noise sources.

II. INDIGENOUS SOUND LEVELS IN BRYCE CANYON NATIONAL PARK

Sound levels were measured at three types of locations within the Park: Near high use areas, such as Bryce Point and Yovimpa Point; along trails; and near campsites. Most of the sites near high use areas were chosen so as to be shielded from sounds produced by human activity, yet located as close as possible to the high use areas. The entrance to the Bryce Point parking lot was an exception; it was not shielded from human activity. The general measurement locations and specific measurement sites are indicated in Figures 1-3, and identified in Table I.

At each site sound levels were measured continuously, usually with a microphone four to five feet above ground level (on a tripod), and always with a wind screen, for periods that ranged from 15 minutes to nine hours. A-weighting, fast response, and ANSI Type I instrumentation were used exclusively. The most frequently used measurement periods, 40 minutes and one hour, were determined primarily by equipment considerations, such as magnetic tape reel size and tape speed. As a rule, each measurement gave the equivalent level for the measurement period, the minimum level and the maximum level during the measurement period, principal features of the cumulative sound level distribution, and the standard deviation of sound levels sampled (usually eight times per second) during the measurement period. The results from over 63 hours of such measurements are contained in Appendix B.

Before proceeding to some general inferences from the data, it seems appropriate to offer a few comments on interpretation. The cumulative distribution results ($L_{.01}$, $L_{.1}$, L_1, L_5, etc.) can be very useful in attempting to reconstruct some features of the acoustic environment during the

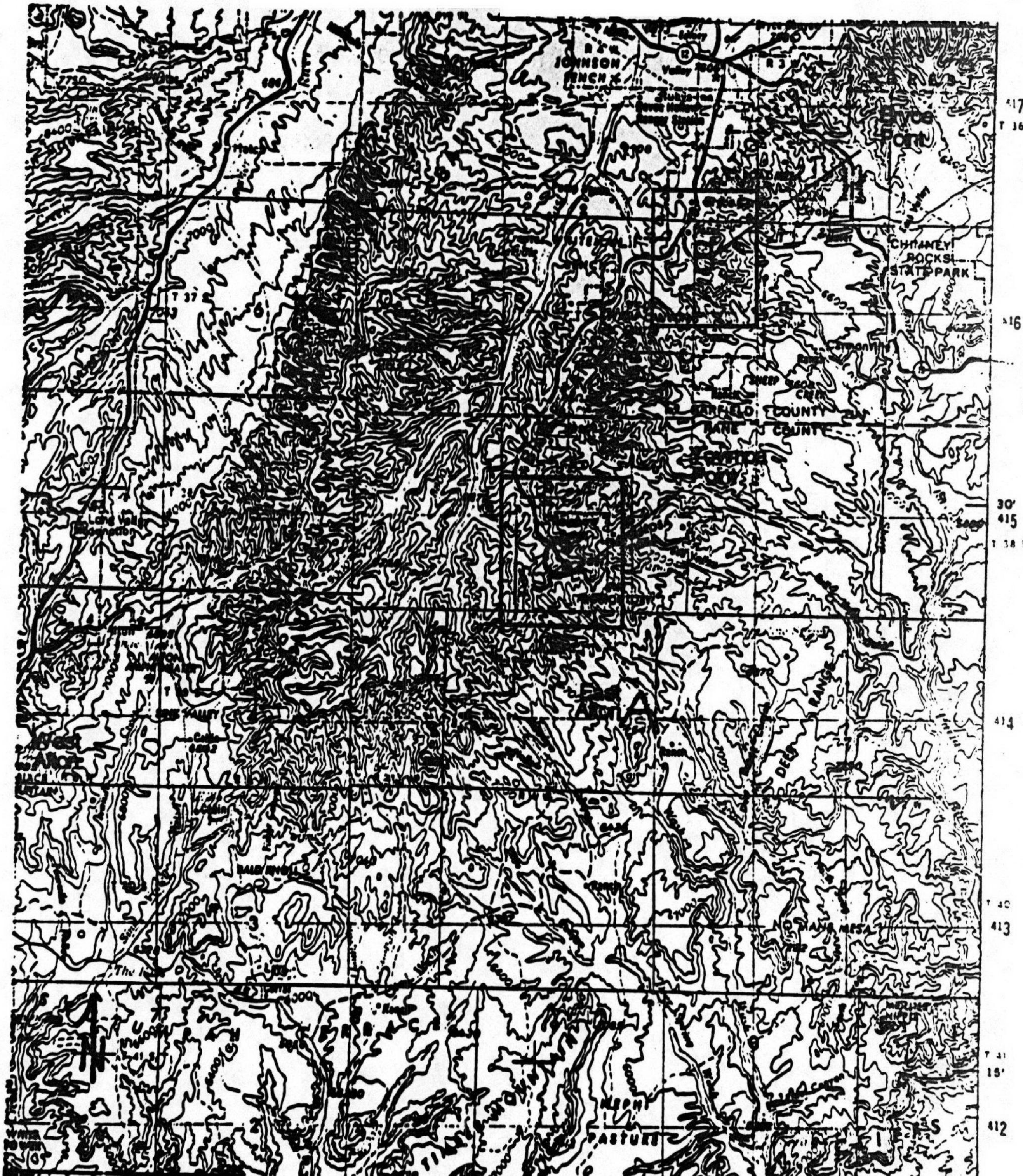

FIGURE 1. Bryce Canyon National Park and environs, showing location A of air blasts on June 6, 1980, and boundaries of detail areas B and C (see Figures 2 and 3).

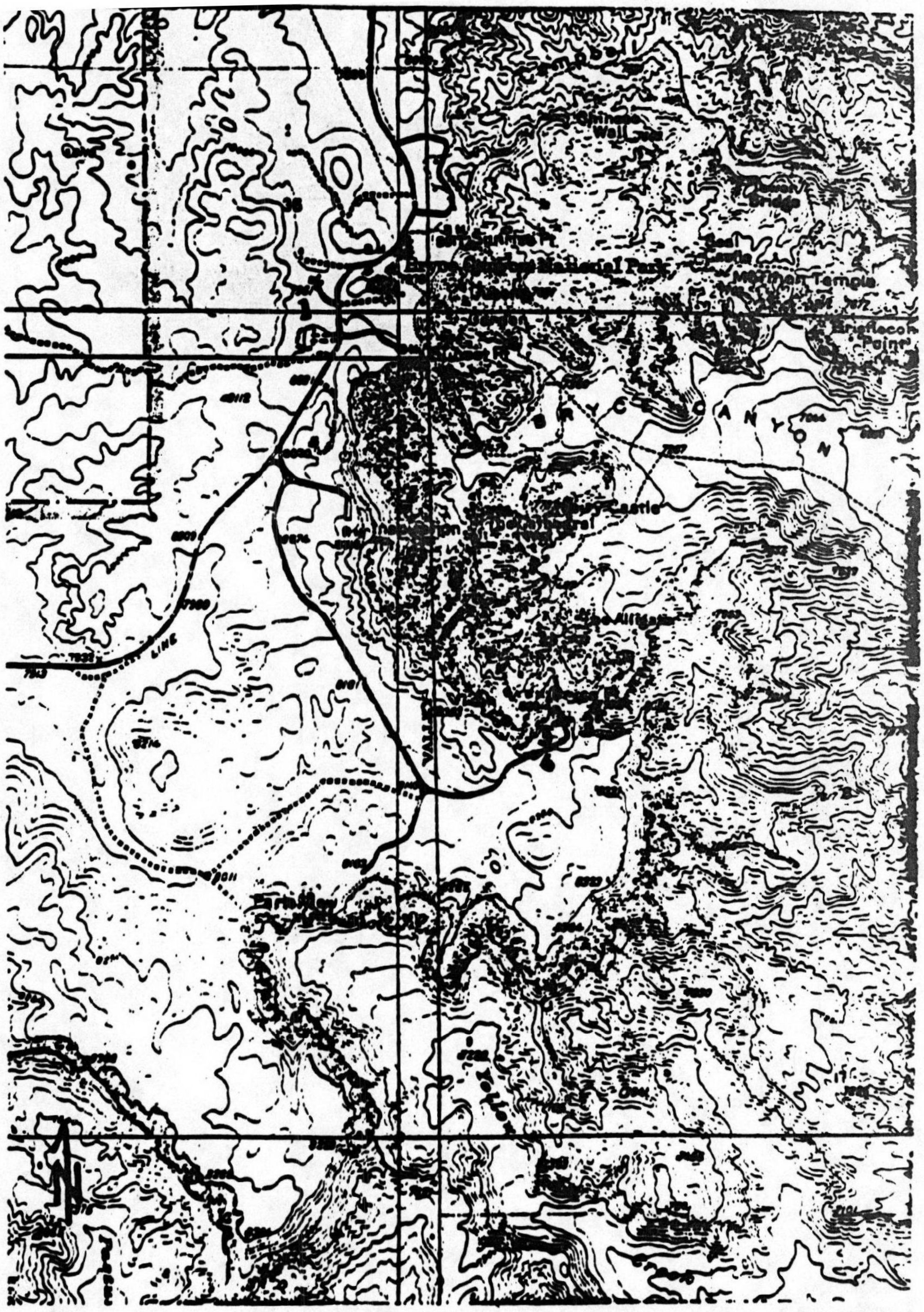

FIGURE 2. Detail area B in Bryce Canyon National Park, showing measurement sites 1 through 6 (see Table I for more precise specifications of measurement locations).

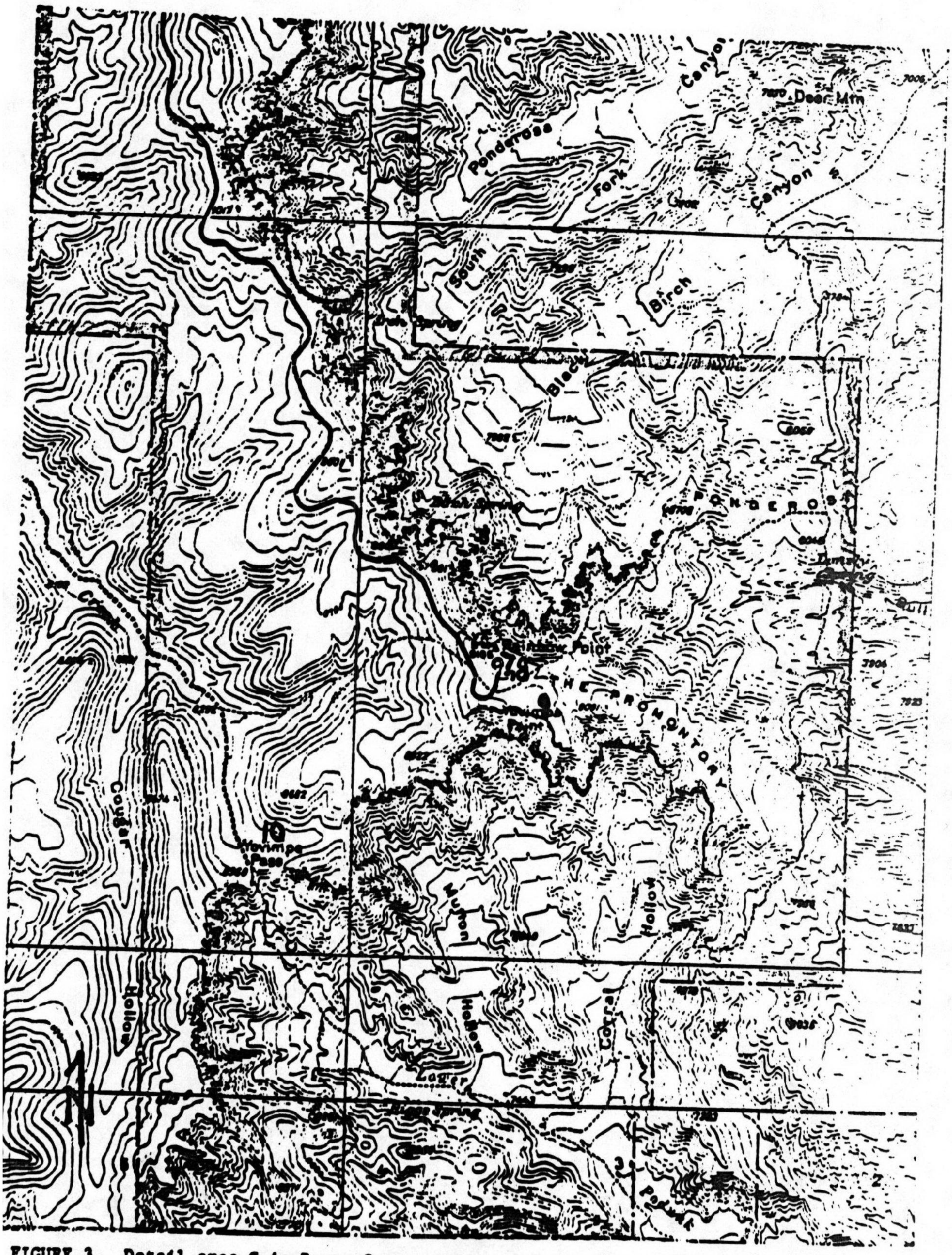

FIGURE 3. Detail area C in Bryce Canyon National Park, showing measurement sites 7 through 10 (see Table I for more precise specifications of measurement locations).

TABLE I. Location of Measurement Sites

SITE	LOCATION
1. Sunset Campground.	This site was on top of the ridge behind the amphitheater, about 200 feet from the back row of seats.
2. Bryce Point.	This site was near the parking lot, next to the small sign at the entrance to the lot. The same site number is also used for the location of a site that was midway north-south in the bus lane, about three feet from the low stone rail.
3. Bryce Point.	This site was about 320 yards down along the trail that starts at Bryce Point (Bryce Point Trail).
4. Bryce Point.	This site was 100 feet beyond the arch on Bryce Point Trail, which makes it about twice as far along the trail as site number 3.
5. Bryce Point.	This site was 100 yards west of the Bryce Point parking lot and 100 yards north of the east-west roadway to the parking lot.
6. Bryce Point.	This site was 150 yards south of the approach road, shielded by a natural berm.
7. Rainbow Point.	This site was 20 yards north of the comfort station.
8. Rainbow Point	This site was 100 feet north of the water tower, which was 50 feet southeast of the comfort station.
9. Yovimpa Point.	This site was 30 yards north of the weather station. The same site number is also used for the location of the site that was 50 yards north of the weather station.
10. Yovimpa Pass.	This site was 200 feet north of the information box.

measurement period. The L_x value specifies the level exceeded X percent of the time: an L_{90} of 21 dBA means the sound levels exceeded 21 dBA during 90 percent of the interval; one may also say, equivalently, that sound levels were less than or equal to 21 dBA during 10 percent of the interval. Similarly, sound levels exceed L_5 for five percent of the time and are less than or equal to L_5 for 95 percent of the time, etc.

Sometimes the acoustic environment is remarkably steady -- then the L_x values differ little among themselves. Sometimes the acoustic environment is remarkably steady, except for brief, relatively loud episodes -- then L_{99} to L_5, say, may differ little among themselves, but L_1, $L_{.1}$ and $L_{.01}$ will be distinctly higher. Appendix B contains many real examples of such cumulative distributions for sites in Bryce Canyon National Park.

The equivalent level (L_{eq}) is the constant level which would have given the same A-weighted dose of acoustic energy during the measurement period as the actual, time dependent levels did. The equivalent level gives more significance to high levels than to low levels; as a result, it tends to overestimate the role indigenous levels play in masking man-made sounds, as will be discussed further in Section VI.

Although measured sound levels in the Park were often notably low, the actual levels were in fact lower still. On more than one occasion, sound levels were lower than could be measured due to instrumental (noise floor) limitations. That is, each sound level meter registers a background level even when there is no input (environmental sound) to the instrument. This background level which varies from instrument to instrument is called the noise floor of the specific instrument.

At night, in the absence of strong winds, equivalent sound levels of 25 dBA are common throughout the Park. Instantaneous sound levels frequently fall below 20 dBA.

During the day, in the absence of strong winds, equivalent sound levels of 20-35 dBA are common along trails in the Park. The wide range of variation is due primarily to footfalls during the measuring periods, which cannot be avoided because some trails are narrow. Instantaneous sound levels frequently fall below 20 dBA. Figure 4, based on the data in Appendix B, provides an example of sound levels along Bryce Point trail.

During the day, in the absence of strong winds, equivalent sound levels of 30-40 dBA are common near high use areas in the Park. Instantaneous sound levels frequently fall below 30 dBA. Figures 5 and 6 provide examples of sound levels near Yovimpa point. Figure 5 includes the time during which seismic blasts were heard from 35 miles away.

A comparison of our June and August measurements indicates that surface winds of 20 miles per hour at Park headquarters are associated with equivalent sound levels in the Park of 45-55 dBA, except in sheltered areas away from trees (such as some trails). Such winds at Park headquarters are very unusual. The results of measurements (at about 1400 hours) from May 1 to October 31 for the last three years are depicted in Table II. The results of continuous measurements[2] from March 1, 1978, to February 28, 1979, on Bald Knoll in the proposed mining area are also depicted in Table II, as are wind speed statistics for the Bryce Canyon Airport[2] from the years 1949-1954. The similarity of these three sets of results supports the view that wind speed statistics from Park headquarters provide an indication of wind speed

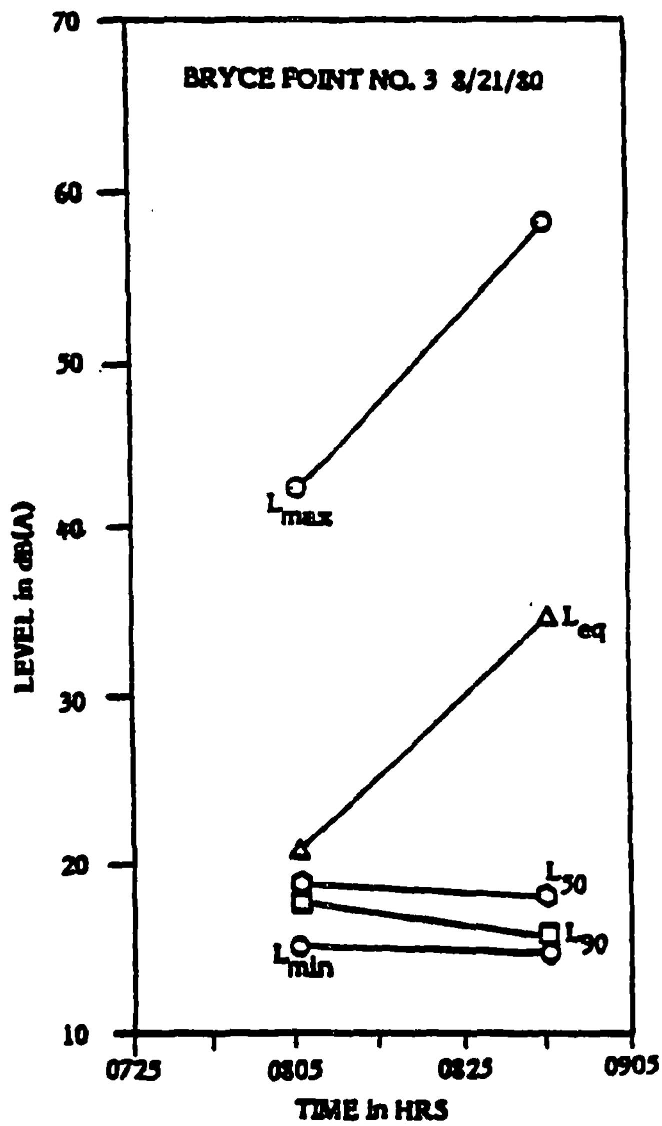

FIGURE 4. Sound levels along Bryce Point trail.

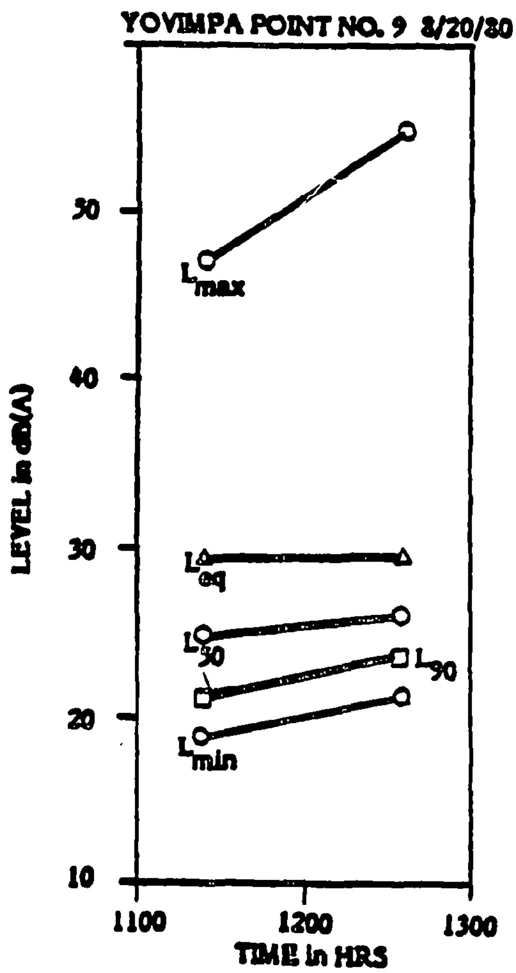

FIGURE 5. Sound levels near Yovimpa Point during the time seismic blasting was heard from 35 miles away.

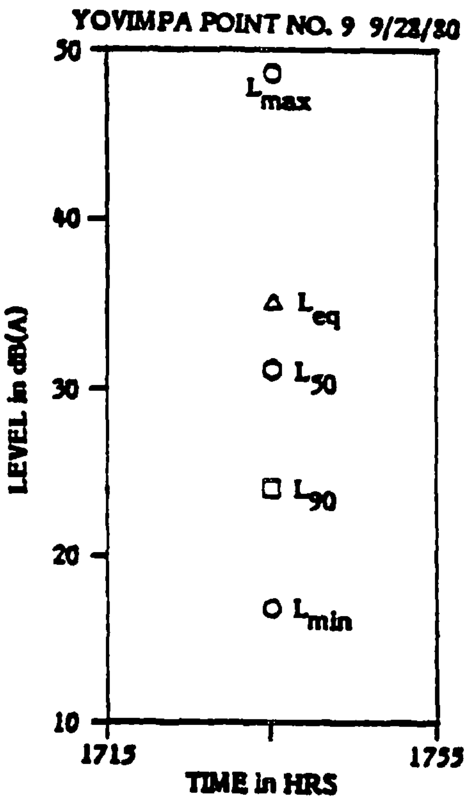

FIGURE 6. Sound levels near Yovimpa Point during a time which included five aircraft flyovers.

TABLE II

CUMULATIVE
WIND SPEED STATISTICS

WIND SPEED (MILES/HOUR)	LOCATION (PERCENT OF TIME AT OR BELOW WIND SPEED)		
	PARK HEADQUARTERS Measured at 1400 Hours - 5/1 to 10/31 1977, 1978, 1979	BALD KNOLL Continuous Measurements - ERT, Inc. 3/1/78 to 2/28/79	BYRCE AIRPORT Wind Rose 1949-1954
0			
1	2.7%		
2	5.8%		31.3%
3	12.2%	20.9%	
4	23.5%		
5	32.8%		
6	42.3%	58.7%	
7	51.5%		59.4%
8	62.4%		
9	69.3%		
10	75.9%	83.8%	
11	80.1%		
12	86.1%		83.3%
13	89.4%		
14	93.4%		
15	96.2%		
16	96.7%	98.0%	
17	97.6%		
18	98.4%		97.2%
19	99.3%		
20	99.6%		

statistics in the Park generally, and hence that strong winds occur infrequently in the Park.

The principal means by which wind affects indigenous levels is interaction with trees. Since the wind conveys mechanical energy at a rate proportional to wind speed cubed, one expects the acoustic energy generated by wind-tree interaction to vary as wind speed cubed also. In other words, the effect of wind on indigenous sound levels should be much less at low wind speeds than at high wind speeds, as the data indicate.

The genuine effect of wind on indigenous sound levels due to wind-tree interaction must be distinguished from the spurious effect due to wind-microphone interaction. The latter was almost never a significant factor in the present study, due to use of wind screens and judicious placement of microphones.

One further aspect of the indigenous sound levels in the Park needs to be mentioned: the distribution of A-weighted energy over frequency (spectra). Sample spectra with and without strong wind are contained in Table III. These results show that spectra are relatively flat below 1000 Hz, with or without wind. This feature of indigenous levels is significant for audibility of manmade sounds from mining, and will be discussed further in Section VI.

TABLE III: Octave band spectra of indigenous sounds

Location	Date	Time	Equivalent level, dBA 31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz
Bryce Point parking lot (site 2)	6/6/80	0815-0830	18.7	27.8	30.2	31.9	33.1	34.7	33.1
Near Yovimpa Point (site 9)	8/20/80	1010-1025	-0.2	13.7	14.3	11.6	17.2	18.1	16.0
Near Yovimpa Point (Site 9)	8/19/80	1030-1045	30.8	34.9	33.7	35.6	42.9	47.1	44.9

While the indigenous levels, as discussed above, were obtained in an effort to minmize unnatural sounds, several man-made noise sources were identified in the Park. Foremost among these unnatural sources are: Surface vehicular traffic, including opening and closing of vehicle doors; aircraft; and human voices.

Despite the presence of these largely unwanted, yet unavoidable sounds, there are a number of important distinctions that must be made between existing man-made noise sources and the introduction of any new man-made noise sources. These distinctions are: characteristics of the noises; area of land affected by noise sources; the expectations of the receiver; and the degree to which the existing sources serve the functions of the public and the National Park Service.

The existing man-made noise sources (except for aircraft noise) can be characterized as having low to moderate noise levels with relatively short duration and range. Noise from surface vehicular traffic, for example, is restrained in most areas by low speed limits which result in low noise levels for automobiles, trucks and buses.

Even if one were inclined to spend a large percentage of his or her time in the Park at or near a parking lot, sound level measurements obtained at the entrance to the Bryce Point parking lot reveal a difference between L_{max} and L_{50} during daytime of approximately 40 decibels. In other words, even at the entrance to a parking lot, indigenous levels of 20 to 30 dBA prevail approximately 50 percent of the time (see Figure 7).

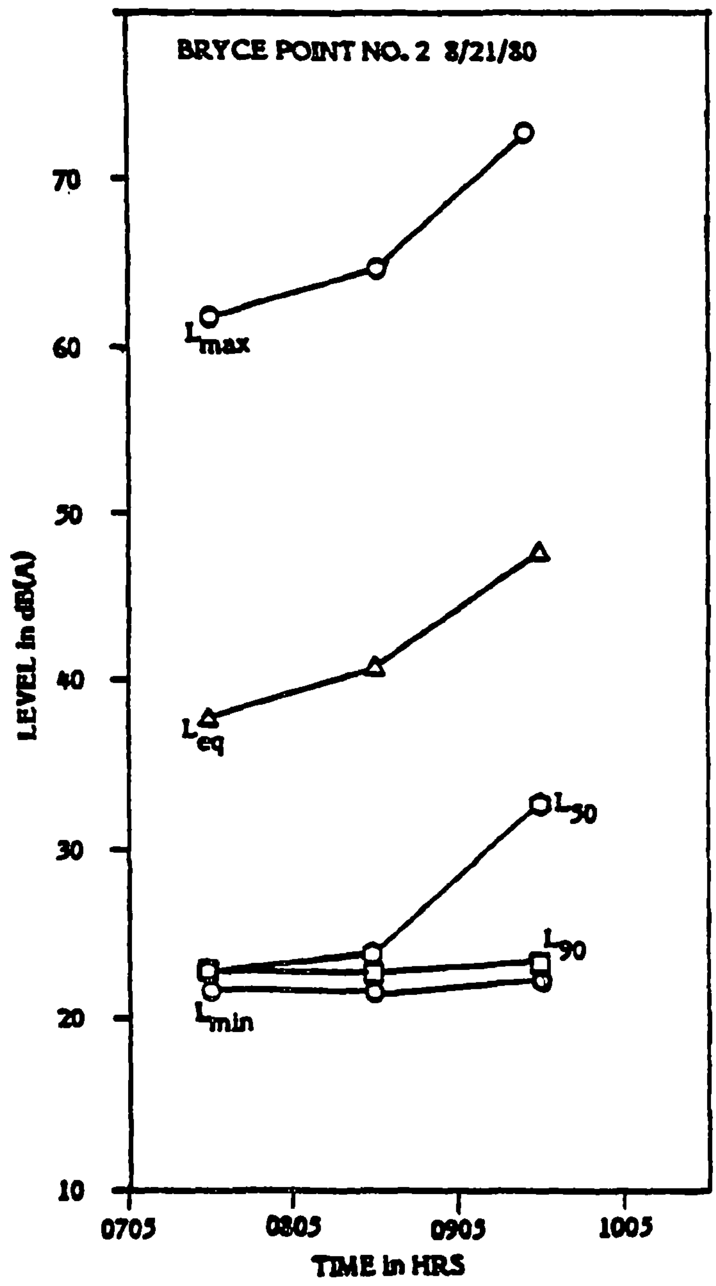

FIGURE 7. Sound levels at the entrance to the Bryce Point parking lot.

Moreover, it was found that the existing man-made noise sources (with the exception of aircraft) are confined to specific and relatively small geographical areas. Again, in the case of surface vehicles, noise is generally confined to areas in the vicinity of roads and parking lots. In contrast to the projected impacts of surface coal mining noise and existing aircraft noise, large areas of the Park are not impacted by the existing man-made noise sources. If and when visitors find existing man-made noise sources annoying, they may easily find portions of the Park devoid of unnatural sounds.

Another important aspect of existing man-made noise sources relates to the types of noises familiar to and reasonably expected by Park visitors. Since most Park visitors travel to the Park by automobile or bus, both the acceptability and familiarity of surface vehicular noises are generally believed to be less objectionable than noises unfamiliar and unusual to the Park and its enjoyment. Sounds which are unfamiliar to the receiver are generally believed to be more distracting.

Although noise pollution from aircraft is a regrettable intrusion in the Park, its effect on indigenous sound levels is not great. For example, during a 40 minute period of measurement near Yovimpa Point, five aircraft flyovers occurred and were recorded (four commercial and one light general aviation aircraft). Maximum sound levels from the aircraft were in the range of 35-45 dBA but indigenous sound levels remained below 31 dBA for fifty percent of the measurement period. The ambient sound level (L_{90}) for the period was 24 dBA. (See Figure 6 and data for September 28, 1980 in Appendix B).

Finally, it should be noted that access to the Park is provided, to the largest extent, by surface transportation. Particularly the private automobile is important to the public for the enjoyment of Bryce Canyon National Park. Therefore, the seemingly modest compromise of surface vehicle noise is offset in some measure by the benefits of access to specific portions of the Park. Any additional compromises (particular noise impacts which would affect large areas) do not appear to carry any benefit to the Park or its intended use.

III. PRINCIPAL SOURCES OF SOUND FROM THE PROPOSED MINE

Sources of sound from the proposed mine will include blasting, 170 ton trucks, electric power generators, crushers, and warning devices. Blasting and 170 ton trucks are likely to be the principal sources and are used exclusively in this report. Additional noise sources are identified in Table IV[3] along with the respective estimated levels.

Near the mine the maximum pressure increase from the blasting is expected to be of the form [4]

$$\Delta p = K \left(D/W^{1/3} \right)^{-n}$$

with K a parameter that depends on the type of blasting, D the distance from blast to observation point (in feet), W the maximum weight of explosive per delay* (in pounds), and n another parameter that depends on the type of blasting and meterological conditions. For the overburden shots, data obtained from the proposed mining area [5] yielded

$K = 0.683$ pounds per square inch,

$n = 1.277$.

For the parting shots, data obtained from other operating mines [6] yielded

$K = 194$ pounds per square inch,

$n = 1.666$.

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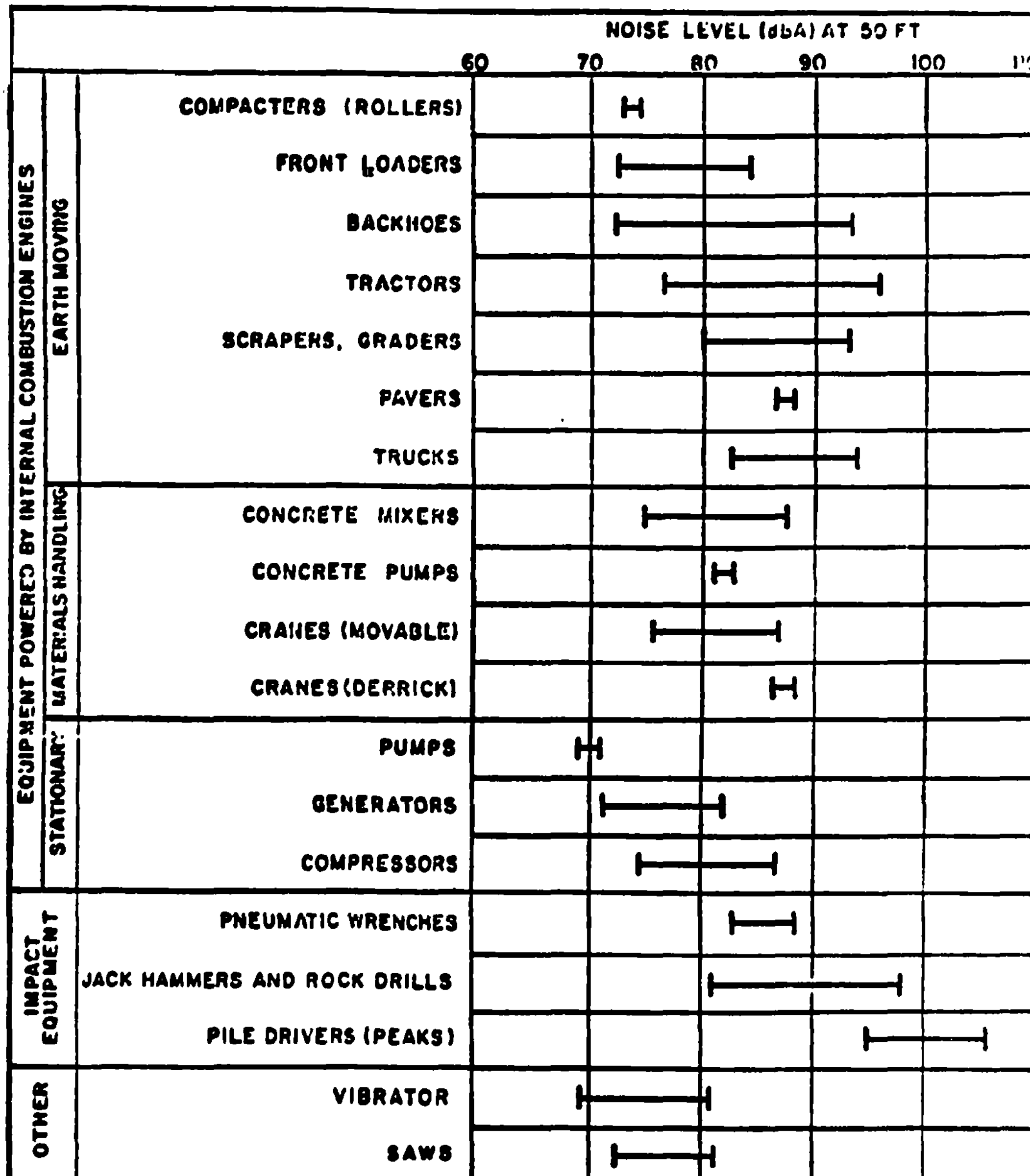
*The values of W used in this report are 1740 pounds for overburden shots and 130 pounds for parting shots.[5]

TABLE IV



Note: Based on Limited Available Data Samples

Coal shots are expected to produce maximum pressure increases near the mine intermediate between those for overburden shots and parting shots.[5]

These estimates for propagation near the mine do not take into account atmospheric absorption or other atmospheric effects, which will be dealt with in the next section. The parameters K and n were obtained from linear regression analysis of seven overburden shot results and 16 parting shot results. The standard errors of the estimates for the predicted maximum pressure increases are + 6 decibels in each case.[5,6]

Beyond about 5000 feet (in the present case), according to Air Force Weapons Laboratory studies[7], the maximum pressure increase from blasting is expected to be of the form

$$\Delta p(D) = \Delta p(D_0) \cdot \left(\frac{D}{D_0}\right)^{-1.1} ,$$

with D_0 5000 feet. This estimate for long range propagation must be supplemented by consideration of atmospheric absorption and other atmospheric effects (see next section).

The preceding estimates for short range and long range propagation concern the overall maximum pressure increase. However, maximum pressure increases in octave bands near the mine are also needed (to predict sound levels rather than sound pressure levels). Octave band analyses of blasts from surface coal mines in Colorado (including Utah International's Trapper Mine) reveal a pattern which makes it possible to resolve the maximum pressure increase near the mine into its octave band components. According to Appendix E, which contains the analyses, estimates of the maximum sound pressure levels of the octave band components may be obtained from the maximum sound pressure level of the overall pressure increase by subtracting the amounts shown in Table V. Knowledge of the octave bands indicated in Table V is sufficient for estimating maximum A-weighted blast sound levels in the Park, because A-weighting makes lower octave bands relatively unimportant, and atmospheric absorption makes higher octave bands relatively unimportant.

A previous study[8] by Bolt, Beranek, and Newman, Inc., makes it possible to estimate sound pressure levels for diesel engine powered trucks. For well maintained 170 ton trucks with typical mufflers, octave band A-weighted sound levels at 50 feet are expected to have the values given in Table VI. According to the study cited, these levels should be reliable to within + 4 decibels. The estimates in Table VI are in good agreement with actual measurements for 170 ton trucks carried out as part of a study of proposed surface mining near the Boundary Water Canoe Area.[9]

TABLE V. Blasting peak octave band sound pressure levels from peak overall sound pressure level

Octave band center frequency, hertz	Peak sound pressure level difference (octave band minus overall), dB
31.5	-6.3
63	-10.8
125	-16.1
250	-23.9

TABLE VI. Octave band sound levels for naturally aspirated, diesel powered 170 ton trucks

Octave band center frequency, hertz	Sound level at 50 feet, dBA
63	60
125	75
250	84
500	85
all	92

IV. ATMOSPHERIC CONDITIONS WHICH AFFECT LONG RANGE SOUND PROPAGATION

If the speed of propagation of an acoustic disturbance increases with altitude, due to wind or a temperature inversion or both, sound levels are enhanced by refraction. Measurements of wind effects on sound levels from blasting have shown that the exponent n in the propagation law is diminished in absolute value by 0.0265 U, where U is the component of the wind velocity (toward the observer) in miles per hour, measured eight meters above ground level.[10] Measurements of combined wind and temperature gradient effects on sound levels from blasting have shown that the exponent n in the propagation law is diminished in absolute value by $0.01\Delta a$, where Δa is the total increase in speed of propagation of an acoustic disturbance (toward the observer) in miles per hour, from ground level upward to the height where the speed ceases to increase.[11] Combined wind and temperature gradient effects in the proposed mining area usually favor enhancement of mining sound levels in the Park, as will be discussed further in Section V. Most of the enhancement occurs within the first 5000 feet from the source.

Over long distances, such as those from the proposed mine to the Park, atmospheric absorption due to humidity can diminish sound levels, particularly those at relatively high frequencies. Atmospheric absorption coefficients in the Park for May through October during the last three years are provided in Appendix D. Also provided are atmospheric absorption coefficients as functions of temperature and relative humidity.[12]

Little is known empirically about the effect of sloping terrain on long distance sound propagation.[13] However, if an atmospheric lid is created for acoustic disturbances by a temperature inversion (or pseudo inversion due to wind), it is plausible that the upward sloping terrain toward the Park would funnel acoustic energy, acting as a converging duct.

The relationship between maximum pressure increase and explosive charge per delay holds only for long enough delays (or effective delays based on actual acoustic path differences).[14] In an inhomogeneous atmosphere, over the long distance between proposed mine and Park, pressure pulses from separate delays may superpose, making the effective explosive charge per delay intermediate between the nominal charge per delay and the total charge. The 17 millisecond delays envisioned[5] for the blasting may be short enough to facilitate such superposition, particularly for the overburden blasts (which would be expected to have a rise time approximately twice as long as the parting blasts).

V. PREDICTED MINING SOUND LEVELS IN THE PARK

During the summer, strong nocturnal temperature inversions are the rule; they are surface based, and occur approximately nine nights out of ten.[15] Approximately five nights out of ten the top of the inversion exceeds 250 meters; approximately one night out of ten the top exceeds 500 meters.[16] Temperature measurements from Bald Knoll (at 10 and 50 meters) indicate mean temperature gradients of five centigrade degrees per 100 meters at 2130 hours, and 8.75 centigrade degrees per 100 meters at 0530 hours.[17] Nocturnal drainage winds from the Park toward the proposed mine average about five miles per hour.[23]

The trucks will be closest to the Park when they are operating in the eastern portion of the proposed mining area. In that case, using the truck octave band sound levels, taking into account atmospheric absorption (which is different for each octave band) for 50 degrees Fahrenheit and 50 percent relative humidity, taking into account also refraction due to the temperature gradients (which is the same for each octave band), including an additional 6.6 dBA decrease per doubling of distance[7], and allowing for the presence of 20 170 ton trucks[5], one finds the estimates given in Table VII. Table VIII contains estimates found in the same way for truck operation in the extreme western portion of the proposed mining area.[18] The reader should bear in mind that nocturnal, indigenous sound levels in the Park frequently fall below 20 dBA, and that there are camp sites relatively near both Yovimpa Point and Bryce Point. Figures 8 and 9 depict with contours some of the predictions for nocturnal sound levels due to trucks.

TABLE VII. Nocturnal sound levels in the Park during the summer due to 20 trucks in East Alton

Sound levels, dBA

Time	10% of nights		50% of nights	
	Yovimpa Point	Bryce Point	Yovimpa Point	Bryce Point
2130	37-45	18-26	28-36	7-15
0530	51-59	34-42	35-43	15-23

TABLE VIII. Nocturnal sound levels in the Park during the summer due to 20 trucks in West Alton

Sound levels, dBA

Time	10% of nights		50% of nights	
	Yovimpa Point	Bryce Point	Yovimpa Point	Bryce Point
2130	15-23	3-11	4-12	-8 to 0
0530	31-39	20-28	13-21	0-8

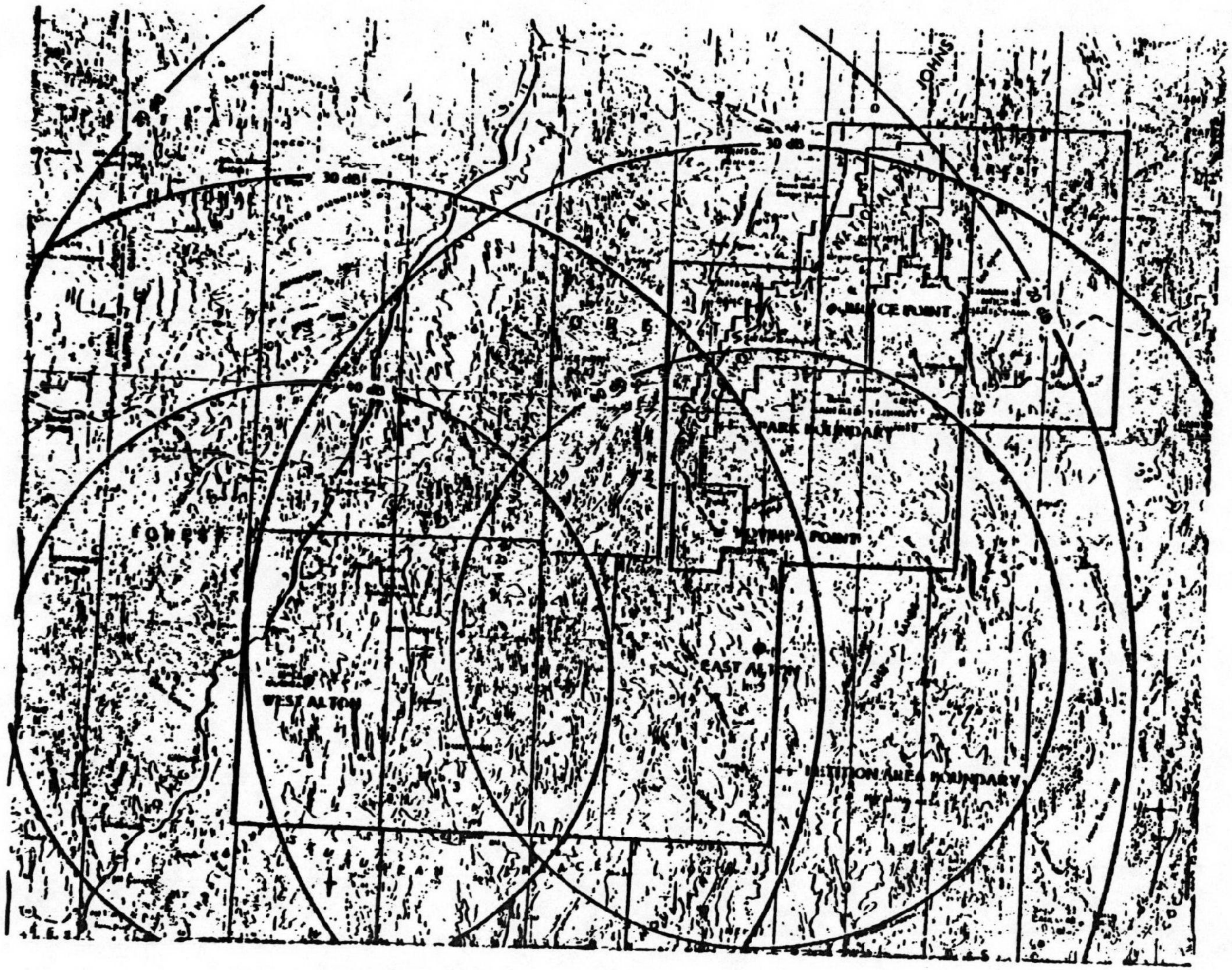


FIGURE 8. Nocturnal sound level contours for trucks (0530 hours on 10% of nights).

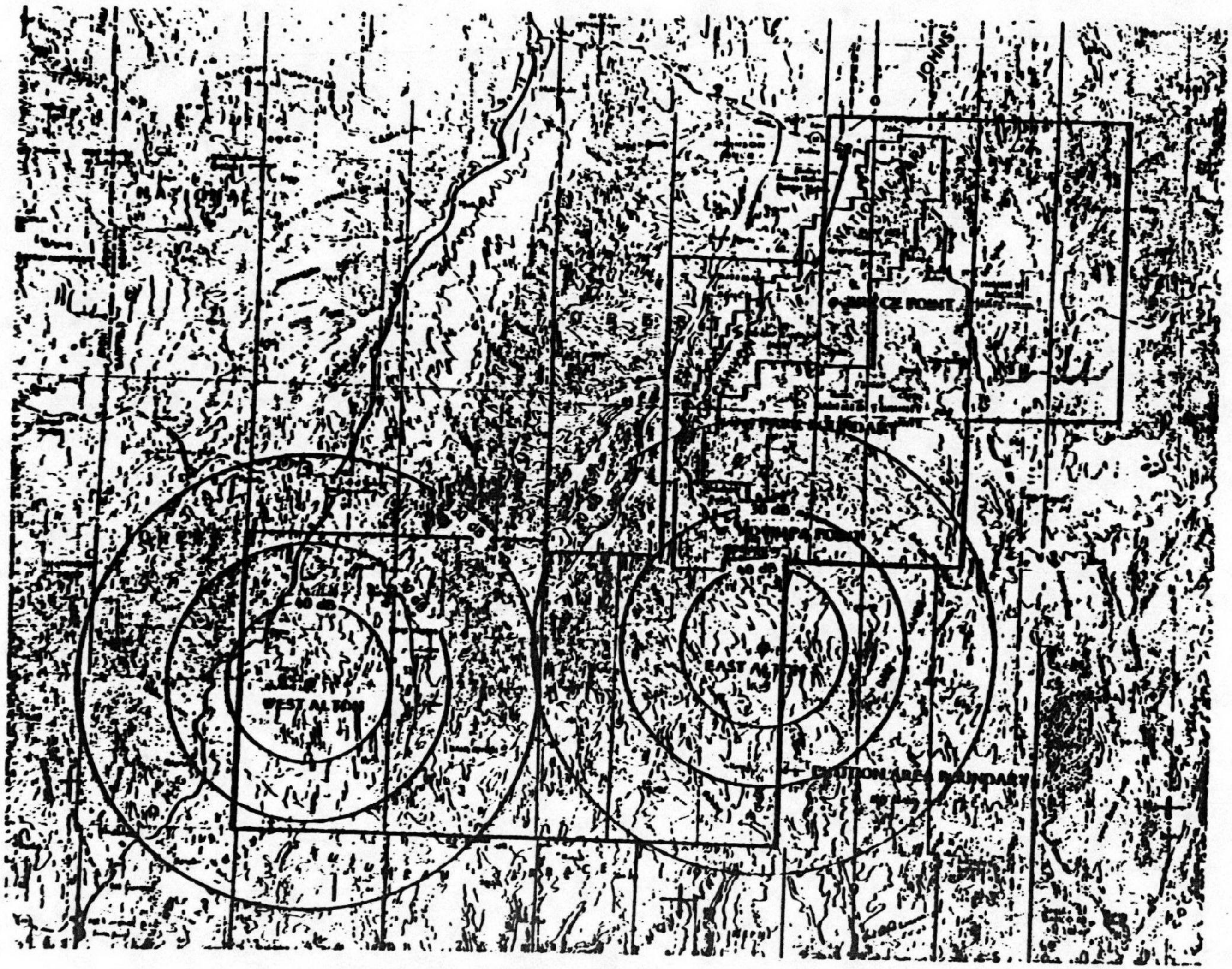


FIGURE 9. Nocturnal sound level contours for trucks (2130 hours on 50% of nights).

During summer days in the Park, mean values for atmospheric absorption in the 31.5, 63, 125 and 250 Hertz octave bands are 0.03, 0.07, 0.19 and 0.44 dB per 1000 feet, respectively (see Appendix D). Using these values and the blasting octave band sound levels at 5000 feet, and again allowing an additional 6.6 dBA decrease per doubling of distance, it is possible to calculate maximum sound levels due to blasting when there is no refraction (other than that included in the empirical propagation equations for blasting). Table IX contains predicted maximum sound levels due to blasting in East Alton (no wind, no inversion); Table X pertains to blasting in West Alton. The reader may wish to bear in mind that indigenous sound levels in the Park under these conditions frequently fall below 30 dBA.

During summer days, the average wind speed (10 meters above ground level) at Bald Knoll is approximately eight miles per hour at mid-morning, increasing to approximately 12 miles per hour at mid-afternoon; at this time of year, the wind usually blows from the south or southwest, toward the Park.[19] With a wind of 10 miles per hour toward the Park, maximum sound levels from blasting are altered to the results shown in Tables XI and XII. Figure 10 shows sound level contours for parting shots with a 10 mile per hour wind toward the Park. The reader should note the fact that a wind of 10 miles per hour blowing toward the Park has a greater effect on the maximum sound levels due to blasting than it does on the indigenous levels in the Park. Analytically, this is due to the fact that the effect of the wind on blasting sound levels is a linear function of wind speed, while the effect of the wind on indigenous levels is a logarithmic function of wind speed.

Other major atmospheric effects may manifest themselves, particularly in the fall and winter, when subsidence inversions occur. Such inversions are

TABLE IX. Maximum sound levels in the Park during the summer due to blasting in East Alton (no wind, no inversion).

Type of Blast	Sound levels, dBA	
	Yovimpa Point	Bryce Point
Overburden	50	35
Parting	66	51

TABLE X. Maximum sound levels in the Park during the summer due to blasting in West Alton (no wind, no inversion).

Type of Blast	Sound levels, dBA	
	Yovimpa Point	Bryce Point
Overburden	33	24
Parting	49	40

TABLE XI. Maximum sound levels in the Park during the summer due to blasting in East Alton with 10 mile per hour wind toward the Park (no inversion).

Type of Blast	Sound levels, dBA	
	Yovimpa Point	Bryce Point
Overburden	67	54
Parting	86	73

TABLE XII. Maximum sound levels in the Park during the summer due to blasting in West Alton with 10 mile per hour wind toward the Park (no inversion).

Type of Blast	Sound levels, dBA	
	Yovimpa Point	Bryce Point
Overburden	53	45
Parting	72	64

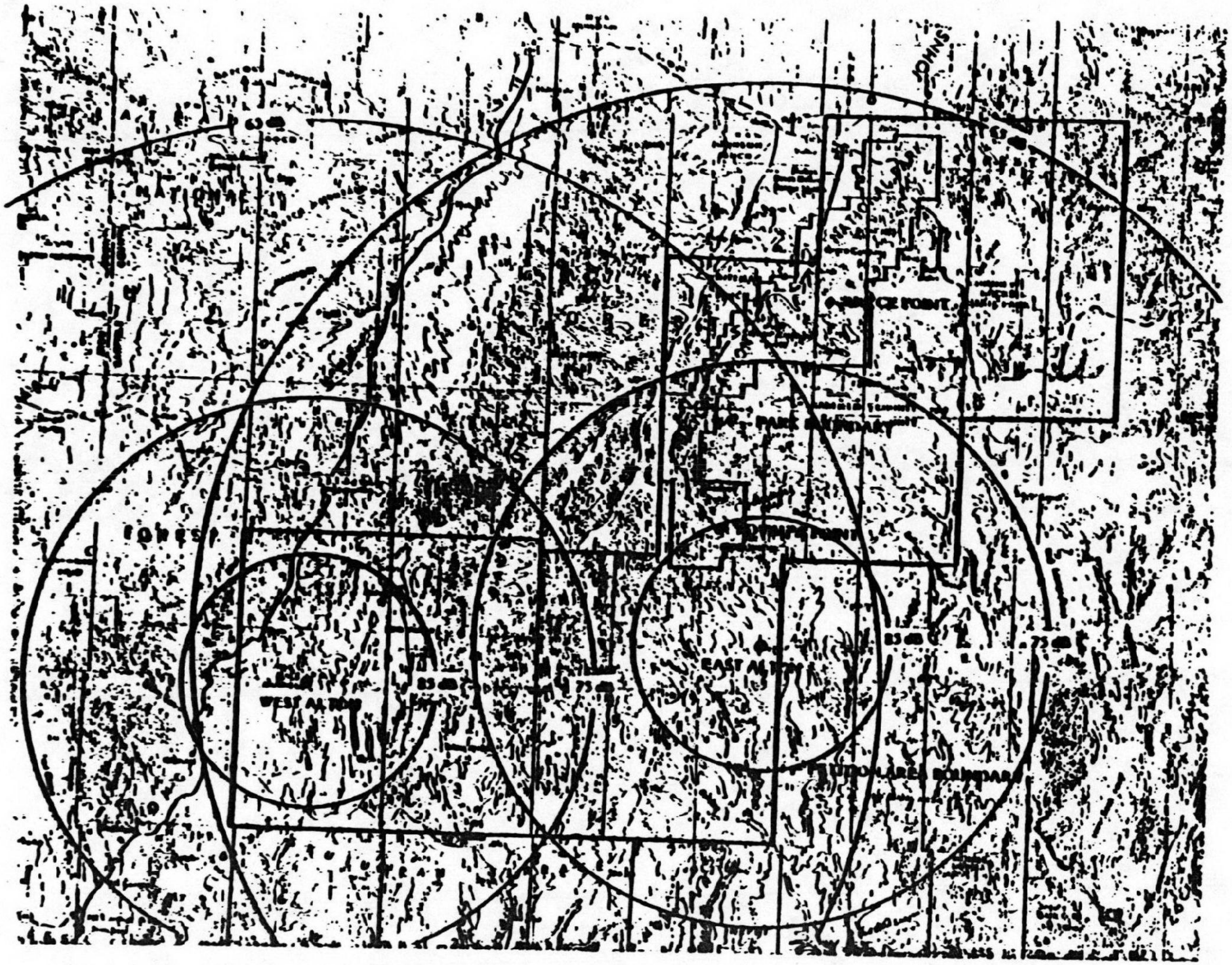


FIGURE 10. Blasting sound level contours for parting shots with a 10 mile per hour wind toward Park.

associated with strong surface winds, and their tops are not as affected by the underlying terrain as ordinary inversions are. Accordingly, a subsidence inversion, if its base reaches the ground, could enhance sound levels greatly as a result of three cooperating mechanisms: refraction by the wind; refraction by the temperature inversion; and concentration of acoustic energy by a converging duct, consisting of the upward sloping terrain, together with the top of the temperature inversion as a lid.

Finally, we remark that a surface wind of 10 miles per hour toward the Park on summer days will enhance sound levels from trucks too. Table XIII shows the expected levels, and Figure 11 provides sound level contours. It is clear that trucks operating in East Alton are likely to be audible on summer days from Yovimpa Point.

TABLE XIII. Sound levels from 20 trucks on summer days with wind of 10 miles per hour toward Park.

Truck location	Sound levels, dBA	
	Yovimpa Point	Bryce Point
East Alton	38-46	18-26
West Alton	16-24	4-12

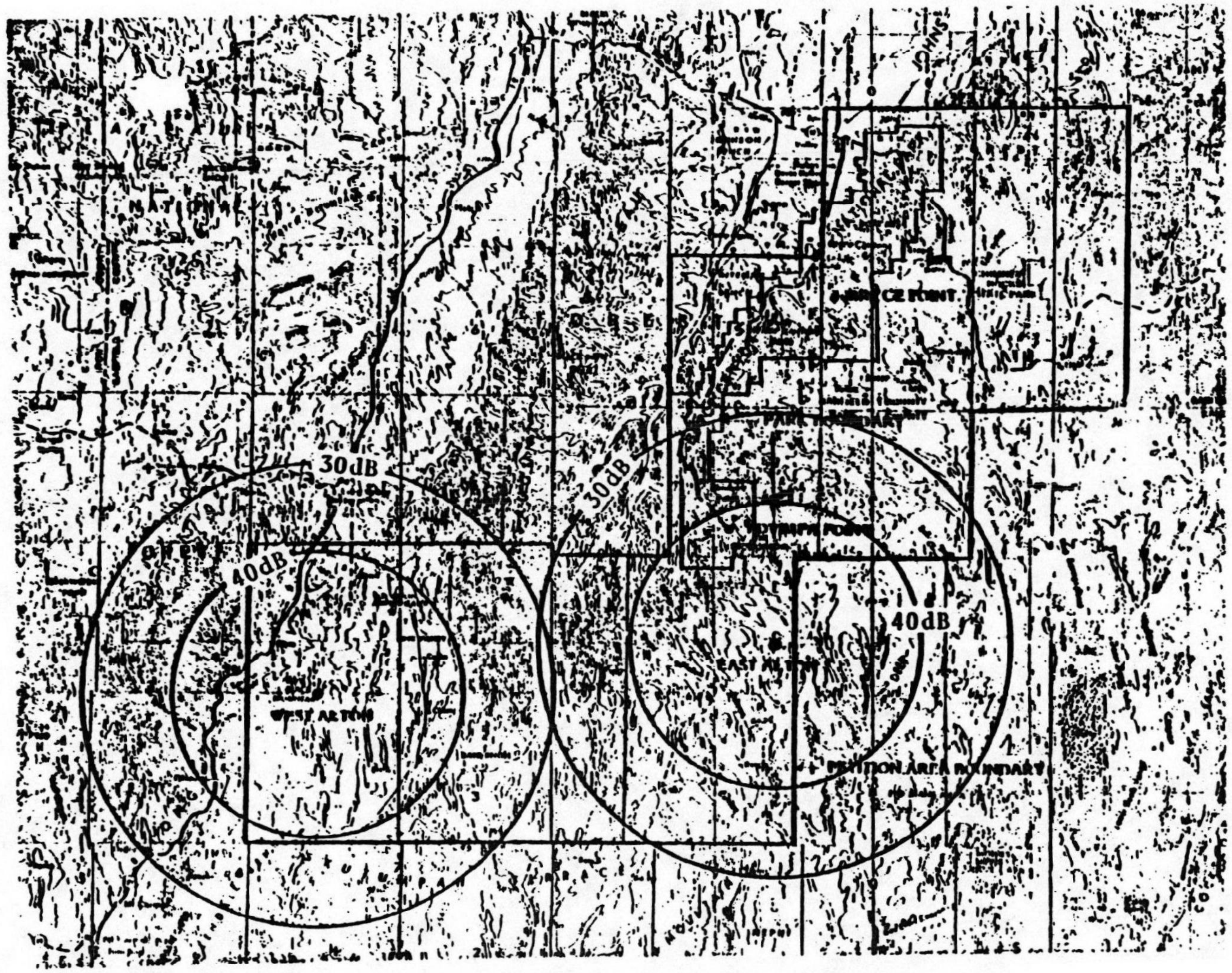


FIGURE 11. Daytime sound level contours during summer due to trucks

VI. AUDIBILITY OF SOUNDS FROM THE PROPOSED MINING

The acoustic impact of a sound is a function of more than the measured or predicted "loudness". This phenomenon is particularly true in assessing the magnitude and importance of surface coal mine noise in the unique setting of a nearby national park. The acoustic impact depends on the characteristics of the sound (amplitude, frequency and duration), the background or indigenous sound levels in which the sound is heard, and the individual attributes or expectation of the listener. The work of Harrison, Clark and Starkey[20] indicates that the importance of the impacts will be heavily influenced by expectations of Park visitors. Further, the acoustic impact must be assessed knowing that "Even the detectability of man-made noise in pristine areas can be of significant annoyance to people."*

Masking is an important consideration in any assessment of audibility. Sounds from the proposed mining will be audible in the Park provided they are not masked by indigenous sounds. The octave band spectra of indigenous sounds contained in Table III have approximately equal equivalent levels for the six octave bands with center frequencies extending from 31.5 Hertz to 1000 Hertz. This means the sounds from the proposed mining will be audible whenever any of their octave band levels reach a level eight decibels <u>less</u> than the overall equivalent level of the indigenous sounds. Of course, as the level of the sounds from the proposed mining increases above this audibility limit, the mining sounds will be perceived as increasingly loud. The data in Appendix B and in Table III and the estimates in Section V indicate that masking of mining noises will occur infrequently.

*From "Towards a National Strategy for Noise Control" USEPA 1977

Actually, the preceding discussion underestimates the limit of audibility for two reasons. First, masking by low level sounds is less effective than masking by high level sounds[21], and as a result low level sounds from mining will be correspondingly more audible. Second, the equivalent levels used above for the octave bands of indigenous sounds do not do justice to the instantaneous levels in the octave bands. These instantaneous levels in the octave bands are several decibels lower than the equivalent levels much of the time. Hence, sounds from mining will be audible more often than is implied by use of the equivalent levels for the octave bands of indigenous sounds.

VII. INTERPRETATION AND CONCLUSION

Surface coal mining noise would be distinctly audible in Bryce Canyon National Park if the Alton Coal Field is developed. The most serious noise impacts would occur at Yovimpa Point from operations in the proposed East Alton area. Noise from West Alton activities would also be audible, particularly blasting. Bryce Canyon National Park is generally an extremely quiet area with meteorological conditions often favorable for long range sound propagation from the proposed coal field toward the Park. Under these conditions, the noise from surface coal mining operation can be heard at relatively great distances from the sources. This report shows that blasting and truck noise will be audible in varying degrees from within the Park during a major proportion of the time. Weather data from three different sources in or near the Park indicate that wind speeds are less than 10 miles per hour during 75% of the time (see Table II). A 10 mile per hour wind would have virtually no masking effect on the surface coal mining noise. Yet, wind speeds in this range have the effect of enhancing long range sound propagation through refraction as discussed in Section V. This will occur when the wind direction is from the coal field towards the Park which happens to be the prevailing condition during summer days. Therefore, surface coal mine noise will impact portions of the Park during much of the time, because the winds toward the Park occur at the "wrong" time of the day. Truck noise will be a continuous source of noise while blasting will occur perhaps two to six times per day[5]. The truck noise will be perceived as a droning of varying levels in the otherwise quiet background of the Park.

Indigenous sound levels in Bryce Canyon National Park are so low that conventional sound descriptors must be used with care in assessing the impact of the proposed surface mining.

However, conventional noise descriptors do reveal a severe impact at Yovimpa Point if the proposed surface mining were concentrated in East Alton. Indigenous sound levels in the Park frequently fall below 20 decibels on the A-weighted scale; this low level is comparable to the quiet found in a high quality sound studio. The projected noise impacts from coal mining activities would come predominantly from two major sources: 170 ton coal trucks and blasting. The coal trucks at East Alton would produce maximum noise levels of 28 to 67 dBA at Yovimpa Point. When compared to the extremely low indigenous levels, truck noise alone would cause a two to 16 fold increase in the perceived loudness of sound levels in the Park. Blasting noise from East Alton is predicted to be as high as 86 dBA at Yovimpa Point. Once again comparing these noise levels to the low indigenous sound levels known to exist in the Park, blasting could be perceived as being as much as 64 times louder than the natural background sound levels.

According to the Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) of the National Research Council[22], for "critical land uses requiring special consideration, the hourly average sound level due to the intruding noise should not be allowed to be higher than 5 dB below the existing hourly average sound level" (emphasis added), and "the noise measure recommended in these guidelines for assessing the environmental impact of high energy impulse noise is the C-weighted sound exposure level." Using the results of Appendix E, one finds the C-weighted sound exposure levels and C-weighted hourly equivalent levels for blasting contained in Table XIV. The integer N (number of delays) is expected to be about 33 for overburden shots and 50 for parting shots[5].

According to Table XIV, whenever a 10 mile per hour wind is blowing toward the Park, CHABA guidelines would be greatly exceeded by overburden or parting shots everywhere in the Park.

TABLE XIV. C-weighted sound exposure levels and C-weighted hourly equivalent levels for blasting

Location of blasting	Type of blasting	C-SEL minus 10 log N, dBC		$C\text{-}l_{eq(1\ hr)}$ minus 10 log N, dBC	
		Yovimpa pt.	Bryce pt.	Yovimpa pt.	Bryce pt.
East Alton	Parting	108	99	73	63
	Overburden	89	80	54	44
West Alton	Parting	97	91	62	56
	Overburden	78	72	43	37

ACKNOWLEDGEMENTS

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16. Reference 15, page 64.

17. Reference 2, pages A-17 and B-17.

18. Here and in the sequel we have used the following distances: East Alton to Yovimpa Point--27,000 feet; East Alton to Bryce Point--74,000 feet; West Alton to Yovimpa Point--82,900 feet; West Alton to Bryce Point--141,500 feet.

19. See Reference 2, p. C-5.

20. Robin T. Harrison, Roger N. Clark, and George H. Stankey, "Predicting Impact of Noise on Recreationists," Forest Service, U.S. Department of Agricultue/EPA Project Record (April 1980).

21. Reference 8, page B-15.

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APPENDIX A: EQUIPMENT LIST

EQUIPMENT LIST

System	Components
A	Digital Acoustics Community Noise Analyzer Model 607-P
	General Radio 1962-9610 ½ inch Microphone
	General Radio 1972-9600 Preamplifier
	General Radio 1567 Sound Level Calibrator
B	General Radio 1981-B Precision Sound Level Meter
	General Radio 1962-9610 ½ inch Microphone
	General Radio 1981-4000 Preamplifier
	Nagra IV-SJ Scientific Tape Recorder
	Taylor Sling Psychrometer
	General Radio 1567 Sound Level Calibrator
	Digital Acoustics Community Noise Analyzer Model 607-P
	General Radio 1521-B Graphic Level Recorder
	Scotch 212 Low Noise Magnetic Tape
C	General Radio 1933 Precision Sound Level Meter and Analyzer
	General Radio 1961-9601 1 inch Microphone
	Nagra IV-SJ Scientific Tape Recorder
	Taylor Sling Psychrometer
	General Radio 1562 Multi-Frequency Calibrator
	Digital Acoustics Community Noise Analyzer Model 607-P
	General Radio 1521-B Graphic Level Recorder
	Scotch 212 Low Noise Magnetic Tape
D	General Radio 1981-B Precision Sound Level Meter
	General Radio 1962-9610 ½ inch Microphone
	General Radio 1981-4000 Preamplifier

System	Components
D (Continued)	Nagra IV-D Scientific Tape Recorder
	Pocket Wind Gauge
	Thermometer
	General Radio 1567 Sound Level Calibrator
	Digital Acoustics Community Noise Analyzer Model 607-P
	General Radio 1521-B Graphic Level Recorder
	Scotch 212 Low Noise Magnetic Tape
E	General Radio 1981-B Precision Sound Level Meter
	General Radio 1962-9610 ½ inch Microphone
	General Radio 1981-4000 Preamplifier
	General Radio 1985 Graphic Level Recorder
	General Radio 1567 Sound Level Calibrator
	Pocket Wind Gauge
	Thermometer
F	General Radio 1933 Precision Sound Level Meter and Analyzer
	General Radio 1961-9601 1 inch Microphone
	General Radio 1521-B Graphic Level Recorder
	Nagra IV-SJ Scientific Tape Recorder
	General Radio 1562 Multi-Frequency Calibrator
	Ampex 641 Low Noise Magnetic Tape
	Digital Acoustics Community Noise Analyzer Model 607-P
G	General Radio 1933 Precision Sound Level Meter and Analyzer
	General Radio 1961-9601 1 inch Microphone
	General Radio 1562 Multi-Frequency Calibrator
	Nagra IV-SJ Scientific Tape Recorder

System	Components
G (Continued)	General Radio 1521-B Graphic Level Recorder
	Thermometer
	Pocket Wind Gauge
	Scotch 177 Low Noise Magnetic Tape
	Digital Acoustics Community Noise Analyzer Model 607-P
H	General Radio 1933 Precision Sound Level Meter and Analyzer
	General Radio 1562 Multi-Frequency Calibrator
	General Radio 1961-9601 1 inch Microphone
	Nagra IV-D Scientific Tape Recorder
	Scotch 177 Low Noise Magnetic Tape
	Taylor Sling Psychrometer
	Pocket Wind Gauge
	General Radio 1521-B Graphic Level Recorder
	Digital Acoustics Community Noise Analyzer Model 607-P
I	General Radio 1933 Precision Sound Level Meter and Analyzer
	General Radio 1961-9601 1 inch Microphone
	General Radio 1985 Graphic Level Recorder
	General Radio 1562 Multi-Frequency Calibrator
	Nagra IV-D Scientific Tape Recorder
	Scotch 177 Low Noise Magnetic Tape
	Pocket Wind Gauge
	Digital Acoustics Community Noise Analyzer Model 607-P
	Taylor Sling Psychronometer
J	General Radio 1981-B Precision Sound Level Meter
	General Radio 1962-9610 ½ inch Microphone

System	Components
J (Continued)	General Radio 1981-4000 Preamplifier
	General Radio 1567 Sound Level Calibrator
	General Radio 1521-B Graphic Level Recorder
	Thermometer

System	Components
K	Metrosonics dB-602 Sound Level Analyzer Genrad 1962-9610 ½ inch Microphone Genrad 1560 P42 Preamplifier Genrad 1562 Multi-Frequency Calibrator Pocket Wind Gauge Taylor Sling Psychrometer
L	Genrad 1945 Community Noise Analyzer Genrad 1962-9610 ½ inch Microphone Genrad 1972-9600 Preamplifier Genrad 1562 Multi-Frequency Calibrator Pocket Wind Gauge Taylor Sling Psychrometer
M	Genrad 1981B Precision Sound Level Meter Genrad 1962-9610 ½ inch Microphone Genrad 1981-4000 Preamplifier Genrad 1567 Sound Level Calibrator Nagra IV-SJ Scientific Tape Recorder Ampex Low Noise #642 Magnetic Tape Digital Accoustics 607P Community Noise Analyzer Pocket Wind Gauge Taylor Sling Psychrometer
N	Genrad 1933 Precision Sound Level Meter and Analyzer Genrad 1961-9601 1 inch Microphone Genrad 1562 Multi-Frequency Calibrator Nagra IV-SJ Scientific Tape Recorder Ampex Low Noise #642 Magnetic Tape Digital Acoustics 607P Community Noise Analyzer Pocket Wind Gauge Taylor Sling Psychrometer

APPENDIX B: INDIGENOUS SOUND LEVELS IN BRYCE CANYON NATIONAL PARK

Date: 5 June 1980

Site: Near Bryce Point (100 yards west of Bryce Point parking lot and 100 yards north of east-west roadway to the parking lot).

Temperature: 58°F

Relative Humidity: 30% (Inferred)

Wind: 0-5 miles per hour with gusts to 10 miles per hour.

Equipment: System B

Comments: The principal sources of sound were winds aloft and birds, despite the proximity of the parking lot.

Time Interval:	1020-1040	1040-1100
L_{eq}, dBA:	43,4	43.3
$L_{.01}$, dBA:	63	61
$L_{.1}$, dBA:	57	55
L_1, dBA:	53	51
L_5, dBA:	49	48
L_{10}, dBA:	46	47
L_{50}, dBA:	39	40
L_{90}, dBA:	34	35
L_{99}, dBA:	32	33
$L_{max.}$, dBA:	62.1	59.7
$L_{min.}$, dBA:	31.5	32.4
Std. Dev., dBA:	4.7	4.4

Date: 5 June 1980

Site: Near Bryce Point (150 yards south of approach road, shielded by natural berm.

Temperature: 66°F

Relative Humidity: 23% (Inferred)

Wind: 0-5 miles per hour with gusts to 10 miles per hour.

Equipment: System B

Comments: Principal sources of sound were winds aloft and birds.

Time Interval:		1325-1345	1345-1405	1418-1438	1438-1458
L_{eq}	,dBA:	45.4	46.2	50.1	49.4
$L_{.01}$	,dBA:	57	58	66	61
$L_{.1}$	,dBA:	56	56	62	59
L_1	,dBA:	53	54	59	58
L_5	,dBA:	50	51	55	54
L_{10}	,dBA:	48	49	53	52
L_{50}	,dBA:	43	44	46	47
L_{90}	,dBA:	36	38	41	42
L_{99}	,dBA:	33	36	38	38
$L_{max.}$	,dBA:	56.7	57.5	65.3	60.3
$L_{min.}$	,dBA:	32.0	35.4	37.3	37.4
Std. Dev.	,dBA:	4.5	4.0	4.5	4.1

Date: 5 June 1980

Site: Near Bryce Point (about 320 yards down along the trail which begins at Bryce Point).

Temperature: Estimated 60°F-65°F

Relative Humidity: 28-23% (Inferred)

Wind: No wind on trail, but high winds aloft.

Equipment: System B

Comments: Five minute intervals used. Principal sources of sound were voices and footsteps of hikers. A 20 minute sample the next day from 5:41 p.m. to 6:01 p.m. yielded a smaller L_{eq} which was however lost due to technical error.

Time Interval:	1607-1612	1612-1617	1617-1622
L_{eq} ,dBA:	43.2	33.5	33.6
$L_{.01}$,dBA:	58	45	46
$L_{.1}$,dBA:	57	43	45
L_{1} ,dBA:	53	40	41
L_{5} ,dBA:	47	38	38
L_{10} ,dBA:	45	36	36
L_{50} ,dBA:	40	31	31
L_{90} ,dBA:	36	30	30
L_{99} ,dBA:	34	30	30
$L_{max.}$,dBA:	57.6	44.1	45.4
$L_{min.}$,dBA:	33.0	29.5	29.5
Std. Dev.,dBA:	4.0	2.3	2.5

Date: 5 June 1980

Site: Near Rainbow Point (on the roof of the comfort station near Rainbow Point).

Temperature: Estimated 50°F to 60°F.

Relative Humidity: 41-28% (Inferred)

Wind: Estimated 10 to 20 knots.

Equipment: System A

Comments: The microphone and preamplifier were mounted on a tripod, which was then lashed to the roof of the comfort station. The rest of the equipment was locked inside the comfort station. Ambient levels at 11:00 A.M. were 50 to 60 dBA.

Time Interval:	1100-1120	1120-1140	1620-1640	1700-1720	1720-1740
L_{eq} ,dBA:	57.3	56.1	56.3	56.1	56.0
$L_{.01}$,dBA:	69	70	-	67	78
$L_{.1}$,dBA:	68	67	-	65	71
L_{1} ,dBA:	64	64	-	62	64
L_{5} ,dBA:	61	60	-	60	60
L_{10} ,dBA:	60	59	-	59	58
L_{50} ,dBA:	55	54	-	54	53
L_{90} ,dBA:	50	49	-	49	38
L_{99} ,dBA:	47	47	-	46	34
$L_{max.}$,dBA:	68.7	69.6	67.0	66.8	77.5
$L_{min.}$,dBA:	46.2	45.1	43.2	45.2	33.2
Std. Dev,dBA:	3.7	3.7	4.0	3.7	7.1

Date: 5 June 1980

Site: Near Yovimpa Point (30 yards north of the weather station).

Temperature: Estimated 40°F

Relative Humidity: 59% (Inferred)

Wind: Estimated 10-20 knots in tree tops, occasional gusts to 30 knots.

Equipment: System A

Comments: The equipment was set up in an area sheltered from the wind. The principal source of sound was wind in the tree tops, which resulted in levels of 40-45 dBA during calm periods; 50-55 dBA usually, and 60-65 dBA during occasional gusty periods.

Time Interval:	0853-0913	0913-0933	0933-0953	0953-1013
L_{eq} ,dBA:	48.1	50.4	51.9	52.7
$L_{.01}$,dBA:	58	61	64	62
$L_{.1}$,dBA:	57	58	62	60
L_1 ,dBA:	55	56	60	58
L_5 ,dBA:	52	54	57	57
L_{10} ,dBA:	50	53	55	56
L_{50} ,dBA:	46	49	49	51
L_{90} ,dBA:	43	43	40	47
L_{99} ,dBA:	40	40	36	45
$L_{max.}$,dBA:	57.4	60.0	63.2	61.4
$L_{min.}$,dBA:	39.2	35.2	34.2	43.2
Std. Dev. ,dBA:	2.9	3.7	5.4	3.3

Date: 6 June 1980

Site: Bryce Point (Midway north-south in bus lane, about 3 feet from low stone rail).

Temperature: 43°F

Relative Humidity: 53% (Inferred)

Wind: Light surface wind.

Equipment: System C

Comments: Twenty minute intervals used. The principal sources of sound were birds and a snorting mule deer.

Time Interval:	0543-0603	0603-0623
L_{eq} ,dBA:	33.7	32.4
$L_{.01}$,dBA:	51	46
$L_{.1}$,dBA:	47	43
L_1 ,dBA:	43	40
L_5 ,dBA:	38	37
L_{10} ,dBA:	36	35
L_{50} ,dBA:	30	30
L_{90} ,dBA:	24	25
L_{99} ,dBA:	20	22
$L_{max.}$,dBA:	50.3	45.3
$L_{min.}$,dBA:	19.4	21.0
Std. Dev,dBA:	4.8	4.0

Date: 6 June 1980

Site: Near Bryce Point (fifth switchback descending along trail from Bryce Point, about 320 yards down the trail).

Temperature: 43°F

Relative Humidity: 46%

Wind: Little or no wind.

Equipment: System C

Comments: Shifting feet, insect buzz, lantern switch, car doors, and shuffling paper were all audible. Twenty minute intervals used.

Time Interval:	2241-2301	2301-2321
L_{eq} ,dBA:	16.9	17.1
$L_{.01}$,dBA:	28	29
$L_{.1}$,dBA:	21	23
L_{1} ,dBA:	19	20
L_{5} ,dBA:	18	18
L_{10} ,dBA:	17	17
L_{50} ,dBA:	16	16
L_{90} ,dBA:	16	16
L_{99} ,dBA:	15	15
$L_{max.}$,dBA:	27.1	28.0
$L_{min.}$,dBA:	14.3	14.6
Std. Dev.,dBA:	0.7	0.8

Date: 6 June 1980

Site: Near Rainbow Point (20 yards north of comfort station).

Temperature: 58°F

Relative Humidity: 30% (Inferred)

Wind: 5-10 miles per hour on the surface.

Equipment: System D

Comments: A fifteen minute sampling period was used. The principal sources of sound were winds aloft and birds.

Time Interval:		0600-0615
L_{eq}	,dBA:	57.1
$L_{.01}$	,dBA:	65
$L_{.1}$	,dBA:	64
L_1	,dBA:	62
L_5	,dBA:	60
L_{10}	,dBA:	59
L_{50}	,dBA:	56
L_{90}	,dBA:	54
L_{99}	,dBA:	52
$L_{max.}$	,dBA:	64.6
$L_{min.}$	,dBA:	44.5
Std. Dev.	,dBA:	2.1

Date: 6 June 1980

Site: Near Yovimpa Point (50 yards north of weather station)

Temperature: Estimated 40°F

Relative Humidity: 59% (Inferred)

Wind: Steady 10 knots early morning, increasing to 20 knots about 10:00

Equipment: System A

Comments: The equipment was set up in an area sheltered from the wind.

Twenty minute sampling periods were used.

The principal source of sound was winds aloft.

Time Interval:	0535-0555	0555-0615	0635-0655	0655-0715
L_{eq} ,dBA:	58.2	57.3	58.1	58.8
$L_{.01}$,dBA:	66	68	67	67
$L_{.1}$,dBA:	65	66	66	66
L_1 ,dBA:	63	64	63	64
L_5 ,dBA:	61	61	61	62
L_{10} ,dBA:	61	59	60	61
L_{50} ,dBA:	57	56	57	57
L_{90} ,dBA:	53	53	54	54
L_{99} ,dBA:	51	50	51	52
$L_{max.}$,dBA:	65.8	67.2	66.4	66.9
$L_{min.}$,dBA:	48.3	47.3	49.3	49.3
Std. Dev,dBA:	2.7	2.8	2.6	2.7

Date: 6 June 1980 (Continued)

Site: Near Yovimpa Point (50 yards north of weather station).

Temperature:

Relative Humidity:

Wind:

Equipment:

Comments:

Time Interval:		0715-0735	0735-0755	0755-0815	0835-0855
L_{eq}	,dBA:	57.7	58.0	58.0	57.1
$L_{.01}$	,dBA:	65	65	68	65
$L_{.1}$	,dBA:	64	63	65	64
L_{1}	,dBA:	63	62	63	63
L_{5}	,dBA:	61	61	61	61
L_{10}	,dBA:	60	60	60	60
L_{50}	,dBA:	56	57	57	55
L_{90}	,dBA:	52	53	53	51
L_{99}	,dBA:	50	51	51	49
$L_{max.}$	,dBA:	64.6	64.9	67.8	64.8
$L_{min.}$	,dBA:	47.3	48.3	49.3	47.3
Std. Dev.	,dBA:	2.8	2.6	2.6	3.2

Date: 6 June 1980 (Continued)

Site: Near Yovimpa Point (50 yards north of weather station).

Temperature:

Relative Humidity:

Wind:

Equipment:

Comments:

Time Interval:	1055-1115	1115-1135
L_{eq} ,dBA:	60.5	59.3
$L_{.01}$,dBA:	72	71
$L_{.1}$,dBA:	71	69
L_{1} ,dBA:	68	66
L_{5} ,dBA:	64	63
L_{10} ,dBA:	63	62
L_{50} ,dBA:	59	58
L_{90} ,dBA:	54	54
L_{99} ,dBA:	50	51
L_{max}, ,dBA:	71.7	70.0
L_{min}, ,dBA:	46.2	50.0
Std. Dev.,dBA:	3.3	2.9

DATE: 18 August 1980

SITE: Near Bryce Point

TEMPERATURE: 58°F

RELATIVE HUMIDITY: 18%

WIND: 0-6 mph in the parking lot, estimated 20 mph up along trail at Bryce Point lookout.

EQUIPMENT: System K

COMMENTS: The equipment was set up beside the small sign at the entrance to the parking lot. The principal sound sources were footsteps, wind, and an occasional car, and aircraft.
Also this equipment has a noise floor of 30 dBA which was reached during the sampling interval.

TIME INTERVAL:	2345-0045	
	Measured	Calculated
L_{eq}, dBA:	43	42.4
$L_{.01}$, dBA:		
$L_{.1}$, dBA:		
L_1, dBA:	52	
L_5, dBA:	48	
L_{10}, dBA:	46	
L_{50}, dBA:	31	
L_{90}, dBA:	30	
L_{99}, dBA:	30	
L Max., dBA:		
L Min., dBA:		
Std. Dev., dBA:		

DATE: 19 August 1980

SITE: Near Bryce Point (150 yards south of approach road, shielded by natural berm).

TEMPERATURE: 71 °F

RELATIVE HUMIDITY: 27%

WIND: 0-5 mph

EQUIPMENT: System L

COMMENTS: The principal sound sources were cars, birds, an occasional wind and insects. Also, two one-hour intervals were used.

TIME INTERVAL:	1545-1645	1645-1745
L_{eq}, dBA:	46	48
$L_{.01}$, dBA:		
$L_{.1}$, dBA:	57	65
L_{1}, dBA:	54	57
L_{5}, dBA:	51	52
L_{10}, dBA:	49	50
L_{50}, dBA:	43	44
L_{90}, dBA:	37	39
L_{99}, dBA:	31	34
L Max., dBA:	60	70
L Min., dBA:	29	32
Std. Dev., dBA:		

DATE: 19 August 1980

SITE: Near Bryce Point (150 yards south of approach road, shielded by natural berm).

TEMPERATURE:

RELATIVE HUMIDITY:

WIND: Calm

EQUIPMENT: System L minus the Taylor Sling Psychrometer

COMMENTS: The principal sources of sound were birds, insects, aircraft, and cars. Three one-hour intervals were used.

TIME INTERVAL:	1900-2000	2000-2100	2100-2200
L_{eq} , dBA:	41	38	33
$L_{.01}$, dBA:			
$L_{.1}$, dBA:	53	52	46
L_1 , dBA:	50	49	43
L_5 , dBA:	46	45	39
L_{10} , dBA:	45	42	37
L_{50} , dBA:	38	34	27
L_{90} , dBA:	32	27	23
L_{99} , dBA:	26	24	23
L Max. , dBA:	55	59	50
L Min. , dBA:	25	23	22
Std. Dev., dBA:			

DATE: 19 August 1980

SITE: Near Bryce Point (100 feet beyond the arch on Bryce Point Trail).

TEMPERATURE: 65°F

RELATIVE HUMIDITY: 36%

WIND: 5 mph from the south.

EQUIPMENT: System K

COMMENTS: The principal sources of sound were crows, other birds in the brush, wind in the tree tops and bushes, and footsteps. Here, three one-hour sampling periods were used.
The measured L_{eq} for the last two hours doesn't seem consistent with the cumulative distribution and hence, the L_{eq} calculated using the cumulative distribution is more reliable.
Also the equipment used here has a noise floor of 30 dBA which was reached during the sampling periods.

TIME INTERVAL:	0945-1045		1045-1145		1145-1245	
	Measured	Calculated	Measured	Calculated	Measured	Calculated
L_{eq}, dBA:	35	36.6	39	32.3	55	35.8
$L_{.01}$, dBA:						
$L_{.1}$, dBA:						
L_1, dBA:	48		41		46	
L_5, dBA:	41		35		40	
L_{10}, dBA:	38		32		38	
L_{50}, dBA:	30		31		30	
L_{90}, dBA:	30		30		30	
L_{99}, dBA:	30		30		30	
L Max., dBA:						
L Min., dBA:						
Std. Dev., dBA:						

DATE: 19 August 1980

SITE: Yovimpa Pass (about 200 feet north of the information box)

TEMPERATURE: 62°F

RELATIVE HUMIDITY: 31%--23%

WIND: Calm on the surface, high winds in tree tops.

EQUIPMENT: System M

COMMENTS: The principal sources of sound here were insects, birds, wind in the tree tops and aircraft. Three forty minute tapes were run.

TIME INTERVAL:	1030-1110	1135-1215	1240-1320
L_{eq} , dBA:	48.3	49.0	53.3
$L_{.01}$, dBA:	64	62	73
$L_{.1}$, dBA:	64	62	68
L_1 , dBA:	59	59	63
L_5 , dBA:	54	55	59
L_{10} , dBA:	51	52	56
L_{50} , dBA:	42	44	48
L_{90} , dBA:	37	37	44
L_{99} , dBA:	36	33	43
L Max. , dBA:	64.7	62.6	73.0
L Min. , dBA:	35.1	32.6	28.1
Std. Dev., dBA:	5.4	6.1	5.2

DATE: 19 August 1980

SITE: Yovimpa Pass (about 200 feet north of the information box).

TEMPERATURE: Estimated 50°F

RELATIVE HUMIDITY:

WIND: Calm

EQUIPMENT: System M minus the Taylor Sling Psychrometer and Pocket Wind Gauge.

COMMENTS:

The principal sources of sound were high-flying aircraft and footsteps on the underbrush.

TIME INTERVAL:	0032-0112
L_{eq}, dBA:	25.5
$L_{.01}$, dBA:	28
$L_{.1}$, dBA:	27
L_1, dBA:	27
L_5, dBA:	26
L_{10}, dBA:	26
L_{50}, dBA:	25
L_{90}, dBA:	24
L_{99}, dBA:	23
L Max., dBA:	28.9
L Min., dBA:	23.6
Std. Dev., dBA:	0.7

DATE: 20 August 1980

SITE: Near Bryce Point

TEMPERATURE: 56°F

RELATIVE HUMIDITY: 36%

WIND: Calm

EQUIPMENT: System L

COMMENTS: The equipment was set up beside the small sign at the entrance to the parking lot again and a one one-hour interval was run. The principal sources of sound were people talking, cars, footsteps, a helicopter, a car-door buzzer, a bus, and aircraft.

TIME INTERVAL:	0845-0945
L_{eq}, dBA:	52
$L_{.01}$, dBA:	
$L_{.1}$, dBA:	69
L_1, dBA:	62
L_5, dBA:	59
L_{10}, dBA:	54
L_{50}, dBA:	32
L_{90}, dBA:	26
L_{99}, dBA:	24
L Max., dBA:	82
L Min., dBA:	23
Std. Dev., dBA:	

DATE: 20 August 1980

SITE: Near Bryce Point (100 yards west of Bryce Point parking lot and 100 yards north of east-west roadway to the parking lot. Behind the hill that borders the automobile parking spaces).

TEMPERATURE: 61°F

RELATIVE HUMIDITY: 31%

WIND: Calm

EQUIPMENT: System L

COMMENTS: The principal sources of sound were footsteps, insects, birds, aircraft, a helicopter, wind rustling the trees and bushes, and cars driving by. Two one-hour intervals were run.

TIME INTERVAL:	1005-1105	1105-1205
L_{eq} , dBA:	33	38
$L_{.01}$, dBA:		
$L_{.1}$, dBA:	48	59
L_{1} , dBA:	45	50
L_{5} , dBA:	40	43
L_{10} , dBA:	35	38
L_{50} , dBA:	25	28
L_{90} , dBA:	23	25
L_{99} , dBA:	23	24
L Max. , dBA:	51	64
L Min. , dBA:	22	23
Std. Dev., dBA:		

DATE: 20 August 1980

SITE: Near Rainbow Point (100 foot north east of the water tower).

TEMPERATURE:

RELATIVE HUMIDITY:

WIND:

EQUIPMENT: System M minus the Taylor Sling Psychrometer

COMMENTS: The principal sources of sound were car doors shutting, jet airplanes flying overhead, a broken branch, people yelling, an airplane flying out near the park boundry, and some suspected seismographic blasting.

TIME INTERVAL:	0940-1020	1043-1123
L_{eq}, dBA:	27.0	30.4
$L_{.01}$, dBA:	44	41
$L_{.1}$, dBA:	41	40
L_{1}, dBA:	37	39
L_{5}, dBA:	30	37
L_{10}, dBA:	28	34
L_{50}, dBA:	24	26
L_{90}, dBA:	24	23
L_{99}, dBA:	23	23
L Max., dBA:	44.2	41.8
L Min., dBA:	22.6	22.4
Std. Dev., dBA:	2.4	4.1

DATE: 20 August 1980

SITE: Near Yovimpa Point (30 yards north of the weather station).

TEMPERATURE: Estimated 40-45°F.

RELATIVE HUMIDITY:

WIND: Calm with an occasional distant breeze in the trees.

EQUIPMENT: System N minus the Taylor Sling Psychrometer

COMMENTS: The principal sound sources were footsteps and distant breezes in the trees.

TIME INTERVAL:	0500-0540
L_{eq}, dBA:	25.0
$L_{.01}$, dBA:	32
$L_{.1}$, dBA:	32
L_1, dBA:	30
L_5, dBA:	28
L_{10}, dBA:	27
L_{50}, dBA:	24
L_{90}, dBA:	21
L_{99}, dBA:	20
L Max., dBA:	32.9
L Min., dBA:	16.4
Std. Dev., dBA:	2.5

DATE: 20 August 1980

SITE: Near Yovimpa Point (30 yards north of the weather station).

TEMPERATURE:

RELATIVE HUMIDITY:

WIND: 0-5 mph

EQUIPMENT: System H minus the Taylor Sling Psychrometer and GenRad 1521-B

COMMENTS: The principal sound sources were car doors in the parking lot, tape recorder noise, cars driving up and leaving area, grasshoppers, and some aircraft.

TIME INTERVAL:	1100-1140	1200-1240
L_{eq} , dBA:	29.3	29.3
$L_{.01}$, dBA:	47	55
$L_{.1}$, dBA:	44	44
L_1 , dBA:	38	37
L_5 , dBA:	34	33
L_{10} , dBA:	32	31
L_{50} , dBA:	25	26
L_{90} , dBA:	21	23
L_{99} , dBA:	19	22
L Max. , dBA:	47.0	55.0
L Min. , dBA:	19.0	21.4
Std. Dev., dBA:	4.4	3.4

DATE: 21 August 1980

SITE: Near Bryce Point

TEMPERATURE:

RELATIVE HUMIDITY:

WIND: Calm

EQUIPMENT: System L minus the Taylor Sling Psychrometer

COMMENTS:

The equipment was again set up beside the small sign at the entrance to the parking lot. It was programmed to run for three one-hour intervals. The principal sources of sound were birds, insects, cars, busses, and people getting in and out of their cars.

TIME INTERVAL:	0705-0805	0805-0905	0905-1005
L_{eq}, dBA:	38	41	48
$L_{.01}$, dBA:			
$L_{.1}$, dBA:	60	62	68
L_1, dBA:	52	59	61
L_5, dBA:	37	44	54
L_{10}, dBA:	32	37	50
L_{50}, dBA:	23	25	33
L_{90}, dBA:	23	23	24
L_{99}, dBA:	22	22	23
L Max., dBA:	62	65	73
L Min., dBA:	22	22	23
Std. Dev., dBA:			

DATE: 21 August 1980

SITE: Near Bryce Point

TEMPERATURE: 65 °F

RELATIVE HUMIDITY: 8%

WIND: 0-2 mph

EQUIPMENT: System N

COMMENTS: The equipment was again set up beside the small sign at the entrance to the parking lot. The principal sound sources were footsteps, an occasional breeze, turning pages, and high-flying aircraft.

TIME INTERVAL:	2340-0020	0040-0120
L_{eq}, dBA:	26.8	26.0
$L_{.01}$, dBA:	40	46
$L_{.1}$, dBA:	38	42
L_{1}, dBA:	35	35
L_{5}, dBA:	31	29
L_{10}, dBA:	28	28
L_{50}, dBA:	25	23
L_{90}, dBA:	23	20
L_{99}, dBA:	21	20
L Max., dBA:	40.1	46.7
L Min., dBA:	19.4	19.4
Std. Dev., dBA:	2.5	3.2

DATE: 21 August 1980

SITE: Near Bryce Point(about 320 yards down along the trail which begins at Bryce Point)

TEMPERATURE: 66°F

RELATIVE HUMIDITY: 6%

WIND: calm

EQUIPMENT: System N

COMMENTS: Two forty minute tapes were run. The principal sources of sound were birds, chipmunks knocking rocks down the trail, people walking by, aircraft, a helicopter,and one bird with just pure aerodynamic sound.

TIME INTERVAL:	0725-0805	0825-0905
L_{eq}, dBA:	21.1	34.9
$L_{.01}$, dBA:	42	58
$L_{.1}$, dBA:	37	56
L_1, dBA:	30	46
L_5, dBA:	23	39
L_{10}, dBA:	21	34
L_{50}, dBA:	19	18
L_{90}, dBA:	18	16
L_{99}, dBA:	17	16
L Max., dBA:	42.7	58.4
L Min., dBA:	15.1	15.4
Std. Dev., dBA:	2.2	7.7

DATE: 21 August 1980

SITE: Near Rainbow Point (just east of the parking lot, 20 yards north of comfort station).

TEMPERATURE: 57°F

RELATIVE HUMIDITY: 22%

WIND: Estimated 0-5 mph in the tree tops, very slight breeze on the ground.

EQUIPMENT:

System A, except that the one inch microphone was used.

COMMENTS:

The equipment was set to run at one-hour intervals. The principal sources of sound were footsteps, wind in the tree tops, high-flying aircraft, and perhaps the technician's car.

TIME INTERVAL:	2245-2345	2345-0045	0045-0145
L_{eq} , dBA:	28.3	29.0	28.1
$L_{.01}$, dBA:	48	40	42
$L_{.1}$, dBA:	45	39	41
L_1 , dBA:	37	37	36
L_5 , dBA:	32	34	33
L_{10} , dBA:	30	32	31
L_{50} , dBA:	24	26	24
L_{90} , dBA:	20	21	20
L_{99} , dBA:	18	19	18
L Max. , dBA:	48.7	40.2	42.7
L Min. , dBA:	17.1	18.1	18.1
Std. Dev., dBA:	4.3	4.1	4.2

DATE: 21 August, 1980 (continued)

SITE: Near Rainbow Point

TEMPERATURE:

RELATIVE HUMIDITY:

WIND:

EQUIPMENT:

COMMENTS:

TIME INTERVAL:	0145-0245	0245-0345	0345-0445
L_{eq} , dBA:	28.1	31.0	34.7
$L_{.01}$, dBA:	50	43	45
$L_{.1}$, dBA:	48	41	44
L_1 , dBA:	40	38	40
L_5 , dBA:	31	35	38
L_{10} , dBA:	28	34	36
L_{50} , dBA:	21	28	33
L_{90} , dBA:	18	21	31
L_{99} , dBA:	17	18	30
L Max. , dBA:	50.9	43.8	45.3
L Min. , dBA:	16.1	17.1	27.1
Std. Dev., dBA:	4.6	5.1	2.3

DATE: 21 August 1980 (continued)

SITE: Near Rainbow Point

TEMPERATURE:

RELATIVE HUMIDITY:

WIND:

EQUIPMENT:

COMMENTS:

TIME INTERVAL:	0445-0545	0545-0645	0645-0745
L_{eq}, dBA:	28.9	22.6	36.4
$L_{.01}$, dBA:	46	35	61
$L_{.1}$, dBA:	44	35	59
L_{1}, dBA:	37	31	47
L_{5}, dBA:	34	27	33
L_{10}, dBA:	32	25	26
L_{50}, dBA:	25	20	19
L_{90}, dBA:	18	17	17
L_{99}, dBA:	17	16	17
L Max., dBA:	46.4	35.9	62.0
L Min., dBA:	16.1	16.1	16.1
Std. Dev., dBA:	4.9	3.3	5.8

DATE: 21 August 1980

SITE: Near Yovimpa Point (30 yards north of the weather station)

TEMPERATURE: 77°F

RELATIVE HUMIDITY:

WIND: Calm on the ground but high winds aloft.

EQUIPMENT: System H minus the Genrad 1521-B.

COMMENTS: One forty-minute tape was used here. The principal sound sources were jets overhead and wind in the trees.

TIME INTERVAL:	1500-1540
L_{eq}, dBA:	34.6
$L_{.01}$, dBA:	54
$L_{.1}$, dBA:	49
L_1, dBA:	42
L_5, dBA:	39
L_{10}, dBA:	38
L_{50}, dBA:	31
L_{90}, dBA:	24
L_{99}, dBA:	21
L Max., dBA:	54.7
L Min., dBA:	19.4
Std. Dev., dBA:	5.1

DATE: 21 August 1980

SITE: Near Yovimpa Point (30 yards north of weather station).

TEMPERATURE: 57°F

RELATIVE HUMIDITY: 22%

WIND: Estimated 0-5 mph in the tree tops.

EQUIPMENT: System L

COMMENTS: The principal sources of sound were wind in the trees and perhaps the technician's car. Three one-hour intervals were run.

TIME INTERVAL:	2230-2330	2330-0030	0030-0130
L_{eq}, dBA:	32	36	35
$L_{.01}$, dBA:			
$L_{.1}$, dBA:	45	48	45
L_1, dBA:	42	46	41
L_5, dBA:	37	43	38
L_{10}, dBA:	35	40	37
L_{50}, dBA:	29	32	33
L_{90}, dBA:	25	28	30
L_{99}, dBA:	24	27	27
L Max., dBA:	47	49	45
L Min., dBA:	23	25	26
Std. Dev., dBA:			

DATE: 22 August 1980

SITE: Near Bryce Point

TEMPERATURE:

RELATIVE HUMIDITY:

WIND:

EQUIPMENT: System L minus the Taylor Sling Psychrometer and Pocket Wind Gauge.

COMMENTS:

Again, the equipment was set up beside the small sign at the entrance to the parking lot. Three one-hour intervals were run and the principal sources of sound were birds, insects, cars, and busses.

TIME INTERVAL:	0734-0834	0834-0934	0934-1034
L_{eq}, dBA:	47	47	48
$L_{.01}$, dBA:			
$L_{.1}$, dBA:	68	67	67
L_1, dBA:	57	60	61
L_5, dBA:	44	52	53
L_{10}, dBA:	35	46	49
L_{50}, dBA:	25	32	39
L_{90}, dBA:	24	26	32
L_{99}, dBA:	23	24	29
L Max., dBA:	79	72	72
L Min., dBA:	23	24	28
Std. Dev., dBA:			

DATE: 22 August 1980

SITE: Near Bryce Point (100 feet west of parking lot and 100 feet north of east/west approach road to parking lot; on the other side of the hill that borders the car parking spaces).

TEMPERATURE:

RELATIVE HUMIDITY:

WIND: Estimated 0-5 mph in the tree tops.

EQUIPMENT: System L minus the Taylor Sling Psychrometer

COMMENTS: The equipment was set to run for three one-hour intervals. The principal sources of sound were wind in the trees, and an occasional animal, bird, or insect later in the sampling period. High-flying aircraft were an additional sound source.

TIME INTERVAL:	0400-0500	0500-0600	0600-0700
L_{eq} , dBA:	25	23	33
$L_{.01}$, dBA:			
$L_{.1}$, dBA:	35	27	54
L_1 , dBA:	32	25	46
L_5 , dBA:	28	24	32
L_{10} , dBA:	27	24	25
L_{50} , dBA:	24	24	22
L_{90} , dBA:	23	22	22
L_{99} , dBA:	23	22	22
L Max. , dBA:	37	31	57
L Min. , dBA:	22	22	22
Std. Dev., dBA:			

DATE: 22 August 1980

SITE: Near Bryce Point (about 320 yards down the trail from Bryce Point, half way down the fifth switchback).

TEMPERATURE: 64°F

RELATIVE HUMIDITY: 43%

WIND: Calm on the trail, 10 mph gusting to 20 mph in tree tops in parking lot.

EQUIPMENT: System A plus the Taylor Sling Psychrometer and Pocket Wind Gauge, except that the one inch microphone was used.

COMMENTS: Three forty-minute intervals were used here. The only principal sound source was a car that entered the parking lot and idled there a minute or two.

TIME INTERVAL:	2230-2310	2310-2350	2350-0030
L_{eq}, dBA:	21.8	23.0	23.0
$L_{.01}$, dBA:	38	37	49
$L_{.1}$, dBA:	36	34	34
L_{1}, dBA:	29	30	30
L_{5}, dBA:	24	27	26
L_{10}, dBA:	23	25	25
L_{50}, dBA:	20	20	20
L_{90}, dBA:	18	19	18
L_{99}, dBA:	18	18	17
L Max., dBA:	38.7	37.1	49.1
L Min., dBA:	17.1	17.1	17.1
Std. Dev., dBA:	2.2	2.8	2.9

DATE: 22 August 1980

SITE: Near Rainbow Point (about 100 feet north of the water tower).

TEMPERATURE:

RELATIVE HUMIDITY:

WIND:

EQUIPMENT: System L minus the Taylor Sling Psychrometer and Pocket Wind Gauge.

COMMENTS: No comments noted.

TIME INTERVAL:	1900-2000
L_{eq} , dBA:	40
$L_{.01}$, dBA:	
$L_{.1}$, dBA:	50
L_1 , dBA:	48
L_5 , dBA:	45
L_{10} , dBA:	43
L_{50} , dBA:	38
L_{90} , dBA:	33
L_{99} , dBA:	29
L Max. , dBA:	54
L Min. , dBA:	27
Std. Dev., dBA:	

DATE: 22 August 1980

SITE: Sunset campground (on top of the ridge behind the amphitheater, 200 feet from the back row of seats).

TEMPERATURE:

RELATIVE HUMIDITY:

WIND:

EQUIPMENT: System L minus the Taylor Sling Psychrometer and Pocket Wind Gauge.

COMMENTS: The equipment was set to run for a one-hour interval. The principal sound sources were birds, insects, and some human activity.

TIME INTERVAL:	1400-1500
L_{eq}, dBA:	50
$L_{.01}$, dBA:	
$L_{.1}$, dBA:	64
L_1, dBA:	59
L_5, dBA:	55
L_{10}, dBA:	53
L_{50}, dBA:	48
L_{90}, dBA:	43
L_{99}, dBA:	40
L Max., dBA:	71
L Min., dBA:	38
Std. Dev., dBA:	

DATE: 23 August 1980

SITE: Near Rainbow Point (100 feet northeast of the water tower)

TEMPERATURE: 55°F

RELATIVE HUMIDITY: 81%

WIND: Calm

EQUIPMENT: System L

COMMENTS: Two one-hour intervals were run. The principal sources of sound were rain, thunder, and hail.

TIME INTERVAL:	1510-1610	1610-1710
L_{eq}, dBA:	61	49
$L_{.01}$, dBA:		
$L_{.1}$, dBA:	85	70
L_1, dBA:	71	59
L_5, dBA:	54	54
L_{10}, dBA:	48	51
L_{50}, dBA:	35	35
L_{90}, dBA:	26	27
L_{99}, dBA:	23	24
L Max., dBA:	90	77
L Min., dBA:	23	23
Std. Dev., dBA:		

DATE: 23 August 1980

SITE: Near Yovimpa Point (30 yards north of weather station)

TEMPERATURE: 58°F

RELATIVE HUMIDITY: 60%

WIND: 0-5 mph

EQUIPMENT: System L

COMMENTS: The principal sources of sound were wind in the tree tops, people walking and talking, and the rain storm itself. This set up ran for two one-hour intervals.

TIME INTERVAL:	1830-1930	1930-2030
L_{eq}, dBA:	40	29
$L_{.01}$, dBA:		
$L_{.1}$, dBA:	63	48
L_1, dBA:	49	38
L_5, dBA:	35	33
L_{10}, dBA:	32	30
L_{50}, dBA:	25	24
L_{90}, dBA:	23	23
L_{99}, dBA:	22	22
L Max., dBA:	70	58
L Min., dBA:	22	22
Std. Dev., dBA:		

DATE: 23 August 1980

SITE: Sunset campground (on top of the ridge behind the amphitheater, 200 feet from the back row of seats).

TEMPERATURE:

RELATIVE HUMIDITY:

WIND: Calm

EQUIPMENT: System L minus the Taylor Sling Psychrometer

COMMENTS: The principal sound sources were light rain and an occasional breeze. The equipment was set to run for three one-hour intervals.

TIME INTERVAL:	2230-2330	2330-0030	0030-0130
L_{eq}, dBA:	26	25	24
$L_{.01}$, dBA:			
$L_{.1}$, dBA:	39	39	34
L_{1}, dBA:	35	34	32
L_{5}, dBA:	31	29	27
L_{10}, dBA:	29	27	25
L_{50}, dBA:	25	22	22
L_{90}, dBA:	22	22	22
L_{99}, dBA:	22	22	22
L Max., dBA:	41	42	35
L Min., dBA:	22	22	22
Std. Dev., dBA:			

DATE: 28 September 1980

SITE: Near Yovimpa Point (about 30 yards north of weather station)

TEMPERATURE: 66°F

RELATIVE HUMIDITY:

WIND: 0-5 mph on the ground with occasional winds aloft.

EQUIPMENT: System N

COMMENTS: The equipment was set to run for one forty-minute interval. The principal sound sources were winds aloft, occasional cars, voices, and high flying jets.

TIME INTERVAL: 1715-1755

L_{eq}, dBA:	35.2
$L_{.01}$, dBA:	48
$L_{.1}$, dBA:	47
L_{1}, dBA:	45
L_{5}, dBA:	41
L_{10}, dBA:	38
L_{50}, dBA:	31
L_{90}, dBA:	24
L_{99}, dBA:	18
L Max., dBA:	48.5
L Min., dBA:	17.1
Std. Dev., dBA:	5.7

L_{eq}, dBA

Date & Time

SITE	6/5	6/6	8/18	8/19	8/20	8/21	8/22	8/23
2		0543-0603: 33.7 0603-0623: 32.4	2345-0045: 43		0845-0945: 52	0705-0805: 38 0805-0905: 41 0905-1005: 48 2340-0020: 26.8 0040-0120: 26.0	0734-0834: 47 0834-0934: 47 0934-1034: 48	
5	1020-1040: 43.4 1040-1100: 43.3				1005-1105: 33 1105-1205: 38		0400-0500: 25 0500-0600: 23 0600-0700: 33	
6	1325-1345: 45.4 1345-1405: 46.2 1418-1438: 50.1 1438-1458: 49.4			1545-1645: 46 1645-1745: 48 1900-2000: 41 2000-2100: 38 2100-2200: 33				
3	1607-1612: 43.2 1612-1617: 33.5 1617-1622: 33.6	2241-2301: 16.9 2301-2321: 17.1				0725-0805: 21,1 0825-0905: 34,9	2230-2310: 21.8 2310-2350: 23.0 2350-0030: 23,0	
4				0945-1045: 37 1045-1145: 32 1145-1245: 36				
7	1100-1120: 57.3 1120-1140: 56.1 1620-1640: 56.3 1700-1720: 56.1 1720-1740: 56.0	0600-0615: 57,1				2245-2345: 28.3 2345-0045: 29.0 0045-0145: 28.1 0145-0245: 28,1 0245-0345: 31.0 0345-0445: 34,7 0445-0545: 28.9 0545-0645: 22,6 0645-0745: 36,4		

L_{eq} ,dBA

Date & Time

(Continued)

SITE	6/5	6/6	8/18	8/19	8/20	8/21	8/22	8/23
8					0940-1020: 27.0 1043-1123: 30.4		1900-2000: 40	1510-1610: 61 1610-1710: 49
9	0853-0913: 48.1 0913-0933: 50.4 0933-0953: 51.9 0953-1013: 52.7	0535-0555: 58.2 0555-0615: 57.3 0635-0655: 58.1 0655-0715: 58.8 0715-0735: 57.7 0735-0755: 58.0 0755-0815: 58.0 0835-0855: 57.1 1055-1115: 60.5 1115-1135: 59.3			0500-0540: 25.0 1100-1140: 29.3 1200-1240: 29.3	1500-1540: 34.6 2230-2330: 32 2330-0030: 36 0030-0130: 35		1830-1930: 40 1930-2030: 29
10				1030-1110: 48.3 1135-1215: 49.0 1240-1320: 53.3 0032-0112: 25.5				
1							1400-1500: 50	2230-2330: 26 2330-0030: 25 0030-0130: 24

L_{10}, dBA

Date & Time

SITE	6/5	6/6	8/18	8/19	8/20	8/21	8/22	8/23
2		0543-0603: 36 0603-0623: 35	2345-0045: 46		0845-0945: 54	0705-0805: 32 0805-0905: 37 0905-1005: 50 2340-0020: 28 0040-0120: 28	0734-0834: 35 0834-0934: 46 0934-1034: 49	
5	1020-1040: 46 1040-1100: 48				1005-1105: 35 1105-1205: 38		0400-0500: 27 0500-0600: 24 0600-0700: 25	
6	1325-1345: 48 1345-1405: 49 1418-1438: 53 1438-1458: 52			1545-1645: 49 1645-1745: 50 1900-2000: 45 2000-2100: 42 2100-2200: 37				
3	1607-1612: 45 1612-1617: 36 1617-1622: 36	2241-2301: 17 2301-2321: 17				0725-0805: 21 0825-0905: 34	2230-2310: 23 2310-2350: 25 2350-0030: 25	
4				0945-1045: 38 1045-1145: 32 1145-1245: 38				
7	1100-1120: 60 1120-1140: 59 1700-1720: 59 1720-1740: 58	0600-0615: 59				2245-2345: 30 2345-0045: 32 0045-0145: 31 0145-0245: 28 0245-0345: 34 0345-0445: 36 0445-0545: 32 0545-0645: 25 0645-0745: 26		1510-1610: 48 1610-1710: 51

L_{10} ,dBA

Date & Time (Continued)

SITE	6/5	6/6	8/18	8/19	8/20	8/21	8/22	8/23
8					0940-1020: 28 1043-1123: 34		1900-2000: 43	
9	0853-0913: 50 0913-0933: 53 0933-0953: 55 0953-1013: 56	0535-0855: 61 0555-0615: 59 0635-0655: 60 0655-0715: 61 0715-0735: 60 0735-0755: 60 0755-0815: 60 0835-0855: 60 1055-1115: 63 1115-1135: 62			0500-0540: 27 1100-1140: 32 1200-1240: 31	1500-1540: 38 2230-2330: 35 2330-0030: 40 0030-0130: 37		1830-1930: 32 1930-2030: 30
10				1030-1110: 51 1135-1215: 52 1240-1320: 56 0032-0112: 26				
1							1400-1500: 53	2230-2330: 29 2330-0030: 27 0030-0130: 25

L_{50}, dBA

Date & Time

SITE	6/5	6/6	8/18	8/19	8/20	8/21	8/22	8/23
2		0543-0603: 30 0603-0623: 30	2345-0045: 31		0845-0945: 32	0705-0805: 23 0805-0905: 25 0905-1005: 33 2340-0020: 25 0040-0120: 23	0734-0834: 25 0834-0934: 32 0934-1034: 39	
5	1020-1040: 39 1040-1100: 40				1005-1105: 25 1105-1205: 28		0400-0500: 24 0500-0600: 24 0600-0700: 22	
6	1325-1345: 43 1345-1405: 44 1418-1438: 46 1438-1458: 47			1545-1645: 43 1645-1745: 44 1900-2000: 38 2000-2100: 34 2100-2200: 27				
3	1607-1612: 40 1612-1617: 31 1617-1622: 3	2241-2301: 16 2301-2321: 16				0725-0805: 19 0825-0905: 18	2230-2310: 20 2310-2350: 20 2350-0030: 20	
4				0945-1045: 30 1045-1145: 31 1145-1245: 30				
7	1100-1120: 55 1120-1140: 54 1700-1720: 54 1720-1740: 53	0600-0615: 56				2245-2345: 24 2345-0045: 26 0045-0145: 24 0145-0245: 21 0245-0345: 28 0345-0445: 33 0445-0545: 25 0545-0645: 20		

L_{50}, dBA

(Continued)

SITE	6/5	6/6	8/18	8/19	8/20	8/21	8/22	8/23
7						0645-0745: 19		
8					0940-1020: 24 1043-1123: 26		1900-2000: 38	1510-1610: 35 1610-1710: 35
9	0853-0913: 46 0913-0933: 49 0933-0953: 49 0953-1013: 51	0535-0555: 57 0555-0615: 56 0635-0655: 57 0655-0715: 57 0715-0735: 56 0735-0755: 57 0755-0815: 57 0815-0855: 55 1055-1115: 59 1115-1135: 58			0500-0540: 24 1100-1140: 25 1200-1240: 26	1500-1540: 31 2230-2330: 29 2330-0030: 32 0030-0130: 33		1830-1930: 25 1930-2030: 24
10				1030-1110: 42 1135-1215: 44 1240-1320: 48 0032-0112: 25				
1							1400-1500: 48	2230-2330: 25 2330-0030: 22 0030-0130: 22

L_{90},dBA

Date and Time

SITE	6/5	6/6	8/18	8/19	8/20	8/21	8/22	8/23
2		0543-0603: 24 0603-0623: 25	2345-0045: 30		0845-0945: 26	0705-0805: 23 0805-0905: 23 0905-1005: 24 2340-0020: 23 0040-0120: 20	0734-0834: 24 0834-0934: 26 0934-1034: 32	
5	1020-1040: 34 1040-1100: 35				1005-1105: 23 1105-1205: 25		0400-0500: 23 0500-0600: 22 0600-0700: 22	
6	1325-1345: 36 1345-1405: 38 1418-1438: 41 1438-1458: 42			1545-1645: 37 1645-1745: 39 1900-2000: 32 2000-2100: 27 2100-2200: 23				
3	1607-1612: 36 1612-1617: 30 1617-1622: 30	2241-2301: 16 2301-2321: 16				0725-0805: 18 0825-0905: 16	2230-2310: 18 2310-2350: 19 2350-0030: 18	
4				0945-1045: 30 1045-1145: 30 1145-1245: 30				
7	1100-1120: 50 1120-1140: 49 1700-1720: 49 1720-1740: 38	0600-0615: 54				2245-2345: 20 2345-0045: 21 0045-0145: 20 0145-0245: 18 0245-0345: 21 0345-0445: 31 0445-0545: 18		

L_{90} ,dBA

(Continued)

	6/5	6/6	8/18	8/19	8/20	8/21	8/22	8/23
7						0545-0645: 17 0645-0745: 17		
8					0940-1020: 24 1043-1123: 23		1900-2000: 33	1510-1610: 26 1610-1710: 27
9	0853-0913: 43 0913-0933: 43 0933-0953: 40 0953-1013: 47	0535-0555: 53 0555-0615: 53 0635-0655: 54 0655-0715: 54 0715-0735: 52 0735-0755: 53 0755-0815: 53 0835-0855: 51 1055-1115: 54 1115-1135: 54			0500-0540: 21 1100-1140: 21 1200-1240: 23	1500-1540: 24 2230-2330: 25 2330-0030: 28 0030-0130: 30		1830-1930: 23 1930-2030: 23
10				1030-1110: 37 1135-1215: 37 1240-1320: 44 0032-0112: 24				
1							1400-1500: 43	2230-2330: 22 2330-0030: 22 0030-0130: 22

APPENDIX C: BLASTING DATA

BRYCE CANYON/WESTERN SLOPE BLAST DATA

DATE	LOCATION	EQUIPMENT, SYSTEM	TYPE OF BLAST	DISTANCE TO BLAST, FEET	MAXIMUM SOUND PRESSURE LEVEL, dB	MAXIMUM SOUND LEVEL, dBA
6/6	Yovimpa Point	A	Air I	26,900	-	61
"	Rainbow Point	D	"	28,000	>92.7	68.8
"	Bryce Point	C	"	74,000	86.2	56.4
"	Yovimpa Point	A	Air II	26,900	-	69
"	Rainbow Point	D	"	28,000	>95.7	68.8
"	Bryce Point	C	"	74,000	86.9	>58.5
6/23	EFC*	E	Coal	1,500	-	79
"	"	H	"	8,000	84.2	66.1
"	"	E	"	8,000	-	65.7
"	"	E	Overburden	8,000	-	86.2
"	"	G	"	16,000	89.2	65.2
"	"	E	"	16,000	-	67.8
6/24	EFC	E	Overburden	18,500	-	57.2
"	"	G	"	24,900	80.8	57.0
"	P & M**	G	Coal	5,000	107.2	80.4
"	"	E	"	5,000	-	83.1
"	"	H	"	6,500	99.5	74.9
"	"	E	"	6,500	-	75.0
6/25	UII***	H	Coal	11,700	92.1	55.5
"	"	E	"	12,500	-	60.2
"	"	E	"	20,500	-	55.4
6/26	"	E	Overburden	13,000	-	62.1
"	"	E	"	21,400	-	55.1
"	"	E	Coal	12,400	-	66.1
"	"	H	"	17,000	106.7	75.3
"	"	E	"	23,000	-	54.5
8/20	Yovimpa Point	H	Air I	184,800	65.1	36.2
8/20	Yovimpa Point	H	Air II	184,800	65.3	43.4
8/20	Rainbow Point	M	Air III	184,800	>78.7	42.4

*EFC = Energy Fuels Corp. Mine No. 3
**P&M = Pittsburg & Midway Mine
***UII = Utah International Inc. Trapper Mine

BRYCE CANYON/WESTERN SLOPE BLAST DATA (Continued)

DATE	LOCATION	TYPE OF BLAST	TEMPERATURE, °F	RELATIVE HUMIDITY, %	CHARGE WEIGHT PER DELAY, POUNDS	SCALED DISTANCE, FEET / (Pounds)$^{1/3}$
6/6	Yovimpa Point	Air I	40 (Estimated)	59	100	5,795
"	Rainbow Point	"	-	-	"	6,032
"	Bryce Point	"	43	53	"	15,942
"	Yovimpa Point	Air II	-	-	"	5,795
"	Rainbow Point	"	58	30	"	6,032
"	Bryce Point	"	-	-	"	15,942
6/23	EFC*	Coal	-	-	1,550	129
"	"	"	76	38	"	691
"	"	"	-	-	"	"
"	"	Overburden	-	-	6,853	421
"	"	"	88	15	"	842
"	"	"	-	-	"	"
6/24	"	"	-	-	2,597	1,345
"	"	"	80	29	"	1,811
"	P&M**	Coal	-	-	150	941
"	"	"	-	-	"	"
"	"	"	83	21	"	1,223
"	"	"	-	-	"	"
6/25	UII***	"	78	31	134	2,286
"	"	"	89	16	"	2,442
"	"	"	85	19	"	4,006
6/26	"	Overburden	-	-	8,400	639
"	"	"	-	-	"	1,200
"	"	Coal	85	22	123	2,493
"	"	"	-	-	"	3,418
"	"	"	85	21	"	4,625
8/20	Yovimpa Point	Air I	-	-	100-110	39,192
"	"	Air II	-	-	"	"
"	Rainbow Point	Air III	-	-	"	"

*EFC = Energy Fuels Corporation Mine No. 3
**P&M = Pittsburg & Midway Mine
***UII = Utah International Inc. Trapper Mine

BRYCE CANYON/WESTERN SLOPE BLAST DATA (Continued)

DATE	LOCATION	TYPE OF BLAST	Max. Octave Band Sound Levels, dBA 31.5Hz	63Hz	125Hz	250Hz	500Hz
6/6	Rainbow Point	Air I	51.7	61.5	64.1	62.0	57.1
"	Bryce Point	"	52.4	54.7	51.1	-	-
"	Rainbow Point	Air II	55.9	60.8	63.8	64.1	61.4
"	Bryce Point	"	44.9	54.6	55.4	46.1	-
8/20	Yovimpa Point	Air I	25.4	30.2	32.8	-	-
"	"	Air II	24.2	35.7	41.1	41.6	34.3
"	Rainbow Point	Air III	39.6	35.3	29.8	15.8	14.6

APPENDIX D: ATMOSPHERIC ABSORPTION DATA FOR BRYCE CANYON NATIONAL PARK

MEAN AND STANDARD DEVIATION OF ATMOSPHERIC ATTENUATION COEFFICIENTS FOR TWO-WEEK INTERVALS AT BRYCE CANYON NATIONAL PARK, 1977-1980(THROUGH 6/10).

NU IN HERTZ
ALPHA(NU) IN DB/1000FT

	ALPHA(16)		ALPHA(31.5)		ALPHA(63)		ALPHA(125)		ALPHA(250)		ALPHA(500)	
TIME OF YEAR	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
5/1 -- 5/15	.014	.009	.030	.016	.069	.025	.165	.034	.367	.079	.790	.341
5/16 -- 5/31	.013	.008	.028	.013	.069	.021	.173	.030	.381	.056	.732	.112
6/1 -- 6/15	.016	.011	.035	.019	.083	.029	.203	.038	.445	.084	.873	.177
6/16 -- 6/30	.016	.011	.035	.020	.086	.031	.218	.037	.486	.049	.930	.128
7/1 -- 7/15	.016	.013	.035	.022	.086	.035	.219	.042	.501	.044	.982	.114
7/16 -- 7/31	.007	.007	.019	.013	.059	.024	.182	.045	.475	.067	.938	.107
8/1 -- 8/15	.009	.009	.022	.016	.064	.027	.189	.046	.477	.065	.934	.105
8/16 -- 8/31	.008	.005	.020	.010	.059	.018	.178	.034	.441	.052	.83[illegible]	.085
9/1 -- 9/15	.009	.008	.022	.014	.063	.024	.182	.041	.446	.062	.860	.114
9/16 -- 9/30	.011	.008	.026	.014	.066	.022	.179	.026	.419	.047	.825	.165
10/1 -- 10/15	.021	.010	.043	.017	.093	.026	.208	.031	.436	.048	.910	.228
10/16 -- 10/31	.013	.007	.027	.013	.065	.020	.161	.029	.354	.055	.711	.201

ATMOSPHERIC ATTENUATION COEFFICIENTS

DRY BULB TEMPERATURE AND RELATIVE HUMIDITY DATA FOR BRYCE CANYON NATIONAL PARK ACQUIRED FROM THE NATIONAL PARK SERVICE

DATA WAS USED FROM THE FOLLOWING TIME PERIODS:

5/1/77 - 10/31/77
5/1/78 - 10/31/78
5/1/79 - 10/31/79
5/1/80 - 6/10/80

TIME OF DATA OBSERVATION: 2:00 PM DMST
ELEVATION: 8000 FT.

THE ABSORPTION COEFFICIENTS WERE OBTAINED FROM A REFERENCE TABLE USING A CUBIC SPLINE INTERPOLATION PROCEDURE.

A LINEAR LEAST-SQUARES PROCEDURE WAS USED TO EXTRAPOLATE RELATIVE HUMIDITIES ABOVE 90 PERCENT

A LINEAR EXTRAPOLATION WAS USED TO DETERMINE COEFFICIENTS FOR T LESS THAN 32 DEGREES

THE COMPUTED COEFFICIENTS HAVE BEEN CORRECTED FOR PRESSURE AND CONVERTED FROM DB/100M TO DB/1000FT.

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES) 16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
5/1/77	NO DATA WAS RECORDED BY THE NATIONAL PARK SERVICE							
5/2/77	62.0	11.0	.032	.062	.120	.231	.541	1.693
5/3/77	60.0	8.0	.027	.052	.103	.210	.546	1.823
5/4/77	60.0	22.0	.025	.049	.097	.192	.364	.769
5/5/77	55.0	40.0	.007	.018	.055	.164	.377	.695
5/6/77	51.0	41.0	.007	.019	.055	.159	.358	.673
5/7/77	43.0	100.0	.003	.011	.038	.126	.302	.504
5/8/77	54.0	39.0	.007	.019	.056	.164	.373	.697
5/9/77	52.0	42.0	.007	.018	.054	.159	.361	.666
5/10/77	45.0	45.0	.008	.020	.053	.147	.323	.629
5/11/77	56.0	21.0	.028	.053	.100	.183	.352	.873
5/12/77	58.0	23.0	.024	.048	.094	.182	.345	.743
5/13/77	53.0	34.0	.011	.025	.064	.166	.363	.722
5/14/77	42.0	80.0	.011	.024	.057	.135	.287	.527
5/15/77	53.0	83.0	.006	.015	.043	.127	.325	.653
5/16/77	48.0	38.0	.010	.023	.059	.159	.349	.708
5/17/77	41.0	34.0	.014	.030	.065	.149	.332	.845
5/18/77	36.0	54.0	.013	.027	.058	.126	.259	.589
5/19/77	47.0	37.0	.011	.024	.061	.158	.346	.725
5/20/77	48.0	48.0	.007	.018	.051	.148	.328	.595
5/21/77	57.0	30.0	.014	.030	.071	.173	.365	.711
5/22/77	68.0	16.0	.031	.061	.121	.235	.472	.152
5/23/77	60.0	22.0	.025	.049	.097	.192	.364	.769
5/24/77	34.0	100.0	.004	.012	.038	.115	.252	.410
5/25/77	46.0	63.0	.010	.023	.055	.130	.296	.534

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
5/26/77	51.0	56.0	.007	.018	.050	.144	.327	.574
5/27/77	57.0	38.0	.007	.019	.056	.167	.387	.718
5/28/77	63.0	22.0	.023	.047	.097	.201	.386	.756
5/29/77	68.0	58.0	.006	.015	.045	.140	.390	.827
5/30/77	70.0	24.0	.014	.033	.082	.210	.444	.756
5/31/77	78.0	15.0	.029	.059	.124	.266	.531	1.048
6/1/77	79.0	18.0	.020	.043	.103	.253	.537	.963
6/2/77	75.0	30.0	.004	.015	.054	.187	.483	.891
6/3/77	78.0	17.0	.023	.049	.111	.258	.531	.985
6/4/77	75.0	25.0	.009	.023	.070	.210	.488	.832
6/5/77	75.0	45.0	.005	.014	.046	.151	.439	.954
6/6/77	77.0	35.0	.002	.010	.045	.168	.481	.974
6/7/77	76.0	23.0	.011	.027	.077	.222	.499	.844
6/8/77	67.0	46.0	.005	.015	.049	.157	.417	.812
6/9/77	55.0	73.0	.008	.019	.049	.133	.331	.662
6/10/77	67.0	33.0	.006	.018	.057	.177	.434	.797
6/11/77	68.0	27.0	.012	.027	.072	.195	.429	.745
6/12/77	70.0	20.0	.022	.046	.101	.229	.455	.841
6/13/77	73.0	20.0	.020	.042	.098	.235	.480	.854
6/14/77	75.0	10.0	.039	.074	.139	.248	.477	1.178
6/15/77	75.0	12.0	.037	.071	.138	.259	.501	1.164
6/16/77	78.0	13.0	.034	.067	.135	.268	.523	1.098
6/17/77	77.0	12.0	.036	.071	.138	.264	.509	1.126
6/18/77	76.0	16.0	.028	.056	.120	.259	.518	1.019
6/19/77	74.0	19.0	.021	.045	.103	.242	.493	.896
6/20/77	67.0	26.0	.014	.031	.077	.197	.418	.726

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES) 16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
6/21/77	68.0	24.0	.016	.035	.084	.206	.425	.735
6/22/77	70.0	32.0	.005	.017	.056	.180	.451	.830
6/23/77	76.0	23.0	.011	.027	.077	.222	.499	.844
6/24/77	68.0	33.0	.006	.017	.056	.178	.439	.810
6/25/77	61.0	54.0	.006	.016	.049	.149	.376	.705
6/26/77	78.0	27.0	.004	.015	.058	.200	.508	.910
6/27/77	77.0	29.0	.003	.014	.054	.190	.498	.917
6/28/77	78.0	27.0	.004	.015	.058	.200	.508	.910
6/29/77	76.0	23.0	.011	.027	.077	.222	.499	.844
6/30/77	83.0	17.0	.018	.042	.102	.260	.571	1.033
7/1/77	80.0	34.0	.001	.009	.043	.168	.497	1.029
7/2/77	78.0	22.0	.011	.028	.079	.228	.518	.881
7/3/77	65.0	56.0	.006	.018	.048	.145	.387	.772
7/4/77	58.0	79.0	.005	.014	.041	.123	.336	.720
7/5/77	70.0	35.0	.004	.014	.051	.173	.449	.851
7/6/77	75.0	20.0	.018	.040	.095	.238	.498	.870
7/7/77	79.0	12.0	.035	.069	.138	.270	.520	1.102
7/8/77	80.0	17.0	.022	.047	.108	.260	.547	.998
7/9/77	78.0	8.0	.038	.073	.135	.236	.438	1.051
7/10/77	75.0	17.0	.026	.053	.115	.253	.509	.980
7/11/77	78.0	11.0	.037	.072	.140	.263	.502	1.117
7/12/77	80.0	22.0	.009	.025	.075	.227	.534	.918
7/13/77	76.0	26.0	.007	.020	.065	.205	.495	.859
7/14/77	83.0	11.0	.034	.067	.137	.279	.541	1.088
7/15/77	79.0	18.0	.020	.043	.103	.253	.537	.963
7/16/77	82.0	28.0	.001	.010	.049	.190	.530	1.011

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
7/17/77	69.0	58.0	.006	.015	.045	.139	.392	.844
7/18/77	75.0	36.0	.003	.011	.046	.167	.470	.942
7/19/77	62.0	72.0	.005	.013	.040	.126	.352	.764
7/20/77	58.0	75.0	.006	.016	.044	.128	.338	.712
7/21/77	66.0	53.0	.006	.016	.049	.149	.396	.788
7/22/77	68.0	54.0	.006	.016	.048	.146	.399	.823
7/23/77	72.0	46.0	.005	.015	.048	.153	.430	.899
7/24/77	64.0	64.0	.005	.014	.043	.134	.369	.773
7/25/77	75.0	20.0	.018	.040	.095	.238	.498	.870
7/26/77	78.0	22.0	.011	.028	.079	.228	.518	.881
7/27/77	75.0	25.0	.009	.023	.070	.210	.488	.832
7/28/77	83.0	19.0	.013	.031	.087	.245	.565	.999
7/29/77	83.0	22.0	.006	.020	.068	.223	.554	.978
7/30/77	82.0	16.0	.023	.048	.112	.267	.564	1.040
7/31/77	81.0	13.0	.032	.064	.132	.276	.545	1.084
8/1/77	83.0	9.0	.036	.070	.137	.266	.500	1.041
8/2/77	84.0	10.0	.034	.067	.137	.277	.534	1.075
8/3/77	78.0	20.0	.015	.035	.091	.240	.523	.904
8/4/77	72.0	37.0	.003	.013	.048	.167	.455	.893
8/5/77	81.0	20.0	.012	.030	.084	.239	.547	.950
8/6/77	82.0	14.0	.028	.058	.125	.276	.560	1.075
8/7/77	80.0	22.0	.009	.025	.075	.227	.534	.918
8/8/77	78.0	20.0	.015	.035	.091	.240	.523	.904
8/9/77	80.0	15.0	.027	.057	.122	.269	.546	1.048
8/10/77	75.0	22.0	.014	.032	.084	.227	.492	.835
8/11/77	77.0	32.0	.002	.011	.048	.178	.491	.951

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES) 16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
8/12/77	73.0	47.0	.006	.015	.048	.151	.429	.916
8/13/77	78.0	30.0	.002	.012	.051	.185	.501	.950
8/14/77	73.0	41.0	.004	.013	.047	.159	.448	.918
8/15/77	69.0	48.0	.006	.016	.049	.154	.417	.843
8/16/77	63.0	76.0	.004	.011	.036	.119	.348	.788
8/17/77	61.0	90.0	-.000	.004	.024	.103	.333	.767
8/18/77	73.0	41.0	.004	.013	.047	.159	.448	.918
8/19/77	75.0	36.0	.003	.011	.046	.167	.470	.942
8/20/77	78.0	35.0	.002	.010	.044	.167	.485	.994
8/21/77	78.0	33.0	.002	.010	.046	.174	.493	.980
8/22/77	60.0	62.0	.006	.016	.047	.140	.360	.702
8/23/77	66.0	53.0	.006	.016	.049	.149	.396	.789
8/24/77	72.0	46.0	.005	.015	.048	.153	.430	.899
8/25/77	73.0	29.0	.006	.018	.059	.191	.470	.842
8/26/77	70.0	32.0	.005	.017	.056	.180	.451	.830
8/27/77	62.0	21.0	.025	.050	.101	.202	.385	.806
8/28/77	69.0	22.0	.019	.040	.092	.217	.438	.771
8/29/77	73.0	20.0	.020	.042	.098	.235	.480	.854
8/30/77	76.0	23.0	.011	.027	.077	.222	.499	.844
8/31/77	76.0	21.0	.015	.034	.088	.233	.503	.861
9/1/77	73.0	20.0	.020	.042	.098	.235	.480	.854
9/2/77	76.0	21.0	.015	.034	.088	.233	.503	.861
9/3/77	57.0	100.0	-.000	.004	.024	.102	.322	.722
9/4/77	74.0	32.0	.004	.014	.052	.180	.474	.895
9/5/77	74.0	32.0	.004	.014	.052	.180	.474	.895
9/6/77	77.0	21.0	.014	.033	.086	.234	.512	.875

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
9/7/77	80.0	19.0	.016	.037	.093	.247	.542	.951
9/8/77	80.0	15.0	.027	.057	.122	.269	.546	1.048
9/9/77	78.0	17.0	.023	.049	.111	.258	.531	.985
9/10/77	55.0	94.0	.001	.007	.030	.112	.327	.683
9/11/77	58.0	84.0	.004	.012	.038	.121	.331	.696
9/12/77	65.0	41.0	.005	.015	.050	.164	.420	.790
9/13/77	70.0	20.0	.022	.046	.101	.229	.455	.841
9/14/77	61.0	67.0	.006	.015	.044	.133	.356	.734
9/15/77	68.0	18.0	.027	.055	.113	.233	.457	.961
9/16/77	65.0	18.0	.029	.058	.113	.224	.441	.995
9/17/77	53.0	27.0	.018	.037	.080	.176	.352	.691
9/18/77	61.0	30.0	.012	.027	.069	.178	.389	.720
9/19/77	68.0	18.0	.027	.055	.113	.233	.457	.961
9/20/77	62.0	46.0	.005	.015	.050	.159	.398	.735
9/21/77	56.0	33.0	.011	.025	.064	.170	.374	.722
9/22/77	64.0	23.0	.021	.043	.092	.200	.391	.728
9/23/77	63.0	12.0	.033	.064	.123	.234	.527	1.587
9/24/77	66.0	22.0	.021	.044	.095	.210	.411	.757
9/25/77	69.0	8.0	.035	.067	.122	.214	.453	1.360
9/26/77	68.0	24.0	.016	.035	.084	.206	.425	.735
9/27/77	66.0	35.0	.006	.017	.054	.173	.429	.796
9/28/77	65.0	52.0	.006	.016	.049	.151	.395	.770
9/29/77	67.0	33.0	.006	.018	.057	.177	.434	.797
9/30/77	50.0	35.0	.011	.025	.063	.163	.354	.727
10/1/77	57.0	38.0	.007	.019	.056	.167	.387	.716
10/2/77	62.0	31.0	.010	.025	.065	.178	.399	.734

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES) 16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
10/3/77	70.0	26.0	.011	.027	.073	.201	.445	.761
10/4/77	68.0	24.0	.016	.035	.084	.206	.425	.735
10/5/77	NO DATA WAS RECORDED BY THE NATIONAL PARK SERVICE							
10/6/77	59.0	75.0	.008	.015	.043	.126	.341	.727
10/7/77	58.0	27.0	.018	.037	.080	.178	.352	.891
10/8/77	57.0	15.0	.030	.059	.114	.220	.509	1.542
10/9/77	61.0	20.0	.027	.053	.105	.203	.390	.879
10/10/77	52.0	33.0	.012	.027	.066	.165	.356	.729
10/11/77	62.0	24.0	.021	.042	.089	.192	.373	.709
10/12/77	57.0	34.0	.010	.023	.062	.170	.381	.724
10/13/77	62.0	21.0	.025	.050	.101	.202	.385	.806
10/14/77	67.0	14.0	.034	.066	.127	.242	.495	1.289
10/15/77	67.0	17.0	.030	.058	.117	.234	.463	1.049
10/16/77	66.0	16.0	.031	.061	.121	.235	.472	1.152
10/17/77	66.0	16.0	.031	.061	.121	.235	.472	1.152
10/18/77	63.0	25.0	.018	.038	.084	.192	.382	.697
10/19/77	64.0	23.0	.021	.043	.092	.200	.391	.726
10/20/77	42.0	93.0	.005	.013	.041	.128	.297	.502
10/21/77	49.0	54.0	.007	.018	.050	.143	.320	.562
10/22/77	54.0	49.0	.008	.018	.050	.152	.355	.625
10/23/77	54.0	26.0	.021	.042	.084	.167	.324	.716
10/24/77	59.0	25.0	.021	.042	.087	.181	.351	.695
10/25/77	64.0	40.0	.005	.015	.051	.166	.417	.778
10/26/77	69.0	13.0	.035	.068	.131	.246	.499	1.291
10/27/77	58.0	31.0	.012	.028	.068	.174	.375	.717
10/28/77	55.0	36.0	.009	.022	.060	.167	.376	.716

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
10/29/77	44.0	100.0	.003	.011	.038	.125	.306	.518
10/30/77	51.0	32.0	.014	.030	.068	.164	.348	.737
10/31/77	40.0	46.0	.010	.023	.055	.139	.299	.644
5/1/78	55.0	32.0	.012	.028	.067	.169	.365	.721
5/2/78	51.0	66.0	.009	.021	.053	.139	.318	.587
5/3/78	56.0	59.0	.007	.017	.049	.144	.347	.635
5/4/78	56.0	17.0	.030	.058	.110	.206	.451	1.311
5/5/78	48.0	4.0	.008	.020	.055	.169	.551	1.768
5/6/78	31.0	44.0	.017	.033	.064	.123	.292	.832
5/7/78	40.0	58.0	.011	.024	.056	.132	.270	.531
5/8/78	51.0	51.0	.006	.017	.050	.148	.336	.589
5/9/78	58.0	23.0	.024	.048	.094	.182	.345	.743
5/10/78	64.0	17.0	.030	.059	.118	.226	.453	1.103
5/11/78	65.0	21.0	.024	.048	.100	.211	.408	.794
5/12/78	64.0	17.0	.030	.059	.118	.226	.453	1.103
5/13/78	69.0	19.0	.025	.050	.107	.231	.454	.891
5/14/78	73.0	15.0	.032	.063	.127	.255	.502	1.090
5/15/78	67.0	23.0	.019	.039	.089	.208	.417	.739
5/16/78	42.0	54.0	.010	.022	.053	.135	.285	.546
5/17/78	NO DATA WAS RECORDED BY THE NATIONAL PARK SERVICE							
5/18/78	56.0	25.0	.022	.044	.087	.173	.332	.710
5/19/78	65.0	21.0	.024	.048	.100	.211	.408	.794
5/20/78	66.0	25.0	.016	.035	.082	.198	.408	.715
5/21/78	63.0	36.0	.006	.018	.055	.171	.414	.766
5/22/78	69.0	34.0	.005	.016	.053	.175	.445	.831
5/23/78	63.0	25.0	.018	.038	.084	.192	.382	.697

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
5/24/78	54.0	22.0	.027	.051	.096	.173	.333	.841
5/25/78	59.0	21.0	.027	.052	.101	.192	.366	.832
5/26/78	59.0	25.0	.021	.042	.087	.181	.351	.695
5/27/78	61.0	23.0	.023	.045	.093	.192	.366	.727
5/28/78	67.0	20.0	.024	.049	.103	.221	.431	.840
5/29/78	74.0	21.0	.016	.037	.091	.231	.486	.837
5/30/78	71.0	27.0	.009	.024	.068	.198	.454	.785
5/31/78	63.0	36.0	.006	.018	.055	.171	.414	.766
6/1/78	68.0	12.0	.036	.069	.131	.242	.502	1.377
6/2/78	65.0	24.0	.018	.039	.087	.200	.398	.714
6/3/78	67.0	23.0	.019	.039	.089	.208	.417	.739
6/4/78	53.0	67.0	.009	.020	.052	.139	.327	.615
6/5/78	59.0	40.0	.006	.017	.053	.165	.395	.724
6/6/78	69.0	31.0	.007	.019	.059	.183	.444	.806
6/7/78	73.0	23.0	.014	.032	.082	.219	.472	.799
6/8/78	74.0	21.0	.016	.037	.091	.231	.486	.837
6/9/78	78.0	13.0	.034	.067	.135	.268	.523	1.098
6/10/78	78.0	6.0	.035	.066	.119	.201	.369	.924
6/11/78	72.0	25.0	.011	.027	.075	.208	.462	.783
6/12/78	77.0	20.0	.016	.037	.092	.240	.515	.892
6/13/78	77.0	17.0	.024	.051	.112	.256	.523	.981
6/14/78	77.0	29.0	.003	.014	.054	.190	.498	.917
6/15/78	74.0	19.0	.021	.045	.103	.242	.493	.896
6/16/78	73.0	15.0	.032	.063	.127	.255	.502	1.090
6/17/78	73.0	13.0	.036	.069	.134	.256	.502	1.180
6/18/78	78.0	17.0	.025	.052	.114	.255	.516	.980

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES) 16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
6/19/78	73.0	18.0	.024	.051	.110	.245	.490	.937
6/20/78	76.0	16.0	.028	.056	.120	.259	.518	1.019
6/21/78	80.0	19.0	.016	.037	.093	.247	.542	.951
6/22/78	78.0	20.0	.015	.035	.091	.240	.523	.904
6/23/78	75.0	28.0	.005	.017	.060	.196	.485	.864
6/24/78	79.0	23.0	.008	.023	.072	.221	.524	.898
6/25/78	72.0	17.0	.027	.056	.117	.247	.489	.993
6/26/78	75.0	17.0	.026	.053	.115	.253	.509	.980
6/27/78	73.0	15.0	.032	.063	.127	.255	.502	1.090
6/28/78	63.0	51.0	.006	.016	.049	.153	.390	.738
6/29/78	67.0	43.0	.005	.015	.049	.161	.424	.817
6/30/78	73.0	15.0	.032	.063	.127	.255	.502	1.090
7/1/78	75.0	22.0	.014	.032	.084	.227	.492	.835
7/2/78	76.0	16.0	.028	.056	.120	.259	.518	1.019
7/3/78	74.0	16.0	.029	.058	.121	.255	.505	1.030
7/4/78	74.0	11.0	.038	.073	.138	.252	.490	1.204
7/5/78	73.0	10.0	.039	.073	.137	.243	.476	1.239
7/6/78	75.0	15.0	.031	.062	.126	.260	.512	1.066
7/7/78	76.0	16.0	.028	.056	.120	.259	.518	1.019
7/8/78	79.0	24.0	.007	.020	.067	.215	.521	.902
7/9/78	79.0	31.0	.002	.010	.048	.180	.504	.982
7/10/78	77.0	29.0	.003	.014	.054	.190	.498	.917
7/11/78	75.0	30.0	.004	.015	.054	.187	.483	.891
7/12/78	79.0	18.0	.020	.043	.103	.253	.537	.963
7/13/78	82.0	28.0	.001	.010	.049	.190	.530	1.011
7/14/78	86.0	33.0	-.001	.006	.038	.162	.522	1.158

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES) 16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
7/15/78	80.0	37.0	.002	.009	.042	.159	.483	1.044
7/16/78	81.0	37.0	.001	.009	.041	.158	.486	1.065
7/17/78	55.0	89.0	.001	.007	.031	.117	.332	.680
7/18/78	74.0	51.0	.006	.016	.047	.144	.417	.929
7/19/78	78.0	25.0	.006	.019	.065	.210	.512	.889
7/20/78	80.0	24.0	.006	.019	.065	.215	.529	.922
7/21/78	78.0	22.0	.011	.028	.079	.228	.518	.881
7/22/78	77.0	19.0	.019	.041	.099	.245	.518	.917
7/23/78	80.0	29.0	.002	.011	.050	.188	.516	.980
7/24/78	81.0	32.0	.001	.008	.044	.174	.510	1.035
7/25/78	80.0	34.0	.001	.009	.043	.168	.497	1.029
7/26/78	85.0	37.0	.001	.007	.038	.151	.494	1.150
7/27/78	81.0	35.0	.001	.008	.042	.164	.496	1.057
7/28/78	79.0	41.0	.003	.011	.043	.151	.462	1.031
7/29/78	80.0	31.0	.001	.010	.046	.179	.509	1.004
7/30/78	82.0	35.0	.001	.008	.041	.162	.499	1.078
7/31/78	61.0	90.0	-.000	.004	.024	.103	.333	.767
8/1/78	73.0	47.0	.006	.015	.048	.151	.429	.916
8/2/78	79.0	28.0	.003	.013	.054	.194	.512	.944
8/3/78	76.0	40.0	.003	.012	.045	.158	.460	.972
8/4/78	80.0	19.0	.016	.037	.093	.247	.542	.951
8/5/78	80.0	24.0	.006	.019	.065	.215	.529	.922
8/6/78	75.0	30.0	.004	.015	.054	.187	.483	.891
8/7/78	83.0	38.0	.001	.009	.039	.152	.484	1.109
8/8/78	79.0	33.0	.001	.010	.045	.173	.497	1.001
8/9/78	82.0	28.0	.001	.010	.049	.190	.530	1.011

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
8/10/78	75.0	39.0	.003	.012	.046	.161	.461	.952
8/11/78	74.0	47.0	.006	.015	.047	.149	.430	.934
8/12/78	70.0	55.0	.006	.016	.047	.143	.401	.658
8/13/78	73.0	29.0	.006	.018	.059	.191	.470	.842
8/14/78	65.0	56.0	.006	.016	.048	.145	.387	.772
8/15/78	70.0	55.0	.006	.016	.047	.143	.401	.858
8/16/78	75.0	20.0	.018	.040	.095	.238	.498	.870
8/17/78	74.0	24.0	.011	.027	.076	.215	.480	.811
8/18/78	67.0	36.0	.005	.016	.053	.171	.434	.813
8/19/78	74.0	29.0	.005	.017	.058	.191	.477	.860
8/20/78	68.0	54.0	.006	.016	.048	.146	.399	.823
8/21/78	70.0	48.0	.006	.016	.049	.153	.420	.861
8/22/78	72.0	40.0	.004	.013	.047	.162	.448	.900
8/23/78	74.0	24.0	.011	.027	.076	.215	.480	.811
8/24/78	74.0	27.0	.007	.020	.064	.200	.478	.834
8/25/78	75.0	22.0	.014	.032	.084	.227	.492	.835
8/26/78	75.0	25.0	.009	.023	.070	.210	.488	.832
8/27/78	72.0	37.0	.003	.013	.048	.167	.455	.893
8/28/78	76.0	28.0	.005	.016	.058	.195	.492	.883
8/29/78	78.0	22.0	.011	.028	.079	.228	.518	.881
8/30/78	75.0	36.0	.003	.011	.046	.167	.470	.942
8/31/78	74.0	35.0	.003	.012	.048	.171	.469	.918
9/1/78	78.0	41.0	.003	.012	.044	.153	.460	1.011
9/2/78	77.0	37.0	.002	.011	.044	.163	.474	.984
9/3/78	77.0	26.0	.006	.018	.063	.205	.502	.878
9/4/78	73.0	41.0	.004	.013	.047	.159	.448	.918

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
9/5/78	74.0	54.0	.006	.016	.046	.139	.407	.927
9/6/78	73.0	44.0	.005	.014	.047	.155	.439	.918
9/7/78	52.0	88.0	.003	.010	.036	.123	.327	.638
9/8/78	67.0	39.0	.004	.015	.050	.168	.431	.819
9/9/78	71.0	49.0	.006	.016	.049	.150	.419	.877
9/10/78	68.0	30.0	.008	.021	.062	.185	.436	.781
9/11/78	59.0	17.0	.030	.059	.113	.213	.447	1.223
9/12/78	57.0	42.0	.006	.017	.052	.162	.384	.697
9/13/78	62.0	46.0	.005	.015	.050	.159	.398	.735
9/14/78	57.0	65.0	.007	.018	.048	.138	.344	.665
9/15/78	57.0	69.0	.007	.017	.048	.135	.341	.679
9/16/78	62.0	54.0	.006	.016	.049	.149	.380	.721
9/17/78	61.0	42.0	.005	.016	.051	.163	.402	.737
9/18/78	43.0	36.0	.013	.027	.063	.153	.335	.778
9/19/78	40.0	58.0	.011	.024	.056	.132	.270	.531
9/20/78	48.0	33.0	.014	.029	.067	.160	.342	.757
9/21/78	53.0	34.0	.011	.025	.064	.166	.363	.722
9/22/78	64.0	30.0	.010	.025	.066	.182	.408	.739
9/23/78	70.0	29.0	.008	.021	.063	.190	.449	.795
9/24/78	60.0	53.0	.006	.016	.049	.150	.374	.689
9/25/78	65.0	38.0	.005	.016	.052	.168	.424	.791
9/26/78	71.0	27.0	.009	.024	.068	.198	.454	.785
9/27/78	73.0	32.0	.004	.014	.053	.180	.469	.877
9/28/78	71.0	33.0	.004	.015	.053	.178	.456	.853
9/29/78	70.0	23.0	.016	.036	.086	.215	.445	.763
9/30/78	74.0	16.0	.029	.058	.121	.255	.505	1.030

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
10/1/78	73.0	18.0	.024	.051	.110	.245	.490	.937
10/2/78	65.0	24.0	.018	.039	.087	.200	.398	.714
10/3/78	66.0	13.0	.035	.066	.127	.240	.505	1.395
10/4/78	66.0	22.0	.021	.044	.095	.210	.411	.757
10/5/78	67.0	11.0	.036	.068	.129	.237	.504	1.450
10/6/78	71.0	16.0	.030	.060	.122	.248	.489	1.062
10/7/78	68.0	18.0	.027	.055	.113	.233	.457	.961
10/8/78	68.0	15.0	.033	.064	.125	.243	.487	1.187
10/9/78	65.0	27.0	.014	.031	.075	.190	.404	.715
10/10/78	66.0	25.0	.016	.035	.082	.198	.408	.715
10/11/78	64.0	26.0	.016	.034	.080	.191	.393	.702
10/12/78	65.0	34.0	.006	.018	.057	.175	.423	.780
10/13/78	67.0	26.0	.014	.031	.077	.197	.418	.726
10/14/78	65.0	15.0	.033	.063	.123	.235	.485	1.267
10/15/78	69.0	16.0	.031	.061	.122	.243	.481	1.093
10/16/78	67.0	29.0	.010	.024	.066	.187	.426	.757
10/17/78	62.0	46.0	.005	.015	.050	.159	.398	.735
10/18/78	57.0	39.0	.007	.018	.055	.166	.387	.712
10/19/78	62.0	31.0	.010	.025	.065	.178	.359	.734
10/20/78	44.0	100.0	.003	.011	.038	.125	.306	.518
10/21/78	46.0	94.0	.003	.011	.039	.126	.311	.549
10/22/78	47.0	58.0	.009	.020	.052	.140	.304	.541
10/23/78	46.0	63.0	.010	.023	.055	.138	.296	.534
10/24/78	45.0	74.0	.012	.026	.058	.138	.293	.545
10/25/78	46.0	63.0	.010	.023	.055	.138	.296	.534
10/26/78	53.0	57.0	.007	.018	.050	.144	.335	.594

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
10/27/78	57.0	42.0	.006	.017	.052	.162	.384	.697
10/28/78	59.0	28.0	.016	.034	.076	.177	.364	.696
10/29/78	59.0	28.0	.016	.034	.076	.177	.364	.696
10/30/78	47.0	70.0	.011	.024	.057	.138	.300	.555
10/31/78	46.0	69.0	.011	.025	.058	.138	.296	.544
5/1/79	59.0	28.0	.016	.034	.076	.177	.364	.696
5/2/79	45.0	68.0	.012	.025	.058	.138	.291	.534
5/3/79	52.0	52.0	.006	.017	.050	.147	.338	.593
5/4/79	60.0	15.0	.031	.061	.117	.225	.495	1.430
5/5/79	62.0	21.0	.025	.059	.101	.202	.385	.806
5/6/79	59.0	25.0	.021	.042	.087	.181	.351	.695
5/7/79	46.0	46.0	.008	.019	.052	.148	.324	.614
5/8/79	32.0	100.0	.004	.012	.036	.108	.236	.399
5/9/79	36.0	18.0	.018	.038	.083	.202	.612	1.999
5/10/79	40.0	39.0	.012	.026	.060	.146	.323	.765
5/11/79	50.0	40.0	.008	.020	.056	.159	.355	.682
5/12/79	57.0	22.0	.026	.050	.097	.182	.346	.796
5/13/79	65.0	38.0	.005	.016	.052	.168	.424	.791
5/14/79	69.0	31.0	.007	.019	.059	.183	.444	.806
5/15/79	65.0	49.0	.006	.016	.050	.155	.402	.774
5/16/79	63.0	36.0	.006	.018	.055	.171	.414	.766
5/17/79	64.0	40.0	.005	.015	.051	.166	.417	.778
5/18/79	70.0	42.0	.004	.014	.048	.160	.436	.867
5/19/79	69.0	28.0	.010	.024	.067	.193	.439	.768
5/20/79	62.0	39.0	.005	.016	.053	.167	.409	.756
5/21/79	69.0	28.0	.010	.024	.067	.193	.439	.768

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
5/22/79	75.0	25.0	.009	.023	.070	.210	.488	.832
5/23/79	60.0	62.0	.006	.016	.047	.140	.360	.702
5/24/79	56.0	59.0	.007	.017	.049	.144	.347	.635
5/25/79	60.0	66.0	.006	.016	.046	.135	.354	.715
5/26/79	50.0	100.0	.002	.008	.032	.118	.320	.609
5/27/79	61.0	50.0	.006	.016	.050	.154	.385	.709
5/28/79	65.0	49.0	.006	.016	.050	.155	.402	.774
5/29/79	59.0	48.0	.005	.016	.050	.156	.381	.687
5/30/79	54.0	58.0	.007	.018	.050	.144	.339	.607
5/31/79	56.0	46.0	.006	.016	.051	.157	.372	.663
6/1/79	60.0	41.0	.005	.016	.052	.164	.399	.729
6/2/79	66.0	25.0	.016	.035	.082	.198	.408	.715
6/3/79	63.0	40.0	.005	.016	.052	.166	.413	.766
6/4/79	63.0	51.0	.006	.016	.049	.153	.390	.738
6/5/79	75.0	36.0	.003	.011	.046	.167	.470	.942
6/6/79	76.0	21.0	.015	.034	.088	.233	.503	.861
6/7/79	57.0	51.0	.006	.016	.050	.152	.365	.651
6/8/79	48.0	38.0	.010	.023	.059	.159	.349	.708
6/9/79	NO DATA WAS RECORDED BY THE NATIONAL PARK SERVICE							
6/10/79	64.0	26.0	.016	.034	.080	.191	.393	.702
6/11/79	72.0	31.0	.005	.016	.056	.184	.463	.850
6/12/79	79.0	33.0	.001	.010	.045	.173	.497	1.001
6/13/79	78.0	17.0	.023	.049	.111	.258	.531	.985
6/14/79	76.0	26.0	.007	.020	.065	.205	.495	.859
6/15/79	72.0	17.0	.027	.056	.117	.247	.489	.993
6/16/79	71.0	27.0	.009	.024	.068	.198	.454	.785

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
6/17/79	65.0	24.0	.018	.039	.087	.200	.398	.714
6/18/79	52.0	33.0	.012	.027	.066	.165	.356	.729
6/19/79	65.0	27.0	.014	.031	.075	.190	.404	.715
6/20/79	70.0	15.0	.032	.064	.126	.248	.492	1.142
6/21/79	73.0	29.0	.006	.018	.059	.191	.470	.842
6/22/79	75.0	39.0	.003	.012	.046	.161	.461	.952
6/23/79	78.0	33.0	.002	.010	.046	.174	.493	.980
6/24/79	79.0	26.0	.004	.016	.060	.204	.517	.919
6/25/79	80.0	15.0	.027	.057	.122	.269	.546	1.048
6/26/79	79.0	14.0	.031	.062	.129	.270	.535	1.071
6/27/79	80.0	19.0	.016	.037	.093	.247	.542	.951
6/28/79	84.0	22.0	.005	.018	.066	.221	.561	1.000
6/29/79	80.0	37.0	.002	.009	.042	.159	.483	1.044
6/30/79	79.0	36.0	.002	.010	.043	.163	.485	1.020
7/1/79	79.0	36.0	.002	.010	.043	.163	.485	1.020
7/2/79	78.0	30.0	.002	.012	.051	.185	.501	.950
7/3/79	70.0	20.0	.022	.046	.101	.229	.455	.841
7/4/79	70.0	20.0	.022	.046	.101	.229	.455	.841
7/5/79	73.0	29.0	.006	.018	.059	.191	.470	.842
7/6/79	75.0	20.0	.018	.040	.095	.238	.498	.870
7/7/79	78.0	20.0	.015	.035	.091	.240	.523	.904
7/8/79	79.0	23.0	.008	.023	.072	.221	.524	.898
7/9/79	84.0	16.0	.020	.045	.107	.267	.582	1.066
7/10/79	84.0	14.0	.026	.055	.122	.279	.579	1.094
7/11/79	82.0	10.0	.036	.070	.139	.270	.513	1.070
7/12/79	85.0	17.0	.016	.038	.097	.259	.580	1.067

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES) 16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
7/13/79	83.0	38.0	.001	.009	.039	.152	.484	1.109
7/14/79	79.0	41.0	.003	.011	.043	.151	.462	1.031
7/15/79	84.0	34.0	-.000	.007	.039	.162	.510	1.118
7/16/79	80.0	42.0	.003	.012	.042	.148	.458	1.050
7/17/79	79.0	23.0	.008	.023	.072	.221	.524	.898
7/18/79	74.0	54.0	.006	.016	.046	.139	.407	.927
7/19/79	75.0	45.0	.005	.014	.046	.151	.439	.954
7/20/79	75.0	48.0	.006	.015	.047	.146	.428	.950
7/21/79	65.0	68.0	.004	.012	.040	.127	.365	.800
7/22/79	73.0	26.0	.009	.024	.069	.204	.470	.806
7/23/79	72.0	40.0	.004	.013	.047	.162	.448	.900
7/24/79	79.0	18.0	.020	.043	.103	.253	.537	.963
7/25/79	84.0	22.0	.005	.018	.066	.221	.561	1.000
7/26/79	84.0	25.0	.002	.011	.053	.202	.550	1.020
7/27/79	83.0	31.0	-.000	.007	.043	.175	.522	1.071
7/28/79	82.0	28.0	.001	.010	.049	.190	.530	1.011
7/29/79	80.0	19.0	.016	.037	.093	.247	.542	.951
7/30/79	82.0	49.0	.005	.014	.042	.130	.420	1.068
7/31/79	80.0	17.0	.022	.047	.108	.260	.547	.998
8/1/79	82.0	19.0	.014	.033	.089	.246	.558	.981
8/2/79	79.0	18.0	.020	.043	.103	.253	.537	.963
8/3/79	86.0	16.0	.018	.041	.102	.267	.600	1.103
8/4/79	86.0	24.0	.001	.010	.052	.202	.563	1.058
8/5/79	85.0	25.0	.001	.010	.051	.199	.555	1.044
8/6/79	80.0	48.0	.006	.015	.044	.137	.428	1.038
8/7/79	57.0	84.0	.004	.012	.037	.119	.332	.711

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES) 16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
8/8/79	76.0	43.0	.004	.013	.045	.152	.448	.974
8/9/79	79.0	33.0	.001	.010	.045	.173	.497	1.001
8/10/79	81.0	45.0	.004	.013	.042	.140	.442	1.064
8/11/79	80.0	31.0	.001	.010	.046	.179	.509	1.004
8/12/79	67.0	57.0	.006	.015	.046	.142	.390	.808
8/13/79	65.0	52.0	.006	.016	.049	.151	.395	.770
8/14/79	61.0	62.0	.006	.016	.046	.139	.363	.718
8/15/79	53.0	78.0	.008	.019	.049	.131	.323	.646
8/16/79	52.0	83.0	.006	.016	.045	.128	.322	.639
8/17/79	60.0	71.0	.006	.015	.043	.130	.348	.731
8/18/79	56.0	55.0	.006	.017	.049	.147	.353	.632
8/19/79	55.0	64.0	.008	.018	.050	.140	.337	.633
8/20/79	57.0	55.0	.006	.017	.049	.148	.357	.645
8/21/79	67.0	43.0	.005	.015	.049	.161	.424	.817
8/22/79	70.0	29.0	.008	.021	.063	.190	.449	.795
8/23/79	73.0	26.0	.009	.024	.069	.204	.470	.808
8/24/79	72.0	22.0	.016	.036	.089	.223	.465	.798
8/25/79	75.0	22.0	.014	.032	.084	.227	.492	.835
8/26/79	65.0	56.0	.006	.016	.048	.145	.387	.772
8/27/79	78.0	44.0	.004	.013	.044	.148	.447	1.010
8/28/79	72.0	37.0	.003	.013	.048	.167	.455	.893
8/29/79	72.0	31.0	.005	.016	.056	.184	.463	.850
8/30/79	72.0	31.0	.005	.016	.056	.184	.463	.850
8/31/79	71.0	42.0	.004	.014	.048	.160	.440	.884
9/1/79	74.0	27.0	.007	.020	.064	.200	.478	.834
9/2/79	73.0	32.0	.004	.014	.053	.180	.469	.877

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
9/3/79	76.0	23.0	.011	.027	.077	.222	.499	.844
9/4/79	77.0	29.0	.003	.014	.054	.190	.498	.917
9/5/79	79.0	26.0	.004	.016	.060	.204	.517	.919
9/6/79	80.0	22.0	.009	.025	.075	.227	.534	.918
9/7/79	79.0	33.0	.001	.010	.045	.173	.497	1.001
9/8/79	77.0	46.0	.005	.014	.046	.146	.437	.989
9/9/79	72.0	56.0	.006	.015	.045	.138	.401	.893
9/10/79	74.0	27.0	.007	.020	.064	.200	.478	.834
9/11/79	76.0	23.0	.011	.027	.077	.222	.499	.844
9/12/79	75.0	28.0	.005	.017	.060	.196	.485	.864
9/13/79	73.0	20.0	.020	.042	.098	.235	.480	.854
9/14/79	66.0	46.0	.005	.015	.049	.158	.413	.798
9/15/79	62.0	35.0	.007	.019	.057	.172	.409	.754
9/16/79	67.0	36.0	.005	.016	.053	.171	.434	.813
9/17/79	75.0	28.0	.005	.017	.060	.196	.485	.864
9/18/79	71.0	42.0	.004	.014	.048	.163	.440	.884
9/19/79	62.0	54.0	.006	.016	.049	.149	.380	.721
9/20/79	67.0	50.0	.006	.016	.049	.152	.406	.808
9/21/79	67.0	44.0	.005	.015	.049	.160	.421	.816
9/22/79	71.0	36.0	.004	.013	.050	.170	.453	.872
9/23/79	73.0	29.0	.006	.018	.059	.191	.470	.842
9/24/79	70.0	29.0	.008	.021	.063	.190	.449	.795
9/25/79	68.0	33.0	.006	.017	.056	.178	.439	.810
9/26/79	68.0	51.0	.006	.016	.049	.150	.406	.823
9/27/79	70.0	29.0	.008	.021	.063	.190	.449	.795
9/28/79	70.0	38.0	.004	.014	.049	.167	.445	.863

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES) 16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
9/29/79	70.0	42.0	.004	.014	.048	.160	.436	.867
9/30/79	71.0	42.0	.004	.014	.048	.160	.440	.884
10/1/79	73.0	50.0	.006	.016	.048	.147	.419	.912
10/2/79	71.0	33.0	.004	.015	.053	.178	.458	.853
10/3/79	74.0	35.0	.003	.012	.048	.171	.469	.918
10/4/79	72.0	19.0	.023	.047	.105	.238	.477	.889
10/5/79	72.0	17.0	.027	.056	.117	.247	.489	.993
10/6/79	73.0	13.0	.036	.069	.134	.256	.502	1.180
10/7/79	72.0	19.0	.023	.047	.105	.238	.477	.889
10/8/79	69.0	22.0	.019	.040	.092	.217	.438	.771
10/9/79	72.0	17.0	.027	.056	.117	.247	.489	.993
10/10/79	72.0	9.0	.038	.072	.132	.231	.461	1.263
10/11/79	68.0	21.0	.021	.045	.098	.219	.433	.796
10/12/79	69.0	19.0	.025	.050	.107	.231	.454	.891
10/13/79	65.0	24.0	.018	.039	.087	.200	.398	.714
10/14/79	59.0	28.0	.016	.034	.076	.177	.364	.696
10/15/79	67.0	23.0	.019	.039	.089	.208	.417	.739
10/16/79	61.0	38.0	.006	.017	.054	.168	.405	.747
10/17/79	58.0	39.0	.006	.018	.054	.166	.391	.719
10/18/79	60.0	33.0	.009	.023	.062	.174	.394	.734
10/19/79	55.0	49.0	.006	.016	.050	.153	.360	.635
10/20/79	46.0	81.0	.010	.022	.053	.135	.303	.564
10/21/79	37.0	77.0	.013	.028	.060	.131	.264	.504
10/22/79	47.0	64.0	.010	.023	.055	.139	.300	.543
10/23/79	53.0	34.0	.011	.025	.064	.166	.363	.722
10/24/79	58.0	31.0	.012	.028	.068	.174	.375	.717

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
10/25/79	62.0	28.0	.014	.031	.074	.183	.385	.704
10/26/79	58.0	35.0	.008	.021	.060	.170	.388	.728
10/27/79	54.0	26.0	.021	.042	.084	.167	.324	.716
10/28/79	54.0	22.0	.027	.051	.098	.173	.333	.841
10/29/79	27.0	39.0	.018	.035	.064	.118	.311	1.058
10/30/79	35.0	23.0	.016	.031	.064	.143	.409	1.479
10/31/79	32.0	64.0	.016	.032	.063	.121	.238	.565
5/1/80	34.0	100.0	.004	.012	.038	.115	.252	.410
5/2/80	51.0	56.0	.007	.018	.050	.144	.327	.574
5/3/80	60.0	33.0	.009	.023	.062	.174	.394	.734
5/4/80	69.0	41.0	.004	.014	.049	.163	.435	.850
5/5/80	47.0	87.0	.005	.014	.042	.129	.314	.574
5/6/80	46.0	81.0	.010	.022	.053	.135	.303	.564
5/7/80	49.0	76.0	.010	.023	.054	.136	.310	.590
5/8/80	52.0	57.0	.007	.018	.050	.144	.330	.583
5/9/80	47.0	63.0	.010	.022	.055	.139	.301	.541
5/10/80	37.0	30.0	.016	.032	.065	.139	.337	1.044
5/11/80	34.0	92.0	.006	.016	.042	.117	.253	.449
5/12/80	43.0	55.0	.009	.021	.053	.136	.288	.539
5/13/80	49.0	49.0	.007	.017	.051	.148	.330	.590
5/14/80	44.0	80.0	.011	.024	.056	.136	.294	.543
5/15/80	48.0	59.0	.009	.020	.052	.140	.308	.547
5/16/80	58.0	43.0	.006	.016	.051	.162	.387	.700
5/17/80	56.0	46.0	.006	.016	.051	.157	.372	.663
5/18/80	55.0	45.0	.006	.016	.051	.158	.369	.660
5/19/80	64.0	23.0	.021	.043	.092	.200	.391	.726

DATE	DRY BULB TEMPERATURE (DEG F)	RELATIVE HUMIDITY (PCT)	ATMOSPHERIC ATTENUATION COEFFICIENTS (DB/1000FT) (AT SPECIFIC OCTAVE BAND FREQUENCIES)					
			16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
5/20/80	69.0	25.0	.014	.031	.079	.204	.435	.744
5/21/80	72.0	19.0	.023	.047	.105	.238	.477	.889
5/22/80	65.0	27.0	.014	.031	.075	.193	.404	.715
5/23/80	56.0	37.0	.008	.020	.058	.167	.382	.715
5/24/80	NO DATA WAS RECORDED BY THE NATIONAL PARK SERVICE							
5/25/80	35.0	68.0	.015	.030	.062	.128	.250	.520
5/26/80	51.0	32.0	.014	.030	.068	.164	.348	.737
5/27/80	56.0	29.0	.016	.033	.075	.171	.353	.708
5/28/80	51.0	41.0	.007	.019	.055	.159	.358	.673
5/29/80	58.0	35.0	.008	.021	.060	.170	.388	.728
5/30/80	61.0	23.0	.023	.045	.093	.192	.366	.727
5/31/80	60.0	22.0	.025	.049	.097	.192	.364	.769
6/1/80	53.0	30.0	.016	.033	.073	.166	.345	.724
6/2/80	61.0	23.0	.023	.045	.093	.192	.366	.727
6/3/80	64.0	30.0	.010	.025	.066	.182	.408	.739
6/4/80	67.0	26.0	.014	.031	.077	.197	.418	.726
6/5/80	66.0	22.0	.021	.044	.095	.210	.411	.757
6/6/80	65.0	18.0	.029	.056	.113	.224	.441	.995
6/7/80	67.0	11.0	.036	.069	.129	.237	.504	1.458
6/8/80	74.0	9.0	.039	.073	.135	.236	.457	1.193
6/9/80	78.0	11.0	.037	.072	.140	.263	.502	1.117
6/10/80	77.0	3.0	.023	.042	.074	.119	.217	.591

ATMOSPHERIC ATTENUATION COEFFICIENTS FOR T=32.0 IN DB/1000FT AT 8000FT

ALPHA(T,RH,F)

RH(PCT)	16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
2.0	.009	.021	.055	.155	.471	1.085
4.0	.015	.035	.035	.263	.804	1.883
6.0	.019	.044	.117	.332	1.016	2.427
8.0	.021	.049	.129	.365	1.122	2.748
10.0	.021	.049	.136	.369	1.139	2.876
12.0	.020	.047	.122	.349	1.064	2.849
14.0	.018	.042	.110	.313	.979	2.703
16.0	.016	.035	.094	.268	.645	2.460
18.0	.013	.031	.079	.222	.706	2.223
20.0	.012	.026	.066	.183	.584	1.972
22.0	.011	.024	.058	.157	.494	1.762
24.0	.011	.023	.054	.141	.435	1.592
26.0	.011	.024	.054	.134	.401	1.455
28.0	.012	.025	.056	.133	.381	1.343
30.0	.013	.027	.058	.133	.369	1.248
32.0	.014	.028	.060	.133	.357	1.163
34.0	.015	.029	.061	.133	.344	1.066
36.0	.015	.030	.062	.132	.331	1.018
38.0	.016	.031	.063	.131	.319	.956
40.0	.016	.031	.063	.129	.307	.902
42.0	.016	.032	.063	.127	.295	.853
44.0	.016	.032	.063	.125	.284	.809
46.0	.016	.032	.063	.124	.273	.771
48.0	.016	.032	.062	.122	.264	.737
50.0	.016	.032	.062	.121	.257	.706
52.0	.016	.032	.062	.120	.251	.678
54.0	.018	.032	.062	.120	.246	.653
56.0	.017	.032	.062	.120	.242	.631
58.0	.017	.032	.062	.120	.240	.611
60.0	.017	.032	.063	.120	.239	.594
62.0	.016	.032	.063	.121	.238	.579
64.0	.016	.032	.063	.121	.238	.565
66.0	.016	.032	.062	.122	.239	.554
68.0	.016	.031	.062	.122	.240	.544
70.0	.015	.031	.061	.122	.241	.535
72.0	.015	.030	.060	.122	.242	.528
74.0	.014	.029	.059	.122	.243	.522
76.0	.014	.028	.059	.122	.244	.516
78.0	.013	.027	.056	.121	.245	.511
80.0	.012	.025	.054	.120	.246	.506
82.0	.011	.023	.052	.118	.246	.501
84.0	.010	.021	.049	.117	.246	.496
86.0	.009	.019	.046	.114	.245	.490
88.0	.007	.017	.042	.112	.244	.483
90.0	.006	.014	.039	.104	.242	.476
92.0	.007	.016	.041	.110	.239	.446
94.0	.006	.015	.040	.110	.236	.434
96.0	.006	.014	.039	.109	.237	.422
98.0	.005	.013	.037	.109	.237	.411
100.0	.004	.012	.036	.108	.236	.399

ATMOSPHERIC ATTENUATION COEFFICIENTS FOR T=50.0 IN DB/1000FT AT 8000FT

ALPHA(T,RH,F)

RH(PCT)	16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
2.0	.005	.011	.031	.091	.306	1.004
4.0	.009	.021	.056	.162	.520	1.706
6.0	.013	.030	.074	.207	.653	2.143
8.0	.017	.037	.088	.233	.717	2.350
10.0	.020	.043	.098	.243	.723	2.365
12.0	.023	.048	.103	.239	.682	2.226
14.0	.026	.051	.105	.226	.610	1.980
16.0	.028	.053	.104	.207	.523	1.678
18.0	.028	.054	.102	.189	.437	1.370
20.0	.028	.053	.098	.172	.367	1.107
22.0	.027	.051	.093	.162	.325	.926
24.0	.025	.047	.089	.157	.308	.821
26.0	.022	.043	.083	.157	.309	.770
28.0	.019	.038	.078	.159	.320	.753
30.0	.017	.034	.073	.161	.334	.750
32.0	.014	.030	.069	.163	.345	.745
34.0	.012	.027	.065	.163	.352	.734
36.0	.010	.024	.061	.162	.356	.720
38.0	.009	.022	.059	.161	.357	.702
40.0	.008	.020	.056	.159	.355	.682
42.0	.007	.019	.054	.157	.352	.661
44.0	.007	.018	.053	.155	.348	.641
46.0	.007	.017	.051	.152	.343	.621
48.0	.003	.017	.051	.150	.338	.603
50.0	.007	.017	.050	.148	.333	.588
52.0	.007	.017	.050	.146	.328	.577
54.0	.007	.018	.050	.144	.325	.570
56.0	.007	.018	.051	.143	.322	.565
58.0	.003	.019	.051	.142	.319	.564
60.0	.008	.020	.052	.141	.317	.564
62.0	.009	.020	.053	.140	.316	.567
64.0	.009	.021	.053	.140	.315	.571
66.0	.010	.022	.054	.139	.314	.576
68.0	.010	.022	.054	.139	.313	.581
70.0	.010	.022	.054	.138	.313	.587
72.0	.010	.022	.054	.137	.313	.593
74.0	.010	.022	.054	.136	.313	.598
76.0	.010	.022	.053	.135	.313	.603
78.0	.009	.021	.052	.134	.314	.607
80.0	.009	.020	.050	.133	.315	.610
82.0	.008	.018	.048	.131	.316	.612
84.0	.007	.016	.045	.130	.318	.613
86.0	.005	.014	.042	.128	.321	.613
88.0	.003	.011	.037	.126	.324	.611
90.0	.001	.007	.033	.123	.327	.608
92.0	.003	.010	.035	.123	.321	.605
94.0	.002	.009	.035	.122	.321	.606
96.0	.002	.009	.034	.120	.321	.607
98.0	.002	.009	.033	.119	.320	.608
100.0	.002	.008	.032	.118	.320	.609

ATMOSPHERIC ATTENUATION COEFFICIENTS FOR T=63.0 IN DB/1000FT AT 6000FT

ALPHA(T,RH,F)

RH(PCT)	16HZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
2.0	.014	.025	.045	.077	.174	.587
4.0	.024	.014	.080	.136	.305	1.003
6.0	.030	.057	.104	.101	.399	1.269
8.0	.035	.065	.120	.213	.453	1.406
10.0	.036	.069	.129	.232	.492	1.435
12.0	.036	.069	.131	.242	.502	1.377
14.0	.034	.066	.128	.243	.495	1.259
16.0	.031	.051	.121	.240	.478	1.111
18.0	.027	.055	.113	.233	.457	.961
20.0	.023	.048	.103	.224	.439	.839
22.0	.020	.041	.093	.215	.429	.765
24.0	.015	.035	.084	.206	.425	.735
26.0	.013	.030	.076	.199	.427	.736
28.0	.010	.025	.069	.192	.431	.756
30.0	.008	.021	.062	.185	.436	.781
32.0	.006	.018	.058	.180	.439	.802
34.0	.005	.016	.054	.175	.440	.817
36.0	.005	.015	.052	.171	.439	.827
38.0	.004	.014	.050	.168	.437	.832
40.0	.004	.014	.049	.165	.434	.834
42.0	.004	.014	.049	.162	.430	.834
44.0	.005	.015	.049	.159	.425	.832
46.0	.005	.015	.049	.157	.420	.829
48.0	.006	.016	.049	.154	.414	.826
50.0	.006	.016	.049	.152	.409	.823
52.0	.006	.016	.049	.149	.404	.822
54.0	.006	.016	.048	.146	.399	.823
56.0	.006	.016	.047	.143	.395	.824
58.0	.006	.015	.045	.140	.390	.827
60.0	.005	.014	.044	.137	.386	.830
62.0	.005	.014	.042	.133	.382	.834
64.0	.004	.013	.040	.130	.378	.838
66.0	.004	.012	.038	.127	.373	.842
68.0	.003	.011	.037	.123	.369	.846
70.0	.003	.010	.035	.120	.365	.850
72.0	.002	.009	.033	.116	.361	.853
74.0	.002	.008	.031	.113	.357	.856
76.0	.002	.007	.030	.110	.352	.858
78.0	.001	.007	.029	.106	.348	.859
80.0	.001	.005	.027	.103	.344	.861
82.0	.001	.005	.025	.100	.339	.861
84.0	.000	.005	.024	.097	.335	.861
86.0	.000	.004	.023	.094	.331	.861
88.0	.000	.004	.022	.091	.327	.860
90.0	.000	.004	.020	.088	.323	.859
92.0	.000	.003	.019	.084	.318	.863
94.0	.000	.002	.018	.081	.314	.865
96.0	.000	.002	.016	.078	.309	.867
98.0	.000	.001	.015	.075	.305	.869
100.0	.000	.000	.013	.071	.301	.870

ATMOSPHERIC ATTENUATION COEFFICIENTS FOR T=86.0 IN DB/1000FT AT 8000FT

ALPHA(T,RH,F)

RH(PCT)	1GHZ	31.5HZ	63HZ	125HZ	250HZ	500HZ
2.0	.014	.028	.054	.101	.180	.379
4.0	.024	.047	.093	.178	.322	.669
6.0	.030	.059	.118	.232	.430	.678
8.0	.032	.064	.131	.267	.508	1.018
10.0	.031	.063	.133	.285	.560	1.098
12.0	.028	.058	.128	.288	.589	1.130
14.0	.023	.050	.117	.281	.601	1.127
16.0	.018	.041	.102	.267	.600	1.103
18.0	.012	.031	.086	.249	.592	1.073
20.0	.007	.022	.072	.231	.551	1.050
22.0	.003	.015	.060	.215	.571	1.046
24.0	.001	.010	.052	.202	.563	1.058
26.0	-.000	.008	.046	.191	.555	1.080
28.0	-.001	.006	.043	.182	.547	1.106
30.0	-.001	.006	.040	.174	.538	1.132
32.0	-.001	.006	.038	.166	.527	1.151
34.0	-.000	.006	.037	.159	.515	1.164
36.0	.000	.007	.037	.152	.502	1.171
38.0	.001	.008	.037	.143	.488	1.173
40.0	.002	.009	.037	.140	.473	1.171
42.0	.003	.010	.037	.135	.458	1.165
44.0	.003	.011	.037	.130	.443	1.156
46.0	.004	.012	.037	.125	.428	1.146
48.0	.005	.012	.037	.120	.414	1.133
50.0	.005	.013	.037	.116	.401	1.121
52.0	.005	.013	.036	.113	.390	1.108
54.0	.005	.012	.035	.109	.379	1.095
56.0	.004	.011	.033	.106	.370	1.082
58.0	.004	.010	.032	.102	.361	1.069
60.0	.003	.009	.030	.100	.353	1.056
62.0	.003	.009	.028	.097	.346	1.044
64.0	.002	.007	.026	.094	.340	1.032
66.0	.001	.006	.024	.092	.334	1.020
68.0	.001	.005	.022	.090	.328	1.008
70.0	.000	.004	.020	.088	.322	.996
72.0	-.000	.003	.019	.086	.317	.985
74.0	-.001	.002	.018	.084	.311	.973
76.0	-.001	.002	.018	.082	.305	.963
78.0	-.000	.003	.018	.080	.300	.953
80.0	-.000	.003	.017	.079	.294	.945
82.0	.001	.004	.019	.077	.288	.937
84.0	.002	.005	.020	.076	.281	.930
86.0	.003	.007	.022	.074	.275	.925
88.0	.004	.010	.025	.072	.268	.922
90.0	.006	.013	.028	.071	.261	.920
92.0	.004	.010	.023	.067	.251	.902
94.0	.004	.010	.023	.064	.244	.892
96.0	.004	.010	.023	.062	.237	.882
98.0	.005	.010	.022	.060	.230	.872
100.0	.005	.010	.022	.057	.223	.862

APPENDIX E: OCTAVE BAND ANALYSES OF COAL BLAST MEASUREMENTS

It was shown in Reference 4 that near a mine it is possible to simulate pressure time histories of surface mining blasts wih simple (damped sine wave) mathematical expressions. Fourier analysis of the simulations suggests that (flat) sound exposure levels should decrease 6 dB per octave. Table XV shows that there is in fact some empirical confirmation of this hypothesis. Accordingly, we use the last column of Table XV to calculate octave band sound exposure levels from the overall sound exposure level, but only near the blast site. Similarly, we use the last column in Table XVI to calculate the overall sound exposure level from the peak sound pressure level. In this way we obtain a practical path connecting peak over pressures to octave band sound exposure levels.

The preceding results suggest examining peak sound pressure levels in hope of finding some similar pattern. Table XVII demonstrates that very nearly the same pattern or regularity (6 dB down per octave) seems to underlie Tables XV and XVII. Accordingly, we use the last column of Table XVII to infer peak octave band sound pressure levels from peak overall sound pressure levels, but again only near the blast site.

The net result of these considerations is that the predictions for peak overall sound pressures near blast sites introduced in Section III imply corresponding assertions about octave band sound pressure levels and octave band sound exposue levels, both of which are needed to predict sound levels and noise impact.

The only remaining point is that for N delays one must include a factor 10 log N to account for the N acoustic energy doses.

TABLE XV. Flat blasting sound exposure level differences (octave band minus overall), dB

Octave Band center frequency, Hertz	Coal blasts				
	EFC	P&M	1st UII	2nd UII	Average
31.5	-5.5	-8.5	-5.3	-4.2	-5.9
63	-7.2	-15.5	-14.3	-5.2	-10.6
125	-12.1	-8.5	-18.4	-15.3	-16.1
250	-16.9	-22.4	-25.9	-25.0	-22.6
500	-18.2	-24.3	-27.7	-44.2	-28.6

TABLE XVI: Flat sound exposure level minus peak sound pressure level, dB

Coal Blasts				
EFC	P&M	1st UII	2nd UII	Average
-4.2	-4.7	-4.6	-6.3	-5.0

TABLE XVII: Blasting peak sound pressure level differences (octave band minus overall), dB

Octave Band center frequency, Hertz	Coal blasts				
	EFC	P&M	1st UII	2nd UII	Average
31.5	-6.2	-8	-6.5	-4.8	-6.3
63	-7.5	-16	-14.5	-5.2	-10.8
125	-11.8	-18.6	-20.4	-13.7	-16.1
250	-18.6	-24	-27	-25.9	-23.9
500	-19	-25.7	-30.5	-41.5	-29.2