Noise Analysis

Excelaron Oil Project, Huasna Valley

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Prepared for

EXCELARON, LLC
c/o C.M. Florence, AICP Agent
OASIS ASSOCIATES, INC.
3427 Miguelito Court
San Luis Obispo, CA 93401

Prepared by

David Dubbink Associates
864 Osos Street, Suite D
San Luis Obispo, CA 93401 USA
Tel: (805) 541-5325
Fax:(805) 541-5326
dubbink@noisemanagement.com

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Introduction

This report describes the existing acoustic environment of the Excelaron Oil project in the Huasna Valley along with estimates of noise levels during construction and operation. There have been multiple acoustic studies related to this project. In March of 2008 we prepared a study in support of a Negative Declaration for the project. Subsequent to this, two additional studies were conducted by Dr. David Lord for the Huasna Valley Association. In one, Lord evaluated the levels of ambient sound in the Valley. In the second, he estimated the noise exposure from drilling operations. This report draws on these earlier studies and supplements them with additional analysis.

The following reports and sources were used in preparation of this study:

1. Acoustic Study for Huasna Valley Well Sites, David Dubbink Associates. 2008
2. Sound Level Assessment of Huasna Valley, David Lord Acoustic Consulting, February 17, 2008.
3. Sound Level Assessment II, Huasna Valley, David Lord Acoustic Consulting, March 19, 2008.
4. Project Description; Executive Summary and Enclosures, Excelaron, May, 2009
5. County of San Luis Obispo General Plan Noise Element; Policy Document / Acoustical Design Manual. 1992.
6. County of San Luis Obispo General Plan Noise Element, Technical Reference Document. 1992.
7. County of San Luis Obispo, County Code, Title 22 Land Use, Noise Standards, Chapter 22.10.120
8. Noise Measurements of Drilling Operations, Sound Level Checks Rig Number 4 (February 1996), Rigs 14 and 15 (January 2008) and Rig 44 (April 1996), Kenai Drilling
9. Transportation- and Construction-Induced Vibration Guidance Manual, Caltrans 2004.
10. Federal Agency Review of Selected Airport Noise Analysis Issues, FICON, 1992.
11. FHWA Roadway Construction Noise Model. U.S. Department of Transportation. 2006.

Noise Fundamentals

Noise is often defined as, “unwanted sound”. The physics of sound is well understood but evaluating the ways that sounds intrude on human activity is more subjective. Some people have a high tolerance for sound and others are extremely noise sensitive.

Fluctuations in air pressure are experienced as sound when the fluctuations occur at certain intensities and frequencies. Because the range of audible sound levels is enormous, sound intensity is measured using a logarithmic metric, “decibel” (abbreviated dB). When sound from two sources is combined, the addition is logarithmic too. A 70 dB sound added to a 70 dB sound produces a total of 73 dB, a three decibel increase. The frequency of a sound also affects what people experience. We hear sounds in the 1,000 to 5,000 Hz range better than very high or low frequencies. Because of this, the measurement of environmental sounds is typically weighted to account for the way we hear them. Sound levels, when they are corrected to correspond to people's hearing, are identified as being "A weighted – abbreviated dB(A)".

Community noise levels vary over time and the acoustic experience can be represented in several ways using differing metrics. One descriptive metric is *Lmax* which represents the loudest instant during an event. The sound environment might also be characterized by its energy average over a period of time. This metric is *Leq*. An environment can also be described by the percentage of time that sound levels are above or below some specific values. The metrics *L10* and *L90* represent the decibel levels that are exceeded 10% of the time or exceeded 90% of the time respectively. Still another metric *SEL* compresses all of the noise energy in an event as if it occurred in a single second. Such normalization makes it possible to add sounds from multiple events on a common basis. Community planners make use of such combinations to characterize noise exposure over time. The metric *DNL* (or *Ldn*) is a noise descriptor that combines all noise events over a 24 hour period with a 10 dB penalty added to night time sounds (10 PM – 7 AM) to account for their greater potential for community disruption. An additional description of these various noise metrics is included in Appendix A.

A sound level meter can be used to determine the levels of noise exposure according to any of these differing metrics.

Sound levels, however measured, attenuate with distance from the source. For single point sources the attenuation rate is 6 dB with each doubling of distance. For a line source, such as a road, the attenuation is less, 3 dB with each doubling of distance. These are theoretical numbers based on the basic physics of sound propagation. In community settings the attenuation will vary with the nature of the noise, surface character, reflections, and atmospheric conditions. Wind and temperature inversions can significantly effect how sound travels.

Planners and acoustical engineers have developed technical tools that describe how sound propagates. These "models" can be used to estimate sound exposure levels associated with future projects and the effectiveness of possible mitigations. Noise environments and forecasts are often depicted on maps using contour lines Figure 1 is an example of such a map. As with a topographic map, the lines represent lines of equal noise exposure.

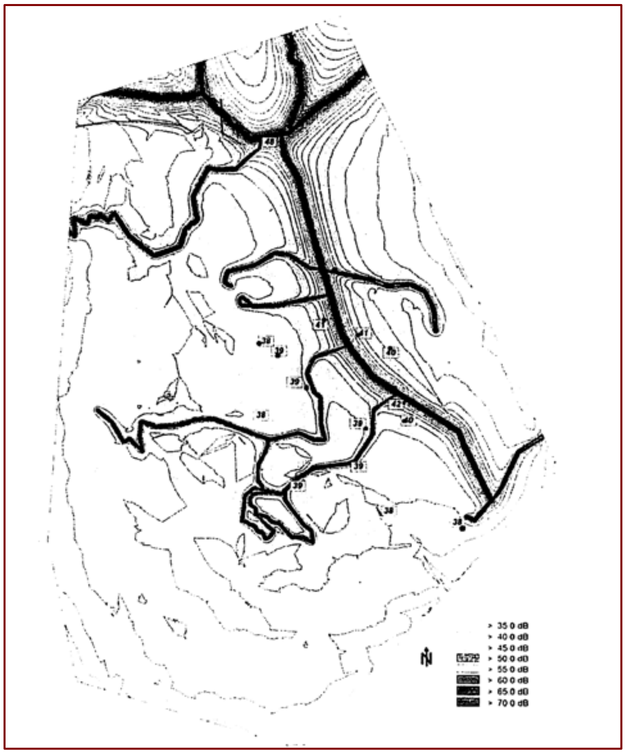


Figure 1: Huasna Valley – Daytime Leq

The Acoustic Setting

The initial step in this noise analysis is to describe the present noise setting and the acoustic impacts of the project.

Road traffic is currently the principle noise source in the Huasna Valley, and traffic volumes are light. The acoustic report prepared by Dr. David Lord included measurements of ambient sound levels. He reported that the lowest levels ranged from a low of 20 dB (which is at the floor of the sensitivity of sound meter) to a high of 65 dB near the intersection of Huasna Valley Road and Huasna Township Road. His report included illustrative maps showing noise exposure according to several metrics. These included the daily noise exposure (Ldn) and the hourly energy averages (Leq) for day and nighttime periods. Figure 1, illustrating daytime Leq contours, shows the pattern of noise exposure. For daytime Leq the levels vary from a maximum Leq of 48 at the road junction at the top of the map to levels of 36 dB or below in the outlying areas. At night, the levels drop by around 5 dB.

Figure 2 shows a histogram depicting the change in hourly Leq over a 24 hour period. (The histogram is from Dr. Lord's initial report.) There is a 9 dB variation between the energy during the noisiest hours of the day (45 dB) and the quietest hours at night (36 dB). The overall daily Leq for the measurement location was 43 dB.

In our earlier acoustic study for the well sites we estimated ambient noise levels to be at the 40 dB level so Dr. Lord's description of ambient noise in the Valley is consistent with our own assessment.

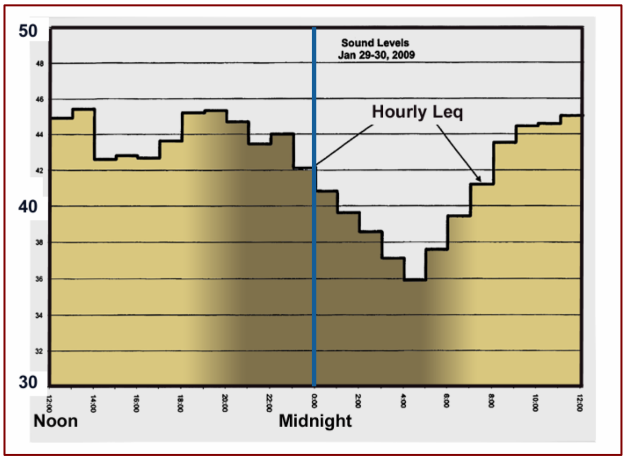


Figure 2: Daily (24 Hour) Leq Histogram

Noise Assessment – Proposed Project

Figure 3 on the following page shows an aerial view of the project site looking north. It includes a representation of the 3D topography. The diagram of the road system, the locations of the well sites, and the position of the nearest residences are overlaid on the image.

From an acoustic standpoint, the project can be divided into several phases. There is an initial construction phase for site preparation followed by up to five cyclic periods of drilling and test operations. The preparatory work involves minor grading to pads and road improvement, addition of gravel and other surface treatment and installation of new deck surfacing on the Huasna River Bridge. This construction work will take place during daytime hours. Following this, four production wells and a reinjection well will be drilled at Well Pad 2 depicted on Figure 3. Subsequently, the wells will be operated in an evaluation mode for three months. If the results of the test are promising, the following year two more wells will be drilled at Well Pad 1. A well construction period of one month will be followed by a period of continuous operation and evaluation. If the wells prove to be economically productive, two additional wells will be added each following year until a total of 12 operating wells are in place. (The exact positioning of the subsequent wells will be determined by the performance of the initial units). The recovered oil is to be removed by tanker trucks at a projected maximum rate of six round trips per day.

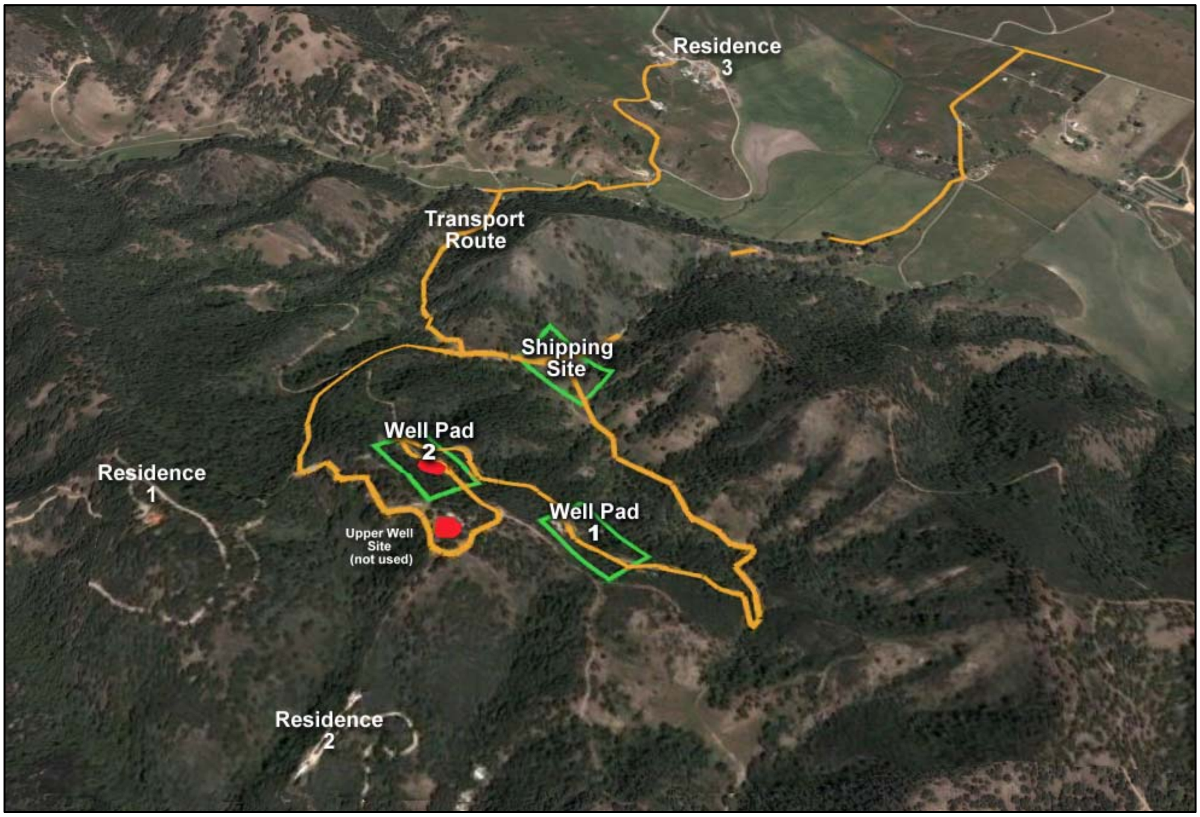


Figure 3: Aerial View of Well Pads and Shipping Site with 3D Topography

It might be helpful to supplement the graphic image by adding some narrative describing the setting. The shadow and the denser tree cover are on the north facing slopes. Residence 1 is on a hilltop (1,435 elevation) and has a view across a small valley of the next hill with a road that rises to the Upper Well Site (at 1,306 elevation, marked by a red dot). This Upper Well Site was part of an earlier plan but is not included in the current project. Residence 2 is to the south (1,118 elevation), on the same ridgeline as Well Pad 2. After the road crests the ridge at the Upper Well Site it doubles back to the north, dropping along the back side of the ridge. Well Pad 2 (1,176 elevation) is at the side of this road. Well Pad 2 site is not visible from either residence because of blocking topography. The road doubles back once again and continues its descent along the back side of the ridge and passes by the Well Pad 1 (at the 1,078 elevation). This site too is blocked from the views from the residences by the ridge line. The Shipping Site is still lower in elevation on a level area enclosed by hills (at the 849 foot elevation).

Figure 4 on the following page shows a straight down aerial view of the site. The property line outlines are shown as well as the haul route that will be followed by the tanker trucks.

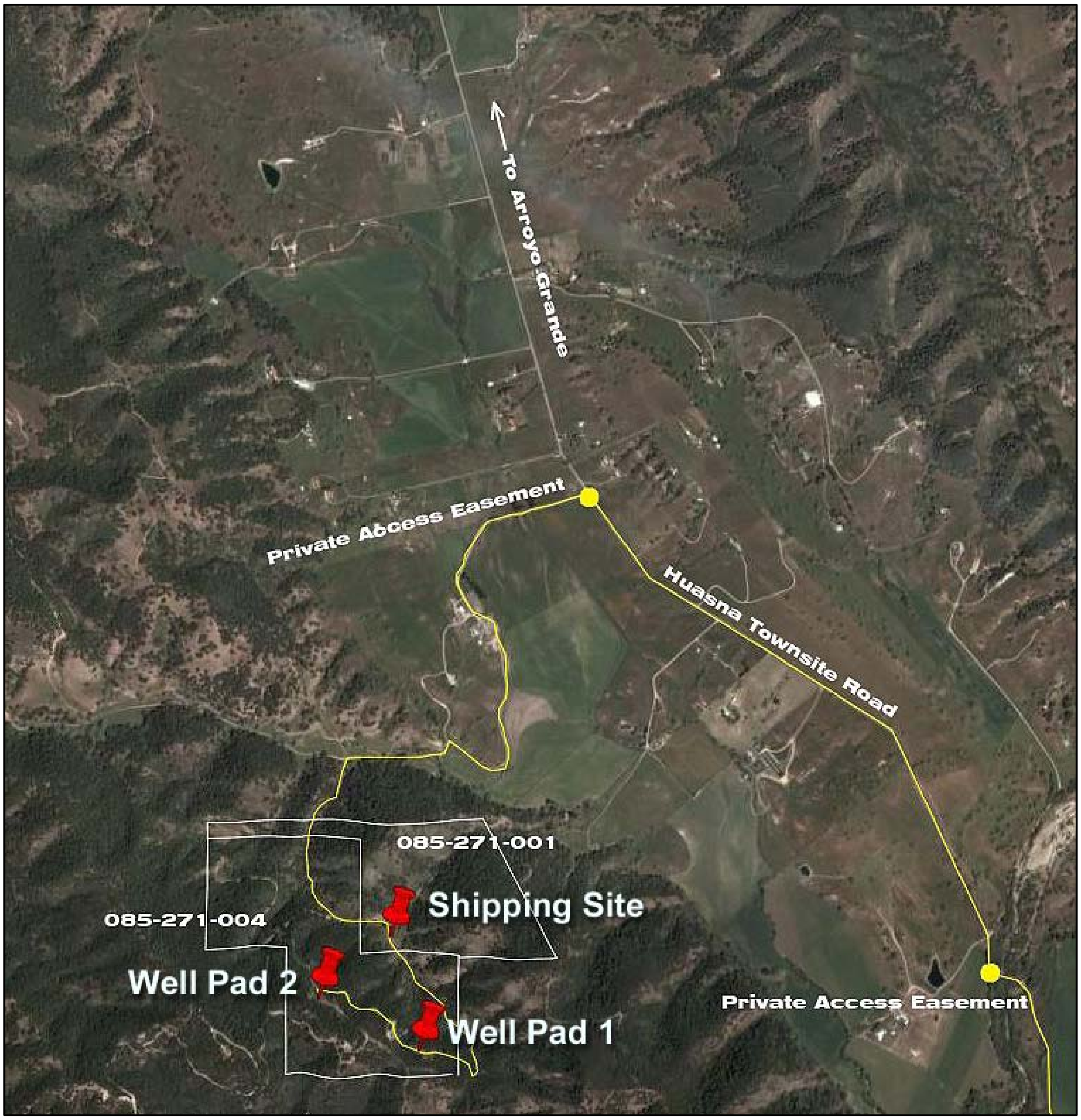


Figure 4: Aerial Showing Property Lines and Haul Route

CEQA Concerns

The California Environmental Quality Act (CEQA) includes a list of five questions that are to be used to gauge the potential environmental impacts of projects. The questions asked are whether the project results in:

1. *Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?*
2. *Exposure of persons to or generation of excessive ground borne vibration or ground borne noise levels?*
3. *A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?*
4. *A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?*

There are two additional questions that do not apply to this project.

5. *For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?*
6. *For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?*

Response to the several questions requires; 1) a review of County and other applicable standards, 2) a description of the present ambient noise levels, 3) estimates of future noise levels and 4) a comparison of current and future noise levels to existing levels on both a temporary and a permanent basis. The question of ground borne vibration and noise needs to be evaluated separately according to relevant standards. CEQA also requires an evaluation of project alternatives, including “no project”.

County Standards and Applicable Standards of Other Agencies

People will not be exposed to noise levels in excess of those established in the County’s general plan or noise ordinance, or applicable standards of other agencies

Multiple agencies and organizations have proposed standards for evaluating noise impacts. These include the World Health Organization, and the Federal Interagency Committee on Noise (FICON).[1] FICON has sponsored studies intended to promote consistency of standards among these federal agencies. In California the state transportation agency has published guidelines related to noise management issues for highway construction and airports.

The CEQA Guidelines do not provide numerical thresholds defining the levels where noise becomes significant. The Governor’s Office of Planning and Research (OPR) has

[1] This includes the Department of Defense (Air Force, Navy, and Army), the Environmental Protection Agency, the Department of Transportation, the Department of Housing and Urban Development, and the Department of Veterans Affairs.

published guidelines for the preparation of the Noise Elements that are a required component of a local General Plan. The planning guidelines draw on recommendations by the California Office of Noise Control. In urban areas most noise is produced by transportation noise sources. Table 1 shows the compatibility standards recommended for California. The noise exposure levels are expressed in terms of daily exposure measured by Ldn (CNEL is a closely related standard used in California – see Appendix A for more information).

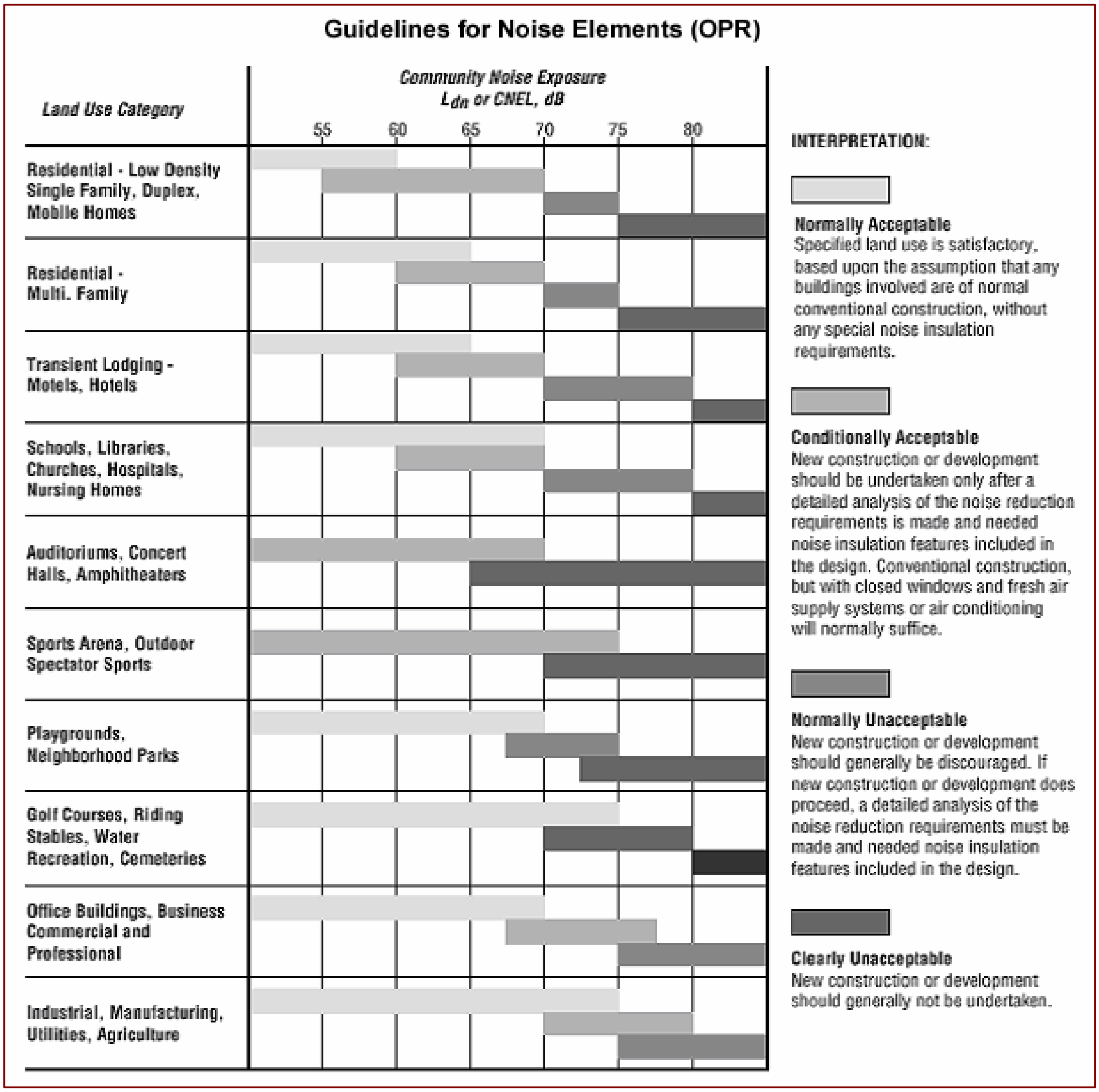


Table 1: Office of Planning and Research - Compatibility Guidelines

The San Luis Obispo County General Plan includes the required Noise Element. The first of the CEQA questions asks whether the project conforms to general plan standards. The County's standards for exposure to transportation noise sources replicate the standards recommended in the state guidelines (Table 1). The county's General Plan and associated Land Use Ordinance include additional standards limiting the levels of noise that can be produced and experienced at adjacent properties.

The County standards for the noise that can be produced by projects are expressed in both an hourly energy average (Leq) and a not-to-be-exceeded peak level (Lmax). There are daytime and nighttime standards as well as a consideration of the added annoyance of certain noise sources. Levels are to be measured at the property line of noise impacted neighbors.

	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Hourly Leq, dB	50	45
Maximum level, dB	70	65
Maximum level, dB-Impulsive Noise	65	60

The standards are to be lowered by 5 dB if the sound qualities are of an impulsive character or are speech or music. The Land Use Ordinance states that noise levels from activities are to be evaluated at the property line of adjoining uses. However, this is not well-suited to acreage residential land uses on large acreage and rolling terrain such as the Huasna Valley. At the source side, there are problems in pinpointing the source of sounds events since these are dispersed over multiple locations and the intensity of activities changes with time. At the receiver end there can also be problems if the property line is shielded by topography and the residence is not. This is the case for one of the homes that is closest to the Excelaron activities.

The County exempts construction noise from regulation as long as activities take place between 7 AM and 9 PM weekdays and 8 AM and 5 PM on weekends. The county has no standards related to ground vibration.

Caltrans has developed threshold guidelines related to vibration from construction activity and equipment. The standards relate to both the potential for structural damage and community perception. Their guidelines report that minor cracking of plaster might be expected when ground movement, measured by peak particle velocity (PPV), exceeds .3 inches per second. In the case of human perception, a PPV of .01 represents the level where vibration is perceptible and when PPV exceeds 0.04 the ground vibration becomes distinctly perceptible.

Project Noise Impacts

Project noise sources include project generated traffic, construction activities and sound from continuing operations. These vary with the phasing of activities over time.

Noise from Traffic

Estimates have been made of the numbers of daily trips associated with all phases of the work. The initial phase of site preparation and road and bridge improvement phase generates the greatest activity and is used as a “worst case” scenario.

In the initial phase of the project, 32 average daily trips (ADT) are predicted for the heaviest day of travel. The total breaks down into four trips made by the work crew (assumed to travel by pickup truck) with the remaining 28 trips hauling gravel and equipment made by heavier trucks. For all other phases of project activity the traffic counts are substantially less. The total ADT during the drilling phase is 21 daily trips with two thirds of the trips made by workers. During production, the ADT is 20 trips, mostly trips by the tandem tanker trucks.

The Federal Highway Administration has developed a model that uses vehicle counts, traffic mix and surface conditions and produce estimates of hourly Leq. The TNMLook screening model is used to estimate hourly Leq for any mix of traffic conditions.

There is a problem with the comparability of noise metrics in applying the TNM model to evaluate the noise standards in the County Noise Element. The TNM produces forecasts in terms of the Leq metric, while the County standards are stated in daily Ldn. However, there is a fairly consistent correspondence between the peak hour Leq and the daily Ldn. Dr. Lord's study indicates that the peak hour Leq was 45 and the same day's Ldn was 47. In our analysis we'll assume that this relationship will exist for future traffic. In the County's (and the State's) standards for compatibility (Table 1), noise issues for the most sensitive activities start to come into effect when the daily Ldn exceeds 55 dB. The Ldn in the Valley was two decibels less than the peak hour Leq so the "equivalent" peak hour Leq standard is 53 dB.

In calculating peak hour Leqs using the TNM tables we will look at existing noise levels and estimate the change attributable to the addition of project traffic. Data on existing traffic flows is based on counts made by Dr. Lord as part of his study of ambient sound. He reported that, during the peak hour of travel, there were 24 cars and 6 heavy trucks. The FHWA model can be used to estimate the distance from the centerline of the road to the 53 dB Leq contour line. With this traffic, at an average speed of 40 mph and "soft" site conditions, the distance is 63 feet.

The increase in noise levels attributable to project traffic can be estimated by adding the project generated vehicle trips to the TNM model. The peak traffic occurs during the construction phase. The conservative assumption is that all of the worker traffic occurs during the peak hour (2 pickup trucks) and 20 percent of the truck traffic, evenly split between medium and heavy trucks (3 trucks each). With these assumptions, the distance where the 53 dB level is reached is 80 feet from the roadway centerline. It might be noted that the heavy truck traffic during peak hour during the project's operation phase is likely to be 3 or fewer trucks. (Dr. Lord assumed it would be 3 trucks).

In terms of decibel change, at a distance of 100 feet from the centerline, the existing traffic noise level is 49 dB Leq. The addition of project traffic raises this to 51 dB. Dr. Lord's second sound level assessment includes reference information related to how people perceive changes in noise levels.

> ***1 dBA increase*** *in sound level is perceived as a barely audible increase by most people and is usually not judged to be significant.*
> ***3 dBA increase*** *in sound level, is clearly perceived and is a clearly audible increase, considered to be a "significant" impact under some planning standards and threshold evaluations.*
> ***10 dBA increase*** *in sound level, is perceived as a "doubling" of sound levels.*

By these standards, the 2 dB increase would be noticeable but not exceed the 3 dB significance level. It should be noted that this 3 dB threshold is *not* a County standard. The County regulations do not include numeric thresholds dealing with change from existing background levels except in cases where levels are already in excess of compatibility standards.

The previously referenced FICON report examined the significance of changes in exposure to airport noise concluding that, "*a DNL 3 dB; increase due to the proposed project is an appropriate [screening] value to use.*"

The numbers on the previous page reflect forecasts of truck and project traffic during the heaviest travel day during the initial preparation phase of the project. Traffic is less during drilling and operation phases, and the associated change in noise levels is less too.

Noise from Drilling

Noise from drilling operations was extensively addressed in our previous noise study (Dubbink, 2008) and can be summarized as follows.

The construction (well-drilling) phase involves heavy equipment that will be operational for about seven days per well site. The equipment is noisy; involving diesel generators, pumps, a shaker, and a powered drill. To meet OSHA requirements records are maintained by the drilling companies regarding the noise levels for each piece of equipment. Reports for a comparable well drilling operation, made by Kenai Drilling are reproduced in the appendix. The noise levels shown in the table are, for the most part, taken directly next to the sources. The table shows the levels for some of the noisier equipment normalized to a 50 foot reference position. Both our own and Dr. Lord's studies included estimates of noise exposure to the closest residences. Our study said that:

Residence 1 is 1,300 feet from the Upper Well Site and has a direct line of site across a valley. There is no influence of intervening topography or vegetation. This is not the case for Residence 2 [where there is intervening topography]. *"Soft" terrain can reduce exposure levels by 10 dB at the 950 foot distance. It is likely that the construction noise experienced at this location will be less shown in* [Table 2] *and it could be even less than at the more distant residence. Topography blocks both residents from direct exposure to noise from the* [Well Site 2]. *The sixty foot hill would lessen noise exposure by at least 10 dB.*

Table 2 displays the numeric data. This table differs from the one in the earlier report in that values have been added giving estimates of the noise generated at Well Pad 2.

				Residence 1		Residence 2	
Source	**Distance**	**Level**	**@15 Feet**	**Upper Site**	**Well Pad 2**	**Upper Site**	**Well Pad 2**
Drawworks Engine	3	105	81	52.7	43	55.4	45
Shaker	3	96	72	43.7	34	46.4	36
Generator House	10	93	79	50.7	41	53.4	43

Table 2: Noise Exposure of Residences 1 and 2

In evaluating the same two residences and multiple drilling sites, Dr. Lord did not differentiate between the noise contributions of the various sites. His computation includes sound sources at multiple drilling locations but all of these were at greater distance from the residences. He estimated LDN and day and nighttime Leqs. In our own calculation we were estimating maximum noise levels but these are comparable to daytime Leq if the drilling activity is continuous. Lord estimated that exposure levels for Residence 1 would be 43 Leq and at Residence 2 the daytime Leq value would be 42 dB. (At the time Dr. Lord made his analysis the Upper Site had been deleted from the project). Our estimates for the noise exposure at the residences from activities at the Lower Site are virtually the same as Dr. Lord's estimates.

Neither Lord's study or our earlier study evaluated noise from Well Pad 1. This is a more recent project component. However, adding the site would not significantly change either Lord's analysis or our own. The location of Well Pad 1 is similar to that of Well Pad 2 in that it is separated from the nearest residents by the same ridge line. The height of the blocking ridge relative to the homes exceeds 100 feet in both situations. Sounds from the two separate well pads are not additive because the drilling activities will take place at different times.

The County exempts construction noise from regulation as long as it occurs during the prescribed daytime hours. The site preparation and drilling activities are not inconsistent with County standards as long as they occur during these periods. Even if the activities were not exempted the sound levels associated with drilling meet the County's standards for maximum allowable noise. The County's daytime standard is a Leq of 50 with a nighttime standard of 45 dB. Our estimates of noise exposure to the closest residences are at or below these limits – as are the estimates made by Dr. Lord.

Noise from Continuing Operations

Kenai Drilling has measured the noise levels of well pump operations at 50 dB at a distance of 325 feet. Extrapolating this to the locations of the residences, and reducing the number by 10 decibels to account for topographic blocking, puts the well operation sounds in the 28 to 30 dB range.

The activities at the staging area and shipping site are separated from the residences by a distance of a half a mile and an additional hundred feet of topographic shielding. We have measured the sound a diesel truck makes when starting up from a stop as 78 decibels measured at a 50 foot distance. At a distance of 2,500 feet the level would be 44 dB. Reducing this by a minimum of 10 dB to allow for topographic shielding lowers the exposure estimate to less than 34 dB.

The noise levels for pumping operations and truck activities approximate the present ambient noise levels. Such noise levels are substantially below the noise limits set in the County's Land Use ordinance. However, this is not to say that the sounds of drilling activity and future operations will be inaudible in the Valley. The noticability of a sound against a background of other sounds relates to its frequency, and acoustic characteristics as well as its intensity. With background levels is the 30 to 40 dB range, the sound of a pumping operation and truck movements at the 30 to 34 dB levels will be audible. Ordinary conversation takes place at around a 65 dB level so sounds at such low levels would not be considered disruptive - although mechanical sounds could be bothersome to people accustom to a very quiet setting,

Ground Vibration

The extent of ground born vibration is a function of the activity, distance, and soil composition. The Caltrans report on vibration tolerance thresholds for structures and people includes formulae for estimating impacts using all of these criteria. The report includes vibration ratings for various activities. The listing does not include oil well drilling but does include drilling foundation shafts for caissons. The vibration level for this activity is a PPV value of .089 per inch measured 25 feet from the source. Using the Caltrans formula, drilling at Well Pad 2 would produce a PPV value of .002 at the nearest residence. Ground born vibration at this level is not be likely to damage structures or be readily perceptible.

Conclusions and Mitigations

The Excelaron Oil project in the Huasna Valley does not result in noise levels that violate County standards or the standards of other relevant agencies.

Ground borne vibration is well below levels where it might be considered excessive.

If well operations prove economically viable, continuing pumping and transfer operations will result in a permanent increase in ambient sound levels. While the sounds will be audible, they do not represent a significant change in terms of an increase in cumulative sound levels as measured by standards applied by other agencies (the County does not have its own threshold standard for change above ambient noise level).

There will be temporary increases in sound levels during the construction phases of the project. The County exempts construction noise from regulation except for restrictions on the time periods when the activity is permitted. Even though exempted, the noise from construction activities does not exceed the levels established for noise sources that are not exempted.

While the project does not create noise problems in terms of County standards or the guidelines from other agencies, noise management is still be a matter of concern. In this remote setting, noise levels that are in full conformance with county requirements will make a difference in the acoustic environment.

Actions can be taken to further reduce impacts and potential disruption. The permitted hours for construction activities should be respected and written into project conditions. A noise management plan should be drawn up for the project that deals with equipment used and it’s positioning during construction and operations. Equipment producing directional noise should be oriented so that noise is directed the away from the closest receivers. It may be possible to position construction trailers, storage tanks or graded materials to screen noise sources. Source control is important. Engines should be equipped with mufflers that are maintained in good repair. The noise produced by equipment used in construction and operations should not exceed the averages for equipment type described in Federal Highway Administration’s Construction Noise

Model. Appendix C is a table showing these noise limits. OSHA backup warning beepers should be adjusted to the minimum levels needed to insure worker safety. The conformance should be verified through monitoring and reporting requirements.

There are also things that can be done to lessen the potential for problems. Project plans and construction schedules should be made known in advance to the nearby residents. Residents should be provided with contact information to report problems. The contractor should also make sure workers understand noise management issues and have instructions on how to minimize impacts.

Appendix A

DEFINITIONS

A-Weighted Level: The sound level in decibels as measured on a sound level meter using the A-weighting lter network. The A-weighting lter deemphasizes the very low and very high frequency components of the sound in a manner similar to the response of th e human ear and gives good correlation with subjective reactions to noise.

Ambient Noise: The composite of noise from all sources near and far. In this context, the ambient noise level constitutes the normal or existing level of environmental noise at a given location.

CNEL: Community Noise Equivalent Level. The average equivalent A-weighted sound level during a 24hour day, obtained after addition of five decibels to sound levels in the evening from 7 p.m. to 10 p.m. and after addition of 10 decibels to sound levels in the night from 10 p.m. to 7 a.m.

Decibel, dB: A unit of measurement describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 micronewtons per square meter).

Intrusive Noise: That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence, and tonal or informational content as well as the prevailing noise level.

L10: The A-weighted sound level exceeded ten percent of the sample time. Similarly, L50, L90 etc.

Ldn: DayNight Average Level. The average equivalent A-weighted sound level during a 24hour day, obtained after addition of 10 decibels to sound levels in the night after 10 p.m. and before 7 a.m.

Leq: Equivalent energy level. The sound level corresponding to a steady state sound level containing the same total energy as a time varying signal over a given sample period. Leq is typically computed over 1, 8, and 24hour sample periods.

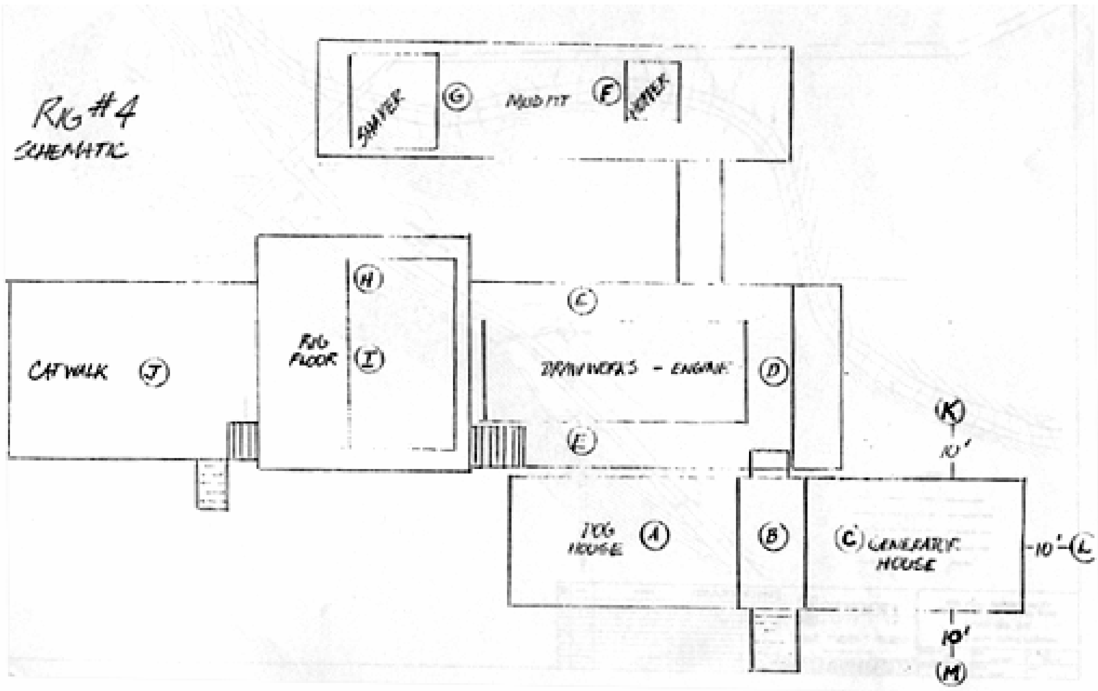
Noise Contours: Lines drawn about a noise source indicating equal levels of noise exposure. CNEL and Ldn are metrics utilized to describe annoyance due to noise and to establish land use planning criteria for noise.

Trip: In traffic planning a “trip” is counted with each origin to destination vehicle movement. A drive to work and a drive back home would count as two trips.

> **Note:** CNEL and Ldn represent daily levels of noise exposure averaged on an annual or daily basis, while Leq represents the equivalent energy noise exposure for a shorter time period, typically one hour.

Appendix B

Noise Measurements of Drilling Operations



LOCATION ON RIG	SOUND LEVEL (dBA) (engines at idle)	SOUND LEVEL (dBA) (engines pulling)
A (door open)	88.5	88.5
A (door closed)	75	75
B	99.5	99.5
C	104.7	104.7
D	88	105
E	88	96
F	90	95.5
G	90	95.5
H	88	91
I	82	90
J	82	84
K	92.5	92.5
L	91.7	91.7
M	86.5	86.5

All of the sound level checks were taken with a sound meter set on the A level, slow response

Source: Rig Number 4, Kenai Drilling 2/15/96

Appendix C

Noise Limits for Construction Equipment

CA/T Noise Emission Reference Levels and Usage Factors

filename: EQUIPLST.xls

revised: 7/26/05

Equipment Description	Impact Device ?	Acoustical Use Factor (%)	Spec 721.560 Lmax @ 50ft (dBA, slow)	Actual Measured Lmax @ 50ft (dBA, slow) (samples averaged)	No. of Actual Data Samples (Count)
All Other Equipment > 5 HP	No	50	85	-- N/A --	0
Auger Drill Rig	No	20	85	84	36
Backhoe	No	40	80	78	372
Bar Bender	No	20	80	-- N/A --	0
Blasting	Yes	-- N/A --	94	-- N/A --	0
Boring Jack Power Unit	No	50	80	83	1
Chain Saw	No	20	85	84	46
Clam Shovel (dropping)	Yes	20	93	87	4
Compactor (ground)	No	20	80	83	57
Compressor (air)	No	40	80	78	18
Concrete Batch Plant	No	15	83	-- N/A --	0
Concrete Mixer Truck	No	40	85	79	40
Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Drill Rig Truck	No	20	84	79	22
Drum Mixer	No	50	80	80	1
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA, VMS signs)	No	50	70	73	74
Gradall	No	40	85	83	70
Grader	No	40	85	-- N/A --	0
Grapple (on backhoe)	No	40	85	87	1
Horizontal Boring Hydr. Jack	No	25	80	82	6
Hydra Break Ram	Yes	10	90	-- N/A --	0
Impact Pile Driver	Yes	20	95	101	11
Jackhammer	Yes	20	85	89	133
Man Lift	No	20	85	75	23
Mounted Impact Hammer (hoe ram)	Yes	20	90	90	212
Pavement Scarafier	No	20	85	90	2
Paver	No	50	85	77	9
Pickup Truck	No	40	55	75	1
Pneumatic Tools	No	50	85	85	90
Pumps	No	50	77	81	17
Refrigerator Unit	No	100	82	73	3
Rivit Buster/chipping gun	Yes	20	85	79	19
Rock Drill	No	20	85	81	3
Roller	No	20	85	80	16
Sand Blasting (Single Nozzle)	No	20	85	96	9
Scraper	No	40	85	84	12
Shears (on backhoe)	No	40	85	96	5
Slurry Plant	No	100	78	78	1
Slurry Trenching Machine	No	50	82	80	75
Soil Mix Drill Rig	No	50	80	-- N/A --	0
Tractor	No	40	84	-- N/A --	0
Vacuum Excavator (Vac-truck)	No	40	85	85	149
Vacuum Street Sweeper	No	10	80	82	19
Ventilation Fan	No	100	85	79	13
Vibrating Hopper	No	50	85	87	1
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44
Warning Horn	No	5	85	83	12
Welder / Torch	No	40	73	74	5

The grayed out Acoustical Use Factor column is from the source document and does not relate to the Huasna project. The next column, Spec 721.560, gives the noise limits.

Source: Roadway Construction Noise Model User's Guide, page 3, FHWA January 2006