Environmental Noise Assessment

Glenbrook Estates

Redding, California

Project # 2005-026

Prepared For:

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INTRODUCTION

The Glenbrook Estates residential project is located east of Interstate 5 and north of Hilltop Drive in the City of Redding. Due to the proximity of I-5 and Hilltop Drive to the project site, the City of Redding requested that an acoustical analysis be prepared to demonstrate that exterior and interior noise levels at the proposed residential uses do not exceed acceptable limits. The intent of this analysis is to determine the existing and future traffic noise exposure at the project site, and to provide mitigation measures where future noise levels are expected to exceed the City of Redding General Plan noise level standards. Figure 1 shows the project site.

The project site consists of 56 apartment units in 4 buildings, 111 townhome lots, 72 single family dwelling (S.F.D.) cluster lots, and 167 SFD lots, ranging in size from 35' x 70' to 70' x 110'. In order to simplify this report, lots have been assigned group #'s, which will be referenced in this study. Figure 1 shows the delineations of each lot grouping. The grouping designations are as follows:

- Group #1 - Apartments
- Group #2 - SFD- Lots #163 through #167
- Group #3 - Cluster S.F.D. - Lots #200 through #239
- Group #4 - Townhomes - Lots #297 through #350
- Group #5 - Townhomes - Lots #286 through #296
- Group #6 - Townhomes - Lots #277 through #285
- Group #7 - SFD - 3 lots without numbering
- Group #8 - SFD - 5 lots without numbering
- Group #9 - Townhomes - Lots #254 through #276
- Group #10 - Townhomes - Lots #240 through #247

BACKGROUND ON NOISE AND ACOUSTICAL TERMINOLOGY[1]

Noise is often described as unwanted sound. Sound is defined as any pressure variation in air that the human ear can detect. If the pressure variations occur frequently enough (at least 20 times per second) they can be heard, and are called sound. The number of pressure variations per second is called the frequency of sound, and is expressed as cycles per second, called Hertz (Hz).

Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale uses the hearing threshold (20 micropascals of pressure), as a point of reference, defined as 0 dBA. Other sound pressures are then compared to the reference pressure, and the logarithm is taken to keep the numbers in a practical range. The decibel scale allows a million-fold increase in pressure to be expressed as 120 dBA. Another useful aspect of the decibel scale is that changes in decibel levels correspond closely to human perception of relative loudness. Figure 2 illustrates common noise levels associated with various sources.

[1] For an explanation of these terms, see Appendix A: "Acoustical Terminology"

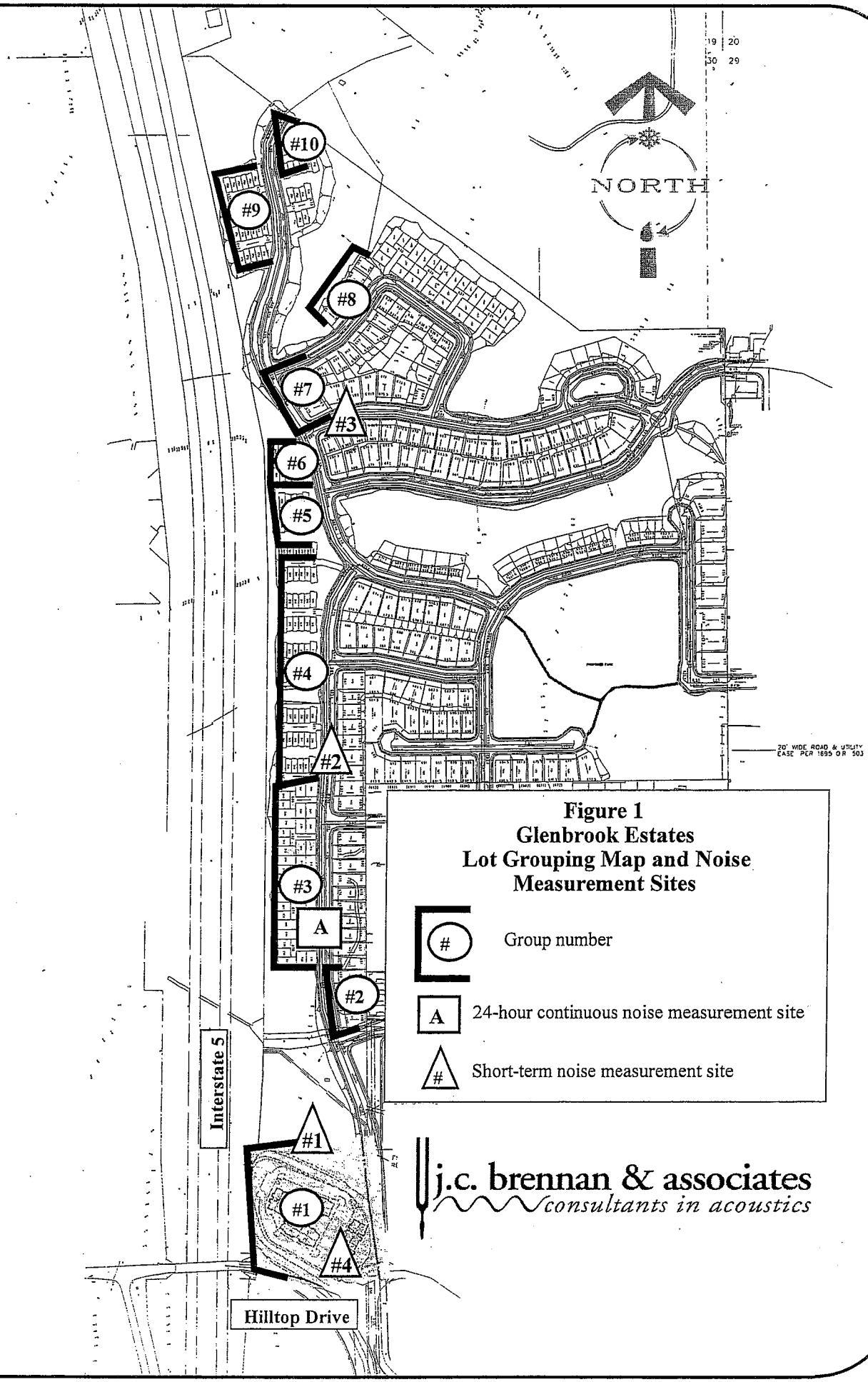

Figure 1
Glenbrook Estates
Lot Grouping Map and Noise Measurement Sites

(#) Group number

A 24-hour continuous noise measurement site

(#) Short-term noise measurement site

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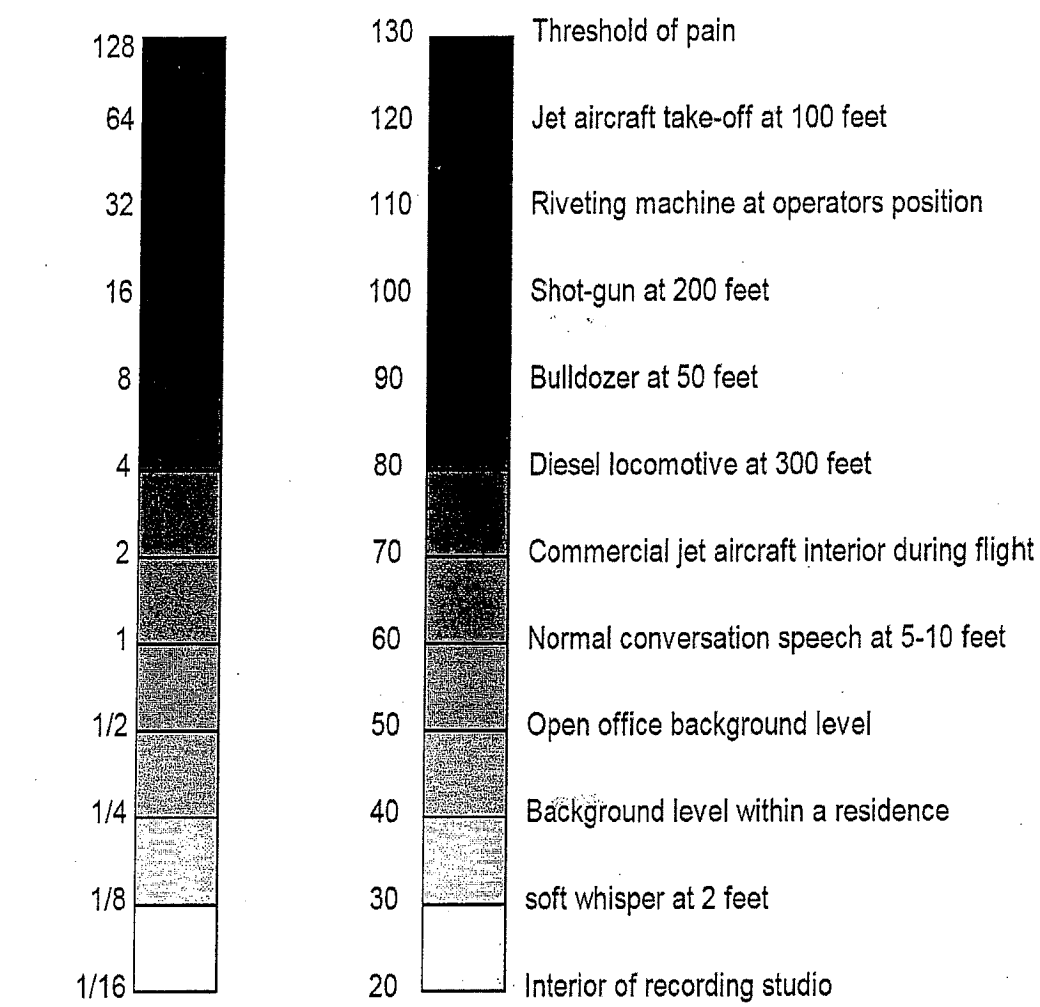
Figure 2

Typical A-Weighted Sound Levels of Common Noise Sources



The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable, and can be approximated by weighing the frequency response of a sound level meter by means of the standardized A-weighing network. There is a strong correlation between A-weighted sound levels (expressed as dBA) and community response to noise. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. All noise levels reported in this section are in terms of A-weighted levels.

Community noise is commonly described in terms of the "ambient" noise level, which is defined as the all-encompassing noise level associated with a given noise environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{eq}). The L_{eq} is the foundation of the day/night average noise descriptor, L_{dn}, and shows very good correlation with community response to noise.

The Day-night Average Level (Ldn) is based upon the average noise level over a 24-hour day, with a +10 decibel weighing applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because Ldn represents a 24-hour average, it tends to disguise short-term variations in the noise environment.

The noise level criteria which are described in this report include descriptors such as the Lmax which is the maximum noise level which may occur during a time period, Leq which is the logarithmic average over a given period of time.

CRITERIA FOR ACCEPTABLE NOISE EXPOSURE

City of Redding General Plan Noise Element:

The City of Redding General Plan Noise Element establishes goals, policies and criteria for determining land use compatibility with major noise sources within the community. The following provides the applicable goals, policies and criteria for evaluating the feasibility and potential noise impacts associated with the proposed Glenbrook Estates.

Goal N1 - Protect residents from the harmful and annoying effects of exposure to excessive noise.

> *Policy N1C - Require an acoustical analysis for new development in locations where exterior and/or interior noise levels will likely exceed the City's noise standards to determine appropriate mitigation measures.*
>
> *Policy N1D - Encourage the use of site planning and building materials/design as primary methods of noise attenuation.*
>
> *Policy N1F - Discourage use of noise barriers and walls constructed exclusively for noise attenuation purposes, where possible. In instances where noise barriers cannot be avoided, require the use of site planning and building material/design features in conjunction with barriers to mitigate visual impacts and reduce the size of barriers.*

Goals N2 - Protect residents from exposure to excessive transportation-related noise.

> *Policy N2A - Update existing and projected noise contours periodically for all transportation noise sources.*

Policy N2C - Mitigate noise created by new transportation noise sources consistent with the levels specified in Table 5-4 (Table 1 of this report) *in outdoor activity areas and interior spaces of existing noise-sensitive land uses.*

Issues

One of the issues relevant to this project is where on the project site should the City apply the exterior noise level criteria. The exterior noise level criterion is generally applied at the outdoor activity areas of a project site. In the case of a single family residential development, the exterior noise level standard is applied at the back yard area of each residence.

In the case of multi-family residential developments, the standard could be applied at the individual patios, a property line, or at a common area which is designated for recreation or outdoor activities such as the recreation or pool areas. This practice is common in many jurisdictions. Generally, the intent is to allow for an outdoor area where individuals can relax and conduct outdoor activities, and then focus on maintaining interior noise levels consistent with the General Plan Noise Element for each of the individual units.

The proposed Glenbrook Estates project does include single family back yards for single family residences, a designated common outdoor area for the apartment complex, as well as individual outdoor patio areas for the townhomes on the project site. This analysis will focus on applying the exterior noise level criterion at the outdoor activity areas for single family residences, townhomes, and the apartment complex.

Table 1
(Table 5-4 of the City of Redding General Plan Noise Element)
Maximum Allowable Noise Exposure
Transportation Noise Sources

Land Use	Outdoor Activity Areas[1] L_{dn}/CNEL, dB	Interior Spaces	
		L_{dn}/CNEL, dB	Leq, dB[2]
Residential	60[3]	45	--
Transient Lodging	60[3]	45	--
Hospitals, Nursing Homes	60[3]	45	--
Theaters, Auditoriums, Music Halls	--	--	35
Churches, Meeting Halls	60[3]	--	40
Office Buildings	--	--	45
Schools, Libraries, Museums	--	--	45
Playgrounds, Neighborhood Parks	70	--	--

[1] The exterior noise level standard shall be applied to the outdoor activity area of the receiving land use. Outdoor activity areas are normally located near or adjacent to the main structure and often occupied by porches, patios, balconies, etc.
[2] As determined for a typical worst-case hour during periods of use.
[3] Where it is not possible to reduce noise in outdoor activity areas to 60 dB L L_{dn}/CNEL or less, using a practical application of the best-available noise reduction measures, higher noise levels may be allowed provided that practical exterior noise-level reduction measures have been implemented and that interior noise levels are in compliance with this table.

EVALUATION OF TRAFFIC NOISE LEVELS AT THE PROJECT SITE

Traffic Noise Prediction Methodology:

j.c. brennan & associates, Inc., employs the Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (FHWA RD-77-108) for the prediction of traffic noise levels. The model is based upon the CALVENO noise emission factors for automobiles, medium trucks and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, topography and the acoustical characteristics of the site.

Existing Traffic Noise:

On June 10, 2005, j.c. brennan & associates, Inc., staff conducted short-term noise level measurements and concurrent traffic counts for I-5 and Hilltop Drive on the project site. The purpose of the short-term traffic noise level measurement is to determine the accuracy of the FHWA model in describing the existing noise environment on the project site, while accounting for shielding from existing intervening structures and topographic features, actual travel speeds, and roadway grade. Noise measurement results were compared to the FHWA model results by entering the

observed traffic volume, speed, and distance as inputs to the FHWA model. See Figure 1 for noise measurement locations.

Instrumentation used for the noise measurement was a Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meter which was calibrated in the field before use with an LDL CAL-200 acoustical calibrator. Table 2 shows the results of the traffic noise calibrations. A complete listing of FHWA Model inputs is provided in Appendix B.

Table 2
Comparison of FHWA Model to Measured Traffic Noise Levels

Location		Observed Speed (mph)	Dist. (Feet)*	Measured L_{eq}, dB	Modeled L_{eq}, dB**	Difference	Relative Elevation
Roadway Name	Site						
Interstate 5	1	60	360	64.5	66.9	-2.4 dB	-20
	2	60	390	60.4	66.7	-6.3 dB	20
	3	60	415	63.7	66.9	-3.2 dB	10
Hilltop Dr.	4	30	65	59.9	61.3	-1.4 dB	5

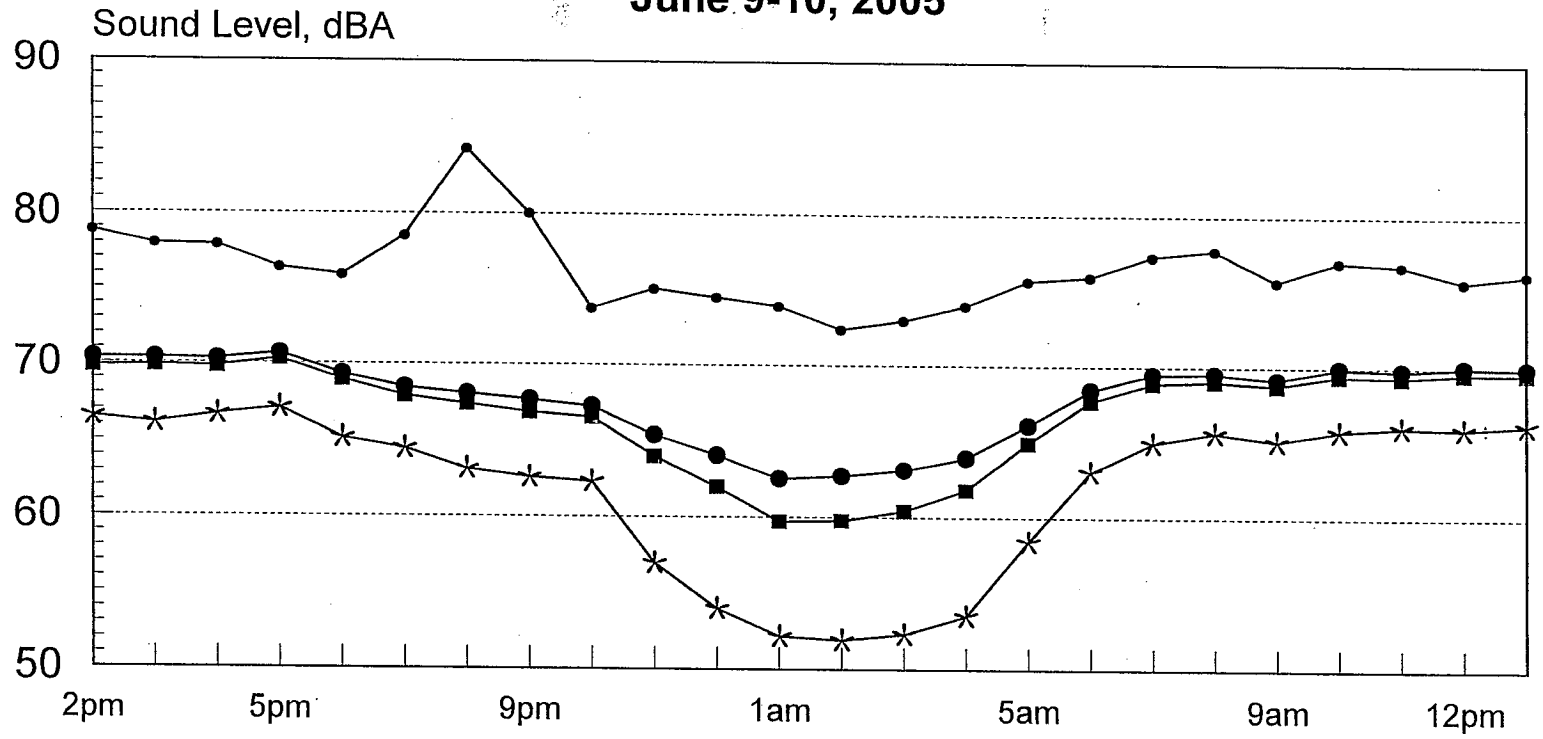
*The noise measurement location is measured from the roadway centerline.
**Acoustically "soft" site assumed

Based upon the calibration results, the FHWA Model was found to over-predict I-5 traffic noise levels by 2.4 - 6.3 dB. The difference between measured and modeled traffic noise levels on the project site is attributed to shielding provided by intervening topography between the roadway and the noise measurement locations for I-5. To remain conservative, a -2 dB offset has been applied to the FHWA model for future I-5 traffic noise levels.

The FHWA Model was also found to over-predict Hilltop Drive noise levels by 1.4 dB at the proposed apartments. The difference between measured and modeled traffic noise levels is considered to be within the tolerance of the FHWA model. Therefore, no corrections to the model were applied to Hilltop Drive.

In addition to the traffic noise calibration measurements, continuous 24-hour noise level measurements were conducted on June 9-10, 2005. The purpose of the continuous noise measurement was to determine the effective day/night traffic split for I-5. Figure 1 shows the location of the continuous noise measurement site. Figure 3 graphically shows the results of the continuous noise monitoring for Thursday/Friday June 9-10, 2005.

Figure 2
Continuous Measured Hourly Noise Levels
Glenbrook Estates
June 9-10, 2005



Ldn = 73.4 dB

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Future Exterior Traffic Noise Levels:

To predict the future traffic noise levels at the project site, j.c. brennan & associates, Inc., used traffic information provided by OMNI-MEANS Ltd. Engineers and Planners, and by the CalTrans Office of Travel Forecasting and Modeling. Interstate 5 proved to be the dominant traffic noise source on the project site. A complete listing of FHWA Model inputs without accounting for shielding is provided in Appendix C.

Shielding can be expected at the nearest residential outdoor activity areas due to the residential buildings on the project site. These shielding effects are discussed in the Caltrans Technical Noise Supplement (Section N-2144, Caltrans 1998 Technical Noise Supplement, TeNS).

> Depending on the site geometry, the first row of houses or buildings next to a highway may shield the second and successive rows. This is often the case where the facility is at-grade or depressed. The amount of noise reduction varies with house or building sizes, spacing of houses or buildings, and site geometry. Generally, for an at-grade facility in an average residential area where the first row houses cover at least 40% of total area (i.e. no more than 60% spacing), the reduction provided by the first row is reasonably assumed at 3 dBA, and 1.5 dBA for each additional row. For example, behind the fist row we may expect a 3 dBA noise reduction, behind the second row 4.5 dBA, third row 6 dBA, etc. For houses or buildings "packed" tightly, (covering about 65-90% of the area, with 10-35% open space), the first row provides about 5 dBA reduction. Successive rows still reduce 1.5 dBA per row.

In some areas on the project site, the construction of proposed residential buildings will provide acoustical shielding for a number of residential outdoor activity areas. Therefore, a conservative adjustment was applied at the common outdoor activity areas of Groups #1, #2, #7 and #8 to account for shielding by intervening residential building facades.

Significant shielding also occurs due to intervening topography on the project site. The two groups that receive shielding from topography are Groups #2 and #8. The shielding provided by intervening topography was calculated based on building pad elevations and grading plans provided by Sharrah Dunlap Sawyer, Inc., dated December 2005.

Table 3 shows the predicted future traffic noise levels on the project site for I-5, while accounting for shielding, as discussed. A complete listing of FHWA Model inputs with shielding accounted for is provided in Appendix D.

Table 3
Predicted Future Traffic Noise Levels
Glenbrook Estates

Lot Grouping	Distance to Roadway Centerline (in feet)	Noise Level Without Accounting for Shielding (dB Ldn)	Adjustment to Account for Shielding		Predicted Ldn at Outdoor Activity Area while Accounting for Shielding
			Building Facades	Intervening Topography	
Group 1	350'	71 dB Ldn	-5[1]		66 dB Ldn
Group 2	540'	68 dB Ldn	-5[1]	-4[2]	59 dB Ldn
Group 3	255'	73 dB Ldn	0		73 dB Ldn
Group 4	250'	73 dB Ldn	0		73 dB Ldn
Group 5	240'	74 dB Ldn	0		74 dB Ldn
Group 6	230'	74 dB Ldn	0		74 dB Ldn
Group 7	325'	72 dB Ldn	-5[1]		67 dB Ldn
Group 8	485'	69 dB Ldn	-3[1]	-6[2]	60 dB Ldn
Group 9	205'	75 dB Ldn	0		75 dB Ldn
Group 10	460'	69 dB Ldn	0		69 dB Ldn

Source: j.c. brennan & associates, Inc.
[1]Based upon shielding from proposed buildings to be constructed on the project site.
[2]Based upon grading plan and building pad elevations.

Table 3 data indicates that future traffic noise levels attributed to I-5 will exceed the 60 dB Ldn noise level criterion at the nearest residential outdoor activity areas, common outdoor activity areas, and individual patios for residential lots adjacent to I-5. In order to achieve compliance with the City of Redding's 60 dB Ldn exterior noise level standard, mitigation measures will be required.

Future Interior Noise Levels:

Standard residential construction (wood siding or two-coat stucco siding, STC-26 windows, door weatherstripping, exterior wall insulation, composition plywood roof, etc.), results in an exterior to interior noise reduction of 25 dB with windows closed, and approximately 15 dB with windows open. Generally, second floor facades will be exposed to traffic noise levels approximately 2-3 dB higher than first floor facades. This is due to the lack of excess ground absorption. Also, second floor receivers would not benefit from shielding due to sound walls.

The future exterior traffic noise levels for Groups #1 through #10 adjacent to I-5 are predicted to range between 66 dB to 75 dB Ldn for first floor facades. The predicted second floor facades for Groups #1 through #10 nearest to I-5 will be exposed to future traffic noise levels that range between 68 dB to 78 dB Ldn for second floor facades.

Based upon a 25 dB exterior to interior building facade noise reduction provided by standard residential construction, future interior traffic noise levels for Groups #1, #3 through #7, #9, and #10 are predicted to exceed the City of Redding interior noise level criterion of 45 dB Ldn for first and second floor facades.

MITIGATION MEASURES

Mitigation for Exterior Future Traffic Noise Levels:

j.c. brennan & associates, Inc., conducted a noise barrier performance analysis to determine the insertion loss and resulting cumulative noise levels provided by varying barrier heights at the nearest outdoor activity areas. In order to meet the "Normally Acceptable" standard of 60 dB Ldn, a barrier height of 15 feet would be required at some property lines. This analysis will discuss mitigation measures required to achieve the 60 dB Ldn standard and a 65 dB Ldn standard.

Appendix D shows a complete listing of inputs used in the FHWA Model Noise Barrier Effectiveness Model. The results are summarized in Table 5. For groups that show "NA", intervening topography (relative to proposed building pads) provides adequate shielding for the outdoor activity areas.

Table 5
Predicted I-5 Future Traffic Noise Levels with Various Noise Barrier Heights

Group #	Pad Elevation (feet)	Base of Barrier Elevation (feet)	Noise Levels Without Barriers (Ldn)	Distance to I-5 centerline (feet)	Noise Level with the Varying Property Line Barrier Heights (dB, Ldn)							
					8'	9'	10'	11'	12'	13'	14'	15'
1	665	660	66 dB	350	**60**	60	60	59	59	58	58	57
2	655	662	63 dB	540	NA	NA	NA	NA	NA	NA	NA	NA
3	680	680	73 dB	255	65	64	63	62	61	**60**	59	59
4	685	685	73dB	250	64	63	62	61	**60**	59	59	58
5	686	686	74 dB	240	64	63	63	62	61	**60**	60	59
6	689	689	74 dB	230	64	63	62	61	**60**	59	59	58
7	673	665	71 dB	325	62	62	62	62	62	61	**60**	60
8	643	660	66 dB	485	NA	NA	NA	NA	NA	NA	NA	NA
9	640	640	75 dB	205	66	65	64	62	61	61	**60**	60
10	630	630	69 dB	460	64	64	63	63	62	62	61	**60**

Source: j.c. brennan & associates, Inc. with FHWA-RD-77-108
Barrier heights are relative to building pad elevations and base of barrier elevations, as listed above.
Bold numbers indicate compliance with the City of Redding exterior noise level standard of 60 dB Ldn.

The results of the barrier analysis shown in Table 5 indicate that the construction of a solid noise barrier (relative to the proposed barrier base elevations and proposed pad elevations listed in

Appendix D) along the property lines of the multi family residences and single family residences adjacent to I-5 is required.

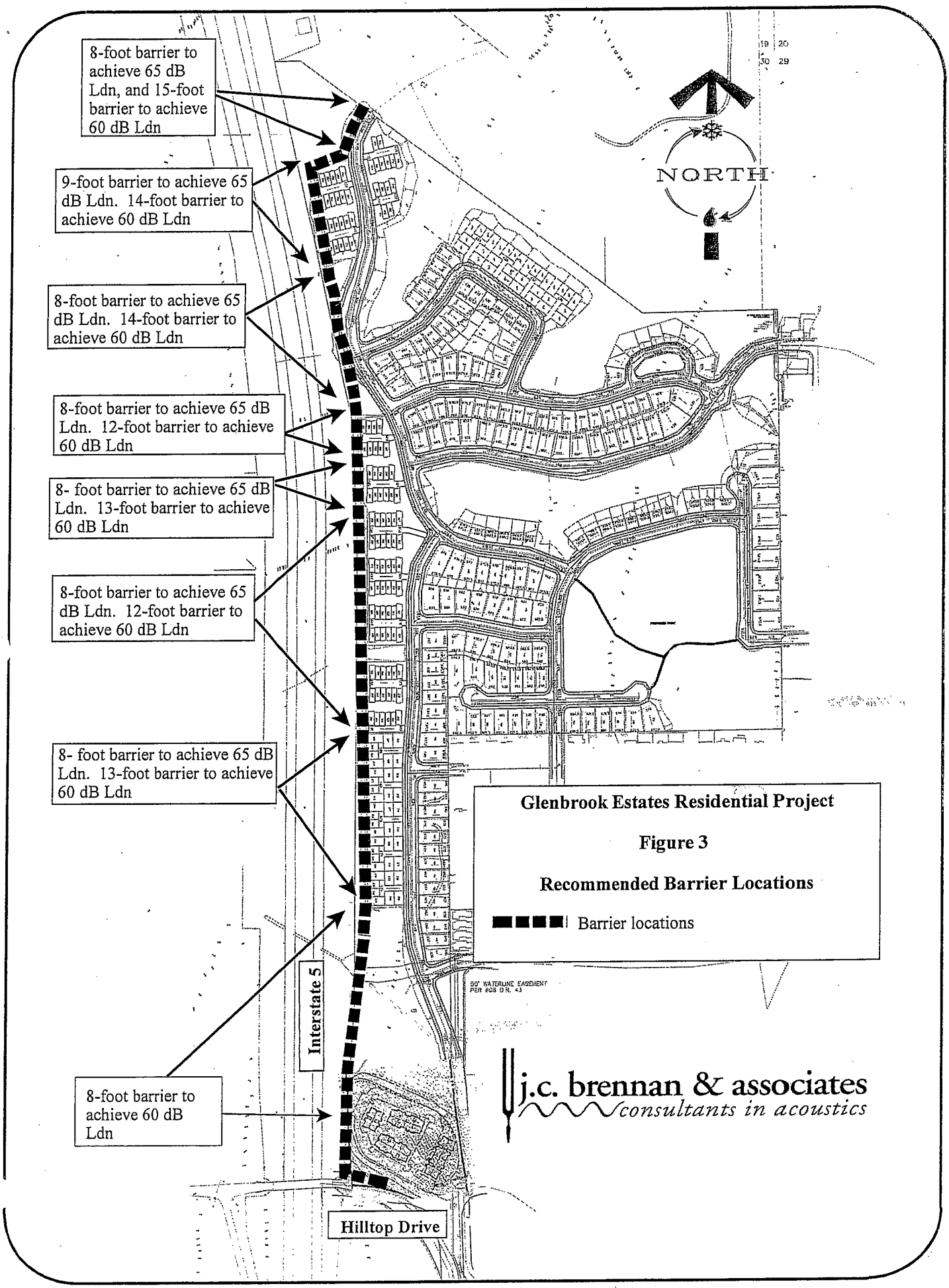
In order to ensure compliance with the City of Redding's exterior noise level standard of 60 dB Ldn for outdoor activity areas on the project site, j.c. brennan & associates, Inc., recommends the construction of a continuous solid noise barrier along the western project boundary line adjacent to I-5. The barrier height should vary from 8-feet to 15-feet, as shown in Figure 3. Barrier locations and heights to achieve the 60 dB Ldn standard and a 65 dB Ldn standard are shown in Figure 3.

Mitigation for Interior Future Traffic Noise Levels:

Table 3 indicates that future traffic noise levels at the first row of residences in the Glenbrook Estates development, adjacent to I-5 are predicted to range between 64 dB and 75 dB Ldn. The predicted future Ldn at the first floor facades of those residences would be approximately 65 dB Ldn or less, while accounting for shielding from the proposed barriers and intervening topography. Exterior noise levels at second floor facades are approximately 2-3 dB higher than at first floors, and are predicted to range from 68 dB and 78 dB Ldn. This is due to reduced ground absorption of sound at elevated locations.

Standard residential construction (wood siding, STC-26 windows, door weatherstripping, exterior wall insulation, composition plywood roof, etc.), results in an exterior to interior noise reduction of at least 25 dB with windows closed, and approximately 15 dB with windows open. Therefore, standard construction would be acceptable for the first floor facades of this project provided that mechanical ventilation (air conditioning) is included to allow occupants to close doors and windows to achieve the desired traffic noise isolation. This accounts for shielding from proposed barriers.

Standard construction may not be sufficient at second-floor facades of the first row of lots facing I-5. In order to determine the specific construction practices necessary for the second floor rooms of the first row of residential buildings facing I-5, and to ensure compliance with the interior noise level standard of 45 dB Ldn, a detailed exterior to interior building facade noise reduction analysis would be needed. Information required for such an analysis would include detailed construction plans, floor plans, and building elevations.


8-foot barrier to achieve 65 dB Ldn, and 15-foot barrier to achieve 60 dB Ldn
9-foot barrier to achieve 65 dB Ldn. 14-foot barrier to achieve 60 dB Ldn
8-foot barrier to achieve 65 dB Ldn. 14-foot barrier to achieve 60 dB Ldn
8-foot barrier to achieve 65 dB Ldn. 12-foot barrier to achieve 60 dB Ldn
8- foot barrier to achieve 65 dB Ldn. 13-foot barrier to achieve 60 dB Ldn
8-foot barrier to achieve 65 dB Ldn. 12-foot barrier to achieve 60 dB Ldn
8- foot barrier to achieve 65 dB Ldn. 13-foot barrier to achieve 60 dB Ldn
8-foot barrier to achieve 60 dB Ldn
NORTH
Interstate 5
Hilltop Drive
Glenbrook Estates Residential Project
Figure 3
Recommended Barrier Locations
Barrier locations
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CONCLUSIONS

The first row of residential units adjacent to I-5 in the Glenbrook Estates development project site will be exposed to future traffic noise levels in excess of the City of Redding 60 dB Ldn standard for new residential developments. The following noise mitigation measures could be utilized to achieve compliance with the City noise standards:

1. In order to ensure compliance with the City of Redding's exterior noise level standard of 60 dB Ldn for outdoor activity areas on the project site, j.c. brennan & associates, Inc., recommends the construction of a continuous solid noise barrier (relative to the proposed barrier base elevations and proposed pad elevations listed in Appendix D) along the western project boundary line adjacent to I-5. The barrier height should vary from 8-feet to 15-feet. Barrier locations and heights to achieve the 60 dB Ldn standard and a 65 dB Ldn standard are shown in Figure 3.

2. Standard construction may not be sufficient at second-floor facades of the first row of lots facing I-5. In order to determine the specific construction practices necessary for the second floor rooms of the first row of residential buildings facing I-5, and to ensure compliance with the interior noise level standard of 45 dB Ldn, a detailed exterior to interior building facade noise reduction analysis would be needed. Information required for such an analysis would include detailed construction plans, floor plans, and building elevations.

3. Air conditioning would be required to allow occupants to close windows and doors for required acoustical isolation.

These conclusions are based upon the traffic noise level data collected by j.c. brennan & associates, Inc., and future traffic contained within the traffic study prepared for this project. Variations from the proposed site plans could cause noise levels at the project site to differ from those predicted in this analysis.

Barriers should be constructed of an earth berm, concrete or masonry block, or precast concrete. Wood is not recommended due to eventual warping and shrinking of materials which results in openings and cracks which compromise the barrier longevity. Other prefabricated barriers may be used. However, they should be reviewed by an acoustical consultant.

The estimate of a 25 dB exterior to interior traffic noise reduction with windows closed is based on j.c. brennan & associates, Inc., staff analysis and field testing conducted in recent years. Careful workmanship is required to ensure that the performance of the actual facades is consistent with this estimate. It is the responsibility of the builder to ensure that all materials and construction practices employed for this project are consistent with local building code requirements and with the recommendations cited in this report. j.c. brennan & associates, Inc., is not responsible for degradation of acoustical performance due to failure to adhere to the recommendations or applicable building code requirements.

Appendix A

Acoustical Terminology

Acoustics	The science of sound.
Ambient Noise	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
Attenuation	The reduction of an acoustic signal.
A-Weighting	A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.
Decibel or dB	Fundamental unit of sound, A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.
CNEL	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.
Frequency	The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.
Ldn	Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.
Leq	Equivalent or energy-averaged sound level.
Lmax	The highest root-mean-square (RMS) sound level measured over a given period of time.
L(n)	The sound level exceeded a described percentile over a measurement period. For instance, an hourly L50 is the sound level exceeded 50% of the time during the one hour period.
Loudness	A subjective term for the sensation of the magnitude of sound.
Noise	Unwanted sound.
Peak Noise	The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.
RT_{60}	The time it takes reverberant sound to decay by 60 dB once the source has been removed.
Sabin	The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 sabin.
Threshold of Hearing	The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing.
Threshold of Pain	Approximately 120 dB above the threshold of hearing.
Impulsive	Sound of short duration, usually less than one second, with an abrupt onset and rapid decay.
Simple Tone	Any sound which can be judged as audible as a single pitch or set of single pitches.

Appendix B

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Calibration Worksheet

Project Information:

Job Number: 2005-026
Project Name: Davis Ridge Residential
Roadway Tested: Interstate 5
Test Location: Site 1
Test Date: June 10, 2005

Weather Conditions:

Temperature (Fahrenheit): 85
Relative Humidity: Dry
Wind Speed and Direction: 10-12 mph from South
Cloud Cover: Mild Overcast

Sound Level Meter:

Sound Level Meter: LDL Model 820
Calibrator: LDL Model CA200
Meter Calibrated: Immediately before and after test
Meter Settings: A-weighted, slow response

Microphone:

Microphone Location: On Project Site
Distance to Centerline (feet): 362
Microphone Height: 5 feet above ground
Intervening Ground (Hard or Soft): **Soft**
Elevation Relative to Road (feet): -20

Roadway Condition:

Pavement Type Asphalt
Pavement Condition: Good
Number of Lanes: 4
Posted Maximum Speed (mph): 65

Test Parameters:

Test Time: 2:00 PM
Test Duration (minutes): 10
Observed Number Automobiles: 814
Observed Number Medium Trucks: 68
Observed Number Heavy Trucks: 50
Observed Average Speed (mph): 60

Model Calibration:

Measured Average Level (L_{eq}): 64.5
Level Predicted by FHWA Model: 66.9
Difference: ***2.4 dB***

Conclusions:

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Appendix B

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Calibration Worksheet

Project Information:

Job Number: 2005-026
Project Name: Davis Ridge Residential
Roadway Tested: Interstate 5
Test Location: Site 2
Test Date: June 10, 2005

Weather Conditions:

Temperature (Fahrenheit): 85
Relative Humidity: Dry
Wind Speed and Direction: 10-12 mph from South
Cloud Cover: Mild Overcast

Sound Level Meter:

Sound Level Meter: LDL Model 820
Calibrator: LDL Model CA200
Meter Calibrated: Immediately before and after test
Meter Settings: A-weighted, slow response

Microphone:

Microphone Location: On Project Site
Distance to Centerline (feet): 390
Microphone Height: 5 feet above ground
Intervening Ground (Hard or Soft): **Soft**
Elevation Relative to Road (feet): 20

Roadway Condition:

Pavement Type Asphalt
Pavement Condition: Good
Number of Lanes: 4
Posted Maximum Speed (mph): 65

Test Parameters:

Test Time: 2:24 PM
Test Duration (minutes): 10
Observed Number Automobiles: 755
Observed Number Medium Trucks: 58
Observed Number Heavy Trucks: 72
Observed Average Speed (mph): 60

Model Calibration:

Measured Average Level (L_{eq}): 60.4
Level Predicted by FHWA Model: 66.7
Difference: ***6.3 dB***

Conclusions:

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Appendix B

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Calibration Worksheet

Project Information:

Job Number: 2005-026
Project Name: Davis Ridge Residential
Roadway Tested: Interstate 5
Test Location: Site 3
Test Date: June 10, 2005

Weather Conditions:

Temperature (Fahrenheit): 85
Relative Humidity: Dry
Wind Speed and Direction: 10-12 mph from South
Cloud Cover: Mild Overcast

Sound Level Meter:

Sound Level Meter: LDL Model 820
Calibrator: LDL Model CA200
Meter Calibrated: Immediately before and after test
Meter Settings: A-weighted, slow response

Microphone:

Microphone Location: On Project Site
Distance to Centerline (feet): 412
Microphone Height: 5 feet above ground
Intervening Ground (Hard or Soft): **Soft**
Elevation Relative to Road (feet): 10

Roadway Condition:

Pavement Type Asphalt
Pavement Condition: Good
Number of Lanes: 4
Posted Maximum Speed (mph): 65

Test Parameters:

Test Time: 3:28 PM
Test Duration (minutes): 10
Observed Number Automobiles: 820
Observed Number Medium Trucks: 72
Observed Number Heavy Trucks: 79
Observed Average Speed (mph): 60

Model Calibration:

Measured Average Level (L_{eq}): 63.7
Level Predicted by FHWA Model: 66.9
Difference: ***3.2 dB***

Conclusions:

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Appendix B

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Calibration Worksheet

Project Information:

Job Number:	2005-026
Project Name:	Davis Ridge Residential
Roadway Tested:	Hilltop Dr.
Test Location:	Site 4
Test Date:	June 10, 2005

Weather Conditions:

Temperature (Fahrenheit):	85
Relative Humidity:	Dry
Wind Speed and Direction:	10-12 mph from South
Cloud Cover:	Mild Overcast

Sound Level Meter:

Sound Level Meter:	LDL Model 820
Calibrator:	LDL Model CA200
Meter Calibrated:	Immediately before and after test
Meter Settings:	A-weighted, slow response

Microphone:

Microphone Location:	On Project Site
Distance to Centerline (feet):	65
Microphone Height:	5 feet above ground
Intervening Ground (Hard or Soft):	**Soft**
Elevation Relative to Road (feet):	5

Roadway Condition:

Pavement Type	Asphalt
Pavement Condition:	Good
Number of Lanes:	2
Posted Maximum Speed (mph):	35

Test Parameters:

Test Time:	3:45 PM
Test Duration (minutes):	10
Observed Number Automobiles:	58
Observed Number Medium Trucks:	2
Observed Number Heavy Trucks:	3
Observed Average Speed (mph):	30

Model Calibration:

Measured Average Level (L_{eq}):	59.9
Level Predicted by FHWA Model:	61.3
Difference:	***1.4 dB***

Conclusions:

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Appendix C-1

FHWA-RD-77-108 Highway Traffic Noise Prediction Model
Data Input Sheet

Project #: 2005-026 Glenbrook Estates
Description: Future Traffic
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	ADT	Day %	Eve %	Night %	% Med. Trucks	% Hvy. Trucks	Speed	Distance	Offset (dB)
1	Interstate 5	Group 1	140,700	76		24	1.4	10.9	60	350	-2
2	Interstate 5	Group 2	140,700	76		24	1.4	10.9	60	540	-2
3	Interstate 5	Group 3	140,700	76		24	1.4	10.9	60	255	-2
4	Interstate 5	Group 4	140,700	76		24	1.4	10.9	60	250	-2
5	Interstate 5	Group 5	140,700	76		24	1.4	10.9	60	240	-2
6	Interstate 5	Group 6	140,700	76		24	1.4	10.9	60	230	-2
7	Interstate 5	Group 7	140,700	76		24	1.4	10.9	60	325	-2
8	Interstate 5	Group 8	140,700	76		24	1.4	10.9	60	485	-2
9	Interstate 5	Group 9	140,700	76		24	1.4	10.9	60	205	-2
10	Interstate 5	Group 10	140,700	76		24	1.4	10.9	60	460	-2
11	Hilltop Drive	Group 1	20,510	87		13	1.5	1	35	250	
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											

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Appendix C-2

FHWA-RD-77-108 Highway Traffic Noise Prediction Model
Predicted Levels

Project #: 2005-026 Glenbrook Estates
Description: Future Traffic
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	Autos	Medium Trucks	Heavy Trucks	Total
1	Interstate 5	Group 1	67.2	55.9	68.5	71
2	Interstate 5	Group 2	64.4	53.1	65.7	68
3	Interstate 5	Group 3	69.3	57.9	70.6	73
4	Interstate 5	Group 4	69.4	58.1	70.7	73
5	Interstate 5	Group 5	69.7	58.3	70.9	74
6	Interstate 5	Group 6	70.0	58.6	71.2	74
7	Interstate 5	Group 7	67.7	56.4	69.0	72
8	Interstate 5	Group 8	65.1	53.8	66.4	69
9	Interstate 5	Group 9	70.7	59.4	72.0	75
10	Interstate 5	Group 10	65.5	54.1	66.7	69
11	Hilltop Drive	Group 1	55.2	46.7	50.2	57

Appendix C-3

FHWA-RD-77-108 Highway Traffic Noise Prediction Model
Noise Contour Output

Project #: 2005-026 Glenbrook Estates
Description: Future Traffic
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	-------- Distances to Traffic Noise Contours -------- 75	70	65	60	55
1	Interstate 5	Group 1	191	412	887	1911	4117
2	Interstate 5	Group 2	191	412	887	1911	4117
3	Interstate 5	Group 3	191	412	887	1911	4117
4	Interstate 5	Group 4	191	412	887	1911	4117
5	Interstate 5	Group 5	191	412	887	1911	4117
6	Interstate 5	Group 6	191	412	887	1911	4117
7	Interstate 5	Group 7	191	412	887	1911	4117
8	Interstate 5	Group 8	191	412	887	1911	4117
9	Interstate 5	Group 9	191	412	887	1911	4117
10	Interstate 5	Group 10	191	412	887	1911	4117
11	Hilltop Drive	Group 1	15	33	71	153	330

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Appendix D

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information:

Job Number: 2005-026
Project Name: Glenbrook Estates
Roadway Name: Interstate 5

Traffic Data:

Year:	2026
Average Daily Traffic Volume:	140,700
Percent Daytime Traffic:	76
Percent Nighttime Traffic:	24
Percent Medium Trucks (2 axle):	1.4
Percent Heavy Trucks (3+ axle):	10.9
Assumed Vehicle Speed (mph):	60
Intervening Ground Type (hard/soft):	**Soft**

Traffic Noise Levels:

				----------L_{dn}, dB----------			
Location:	**Description**	**Distance**	**Offset (dB)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**
1	Group 1	350	-7	62	51	63	66
2	Group 2	482	-7	60	49	61	64
3	Group 3	240	-2	70	58	71	74
4	Group 4	240	-2	70	58	71	74
5	Group 5	225	-2	70	59	71	74
6	Group 6	220	-2	70	59	72	74
7	Group 7	300	-2	68	57	69	72
8	Group 8	460	-5	62	51	64	66
9	Group 9	198	-2	71	60	72	75
10	Group 10	460	-2	65	54	67	69

Traffic Noise Contours (No Calibration Offset):

L_{dn} Contour, dB	Distance from Centerline, (ft)
75	260
70	560
65	1206
60	2598

Notes:

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Appendix D

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2005-026
Project Name: Glenbrook Estates
Roadway Name: Interstate 5
Location(s): 1

Noise Level Data:

Year: 2026
Auto L_{dn}, dB: 62
Medium Truck L_{dn}, dB: 51
Heavy Truck L_{dn}, dB: 63

Site Geometry:

Receiver Description: Group 1
Centerline to Barrier Distance (C_1): 150
Barrier to Receiver Distance (C_2): 200
Automobile Elevation: 660
Medium Truck Elevation: 662
Heavy Truck Elevation: 668
Pad/Ground Elevation at Receiver: 660
Receiver Elevation[1]: 665
Base of Barrier Elevation: 660
Starting Barrier Height 6

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height[2] (ft)	L_{dn}, dB				Barrier Breaks Line of Sight to...		
		Autos	Medium Trucks	Heavy Trucks	Total	Autos?	Medium Trucks?	Heavy Trucks?
666	6	56	45	59	**61**	Yes	Yes	No
667	7	56	45	58	**61**	Yes	Yes	Yes
668	8	56	45	58	**60**	Yes	Yes	Yes
669	9	55	44	58	**60**	Yes	Yes	Yes
670	10	55	44	58	**60**	Yes	Yes	Yes
671	11	54	43	57	**59**	Yes	Yes	Yes
672	12	54	43	57	**59**	Yes	Yes	Yes
673	13	53	42	57	**58**	Yes	Yes	Yes
674	14	53	42	56	**58**	Yes	Yes	Yes

Notes: 1.Standard receiver elevation is five feet above grade/pad elevations at the receiver location(s)

Appendix D

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2005-026
Project Name: Glenbrook Estates
Roadway Name: Interstate 5
Location(s): 2

Noise Level Data:

Year: 2026
Auto L_{dn}, dB: 60
Medium Truck L_{dn}, dB: 49
Heavy Truck L_{dn}, dB: 61

Site Geometry:

Receiver Description: Group 2
Centerline to Barrier Distance (C_1): 400
Barrier to Receiver Distance (C_2): 140
Automobile Elevation: 660
Medium Truck Elevation: 662
Heavy Truck Elevation: 668
Pad/Ground Elevation at Receiver: 655
Receiver Elevation[1]: 660
Base of Barrier Elevation: 662
Starting Barrier Height 0

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height[2] (ft)	L_{dn}, dB Autos	Medium Trucks	Heavy Trucks	Total	Barrier Breaks Line of Sight to... Autos?	Medium Trucks?	Heavy Trucks?
662	0	55	44	57	**59**	Yes	Yes	No
663	1	55	44	56	**59**	Yes	Yes	Yes
664	2	54	43	56	**59**	Yes	Yes	Yes
665	3	54	43	56	**58**	Yes	Yes	Yes
666	4	54	42	56	**58**	Yes	Yes	Yes
667	5	53	42	55	**58**	Yes	Yes	Yes
668	6	53	41	55	**57**	Yes	Yes	Yes
669	7	52	41	55	**57**	Yes	Yes	Yes
670	8	52	41	54	**56**	Yes	Yes	Yes

Notes: 1.Standard receiver elevation is five feet above grade/pad elevations at the receiver location(s)

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Appendix D

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2005-026
Project Name: Glenbrook Estates
Roadway Name: Interstate 5
Location(s): 3

Noise Level Data:

Year: 2026
Auto L_{dn}, dB: 70
Medium Truck L_{dn}, dB: 58
Heavy Truck L_{dn}, dB: 71

Site Geometry:

Receiver Description: Group 3
Centerline to Barrier Distance (C_1): 240
Barrier to Receiver Distance (C_2): 15
Automobile Elevation: 660
Medium Truck Elevation: 662
Heavy Truck Elevation: 668
Pad/Ground Elevation at Receiver: 680
Receiver Elevation[1]: 685
Base of Barrier Elevation: 680
Starting Barrier Height 8

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height[2] (ft)	L_{dn}, dB Autos	Medium Trucks	Heavy Trucks	Total	Barrier Breaks Line of Sight to... Autos?	Medium Trucks?	Heavy Trucks?
688	8	61	49	62	**65**	Yes	Yes	Yes
689	9	59	48	61	**64**	Yes	Yes	Yes
690	10	59	47	60	**63**	Yes	Yes	Yes
691	11	58	46	59	**62**	Yes	Yes	Yes
692	12	57	46	58	**61**	Yes	Yes	Yes
693	13	56	45	58	**60**	Yes	Yes	Yes
694	14	56	44	57	**60**	Yes	Yes	Yes
695	15	55	44	57	**59**	Yes	Yes	Yes
696	16	55	44	56	**59**	Yes	Yes	Yes

Notes: 1.Standard receiver elevation is five feet above grade/pad elevations at the receiver location(s)

Appendix D

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2005-026
Project Name: Glenbrook Estates
Roadway Name: Interstate 5
Location(s): 4

Noise Level Data:

Year: 2026
Auto L_{dn}, dB: 70
Medium Truck L_{dn}, dB: 58
Heavy Truck L_{dn}, dB: 71

Site Geometry:

Receiver Description: Group 4
Centerline to Barrier Distance (C_1): 240
Barrier to Receiver Distance (C_2): 10
Automobile Elevation: 660
Medium Truck Elevation: 662
Heavy Truck Elevation: 668
Pad/Ground Elevation at Receiver: 685
Receiver Elevation[1]: 690
Base of Barrier Elevation: 685
Starting Barrier Height 8

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height[2] (ft)	L_{dn}, dB Autos	Medium Trucks	Heavy Trucks	Total	Barrier Breaks Line of Sight to... Autos?	Medium Trucks?	Heavy Trucks?
693	8	60	49	61	**64**	Yes	Yes	Yes
694	9	59	47	60	**63**	Yes	Yes	Yes
695	10	58	46	59	**62**	Yes	Yes	Yes
696	11	57	45	58	**61**	Yes	Yes	Yes
697	12	56	45	57	**60**	Yes	Yes	Yes
698	13	55	44	57	**59**	Yes	Yes	Yes
699	14	55	44	56	**59**	Yes	Yes	Yes
700	15	54	43	56	**58**	Yes	Yes	Yes
701	16	54	42	55	**58**	Yes	Yes	Yes

Notes: 1.Standard receiver elevation is five feet above grade/pad elevations at the receiver location(s)

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Appendix D

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2005-026
Project Name: Glenbrook Estates
Roadway Name: Interstate 5
Location(s): 5

Noise Level Data:

Year: 2026
Auto L_{dn}, dB: 70
Medium Truck L_{dn}, dB: 59
Heavy Truck L_{dn}, dB: 71

Site Geometry:

Receiver Description: Group 5
Centerline to Barrier Distance (C_1): 225
Barrier to Receiver Distance (C_2): 15
Automobile Elevation: 660
Medium Truck Elevation: 662
Heavy Truck Elevation: 668
Pad/Ground Elevation at Receiver: 686
Receiver Elevation[1]: 691
Base of Barrier Elevation: 686
Starting Barrier Height 8

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height[2] (ft)	L_{dn}, dB Autos	Medium Trucks	Heavy Trucks	Total	Barrier Breaks Line of Sight to... Autos?	Medium Trucks?	Heavy Trucks?
694	8	60	49	62	**64**	Yes	Yes	Yes
695	9	59	48	61	**63**	Yes	Yes	Yes
696	10	59	47	60	**63**	Yes	Yes	Yes
697	11	58	46	59	**62**	Yes	Yes	Yes
698	12	57	46	59	**61**	Yes	Yes	Yes
699	13	56	45	58	**60**	Yes	Yes	Yes
700	14	56	44	57	**60**	Yes	Yes	Yes
701	15	56	44	57	**59**	Yes	Yes	Yes
702	16	55	43	57	**59**	Yes	Yes	Yes

Notes: 1.Standard receiver elevation is five feet above grade/pad elevations at the receiver location(s)

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Appendix D

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2005-026
Project Name: Glenbrook Estates
Roadway Name: Interstate 5
Location(s): 6

Noise Level Data:

Year: 2026
Auto L_{dn}, dB: 70
Medium Truck L_{dn}, dB: 59
Heavy Truck L_{dn}, dB: 72

Site Geometry:

Receiver Description: Group 6
Centerline to Barrier Distance (C_1): 220
Barrier to Receiver Distance (C_2): 10
Automobile Elevation: 655
Medium Truck Elevation: 657
Heavy Truck Elevation: 663
Pad/Ground Elevation at Receiver: 689
Receiver Elevation[1]: 694
Base of Barrier Elevation: 689
Starting Barrier Height 8

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height[2] (ft)	L_{dn}, dB Autos	Medium Trucks	Heavy Trucks	Total	Barrier Breaks Line of Sight to... Autos?	Medium Trucks?	Heavy Trucks?
697	8	60	49	61	**64**	Yes	Yes	Yes
698	9	59	48	60	**63**	Yes	Yes	Yes
699	10	58	46	59	**62**	Yes	Yes	Yes
700	11	57	46	58	**61**	Yes	Yes	Yes
701	12	56	45	58	**60**	Yes	Yes	Yes
702	13	56	44	57	**59**	Yes	Yes	Yes
703	14	55	44	57	**59**	Yes	Yes	Yes
704	15	54	43	56	**59**	Yes	Yes	Yes
705	16	54	43	56	**58**	Yes	Yes	Yes

Notes: 1.Standard receiver elevation is five feet above grade/pad elevations at the receiver location(s)

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Appendix D

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2005-026
Project Name: Glenbrook Estates
Roadway Name: Interstate 5
Location(s): 7

Noise Level Data:

Year: 2026
Auto L_{dn}, dB: 63
Medium Truck L_{dn}, dB: 52
Heavy Truck L_{dn}, dB: 64

Site Geometry:

Receiver Description: Group 7
Centerline to Barrier Distance (C_1): 365
Barrier to Receiver Distance (C_2): 65
Automobile Elevation: 650
Medium Truck Elevation: 652
Heavy Truck Elevation: 658
Pad/Ground Elevation at Receiver: 673
Receiver Elevation[1]: 678
Base of Barrier Elevation: 665
Starting Barrier Height 8

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height[2] (ft)	L_{dn}, dB Autos	Medium Trucks	Heavy Trucks	Total	Barrier Breaks Line of Sight to... Autos?	Medium Trucks?	Heavy Trucks?
673	8	58	47	60	**62**	No	No	No
674	9	58	47	60	**62**	Yes	No	No
675	10	58	47	59	**62**	Yes	Yes	Yes
676	11	58	47	59	**62**	Yes	Yes	Yes
677	12	57	46	59	**62**	Yes	Yes	Yes
678	13	57	46	59	**61**	Yes	Yes	Yes
679	14	56	45	58	**60**	Yes	Yes	Yes
680	15	56	44	58	**60**	Yes	Yes	Yes
681	16	55	44	57	**59**	Yes	Yes	Yes

Notes: 1.Standard receiver elevation is five feet above grade/pad elevations at the receiver location(s)

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Appendix D

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2005-026
Project Name: Glenbrook Estates
Roadway Name: Interstate 5
Location(s): 8

Noise Level Data:

Year: 2026
Auto L_{dn}, dB: 62
Medium Truck L_{dn}, dB: 51
Heavy Truck L_{dn}, dB: 64

Site Geometry:

Receiver Description: Group 8
Centerline to Barrier Distance (C_1): 460
Barrier to Receiver Distance (C_2): 25
Automobile Elevation: 650
Medium Truck Elevation: 652
Heavy Truck Elevation: 658
Pad/Ground Elevation at Receiver: 643
Receiver Elevation[1]: 648
Base of Barrier Elevation: 660
Starting Barrier Height 0

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height[2] (ft)	L_{dn}, dB				Barrier Breaks Line of Sight to...		
		Autos	Medium Trucks	Heavy Trucks	Total	Autos?	Medium Trucks?	Heavy Trucks?
660	0	49	38	51	**53**	Yes	Yes	Yes
661	1	49	37	50	**53**	Yes	Yes	Yes
662	2	48	37	50	**52**	Yes	Yes	Yes
663	3	48	37	49	**52**	Yes	Yes	Yes
664	4	48	37	49	**52**	Yes	Yes	Yes
665	5	47	36	48	**51**	Yes	Yes	Yes
666	6	47	36	48	**51**	Yes	Yes	Yes
667	7	47	35	48	**50**	Yes	Yes	Yes
668	8	46	35	48	**50**	Yes	Yes	Yes

Notes: 1.Standard receiver elevation is five feet above grade/pad elevations at the receiver location(s)

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Appendix D

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2005-026
Project Name: Glenbrook Estates
Roadway Name: Interstate 5
Location(s): 9

Noise Level Data:

Year: 2026
Auto L_{dn}, dB: 71
Medium Truck L_{dn}, dB: 60
Heavy Truck L_{dn}, dB: 72

Site Geometry:

Receiver Description: Group 9
Centerline to Barrier Distance (C_1): 198
Barrier to Receiver Distance (C_2): 7
Automobile Elevation: 645
Medium Truck Elevation: 647
Heavy Truck Elevation: 653
Pad/Ground Elevation at Receiver: 640
Receiver Elevation[1]: 645
Base of Barrier Elevation: 640
Starting Barrier Height 8

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height[2] (ft)	L_{dn}, dB Autos	L_{dn}, dB Medium Trucks	L_{dn}, dB Heavy Trucks	L_{dn}, dB Total	Barrier Breaks Line of Sight to... Autos?	Medium Trucks?	Heavy Trucks?
648	8	62	51	64	**66**	Yes	Yes	Yes
649	9	61	49	62	**65**	Yes	Yes	Yes
650	10	59	48	61	**64**	Yes	Yes	Yes
651	11	58	47	60	**62**	Yes	Yes	Yes
652	12	57	46	59	**61**	Yes	Yes	Yes
653	13	57	45	58	**61**	Yes	Yes	Yes
654	14	56	45	58	**60**	Yes	Yes	Yes
655	15	56	44	58	**60**	Yes	Yes	Yes
656	16	55	44	57	**59**	Yes	Yes	Yes

Notes: 1.Standard receiver elevation is five feet above grade/pad elevations at the receiver location(s)

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Appendix D

FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2005-026
Project Name: Glenbrook Estates
Roadway Name: Interstate 5
Location(s): 10

Noise Level Data:

Year: 2026
Auto L_{dn}, dB: 65
Medium Truck L_{dn}, dB: 54
Heavy Truck L_{dn}, dB: 67

Site Geometry:

Receiver Description: Group 10
Centerline to Barrier Distance (C_1): 375
Barrier to Receiver Distance (C_2): 85
Automobile Elevation: 635
Medium Truck Elevation: 637
Heavy Truck Elevation: 643
Pad/Ground Elevation at Receiver: 630
Receiver Elevation[1]: 635
Base of Barrier Elevation: 630
Starting Barrier Height 8

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height[2] (ft)	L_{dn}, dB Autos	Medium Trucks	Heavy Trucks	Total	Barrier Breaks Line of Sight to... Autos?	Medium Trucks?	Heavy Trucks?
638	8	60	49	62	**64**	Yes	Yes	Yes
639	9	59	48	61	**64**	Yes	Yes	Yes
640	10	59	48	61	**63**	Yes	Yes	Yes
641	11	58	47	60	**63**	Yes	Yes	Yes
642	12	58	47	60	**62**	Yes	Yes	Yes
643	13	57	46	59	**62**	Yes	Yes	Yes
644	14	57	46	59	**61**	Yes	Yes	Yes
645	15	56	45	58	**60**	Yes	Yes	Yes
646	16	56	45	58	**60**	Yes	Yes	Yes

Notes: 1.Standard receiver elevation is five feet above grade/pad elevations at the receiver location(s)

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