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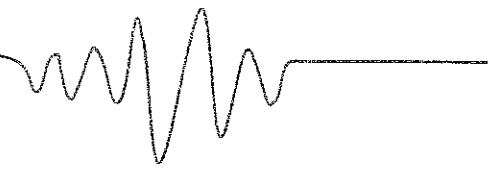

Gas Well Drilling Noise Impact And Mitigation Study

Prepared For: **The Gas Well Drilling Task Force**
Fort Worth, Texas

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April 2006

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1.0 Executive Summary

Behrens and Associates, Inc. was commissioned by the Fort Worth Gas Well Task Force to complete a gas well drilling noise impact and noise mitigation study of gas well drilling rigs currently operating within and near the City of Fort Worth. First, pre-drilling ambient sound level surveys to establish pre-drilling baseline sound levels were completed. Second, the noise levels of three different drilling rigs were measured and documented during various phases of gas well drilling operations. Third, noise mitigation systems were installed and evaluated for their noise reduction potential.

Twenty-four-hour continuous pre-drilling sound level surveys were completed at four drilling sites in and around the City of Fort Worth to establish ambient sound levels at typical drill site locations. Typical daytime hourly sound level between 7:00 AM and 10:00 PM ranged between 54 and 67 dBA with nighttime (10:00 PM to 7:00 AM) hourly averages ranging between 48 to 62 dBA.

Typical gas well drilling noise levels of three different drilling rigs were measured at various times during the drilling, drill pipe tripping and the running of casing. Noise levels were measured in all four directions from the rig with measurable drilling noise recorded up to 700 feet from the drilling rigs. Average drilling sound level at 200 feet was 71 to 79 dBA with drilling rig brake noise audible up to 1,000 feet from the rigs. The running of casing produced the highest measured noise levels with the rig generators producing the highest equipment noise levels of 102 dBA at 10 feet.

Drilling rig noise mitigation systems were installed and tested. The draw works brake noise control systems resulted in a 10 to 17 dBA brake noise reduction at 10 feet and inaudibility of the brake sound at 300 feet. Installation of acoustical blankets on the rig floor and substructure resulted in an 8 to 10 dBA reduction at 300 feet. Sound walls reduced drilling sound levels up to 20 dBA. Installation of enhanced engine and generator engine mufflers resulted in a 2 to 3 dB reduction of the engine noise levels.

The conclusion of the study indicates that drilling noise levels can be reduced to a generally accepted daytime ambient sound level increase of 5 dBA and a nighttime ambient sound level increase of 3 dBA at 200 feet from the drilling operation with optimum site equipment set-up, the installation of a properly designed and installed brake noise control system, rig floor and sub-structure acoustical barrier system and temporary sound control walls. Additional sound reduction can be achieved with the installation of enhanced engine mufflers, the installation of higher sound walls and the optimum positioning of noise generation equipment on the drill sites.

2.0 PRE-DRILLING AMBIENT SOUND LEVELS

To establish and document pre-drilling baseline sound levels at typical gas well drilling sites within and near the City of Fort Worth, a total of four, 24-hour continuous sound level surveys were completed at drill site pads between February 16 and February 28, 2006. The 24-hour sound level surveys were completed at the EnCana Oil & Gas Crowley 272 drill site located on Cleburen Road in southwest Fort Worth, at the XTO Energy Hodge "A" # 1-H drill site located near Everman Parkway and the I-30 Freeway in south Forth Worth, Dale Operating Company Bahan site near Beach Street and Gateway Park, and the Dale Operating Company JLB drill site located north of Randol Mill Road, east of Loop 820 in the northeastern section of the City of Forth Worth.

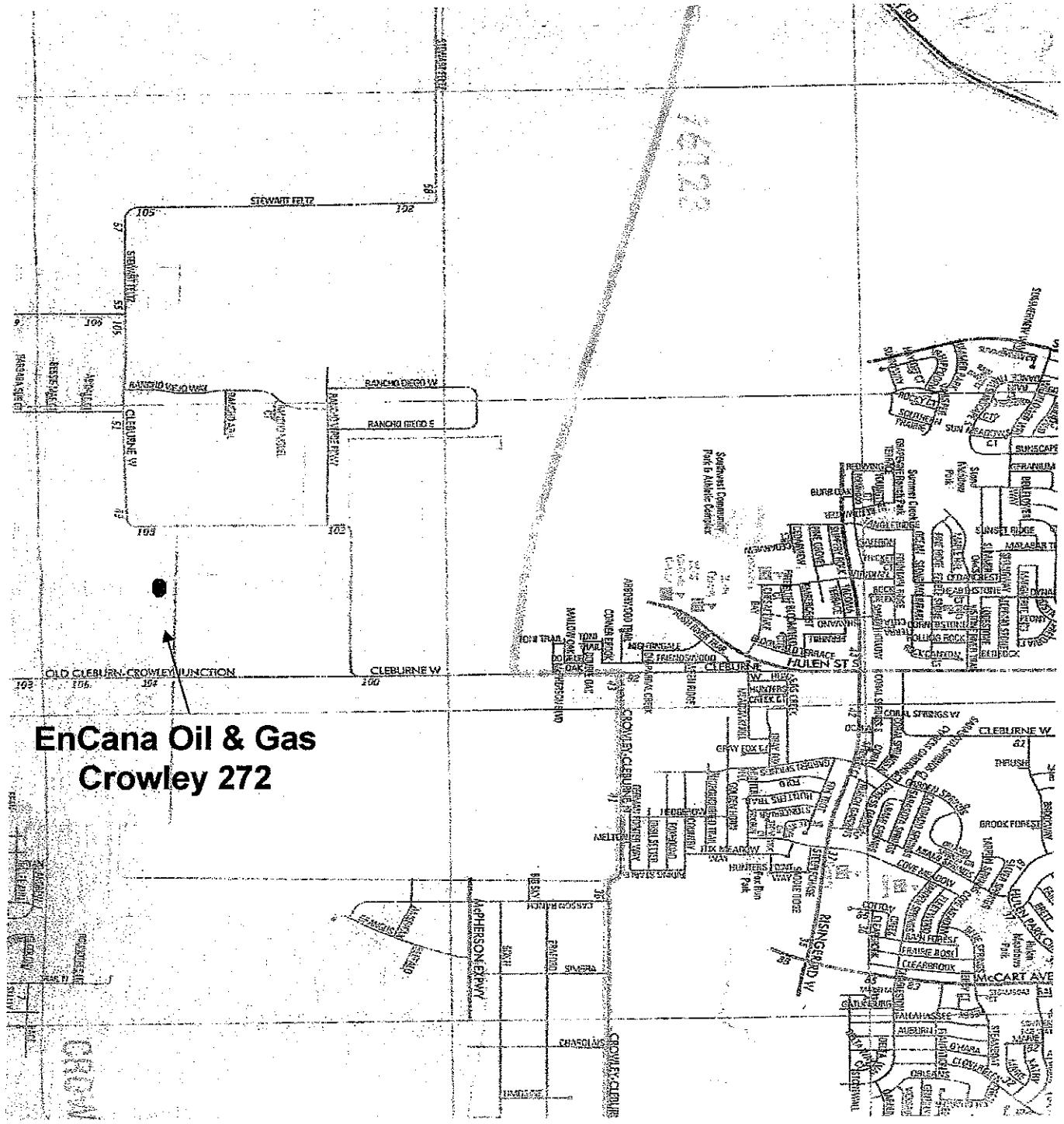
Bruel & Kjaer Model 2238 Type 1 Integrating/Logging Sound Level Meters were programmed and deployed at all four sites to measure and calculate hourly average sound levels and the Community Noise Exposure Level (CNEL). The meters, which were calibrated before each survey, and power sources were located within a locked security enclosure with the recording microphone positioned on top of the enclosure. The enclosures were attached to existing poles and/or structures approximately 5 feet above ground level in open areas of each drill site. A summary of the ambient sound level surveys at each site follows.

2.1 EnCana Oil & Gas

The sound level survey at the EnCana Oil & Gas Crowley 272 drill site commenced at 5:00 PM on Friday, February 17 and ran continuously through 5:00 PM on Saturday, February 18, 2006. The sound level survey was completed near the east side of the drill site, near West Cleburne Road as indicated on the site map in Attachment A. The average hourly daytime ambient sound level ranged from a high of 66 dBA to a low of 60 dBA with the nighttime average hour level ranging from a low of 48 dBA to a high of 57 dBA, as shown in the data graph in Attachment B. The hourly average sound levels starting at 7:00 AM on Saturday, February 18 indicates an increase in background levels due to intermittent construction activities at the site during this period.

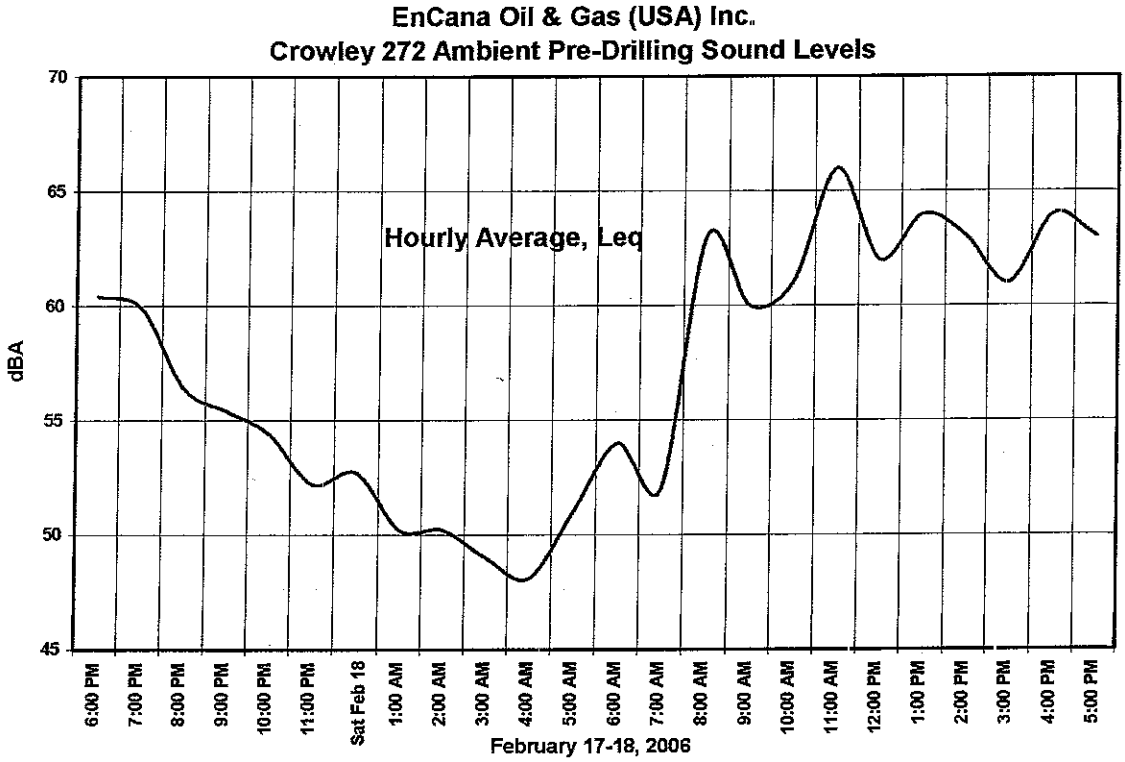
2.2 XTO Energy

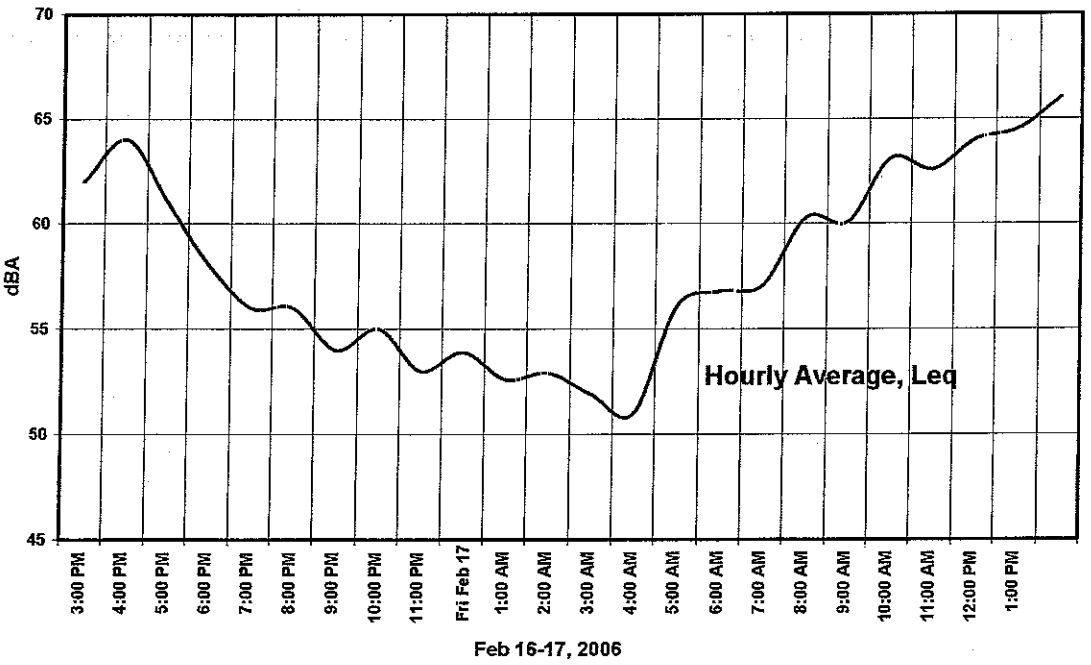
The sound level survey at the XTO Energy Hodge "A" # 1-H drill site commenced at 2:00 PM on Thursday, February 16 and ran continuously through 2:00 PM on Friday, February 17, 2006. The sound level survey was completed near the center of the drill site, near Everman Parkway as indicated on the site map in Attachment C. The average hourly daytime ambient sound level ranged from a high of 66 dBA to a low of 60 dBA with the nighttime average hour level ranging from a low of 52 dBA to a high of 57 dBA, as shown in the data graph in Attachment B. The hourly average daytime sound levels indicate an increase in background levels due to intermittent construction activities on the western portion of the site.



EnCana Oil & Gas
Crowley 272 Ambient Pre-Drilling Sound Level Survey Location

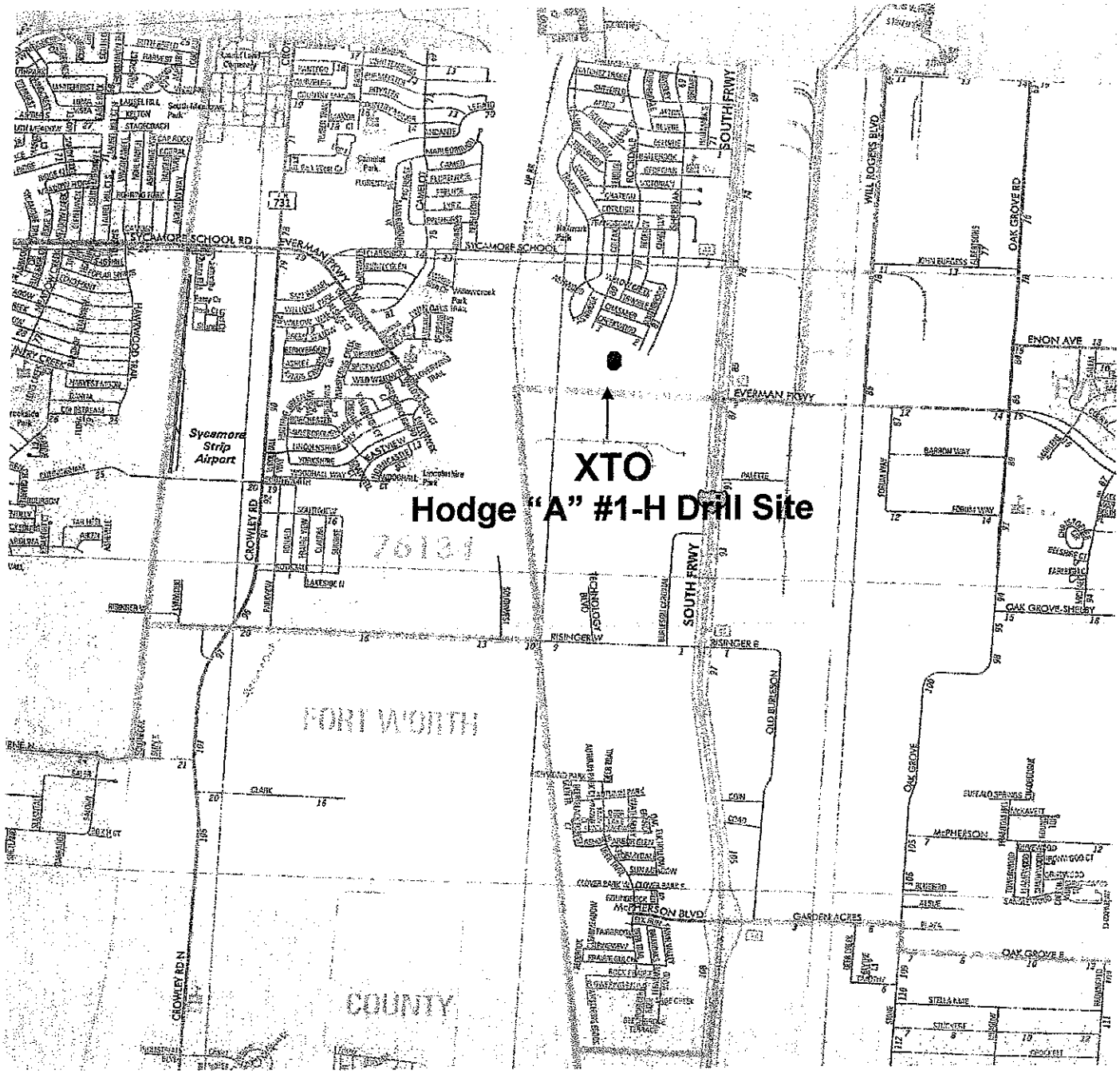
ATTACHEMENT A





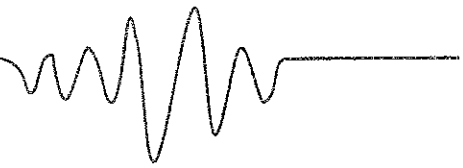
Ambient Pre-Drilling Sound Levels

ATTACHMENT B



XTO Energy
Hodge "A" #1-H Ambient Pre-Drilling Sound Level Survey Location

ATTACHEMENT C



2.3 Dale Operating Company

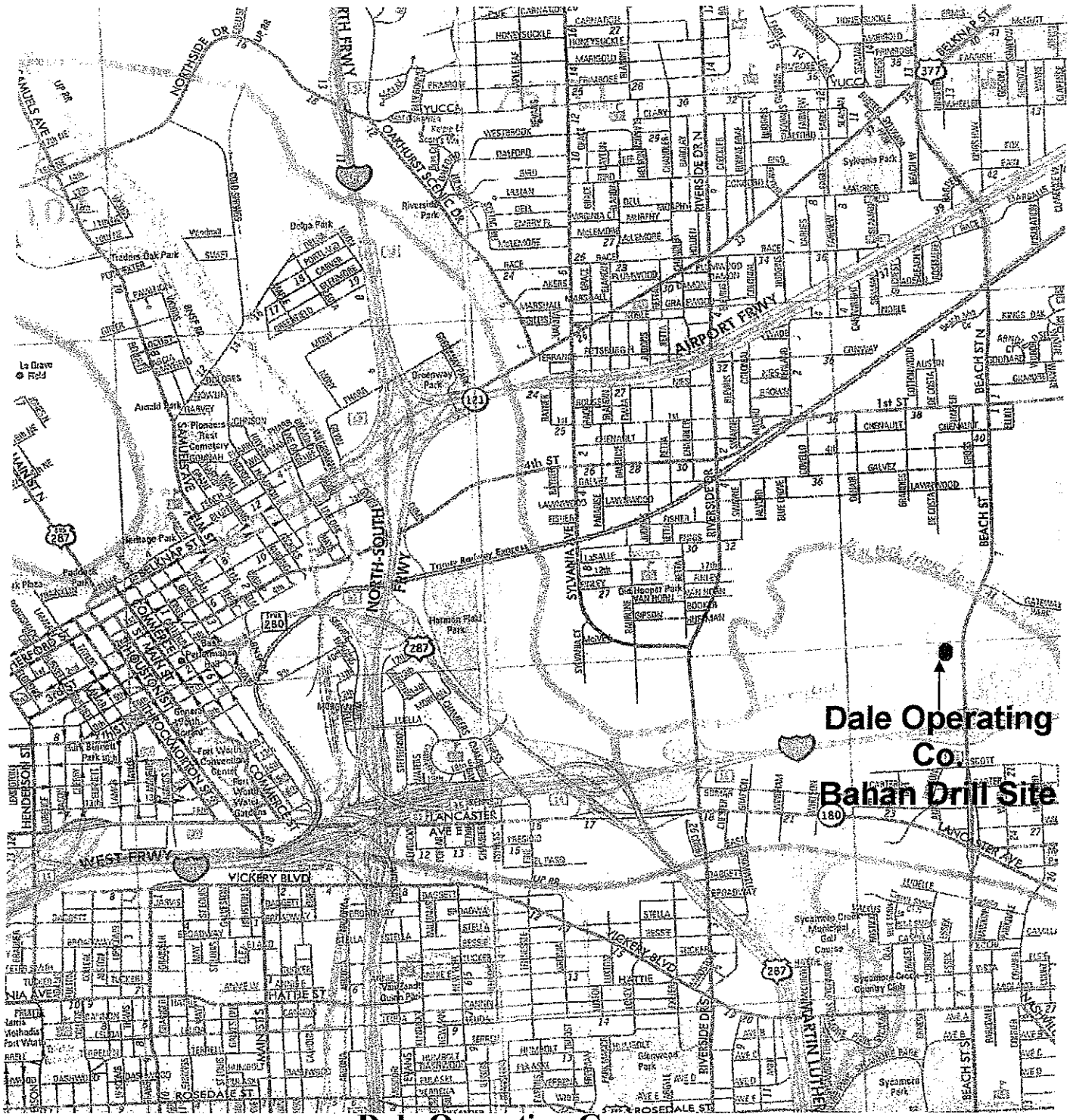
The sound level survey at the Dale Operating Company Bahan drill site commenced at 2:00 PM on Thursday, February 16 and ran continuously through 2:00 PM on Friday, February 17, 2006. The sound level survey was completed near the west side of the drill site, as indicated on the site map in Attachment D. The average hourly daytime ambient sound level ranged from a high of 62 dBA to a low of 59 dBA with the nighttime average hour level ranging from a low of 50 dBA to a high of 57 dBA. The measured sound level data is shown in the data graph in Attachment E. The hourly average level of 62 dBA, recorded at 10:00 PM, indicates an anomalous hourly average increase in background levels due to an unidentified source.

2.4 Dale Operating Company

The sound level survey at the Dale Operating Company JLB drill site commenced at 3:00 PM on Monday, February 27 and ran continuously through 3:00 PM on Tuesday, February 28, 2006. The sound level survey was completed near the drill site, as indicated on the site map in Attachment F. The average hourly daytime ambient sound level ranged from a high of 66 dBA to a low of 60 dBA with the nighttime average hour level ranging from a low of 50 dBA to a high of 56 dBA. The measured sound level data is shown in the data graph in Attachment E.

Current Typical Pre-Drilling Ambient Sound Levels

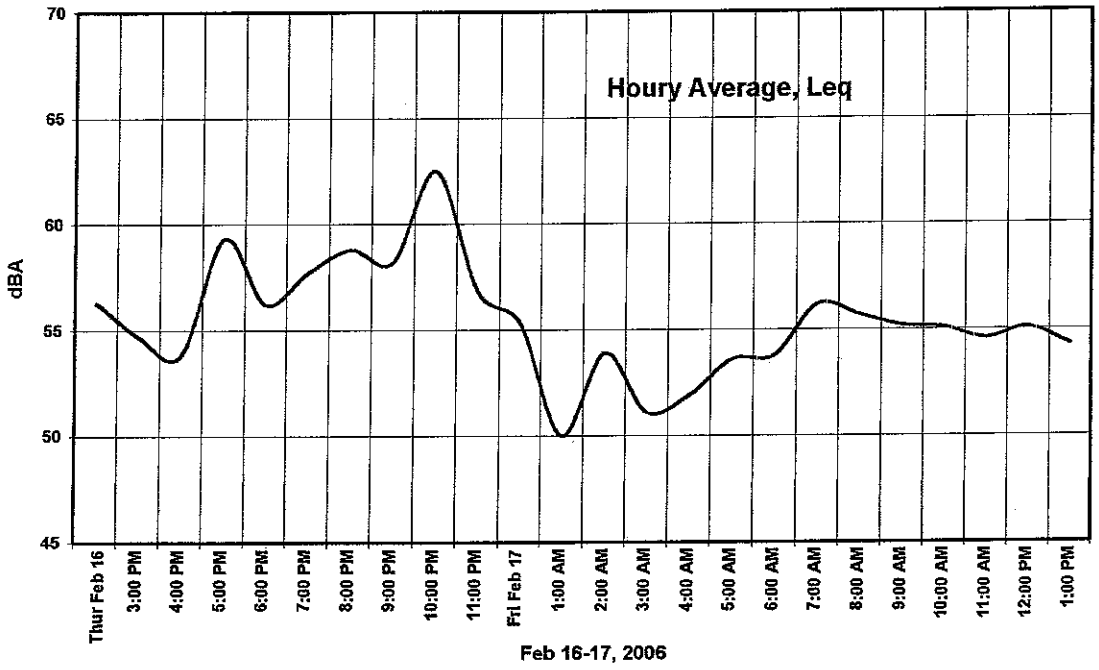
A graph of the measured ambient sound level data from all four sites is shown in Attachment G. The measured ambient sound levels at these four sites represent the current typical daytime/nighttime ambient sound levels of the drilling sites without drilling activities. Based on the measured ambient sound levels from these four drill site locations, the typical hourly average daytime sound level between 7:00 AM and 10:00 PM ranges from a low of 54 dBA to a high of 67dBA. The nighttime hourly average sound levels between 10:00 PM and 7:00 AM range from a low of 48dBA to a high of 62dBA.



Dale Operating Company
Bahan Site Ambient Pre-Drilling Sound Level Survey Location

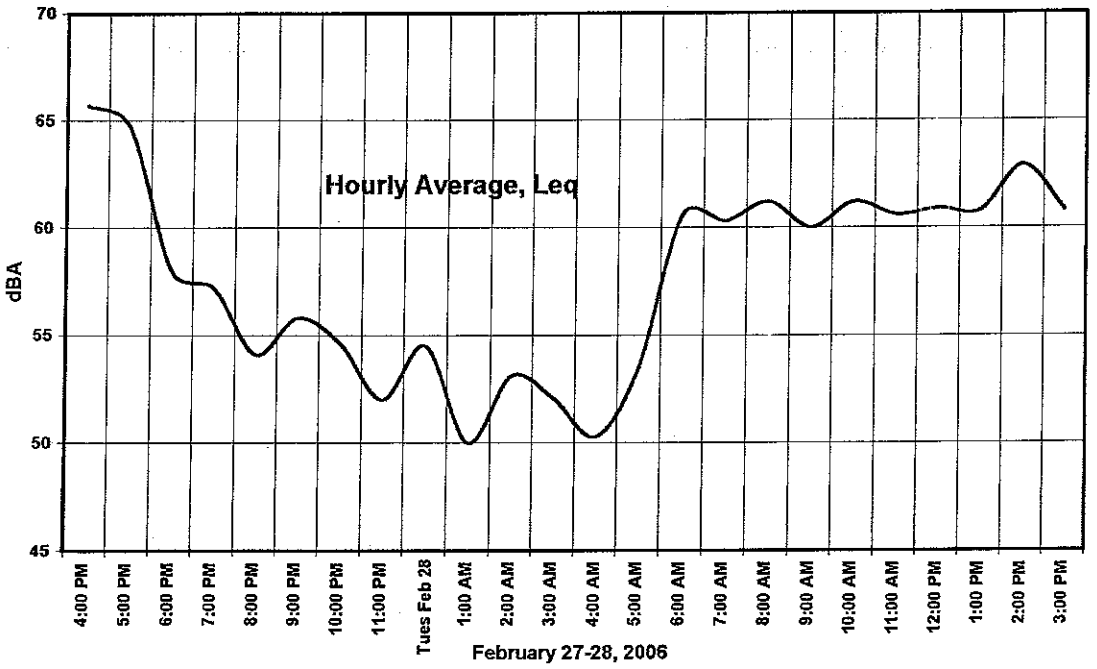
ATTACHMENT D

Dale Operating Company
Bahan Site Ambient Pre-Drilling Sound Levels



Feb 16-17, 2006

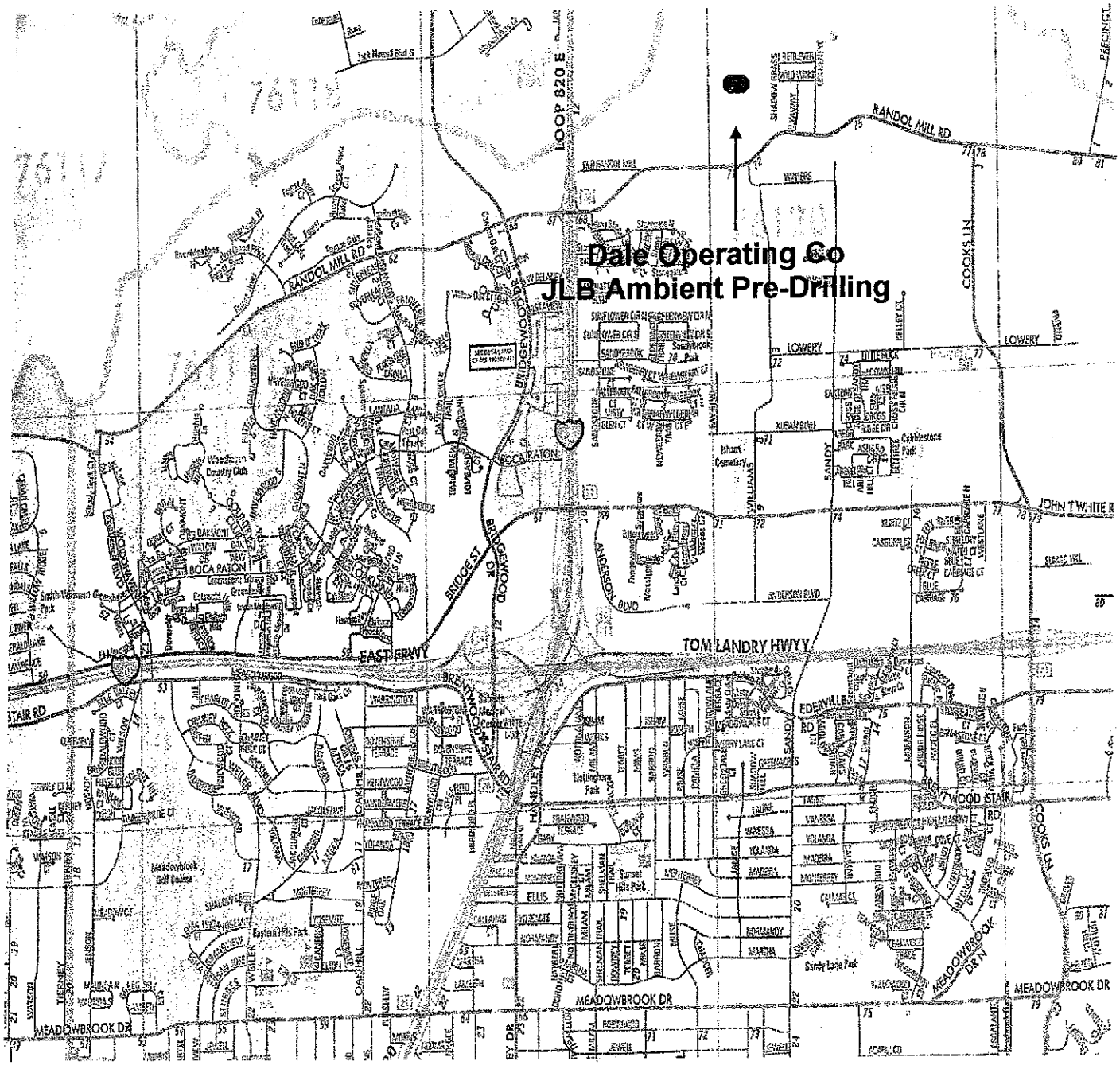
Dale Operating Company
JLB Site Ambient Pre-Drilling Sound Levels



February 27-28, 2006

Ambient Pre-Drilling Sound Levels

ATTACHMENT E

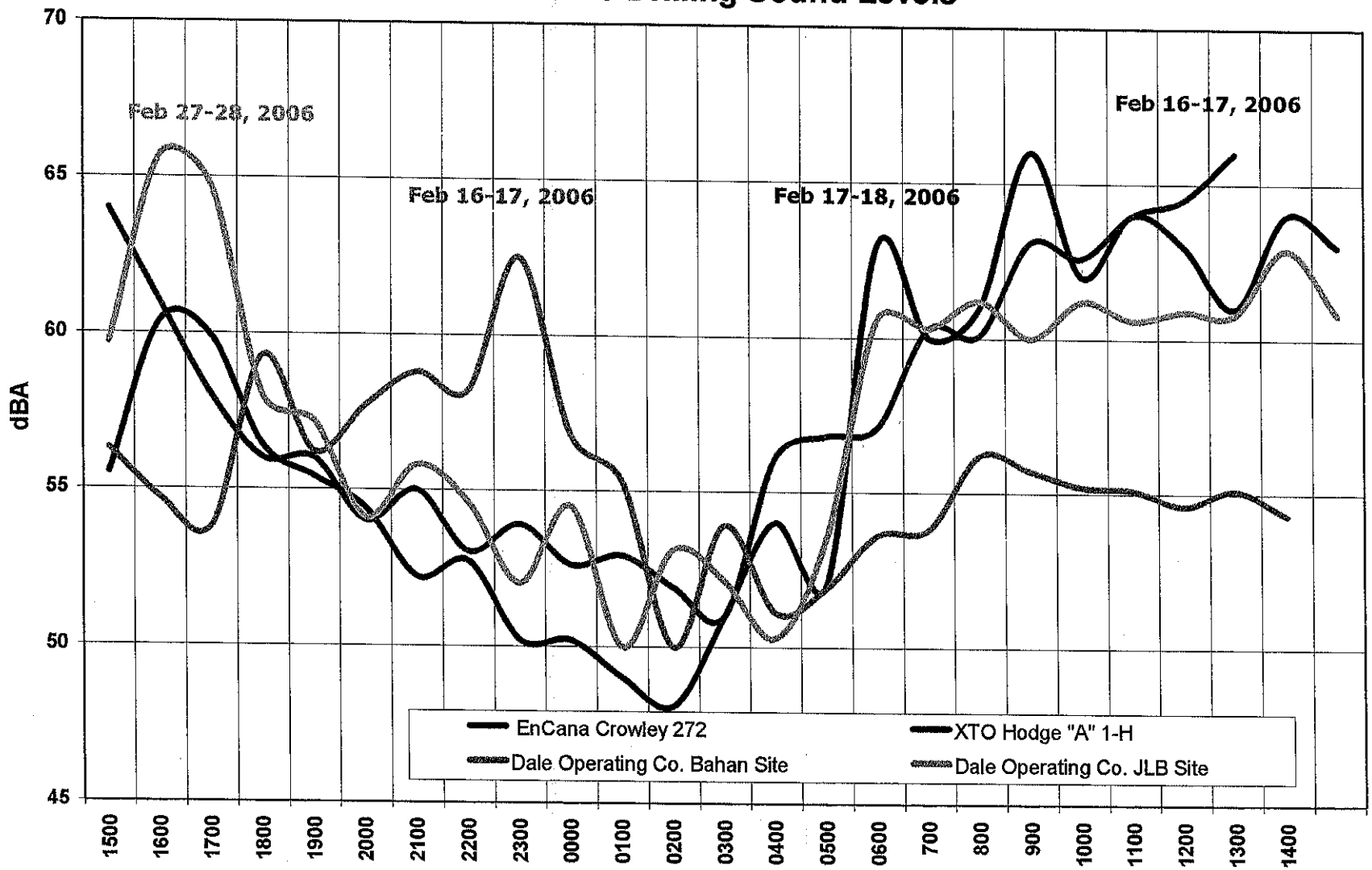


Dale Operating Company
JLB Ambient Pre-Drilling Sound Level Survey Location

ATTACHMENT F

ATTACHMENT G

Ambient Pre-Drilling Sound Levels



3.0 DRILLING NOISE LEVELS

Drilling noise levels were measured at three drilling rigs, the Pioneer 55, Nabors 120, Cactus 120 drilling rigs during various drilling activities between February 16 and March 24, 2006. The three rig's noise level were measured repeatedly during the study to document the changing noise impact conditions generated by the various drilling phase. Two of the rigs, the Pioneer 55 and Nabors 120, are mechanical/electrical powered rigs with a 1,000 horsepower rating and the Cactus 120 drilling rig is a mechanical rig, also rated at 1,000 horsepower. The derrick rating of the rigs ranged from 570,000 to 750,000 pounds with typical drilling depth ranges of 12,000 to 15,000 feet. The three drilling rigs evaluated are considered typical in size and sound level for the gas well drilling in the Fort Worth area.

The drilling rig and ancillary equipment were positioned differently at each drill site due to the size and access point to each drilling pad, along with the type of drilling mud containment system utilized. The diesel powered generators produced the highest sound levels of all equipment operating at each site. Sound levels of 100 to 102 dBA were measured at 10 feet from the engine radiators. The running of casing produced the highest measured noise levels with the rig generators producing the highest equipment noise levels of 102 dBA at 10 feet. The sound levels on the rig floor ranged from 85 dBA to a peak brake noise level of 105 dBA, when measured at 10 feet.

Drilling noise levels were measured in all four directions from the rig with measurable drilling rig noise recorded up to 700 feet from the drilling rigs. The drilling rig brake noise was audible up to 1,000 feet from the rigs. As can be seen in the following table, the average drilling sound level at 200 feet was 71 to 79 dBA.

Measured drilling rig noise levels ranged with measurement distance as follows.

Distance in Feet	Noise Levels from Drilling Equipment in dBA			
	V Door Side of Rig	Generator Side of Rig	Mud Pit Side of Rig	Rear Side of Rig
100	80-82	84-87	75-77	78-81
200	73-77	75-79	71-73	73-76
300	65-73	70-74	67-69	68-70
400	60-70	63-71	60-68	61-68
500	57-61	59-68	56-59	58-60
600	54-58	55-59	54-58	55-59
700	51-54	52-53	51-54	52-55
800	51-54	51-54	51-54	

4.0 DRILLING NOISE MITIGATION

4.1 Draw Works Brake Noise Mitigation

The mechanical brakes of the draw works on some drilling rigs produce an intermittent, high level "screech" noise when in operation, especially when the rig is in the drilling mode. The brake noise narrow frequency band or "pure tone" is typically identified as the most problematic noise source generated by a drilling rig due to the clear audibility of the noise up to 1,000 feet from the rig. The brake noise is especially problematic during the nighttime, when other background noise levels become lower. The brake noise can produce undesirable noise impacts similar to that of vehicle back-up alarm systems.

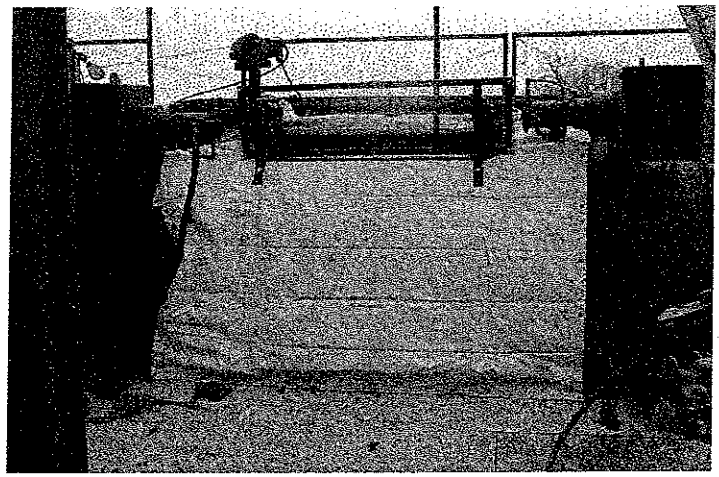
The control and mitigation of mechanical brake noise on typical drilling rigs can be accomplished with the installation of a three-part noise control system. To control sound build-up within the drum housing of the draw works, a sound absorbing anechoic liner should be installed. The sound absorbing liner should have a minimum sound absorption rating of NR .85 and should be installed on a minimum of 50% of the surface area within the drum enclosure. To reduce and/or eliminate sound transmission from the metal drum housing, an acoustical damping shroud constructed of a composite sound barrier and absorbing system should be installed. The shroud should be designed to cover as much of the drum enclosure as possible, including the open cable travel area. To block line-of-sight sound transmission from the cable travel opening, a removable acoustical barrier panel with a minimum height of 18 inches is required. The barrier is recommended to be fabricated of a clear acoustical vinyl with a sound transmission loss rating of an STC-26.

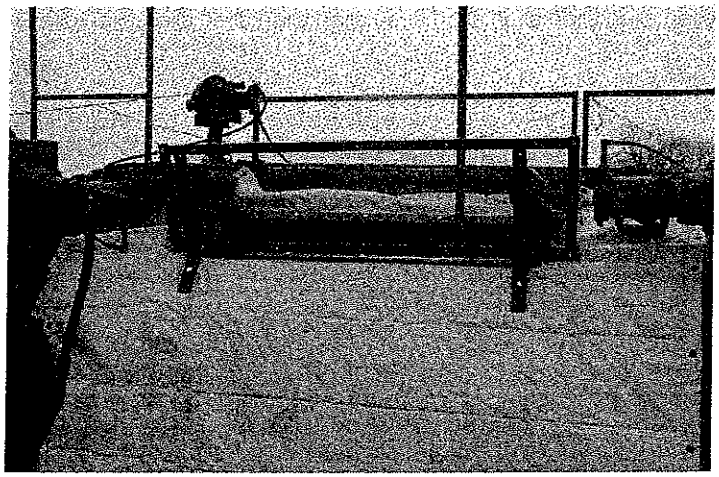
A brake noise control system constructed with the above specifications was fabricated and tested on the Pioneer 55 drilling rig while drilling on the Dale Operating Company Duckhead well site. Photographs of the brake sound control system are shown in Attachment H. Peak brake sound levels before and after the installation of the brake noise control system were measured during typical drilling operations. The results of the measured sound levels were as follows:

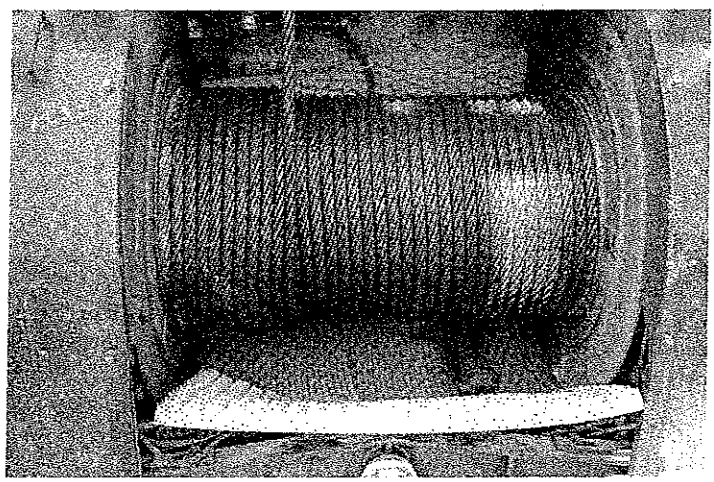
Measurement Distance in Feet (From the Draw Works)	Peak Brake Sound Level in dBA Before Mitigation	Peak Brake Sound Level in dBA After Mitigation
10	102-105	88-92
100	76-80	70-74
200	72-77	65-70
300	67-73	61-65
400	64-70	56-60
500	61-66	53-56

In summary, the installation of a draw works brake sound control system can reduce the peak brake noise levels 13 to17 dBA at the rig floor and 7 dBA at 200 feet. The brake noise becomes inaudible at 300 feet.

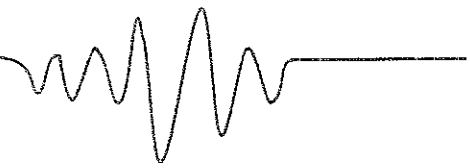
Pioneer Rig 55
Draw Works Brake Sound Mitigation System







ATTACHMENT H



4.2 Enhanced Engine Mufflers

An evaluation of the noise reduction potential of enhanced engine mufflers on the Cactus 120 drilling rig engines drilling for XTO Energy was completed. The standard engine muffler sound emission levels on the Cactus 120 drilling rig were measured and documented before a change-out to enhanced mufflers was completed to provide a quantitative basis for a standard versus enhanced muffler sound level comparison. The measured sound levels of the two rig engines (Caterpillar D379), two generator engines (Caterpillar) and the auxiliary generator (Caterpillar D3412) were completed during typical drilling operations. The measured sound levels of both the standard and enhanced mufflers were measured at 10 feet from the mufflers during normal drilling operation. Photographs of both the standard and enhanced mufflers are shown in Attachment I.

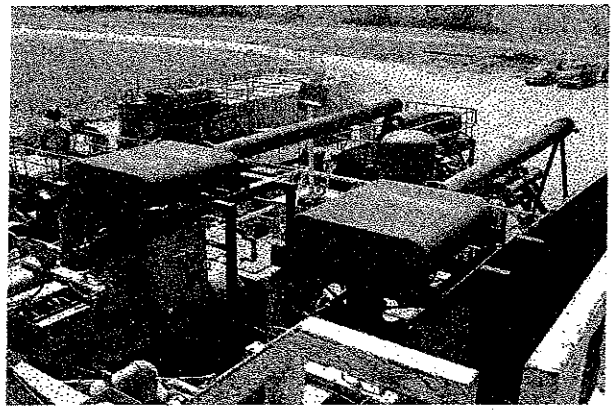
Engine Model		Sound Level in dB								
	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	dBA @ 10'
Caterpillar D379	Standard Muffler	90.1	83.2	89.6	87.2	85.0	80.3	74.8	68.8	92.1
	Enhanced Muffler	88.2	80.2	87.3	85.5	84.3	80.1	73.8	68.0	90.9
Caterpillar D3412	Standard Muffler	82.3	85.0	90.2	92.5	91.2	87.8	82.4	75.1	101.1
	Enhanced Muffler	81.1	84.5	88.9	90.3	89.0	85.4	81.4	74.0	97.8
Caterpillar Generators	Standard Muffler	91.3	88.6	91.0	89.2	88.6	84.3	78.9	75.8	96.7
	Enhanced Muffler	91.0	87.4	88.0	87.6	87.2	83.4	76.1	75.6	94.4

Standard versus Enhanced Muffler Operational Sound Levels

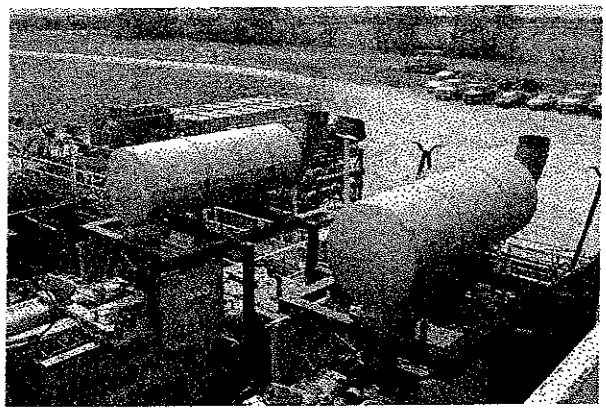
The measured sound level reduction of the two Caterpillar D379 rig engine mufflers was impacted by the installation of short, 45 degree angle discharge pipes on the discharge end of both new mufflers. The standard mufflers which were replaced were equipped with straight exhaust discharge pipes, approximately 8 to 10 feet long. The measured sound levels of the new enhanced mufflers would be expected to be lower if the same discharge pipes were installed on the new mufflers.

The muffler sound contribution of the two generator engines is overwhelmed by engine and generator noise levels, including the radiator fan noise. The enhanced mufflers installed on the two generator engines do not have a substantial contribution to the overall sound reduction of the equipment.

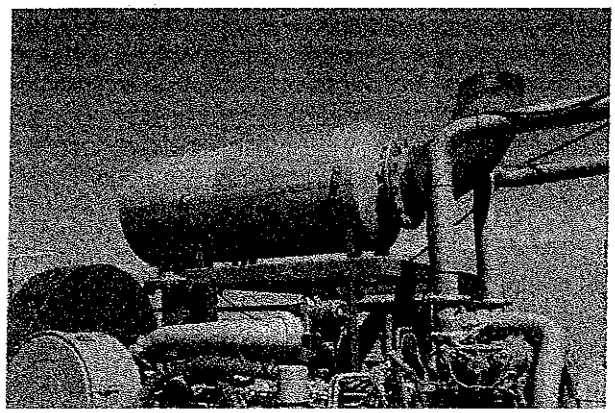
CACTUS RIG 120
MUFFLER PHOTOGRAPHS



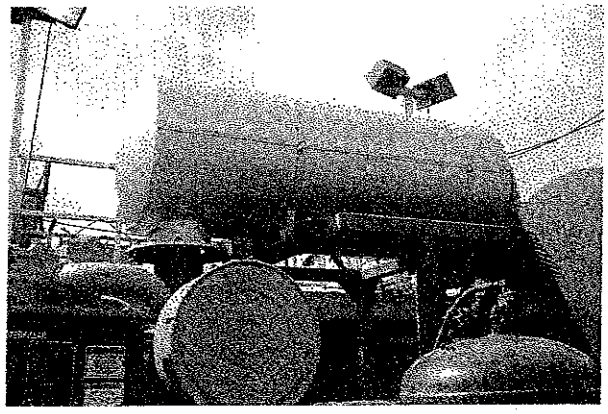
Standard Engine Muffler



Enhanced Engine Muffler

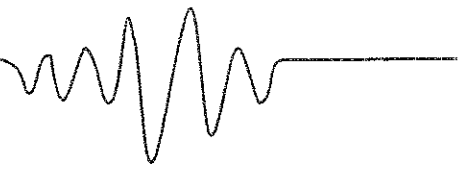


Standard Generator Engine Muffler



Enhanced Engine Muffler

ATTACHMENT I



4.3 Drilling Rig Acoustical Barrier Walls

Drilling noise generated from sources on the rig floor, which is typically 22 to 26 feet above ground level, can be effectively mitigated with the installation of an acoustical barrier wall system around the drilling rig floor. Some drilling rigs, such as the Cactus 120 rig, are currently equipped with rig floor enclosure walls while others are equipped with a canvas weather wall barrier system. Typically the canvas wall panels can be replaced with acoustically rated wall panels without the need to modify the existing support frame system. Additional sound mitigation can be achieved with the enclosure of the rig substructure. Completely enclosing all four sides of the drilling rig with acoustical treatment on each drill site is not typically necessary. In all of the drill sites we investigated for this study, for example, the critical off-site noise receptors were located on only one or two sides of the drill sites. To be effective in these cases, the acoustical panels need only to be installed on the sides of the rig facing the noise sensitive receptors.

The installation of acoustical barrier panels on the substructure of the drilling rig provides additional sound mitigation of the noise emanating from the substructure area of the rig. As with the rig floor, some rigs currently have the substructure enclosed, and only the sides of the rig facing the critical receptors need to be acoustically treated for effective sound transmission control.

As part of our study to quantify the sound reduction potential of rig acoustical enclosures, acoustical blanket panels were installed on one side (opposite the dog house) and the rear side (opposite the V doors) of the Pioneer 55 drilling rig currently drilling for Dale Operating on their Duckhead drill site located at 7373 Randol Mill Road. Drilling sound level measurements were taken before and after the installation of the acoustical wall and substructure barrier system. STC-25 rated acoustical barrier blanket panels were installed on the rig floor and substructure as shown in the following photographs included in Attachment J.

The acoustical blanket panels installed on the rig floor were 12 feet high by 10 feet wide, covering three sides of the rig floor and two sides of the substructure. The sound level measurements of the acoustical barrier blanket panels were completed after the installation of the draw works brake mitigation system. Drilling sound levels as measured on the acoustically treated side of the drilling rig before and after the installation of the acoustical panels is as follows.

Measurement Distance in Feet (From the Drilling Rig	Drilling Sound Level in dBA Without Acoustical Panels	Drilling Sound Level in dBA With Acoustical Panels
100	76-80	68-71
200	72-77	64-68
300	67-73	59-62
400	64-70	55-59
500	61-66	53-56

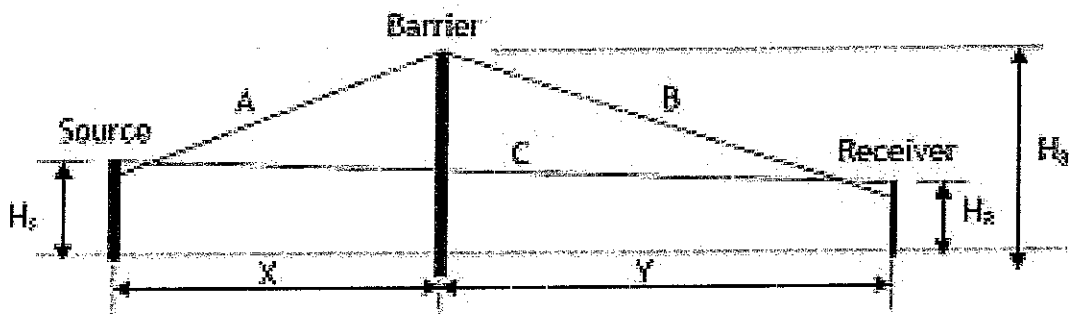
Behrens and Associates, Inc.
Acoustics, Noise and Vibration Consultants

Pioneer Rig 55
Acoustical Wall and Substructure Barrier System

ATTACHEMENT J

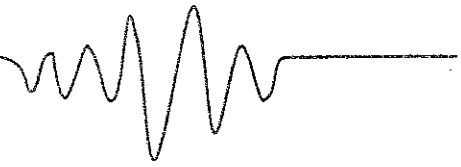
4.4 Drilling Rig Perimeter Sound Walls

The erection of temporary sound walls to control off-site drilling noise impacts is a standard requirement in California and other states for all drill sites where the drilling activity has the potential to increase the ambient daytime hourly average 5 dB and increase the nighttime hourly average 3 dB at the nearest sensitive receptor such as a residence, school, church, park or hospital. The standard model to calculate sound transmission loss (insertion loss) of a sound barrier is as follows:



Parameters:

X	=	Distance of Source to Barrier, FT
Y	=	Distance of Receiver to Barrier, FT
H_S	=	Height of Source above Ground, FT
H_B	=	Height of Barrier above Ground, FT
H_R	=	Height of Receiver above Ground, FT
Δ	=	$H_S - H_R$
A	=	$[X^2 + (H_B - H_S)^2]^{1/2}$
B	=	$[Y^2 + (H_B - H_R)^2]^{1/2}$
C	=	$[(X+Y)^2 + \Delta^2]^{1/2}$
f	=	Radiating Frequency = 300 hz
V	=	Speed of Sound = 1130 ft/s
N	=	Fresnel No. = $2\frac{f(A+B-C)}{V}$



In this study, two types of temporary sound walls systems were evaluated including a barrier wall constructed from empty shipping containers and an STC-25 acoustical barrier blanket wall.

4.1.1 Shipping Container Sound Wall

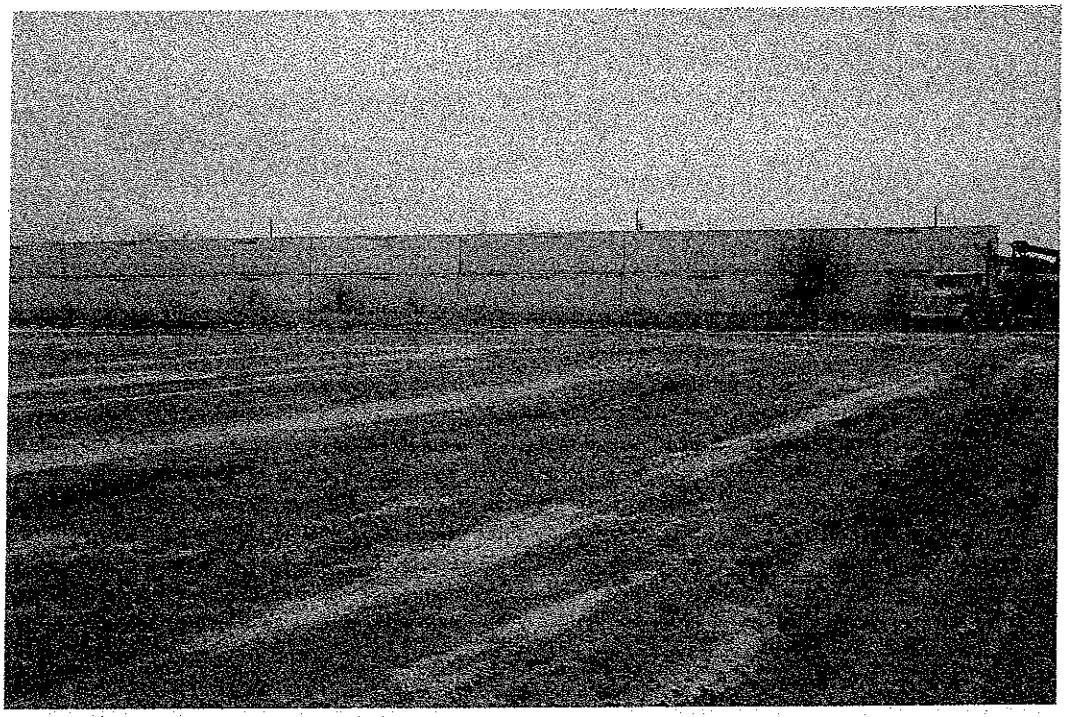
Encana Oil & Gas installed a 20 feet high by 280 feet long sound barrier wall constructed from empty metal shipping containers on their Crowley 272 drilling site. The containers, which were stacked two high, were located approximately 255 feet to the north of the V door side of the Nabors Rig #712. The barriers were positioned to block line-of-site sound transmission between the rig and the nearest residents to the drilling site which were located approximately 455 feet from the rig, on the north side of Cleburne Crowley Road. Photographs of the shipping container sound barrier wall are shown in Attachment K.

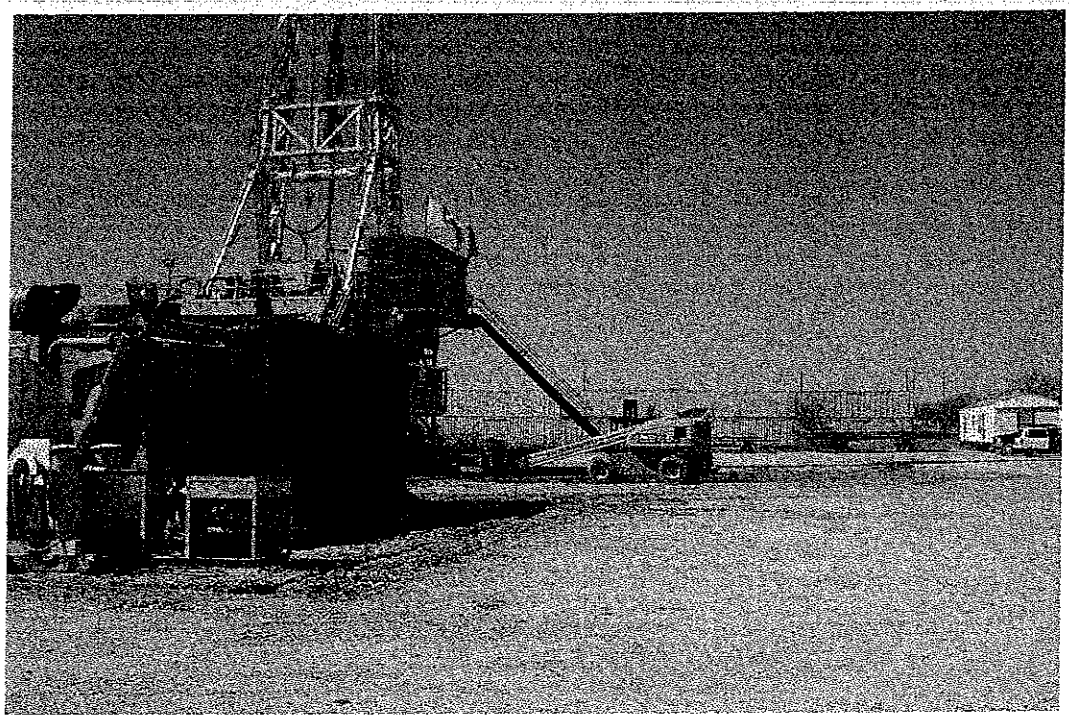
Sound level measurements, including ambient pre-drilling, were taken at the drilling site at four different times during the drilling of the well. The pre-drilling ambient hourly average daytime sound levels, which were measured on February 17 to 18, 2006 at the shipping container location, ranged between 57 and 65 dBA with the nighttime hourly average sound levels ranging from 48 dBA to 54 dBA. Due to site preparation work on the pad during the daytime hours of our survey, the daytime hourly averages were somewhat higher than subsequent ambient sound level measurements at the site. Follow-up sound level measurements indicate that the typical daytime hourly average sound levels range from 50 dBA to 55 dBA at the site.

The hourly average sound levels measured during drilling operations from February 28 to March 1, 2006, 10 feet in front of the containers on the side facing the drilling rig, were a relatively steady 70 dBA. The sound level 10 feet behind the container wall, on the residence side of the wall, ranged from 51 dBA to 57 dBA. The ambient and drilling sound level survey data is shown in the following Attachment L. The 20 feet high container sound wall reduced the drilling noise level from 13 to 19 dBA at this location.

Behrens and Associates, Inc.
Acoustics, Noise and Vibration Consultants

Shipping Container Sound Wall
Crowley 272 Drill Site

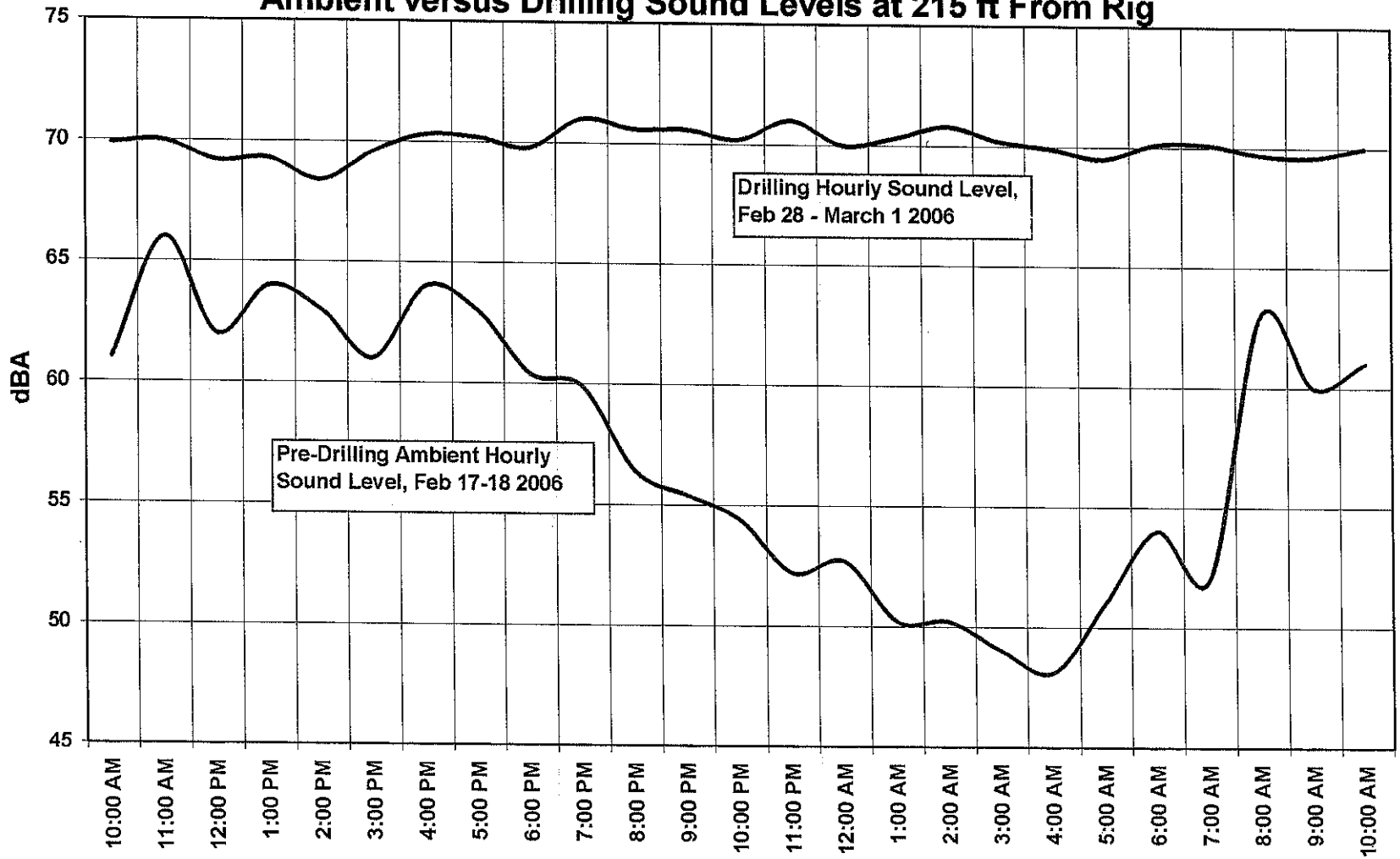




ATTACHEMENT K

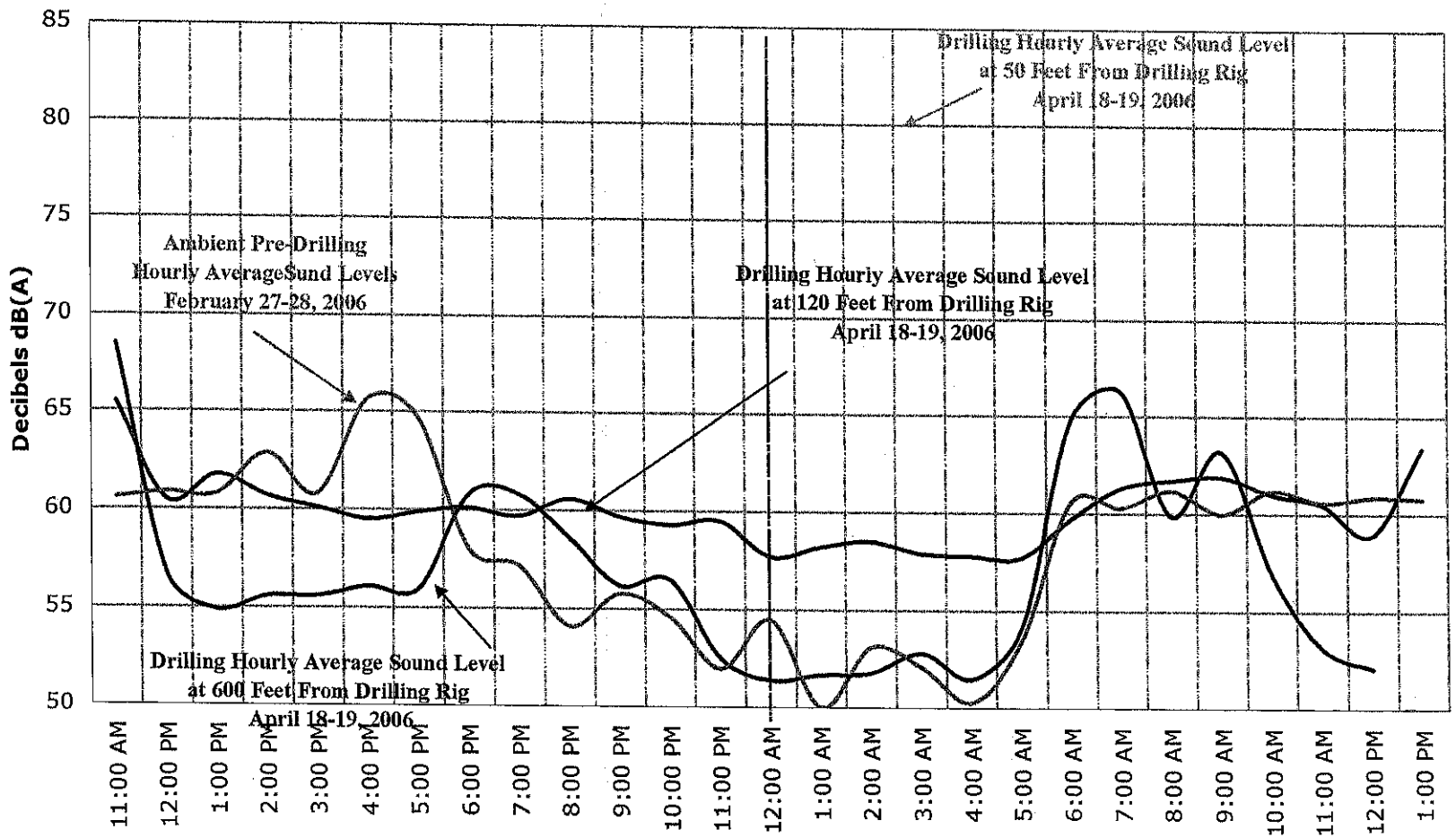
ATTACHMENT L

Encana Oil & Gas (USA) Inc.
Nabors Rig 712 / Crowley 272 Lease
Ambient versus Drilling Sound Levels at 215 ft From Rig



ATTACHMENT M

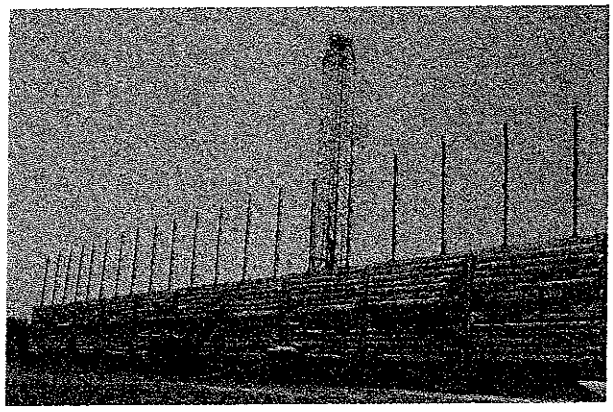
Dale Operating Company
JLB Drill Site

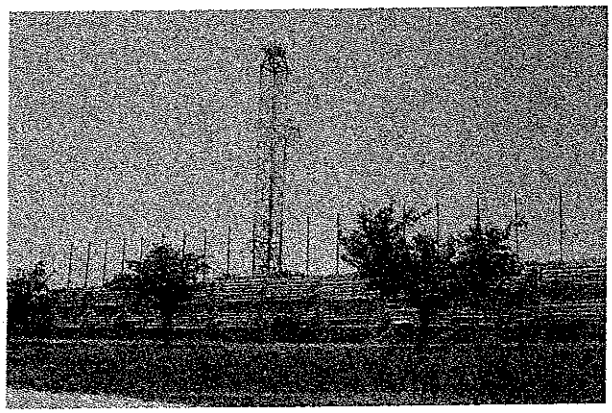


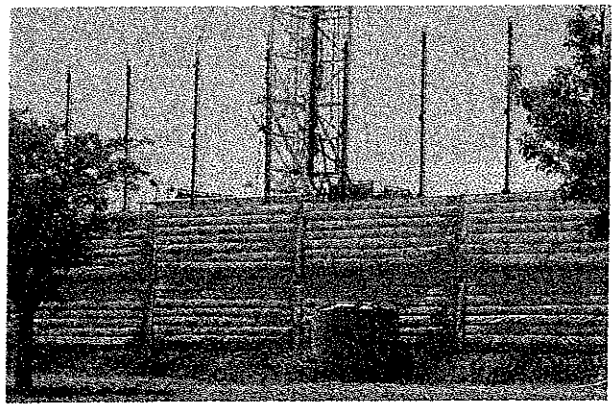
Drilling Noise Level Verses Distance with Pre-Drilling Ambient Level Comparison

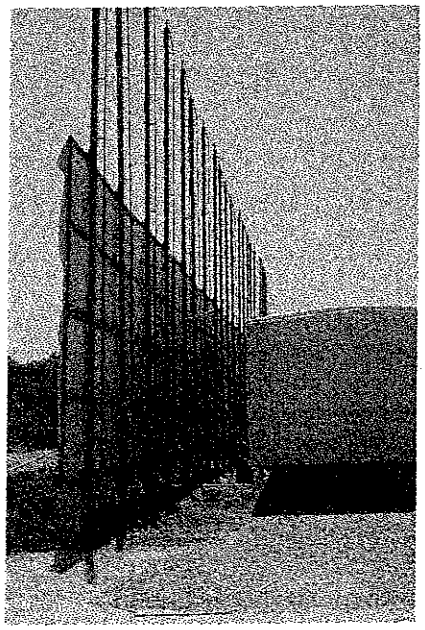
Behrens and Associates, Inc.
Acoustics, Noise and Vibration Consultants

Drilling Rig Sound Wall
Dale Operating Company
JLB Drill Site



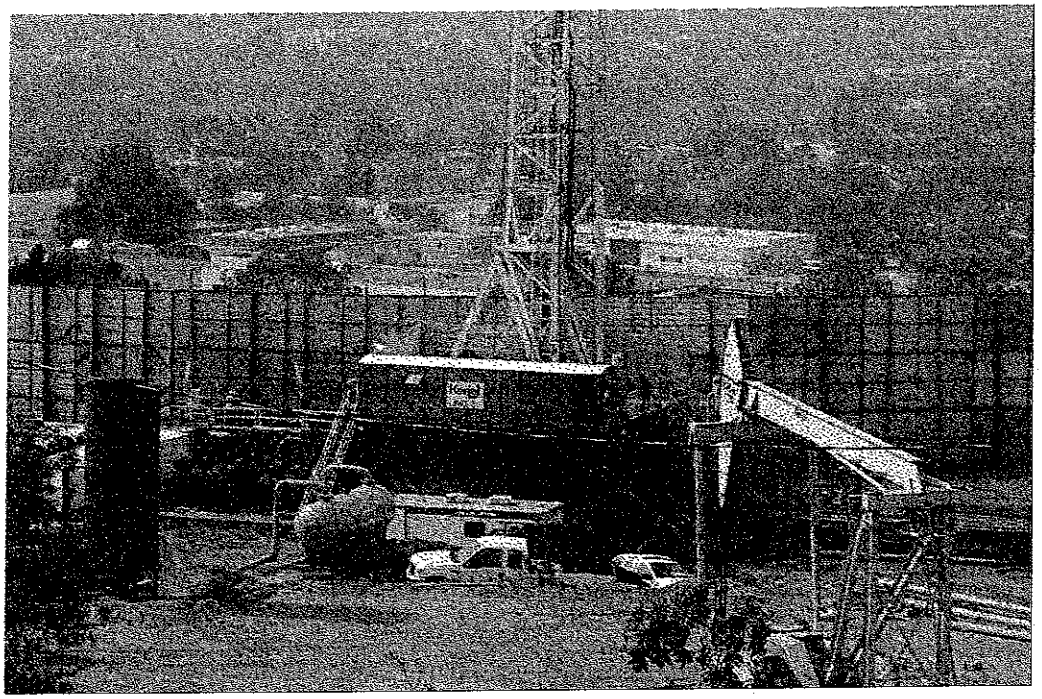


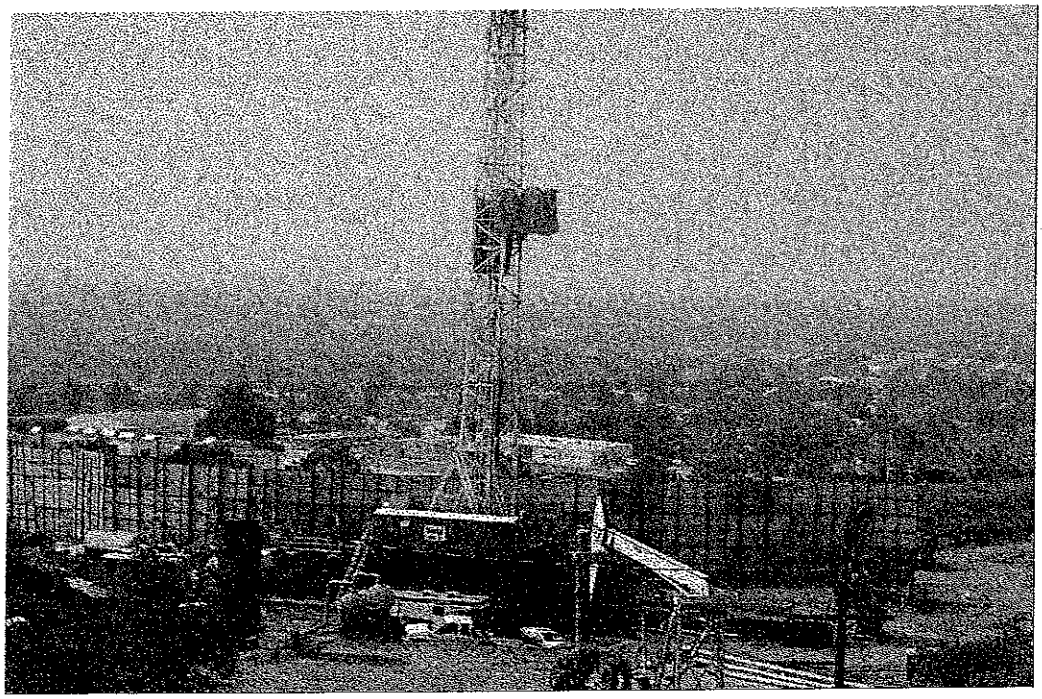




ATTACHMENT N

Drilling Rig Sound Wall
Los Angeles, California





ATTACHMENT O

4.1.2 STC-25 Acoustical Blanket Sound Wall

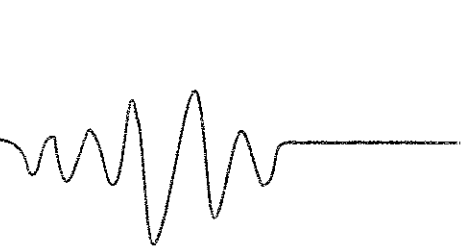
The second type of sound wall evaluated in our study was an STC-25 acoustical barrier blanket sound wall. Dale Operating installed a 16 foot high, 200 feet long sound wall at their JLB drilling site in northeast Fort Worth prior to the drilling rig moving onto the location. The blanket sound wall was erected along the east side of the drilling pad, between the drilling rig and the nearest residential neighborhood, located approximately 700 feet to the east of the drill site. Drilling sound levels were measured between the drilling rig and the sound wall and at two locations outside the sound wall.

Drilling sound levels were measured at 50 feet from the drilling rig at the same time two continuous 24 hour sound level surveys were completed at locations 120 feet and 600 feet from the drilling rig during typical drilling operations between April 18 and 19, 2006. The measured sound level results from these two locations were compared to the ambient pre-drilling sound levels measured at the site between February 27 and 28, 2006. The results of the sound levels measurements are shown in Attachment M.

The drilling rig's operational sound level at 50 feet was a steady 80 dBA between the rig and the sound wall. The drilling noise level 120 feet from the rig, approximately 20 feet from the 16 foot high sound wall ranged from a daytime high of 62 dBA to a nighttime low of 57.5 dBA. The day/night hourly average at 600 feet from the rig followed very closely to the measured pre-drilling hourly average sound levels. The sound wall provided an 18 to 22 dBA sound level reduction at 120 feet and maintained pre-drilling ambient sound levels at 600 feet from the drilling rig.

Photographs of the 16 foot high blanket sound wall installed on the Dale Operating Company's JLB Drill site are included in Attachment N. Photographs of a similar 32 foot high blanket sound wall installed on a Plaines Exploration drilling rig operating in Los Angeles, California are included in Attachment O. At both sites the sound walls are positioned to block the drilling rigs noise from traveling into the adjacent residential neighborhoods. At both sites the blanket sound wall is constructed with 8 foot high by 20 foot long steel frame panels, with STC-25 acoustical blanket panels with flaps attached to each frame. The frames with blanket panels be can be installed in various heights as necessary (8, 16, 24, or 32 feet) and connected to steel support poles which are installed into permanent anchoring sleeves. The sleeves are cemented in place and will remain in place to provide the required structural support and to accommodate the re-installation of the sound wall as necessary for future noise generation activities at the site.

Typically, a drilling site sound wall's layout, length and height are determined after the drill site noise impact potential on close proximity sensitive noise receivers has been evaluated and established. For optimum sound control, the drilling rig and ancillary noise generation equipment should be positioned as close as possible to the sound walls with no gaps or openings in the wall. The sound wall material should have a minimum STC (sound transmission loss) rating of 25. Sound wall gates, if installed, are required to have the same sound loss rating as the wall material and be closed at all times except for material delivery or pick up.



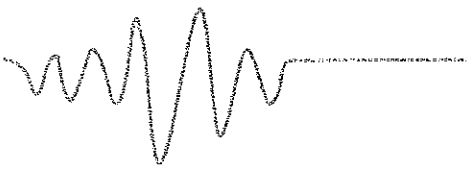
5.0 EVALUATION SUMMARY

Daytime ambient sound levels at typical drilling sites between 7:00 AM and 10:00 PM ranged between 54 and 67 dBA with nighttime hourly averages between 10:00 PM to 7:00 AM ranging from 48 to 62 dBA. The generally accepted temporary increase in the ambient sound levels for drilling (and construction) activities is 5 dBA with allowable nighttime ambient sound level increase of 3 dBA. The resulting maximum allowable daytime drilling noise levels with the temporary increase would be 59 to 72 dBA and 51 to 65 dBA during nighttime periods.

Maximum noise levels measured in all four directions from the rigs at 200 feet ranged from 71 dBA on the sides opposite to the generators to a high of 79 dBA on the radiator facing sides of the drilling rigs. Measurable drilling noise was recorded up to 700 feet from the drilling rigs, with peak drilling rig brake noise audible up to 1,000 feet from the rigs. The running of casing produced the highest measured drilling rig noise levels, with the tripping of drill pipe next. During drilling periods, the peak noise levels are typically generated by the draw works brakes and the rig and generator's diesel engines. On all three drilling rigs, the generator engines produced the highest equipment noise levels, measuring as high as 102 dBA 10 feet from the radiators.

The draw works brake noise control systems resulted in a 10 to 17 dBA brake noise reduction at 10 feet and inaudibility of the brake sound at 300 feet. Installation of acoustical blankets on the rig floor and substructure resulted in an 8 to 10 dBA reduction at 300 feet. Sound walls reduced drilling sound levels up to 20 dBA. Additional sound reduction can be expected with the installation of enhanced engine mufflers, the installation of higher sound walls and the optimum positioning of noise generation equipment on the drill sites.

With the optimum site equipment set-up, maximum daytime drilling noise levels of 59 dBA and maximum nighttime levels of 51 dBA can be achieved at 200 feet from the drilling operation with the properly designed and installed brake noise control system, rig floor and sub-structure acoustical barrier system and temporary sound control walls.



APPENDIX
Glossary of Terminology

Terms	Definition
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
A-Weighted Sound Level	The sound pressure level in decibels as measured on a sound level meter using the A-weighted filter network. The A-weighted filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Community Noise Equivalent Level, CNEL	CNEL is the A-weighted equivalent continuous sound exposure level for a 24-hour period with a ten dB adjustment added to sound levels occurring during nighttime hours (10 pm to 7 am) and a five dB adjustment added occurring during the evening hours (7 pm to 10 pm)
Decibel, dB	A unit for measuring sound pressure level and is equal to 10 times the logarithm to the base 10 of the ratio of the measured sound pressure squared to a reference pressure, which is 20 micropascals.
Equivalent Continuous Sound Level (L_{eq})	The sound level corresponding to a steady state sound level containing the same total energy as a varying signal over a given sample period. L_{eq} is designed to average all the loud and quiet sound levels occurring over a time period.
Maximum A-weighed Sound Level, (L_{max})	The greatest sound level measured on a sound level meter during a designated time interval or event using fast time-average and A-weighting.
Sound Transmission Class, STC	A single number rating of the noise reduction of a material, building or structural element.