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TECHNICAL MEMORANDUM

Date: May 6, 2017

To: GPA Consulting
231 California Street
El Segundo, CA 90245

From: Kurt Legleiter, Principal

Subject: NOISE IMPACT ASSESSMENT FOR THE GOLDEN AVENUE BRIDGE REPLACEMENT/REHABILITATION PROJECT, CITY OF PLACENTIA, CALIFORNIA

INTRODUCTION

This report provides an overview of existing environmental conditions and applicable regulatory framework. Noise impacts are analyzed in support of the Initial Study to be prepared for the proposed project and in accordance with the California Environmental Quality Act (CEQA) guidelines. Supporting materials for this report, including emissions modeling output files, are included in Appendix A.

Project Overview

The project would include replacing a functionally obsolete bridge with a replacement bridge that has the same number of through-traffic lanes as the existing bridge. The anticipated replacement bridge would accommodate two traffic lanes, Class II bike lanes/shoulders, and sidewalks that meet American Association of State Highway and Transportation Officials (AASHTO) minimum standards. In addition, the replacement bridge would be longer in order to accommodate the bike path along the Carbon Canyon Creek Channel as part of the Orange County Loop Bikeway Project. The proposed project area footprint is depicted in Figure 1. The preliminary site plan for the proposed project is depicted in Figure 2.

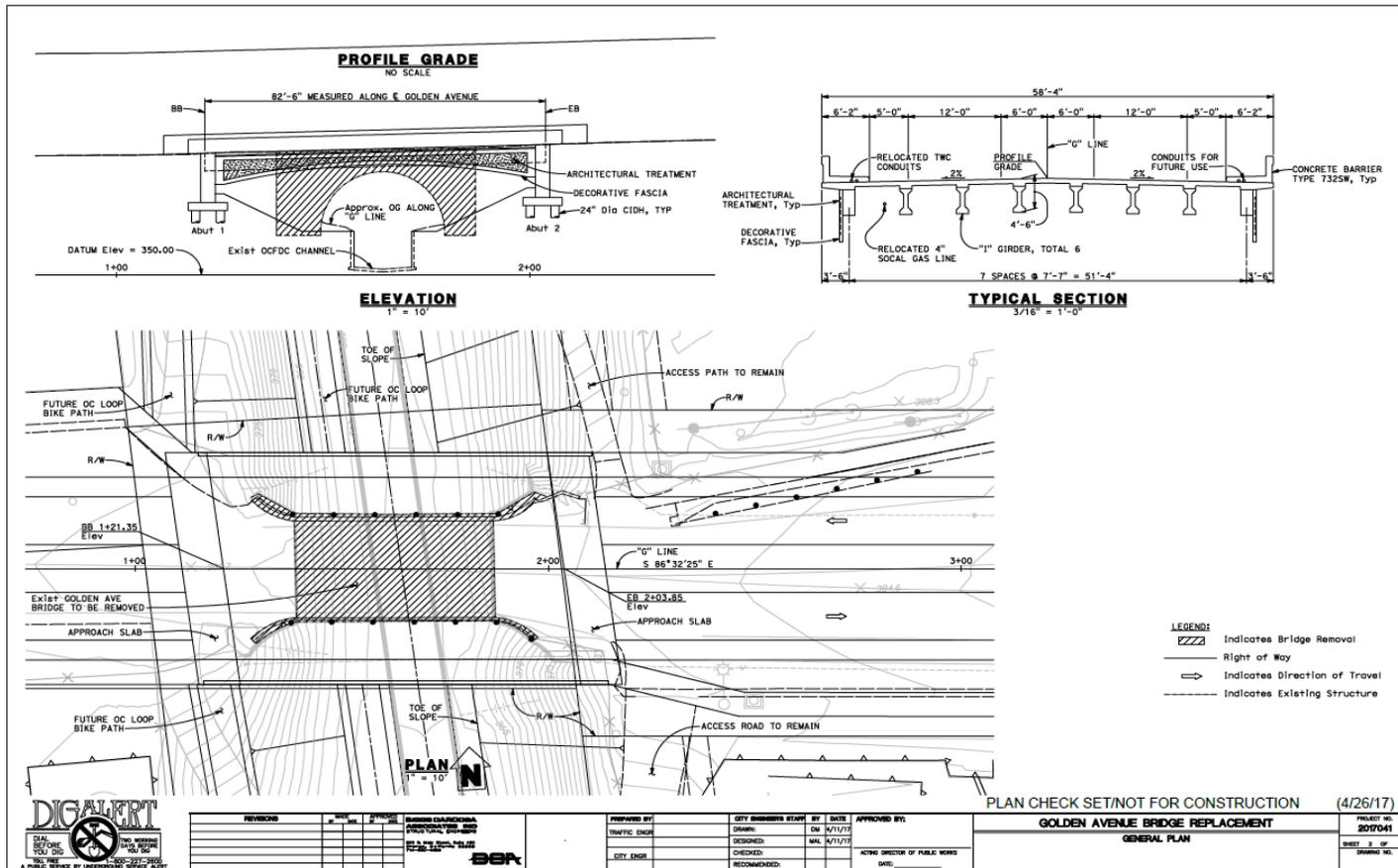
Construction of the proposed project would occur over an approximate four- to six-month period. A majority of the project construction is anticipated to occur during the summer months to minimize impacts to nearby schools.

Figure 1. Project Area Footprint and Nearby Land Uses



All locations are approximate. Not to scale.
Source: City of Placentia 2017a

Figure 2. Preliminary Project Site Plan



Source: Biggs Cardosa Associates, Inc. 2016



Existing Setting

Acoustic Fundamentals

Noise is generally defined as sound that is loud, disagreeable, or unexpected. Sound is mechanical energy transmitted in the form of a wave because of a disturbance or vibration. Sound levels are described in terms of both amplitude and frequency.

Amplitude

Amplitude is defined as the difference between ambient air pressure and the peak pressure of the sound wave. Amplitude is measured in decibels (dB) on a logarithmic scale. For example, a 65 dB source of sound, such as a truck, when joined by another 65 dB source results in a sound amplitude of 68 dB, not 130 dB (i.e., doubling the source strength increases the sound pressure by 3 dB). Amplitude is interpreted by the ear as corresponding to different degrees of loudness. Laboratory measurements correlate a 10 dB increase in amplitude with a perceived doubling of loudness and establish a 3 dB change in amplitude as the minimum audible difference perceptible to the average person.

Frequency

The frequency of a sound is defined as the number of fluctuations of the pressure wave per second. The unit of frequency is the Hertz (Hz). One Hz equals one cycle per second. The human ear is not equally sensitive to sound of different frequencies. For instance, the human ear is more sensitive to sound in the higher portion of this range than in the lower and sound waves below 16 Hz or above 20,000 Hz cannot be heard at all. To approximate the sensitivity of the human ear to changes in frequency, environmental sound is usually measured in what is referred to as "A-weighted decibels" (dBA). On this scale, the normal range of human hearing extends from about 10 dBA to about 140 dBA. Common community noise sources and associated noise levels, in dBA, are depicted in Figure 3.

Addition of Decibels

Because decibels are logarithmic units, sound levels cannot be added or subtracted through ordinary arithmetic. Under the decibel scale, a doubling of sound energy corresponds to a 3-dB increase. In other words, when two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be 3 dB higher than one source under the same conditions. For example, if one automobile produces a sound level of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB; rather, they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together would produce an increase of 5 dB.

Figure 3
Common Noise Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Jet Fly-over at 300m (1000 ft)	110	Rock Band
Gas Lawn Mower at 1 m (3 ft)	100	
Diesel Truck at 15 m (50 ft), at 80 km (50 mph)	90	Food Blender at 1 m (3 ft)
Noisy Urban Area, Daytime	80	Garbage Disposal at 1 m (3 ft)
Gas Lawn Mower, 30 m (100 ft) Commercial Area	70	Vacuum Cleaner at 3 m (10 ft) Normal Speech at 1 m (3 ft)
Heavy Traffic at 90 m (300 ft)	60	Large Business Office
Quiet Urban Daytime	50	Dishwasher Next Room
Quiet Urban Nighttime Quiet Suburban Nighttime	40	Theater, Large Conference Room (Background)
Quiet Rural Nighttime	30	Library Bedroom at Night, Concert Hall (Background)
	20	Broadcast/Recording Studio
	10	
Lowest Threshold of Human Hearing	0	Lowest Threshold of Human Hearing

Source: Caltrans 2016



Sound Propagation & Attenuation

Geometric Spreading

Noise sources are generally characterized as either a localized source (i.e., point source) or a line source. Examples of point sources include construction equipment, vehicle horns, alarms, and amplified sound systems. Examples of a line sources include trains and on-road vehicular traffic. Sound from a point source propagates uniformly outward in a spherical pattern.

For a point source, sound levels generally decrease (attenuate) at a rate of approximately 6 decibels for each doubling of distance from the source, depending on ground surface characteristics. For acoustically hard sites (i.e., sites with a reflective surface between the source and the receiver), no excess ground attenuation is assumed. Parking lots and bodies of water are examples of hard surfaces which generally attenuate at this rate. For acoustically absorptive or soft sites (i.e., those sites with an absorptive ground surface between the source and the receiver, such as soft dirt, grass, or scattered bushes and trees), an excess ground-attenuation value of 1.5 decibels per doubling of distance is normally assumed. When soft surfaces are present, the excess ground attenuation for soft surfaces generally results in an overall attenuation rate of approximately 7.5 decibels per doubling of distance from the point source.

On-road vehicle traffic consists of several localized noise sources on a defined path, and hence can be treated as a line source, which approximates the effect of several point sources. Noise from a line source propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels for line sources attenuate at a rate of approximately 3 decibels for each doubling of distance for hard sites and approximately 4.5 decibels per doubling of distance for soft sites.

Atmospheric Effects

Receptors located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lowered noise levels. Sound levels can be increased at large distances (e.g., more than 500 feet) from the highway due to atmospheric temperature inversion (i.e., increasing temperature with elevation). Other factors such as air temperature, humidity, and turbulence can also have significant effects.

Shielding by Natural or Human-Made Features

A large object or barrier in the path between a noise source and a receiver can substantially attenuate noise levels at the receiver. The amount of attenuation provided by shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receiver specifically to reduce noise. A barrier that breaks the line of sight between a source and a receiver will typically result in minimum 5 dB of noise reduction. Taller barriers provide increased noise reduction.



Human Response to Noise

The human response to environmental noise is subjective and varies considerably from individual to individual. Noise in the community has often been cited as a health problem, not in terms of actual physiological damage, such as hearing impairment, but in terms of inhibiting general well-being and contributing to undue stress and annoyance. The health effects of noise in the community arise from interference with human activities, including sleep, speech, recreation, and tasks that demand concentration or coordination. Hearing loss can occur at the highest noise intensity levels. When community noise interferes with human activities or contributes to stress, public annoyance with the noise source increases. The acceptability of noise and the threat to public well-being are the basis for land use planning policies preventing exposure to excessive community noise levels.

Unfortunately, there is no completely satisfactory way to measure the subjective effects of noise or of the corresponding reactions of annoyance and dissatisfaction. This is primarily because of the wide variation in individual thresholds of annoyance and habituation to noise over differing individual experiences with noise. Thus, an important way of determining a person's subjective reaction to a new noise is the comparison of it to the existing environment to which one has adapted: the so-called "ambient" environment. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged. Regarding increases in A-weighted noise levels, knowledge of the following relationships will be helpful in understanding this analysis:

- Except in carefully controlled laboratory experiments, a change of 1 dB cannot be perceived by humans;
- Outside of the laboratory, a 3-dB change is considered a just-perceivable difference;
- A change in level of at least 5 dB is required before any noticeable change in community response would be expected. An increase of 5 dB is typically considered substantial;
- A 10-dB change is subjectively heard as an approximate doubling in loudness and would almost certainly cause an adverse change in community response.

Noise-Sensitive Land Uses

Noise-sensitive land uses are generally considered to include those uses that would result in noise exposure that could cause health-related risks to individuals. Places where quiet is essential are also considered noise-sensitive uses. Residential dwellings are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise levels. Other land uses such as libraries, places of worship, and recreation areas are also considered noise-sensitive land uses.

Noise-sensitive land uses in the project vicinity consist predominantly of residential land uses. As depicted in Figure 1, the nearest residential land uses are located adjacent to the northwestern and southeastern project footprint boundaries. Residential land uses located southeast of the project area are located within the City of Yorba Linda. Residential land uses generally located to the north and west of the project area are located within the City of Placentia.



Existing Noise Environment

Short-term (10-minute) noise level measurements were conducted on April 21, 2017 for the purpose of documenting and measuring the existing noise environment at various locations in the project vicinity. Ambient noise measurement locations and corresponding measured values (i.e., L_{eq} and L_{max}) are summarized in Table 2.

Based on the measurements conducted, ambient noise levels in the project vicinity are largely influenced by vehicle traffic on Golden Avenue. Measured average noise levels near the property lines of the nearest residential land uses ranged from approximately 58 to 60 dBA L_{eq} . Maximum instantaneous noise levels ranged from approximately 69 to 73 dBA L_{max} . In general, nighttime noise levels are typically 5-10 dB lower than daytime noise levels.

Table 2
Summary of Measured Ambient Noise Levels

Location	Monitoring Period	Primary Noise Sources	Noise Levels (dBA)	
			L_{eq}	L_{max}
2300 California Street, Placentia. Approximately 36 feet from the centerline of Golden Avenue.	1310-1320	Vehicle Traffic	58	69
4011 Winterhaven Street, Yorba Linda. Approximately 36 feet from the centerline of Golden Avenue.	0942-0952	Vehicle Traffic	60	73

Noise measurements were conducted on November 10, 2016 using a Larson Davis Model 820 Type I sound level meter.

REGULATORY SETTING

City of Placentia General Plan Noise Element

The existing Noise Element of the *City of Yorba Linda General Plan (1974)* includes noise standards intended to ensure compatibility of proposed land uses within exterior noise environments and that noise levels at adjacent land uses do not exceed acceptable levels. Construction activities are typically limited to between the hours of 7:00 a.m. and 6 p.m.

City of Placentia Municipal Code

The City of Yorba Linda Municipal Code (Title 23, Zoning, Chapter 23.81, General Regulations and Exceptions) restricts grading, construction, and maintenance of real property to between the hours of seven a.m. and seven p.m. on weekdays, and between hours of nine a.m. and six p.m. on Saturdays. Activities occurring on Sundays and holidays are also restricted, depending on the specific activities being conducted. These restrictions typically do not apply to activities that would otherwise constitute a hazard to individuals or property (City of Placentia 2017b).

City of Yorba Linda Municipal Code

The City of Yorba Linda Municipal Code (Title 8, Health & Safety, Chapter 8.32, Noise Control) includes various provisions intended to protect community residents from prolonged unnecessary, excessive, and annoying sound levels that are detrimental to the public health, welfare, and safety, or are contrary to the public interest. Noise



sources associated with construction-related activities are typically exempt provided the activities do not take place between the hours of eight p.m. and seven a.m. on weekdays, including Saturday, or at any time on Sunday or federal holidays (City of Yorba Linda 2017).

IMPACTS AND MITIGATION MEASURES

Significance Threshold Criteria

According to Appendix G of the CEQA Guidelines, a project would normally have a significant effect on the environment if the project would:

- Result in exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance or of applicable standards of other agencies.
- Result in exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels.
- Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.
- Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.
- Expose people residing or working in the project area to excessive noise levels for a project located within an airport land use plan area or, where such a plan has not been adopted, or within two miles of a public airport or a 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.

Methodology

Construction noise levels were evaluated using the Federal Highway Administration's *Roadway Construction Noise Model* (FHWA 2008). Noise levels were calculated taking into account estimated equipment usage required for construction of the proposed project, based on information provided by the project engineer. Predicted average-hourly noise levels at nearby land uses were calculated assuming the loudest pieces of equipment were to operate simultaneously.

Impacts and Mitigation Measures

Impact Noise-A: *Would the project result in exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance or of applicable standards of other agencies?*

The *City of Placentia General Plan*, *City of Placentia Municipal Code*, *City of Yorba Linda General Plan*, and the *City of Yorba Linda Municipal Code* do not identify noise level standards that apply to construction-related activities. As previously noted, the *City of Placentia Municipal Code* generally limits construction activities to between the hours of 7:00 a.m. to 7:00 p.m. on weekdays and between 9:00 a.m. and 6:00 p.m. on Saturdays. The *City's General Plan Noise Element* is slightly more conservative, limiting construction activities to between the hours of 7:00 a.m. to 6:00



p.m. By comparison, the City of Yorba Linda Municipal Code generally limits construction activities to between the hours of 7:00 a.m. to 8:00 p.m., Monday through Saturday.

The proposed project would not result in long-term changes in vehicle operations (e.g., traffic volumes, vehicle speeds) along Golden Avenue or other area roadways. In addition, the proposed project would not include the installation of any major non-transportation noise sources. As a result, the proposed project would not result in long-term noise impacts. However, as noted in Impact Noise-2, the proposed project would result in potentially significant increases in short-term construction noise levels. As a result, this impact is considered potentially significant. Refer to Impacts Noise-D for additional discussion of short-term noise impacts.

Impact Noise-B: *Would the project result in exposure of persons to or generation of groundborne vibration or groundborne noise levels?*

The effects of ground vibration can vary from no perceptible effects at the lowest levels, low rumbling sounds and detectable vibrations at moderate levels, and slight damage to nearby structures at the highest levels. At the highest levels of vibration, damage to structures is primarily architectural (e.g., loosening and cracking of plaster or stucco coatings) and rarely results in structural damage. The effects of ground vibration are influenced by the duration of the vibration and the distance from the vibration source.

There are no federal, state, or local regulatory standards for vibration. However, various criteria have been established to assist in the evaluation of vibration impacts. For instance, Caltrans has developed vibration criteria based on human perception and structural damage risks. For most structures, Caltrans considers a peak-particle velocity (ppv) threshold of 0.2 inches per second (in/sec) to be the level at which architectural damage (i.e., minor cracking of plaster walls and ceilings) to normal structures may occur. Short periods of ground vibration in excess of 0.2 in/sec ppv can also be expected to result in increased levels of annoyance to people within buildings (Caltrans, 2002, 2014).

Construction activities and related equipment anticipated to be associated with construction of the proposed project generate groundborne vibration levels of approximately 0.21 in/sec (94 VdB), or less, at 25 feet (refer to Table 8). Based on Caltrans measurement data, use of off-road tractors, dozers, earthmovers, and haul trucks generates groundborne vibration levels of less than 0.10 in/sec (87 VdB) at 25 feet, or less than one half of the commonly applied architectural damage risk and human annoyance standards (Caltrans 2002, 2014). The use of large pavement breakers and pile drivers are not anticipated to be required for this project.

The nearest existing structures are located approximately 30 feet from the project site boundaries. Assuming a maximum vibration level of 0.21 in/sec ppv at the project site boundary, the highest predicted construction vibration levels at off-site structures would be approximately 0.17 in/sec ppv, or less. Construction-related vibration levels would not exceed commonly applied standard of 0.2 in/sec at nearby existing land uses. This impact would be considered less than significant.



**Table 8
 Representative Construction Equipment Vibration Levels**

Equipment	Vibration Level at 25 Feet	
	Peak Particle Velocity (ppv, in/sec)	VdB (micro-inch/second)
Vibratory Roller	0.210	94
Caisson Drill	0.089	87
Large Bulldozers	0.089	87
Loaded Trucks	0.076	86
Jackhammer	0.035	79
Small Bulldozers	0.003	58
<i>Source: FTA 2006, Caltrans 2002, 2014</i>		

Impact Noise-C: Would the project result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?

The proposed project would not result in long-term changes in vehicle operations (e.g., traffic volumes, vehicle speeds) along Golden Avenue or other area roadways. In addition, the proposed project would not include the installation of any major non-transportation noise sources. As a result, the proposed project would not result in a substantial permanent increase in ambient noise levels in the project vicinity. No impact.

Impact Noise-D: Would the project result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

Construction noise typically occurs intermittently and varies depending upon the nature or phase (e.g., demolition/land clearing, grading and excavation, erection) of construction. Noise generated by construction equipment, including earth movers, material handlers, and portable generators, can reach high levels. Temporary increases in ambient noise levels, particularly during the nighttime hours, could result in increased levels of annoyance and potential sleep disruption. Although noise ranges were found to be similar for all construction phases, the grading phase tends to involve the most equipment and resulted in slightly higher average-hourly noise levels.

Typical noise levels for individual pieces of construction equipment commonly associated with bridge construction projects are summarized in Table 10. As depicted, individual equipment noise levels typically range from approximately 73 to 83 dBA L_{eq} at 50 feet with intermittent noise levels reaching up to approximately 90 dBA L_{max} . The use of pile drivers and other more intensive noise equipment and activities are not anticipated to be required for this project.

Construction activities may also result in short-term increases in vehicle traffic along area roadways. Typically, a doubling of vehicle traffic would be required before a significant increases in traffic noise levels would occur.



Construction-generated traffic would not result in a doubling of vehicle traffic along area roadways and, therefore, would not result in a substantial increase in traffic noise levels.

As noted earlier in this report, nearby sensitive receptors include residential dwellings, the nearest of which are located adjacent to and northwestern and southeastern boundaries of the project site (refer to Figure 1). Assuming that the two loudest pieces of equipment were to operate simultaneously over a one-hour period, predicted average-hourly exterior noise levels at the nearest residences could reach levels of approximately 81 to 87 dBA L_{eq} , with intermittent noise levels of approximately 84-89 dBA L_{max} . With regard to residential land uses, construction activities that occur during these more noise-sensitive evening and nighttime hours may result in increased levels of annoyance and potential sleep disruption to nearby building occupants. Because such increases would result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity, this impact would be considered potentially significant.

Table 10
Typical Construction Equipment Noise

Equipment	Typical Noise Level (dBA) 50 feet from Source		Distance to Noise Contours (feet, dBA L_{eq})		
	L_{max}	L_{eq}	70 dBA	65 dBA	60 dBA
Air Compressor	80	76	105	187	334
Auger/Drill Rig	85	78	133	236	420
Backhoe/Front End Loader	80	76	105	187	334
Compactor (Ground)	80	73	74	133	236
Concrete Mixer Truck	85	81	187	334	594
Concrete Pump Truck	82	75	94	167	297
Concrete Saw	90	83	236	420	748
Crane	85	77	118	210	374
Dozer/Grader/Excavator/Scraper	85	81	187	334	594
Generator	82	79	149	265	472
Gradall/Forklift	85	81	187	334	594
Jack Hammer	85	78	133	236	420
Pavement Scarifier/Roller	85	78	133	236	420
Paver	85	82	210	374	667
Pneumatic Tools	85	82	210	374	667
Pumps	77	74	83	149	265
Truck (Dump/Flat Bed)	84	80	167	297	529

Based on maximum equipment noise levels. Actual noise levels are typically lower, particularly if equipment is fitted with exhaust mufflers and engine shrouds.
Sources: FTA 2006, FHWA 2008



Mitigation Measures

- MM Noise-1. The following measures shall be implemented to reduce noise impacts at nearby noise-sensitive land uses:
- a) Construction activities, excluding activities required to occur without interruption or activities that would pose a significant safety risk to workers or citizens, shall be limited to between the hours of 7:00 a.m. and 6:00 p.m. on weekdays and between 9:00 a.m. and 6:00 p.m. on Saturdays.
 - b) Internal combustion engines shall be equipped with engine shrouds and exhaust mufflers in accordance with manufacturer recommendations.
 - c) Portable/stationary equipment (e.g., generators, compressors) shall be located at the furthest distance from the nearest residential dwelling.
 - d) To the extent locally available, quieter equipment alternatives, such as electrified equipment, shall be utilized.

Implementation of MM Noise-1 would limit construction activities to between the daytime hours of 7:00 a.m. to 6:00 p.m. on weekdays and 9:00 a.m. to 6:00 p.m. on Saturdays. These hourly limitations would ensure compliance with both City of Placentia and City of Yorba Linda hourly noise restrictions for construction activities. Compliance with MM Noise-1 would also require implementation of various measures, such as the use construction equipment that is properly muffled in accordance with manufacturers' specifications, use of quieter equipment alternatives, such as electrified equipment (to the extent available). These measures can reduce construction noise levels by approximately 10 dB. With mitigation, this impact would be considered less than significant.

Impact Noise-E: *For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public or private airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?*

Impact Noise-F: *For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?*

The proposed project site is not located within an airport land use plan area, nor within two miles of a public or public use airport. The proposed project would not result in exposure of people residing or working in the project area to excessive aircraft noise levels. No Impact.



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APPENDIX A
Noise Modeling



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CONSTRUCTION NOISE MODELING

CONSTRUCTION ACTIVITY	DISTANCE TO NEAREST RESIDENTIAL PROPERTY LINE (Feet)	EQUIPMENT	PREDICTED NOISE LEVELS (dB)	
			LEQ	LMAX
Site Preparation	30	Tractor/Loader/Backhoe		
		Excavator	84	85
Bridge Demolition/Excavation	30	Excavator		
		Compactor	87	89
Bridge Construction/Pile Drilling	30	Drill Rig		
		Compactor	84	89
Paving	30	Paver		
		Roller	81	84

Construction noise levels were modeled using the FHWA's Roadway Construction Noise Model, based on the measured equipment noise levels and usage rates contained in the model assuming the two loudest pieces of equipment operating simultaneously.