6.4 NOISE AND VIBRATION

6.4.1 INTRODUCTION

This section discusses the existing noise environment in the project vicinity, and identifies potential impacts and mitigation measures related to the Proposed Project. Specifically, this section analyzes potential noise and vibration impacts due to the construction and operation of the proposed facilities relative to applicable noise criteria and to the existing ambient noise environment.

The primary noise-related issues associated with the Sacramento Zoo project include live music performances and construction activities. **Figure 6.4-1** shows the project site and the potential locations of the stages. This section discusses the existing noise environment in the immediate project vicinity, and identifies potential impacts and mitigation measures related to the project.

6.4.2 SETTING

ACOUSTICAL TERMINOLOGY

Noise is often described as unwanted sound. Sound is defined as any pressure variation in air that the human ear can detect. If the pressure variations occur frequently enough (at least 20 times per second), 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, called Hertz (Hz).

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 the 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 the A-weighting network. There is a strong correlation between A-weighted sound levels (expressed as dBA) and the way the human ear perceives noise. 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. **Table 6.4-1** provides the descriptions of the various acoustical terminologies.

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 noise environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (Leq), 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 Leq is the foundation of the composite noise descriptor, Ldn, and shows very good correlation with community response to noise.

Insert Figure 6.4-1

The Day-Night Average Level (Ldn) 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 Ldn represents a 24-hour average, it tends to disguise short-term variations in the noise environment.

TABLE 6.4-1
ACOUSTICAL TERMINOLOGY

Term	Definition
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 noise.
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.
L_{50}	The A-weighted noise levels that are exceeded 50% of the time during the measurement period.
Lmax	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.
Noise	Unwanted sound.
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.

SOURCE: Bollard & Brennan, Inc., 2002

EXISTING LAND USES IN THE PROJECT VICINITY

The project site is bordered by Sutterville Road to the south, Land Park Drive to the east, and a Union Pacific Railroad track to the west. Existing land uses in the project vicinity include residential uses to the west, southwest and northwest. William Land Park and Fairytale Town are located to the east across Land Park Drive. The Holy Spirit School is located adjacent to the northwest portion of the site.

Commercial uses and a day care facility are located to the south across Sutterville Road from the project site.

The existing ambient noise environment in the immediate project vicinity is dominated by traffic on local streets, including noise from park users opening and shutting vehicle doors while parking, as well as occasional railroad operations. Interstate 5 (I-5) further to the west of the site is audible during the nighttime hours.

EXISTING TRAFFIC NOISE ENVIRONMENT

To quantify existing ambient noise levels in the vicinity of the project site, short-term noise level measurements at six locations were conducted on and in the vicinity of the project site, and continuous hourly noise level measurements at two locations in neighborhoods adjacent to the project site. See **Figure 6.4-1** for noise measurement locations. The short-term noise level measurements were conducted on December 31, 2001 and again on January 9, 2002. The continuous noise measurement survey was conducted for three full days between December 15th and 17th, 2001. The noise level measurements were conducted to determine typical background noise levels and for comparison to the project noise levels. **Table 6.4-2** shows a summary of the results of the measurements.

Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meters were used for the noise level measurement survey. 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).

EXISTING ZOO NOISE ENVIRONMENT

To understand how local residents perceive the zoo noise environment within their community, a noise survey was undertaken to solicit community input. The results of the noise survey provides anecdotal evidence of how various noises from the Zoo affect local residents. Many factors influence how residents experience noise from the Zoo, many of which are subjective and difficult to quantify. For that reason, the results of the noise survey are presented as background information on existing noise impacts not as scientific data.

A questionnaire was mailed to residences within 900 feet of the center of the Zoo. Of the 277 questionnaires that were sent out, 150 were completed and returned which is a 54 percent response. A copy of the noise questionnaire is provided in **Appendix F.** Residents were asked to categorize the degree to which noise from the Zoo could be heard at their home. The noise categories and number of responses are summarized in **Table 6.4-3**.

The geographic distribution of noise category responses was mixed. While those residents who identified Zoo noise as loud were all within approximately 800 feet of the Zoo's center, other adjacent residents categorized the noise level as audible, barely audible or not audible. The diversity of responses from nearby residents suggests that many variables influence the degree to which noise affects them. Such

variables include: proximity to noise source; the degree to which intervening homes, buildings and vegetation deflect noise; whether the residence faces toward or away from the Zoo; wind direction; and the sensitivity of the resident.

TABLE 6.4-2
EXISTING AMBIENT NOISE MONITORING RESULTS

		Average Measured Hourly Noise Levels						
		24-hour	Daytime (7:00 am - 10:00 pm)			Nighttime (10:00 pm - 7:00 am)		
Site	Location/Date	L_{dn}	L_{eq}	L_{50}	L_{max}	L_{eq}	L_{50}	L_{max}
Continuous 24-hour Noise Measurement Sites								
A	4005 Warren Street							
	Saturday December 15, 2001	61.1	56.6	55.1	71.2	54.2	53.3	62.0
	Sunday December 16, 2001	55.1	52.6	50.8	64.9	47.5	44.9	62.3
	Monday December 17, 2001	56.6	54.4	53.0	65.7	48.9	45.5	61.0
B	4001 Parkside Court							
	Saturday December 15, 2001	61.9	58.7	55.4	72.6	54.6	53.5	62.5
	Sunday December 16, 2001	55.5	54.0	49.5	68.6	47.2	44.8	63.9
	Monday December 17, 2001	55.4	52.8	51.5	65.0	47.9	45.2	60.0
Short-term Noise Measurement Sites								
1	Holy Spirit Parish School	–	50.0	47.0	63.5	December 31, 2001 @ 9:41 a.m.		
		–	51.7	50.6	66.3	December 31, 2001 @ 12:17 p.m.		
		–	56.7	56.6	59.7	January 9, 2002 @ 8:13 p.m.		
2	Darnel Way	–	48.3	47.2	56.0	December 31, 2001 @ 10:00 a.m.		
		–	55.9	55.6	60.7	December 31, 2001 @ 12:45 p.m.		
		–	59.1	59.0	61.3	January 9, 2002 @ 8:30 p.m.		
3	Dublier Gallery Parking Lot	–	60.4	58.5	71.1	December 31, 2001 @ 10:19 a.m.		
		–	63.0	62.0	72.8	December 31, 2001 @ 1:06 p.m.		
		–	61.6	61.1	67.2	January 9, 2002 @ 8:44 p.m.		
4	Fairytale Town/15th Ave.	–	54.9	53.7	66.6	December 31, 2001 @ 10:50 a.m.		
		–	57.1	55.2	70.8	December 31, 2001 @ 1:17 p.m.		
		–	58.2	57.9	61.7	January 9, 2002 @ 7:34 p.m.		
5	Land Park/Pond	–	51.0	49.8	58.7	December 31, 2001 @ 10:20 a.m.		
		–	54.9	53.5	67.0	December 31, 2001 @ 12:46 p.m.		
		–	56.9	56.9	59.8	January 9, 2002 @ 7:49 p.m.		
6	13th Street	–	47.5	45.0	63.7	December 31, 2001 @ 9:55 a.m.		
		–	50.7	49.2	62.0	December 31, 2001 @ 12:23 p.m.		
		–	57.2	57.1	60.1	January 9, 2002 @ 8:01 p.m.		

SOURCE: Bollard & Brennan, Inc., 2002

TABLE 6.4-3
NOISE LEVEL RESPONSES

Noise Categories	Number of Responses	Percentage of Total[1]
Loud (disturbs normal activities)	7	5
Audible (noticeable, doesn't disturb normal activities)	47	31
Barely Audible (not very noticeable, doesn't disturb normal activities)	66	44
Not Audible (is not noticeable)	26	17
Noise level not categorized	4	3
Total	150	100

[1]/ 150 total responses returned to City.
SOURCE: City of Sacramento, 2002

Residents were also asked to specify when they heard noise – daytime or evening, and weekdays or weekends. Additionally, residents were asked to identify the type of noise they were able to hear – whether amplified speech or music, animal noise, or people. Respondents were able to record as many types and times as were applicable. The types and times of noise that residents identified are summarized in **Table 6.4-4** below.

TABLE 6.4-4
NOISE TYPE AND TIME RESPONSES

	Type of Noise				Time of Noise			
	Amplified Speech	Amplified Noise	Animal Noise	People	Weekdays		Weekends	
					Daytime	Evening	Daytime	Evening
Responses[1]	23	46	100	10	55	58	66	56

[1]/ number of responses out of 150 total.
SOURCE: City of Sacramento, 2002, AES, 2002

Finally, residents were asked to provide any additional comments. A wide variety of experiences are reflected in the comments, which have been summarized in **Figure 6.4-2**.

REGULATORY SETTING

CITY OF SACRAMENTO NOISE ORDINANCE

Local noise levels are regulated by General Plan policies and by enforcement of noise ordinance standards. For noise levels due to live music and construction activities, the City of Sacramento noise ordinance contains the applicable noise level criteria. Title 66 of the City of Sacramento Code of Ordinances (Noise Control) establishes noise level criteria for existing noise sources which may affect adjoining agricultural or residential uses. The noise ordinance does not establish noise level criteria for commercial uses. The noise ordinance establishes the following noise level criteria shown in **Table 6.4-5** are applied at any point on the receiver's affected property.

Insert **Figure 6.4-2**

TABLE 6.4-5
CITY OF SACRAMENTO NOISE ORDINANCE CRITERIA

Descriptor	Time of Day	
	Daytime (7a.m.-10p.m.)	Nighttime (10p.m.-7a.m.)
Sound level not to be exceeded >30 minutes/hour (L_{50})	55 dBA	50 dBA
Sound level not to be exceeded >15 minutes/hour (L_{25})	60 dBA	55 dBA
Sound level not to be exceeded >5 minutes/hour (L_{50})	65 dBA	60 dBA
Sound level not to be exceeded >1 minutes/hour (L_{25})	70 dBA	65 dBA
Sound level not to be exceeded at any time (L_{max})	75 dBA	70 dBA

NOTES: Each of the noise limits specified shall be reduced by 5 dBA for impulsive or simple tone noises, or for noises consisting of speech or music.

If the ambient noise level exceeds that permitted by any of the first four categories specified, the allowable noise limit shall be increased in 5 dBA increments in each category to encompass the ambient noise level. If the ambient noise level exceeds the fifth noise level category, the maximum ambient noise level shall be the noise limit for that category.

SOURCE: City of Sacramento, 1999; Bollard & Brennan, 2002.

Exemptions to the noise ordinance include the following:

> Section 8.68.080(d) of the City Code specifically exempts: "Any mechanical device, apparatus or equipment related to or connected with emergency activities or emergency work.";
>
> Section 8.68.080(e) of the City Code specifically exempts: "Noise sources due to the erection (including excavation), demolition, alteration or repair of any building or structure between the hours of 7:00 a.m. and 6:00 p.m., on Monday, Tuesday, Wednesday, Thursday, Friday and Saturday, and between 9:00 a.m. and 6:00 p.m. on Sunday; provided, however, that the operation of the internal combustion engine shall not be exempt pursuant to the subsection if such engine is not equipped with suitable exhaust and intake silencers which are in good working order. The director of building inspections, may permit work to be done during the hours not exempt by this subsection in the case of urgent necessity and in the interest of public health and welfare for a period not to exceed three (3) days. Application for this exemption may be made in conjunction with the application for the work permit or during progress of the work."

CITY OF SACRAMENTO GENERAL PLAN

For noise due to transportation-related noise sources, the City of Sacramento General Plan Noise Element establishes criteria for determining the compatibility of land uses. The criteria are shown in **Figure 6.4-3**. The City of Sacramento General Plan Noise Element also establishes Goals and Policies related to evaluating noise impacts due to projects. Goal A of the General Plan Noise Element states: "Future development should be compatible with the projected year 2016 noise environment". Policy 2 for Goal A goes on to state: "Require mitigation measures to reduce noise exposure to the Normally Acceptable Levels, except where such measures are not feasible". The City of Sacramento General Plan also indicates that when the project is a "noise generator", mitigation measures should be considered if the project would increase the Ldn at a noise-sensitive location by more than 4 dBA.

Insert **Figure 6.4-3**

VIBRATION STANDARDS

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 6.4-6** indicates that the threshold for damage to structures ranges from 2 to 6 in/sec. One-half this minimum threshold, or 1 inch/sec. PPV. is considered a safe criterion that would protect against architectural or structural damage. Caltrans uses a vibration criterion of 0.2 in/sec p.p.v. in the vertical direction for its construction projects, except for pile driving and blasting. This Caltrans criterion addresses the potential for human annoyance as well as structural damage.

TABLE 6.4-6
GENERAL HUMAN AND STRUCTURAL RESPONSES TO VIBRATION LEVELS

Effects on Structures & People	Peak Vibration Threshold (in/sec PPV)
Structural damage to commercial structures	6
Structural damage to residential buildings	2
Architectural damage	1.0
General threshold of human annoyance	0.1
General threshold of human perception	0.01

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

Final Environmental Impact Report: Richmond Transport Project, Orion Environmental Associates, 1990.

Weekly Progress Report for Vibration Monitoring for Richmond Transport, Wilson, Ihrigg & Associates, 1994.

6.4.3 IMPACTS AND MITIGATION MEASURES

SIGNIFICANCE CRITERIA

Generally, a project may have a significant effect on the environment if it will substantially increase the ambient noise levels for adjoining areas or expose people to severe noise or vibration levels. In practice, more specific professional standards have been developed, as discussed previously in the Regulatory Setting heading of this Section. These standards state that a noise impact may be considered significant if it would generate noise that would conflict with local planning criteria or ordinances, or substantially increase noise levels at noise-sensitive land uses.

For this analysis, noise and vibration impacts associated with the proposed project would be considered significant if the following were to occur:

a. Construction occurs before 7:00 a.m. and after 6:00 p.m. Monday through Saturday, before 9:00 a.m. and after 6:00 p.m. on Sunday;

b. Hourly construction noise levels exceed 55 dB L50 at the nearest residential uses.

c. Hourly noise levels due to music exceed 50 dB L50 at the nearest residences. This standard includes the 5 dB penalty for noise sources which consist of music or speech.

d. Overall traffic noise levels increase by 4 dB Ldn, due to the proposed project.

e. Vibration levels in excess of those which could cause damage to equipment, or if the building facades experience vibration levels which exceed 0.1 inch/sec. PPV.

f. Construction related noise that has the potential to result in a significant, prolonged annoyance to Zoo visitors.

METHODOLOGY

TRAFFIC NOISE IMPACT ASSESSMENT

As a means of determining the potential noise impacts associated with the Sacramento Zoo Concept/Vision Plan (Plan), the overall increases in traffic volumes due to the Plan were reviewed, and compared to the existing traffic volumes on the major roadways. It requires a 25% increase in traffic volumes to result in an increase in traffic noise of 1 dBA. Analysis conducted by the City of Sacramento Public Works Department (see Initial Study) estimates that the Plan will generate 342 trips per weekday at buildout. The primary roadways that serve the Zoo, including Land Park Drive and Sutterville Road have significantly higher volumes. The daily traffic volume on Land Park Drive between 14th and 15th Avenues was recorded at 8,391 in 2000. To increase the noise level on Land Park Drive by 1 dBA, it would require an increase of 2,098. The project contributes significantly less (342 trips) than the volume required to raise existing traffic noise levels by 1 dBA (2,098 trips) on Land Park Drive. Therefore, no significant traffic noise impacts are expected to occur on Land Park Drive, or any of the surrounding streets in the project area.

CONSTRUCTION NOISE IMPACT ASSESSMENT METHODOLOGY

During the construction phases of the project, noise from construction activities would add to the noise environment in the immediate project vicinity. Construction activities are expected to occur at a distance of approximately 200-feet to 300-feet from the nearest residences. Equipment which is expected to be used for the construction and trenching activities include excavators, loaders, dump trucks, pneumatic equipment, and pile drivers. Activities involved in construction would generate maximum noise levels, as indicated in **Table 6.4-7**, ranging from 82 to 93 dB at a distance of 50 feet.

Noise would also be generated during the construction phase by increased truck traffic on area roadways. A significant project-generated noise source would be truck traffic associated with transport of heavy materials and equipment to and from construction sites.

CONSTRUCTION VIBRATION ASSESSMENT METHODOLOGY

Vibrations caused by construction activities can be interpreted as energy transmitted in waves through the soil mass. These energy waves generally dissipate with distance from the vibration source, due to

spreading of the energy and frictional losses. The energy transmitted through the ground as vibration, if great enough, can result in structural damage. In order to assess the potential for structural damage associated with vibration from construction activities, the vibratory ground motion in the vicinity of an affected structure is measured in terms of peak particle velocity (PPV), typically in units of inches per second. **Table 6.4-8** shows the results of vibration measurements conducted by Wilson Ihrigg Associates during typical construction activities.

TABLE 6.4-7
CONSTRUCTION EQUIPMENT NOISE

Type of Equipment	Maximum Level, dB at 50 feet
Backhoes and Excavators	85
Heavy Dump Trucks	82
Loaders	86
Pneumatic Tools	85
Pile Drivers	93

SOURCE: *Environmental Noise Pollution*, Patrick R. Cunniff, 1977.
Noise Control for Buildings and Manufacturing Plants, Hoover Keith, 1990
Bollard & Brennan, Inc. file data.

TABLE 6.4-8
SUMMARY OF VIBRATION LEVELS MEASURED DURING CONSTRUCTION ACTIVITIES

Activity	Measured Peak Vibration Levels (in/sec PPV)
Moving CAT (Vibrator)	0.059 @ 42 ft.
Moving CAT (Backhoe)	0.043 @ 30 - 40 ft.
Vibratory Soil Compaction	0.031 - 0.199 @ 38 - 170 ft.
Earth Excavation	0.056 @ 42 ft.

NOTE: These levels are provided for informational purposes only and are not meant to represent projections of actual vibration levels at the project site.
SOURCE: *Weekly Progress Report for Vibration Monitoring for Richmond Transport*, Wilson, Ihrigg & Associates, 1994-95

MUSIC NOISE ASSESSMENT METHODOLOGY

As a means of determining noise impacts associated with the proposed music venues at the Zoo, it was assumed that maximum noise levels due to music would not exceed 90 dBA at a distance of 150 feet from the stage area. This is reasonable, considering that maximum noise levels would be 107 dBA at a distance of 20 feet from the stage, and the typical noise attenuation rate is 6 dB per doubling of distance. These assumed noise levels are based upon measured noise levels collected previously at a rock concert at the Rainbow Orchards music festival, on August 25, 2001. These noise levels are also consistent with noise level data previously collected at the High Sierra Music Festival in Bear Valley in July, 1999.

Although most music events fluctuate in amplitude, and have periods between songs when no music is playing, this analysis also assumed that the maximum noise levels would represent the median hourly noise levels (levels not exceeded 30 minutes of the hour, or hourly L_{50}). These assumptions provide conservative estimates of the potential noise impacts considering that hourly median noise levels associated with musical events generally are between 5 dBA and 20 dBA less than the maximum noise levels.

To assess noise levels in the community, a computer based "Environmental Noise Model" (ENM) was used. 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 model included topographic information from USGS maps, aerial photographs of the area, proposed stage locations, and typical noise spectrum data for pop music.

Two separate stage locations were analyzed for this project. The scenarios for each of the stage locations are referred to as the North Lawn/Pavilion Scenario and the Kampala Center Scenario. **Figure 6.4-4** and **Figure 6.4-5** show the results of the ENM analyses of noise impacts.

MASTER PLAN IMPACTS AND MITIGATION MEASURES

Master Plan Impact 6.4-1 Construction Noise

PP Construction noise levels at and near locations on the project site would fluctuate depending on the particular type, number, and duration of use of various pieces and types of construction equipment. Redevelopment envisioned under the Master Plan will not occur simultaneously. Improvements, renovations, and new construction will occur as funds become available. The effect of construction noise would depend upon the amount and type of construction planned under each phase, the distance between construction activities and the nearest noise-sensitive receptor, and the existing noise levels at those uses.

Existing daytime maximum noise levels currently range from 70-75 dB, and hourly median noise levels generally range between 50 dB and 60 dB L_{50} in the vicinity of the project area.

The assessment of construction noise is based upon maximum noise levels due to construction equipment at a reference distance of 50 feet (**Table 6.4-5**). With the exception of pile drivers, construction equipment will generate noise levels of approximately 85 dB at 50 feet. Pile drivers will produce noise levels of approximately 93 dB at a distance of 50 feet. Using a typical noise attenuation rate of 6 dB per doubling of distance, the predicted maximum noise level at the nearest residences are expected to be 74 Lmax, due to equipment other than pile drivers. This assumes that the nearest residences are no closer than 175 feet from the nearest construction equipment. Pile drivers may be used for construction of a parking garage below the proposed administration building. It was determined that pile driving activities would occur at a distance of more than 450 feet from the nearest noise-sensitive use.

Figure 6.4-4

Figure 6.4-5

The daytime construction period would occur when most people would be awake and many would be away from home. Temporary construction-related noise would be more noticeable during the evening and nighttime since background noise is lower and people generally have a heightened sensitivity during those times. The City's construction noise threshold for purposes of environmental review is compliance with the City's Noise Ordinance. Assuming compliance with the Noise Ordinance, no significant construction noise impact will result. However, construction activities could be expected to result in annoyance to Zoo visitors and nearby residences. This annoyance is considered to be a **less-than-significant impact** under CEQA. However, measures are recommended below to reduce the annoyance level.

AA Implementation of the No Project Alternative is not expected to result in any construction related noise under existing conditions. The long-term assumption under the No Project Alternative is that a 5,300 square foot health care facility would likely be constructed. The type of construction related noise under this alternative is expected to be similar to that of the Proposed Project; however, the extent of the noise generated is expected to be less given the lower level of construction related to implementation under this alternative. However, construction activities could be expected to result in annoyance to Zoo visitors and nearby residences. This annoyance is considered to be a **less-than-significant impact** under CEQA. However, measures are recommended below to reduce the annoyance level.

AB Implementation of the Reduced Intensity Alternative would result in the generation of construction-related noise from the improvement of facilities necessary to maintain AZA and USDA standards. Likely improvements include replacing dilapidated exhibits and holding areas and animal health care facilities. The type of construction related noise is expected to be similar to the Proposed Project; however, the extent of noise generated is expected to be less given the lowered level of construction activities associated with this alternative. Assuming compliance with the Noise Ordinance, no significant construction noise impact will result. However, construction activities could be expected to result in annoyance to Zoo visitors and nearby residences. This annoyance is considered to be a **less-than-significant impact** under CEQA. However, measures are recommended below to reduce the annoyance level.

Master Plan Mitigation 6.4-1 Construction Noise

Each phase implementation for PP, AA, and AB shall be required to include the following mitigation measures. The measures below are recommended to reduce the potential annoyance of Zoo visitors and nearby residences caused by construction activities. Failure to implement the recommendations will not result in a significant environmental effect.

a. Shutting Down of Idle Equipment: The applicant shall require contractors to turn off powered construction equipment when not in use.

b. Use of "Quiet" Equipment: The applicant shall require contractors to use "quiet" models of any conventionally noisy construction equipment such as air compressors, jack hammers and other impact tools.

Significance after Mitigation

Less-than-Significant

Master Plan Impact 6.4-2 Construction Vibration

PP Implementation of the Proposed Project will allow for improvements, renovations, and new construction as funds become available. The effect of construction vibration would depend upon the amount and type of construction planned under each phase, the distance between construction activities and the nearest vibration-sensitive receptor.

The vibration data provided in **Table 6.4-6** indicates that construction equipment vibration levels are well below the threshold of annoyance at distances ranging between 30 and 40 feet. Pile drivers are not assumed to be used for construction of the parking garage below the proposed administration building. Therefore, since most equipment is significantly further in distances from any residences or the school, the vibration levels are not expected to be noticeable. Large vibratory compactors will not produce vibration levels within the threshold of human annoyance at distances of 170 feet. Therefore, there may be some noticeable vibration levels from equipment such as vibratory compactors, but they are not expected to produce vibration levels that may cause annoyance. This is considered to be a **less-than-significant impact**.

AA Implementation of the No Project Alternative is not expected to result in any construction vibration for existing conditions. The long-term assumption under the No Project Alternative is that development of 5,300 square foot health care facility would occur. The type of construction vibration under this alternative is expected to be similar to that of the Proposed Project; however, the extent of the vibrations generated is expected to be less given the lower level of construction related to implementation under this alternative. For purposes of this environmental analysis, construction vibration is not expected to result in an annoyance to vibration-sensitive receptors. Therefore, this is considered a **less-than-significant impact.**

AB Implementation of the Reduced Intensity Alternative would result in the generation of construction vibration from the improvement of facilities necessary to maintain AZA and USDA standards. Likely improvements include replacing dilapidated exhibits and holding areas and animal health care facilities. The type of construction vibration is expected to be similar to the Proposed Project and Alternative A; however, the extent of noise generated is expected to be less given the lowered level of construction activities associated with this alternative. For purposes of this environmental analysis, construction vibration is not expected to potentially result in an annoyance to vibration-sensitive receptors. Therefore, this is considered a **less-than-significant impact.**

Master Plan Mitigation 6.4-2 Construction Vibration

None required.

PHASE 1 IMPACTS AND MITIGATION MEASURES

Phase 1 Impact 6.4-3 Construction Noise

PP Development under Phase 1 would result in construction-related noise related to the development of a 8,460-square-foot (sq. ft.) veterinary clinic, 3,000 sq. ft. kitchen/commons building, 2,400-square-foot food storage building, and a 2,400 sq. ft. storage and shop.

Using a typical noise attenuation rate of 6 dB per doubling of distance, the predicted maximum noise level at the nearest residences are expected to be 74 Lmax, due to equipment other than pile drivers. This assumes that the nearest residences are no closer than 175 feet from the nearest construction equipment. Assuming compliance with the Noise Ordinance, no significant construction noise impact will result. However, construction activities could be expected to result in annoyance to Zoo visitors and nearby residences. This annoyance is considered to be a **less-than-significant impact** under CEQA. However, measures are recommended below to reduce the annoyance level.

AA The No Project Alternative does not include specific Phase I projects; no construction would take place. Therefore, **no impact** will occur.

AB Implementation of the Reduced Intensity Alternative would result in the Phase I development of Medical/Service Complex components including the Veterinary Clinic, Kitchen/Commons, Food Storage, and Storage and Shop buildings. Using a typical noise attenuation rate of 6 dB per doubling of distance, the predicted maximum noise level at the nearest residences are expected to be 74 Lmax, due to equipment other than pile drivers. This assumes that the nearest residences are no closer than 175 feet from the nearest construction equipment. Assuming compliance with the Noise Ordinance, no significant construction noise impact will result. However, construction activities could be expected to result in annoyance to Zoo visitors and nearby residences. This annoyance is considered to be a **less-than-significant impact** under CEQA. However, measures are recommended below to reduce the annoyance level.

Phase 1 Mitigation 6.4-3 Construction Noise

Each phase implementation for PP, AA, and AB shall be required to include the following mitigation measures. The measures below are recommended to reduce the potential annoyance of Zoo visitors and nearby residences caused by construction activities. Failure to implement the recommendations will not result in a significant environmental effect.

a. Shutting Down of Idle Equipment: The applicant shall require contractors to turn off powered construction equipment when not in use.

b. Use of "Quiet" Equipment: The applicant shall require contractors to use "quiet" models of any conventionally noisy construction equipment such as air compressors, jack hammers and other impact tools.

Significance after Mitigation

Less-than-Significant

Phase 1 Impact 6.4-4 Music Noise Levels

PP The proposed Picnic Pavilion would result in a permanent facility to be used for various functions including events that use amplified sound. These activities currently exist at the north lawn area of the project site. Therefore, the predicted music noise contours identified in the beginning of this Section are more representative of the conditions that currently exist, rather than what will occur under the Proposed Project. In addition, the anecdotal information presented in **Section 6.4.2** is also representative of the community response due, in part, to amplified noise occurring at the Zoo for special events.

There is no way of knowing with certainty how many events utilizing amplified sound will occur each year under the proposed Master Plan. The assumption at this time is that the sound system, volume, and sound orientation currently used will continue to be used in the future. Under this assumption, the predicted music noise levels will not exceed the City of Sacramento daytime noise level criteria at the closest nearby residential areas. As can be seen from the noise contours, the 50 dBA noise contour does not extend to the residences west, southwest, and northwest of the noise source under either the North Lawn/Pavilion or Kampala Center options. This conclusion is appropriate provided that maximum noise levels due to music do not exceed 90 dBA at a distance of 150 feet from the stage area. Regardless of the assumptions applied to the predicted noise level, the condition is an existing condition not resulting from the proposed Master Plan. However, a significant impact could result if the placement of the sound system on the new Picnic Pavilion directs noise different than that assumed in **Figures 6.4.4** and **6.4.5**. Also, a new system with greater amplification could also result in a noise impact on neighboring land uses. This would be considered a **significant impact.**

AA, AB The Picnic Pavilion would not be constructed under the No Project and Reduced Intensity Alternatives. The existing amplified noise environment as defined above would continue under these alternatives. The No Project and Reduced Intensity Alternatives will result in a **less-than-significant impact.**

Phase 1 Mitigation 6.4-4 Music Noise Levels

The following mitigation is recommended to reduce the significant impact of the Proposed Project:

a. Restrict hours of music: music should not extend past 10:00 p.m.

b. Restrict music noise levels: music should not exceed a maximum noise level of 90 dBA at a distance of 150 feet from the stage area. Music noise levels must be monitored with a hand held noise meter to assure that noise levels do not exceed a maximum noise level of 90 dB.

c. The sound system on the new picnic pavilion must be directed toward the interior of the Zoo to minimize noise impacts on neighboring land uses.

Significance after Mitigation

Less-than-Significant