3.15 Noise

This section describes the fundamentals of noise and vibration and the existing noise environment in the study area. It also identifies the types of sensitive receptors that may potentially be affected by noise with implementation of the proposed program. This section is composed of the following subsections:

- Section 3.15.1, "Environmental Setting," describes the physical conditions in the study area as they apply to the noise environment.
- Section 3.15.2, "Regulatory Setting," summarizes federal, State, and regional and local laws and regulations pertinent to evaluation of the proposed program's impacts on the existing noise environment, including sensitive receptors.
- Section 3.15.3, "Analysis Methodology and Thresholds of Significance," describes the methods used to assess the environmental effects of the proposed program and lists the thresholds used to determine the significance of those effects.
- Section 3.15.4, "Environmental Impacts and Mitigation Measures for NTMAs," discusses the environmental effects of near-term management activities (NTMAs) and identifies mitigation measures for significant environmental effects.
- Section 3.15.5, "Environmental Impacts, Mitigation Measures, and Mitigation Strategies for LTMAs," discusses the environmental effects of long-term management activities (LTMAs), identifies mitigation measures for significant environmental effects, and addresses conditions in which any impacts would be too speculative for evaluation (CEQA Guidelines, Section 15145).

NTMAs and LTMAs are described in detail in Section 2.4, "Proposed Management Activities."

See Section 3.5, "Biological Resources—Aquatic," for a discussion of noise effects on aquatic species; and Section 3.6, "Biological Resources—Terrestrial," for a discussion of noise effects on terrestrial biological species.

3.15.1 Environmental Setting

Information Sources Consulted

Sources of information used to prepare this section include the following:

- The California Department of Transportation's (Caltrans's) *Transportation- and Construction-Induced Vibration Guidance Manual and Technical Noise Supplement* (Caltrans 2004, 2009)
- *Architectural Acoustics*, by M. David Egan (Egan 1988)
- The Federal Transit Administration's *Transit Noise and Vibration Impact Assessment* (FTA 2006)
- The geographic information system (GIS) layers for aggregate mines, airports, and railroad lines available in Caltrans's online GIS Data Library (Caltrans 2006, 2008, 2010)
- The GIS layer "General Plan Land Use Designations for the State of California" (CRA 2004)

Geographic Areas Discussed

Noise receptors and generators are not discussed separately for the different geographic areas within the study area because of the similarities in their noise receptors and generators. Furthermore, none of the management activities included in the proposed program would be implemented in the SoCal/coastal Central Valley Project/State Water Project (CVP/SWP) service areas. In addition, implementation of the proposed program would not result in long-term reductions in water deliveries to the SoCal/coastal CVP/SWP service areas (see Section 2.6, "No Near- or Long-Term Reduction in Water or Renewable Electricity Deliveries"). Given these conditions, little to no effect on noise receptors and generators is expected in the portion of the SoCal/coastal CVP/SWP service areas located outside of the Sacramento and San Joaquin Valley and foothills and the Sacramento and San Joaquin Valley watersheds. Therefore, this geographic area is not discussed in detail in this section.

Noise Fundamentals

Acoustics is the scientific study that evaluates the perception, propagation, absorption, and reflection of sound waves. Sound is a mechanical form of radiant energy, transmitted by a pressure wave through a solid, liquid, or gaseous medium. Loud, disagreeable, unexpected, or unwanted sound is generally defined as noise; consequently, the perception of sound is subjective and can vary substantially from person to person. Common sources of environmental noise and noise levels are listed in Figure 3.15-1.

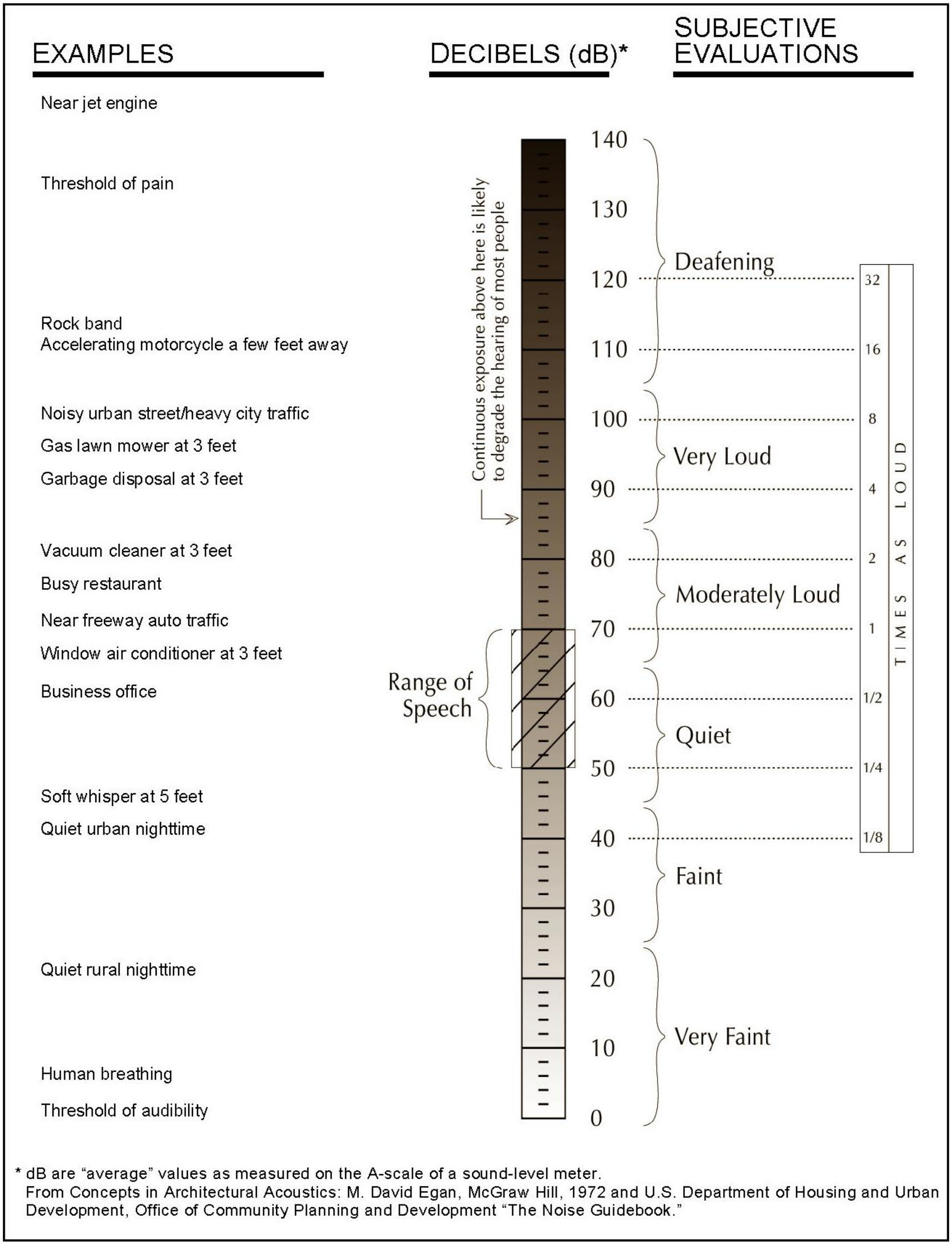

Figure 3.15-1. Common Noise Sources and Levels

Directly measuring sound pressure fluctuations would require the use of a very large and cumbersome range of numbers. Therefore, the decibel (dB) scale was introduced for sound pressure in air, and the standard reference quantity is generally considered to directly correspond to the threshold of human hearing. The use of the decibel is a convenient way to describe the million-fold range of sound pressures to which the human ear is sensitive. A decibel is logarithmic, and combining source levels results in sound amplitude instead of simple mathematical addition. When combining two sources of the same level, the combined overall noise level increases by 3 dB. A sound-level increase of 10 dB corresponds to 10 times the acoustical energy.

The loudness of noise perceived by the human ear depends primarily on the overall noise pressure level and frequency content of the noise source. The human ear is not equally sensitive to loudness at all frequencies in the audible spectrum. To better relate overall sound levels and loudness to human perception, frequency-dependent weighting networks were developed. There is a strong correlation between the way humans perceive noise and A-weighted noise levels (dBA). For this reason, the dBA can be used to predict community response to noise sources, including noise from transportation and stationary sources. Sound levels expressed as dB in this section are A-weighted sound levels, unless noted otherwise.

Noise can be generated by numerous sources that are often divided into two broad categories: mobile sources (transportation noise), such as automobiles, trucks, and airplanes; and stationary sources (nontransportation noise), such as construction sites, machinery, and commercial and industrial operations.

The inverse-square law describes the attenuation, or manner of noise reduction in relation to distance, caused by the pattern in which noise travels from the source to the receptor. As acoustic energy spreads (propagates) through the atmosphere from the source to the receiver, noise levels attenuate (decrease) depending on ground absorption characteristics, atmospheric conditions, and the presence of physical barriers (e.g., walls, building façades, berms). Depending on the intervening ground type between the source and the receptor, noise generated from mobile sources attenuates at a rate of 3 dB (typical for hard surfaces, such as asphalt) to 4.5 dB (typical for soft surfaces, such as grasslands) per doubling of distance. Stationary noise sources spread with more spherical dispersion patterns that attenuate at a rate of 6 to 7.5 dB per doubling of distance, depending on the intervening ground type between the source and the receptor (Caltrans 2009:2-29 and 2-30).

Atmospheric conditions such as wind speed, turbulence, temperature gradients, and humidity may additionally alter the propagation of noise and affect levels at a receptor. Furthermore, the presence of a large object (e.g., barrier, topographic features, intervening building façades) between the source and the receptor can provide significant attenuation of noise levels. The amount of noise level reduction or "shielding" provided by a barrier depends primarily on the size of the barrier (height and density), the location of the barrier in relation to the source and receptors, and the frequency spectra of the noise. Natural barriers, such as berms, hills, or thick dense woods, and human-made features, such as buildings and walls, may be effective noise barriers (Caltrans 2009:2-39 through 2-40).

Noise Descriptors

The intensity of environmental noise fluctuates over time, and several different descriptors of time-averaged noise levels are used. The selection of a proper noise descriptor for a specific source depends on the spatial and temporal distribution, duration, and fluctuation of both the noise source and the environment. The noise descriptors most often used to describe environmental noise are defined as follows:

- **L_{max} (maximum noise level)**—The maximum instantaneous noise level during a specific period of time. The L_{max} may also be referred to as the "peak (noise) level."

- **L_{min} (minimum noise level)**—The minimum instantaneous noise level during a specific period of time.

- **L_x (statistical descriptor)**—The noise level exceeded X percent of a specific period of time. For example, L_{50} is the median noise level, or the level exceeded 50 percent of the time.

- **L_{eq} (equivalent noise level)**—The average noise level. The instantaneous noise levels during a specific period of time in dBA are converted to relative energy values. From the sum of the relative energy values, an average energy value is calculated, which is then converted back to dBA to determine the L_{eq}. In noise environments determined by major noise events, such as aircraft overflights, the L_{eq} value is heavily influenced by the magnitude and number of single events that produce the high noise levels.

- **L_{dn} (day-night average noise level)**—The 24-hour L_{eq} with a 10-dBA "penalty" for noise events that occur during the noise-sensitive hours between 10 p.m. and 7 a.m. In other words, 10 dBA is "added" to noise events that occur in the nighttime hours, and this generates a higher reported noise level when determining compliance with noise standards. The L_{dn} attempts to account for the fact that noise during this specific period of time is a potential source of disturbance with respect to normal sleeping hours.

- **CNEL (community noise equivalent level)**—A noise level similar to the L_{dn} described above, but with an additional 5-dBA "penalty" added to noise events that occur during the noise-sensitive hours between 7 p.m. and 10 p.m., which are typically reserved for relaxation, conversation, reading, and television. When the same 24-hour noise data are used, the reported CNEL is typically approximately 0.5 dBA higher than the L_{dn}.

- **SEL (sound exposure level)**—The cumulative exposure to sound energy over a stated period of time.

Community noise is commonly described in terms of the ambient noise level, which is defined as the all-encompassing noise level associated with a given noise environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level L_{eq}, which corresponds to a steady-state A-weighted sound level containing the same total energy as a time-varying signal over a given time period (typically 1 hour). The L_{eq} is the foundation of the composite noise descriptors such as L_{dn} and CNEL, as defined above, and shows very good correlation with community response to noise.

Human Response to Noise

Excessive and chronic exposure to elevated noise levels can result in auditory and nonauditory effects on humans. Auditory effects are temporary or permanent hearing loss caused by loud noises. Nonauditory effects of exposure to elevated noise levels are behavioral subjective effects of annoyance, nuisance, and dissatisfaction, which lead to interference with activities such as communication, sleep, and learning, and physiological correlations of elevated noise levels and health problems, such as hypertension and cardiovascular disease. The extent to which noise contributes to nonauditory health effects remains a subject of considerable research with no definitive conclusions.

The degree to which noise results in annoyance and interference is highly subjective and may be influenced by several nonacoustic environmental and physical factors (e.g., sensitivity, level of activity, location, time of day, and length of exposure). Predicting human response to new noise environments may be based on an individual's adaptation to an existing noise environment. The greater the change in the noise levels relative to the environment to which an individual has become accustomed, the less tolerable the new noise source will be. Subjective perceptions of changes in noise levels (Table 3.15-1) were developed on the basis of test subjects' reactions to changes in the levels of steady-state pure tones or broadband noise and to changes in levels of a given noise source. It is probably most applicable to noise levels in the range of 50–70 dBA because this is the usual range of voice and interior noise levels. For these reasons, a noise level increase of 3 dBA or more is frequently considered a threshold for determining when substantial degradation of the existing noise environment might occur.

Table 3.15-1. Subjective Reaction to Changes in Noise Levels of Similar Sources

Change in Level (dB)	Subjective Reaction	Factor Change in Acoustical Energy
1	Imperceptible (except for tones)	1.3
3	Just barely perceptible	2.0
6	Clearly noticeable	4.0
10	About twice (or half) as loud	10.0

Source: Egan 1988:21

Key:
dB = decibels

Vibration

Vibration is similar to noise in that it is a pressure wave traveling through an elastic medium, such as air; however, vibration relates to the excitation of a structure or surface, such as in buildings or the ground. Vibration may be caused by either natural phenomena (earthquakes, volcanic eruptions, sea waves, landslides) or human activity (explosions, operation of machinery, traffic, trains, construction equipment). Vibration sources may be continuous (e.g., operating factory machinery) or transient (e.g., explosions).

Vibration levels can be depicted in terms of amplitude and frequency, relative to displacement, velocity, or acceleration, and are commonly expressed in peak particle velocity (PPV) or root-mean-square (RMS) vibration velocity. PPV is defined as the maximum instantaneous positive or negative peak of a vibration signal. PPV is typically used in the monitoring of transient and impact vibration and has been found to correlate well to the stresses experienced by buildings (FTA 2006:7-1 through 7-8; Caltrans 2004:5-7). Root mean square is defined as the positive and negative statistical measure of the magnitude of a varying quantity. PPV and RMS vibration velocity are normally described in inches per second (in/sec).Vibration effects on humans are evaluated in terms of

RMS vibration velocity, which is expressed in vibration decibel notation (VdB) as shown in Table 3.15-2. The range of vibration that is considered relevant as a threshold for environmental effects occurs from approximately 50 VdB, the typical background vibration-velocity level, to 100 VdB, the general threshold where minor damage can occur in fragile buildings (FTA 2006:8-1 through 8-8).

Table 3.15-2. Human Response to Different Levels of Groundborne Noise and Vibration

Vibration-Velocity Level	Human Reaction
65 VdB	Approximate threshold of perception.
75 VdB	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find that transportation-related vibration at this level is unacceptable.
85 VdB	Vibration acceptable only if there are an infrequent number of events per day.

Source: FTA 2006:7-8

Key:
VdB = vibration decibels referenced to 1 microinch per second and based on the root-mean-square velocity amplitude.

Vibration in the community has often been cited as a health problem because it can inhibit general well-being and contribute to undue stress and annoyance. Vibration can interfere with human activities, such as sleep, speech, recreation, and tasks demanding concentration or coordination. Table 3.15-3 shows human perception levels for vibration and thresholds for potential damage to different categories of buildings.

Some typical community sources of perceptible vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. Although effects may be imperceptible at low levels, at moderate and high levels groundborne vibration may result in detectable vibrations and slight damage to nearby structures, respectively. At the highest levels, vibration causes primarily architectural damage to structures (e.g., loosening and cracking of plaster or stucco coatings) and rarely damages structural components.

Table 3.15-3. Vibration Damage/Annoyance Potential

Structure and Condition	Maximum PPV (in/sec)	
	Transient Sources[1]	Continuous/ Frequent Intermittent Sources[1]
Structure Types[2]		
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5
Human Responses		
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.9	0.10
Severe	2.0	0.4

Source: Caltrans 2004

Notes:
[1] Transient sources create a single, isolated vibration event, such as blasting or drop balls (i.e., raising and lowering a heavy steel weight from a crane to break large blocks of material). Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.
[2] Vibration figures indicate the level of vibration that could begin to result in structural damage to the building.

Key:
in/sec = inches per second
PPV = peak particle velocity

Existing Noise Environment

The noise study area, shown in Figure 3.15-2, covers a vast area. For this reason, only major noise sources in the study area are described as part of the existing noise environment. Major noise sources in the study area consist of mobile and stationary sources—primarily highway traffic and local traffic on city streets, railroad operations, airport operations and aircraft overflights, commercial and industrial uses, and quarries/mines. Each of these two categories of noise sources (mobile and stationary) is discussed individually below.

Figure 3.15-2. Major Sources of Mobile-Source Noise in the Extended Systemwide Planning Area

Mobile Sources of Noise Mobile sources are the primary noise sources in the study area because of their dominance in urban areas and the presence of major highways that cross the study area. Mobile sources consist of roadway traffic, train operations, airport operations, airplane overflights, and motorized boats; in general, sources located adjacent to waterways, rivers, or floodways are of greater importance with regard to the effects of the proposed program. The following major mobile sources of noise are found in the study area:

- **Roadways**—Numerous roadways—interstates, highways, local thoroughfares, and rural county roads—traverse the study area. The major roadways that extend through the study area are Interstate 5 (I-5), I-80, and State Route (SR) 99. However, many of the actions associated with the proposed program would require the use of local roads in urban communities and rural roadways to access specific sites (e.g., levees and other flood management infrastructure). Refer to Figure 3.15-2 for the locations of major roadways extending through the study area.

- **Railroads**—Numerous railroad lines traverse the study area. Union Pacific Railroad (UPRR) is the major operator of rail lines in the study area. However, other railway companies operate railways in the study area, such as the Burlington Northern Santa Fe (BNSF) Railway. The main railroad lines operated by UPRR in the study area are the Overland Route and I-5 Corridor. The Overland Route extends from Oakland to Reno, Nevada, and eventually to Chicago. The I-5 Corridor route extends from Seattle to Los Angeles, passing through California's Central Valley. The main railroad line operated by BNSF in the study area extends from the California/Oregon border through the Sacramento and San Francisco Bay areas, through the Central Valley, and into the Los Angeles basin. Refer to Figure 3.15-2 for the location of major rail lines traversing the study area.

- **Airports**—Numerous airports operate in the study area, ranging from international airports to remote runways that serve agricultural needs (e.g., pesticide spraying). Sacramento International Airport is the major airport operating in the study area. Numerous local and regional airports also operate up and down the valley, such as the Red Bluff Municipal Airport and Modesto City-County Airport, which primarily serve as "puddle jumpers" to larger, international airports, such as the Oakland and San Francisco International airports. Refer to Figure 3.15-2 for the location of major airports in the study area.

Stationary Sources of Noise The study area encompasses numerous urban communities with many communities congruent with each other, such as the communities of Manteca and Lathrop. Areas adjacent to SR 99 in particular constitute a seemingly continuous urban, developed region. However, the Sacramento metropolitan area is the largest urban community in the study area, not including the SoCal/coastal CVP/SWP service areas. Figure 3.15-3 shows the locations of major urban land use areas in the study area and major stationary sources of noise. Primary stationary noise sources in the study area are summarized below by land use type. In general, sources located adjacent to waterways, rivers, or floodways are of greater importance with regard to the effects of the proposed program:

- **Large Commercial**—The vast majority of commercial land uses (e.g., shopping malls) are located in urban communities in the study area. These commercial centers generate noise identified as a stationary source. Typical sources of noise created at large commercial centers are parking lot activities, loading dock activities, and traffic entering and exiting the centers.

- **Industry**—Like the large commercial areas discussed previously, industrial centers are located in urban communities spread across the study area. These industrial centers can take different land use designs: business parks, manufacturing facilities, distribution centers, and research and development facilities. Types of noise sources associated with industrial centers are parking lot activities, mechanical equipment (e.g., electrical generators), and heavy truck traffic.

- **Quarry and Mining Operations**—Quarry and mining operations are located in the study area. In particular, a large number of quarry and mining operations are located in Yuba County, mostly along the Yuba River. Quarry sites can require an extensive conveyor system, crushers, screeners, front loaders, bulldozers, draglines, water trucks, haul trucks, hot plants, ready-mix concrete plants, and other large pieces of equipment that generate elevated noise levels. Additionally, many large-scale quarries run during more noise-sensitive night and evening hours to save on electricity costs.

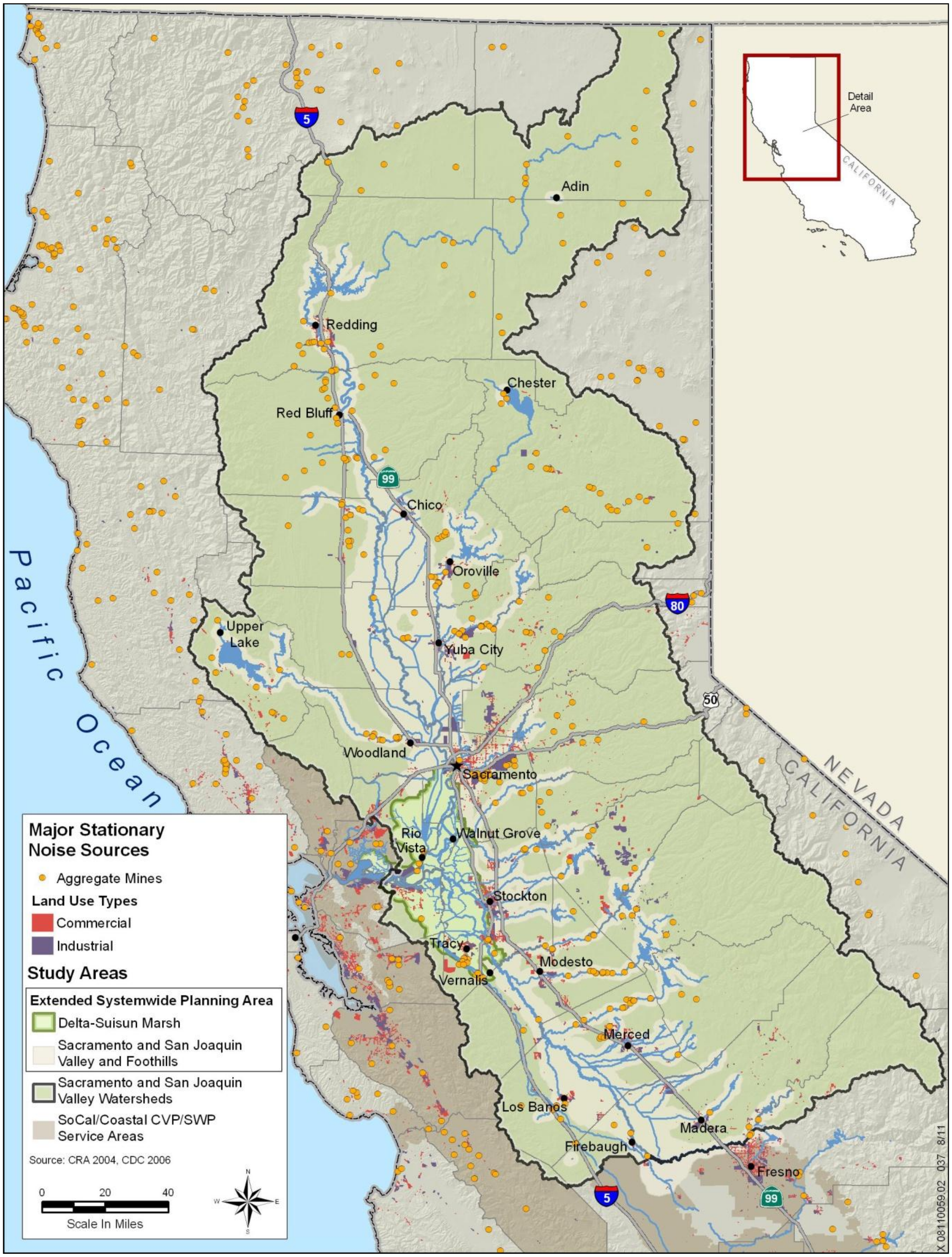

Figure 3.15-3. Major Sources of Stationary-Source Noise in the Extended Systemwide Planning Area

Vibration Sources

Typical sources of perceptible groundborne vibration are operation of construction equipment and steel-wheeled trains, along with traffic on rough, unmaintained roads. Vibration from operational construction equipment could occur throughout the study area, depending on the location of current and future land development projects. Trains operate throughout the study area, as described previously, and vibration would be experienced near the expansive network of rail lines. Lastly, vibration created by traffic on rough roads would most likely occur in remote, rural areas of the study area where unmaintained dirt and unpaved roads are more prevalent.

Sensitive Receptors

Noise-sensitive land uses, or sensitive receptors, are generally considered to include those uses where noise exposure could result in health-related risks to individuals, as well as places where individuals expect quiet to be an essential element of the location. Residential dwellings are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise and potential sleep disruptions. Additional land uses, such as parks, historic sites, cemeteries, and recreation areas, are also considered sensitive to exterior noise. Schools, places of worship, hotels, libraries, nursing homes, retirement residences, and other places where low interior noise levels are essential are also considered noise-sensitive land uses/sensitive receptors. The majority of noise-sensitive land uses in the study area are residential.

3.15.2 Regulatory Setting

The following text summarizes federal, State, and regional and local laws and regulations pertinent to evaluation of the proposed program’s impacts on the existing noise environment in the study area.

Federal

The U.S. Environmental Protection Agency’s (EPA’s) Office of Noise Abatement and Control was originally established to coordinate federal noise control activities. The federal Noise Control Act, enacted in 1972, established programs and guidelines to identify and address the effects of noise on public health, welfare, and the environment. In 1981, EPA administrators determined that subjective issues, such as noise, would be better addressed at lower levels of government. Consequently, in 1982, responsibilities for regulating noise control policies were transferred to state and local governments. However, noise control guidelines and regulations contained in EPA rulings in prior years remain in place and are implemented by designated federal agencies, thereby allowing more individualized control for specific issues by designated local, State, and federal government agencies.

State

The State of California has adopted noise standards in areas of regulation not preempted by the federal government. State standards regulate noise levels of motor vehicles, sound transmission through buildings, occupational noise control, and noise insulation. Title 24 of the California Code of Regulations, also known as the California Building Standards Code, establishes building standards applicable to all occupancies throughout California. The code provides acoustical regulations for both exterior-to-interior sound insulation and sound and impact isolation between adjacent spaces of various occupied units. Title 24 regulations state that interior noise levels generated by exterior noise sources shall not exceed 45 dB L_{dn}, with windows closed, in any habitable room for general residential uses.

Although not adopted by law, the *State of California General Plan Guidelines 2003*, published by the California Governor's Office of Planning and Research (OPR), provides guidance for the compatibility of projects within areas of specific noise exposure. Table 3.15-4 presents what are considered acceptable and unacceptable community noise exposure limits for various land use categories under average daily conditions. It should be noted that the noise standards shown in Table 3.15-4 are more appropriately applied to permanent noise sources (e.g., a commercial building or pump station). Local jurisdictions often adopt separate noise ordinances that address acceptable construction-related noise levels, taking into account necessary temporary increases in ambient noise levels associated with the operation of heavy pieces of construction equipment. OPR's general plan guidelines also present adjustment factors that may be used to arrive at noise acceptability standards that reflect the noise control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution.

Table 3.15-4. California General Plan Land Use Noise Compatibility Guidelines

Land Use Category	Community Noise Exposure ($CNEL/L_{dn}$, dBA)			
	Normally Acceptable[1]	Conditionally Acceptable[2]	Normally Unacceptable[3]	Clearly Unacceptable[4]
Residential—Low Density Single Family, Duplex, Mobile Home	<60	55–70	70–75	75+
Residential—Multiple Family	<65	60–70	70–75	75+
Transient Lodging, Motel, Hotel	<65	60–70	70–80	80+
School, Library, Church, Hospital, Nursing Home	<70	60–70	70–80	80+
Auditorium, Concert Hall, Amphitheater		<70	65+	
Sports Arenas, Outdoor Spectator Sports		<75	70+	
Playground, Neighborhood Park	<70		67.5–75	72.5+
Golf Courses, Stable, Water Recreation, Cemetery	<75		70–80	80+
Office Building, Business Commercial, and Professional	<70	67.5–77.5	75+	
Industrial, Manufacturing, Utilities, Agriculture	<75	70–80	75+	

Source: OPR 2003:244–254

Notes:

[1] Specified land use is satisfactory, based on the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

[2] New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features are included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

[3] New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design. Outdoor areas must be shielded.

[4] New construction or development should generally not be undertaken.

Key:
CNEL = community noise equivalent level
dBA = A-weighted decibels
L_{dn} = day-night average noise level

Regional and Local

Each county and city in the study area has its own general plan policies and local ordinances. Although there are a considerable number of general plan policies and local noise regulations/ordinances applicable to the study area, many of these policies and regulations/ordinances are generally similar among the different jurisdictions. For example, policies and regulations frequently address noise issues related to exempting noise generated by construction activities during daytime hours (e.g., 7 a.m. to 7 p.m.) and/or establishing maximum noise levels allowable during certain times of the day (e.g., 65 dBA L_{dn} during daytime, 55 dBA L_{dn} during evening, 45 dBA L_{dn} during nighttime). In addition, separate from construction noise evaluations, counties and cities typically use land-use compatibility noise levels to evaluate standards for transportation noise levels. For example, Sacramento County's land use compatibility noise levels for transportation noise sources are 65 dBA L_{dn} for outdoor areas and 45 dBA L_{dn} for interior areas at all new residential land uses.

It should be noted that many local noise ordinances either exempt or include special provisions for construction-related noise, thus allowing construction activities to be considered in compliance with the ordinance even if the noise generated exceeds the standards applied to other activities. The separate treatment of construction noise is often an acknowledgment that construction noise is a temporary condition, that reducing noise levels below a particular threshold is frequently infeasible because of the high noise levels inherent with operation of construction equipment, and that construction often must occur near sensitive receptors. Some jurisdictions also make special provisions to allow nighttime construction to occur without considering such construction a violation of applicable noise regulations.

Should a place-based project be defined and pursued as part of the proposed program, and should the CEQA lead agency be subject to the authority of local jurisdictions, the applicable county and city policies and ordinances would be addressed in a project-level CEQA document as necessary.

In community noise assessments, increases in community noise levels associated with implementation of a program or project are "generally not significant" if no noise-sensitive sites are located within the study area, or if the noise level increases would not exceed 3 dB at nearby noise-sensitive locations (Caltrans 2009:2-48 through 2-50). However, using a single value to evaluate an impact relating to a noise level increase does not account for the preexisting ambient noise environment to which people have become accustomed. Studies assessing the percentage of people who are highly annoyed by changes in ambient noise levels indicate that when ambient noise levels are low, a greater change is needed to cause a response. As ambient noise levels increase, less change in noise levels is required to elicit substantial annoyance. The criteria outlined in Table 3.15-5 correlate human response to changes in ambient noise levels and assess degradation of the ambient community noise environment in counties and cities.

Table 3.15-5. Significant Change in Ambient Noise Levels

Existing Ambient Noise Level, L_{dn}/CNEL	Significant Increase
< 60 dB	+ 5 dB or greater
> 60 dB	+ 3 dB or greater

Sources: FICON 1992:3-15; Caltrans 2009:2-47 through 2-50

Key:
CNEL = community noise equivalent level
dB = A-weighted decibels
L_{dn} = day-night average noise level

3.15.3 Analysis Methodology and Thresholds of Significance

This section provides a program-level evaluation of the direct and indirect effects on the noise environment of implementing management actions included in the proposed program. These proposed management actions are expressed as NTMAs and LTMAs. The methods used to assess how different categories of NTMAs and LTMAs could affect the noise environment are summarized in “Analysis Methodology”; thresholds for evaluating the significance of potential impacts are listed in “Thresholds of Significance.” Potential effects related to each significance threshold are discussed in Section 3.15.4, “Environmental Impacts and Mitigation Measures for NTMAs,” and Section 3.15.5, “Environmental Impacts, Mitigation Measures, and Mitigation Strategies for LTMAs.”

Analysis Methodology

Impact evaluations were based on a review of the management actions proposed under the CVFPP, expressed as NTMAs and LTMAs in this PEIR, to determine whether these actions could potentially result in impacts on the noise environment. NTMAs and LTMAs are described in more detail in Section 2.4, “Proposed Management Activities.” The overall approach to analyzing the impacts of NTMAs and LTMAs and providing mitigation is summarized below and described in detail in Section 3.1, “Approach to Environmental Analysis”; analysis methodology specific to noise is described below. NTMAs can consist of any of the following types of activities:

- Improvement, remediation, repair, reconstruction, and operation and maintenance of existing facilities
- Construction, operation, and maintenance of small setback levees
- Purchase of easements and/or other interests in land

- Operational criteria changes to existing reservoirs that stay within existing storage allocations
- Implementation of the vegetation management strategy included in the CVFPP
- Initiation of conservation elements included in the proposed program
- Implementation of various changes to DWR and Statewide policies that could result in alteration of the physical environment

All other types of CVFPP activities fall within the LTMA category. NTMAs are evaluated using a typical "impact/mitigation" approach. Where impact descriptions and mitigation measures identified for NTMAs also apply to LTMAs, they are also attributed to LTMAs, with modifications or expansions as needed.

Implementation of the proposed program would result in construction-related, operational, and maintenance-related noise impacts. This analysis evaluates potential construction noise and noise from facility operations and maintenance activities that could affect noise-sensitive land uses (also referred to as sensitive receptors). Noise-sensitive land uses are described above in Section 3.15.1, "Environmental Setting." Policy issues contained in the CVFPP are also considered, although adoption or modification of policies would have potential to affect noise conditions only indirectly. Typical sources of construction-related noise include heavy equipment operation, truck traffic along access and haul routes, and vehicle traffic associated with the construction labor force.

Operations and maintenance activities could also involve the use of heavy equipment, such as for vegetation management and repairs on new levees and for channel dredging. Operation of heavy equipment would likely be the greatest noise generator from project operations and maintenance. However, facilities associated with the proposed program that have mechanical equipment such as pumps or heating, ventilation, and air conditioning (HVAC) systems could result in a permanent or periodic increase in ambient noise levels.

As discussed above, little to no effect on noise receptors and generators is expected in the SoCal/coastal CVP/SWP service areas outside of the Extended SPA; therefore, those geographic areas are not discussed in detail in this section.

Thresholds of Significance

The following applicable thresholds of significance have been used to determine whether implementing the proposed program would result in a significant impact. These thresholds of significance are based on Appendix G of the CEQA Guidelines, as amended, with slight modifications. A noise impact is considered significant if implementation of the proposed program would do any of the following when compared against existing conditions:

- Expose persons to or generate noise levels at sensitive receptors in excess of standards established in an applicable local general plan or noise ordinance, or applicable standards of other agencies
- Expose persons and/or structures to excessive groundborne vibration or groundborne noise levels
- Result in a substantial permanent increase in ambient noise levels at sensitive receptors
- Result in a substantial temporary or periodic increase in ambient noise levels at sensitive noise receptors
- For a project located within an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public-use airport, expose people residing or working in the project area to excessive noise levels
- For a project within the vicinity of a private airstrip, expose people residing or working in the project area to excessive noise levels

The following thresholds are used to assess groundborne vibration impacts for the second significance threshold:

- Short- and long-term groundborne vibration impacts would be significant when sensitive receptors are exposed to vibration levels that exceed Caltrans's recommended standard of 0.2 in/sec PPV with respect to the prevention of structural damage for normal buildings (Caltrans 2004:17) or the Federal Transit Administration's (FTA's) maximum acceptable vibration standard of 80 VdB with respect to human response for residential uses (i.e., annoyance) (FTA 2006:8-3) at any nearby existing sensitive land uses.

The following thresholds (evaluated in terms of L_{eq}) are used to assess noise impacts for the third significance threshold listed above (i.e., permanent increase in ambient noise levels):

- Where existing ambient noise levels are less than 60 dB, a significant increase would be considered a +5-dB change in ambient noise levels attributable to the project, and where existing ambient noise levels exceed 60 dB, a significant increase would be considered a +3-dB change in ambient noise levels attributable to the project.

The following thresholds (evaluated in terms of L_{eq}) are used to assess noise impacts for the fourth significance threshold listed above (i.e., temporary increase in ambient noise levels):

- For nonconstruction noise sources, where existing ambient noise levels are less than 60 dB, a significant increase would be considered a +5-dB change in ambient noise levels attributable to the project, and where existing ambient noise levels exceed 60 dB, a significant increase would be considered a +3-dB change in ambient noise levels attributable to the project.

- For construction noise sources, noise levels exceeding 70 dBA at the location of sensitive receptors outside of normal construction hours (from 6 a.m. to 8 p.m., Monday through Friday, and from 7 a.m. to 8 p.m., Saturday and Sunday, and any additional period required by the nature of the project or due to unforeseen circumstances that necessitate work in process to be completed), and/or construction noise during normal construction hours in the vicinity of sensitive receptors that has not been reduced through feasible noise control measures.

These thresholds of significance are being applied for purposes of the analysis in this PEIR. As stated above, should a place-based project be defined and pursued as part of the proposed program, and should the CEQA lead agency be subject to the authority of local jurisdictions, the applicable county and city policies and ordinances would be addressed in a project-level CEQA document as necessary.

Significance Thresholds Not Evaluated Further

Although some individual CVFPP management actions may ultimately be located in the vicinity of an airport or private airstrip, no homes, businesses, or similar development would be constructed as part of the proposed program within 2 miles of an airport or private airstrip under the proposed program. Construction workers could be active in areas exposed to aircraft noise; however, the exposure would be temporary, lasting only as long as the construction period. In addition, construction workers would use ear protection on-site as part of standard construction practices. Therefore, program implementation would not result in residents or workers being exposed to excessive aircraft noise, and thresholds of significance related to this topic would not apply to the proposed program. For these reasons, this issue is not evaluated further.

3.15.4 Environmental Impacts and Mitigation Measures for NTMAs

This section describes the physical effects of NTMAs on the noise environment. For each impact discussion, the environmental effect is determined to be either less than significant, significant, potentially significant, or beneficial compared to existing conditions and relative to the thresholds of significance described above. These significance categories are described in more detail in Section 3.1, “Approach to Environmental Analysis.”

Feasible mitigation measures are identified to address significant or potentially significant impacts. Actual implementation, monitoring, and reporting of the PEIR mitigation measures would be the responsibility of the project proponent for each site-specific project. For those projects not undertaken by, or otherwise subject to the jurisdiction of, DWR or the Central Valley Flood Protection Board (Board), the project proponent generally can and should implement all applicable and appropriate mitigation measures. The project proponent is the entity with primary responsibility for implementing specific future projects and may include DWR; the Board; reclamation districts; local flood control agencies; and other federal, State, or local agencies. Because various agencies may ultimately be responsible for implementing (or ensuring implementation of) mitigation measures identified in this PEIR, the text describing mitigation measures below does not refer directly to DWR but instead refers to the “project proponent.” This term is used to represent all potential future entities responsible for implementing, or ensuring implementation of, mitigation measures.

Impact NOI-1 (NTMA): ***Exposure of Sensitive Receptors to Temporary and Short-Term Construction-Related Noise***

Impacts of construction equipment and construction-related traffic on exposure of sensitive receptors to temporary and short-term construction-related noise are discussed separately below.

Construction Equipment

Implementation of NTMAs would result in intermittent construction activities (e.g., levee repairs, improvements, and reconstruction). These construction activities could potentially expose sensitive receptors to noise levels in excess of the applicable noise standards or result in a noticeable increase in ambient noise levels, or both. Construction noise levels in the study area would fluctuate, depending on the particular types of equipment and the number of pieces used and the duration of use. The effects of construction noise depend largely on the type of construction activities occurring on any given day, noise levels generated by those activities, distances to noise-sensitive receptors, any noise-attenuating obstructions between the construction activity and noise-sensitive receptors, and the existing ambient noise environment in the receptor's vicinity. Construction generally occurs in several discrete stages, each phase requiring a specific complement of equipment with varying equipment type, quantity, and intensity. These variations in the operational characteristics of the equipment change the effect that construction has on the noise environment of the project area and the surrounding lands for the duration of the construction process.

Site preparation activities, which involve grading, compacting, and excavation, typically generate the highest noise levels and thus are the focus of this analysis. Equipment used for site preparation often includes backhoes; bulldozers; loaders; excavation equipment, such as graders and scrapers; and compaction equipment. Erection of large structural elements and mechanical systems could require the use of a crane for placement and assembly tasks, which may also generate high noise levels. Pile drivers may be required for construction of some NTMAs. Table 3.15-6 depicts the noise levels generated by various types of construction equipment. For levee projects, building or repairing the levee involves equipment and construction methods very similar to those described above for site preparation, basically requiring the excavation, moving, and compaction of earthen material.

To assess noise levels associated with the various equipment types and operations, construction equipment can be considered to operate in two modes: mobile and stationary. Mobile equipment, such as loaders, graders, and dozers, moves around a construction site, performing tasks in a recurring manner. Stationary equipment is used to perform continuous or periodic operations in a given location for an extended period, such as a pile driver. Thus, determining the effective acoustical center of operations for mobile equipment during the construction process or the location of stationary sources during specific activities is necessary when conducting a noise analysis. Operation of heavy construction equipment typically is characterized by short periods of full-power operation, then by extended periods of operation at lower power, idling, or powered-off conditions.

As indicated in Table 3.15-6, maximum (peak) noise levels for typical construction activities range from 55 to 95 dBA at a distance of 50 feet. Continuous, combined noise levels generated by the simultaneous operation of the loudest pieces of equipment could result in noise levels of 95 dBA at 50 feet. Accounting for the usage factor of individual pieces of equipment and absorption effects, construction activities on a project site would be expected to result in hourly average noise levels of 90 dBA L_{eq} at a distance of 50 feet. Maximum noise levels generated by construction activities are not predicted to exceed 95 dBA L_{max} (maximum sound level) at 50 feet.

Depending on the type and scale of project undertaken, in-water equipment such as tugs and barges may also be required during construction. Typical noise levels from these types of in-water equipment are approximately 78 dBA at 50 feet (Illingworth & Rodkin 2003, as cited in SCPRMD 2008). Based on the expected construction noise levels discussed previously, the use of in-water equipment would contribute to construction noise levels similar to the levels generated by typical heavy onshore construction equipment (e.g., backhoes, bulldozers).

During construction of the Sacramento Area Flood Control Agency's Natomas Levee Improvement Program (NLIP), AECOM conducted in-field noise measurements to field-verify noise modeling conducted previously for the NLIP Phase 2 Landside Improvements EIR. The activities associated with the NLIP and the type of equipment used (e.g., excavators, scrapers, tractors, dozers) are considered representative of the type of activities that could occur and the type of equipment that could be used during NTMA construction. Noise level measurements were taken during specific activities—construction of a cutoff wall, levee degrading, borrow site excavating, and operations at a slurry pond—and are presented in Table 3.15-7. As shown in the table, construction activities associated with levee improvement projects can generate a wide range of noise levels, depending on the equipment being used, type of activities, and location.

Table 3.15-6. Construction Equipment Noise Emission Levels[1]

Equipment Type	Typical Noise Level ($dBA\ L_{max}$) at 50 feet
Asphalt paver	77
Auger drill rig	85
Backhoe	78
Bulldozer	82
Chipper/grinder	89
Compactor	83
Concrete pump truck	82
Crane (mobile)	81
Dump/haul truck	84
Excavator	82[2]
Front-end loader	79
Generator	81
Grader	85
Pickup truck	55
Pile driver (impact)	95
Roller	85
Scraper	84
Slurry plant	86[2]
Tractor	84
Trucks	74–81
Water truck	86[2]

Sources: Bolt, Beranek, and Newman 1981; FTA 2006:12-6 and 12-7

Notes:
[1] Noise levels assume all equipment fitted with properly maintained and operational noise control device, per manufacturer specifications. Noise levels listed are the actual measured noise levels for each piece of heavy construction equipment.
[2] Noise levels measured in field by AECOM during construction of Sacramento Area Flood Control Agency Natomas Levee Improvement Program.

Key:
dBA = A-weighted decibels
L_{max} = maximum sound level.

Table 3.15-7. Measured Levee Construction Noise Levels

Construction Activity	Distance (feet) During Field Verification	Measured Noise Level (L_{eq} dBA) during Field Verification
Cutoff wall construction—main trench excavator	59 (top of levee) 71 (12 feet behind levee)	74.7 63.0
Cutoff wall construction—supporting excavator and dozer	84 (top of levee) 96 (12 feet behind levee)	71.0 63.4
Levee degrading	102 (top of levee) 152 (50 feet behind levee) 195 (top of levee)[1] 195 (top of levee)[1] 195 (top of levee)[1] 195 (top of levee)[1]	79.2 66.7 72.5 75.3 71.6 74.2
Borrow site excavation	110 220	77.9 70.9
Slurry pond—two pumps operating	51 102	78.7 73.4

Source: Data collected by AECOM in 2010

Notes:
[1] Multiple noise measurements were taken at the same location as a result of variability in construction activities and equipment used during levee degrading.

Key:
dBA = A-weighted decibels
L_{eq} = the equivalent hourly average noise level

Noise from localized point sources, such as construction sites, typically decreases by 6 to 7.5 dB with each doubling of distance from source to receptor. The attenuation rate varies depending largely on the type of terrain (paved/natural) over which the noise would travel. Modeled estimates of exterior hourly noise levels in an NTMA construction area are presented in Table 3.15-8. The modeling assumed a conservative attenuation rate of 6 dB per doubling of distance and construction activities using the loudest equipment (i.e., excavator, pile driver, grader). Noise levels are based on distance from the center of activities with no attenuating obstructions.

Table 3.15-8. Summary of Modeled NTMA-Generated Noise Levels

	Distance to Nearest Receptor (feet)	Exterior Noise Level (dBA, L_{eq})
Construction activities, including operation of: • Excavator (85 dBA L_{max} at 50 feet, 40% usage) • Impact pile driver (95 dBA L_{max} at 50 feet, 20% usage) • Grader (85 dBA L_{max} at 50 feet, 40% usage)	50	90
	100	83
	200	77
	300	74
	400	71
	500	69
	1,000	63
	2,000	57
	3,000	54

Source: Data modeled by AECOM in 2011

Key:
dBA = A-weighted decibels
L_{eq} = the equivalent hourly average noise level
L_{max} = maximum sound level

It should be noted that NTMA-generated construction-related noise levels could exceed nontransportation exterior noise standards in portions of the study area, depending on the equipment used and distance to sensitive receptors. Those noise levels also could result in a temporary substantial increase in ambient noise levels, especially if construction activities were to occur outside of normal construction hours. As a result, the temporary, short-term impact of construction-generated noise would be **potentially significant**.

Construction-Related Traffic

Construction-related traffic (e.g., heavy-duty truck travel) on public roadways in off-site areas would generate noise during NTMA construction. The increase in traffic noise levels would depend on the increase in average daily traffic volumes attributable to worker trips and the number of heavy-duty truck trips on haul routes for individual NTMAs. Management actions could require the need for soil transported from a borrow site or delivery of cement, bentonite, or other materials. Soil borrow obtained from a commercial site could be located many miles from a construction site, whereas borrow sites developed specifically for a project could be located near or adjacent to a construction site. Cement needed for a project typically is trucked into the construction site throughout the day. Other materials may be delivered throughout the day.

Traffic noise is generated by a combination of noises created by a vehicle engine and tires. Traffic noise levels are determined by traffic volumes, traffic speeds, and the number of trucks (heavy and medium duty) in the flow of traffic. Levels of traffic noise increase with increased traffic volumes, higher traffic speeds, and greater numbers of trucks. Thus, a change in traffic noise can be assessed based on a change in traffic volume if the speed and other roadway conditions remain the same.

It is assumed that most study area roadways, other than State routes or roadways in and around an urban area, would have relatively low average daily traffic volumes. Typically, traffic volumes must double before the associated increase in noise levels is noticeable (Caltrans 2009:2-15). (As described previously, a 3-dBA increase in noise levels is generally considered to be the minimum perceivable increase by the human ear.) A doubling of traffic volumes could be expected for NTMAs that require large amounts of haul material to be transported from borrow sites to construction sites (e.g., levee construction) along rural roads with low traffic volumes. However, the standard of needing traffic volumes to double to result in a noticeable increase in noise levels assumes that vehicles that would generate the additional traffic are generally the same as those generating the baseline traffic levels. Heavy-duty trucks used for construction can generate substantially more noise than passenger cars; therefore, fewer truck trips would need to be added to generate a noticeable increase in noise levels. Table 3.15-9, based on data previously modeled by AECOM, provides estimates of how many heavy-duty trucks would be needed to increase traffic noise levels by 3 dBA L_{dn} on various roadway types.

Table 3.15-9. Heavy-Duty Truck Trips Needed to Increase Traffic Noise Levels by 3 dBA CNEL/L_{dn}

Roadway Type	Roadway Characteristics	Volume Capacity (average daily traffic)	Truck Trips Needed to Result in 3-dBA CNEL/L_{dn} Increase
Major arterial	Six lanes, 50 mph	55,000	4,000
Primary arterial	Four lanes, 45 mph	35,000	2,150
Secondary arterial	Four lanes, 40 mph	25,000	1,300
Collector	Two lanes, 35 mph	15,000	650
Urban neighborhood	One lane, 25 mph	7,500	175
Rural	One lane, 50 mph	5,000	360

Source: Data modeled by AECOM in 2011
Notes:
Traffic noise levels are predicted at a standard distance of 50 feet from the nearest travel lane and do not account for shielding from existing noise barriers or intervening structures. Traffic noise levels may vary depending on actual setback distances and localized shielding.
Key:
CNEL = community noise equivalent level
dBA = A-weighted decibels
Ldn = day-night average noise level
mph = miles per hour

Haul routes, borrow sites, haul material amounts, and program-related construction traffic volumes have not yet been defined; however, traffic noise levels could increase under the proposed program. A large increase in vehicle trips on a particular roadway, however, would be necessary to substantially increase traffic noise. For example, an NTMA would require 360 additional daily heavy-duty truck trips along a particular rural roadway with an existing average daily traffic volume of 5,000 to result in a 3-dBA L_{dn} or greater increase in noise levels at a nearby sensitive receptor (Table 3.15-9). As indicated in Table 3.15-9, fewer trips would be needed to generate a 3 dBA CNEL/L_{dn} increase on a street in an urban neighborhood (175 daily trips required). However, as described in greater detail in Section 3.19, “Transportation and Traffic,” only very large construction projects would involve construction traffic at these levels, and that traffic would all be anticipated to occur during normal construction hours.

Thus, short-term off-site construction traffic noise under the proposed program would not expose sensitive receptors to noise levels that exceed applicable transportation noise standards or create a substantial temporary increase in ambient noise levels. This impact related to construction traffic would be **less than significant**.

Although the noise impact from construction-related traffic is less than significant, as indicated above, noise generated by construction equipment would result in a **potentially significant** impact. Therefore, mitigation to address construction noise is provided below.

Mitigation Measure NOI-1 (NTMA): ***Implement Noise-Reducing Construction Practices***

Not all measures listed below may be applicable to each management action. Instead, these measures serve as an overlying mitigation framework to be used for specific management actions. The applicability of measures listed below would vary based on the lead agency, location, timing, and nature of each management action.

The project proponent will implement the following measures during construction activities when noise-sensitive receptors are located nearby and could be subject to substantial construction noise in excess of applicable standards or substantially greater than existing conditions.

- Equipment will be operated, stored, and/or maintained as far away as practical from sensitive noise receptors.
- Construction equipment will be properly maintained per manufacturers' specifications and fitted with the best available noise suppression devices (e.g., mufflers, silencers, wraps). All impact tools will be shrouded or shielded, and all intake and exhaust ports on power equipment will be muffled or shielded.
- Equipment that is quieter than standard equipment will be used in the vicinity of sensitive noise receptors. For example, electrically powered equipment will be used instead of internal combustion equipment where use of such equipment is a readily available substitute that accomplishes program tasks in the same manner as internal combustion equipment.
- Construction equipment operating in the vicinity of sensitive noise receptors will not be left idling for extended periods between construction activities.
- To the greatest extent feasible, construction activities will limit the use of "alarms" (e.g., backup indicators) on construction equipment in the vicinity of sensitive noise receptors. One mechanism to achieve this objective is by providing adequate turning movement distance such that construction and delivery vehicles can turn around without having to operate in reverse.
- Construction equipment will be inspected before first use at a project site located near sensitive noise receptors and at least once during construction for compliance with noise reduction measures.

- To the greatest extent feasible, construction outside of normal construction hours will be minimized or avoided completely when located in the vicinity of sensitive noise receptors. Except under extreme circumstances (as in the case of construction of a slurry cutoff wall, which must be in continuous operation), construction activities will be limited to normal construction hours or hours identified in applicable local noise regulations.

- Where stationary construction equipment would result in exceedence of noise standards at a nearby sensitive receptor, temporary noise barriers will be installed where feasible between the stationary construction operation and the sensitive receptor.

- Speed limits will be established and enforced for construction traffic.

Implementing this mitigation measure would reduce Impact NOI-1 (NTMA) to a **less-than-significant level**.

Impact NOI-2 (NTMA): ***Exposure of Sensitive Receptors to, or Generation of, Excessive Groundborne Vibration***

Heavy-duty truck travel on haul routes for material transport and the use of heavy-duty equipment would cause groundborne noise and vibrations during construction of some NTMAs. Groundborne vibration levels would depend on the type of construction equipment used and the operations involved. The groundborne vibration levels caused by various types of construction equipment are summarized in Table 3.15-10.

Table 3.15-10. Representative Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 feet (in/sec)	Approximate Vibration Level (VdB) at 25 feet[1]
Pile driver (impact)	Upper range	1.518	112
	Typical	0.644	104
Pile driver (sonic)	Upper range	0.734	105
	Typical	0.170	93
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58

Sources: Caltrans 2004; FTA 2006

Notes:
[1] Where the vibration level is the root-mean-square velocity expressed in vibration decibels (VdB), assuming a crest factor of 4.

Key:
in/sec = inches per second
PPV = peak particle velocity
VdB = vibration decibel

Specific NTMAs, and thus the vibration-generating equipment that would be used, are unknown at this time. To evaluate vibration impacts at sensitive receptors, the construction activity that would generate the highest PPV (i.e., pile driving) was analyzed. As shown in Table 3.15-11, the potential vibration levels identified for pile driving that could occur in the study area could expose sensitive receptors located within approximately 100 feet to groundborne vibration levels that exceed Caltrans's recommended standard of 0.2 in/sec peak PPV, with respect to the prevention of structural damage for normal buildings (Caltrans 2004). In addition, pile-driving activities could expose receptors located within approximately 300 feet to groundborne vibration levels that exceed FTA's maximum acceptable vibration standard of 80 VdB, with respect to human response for residential uses (i.e., annoyance) (Table 3.15-11) (FTA 2006). This impact would be **potentially significant**.

Table 3.15-11. Summary of Modeled NTMA-Generated Vibration Levels

Operation of Impact Pile Driver	Distance to Nearest Receptor (feet)	PPV at 25 feet (in/sec)	Approximate Vibration Level (VdB) at 25 feet[1]

Operation of Impact Pile Driver	Distance to Nearest Receptor (feet)	PPV at 25 feet (in/sec)	Approximate Vibration Level (VdB) at 25 feet[1]
	25	1.518	112
	50	0.537	103
	100	0.190	94
	150	0.103	88
	200	0.067	84
	250	0.048	82
	300	0.037	79

Sources: Caltrans 2002, FTA 2006

Notes:
[1] Where the vibration level is the root-mean-square velocity expressed in vibration decibels (VdB), assuming a crest factor of 4.

Key:
in/sec = inches per second
PPV = peak particle velocity
VdB = vibration decibel

Mitigation Measure NOI-2 (NTMA): *Implement Vibration-Reducing Construction Practices*

Not all measures listed below may be applicable to each management action. Instead, these measures serve as an overlying mitigation framework to be used for specific management actions. The applicability of measures listed below would vary based on the lead agency, location, timing, and nature of each management action.

The project proponent will implement the following measures before and during construction activities that occur within 300 feet of a receptor sensitive to vibration disturbance:

- A disturbance coordinator will be designated, and this person's contact information will be posted in a location near the construction site that is clearly visible to the nearby receptors most likely to be disturbed. The disturbance coordinator will manage complaints and concerns resulting from activities that cause vibrations. The severity of the vibration concern will be assessed by the disturbance coordinator and, if necessary, evaluated by a qualified noise and vibration control consultant.

- Vibration monitoring will be conducted before and during construction-generated vibration activities occurring within 100 feet of historic structures. Every attempt will be made to limit construction-generated vibration levels in accordance with Caltrans's recommendations during pile driving and other groundborne noise- and vibration-generating activities in the vicinity of historic structures.

- If estimated or recorded vibration levels meet or exceed levels that could damage an adjacent historic feature, the adjacent historic features will be covered or temporarily shored, as necessary, to protect them from vibrations.

- For pile driving required within 100 feet of residences or other occupied structures, alternative installation methods (e.g., pile cushioning, jetting, predrilling, cast-in-place systems, resonance-free vibratory pile drivers) will be used where feasible to reduce the number and amplitude of blows required to seat the pile. If the estimated vibration levels exceed levels that could damage the structures, they will be covered or temporarily shored, as necessary, to protect them from vibrations.

- Pile-driving activities conducted within 300 feet of sensitive receptors will occur during daytime hours to avoid causing sleep disturbance during evening and nighttime hours.

Implementing this mitigation measure would reduce Impact NOI-2 (NTMA) to a **less-than-significant level**.

Impact NOI-3 (NTMA): ***Exposure of Sensitive Receptors to Operational Noise***

Some NTMAs could result in long-term noise from operation of stationary sources (e.g., water pumps). Depending on the location of management actions and the equipment needed for long-term operation, a new source of noise could be introduced near sensitive receptors. Specific NTMAs, and thus the equipment that would be used, are unknown at this time. The most common piece of equipment envisioned as potentially necessary for long-term operation is water pumps, so water pumps are used to evaluate long-term noise impacts on sensitive receptors. Table 3.15-12 presents modeled noise levels identified for water pumps that could occur in the study area and shows the noise levels that sensitive receptors would be exposed to at various distances.

Table 3.15-12. Summary of Modeled Water Pump Noise Levels

Operation of Water Pump	Distance to Nearest Receptor (feet)	Maximum Noise Level (dBA L_{max})	Hourly Equivalent Noise Level (dBA L_{eq})
	50	81	72

Operation of Water Pump	Distance to Nearest Receptor (feet)	Maximum Noise Level (dBA L_{max})	Hourly Equivalent Noise Level (dBA L_{eq})
	100	75	66
	200	69	60
	300	66	57
	400	63	54
	500	61	52
	1,000	55	46

Source: FHWA 2006

Key:
L_{eq} = equivalent noise level
L_{max} = maximum noise level

Specific NTMAs have not yet been defined; however, stationary-source noise levels could increase under the proposed program. For example, operation of a water pump within 100 feet of a sensitive receptor would result in a new noise source, generating an average noise level of 66 dBA Leq during pump operation (Table 3.15-12). Thus, introducing a long-term stationary-source noise under the program could expose sensitive receptors to noise levels that exceed applicable noise standards. This impact would be **potentially significant**.

Mitigation Measure NOI-3 (NTMA): ***Implement Design Techniques to Reduce Operational Noise***

The project proponent will implement the following measures during operation:

- Stationary noise sources (e.g., water pumps) will be located as far away from sensitive receptors as feasible.

- Design techniques to reduce noise (e.g., structure encasing, installation below grade) will be implemented for stationary noise sources (e.g., water pumps) in the vicinity of sensitive receptors. If noise modeling indicates that noise reduction techniques are sufficient to allow the stationary noise source to be located closer to sensitive noise receptors and still not violate applicable noise standards, then the facility may be located closer to the receptor.

Implementing this mitigation measure would reduce Impact NOI-3 (NTMA) to a **less-than-significant level**.

3.15.5 Environmental Impacts, Mitigation Measures, and Mitigation Strategies for LTMAs

This section describes the physical effects of LTMAs on the noise environment. LTMAs include a continuation of activities described as part of NTMAs and all other actions included in the proposed program, and consist of all of the following types of activities:

- Widening floodways (through setback levees and/or purchase of easements)
- Constructing weirs and bypasses
- Constructing new levees
- Changing operation of existing reservoirs
- Achieving protection of urban areas from a flood event with 0.5-percent risk of occurrence
- Changing policies, guidance, standards, and institutional structures
- Implementing additional and ongoing conservation elements

Actions included in LTMAs are described in more detail in Section 2.4, "Proposed Management Activities."

Impacts and mitigation measures identified above for NTMAs would also be applicable to many of the LTMAs and are identified below. The NTMA impact discussions and mitigation measures are modified or expanded where appropriate, or new impacts and mitigation measures are included if needed, to address conditions unique to LTMAs. The same approach to future implementation of mitigation measures described above for NTMAs and the use of the term "project proponent" to identify the entity responsible for implementing mitigation measures also apply to LTMAs.

LTMA Impacts and Mitigation Measures

Impact NOI-1 (LTMA): ***Exposure of Sensitive Receptors to Substantial Temporary and Short-Term Construction-Related Noise***

As described previously for NTMAs, construction activities could potentially expose sensitive receptors to noise levels in excess of the applicable noise standards and/or result in a substantial increase in ambient noise levels. Construction activities associated with LTMAs would be substantially similar to those associated with NTMAs in many cases, and in some instances could involve a greater overall size, level of effort, and period of activity.

Construction-related noise levels could exceed nontransportation exterior noise standards in portions of the study area, depending on the equipment used and their relative distances from nearby sensitive receptors. Those increased noise levels also could result in a temporary substantial increase in ambient noise levels, especially if construction activities were to occur during nighttime hours.

Haul routes, borrow sites, haul material amounts, and program-related construction traffic volumes have not yet been defined; however, traffic noise levels could increase under the proposed program. Although impacts from construction traffic noise would be less than significant for NTMAs, because of the potential for larger projects to be included in the LTMAs, the potential for construction vehicle trips to generate sufficient noise to exceed thresholds is greater. Therefore, for the LTMAs, short-term off-site construction traffic noise could expose sensitive receptors to noise levels that exceed applicable transportation noise standards or create a substantial temporary increase in ambient noise levels.

This temporary, short-term impact would be **potentially significant**.

Mitigation Measure NOI-1a (LTMA)*: Implement Mitigation Measure NOI-1 (NTMA)*

Implementing this mitigation measure would reduce nontransportation-related construction noise impacts under Impact NOI-1 (LTMA) to a **less-than-significant level**.

Mitigation Measure NOI-1b (LTMA): *Minimize Construction-Related Traffic Noise*

Where the project-specific noise analysis conducted as part of CEQA review for a project indicates that noise from construction traffic could exceed applicable standards at a sensitive receptor, an additional individual traffic noise analysis will be prepared. The individual traffic noise analysis will be conducted as haul routes are determined to establish existing average noise conditions and model the noise contribution from project construction. The traffic noise analysis will take into account daily traffic volumes, fleet mixes (percentages of automobiles, medium-duty trucks, and heavy-duty trucks during daytime, evening, and nighttime hours), and vehicle speeds along designated haul-route roadways. If the individual traffic noise analysis also concludes that applicable noise standards are exceeded at a sensitive receptor, the analysis will identify additional measures to reduce noise levels at sensitive receptors and these measures will be implemented by the project proponent. Measures could include (but would not be limited to) using alternative traffic routes, splitting trips among multiple routes, or directing noisier vehicles to use less noise-sensitive routes.

Implementing this mitigation measure would reduce transportation-related construction noise impacts under Impact NOI-1 (LTMA) to a **less-than-significant level**.

Impact NOI-2 (LTMA): ***Exposure of Sensitive Receptors to or Generation of Excessive Groundborne Vibration***

As described previously for NTMAs, construction activities in the study area may result in varying degrees of temporary ground vibration, depending on the specific construction equipment used and the operations involved. Construction activities associated with LTMAs would be substantially similar to those associated with NTMAs in many cases, and in some instances could involve a greater overall size, level of effort, and period of activity.

Specific LTMAs, and thus the vibration-generating equipment that would be used, are unknown at this time. Modeling conducted for the proposed program indicated that vibration levels identified for pile driving that could occur in the study area could expose sensitive receptors located within 100 feet to groundborne vibration levels that exceed Caltrans's recommended standard of 0.2 in/sec peak PPV, with respect to the prevention of structural damage for normal buildings (Caltrans 2004). In addition, pile-driving activities would expose receptors located within 300 feet to groundborne vibration levels that exceed FTA's maximum acceptable vibration standard of 80 VdB, with respect to human response for residential uses (i.e., annoyance) (Table 3.15-11) (FTA 2006). This impact would be **potentially significant**.

Mitigation Measure NOI-2 (LTMA): ***Implement Mitigation Measure NOI-2 (NTMA)***

Implementing this mitigation measure would reduce Impact NOI-2 (LTMA) to a **less-than-significant level**.

Impact NOI-3 (LTMA): ***Exposure of Sensitive Receptors to Operational Noise***

As described previously for NTMAs, operation of management actions in the study area may result in varying degrees of long-term noise, depending on the operations involved. Operational activities associated with LTMAs would be substantially similar to those associated with NTMAs, although some LTMAs would involve larger facilities with greater potential for operational noise generation (e.g., dams with hydroelectric facilities).

LTMAs could result in long-term noise from operation of stationary sources (e.g., water pumps). Depending on the location of management actions and the equipment needed for long-term operation, a new source of noise could be introduced near sensitive receptors. Specific LTMAs have not yet been defined; however, stationary source noise levels could increase under the proposed program. Thus, introducing a long-term stationary source noise under the program could expose sensitive receptors to noise levels that exceed applicable noise standards. This impact would be **potentially significant**.

Mitigation Measure NOI-3 (LTMA): ***Implement Mitigation Measure NOI-3 (NTMA)***

Implementing this mitigation measure would reduce Impact NOI-3 (LTMA) to a **less-than-significant** level.

LTMA Impact Discussions and Mitigation Strategies

The impacts of the proposed program's NTMAs and LTMAs related to noise and the associated mitigation measures are thoroughly described and evaluated above. The general narrative descriptions of additional LTMA impacts and mitigation strategies that are included in other sections of this draft PEIR are not required for noise.