NOISE & VIBRATION

A. PROJECT DESCRIPTION

The Riverside County Transportation Commission (RCTC) proposes to establish a commuter rail service on the portion of the San Jacinto Branch Line between South Perris and Riverside as an extension of the Metrolink 91 commuter rail service to Los Angeles. This proposed service, to be known as the Perris Valley Line (PVL), would operate on existing rail right of way owned by RCTC, and would create 5 new stations and use the existing Riverside station.

This report describes the existing noise and vibration conditions in the study area for the locally preferred Perris Valley Line Commuter Rail Alternative, with the Citrus Connection. This alternative would introduce transit noise sources in areas where they do not now exist. The section presents forecasted noise levels that are expected to be generated by the proposed project, along with the applicable standards and criteria used to assess future environmental noise impacts for a rail project. The methodologies used in the assessments are also described. The types and effectiveness of mitigation measures that can be used to reduce noise levels to less than significant levels are identified.

Overview

The Federal Transit Administration's, *Transit Noise and Vibration Impact Assessment, May 2006*, guidelines were followed to conduct the detailed noise and vibration impact assessments presented in this report. For this analysis, FTA's Detailed Assessment procedures were used to identify areas where noise or vibration impacts would be likely to occur. The results of the Detailed Analysis were used to develop specific mitigation measures that would reduce impacts to less than significant levels under the Federal Transit Administration (FTA) impact criteria and California Environmental Quality Act (CEQA) criteria, where appropriate. This report also updates the draft FTA Environmental Assessment (EA) prepared under the National Environmental Policy Act (NEPA).

As part of this update, previously measured noise levels were augmented with new field measurements of existing noise. These measurements include specific locations requested by the public through comments on the NEPA Draft EA. Additional noise measurements were taken for the detailed analysis to ensure a more representative assessment of the existing noise environment.

Noise and Vibration Assessment Approach

The basic steps used to identify the potential noise and vibration impacts and recommend mitigation measures are:

1. Identify representative noise- and vibration-sensitive receptors in the PVL corridor.

2. Determine existing noise and vibration levels. This is done through a program of short- and long- term measurements.

3. Develop noise and vibration prediction models. The models are based on previous measurements of noise and vibration from Metrolink trains, the planned operating conditions (speed, number and length of trains), and the year 2025 concept PVL schedule.

4. Estimate future noise and vibration levels at the representative receivers.

5. Recommend specific noise and vibration mitigation measures to minimize or eliminate the predicted impacts.

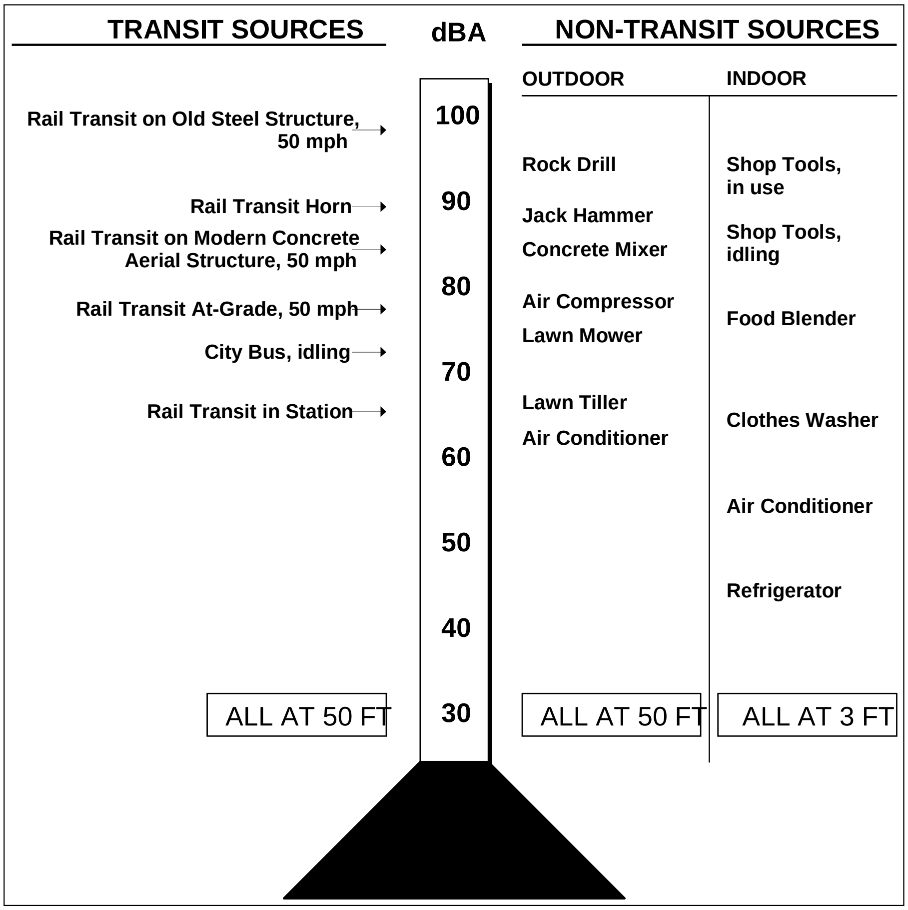
Background

Noise

Noise, otherwise known as unwanted sound, is a fluctuating disturbance of the air caused by the propagation of sound pressure waves. Sound is measured using a logarithmic unit called a decibel (dB). Noises contain sound energy at different frequencies whose range depends on the individual noise source. Human hearing does not register the sound levels of all noise frequencies equally, and reduces the impression of high and low-pitched sounds. To replicate the response of the human ear to noise, the noise levels at different frequencies must be adjusted using a process referred to as A-weighting. Under such a process, the resulting level is said to be an A-weighted sound level and is commonly expressed as dBA.

Noise levels relate the magnitude of the sound pressure to a standard reference value. Normally encountered sounds lie in the range of 40 to 120 dBA. A sample of common transit-related and other noise sources expressed in A-weighted decibels is shown on Figure 1.

Figure 1: Common Indoor and Outdoor Noise Levels



Source: Transit Noise and Vibration Impact Assessment, FTA, May 2006

Noise levels from human activities at a specific location can vary widely over time. The equivalent noise level (L_{eq}) represents the time-varying noise levels produced over a specified period of time as a single number. This represents the equivalent steady noise level, which, over a given period, contains the same energy as the time-varying noise during the same period. The most common time period is one hour, represented as $L_{eq\,(h)}$. This descriptor is commonly used to express the results from noise measurements, predictions and impact assessments at sensitive receivers where sleep is not an issue. At sensitive receivers where sleep is essential, such as residences and hospitals, the descriptor most often used in noise analyses is the day-night average sound level or L_{dn}. L_{dn} is defined as the cumulative noise exposure from all events over a 24-hour period, but with a 10 dB penalty imposed on noise occurring between 10 p.m. to 7 a.m. since people tend to be more sensitive to noises during these hours. Typical ranges for L_{dn} for community noise are shown in Table 1.

Table 1: Typical Range of Ldn in Populated Areas

Area- Category	***Ldn, dBA***
Downtown City	75–85
"Very Noisy" Urban Residential Areas	65-75
"Quiet" Urban Residential Areas	60-65
Suburban Residential Areas	55-60
Small Town Residential Areas	45-55

L_{dn}= cumulative noise

Source: Federal Transit Administration, 2006.

A few general relationships may be helpful in understanding the decibel scale:

- An increase of 1 dBA cannot be perceived by the human ear.
- A 3 dBA increase is normally the smallest change in sound levels that is perceptible to the human ear.
- A 10 dBA increase in noise level corresponds to tenfold increase in noise energy, but a listener would only judge a 10 dBA increase as being twice as loud.
- A 20 dBA increase would result in a dramatic change in how a listener would perceive the sound.

Noises associated with commuter rail are generated from the following system elements:

- Diesel exhaust, which is in part a function of the rate of acceleration and speed
- Cooling fans
- Wheel/rail interaction (a function of the condition of wheels and type (e.g., welded or jointed), truck suspension and condition of the rails
- Structures, such as trestles, that may amplify sound
- Horns and crossing gate bells (at and approaching grade crossings).

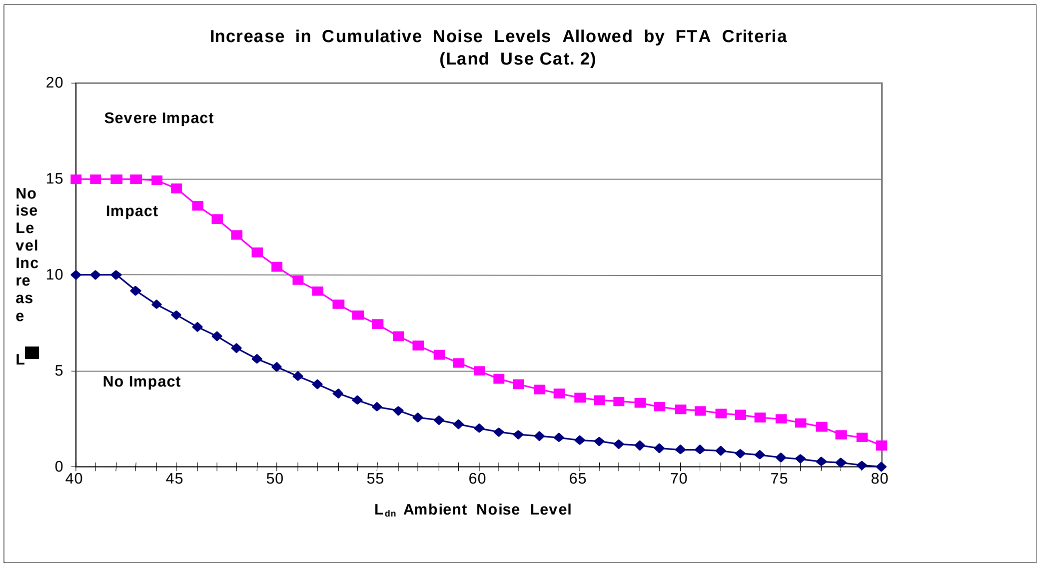
Commuter rail noise, as perceived by an individual at a given location and time, is a function of several factors, including:

- the distance from the noise source to the receiver
- intervening terrain between a receiver and a noise source

- the existence of natural or constructed noise barriers
- the combination of railroad-related noise levels and other local sources of noise.

The FTA has established noise criteria to assess potential impacts of various transit projects. A graphical depiction of the noise criteria is shown on Figure 2 for three categories of land use defined in Table 2. Noise impacts resulting from a proposed project are determined by comparing the existing and future project-related outdoor noise levels.

Figure 2: Allowable Transit Noise Increases



Source: Federal Transit Administration

Table 2: Land Use Categories and Metrics for Transit Noise		
Land Use Category	***Noise Metric (dBA)***	***Description of Land Use Category***
1	Outdoor Leq(h)*	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
2	Outdoor Ldn	Residences and buildings where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor Leq(h)*	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.
L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity		
Source: FTA, Transit Noise and Vibration Impact Assessment, May 2006		

As the existing level of ambient noise increases, the allowable level of transit noise also increases, but the total amount by which that community's noise can increase, without an impact, is reduced. Noise level increases, defined by the FTA guidance as "impacts" or "severe impacts", occur when the existing levels are surpassed by more than the allowable increase.

The terms No Impact, Impact, and Severe Impact are defined as follows:

> No Impact – The project, on average, will result in an insignificant increase in the number of people "highly annoyed" by new noise.
>
> Impact - This is a moderate impact. The change in cumulative noise is noticeable to most people, but may not be sufficient to cause strong, adverse community reactions.
>
> Severe Impacts - A significant percentage of people would be highly annoyed by the noise, perhaps resulting in vigorous community reaction attended by litigation.

For land use categories 1 and 3, the L_{eq} noise descriptor is used while land use category 2 properties are assessed utilizing the L_{dn} descriptor. These criteria do not apply to industrial or commercial areas since they are generally compatible with high noise levels.

The criteria for assessing impacts were developed based on numerous studies of human annoyance due to cumulative increases in noise. Table 3 shows several examples of allowable transit noise increases illustrating this relationship.

Table 3: Examples Of Noise Impact Criteria For Transit Projects

(Ldn or Leq in dBA)

Existing Noise Levels	*Allowable Project Noise Level*	*Allowable Combined Total Noise Level*	*Allowable Noise Level Increase*
45	51	52	7
50	53	55	5
55	55	58	3
60	57	62	2
65	60	66	1
70	64	71	1
75	65	75	0

Source: FTA Manual for Transit Noise and Vibration Impact Assessment, FTA, May 2006

As shown in Table 3, as existing and allowable combined total noise levels increase, the allowable change in noise level decreases.

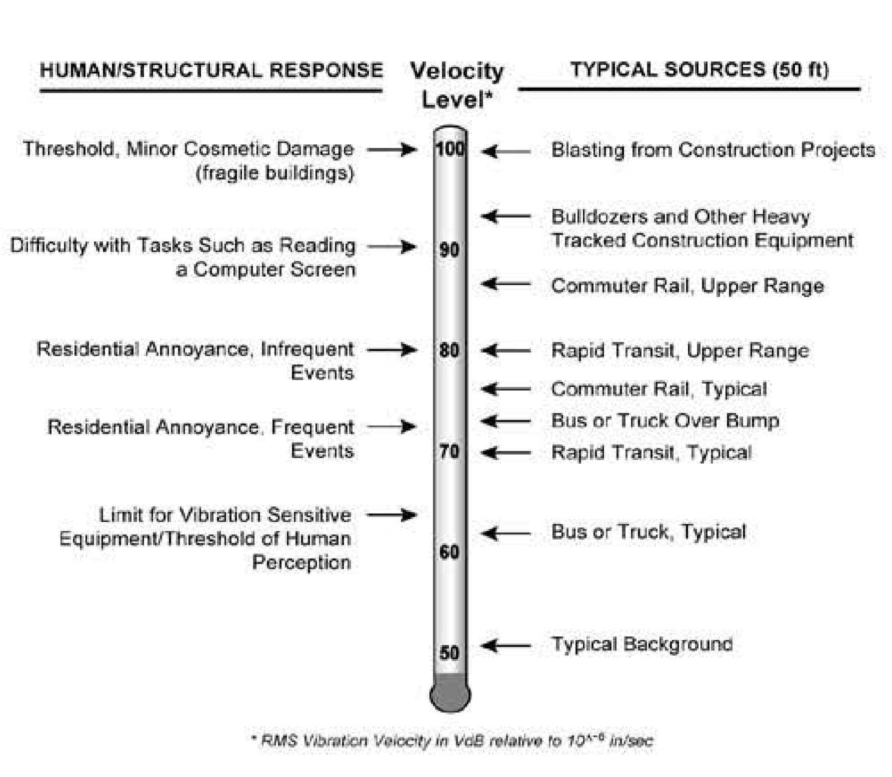
<u>Vibration</u>

An important consideration for rail transit projects is vibration that is transmitted from rail movement on the tracks through the ground to adjacent dwellings. The vibration is caused by the interaction of the wheels and rails and may be perceived by building occupants as "feelable"vibration. Ground-borne vibration can cause windows, pictures on walls or items on shelves to rattle. Although the perceived vibration from train passbys can be intrusive to building occupants, the vibration is almost never of sufficient magnitude to cause even minor cosmetic damage to buildings.

When evaluating human response, ground-borne vibration is usually expressed in terms of root mean square (RMS) vibration velocity. RMS is defined as the average of the squared amplitude of the vibration signal. To avoid confusion with sound decibels, the abbreviation VdB is used for vibration decibels.

Figure 3 shows typical vibration levels from rail and non-rail sources as well as the human and structure response to such levels.

Figure 3: Typical Vibration Levels



Although there has been relatively little research into human and building response to ground-borne vibration, there is substantial experience with vibration from rail systems. In general, this collective experience indicates that:

- It is rare that ground-borne vibration from transit systems results in building damage, even minor cosmetic damage as noted above. The primary consideration therefore is whether vibration will be intrusive to building occupants or will interfere with interior activities or machinery.

- The threshold for human perception is approximately 65 VdB. Vibration levels in the range of 70 to 75 VdB are often noticeable but acceptable. Beyond 80 VdB, vibration levels are often considered unacceptable.

- For human annoyance, there is a relationship between the number of daily events and the degree of annoyance caused by ground-borne vibration. The FTA guidance manual includes an 8 VdB higher impact threshold if there are fewer than 70 events per day. The higher threshold is applicable to the PVL commuter rail project.

The FTA vibration criteria are based on the maximum ground vibration caused by a typical train passby. As noted above, the infrequency criteria are applicable to the PVL project as there would be substantially fewer than 70 trains per day.

Similar to the FTA noise criteria, the FTA vibration criteria are based on three land use categories, although the categories are somewhat different. One important difference is that outdoor spaces are not included in Category 3 for vibration. This is because human annoyance from ground-borne vibration requires the interaction of the ground vibration with a building structure. Consequently, the criteria apply to indoor spaces only and there are no vibration impact thresholds for outdoor spaces such as parks.

Table 4 shows FTA criteria for ground-borne vibration from rail transit systems. For residential buildings (Category 2), the threshold applicable to this project is 80 VdB. The applicable threshold for schools and churches (Category 3) is 83 VdB.

It is important to note that the FTA vibration thresholds do not specifically account for existing vibration. In most cases, the existing environment does not include a significant number of sources or events that generate perceptible ground-borne vibration. Because of this, and in order to create a very conservative assessment that over-predicts potential impacts the BNSF operations on the SJBL per day have not been considered in the assessment of potential PVL vibration impacts.

Table 4: Ground-Borne Vibration (GBV) Impact Criteria for General Assessment

Land Use Category	GBV Impact Levels (VdB re: 1 micro-inch / sec)			GBV Impact Levels (dB re: 20 micro Pascals/ sec)		
	Frequent Events [1]	Occasional Events [2]	Infrequent Events [3]	Frequent Events [2]	Occasional Events [3]	Infrequent Events [4]
Category 1: Buildings where vibration would interfere with interior operations	65 VdB	65 VdB	65 VdB	NA [4]	NA [4]	NA [4]
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primary daytime use	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

1 "Frequent Events" is defined as more than 70 vibration events per day.

2 "Occasional Events" is defined as between 30 and 70 vibration events per day.

3 "Infrequent Events" is defined as less than 30 vibration events per day.

4 N/A means "not applicable". Vibration-sensitive equipment is not sensitive to ground-borne noise.

B. EXISTING CONDITIONS

Noise Environment

The project rail corridor includes portions of the following two active rail segments:

- San Jacinto Branch Line (SJBL) between Highgrove and Perris
- BNSF Main Line between Highgrove and the Downtown Riverside Metrolink Station, to be connected to the SJBL by the proposed new Citrus Connection

Noise environment conditions for each segment are described below.

- The SJBL corridor currently has about two freight trains traveling on it daily. These trains typically consist of three diesel locomotives and about 25 freight cars and travel at maximum speeds of 20 mph. In those portions of this corridor with residential development and -roadway-railway at-grade crossings, horn noise is a significant contributor to the noise environment, along with local roadway traffic. For the portion of the SJBL corridor closely paralleling I-215, where there are no sensitive receptors, the ambient noise environment is substantially affected by vehicular traffic from the freeway.

- The BNSF Mainline through the study area has between 60 and 80 trains traveling along it during a typical 24-hour period. The majority of these trains (about eighty percent) are freight traffic. These trains generally operate with three to four diesel locomotives and are about 50 to 100 freight cars in length. They travel at about 30 mph. The remaining traffic consists of mostly Metrolink rail traffic and a few Amtrak trains. The Metrolink trains have a single diesel locomotive and about three passenger cars and travel at average speeds of 50 mph. The Amtrak trains also travel at about 50 mph and have two to three diesel locomotives and about 15 cars. Train traffic occurs during both day and night hours. The noise environment in the Highgrove to Riverside BNSF Main Line segment is dominated by the extremely heavy volume of rail activity. In addition, vehicles traveling State Route 60, I-215, and local streets make significant noise contributions.

Noise Measurement Program

Three noise measurement programs have been undertaken for the Perris Valley Line project, and their results are summarized here. The three programs were undertaken in 2002, 2005, and in 2008. In 2002, a general noise assessment was conducted; in 2005 and for the 2008 updates of the noise analysis, detailed noise assessments were conducted.

A noise measurement program was conducted to obtain the existing ambient noise levels along the study corridor at selected sensitive receivers. The measurement sites were selected on the basis of several factors, the most important of which was the site's potential sensitivity to changes in noise or vibration levels. For the 2002 study, thirty-two noise sensitive sites were monitored along the project corridor. Each noise site was either representative of a unique noise environment or of similarly situated receivers nearby. As the existing SJBL corridor passes through several residential neighborhoods, (Category 2 land use), most of the sensitive receivers are residential in nature. Several Category 3 land uses are also included as receivers; these included schools, churches and senior centers. For the 2002 measurement program and the Draft EA, both long-term (24-hour) and short-term measurements were conducted at numerous sites along the proposed alignment as described in the following section.

As the field-measured noise levels were primarily representative of the traffic portion of the ambient noise environment and the corridor being also influenced by noise generated by existing rail traffic, the FTA Transit Noise and Vibration Assessment Manual was used to generate existing noise levels associated with current rail activity. The assessment was based on actual train operations (type of train, speed, time of day or night), including horn noise at the at-grade rail crossings. Once the existing noise levels due to rail activity were generated, these levels were combined with the monitored noise levels to arrive at the total existing ambient noise levels at each monitored location.

Monitored noise levels resulting in an equivalent hourly noise level (Leq) were, according to the time of day they were monitored, adjusted according to FTA procedures to obtain the resulting L_{dn} noise level for Category 2 receivers. No adjustments were required for monitored noise levels at Category 3 receivers since L_{eq} is the appropriate noise descriptor.

Existing noise levels were measured (a) in 2002 for the general noise assessment reported in the NEPA Draft EA and (b) in 2005 and again in 2008 for the detailed noise assessment for this report.

General Noise Assessment for the 2002 Draft EA

Noise measurements were taken with a Larson & Davis Model 820 Type I sound level meter. A windscreen was placed over the microphone for all measurements. The meter was properly calibrated before and after all measurements using a Larson & Davis Model Cal250 calibrator. There were no variances between the beginning and ending calibration measurements.

All locations were monitored during a three-day period (May 14-16, 2002), typically during the peak morning or afternoon traffic hours. The weather during the measurement program was hot and sunny. The descriptor recorded during field measurements was Leq. These measured values were used to derive a calculated Ldn value. A tabulation of the results of the calculations of existing noise levels at potentially sensitive, monitored locations for the Draft EA is provided in Table 5. Monitoring locations for the Draft EA are shown on Figure 4a.

The 2002 existing noise levels at sensitive receptors along the BNSF Mainline portion of the corridor are high and in the “downtown city” noise range. The 2002 existing noise levels at residential areas of Riverside and Perris adjacent to the SJBL are in the “’very noisy’ urban residential areas” range as shown in Table 5.

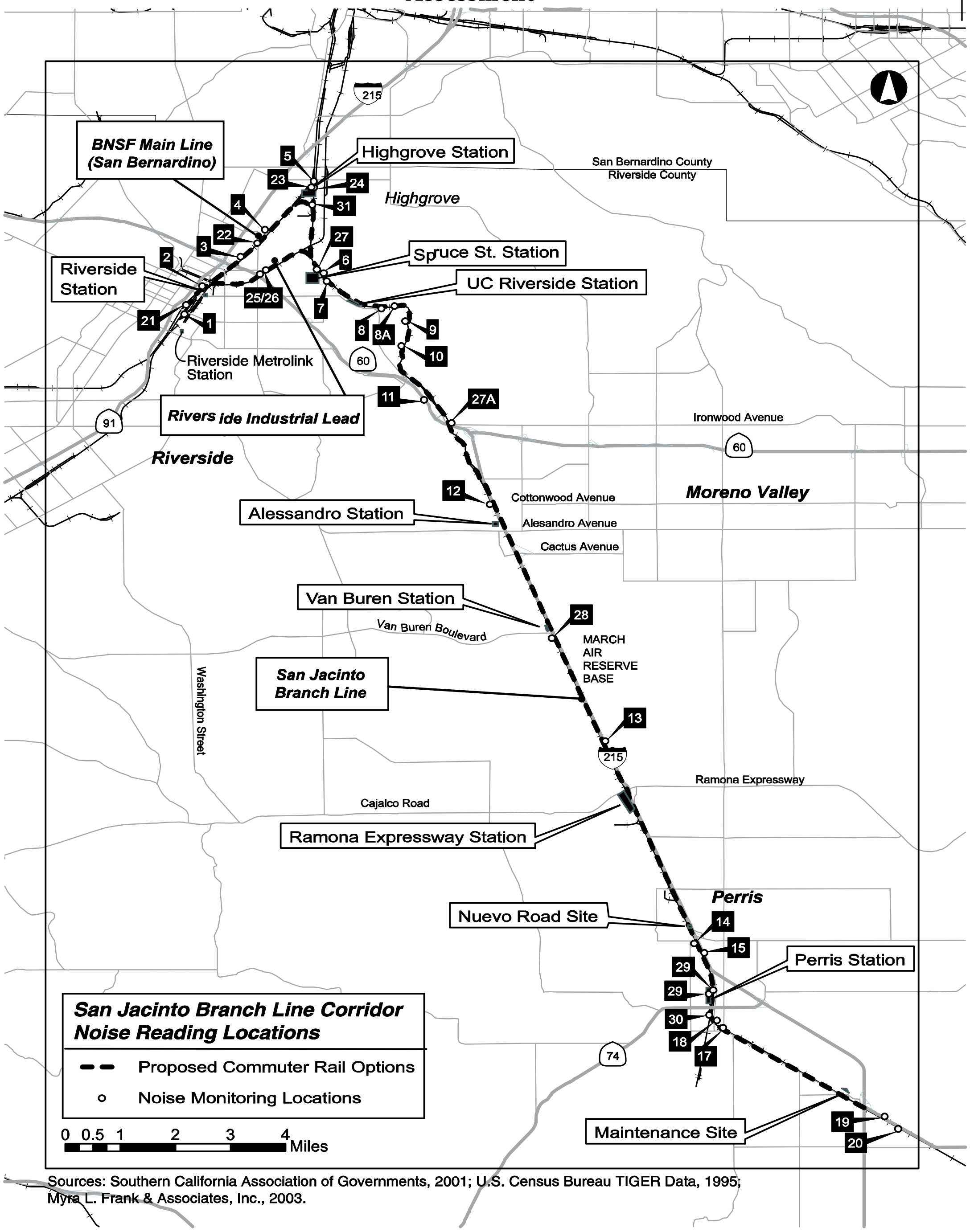
Table 5: Existing Noise Levels - 2002 Draft EA General Noise Assessment

Site No.	Land Use	Description	Horn Noise?	Distance To Track (feet)	Existing Noise Level (Ldn)
1	SFR	3015 9th St	Y	450	74
2	SFR	3112 1st St	Y	180	79
3	SFR	1901 Thornton Ave	Y	80	82
4	SFR	1148 Ardmore St	Y	340	76
5	SFR	Transit & Villa Streets	Y	330, 20	78
6	SFR	Kentwood Dr	Y	55	70
7	MFR	10 Watkins Dr	Y	125	68
8	SFR	Nisbet Way	Y	80	68
8A	SFR	Nisbet Way	Y	50	70
9	SFR	Big Springs Road	N	125	54
10	SFR	Manfield	N	110	56
11	SFR	20511 Claremont	N	560	61
12	SFR	7005 Old Frontage Rd	N	500	60
13	SFR	California & Wade Streets	N	240	68
14	School	Nan Sanders Elementary	N	140	60*
15	SFR	234 Bowen St	N	230	59
16	SFR	30 C St	Y	210	66
17	SFR	10th St & Perris Blvd	Y	75	69
18	SFR	124 8th St	Y	300,250	64
19	Hotel	Case St(Hwy 74)	N	130	75
20	SFR	25688 Sherman Rd	N	330	54
21	Commercial	Old Spaghetti Factory	Y	250	72*
22	SFR	Marlborough Avenue	Y	320	76
23	SFR	Villa St	Y	330,125	76
24	SFR	Transit Ave	Y	200,30	79
25/26	SFR	Trailer park	Y	50	72
27	Church	St Georges	Y	180	67*
27A	MFR	Box Spring & Morton	N	125	57
28	Cemetery		N	100	61*
29	Senior Citizens Center	San Jacinto & D St	Y	95	70*
30	SFR	C St & 7th St	Y	60	71
31	SFR	1021 Citrus St	Y	60	70

Notes:
* Noise levels presented as Leq
SFR = Single family residence
MFR - Multi-family residence

Source: STV Inc. 2002

Figure 4a: Noise Monitoring Locations for 2002 General Noise Assessment



Sources: Southern California Association of Governments, 2001; U.S. Census Bureau TIGER Data, 1995; Myra L. Frank & Associates, Inc., 2003.

Detailed Noise Assessment for the Final EA (2005)

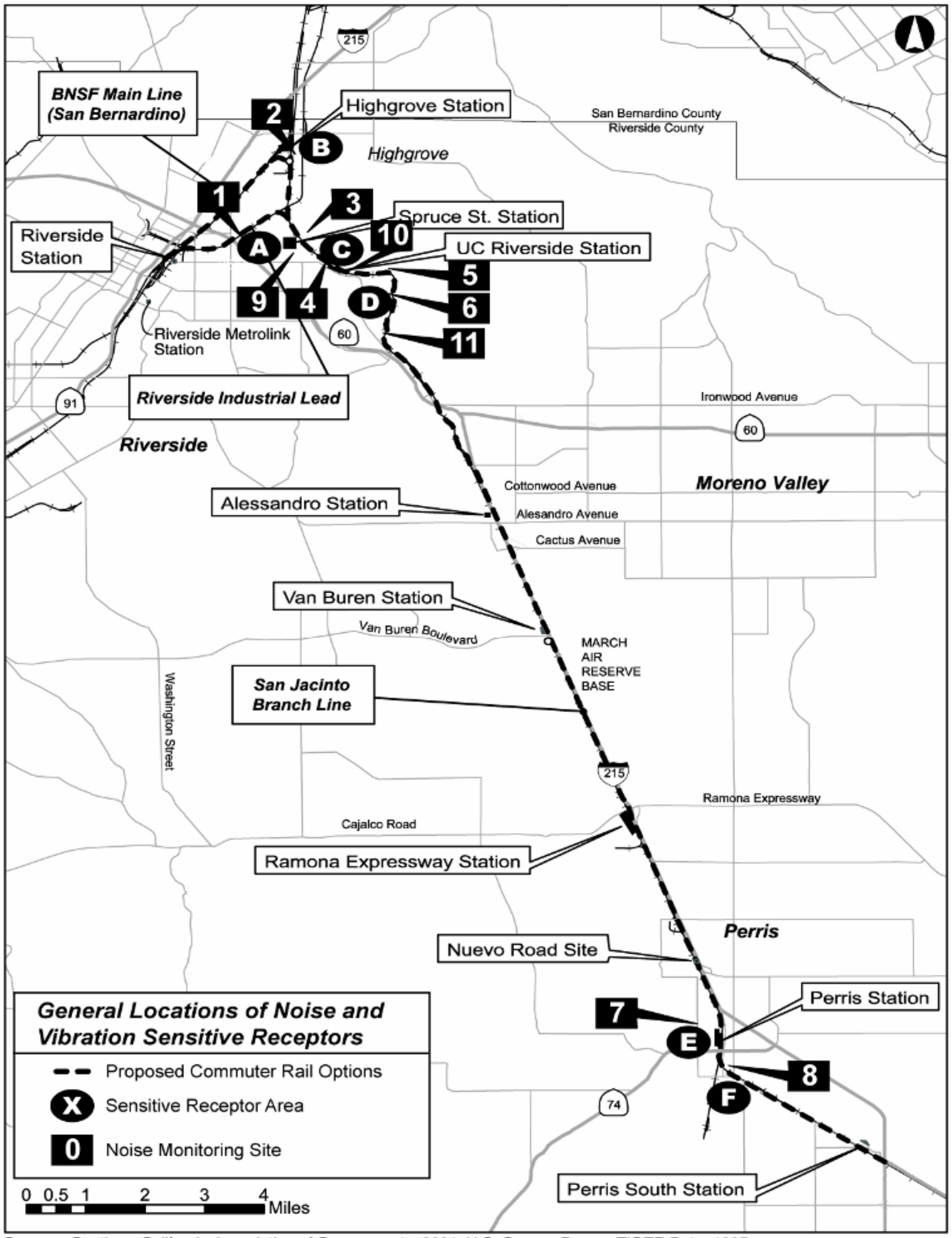
For the 2005 update of the Draft EA, FTA's detailed noise assessment was conducted. New noise measurements locations included those recommended from comments on the NEPA Draft EA.

The existing noise and vibration conditions in the corridor were documented in July 2005 through measurements at the locations shown in Figure 4b. Long-term (more than 24 hour) noise measurements were performed at Sites 1 through 8 and short-term measurements were performed at Sites 9 though 12. Vibration measurements were performed at all sites except Sites 7, 9 and 12. The goal of the measurements was to document the existing noise and vibration conditions in the proposed PVL corridor and to develop information that assists in predicting future Metrolink vibration levels in the corridor. The overall results of the measurements are summarized in Table 6.

The following is an overview of the existing noise and vibration environment in each major section of the corridor:

- **Residential areas north of UCR:** The majority of the sensitive receptors in this area are single family residences north of the SJBL along Kentwood, Highland, West Campus View, and East Campus View. In addition, there are some multi-family residences along Watkins Drive, churches at Watkins and Spruce Street and near the Mt. Vernon crossing, and the Highland Elementary School. Except for receptors located on Watkins Drive, background noise levels in this area are relatively low. Three long-term measurements (at Sites 3, 4 and 5) and three short-term measurements (at Sites 9, 10, and 12) were performed in this area. The measured Ldn including the freight train noise was up to 16 dBA higher than the Ldn with the train noise removed. Important sources of train noise are train horns sounded at grade crossings, locomotives going uphill operating under high power settings, and wheel squeal on curves. The measured levels of train vibration in this area ranged from 70 to 73 VdB. As discussed later, much of the track in this area is older jointed rail.

Figure 4b: Noise Monitoring Locations for Detailed Noise Assessment



Sources: Southern California Association of Governments, 2001; U.S. Census Bureau TIGER Data, 1995; Myra L. Frank & Associates, Inc., 2003.

Table 6. Summary of Noise and Vibration Measurements (2005)

Site[7]	Area[1]	Measure Type[2]	Dist. from Tracks (ft.)	Ldn, dBA		Avg. Train Vib., VdB[4]	No. of Trains[5]
				With Trains	Without Trains[3]		
1. Mobile Home Park, Riverside	A	LT	35	63	62	82	3
2. Transit Avenue, Highgrove	B	LT	35	67	67	72	3
3. Kentwood / Spruce, Riverside	C	LT	100	67	59	73	8
4. W. Campus View, Riverside	C	LT	83	66	57	72	8
5. E. Campus View, Riverside	C	LT	62	65	49	70	2
6. Big Springs Rd., Riverside	D	LT	90	62	54	58	2
7. C Street, Perris	E	LT	240	67	67	--	2
8. 8th Street, Perris	F	LT	300	--	59	--	0
9. Church at Spruce & Watkins, Riverside	C	ST	150	--	61	--	0
10. Church at Mt. Vernon Crossing, Riverside	C	ST	50	--	49	78[6]	1
11. Hyatt School / E. Manfield Rd., Riverside	D	ST	50	--	50	68[6]	1
12. Highland Park off Kentwood, Riverside	C	ST	50	--	56	--	0

Notes:

(1) Community areas shown in the Noise & Vibration Technical Report.

(2) LT = long term (24 hours or more), ST = short term (30 minutes to one hour).

(3) For measurements that included one or more train events, this column shows what the Ldn would have been without the train noise. No trains passed during the short term noise measurements.

(4) Average train vibration level when locomotives passed measurement position.

(5) Total number of trains passing measurement position during measurements.

(6) Train vibration measurements were performed at a different time than the short-term noise measurements. Shown are the train vibration levels at 50 ft from track center; not shown are the measured train vibration levels at three other distances.

(7) Highlighted sites are no longer being considered in the analysis of the Citrus Alternative in 2008.

Source: ATS Consulting, 2005

- **Residential area east of UCR:** This area is similar to the neighborhoods north of UCR, except that there are no grade crossings so train horn noise is not a noise source in this area. Because of the number of large and small horizontal curves, freight trains that currently operate in this area often generate wheel squeal. There was one long-term measurement (Site 6) and one short-term measurement (Site 11) in this area. The measured Ldn at Site 6 was 62 dBA, and 54 dBA with the train noise removed. In addition, a train vibration measurement was performed at Site 11. Maximum train vibration levels at Site 6 averaged 58 VdB, significantly lower than the vibration levels measured in the neighborhoods north of the UCR campus. The measurements indicate that the older jointed track in the area west of the Mt. Vernon crossing is causing vibration levels to be higher than along other sections of the SJBL where newer welded rail is installed.
- **Moreno Valley/I-215 Corridor:** There are no noise sensitive receptors close enough to the alignment for there to be noise or vibration impacts from the point where the San Jacinto Branch reaches the I-215 corridor until it reaches the City of Perris. This section does include some former March Air Reserve Base housing. This housing is no longer used for residential purposes.
- **Central Section of Perris:** The SJBL passes through the City of Perris between C and D Streets turning east to follow Case Road in the southern section of the city. Freight train operations are less frequent in Perris since many of the BNSF customers served on the San Jacinto_Branch Line are located north of Perris. The dominant noise sources in the central section of Perris are traffic on surface streets along with intermittent emergency vehicle sirens. The residences are all far enough from the freight train tracks that vibration is not expected to be significant or adverse to buildings or people. The measured Ldn at Site 7 on C Street was 67 dBA. There was some train activity during this measurement although the train noise only marginally added to the Ldn. With train noise subtracted, the Ldn was still 67 dBA.
- **South Perris:** In the southern section of Perris, the SJBL turns to the east and parallels Case Road to the South Perris terminal station at the junction of State Route 74 and Interstate 215. The last noise sensitive receptor is an apartment complex on Case Road just east of Perris Boulevard. One 24-hour noise measurement was performed in this area (Site 8) where the measured Ldn was 59 dBA. The primary noise sources were local traffic and landscaping activities with background noise from traffic on I-215. No freight trains passed during the 24-hour measurement at Site 8.

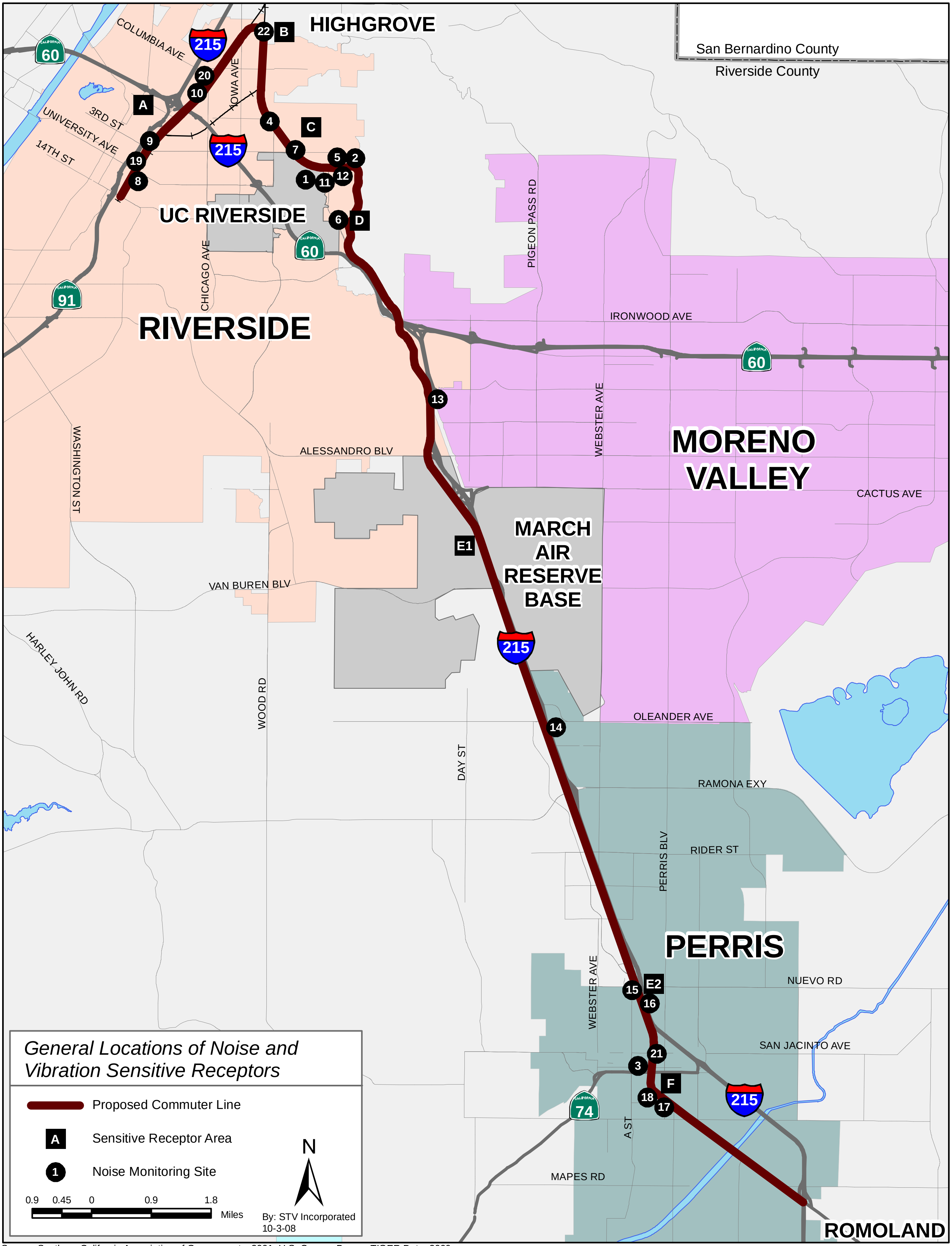
<u>Detailed Noise Assessment - 2008</u>

For this report, the noise monitoring program included, re-measurement at all previously monitored locations. In addition, several new locations were added to the monitoring program.

The existing noise conditions in the corridor were documented in April and July 2008 through measurements at the locations shown on Figure 5. Sites 1-7 were re-measured to update sites monitored during the July 2005 monitoring. They include both long-term (more than 24 hour) and short-term noise measurements. The remaining sites, with the exception of Site 18, were measured in May 2002 and measured again for this report. Site 18 represents new residential construction. Additional vibration measurements were not performed for this report as increases in vehicular traffic would not have any significant affect on existing vibration levels. The goal of the measurements was to document the existing noise conditions in the proposed PVL corridor and to develop information that assists in predicting future Metrolink noise and vibration levels in the corridor. The overall results of the measurements are summarized in Table 7.

Following is an overview of the existing noise and vibration environment in each major section of the corridor:

- **Citrus Avenue, Highgrove:** The preferred alternative, with the Citrus Connection, would affect a residential neighborhood parallel to and abutting the SJBL between Spring and Citrus Streets. Existing noise in this area is dominated by train horns from freight movement along the nearby BNSF Mainline. In addition, the distant BNSF and UP mainline tracks that range from 200 to 700 feet from the area also contribute to existing noise. The measured Ldn in this vicinity was 73 dBA.
- **Residential areas north & northeast of UCR:** The majority of the sensitive receptors in this area are single family residences north of the SJBL along Kentwood, Highland, West Campus View, and East Campus View. In addition, there are some multi-family residences along Watkins Drive, churches at Watkins Drive and Spruce Street and near the Mt. Vernon crossing, and the Highland Elementary School. Except for receptors located on Watkins Drive, background noise levels in this area are relatively low. Four long-term measurements (at Sites 1, 2, 11 and 12) and three short-term measurements (at Sites 4, 5, and 7) were performed in this area. Important sources of train noise are train horns sounded at grade crossings, freight locomotives going uphill operating under high power settings, and wheel squeal on curves. Measured Ldn ranged from 55.9dBA to 65.8dBA.
- **Residential area east and southeast of UCR:** This area is similar to the neighborhoods north of UCR, except that there are limited grade crossings so train horns are not an issue at most of the sites. Because of the number of large and small horizontal curves, freight trains that currently operate in this area often generate wheel squeal. There was one short-term measurement (Site 6) in this area representative of the Hyatt Elementary School. The measurement was 46.3 dBA.
- **Moreno Valley/I-215 Corridor:** Although the majority of noise sensitive receptors are far from the proposed alignment and on the opposite side of I215, noise measurements were taken to update and confirm previously measured noise data. Two locations (Sites 12 and 13) were monitored.



Source: Southern California Assosiation of Governments, 2001; U.S. Census Bureau TIGER Data, 2000

Table 7. Summary of Noise Measurements (2008)					
Site #	**Location**	**Area**	**Measure Type[1]**	**Dist. from Tracks (ft.)**	**Ldn, dBA**
1	518 West Campus View Dr	C	LT	117	59.0
2	232 East Campus View Dr	C	LT	65	55.9
3	228 C Street	F	LT	244	70.0
4	Spruce & Watkins Drive	C	ST1	190	56.7
5	Mount Vernon Ave & East Campus View Dr	C	ST1	163	51.7
6	4466 Mount Vernon Ave	D	ST1	370	46.3
7	700 Highlander Dr	C	ST1	88	52.1
8	3015 9th Street	A	ST2	450	69.1
9	3112 1st Street	A	LT	210	75.1
10	1901 Thornton Ave	A	LT	90	76.4
11	2970 Watkins Dr	C	LT	124	65.8
12	137 Nisbet Way	C	LT	180	62.3
13	7005 Old Frontage Rd	E1	ST2	564	62.1
14	California& Wade Street	E1	ST2	258	69.6
15	1461 N A Street	E2	ST1	123	61.6
16	234 Bowen St	E2	ST2	235	58.7
17	State St & S Perris Blvd	F	ST2	120	63.6
18	New Homes	F	ST2	300	53.6
19	Old Spaghetti Factory	A	ST1	280	64.5
20	1824 Marlboro Ave	A	ST2	260	63.4
21	San Jacinto & D St	F	ST1	72	59.0
22	1027 Citrus St	B	LT	62	73.4

Notes:
(1) LT = long term (24 hours or more), ST1 = short term (30 minutes to one hour), ST2 = short term (measurement adjusted to reflect LT Ldn)
Source: STV Incorporated, 2008

- **Downtown Perris:** The SJBL passes through the City of Perris between C and D Streets turning east to follow Case Road in the southern section of the city. Freight train operations are less frequent in Perris since many of the BNSF customers served by the San Jacinto Branch are located north of Perris. Two long-term measurements (at Sites 3 and 16) and two short-term measurements (at Sites 15 and 21) were performed in this area. The dominant noise sources in the central section of Perris are still traffic on surface streets along with intermittent emergency vehicle sirens.

- **South Perris:** In the southern section of Perris, the SJBL turns to the east and parallels Case Road to the South Perris terminal station at the junction of State Route

74 and Interstate 215. The last noise sensitive receptor is an apartment complex on Case Road just east of Perris Boulevard. Two long-term noise measurements were performed in this area (Sites 17 and 18). The primary noise sources were local traffic and landscaping activities with background noise from traffic on I-215. It appears that no freight trains passed during the 24-hour measurements.

C. NOISE AND VIBRATION ANALYSIS METHODOLOGIES

Following is an outline of the approach used to identify potential noise and vibration impacts from the proposed Perris Valley Line Commuter Rail Extension. In general, the approach follows the Detailed Assessment guidelines outlined in the FTA Guidance Manual with modifications to account for the measurement results in the PVL corridor and previous experience with Metrolink noise and vibration. The general steps are:

1. Identify representative noise- and vibration-sensitive receptors. Sensitive land uses along the corridor were identified first using aerial photography. Field visits were then conducted to confirm land uses and gather additional relevant information. Sensitive receivers were then grouped together based on their location relative to the tracks, grade crossings, and other geographic and PVL operational factors that might affect noise and vibration levels. Within each grouping, a representative receptor was included in the noise model (see step 3 below). The representative locations were developed based on previous studies, additional field review and comments received during the federal environmental process.

2. Determine existing noise and vibration levels. Measurements of existing noise levels were taken at a number of locations along the corridor as discussed previously (refer to Table 7, above). A single noise measurement site was "assigned" to each group of receptors. One unusual factor along this corridor is that the BNSF freight operations are the dominant noise source in some sections of the corridor and there can be significant variations in Ldn depending on the number of trains that passed during the measurement period and how many of these trains passed during nighttime hours. To avoid understating the potential impacts, the measured noise levels at locations where there were more than two trains per 24 hours were adjusted down to the equivalent of two trains per day.

The FTA guidance manual does not generally account for existing vibration levels in the prediction of potential vibration impacts. Therefore, conservatively, existing vibration levels were not incorporated into the prediction model.

3. Develop noise and vibration prediction models. Models were developed to predict future noise and vibration levels from the proposed Metrolink PVL operations. The noise predictions were based on the forecasted number of daily trains and the distribution of these trains throughout the day (early morning, daytime, and evening), the distance from the tracks, the train speed, and other site-specific conditions such as acoustic shielding and grade crossings.

The vibration model is based on the measured levels of freight train vibration in the corridor and previous measurements of freight train and Metrolink vibration at the same sites. Specific model inputs and assumptions are discussed below.

4. Estimate future noise and vibration levels at the representative receivers. Using the models described above, future train-generated noise and vibration levels were estimated and compared against the applicable FTA impact thresholds to identify potential noise and vibration impacts. See the “Environmental Impacts “section below for a discussion of predicted noise and vibration impacts. Two of the key components of the predictions are the planned train schedule and the train speeds. The concept schedule is shown in Table 8 below.

5. Recommend noise and vibration mitigation. Noise and vibration mitigation options were evaluated where potential impacts were predicted. Generally, noise mitigation options include constructing sound walls. Separately, the City of Riverside and the City of Perris may propose “quiet zones,” where train horns are not blown at grade crossings, but this mitigation technique cannot be implemented by RCTC alone, and thus was not considered as mitigation.

Table 8: Conceptual Train Schedule Used for Noise Analysis

In-bound Trains	New AM Peak	Revised 701	Revised 703	New AM Peak	New Mid-Day	New Reverse Peak
South Perris	3:48 AM	4:48 AM	5:48 AM	6:13 AM	2:50 PM	3:42 PM
Perris	3:53 AM	4:53 AM	5:53 AM	6:18 AM	2:55 PM	3:47 PM
Moreno Valley	4:07 AM	5:07 AM	6:07 AM	6:32 AM	3:09 PM	4:01 PM
UC Riverside	4:19 AM	5:19 AM	6:19 AM	6:44 AM	3:21 PM	4:13 PM
Palmyrita	4:22 AM	5:22 AM	6:22 AM	6:47 AM	3:24 PM	4:16 PM
Riverside	4:29 AM	5:29 AM	6:29 AM	6:54 AM	3:31 PM	4:23 PM
Out-bound Trains	**New Reverse Peak**	**New Mid-Day**	**New Peak**	**Revised 706**	**Revised 708**	**New Peak**
Riverside	7:38 AM	1:51 PM	4:54 PM	5:43 PM	6:48 PM	8:39 PM
Palmyrita	7:46 AM	1:58 PM	5:04 PM	5:53 PM	6:58 PM	8:49 PM
UC Riverside	7:53 AM	2:01 PM	5:08 PM	5:57 PM	7:02 PM	8:53 PM
Moreno Valley	8:05 AM	2:13 PM	5:22 PM	6:11 PM	7:16 PM	9:07 PM
Perris	8:19 AM	2:27 PM	5:35 PM	6:24 PM	7:29 PM	9:20 PM
South Perris	8:32 AM	2:32 PM	5:40 PM	6:29 PM	7:34 PM	9:25 PM

Noise

The specific procedures used on each of the major noise sources are discussed below.

- Train Horns

Federal Railroad Administration regulations require that freight and commuter train horns be sounded prior to all public grade crossings unless a quiet zone has been established. The horn is required to produce "… a minimum sound level of 96 dB (A) and a maximum sound level of 110 dB (A) at 100 feet forward of the locomotive in its direction of travel." Freight train horns are typically set near the maximum FRA level and the horns are located on top of the locomotives.

Instead of air horns, Metrolink uses air whistles that are mounted on the front of the vehicle 2 to 3 feet above the ground. The sound levels for the Metrolink whistles are set close to the FRA minimum required sound level. The Metrolink locomotives and cab cars still have roof-mounted air horns although these are used only as a backup for the whistles. Through the lower sound level of the air whistles and the mounting location in front of the train, the community noise levels from Metrolink horns are approximately 10 dBA less than for a typical freight train horn.

The projections of Metrolink horn noise are based on testing performed by LTK Engineering in 1994 (when the horns were first installed by Metrolink) and measurements by ATS Consulting near Metrolink grade crossings in Santa Ana and Moorpark. Based on the LTK measurements, it was estimated that the Sound Equivalent Level (SEL – or the cumulative noise exposure from a single noise event) from the Metrolink horns at grade crossings would be 96 dBA at a distance of 100 feet and a speed of 50 mph. This incorporates the following assumptions:

- Metrolink horns are set to 100 dBA at a distance of 100 ft in front of the locomotive or cab car,
- Train is traveling at 50 mph,
- The horn is sounded continuously starting at 1/4 mile prior to a crossing and ending as the train reaches the crossing,
- The receiver is located at a distance of 250 feet from the crossing and 100 ft from the track centerline, and
- The directivity is such that horn noise is -11 dBA at an angle of 90° (0° is to the front of the train)

The projected SEL based on stationary horn measurements has been confirmed by measurements of Metrolink train noise at grade crossings in Moorpark and Santa Ana. This indicates that the model, based solely on the yard measurements, slightly overstates the levels of horn noise. As a result, the prediction formula was adjusted so that the horn SEL at 100 ft was 95 dBA.

- Locomotive Engine Noise

Locomotive noise sources include the engine, exhaust, and cooling fans. Most locomotives have eight throttle settings and studies have shown that sound level increases by approximately 2 dBA with each step increase in throttle setting. In practice, locomotive engineers tend to constantly adjust the throttle setting with higher average throttle settings being used at higher speeds. As a result, locomotive noise tends to increase with speed.

The approach taken to predicting the levels of locomotive noise is:

a. Data from previous measurements of Metrolink noise in Santa Clarita was reanalyzed to approximately separate the locomotive and rail car noise.

b. The average locomotive SEL was calculated for the separated locomotive curves for pull and push trains. The average locomotive SEL was 88.0 dBA at a speed of 67 mph and a distance of 70 feet from the tracks.

c. The formulas in the FTA Guidance Manual were used to adjust the reference SEL from step b to the appropriate speeds and distances for the PVL corridor.

d. In areas where the trains would be accelerating from the stations or going up significant grades, the locomotive noise was adjusted up by 6 dBA, equivalent to the locomotives operating at maximum throttle.

- Wheel/Rail Noise

Wheel/rail noise is the noise of steel wheels rolling on steel rails. Normal wheel/rail noise will increase with train speed. Factors that can substantially increase wheel/rail noise are wheel impacts at the gaps in jointed rail, wheel impacts at switches and turnouts where tracks cross, and wheel squeal on curves.

The procedures in the FTA Guidance Manual were used to estimate the levels of wheel rail noise. As discussed above, the locomotive noise was approximately separated from the rail car noise for a series of Metrolink noise measurements in Santa Clarita. The result of this analysis indicates_that Metrolink wheel/rail noise is the equivalent of an Lmax of 77 dBA at a speed of 67 mph and a distance of 70 feet from the tracks.

Wheel squeal was not included in the noise projections because:

- wheel squeal is highly variable, which makes accurate projections difficult,
- the character of wheel squeal noise makes it more annoying than would be indicated by its A-weighted sound level (this additional annoyance potential is sometimes accounted for by adding a 5 decibel penalty to wheel noise), and
- steps are taken as part of SCRRA's ongoing maintenance program to minimize wheel squeal in all areas of the corridor with short radius curves by periodic grinding of the rail to more closely match the profile of the rail wheels.

Vibration

The FTA impact criteria for ground-borne vibration are based on the amount of vibration generated within living spaces. This means that accurate predictions of ground-borne vibration require accounting for: (1) the forces generated by the interaction of the wheels and rails, (2) the effects that the localized soil conditions have on vibration propagation, and (3) how building structures respond to ground vibration. There are two basic approaches to developing predictions for the environmental assessment of proposed rail corridors, which are: (1) apply generalized curves given in the FTA guidance manual, and (2) perform detailed testing to estimate each of the three criteria given above.

Because there are existing freight operations on the San Jacinto Branch Line, a hybrid approach was used: the measured levels of freight train vibration have been adjusted to account for the difference between freight train and Metrolink vibration. The difference between freight and Metrolink vibration was based on previous measurements of freight train_and Metrolink vibration in Moorpark and Irvine. This approach provides for the most accurate assessment of potential vibration impacts and the need for vibration mitigation.

The key elements of the vibration projection procedure used for the PVL analysis are:

a. Existing Freight Vibration: One factor observed in the measurements was that they generally fell into two distinct groups, with the higher levels occurring at locations with old jointed track and the lower levels occurring at locations with relatively new welded track. There was a 9 VdB difference between the two groups. Because new track construction for the Perris Valley Line is proposed to be welded rail, the lower curve plus 5 VdB were used as the base for the projections. The 5 VdB adjustment is to ensure that the projections are conservative and allow for variations that may result in areas with efficient vibration propagation. This assumption is equivalent to assuming that replacement of the existing jointed rail with new continuously welded rail would reduce vibration levels by 4 VdB.

b. Difference between Metrolink and Freight Vibration: Previous measurements have shown that, under the same operating conditions, freight train vibration tends to be higher than commuter rail vibration. Possible reasons for this include the heavier freight train axle loads, the use of heavier locomotives for freight operations, and the greater control that commuter rail systems have over the maintenance of their rolling stock. At the Moorpark measurement site, maximum vibration from Metrolink trains at an average speed of 65 mph was generally lower than vibration from a freight train at 30 to 35 mph. For the Irvine measurement, freight train vibration at 35 mph was approximately 4 VdB less than Metrolink vibration at 70 mph. Assuming a speed dependence of 20×log (speed) as recommended by the FTA Guidance Manual, this indicates that vibration from 45 mph Metrolink trains would be approximately equal to the vibration from a 30 mph freight train. For the Perris Valley Line it was conservatively assumed that Metrolink operations at 30 mph would generate vibration equal to the existing freight train vibration.

c. Speed Adjustment: Ground vibration tends to increase with speed at a rate proportional to 20×log (speed). This means that vibration from a 50 mph Metrolink train is expected to be 4.4 VdB higher than at 30 mph.

d. Building Response: How vibration changes as it propagates from the ground through a building foundation and structure into living spaces will vary widely depending on the building construction. The buildings that could be adversely affected by vibration from the Perris Valley Line appear to be primarily wood frame construction. Experience demonstrates that vibration on the first floor of this type of building will be about 3 VdB lower than the exterior ground vibration. There can be amplification when there is a basement or crawl space under the first floor, particularly if there are fewer than the normal number of load-bearing vertical supports. The vibration on the second floors of wood frame buildings tends to be substantially more variable than for the first floors. There is some indication from recent measurements that buildings with flexible floors tend to vibrate more. The amplification can be at specific resonances of the building and can vary from room to room. Building response was accounted for by subtracting 3 VdB for first floor living spaces and adding 5 VdB for second floor living spaces.

5. Estimates of future noise and vibration levels at the representative receivers. Using the models described above, future train-generated noise and vibration levels were estimated and compared against the applicable FTA impact thresholds to identify potential noise and vibration impacts. The results of the noise and vibration modeling are described in later sections.

6. Develop noise and vibration mitigation. Noise and vibration mitigation options were evaluated where potential impacts were predicted. Generally, noise mitigation options could include constructing sound walls, enhancing residential sound insulation, or if desired by the cities of Riverside and Perris, establishing quiet zones that eliminate the need for train horns at grade crossings. The most cost-effective method of mitigating vibration impacts is typically to install a resilient layer under sections of track where a vibration impact is projected. This layer may take the form of ballast mats or 12 inch thick layers of shredded tires. The mitigation measures are described in later sections.

D. ENVIRONMENTAL IMPACTS

Long-Term Noise Impacts

- Stations

Noise due to the operation of a train station is primarily associated with automobile traffic entering and exiting the station drop-off and parking areas. The noise analysis was based on parking lots for 400 to 872 cars at the commuter rail stations with parking (all except the UCR station which has none). As the proposed stations are all in areas where existing roadway vehicle traffic is substantial on nearby streets or freeways, and experience from past detailed modeling shows the small increment in noise arising from additional traffic bound to or from the commuter rail stations would likely result in negligible noise increases. In addition, most stations are near grade crossings where trains would be required to blow their horns. Consequently, the noise related to the blowing of train horns would dwarf any other noise related to the station operation. Therefore, an analysis of station noise at the proposed station locations was not performed.

- Trains

With the proposed project, commuter train operations would consist of 12 total movements per day. These operations would include four trains leaving Perris for Los Angeles in the morning peak period, one mid-day train and one reverse peak train in the afternoon to Los Angeles, and one reverse peak and one mid-day train from Los Angeles, plus four evening peak trains from Los Angeles to South Perris. Future project noise levels due to train movements were predicted at selected sites in the same manner as were estimated for the existing conditions. Procedures in the FTA Noise and Vibration Impact Assessment manual were used to forecast noise levels due to the movement of locomotives and train cars as well as for horn noise (where applicable). These noise levels were then combined to determine the total noise level for future conditions including the new train service.

It is assumed that trains would operate with one diesel locomotive and six to eight passenger cars on rail. Depending upon the level of required noise mitigation, the rail would be upgraded from the current jointed to continuously welded rail at selected locations. Free flow train speeds along the study corridor will range from 30 to approximately 70 mph. Federal Railroad Administration and California Public Utilities Commission rules currently require that all trains approaching roadway-rail grade crossings blow their horns for one-quarter of a mile prior to reaching the grade crossing.

Tables 9 and 10 shows the results of the Detailed Noise Impact Assessment conducted in 2008. The projected noise impacts are summarized below.

Table 9: Detailed Noise Impact Assessment (2008) Category 2 Land Uses

Description[1]	Dist. To Track CL, ft	Land Use	No. Dwelling Units	Track Side[2]	Horn	Exist Ldn, dBA	Speed, mph		Predicted Ldn, dBA	Impact Threshold		Impacts, No. Dwelling Units		
							IB	OB		Impact	Severe	Type	Impact	Severe
RIVERSIDE, San Jacinto Branch Line														
Kentwood 1	170	SF	5	IB	OB	65	35	35	568	60.6	66	None		
Kentwood 2	140	SF	4	IB	OB	65	35	35	57.6	60.6	66	None		
Kentwood 3	80	SF	14	IB	IB	65	35	35	65.6	60.6	66	Impact	14	
Watkins 1	140	MF	6	OB	IB	66	35	35	64.6	62	68	Impact	6	
Watkins 2	140	MF	10	OB	OB	66	35	35	61.6	62	68	None		
Watkins 3	140	MF	7	OB	NO	66	35	35	608	62	68	None		
Watkins 4	125	MF	9	OB	IB	66	35	35	65.2	62	68	Impact	9	
Watkins 5	125	MF	4	OB	OB	66	35	35	62.1	62	68	Impact	4	
Highlander	127	SF	10	IB	OB	59	35	35	58.0	58	64	Impact	6	
W. Campus View 1	127	SF	13	IB	IB	59	35	35	63.5	58	64	Severe		13
W. Campus View 2	117	SF	13	IB	NO	59	35	35	56.0	58	64	None		
Nisbet	137	SF	11	OB	OB	62	35	35	62.1	59	65	Impact	11	
W. Campus View 3	125	SF	9	IB	OB	62	35	35	62.5	59	65	Impact	9	
Mt. Vernon 1	110	SF	1	OB	OB	62	35	35	66.3	59	65	Severe		1
Mt. Vernon 2	180	SF	1	OB	OB	62	35	35	64.1	59	65	Impact	1	
E. Campus View 1	80	SF	3	IB	IB	56	35	35	65.8	56	63	Severe		3
E. Campus View 2	65	SF	9	IB	IB	56	35	35	66.7	56	63	Severe		9
1st Street	210	SF	2	OB	IB	75	72	72	61.5	66	74	None		
Thornton Avenue	90	SF	17	OB	OB	76	72	72	65.2	66	75	None		
Citrus Street	62	SF	3	IB	OB	73	30	30	65.7	66	72	None		
Big Springs & Highlander	120	SF	4	OB	No	62	30	30	55.9	58.7	64.2	None		
Quail and Swain	140	SF	5	OB	No	62	30	30	55.2	58.7	64.2	None		
Masters Avenue	170	SF	4	OB	No	62	30	30	54.3	58.7	64.2	None		
E. Manfield Street	130	SF	3	OB	No	62	30	30	56.9	58.7	64.2	None		
Total, SJBL, Riverside													60	26

Table 9: Detailed Noise Impact Assessment (2008) Category 2 Land Uses

Description[1]	Dist. To Track CL, ft	Land Use	No. Dwelling Units	Track Side[2]	Horn	Exist Ldn, dBA	Speed, mph		Predicted Ldn, dBA	Impact Threshold		Impacts, No. Dwelling Units		
							IB	OB		Impact	Severe	Type	Impact	Severe
PERRIS														
C Street	244	SF	19	OB	Both	70	46	46	61.1	65	68	None		
10th Street	120	SF	1	OB	Both	74	46	46	64.1	66	73	None		
Perris Blvd	80	SF	1	OB	Both	74	46	46	65.9	66	73	None		
9th Street	300	SF	5	IB	Both	66	46	46	60.2	62	66	None		
Case Road	130	MF	12	OB	IB	74	46	46	63.8	66	73	None		
Total, SJBL, Perris													0	0

Notes:

[1] Appendix C shows each receptor cluster on aerial photographs.

[2] IB = inbound side of track, OB = outbound side of tracks

Source; STV Inc., 2008 , ATS Consulting, 2005-2006

Table 10: Detailed Noise Impact Assessment (2008) Category 3 Land Uses

Description	Dist. To Track CL, ft	Side[1]	Horn	Exist Leq,[2] dBA	Speed, mph		Predict Leq, dBA	Impact Threshold		Impact Type
					IB	OB		Impact	Severe	
Church, Watkins & Spruce	190	OB	IB	57	35	35	61.8	62	68	None
Highland Elementary	88	IB	IB	52	35	35	62.1	60	66	Impact
Church, Mt. Vernon	163	IB	OB	52	35	35	62.5	60	66	Impact
Hyatt Elementary School	370	OB	No	46	35	35	57.4	58	65	None
Senior Citizens Center	72	IB	OB	59	44	44	61.8	63	69	None
St. James School	350	OB	Both	60	35	35	58.2	62.6	68.3	None
St. James Church	700	OB	Both	60	35	35	52.1	62.6	68.3	None

Notes:
(1) IB = inbound side of tracks, OB = outbound side of tracks
(2) Existing Leq is based on short-term noise measurements or daytime Leq with no freight train noise.

Source; STV Inc., 2008 , ATS Consulting, 2005-2006

Long-Term Vibration Impacts

Details of the vibration predictions are presented in Table 11 for residential land uses and Table 12 for institutional land uses (schools and churches). The vibration levels in Table 11 and Table 12 have been predicted using the procedures outlined above and assuming 5 VdB amplification by floor resonances. Thus, for buildings with a single floor, particularly slab-on-grade construction, the vibration predictions should be conservatively high. Also, as discussed above, the train vibration measurements in the neighborhoods north and east of UCR indicate that there may be as much as a 9 VdB reduction in vibration when the existing jointed rail is replaced with new continuous welded rail. To be conservative, for the predictions assume only a 4 VdB improvement from replacing the existing jointed rail with continuous welded rail

Table 11. Predicted Levels of Ground-Borne Vibration, Category 2 (Residential) Land Uses

Description	Dist (Ft)	Land Use	No. Dwell Units	Track Side	Speed		Impact Threshold	Predicted Vibration	Impact	
					IB	OB	VdB	VdB	Y/N?	No.
RIVERSIDE, San Jacinto Branch Line										
Kentwood1	170	SF	5	IB	35	35	80	70		
Kentwood2	140	SF	4	IB	35	35	80	71		
Kentwood3	80	SF	14	IB	35	35	80	76		
Watkins1	124	MF	3	OB	35	35	80	73		
Watkins2	140	MF	7	OB	35	35	80	71		
Highlander	125	SF	10	IB	50	35	80	76		
W. Campus View1	125	SF	12	IB	50	35	80	76		
W. Campus View2A	125	SF	10	IB	50	35	80	76		
W. Campus View2B	120	SF	23	IB	35	35	80	73		
W. Campus View3	125	SF	8	IB	35	35	80	72		
Watkins 3	125	SF	1	OB	35	35	80	72		
Nisbet	130	SF	11	OB	35	35	80	72		
Mt. Vernon 1	110	SF	1	OB	35	35	80	74		
Mt. Vernon 2	180	SF	1	OB	35	35	80	69		
E. Campus View1	80	SF	3	IB	35	35	80	76		
E. Campus View2	65	SF	9	IB	40	35	80	79		
Big Springs &Hillander	120	SF	4	OB	30	30	80	71		
Quail and Swain	140	SF	5	OB	30	30	80	70		
Masters Avenue	170	SF	4	OB	30	30	80	68		
Manfield Street	130	SF	3	OB	30	30	80	71		
Total, SJBL, Riverside										**0**

Table 11 Continued. Predicted Levels of Ground-Borne Vibration, Category 2 (Residential) Land Uses										
Description	Dist (Ft)	Land Use	No. Dwell Units	Track Side	Speed		Impact Threshold	Predicted Vibration	Impact	
					IB	OB	VdB	VdB	Y/N?	No.
PERRIS, San Jacinto Branch Line										
C Street1	220	SF	15	OB	35	35	80	68		
C Street2	240	SF	7	OB	35	35	80	67		
7th Street	400	SF	4	IB	35	35	80	62		
8th Street 1	280	SF	2	IB	35	35	80	65		
8th Street 2	270	SF	3	OB	35	35	80	66		
10th Street	150	SF	3	OB	35	35	80	71		
Perris Blvd 1	80	SF	1	OB	35	35	80	76		
Perris Blvd 2	180	SF	2	OB	35	35	80	69		
Case Road	130	MF	4	OB	35	35	80	72		
Total, SJBL, Perris										**0**

Table 12. Predicted Levels of Ground-Borne Vibration, Category 3 (Institutional) Land Uses									
Description	Dist (Ft)	Land Use	Track Side	Speed		Impact Threshold	Predicted Vibration	Impact	
				IB	OB	VdB	VdB	Y/N?	No.
Church, Watkins & Spruce	175	Church	OB	35	35	83	70	N	
Highland Elementary	90	School	IB	35	35	83	75	N	
Church, Mt. Vernon	150	Church	IB	35	35	83	71	N	
Hyatt Elementary School	400	School	OB	30	30	83	61	N	
St. James School	350	School	OB	35	35	83	64	N	
St. James Church	700	Church	OB	35	35	83	58	N	

- Citrus Connection Alternative Impact Summary

<u>Noise</u>

Under the detailed methodology, noise impacts are projected at several category 2 areas along the SJBL in Riverside residential areas north of the UCR campus. The majority of the predicted impacts would be a result of the train horns being sounded by trains scheduled to pass through areas with sensitive land uses prior to 7 AM, the dividing line between nighttime and daytime in the calculation of Ldn. Each train before 7 AM