E. NOISE AND VIBRATION

This section describes existing noise and vibration conditions, sets forth criteria for determining the significance of noise and vibration impacts, and estimates the likely noise and vibration impacts that would result from development of the proposed project. Mitigation measures are recommended, if required, to address significant environmental impacts.

1. Setting

This section describes the characteristics of sound and vibration, the regulations related to noise, and the existing noise sources in and adjacent to the project area.

a. Characteristics of Sound. Noise is generally defined as unwanted sound. Noise consists of any sound that may produce physiological or psychological damage and/or interfere with communication, work, rest, recreation, and sleep.

To the human ear, sound has two significant characteristics: *pitch* and *loudness*. Pitch is the number of complete vibrations or cycles per second of a wave that results in the range of tone from high to low. Loudness is the strength of a sound that describes a noisy or quiet environment, and it is measured by the amplitude of the sound wave. Loudness is determined by the intensity of the sound waves combined with the reception characteristics of the human ear. Sound intensity refers to how hard the sound wave strikes an object, which in turn produces the sound's effect. This characteristic of sound can be precisely measured with instruments. The analysis of a project defines the noise environment of the project area in terms of sound intensity and its effects on adjacent sensitive land uses.

(1) Measurement of Sound. Sound intensity is measured through the A-weighted scale to correct for the relative frequency response of the human ear. That is, an A-weighted noise level de-emphasizes low and very high frequencies of sound similar to the human ear's de-emphasis of these frequencies. Unlike linear units such as inches or pounds, decibels are measured on a logarithmic scale, representing points on a sharply rising curve. Table IV.E-1 contains a list of typical acoustical terms and definitions. Table IV.E-2 shows representative outdoor and indoor noise levels in units of dBA.

A decibel (dB) is a unit of measurement which indicates the relative intensity of a sound. The 0 point on the dB scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Changes of 3 dB or less are only perceptible in laboratory environments. Audible increases in noise levels generally refer to a change of 3 dB or more, as this level has been found to be barely perceptible to the human ear in outdoor environments. Sound levels in dB are calculated on a logarithmic basis. An increase of 10 dB

Table IV.E-1 Definitions of Acoustical Terms

Term	Definitions
Decibel, dB	A unit of level that denotes the ratio between two quantities proportional to power; the number of decibels is 10 times the logarithm (to the base 10) of this ratio.
Frequency, Hz	Of a function periodic in time, the number of times that the quantity repeats itself in one second (i.e., number of cycles per second).
A-Weighted Sound Level, dBA	The sound level obtained by use of A-weighting. 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.
L01, L10, L50, L90	The fast A-weighted noise levels equaled or exceeded by a fluctuating sound level for 1 percent, 10 percent, 50 percent, and 90 percent of a stated time period.
Equivalent Continuous Noise Level, Leq	The level of a steady sound that, in a stated time period and at a stated location, has the same A-weighted sound energy as the time varying sound.
Community Noise Equivalent Level, CNEL	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of five decibels to sound levels occurring in the evening from 7:00 p.m. to 10:00 p.m. and after the addition of 10 decibels to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m.
Day/Night Noise Level, Ldn	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 10 decibels to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m.
Lmax, Lmin	The maximum and minimum A-weighted sound levels measured on a sound level meter, during a designated time interval, using fast time averaging.
Ambient Noise Level	The all encompassing noise associated with a given environment at a specified time, usually a composite of sound from many sources at many directions, near and far; no particular sound is dominant.
Intrusive	The noise that 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: Handbook of Acoustical Measurements and Noise Control, 1991.

represents a 10-fold increase in acoustic energy, while 20 dB is 100 times more intense, 30 dB is 1,000 times more intense. Each 10-dB increase in sound level is perceived as approximately a doubling of loudness.

As noise spreads from a source, it loses energy so that the farther away the noise receiver is from the noise source, the lower the perceived noise level would be. Geometric spreading causes the sound level to attenuate or be reduced, resulting in a 6 dB reduction in the noise level for each doubling of distance from a single point source of noise to the noise sensitive receptor of concern.

There are many ways to rate noise for various time periods, but an appropriate rating of ambient noise affecting humans also accounts for the annoying effects of sound. Equivalent

continuous sound level (Leq) is the total sound energy of time varying noise over a sample period. However, the predominant rating scales for communities in the State of California are the Ldn, the community noise equivalent level (CNEL), and the day-night average level (Ldn) based on A-weighted decibels (dBA). CNEL is the time varying noise over a 24-hour period, with a 5 dBA weighting factor applied to the hourly Leq for noises occurring from 7:00 p.m. to 10:00 p.m. (defined as relaxation hours) and 10 dBA weighting factor applied to noise occurring from 10:00 p.m. to 7:00 a.m. (defined as sleeping hours). Ldn is similar to the CNEL scale, but without the adjustment for events occurring during the evening relaxation hours. CNEL and Ldn are within one dBA of each other and are normally exchangeable. The noise adjustments are added to the noise events occurring during the more sensitive hours. Typical A-weighted sound levels from various sources are described in Table IV.E-2.

Noise standards in terms of percentile exceedance levels, Ldn, are often used together with the Lmax for noise enforcement purposes. When specified, the percentile exceedance levels are not to be exceeded by an offending sound over a stated time period. For example, the L10 noise level represents the level exceeded ten percent of the time during a stated period. The L50 noise level represents the median noise level. Half the time the noise level exceeds this level, and half the time it is less than this level. The L90 noise level represents the noise level exceeded 90 percent of the time and is considered the lowest noise level experienced during a monitoring period. It is normally referred to as the background noise level. For a relatively steady noise, the measured Leq and L50 are approximately the same.

Noise impacts can be described in three categories. The first is audible impacts that refer to increases in noise levels noticeable to humans. Audible increases in noise levels generally refer to a change of 3.0 dBA or greater, since, as described earlier, this level has been found to be barely perceptible in exterior environments. The second category, potentially audible, refers to a change in the noise level between 1.0 and 3.0 dB. This range of noise levels has been found to be noticeable only in laboratory environments. The last category is changes in noise level of less than 1.0 dB that are inaudible to the human ear. Only audible changes in existing ambient or background noise levels are considered potentially significant.

(2) Physiological Effects of Noise. Physical damage to human hearing begins at prolonged exposure to noise levels higher than 85 dBA. Exposure to high noise levels affects our entire system, with prolonged noise exposure in excess of 75 dBA increasing body tensions, and thereby affecting blood pressure, functions of the ear, and the nervous system. In comparison, extended periods of noise exposure above 90 dBA would result in permanent cell damage. When the noise level reaches 120 dBA, a tickling sensation occurs in the human ear even with short-term exposure. This level of noise is called the threshold of feeling.

Table IV.E-2 Typical A-Weighted Sound Levels

Noise Source	A-Weighted Sound Level in Decibels	Noise Environments
Near Jet Engine	140	Deafening
Civil Defense Siren	130	Threshold of pain
Hard Rock Band	120	Threshold of feeling
Accelerating Motorcycle at a Few Feet Away	110	Very loud
Pile Driver; Noisy Urban Street/Heavy City Traffic	100	Very loud
Ambulance Siren; Food Blender	95	Very loud
Garbage Disposal	90	Very loud
Freight Cars; Living Room Music	85	Loud
Pneumatic Drill; Vacuum Cleaner	80	Loud
Busy Restaurant	75	Moderately loud
Near Freeway Auto Traffic	70	Moderately loud
Average Office	60	Moderate
Suburban Street	55	Moderate
Light Traffic; Soft Radio Music in Apartment	50	Quiet
Large Transformer	45	Quiet
Average Residence Without Stereo Playing	40	Faint
Soft Whisper	30	Faint
Rustling Leaves	20	Very faint
Human Breathing	10	Very faint

Source: Compiled by LSA Associates, Inc., 2007.

b. Characteristics of Ground-Borne Vibration. Vibrating objects in contact with the ground radiate vibration waves through various soil and rock strata to the foundations of nearby buildings. As the vibration propagates from the foundation throughout the remainder of the building, the vibration of floors and walls may cause perceptible vibration from the rattling of windows or a rumbling noise. The rumbling sound caused by the vibration of room surfaces is called ground-borne noise. When assessing annoyance from ground-borne noise, vibration is typically expressed as root mean square (rms) velocity in units of decibels of 1 micro-inch per second. To distinguish vibration levels from noise levels, the unit is written as "VdB." Human perception to vibration starts at levels as low as 67 VdB and sometimes lower. Annoyance due to vibration in residential settings starts at approximately 70 VdB. Ground-borne vibration is almost never annoying to people who are outdoors. Although the motion of the ground may be perceived, without the effects associated with the shaking of the building, the motion does not provoke the same adverse human reaction.

In extreme cases, excessive groundborne vibration has the potential to cause structural damage to buildings. When assessing the potential for building damage, vibration levels are expressed as peak particle velocity (PPV) in units of inches per second. Common sources of ground-borne vibration include trains and construction activities such as blasting, pile driving and operating heavy earthmoving equipment.

c. Noise Regulatory Framework. The following section summarizes the regulatory framework related to noise, including federal, State and City of Oakland plans, policies and standards.

(1) U.S. Environmental Protection Agency (EPA). In 1972 Congress enacted the Noise Control Act. This act authorized the EPA to publish descriptive data on the effects of noise and establish levels of sound "requisite to protect the public welfare with an adequate margin of safety." These levels are separated into health (hearing loss levels) and welfare (annoyance levels), as shown in Table IV.E-3. The EPA cautions that these identified levels are not standards because they do not take into account the cost or feasibility of the levels.

For protection against hearing loss, 96 percent of the population would be protected if sound levels are less than or equal to an Leq(24) of 70 dB. The "(24)" signifies an Leq duration of 24 hours. The EPA activity and interference guidelines are designed to ensure reliable speech communication at about 5 feet in the outdoor environment. For outdoor and indoor environments, interference with activity and annoyance should not occur if levels are below 55 dBA and 45 dBA, respectively.

The noise effects associated with an outdoor Ldn of 55 dB are summarized in Table IV.E-4. At 55 dB Ldn, 95 percent sentence clarity (intelligibility) may be expected at 3.5 meters, and no community reaction. However, 1 percent of the population may complain about noise at this level and 17 percent may indicate annoyance.

Table IV.E-3 Summary of EPA Noise Levels

Type of Effects	Magnitude of Effect
Speech – Indoors	100 percent sentence intelligibility (average) with a 5 dB margin of safety.
Speech – Outdoors	100 percent sentence intelligibility (average) at 0.35 meters. 99 percent sentence intelligibility (average) at 1.0 meters. 95 percent sentence intelligibility (average) at 3.5 meters.
Average Community Reaction	None evident; 7 dB below level of significant complaints and threats of legal action and at least 16 dB below "vigorous action."
Complaints	1 percent dependent on attitude and other non-level related factors.
Annoyance	17 percent dependent on attitude and other non-level related factors.
Attitude Towards Area	Noise essentially the least important of various factors.

"Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety." March.

Source: U.S. Environmental Protection Agency, 1974.

(2) Federal Transit Administration (FTA). For residential buildings, the Federal Transit Administration (FTA) has established a ground-borne vibration significant impact

threshold of 72 VdB for frequent events[1] and 80 VdB for infrequent events.[2] Most rapid transit operations fall into the frequent event category. Table IV.E-5 indicates the FTA's construction vibration damage criteria.

(3) State of California. The State of California has established regulations that help prevent adverse impacts to occupants of buildings located near noise sources. Referred to as the "State Noise Insulation Standard," it requires buildings to meet performance standards through design and/or building materials that would offset any noise source in the vicinity of the receptor. State regulations include requirements for the construction of new hotels, motels, apartment houses, and dwellings other than detached single-family dwellings that are intended to limit the extent of noise transmitted into habitable spaces. These requirements are found in the California Code of Regulations, Title 24 (known as the Building Standards Administrative Code), Part 2 (known as the California Building Code), Appendix Chapters 12 and 12A. For limiting noise transmitted between adjacent dwelling units, the noise insulation standards specify the extent to which walls, doors, and floor ceiling assemblies must block or absorb sound. For limiting noise from exterior noise sources, the noise insulation standards set an interior standard of 45 dBA CNEL in any

Table IV.E-4 Summary of Human Effects in Areas Exposed to 55 dBA Ldn

Effect	Level	Area
Hearing loss	Leq(24) $\leq$ 70 dB	All areas.
Outdoor activity interference and annoyance	Ldn $\leq$ 55 dB	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
	Leq(24) $\leq$ 55 dB	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor activity interference and annoyance	Leq $\leq$ 45 dB	Indoor residential areas.
	Leq(24) $\leq$ 45 dB	Other indoor areas with human activities such as schools, etc.

Source: U.S. Environmental Protection Agency, 1974. "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety." March.

Table IV.E-5 Construction Vibration Damage Criteria

Building Category	PPV (Inches/ Second)	Approximate VdB
I. Reinforced – Concrete, Steel or Timber (no plaster)	0.5	102
II. Engineered Concrete and Masonry (no plaster)	0.3	98
III. Non Engineer Timber and Masonry Buildings	0.2	94
IV. Buildings Extremely Susceptible to Vibration Damage	0.12	90

Source: Federal Transit Administration.

[1] The FTA defines "Frequent Events" as more than 70 vibration events per day and "Infrequent Events" as fewer than 70 vibration events per day.

[2] Federal Transit Administration, U.S. Department of Transportation, 2006. *Transit Noise and Vibration Impact Assessment.* May.

habitable room with all doors and windows closed. In addition, the standards require preparation of an acoustical analysis demonstrating the manner in which dwelling units have been designed to meet this interior standard, where such units are proposed in an area with exterior noise levels greater than 60 dBA CNEL.

The State has also established land use compatibility guidelines for determining acceptable noise levels for specified land uses. However, the City has adopted and modified the State's land use compatibility guidelines, as discussed below.

(4) City of Oakland. Locally, the City of Oakland addresses noise in the City's General Plan Noise Element, the Municipal Code Noise Ordinances, and in the Standard Conditions of Approval.

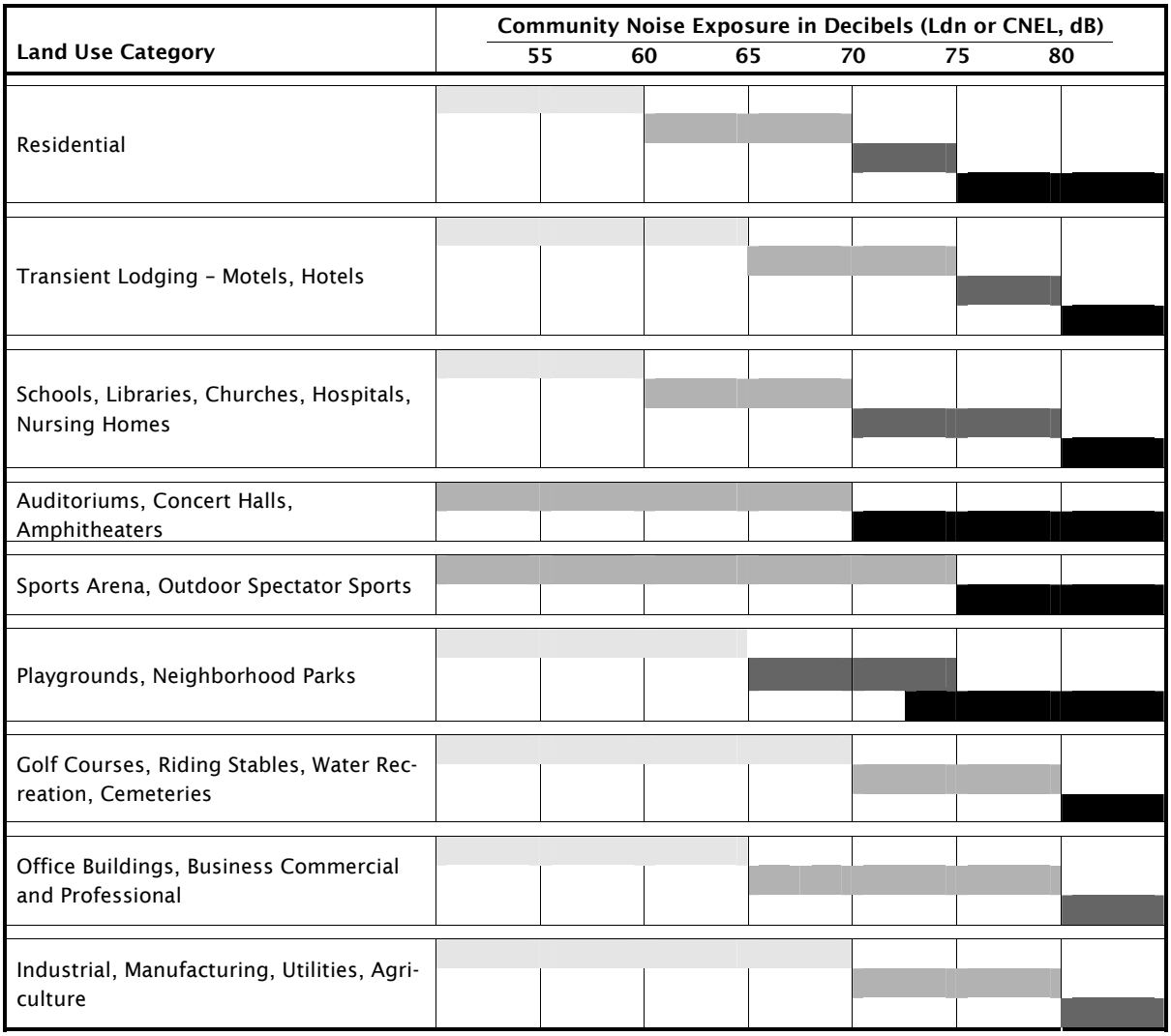
City of Oakland's General Plan Noise Element. The City of Oakland adopted a revised Noise Element in June of 2005.

The City has also established acceptable exterior noise thresholds for new residential and new commercial land use development of 60 dBA Ldn and 65 dBA Ldn respectively. As shown in Table IV.E-6, for proposed new residential uses, noise levels exceeding 60 dBA Ldn are conditionally acceptable provided a noise analysis identifies necessary noise reduction measures to achieve the interior noise level standard of 45 dBA Ldn.

The following are the noise policies and action steps of the Noise Element and other elements of the General Plan that are applicable to the proposed project.

- Policy 1: Ensure the compatibility of existing and, especially, of proposed development projects not only with neighboring land uses but also with their surrounding noise environment.
    - Action 1.1: Use the noise-land use compatibility matrix (Figure 6 *of the Noise Element [Table IV.E-7 following]*) in conjunction with the noise contour maps (especially for roadway traffic) to evaluate the acceptability of residential and other proposed land uses and also the need for any mitigation or abatement measures to achieve the desired degree of acceptability.
    - Action 1.2: Continue using the City's zoning regulations and permit processes to limit the hours of operation of noise-producing activities which create conflicts with residential uses and to attach noise-abatement requirements to such activities.
- Policy 2: Protect the noise environment by controlling the generation of noise by both stationary and mobile noise sources.
- Policy 3: Reduce the community's exposure to noise by minimizing the noise levels that are *received* by Oakland residents and others in the City. (This policy addresses the *reception* of noise whereas Policy 2 addresses the *generation* of noise.)
    - Action 3.1: Continue to use the building-permit application process to enforce the California Noise Insulation Standards regulating the maximum allowable interior noise level in new multi-unit buildings.

Table IV.E-6 Noise Land Use Compatibility Matrix



NORMALLY ACCEPTABLE
Development may occur without an analysis of potential noise impacts *to the proposed development* (though it might still be necessary to analyze noise impacts that the project might have *on its surroundings*).

CONDITIONALLY ACCEPTABLE
Development should be undertaken only after an analysis of noise-reduction requirements is conducted, and if necessary noise-mitigating features are included in the design. Conventional construction will usually suffice as long as it incorporates air conditioning or forced-air-supply systems, though it will likely require that project occupants maintain their windows closed.

NORMALLY UNACCEPTABLE
Development should generally de discouraged; it may be undertaken only if a detailed analysis of the noise-reduction requirements is conducted, and if highly effective noise insulation, mitigation or abatement features are included in the design.

CLEARLY UNACCEPTABLE
Development should not be undertaken.

Source: Oakland, City of, 2005. *City of Oakland General Plan, Noise Element, Figure 6.* June.

- Action 3.2: Review the City's noise performance standards and revise them as appropriate to be consistent with City Council policy.
- Action 3.3: Demand that Caltrans implement sound barriers, building retrofit programs and other measures to mitigate to the maximum extent feasible noise impacts on residential and other sensitive land uses from any new, widened or upgraded roadways; any new sound barrier must conform with City policies and standards regarding visual and aesthetic resources and quality.

- Policy I/C4.2: Minimizing nuisances. The potential for new or existing industrial or commercial uses, including seaport and airport activities, to create nuisance impacts on surrounding residential land uses should be minimized through appropriate siting and efficient implementation and enforcement of environmental and development controls.
- Policy N3.9: Orienting residential development. Residential developments should be encouraged to face the street and to orient their units to desirable sunlight and views, while avoiding unreasonably blocking sunlight and views for neighboring buildings, respecting the privacy needs of residents of the development and surrounding properties, providing for sufficient conveniently located on-site open space, and avoiding undue noise exposure.

City of Oakland Municipal Code Noise Ordinances. The noise ordinances of the City's Municipal Code[3] also regulate the maximum allowable daytime average receiving noise level for construction activity. These noise levels are shown in Table IV.E-7.

Table IV.E-7 City of Oakland Construction Noise Standards at Receiving Property Line, dBA

	Daily 7:00 a.m. to 7:00 p.m.	Weekends 9:00 a.m. to 8:00 p.m.
Short-Term Operation[a]		
Residential	80	65
Commercial, Industrial	85	70
Long-Term Operational[b]		
Residential	65	55
Commercial, Industrial	70	60

[a] Short-term construction or demolition operation is less than 10 days.
[b] Long-term construction or demolition operation is 10 days or more.
Source: City of Oakland Municipal Code Section 17.120.050 Noise.

Municipal Code 17.120.060 outlines the City of Oakland's performance standards with regards to residential development exposed to groundborne vibration. The code restricts all activities outside of the M-40 and M-30 zones from creating a vibration that would be perceptible without instruments by the average person at or beyond any lot line of the lot containing such activities. Groundborne vibration caused by motor vehicles, trains, and temporary construction or demolition work is exempt from this standard.

The City's maximum allowable operational noise level standards for residential and commercial land uses in terms of percentile exceedance are shown in Table IV.E-8.

[3] Section 17.120 and Section 8.18.

City of Oakland's Standard Conditions of Approval. The City's Standard Conditions of Approval relevant to this impact topic are listed below for reference. The conditions of approval will be adopted as requirements of the proposed project if the project is approved by the City to help ensure no significant impacts (for the applicable topic) occur, as a result they are not listed as mitigation measures.

Table IV.E-8 City of Oakland Operational Noise Standards at Receiving Property Line, dBA

Cumulative Number of Minutes in Either the Daytime or Nighttime 1-Hour Time Period	Residential Daytime 7:00 a.m. to 10:00 p.m.	Residential Nighttime 10:00 p.m. to 7:00 a.m.	Commercial Use, Anytime
20	60	45	65
10	65	50	70
5	70	55	75
1	75	60	80
0	80	65	85

Source: City of Oakland Municipal Code Section 17.120.050 Noise.

COA NOISE-1: Days/Hours of Construction Operation. *Ongoing throughout demolition, grading, and/or construction.* The project applicant shall require construction contractors to limit standard construction activities as follows:

a) Construction activities are limited to between 7:00 a.m. and 7:00 p.m. Monday through Friday, except that pile driving and/or other extreme noise generating activities greater than 90 dBA limited to between 8:00 a.m. and 4:00 p.m. Monday through Friday.

b) Any construction activity proposed to occur outside of the standard hours of 7:00 a.m. to 7:00 p.m. Monday through Friday for special activities (such as concrete pouring which may require more continuous amounts of time) shall be evaluated on a case-by-case basis, with criteria including the proximity of residential uses and a consideration of resident's preferences for whether the activity is acceptable if the overall duration of construction is shortened and such construction activities shall only be allowed with the prior written authorization of the Building Services Division.

c) Construction activity shall not occur on Saturdays, with the following possible exceptions:

- Prior to the building being enclosed, requests for Saturday construction for special activities (such as concrete pouring which may require more continuous amounts of time), shall be evaluated on a case-by-case basis, with criteria including the proximity of residential uses and a consideration of resident's preferences for whether the activity is acceptable if the overall duration of construction is shortened. Such construction activities shall only be allowed on Saturdays with the prior written authorization of the Building Services Division.

- After the building is enclosed, requests for Saturday construction activities shall only be allowed on Saturdays with the prior written authorization of the Building Services Division, and only then within the interior of the building with the doors and windows closed.

d) No extreme noise generating activities (greater than 90 dBA) shall be allowed on Saturdays, with no exceptions.

e) No construction activity shall take place on Sundays or Federal holidays.

f) Construction activities include but are not limited to: truck idling, moving equipment (including trucks, elevators, etc.) or materials, deliveries, and construction meetings held on-site in a non-enclosed area.

COA NOISE-2: Noise Control. *Ongoing throughout demolition, grading, and/or construction.* To reduce noise impacts due to construction, the project applicant shall require construction contractors to implement a site-specific noise reduction program, subject to city review and approval, which includes the following measures:

a) Equipment and trucks used for project construction shall utilize the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures and acoustically-attenuating shields or shrouds, wherever feasible).

b) Except as provided herein, impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for project construction shall be hydraulically or electrically powered wherever possible to avoid noise associated with compressed air exhaust from pneumatically powered tools. However, where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used; this muffler can lower noise levels from the exhaust by up to about 10 dBA. External jackets on the tools themselves shall be used if such jackets are commercially available, and this could achieve a reduction of 5 dBA. Quieter procedures shall be used, such as drills rather than impact equipment, whenever such procedures are available and consistent with construction procedures.

c) Stationary noise sources shall be located as far from adjacent receptors as possible, and they shall be muffled and enclosed within temporary sheds, incorporate insulation barriers, or use other measures as determined by the City to provide equivalent noise reduction.

d) The noisiest phases of construction shall be limited to less than 10 days at a time. Exceptions may be allowed if the City determines an extension is necessary and all available noise reduction controls are implemented.

COA NOISE-3: Noise Complaint Procedures. *Ongoing throughout demolition, grading, and/or construction.* Prior to the issuance of each building permit, along with the submission of construction documents, the project applicant shall submit to the City Building Services Division a list of measures to respond to and track complaints pertaining to construction noise. These measures shall include:

a) A procedure and phone numbers for notifying the City Building Services Division staff and Oakland Police Department; (during regular construction hours and off-hours);

b) A sign posted on-site pertaining with permitted construction days and hours and complaint procedures and who to notify in the event of a problem. The sign shall also include a listing of both the City and construction contractor's telephone numbers (during regular construction hours and off-hours);

c) The designation of an on-site construction complaint and enforcement manager for the project;

d) Notification of neighbors and occupants within 300 feet of the project construction area at least 30 days in advance of extreme noise generating activities about the estimated duration of the activity; and

e) A preconstruction meeting shall be held with the job inspectors and the general contractor/on-site project manager to confirm that noise measures and practices (including construction hours, neighborhood notification, posted signs, etc.) are completed.

COA NOISE-4: Interior Noise. *Prior to issuance of a building permit.* If necessary to comply with the interior noise requirements of the City of Oakland's General Plan Noise Element and achieve an acceptable interior noise level, noise reduction in the form of sound-rated assemblies (i.e., windows, exterior doors, and walls) shall be incorporated into project building design, based upon recommendations of a qualified acoustical engineer. Final recommendations for sound-rated assemblies will depend on the specific building designs and layout of buildings on the site and shall be determined during the design phase.

COA NOISE-5: Pile Driving and Other Extreme Noise Generators. *Ongoing throughout demolition, grading, and/or construction.* To further reduce potential pier drilling, pile driving and/or other extreme noise generating construction impacts greater than 90 dBA, a set of site-specific noise attenuation measures shall be completed under the supervision of a qualified acoustical consultant. Prior to commencing construction, a plan for such measures shall be submitted for review and approval by the City to ensure that maximum feasible noise attenuation will be achieved. This plan shall be based on the final design of the project. A third-party peer review, paid for by the project applicant, may be required to assist the City in evaluating the feasibility and effectiveness of the noise reduction plan submitted by the project applicant. The criterion for approving the plan shall be a determination that maximum feasible noise attenuation will be achieved. A special inspection deposit is required to ensure compliance with the noise reduction plan. The amount of the deposit shall be determined by the Building Official, and the deposit shall be submitted by the project applicant concurrent with submittal of the noise reduction plan. The noise reduction plan shall include, but not be limited to, an evaluation of implementing the following measures. These attenuation measures shall include as many of the following control strategies as applicable to the site and construction activity:

a) Erect temporary plywood noise barriers around the construction site, particularly along on sites adjacent to residential buildings;

b) Implement "quiet" pile driving technology (such as pre-drilling of piles, the use of more than one pile driver to shorten the total pile driving duration), where feasible, in consideration of geotechnical and structural requirements and conditions;

c) Utilize noise control blankets on the building structure as the building is erected to reduce noise emission from the site;

d) Evaluate the feasibility of noise control at the receivers by temporarily improving the noise reduction capability of adjacent buildings by the use of sound blankets for example, and implement such measure if such measures are feasible and would noticeably reduce noise impacts; and

e) Monitor the effectiveness of noise attenuation measures by taking noise measurements.

COA NOISE-6: Vibrations Adjacent Historic Structures. *Prior to issuance of a demolition, grading or building permit.* The project applicant shall retain a structural engineer or other appropriate professional to determine threshold levels of vibration and cracking that could

damage buildings adjacent to the project site and design means and methods of construction that shall be utilized to not exceed the thresholds.

d. Existing Noise Environment. The project components are located in a dense urban area with a variety of land uses surrounding the site. State Route 24 (SR-24) and the BART tracks are located to the west of the project site. A residential neighborhood, which includes a mix of densities, is located further west. A church and commercial uses are located to the east across Telegraph Avenue from the project site. To the north of the project site, across 40th Street, are residential and commercial uses. Commercial uses are located to the south of the project site. The following section describes the existing noise environment and identifies primary noise sources in the project vicinity.

The closest sensitive receptors would be the residential land uses located adjacent to the project site on West MacArthur Boulevard and on Telegraph Avenue. Additional residential buildings are located approximately 100 feet north of the site across 40th Street and 120 feet south of the site across West MacArthur Boulevard. Noise sensitive land uses on the east side of Telegraph Avenue include residential and church land uses. The construction and operation of the proposed project could affect these surrounding sensitive land uses.

(1) Existing Ambient Noise. Ambient noise sources in the vicinity of the project include the transportation noise from traffic on SR-24, I-580, 40th Street, West MacArthur Boulevard, and Telegraph Avenue. Occasional BART noise sources, parking lot activities noise sources, and natural noise sources such as wind and birds also contribute to the ambient noise environment.

Short-term ambient noise monitoring on the project site was conducted on July 11, 2007 between the hours of 11:00 a.m. and 1:00 p.m. at four separate locations in the project vicinity by LSA Associates, Inc. The purpose of this noise monitoring was to document the existing noise environment and capture the noise levels associated with operations and activities in the project vicinity. Table IV.E-9 lists the noise levels measured during the short-term 20-minute noise measurements. Maximum and minimum noise levels were recorded as well as the equivalent continuous noise level measure Leq. Each of the four 20-minute measurements taken on the proposed project site includes at least one BART train passing during each of the monitoring periods. Other sources of noise observed include noise from parking lot activities which include driving, people conversing, car doors shutting, vehicles starting, etc. Results of all monitoring are shown in Table IV.E-9. Results indicate that current noise levels in the project vicinity range from 61.1 to 66.8 dBA Leq. The meteorological conditions at the time of each noise measurement are shown in Table IV.E-10. Figure IV.E-1 shows the monitoring locations.

Table IV.E-9 Short-Term Ambient Noise Monitoring Results, dBA

Location Number	Location Description	Start Time	Leq [a]	Lmax[b]	Lmin [c]	Noise Sources
1	526 MacArthur Boulevard, 30' from north fence, 10' from east fence	11:00	61.1	73.8	58.0	Traffic on MacArthur Boulevard & SR-24, parking lot activities
2	Apgar Street, 12' from northwest corner of 3847 Telegraph Avenue, 35' from BART Parking lot entrance	11:25	65.1	77.1	60.7	Traffic on Telegraph Avenue & SR-24, BART, parking lot activities
3	BART parking lot between stalls 24 & 25	11:50	66.8	72.5	59.3	Traffic on SR-24, parking lot activities, BART
4	55' south of 40th Street on right edge of northeast BART parking entrance	12:15	65.6	74.0	60.6	Traffic on SR-24 & 40th Street, parking lot activity, BART

[a] Leq represents the average of the sound energy occurring over the 20-minute time period.
[b] Lmax is the highest instantaneous sound level measured during the 20-minute time period.
[c] Lmin is the lowest instantaneous sound level measured during the 20-minute time period.

Source: LSA Associates, Inc., July 2007.

(2) Existing Traffic Noise. The existing traffic noise levels for roadway segments in the project vicinity are listed in Table IV.E-11. This table was generated from roadway traffic volumes data, vehicle speeds, and roadway geometry, using the Federal Highways Administration (FHWA) highway traffic noise prediction model, FHWA RD-77-108. Existing noise levels along select roadway segments in the vicinity of the project (at 50 feet from the centerline of the outermost travel lane) range from 61.7 dBA to 80.4 dBA Ldn.

Table IV.E-10 Meteorological Conditions During Ambient Noise Monitoring

Location Number	Maximum Wind Speed (mph)	Average Wind Speed (mph)	Temp. (F)	Relative Humidity (%)
1	4.4	1.3	69.7	67
2	3.0	1.0	70.8	57
3	4.6	1.4	70.6	53
4	3.4	0.9	70.3	64

Source: LSA Associates, Inc., July 2007.

(3) Existing Rail Noise. The BART rail line is located west of the project site dividing the west- and east-bound lanes or SR-24. Figure 3 of the City's Noise Element of the General Plan[4] shows that the western portion of the project site within approximately 200 feet of the BART rail lines lies within the 60 dBA Ldn BART noise contour.

[4] City of Oakland, 2005. *City of Oakland General Plan, Noise Element.* June.

FIGURE IV.E-1

Legend

Project Site

1 Noise monitoring locations

N

0 100 200

feet

MacArthur Transit Village Project EIR

Noise Monitoring Locations

SOURCE: GOOGLE MAPS, 2007.

I:\MGB0701 macarthur bart\figures\Fig_IVE1.ai (7/31/07)

Table IV.E-11 Existing Traffic Noise Levels, dBA

Roadway Segment	ADT[a]	Center-line to 70 Ldn (feet)	Center-line to 65 Ldn (feet)	Center-line to 60 Ldn (feet)	Ldn (dBA) 50 feet from Centerline of Outermost Lane
M.L. King Jr. Way – 45th Street to 40th Street	8,100	< 50[b]	< 50	88	61.8
Telegraph Avenue – 45th Street to 40th Street	20,100	< 50	62	126	63.7
40th Street - West Street to M.L. King Jr. Way	14,500	< 50	63	129	63.9
40th Street - M.L. King Jr. Way to BART Access	17,200	< 50	70	144	64.6
40th Street - BART Access to Telegraph Avenue	16,900	< 50	69	142	64.5
M.L. King Jr. Way – 40th Street to MacArthur Boulevard	7,900	< 50	< 50	86	61.7
Telegraph Avenue – 40th Street to 38th Street	17,500	< 50	57	115	63.1
Telegraph Avenue – 38th Street to MacArthur Boulevard	18,000	< 50	58	117	63.2
MacArthur Boulevard - West Street to M.L. King Jr. Way	12,000	< 50	60	115	62.7
MacArthur Boulevard - BART Access to Telegraph Avenue	12,700	< 50	62	120	62.9
SR-24 - I-580 to 42nd Street	150,700	365	781	1,681	79.4
I-580 - Telegraph Avenue to SR-24	213,300	460	984	2,117	80.4

Note: The shaded areas in the table indicate the roadway segments adjacent to the project site.

[a] ADT=Average Daily Traffic.

[b] Traffic noise within 50 feet of roadway centerline requires site specific analysis.

Source: LSA Associates, Inc., 2007.

Noise generated by BART train passbys was assessed in accordance with the U.S. Department of Transportation, Federal Transit Administration (FTA) recommended methodology obtained from chapter six of Transit Noise and Vibration Impact Assessment.

The calculated train noise level at 50 feet from the BART track centerline is approximately 69 dBA Ldn including warning horns. The closest noise sensitive land uses within the project site could be located approximately 225 feet from the track centerline. At this distance and assuming a direct line of sight, the predicted BART train noise levels would be 62.5 dBA Ldn with warning horns at the closest sensitive receptor.

(4) Existing Aircraft Noise. The San Francisco International Airport is located 15 miles southwest of the project site (across the Bay) and the Oakland International Airport is located approximately 6 miles south of the site. Due to the distance from these airports and

orientation of flight paths, the project site is not located within the 65 dBA CNEL noise contours for either the San Francisco or Oakland International Airports.

2. Impacts and Mitigation Measures

This section evaluates potential noise and vibration impacts associated with the proposed project. It also identifies mitigation measures to address these impacts, as appropriate.

a. Criteria of Significance. The proposed project would result in a significant noise or vibration impact if it would:

- Expose persons to or generate noise levels in excess of standards established in the Oakland General Plan or applicable standards of other agencies (e.g., Occupational Safety and Health Administration (OSHA)).
- Violate the City of Oakland Noise Ordinance (Oakland Planning Code Section 17.120.050) regarding operational noise.
- Violate the City of Oakland Noise Ordinance (Oakland Planning Code Section 17.120.050) regarding construction noise, except if an acoustical analysis is performed and all noise-related Standard Conditions of Approval imposed:

  During the hours of 7:00 p.m. to 7:00 a.m. on weekdays and 8:00 p.m. to 9:00 a.m. on weekends and federal holidays, noise levels received by any land use from construction or demolition shall not exceed the applicable nighttime operational noise level standard (see Table IV.E-6).
- Violate the City of Oakland Noise Ordinance (Oakland Municipal Code Section 8.18.020) regarding nuisance of persistent construction-related noise.
- Create a vibration which is perceptible without instruments by the average person at or beyond any lot line containing vibration-causing activities not associated with motor vehicles, trains, and temporary construction or demolition work, except activities located within the (a) M-40 zone or (b) M-30 zone more than 400 feet from any legally occupied residential property (Oakland Planning Code Section 17.120.060).
- Generate interior Ldn or CNEL greater than 45 dBA for multi-family dwellings, hotels, motels, dormitories and long-term care facilities (and may be extended by local legislative action to include single family dwellings) per California Noise Insulation Standards (CCR Part 2, Title 24).
- Result in a 5 dBA permanent increase in ambient noise levels in the project vicinity above levels existing without the project.
- Conflict with State land use compatibility guidelines for all specified land uses for determination of acceptability of noise (Source: State of California, Governor's Office of Planning and Research, *General Plan Guidelines, 2003*).

- Be located within an airport land use plan and would expose people residing or working in the project area to excessive noise levels.
- Be located within the vicinity of a private airstrip, and would expose people residing or working in the project area to excessive noise levels.

b. Less-than-Significant Noise and Vibration Impacts. Less-than-significant noise impacts of the proposed project are discussed below.

(1) Stationary Noise Sources. Stationary noise is regulated under Chapter 17 of the City of Oakland Municipal Code as shown in Table IV.E-8. Stationary noise sources that may be associated with the project include mechanical ventilation and idling delivery trucks associated with the commercial portion of the project. The proposed project would not include manufacturing processes or mechanical ventilation equipment that would generate excess noise or vibration levels. Noise generated by mechanical machinery such as air conditioners and emergency generators would be similar to noise levels existing in the vicinity of the project site and would not create a significant increase in noise levels. Likewise, noise generated from the residential parking areas and BART parking garage would not be substantially higher than the current noise levels generated by similar uses in the project area. Therefore, noise from project related stationary noise sources would result in less-than-significant impacts on noise sensitive land uses in the project vicinity.

(2) Construction Related Noise and Vibration Sources. Two types of short-term noise impacts would occur during demolition, site remediation and project construction. The first is the increase in traffic flow on local streets, associated with the transport of workers, equipment, and materials to and from the project site. The pieces of heavy equipment for site remediation, grading and construction would be moved to the site and remain for the duration of each construction phase. The increase in traffic flow on the surrounding roads due to construction traffic is expected to be minimal. However, there would be short-term intermittent high noise levels associated with trucks arriving at and departing from the project site.

The second type of short-term noise impact is related to the noise generated by heavy equipment operating on the project site. Construction (including demolition of existing structures and site remediation) is performed in discrete steps, each of which has its own mix of equipment and, consequently, its own noise characteristics. These various sequential phases would change the character of the noise generated on the site and, therefore, the noise levels surrounding the site as construction progresses. Despite the variety in the type and size of construction equipment, similarities in the dominant noise sources and patterns of operation allow construction related noise ranges to be categorized by work phase. Table IV.E-12 lists typical construction equipment noise levels recommended for noise impact assessments, based on a distance of 50 feet between the equipment and a noise receptor.

As shown in Table IV.E-12, the maximum noise level generated by each hydraulic excavator on the proposed project site is anticipated to be 86 dBA Lmax at 50 feet from the earthmover. Each bulldozer would generate 88 dBA Lmax at 50 feet. The maximum noise level generated by water and pickup trucks is approximately 86 dBA Lmax at 50 feet from these vehicles. With each doubling of the number of sound sources of equal strength, the noise level increases by 3 dBA (e.g., two excavators operating at 86 dBA yield a total noise level of 89 dBA). Assuming that each piece of construction equipment operates simultaneously, the worst case combined noise level during this phase of construction would be 91 dBA Lmax at a distance of 50 feet from an active construction area. The nearest noise sensitive land use would be located within 50 feet of the project site at 3847 Telegraph Avenue.

Table IV.E-12 Typical Construction Equipment Maximum Noise Levels, Lmax

Type of Equipment	Range of Maximum Sound Levels (dBA at 50 feet)	Suggested Maximum Sound Levels for Analysis (dBA at 50 feet)
Pile Drivers	81 to 96	93
Rock Drills	83 to 99	96
Jackhammers	75 to 85	82
Pneumatic Tools	78 to 88	85
Pumps	68 to 80	77
Scrapers	83 to 91	87
Haul Trucks	83 to 94	88
Electric Saws	66 to 72	70
Portable Generators	71 to 87	80
Rollers	75 to 82	80
Dozers	85 to 90	88
Tractors	77 to 82	80
Front-End Loaders	86 to 90	88
Hydraulic Backhoe	81 to 90	86
Hydraulic Excavators	81 to 90	86
Graders	79 to 89	85
Air Compressors	76 to 89	85
Trucks	81 to 87	85

Source: Bolt, Beranek & Newman, 1987. Noise Control for Buildings and Manufacturing Plants.

Construction of the project is to occur over a seven-year period, beginning in 2009. During this period, a wide variety of construction remediation and demolition equipment would be used and materials would be transported to and from the site during each development phase. It is anticipated larger mechanical equipment such as tractors, scrapers and trucks would be used during the remediation and demolition phase. This phase would also include equipment to grind existing concrete for reuse on-site. Construction activities would include the use of smaller power tools, generators and other sources of noise. Depending on final foundation requirements, pile driving may also be necessary for project construction.

Construction-related noise associated with possible pile driving on the project site could impact noise sensitive receptors adjacent to these areas. As shown in Table IV.E-12, the maximum airborne noise level generated by a pile driver on the proposed project site is anticipated to be 93 dBA Lmax at 50 feet from the pile driver. The closest receptors include the existing residential land uses that adjoin the project site on MacArthur Boulevard and Telegraph Avenue. These receptors are located within 50 feet of potential pile driving areas. At this distance they would be exposed to maximum noise levels due to pile driving of up to 93 dBA Lmax.

The impacts from construction noise, including pile driving, would be reduced to less-than-significant levels with implementation of the City's Days/Hours of Construction Operation, and Noise Control Noise Complain Procedures, and Pile Driving and Other Extreme Noise Generators Standard Conditions of Approval (see COA's NOISE-1, NOISE-2, NOISE-3 and NOISE-5 on pages 290 to 292) for construction noise as described in Section IV.E-1.c(4).

To address impacts from pile driving and other extreme noise generating construction activities that may expose sensitive receptors to noise levels greater than 90 dBA Lmax, the City's Standard Conditions of Approval (see COA NOISE-1, NOISE-2, NOISE-3 and NOISE-5) mandate that a site specific noise reduction plan be developed and submitted for review and approval by the City to ensure that maximum feasible noise attenuation will be achieved. Implementation of these Standard Conditions of Approval would ensure that potential impacts resulting from construction-activity noise would be less than significant.

Construction activities associated with implementation of the project, including proposed pile driving activities, could temporarily expose persons in the vicinity of the proposed project construction areas to ground-borne vibration or ground-borne noise levels. Typical groundborne vibration levels measured at a distance of 50 feet from heavy construction equipment in full operation, such as bulldozers or other heavy tracked equipment, range up to approximately 94 VdB. This is above the damage threshold for historic or fragile buildings shown in Table IV.E-3. The City's Vibration Adjacent to Historic Structures Standard Conditions of Approval (see COA NOISE-5 on page 292) would ensure the impact remains less than significant.

Pile driving has the potential to generate both high airborne sound levels and ground-borne vibration levels. Pile driving activities have the potential to damage buildings within the project site and near the site. Maximum ground-borne vibration levels associated with potential pile driving within the site could range from 1.15 PPV for structures 30 feet away and 0.30 PPV for structures 75 feet away.[5] This level of vibration would not be considered significant. Noise from pile driving is discussed above.

(2) Groundborne Noise and Vibration Sources. Railroad activity can be a source of groundborne noise and vibration. However, vibration from BART train activity would not be perceptible at potential noise sensitive land uses on the project site due to the distance of the BART rail line from the project site and the difference in elevation between the rail line and the project site.

[5] Federal Transit Administration, U.S. Department of Transportation, 1995. *Transit Noise and Vibration Impact Assessment.*

(3) Traffic Noise Sources. Traffic generated by the proposed project would not be significant enough to result in any perceptible changes in noise. However, anticipated cumulative traffic and BART train noise sources could result in noise levels that would impact the proposed project.

Local traffic will generate long-term exterior noise exceeding Normally Acceptable Levels on the project site and could expose site users to unacceptable noise levels.

The existing and future traffic noise levels were calculated using the FHWA Highway Traffic Noise Prediction Model. These project scenarios were evaluated: Existing with Project, Cumulative 2015 Baseline[6] with Project, and Cumulative 2030 Baseline with Project.[7] Traffic data used in the model for City roadways were obtained from the traffic impact analysis prepared by Fehr & Peers (August, 2007). Traffic data used for SR-24 and I-580 were based on Caltrans' latest available traffic volume data and assume a 3 percent annual increase.[8] The resulting noise levels were weighted and summed over a 24-hour period in order to determine the Ldn values. Ldn contours are derived through a series of computerized iterations to isolate the 60, 65, and 70 dBA Ldn contours for traffic noise levels in the project area. The existing traffic noise levels on roadways segments in the project vicinity are shown in Table IV.E-11. Table IV.E-13 lists traffic noise levels for existing conditions *with* the project. Tables IV.E-14 and IV.E-15 list the traffic noise levels for Cumulative 2015 Baseline conditions *without* and *with* the project respectively. Tables IV.E-16 and IV.E-17 list the traffic noise levels for Cumulative 2030 Baseline conditions *without* and *with* the proposed project respectively.

Tables IV.E-13, IV.E-15, and IV.E-17 show that there would be a less-than-significant increase under with the project conditions compared to the baseline without the project conditions. Highway traffic noise levels would remain unchanged due to the very small percentage of project-generated traffic in relation to existing vehicle traffic on SR-24 and I-580. The largest increase in traffic-related noise on City roadway segments with implementation of the project would be on MacArthur Boulevard from the BART access driveway to Telegraph Avenue, which would be an increase of 0.5 dBA from baseline levels. This noise level increase is well below the 3 dBA increase considered to be perceptible by the human ear in an outdoor environment and clearly below the significance threshold of 5 dBA. No

[6] Baseline conditions include past, present, existing, pending and reasonably foreseeable future development.

[7] Ibid.

[8] Caltrans, 2005. *2004 Annual Average Daily Truck Traffic on the California State Highway System*. August.

Table IV.E-13 Existing with Project Traffic Noise Levels, dBA

Roadway Segment	ADT[a]	Center-line to 70 Ldn (feet)	Center-line to 65 Ldn (feet)	Center-line to 60 Ldn (feet)	Ldn (dBA) 50 Feet from Centerline of Outer-most Lane	Increase over Existing Conditions
M.L. King Jr. Way – 45th Street to 40th Street	8,400	< 50	< 50	90	61.9	0.1
Telegraph Avenue – 45th Street to 40th Street	20,900	< 50	63	129	63.9	0.2
40th Street – West Street to M.L. King Jr. Way	15,100	< 50	65	132	64.0	0.1
40th Street – M.L. King Jr. Way to BART Access	18,000	< 50	72	148	64.8	0.2
40th Street - BART Access to Telegraph Avenue	16,800	< 50	69	142	64.5	0.0
M.L. King Jr. Way – 40th Street to MacArthur Blvd.	8,400	< 50	< 50	90	61.9	0.2
Telegraph Avenue – 40th Street to 38th Street	18,900	< 50	60	121	63.4	0.3
Telegraph Avenue – 38th Street to MacArthur Blvd.	19,200	< 50	60	122	63.5	0.3
MacArthur Blvd. – West Street to M.L. King Jr. Way	12,400	< 50	61	118	62.8	0.1
MacArthur Blvd. – BART Access to Telegraph Ave.	14,300	< 50	65	129	63.4	0.5
SR-24 – I-580 to 42nd Street	150,700	365	781	1,681	79.4	0.0
I-580 – Telegraph Avenue to SR-24	213,300	460	984	2,117	80.4	0.0

Note: The shaded areas in the Tables IV.E-13 through IV.E-17 indicate the roadway segments adjacent to the project site.
[a] ADT=Average Daily Trips calculated from traffic volumes in the Fehr & Peers TIA. Model rounds ADT up to 100 trips.
Source: LSA Associates, Inc., 2007.

Table IV.E-14 Cumulative 2015 Baseline[a] Without Project Traffic Noise Levels, dBA

Roadway Segment	ADT	Center-line to 70 Ldn (feet)	Center-line to 65 Ldn (feet)	Center-line to 60 Ldn (feet)	Ldn (dBA) 50 Feet from Centerline of Outermost Lane
M.L. King Jr. Way – 45th Street to 40th Street	9,900	< 50	< 50	100	62.6
Telegraph Avenue – 45th Street to 40th Street	26,100	< 50	72	149	64.8
40th Street – West Street to M.L. King Jr. Way	17,000	< 50	70	143	64.5
40th Street – M.L. King Jr. Way to BART Access	19,700	< 50	76	157	65.2
40th Street – BART Access to Telegraph Avenue	19,500	< 50	75	156	65.1
M.L. King Jr. Way – 40th Street to MacArthur Blvd.	9,500	< 50	< 50	97	62.5
Telegraph Avenue – 40th Street to 38th Street	22,700	< 50	67	136	64.2
Telegraph Avenue – 38th Street to MacArthur Blvd.	23,100	< 50	67	137	64.3
MacArthur Blvd. – West Street to M.L. King Jr. Way	17,100	< 50	72	144	64.2
MacArthur Blvd. – BART Access to Telegraph Ave.	17,700	< 50	73	147	64.3
SR-24 – I-580 to 42nd Street	190,900	427	914	1,968	80.4
I-580 – Telegraph Avenue to SR-24	270,200	537	1,152	2,478	81.4

[a] Baseline conditions included past, present, existing, pending and reasonably foreseeable future development.
Source: LSA Associates, Inc., 2007.

Table IV.E-15 Cumulative 2015 Baseline[a] Plus Project Traffic Noise Levels, dBA

Roadway Segment	ADT	Center-line to 70 Ldn (feet)	Center-line to 65 Ldn (feet)	Center-line to 60 Ldn (feet)	Ldn (dBA) 50 Feet from Centerline of Outer-most Lane	Increase over Future 2015 w/o Project Conditions
M.L. King Jr. Way – 45th Street to 40th Street	10,200	< 50	< 50	102	62.8	0.2
Telegraph Avenue – 45th Street to 40th Street	26,900	< 50	73	152	65.0	0.2
40th Street – West Street to M.L. King Jr. Way	17,700	< 50	71	146	64.7	0.2
40th Street – M.L. King Jr. Way to BART Access	20,500	< 50	78	161	65.4	0.2
40th Street – BART Access to Telegraph Ave.	19,400	< 50	75	155	65.1	0.0
M.L. King Jr. Way – 40th St. to MacArthur Blvd.	10,100	< 50	< 50	101	62.7	0.2
Telegraph Avenue – 40th Street to 38th Street	24,200	< 50	69	141	64.5	0.3
Telegraph Ave. – 38th Street to MacArthur Blvd.	24,400	< 50	69	142	64.5	0.2
MacArthur Blvd. – West Street to M.L. King Jr. Way	17,600	< 50	73	147	64.3	0.1
MacArthur Blvd. – BART Access to Telegraph Ave.	19,500	< 50	78	157	64.8	0.5
SR-24 – I-580 to 42nd Street	190,900	427	914	1,968	80.4	0.0
I-580 – Telegraph Avenue to SR-24	270,200	537	1,152	2,478	81.4	0.0

[a] Baseline conditions included past, present, existing, pending and reasonably foreseeable future development.

Source: LSA Associates, Inc., 2007.

Table IV.E-16 Cumulative 2030 Baseline[a] Without Project Traffic Noise Levels, dBA

Roadway Segment	ADT	Center-line to 70 Ldn (feet)	Center-line to 65 Ldn (feet)	Center-line to 60 Ldn (feet)	Ldn (dBA) 50 feet from Centerline of Outermost Lane
M.L. King Jr. Way – 45th Street to 40th Street	12,300	< 50	56	115	63.6
Telegraph Avenue – 45th Street to 40th Street	29,600	< 50	78	161	65.4
40th Street – West Street to M.L. King Jr. Way	23,300	< 50	84	175	65.9
40th Street – M.L. King Jr. Way to BART Access	25,800	< 50	90	187	66.4
40th Street – BART Access to Telegraph Avenue	25,700	< 50	89	187	66.3
M.L. King Jr. Way – 40th Street to MacArthur Blvd.	11,400	< 50	53	109	63.2
Telegraph Avenue – 40th Street to 38th Street	27,700	< 50	75	154	65.1
Telegraph Avenue – 38th Street to MacArthur Blvd.	28,400	< 50	76	157	65.2
MacArthur Blvd. – West Street to M.L. King Jr. Way	25,400	< 50	90	186	65.9
MacArthur Blvd. – BART Access to Telegraph Ave.	25,900	< 50	91	189	66.0
SR-24 – I-580 to 42nd Street	297,400	572	1,228	2,644	82.4
I-580 – Telegraph Avenue to SR-24	420,900	720	1,547	3,330	83.4

[a] Baseline conditions included past, present, existing, pending and reasonably foreseeable future development.

Source: LSA Associates, Inc., 2007.

Table IV.E-17 Cumulative 2030 Baseline[a] Plus Project Traffic Noise Levels, dBA

Roadway Segment	ADT	Center-line to 70 Ldn (feet)	Center-line to 65 Ldn (feet)	Center-line to 60 Ldn (feet)	Ldn (dBA) 50 feet from Centerline of Outer-most Lane	Increase over Future 2030 No Project Conditions
M.L. King Jr. Way – 45th Street to 40th Street	12,600	< 50	56	117	63.7	0.1
Telegraph Avenue – 45th Street to 40th Street	30,400	< 50	79	164	65.5	0.1
40th Street – West Street to M.L. King Jr. Way	24,000	< 50	86	179	66.0	0.1
40th Street – M.L. King Jr. Way to BART Access	26,700	< 50	91	192	66.5	0.1
40th Street – BART Access to Telegraph Ave.	25,600	< 50	89	186	66.3	0.0
M.L. King Jr. Way – 40th St. to MacArthur Blvd.	12,000	< 50	55	113	63.5	0.3
Telegraph Ave. – 40th Street to 38th Street	29,200	< 50	77	160	65.3	0.2
Telegraph Ave. – 38th St. to MacArthur Blvd.	29,700	< 50	78	162	65.4	0.2
MacArthur Blvd. – West St. to M.L. King Jr. Way	25,900	< 50	91	189	66.0	0.1
MacArthur Blvd. – BART Access to Telegraph Ave.	27,700	< 50	95	197	66.3	0.3
SR-24 – I-580 to 42nd Street	297,400	572	1,228	2,644	82.4	0.0
I-580 – Telegraph Avenue to SR-24	420,900	720	1,547	3,330	83.4	0.0

[a] Baseline conditions included past, present, existing, pending and reasonably foreseeable future development.

Source: LSA Associates, Inc., 2007.

significant traffic noise impacts would occur for off-site land uses. As a result, no mitigation is required to address off-site traffic related noise impacts.

Highway traffic noise sources are the dominant noise source on the project site. Based on Figure 2 of the Noise Element of the City's General Plan, the project site would lie within the projected 70 dBA Ldn roadway noise contour lines of SR-24/I-580 for the year 2025. Modeled traffic noise levels on SR-24 would range up to 74.6 dBA Ldn under Cumulative 2030 Baseline with Project conditions at the nearest potential sensitive receptors on the project site. Noise from traffic along adjacent City streets would also significantly impact potential sensitive land uses on the project site. Noise levels from traffic on MacArthur Boulevard and 40th Street would reach up to 66.3 dBA Ldn at 50 feet from the outermost travel lane of each roadway under Cumulative 2030 Baseline with Project conditions.

These noise levels exceed the "normally acceptable" level established by the City's land use compatibility chart. In accordance with the General Plan Noise Element, in areas with noise levels from 60 dBA to 75 dBA Ldn, construction of medium- to high-density residential buildings would require acoustic analysis to determine the insulation needed to maintain an interior noise level of 45 dBA Ldn.

Based on the Standard Conditions of Approval that are considered part of the project for purposes of this analysis, noise reduction measures in the form of sound-rated assemblies will be incorporated into project building design. Final recommendations for sound-rated assemblies will depend on the specific building designs and layout of buildings on the site and shall be determined during the design phase based upon the recommendations of a qualified acoustical engineer. Based on current site plans, sound-rated assemblies and forced air systems could be used to achieve City Standards.

Based on the EPA's Protective Noise Levels,[9] with a combination of walls, doors, and windows, standard construction for northern California residential buildings would provide more than 25 dBA in exterior to interior noise reduction with windows closed and 15 dBA or more with windows open. With windows open, sensitive receptors on the project site nearest to SR-24 would not meet the interior noise standard (i.e., 74.6 dBA – 15 dBA = 59.6 dBA). Similarly, sensitive receptors on the project site within 50 feet of the outermost travel lane of West MacArthur Boulevard and 40th Street would also not meet the interior noise standard (i.e., 66.3 dBA – 15 dBA = 51.3 dBA). As a result, an alternate form of ventilation, such as air conditioning systems, would be required to ensure that windows could remain closed for a prolonged period of time.

However, even with windows closed using standard northern California residential construction, rooms directly exposed to and located within 240 feet of the centerline of SR-24 would not meet the interior noise standard of 45 dBA Ldn (i.e., 74.6 dBA – 25 dBA = 49.6 dBA). Therefore, in addition to an alternate form of ventilation, building facades directly exposed to this roadway segment must be constructed to have an overall minimum sound transmission class (STC) rating that would reduce traffic noise impacts to meet the interior noise standard of 45 dBA Ldn. The actual ratings must be determined as part of the project specific environmental noise study required by the City. Therefore, the actual required STC ratings might be slightly higher or lower depending on the amount of exposure of each building façade to the noise source. Quality control must be exercised in construction to ensure all air-gaps and penetrations of the building shell are controlled and sealed.

Exterior active use areas would also be exposed to traffic noise levels. There are no noise standards that specifically regulate private open space use areas, but the following is recommended to help ensure noise within outdoor use areas is minimized. A building located between a noise source and receptor would provide a minimum of 15 dBA reduction. Therefore, to minimize impacts to outdoor active use areas, such uses should be sheltered by buildings from direct exposure to SR-24, 40th Street, and West MacArthur Boulevard (see Recommendation NOISE-1 below). Outdoor active use areas including playgrounds, patios, and decks should be sheltered by buildings or by locating such uses a minimum distance of 87 to 372 feet from these roadways to reduce noise impacts. More

[9] EPA 550/9-79-100, November 1978.

specifically, to reduce traffic noise, exterior active use areas should be located a minimum of 87 feet from the centerline of 40th Street, a minimum of 94 feet from the centerline of West MacArthur Boulevard, and a minimum of 372 feet from the centerline of SR-24.

As noted under the existing noise environment discussion (Section IV.E.1.d), an LSA noise technician conducted ambient noise monitoring on the project site to capture noise levels associated with existing operations and activities in the project vicinity. Maximum and minimum noise levels were recorded as well as the equivalent continuous noise level measure Leq. Each of the short-term measurements recorded the approach and departure of at least one BART train. As observed and noted at the time of the recordings, each of the highest single event maximum noise levels resulted from vehicular activity. In particular, for the short-term measurement at site location number 3, nearest to BART and SR-24, the maximum single event noise level sources were buses on the BART access road. Although BART activity was audible (and recorded as part of each measurement) on the project site, BART activity did not produce any single event noise levels higher than existing vehicular noise levels surrounding the site.

Additional analysis was performed to determine the 24-hour weighted effects of BART train activity on future noise sensitive receptors on the project site.

The existing BART rail line and the MacArthur BART boarding platforms are located approximately 225 feet from potential on-site noise sensitive land uses. For purposes of this analysis it is assumed, based on the current train schedule that a maximum of 430 BART trains would pass through the MacArthur BART train station per day. The daily noise level generated by these transit activities was estimated in accordance with the U.S. Department of Transportation, Federal Transit Administration (FTA) recommended methodology obtained from chapter six of *Transit Noise and Vibration Impact Assessment*.[10] The estimation of transit noise levels was based on a combined total of approximately 404 daytime (7:00 a.m. – 10:00 p.m.) and 26 nighttime (10:00 p.m. – 7:00 a.m.) trains during a typical weekday with warning horns sounding as trains approach the station. The calculation assumed an average of 10 cars per train for daytime and five cars per train for nighttime trains and an estimated average speed of 30 miles per hour when approaching and leaving the MacArthur BART station. The calculated train noise level with these assumptions and measured at 50 feet from the BART track centerline is approximately 69 dBA Ldn including warning horns.

Average hourly daytime noise levels from BART trains near the project site can reach 71 dBA Leq(h) at 50 feet (with warning horns). Average hourly nighttime noise levels can reach 69 dBA Leq(h) at 50 feet (with warning horns). The closest noise sensitive land uses within the project site could be located approximately 225 feet from the track centerline. At this

[10] Federal Transit Administration, 2006. *Transit Noise and Vibration Impact Assessment*. May.

distance and assuming a direct line of sight, the predicted train noise levels would be 62.5 dBA Ldn at the façade of these sensitive receptors. This noise level would be reduced to below 60 dBA Ldn at a distance of 400 feet from the track centerline. This data corresponds to the Railroad/BART Noise Contours figure in the Noise Element of the Oakland General Plan[11] which shows that the western portion of the project site would be within the 60 dBA Ldn BART noise contour.

As noted under the discussion of traffic noise impacts (Section IV.E.2.b(3)), noise levels from traffic on SR-24 would range up to 74.6 dBA Ldn under year 2030 baseline with project conditions at the façade of the nearest sensitive receptors on the project site. This is more than 10 dBA greater than that of the calculated BART train activity noise levels of 62.5 dBA Ldn at these receptors. The principles of sound show that the addition of a noise source 10 dBA lower than another noise source would not increase the ambient noise. Therefore, noise from vehicular activity on SR-24 would remain the dominant noise source affecting the project site.

Traffic and BART-related noise impacts would be reduced to a less-than-significant level with implementation of the City's Interior Noise Standard Conditions of Approval (see COA NOISE-4 on page 292). Final site-specific design features must be determined as part of the project specific environmental noise study required by the City. Therefore, the final required design features may change slightly from the following recommendations based on the results of this project-specific analysis.

COA NOISE-4: Interior Noise. *Prior to issuance of a building permit.* If necessary to comply with the interior noise requirements of the City of Oakland's General Plan Noise Element and achieve an acceptable interior noise level, noise reduction in the form of sound-rated assemblies (i.e., windows, exterior doors, and walls) shall be incorporated into project building design, based upon recommendations of a qualified acoustical engineer. Final recommendations for sound-rated assemblies will depend on the specific building designs and layout of buildings on the site and shall be determined during the design phase; however, the following sound-rated assembly recommendations, based on the conceptual project layout and design (described in Chapter III, Project Description) should be included in the final study and will be included in the Standard Condition of Approval:

An alternate form of ventilation, such as air conditioning systems, shall be included in the design for all units located within 659 feet of the centerline of SR-24, or within 153 feet of the centerline of 40th Street, or within 166 feet of the centerline of MacArthur Boulevard to ensure that windows can remain closed to meet the interior noise standard and Uniform Building Code Requirements.

All residential building façades directly exposed to and within 240 feet of the centerline of SR-24 must be constructed to meet the interior DNL 45 dB requirement; this likely could be achieved

[11] City of Oakland, 2005. *City of Oakland General Plan, Noise Element, Figure 3: Railroad/BART Noise Contours (Year 2000)*. June.

with an overall STC-30 rating with windows having a minimum STC-34 rating. This could be achieved with a typical 1-inch insulated glazing assembly, possibly with one light being laminated (or other appropriate example assembly). Quality control must be exercised in construction to ensure all air-gaps and penetrations of the building shell are controlled and sealed.

The following measure is also recommended to help minimize the effect of noise in outdoor use areas (the measure is not a required mitigation measure as there is no standard for private outdoor use area):

Recommendation NOISE-1: All exterior active use areas, including playgrounds, patios, and decks, shall either be shielded by buildings to block any direct line of sight to 40th Street, MacArthur Boulevard, or SR-24; or be located a minimum of 87 feet from the centerline of 40th Street, a minimum of 94 feet from the centerline of MacArthur Boulevard, and a minimum of 372 feet from the centerline of SR-24.

c. Significant Noise and Vibration Impacts. The proposed project would not result in any significant noise or vibration-related impacts.

d. Cumulative Noise and Vibration Impacts. The geographic area considered for the noise cumulative analysis includes the area in close proximity to the project site including North Oakland, parts of West Oakland and Downtown/Oakland Central, south of I-580 to Grand Avenue between San Pablo Avenue on the west and Harrison Street on the east. This area is generally depicted on Figure I-1 on page 2. The cumulative analysis considers shorter-term construction related noise and longer-term operational and traffic related noise, based on the land use projections detailed in Appendix C.

Longer-term noise from cumulative development (including past, present, existing, approved, pending, and reasonably forseeable future development) in the area would primarily occur from motor vehicle traffic. Cumulative traffic noise levels in the project area were estimated using traffic data provided by Fehr and Peers and are presented in Table IV.E-17. As shown in the table, the combination of project and cumulative traffic would not increase traffic noise levels by greater than 5 dBA along the analyzed roadway segments. Therefore, this increase would not be perceptible over the total noise levels that were monitored along these segments. Traffic noise forms one component of the total noise environment. An increase in traffic noise of 5 dBA would not necessarily translate to an increase of 5 dBA in the total ambient noise environment. When the resultant noise levels from project combined with cumulative traffic (past, present, existing, approved, pending and reasonably foreseeable future development) along these segments are logarithmically added to the existing monitored noise levels, the increase would be less than 5 dBA and hence, less than significant.

Noise impacts under cumulative conditions must consider other projects in the vicinity that could contribute a significant cumulative impact on sensitive receptors. Other planned

major construction projects in the MacArthur BART project vicinity include the Kaiser Permanente project located at the intersection of MacArthur Boulevard and Broadway. This planned project is located approximately 0.4 miles (2,100 feet) east of the project site. Existing land uses between the two projects primarily consist of residential land uses with commercial and recreational land uses interspersed.

Two types of short-term noise impacts would occur during demolition and construction phases for both projects. The first is the increase in traffic flow on local streets associated with the transport of workers, equipment, and materials to and from the project sites. Although both projects may result in increases in traffic volumes on the same roadway segments (such as along MacArthur Boulevard), these increases would be expected to be minimal and would result in a less-than-significant impact on sensitive receptors in the vicinity.

The second type of short-term noise impact is related to the noise generated by heavy equipment operating on the project site. Demolition and site preparation phases are typically the loudest phases of construction due to the types of equipment used. The worst case combined noise level during this phase of construction would be approximately 91 dBA Lmax at a distance of 50 feet from an active construction area. The nearest noise sensitive land uses to both project sites would be located approximately 1,050 feet from each site (those residential land uses located half-way between the Telegraph Avenue and MacArthur Boulevard intersection and the intersection of Broadway and MacArthur Boulevard). At this distance and assuming a direct line of sight to both sites, the combined noise levels would be less than 65 dBA Lmax due to distance attenuation alone. Therefore, due to the distance between both project sites and intervening structures, noise from construction equipment operating on both sites would not be audible above the ambient noise levels at sensitive receptors located between the two sites. In addition, the impacts from construction noise at both sites, including pile driving, would be reduced to less-than-significant levels with implementation of the City's Standard and Uniformly Applied Conditions of Approval for construction noise as described in Section IV.E-1.b(3). Compliance with the conditions of approval applicable to construction hours of operation, noise control, noise complaint procedures, and pile driving and other extreme noise generators, would ensure that both projects comply with the City's Noise Ordinance. As the City's Standard and Uniformly Applied Conditions of Approval are included as part of the project, this cumulative impact would be considered less-than-significant.