13. NOISE

Noise concerns typically raised by a mixed use development include project compatibility with the existing noise environment, noise impacts from project-generated traffic, noise impacts from project on-site activity (mechanical equipment, etc.), and construction-period noise impacts. The following chapter discusses the fundamentals of environmental acoustics; describes the existing noise setting and relevant standards, guidelines, and regulations; identifies related project impacts; and recommends measures warranted to mitigate identified significant noise impacts. The findings in this chapter are based on an independent analysis completed by the EIR noise consultants, Illingworth & Rodkin, Inc.

13.1 SETTING

13.1.1 Fundamentals of Acoustics

(a) Noise Quantification. Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. There are several noise measurement scales that are used to describe noise in a particular location. *A decibel (dB)* is a unit of measurement that indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. A "decibel" and other acoustical terms are defined in Table 13.1.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about 1 dBA plus or minus. Various computer models are used to predict environmental noise levels from sources such as roadways and airports. The accuracy of the predictive models depends upon the distance between receptor and source. Close to the noise source, the modeling can be are accurate to within plus or minus 1 to 2 dBA.

(b) Common Noise Level Descriptors. There are several methods of characterizing sound. The most common in California is the *A-weighted sound level*, or *dBA*. This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are indicated in Table 13.2.

Table 13.1
DEFINITIONS OF ACOUSTICAL TERMS

Term	Definitions
Decibel, dB	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 micronewtons per square meter).
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound levels in this report are A-weighted, unless reported otherwise.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 PM to 10:00 PM and after addition of 10 decibels to sound levels measured in the night between 10:00 PM and 7:00 AM.
Day/Night Noise Level, L_{dn}	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 PM and 7:00 AM.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

SOURCE: Illingworth & Rodkin, Inc.

Table 13.2
TYPICAL SOUND LEVELS MEASURED IN THE ENVIRONMENT AND INDUSTRY

At a Given Distance from Noise Source	A-Weighted Sound Level in Decibels	Noise Environments	Subjective Impression
	140		
Civil Defense Siren (100')	130		
Jet Takeoff (200')	120		Pain Threshold
	110	Rock Music Concert	
Diesel Pile Driver (100')	100		Very Loud
	90	Boiler Room	
Freight Cars (50')		Printing Press Plant	
Pneumatic Drill (50')	80		
Freeway (100')		In Kitchen With Garbage	
Vacuum Cleaner (10')	70	Disposal Running	Moderately Loud
	60	Data Processing Center	
Light Traffic (100')	50	Department Store	
Large Transformer (200')			
	40	Private Business Office	Quiet
Soft Whisper (5')	30	Quiet Bedroom	
	20	Recording Studio	
	10		Threshold of Hearing
	0		

SOURCE: Illingworth & Rodkin, Inc.

Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This energy-equivalent sound/noise descriptor is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

(c) Human Sensitivity to Noise. Since human sensitivity to noise increases during the evening and at night--because excessive noise interferes with the ability to sleep--24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level, CNEL*, is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 PM - 10:00 PM) and a 10 dB addition to nocturnal (10:00 PM - 7:00 AM) noise levels. The *Day/Night Average Sound Level,* L_{dn}, is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

13.1.2 Effects of Noise

(a) Hearing Loss. Hearing loss occurs mainly due to chronic exposure to excessive noise, but may also be due to a single event such as an explosion. Natural hearing loss associated with aging may also be accelerated from chronic exposure to loud noise.

The state's Occupational Safety and Health Administration (OSHA) has established a noise exposure standard that represents the threshold where hearing loss may occur from long-term exposures. The OSHA-established maximum allowable noise level in the state is 85 dBA averaged over eight hours. If the noise is above 85 dBA, the allowable exposure time is correspondingly shorter.

(b) Sleep and Speech Interference. The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors, the thresholds are about 15 dBA higher. Steady noise of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. The residential interior noise standard for multifamily housing is set by the State at 45 dBA L_{dn}. This standard is designed for sleep and speech protection; most jurisdictions apply this criterion for all residential uses (multifamily and single-family).

With conventional wood-frame and steel-frame construction, structural noise attenuation is typically 12-to-17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer structure. Sleep and speech interference is therefore possible when exterior noise levels are about 57-to-62 dBA L_{dn} with windows open and 65-to-70 dBA L_{dn} with windows closed.

Noise levels of 55-to-60 dBA are common along collector streets and secondary arterials, while 65-to-70 dBA is a typical value for a primary/major arterial. Noise levels of 75-to-80 dBA are

typical for the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways typically need to be able to have their windows closed; those facing major roadways and freeways typically need special noise-attenuating glass windows.

(c) Community Annoyance. Attitude surveys have been completed to determine levels of community annoyance related to noise intruding into homes or outdoor activity areas. In these surveys, it was determined that the causes for annoyance include radio and television, house vibrations, and interference with speech, sleep, and rest.

The L_{dn} as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 55 dBA L_{dn}. At an L_{dn} of about 60 dBA, approximately two percent of the population is highly annoyed. When the L_{dn} increases to 70 dBA, the percentage of the population highly annoyed increases to about 12 percent of the population. There is, therefore, an increase of those highly annoyed of about one percent per dBA between an L_{dn} of 60-to-70 dBA. Between an L_{dn} of 70-to-80 dBA, each decibel increase extends by about two percent the percentage of the population highly annoyed. People tend to respond more adversely to aircraft noise.

13.1.3 Existing Noise Environment

(a) Noise Measurements. The Marina Shores Village project site is composed of two discontiguous properties known as Pete's Harbor (on the north) and Peninsula Marina (on the south), separated by the "Villas at Bair Island" and Bair Island Marina residential and marina development. The noise environments of the two project properties vary depending on the noise sources affecting the vicinity. The noise environment at the Pete's Harbor property results primarily from overflights to/from San Carlos Airport, while distant noise generated by vehicular traffic along the U.S. 101 freeway contributes to the ambient noise environment on the property. The noise environment at the Peninsula Marina property is predominantly the result of vehicular traffic along the U.S. 101 freeway and Bair Island Road. Other noise sources contributing to the overall noise environment at the Peninsula Marina property include overflights to/from San Carlos Airport as well as industrial and commercial sources within and near the property.

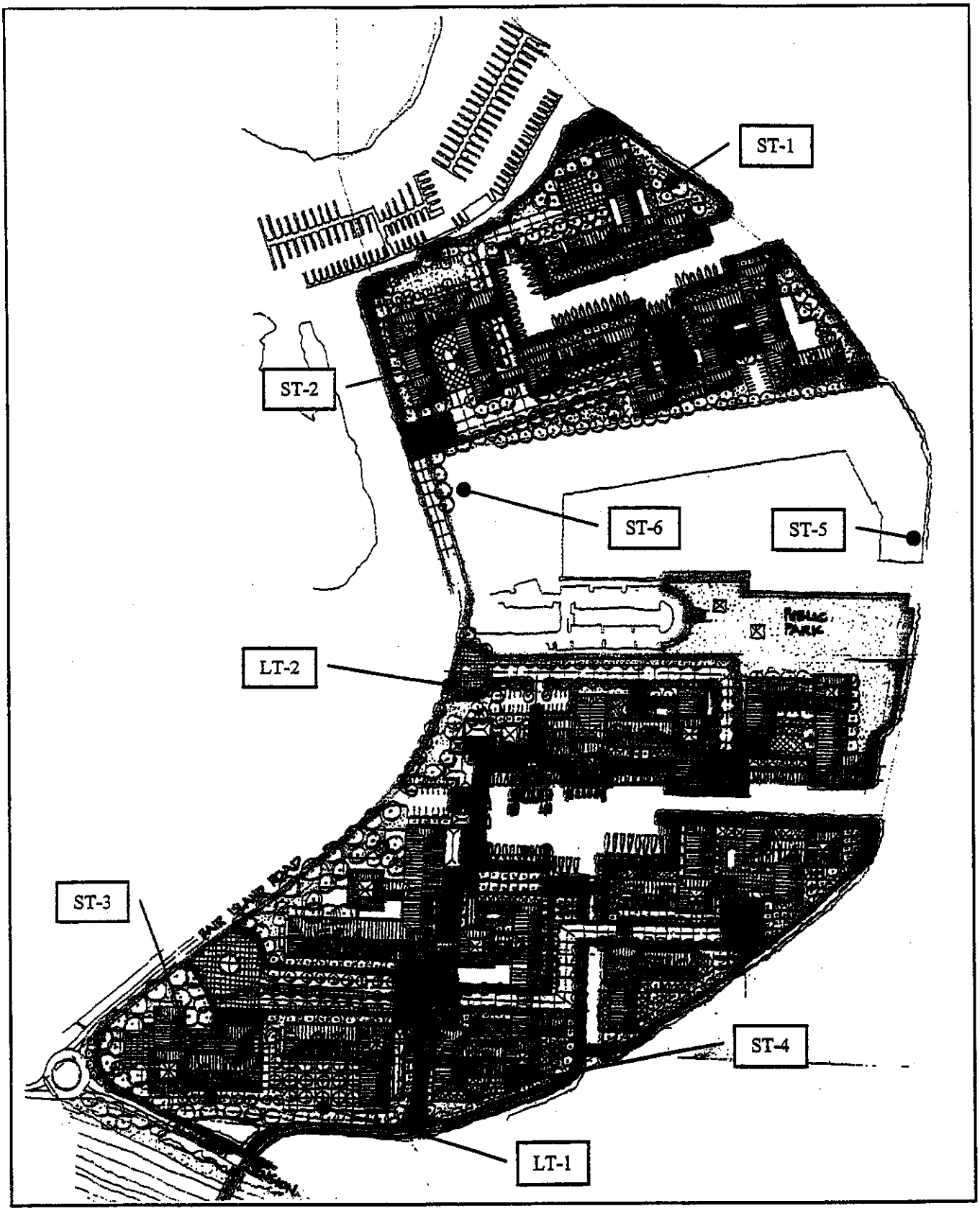
A survey of the existing noise environments of the two properties was performed from Wednesday, January 16, 2002 to Friday, January 18, 2002. The goal of the survey was to quantify the predominant sources of noise affecting the project site, identify existing noise-sensitive receiver locations, and identify existing noise-generating land uses near the project site. Two long-term noise measurements (24-hour or more durations) and six short-term (10-minute) noise measurements were completed during the noise monitoring period. The noise measurement locations are identified on Figure 13.1. The results of the long-term noise measurements are charted on Figures 13.2 and 13.3.

(b) Pete's Harbor Property Noise Levels. The Pete's Harbor property is located at the terminus of Bair Island Road. The parcel is bounded by Smith Slough and the Bair Island National Wildlife Refuge on the west, Redwood Creek on the north and east, and the "Villas at Bair Island" apartment community and marina on the south. The primary noise source affecting the property is aircraft operations associated with San Carlos Airport. Other noise sources contributing to the noise environment on the property include U.S. 101 and traffic on Bair Island Road. Two short-term noise measurements (ST-1 and ST-2 on Figure 13.1) were conducted to quantify noise levels at the Pete's Harbor property. Based on these measurements, the estimated CNEL noise level on the property is approximately 60 dBA or less. A summary of the data collected is included in Table 13.3.

(c) Peninsula Marina Property Noise Levels. The Peninsula Marina property is located north of U.S. 101 and bounded on the north by the "Villas at Bair Island" apartment complex and associated marina. U.S. 101 and live-aboard boats (Docktown) border Peninsula Marina on the south and east. Commercial and multifamily residential uses (Marina Pointe) along Bair Island Road border on the west.

One 24-hour noise measurement and two 10-minute noise measurements were conducted on the Peninsula Marina property. The long-term noise measurement (LT-1 on Figure 13.1) was made approximately 375 feet from the centerline of the near northbound U.S. 101 travel lane to quantify existing ambient noise levels generated by traffic along U.S. 101. The two short-term noise measurements (ST-3 and ST-4 on Figure 13.1) were conducted to quantify at what rate noise levels drop-off with distance from U.S. 101. The estimated existing CNEL noise levels at the Peninsula Marina property range from about 76 dBA in areas of the property nearest U.S. 101 to about 60 dBA at the northernmost portion of the property. A summary of the data collected at the Peninsula Marina property is listed in Table 13.3; the hourly distribution of noise levels measured at Site LT-1 is depicted on Figure 13.2.

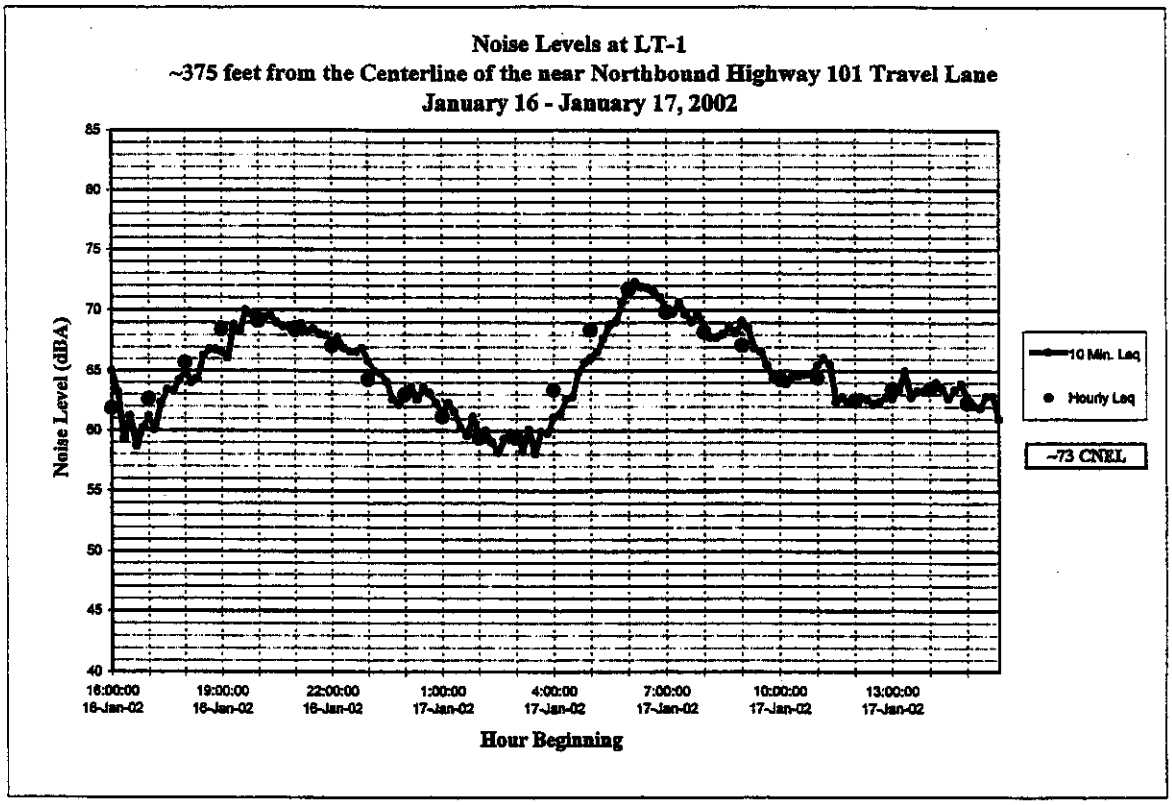
(d) Nearest Noise-Sensitive Land Uses. Noise levels were monitored at three locations to represent the existing noise environment affecting residential land uses adjacent to the project site. One 24-hour noise measurement and two 10-minute noise measurements were conducted. The long-term noise measurement (LT-2 on Figure 13.1) was made approximately 50 feet from the centerline of Bair Island Road at the approximate setback of existing residential receivers in the area (i.e., "Villas at Bair Island" and Marina Pointe). The short-term noise measurements (ST-5 and ST-6 on Figure 13.1) were conducted to quantify noise levels at residential land uses adjoining Bair Island Road (i.e., the Villas and Marina Pointe) and at existing residential land uses along Redwood Creek (i.e., the eastern portion of the Villas). Existing CNEL noise levels are approximately 61 dBA or less. A summary of the data collected is listed in Table 13.3. Additionally, the hourly distribution of noise levels measured at Site LT-2 is depicted on Figure 13.3.

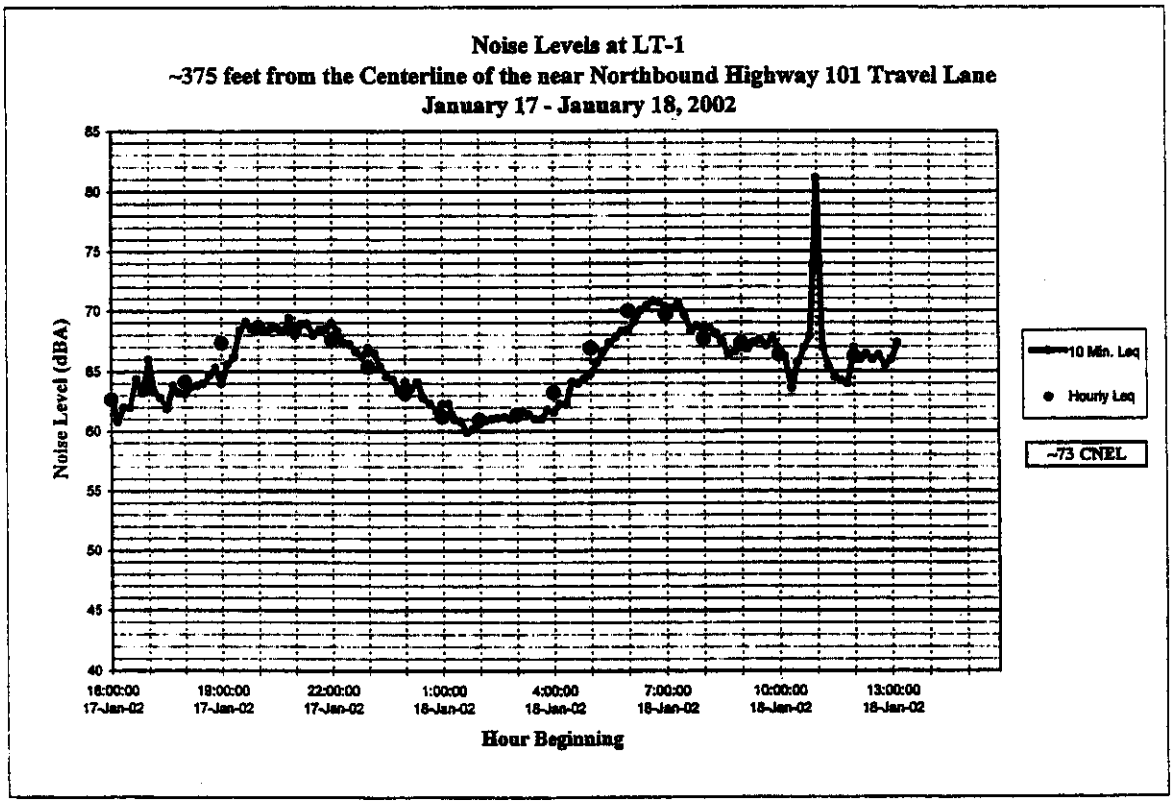


SOURCE: Illingworth & Rodkin, Inc.

Figure 13.1

NOISE MEASUREMENT LOCATIONS

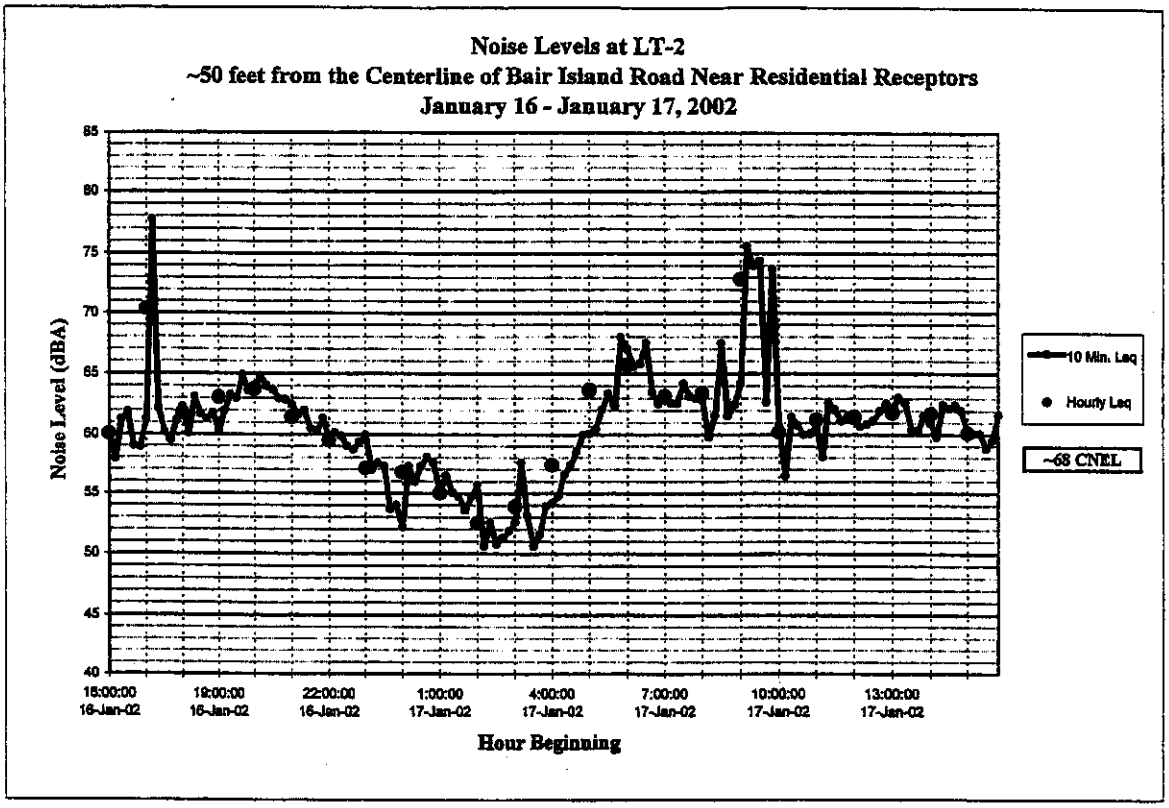


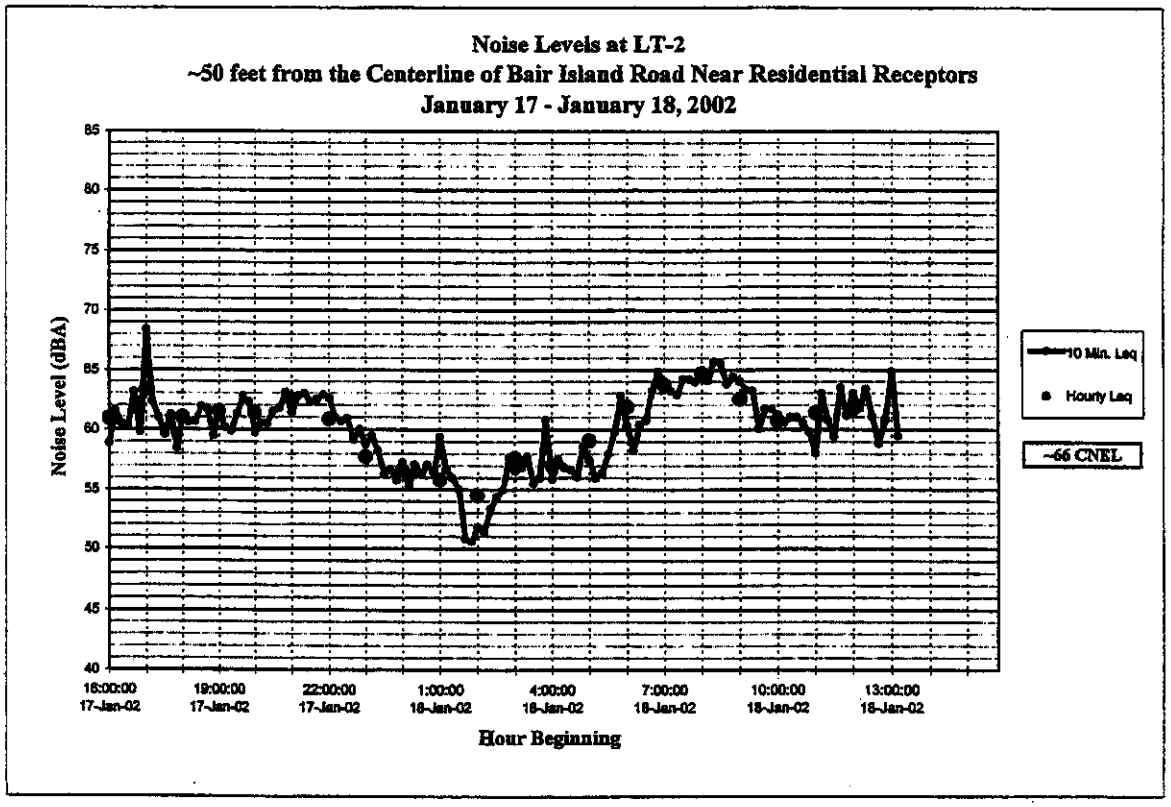


SOURCE: Illingworth & Rodkin, Inc.

Figure 13.2

MEASURED HOURLY NOISE LEVELS AT THE PROJECT SITE'S U.S. 101 FRONTAGE (SITE LT-1)





SOURCE: Illingworth & Rodkin, Inc.

Figure 13.3

MEASURED HOURLY NOISE LEVELS AT THE PROJECT SITE'S BAIR ISLAND ROAD FRONTAGE (SITE LT-2)

Table 13.3
SUMMARY OF NOISE MEASUREMENT DATA

Site*	Type	Date	Time	Noise Measurement Location	10 Minute Leq	Estimated CNEL
LT-1	Reference	1/16/02 to 1/18/02	15:10 to 13:10	Approximately 375 feet from the centerline of the near northbound U.S. 101 travel lane; microphone 12 feet above surrounding ground.	--	73
LT-2	Reference	1/16/02 to 1/18/02	14:30 to 13:10	Approximately 50 feet from the centerline of Bair Island Road near residential receptors; microphone 10 feet above surrounding ground.	--	66-68
ST-1	Satellite	01/18/02	12:00 to 12:10	Eastern portion of Pete's Harbor property near existing marina.	60	<60
ST-2	Satellite	01/18/02	12:00 to 12:10	Pete's Harbor parking lot near Bair Island Road.	63	<60
ST-3	Satellite	01/18/02	13:00 to 13:10	Approximately 200 feet from the centerline of the near northbound U.S. 101 travel lane; microphone 5 feet above surrounding ground.	69	76
ST-4	Satellite	01/18/02	13:00 to 13:10	Approximately 700 feet from the centerline of the near northbound U.S. 101 travel lane; microphone 5 feet above surrounding ground.	59	66
ST-5	Satellite	01/18/02	12:30 to 12:40	Southeasternmost apartment building of "Villas at Bair Island," with view of asphalt plant.	57	60
ST-6	Satellite	01/18/02	12:30 to 12:40	Approximately 75 feet from the centerline of Bair Island Road at the setback of the nearest apartments of "Villas at Bair Island."	54	59-61

SOURCE: Illingworth & Rodkin, Inc., January 2002.

* Sites are identified on Figure 13.1 (Noise Measurement Locations).

13.2 PERTINENT PLANS AND POLICIES

Pertinent to the proposed project, the State of California, the City of Redwood City, and the Airport Land Use Commission (ALUC) for San Mateo County have established regulations, plans, and policies designed to limit noise exposure at noise-sensitive land uses. These include Title 24 of the State of California Building Code, the Redwood City Strategic General Plan *Noise Element*, and the San Carlos Airport Land Use Plan (ALUP).

13.2.1 Title 24, Part 2 of the State of California Building Code

New multifamily housing in California is subject to the environmental noise limits set forth in Title 24, Part 2, of the State Building Code (SBC). The SBC-stipulated maximum interior noise level limit is 45 L_{dn} or CNEL. Where exterior noise levels exceed 60 L_{dn} or CNEL, the SBC stipulates that an acoustical report must be submitted with the building plans describing the noise control measures which have been incorporated into the design to meet the SBC-stipulated interior noise limit.

13.2.2 Redwood City Strategic General Plan Noise Element

The Redwood City Strategic General Plan *Noise Element* (adopted in 1990) identifies noise and land use compatibility recommendations for proposed land uses and includes objectives and policies to guide development.

The following "general land use recommendations" are listed in the *Noise Element*:

- *Residential land uses are considered satisfactory in noise environments of less than 55 dBA CNEL.*
- *Noise environments of between 55 dBA and 60 dBA CNEL are considered "conditionally acceptable" for residential development. Under these conditions, new development should be undertaken only after a detailed analysis of noise reduction requirements is made and needed noise insulation features are included in the project's design.*
- *New residential construction or development should not be undertaken in noise environments exceeding 60 dBA CNEL.*

The *Noise Element* also contains the following objectives and policies pertinent to the proposed project:

- *Minimize the impact of noise on people through noise reduction and project suppression techniques, and through appropriate land use policies.* (Objective 1, page 11-2)
- *Reduce future impact of all types of point source noise.* (Objective 2, page 11-2)

- *Reduce ambient noise levels in all parts of the City to safe, optimum levels.* (Objective 3, page 11-2)

- *Limit the hours of operation at all noise generation sources wherever practicable, unless an emergency exists.* (Policy N-2, page 11-2)

- *Require all exterior noise sources (construction operations, air compressors, pumps, fans, and leaf blowers) to use available noise suppression devices and techniques to bring exterior noise down to acceptable levels compatible with adjacent land uses.* (Policy N-3, page 11-2)

- *Land uses within the Planning Boundary of San Carlos Airport shall be compatible with the Aircraft Noise/Land Use Compatibility Standards found at page 8* [IV-28] *of the 1981 San Mateo County Airport Land Use Plan* [updated December 1996]. *The "Planning Boundary" for the San Carlos Airport is considered the ground area encompassed by the combination of the line depicting the 55 CNEL Noise Contour, as shown on the Noise Contour Map at page 7* [IV-26] *of the 1981* [1996] *San Mateo County Airport Land Use Plan and the outer boundary (Elevation 359) of the Hazard Zoning Plan at page 11* [IV-36] *of the 1981* [1996] *San Mateo County Airport Land Use Plan.* (Policy N-5, page 11-2)

- *Redwood City will take appropriate steps to reduce noise impacts to residents living near the San Carlos Airport and major arterials, particularly the Bayshore Freeway.* (Policy N-7, page 11-3)

13.2.3 San Carlos Airport Land Use Plan

The San Carlos Airport Land Use Plan (ALUP), which is a chapter of the San Mateo County ALUP, establishes airport noise and land use compatibility standards for development in the airport vicinity of San Carlos Airport and its takeoff and approach zones. Projected airport takeoff and approach zone CNEL noise contours presented in this plan are used to evaluate land use compatibility for proposed underlying developments; the 55 dBA CNEL noise contour is recognized as the threshold for review by the Airport Land Use Commission (ALUC). Underlying residential land uses are considered compatible in noise environments less than 55 dBA CNEL, conditionally compatible in noise environments between 55 dBA CNEL and 60 dBA CNEL, and incompatible in noise environments greater than 60 dBA CNEL.

13.3 IMPACTS AND MITIGATION MEASURES

Comment: new tab grid for indented text underneath boxes--(just the old one with 1.167 added)

13.3.1 Significance Criteria

Based on the CEQA Guidelines, the proposed project would be considered in this EIR to have a

significant noise impact if it would result in:[1]

(1) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;

(2) Exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels;

(3) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;

(4) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project; or

(5) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, exposure of people residing or working in the project area to excessive noise levels.

CEQA does not define what noise level increase would be considered "substantial" (see items 3 and 4 above). Typically, if the L_{dn} or CNEL resulting from the project would increase by 3 dBA or more at noise-sensitive receivers, a noise impact would be considered significant. Where the existing noise level is lower, a somewhat higher increase can be tolerated before significance occurs.

Specific to the proposed project, a significant noise impact would result if:

- Land uses proposed by the project would be exposed to noise levels exceeding the City's established guidelines for noise and land use compatibility (as listed in subsection 13.2.2 above);

- Land uses proposed by the project would be exposed to noise levels in excess of the applicable policies and standards of the San Carlos Airport Land Use Plan (as described in subsection 13.2.3 above);

- Adjacent or on-site land uses would be exposed to perceptible project construction-related vibration levels for an extended period of time or during sensitive evening and nighttime hours;

- Noise levels were to increase substantially at existing noise-sensitive land uses (e.g., residences) as a result of the project; or

[1] CEQA Guidelines, Appendix G, item XI(a-e).

- The project resulted in a noise level increase of 3 dBA or greater at noise-sensitive land uses.

Construction noise levels are treated somewhat differently because they are a short-term effect. For purposes of this EIR, a significant noise impact would be determined if project construction activities were to:

- interfere with speech, sleep, or normal residential activities; or

- cause hourly average noise levels received at noise-sensitive land uses to exceed 60 dBA during the daytime, 55 dBA at night, or the ambient noise level in higher noise environments.

13.3.2 Impact and Mitigation Measures

(a) Project Compatibility with the Existing Noise Environment. The proposed project residents, employees, and visitors would be exposed to various existing and projected noise sources, including aircraft operations to and from San Carlos Airport, industrial operations along Seaport Boulevard, and vehicular traffic on U.S. 101, East Bayshore Road, and Bair Island Road. Each of these impacts is discussed below.

Impact 13-1: Project Compatibility with the Existing and Projected Noise Environment. As currently proposed at this preliminary stage of project architectural design, residential units located in the tower structures would be up to 23 stories above ground level. Residences on the uppermost stories of these structures would not be shielded from distant noise sources (e.g., U.S. 101) by intervening buildings or terrain. Noise levels at the facades of the uppermost residences would be expected to be greater than 60 dBA CNEL due primarily to freeway and aviation noise, a noise environment in which "new residential construction or development should not be undertaken" according to the Redwood City Strategic General Plan *Noise Element* and which is also considered incompatible with residential uses according to the San Carlos Airport Land Use Plan. This condition would therefore represent a ***potentially significant impact*** (see criteria 1, 3, and 5 and explanatory text in subsection 13.3.1, "Significance Criteria," above).

(a) Pete's Harbor Property. The future noise environment of the Pete's Harbor property would continue to result primarily from aircraft operations at San Carlos Airport. Local traffic on Bair Island Road and distant vehicular traffic along U.S. 101 would also contribute to the noise environment. The proposed project site plan (see Figure 13.1) indicates that outdoor use areas would be located in areas shielded by buildings to reduce noise generated by nearby surface vehicular traffic. The overall noise environment would be expected to remain below 60 dBA CNEL at proposed outdoor use areas.

Noise generated by aircraft would therefore be higher than the noise resulting from vehicular traffic and would continue to dominate the noise environment of outdoor use areas proposed on the Pete's Harbor property. The CNEL noise level at these areas resulting from San Carlos Airport would be expected to remain below 55 dBA CNEL in the future, assuming similar operation levels and conditions at the airport. Projected CNEL noise levels at the proposed outdoor areas would therefore be considered compatible with the proposed land uses.

The site plan (see Figure 13.1) indicates that Bair Island Road would terminate at the Pete's Harbor property and transition into a driveway rather than operate as a through road. Noise levels generated by Bair Island Road would be expected to be below 55 dBA CNEL. Other distant noise sources in the area (e.g., U.S. 101, industry along Seaport Boulevard) would continue to generate noise levels less than 55 dBA CNEL.

In summary, the character of the noise environment on the Pete's Harbor property would include the steady background noise levels generated by distant vehicular traffic punctuated by aircraft overflights. The overall noise environment at ground- and podium-level would be expected to range from about 58 dBA to 60 dBA CNEL and would be expected to be less than 60 dBA CNEL at shielded outdoor use areas on the property. Therefore, the effects of noise on project ground- and podium-level outdoor use areas would be considered a *less-than-significant impact*.

As currently proposed at this preliminary stage of project architectural design, residential units located on the Pete's Harbor property would be up to 21 stories above ground level. Residences on the uppermost stories would not be shielded from distant noise sources (e.g., U.S. 101) by intervening buildings or terrain. Noise levels at the facades of these units would be expected to be greater than 60 dBA CNEL. This condition would represent a ***potentially significant impact***.

(b) Peninsula Marina Property. The current exterior noise environment at the Peninsula Marina property results primarily from vehicular traffic along U.S. 101. Measured CNEL noise levels throughout the property ranged from approximately 60 dBA to 76 dBA. Future noise levels generated by U.S. 101 would be expected to increase by about 0 to 1 dBA CNEL as a result of future traffic volume increases. Therefore, noise levels throughout the Peninsula Marina property would require that outdoor use areas be located in shielded areas as far as practical from the highway and Bair Island Road, preferably north and east of proposed buildings. Exterior noise levels would be reduced by 10 to 15 dBA if outdoor use areas were located in this manner. A review of the proposed site plan (see Figure 13.1) indicates that outdoor use areas (e.g., pools, retail plaza) are located over 800 feet from U.S. 101. At this distance, future outdoor noise levels, assuming no shielding by intervening structures, would be approximately 68 dBA CNEL. Orienting the outdoor use areas north of residential buildings and away from Bair Island Road, as shown in the site plan, would reduce noise levels to below 60 dBA CNEL. Therefore, noise levels at ground- and podium-level outdoor use areas would be considered "conditionally acceptable" according to the General Plan

Noise Element (for residential land uses). This condition would represent a *less-than-significant impact* so long as the project design incorporates site planning to reduce noise in outdoor use areas.

As currently proposed at this preliminary stage of project architectural design, residential units located on the Peninsula Marina property would be up to 23 stories above ground level. Residences on the uppermost stories would not be shielded from vehicular traffic noise generated by U.S. 101. Noise levels at the facades of these units would be expected to be greater than 60 dBA CNEL. This condition would represent a ***potentially significant impact***.

Mitigation 13-1. Conduct and submit an *acoustical study* for the project multifamily residential component in accordance with State Title 24 requirements. The study report shall identify to the satisfaction of the City of Redwood City Building Department noise insulation features and other elements (e.g., forced-air mechanical ventilation, sound-rated windows) to be included in the design of the project residential structures sufficient to maintain interior noise levels at or below City and State standards (45 L_{dn}). This report shall be submitted to and approved by the Building Department prior to issuance of a residential building permit. Implementation of this measure would reduce this potential impact to a ***less-than-significant level***.

Project-Generated Off-Site Traffic Noise. Project-generated traffic would increase traffic volumes on the local roadway network, which would slightly increase existing noise levels along roadways. Based on a review of the traffic analysis completed for this EIR by Fehr & Peers Associates, Inc. (see chapter 7), noise levels on roadways in the project vicinity would increase by less than 1 dBA CNEL. Given the project's proximity to U.S. 101, many of the roadway segments where the largest relative increases in traffic would occur are where the highest noise levels already exist. Although projected traffic volumes on certain roadway segments may double over the existing traffic volumes (e.g., Bair Island Road) due to projected cumulative traffic increases, the existing total noise levels generated by the highway and San Carlos Airport would increase only by approximately 1 dBA with the additional project traffic. In areas distant from the project site, traffic volume increases would be less, and the associated increase in noise levels resulting from the project would be immeasurable. This project effect would therefore represent a ***less-than-significant impact***.

Mitigation. No significant impact has been identified; no mitigation is required.

Impact 13-2: Ground-Borne Vibration Levels. Project construction would involve pile driving of piles up to 95 feet in length (and potentially longer, depending on

project final design and engineering) (see subsection 11.3.4 in chapter 11, Soils and Geology, of this EIR), which could result in ground-borne vibration levels that damage nearby structures or interfere with the enjoyment of daily activities. This effect would be considered a ***potentially significant impact*** (see criterion 2 and explanatory text in subsection 13.3.1, "Significance Criteria," above).

The project would involve construction on fill where piles would be required in the building foundations (see subsection 11.3.4 in chapter 11, Soils and Geology, herein). Construction sequencing would consist of demolition of existing structures and other site preparation work, earth-moving and filling of the existing and former marinas, foundation work, and new building erection.

Pile driving has the potential to generate the highest ground vibration levels and could cause architectural damage, particularly when it occurs within 100 feet of structures. Other activities during project construction--such as use of jackhammers, rock drills, and other high-power or vibratory tools and rolling stock equipment (tracked vehicles, compactors, etc.)--could also potentially generate substantial vibration in the immediate project vicinity. Depending on the proximity of existing structures to the construction area and the methods of construction used, high vibration levels may affect nearby properties.

Construction activities can cause vibration that varies in intensity depending on several factors. Because of the percussive nature of pile driving activities, the use of the peak particle velocity descriptor (ppv) has been routinely used to measure and assess ground-borne vibration. Peak particle velocity has been used almost exclusively to assess the potential of vibration to induce structural damage and the degree of annoyance for humans.[2, 3]

[2]Dowding, Charles H. Construction Vibrations, Prentice Hall, 1996.

[3]Oriard, Lewis L. *The Effects of Vibration and Environmental Forces*, International Society of Explosives Engineers, 1999.

The two primary concerns with construction-induced vibration--the potential to damage a structure and to interfere with the enjoyment of daily activities--are evaluated against different vibration limits. Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Studies[4] have shown that the threshold of perception for average persons is in the range of 0.2-to-0.3 millimeters per second (mm/sec) (0.008-to-0.012 inches/sec) ppv. However, persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level.

Researchers have found safe vibration limits that can be applied to assess the potential for damaging a structure; however, vibration limits vary by researcher, and there is no general consensus as to what amount of vibration may pose a threat to a building. Furthermore, structural damage can be classified as cosmetic only, such as minor cracking of building elements, or it may threaten the integrity of the building. Construction-induced vibration that can be structurally damaging to a building is very rare and has been observed only in instances where the structure is already in a high state of disrepair and when the construction activity occurs immediately adjacent to the structure.

The California Department of Transportation uses a vibration limit of 12.7 mm/sec (0.5 inches/sec) ppv for structurally sound buildings designed to modern engineering standards. A conservative vibration limit of 5 mm/sec (0.2 inches/sec) ppv has been used for buildings that are found to be structurally sound but for which structural damage is a major concern. For historic buildings or buildings that are documented to be structurally weakened, a conservative limit of 2 mm/sec (0.08 inches/sec) ppv is often used to provide the highest level of protection. All of these limits have been used successfully, and compliance with these limits has not been known to result in appreciable structural damage. All vibration limits referred to herein apply on the ground level and take into account the response of structural elements (i.e. walls and floors) to ground-borne vibration.

Vibration levels resulting from project construction, if perceptible at nearby properties, would be intermittent and of short duration, especially for the construction operations that have the highest potential for producing vibration (pile driving and use of jackhammers and other high power tools).

Mitigation 13-2. Reduce ground-borne vibration levels during project construction by incorporating conditions in project construction agreements that stipulate the following ground-borne vibration abatement measures:

- Restrict vibration-generating construction activity to between the hours of 7:00 AM and 7:00 pm, Monday through Friday. Prohibit such construction

[4]Ernzen, James and Schexnayder, Cliff J. *NCHRP Synthesis 218*, Transportation Research Board, 1996.

activity on weekends and holidays.

- Notify occupants of land uses located within 200 feet of pile-driving activities of the project construction schedule in writing.

- Pre-drill pile holes to minimize the number of percussions required to seat the pile.

Implementation of these measures would reduce this potential impact to a ***less-than-significant level.***

Aircraft Noise Exposure. The entire project site is located beyond the 55 dB CNEL noise contour established in the San Carlos Airport Land Use Plan. Therefore, the noise environment resulting from aircraft operations at San Carlos Airport would be considered compatible with the proposed residential and commercial land uses on the site. This condition would represent a ***less-than-significant impact***.

Mitigation. No significant impact has been identified; no mitigation is required.

Impact 13-3: Project Demolition and Construction Noise. Project demolition and construction activities would temporarily elevate noise levels at adjacent residential receptors ("Villas at Bair Island," Marina Pointe, Docktown) as well as at on-site residential areas constructed and inhabited during earlier phases of the project construction period. Noise levels at 50 feet from the construction equipment source could reach approximately 105 dBA, resulting in intermittent interference with typical residential activities. These noise level increases could exceed the noise limits established in the Redwood City Strategic General Plan *Noise Element*. This possibility represents a ***potentially significant short-term noise impact*** (see criteria 1 and 4 and explanatory text in subsection 13.3.1, "Significance Criteria," above).

Construction activities generate considerable amounts of noise, especially during the demolition phase and the construction of project infrastructure when heavy equipment is used. Construction activities associated with the project would include a demolition phase, site preparation, construction of drainage facilities and the installation of utilities, and construction of the building foundations, building cores, and shells.

The effects of noise resulting from construction depend on the noise generated by various pieces of construction equipment, the timing and duration of noise generating activities, and the distance between construction noise sources and noise-sensitive receptors. Noise levels

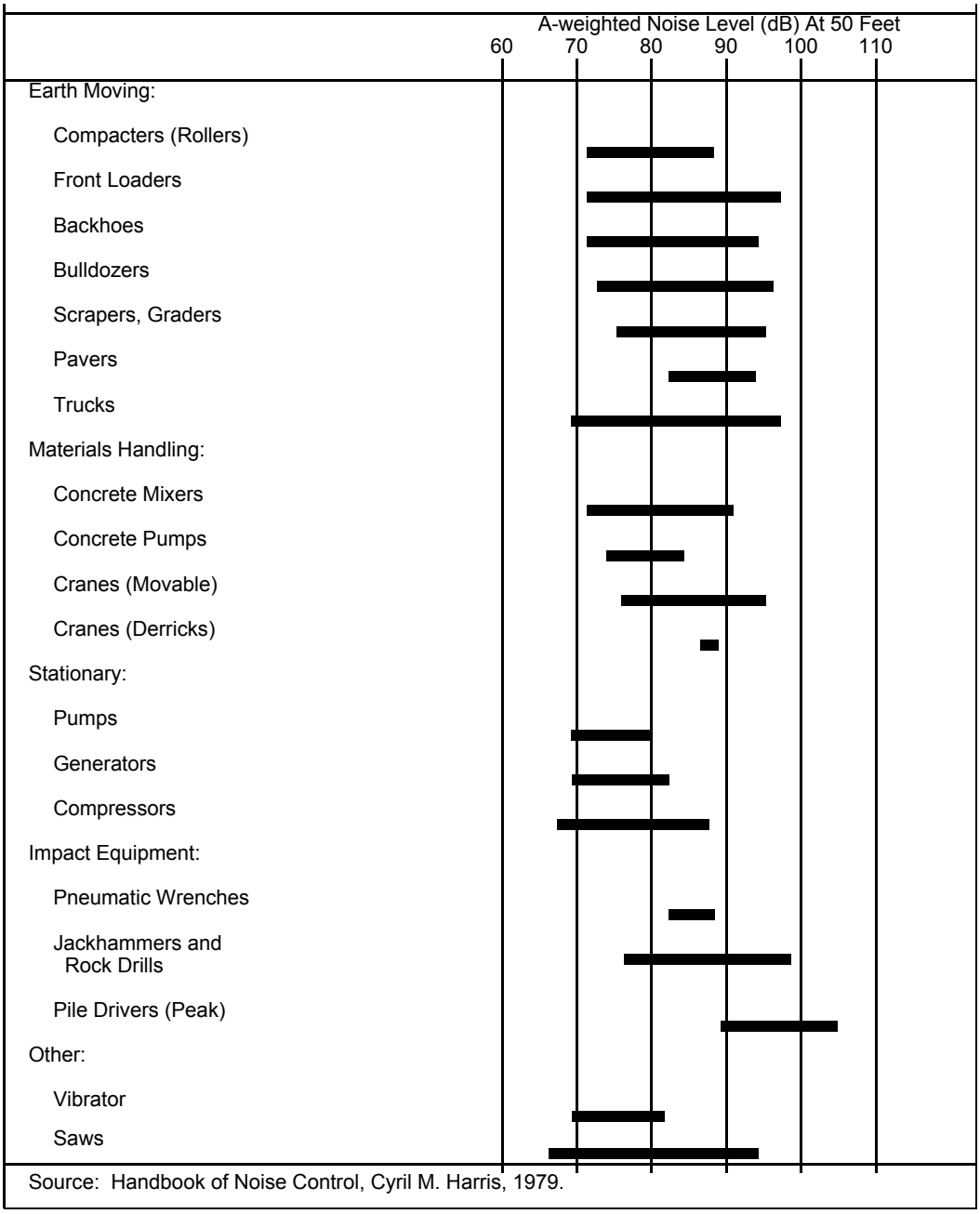
during construction would occur in phases, including demolition of existing structures on the project site, grading and excavation, the construction of foundations (including pile driving), the erection of the new structures, and finishing. Tables 13.4 and 13.5 depict typical noise levels generated by construction equipment at a distance of 50 feet from the source and at a distance of 50 feet from the construction activity center, respectively. The highest maximum noise levels generated by project construction would typically range from approximately 90-to-105 dBA at a distance of 50 feet from the noise source. These noise levels would result primarily from pile drivers, jack hammers, and other percussive pieces of equipment.

Typical hourly average construction-generated noise levels would be approximately 81 dBA to 89 dBA measured at a distance of 50 feet from the center of the site during busy construction periods. Construction-generated noise levels drop off at a rate of about 6 dBA per doubling of distance between the source and receptor. Shielding by buildings or terrain typically result in much lower construction noise levels at distant receptors.

Construction noise impacts result primarily when construction activities occur during noise-sensitive times of the day (i.e., early morning, evening, or nighttime hours), the construction occurs in areas immediately adjoining noise-sensitive land uses, or when construction durations last over extended periods of time. Limiting construction to daytime hours is often a simple method of reducing the potential for noise impacts. In areas immediately adjacent to construction, controls such as constructing temporary noise barriers and utilizing “quiet” construction equipment can also reduce the potential for noise impacts.

The applicant anticipates that project construction would occur over approximately ten years, dependent on market conditions. Project construction could expose existing noise-sensitive land uses and future noise-sensitive land uses built during the earlier phases of the project to noise levels substantially exceeding the ambient noise environment and the 60 dBA L_{eq} *Noise Element* threshold for several years. This condition is considered a *significant noise impact*.

Table 13.4
TYPICAL CONSTRUCTION EQUIPMENT NOISE LEVEL RANGES



Source: Handbook of Noise Control, Cyril M. Harris, 1979.

Table 13.5
TYPICAL RANGES OF ENERGY-EQUIVALENT NOISE LEVELS AT 50 FEET, L_{eq} IN dBA, AT CONSTRUCTION SITES

	Domestic Housing		Office Building, Hotel, Hospital, School, Public Works		Industrial, Parking Garage, Religious, Amusement and Recreation, Store, Service Station		Public Works, Roads and Highways, Sewers and Trenches	
	I	II	I	II	I	II	I	II
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundations	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	75	89	74	84	84

SOURCE: U.S. EPA, Legal Compilation on Noise, Vol. 1, p. 2-104, 1973.

I - All pertinent equipment present at site.
II - Minimum required equipment present at site.

Mitigation 13-3. Reduce project demolition- and construction-period noise impacts on nearby residences by incorporating conditions in project demolition and construction agreements that stipulate the following conventional construction-period noise abatement measures:

- *Construction Plan.* Prepare a detailed construction plan identifying the schedule for major noise-generating construction activities. The construction plan shall identify a procedure for coordination with adjacent noise-sensitive facilities so that construction activities and the event schedule can be scheduled to minimize noise disturbance.

- *Noise Disturbance Coordinator.* Designate a "noise disturbance coordinator" who would be responsible for responding to any local complaints about construction noise. The disturbance coordinator would determine the cause of the noise complaint (e.g., starting too early, bad muffler, etc.) and institute reasonable measures warranted to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site. (The City should be responsible for designating a noise disturbance coordinator and the project applicant should be responsible for posting the phone number and providing construction schedule notices).

- *Construction Hours.* Restrict noise-generating construction activity to between the hours of 7:00 AM and 7:00 PM, Monday through Friday. Prohibit such construction activities on weekends and holidays.

- *Construction Barrier.* Construct a perimeter, solid plywood construction barrier, eight feet high, to shield nearby residential land uses from construction noise. Prohibit site access on common boundaries between the project site and adjacent residential land uses (e.g., the "Villas at Bair Island") during construction phases.

- *Construction Equipment Mufflers and Maintenance.* Properly muffle and maintain all construction equipment powered by internal combustion engines.

- *Equipment Location.* Locate all stationary noise-generating construction equipment, such as air compressors, as far as practical from nearby residences.

(continued)

Mitigation 13-3 (continued).

- *Truck Routes.* Route all construction traffic to and from the project site via designated truck routes where practical. Prohibit construction-related heavy truck traffic in residential areas where feasible.

- *Quiet Equipment Selection.* Utilize "quiet" construction equipment, particularly air compressors, whenever possible.

- *Pile Driving.* Utilize multiple pile drivers to expedite this phase of project construction and reduce the duration of associated impacts.

- *Blanket Barriers.* Cover pile drivers with temporary noise-control blanket barriers.

- *Pile Holes.* Pre-drill foundation pile holes to minimize the number of percussions required to seat the pile.

Implementation of these measures would substantially reduce project construction-period noise impacts, but occasional exceedances of the City standards (60 dBA L_{dn}) at nearby residential areas may still occur. As a result, this impact would remain ***significant and unavoidable***.

Cumulative Noise Impacts. Based on existing and projected cumulative traffic volumes identified in chapter 7 (Transportation and Circulation) of this EIR, future traffic noise level increases in Redwood City with the project would be approximately 0-to-1 dBA higher than cumulative noise levels without the project. An increase of 0-to-1 dBA is imperceptible to the human ear and is therefore considered to be a ***less-than-significant cumulative impact***.

Mitigation. No significant impact has been identified; no mitigation is required.