2.14 Noise and Vibration

2.14.1 Regulatory Setting

NEPA and CEQA provide the broad basis for analyzing and abating highway traffic noise effects. The intent of these laws is to promote the general welfare and to foster a healthy environment. The requirements for noise analysis and consideration of noise abatement and/or mitigation, however, differ between NEPA and CEQA.

2.14.1.1 California Environmental Quality Act

CEQA requires a strictly baseline versus build analysis to assess whether a proposed project will result in a noise impact. If a proposed project is determined to cause a significant noise impact under CEQA, CEQA dictates that mitigation measures must be incorporated into the project unless those measures are not feasible. The rest of this section will focus on the NEPA 23 CFR 772 noise analysis; please see Chapter 3 of this document for further information on noise analysis under CEQA.

2.14.1.2 National Environmental Policy Act and 23 CFR 772

For highway transportation projects with FHWA (and Caltrans, as assigned) involvement, the Federal-Aid Highway Act of 1970 and the associated implementing regulations (23 CFR 772) govern the analysis and abatement of traffic noise impacts. The regulations require that potential noise impacts in areas of frequent human use be identified during the planning and design of a highway project. The regulations include noise abatement criteria (NAC) that are used to determine when a noise impact would occur. The NAC differ depending on the type of land use under analysis. For example, the NAC for residences (67 A-weighted decibels [dBA]) is lower than the NAC for commercial areas (72 dBA). Table 2.14-1 lists the NAC for use in the NEPA 23 CFR 772 analysis.

Table 2.14-1. Noise Abatement Criteria for NEPA Analysis

Activity Category	NAC (hourly A-weighted noise level, Leq[h])	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[a]	67 (Exterior)	Residential.
C[a]	67 (Exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52 (Interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72 (Exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A–D or F.
F	No NAC—reporting only	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (e.g., water resources, water treatment, and electrical), and warehousing.
G	No NAC—reporting only	Undeveloped lands that are not permitted.

Leq(h) = hourly equivalent sound level
NAC = noise abatement criteria.
[a] Includes undeveloped lands permitted for this activity category.
Source: 23 CFR 772.

Figure 2.14-1 lists the noise levels of common activities to enable readers to compare the actual and predicted highway noise levels discussed in this section with common activities.

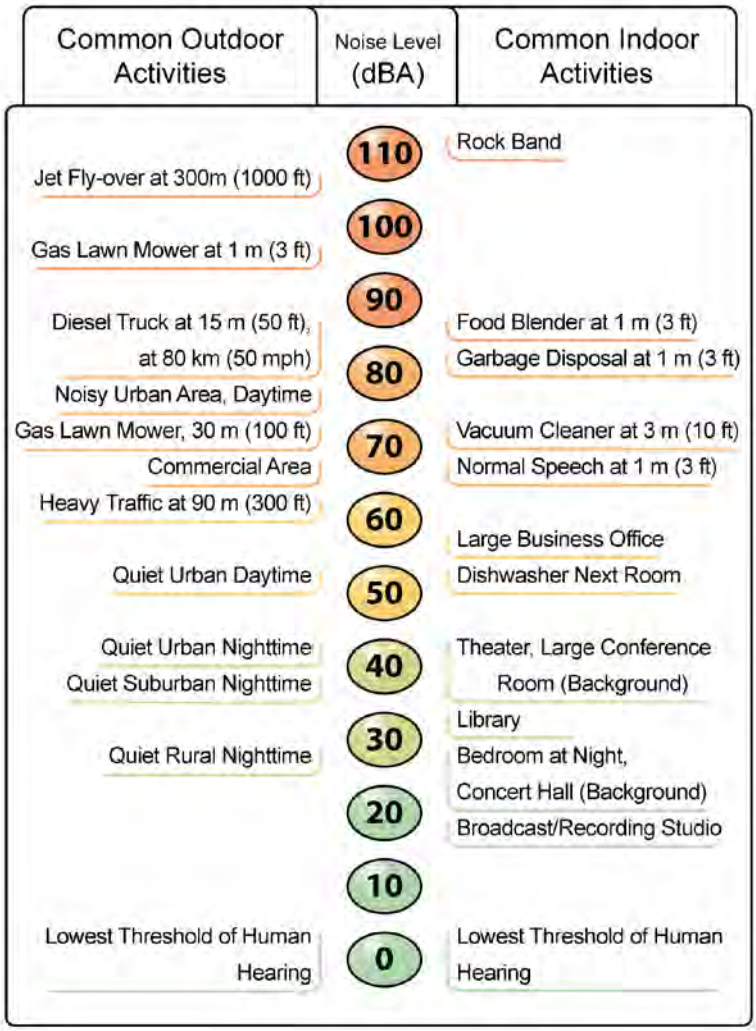

Figure 2.14-1. Noise Levels of Common Activities

According to Caltrans' *Traffic Noise Analysis Protocol for New Highway Construction and Reconstruction Projects, May 2011*, a noise impact occurs when the predicted future noise level with the project substantially exceeds the existing noise level (defined as a 12 dBA or more increase) or when the future noise level with the project approaches or exceeds the NAC. Approaching the NAC is defined as coming within 1 dBA of the NAC.

If it is determined that the project will result in noise impacts, potential abatement measures must be considered. Noise abatement measures that are determined to be reasonable and feasible at the time of final design are incorporated into the project plans and specifications. This document discusses noise abatement measures that would likely be incorporated into the project.

Caltrans' Traffic Noise Analysis Protocol sets forth the criteria for determining when an abatement measure is reasonable and feasible. Feasibility of noise abatement is basically an engineering concern. A minimum 5-dBA reduction in the future noise level must be achieved for

an abatement measure to be considered feasible. Other considerations include topography, access requirements, other noise sources, and safety considerations. The reasonableness determination is basically a cost-benefit analysis. Factors used in determining whether a proposed noise abatement measure is reasonable include the noise reduction design goal, residents' acceptance, and the cost per benefited residence. To meet the noise reduction design goal, a barrier must provide at least 7 dB of noise reduction at one or more benefited receptors. This design goal applies to any receptor and is not limited to affected receptors.

2.14.2 Affected Environment

This section is a summary of the analysis documented in the *Noise Study Technical Report* (NSR) (ICF International 2015a) prepared for the proposed project. The NSR discusses potential noise impacts and related noise abatement measures associated with construction and operation of mainline and interchange improvements on I-80 and SR 65. The NSR was prepared to comply with 23 CFR 772, *Procedures for Abatement of Highway Traffic Noise*, and Caltrans' noise analysis policies as described in the *Traffic Noise Analysis Protocol*. The report is available on the project website at http://8065interchange.org/.

2.14.2.1 Land Uses and Sensitive Receptors

Single-family and multi-family residences were identified as Activity Category B land uses in the project area. Outdoor recreational uses, schools, places of worship, parks, and cemeteries were identified as Activity Category C land uses. Outdoor areas associated with hotels were identified as Activity Category E land uses. Several commercial (Activity Category F) and undeveloped (Activity Category G) land uses are not subject to noise impacts, as described in Table 2.14-1. I-80 runs east to west and SR 65 runs north to south. The project area was divided into three subareas, as described below. Figure 2.14-2 identifies the land use types in the project area.

South of I-80: Much of the project area south of I-80 consists of commercial use, undeveloped, open space, and park use. Two hotels with outdoor swimming pools (Activity Category E) are located near the Douglas Boulevard interchange. Two hotels are located adjacent to the Taylor Road interchange, one with an outdoor swimming pool and one with an outdoor ball court. Olympus Pointe Sculpture Park and walking trails (Activity Category C) are adjacent to Atlantic Street and Taylor Road. The Golfland-Sunsplash miniature golf course and water park (Activity Category C) are located adjacent to Roseville Parkway. Sutter Roseville Medical Center includes a ball court (Activity Category C) located near the I-80/SR 65 interchange. The Phoenician apartment complex and two other residential subdivisions (Activity Category B) are set back over 500 feet from I-80. Another residential neighborhood is located on Rustic Hills Drive, near the northern terminus of the project.

Northeast of the I-80/SR 65 interchange: This subarea lies north of I-80 and east of SR 65. The subarea consists primarily of single-family and multi-family residences (Activity Category B) and commercial uses (Activity Category F). Rocklin Mobile Home Park (Activity Category B) is located near the northern terminus of the project. A cemetery (Activity Category C) is located off Kannasto Road near the northern terminus of the project. Woodside Park (Activity Category C)

Figure 2.14-2
Noise Prediction Locations and Evaluated Noise Barriers
Sheet 1

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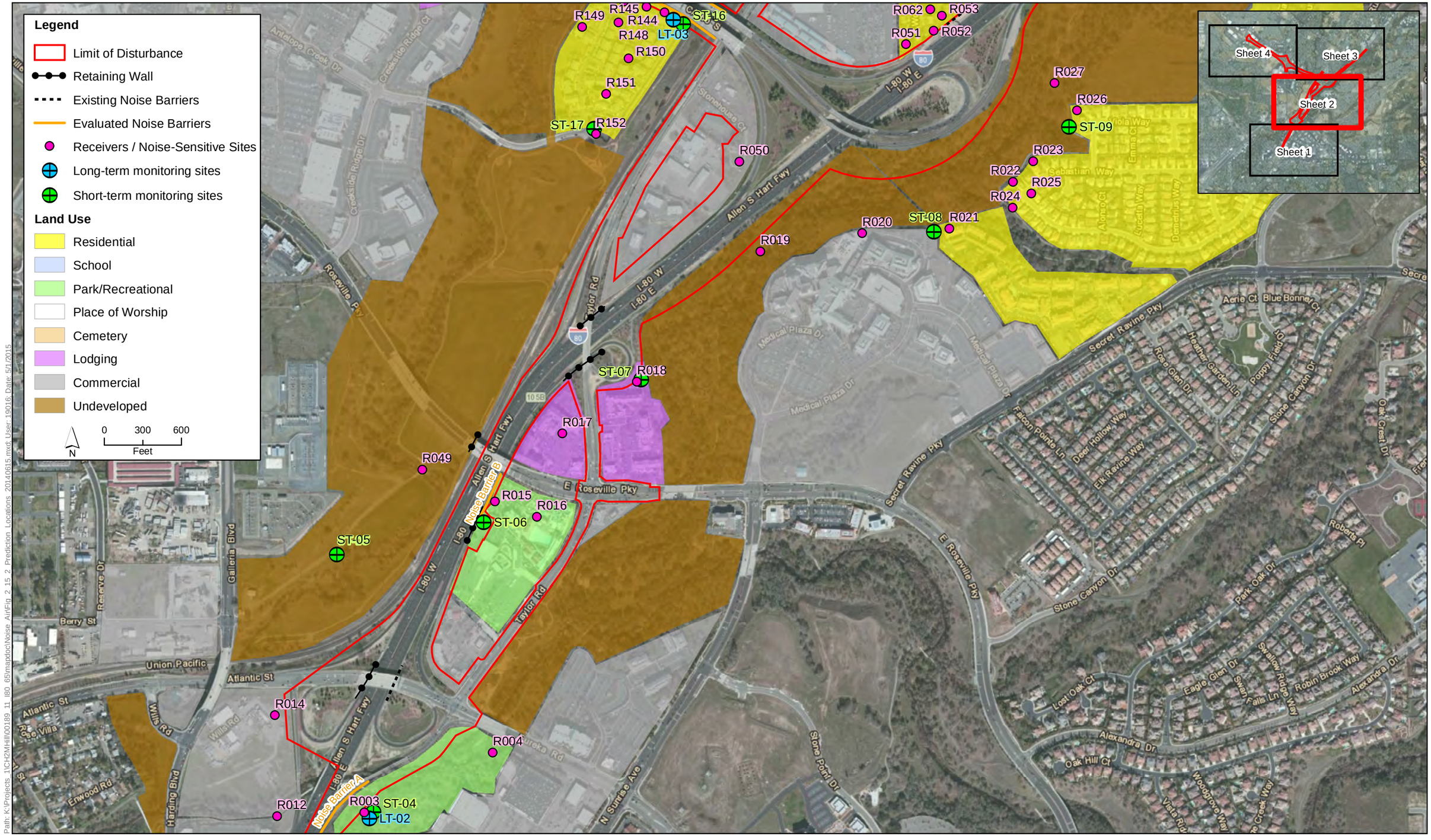

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Figure 2.14-2
Noise Prediction Locations and Evaluated Noise Barriers
Sheet 2

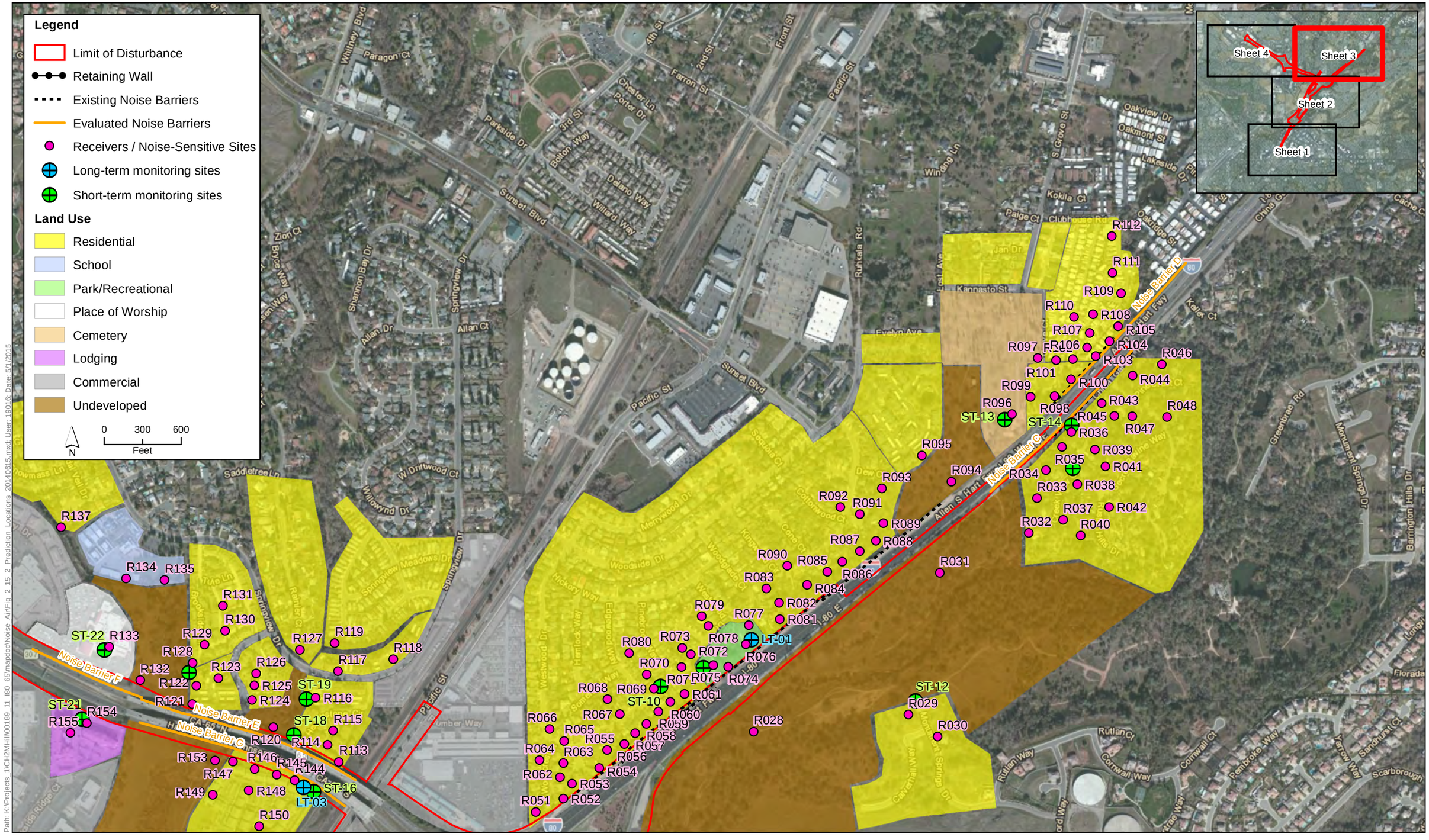

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Figure 2.14-2
Noise Prediction Locations and Evaluated Noise Barriers
Sheet 3

Figure 2.14-2
Noise Prediction Locations and Evaluated Noise Barriers
Sheet 4

is located adjacent to I-80 within a large residential neighborhood adjacent to the I-80/SR 65 interchange. There are a series of existing soundwalls with heights of 12 to 14 feet along the neighborhood frontage to I-80. West of Taylor Road, SR 65 is on an elevated structure, adjacent to several multi-family and apartment housing complexes (Activity Category B), including Hearthstone, Springview Village, Placer West, and Woodstream. Each of these complexes includes common outdoor use areas such as swimming pools and playgrounds. Destiny Christian Church includes a playground (Activity Category C) with a line-of-sight to SR 65. Antelope Creek Elementary School (Activity Category C) is set back over 500 feet from SR 65.

Northwest of the I-80/SR 65 interchange: This subarea lies north of I-80 and west of SR 65. The subarea consists primarily of commercial uses (Activity Category F) and park uses (Activity Category C). The Galleria at Roseville shopping center, offices, and apartments are located west of Galleria Boulevard. The Galleria apartment buildings and condominiums (Activity Category B) are set back over 500 feet from SR 65. Several hotels with outdoor swimming pools are located along both the SR 65 and I-80 frontage (Activity Category E). The Preserve at Creekside apartment complex (Activity Category B) is located adjacent to the East Roseville Viaduct near the I-80/SR 65 interchange. The Antelope Creek bicycle trail (Activity Category C) extends through much of the area. John Adams Academy includes an outdoor playground (Activity Category C) with a line-of-sight to I-80. Several hotels with outdoor swimming pools are located near the Douglas Road interchange, as well as a multi-family residential neighborhood, set back approximately 500 feet from I-80.

2.14.2.2 Noise Monitoring

The existing noise environment was characterized based on the short- and long-term noise monitoring that was conducted in the project area.

Long-term monitoring was conducted at three locations. The purpose of the long-term noise measurement was to determine the changes in noise levels within the project area throughout a typical day. Sound level data were collected from Monday, December 10 to Wednesday, December 12, 2012. Long-term monitoring site locations are shown in Figure 2.14-2.

Long-term monitoring site LT-01 was located within Woodside Park off of Westwood Drive in Rocklin. The monitor was attached to a tree near a basketball court. A sound wall with a nominal height of 14 feet extends along the frontage of the park facing I-80. The worst-hour noise level measured was 62.8 dBA Leq(h) [hourly equivalent sound level] during the 7 a.m. hour. Long-term monitoring site LT-02 was located within Olympus Pointe Sculpture Park in Roseville. The monitor was attached to a tree within 100 feet of the Cosmos sculpture in the center of the park, facing I-80. The worst-hour noise level measured was 68.2 dBA Leq(h) during the 1 p.m. hour. Long-term monitoring site LT-03 was located within the Preserve at Creekside apartment complex in Roseville. The monitor was attached to a tree approximately 75 feet from the edge of the East Roseville Viaduct. The worst-hour noise level measured was 60.9 dBA Leq(h) during the 1 p.m. hour.

Results of short-term noise monitoring are shown in Table 2.14-2. All measurements were 15 minutes in duration. Traffic noise was observed to be the dominant ambient noise source at all sites. Short-term monitoring locations are shown in Figure 2.14-2.

Table 2.14-2. Summary of Short-Term Measurements

Receptor	Address	Land Uses/ Activity Category	Start Date/ Time	Leq
ST-01	Best Western Plus, 220 Harding Boulevard, Roseville	Hotel/E	12/11/12 9:00 AM	63.2
ST-02	Breuner Drive, Roseville	Duplex residential/B	12/11/12 9:00 AM	63.2
ST-03	John Adams Academy, 1 Sierra Gate Plaza, Roseville	School/C	12/11/12 10:38 AM	63.9
ST-04	Olympus Point Sculpture Park, Roseville	Park/C	12/11/12 10:38 AM	61.7
ST-05	Antelope Creek Trail, Roseville	Park/C	12/12/12 10:43 AM	61.5
ST-06	Golfland-Sunsplash, Taylor Road	Recreation area/C	12/12/12 10:43 AM	64.9
ST-07	Residence Inn, 1930 Taylor Road, Roseville	Hotel/E	12/12/12 12:00 PM	56.9
ST-08	Phoenician Apartments, 1501 Secret Ravine Parkway, Roseville	Multi-family residential/B	12/10/12 4:20 PM	53.7
ST-09	Emerald Creek Subdivision, Roseville	Residential/B	12/10/12 4:21 PM	56.4
ST-10	3228 Westwood Drive, Rocklin	Residential/B	12/10/12 12:06 PM	53.8
ST-11	Woodside Park, Rocklin	Park/C	12/10/12 12:47 PM	56.3
ST-12	Monument Spring Road, Rocklin	Residential/B	12/12/12 1:19 PM	56.7
ST-13	Cemetery, Kannasto Street, Rocklin	Cemetery/C	12/12/12 1:19 PM	59.0
ST-14	China Garden Road, Rocklin	Residential/B	12/12/12 3:19 PM	60.4
ST-15	6375 Rustic Hills Drive, Rocklin	Residential/B	12/10/12 3:19 PM	55.6
ST-16	Preserve at Creekside Apartments, Roseville	Multi-family residential/B	12/11/12 3:35 PM	66.7
ST-17	Preserve at Creekside Apartments, Roseville	Multi-family residential/B	12/12/12 12:00 PM	58.4
ST-18	Hearthstone Apartments, Rocklin	Multi-family residential/B	12/11/12 3:30 PM	62.8
ST-19	Springview Village Apartments, Rocklin	Multi-family residential/B	12/11/12 4:08 PM	56.5
ST-20	Placer West Apartments, Rocklin	Multi-family residential/B	12/11/12 2:54 PM	57.8
ST-21	Homewood Suites, 401 Creekside Ridge Court, Roseville	Hotel/E	12/11/12 4:08 PM	64.2
ST-22	Destiny Christian Church, 6900 Destiny Drive, Rocklin	Place of worship/C	12/11/12 2:18 PM	69.7
ST-23	Office Park, 516 Gibson Drive, Roseville	Offices-outdoor use/E	12/11/12 12:02 PM	61.0
ST-24	Terrace Apartments, Gibson Drive, Roseville	Multi-family residential/B	12/11/12 12:02 PM	57.7

2.14.3 Environmental Consequences

The proposed project is a Type 1 project as defined in 23 CFR 772 because it would physically alter both the vertical and horizontal alignment of an existing highway. To determine whether the project would result in a noise impact that requires consideration of noise abatement, traffic noise levels under existing and design year (2040) conditions were predicted using the FHWA Traffic Noise Model (TNM), Version 2.5. TNM is a computer model based on two FHWA reports: FHWA-PD-96-009 and FHWA-PD-96-010. Key inputs to the traffic noise model were the locations of roadways, shielding features (e.g., topography and buildings), noise barriers, and

receptors, and ground type. Three-dimensional representations of these inputs were developed using computer-aided design drawings, aerials, and topographic contours provided by the project engineer. Traffic data for the project was obtained from the *Transportation Analysis Report* prepared by Fehr & Peers (2014) for the project.

2.14.3.1 Build Alternatives

The following discussion applies to all build alternatives.

Exposure of Noise Sensitive Land Uses to Increased Traffic Noise

Traffic noise levels for design year (2040) no-build conditions range from 48 to 78 dBA Leq(h). Under design year build conditions, predicted traffic noise levels range from 49 to 79 dBA Leq(h). This range of noise levels applies to all three build alternatives. Traffic noise levels would approach or exceed the NAC for residential use (Activity Category B) at 271 dwelling units under all three build alternatives. For all three build alternatives, several Activity Category C land uses would be affected, including seven parks, two playgrounds (one at a school and one at a place of worship), and an outdoor recreational area. One outdoor swimming pool at a hotel would be affected (Activity Category E).

Traffic noise levels are predicted to exceed the NAC at Activity Category B, Activity Category C, and Activity Category E land uses in the project area under design year conditions. This is considered to result in an adverse effect due to increased traffic noise, and noise abatement must be considered.

Exposure of Noise-Sensitive Land Uses to Construction Noise

During construction of the project, noise from construction activities may intermittently dominate the noise environment in the immediate area of construction. Construction noise is regulated by provisions in Section 14-8.02, “Noise Control,” of the Caltrans Standard Specifications.

Two types of short-term noise impacts would occur during project construction. The first type would be from construction crew commutes and the transport of construction equipment and materials to the project site, which would incrementally raise noise levels on access roads leading to the site. The pieces of heavy equipment for grading and construction activities would be moved onsite, would remain for the duration of each construction phase, and would not add to the daily traffic volume in the project vicinity. The maximum noise level from a single truck passby would have an upper range of 87 dBA Lmax (maximum sound level) at a distance of 50 feet. However, the projected construction traffic would be minimal when compared to existing traffic volumes on other affected streets, and the associated long-term noise level change would not be perceptible. Therefore, construction-related worker commutes and equipment transport noise impacts would be short term and would not be adverse.

The second type of short-term noise impact would be caused by construction activities. Construction is performed in distinct steps, each of which has its own mix of equipment and consequently its own noise characteristics. These various sequential phases would change the

character of the noise generated and the noise levels along the project alignment as construction progresses. Despite the variety in the type and size of construction equipment, similarities in the dominant noise sources and patterns of operation allow construction-related noise ranges to be categorized by work phase. Table 2.14-3 lists typical construction equipment noise levels (Lmax) recommended for noise impact assessments, based on a distance of 50 feet between the equipment and a noise receptor.

Table 2.14-3. Typical Construction Equipment Noise Levels

Type of Equipment	Range of Maximum Sound Levels (dBA Lmax at 50 feet)	Suggested Typical Maximum Sound Levels for Analysis (dBA Lmax at 50 feet)
Pile drivers	81 to 96	93
Rock drills	83 to 99	96
Jackhammers	75 to 85	82
Pneumatic tools	78 to 88	85
Pumps	74 to 84	80
Scrapers	83 to 91	87
Haul trucks	83 to 94	88
Cranes	79 to 86	82
Portable generators	71 to 87	80
Rollers	75 to 82	80
Dozers	77 to 90	85
Tractors	77 to 82	80
Front-end loaders	77 to 90	86
Hydraulic backhoe	81 to 90	86
Hydraulic excavators	81 to 90	86
Graders	79 to 89	86
Air compressors	76 to 89	86
Trucks	81 to 87	86

dBA = A-weighted decibels
Lmax = maximum instantaneous noise level
Source: Bolt, Beranek & Newman 1987.

Typical equipment noise levels at a distance of 50 feet from an active construction area range up to 96 dBA Lmax during the noisiest construction phases. Bridge construction would require the use of pile drivers. As shown in Table 2.14-3, pile-driving generates typical noise levels of 93 dBA Lmax at a distance of 50 feet.

Earthmoving equipment includes excavation machinery such as backfillers, bulldozers, and front loaders. Earthmoving and compacting equipment includes compactors, scrapers, and graders. Typical operating cycles for these types of construction equipment may involve 1 or 2 minutes of full-power operation followed by 3 or 4 minutes at lower power settings.

Construction of the proposed project is expected to require the use of earthmovers, bulldozers, paving machines, water trucks, dump trucks, concrete trucks, rollers, and pickup trucks. Typical noise levels associated with the use of construction equipment are estimated between 80 and 88 dBA Lmax at a distance of 50 feet from the active construction area for the grading phase. As seen in Table 2.14-3, the maximum noise level generated by each earthmover is assumed to be approximately 86 dBA Lmax at 50 feet from the earthmover in operation. Each bulldozer would generate approximately 85 dBA Lmax at 50 feet. The maximum noise level generated by water trucks and pickup trucks is approximately 86 dBA Lmax at 50 feet from these vehicles. Each doubling of the sound source with equal strength increases the noise level by 3 dBA.

Each piece of construction equipment operates as an individual point source. The worst-case composite noise level at the nearest residence during this phase of construction would be 91 dBA Lmax (at a distance of 50 feet from an active construction area).

Construction noise would be short term, intermittent, and overshadowed by local traffic noise. No adverse noise impacts from construction are anticipated because construction would be conducted in compliance with provisions in Section 14-8.02, “Noise Control,” of the Caltrans Standard Specifications, and applicable local noise standards.

2.14.3.2 No Build Alternative

Exposure of Noise-Sensitive Land Uses to Increased Traffic Noise

Under the No Build Alternative, noise levels associated with traffic would increase in the future, as traffic congestion associated with growth increases (Table 2.14-3). There would be no adverse effect due to increased traffic noise from the interchange improvements, because the project would not be built in the design year.

2.14.4 Avoidance, Minimization, and/or Mitigation Measures

2.14.4.1 Noise Abatement Evaluation under 23 CFR 772

According to 23 CFR 772(13)(c), federal funding may be used for the following abatement measures.

- Construction of noise barriers, including acquisition of property rights, either within or outside the highway right-of-way. Landscaping is not a viable noise abatement measure.
- Traffic management measures including, but not limited to, traffic control devices and signage for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.
- Alteration of horizontal and vertical alignments.
- Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development that would be adversely affected by traffic noise.

- Noise insulation of Activity Category D land use facilities. Post-installation maintenance and operational costs for noise insulation are not eligible for federal-aid funding.

Each noise barrier was evaluated for feasibility based on its achievable noise reduction. For each noise barrier found to be acoustically feasible, reasonable cost allowances were calculated. The unit cost allowance currently is $64,000 per benefited residence. Total allowances are calculated by multiplying the cost allowance per residence by the number of benefited residences. More detail is provided in the *Noise Study Technical Report* available on the project website at http://8065interchange.org/.

For any noise barrier to be considered reasonable from a cost perspective, the estimated cost of the noise barrier should be equal to or less than the total cost allowance calculated for the barrier. The cost calculations of the noise barrier should include all items appropriate and necessary for construction of the barrier, such as traffic control, drainage modification, and retaining walls.

The design of noise barriers is preliminary and has been conducted at a level appropriate for environmental review, not for final design of the project. Preliminary information on the physical location, length, and height of noise barriers is provided in this report. If pertinent parameters change substantially during final project design, preliminary noise barrier designs may be modified or eliminated from the final project. A final decision on the construction of noise abatement will be made upon completion of the project design.

The following is a discussion of noise barriers evaluated in the TNM for each of the project subareas. The barrier discussions apply to all build alternatives. Any differences in results between build alternatives for a given barrier design are described where applicable. Noise barriers are shown in Figure 2.14-2.

South of I-80

Noise Barrier A

The traffic noise modeling results indicate that noise levels of up to 67 dBA Leq(h) are predicted at Olympic Pointe Sculpture Park. Traffic noise levels would increase by up to 1 dB relative to existing conditions, which would not result in a substantial increase in noise levels. However, traffic noise levels would approach or exceed the NAC for Activity Category C land use at one receiver location. Therefore, traffic noise impacts are predicted to occur, and noise abatement must be considered.

An acoustical analysis was conducted for Noise Barrier A, which would extend along the edge-of-shoulder of the eastbound I-80 off-ramp to Eureka Road. The total length of the barrier would be 870 feet. At a height of 20 feet, the barrier would provide up to 6 dB of noise reduction, which would not meet the design goal of 7 dB. While the design goal cannot be achieved for this barrier, the minimum noise reduction requirement of 5 dB can be achieved, benefiting one receiver location at the park (Activity Category C). Therefore, the barrier is considered feasible. Calculated noise reductions and reasonable allowances for each barrier height are summarized in Table 2.14-4.

Table 2.14-4. Summary of Reasonableness Determination Data—Barrier A

Location: Olympus Pointe Sculpture Park, Roseville						
Predicted Sound Level without Barrier						
Design receptor:	R003 (Park use)					
Design year noise level, dBA Leq(h):	66 dBA (Alternatives 1–3)					
Design year noise level minus existing noise level:	1 dBA					
Design Year with Barrier	**10-Foot Barrier**	**12-Foot Barrier**	**14-Foot Barrier**	**16-Foot Barrier**	**18-Foot Barrier**	**20-Foot Barrier**
Barrier noise reduction, dB	2	4	5	5	6	6
Barrier design goal met?	No	No	No	No	No	No
Number of benefited receivers	0	0	1	1	1	1
Reasonable allowance per benefited receiver	$64,000	$64,000	$64,000	$64,000	$64,000	$64,000
Total reasonable allowance	$0	$0	$64,000	$64,000	$64,000	$64,000

Noise Barrier B

The traffic noise modeling results indicate that noise levels of up to 68 dBA Leq(h) are predicted at the Golfland miniature golf course. Traffic noise levels would increase by up to 2 dB relative to existing conditions, which would not result in a substantial increase in noise levels. However, traffic noise levels would approach or exceed the NAC for Activity Category C land use at one receiver location. Therefore, traffic noise impacts are predicted to occur, and noise abatement must be considered.

An acoustical analysis was conducted for Noise Barrier B, which would extend along the top of the I-80 right-of-way near the termination of the I-80 eastbound Eureka Road slip on-ramp. The barrier would be a total length of 370 feet. The barrier would meet the noise reduction design goal of 7 dB at a height of 16 feet. Calculated noise reductions and reasonable allowances for each barrier height are summarized in Table 2.14-5.

Table 2.14-5. Summary of Reasonableness Determination Data—Barrier B

Location: Golfland miniature golf course, Roseville					
Predicted Sound Level without Barrier					
Design receptor:	R015 (Recreational use)				
Design year noise level, dBA Leq(h):	68 dBA (Alternatives 1–3)				
Design year noise level minus existing noise level:	2 dBA				
Design Year with Barrier	**8-Foot Barrier**	**10-Foot Barrier**	**12-Foot Barrier**	**14-Foot Barrier**	**16-Foot Barrier**
Barrier noise reduction, dB	5	5	6	6	7
Barrier design goal met?	No	No	No	No	Yes
Number of benefited receivers	1	1	1	1	1
Reasonable allowance per benefited residence	$64,000	$64,000	$64,000	$64,000	$64,000
Total reasonable allowance	$64,000	$64,000	$64,000	$64,000	$64,000

Noise Barrier C

The traffic noise modeling results indicate that noise levels of up to 72 dBA Leq(h) are predicted at the residential neighborhood on Rustic Hills Drive. Traffic noise levels would increase by up to 2 dB relative to existing conditions, which would not result in a substantial increase in noise levels. However, traffic noise levels would approach or exceed the NAC for Activity Category B land use at five receiver locations representing a total of 10 residential units. Therefore, traffic noise impacts are predicted to occur, and noise abatement must be considered.

An acoustical analysis was conducted for Noise Barrier C, which would extend along I-80 eastbound adjacent to the northern terminus of the project. The barrier would replace the existing wall that currently extends along a portion of the neighborhood frontage. Noise Barrier C would extend the existing wall by 610 linear feet to the west, for a total wall length of 1,530 feet. The barrier would meet the noise reduction design goal of 7 dB at a height of 12 feet. Calculated noise reductions and reasonable allowances for each barrier height are summarized in Table 2.14-6.

Table 2.14-6. Summary of Reasonableness Determination Data—Barrier C

Location: Rustic Hills Drive, Rocklin					
Predicted Sound Level without Barrier					
Design receptor:	R035 (Single-family residential)				
Design year noise level, dBA Leq(h):	72 dBA (Alternatives 1–3)				
Design year noise level minus existing noise level:	2 dBA				
Design Year with Barrier	**8-Foot Barrier**	**10-Foot Barrier**	**12-Foot Barrier**	**14-Foot Barrier**	**16-Foot Barrier**
Barrier noise reduction, dB	5	6	8	9	9
Barrier design goal met?	No	No	Yes	Yes	Yes
Number of benefited receivers	2	4	7	10	10
Reasonable allowance per benefited residence	$64,000	$64,000	$64,000	$64,000	$64,000
Total reasonable allowance	$128,000	$256,000	$448,000	$640,000	$640,000

Northeast of the I-80/SR 65 Interchange

Noise Barrier D

The traffic noise modeling results indicate that noise levels of up to 78 dBA Leq(h) are predicted at Rocklin Mobile Home Park. Traffic noise levels would increase by up to 2 dB relative to existing conditions, which would not result in a substantial increase in noise levels. However, traffic noise levels would approach or exceed the NAC for Activity Category B land use at nine receiver locations representing a total of 53 residential units. Therefore, traffic noise impacts are predicted to occur, and noise abatement must be considered.

An acoustical analysis was conducted for Noise Barrier D, which would extend along I-80 westbound adjacent to the northern terminus of the project. The barrier would replace the existing wall that currently extends along a portion of the neighborhood frontage. Noise Barrier D would be 1,450 feet in total length. The barrier would meet the noise reduction design

goal of 7 dB at a height of 12 feet. Calculated noise reductions and reasonable allowances for each barrier height are summarized in Table 2.14-7.

Table 2.14-7. Summary of Reasonableness Determination Data—Barrier D

Location: Rocklin Mobile Home Park					
Predicted Sound Level without Barrier					
Design receptor:	R105 (Residential – mobile home park)				
Design year noise level, dBA Leq(h):	78 dBA (Alternatives 1–3)				
Design year noise level minus existing noise level:	2 dBA				
Design Year with Barrier	**8-Foot Barrier**	**10-Foot Barrier**	**12-Foot Barrier**	**14-Foot Barrier**	**16-Foot Barrier**
Barrier noise reduction, dB	3	5	7	10	11
Barrier design goal met?	No	No	Yes	Yes	Yes
Number of benefited receivers	0	4	13	13	20
Reasonable allowance per benefited residence	$64,000	$64,000	$64,000	$64,000	$64,000
Total reasonable allowance	$0	$256,000	$832,000	$832,000	$1,280,000

Noise Barrier E

The traffic noise modeling results indicate that noise levels of up to 69 dBA Leq(h) are predicted at multi-family residential apartment buildings and condominiums adjacent to the East Roseville Viaduct. Traffic noise levels would increase by up to 4 dB relative to existing conditions, which would not result in a substantial increase in noise levels. However, traffic noise levels would approach or exceed the NAC for Activity Category B land use at three receiver locations representing a total of 64 residential units and for Activity Category C land use at 1 receiver location representing park use. Therefore, traffic noise impacts are predicted to occur, and noise abatement must be considered.

An acoustical analysis was conducted for Noise Barrier E, which would extend along the northbound SR 65 structure edge-of-pavement. The total length of Noise Barrier E would be 1,870 feet. For safety reasons, noise barriers with footings located within 15 feet of travel lanes cannot exceed 14 feet in height. However, because SR 65 is on an elevated structure in this area, it is possible to break the receiver line-of-sight to heavy truck exhaust stacks with a lower wall. Noise Barrier E would meet the noise reduction design goal of 7 dB at a height of 10 feet. Calculated noise reductions and reasonable allowances for each barrier height are summarized in Table 2.14-8.

Table 2.14-8. Summary of Reasonableness Determination Data—Barrier E

Location: North of SR 65, east of Stanford Ranch Road				
Predicted Sound Level without Barrier				
Design receptor:	R113 (Multi-family residential)			
Design year noise level, dBA Leq(h):	69 dBA (Alternatives 2 and 3); 67 dBA (Alternative 1)			
Design year noise level minus existing noise level:	4 dBA			
Design Year with Barrier	**8-Foot Barrier**	**10-Foot Barrier**	**12-Foot Barrier**	**14-Foot Barrier**
Barrier noise reduction, dB	6	7	7	8
Barrier design goal met?	No	Yes	Yes	Yes
Number of benefited receivers	235	250	263	279
Reasonable allowance per benefited residence	$64,000	$64,000	$64,000	$64,000
Total reasonable allowance	$15,040,000	$16,000,000	$16,832,000	$17,856,000

Noise Barrier F

The traffic noise modeling results indicate that noise levels of up to 71 dBA Leq(h) are predicted at the outdoor playground at Destiny Christian Church. Traffic noise levels would increase by up to 2 dB relative to existing conditions, which would not result in a substantial increase in noise levels. However, traffic noise levels would approach or exceed the NAC for Activity Category C land use at one receiver location. Therefore, traffic noise impacts are predicted to occur, and noise abatement must be considered.

An analysis was conducted for Noise Barrier F, which would extend along northbound SR 65 within the right-of-way. The total length of the barrier would be 950 feet. At a height of 20 feet, the barrier would provide up to 6 dB of noise reduction, which would not meet the design goal of 7 dB. While the design goal cannot be achieved for this barrier, the minimum noise reduction requirement of 5 dB can be achieved, benefiting one receiver location at the playground (Activity Category C). Therefore the barrier is considered feasible. Calculated noise reductions and reasonable allowances for each barrier height are summarized in Table 2.14-9.

Table 2.14-9. Summary of Reasonableness Determination Data—Barrier F

Location: Destiny Christian Church						
Predicted Sound Level without Barrier						
Design receptor:	R133 (Playground – place of worship)					
Design year noise level, dBA Leq(h):	71 dBA (Alternatives 1-3)					
Design year noise level minus existing noise level:	2 dBA					
Design Year with Barrier	**10-Foot Barrier**	**12-Foot Barrier**	**14-Foot Barrier**	**16-Foot Barrier**	**18-Foot Barrier**	**20-Foot Barrier**
Barrier noise reduction, dB	3	4	5	5	6	6
Barrier design goal met?	No	No	No	No	No	No
Number of benefited receivers	0	0	1	1	1	1
Reasonable allowance per benefited residence	$64,000	$64,000	$64,000	$64,000	$64,000	$64,000
Total Reasonable Allowance	$0	$0	$64,000	$64,000	$64,000	$64,000

Northwest of the SR 65 Interchange

Noise Barrier G

The traffic noise modeling results indicate that noise levels of up to 70 dBA Leq(h) are predicted at multi-family residential apartment buildings and condominiums adjacent to the elevated section of SR 65 east of Stanford Ranch Road. Traffic noise levels would increase by up to 9 dB relative to existing conditions, which would not result in a substantial increase in noise levels. However, traffic noise levels would approach or exceed the NAC for Activity Category B land use at six receiver locations representing a total of 144 residential units. Therefore, traffic noise impacts are predicted to occur, and noise abatement must be considered.

An acoustical analysis was conducted for Noise Barrier G, which would extend along the southbound SR 65 structure edge-of-pavement. The total length of Noise Barrier G would be 1,800 feet. For safety reasons, noise barriers with footings located within 15 feet of travel lanes cannot exceed 14 feet in height. However, because SR 65 is on an elevated structure in this area, it is possible to break the receiver line-of-sight to heavy truck exhaust stacks with a lower wall. Noise Barrier G would meet the noise reduction design goal of 7 dB at a height of 10 feet. Calculated noise reductions and reasonable allowances for each barrier height are summarized in Table 2.14-10.

Table 2.14-10. Summary of Reasonableness Determination Data—Barrier G

Location: South of SR 65, east of Stanford Ranch Road				
Predicted Sound Level without Barrier				
Design receptor:	R146 (Multi-family residential)			
Design year noise level, dBA Leq(h):	74 dBA (Alternatives 2 and 3); 73 dBA (Alternative 1)			
Design year noise level minus existing noise level:	4 dBA			
Design Year with Barrier	**8-Foot Barrier**	**10-Foot Barrier**	**12-Foot Barrier**	**14-Foot Barrier**
Barrier noise reduction, dB	6	7	7	8
Barrier design goal met?	No	Yes	Yes	Yes
Number of benefited receivers	128	128	128	128
Reasonable allowance per benefited residence	$64,000	$64,000	$64,000	$64,000
Total reasonable allowance	$8,192,000	$8,192,000	$8,192,000	$8,192,000

Noise Barrier H

The traffic noise modeling results indicate that noise levels of up to 69 dBA Leq(h) are predicted at the outdoor playground at John Adams Academy on Harding Boulevard. Traffic noise levels would increase by up to 2 dB relative to existing conditions, which would not result in a substantial increase in noise levels. However, traffic noise levels would approach or exceed the NAC for Activity Category C land use at one receiver location. Therefore, traffic noise impacts are predicted to occur, and noise abatement must be considered.

An acoustical analysis was conducted for Noise Barrier H, which would extend along the school frontage facing I-80 westbound. The total length of the barrier would be 860 feet. The barrier would meet the noise reduction design goal of 7 dB at a height of 12 feet. Calculated noise reductions and reasonable allowances for each barrier height are summarized in Table 2.14-11.

Table 2.14-11. Summary of Reasonableness Determination Data—Barrier H

Location: John Adams Academy, Harding Boulevard					
Predicted Sound Level without Barrier					
Design receptor:	R011 (School playground)				
Design year noise level, dBA Leq(h):	69 dBA (Alternatives 1–3)				
Design year noise level minus existing noise level:	2 dBA				
Design Year with Barrier	**8-Foot Barrier**	**10-Foot Barrier**	**12-Foot Barrier**	**14-Foot Barrier**	**16-Foot Barrier**
Barrier noise reduction, dB	4	5	7	8	8
Barrier design goal met?	No	No	Yes	Yes	Yes
Number of benefited receivers	0	1	1	1	1
Reasonable allowance per benefited residence	$64,000	$64,000	$64,000	$64,000	$64,000
Total reasonable allowance	$0	$64,000	$64,000	$64,000	$64,000

Noise Abatement Decision Report

A *Noise Abatement Decision Report* (ICF International 2015b) was prepared to include noise abatement construction cost estimates that were prepared by the project engineer based on site-specific conditions. The report is available on the project website at http://8065interchange.org/. These cost estimates were compared to total reasonableness allowances for noise barriers, as shown in Table 2.14-12. As shown in the table, Noise Barriers A, B, F, and H did not meet the design goal or the cost of the barrier was not reasonable.

The recommended height of Noise Barrier C is 14 feet. This height would match the existing noise barrier along the neighborhood frontage of Rustic Hills Drive and would meet both the noise abatement and noise reduction criteria. At a height of 14 feet, Noise Barrier C would benefit 10 residences at a reasonable allowance of $64,000 per residence, yielding a total reasonable allowance of $640,000. The estimated construction cost to build the 14-foot barrier is $223,495, which is within the barrier cost allowance.

The recommended height of Noise Barrier D is 16 feet. This height would meet both the noise abatement and noise reduction criteria. At a height of 16 feet, Noise Barrier D would benefit 20 residences at a reasonable allowance of $64,000 per residence, yielding a total reasonable allowance of $1,280,000. The estimated construction cost to build the 16-foot barrier is $590,317, which is within the barrier cost allowance.

The recommended height of Noise Barrier E is 14 feet. This height would meet both the noise abatement and noise reduction criteria. At a height of 14 feet, Noise Barrier E would benefit 279 residences at a reasonable allowance of $64,000 per residence, yielding a total reasonable allowance of $17,856,000. The estimated construction cost to build the 14-foot barrier is $564,117, which is within the barrier cost allowance.

The recommended height of Noise Barrier G is 10 feet. This height would meet both the noise abatement and noise reduction criteria. At a height of 10 feet, Noise Barrier G would benefit 128 residences at a reasonable allowance of $64,000 per residence, yielding a total reasonable allowance of $8,192,000. The estimated construction cost to build the 10-foot barrier is $399,000, which is within the barrier cost allowance.

Based on the studies completed to date, the project proponent intends to incorporate noise abatement in the form of Noise Barriers C, D, E and G, at the heights recommended above. Calculations based on preliminary design data show that the barriers will reduce noise levels by 5 to 11 dBA for 437 residences at a cost of $1,776,929. If during final design conditions have substantially changed, noise abatement may not be necessary. The final decision on noise abatement will be made upon completion of the project design and the public involvement processes.

Table 2.14-12. Summary of Cost Reasonableness of Evaluated Barriers

Noise Barrier	Type	Barrier Height (feet)	Total Noise-Sensitive Receptors Benefited	Barrier Length (feet)	Barrier Surface Area (sq feet)	Barrier Cost Allowance (dollars per benefited receptor)	Barrier Cost Allowance (total dollars)	Engineer's Cost Estimate (total dollars)	Design Goal Met?	Is Barrier Cost-Reasonable?
A (Alt. 3)	Miners Ravine bridge (widen – Alt 3)	14	1	870	12,180	$64,000	$64,000	$262,450	No	No
A (Alt. 3)	Miners Ravine bridge (widen – Alt 3)	16	1	870	13,920	$64,000	$64,000	$297,250	No	No
A (Alt. 1 & 2)	Miners Ravine bridge (existing bridge – Alt 1 & 2)	14	1	870	12,180	$64,000	$64,000	$612,450	No	No
A (Alt. 1 & 2)	Miners Ravine bridge (existing bridge – Alt 1 & 2)	16	1	870	13,920	$64,000	$64,000	$647,250	No	No
B	On grade (along EB I-80)	8	1	370	2,960	$64,000	$64,000	$85,267	No	No
B	On grade (along EB I-80)	10	1	370	3,700	$64,000	$64,000	$101,967	No	No
B	On grade (along EB I-80)	12	1	370	4,440	$64,000	$64,000	$118,667	No	No
B	On grade (along EB I-80)	14	1	370	5,180	$64,000	$64,000	$135,367	No	No
B	On grade (along EB I-80)	16	1	370	5,920	$64,000	$64,000	$151,117	Yes	No
C	On grade (along EB I-80)	8	2	612	4,896	$64,000	$128,000	$140,630	No	No
C	On grade (along EB I-80)	10	4	612	6,120	$64,000	$256,000	$168,210	No	Yes
C	On grade (along EB I-80)	12	7	612	7,344	$64,000	$448,000	$195,790	Yes	Yes
C	**On grade (along EB I-80)**	**14**	**10**	**612**	**8,568**	**$64,000**	**$640,000**	**$223,370**	**Yes**	**Yes**
C	On grade (along EB I-80)	16	10	612	9,792	$64,000	$640,000	$249,400	Yes	Yes
D	On grade (along WB I-80)	10	4	1,450	14,500	$64,000	$256,000	$398,067	No	No
D	On grade (along WB I-80)	12	13	1,450	17,400	$64,000	$832,000	$463,367	Yes	Yes

Noise Barrier	Type	Barrier Height (feet)	Total Noise-Sensitive Receptors Benefited	Barrier Length (feet)	Barrier Surface Area (sq feet)	Barrier Cost Allowance (dollars per benefited receptor)	Barrier Cost Allowance (total dollars)	Engineer's Cost Estimate (total dollars)	Design Goal Met?	Is Barrier Cost-Reasonable?
D	On grade (along WB I-80)	14	13	1,450	20,300	$64,000	$832,000	$528,667	Yes	Yes
D	**On grade (along WB I-80)**	**16**	**20**	**1,450**	**23,200**	**$64,000**	**$1,280,000**	**$590,317**	**Yes**	**Yes**
E	East Roseville Viaduct (on NB widen)	8	235	1,870	14,960	$64,000	$15,040,000	$339,717	No	Yes
E	East Roseville Viaduct (on NB widen)	10	250	1,870	18,700	$64,000	$16,000,000	$414,517	Yes	Yes
E	East Roseville Viaduct (on NB widen)	12	263	1,870	22,440	$64,000	$16,832,000	$489,317	Yes	Yes
E	**East Roseville Viaduct (on NB widen)**	**14**	**279**	**1,870**	**26,180**	**$64,000**	**$17,856,000**	**$564,117**	**Yes**	**Yes**
F	On grade (along NB SR-65)	14	1	950	13,300	$64,000	$64,000	$346,583	No	No
F	On grade (along NB SR-65)	16	1	950	15,200	$64,000	$64,000	$386,983	No	No
G	East Roseville Viaduct (on SB widen)	8	128	1,800	14,400	$64,000	$8,192,000	$327,000	No	Yes
G	**East Roseville Viaduct (on SB widen)**	**10**	**128**	**1,800**	**18,000**	**$64,000**	**$8,192,000**	**$399,000**	**Yes**	**Yes**
G	E. Roseville Viaduct (on SB widen)	12	128	1,800	21,600	$64,000	$8,192,000	$471,000	Yes	Yes
G	East Roseville Viaduct (on SB widen)	14	128	1,800	25,200	$64,000	$8,192,000	$543,000	Yes	Yes
H	On grade (along WB I-80)	10	1	860	8,600	$64,000	$64,000	$236,308	No	No
H	On grade (along WB I-80)	12	1	860	10,320	$64,000	$64,000	$275,058	Yes	No
H	On grade (along WB I-80)	14	1	860	12,040	$64,000	$64,000	$313,808	Yes	No
H	On grade (along WB I-80)	16	1	860	13,760	$64,000	$64,000	$350,383	Yes	No

Bold and underline indicates recommended noise barrier.

2.14.4.2 Minimize Noise Effects from Construction

Standard Caltrans procedures include implementation of the following measures to minimize the temporary noise effects from construction.

- All equipment will have sound-control devices that are no less effective than those provided on the original equipment. No equipment will have an unmuffled exhaust.
- The construction contractor will implement appropriate additional noise measures, including changing the location of stationary construction equipment, turning off idling equipment, rescheduling construction activity, notifying adjacent residents in advance of construction work, and installing acoustic barriers around stationary construction noise sources.

2.14.5 References Cited

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

Fehr & Peers. 2014. *Transportation Analysis Report – I-80/SR 65 Interchange Improvements*. Roseville, CA.

ICF International. 2015a. *Noise Study Report – I-80/SR 65 Interchange Improvements Project, Placer County, Interstate 80 and State Route 65*. Sacramento, CA. May.

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