Long Valley Road/Valley Circle/ US-101 Project

Noise and Vibration Study

prepared for

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1 Project Description and Impact Summary

1.1 Introduction

This study analyzes the potential noise and vibration impacts of the proposed Long Valley Road/Valley Circle/US-101 Project (project) in the City of Hidden Hills, Los Angeles County, California. Rincon Consultants, Inc. (Rincon) prepared this study under contract to Willdan Engineering for the City of Hidden Hills, the lead agency for the project, to use in support of the environmental documentation being prepared pursuant to the California Environmental Quality Act (CEQA). The purpose of this study is to analyze the project's noise and vibration impacts related to both temporary construction activity and long-term operation of the project. Table 1 provides a summary of project impacts.

Table 1 Summary of Impacts

Impact Statement	Level of Significance	Applicable Recommendations
Issue 1: Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;	Less Than Significant Impact With Mitigation (Construction) Less Than Significant Impact With Mitigation (Operation)	Mitigation measure NOI-1 (Construction) Mitigation measure NOI-2 (Operation)
Issue 2: Generation of excessive ground-borne vibration or ground-borne noise levels.	Less Than Significant Impact	None
Issue 3: For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels.	No Impact	None

Mitigation Measures

NOI-1 Construction Noise Reduction

Noise barriers with a minimum height of eight feet shall be placed between the construction equipment and adjacent residentially-zoned properties when construction is performed within 80 feet of the single-family residential property boundaries in the City of Hidden Hills and the single-family zoned nursery property in the City of Los Angeles. The noise barriers shall be constructed of material with a minimum weight of two pounds per square foot with no gaps or perforations. Noise barriers may be constructed of, but not limited to, 5/8-inch plywood, 5/8-inch oriented strand board, and hay bales. Example noise reduction equipment product sheets are included in Appendix D.

NOI-2 Permanent Sound Wall

A permanent noise barrier shall be erected at the northern parking lot area along the northern boundary with the single-family residence (23537 Long Valley Road). The top of the noise barrier will be a minimum of eight-feet above the final grade of the parking lot and be constructed of a material with a minimum weight of 4 pounds per square foot with no gaps of perforations. Noise barriers may be constructed of, but are not limited to, masonry block, concrete panels, 1/8 inch thick steel sheets, 1-1/2 inch wood fencing, or 1/4 inch glass panels. If wood is used as the primary barrier component, the fence boards must overlap or be of "tongue and groove" construction with a joining compound between the boards to ensure there would be gaps or holes in the fence; and annual inspection and maintenance must be conducted for the life of the project to ensure the barrier continues to perform to the minimum requirements. The permanent noise barrier may be installed as the required noise barrier for construction under mitigation measure NOI-1, if the permanent noise barrier is installed with hand tools (i.e., not with mechanical equipment that would exceed construction noise standards).

1.2 Project Summary

Project Location

The project site is located on the southwestern edge of the San Fernando Valley in the southern Simi Hills Transverse Range, just north of the U.S. 101 Freeway (Figure 1). The western half of the project is located in the City of Hidden Hills, and the eastern half is located in the City of Los Angeles (Figure 2). The project is located on an approximate 2.57-acre area along Long Valley Road, extending from the Long Valley Road entry gate to Hidden Hills (hereafter referred to as "guard house") down to the Hidden Hills/Los Angeles boundary (approximately 250 feet southeast of the guard house entrance), and in Los Angeles jurisdiction, further along Long Valley Road to the Valley Center Boulevard intersection, where the project continues for approximately 500 feet north along the west side of Valley Circle Boulevard.

Project Description

The proposed project consists of easing traffic congestion at the Long Valley Road and Valley Circle Boulevard/U.S. 101 on-ramp intersection, improving pedestrian access on Long Valley Road and Valley Circle Boulevard, and improving vehicle access and queuing at the gate entry with proposed improvements for a new parking lot to accommodate a staging and prescreening area adjacent to the entry gate. Specific project components are described below, along with anticipated construction activities.

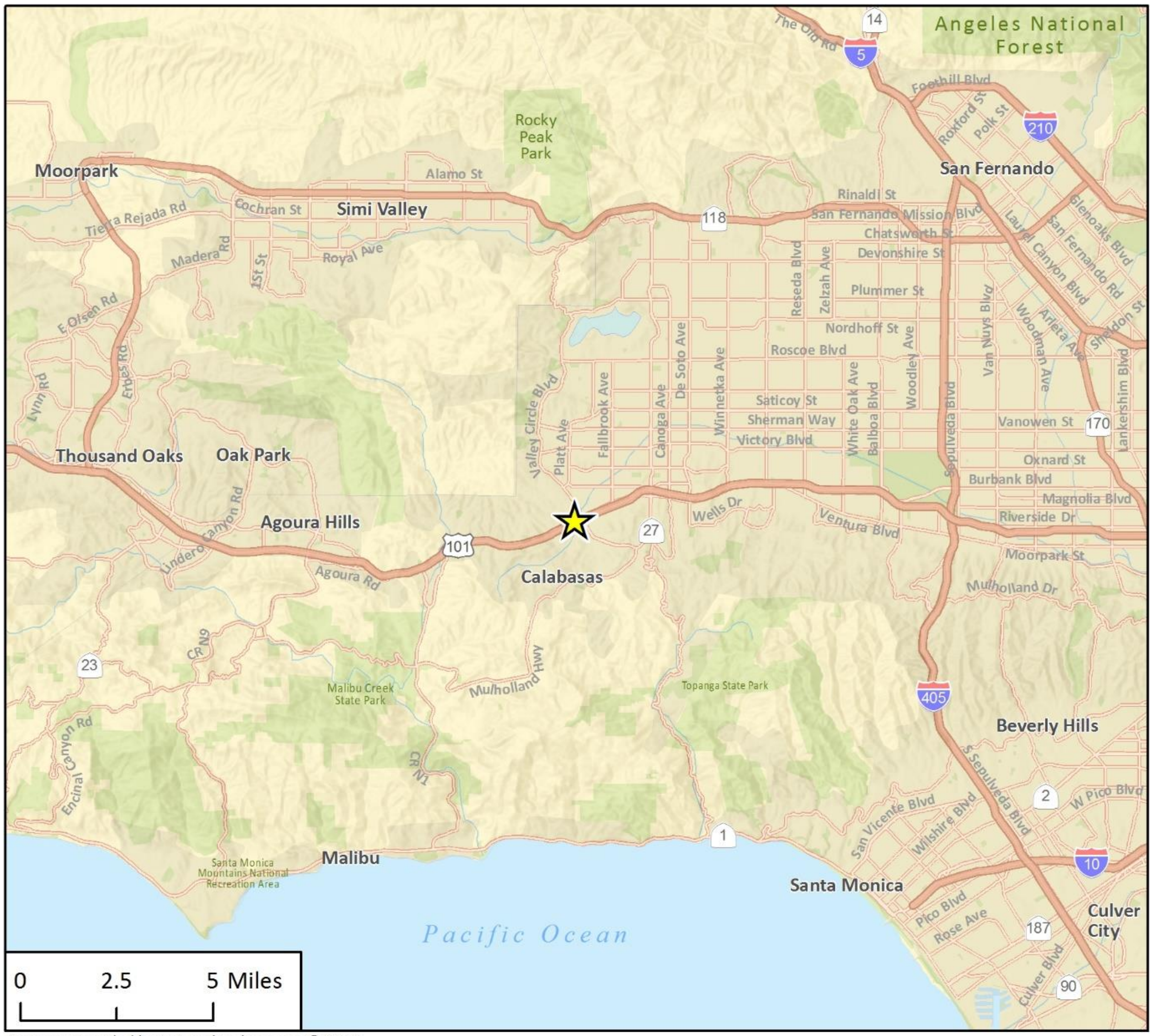
Project components include (see Appendix A for conceptual project plans):

- Roadway and sidewalk improvements (drainage, right-of-way [ROW] acquisition)
- Parking lot improvements (landscaping, irrigation)
- Entry gate improvements (Guard house, gate access, and island median modifications)

Roadway and Sidewalk Improvements

The project would construct a new westbound right-turn lane at the Long Valley Road and U.S. 101 on-ramp intersection to reduce traffic congestion and improve traffic flow/access at the Long Valley Road entry gate. Approximately 1,200 square feet of street right-of-way would be acquired along

Figure 1 Regional Location



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Project Location

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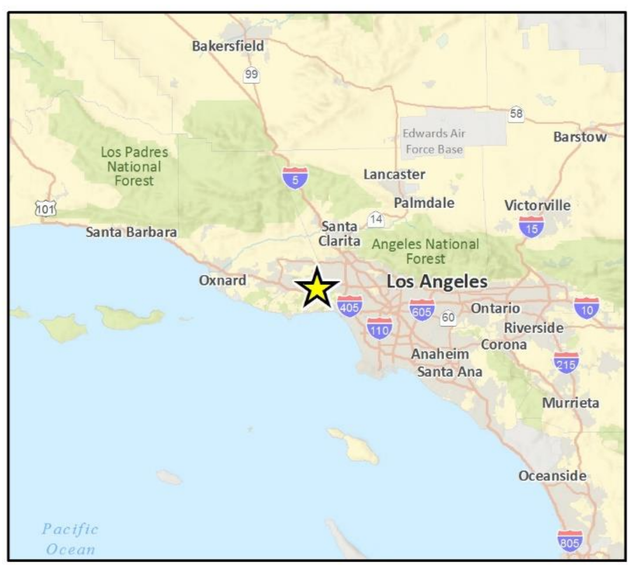

Figure 2 Project Site Location and Noise Measurement Locations

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the north side of Long Valley Road to accommodate the roadway improvements. The proposed ROW acquisition would be a ten-foot wide strip extending approximately 240 feet along Long Valley Road.

To enhance pedestrian safety and access to retail shops on Valley Circle Boulevard/Mullholland Drive, new sidewalk improvements will be installed along the north side of Long Valley Road and extend to the west side of Valley Circle Boulevard. The sidewalk improvements will be five feet wide and 660 linear feet along Long Valley Road, which will transition to ten-foot wide along Valley Circle Boulevard for approximately 380 linear feet, terminating at a marked crosswalk at the Ventura Boulevard intersection. To accommodate the new sidewalk on Long Valley Road, a four-foot high retaining wall will be installed to maintain pedestrian access adjacent to the sloping property from the Boething Treeland Farms, Inc. nursery (hereafter referred to as nursery), which is located on the large property in Los Angeles adjacent to the east of the parking lot area; it will extend for approximately 250 linear feet from the intersection of Long Valley Road and Valley Circle Boulevard. Based on the existing topography, change in elevation from the start of the sidewalk at the entry gate to its end on Valley Circle Boulevard will be approximately 105 feet. The new sidewalk will also cross over an existing box culvert, located midway along Long Valley Road. The majority of the roadway and parkway improvement will be constructed within the City of Los Angeles, with a small portion in the City of Hidden Hills.

Parking Lot and Staging Area

The project will include development of two parking lot areas. The first parking lot will be developed as a park and ride-style facility and vehicle staging area on a vacant parcel to the east of the entry gate. The vehicle staging area would be for queuing for the entry gate. The approximately 0.44 acre triangular-shaped lot is on the north side of Long Valley Road and within the City of Hidden Hills. the nursery is located to the east and single-family homes to the west of the staging area. Development of the vacant parcel would consist of 16 parking spaces (14 standard spaces and 2 handicapped spaces), pedestrian access, staging area for vehicle queuing curb and gutter, paving and preservation of existing oak trees with the addition of new trees, landscaping and landscape features.

The second parking lot area would include reconfiguration of an existing parking area located along the south side of Long Valley Road. These improvements would relocate the existing 7 parking spaces along Long Valley Road and construct an approximately 0.4-acre new parking lot to allow vehicle ingress and egress without conflicting with traffic on Long Valley Road. Proposed improvements would consist of 11 parking spaces (8 standard spaces with six spaces in stacked parking configuration, 2 compact spaces and 1 handicapped space), pedestrian access, curb and gutter, paving, and preservation of existing oak trees with the addition of new trees and landscaping.

Guardhouse and Entry Gate Improvements

A new guardhouse and entry gates will replace the existing ones and be located easterly approximately 12 feet to the east of their current position. This relocation is designed to accommodate U-turn movements at the entry gate and provide efficient access from the adjacent parking areas. The new guardhouse and entry gate will also be widened to provide two ingress lanes; the lane adjacent to the guardhouse will be actuated by an attendant for visitors and a separate outside lane will be actuated automatically with an electronic pass key for residents only. These improvements are anticipated to require an additional 12 feet of ROW.

Construction Phasing and Schedule

The project will be completed in two phases. Phase one will encompass improvements within Hidden Hills. Phase two will involve improvements within Los Angeles. Considering the sensitivity of the project timing and the amount of time required for processing approvals from various agencies, the improvements within the limits of Hidden Hills (i.e., phase one) will be completed first. Phase one improvements will include the parking lot, pavement improvements, striping, and signage and potential inclusion of the guardhouse relocation, traffic turn-around, and additional parking lot across the street. Phase two improvements in Los Angeles include sidewalk, striping, and median improvements on Long Valley Road and Valley Circle Boulevard. The improvements will widen the roadway to accommodate the sidewalks; however, the vehicle lanes would remain in approximately the same area. Such improvements will be limited to shallow excavation where any ground disturbance would not exceed two feet below existing grade. General construction activities will involve grading, paving, landscape, irrigation, striping, concrete construction and potentially drilling for water quality.

It is anticipated that construction of the project would commence in the Summer of 2019 and last approximately six months. Assuming this construction time frame, the proposed project would be completed by December 2019.

2 Background

2.1 Overview of Sound Measurement

Sound is a vibratory disturbance created by a moving or vibrating source, which is capable of being detected by the hearing organs. Noise is defined as sound that is loud, unpleasant, unexpected, or undesired and may therefore be classified as a more specific group of sounds. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance, and, in the extreme, hearing impairment (Caltrans 2013a).

Noise levels are commonly measured in decibels (dB) using the A-weighted sound pressure level (dBA). The A-weighting scale is an adjustment to the actual sound pressure levels so that they are consistent with the human hearing response, which is most sensitive to frequencies around 4,000 Hertz and less sensitive to frequencies around and below 100 Hertz (Kinsler, et. al. 1999). Decibels are measured on a logarithmic scale that quantifies sound intensity in a manner similar to the Richter scale used to measure earthquake magnitudes. A doubling of the energy of a noise source, such as doubling of traffic volume, would increase the noise level by 3 dB; dividing the energy in half would result in a 3 dB decrease (Crocker 2007).

Human perception of noise has no simple correlation with sound energy: the perception of sound is not linear in terms of dBA or in terms of sound energy. Two sources do not “sound twice as loud” as one source. It is widely accepted that the average healthy ear can barely perceive changes of 3 dBA, increase or decrease (i.e., twice the sound energy); that a change of 5 dBA is readily perceptible (8 times the sound energy); and that an increase (or decrease) of 10 dBA sounds twice (half) as loud ([10.5x the sound energy] Crocker 2007).

Sound changes in both level and frequency spectrum as it travels from the source to the receiver. The most obvious change is the decrease in level as the distance from the source increases. The manner by which noise reduces with distance depends on factors such as the type of sources (e.g., point or line, the path the sound will travel, site conditions, and obstructions). Noise levels from a point source typically attenuate, or drop off, at a rate of 6 dBA per doubling of distance (e.g., construction, industrial machinery, ventilation units). Noise from a line source (e.g., roadway, pipeline, railroad) typically attenuates at about 3 dBA per doubling of distance (Caltrans 2013a). The propagation of noise is also affected by the intervening ground, known as ground absorption. A hard site, such as a parking lot or smooth body of water, receives no additional ground attenuation and the changes in noise levels with distance (drop-off rate) result from simply the geometric spreading of the source. An additional ground attenuation value of 1.5 dBA per doubling of distance applies to a soft site (e.g., soft dirt, grass, or scattered bushes and trees) (Caltrans 2013a). Noise levels may also be reduced by intervening structures; the amount of attenuation provided by this “shielding” depends on the size of the object and the frequencies of the noise levels. Natural terrain features such as hills and dense woods, and man-made features such as buildings and walls, can significantly alter noise levels. Generally, any large structure blocking the line of sight will provide at least a 5-dBA reduction in source noise levels at the receiver (Federal Highway Administration [FHWA] 2017). Structures can substantially reduce exposure to noise as well. The FHWA’s guidelines indicate that modern building construction generally provides an exterior-to-interior noise level reduction of 20 to 35 dBA with closed windows.

The impact of noise is not a function of loudness alone. The time of day when noise occurs and the duration of the noise are also important factors of project noise impact. Most noise that lasts for more than a few seconds is variable in its intensity. Consequently, a variety of noise descriptors have been developed. One of the most frequently used noise metrics is the equivalent noise level (L_{eq}); it considers both duration and sound power level. L_{eq} is defined as the single steady A-weighted level equivalent to the same amount of energy as that contained in the actual fluctuating levels over time. Typically, L_{eq} is summed over a one-hour period. L_{max} is the highest root mean squared (RMS) sound pressure level within the sampling period, and L_{min} is the lowest RMS sound pressure level within the measuring period (Crocker 2007).

Noise that occurs at night tends to be more disturbing than that occurring during the day. Community noise is usually measured using Day-Night Average Level (DNL), which is the 24-hour average noise level with a +10 dBA penalty for noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours; it is also measured using Community Noise Equivalent Level (CNEL), which is the 24-hour average noise level with a +5 dBA penalty for noise occurring from 7:00 p.m. to 10:00 p.m. and a +10 dBA penalty for noise occurring from 10:00 p.m. to 7:00 a.m. (Caltrans 2013a). Noise levels described by DNL and CNEL usually differ by about 1 dBA. The relationship between the peak-hour L_{eq} value and the Ldn/CNEL depends on the distribution of traffic during the day, evening, and night. Quiet suburban areas typically have CNEL noise levels in the range of 40 to 50 dBA, while areas near arterial streets are in the 50 to 60-plus CNEL range. Normal conversational levels are in the 60 to 65-dBA L_{eq} range; ambient noise levels greater than 65 dBA L_{eq} can interrupt conversations (FTA 2018).

2.2 Vibration

Groundborne vibration of concern in environmental analysis consists of the oscillatory waves that move from a source through the ground to adjacent structures. The number of cycles per second of oscillation makes up the vibration frequency, described in terms of Hz. The frequency of a vibrating object describes how rapidly it oscillates. The normal frequency range of most groundborne vibration that can be felt by the human body starts from a low frequency of less than 1 Hz and goes to a high of about 200 Hz (Crocker 2007).

While people have varying sensitivities to vibrations at different frequencies, in general they are most sensitive to low-frequency vibration. Vibration in buildings, such as from nearby construction activities, may cause windows, items on shelves, and pictures on walls to rattle. Vibration of building components can also take the form of an audible low-frequency rumbling noise, referred to as groundborne noise. Groundborne noise is usually only a problem when the originating vibration spectrum is dominated by frequencies in the upper end of the range (60 to 200 Hz), or when foundations or utilities, such as sewer and water pipes, physically connect the structure and the vibration source (Federal Transit Administration [FTA] 2018). Although groundborne vibration is sometimes noticeable in outdoor environments, it is almost never annoying to people who are outdoors. The primary concern from vibration is that it can be intrusive and annoying to building occupants and vibration-sensitive land uses.

Vibration energy spreads out as it travels through the ground, causing the vibration level to diminish with distance away from the source. High-frequency vibrations diminish much more rapidly than low frequencies, so low frequencies tend to dominate the spectrum at large distances from the source. Discontinuities in the soil strata can also cause diffractions or channeling effects that affect the propagation of vibration over long distances (Caltrans 2013b). When a building is impacted by vibration, a ground-to-foundation coupling loss will usually reduce the overall vibration level. However, under rare circumstances, the ground-to-foundation coupling may actually amplify the vibration level due to structural resonances of the floors and walls.

Vibration amplitudes are usually expressed in peak particle velocity (PPV) or root mean squared (RMS) vibration velocity. The PPV and RMS velocity are normally described in inches per second (in./sec.). PPV is defined as the maximum instantaneous positive or negative peak of a vibration signal. PPV is often used in monitoring of blasting vibration because it is related to the stresses that are experienced by buildings (Caltrans 2013b).

2.3 Sensitive Receivers

Noise exposure goals for various types of land uses reflect the varying noise sensitivities associated with those uses. Under Hidden Hills's General Plan, the entire jurisdiction is considered noise sensitive because it is an entirely residential area (Hidden Hills 1995). The following land uses are considered noise sensitive in Los Angeles: single-family and multi-unit dwellings, long-term care facilities (including convalescent and retirement facilities), dormitories, motels, hotels, transient lodgings and other residential uses; houses of worship; hospitals; libraries; schools; auditoriums; concert halls; outdoor theaters; nature and wildlife preserves, and parks (Los Angeles 1999).

Vibration sensitive receivers are similar to noise sensitive receivers, such as residences, and institutional uses, such as schools, churches, and hospitals. However, vibration sensitive receivers also include buildings where vibrations may interfere with vibration-sensitive equipment, affected by levels that may be well below those associated with human annoyance.

2.4 Project Noise Setting

The most common source of noise in the project site vicinity is vehicular traffic from U.S. 101 Freeway. Ambient noise levels are generally highest during the daytime and rush hour.

The nearest sensitive receivers to the project site are single-family residences located in Hidden Hills, to the west and north of project construction in the western portion of the project. The future parking lot area and part of the improvements along Long Valley border the nursery under Los Angeles jurisdiction, which is zoned RA-1VL (Suburban). Continuing in the Los Angeles, east of the nursery property on Long Valley Road and on Valley Circle Boulevard, the project is adjacent to properties zoned PF-1XL (Public Facilities), which are undeveloped properties. Single-family residences are located approximately 250 feet to the east across Valley Center Boulevard from project construction.

To characterize ambient sound levels at and near the project site, two 15-minute sound level measurements were conducted on April 3, 2019. Noise Measurement (NM) 1 was taken in the future car park area to ascertain ambient noise levels near the residential uses in Hidden Hills; NM 2 was taken just south of the nursery property, on the northside of Long Valley Road, facing the U.S. 101 Freeway, to ascertain ambient noise levels at the nursery property boundary. Figure 2 shows the noise measurement locations, Table 2 summarizes the results of the noise measurements, and Table 3 shows the recorded traffic volumes from the noise measurement near U.S. 101 Freeway. Detailed sound level measurement data are included in Appendix B.

Table 2 Project Vicinity Sound Level Monitoring Results

Measurement Location	Measurement Location	Sample Times	Approximate Distance to Primary Noise Source	L_{eq} (dBA)	Lmin (dBA)	Lmax (dBA)
1	Future car park area, facing U.S. 101 Freeway	11:19 – 11:34 a.m.	Approximately 350 feet to centerline of U.S. 101 Freeway	60.9	57.7	67.5
2	Just south of the nursery property, on the northside of Long Valley Road, facing U.S. 101 Freeway	11:40 – 11:55 a.m.	Approximately 112 feet to centerline of U.S. 101 Freeway	76.0	71.1	86.5

See Figure 2 for Noise Measurement Locations.
Detailed sound level measurement data are included in Appendix B.

Table 3 Sound Level Monitoring Traffic Counts

Measurement	Roadway	Traffic	Autos	Medium Trucks	Heavy Trucks
1	Long Valley Road (near Hidden Hills entrance sign)	15-minute count	52	4	0
		One-hour Equivalent	208	16	0
Percent			**93%**	**7%**	**0%**
2	U.S. 101 Freeway	15-minute count	1,365	45	30
		One-hour Equivalent	5,460	180	120
Percent			**95%**	**3%**	**2%**

Note: Detailed sound level measurement data are included in Appendix B.

2.5 Applicable Regulatory Setting

The lead agency for the project is Hidden Hills. Hidden Hills' noise regulations are provided; however, Hidden Hills does not provide quantitative thresholds for construction or operational noise sources. Therefore, to provide an analysis of potential noise impacts from the project, the Los Angeles' quantitative standards, described below, are used for the analysis.

City of Hidden Hills

The Noise Control Ordinance of Hidden Hills (Title 3, Chapter 8) provides the Hidden Hills' noise control regulations. Section 3-8-4 prohibits the making of sounds or vibrations which are annoying or so prolonged or unnatural as to cause discomfort, and Section 3-8-5 restricts activities that would result in loud and/ or unnecessary noises and includes restrictions on construction hours. Construction activities are prohibited after 8 p.m. or before 7 a.m. on weekdays, after 8 p.m. or before 8 a.m. on Saturdays, or at any time on Sundays or holidays.

City of Los Angeles

Noise Element

The goals, policies, and actions contained in the Noise Element of the Los Angeles General Plan focus on establishing and applying criteria for acceptable noise levels for different land uses in order to minimize the negative impacts of noise, especially at sensitive receivers (Los Angeles 1999). Quantitative noise values established for land use compatibility from the Noise Element were adapted by the *L.A. CEQA Thresholds Guide*, discussed in the following section and contained in Table 4.

- In support of the Noise Element goals and actions, the *L.A. CEQA Thresholds Guide* contains construction and operational noise thresholds. According to the thresholds guide, if construction would occur within 500 feet of a noise sensitive land use, a project would normally have a significant impact on noise levels from construction if:
- Construction activities lasting more than one day would exceed existing ambient exterior noise levels by 10 dBA or more at a noise sensitive use;
- Construction activities lasting more than 10 days in a three month period would exceed existing ambient exterior noise levels by 5 dBA or more at a noise sensitive use; or
- Construction activities would exceed the ambient noise level by 5 dBA at a noise sensitive use between the hours of 9:00 p.m. and 7:00 a.m. Monday through Friday, before 8:00 a.m. or after 6:00 p.m. on Saturday, or at any time on Sunday

The *L.A. CEQA Thresholds Guide* also contains a land use and noise compatibility matrix (shown in Table 4), which determines the normally acceptable, conditionally acceptable, normally unacceptable, and clearly unacceptable noise levels for various land uses (Los Angeles 2006).

The *L.A. CEQA Thresholds Guide* includes thresholds for on-site operational and off-site roadway noise. According to the *L.A. CEQA Thresholds Guide*, on-site operational and off-site roadway noise would result in significant impacts if the project would cause the ambient noise level measured at the property line of affected uses to increase by 3 dBA CNEL to or within the “normally unacceptable” or “clearly unacceptable” category as identified in Table 4, or by 5 dBA CNEL or more (Los Angeles 2006).

Table 4 City of Los Angeles Land Use and Noise Compatibility Matrix (dBA CNEL)

Land Use	Normally Acceptable[1]	Conditionally Acceptable[2]	Normally Unacceptable[3]	Clearly Unacceptable[4]
Single-Family, Duplex, Mobile Homes	50 – 60	55 – 70	70 – 75	70+
Multi-Family	50 – 65	60 – 70	70 – 75	70+
School, Library, Church, Hospital, Nursing Home	50 – 70	60 – 70	70 – 80	80+
Transient Lodging, Motel, Hotel	50 – 65	60 – 70	70 – 80	80+
Auditorium, Concert Hall, Amphitheater	–	50 – 70	–	65+
Sports Arena, Outdoor Spectator Sports	–	50 – 75	–	70+
Playground, Neighborhood Park	50 – 70	–	65 – 75	72+
Golf Course, Riding Stable, Water Recreation, Cemetery	50 – 75	–	70 – 80	80+
Office Building, Business, Commercial, Professional	50 – 70	67 – 77	75+	–
Agriculture, Industrial, Manufacturing, Utilities	50 – 75	70 – 80	75+	–

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

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

[3] Normally Unacceptable: 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.

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

Note: Noise levels are provided in dBA CNEL.

Source: City of Los Angeles 2006

Municipal Code

Los Angeles also implements and enforces construction and operational noise regulations through the Los Angeles Municipal Code (LAMC). LAMC Section 112.05 limits noise from construction equipment located within 500 feet of a residential zone to 75 dBA L_{max} between 7:00 a.m. and 10:00 p.m., as measured at a distance of 50 feet from the source, unless compliance is technically infeasible. Technical infeasibility means that noise limitations cannot be met despite the use of mufflers, shields, sound barriers and/or other noise reduction devices or techniques during the operation of construction equipment. LAMC Section 41.40 also restricts construction activity to the hours below:

- Monday through Friday between 7:00 a.m. and 9:00 p.m.
- Saturdays and National Holidays between 8:00 a.m. and 6:00 p.m.
- No construction on Sundays except for residents
- For operational noise, the property line noise limits are defined under LAMC Section 111.03 and are listed in Table 5

Table 5 City of Los Angeles Property Line Noise Level Limits

Zone	Presumed Ambient Noise Level (dBA)	
	Day	Night
A1, A2, RA, RE, RS, RD, RW1, RW2, R1, R2, R3, R4, and R5	50	40
P, PB, CR, C1, C1.5, C2, C4, C5, and CM	60	55
M1, MR1, and MR2	60	55
M2 and M3	65	65

Source: LAMC Section 111.03

3 Methodology

3.1 Construction Noise

Construction noise was estimated using the FHWA Roadway Construction Noise Model (RCNM) (FHWA 2006). RCNM predicts construction noise levels for a variety of construction operations based on empirical data and the application of acoustical propagation formulas. Using RCNM, construction noise levels were estimated at noise sensitive receivers near the project site. RCNM provides reference noise levels for standard construction equipment, with an attenuation of 6 dBA per doubling of distance for stationary equipment.

Variation in power imposes additional complexity in characterizing the noise source level from construction equipment. Power variation is accounted for by describing the noise at a reference distance from the equipment operating at full power and adjusting it based on the duty cycle of the activity to determine the L_{eq} of the operation (FHWA 2018). Each phase of construction has a specific equipment mix, depending on the work to be accomplished during that phase. Each phase also has its own noise characteristics; some will have higher continuous noise levels than others, and some have high-impact noise levels.

Construction activity would result in temporary noise in the project area, exposing surrounding sensitive receivers to increased noise levels. The project will involve grading, paving, landscape installation, striping, concrete construction, and drilling for water quality. Excavation would be limited to two feet below ground surface. Construction noise would typically be higher during the heavier periods of initial construction (i.e., grading) and would be lower during the later construction phases (i.e., paving, landscape installation, striping, concrete construction, and drilling for water quality). Typical heavy construction equipment during project grading could include dozers, excavators, loaders, and dump trucks. It is assumed that diesel engines would power all construction equipment. Construction equipment would not all operate at the same time or location. In addition, construction equipment would not be in constant use during the 8-hour operating day.

A potential construction scenario includes a loader and a dump truck working to grade for the roadway improvements and a paver completing a section of road already graded. Therefore, a loader, dump truck, and paver were analyzed together for construction noise impacts due to their likelihood of being used in conjunction at the same time and therefore a conservative scenario for the greatest noise generation during construction. At a distance of 50 feet, a loader, dump truck, and paver would generate a noise level of 78.8 dBA L_{eq} and 79.1 dBA L_{max} (RCNM calculations are included in Appendix C). The 75 dBA L_{max} noise contour would be located at approximately 80 feet.

3.2 Groundborne Vibration

The proposed project does not include any substantial vibration sources associated with operation. Thus, construction activities have the greatest potential to generate ground-borne vibration affecting nearby receivers, especially during grading and excavation of the project site. The greatest vibratory source during construction within the project vicinity would be a vibratory roller. Neither blasting nor pile driving would be required for construction of the proposed project. Construction vibration estimates are based on vibration levels reported by Caltrans and the FTA (Caltrans 2013b, FTA 2018). Table 6 shows typical vibration levels for various pieces of construction equipment used in the assessment of construction vibration (FTA 2018).

Table 6 Vibration Levels Measured during Construction Activities

Equipment		PPV at 25 ft. (in/sec)
Pile Driver (impact)	Upper range	1.518
	Typical	0.644
Pile Driver (sonic)	Upper range	0.734
	Typical	0.170
Hydromill (slurry wall)	Soil	0.008
	Rock	0.017
Clam Shovel Drop (slurry wall)		0.202
Vibratory Roller		0.210
Hoe Ram		0.089
Large Bulldozer		0.089
Caisson Drilling		0.089
Loaded Trucks		0.076
Jackhammer		0.035
Small Bulldozer		0.003

Source: FTA 2018

Vibration limits used in this analysis to determine a potential impact to local land uses from construction activities, such as blasting, pile-driving, vibratory compaction, demolition, drilling, or excavation, are based on information contained in Caltrans' *Transportation and Construction Vibration Guidance Manual* and the Federal Transit Administration and the FTA *Transit Noise and Vibration Impact Assessment Manual* (Caltrans 2013b; FTA 2018). Maximum recommended vibration limits by the American Association of State Highway and Transportation Officials (AASHTO) are identified in Table 7.

Table 7 AASHTO Maximum Vibration Levels for Preventing Damage

Type of Situation	Limiting Velocity (in./sec.)
Historic sites or other critical locations	0.1
Residential buildings, plastered walls	0.2–0.3
Residential buildings in good repair with gypsum board walls	0.4–0.5
Engineered structures, without plaster	1.0–1.5

Source: Caltrans 2013b

Based on AASHTO recommendations, limiting vibration levels to below 0.4 PPV in./sec. at residential structures would prevent structural damage regardless of building construction type. These limits are applicable regardless of the frequency of the source. However, as shown in Table 8 and Table 9 potential human annoyance associated with vibration is usually different if it is generated by a steady state or a transient vibration source.

Table 8 Human Response to Steady State Vibration

PPV (in./sec.)	Human Response
3.6 (at 2 Hz)–0.4 (at 20 Hz)	Very disturbing
0.7 (at 2 Hz)–0.17 (at 20 Hz)	Disturbing
0.10	Strongly perceptible
0.035	Distinctly perceptible
0.012	Slightly perceptible

Source: Caltrans 2013b

Table 9 Human Response to Transient Vibration

PPV (in./sec.)	Human Response
2.0	Severe
0.9	Strongly perceptible
0.24	Distinctly perceptible
0.035	Barely perceptible

Source: Caltrans 2013b

As shown in Table 8, the vibration level threshold at which steady vibration sources are considered to be distinctly perceptible is 0.035 in./sec. PPV. This is roughly equivalent to the FTA identified threshold of 78 VdB for assessing impacts to residential land uses from infrequent events. This threshold is used for assessing passing trains in the FTA Manual. However, as shown in Table 9, the vibration level threshold at which transient vibration sources (such as construction equipment) are considered to be distinctly perceptible is 0.24 in./sec. PPV. This is roughly equivalent to 94 VdB. This analysis uses the distinctly perceptible threshold for purposes of assessing vibration impacts.

Although groundborne vibration is sometimes noticeable in outdoor environments, groundborne vibration is almost never annoying to people who are outdoors; therefore, the vibration level threshold for human perception is assessed at occupied structures (FTA 2018). Therefore, vibration impacts are assessed at the structure of an affected property.

3.3 Operational Noise Sources

Activities from users of the parking areas would include vehicle arrival, limited idling of the vehicle, occupants exiting their vehicle, door closure, conversations among passengers, occupants entering the vehicle, vehicle startup, and departure. Noise from typical parking lot activities such as car alarms can reach up to 83 dBA at 10 feet; door slams up to 78 dBA at 10 feet; vehicle tire squeals up to 80 dBA at 10 feet; and car horns up to 83 dBA at 10 feet (Gordon Bricken & Associates 1996).

The project would not result in the generation of new vehicle trips. The project is providing additional sidewalks, striping, and medians on the roadway; however, the project is not widening vehicle lanes and therefore is not putting vehicles closer to residential properties than existing roadways.

3.4 Significance Thresholds

The following thresholds are based on Los Angeles' and Hidden Hills' noise thresholds, and Appendix G of the CEQA guidelines. Noise impacts would be considered significant if:

- **Issue 1:** The project would result in the generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
  - **Temporary:** Based on LAMC Sections 112.05 and 41.40, construction noise would be significant if:
    - Noise levels exceed a maximum noise level of 75 dBA when measured at a distance of 50 feet from the source and within 500 feet of a residential zone unless technically infeasible; or
    - Construction noise is generated outside of allowable construction hours.

    According to the L.A. CEQA Thresholds Guide, if construction would occur within 500 feet of a noise sensitive land use, a project would normally have a significant impact on noise levels from construction if:

    - Construction activities lasting more than one day would exceed existing ambient exterior noise levels by 10 dBA or more at a noise sensitive use;
    - Construction activities lasting more than 10 days in a three month period would exceed existing ambient exterior noise levels by 5 dBA or more at a noise sensitive use; or
    - Construction activities would exceed the ambient noise level by 5 dBA at a noise sensitive use between the hours of 9:00 p.m. and 7:00 a.m. Monday through Friday, before 8:00 a.m. or after 6:00 p.m. on Saturday, or at any time on Sunday
  - **Permanent:** Based on LAMC Sections 111.03, operational noise would be significant if:
    - Noise levels exceed 50 dBA from 7:00 a.m. to 10:00 p.m. or 40 dBA from 10:00 p.m. to 7:00 a.m. at a residentially-zoned property.

    Based on the L.A. CEQA Thresholds Guide, project operational noise would result in a significant impact if

    - The project would cause the ambient noise level measured at the property line of affected uses to increase by 3 dBA CNEL to or within the "normally unacceptable" or "clearly unacceptable" category as identified in Table 4, or by 5 dBA CNEL or more.
- **Issue 2:** The project would result in the generation of excessive ground-borne vibration or ground-borne noise levels.
  - This would occur if the project would subject vibration-sensitive land uses to construction-related ground-borne vibration that exceeds the distinctly perceptible vibration annoyance potential criteria for human receivers of 0.24 in./sec. PPV, or the residential structural damage criteria of 0.5 PPV in./sec.

- **Issue 3:** For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, if the project exposes people residing or working in the project area to excessive noise levels.

4 Impact Analysis

4.1 Issue 1 – Temporary and Permanent Noise Increase

Issue: Would the project result in generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

Construction

Project construction would occur nearest to sensitive noise uses in Hidden Hills. During construction of the northern parking lot and staging area, construction would occur adjacent to a single-family residence (23537 Long Valley Road). In Los Angeles, project construction would occur adjacent to a residentially-zoned parcel for the tree nursery. Over the course of a typical construction day, construction equipment would be located as close as 25 feet to the residential properties, but would typically be located at an average distance further away due to the nature of construction. Therefore, it is conservatively assumed that over the course of a typical construction day the construction equipment would operate 50 feet from the nearest residential property lines.

As described under Section 3.1, at a distance of 50 feet, a loader, dump truck, and paver would generate a noise level of 79.1 dBA L_{max} and 78.8 dBA L_{eq}. The 75 dBA L_{max} noise contour would be located at approximately 80 feet. The LAMC construction noise threshold is 75 dBA L_{max}; therefore, noise levels may exceed the 75 dBA L_{max} threshold when performed within 80 feet of nearby residentially-zoned properties.

In addition, the *L.A. CEQA Thresholds Guide* construction noise threshold states that a significant impact would occur if construction activities lasting more than 10 days in a three month period would exceed existing ambient exterior noise levels by 5 dBA or more at a noise sensitive use. For this threshold, the nursery property would not be considered a noise sensitive use. As shown in Table 2, ambient noise levels in the general area for the northern parking lot was measured at 60.9 dBA L_{eq}. Construction noise levels would exceed the *L.A. CEQA Thresholds Guide* construction threshold if noise levels at the residence to the north of the parking lot (23537 Long Valley Road) exceed 65.9 dBA L_{eq}. The 65.9 dBA L_{eq} noise contour from construction would be approximately 225 feet. Therefore, if construction occurs within 225 feet of nearby residences, construction noise impacts would be significant.

Operation

Parking Areas

As described under Section 3.3, activities from patrons of the parking areas would include vehicle arrival, limited idling of the vehicle, occupants exiting their vehicle, door closure, conversations among passengers, occupants entering the vehicle, vehicle startup, and departure. In addition, noise would be generated from vehicles queuing at the staging location for entrance through the entry gate into the Hidden Hills residential neighborhoods. The project would include 16 parking spaces and a staging area (queuing line) for the entry gate on the northern parking lot, and 11 parking spaces on the southern parking lot. From the northern lot, these activities would occur as approximately from 10 feet to 125 feet from the nearest residential property (23537 Long Valley Road); from the southern lot, they would take place approximately 200 to 250 feet from 23537 Long Valley Road. For the purposes of modeling, noise was assumed to occur at a conservative, approximate average distance of 40 feet.

The FTA's General Transit Noise Assessment noise model was used to calculate potential noise levels generated by the parking areas, using the "Park & Ride Lot" source (FTA 2006) with 27 vehicles during the noisiest hour. With these assumptions, the noise level at the nearest residential property would be 49 dBA. Conservatively assuming this noise level occurs all hours of the day, this would result in a CNEL of 55.7. As shown in Table 2, ambient noise levels in the general area for the northern parking lot was measured at 60.9 dBA L_{eq}. Per the L*.A. CEQA Thresholds Guide* threshold, a 3 dBA CNEL increase would be a significant impact. Since the project would increase ambient noise levels to approximately 62.0 dBA, this would not exceed the guide's threshold increase of 3 dBA CNEL. However, the LAMC regulates noise levels to not exceed 50 dBA from 7:00 a.m. to 10:00 p.m. or 40 dBA from 10:00 p.m. to 7:00 a.m. at a residentially-zoned property, and the modeled noise level of 49 dBA would conform to the daytime standard but would exceed the nighttime standard. The nearest residence is separated from the parking area by an approximately 5-foot CMU block wall, which would attenuate noise levels. However, the wall's height would not be tall enough to completely block the line of sight between the noise sources and the adjacent residence, and would therefore not provide substantial attenuation to reduce noise levels below significance. Therefore, impacts from operational noise would be significant.

Off-site Traffic Noise

The project would not generate new vehicle trips that would increase noise levels on nearby roadways. The project may redirect some trips to the park and ride-style parking lot area that would not have otherwise driven north on Long Valley Road; however, given the number of parking spots (27) and the low speeds that would occur in this area, any increase in traffic would result in a negligible increase in noise. In addition, the project would not widen the vehicle lanes on existing roadways. Therefore, traffic noise impacts from the project would be less than significant.

Mitigation Measures

Mitigation measure NOI-1 would be implemented to ensure construction noise does not exceed the 75 dBA L_{max} threshold.

NOI-1 Construction Noise Reduction

Noise barriers with a minimum height of ten feet shall be placed between the construction equipment and adjacent noise sensitive uses (single-family residences) in Hidden Hills when construction is performed within 225 feet of the residences. In addition, noise barriers with a minimum height of eight feet shall be placed when construction is performed within 80 feet of the single-family zoned nursery property in Los Angeles. The noise barriers shall be constructed of material with a minimum weight of two pounds per square foot with no gaps or perforations. Noise barriers may be constructed of, but not limited to, 5/8-inch plywood, 5/8-inch oriented strand board, and hay bales. Example noise reduction equipment product sheets are included in Appendix D.

Mitigation measure NOI-2 would be implemented to ensure noise from the project's parking lot and entry gate staging area does not exceed 40 dBA from 10:00 p.m. to 7:00 a.m. at a residentially-zoned property.

NOI-2 Permanent Sound Wall

A permanent noise barrier shall be erected at the northern parking lot area along the northern boundary with the single-family residence (23537 Long Valley Road). The top of the noise barrier will be a minimum of eight-feet above the final grade of the parking lot and be constructed of a material with a minimum weight of 4 pounds per square foot with no gaps of perforations. Noise barriers may be constructed of, but are not limited to, masonry block, concrete panels, 1/8 inch thick steel sheets, 1-1/2 inch wood fencing, or 1/4 inch glass panels. If wood is used as the primary barrier component, the fence boards must overlap or be of "tongue and groove" construction with a joining compound between the boards to ensure there would be gaps or holes in the fence; and annual inspection and maintenance must be conducted for the life of the project to ensure the barrier continues to perform to the minimum requirements. The permanent noise barrier may be installed as the required noise barrier for construction under mitigation measure NOI-1, if two-foot of temporary sound wall is added to the top of the wall and if the permanent noise barrier is installed with hand tools (i.e., not with mechanical equipment that would exceed construction noise standards).

Significance After Mitigation

According to the Housing and Urban Development's Barrier Performance Module, a ten-foot barrier would result in a noise reduction of approximately 13 dBA, resulting in construction noise levels that are approximately 65.8 dBA L_{eq} at 50 feet and therefore do not exceed the ambient plus 5 dBA construction noise limit (65.9 dBA L_{eq}) at the noise sensitive uses in Hidden Hills (noise barrier performance calculations included in Appendix E). According to the Housing and Urban Development's Barrier Performance Module, an eight-foot barrier would result in a noise reduction of approximately 10 dBA, resulting in construction noise levels that are approximately 69 dBA L_{max} at 50 feet and therefore do not exceed the 75 dBA L_{max} threshold at the residentially-zoned nursery property in Los Angeles. Therefore, with implementation of mitigation measure NOI-1, construction noise impacts would be less than significant.

With the 10 dBA reduction shown in Appendix E, the permanent sound wall for operational noise would result in a noise level of approximately 39 dBA at the adjacent single-family residential property. Therefore, noise levels would not exceed the LAMC's nighttime noise limit of 40 dBA. With implementation of mitigation measure NOI-2, operational noise impacts would be less than significant.

4.2 Issue 2 – Vibration

Issue:	Would the project result in generation of excessive ground-borne vibration or ground-borne noise levels? *(Less Than Significant Impact)*

Construction activities known to generate excessive ground-borne vibration, such as pile driving, would not be conducted by the project. The greatest anticipated source of vibration during general project construction activities would be from a vibratory roller, which may be used during paving activities and may be used within 25 feet of the nearest off-site residential structure. A vibratory roller would create approximately 0.210 in./sec. PPV at a distance of 25 feet (Caltrans 2013b). This would be lower than what is considered a distinctly perceptible impact for humans of 0.24 in./sec. PPV, and the structural damage impact to residential structures of 0.5 in./sec. PPV. Therefore, although a vibratory roller may be perceptible to nearby human receivers, temporary impacts associated with the roller (and other potential equipment) would be less than significant.

The project does not include any substantial vibration sources associated with operation. Therefore, operational vibration impacts would be less than significant.

4.3 Issue 3 – Airport Noise

Issue: For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels? *(No Impact)*

The Van Nuys Airport is located approximately nine miles east of the project site. The project site is not located within two miles of a public airport or private airstrip, or located in an airport land use plan. Therefore, no substantial noise exposure would occur to construction workers or users of the park and ride from aircraft noise, and no impacts would occur.

5 Conclusions

Construction noise would exceed the construction noise thresholds of 75 dBA L_{max} and ambient noise plus 5 dBA at nearby residential properties. Mitigation measure NOI-1 is required to implement a sound wall reduce construction noise exposure at nearby sensitive receivers to less than significant levels.

Noise from typical parking lot activities would exceed the nighttime property line noise threshold of 40 dBA at the single-family residential to the north of the northern parking lot. Mitigation measure NOI-2 is required to implement a sound wall to reduce operational noise exposure at nearby sensitive receivers to less than significant.

The proposed project would not generate new vehicle trips, and no impacts would occur from an increase in traffic noise.

The project would generate groundborne vibration during construction. Groundborne vibration would not exceed the applicable vibration thresholds. Therefore, construction-related vibration impacts would be less than significant.

No substantial noise exposure would occur to construction workers or users of the park and ride from aircraft noise.

6 References

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Appendix A

Conceptual Project Plans

CITY OF HIDDEN HILLS

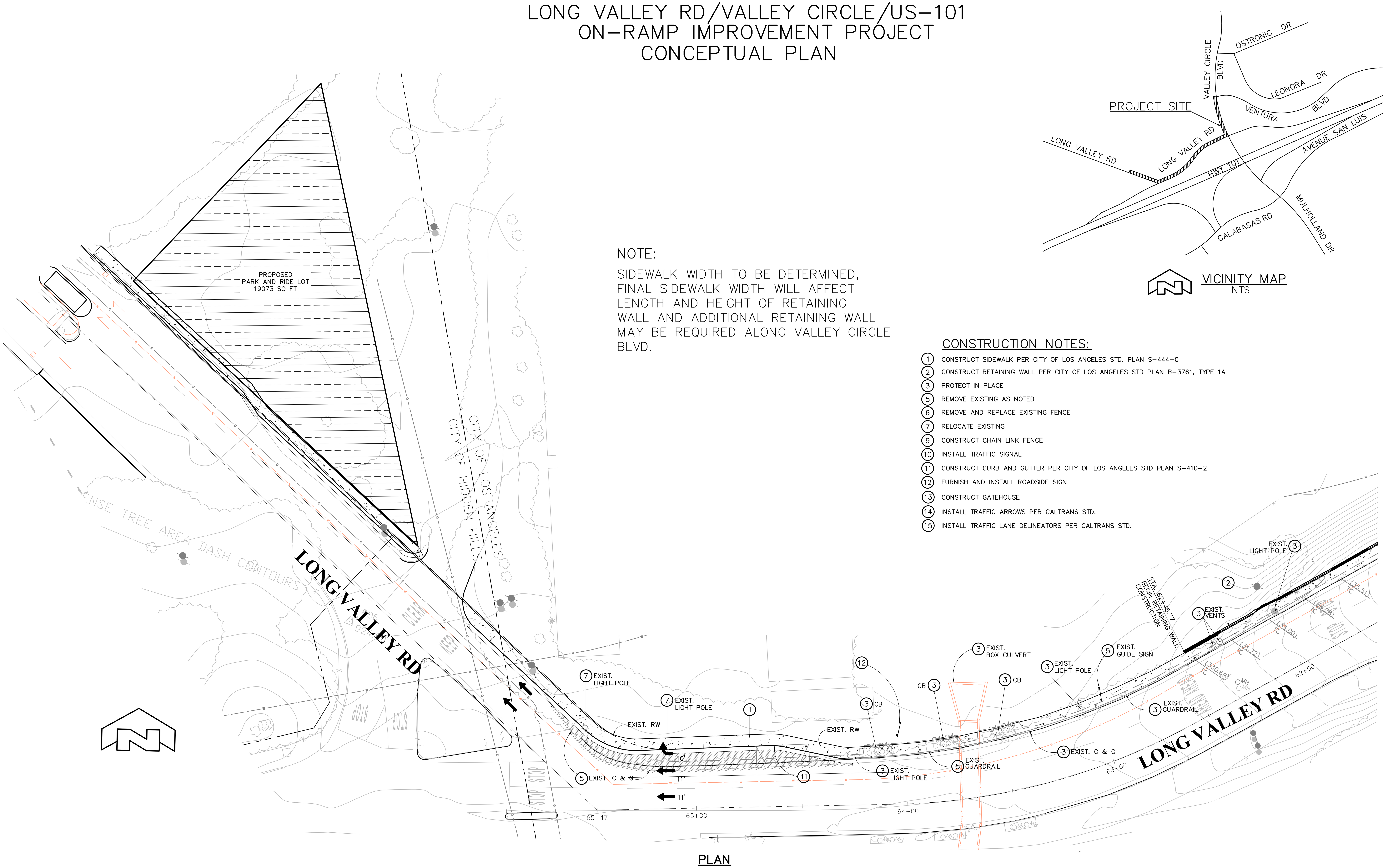
LONG VALLEY RD/VALLEY CIRCLE/US-101 ON-RAMP IMPROVEMENT PROJECT CONCEPTUAL PLAN

NOTE:

SIDEWALK WIDTH TO BE DETERMINED, FINAL SIDEWALK WIDTH WILL AFFECT LENGTH AND HEIGHT OF RETAINING WALL AND ADDITIONAL RETAINING WALL MAY BE REQUIRED ALONG VALLEY CIRCLE BLVD.

CONSTRUCTION NOTES:

1. CONSTRUCT SIDEWALK PER CITY OF LOS ANGELES STD. PLAN S-444-0
2. CONSTRUCT RETAINING WALL PER CITY OF LOS ANGELES STD PLAN B-3761, TYPE 1A
3. PROTECT IN PLACE
5. REMOVE EXISTING AS NOTED
6. REMOVE AND REPLACE EXISTING FENCE
7. RELOCATE EXISTING
9. CONSTRUCT CHAIN LINK FENCE
10. INSTALL TRAFFIC SIGNAL
11. CONSTRUCT CURB AND GUTTER PER CITY OF LOS ANGELES STD PLAN S-410-2
12. FURNISH AND INSTALL ROADSIDE SIGN
13. CONSTRUCT GATEHOUSE
14. INSTALL TRAFFIC ARROWS PER CALTRANS STD.
15. INSTALL TRAFFIC LANE DELINEATORS PER CALTRANS STD.



PLAN

SCALE: 1" = 20'

PLAN

SCALE: 1" = 20'

CONSTRUCTION NOTES:

1. CONSTRUCT SIDEWALK PER CITY OF LOS ANGELES STD. PLAN S-444-0
2. CONSTRUCT RETAINING WALL PER CITY OF LOS ANGELES STD PLAN B-3761, TYPE 1A
3. PROTECT IN PLACE
4. ADJUST TO GRADE
7. RELOCATE EXISTING
8. CONSTRUCT CURB RAMP

CITY OF HIDDEN HILLS

LONG VALLEY RD/VALLEY CIRCLE/US-101
ON-RAMP IMPROVEMENT PROJECT
CONCEPTUAL PLAN

SHEET 2 OF 2

2/19/19

THE CITY OF HIDDEN HILLS

CONCEPTUAL STUDY - PARKING/STAGING AND ENTRY FEATURE UPGRADE

PREPARED BY: L. NEWMAN DESIGN GROUP, INC.

Appendix B

Noise Measurement Data

Rincon Consultants, Inc.
Environmental Scientists Planners Engineers
www.rinconconsultants.com

Ambient Noise Survey Data Sheet

Instructions: Document noise measurement locations with a photo of the site, including the noise meter. Additionally, take notes on general and secondary noise sources, including the instantaneous noise level if possible. As a reminder, A/C weighting should be set to "A" and generally response time should be set to "fast." For additional information, please review the *Noise Measurement Protocol* in the pelican case.

Project Name: Hidden Hills Tech **Job Number:** 18-07013
Date: 4/3/19 **Operator Name:** Jorge Mendieta

Measurement #1

Location: NM1 (Northern point) **Begin time:** 11:19 AM **Finish time:** 11:34 AM
Measurement No.: 1 **Wind (mph):** 7 mph **Direction:** SSE
Cloud Cover Class: Overcast (>80%) ☐ Light (20-80%) ☑ Sunny (<20%) ☐
Calibration (dB): Start: 94.0 End: ____
Primary Noise Sources: Vehicles + freeway noise **Distance:** ____
Secondary Noise Sources: Birds chirping
Notes: Long valley Road → relatively quiet, 101 Freeway is the major noise source. Rincon Bio + Cultural staff were onsite as well
Traffic Count: Passenger Cars: 52
Medium to Heavy Duty Trucks (3 axles): 4 Heavy Duty Trucks (4+ axles): 0
Instantaneous Noise Sources/Levels (e.g., airplane, bus airbrake, etc.): helicopter (1), aircraft (1)
Leq: 60.9 **SEL:** ____ **Lmax:** 67.5 **Lmin:** 57.7 **PK:** ____
L(05): ____ **L(10):** ____ **L(50):** ____ **L(90):** ____ **L(95):** ____
Response: Slow ☑ Fast ☐ Peak ☐ Impulse ☐

Measurement #2

Location: NM 2 (Southern Point) **Begin time:** 11:40 AM **Finish time:** 11:55 AM
Measurement No.: 2 **Wind (mph):** 7 mph **Direction:** SSE
Cloud Cover Class: Overcast (>80%) ☐ Light (20-80%) ☑ Sunny (<20%) ☐
Calibration (dB): Start: 94.0 End: ____
Primary Noise Sources: vehicles/Trucks **Distance:** 112 ft (to middle of 101 Freeway)
Secondary Noise Sources: Birds, vehicles travelling along Long Valley Road
Notes: Traffic count only reflects vehicles travelling westward along 101 Freeway within first five minutes of the measurement
Traffic Count: Passenger Cars: 455
Medium to Heavy Duty Trucks (3 axles): 15 Heavy Duty Trucks (4+ axles): 10
Instantaneous Noise Sources/Levels (e.g., airplane, bus airbrake, etc.): Truck airbrake, helicopter (1)
Leq: 76.0 **SEL:** ____ **Lmax:** 86.5 **Lmin:** 71.1 **PK:** ____
L(05): ____ **L(10):** ____ **L(50):** ____ **L(90):** ____ **L(95):** ____
Response: Slow ☑ Fast ☐ Peak ☐ Impulse ☐

- Freq Weight : A
- Time Weight : SLOW
- Level Range : 40-100
- Max dB : 67.5 - 2019/04/03 11:26:44
- Level Range : 40-100
- SEL : 90.4
- Leq : 60.9
-

No.s	Date Time	(dB)
1	2019/04/03 11:19:02	61.1
2	2019/04/03 11:19:05	61.8
3	2019/04/03 11:19:08	61.9
4	2019/04/03 11:19:11	62.9
5	2019/04/03 11:19:14	62.8
6	2019/04/03 11:19:17	61.4
7	2019/04/03 11:19:20	62.5
8	2019/04/03 11:19:23	61.6
9	2019/04/03 11:19:26	60.9
10	2019/04/03 11:19:29	60.7
11	2019/04/03 11:19:32	60.3
12	2019/04/03 11:19:35	59.8
13	2019/04/03 11:19:38	59.9
14	2019/04/03 11:19:41	60.3
15	2019/04/03 11:19:44	60.9
16	2019/04/03 11:19:47	61.0
17	2019/04/03 11:19:50	60.6
18	2019/04/03 11:19:53	60.9
19	2019/04/03 11:19:56	60.5
20	2019/04/03 11:19:59	61.1
21	2019/04/03 11:20:02	60.8
22	2019/04/03 11:20:05	60.6
23	2019/04/03 11:20:08	60.7
24	2019/04/03 11:20:11	61.6
25	2019/04/03 11:20:14	60.8
26	2019/04/03 11:20:17	60.7
27	2019/04/03 11:20:20	60.5
28	2019/04/03 11:20:23	61.4
29	2019/04/03 11:20:26	61.1
30	2019/04/03 11:20:29	60.8
31	2019/04/03 11:20:32	60.0
32	2019/04/03 11:20:35	60.6
33	2019/04/03 11:20:38	61.6
34	2019/04/03 11:20:41	63.4
35	2019/04/03 11:20:44	63.4
36	2019/04/03 11:20:47	63.0
37	2019/04/03 11:20:50	62.4
38	2019/04/03 11:20:53	61.3
39	2019/04/03 11:20:56	61.0
40	2019/04/03 11:20:59	61.6
41	2019/04/03 11:21:02	61.1
42	2019/04/03 11:21:05	62.2
43	2019/04/03 11:21:08	60.9
44	2019/04/03 11:21:11	60.8
45	2019/04/03 11:21:14	61.3
46	2019/04/03 11:21:17	61.7
47	2019/04/03 11:21:20	62.6
48	2019/04/03 11:21:23	62.0
49	2019/04/03 11:21:26	61.1
50	2019/04/03 11:21:29	61.1
51	2019/04/03 11:21:32	61.1
52	2019/04/03 11:21:35	61.9
53	2019/04/03 11:21:38	61.5
54	2019/04/03 11:21:41	61.3
55	2019/04/03 11:21:44	60.5
56	2019/04/03 11:21:47	59.5
57	2019/04/03 11:21:50	60.1
58	2019/04/03 11:21:53	61.8
59	2019/04/03 11:21:56	61.4
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62	2019/04/03 11:22:05	61.5
63	2019/04/03 11:22:08	60.8
64	2019/04/03 11:22:11	62.0
65	2019/04/03 11:22:14	61.7
66	2019/04/03 11:22:17	62.2
67	2019/04/03 11:22:20	62.4
68	2019/04/03 11:22:23	62.5
69	2019/04/03 11:22:26	60.8
70	2019/04/03 11:22:29	60.1
71	2019/04/03 11:22:32	59.7
72	2019/04/03 11:22:35	60.4
73	2019/04/03 11:22:38	60.7
74	2019/04/03 11:22:41	61.9
75	2019/04/03 11:22:44	62.4
76	2019/04/03 11:22:47	63.0
77	2019/04/03 11:22:50	62.3
78	2019/04/03 11:22:53	61.5
79	2019/04/03 11:22:56	61.1
80	2019/04/03 11:22:59	61.8
81	2019/04/03 11:23:02	62.0
82	2019/04/03 11:23:05	61.6
83	2019/04/03 11:23:08	61.8
84	2019/04/03 11:23:11	62.4
85	2019/04/03 11:23:14	61.8

86	2019/04/03	11:23:17	61.3
87	2019/04/03	11:23:20	61.0
88	2019/04/03	11:23:23	60.3
89	2019/04/03	11:23:26	59.3
90	2019/04/03	11:23:29	59.4
91	2019/04/03	11:23:32	59.6
92	2019/04/03	11:23:35	60.3
93	2019/04/03	11:23:38	59.5
94	2019/04/03	11:23:41	58.8
95	2019/04/03	11:23:44	59.2
96	2019/04/03	11:23:47	59.5
97	2019/04/03	11:23:50	59.2
98	2019/04/03	11:23:53	59.6
99	2019/04/03	11:23:56	60.1
100	2019/04/03	11:23:59	60.3
101	2019/04/03	11:24:02	60.0
102	2019/04/03	11:24:05	60.6
103	2019/04/03	11:24:08	60.2
104	2019/04/03	11:24:11	60.5
105	2019/04/03	11:24:14	60.9
106	2019/04/03	11:24:17	60.3
107	2019/04/03	11:24:20	59.4
108	2019/04/03	11:24:23	60.0
109	2019/04/03	11:24:26	60.1
110	2019/04/03	11:24:29	59.3
111	2019/04/03	11:24:32	59.7
112	2019/04/03	11:24:35	59.4
113	2019/04/03	11:24:38	60.7
114	2019/04/03	11:24:41	60.9
115	2019/04/03	11:24:44	60.9
116	2019/04/03	11:24:47	60.3
117	2019/04/03	11:24:50	58.8
118	2019/04/03	11:24:53	62.2
119	2019/04/03	11:24:56	61.8
120	2019/04/03	11:24:59	61.2
121	2019/04/03	11:25:02	61.6
122	2019/04/03	11:25:05	60.8
123	2019/04/03	11:25:08	61.4
124	2019/04/03	11:25:11	61.0
125	2019/04/03	11:25:14	60.6
126	2019/04/03	11:25:17	60.0
127	2019/04/03	11:25:20	61.9
128	2019/04/03	11:25:23	62.1
129	2019/04/03	11:25:26	62.2
130	2019/04/03	11:25:29	61.7
131	2019/04/03	11:25:32	61.4
132	2019/04/03	11:25:35	60.5
133	2019/04/03	11:25:38	60.7
134	2019/04/03	11:25:41	60.5
135	2019/04/03	11:25:44	60.6
136	2019/04/03	11:25:47	60.9
137	2019/04/03	11:25:50	60.5
138	2019/04/03	11:25:53	60.9
139	2019/04/03	11:25:56	61.4
140	2019/04/03	11:25:59	62.8
141	2019/04/03	11:26:02	61.4
142	2019/04/03	11:26:05	61.0
143	2019/04/03	11:26:08	62.1
144	2019/04/03	11:26:11	63.5
145	2019/04/03	11:26:14	63.9
146	2019/04/03	11:26:17	62.3
147	2019/04/03	11:26:20	60.1
148	2019/04/03	11:26:23	59.7
149	2019/04/03	11:26:26	59.1
150	2019/04/03	11:26:29	59.5
151	2019/04/03	11:26:32	65.2
152	2019/04/03	11:26:35	61.0
153	2019/04/03	11:26:38	61.5
154	2019/04/03	11:26:41	63.2
155	2019/04/03	11:26:44	63.0
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157	2019/04/03	11:26:50	58.8
158	2019/04/03	11:26:53	58.4
159	2019/04/03	11:26:56	58.1
160	2019/04/03	11:26:59	59.2
161	2019/04/03	11:27:02	59.1
162	2019/04/03	11:27:05	60.2
163	2019/04/03	11:27:08	60.1
164	2019/04/03	11:27:11	62.2
165	2019/04/03	11:27:14	61.8
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167	2019/04/03	11:27:20	60.6
168	2019/04/03	11:27:23	59.8
169	2019/04/03	11:27:26	60.5
170	2019/04/03	11:27:29	60.8
171	2019/04/03	11:27:32	60.5
172	2019/04/03	11:27:35	59.8
173	2019/04/03	11:27:38	59.4
174	2019/04/03	11:27:41	59.3
175	2019/04/03	11:27:44	60.1
176	2019/04/03	11:27:47	59.8
177	2019/04/03	11:27:50	59.9
178	2019/04/03	11:27:53	60.0
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180	2019/04/03	11:27:59	60.1
181	2019/04/03	11:28:02	59.9
182	2019/04/03	11:28:05	59.8
183	2019/04/03	11:28:08	59.8
184	2019/04/03	11:28:11	59.6

185	2019/04/03 11:28:14	60.5
186	2019/04/03 11:28:17	60.8
187	2019/04/03 11:28:20	60.2
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189	2019/04/03 11:28:26	59.3
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192	2019/04/03 11:28:35	60.2
193	2019/04/03 11:28:38	59.5
194	2019/04/03 11:28:41	63.0
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203	2019/04/03 11:29:08	59.9
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207	2019/04/03 11:29:20	60.9
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221	2019/04/03 11:30:02	61.3
222	2019/04/03 11:30:05	60.5
223	2019/04/03 11:30:08	60.5
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225	2019/04/03 11:30:14	60.1
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232	2019/04/03 11:30:35	60.5
233	2019/04/03 11:30:38	59.5
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235	2019/04/03 11:30:44	59.2
236	2019/04/03 11:30:47	59.9
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239	2019/04/03 11:30:56	58.8
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242	2019/04/03 11:31:05	59.6
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245	2019/04/03 11:31:14	59.5
246	2019/04/03 11:31:17	59.2
247	2019/04/03 11:31:20	59.0
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262	2019/04/03 11:32:05	60.9
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264	2019/04/03 11:32:11	61.1
265	2019/04/03 11:32:14	61.4
266	2019/04/03 11:32:17	61.2
267	2019/04/03 11:32:20	61.4
268	2019/04/03 11:32:23	60.8
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270	2019/04/03 11:32:29	61.2
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272	2019/04/03 11:32:35	60.8
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274	2019/04/03 11:32:41	61.9
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276	2019/04/03 11:32:47	61.1
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278	2019/04/03 11:32:53	60.6
279	2019/04/03 11:32:56	59.5
280	2019/04/03 11:32:59	59.5
281	2019/04/03 11:33:02	59.6
282	2019/04/03 11:33:05	59.4
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284	2019/04/03 11:33:11	62.3
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286	2019/04/03 11:33:17	63.1
287	2019/04/03 11:33:20	62.6
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297	2019/04/03 11:33:50	62.5
298	2019/04/03 11:33:53	63.2
299	2019/04/03 11:33:56	62.5
300	2019/04/03 11:33:59	62.3

- Freq Weight : A
- Time Weight : SLOW
- Level Range : 40-100
- Max dB : 86.5 - 2019/04/03 11:49:04
- Level Range : 40-100
- SEL : 105.5
- Leq : 76.0
-

No.s	Date Time	(dB)
1	2019/04/03 11:40:00	78.6
2	2019/04/03 11:40:03	78.6
3	2019/04/03 11:40:06	75.6
4	2019/04/03 11:40:09	74.7
5	2019/04/03 11:40:12	74.4
6	2019/04/03 11:40:15	74.5
7	2019/04/03 11:40:18	72.7
8	2019/04/03 11:40:21	74.4
9	2019/04/03 11:40:24	76.6
10	2019/04/03 11:40:27	76.9
11	2019/04/03 11:40:30	76.2
12	2019/04/03 11:40:33	75.5
13	2019/04/03 11:40:36	75.1
14	2019/04/03 11:40:39	77.0
15	2019/04/03 11:40:42	74.8
16	2019/04/03 11:40:45	74.2
17	2019/04/03 11:40:48	74.7
18	2019/04/03 11:40:51	74.3
19	2019/04/03 11:40:54	73.7
20	2019/04/03 11:40:57	75.7
21	2019/04/03 11:41:00	77.9
22	2019/04/03 11:41:03	77.7
23	2019/04/03 11:41:06	77.3
24	2019/04/03 11:41:09	76.9
25	2019/04/03 11:41:12	78.1
26	2019/04/03 11:41:15	77.6
27	2019/04/03 11:41:18	76.0
28	2019/04/03 11:41:21	75.2
29	2019/04/03 11:41:24	76.1
30	2019/04/03 11:41:27	77.0
31	2019/04/03 11:41:30	76.4
32	2019/04/03 11:41:33	74.6
33	2019/04/03 11:41:36	73.9
34	2019/04/03 11:41:39	74.5
35	2019/04/03 11:41:42	73.2
36	2019/04/03 11:41:45	72.7
37	2019/04/03 11:41:48	72.0
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39	2019/04/03 11:41:54	73.6
40	2019/04/03 11:41:57	75.2
41	2019/04/03 11:42:00	74.7
42	2019/04/03 11:42:03	75.2
43	2019/04/03 11:42:06	83.4
44	2019/04/03 11:42:09	79.7
45	2019/04/03 11:42:12	79.2
46	2019/04/03 11:42:15	75.4
47	2019/04/03 11:42:18	75.1
48	2019/04/03 11:42:21	75.6
49	2019/04/03 11:42:24	75.8
50	2019/04/03 11:42:27	76.0
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53	2019/04/03 11:42:36	75.4
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59	2019/04/03 11:42:54	79.6
60	2019/04/03 11:42:57	74.8
61	2019/04/03 11:43:00	74.0
62	2019/04/03 11:43:03	75.3
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73	2019/04/03 11:43:36	75.6
74	2019/04/03 11:43:39	75.9
75	2019/04/03 11:43:42	73.4
76	2019/04/03 11:43:45	73.7
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78	2019/04/03 11:43:51	76.3
79	2019/04/03 11:43:54	77.9
80	2019/04/03 11:43:57	77.6
81	2019/04/03 11:44:00	76.5
82	2019/04/03 11:44:03	77.6
83	2019/04/03 11:44:06	77.9
84	2019/04/03 11:44:09	77.0
85	2019/04/03 11:44:12	75.2

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98	2019/04/03	11:44:51	75.6
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112	2019/04/03	11:45:33	75.6
113	2019/04/03	11:45:36	76.6
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259	2019/04/03	11:52:54	76.0
260	2019/04/03	11:52:57	76.4
261	2019/04/03	11:53:00	78.5
262	2019/04/03	11:53:03	77.1
263	2019/04/03	11:53:06	76.4
264	2019/04/03	11:53:09	76.9
265	2019/04/03	11:53:12	76.8
266	2019/04/03	11:53:15	77.4
267	2019/04/03	11:53:18	76.2
268	2019/04/03	11:53:21	76.1
269	2019/04/03	11:53:24	74.5
270	2019/04/03	11:53:27	74.6
271	2019/04/03	11:53:30	75.9
272	2019/04/03	11:53:33	76.0
273	2019/04/03	11:53:36	74.6
274	2019/04/03	11:53:39	77.4
275	2019/04/03	11:53:42	79.6
276	2019/04/03	11:53:45	78.6
277	2019/04/03	11:53:48	82.7
278	2019/04/03	11:53:51	79.7
279	2019/04/03	11:53:54	74.9
280	2019/04/03	11:53:57	72.6
281	2019/04/03	11:54:00	73.6
282	2019/04/03	11:54:03	74.8
283	2019/04/03	11:54:06	74.1

284	2019/04/03	11:54:09	73.8
285	2019/04/03	11:54:12	75.4
286	2019/04/03	11:54:15	74.9
287	2019/04/03	11:54:18	74.9
288	2019/04/03	11:54:21	74.4
289	2019/04/03	11:54:24	76.2
290	2019/04/03	11:54:27	75.5
291	2019/04/03	11:54:30	76.4
292	2019/04/03	11:54:33	75.4
293	2019/04/03	11:54:36	76.0
294	2019/04/03	11:54:39	76.4
295	2019/04/03	11:54:42	76.5
296	2019/04/03	11:54:45	76.1
297	2019/04/03	11:54:48	74.0
298	2019/04/03	11:54:51	74.6
299	2019/04/03	11:54:54	74.8
300	2019/04/03	11:54:57	76.2

Appendix C

Roadway Construction Noise Model (RCNM) Results and Modeled Equipment

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 5/24/2019
Case Description: Hidden Hills Noise Report

---- Receptor #1 ----

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Residential	Residential	75	75	75

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Front End Loader	No	40		79.1	50	0
Dump Truck	No	40		76.5	50	0
Paver	No	50		77.2	50	0

Calculated (dBA)

Equipment		*Lmax	Leq
Front End Loader		79.1	75.1
Dump Truck		76.5	72.5
Paver		77.2	74.2
	Total	79.1	78.8

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 5/24/2019
Case Descriptic Hidden Hills Noise Report

---- Receptor #1 ----

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Residential	Residential	75	75	75

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Front End Loader	No	40		79.1	80	0
Dump Truck	No	40		76.5	80	0
Paver	No	50		77.2	80	0

Calculated (dBA)

Equipment		*Lmax	Leq
Front End Loader		75	71
Dump Truck		72.4	68.4
Paver		73.1	70.1
	Total	75	74.8

*Calculated Lmax is the Loudest value.

Appendix D

Noise Reduction Equipment Product Sheets

Acoustical Surfaces, Inc.

SOUNDPROOFING, ACOUSTICS, NOISE & VIBRATION CONTROL SPECIALISTS
123 Columbia Court North • Suite 201 • Chaska, MN 55318
(952) 448-5300 • Fax (952) 448-2613 • (800) 448-0121
Email: sales@acousticalsurfaces.com
Visit our Website: www.acousticalsurfaces.com

We Identify and S.T.O.P. Your Noise Problems

Echo Barrier™

The Industry's First Reusable, Indoor/ Outdoor Noise Barrier/Absorber

- Superior acoustic performance
- Industrial durability
- Simple and quick installation system
- Lightweight for easy handling
- Unique roll-up design for compact storage and transportation
- Double or triple up for noise 'hot spots'
- Ability to add branding or messages
- Range of accessories available
- Weatherproof – absorbs sound but not water
- Fire retardant
- 1 person can do the job of 2 or 3 people

Why is it all too often we see construction sites with fencing but no regard for sound issues created from the construction that is taking place? This is due to the fact that there has not been an efficient means of treating this type of noise that was cost effective ***until now.***

Echo Barrier temporary fencing is a reusable, outdoor noise barrier. Designed to fit on all types of temporary fencing. Echo Barrier absorbs sound while remaining quick to install, light to carry and tough to last.

BENEFITS: Echo Barrier can help reduce noise complaints, enhance your company reputation, extend site operating hours, reduce project timescales & costs, and improve working conditions.

APPLICATIONS: Echo Barrier works great for construction & demolition sites; rail maintenance & replacement; music, sports and other public events; road construction; utility/maintenance sites; loading and unloading areas; outdoor gun ranges.

DIMENSIONS: 6.56' × 4.49'.

WEIGHT: 13 lbs.

ACOUSTIC PERFORMANCE: 10-20dB noise reduction (greater if barrier is doubled up).

INSTALLATION: The Echo Barrier is easily installed using our quick hook system and specially designed elastic ties.

Echo Barrier Transmission Loss Field Data

	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	8KHz
Single Layer	6	12	16	23	28	30	30
Double Layer	7	19	24	28	32	31	32

Appendix E

Noise Barrier Performance Calculations

Barrier Performance Module

This module provides to the user a measure on the barrier's effectiveness on noise reduction. A list of the input/output variables and their definitions, as well as illustrations of different scenarios are provided.

Calculator

View Day/Night Noise Level Calculator (/programs/environmental-review/dnl-calculator/)

View Descriptions of the Input/Output variables.

Note: Tool tips, containing field specific information, have been added in this tool and may be accessed by hovering over the Input and Output variables with the mouse.

WARNING: If there is direct line-of-sight between the Source and the Observer, the module will report erroneous attenuation. "Direct line-of-sight" means if the 5' tall Observer can see the noise Source (cars, trucks, trains, etc.) over the Barrier (wall, hill/excavation, building, etc.), the current version of Barrier Performance Module will not accurately calculate the attenuation provided. In this instance, there is unlikely to be any appreciable attenuation.

Road/Rail Site DNL:

Note: Barrier height must block the line of sight

Input Data

H	10	**R^1**	15
S	5	**D^1**	15
O	5	**α**	180

Calculate Output

Output Data

h	5	**R**	15
D	15	**FS**	13.3265

New Site DNL:

-13.3265

Refresh

Note: If you have separate Road and Rail DNL values, please enter the values below to calculate the new site DNL:

Road DNL:

Rail DNL:

Calculate

Combined New Site DNL:

Input/Output Variables

Input Variables

The following variables and definitions from the barrier being assessed are the input required for the web-based barrier performance module:

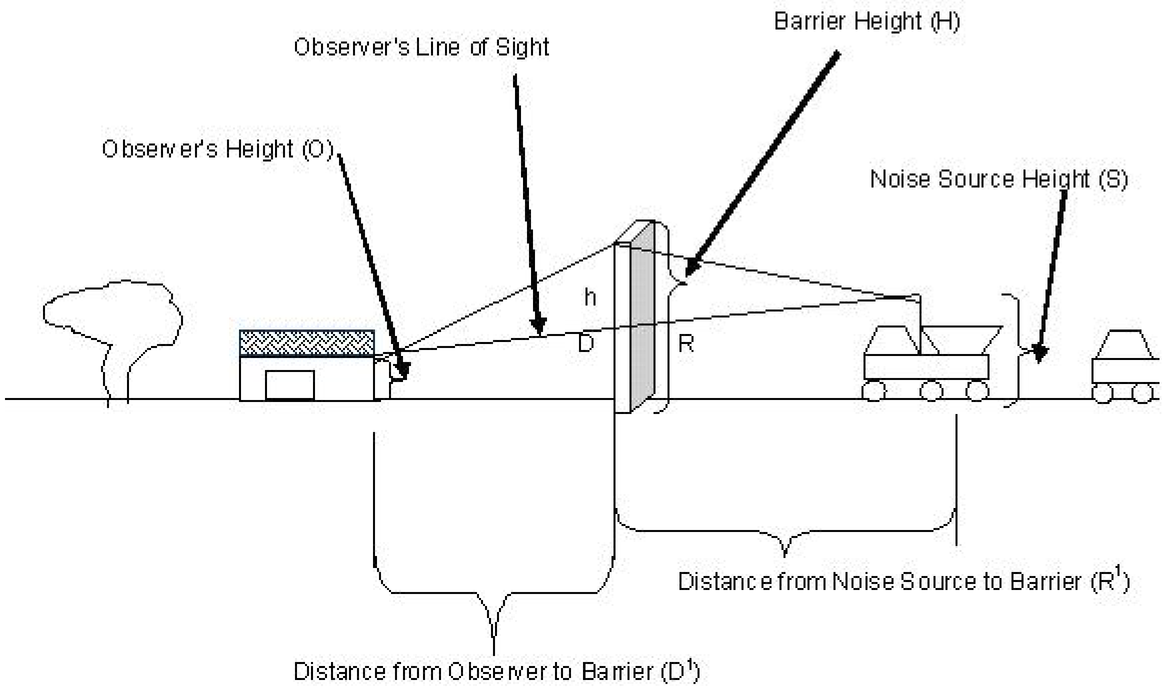
- H = Barrier Height
- S = Noise Source Height
- O = Observer Height (known as the receiver)
- R^1 = Distance from Noise Source to Barrier
- D^1 = Distance from the Observer to the Barrier
- α = Line of sight angle between the Observer and the Noise Source, subtended by the barrier at observer's location

Output Variables

Definitions of the output variables from the mitigation module of the Day/Night Noise Level Assessment Tools as part of the Assessment Tools for Environmental Compliance:

- h = The shortest distance from the barrier top to the line of sight from the Noise source to the Observer.
- R = Slant distance along the line of sight from the Barrier to the Noise Source
- D = Slant distance along the line of sight from the Barrier to the Observer

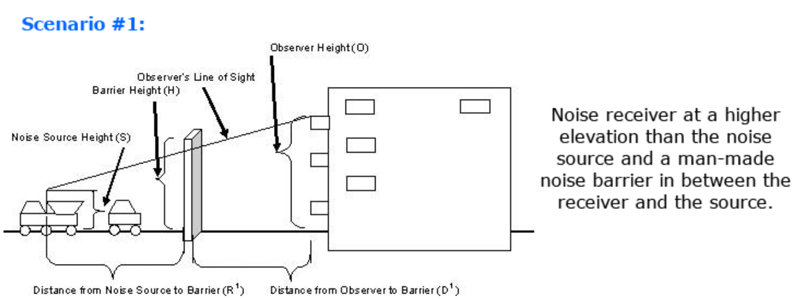
The “actual barrier performance for barriers of finite length” is noted on the worksheets(in the Guidebook) as **FS**.



Barrier Implementation Scenarios

Locate the cursor on the following thumbnails to enlarge the respective scenario as implementation examples of the barrier performance module.

Scenario #1:

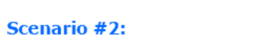


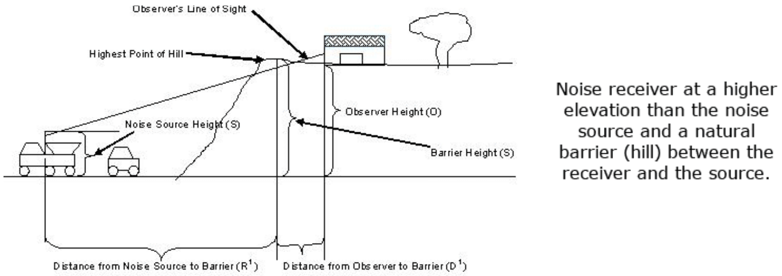
Noise receiver at a higher elevation than the noise source and a man-made noise barrier in between the receiver and the source.

(https://www.hudexchange.info/resources/documents/Barrier-Performance-Module-Barrier-Implementation-Scenario-1.gif)

view larger version of image (/resource/3841/barrier-performance-module-bpm-barrier-implementation-scenarios/)

Scenario #2:



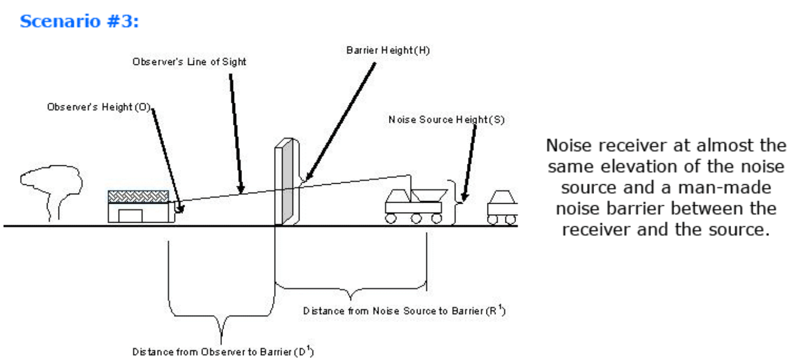


Noise receiver at a higher elevation than the noise source and a natural barrier (hill) between the receiver and the source.

(https://www.hudexchange.info/resources/documents/Barrier-Performance-Module-Barrier-Implementation-Scenario-2.gif)

view larger version of image (/resource/3841/barrier-performance-module-bpm-barrier-implementation-scenarios/)

Scenario #3:

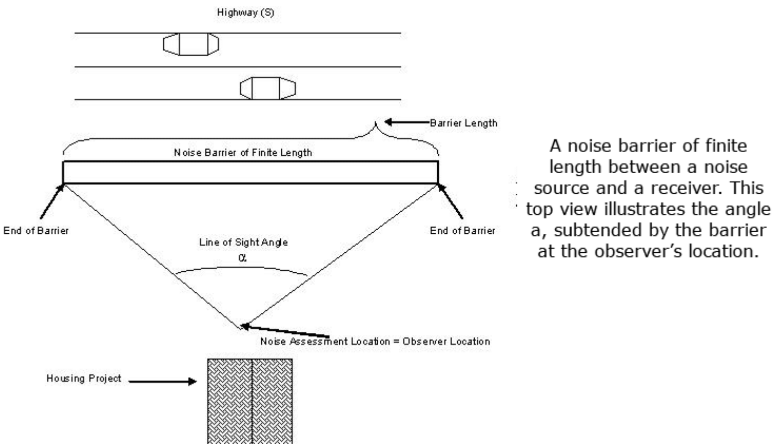


Noise receiver at almost the same elevation of the noise source and a man-made noise barrier between the receiver and the source.

(https://www.hudexchange.info/resources/documents/Barrier-Performance-Module-Barrier-Implementation-Scenario-3.gif)

view larger version of image (/resource/3841/barrier-performance-module-bpm-barrier-implementation-scenarios/)

Scenario #4:



A noise barrier of finite length between a noise source and a receiver. This top view illustrates the angle α, subtended by the barrier at the observer's location.

(https://www.hudexchange.info/resources/documents/Barrier-Performance-Module-Barrier-Implementation-Scenario-4.gif)

view larger version of image (/resource/3841/barrier-performance-module-bpm-barrier-implementation-scenarios/)

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WARNING: If there is direct line-of-sight between the Source and the Observer, the module will report erroneous attenuation. "Direct line-of-sight" means if the 5' tall Observer can see the noise Source (cars, trucks, trains, etc.) over the Barrier (wall, hill/excavation, building, etc.), the current version of Barrier Performance Module will not accurately calculate the attenuation provided. In this instance, there is unlikely to be any appreciable attenuation.

Road/Rail Site DNL:

Note: Barrier height must block the line of sight

Input Data

H	8	**R^1**	15
S	5	**D^1**	15
O	5	**α**	180

Calculate Output

Output Data

h	3	**R**	15
D	15	**FS**	10.6808

New Site DNL:

-10.6808

Refresh

Note: If you have separate Road and Rail DNL values, please enter the values below to calculate the new site DNL:

Road DNL:

Rail DNL:

Calculate

Combined New Site DNL:

Input/Output Variables

Input Variables

The following variables and definitions from the barrier being assessed are the input required for the web-based barrier performance module:

- H = Barrier Height
- S = Noise Source Height
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- D^1 = Distance from the Observer to the Barrier
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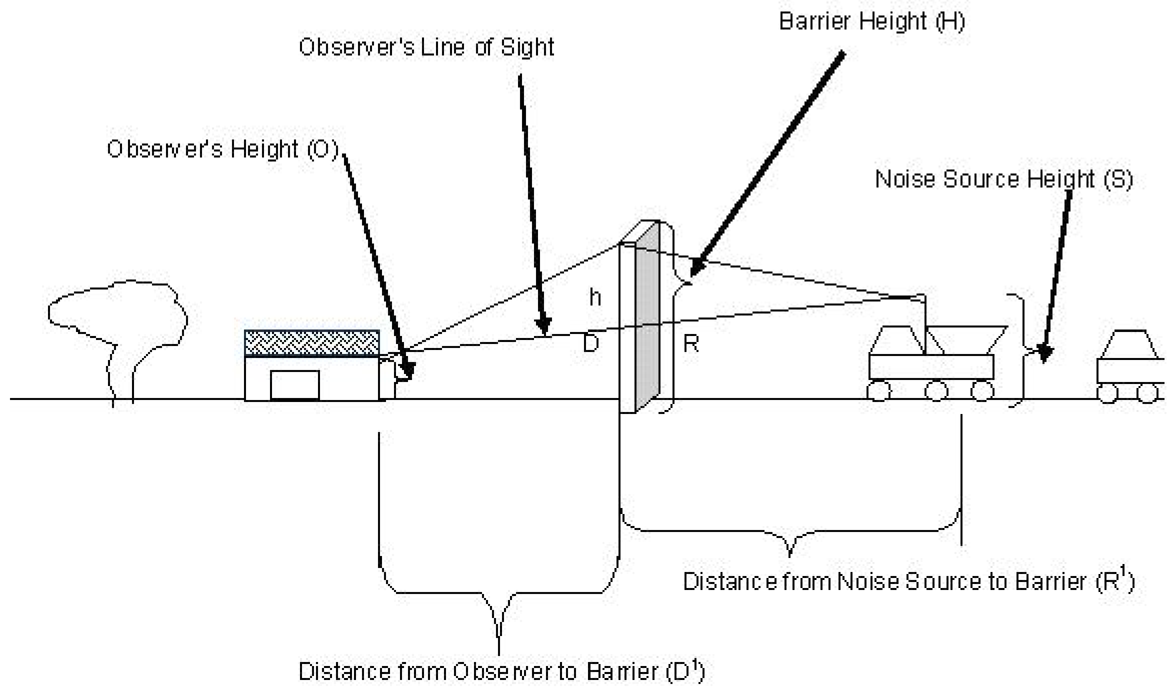

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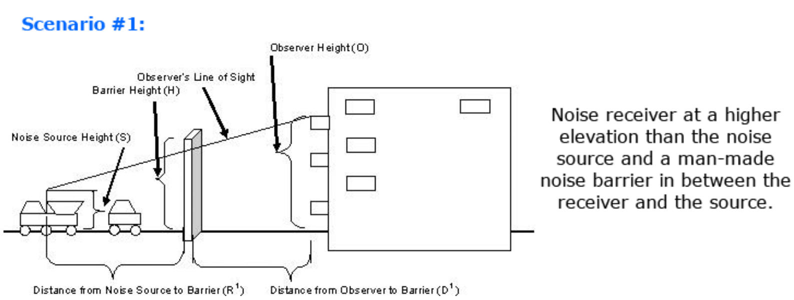
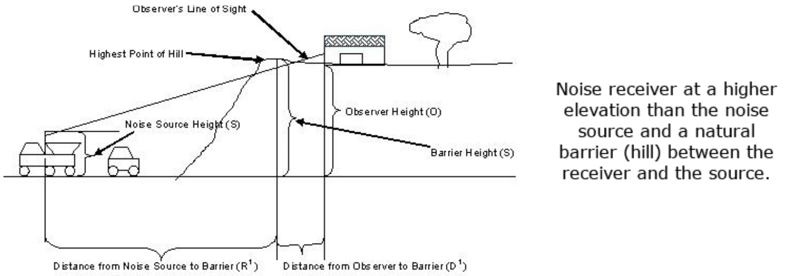


Noise receiver at a higher elevation than the noise source and a man-made noise barrier in between the receiver and the source.

(https://www.hudexchange.info/resources/documents/Barrier-Performance-Module-Barrier-Implementation-Scenario-1.gif)

view larger version of image (/resource/3841/barrier-performance-module-bpm-barrier-implementation-scenarios/)

Scenario #2:

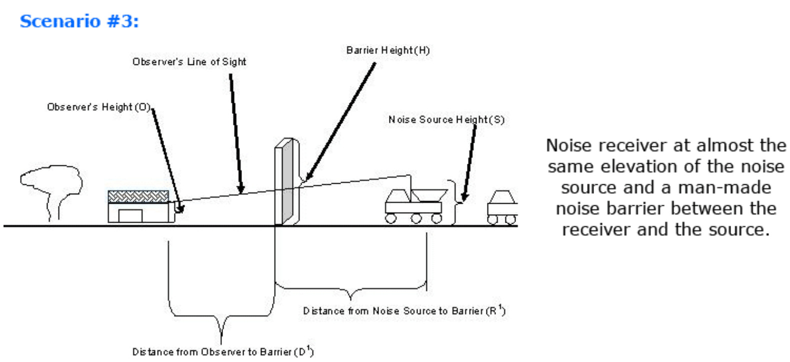


Noise receiver at a higher elevation than the noise source and a natural barrier (hill) between the receiver and the source.

(https://www.hudexchange.info/resources/documents/Barrier-Performance-Module-Barrier-Implementation-Scenario-2.gif)

view larger version of image (/resource/3841/barrier-performance-module-bpm-barrier-implementation-scenarios/)

Scenario #3:

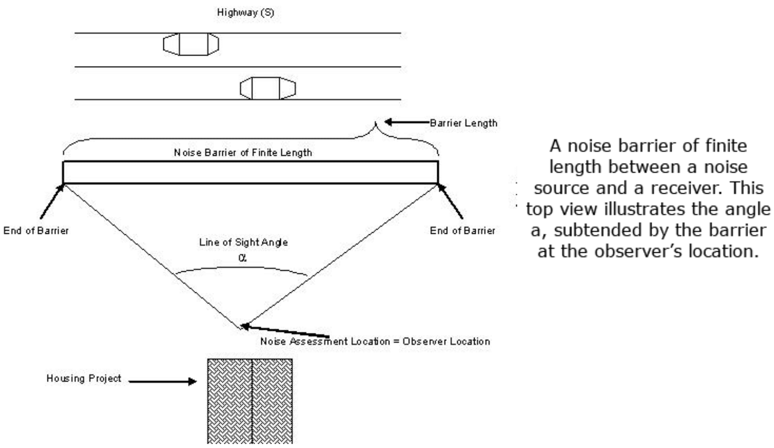


Noise receiver at almost the same elevation of the noise source and a man-made noise barrier between the receiver and the source.

(https://www.hudexchange.info/resources/documents/Barrier-Performance-Module-Barrier-Implementation-Scenario-3.gif)

view larger version of image (/resource/3841/barrier-performance-module-bpm-barrier-implementation-scenarios/)

Scenario #4:



A noise barrier of finite length between a noise source and a receiver. This top view illustrates the angle α, subtended by the barrier at the observer's location.

(https://www.hudexchange.info/resources/documents/Barrier-Performance-Module-Barrier-Implementation-Scenario-4.gif)

view larger version of image (/resource/3841/barrier-performance-module-bpm-barrier-implementation-scenarios/)

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