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May 9, 2017

Baseline Noise Monitoring Adjacent to Waste Connections Well Site

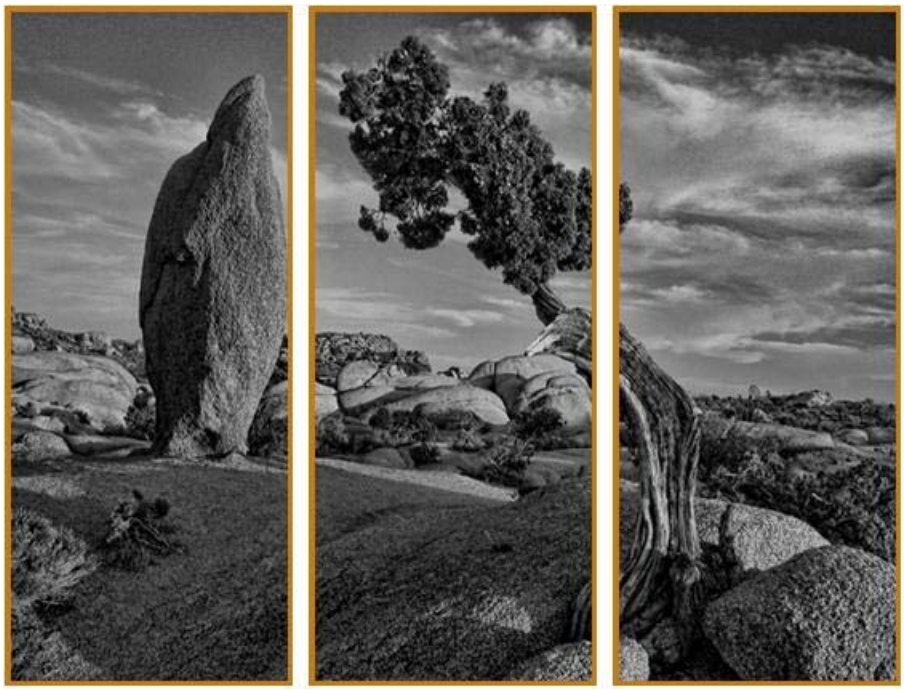
Noise Monitoring of Crestone Peak Resources Operations Erie, Colorado

Prepared For:

Town of Erie
645 Holbrook Street
Erie, CO 80516

Pinyon Project No.:

11769502



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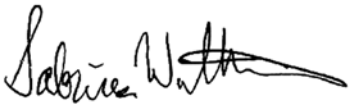

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Reviewed by:

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1. Introduction

The Town of Erie (Town) has contracted with Pinyon Environmental (Pinyon) to perform noise monitoring near the Crestone Peak Resources (Crestone) Waste Connections well site. Pinyon collected continuous noise measurements at two locations adjacent to the well site. Sampling Site 1 is located approximately 350-feet to the southeast of the well site and collected A-weighted noise measurements. Sampling Site 2 is located near a residential neighborhood approximately 1,400-feet to the southwest of the well site and collected both A-weighted and C-weighted noise measurements. Baseline noise measurements began on April 14th, 2017 at approximately 5:00 PM and lasted until April 25th, 2017 at approximately 6:00 AM. Crestone began deploying vehicles and equipment to the Waste Connections well site at approximately 7:00 AM on April 15, 2017. However, drilling operations had not commenced during the baseline noise monitoring period. The baseline noise monitoring data was analyzed to evaluate current noise levels at these locations prior to Crestone beginning their well production activities.

2. Methodology

2.1 Noise Monitoring Approach

In accordance with Colorado Oil and Gas Conservation Committee (COGCC) rule 802, well production facilities may not exceed the maximum permissible noise levels established in accordance to section 802.b of the rule as shown in Table 2-1. In addition to the maximum permissible A-weighted noise levels, expressed in A-weighted decibels (dBA) shown in Table 2-1, COGCC rule 802 specifies that operators may not exceed 65 C-weighted decibels (dBC) measured from the exterior wall of the residence or occupied structure nearest to the noise source at a distance of 25-feet from the structure.

Table 2-1 COGCC Maximum Permissible Noise Levels

Zone	Maximum Permissible Noise Level	
	7:00am to 7:00pm	7:00pm to 7:00am
Residential/Agricultural/Rural	55 dBA	50 dBA
Commercial	60 dBA	55 dBA
Light Industrial	70 dBA	65 dBA
Industrial	80 dBA	75 dBA

dBA A-weighted decibel

Pinyon mobilized to Sampling Site 1 (Light Industrial Zone) and Sampling Site 2 (Residential/Agricultural/Rural Zone) and monitored for noise at these locations using 3M Quest SoundPro DL Type 1 datalogging sound level meters. The sound level meters collected continuous measurements of both A-weighted and C-weighted decibels, as applicable to the location. At Sampling Site 1 the sound level meter monitored continuously for A-weighted noise. Sampling Site 2 collected continuous A-weighted and C-weighted noise. The baseline monitoring period lasted from April 14th, 2017 at approximately 5:00 PM through April 25th, 2017 at approximately 6:00 AM at which time Crestone began drilling operations at the well site.

The sound level meters are configured with a data logging system that uploads one minute time resolved measurements to a secure online database at ten minute intervals. Pinyon's Noise Specialist and Field Technicians have been provided an account to access the database including username and password. The sound level meters are configured with an alert system that send a message to Pinyon's Noise Specialist as soon as the data is uploaded indicating that established noise criteria levels based on whether the monitored equivalent continuous noise level (Leq) has been exceeded. Leq is the preferred method to describe noise levels that vary over time, resulting in a single decibel value that takes into account the total sound energy over the period of time of interest. The Town and Pinyon agreed to set the alert system at 70 Leq dBA for A-weighted noise at Sampling Site 1, 55 Leq dBA for A-weighted noise at Sampling Site 2 and 70 Leq dBC for C-weighted noise at Sampling Site 2. These noise criteria levels were established based on the COGCC's maximum permissible noise levels, as well as baseline noise monitoring data collected prior to Crestone mobilizing to the well site. The C-weighted noise alert criteria level at Sampling Site 2 is set higher than the COGCC's maximum permissible noise level because baseline noise measurements collected prior to Crestone's operations exceeded this level. In general, the noise criteria levels reflect a 3 decibel increase from baseline noise levels. A 3 decibel increase in noise is considered to be barely perceptible to the human ear.

2.2 Noise Monitoring Data Analysis

Pinyon's Noise specialist downloaded the noise monitoring data from the online database for the baseline collection period. The data was then formatted into spreadsheets that allowed for analysis of the noise

monitoring data. Pinyon utilized statistical methods, as well as graphical representations of the data, to determine baseline noise levels at the two sampling locations during the monitoring period. Initial analysis of the monitor data indicated differences in observed noise levels based on time of day and day of week. Furthermore, COGCC's rule 802 specifies different maximum permissible noise levels based on time of day. Therefore, for the statistical analysis of the noise measurements, the monitor data was split into four discrete analytical groups:

- Weekday Daytime: Monday—Friday, 7:00 AM—6:59 PM
- Weekday Nighttime: Monday—Friday, 7:00 PM—6:59 AM
- Weekend Daytime: Saturday—Sunday, 7:00 AM—6:59 PM
- Weekend Nighttime: Saturday—Sunday, 7:00 AM—6:59 PM

Section 3-2 describes how differences in the statistical mean between these groups were analyzed to confirm whether statistically significant differences existed that warranted discreet analysis between the monitoring periods. To determine the distribution of the noise monitoring data, the statistical mean, median and mode were calculated. The statistical mean, median and mode are used to evaluate the statistical distribution of the noise monitoring data. If these three variables are close together in value it represents that the data follows the normal distribution. Large data sets, such as the baseline noise monitoring data tend to follow the normal distribution, which is referred to as the central limit theorem. Determining the distribution of the noise monitoring data is important because this distribution is used to determine the appropriate statistical methods for further analysis. The observed relationship between the statistical mean, median and mode for the monitored datasets was determined to follow the normal distribution. The standard deviation for each monitoring periods was also calculated to evaluate the amount of variation in the baseline noise monitoring data.

3. Data Analysis Results

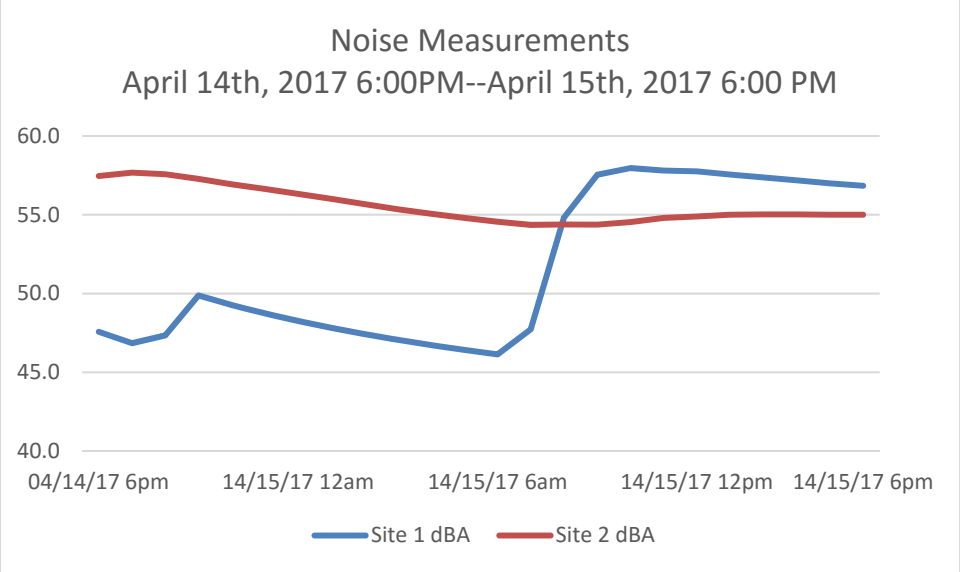
3.1 Graphical Representations of Data

Pinyon evaluated the noise monitoring data and generated several graphs that represented average conditions during the baseline monitoring data. This section presents those graphs along with a narrative describing noise monitoring conditions during the sampling periods described in Section 2-2.

3.1.1 Noise Conditions Prior to and Immediately After Crestone Arrived at the Well Site

The noise meters collected data for approximately 13-hours prior to Crestone beginning activities at the well site on April 15th, 2017 at approximately 7:00 AM as shown in Figure 3-1. When Crestone began their activities at the well site an increase in A-weighted noise measurements was detected at Site 1; however, there was no significant increase in A-weighted noise at Site 2 during this time.

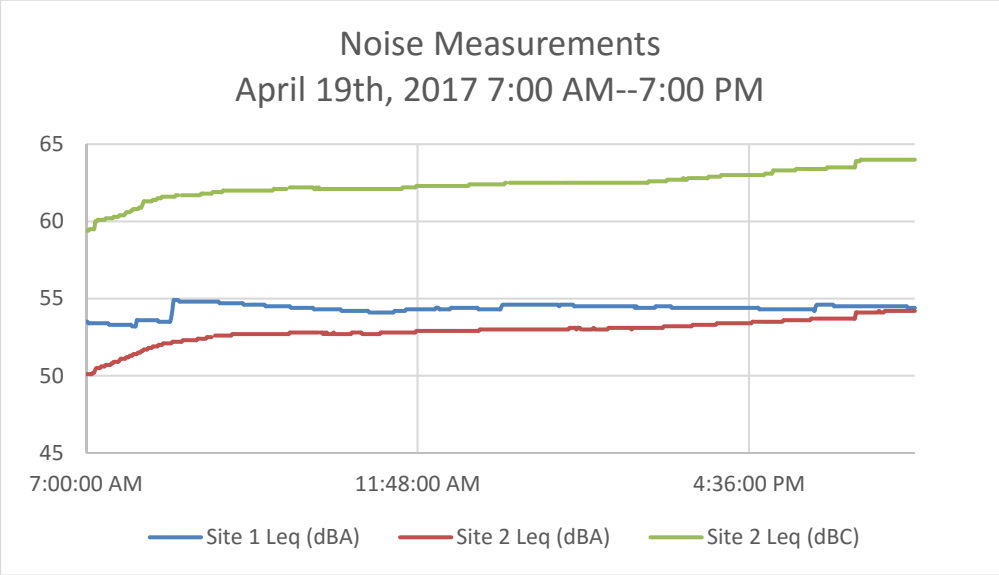
Figure 3-1 Initial 24-hours of Noise Measurements



3.1.2 Average Weekday Daytime Conditions

Figure 3-2 shows noise monitoring data collected during average weekday daytime conditions. The A-weighted monitor at Site 1 detected noise attributable to Crestone's activities at the well site as shown by the measured noise levels exceeding those measured at Site 2. There was also a slight upward trend in C-weighted noise during this period. At approximately 5:00 PM on April 19th, 2017 A-weighted noise measurements at Site 1 began to decrease becoming roughly equivalent with the A-weighted noise measurements collected at Site 2. This period likely coincides with Crestone demobilizing from Site 1 for the evening.

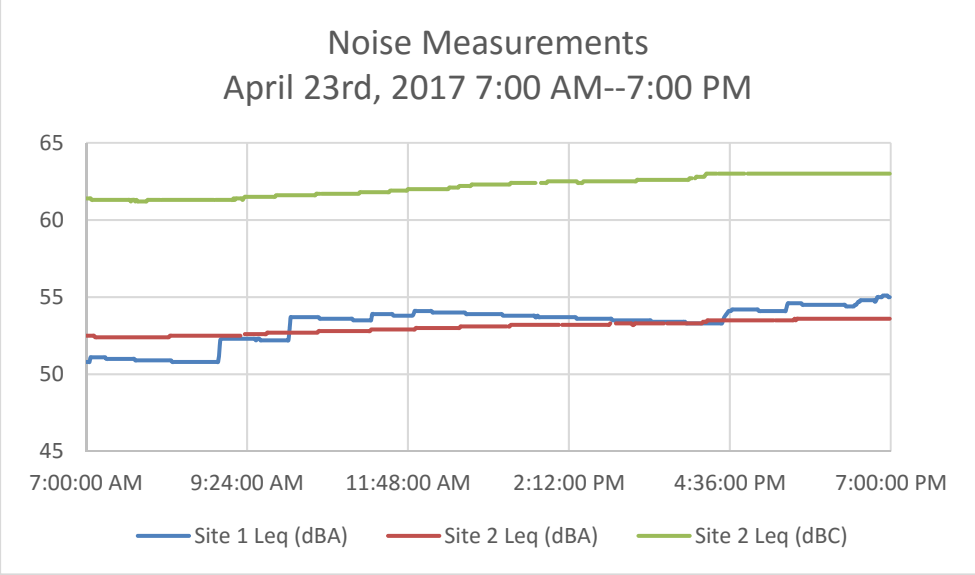
Figure 3-2 Noise Measurements Collected During Average Weekday Daytime Conditions



3.1.3 Average Weekend Daytime Conditions

Figure 3-3 shows average noise measurements collected during the weekend daytime condition that coincides with Crestone's activities at the well site. Noise measurements collected show that A-weighted noise levels measured from Site 1 and Site 2 were close in value and elevated C-weighted noise levels were not observed.

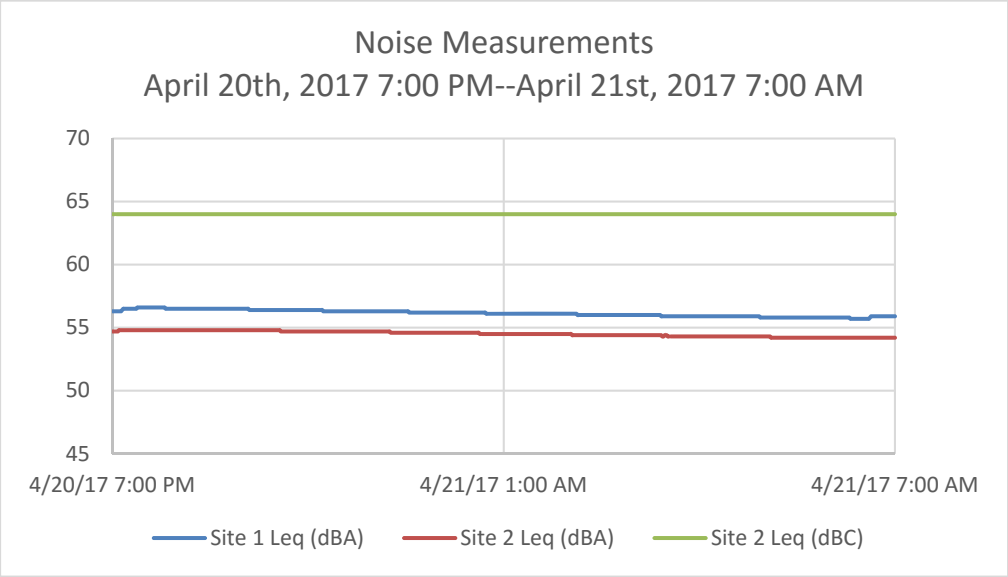
Figure 3-3 Noise Measurements Collected During Average Weekend Daytime Conditions



3.1.4 Average Weekday Nighttime Conditions

Figure 3-4 shows noise measurements collected during average weekday nighttime conditions. Both A-weighted and C-weighted noise was flat during this period. A-weighted noise measurements at Site 1 were higher than Site 2 most likely indicating that Crestone had activity at the well site during this period. The A-weighted noise measurements collected at Site 2 during this period were higher than the COGCC maximum permissible nighttime noise levels, but maximum permissible noise levels at Site 1 were not exceeded.

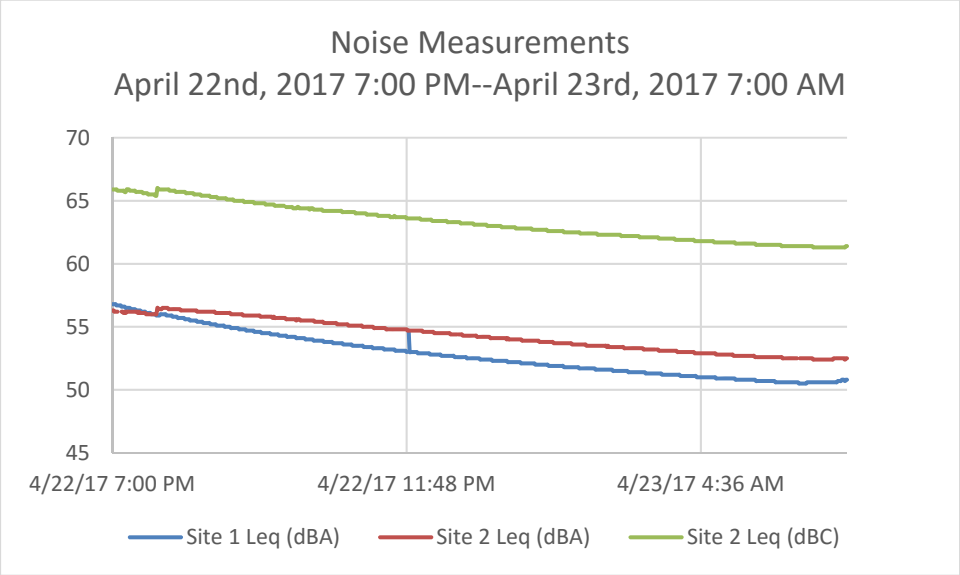
Figure 3-4 Noise Measurements Collected During Average Weekday Nighttime Conditions



3.1.5 Average Weekend Nighttime Conditions

Figure 3-5 shows average noise measurements collected during weekend nighttime conditions during the baseline monitoring period. For most of the period A-weighted noise levels were higher at Site 2 than Site 1 indicating that Crestone did not have activities during most of this period. A-weighted noise at Site 2 exceeded the COGCC's maximum permissible nighttime noise levels until approximately 12:00 AM on April 23rd, 2017. Since noise levels were lower at Site 1 than Site 2 it is unlikely that the elevated noise as measured from Site 2 was attributable to activities at the well site and were likely attributable to activity in the neighborhood, such as amplified music during this period.

Figure 3-5 Noise Measurements Collected During Average Weekend Nighttime Conditions



3.2 Statistical Analysis of Noise Monitor Data

3.2.1 Summary Statistics

Tables 3-1, 3-2 and 3-3 show the summary statistics for the three monitoring sites. The statistical mean, median and mode were close in value for all time periods for all three of the noise monitors. The standard deviation was less than three decibels for all three monitors for all four time periods. A standard deviation of less than three decibels indicates that the average variation in A-weighted and C-weighted noise during the four monitoring periods is barely perceptible to the human ear.

Table 3-2 Summary Statistics for A-weighted Noise at Site I Leq (dBA)

Period	Mean	Median	Mode	Standard Deviation
Weekday Daytime	56.9	56.7	58.7	1.5
Weekday Nighttime	55.9	56.2	56.2	2.6
Weekend Daytime	53.6	53.7	53.7	1.6
Weekend Nighttime	53.5	54.0	54.2	1.5

Table 3-3 Summery Statistics for A-weighted Noise at Site 2 Leq (dBA)

Period	Mean	Median	Mode	Standard Deviation
Weekday Daytime	54.1	53.8	55.0	1.4
Weekday Nighttime	54.0	54.2	53.4	1.7
Weekend Daytime	53.7	53.2	53.2	1.6
Weekend Nighttime	53.9	53.6	53.6	1.1

Table 3-4 Summery Statistics for C-weighted Noise at Site 2 Leq (dBC)

Period	Mean	Median	Mode	Standard Deviation
Weekday Daytime	64.3	64.0	65.4	1.4
Weekday Nighttime	64.2	64.0	64.0	1.7
Weekend Daytime	63.0	62.6	63.0	1.6
Weekend Nighttime	63.2	63.0	63.0	1.0

3.2.2 Statistical Differences Between Noise Monitoring Periods

Pinyon observed a difference in the measured noise values between the four monitoring periods while statistically analyzing the monitoring data and this difference was also observed when generating graphical representations of the measured noise values at the three noise monitors. For this reason, the monitoring data was separated into the four monitoring periods discussed in Section 2-2. A t-test was performed to determine whether the differences in calculated mean values were statistically significant. A t-test is a statistical method for evaluating the difference in means between two sample groups. The higher the t-value the greater the difference between the two means. To assess the level of confidence in the calculated t-value, a p-value is calculated. The p-value is based on the magnitude of the t-value and the total number of samples collected between the two monitoring periods. A p-value of less than or equal to 0.05 means that there is a 95% confidence level that the difference between means is statistically significant. Table 3-5 shows the t-value and p-value for each of the four comparisons at the three monitors. The calculated p-values were less than 0.05 for all comparisons meaning that the means are statistically significantly different at the 95% confidence interval except for the weekend daytime vs. weekend nighttime comparison at Site 1. For the baseline monitoring there was no statistically significant difference between the weekend daytime and weekend nighttime mean values at Site 1.

Table 3-5 Statistical t-test Result for Difference of Means for the Four Monitoring Periods

Comparison Periods	Site 1 dBA		Site 2 dBA		Site 2 dBC	
	t-value	p-value	t-value	p-value	t-value	p-value
Weekday Daytime vs. Weekend Daytime	52.4	<0.001	6.73	<0.001	27.6	<0.001
Weekday Nighttime vs. Weekend Nighttime	44.7	<0.001	3.52	0.005	29.0	<0.001
Weekday Daytime vs. Weekday Nighttime	21.6	<0.001	2.95	0.0032	3.17	0.0015
Weekend Daytime vs. Weekend Nighttime	0.64	0.5196	-2.61	0.0091	-3.82	<0.001

dBA A-weighted decibels
dBC C-weighted decibels

4. Conclusions

Pinyon collected baseline continuous noise measurements at two monitoring locations adjacent to Crestone's Waste Connections well site for approximately ten days. Crestone did mobilize to the well site during this time; however, drilling operations had not commenced. An evaluation of the noise measurements collected showed that after the 12-hours of measurements the monitors detected an increase in ambient noise levels likely attributable to Crestone's activities during the baseline period at both monitoring locations. Analysis of the noise measurements indicated statistically significant differences between observed mean values for four time periods: weekdays from 7:00 AM to 7:00 PM, weekdays from 7:00 PM to 7:00 AM, weekends from 7:00 AM to 7:00 PM and weekends from 7:00 PM to 7:00 AM except for A-weighted noise at Site 1 where no significant difference between daytime and nighttime noise levels on weekends was observed.

During the baseline monitoring, there were no exceedances of the COGCC's maximum permissible noise levels at Site 1 during daytime or nighttime hours. The COGCC's maximum permissible nighttime A-weighted noise levels were exceeded at Site 2 on several occasions. A comparison of A-weighted noise levels during these periods indicated that some exceedances may have been resultant from Crestone's operations. However, during other nighttime periods of elevated A-weighted noise, monitored levels at Site 1 were lower than Site 2 indicating that the observed increase was likely attributable to activity in the neighborhood adjacent to Site 2.

Pinyon will continue to monitor continuously for noise at Site 1 and Site 2 throughout Crestone's operations at the well site and will compare measured levels of A-weighted and C-weighted noise to baseline levels in order to assess potential changes in ambient noise levels during various phases of activity and determine if exceedances of the COGCC's maximum permissible noise levels are observed.