# Environmental Noise Assessment

# Sierra Pacific Industries
# Cogeneration Plant Expansion

Anderson, California

Job # 2009-150A

Prepared For:

**Sierra Pacific Industries**

P.O. Box 10939
Anderson, CA 96007

Attn: Cedric Twight

Prepared By:


**j.c. brennan & associates, Inc.**

Jim Brennan
President
Member, Institute of Noise Control Engineering


April 8, 2010

## INTRODUCTION

This section discusses the existing noise environment in the project vicinity, and identifies potential noise impacts and mitigation measures related to the new cogeneration power plant at the Anderson Sierra Pacific Industries lumber mill. Specifically, this section analyzes potential noise impacts due to the development of the project relative to applicable noise criteria and to the existing ambient noise environment.

## ENVIRONMENTAL SETTING

### Acoustical Terminology

Acoustics is the science of sound. Sound may be thought of as mechanical energy of a vibrating object transmitted by pressure waves through a medium to human (or animal) ears. If the pressure variations occur frequently enough (at least 20 times per second), then they can be heard and are called sound. The number of pressure variations per second is called the frequency of sound, and is expressed as cycles per second or Hertz (Hz).

Noise is a subjective reaction to different types of sounds. Noise is typically defined as (airborne) sound that is loud, unpleasant, unexpected or undesired, and may therefore be classified as a more specific group of sounds. Perceptions of sound and noise are highly subjective: one person's music is another's headache.

Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale uses the hearing threshold (20 micropascals), as a point of reference, defined as 0 dB. Other sound pressures are then compared to this reference pressure, and the logarithm is taken to keep the numbers in a practical range. The decibel scale allows a million-fold increase in pressure to be expressed as 120 dB, and changes in levels (dB) correspond closely to human perception of relative loudness.

The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable, and can be approximated by A-weighted sound levels. There is a strong correlation between A-weighted sound levels (expressed as dBA) and the way the human ear perceives sound. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. All noise levels reported in this section are in terms of A-weighted levels, but are expressed as dB, unless otherwise noted.

The decibel scale is logarithmic, not linear. In other words, two sound levels 10 dB apart differ in acoustic energy by a factor of 10. When the standard logarithmic decibel is A-weighted, an increase of 10 dBA is generally perceived as a doubling in loudness. For example, a 70 dBA sound is half as loud as an 80 dBA sound, and twice as loud as a 60 dBA sound.

Community noise is commonly described in terms of the ambient noise level, which is defined as the all-encompassing noise level associated with a given environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level ($L_{eq}$), which corresponds to a steady-state A weighted sound level containing the same total energy as a time varying signal over a given time period (usually one hour). The $L_{eq}$ is the foundation of the composite noise descriptor, $L_{dn}$, and shows very good correlation with community response to noise.

The day/night average level ($L_{dn}$) is based upon the average noise level over a 24-hour day, with a +10 decibel weighing applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because $L_{dn}$ represents a 24-hour average, it tends to disguise short-term variations in the noise environment.

Table 1 lists several examples of the noise levels associated with common situations. Appendix A provides a summary of acoustical terms used in this report.

### Effects of Noise on People

The effects of noise on people can be placed in three categories:

- Subjective effects of annoyance, nuisance, and dissatisfaction
- Interference with activities such as speech, sleep, and learning
- Physiological effects such as hearing loss or sudden startling

Environmental noise typically produces effects in the first two categories. Workers in industrial plants can experience noise in the last category. There is no completely satisfactory way to measure the subjective effects of noise or the corresponding reactions of annoyance and dissatisfaction. A wide variation in individual thresholds of annoyance exists and different tolerances to noise tend to develop based on an individual's past experiences with noise.

Thus, an important way of predicting a human reaction to a new noise environment is the way it compares to the existing environment to which one has adapted: the so-called ambient noise level. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by those hearing it.

**Table 1**
**Typical Nose Levels**

| **Common Outdoor Activities** | **Noise Level (dBA)** | **Common Indoor Activities** |
| --- | --- | --- |
| | --110-- | Rock Band |
| Jet Fly-over at 300 m (1,000 ft) | --100-- | |
| Gas Lawn Mower at 1 m (3 ft) | --90-- | |
| Diesel Truck at 15 m (50 ft), at 80 km/hr (50 mph) | --80-- | Food Blender at 1 m (3 ft)<br>Garbage Disposal at 1 m (3 ft) |
| Noisy Urban Area, Daytime<br>Gas Lawn Mower, 30 m (100 ft) | --70-- | Vacuum Cleaner at 3 m (10 ft) |
| Commercial Area<br>Heavy Traffic at 90 m (300 ft) | --60-- | Normal Speech at 1 m (3 ft) |
| Quiet Urban Daytime | --50-- | Large Business Office<br>Dishwasher in Next Room |
| Quiet Urban Nighttime | --40-- | Theater, Large Conference Room (Background) |
| Quiet Suburban Nighttime | --30-- | Library |
| Quiet Rural Nighttime | --20-- | Bedroom at Night, Concert Hall (Background) |
| | --10-- | Broadcast/Recording Studio |
| Lowest Threshold of Human Hearing | --0-- | Lowest Threshold of Human Hearing |

Source: Caltrans, Technical Noise Supplement, Traffic Noise Analysis Protocol. October 1998.

With regard to increases in A-weighted noise level, the following relationships occur:

- Except in carefully controlled laboratory experiments, a change of 1 dBA cannot be perceived;
- Outside of the laboratory, a 3 dBA change is considered a just-perceivable difference;
- A change in level of at least 5 dBA is required before any noticeable change in human response would be expected; and
- A 10 dBA change is subjectively heard as approximately a doubling in loudness, and can cause an adverse response.

Stationary point sources of noise – including stationary mobile sources such as idling vehicles – attenuate (lessen) at a rate of approximately 6 dB per doubling of distance from the source, depending on environmental conditions (i.e. atmospheric conditions and either vegetative or manufactured noise barriers, etc.). Widely distributed noises, such as a large industrial facility spread over many acres, or a street with moving vehicles, would typically attenuate at a lower rate.

All noise levels reported in this section are in terms of A-weighted levels, unless otherwise described. Table 2 shows acoustical terminology used in this report.

**Table 2**
**Acoustical Terminology**

| | |
|---|---|
| **Acoustics** | The science of sound. |
| **Ambient Noise** | The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study. |
| **Attenuation** | The reduction of an acoustic signal. |
| **A-Weighting** | A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response. |
| **Decibel or dB** | Fundamental unit of sound, A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell. |
| **Frequency** | The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz. |
| **$L_{dn}$** | Day/Night Average Sound Level. Similar to CNEL but with no evening weighting. |
| **$L_{eq}$** | Equivalent or energy-averaged sound level. |
| **$L_{max}$** | The highest root-mean-square (RMS) sound level measured over a given period of time. |
| **Loudness** | A subjective term for the sensation of the magnitude of sound. |
| **Masking** | The amount (or the process) by which the threshold of audibility is for one sound is raised by the presence of another (masking) sound. |
| **Noise** | Unwanted sound. |
| **Peak Noise** | The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level. |
| **Sound Power** | Sound which radiates from a sound source, and is independent of distance. |
| **Threshold of Hearing** | The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing. |
| **Threshold of Pain** | Approximately 120 dB above the threshold of hearing. |

## Project Description, Location, and Existing Land Uses in the Project Vicinity

The project site is located in Shasta County, immediately northwest of the City limits of Anderson, and southeast of the City of Redding. The project is located on a 121.39-acre parcel at the end of Riverside Avenue, five- tenths of a mile west of the Interstate 5

Interchange. The northeastern border of the project site is adjacent to the Sacramento River. The southwestern border of the project site is adjacent to State Route (SR) 273 and a Union Pacific Railroad line. The project site is accessed by Riverside Avenue. The project site and areas of proposed improvement are shown in Figure 1.

The project site is bounded by the Sacramento River to the northeast, SR 273 to the southwest, and Spring Gulch to the southeast. The Siskiyou Forest Products manufacturing facility is located to the southwest of the project site. Lands to the northwest of the project site consist of agricultural lands and undeveloped open space. The northwest boundary of the site is bordered by an Anderson Cottonwood Irrigation District (ACID) Canal Overflow ditch. The properties adjacent to the project site are generally used for commercial and light industrial activities. There are existing residences in a mobile home park located across the Sacramento River to the north and northeast of the project site. There are a limited number of existing residences located across SR 273 to the southwest of the project site.

The existing sawmill is powered by a wood-fired co-generation plant. The fuel consists of the sawdust and woodchips that are bi-products from the sawing of lumber from logs. The fuel is stored in a large pile and covered fuel bin. Conveyors move the fuel to the existing boiler and a stream driven turbine converts mechanical energy into electrical energy. Excess steam is conveyed via above-ground pipeline to the lumber kilns to dry lumber. The existing co-generation plant also utilizes a two cell cooling tower and ash bin. The existing wood fired boiler was completed in March 1997. The existing turbine and electrical generator was operational in December 1997. The existing generator is rated to produce 4MW of electricity and the boiler is rated to produce 80,000 lbs of steam.

The proposed project consists of the construction and operation of a new co-generation power facility on the project site. The proposed co-generation plant will involve construction of a new fuel handling building, boiler building, turbine building, cooling tower, electrostatic precipitator, ash silo and electric substation. The boiler associated with the plant will burn biomass fuel (i.e., non-treated wood and agricultural crop residues, as well as urban wood-waste) generated by the lumber manufacturing facility on-site, regional lumber manufacturing facilities, and other biomass fuel sources to produce approximately 250,000 pounds of steam per hour. The steam will be used to dry lumber in existing kilns and for a steam turbine. The steam turbine will drive a generator that will produce up to 23 megawatts of electricity for on-site use as well as for sale to the local power grid.

The existing smaller co-generation plant on-site will be maintained as a backup facility so that the sawmill operation can be normalized during maintenance operations on the new co-generation plant. Upon completion of the proposed project, the two onsite co-generation plants will not operate simultaneously.

**Figure 1**

**SPI Lumber Mill Site, Noise Measurement Sites & Project Area**


# : Noise Measurement Sites

SPI Site Boundaries

Cogeneration Plant Area

Osprey Nest Site

j.c. brennan & associates
*consultants in acoustics*

## Existing Background Noise Environment

The project site noise environment is subjectively considered fairly loud, due to the amount of on-site equipment which operates from approximately 6:00 a.m. to midnight. In addition, adjacent operations from the Siskiyou Forest Products operations, railroad operations and nearby I-5 and S.R. 273 contribute to the noise environment in the project vicinity. To quantify typical noise levels at the property lines of the project site and in the immediate project vicinity, continuous 24-hour ambient noise surveys were conducted at three locations on October 20-21, 2009. The ambient noise monitoring sites are described as follows:

- Site 1: This site is located along the southwest property line, and adjacent to the Siskiyou Forest Products lumber mill facility. Based upon field observations, the background noise environment is dominated by activity at the SPI mill and the Siskiyou Forest Products mill. The cogeneration plant was located approximately 1,200 feet from the existing cogeneration plant, and the noise levels were not audible at this site;

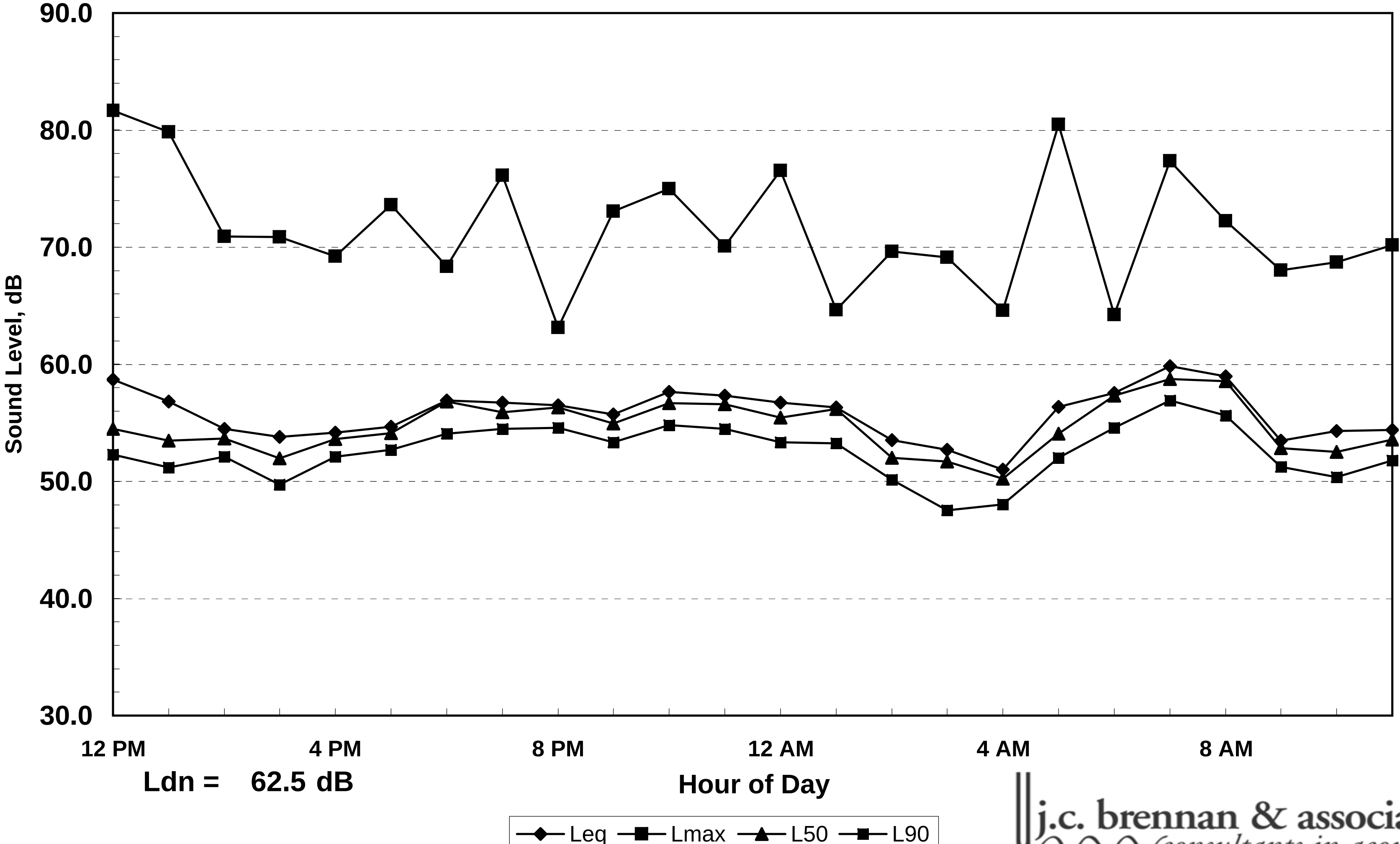
- Site 2: This site is located along the southeast property line, and adjacent to a greenbelt and light industry/manufacturing facilities. Based upon field observations, the background noise environment at this site was dominated by activity at the SPI mill. The noise measurement site was located approximately 1,250 feet from the existing cogeneration plant, and the noise levels were not audible at this site.

- Site 3: This site is located to the northeast, and across the Sacramento River. This site is in direct line of sight to the existing and proposed power plant, within the Sacramento River RV Resort (Space 95). Based upon field observations, the background noise environment at this site was dominated by activity at the RV Resort, I-5 traffic, and some activity at the SPI mill. The cogeneration plant noise levels were not audible at this site.

Noise measurement equipment consisted of Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meters. The meters were calibrated before and after use with an LDL Model CA200 acoustical calibrator to ensure the accuracy of the measurements. The equipment used meets all pertinent specifications of the American National Standards Institute for Type 1 sound level meters (ANSI S1.4).

A summary of the noise measurement data for the 24-hour continuous noise measurement site is shown in Table 3. The results of the noise measurements are shown graphically on Figures 2 through 4. Noise measurement locations are shown on Figure 1. Figure 5 shows the distances from the existing and proposed cogeneration plant locations to the nearest noise-sensitive receivers.

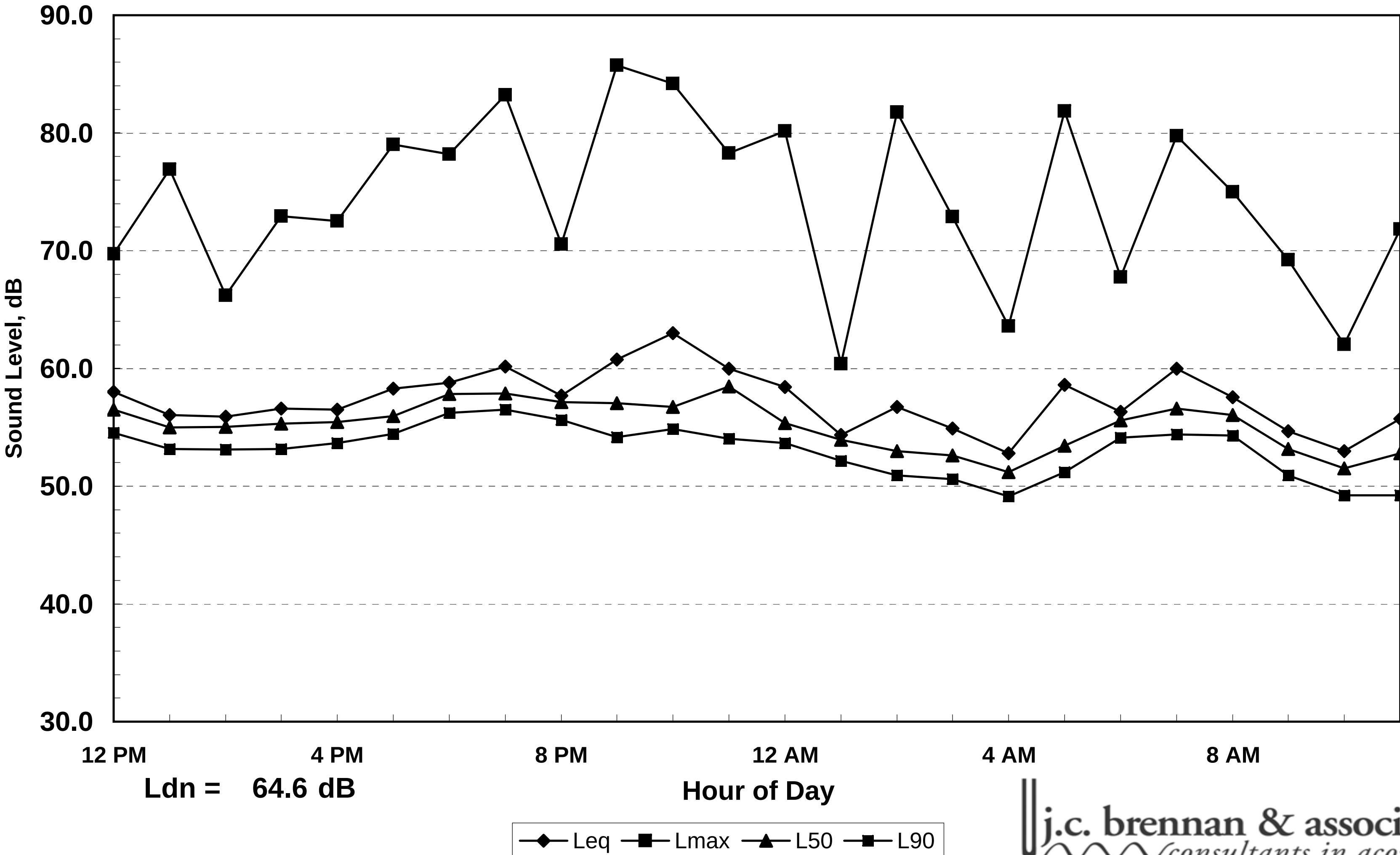
**Figure 2**
SPI Anderson
24hr Continuous Noise Monitoring - Site 1
10/20-21/2009




**Ldn = 62.5 dB**

j.c. brennan & associates
*consultants in acoustics*

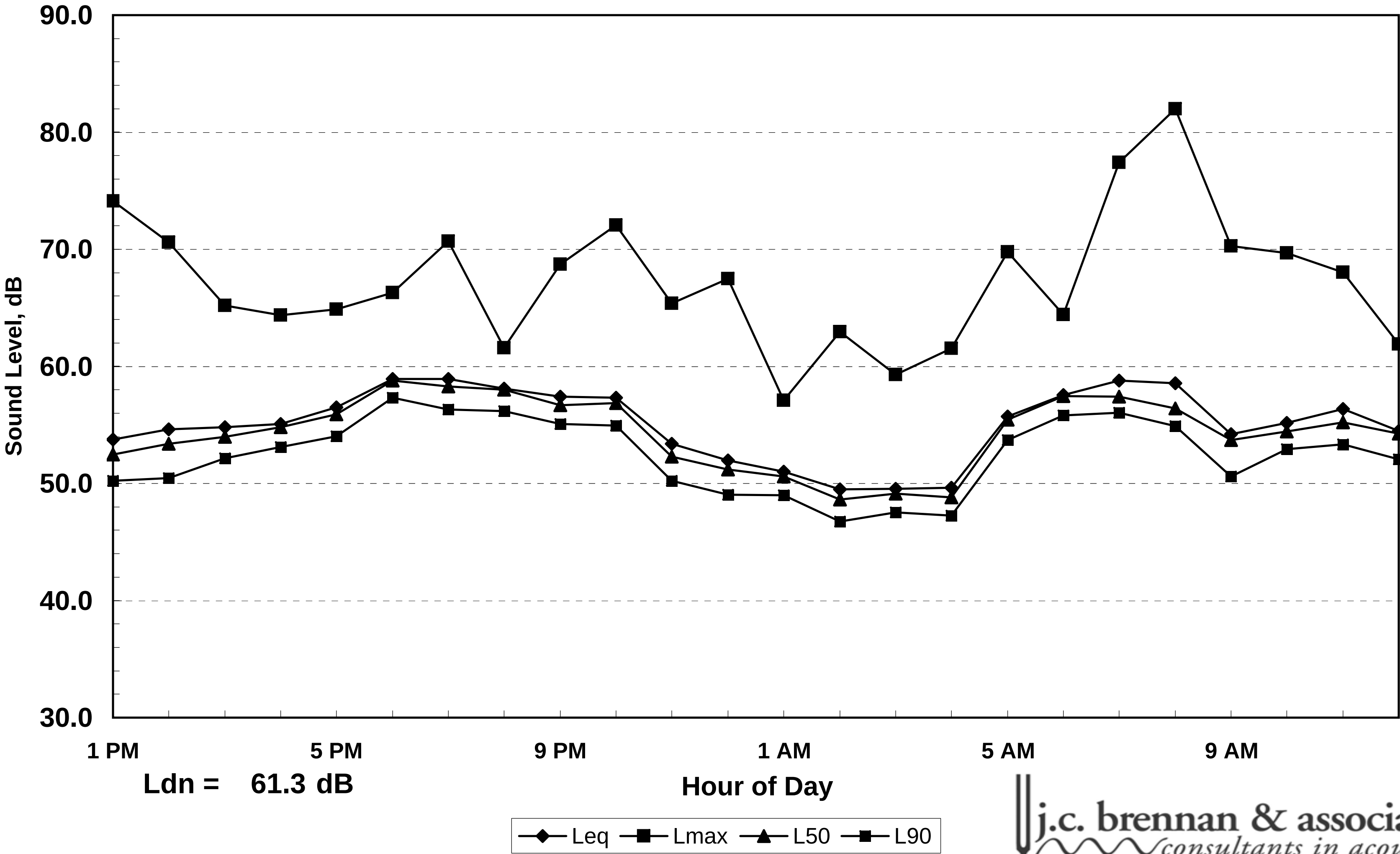
**Figure 3**
SPI Anderson
24hr Continuous Noise Monitoring - Site 2
10/20-21/2009




Ldn = 64.6 dB

j.c. brennan & associates
*consultants in acoustics*

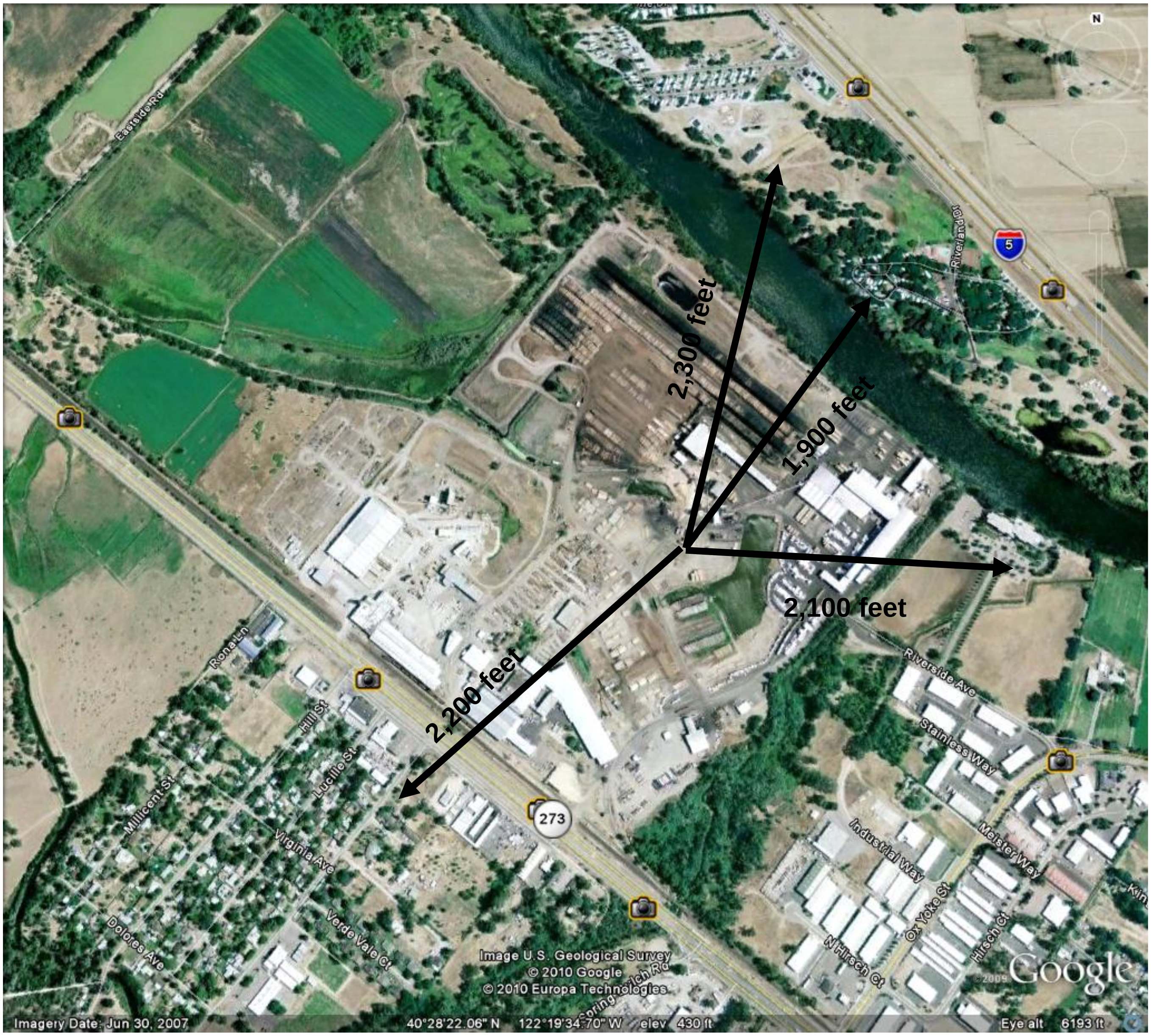
**Figure 4**
SPI Anderson
24hr Continuous Noise Monitoring - Site 3
10/20-21/2009




j.c. brennan & associates
*consultants in acoustics*

**Figure 5**

**Project Site and Distances to the Nearest Noise-Sensitive Receptors**




N

j.c. brennan & associates
consultants in acoustics

| Table 3<br>Summary of Continuous Measured Ambient Noise Levels | | | | | | |
|---|---|---|---|---|---|---|
| **Ldn** | Average Hourly Daytime (7:00am - 10:00pm) | | | Average Hourly Nighttime (10:00pm – 7:00am) | | |
| | **Leq** | **L50** | **Lmax** | **Leq** | **L50** | **Lmax** |
| Site 1 – Southwest Property Line | | | | | | |
| **62.5 dBA** | **56.4 dBA** | **55 dBA** | **72.2 dBA** | **56.0 dBA** | **55 dBA** | **70.5 dBA** |
| Site 2 – Southeast Property Line | | | | | | |
| **64.6 dBA** | **57.8 dBA** | **56 dBA** | **74.2 dBA** | **58.3 dBA** | **55 dBA** | **74.5 dBA** |
| Site 3 – Sacramento RV Resort | | | | | | |
| **61.3 dBA** | **56.6 dBA** | **56 dBA** | **69.4 dBA** | **54.6 dBA** | **53 dBA** | **64.4 dBA** |
| Source: j.c. brennan & associates, Inc. - 2009 | | | | | | |

## Existing Power Plant Noise Levels

The existing power plant includes a 4 megawatt (MG) turbine generator with a 2-Cell cooling tower and 80,000 pound per hour boiler. As a means of determining the noise levels associated with the existing cogeneration power plant, j.c. brennan & associates, Inc. conducted noise level measurements of the cogeneration plant operations. The noise measurements were conducted for a period of time that a steady-state Leq was observed. The plant operations reflected typical operating conditions. Overall A-weighted noise levels and frequency analyses of the plant operation noise levels were conducted. All noise measurements were conducted in the free-field to assess all noise sources associated with the equipment. The primary noise sources included the cooling tower, boiler and steam turbine. Noise levels associated with the cooling tower were isolated. However, noise levels associated with the turbine and boiler could not be isolated individually. Therefore, the overall noise levels associated with the boiler and turbine operations were measured together. Table 4 shows the results of the noise measurements.

Noise measurement equipment consisted of Larson Davis Laboratories (LDL) Model 824 precision integrating sound level meter. The meter was equipped with 1/3 and 1/1 octave band filters. The meter was calibrated before and after use with an LDL Model CA200 acoustical calibrator to ensure the accuracy of the measurements. The equipment used meets all pertinent specifications of the American National Standards Institute for Type 1 sound level meters (ANSI S1.4) and frequency analyzers.

| Table 4<br>Existing SPI Cogeneration Plant Noise Levels | | | |
|---|---|---|---|
| Source | Distance | Sound Level | |
| | | Leq | Converted Sound Power Level |
| Cooling Tower | 30 feet | 72.7 dBA | 102 dBA |
| Boiler & Steam Turbine | 70 feet | 71.6 dBA | 112 dBA |
| Source: j.c. brennan & associates, Inc. - 2009 | | | |

The noise level data shown in Table 4, and the frequency data shown in Table 5 were used to determine the overall noise levels associated with the existing cogeneration power plant.

As a means of predicting noise levels associated with the existing cogeneration plant operations, j.c. brennan & associates, Inc. used the computer based "Environmental Noise Model" (ENM). The ENM is capable of projecting the locations of noise contours for multiple noise sources, while accounting for natural topography, ground type, atmospheric conditions, noise source directionality, height of the noise sources, and frequency content of the noise sources.

Inputs to the ENM were obtained from base maps for the site. Other inputs to the ENM included temperature and the relative humidity. In addition, existing buildings on the site, including the sawmill, kilns and planer building, as well as the log decks, were digitized into the model to account for shielding. Noise level and sound power data were based upon the noise measurements described above. Octave band sound power levels which were used for direct inputs to the ENM for each individual piece of the cogeneration plant equipment are contained within Table 5.

**Table 5**
**Existing Cogeneration Power Plant ENM Input Sound Power Levels**

| | Linear Octave Band Center Frequency, Hz in dB | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Component | 31.5 | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | dBA |
| Turbine/Boiler | **115** | **118** | **114** | **110** | **106** | **102** | **99** | **96** | **91** | **112** |
| Cooling Tower | **107** | **113** | **109** | **104** | **101** | **93** | **89** | **86** | **85** | **102** |
| Source: j.c. brennan & associates, Inc. - 2009 | | | | | | | | | | |

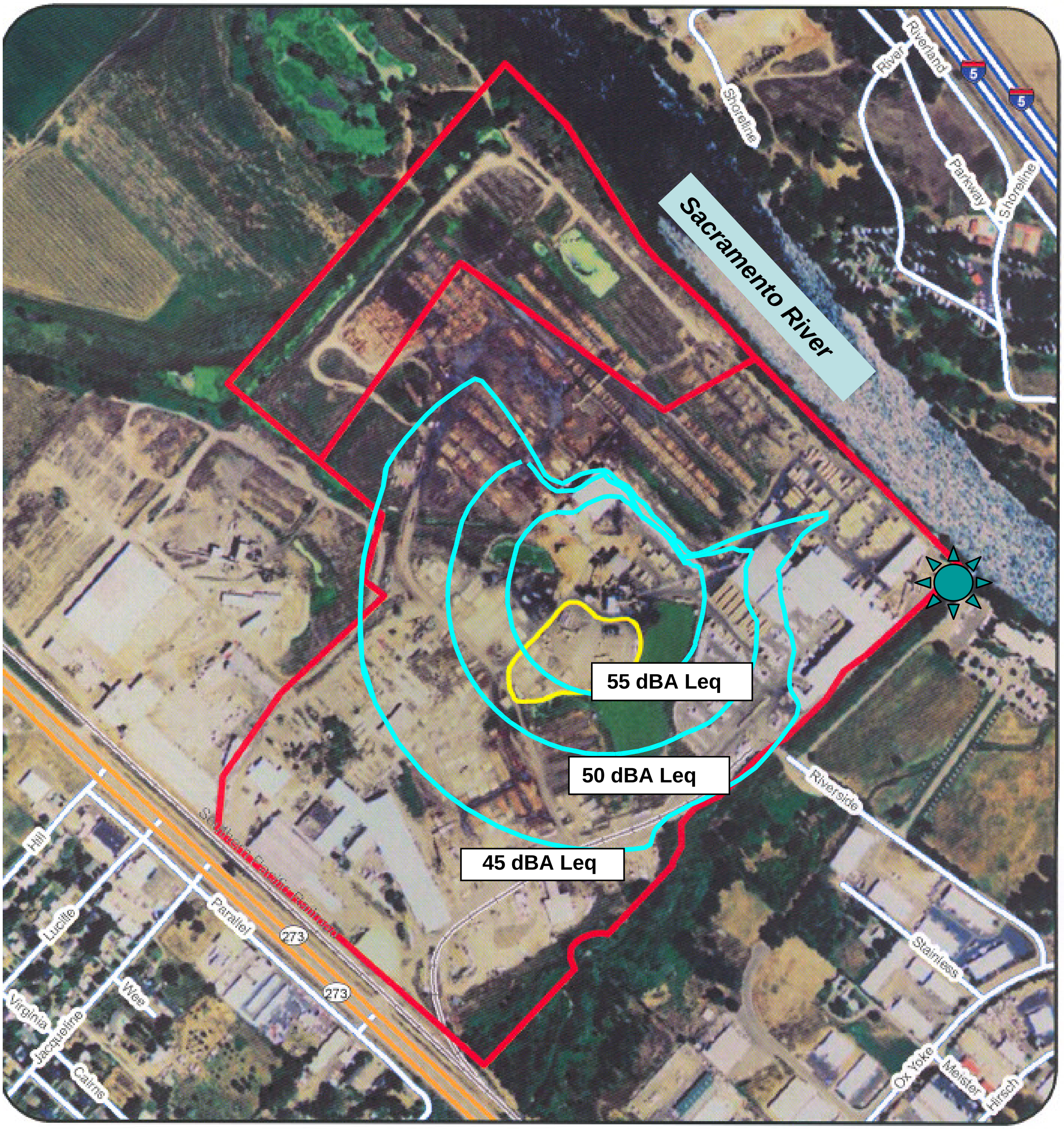
Figure 6 shows the noise contours associated with the existing cogeneration power plant operations. Based upon the analysis, existing cogeneration power plant, 45 dBA Leq noise contour is confined to the existing SPI mill site. In addition, the cogeneration power plant noise levels are more than 10 dBA less than the existing background noise levels.

### Existing Lumber Mill Noise Levels at Osprey Nesting Site

Currently, there is an existing Osprey nesting site located on an electrical transmission tower at the northeast corner of the lumber mill site. Figure 1 shows the location of the Osprey Nesting Site. j.c. brennan & associates, Inc. conducted noise level measurements of the lumber mill operations at the base of the tower. The primary noise sources were the planer building and the bag house. Measured noise levels were approximately 70 dB Leq at the base of the tower. Assuming that other contributions of noise occur at the elevated nesting site, it is estimated that the lumber mill noise levels could be as high as 73 dB Leq at the nesting site. It should be noted that this nesting site is used on an annual basis, and therefore do not appear to be affected by the noise. This analysis is not intended to establish criteria for nesting sites, and only intends to note that the site exists.

**Figure 6**

**Existing SPI Lumber Mill Cogeneration Plant Noise Levels**




Noise Level Contours

SPI Site Boundaries

Cogeneration Plant Area

Osprey Nest Site

j.c. brennan & associates
*consultants in acoustics*

### Existing Roadway Traffic Noise Levels

To describe existing traffic noise levels on the area roadways, j.c. brennan & associates, Inc. used the Federal Highway Administration Highway Traffic Noise Prediction Model (FHWA RD-77-108). The FHWA model is the analytical method which was developed for highway traffic noise prediction for most state and local agencies, including the California Department of Transportation (Caltrans).

The FHWA model is based upon the Calveno reference noise emission factors for automobiles, medium trucks and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. The FHWA model was developed to predict hourly Leq values for free-flowing traffic conditions. To predict Ldn values, it is necessary to determine the day/night distribution of traffic and adjust the traffic volume input data to yield an equivalent hourly traffic volume. Average daily traffic (ADT) volumes for existing conditions were obtained from the traffic study prepared for the project by Omni Means. In addition, heavy truck traffic counts were also provided by Omni Means. The FHWA Model inputs are contained in Appendix B. Table 6 shows the predicted existing traffic noise levels at a reference distance of 100 feet from the roadway centerlines. Appendix B contains the FHWA Model inputs.

**Table 6**
**Existing Traffic Noise Levels and Distances to Noise Contours**

| Roadway | Segment | ADT | Ldn @ 100 feet | Distance to Ldn Contour (feet)[1] | | |
|---|---|---|---|---|---|---|
| | | | | 60 dB | 65 dB | 70 dB |
| Riverside Ave. | North of Ox Yoke Rd. | 2440 | 58 dBA | 74 | 35 | 16 |
| Ox Yoke Rd. | East of Riverside Ave. | 8460 | 60 dBA | 102 | 48 | 22 |
| Ox Yoke Rd. | West of Riverside Ave. | 7200 | 59 dBA | 92 | 43 | 20 |

[1] Distances to traffic noise contours are measured in feet from the centerlines of the roadways.
Source: FHWA-RD-77-108 with inputs from Omni Means Transportation Consultants, Caltrans and j.c. brennan & associates, Inc.

## REGULATORY SETTING

### Federal

There are no federal noise requirements or regulations that bear directly on local actions of Shasta County. The Noise Control Act of 1972 directed the United States Environmental Protection Agency (EPA) to develop noise guidelines that would protect the population from the adverse effects of environmental noise. The EPA published a guideline, entitled EPA Levels Document, Report No. 556/9-74-664, containing recommendations for noise levels affecting residential land use of 55 Ldn dBA for outdoors and 45 Ldn dBA for indoors. The agency is careful to stress that the recommendations contain a factor of safety and do not consider technical or economic feasibility issues, and therefore, should not be construed as standards or regulations.

The Federal Department of Housing and Urban Development (HUD) standards (24 CFR Part 51, subpart B) define the 65 Ldn dBA as an acceptable outdoor noise level for residential uses. If outdoor noise levels exceed 75 dBA Ldn, the interior noise level in residential homes could exceed 45 dBA, however, with proper insulation and other construction techniques, the interior noise level can be reduced to the 45 dBA level.

**State of California**

California encourages each local jurisdiction to perform noise studies and implement a noise element as part of its general plan. The Governor's Office of Planning and Research (in conjunction with the California Department of Health Services) has published guidelines for evaluating the compatibility of various land uses as a function of community noise exposure. The Department of Health guidelines indicate that residential land uses and other noise-sensitive uses would generally be acceptable without special noise insulation requirements in areas where exterior ambient noise levels do not exceed approximately 60 dBA (day-night noise levels, Ldn or CNEL). Residential uses in areas with an Ldn between 60 and 65 dBA would generally be acceptable with noise reduction measures or insulation, and residential uses should generally be discouraged in areas where noise levels are above 65 dBA Ldn.

**California Environmental Quality Act (CEQA) Standards**:

Criteria for determining the significance of noise impacts were developed based on information contained in the California Environmental Quality Act Guidelines (State CEQA Guidelines). According to those guidelines, a project may have a significant effect on the environment if it will satisfy the following conditions:

A. Exposure of persons to or generation of noise levels in excess of standards established in the local jurisdiction General Plan. Specifically, exterior noise levels of 60 dB Ldn for traffic noise sources and the standards shown in Table 7 for on-site activities.

B. A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project. For this project, a substantial increase is considered to be more than 4 dB. This is used, based upon the previous discussion that a 3 dB change is barely perceptible, and a 5 dB change is clearly perceptible.

C. For a project located within an airport land use plan or, where such a plan has not be adopted, within two miles of a public airport or public use airport, where the project would expose people residing or working in the area to excessive noise levels.

D. For a project within the vicinity of a private airstrip, where the project would expose people residing or working in the project area to excessive noise levels.

**Shasta County General Plan**

The goals of the Shasta County General Plan Noise Element are:

1. To protect County residents from the harmful and annoying effects of exposure to excessive noise.

2. To protect the economic base of the County by preventing incompatible land uses from encroaching upon existing or planned noise-producing uses.

3. To encourage the application of state of the art land use planning methodologies in areas of potential noise conflicts.

The following specific policies which would be applicable to this project were adopted by the Shasta County General Plan to accomplish the goals of the Noise Element:

1. Noise created by new proposed non-transportation noise sources shall be mitigated so as not to exceed the noise level standards of Table 7 (Table N-IV of the Shasta County General Plan) as measured immediately within the property line of lands designated for noise-sensitive uses.

Note: For the purposes of the Noise Element, transportation noise sources are defined as traffic on public roadways, railroad line operations and aircraft in flight. Control of noise from these sources is preempted by Federal and State regulations. Other noise sources are presumed to be subject to local regulations, such as a noise control ordinance. Non-transportation noise sources may include industrial operations, outdoor recreation facilities, HVAC units, loading docks, etc.

3. Where proposed non-residential land uses are likely to produce noise levels exceeding the performance standards of Table 7 (Table N-IV of the Shasta County General Plan), at existing or planned noise-sensitive uses, an acoustical analysis shall be required as part of the environmental review process so that noise mitigation may be included in the project design.

**Table 7**
**(Table N-IV of the Shasta County General Plan)**
**Noise Level Performance Standards for New Projects**
**Affected by or Including Non-transportation Sources**

| Noise Level Descriptor | Daytime (7 a.m. to 10 p.m.) | Nighttime (10 p.m. to 7 a.m.) |
|---|---|---|
| Hourly $L_{eq}$, dB | 55 | 50 |

Each of the noise levels specified above shall be lowered by five dB for simple tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises (e.g., humming sounds, outdoor speaker systems). These noise level standards do not apply to residential units established in conjunction with industrial or commercial uses (e.g., caretaker dwellings).

The County can impose noise level standards which are more restrictive than those specified above based upon determination of existing low ambient noise levels.

In rural areas where large lots exist, the exterior noise level standard shall be applied at a point 100' away from the residence.

Industrial, light industrial, commercial and public service facilities which have the potential for producing objectionable noise levels at nearby noise-sensitive uses are dispersed throughout the County. Fixed noise sources which are typically of concern include, but are not limited to the following:

| | |
|---|---|
| HVAC Systems | Cooling Towers/Evaporative Condensers |
| Pump Stations | Lift Stations |
| Emergency Generators | Boilers |
| Steam Valves | Steam Turbines |
| Generators | Fans |
| Air Compressors | Heavy Equipment |
| Conveyor Systems | Transformers |
| Pile Drivers | Grinders |
| Drill Rigs | Gas or Diesel Motors |
| Welders | Cutting Equipment |
| Outdoor Speakers | Blowers |

The types of uses which may typically produce the noise sources described above include but are not limited to: industrial facilities including lumber mills, trucking operations, tire shops, auto maintenance shops, metal fabricating shops, shopping centers, drive-up windows, car washes, loading docks, public works projects, batch plants, bottling and canning plants, recycling centers, electric generating stations, race tracks, landfills, sand and gravel operations, and athletic fields.

6a. Noise created by new transportation noise sources shall be mitigated so as not to exceed the levels specified in Table 8 (Table N-VI of the Shasta County General Plan) at outdoor activity areas or interior spaces of existing noise-sensitive land uses.

8. Where noise mitigation measures are required to achieve the County's noise standards, the emphasis of such measures shall be placed upon site planning and project design. The use of noise barriers shall be considered a means of achieving the noise standards only after all other practical design-related noise mitigation measures have been integrated into the project.

**Table 8**
**(Table N-VI of the Shasta County General Plan)**
**Maximum Allowable Noise Exposure**
**Transportation Noise Sources**

| Land Use | Outdoor Activity Areas[1] $L_{dn}$/CNEL, dB | Interior Spaces | |
|---|---|---|---|
| | | $L_{dn}$/CNEL,dB | $L_{eq}$, dB[2] |
| Residential | 60[3] | 45 | -- |
| Transient Lodging | 60[4] | 45 | -- |
| Hospitals, Nursing Homes | 60[3] | 45 | -- |
| Theaters, Auditoriums, Music Halls | -- | -- | 35 |
| Churches, Meeting Halls | 60[3] | -- | 40 |
| Office Buildings | -- | -- | 45 |
| Schools, Libraries, Museums | -- | -- | 45 |
| Playgrounds, Neighborhood Parks | 70 | -- | -- |

1 Where the location of outdoor activity areas is unknown, the exterior noise level standard shall be applied to the property line of the receiving land use.
Where it is not practical to mitigate exterior noise levels at patio or balconies of apartment complexes, a common area such as a pool or recreation area may be designated as the outdoor activity area.

2 As determined for a typical worst-case hour during periods of use.

3 Where it is not possible to reduce noise in outdoor activity areas to 60 dB $L_{dn}$/CNEL or less using a practical application of the best-available noise reduction measures, an exterior noise level of up to 65 dB $L_{dn}$/CNEL may be allowed provided that available exterior noise level reduction measures have been implemented and interior noise levels are in compliance with this table.

4 In the case of hotel/motel facilities or other transient lodging, outdoor activity areas such as pool areas may not be included in the project design. In these cases, only the interior noise level criterion will apply.

## Vibration Impact Criteria

Vibration is like noise in that it involves a source, a transmission path, and a receiver. While vibration is related to noise, it differs in that in that noise is generally considered to be pressure waves transmitted through air, whereas vibration usually consists of the excitation of a structure or surface. As with noise, vibration consists of an amplitude and frequency. A person's perception to the vibration will depend on their individual sensitivity to vibration, as well as the amplitude and frequency of the source and the response of the system which is vibrating. Vibration can be measured in terms of acceleration, velocity, or displacement. A common practice is to monitor vibration measures in terms of peak particle velocities in inches per second. Standards pertaining to perception as well as damage to structures have been developed for vibration levels defined in terms of peak particle velocities.

Shasta County does not contain specific policies pertaining to vibration levels. However, vibration levels associated with construction activities are discussed in this report.

Human and structural response to different vibration levels is influenced by a number of factors, including ground type, distance between source and receptor, duration, and the number of perceived vibration events. Table 9, which was developed by Caltrans, shows the vibration levels which would normally be required to result in damage to structures. The vibration levels are presented in terms of peak particle velocity in inches per second.

Table 9 indicates that the threshold for damage to structures ranges from 2 to 6 in/sec. One-half this minimum threshold or 1 in/sec p.p.v. is considered a safe criterion that would protect against architectural or structural damage. The general threshold at which human annoyance could occur is notes as 0.1 in/sec p.p.v.

| Table 9<br>Effects of Vibration on People and Buildings | | | |
|---|---|---|---|
| Peak Particle Velocity inches/second | Peak Particle Velocity mm/second | Human Reaction | Effect on Buildings |
| 0-.006 | 0.15 | Imperceptible by people | Vibrations unlikely to cause damage of any type |
| .006-.02 | 0.5 | Range of Threshold of perception | Vibrations unlikely to cause damage of any type |
| .08 | 2.0 | Vibrations clearly perceptible | Recommended upper level of which ruins and ancient monuments should be subjected |
| 0.1 | 2.54 | Level at which continuous vibrations begin to annoy people | Virtually no risk of architectural damage to normal buildings |
| 0.2 | 5.0 | Vibrations annoying to people in buildings | Threshold at which there is a risk of architectural damage to normal dwellings |
| 1.0 | 25.4 | | Architectural Damage |
| 2.0 | 50.4 | | Structural Damage to Residential Buildings |
| 6.0 | 151.0 | | Structural Damage to Commercial Buildings |

Source: Survey of Earth-borne Vibrations due to Highway Construction and Highway Traffic, Caltrans 1976.

### Significance of Changes in Ambient Noise Levels

The potential increase in traffic noise from the project is a factor in determining significance. Research into the human perception of changes in sound level indicates the following:

- A 3 dB change is barely perceptible,
- A 5 dB change is clearly perceptible, and
- A 10 dB change is perceived as being twice or half as loud.

## METHODOLOGY

The analysis of noise impacts for this project focuses on the following areas:

1. Noise impacts due to on-site cogeneration plant operations;
2. Noise impacts due to increased traffic noise levels;
3. Noise impacts due to construction activities;
4. Vibration impacts due to construction activities;

## Noise Impact Assessment Methodology for Cogeneration Plant Noise Levels

To determine the future noise levels associated with the proposed cogeneration power plant, the ENM was once again used to determine the locations of the future noise contours. Table 10 shows the sound power inputs to the ENM. Noise level data used as direct inputs to the ENM were provided by one of the potential turbine manufacturer's (General Electric), and noise level data for the proposed boiler and cooling tower were based upon noise measurement data collected by ENVIRON consultants at the SPI Aberdeen Washington power plant. This analysis assumes that the boiler would be equipped with a silencer on the steam vent. Locations of each piece of equipment were provided by SPI. Figure 7 shows the locations of the Leq contours associated with the new power plant.

**Table 10**
**Future Cogeneration Power Plant ENM Input Sound Power Levels**

| Component | Linear Octave Band Center Frequency, Hz in dB | | | | | | | | | dBA |
|---|---|---|---|---|---|---|---|---|---|---|
| | 31.5 | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | |
| Turbine<br>*Gear Reducer<br>Generator | **122** | **117** | **110** | **106** | **97** | **80** | **76** | **74** | **63** | **100.8** |
| Cooling Tower | **116** | **115** | **108** | **108** | **102** | **99** | **98** | **93** | **85** | **105.8** |
| Boiler | **101** | **100** | **94** | **94** | **96** | **86** | **82** | **78** | **73** | **94.8** |

Source: General Electric & ENVIRON - 2009
*Gear Reducer has sound absorbing cover.

Based upon the ENM contours shown in Figure 7 for the proposed cogeneration power plant, the noise levels associated with the proposed plant will be approximately 1 dBA to 3 dBA dBA lower than the existing plant. This is due to the fact that the equipment is new and more efficient, the boiler and turbine will be located within metal buildings, and the boiler will be fitted with a silencer on the steam vent. In addition, the noise levels associated with the proposed power plant are less than the measured daytime and nighttime ambient noise levels shown in Table 3. The 50 dBA and 55 dBA Leq noise contours are confined to the project site. The 45 dBA Leq noise contour is confined to the project site, and the industrial uses to the east, and does not encroach upon any noise-sensitive land uses. No increases in overall ambient noise levels are expected to occur. To provide a direct comparison, Figure 8 shows the locations of the existing cogeneration plant 45 dBA Leq contour, and the proposed cogeneration plant 45 dBA Leq noise level contour.

**Figure 7**

**Future SPI Lumber Mill Cogeneration Plant Noise Levels**


Noise Level Contours

Osprey Nest Site

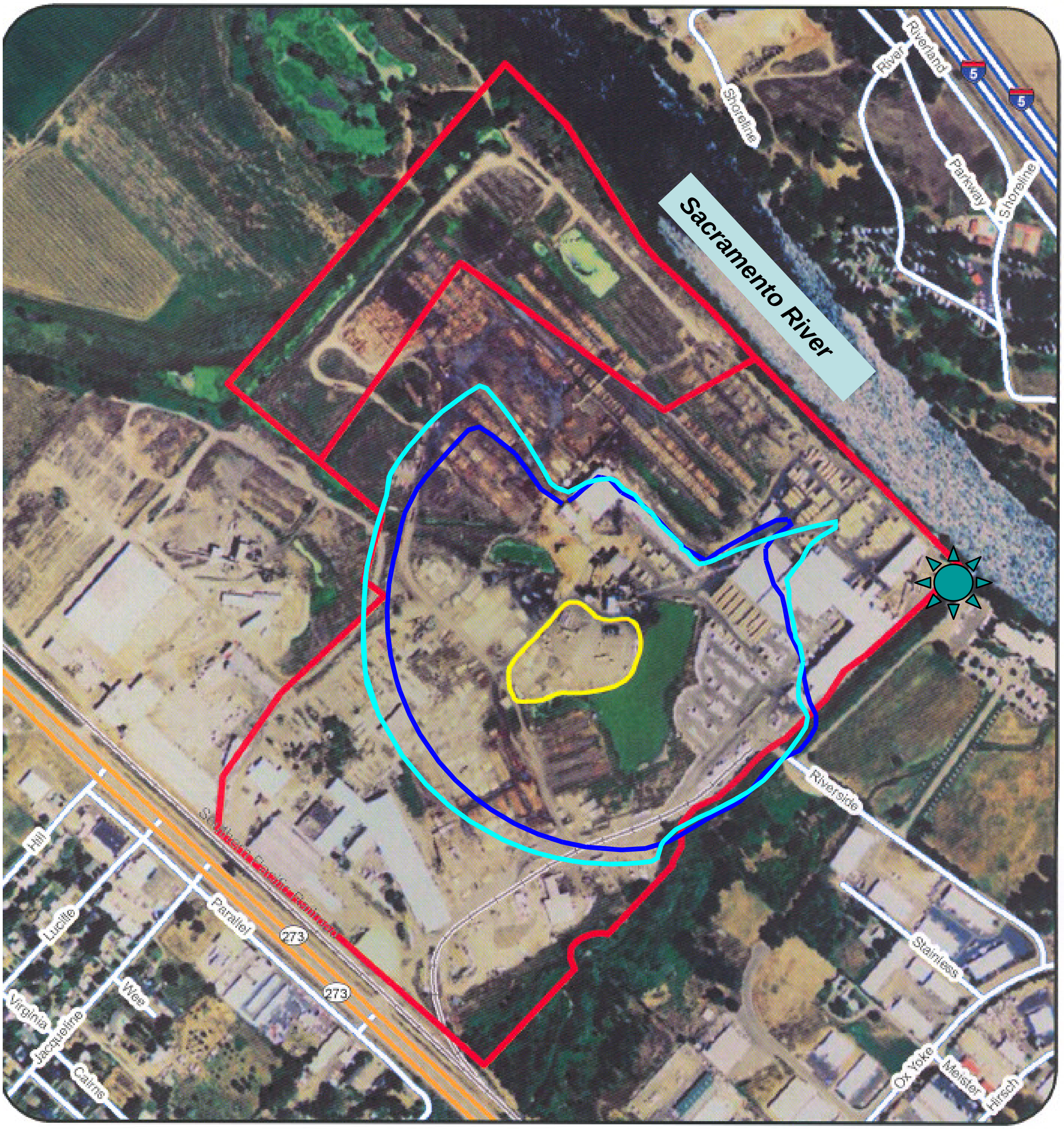
SPI Site Boundaries

Cogeneration Plant Area

j.c. brennan & associates
*consultants in acoustics*

**Figure 8**

**SPI Lumber Mill Existing + Future 45 dBA Leq Noise Level Contour Locations**




Existing 45 dBA Leq Noise Level Contour

Future 45 dBA Leq Noise Level Contour

SPI Site Boundaries

Cogeneration Plant Area

Osprey Nest Site

j.c. brennan & associates
*consultants in acoustics*

## Noise Impact Assessment Methodology for Traffic Noise

To describe future noise levels due to traffic, the Federal Highway Administration Highway Traffic Noise Prediction Model (FHWA RD-77-108) was used. The FHWA model is based upon the Calveno reference noise factors for automobiles, medium trucks and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site.

The FHWA model was developed to predict hourly Leq values for free-flowing traffic conditions. To predict Ldn values, it is necessary to determine the day/night distribution of traffic and adjust the traffic volume input data to yield an equivalent hourly traffic volume.

Direct inputs to the FHWA model included traffic volumes contained within the project traffic analysis, as well as truck volumes contained in the analysis. It is estimated that an additional 26 truck trips per day, to and from the facility, will be required for the new facility, and approximately 6 additional employee vehicles, to and from the facility, per day.

Table 11 shows the results of the changes in traffic noise levels for the Existing Plus Project scenario, Cumulative scenario and the Cumulative Plus Project scenario. Appendix B contains the FHWA Model inputs.

Based upon the analysis, no noise-sensitive or other land uses will result in exceedances of the County General Plan Noise Element criteria. In addition, the additional project related traffic will not result in a significant increase in traffic noise levels. Changes in traffic noise levels were calculated to be no more than 1 dB Ldn.

## Table 11

## Project Changes in Traffic Noise Levels by Scenario

| Roadway | Segment | Existing + Project | | | | Cumulative No Project | | | Cumulative + Project | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ldn @ 100’ | Δ | Distances to Contours (Ldn) | | Ldn @ 100’ | Distances to Contours (Ldn) | | Ldn @ 100’ | Δ | Distances to Contours (Ldn) | |
| | | | | 60 dB | 65 dB | | 60 dB | 65 dB | | | 60 dB | 65 dB |
| Riverside Ave. | Ox Yoke to Entrance | 58 dB | 0 dB | 79’ | 36’ | 60 dB | 101’ | 47’ | 60 dB | 0 dB | 102’ | 48’ |
| Ox Yoke Rd. | East of Riverside | 61 dB | +1 dB | 109’ | 51’ | 61 dB | 125’ | 58’ | 62 dB | +1dB | 133’ | 62’ |
| Ox Yoke Rd. | West of Riverside | 60 dB | 0 dB | 98’ | 46’ | 61 dB | 114’ | 53’ | 61 dB | 0 dB | 122’ | 57’ |

Source: Omni Means Traffic Analysis – 2007 & j.c. brennan & associates, Inc. - 2009

## Noise Impact Assessment Methodology for Construction Noise

Construction noise was analyzed using data compiled by the Federal Highway Administration Roadway Construction Noise Model User's Guide.

Activities involved in construction would generate maximum noise levels, as indicated in Table 12, ranging from 76 to 90 dB at a distance of 50 feet. Construction activities would be temporary in nature and are anticipated to occur during normal daytime working hours.

**Table 12**
**Construction Equipment Noise**

| Type of Equipment | Maximum Level, dBA at 50 feet |
|---|---|
| Backhoe | 78 |
| Compactor | 83 |
| Compressor (air) | 78 |
| Concrete Saw | 90 |
| Dozer | 82 |
| Dump Truck | 76 |
| Excavator | 81 |
| Generator | 81 |
| Jackhammer | 89 |
| Pneumatic Tools | 85 |
| Pile Driving | 95 - 100 |

Source: *Roadway Construction Noise Model User's Guide*. Federal Highway Administration. FHWA-HEP-05-054. January 2006.

## Vibration Impact Assessment Methodology for Construction-related Vibration

The types of construction vibration impacts include human annoyance and building structural damage. The analysis of construction vibration impacts will utilize vibration data for various pieces of construction equipment compiled by the Federal Transit Administration and j.c. brennan & associates, Inc.. Table 13 provides a list of vibration levels expected from various types of construction equipment.

**Table 13**
**Vibration Levels for Varying Construction Equipment**

| Type of Equipment | Peak Particle Velocity @ 25 feet (inches/second) | Approximate Velocity Level @ 25 feet (VdB) |
|---|---|---|
| Large Bulldozer | 0.089 | 87 |
| Loaded Trucks | 0.076 | 86 |
| Small Bulldozer | 0.003 | 58 |
| Auger/drill Rigs | 0.089 | 87 |
| Jackhammer | 0.035 | 79 |
| Vibratory Hammer | 0.070 | 85 |
| Vibratory Compactor/roller | 0.210 | 94 |
| *Pile Driver | 0.055 - 0.078 @ 100 feet | -- |

Source: Federal Transit Administration, Transit Noise and Vibration Impact Assessment Guidelines, May 2006

* Source: j.c. brennan & associates, Inc. - 2008

## SPECIFIC IMPACTS AND MITIGATION MEASURES

### Impact 1 - Cogeneration Plant Noise Impacts

Based upon the analysis, the noise levels associated with the proposed plant will be approximately 3 dBA less than the existing plant. In addition, the noise levels associated with the proposed power plant are less than the measured daytime and nighttime ambient noise levels shown in Table 3, and as measured at the project property lines, and to the northeast across the Sacramento River. The 50 dBA and 55 dBA Leq noise contours are confined, primarily, to the project site. The 45 dBA Leq noise contour is confined to the project site, and the industrial uses to the east, and does not encroach upon any noise-sensitive land uses. No increases in overall ambient noise levels are expected to range between 0 dBA and 3 dBA.

No significant increases in noise levels are expected to occur, and the noise levels will not exceed the Shasta County General Plan noise level criteria. ***This impact is less than significant***.

### Mitigation for Impact 1: None Required

**Impact 2 – Traffic Noise Impacts**

Based upon the traffic noise analysis contained in Table 11, the project will not result in exceedances of the County traffic noise criteria. In addition, the project will not result in a significant increase in traffic noise levels. The increases in traffic noise levels due to the project have been calculated to be less than 1 dB Ldn. ***This is a less than significant impact.***

**Mitigation for Impact 2: None Required.**

**Impact 3 – Construction Noise Impacts:** Activities associated with construction will result in temporary elevated noise levels within the immediate area.

Activities involved in construction would generate maximum noise levels, as indicated in Table 12, ranging from 76 to 90 dB at a distance of 50 feet, and up to 100 dBA if pile driving is required. Construction activities would be temporary in nature and are anticipated to occur during normal daytime working hours.

Because construction activities could result in periods of elevated noise levels at existing residences, this impact is considered potentially significant.

**Mitigation for Impact 3:**

Implementation of the following noise mitigation measures would reduce this impact to a *less than significant level.*

**MM 1:** Construction activities should be restricted to daytime hours. Construction equipment should be equipped with proper mufflers and in good working order.

Locate fixed construction equipment such as compressors and generators as far as possible from sensitive receptors. To the extent possible, impact tools such as pile drivers and jack hammers should be shielded, and muffle or shield exhaust ports on power construction equipment.

**Significance after Mitigation: Less than Significant**

**Impact 4 – Construction Vibration Impacts:** The primary construction activities associated with the project would occur when the equipment is installed and buildings are constructed. Comparing Table 9, which contains the criteria for acceptable vibration levels, to Table 13, which shows potential vibration impacts, it is not expected that vibration impacts would occur which would cause any structural damage. ***This impact is considered to be less than significant.***

.

**Mitigation for Impact 4: None Required**

**Appendix A**

**Acoustical Terminology**

**Acoustics** The science of sound.

**Ambient Noise** The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.

**Attenuation** The reduction of an acoustic signal.

**A-Weighting** A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.

**Decibel or dB** Fundamental unit of sound, A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.

**CNEL** Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.

**Frequency** The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.

**Ldn** Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.

**Leq** Equivalent or energy-averaged sound level.

**Lmax** The highest root-mean-square (RMS) sound level measured over a given period of time.

**L(n)** The sound level exceeded a described percentile over a measurement period. For instance, an hourly L50 is the sound level exceeded 50% of the time during the one hour period.

**Loudness** A subjective term for the sensation of the magnitude of sound.

**Noise** Unwanted sound.

**Peak Noise** The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.

**$RT_{60}$** The time it takes reverberant sound to decay by 60 dB once the source has been removed.

**Sabin** The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 sabin.

**Sound Power** Sound which radiates from a source, and is independent of distance.

**Threshold of Hearing** The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing.

**Threshold of Pain** Approximately 120 dB above the threshold of hearing.

**Impulsive** Sound of short duration, usually less than one second, with an abrupt onset and rapid decay.

**Simple Tone** Any sound which can be judged as audible as a single pitch or set of single pitches.

j.c. brennan & associates
consultants in acoustics

**Appendix B-1**

## FHWA-RD-77-108 Highway Traffic Noise Prediction Model
## Data Input Sheet

Project #: 2009-150
Description: SPI Anderson
Ldn/CNEL: Ldn
Hard/Soft: Soft

| Segment | Roadway Name | Segment Description | ADT | Day % | Eve % | Night % | % Med. Trucks | % Hvy. Trucks | Speed | Distance | Offset (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Riverside | Existing | 2,440 | 85 | | 15 | 2 | 8 | 30 | 100 | |
| 2 | Ox Yoke | Existing North | 8,460 | 87 | | 13 | 2 | 3 | 30 | 100 | |
| 3 | Ox Yoke | Existing South | 7,200 | 87 | | 13 | 2 | 3 | 30 | 100 | |
| 4 | | | | | | | | | | | |
| 5 | Riverside | Existing + Project | 2,504 | 86 | | 14 | 2 | 9 | 30 | 100 | |
| 6 | Ox Yoke | Existing + Project North | 8,492 | 87 | | 13 | 2 | 3.5 | 30 | 100 | |
| 7 | Ox Yoke | Existing + Project South | 7,232 | 87 | | 13 | 2 | 3.5 | 30 | 100 | |
| 8 | | | | | | | | | | | |
| 9 | Riverside | Cumulative | 3,840 | 85 | | 15 | 2 | 8 | 30 | 100 | |
| 10 | Ox Yoke | Cumulative North | 11,410 | 87 | | 13 | 2 | 3 | 30 | 100 | |
| 11 | Ox Yoke | Cumulative South | 9,970 | 87 | | 13 | 2 | 3 | 30 | 100 | |
| 12 | | | | | | | | | | | |
| 13 | Riverside | Cumulative + Project | 3,904 | 86 | | 14 | 2 | 8.5 | 30 | 100 | |
| 14 | Ox Yoke | Cumulative + Project North | 11,442 | 87 | | 13 | 2 | 3.5 | 30 | 100 | |
| 15 | Ox Yoke | Cumulative + Project South | 10,002 | 87 | | 13 | 2 | 3.5 | 30 | 100 | |
| 16 | | | | | | | | | | | |
| 17 | | | | | | | | | | | |
| 18 | | | | | | | | | | | |
| 19 | | | | | | | | | | | |
| 20 | | | | | | | | | | | |
| 21 | | | | | | | | | | | |
| 22 | | | | | | | | | | | |
| 23 | | | | | | | | | | | |
| 24 | | | | | | | | | | | |
| 25 | | | | | | | | | | | |

j.c. brennan & associates
consultants in acoustics

**Appendix B-2**

## FHWA-RD-77-108 Highway Traffic Noise Prediction Model
## Predicted Levels

Project #: 2009-150
Description: SPI Anderson
Ldn/CNEL: Ldn
Hard/Soft: Soft

| Segment | Roadway Name | Segment Description | Autos | Medium Trucks | Heavy Trucks | Total |
|---|---|---|---|---|---|---|
| 1 | Riverside | Existing | 50.0 | 44.0 | 57.1 | 58 |
| 2 | Ox Yoke | Existing North | 55.2 | 49.1 | 57.9 | 60 |
| 3 | Ox Yoke | Existing South | 54.5 | 48.4 | 57.2 | 59 |
| 5 | Riverside | Existing + Project | 49.9 | 43.9 | 57.6 | 58 |
| 6 | Ox Yoke | Existing + Project North | 55.2 | 49.1 | 58.6 | 61 |
| 7 | Ox Yoke | Existing + Project South | 54.5 | 48.4 | 57.9 | 60 |
| 9 | Riverside | Cumulative | 51.9 | 46.0 | 59.1 | 60 |
| 10 | Ox Yoke | Cumulative North | 56.5 | 50.4 | 59.2 | 61 |
| 11 | Ox Yoke | Cumulative South | 56.0 | 49.8 | 58.7 | 61 |
| 13 | Riverside | Cumulative + Project | 51.8 | 45.9 | 59.3 | 60 |
| 14 | Ox Yoke | Cumulative + Project North | 56.5 | 50.4 | 59.9 | 62 |
| 15 | Ox Yoke | Cumulative + Project South | 56.0 | 49.8 | 59.3 | 61 |

**Appendix B-3**

## FHWA-RD-77-108 Highway Traffic Noise Prediction Model
## Noise Contour Output

Project #: 2009-150
Description: SPI Anderson
Ldn/CNEL: Ldn
Hard/Soft: Soft

| Segment | Roadway Name | Segment Description | -------- Distances to Traffic Noise Contours -------- 75 | 70 | 65 | 60 | 55 |
|---|---|---|---|---|---|---|---|
| 1 | Riverside | Existing | 7 | 16 | 35 | 74 | 160 |
| 2 | Ox Yoke | Existing North | 10 | 22 | 48 | 102 | 221 |
| 3 | Ox Yoke | Existing South | 9 | 20 | 43 | 92 | 198 |
| 5 | Riverside | Existing + Project | 8 | 17 | 36 | 79 | 169 |
| 6 | Ox Yoke | Existing + Project North | 11 | 24 | 51 | 109 | 236 |
| 7 | Ox Yoke | Existing + Project South | 10 | 21 | 46 | 98 | 212 |
| 9 | Riverside | Cumulative | 10 | 22 | 47 | 101 | 217 |
| 10 | Ox Yoke | Cumulative North | 13 | 27 | 58 | 125 | 269 |
| 11 | Ox Yoke | Cumulative South | 11 | 25 | 53 | 114 | 246 |
| 13 | Riverside | Cumulative + Project | 10 | 22 | 48 | 102 | 221 |
| 14 | Ox Yoke | Cumulative + Project North | 13 | 29 | 62 | 133 | 287 |
| 15 | Ox Yoke | Cumulative + Project South | 12 | 26 | 57 | 122 | 263 |

j.c. brennan & associates
*consultants in acoustics*