NOISE AND VIBRATION IMPACT ASSESSMENT FOR THE MID-CITY/EXPOSITION LIGHT RAIL TRANSIT PROJECT

FINAL REPORT

HMMH Report No. 299980-01

October 2005

Prepared for:

DMJM Harris

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1 INTRODUCTION AND SUMMARY

This report presents a noise and vibration impact assessment for the Mid-City/Exposition Corridor LRT Project. Harris Miller Miller & Hanson Inc. (HMMH) carried out this assessment for the Los Angeles County Metropolitan Transportation Authority under subcontract to DMJM Harris. The objective of the study was to assess the potential noise and vibration impacts of the planned LRT rail operations at community locations adjacent to the corridor.

The background and results of the assessment are described below. Section 2 provides a discussion of environmental noise and vibration basics, and Section 3 describes the existing noise and vibration conditions and measurement results. The criteria used to assess noise and vibration impact are presented in Section 4, and projections of future noise and vibration conditions are described in Section 5. Section 6 summarizes the impact assessment, and potential mitigation measures are outlined in Section 7. Appendix A includes measurement site photographs, and detailed noise and vibration data are provided in Appendix B and Appendix C, respectively. Appendix D contains a set of plan and profile maps identifying all sensitive land uses along the Mid-City/Exposition Corridor, noise and vibration impacts, and locations of noise and vibration mitigation measures.

1.1 Background

The Locally Preferred Alternative (LPA), in large part, uses the existing Exposition Right of Way (ROW) owned by Metro, which extends from south of Downtown Los Angeles to Santa Monica for approximately 16 miles. This corridor is currently an abandoned railroad ROW that runs parallel to I-10 (Santa Monica Freeway), one of the most heavily used and congested freeways in the nation. Historically, the Exposition Corridor had both freight and inter-urban passenger rail service during the 20th Century. Southern Pacific Railroad formerly owned the ROW until purchased by Metro in 1990. Since that time, the corridor has been recognized in local and regional planning documents as a possible transit corridor. The corridor has consistently been an element of Metro's Long Range Transportation Plan.

In 2000, Metro considered the Exposition Corridor as part of the Mid-City/Westside Transit Corridor Draft EIS/EIR. In this assessment, two parallel transit corridors were evaluated to extend transit service to West Los Angeles. One was to run along Wilshire Boulevard extending from the Wilshire/Western Metro Red Line Station to Santa Monica, and the other along the Exposition ROW extending from the Metro Blue Line Station at 7th Street/Metro Center to Santa Monica. The Draft EIS/EIR evaluated No Action, TSM and two build alternatives along Exposition Corridor, i.e., a bus rapid transit option (BRT) and a light rail transit option (LRT). Along the Exposition route, a Minimum Operable Segment (MOS) was identified in the Draft EIS/EIR as Alternative 3A. This would extend either BRT or LRT service from Downtown Los Angeles to Culver City.

Based on the findings of the Draft EIS/EIR, in June 2001 Metro separated the two corridors into individual projects. Metro adopted an LPA for BRT service along Wilshire Boulevard and adopted LRT extending from Downtown Los Angeles to Culver City as the LPA along the Exposition Corridor. Metro determined that each project would be environmentally cleared separately. This document deals solely with the Mid-City/Exposition Corridor and is not part of an area-wide transit study. The LPA of the Exposition Corridor is also known as the Mid-City/Exposition LRT Project. For the purposes of this document, the LPA will be identified as part of the Mid-City/Exposition LRT Project, or the proposed Project.

The route of the LPA runs from a joint terminal facility with the Metro Blue line at the 7th Street/Metro Center in Downtown Los Angeles to a terminal station at Venice Boulevard near Washington and

Robertson Boulevards in Culver City, a distance of approximately ten miles. The dual track alignment will have up to eleven stations. Three stations will be shared with the Metro Blue Line and eight new stations will be constructed exclusively for Mid-City/Exposition LRT trains. Two of the new stations will be constructed as part of an elevated bridge structure spanning a major thoroughfare. The length of the LPA route not shared with the Metro Blue Line is 7.7 miles. In the new construction segment, the LRT will operate either in the center or curb lane of selected streets or within the Metro-owned Exposition ROW. Specifically, the LPA would use the existing Metro Blue Line track facilities extending from the 7th Street/Metro Center along the at-grade portions of Flower Street and along the at-grade portion of Washington Boulevard until the intersection of Washington Boulevard and Hill Street. At Hill Street, the line would turn southward in the middle of Hill Street until it reaches the Exposition ROW. The line would then proceed westward using this ROW until the terminal station at Venice and Washington Boulevards.

Alignment options are also included for consideration in the Project. These alignment options are known as Design Options to the LPA. These design options are located within the Downtown Los Angeles Connection segment and the West End segment. Within the Downtown Los Angeles Connection segment, two potential design options; the Hill Street Couplet Design Option and the Flower Street Design Option, are under consideration and have been analyzed below. At the west end of the project, several options to the LPA Venice/Robertson station (Culver City Aerial, ROW, and North of ROW Options A, B and C) have been analyzed.

1.2 Summary of Results

1.2.1 Noise Impact Assessment

The results of the noise analysis indicate that the existing noise environment at locations near the project alignment is dominated by noise from railroad operations and major arterial roadways, such as Exposition Boulevard and National Boulevard, along with general community noise. Based on Federal Transit Administration (FTA) criteria, it is predicted that without mitigation, the proposed LRT operations will cause noise impact at the locations listed in Tables 1, 2 and 3. Detailed information regarding the impacts can be found in Section 6.1.

A number of noise mitigation measures can be considered for the impacts in Table 1. The two most likely methods of noise mitigation for operational noise are sound barriers and sound insulation. Sound insulation treatments are typically applied to buildings in areas where barriers would not be effective. These areas are primarily located near grade crossings, where additional noise impact is caused by LRT whistles and grade-crossing bells, as shown in Table 2. Lowering the crossing bell sound levels can also reduce the noise impact near grade crossings. Relocation of crossovers away from noise-sensitive receptors, or the use of special crossovers, such as spring-rail frogs would also reduce the noise impact at locations shown in Table 3. The selection of mitigation will depend on more detailed analysis during final design, including input from abutting neighbors.

Table 1. Summary of LRT Operational Noise Impacts

Segment	Number of Impacts			
	Impact		Severe	
	SF	MF	SF	MF
Downtown to Exposition Blvd.	0	0	0	0
Exposition Blvd., Vermont Ave. to Western Ave.	0	0	0	0
Exposition Blvd., Western Ave. to 2nd Ave.	0	4	0	0
North side of Exposition Blvd., 2nd Ave. to 10th Ave.	0	0	0	0
South side of Exposition Blvd., 2nd Ave. to 10th Ave.	23	0	42	0
North side of Exposition Blvd, Crenshaw Blvd to Field Ave	0	0	0	0
South side of Exposition Blvd, Crenshaw Blvd to Farmdale Ave	16	1	0	0
South side of Exposition Blvd, La Brea Ave to Cloverdale Ave	6	1	3	0
North side of Jefferson Blvd, La Brea Ave to La Cienega	0	0	0	0
South side of Jefferson Blvd, Cloverdale Ave to Carmona Ave	5	0	0	0
North side of National Blvd, Fay Ave to Helms Ave	10	0	4	0
Total:	**60**	**6**	**49**	**0**

Table 2. Summary of Noise Impacts from Grade Crossing Audible Warnings

Grade Crossing	Increase in Ldn (dBA)	Number of Impacts			
		Impact		Severe	
		SF	MF	SF	MF
Arlington Avenue	1 to 4	2	3	0	1
7th Avenue	1 to 8	0	0	3	0
Private Crossing (9th Avenue)	1 to 2	0	0	4	0
10th Avenue	--	--	--	--	--
11th Avenue	--	--	--	--	--
Buckingham Road	1 to 2	0	0	4	2
Farmdale Avenue	1 to 3	0	0	0	2
Private Crossing (Hauser Blvd.)	0 to 2	0	0	0	0
Wesley Street	0 to 1	0	0	0	0
National Boulevard	--	--	--	--	--
Washington Boulevard	--	--	--	--	--
Total:		**2**	**3**	**11**	**5**

Table 3. Summary of Noise Impacts from Proposed Crossover Locations

Crossover Location	Impact Assessment Without Crossover	Impact Assessment With Crossover
Station 103	No Impact	No Impact
Station 111[1]	No Impact	No Impact
Station 152[1]	No Impact	No Impact
Station 213	No Impact	Impact
Station 311	Severe Impact (South)/ No Impact (North)	Severe Impact (South)/ Impact (North)
Station 413	Impact (South)/ No Impact (North)	Severe Impact (South)/ Impact (North)
Station 482[2]	Impact	Severe Impact
Station 484[3]	Impact	Severe Impact
Station 486[4]	Impact	Severe Impact
Station 489[5]	No Impact	No Impact

1. These crossovers are associated with the Flower Street Design Option.
2. This crossover is associated with the Venice/Robertson Station North of ROW Option C.
3. This crossover is associated with the Venice/Robertson Station North of ROW Option B.
4. This crossover is associated with the Venice/Robertson Station North of ROW Option A and the ROW Option.
5. This crossover is associated with the Venice/Robertson Aerial Option and the LPA.

1.2.2 Vibration Impact Assessment

There are no significant existing sources of vibration along the corridor. Based on FTA criteria, it is projected that without mitigation, the LRT operations will cause vibration impact at the locations listed in Table 4. Vibration impacts related to crossovers will occur at the locations listed in Table 5. All of these impacts are related to annoyance effects and not to building damage effects. Detailed information regarding the impacts can be found in Section 6.2.

There are a number of options available for the mitigation of vibration impacts. The most common method is ballast mats. Ballast mats consist of pads made of rubberlike material placed on an asphalt or concrete base with the normal ballast, ties and rail on top. Because the vibration reduction provided by ballast mats is limited at lower frequencies, their effectiveness is dependent on the frequency content of vibration. Relocation of crossovers away from vibration-sensitive receptors or the use of special crossovers such as spring-rail frogs would also reduce the vibration impact. Mitigation options will be evaluated in more detail during final design, and the most appropriate measures will be selected based on feasibility, cost effectiveness, and community input.

Table 4. Summary of Vibration Impacts

Segment	Number of Impacts	
	SF	MF
Downtown to Exposition Blvd.	0	0
Exposition Blvd., from Vermont Ave. to Western Ave.	93	18
Exposition Blvd., from Western Ave. to Arlington Ave.	3	5
Exposition Blvd., from Arlington Ave. to Crenshaw Blvd.	54	0
Exposition Blvd., from Crenshaw Blvd. to La Brea Ave.	0	0
Jefferson Blvd., from La Brea Ave. to La Cienega Blvd.	0	0
National Blvd., from La Cienega Blvd. to Venice Blvd.	0	0
Total:	**150**	**23**

Table 5. Summary of Vibration Impacts from Proposed Crossover Locations

Crossover Location	Impact Assessment Without Crossover	Impact Assessment With Crossover
Station 103	No Impact	No Impact
Station 111[1]	No Impact	No Impact
Station 152[1]	No Impact	No Impact
Station 213	Impact	Impact
Station 311	Impact (South)/ No Impact (North)	Impact (South)/ Impact (North)
Station 413	No Impact	Impact
Station 482[2]	No Impact	Impact
Station 484[3]	No Impact	Impact
Station 486[4]	No Impact	Impact
Station 489[5]	No Impact	Impact

1. These crossovers are associated with the Flower Street Design Option.
2. This crossover is associated with the Venice/Robertson Station North of ROW Option C.
3. This crossover is associated with the Venice/Robertson Station North of ROW Option B.
4. This crossover is associated with the Venice/Robertson Station North of ROW Option A and the ROW Option.
5. This crossover is associated with the Venice/Robertson Aerial Option and the LPA.

2 ENVIRONMENTAL NOISE AND VIBRATION BASICS

2.1 Noise Fundamentals and Descriptors

Noise is typically defined as unwanted or undesirable sound, where sound is characterized by small air pressure fluctuations above and below the atmospheric pressure. The basic parameters of environmental noise that affect human subjective response are (1) intensity or level, (2) frequency content and (3) variation with time. The first parameter is determined by how greatly the sound pressure fluctuates above and below the atmospheric pressure, and is expressed on a compressed scale in units of decibels. By using this scale, the range of normally encountered sound can be expressed by values between 0 and 120 decibels. On a relative basis, a 3-decibel change in sound level generally represents a barely noticeable change outside the laboratory, whereas a 10-decibel change in sound level would typically be perceived as a doubling (or halving) in the loudness of a sound.

The frequency content of noise is related to the tone or pitch of the sound, and is expressed based on the rate of the air pressure fluctuation in terms of cycles per second (called Hertz and abbreviated as Hz). The human ear can detect a wide range of frequencies from about 20 Hz to 17,000 Hz. However, because the sensitivity of human hearing varies with frequency, the A-weighting system is commonly used when measuring environmental noise to provide a single number descriptor that correlates with human subjective response. Sound levels measured using this weighting system are called "A-weighted" sound levels, and are expressed in decibel notation as "dBA." The A-weighted sound level is widely accepted by acousticians as a proper unit for describing environmental noise.

Because environmental noise fluctuates from moment to moment, it is common practice to condense all of this information into a single number, called the "equivalent" sound level (Leq). Leq can be thought of as the steady sound level that represents the same sound energy as the varying sound levels over a specified time period (typically 1 hour or 24 hours). Often the Leq values over a 24-hour period are used to calculate cumulative noise exposure in terms of the Day-Night Sound Level (Ldn). Ldn is the A-weighed Leq for a 24-hour period with an added 10-decibel penalty imposed on noise that occurs during the nighttime hours (between 10 P.M. and 7 A.M.). Many surveys have shown that Ldn is well correlated with human annoyance, and therefore this descriptor is widely used for environmental noise impact assessment. Figure 1 provides examples of typical noise environments and criteria in terms of Ldn. While the extremes of Ldn are shown to range from 35 dBA in a wilderness environment to 85 dBA in noisy urban environments, Ldn is generally found to range between 55 dBA and 75 dBA in most communities. As shown in Figure 1, this spans the range between an "ideal" residential environment and the threshold for an unacceptable residential environment according to U.S. Federal agency criteria.

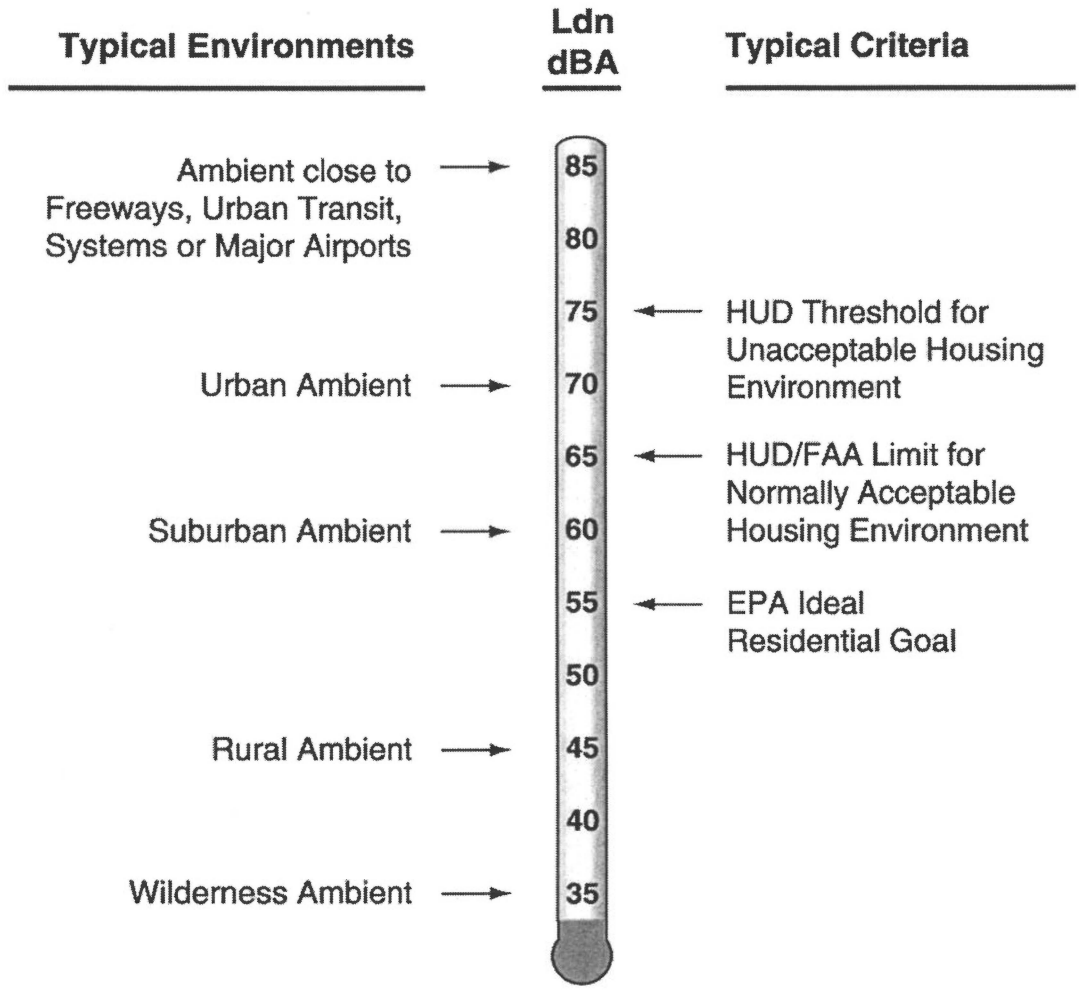


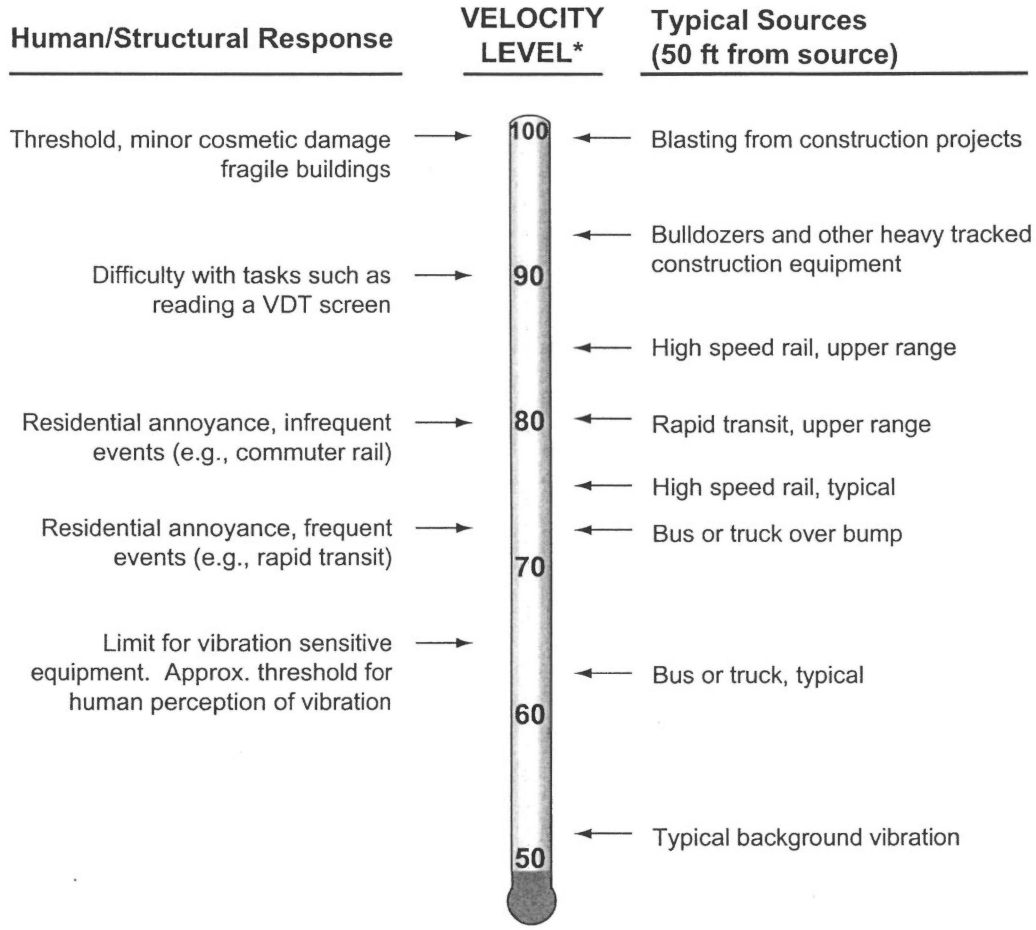
Figure 1. Examples of Typical Outdoor Noise Exposure

2.2 Ground-Borne Vibration Fundamentals and Descriptors

Ground-borne vibration is the oscillatory motion of the ground about some equilibrium position that can be described in terms of displacement, velocity or acceleration. Because sensitivity to vibration typically corresponds to the amplitude of vibration velocity within the low-frequency range of most concern for environmental vibration (roughly 5-100 Hz), velocity is the preferred measure for evaluating ground-borne vibration from transit projects.

The most common measure used to quantify vibration amplitude is the peak particle velocity (PPV), defined as the maximum instantaneous peak of the vibratory motion. PPV is typically used in monitoring blasting and other types of construction-generated vibration, since it is related to the stresses experienced by building components. Although PPV is appropriate for evaluating building damage, it is less suitable for evaluating human response, which is better related to the average vibration amplitude. Thus, ground-borne vibration from transit trains is usually characterized in terms of the "smoothed" root mean square (rms) vibration velocity level, in decibels (VdB), with a reference quantity of one micro-inch per second. VdB is used in place of dB to avoid confusing vibration decibels with sound decibels.

Figure 2 illustrates typical ground-borne vibration levels for common sources as well as criteria for human and structural response to ground-borne vibration. As shown, the range of interest is from approximately 50 to 100 VdB, from imperceptible background vibration to the threshold of damage. Although the approximate threshold of human perception to vibration is 65 VdB, annoyance is usually not significant unless the vibration exceeds 70 VdB.



** RMS Vibration Velocity Level in VdB relative to 10^{-6} inches/second*

Figure 2. Typical Ground-Borne Vibration Levels and Criteria

3 EXISTING CONDITIONS

3.1 Noise Measurements

3.1.1 Locations and Tests

Noise-sensitive land use along the project corridor was identified based on preliminary alignment drawings, aerial photographs and a visual survey of the alignment. Areas adjacent to the proposed corridor include primarily single-family and multi-family residences, along with some non-residential (commercial) and institutional land uses. Adjacent uses are currently exposed primarily to noise from traffic on Exposition Boulevard and other major roadways, along with local community activities and occasional aircraft noise.

Existing ambient noise in the project corridor were characterized through direct measurements at selected sites along the proposed alignment during July and August 2000 along the corridor. Estimating existing noise exposure is an important step in the noise impact assessment since, as indicated above, the thresholds for noise impact are based on the existing levels of noise exposure. The measurements included long-term (typically 24-hour) and short-term (typically 1-hour) monitoring of the A-weighted sound level at representative noise-sensitive locations.

All of the measurement sites were located in noise-sensitive areas, and were selected to represent a range of existing noise conditions along the corridor. Figure 3 shows the general location of the 9 long-term and 4 short-term monitoring sites along the corridor. Measurement site photographs are included in Appendix A.

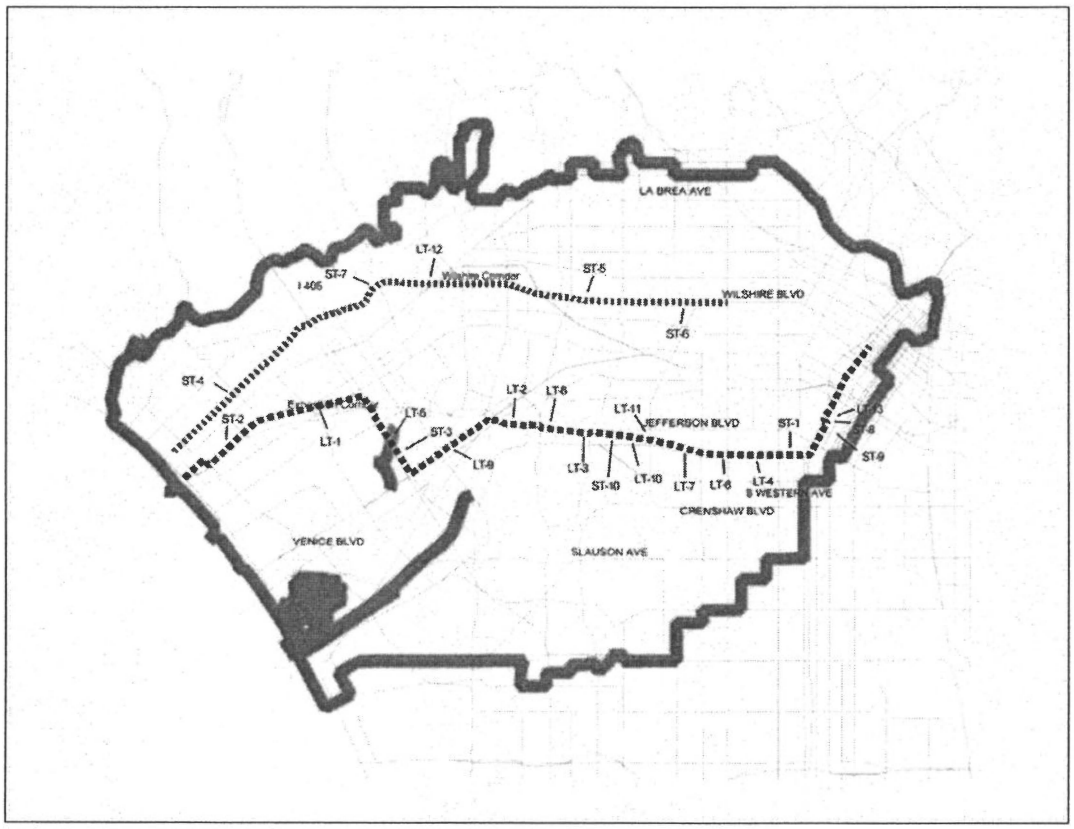


Figure 3. Ambient Noise Monitoring Locations

3.1.2 Instrumentation and Procedures

Long-term, ambient noise measurements were conducted at the sites shown in Figure 3. At each of these locations, unattended Larson Davis Model 870 portable, automatic noise monitors were used to continuously sample the A-weighted sound level (with slow response), typically over a 24-hour period. The noise monitors were programmed to record hourly results, including the maximum sound level (Lmax), the equivalent sound level (Leq) and the statistical percentile sound levels (Ln, denoting the sound level exceeded n percent of the hour). The day-night equivalent sound level (Ldn) was subsequently computed from the hourly Leq data.

In addition, short-term, ambient noise measurements were conducted at the sites shown in Figure 3. At each of these locations, attended Larson Davis Model 820 portable, automatic noise monitors were used to continuously sample the A-weighted sound level, typically over a one-hour period.

The noise measurement equipment described above conforms to ANSI Standard S1.4 for Type 1 (Precision) sound level meters. Calibrations, traceable to the U.S. National Institute of Standards and Technology (NIST) were carried out in the field before and after each set of measurements using acoustical calibrators.

In all cases, the measurement microphone was protected by a windscreen, and supported on a tripod at a height of 4 to 6 feet above the ground. Furthermore, the microphone was positioned to characterize the exposure of the site to the dominant noise sources in the area. For example, microphones were located at the approximate setback lines of the receptors from adjacent roads or rail lines, and were positioned to avoid acoustic shielding by landscaping, fences or other obstructions.

3.1.3 Results

A summary of the existing ambient noise measurement results is provided in Table 6, and detailed data are included in Appendix B. These results were used as a basis for determining the existing noise conditions at all noise-sensitive receptors along the Mid-City/Exposition Corridor. The resulting characterization of existing ambient noise conditions is summarized in Table 6.

Table 6. Summary of Existing Ambient Noise Measurement Results

Site No.	Measurement Location Description	Start of Measurement		Meas. Time (hrs)	Noise Exposure, Ldn/Leq (dBA)
		Date	Time		
LT-13	2400 S. Flower St. (Orthopedic Hospital)	08/03/00	15:00	24	70
LT-4	1250 Exposition Blvd.	07/10/00	16:00	24	69
LT-8	1647 Exposition Blvd.	07/11/00	18:00	24	67
LT-7	2531 Exposition Place	07/11/00	17:00	24	58
LT-11	3719 Exposition Blvd.	07/12/00	19:00	24	65
LT-10	3500 Muirfield Road	07/12/00	18:00	24	60
LT-3	3420 Sycamore Ave.	07/10/00	14:00	24	59
LT-6	5539 Jefferson Blvd.	07/11/00	16:00	24	68
LT-2	3437 Caroline Ave., Culver City	07/10/00	13:00	24	62
ST-8	2400 S. Flower St. (Orthopedic Hospital)	07/13/00	15:15	1	68
ST-9	John Adams Junior High School	07/13/00	16:25	1	66
ST-1	USC, Marshall School of Business - 701 Exposition Blvd.	07/10/00	17:20	1	63
ST-10	Dorsey High School - South of Exposition Blvd.	07/13/00	17:45	1	56

- Site LT-13 was located at the Orthopedic Hospital on South Flower Street. The microphone was located in front of the hospital on Flower Street. Traffic on Flower Street was the dominant noise source at this location. The measured Ldn at this site was 70 dBA.

- Site LT-4 was located south of the proposed alignment, at 1250 Exposition Boulevard. The microphone was located in the front yard of the single-family residence. Traffic on Exposition Boulevard was the dominant noise source at this location. The measured Ldn at this site was 69 dBA.

- Site LT-8 was located north of the proposed alignment, at 1647 Exposition Boulevard. The microphone was located in the front yard of the single-family residence. Traffic on Exposition Boulevard was the dominant source of noise at this site. The measured Ldn at this site was 67 dBA.

- Site LT-7 was located south of the proposed alignment, at 2531 Exposition Place. The microphone was located in the back yard of the single-family residence. Traffic on Exposition Place was the dominant source of noise at this site. The measured Ldn at this site was 58 dBA.

- Site LT-11 was located south of the proposed alignment, at 3719 Exposition Boulevard. The microphone was located in the front yard of the single-family residence. Traffic on Exposition Boulevard was the dominant source of noise at this site. The measured Ldn at this site was 65 dBA.

- Site LT-10 was located south of the proposed alignment, at 3500 Muirfield Road. The microphone was located in the front yard of the single-family residence. Traffic on Exposition Boulevard was the dominant source of noise at this site. The measured Ldn at this site was 60 dBA.

- Site LT-3 was located south of the proposed alignment, at 3420 Sycamore Avenue. The microphone was located in the front yard of the single-family residence. Traffic on Exposition Boulevard and La Brea Avenue was the dominant source of noise at this site. The measured Ldn at this site was 59 dBA.

- Site LT-6 was located south of the proposed alignment, at 5539 Jefferson Boulevard. The microphone was located in the front yard of the single-family residence. Traffic on Jefferson Boulevard was the dominant source of noise at this site. The measured Ldn at this site was 68 dBA.

- Site LT-2 was located north of the proposed alignment, at 3437 caroline Avenue. The microphone was located in the side yard of the single-family residence. Traffic on National Boulevard was the dominant source of noise at this site. The measured Ldn at this site was 62 dBA.

- Site ST-8 was located at the Orthopedic Hospital. Traffic on South Flower Street dominated the noise environment at this site. The measured one-hour Leq at this site was 68 dBA.

- Site ST-9 was located at the John Adams Junior High School. Traffic on Hill Street dominated the noise environment at this site. The measured one-hour Leq at this site was 66 dBA.

- Site ST-1 was located north of the proposed alignment at the USC – Marshall School of Business. Traffic on Exposition Boulevard dominated the noise environment at this site. The measured one-hour Leq at this site was 63 dBA.

- Site ST-10 was located at the Dorsey High School. Traffic on Exposition Boulevard dominated the noise environment at this site. The measured one-hour Leq at this site was 56 dBA.

3.2 Vibration Measurements

3.2.1 Locations and Tests

There are no significant sources of existing ground-borne vibration along the Mid-City/Exposition Corridor. The vibration measurements for this project focused on characterizing the vibration propagation characteristics of the soil at representative locations.

Seven vibration testing sites (V-1 though V-7), at the locations shown in Figure 4, were selected to represent a range of soil conditions in areas along the corridor that include a significant number of vibration-sensitive receptors. During July 2000 and September 2004, ground-borne vibration propagation tests were conducted at each of these sites by impacting the ground and measuring the input force and corresponding ground vibration response at various distances. The resulting force-response transfer function can be combined with the known input force characteristics of an LRT vehicle to predict future vibration levels at locations along the project corridor. The vibration propagation test sites are described below.

- Site V-1 was located at Exposition Place and Fourth Avenue south of the Exposition alignment and west of Arlington Avenue;

- Site V-2 was located at Sycamore Avenue and Exposition Boulevard south of the existing railroad tracks. Sycamore Avenue is located one block west of La Brea;

- Site V-3 was located in Syd Kronenthal Park, north of National Boulevard and west of the Ballona Creek culvert;

- Site V-4 was located in Culver City, in a residential neighborhood at the end of Caroline Avenue, north of the existing tracks and National Boulevard;

- Site V-5 was located at the intersection of Hillcrest Drive and Exposition Boulevard in a residential neighborhood to the south of the existing tracks;

- Site V-6 was located in a residential neighborhood at the end of 4th Avenue, to the south of the existing tracks; and

- Site V-7 was located in a parking lot on the USC campus to the south of the existing tracks and Exposition Boulevard, near Vermont Avenue.

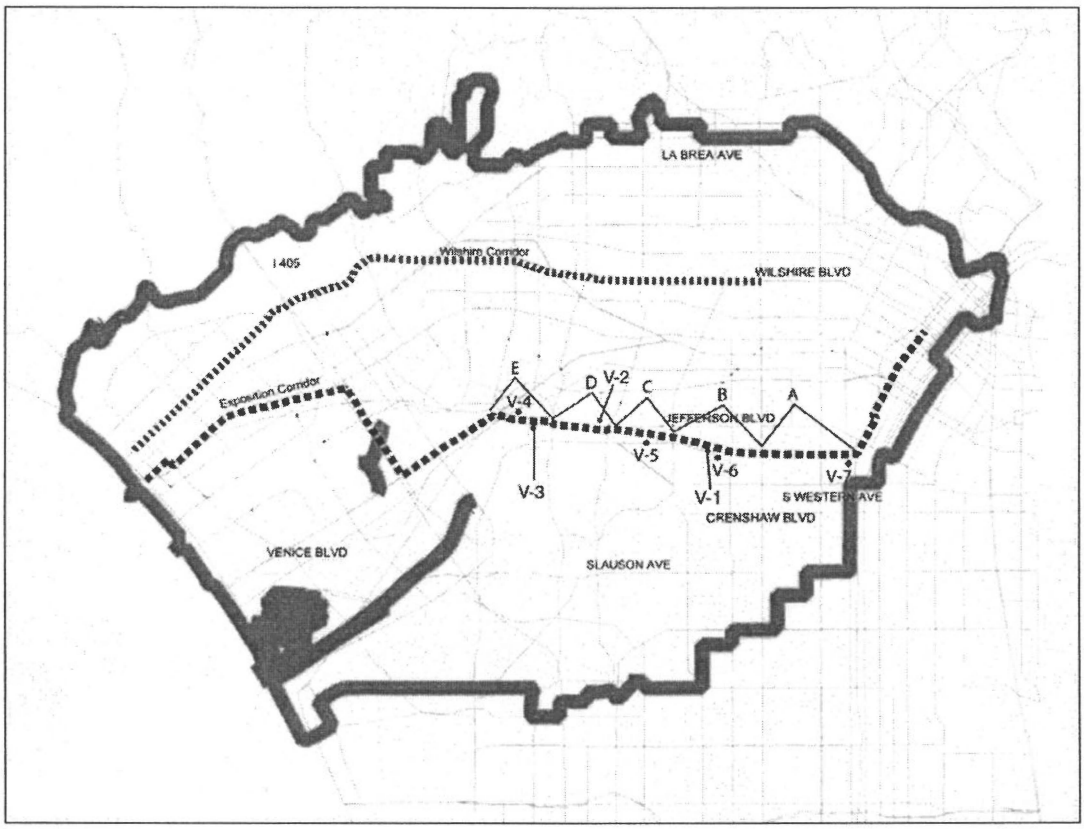


Figure 4. Vibration Testing Locations

3.2.2 Instrumentation and Procedures

The ground vibration measurements were made with high-sensitivity accelerometers mounted in the vertical direction on either paved surfaces, or on top of steel stakes driven into soil. The acceleration signals were recorded on a TEAC Model RD-135T 8-channel digital audio tape (DAT) recorder and subsequently analyzed in the HMMH laboratory.

The vibration propagation test procedure is shown schematically in Figure 5. As shown in the cross section view at the top, the test basically consists of dropping a 60 lb weight from a height of 3 to 4 feet onto the ground. A load cell is used to measure the force of the impact and accelerometers are used to measure the resulting vibration pulses at various distances from the ground. The relationship between the input force and the ground surface vibration, called the transfer mobility, characterizes vibration propagation at this location. It is possible to estimate the ground vibration that would be caused by another source, such as a train, by substituting the train force for the impact force.

The bottom sketch in Figure 5 shows how the dropped weight point source is used to simulate a line vibration source such as a train. Impact tests are made at regular intervals in a line along the rail alignment. For these tests, impacts were done at eleven points, spaced 15 feet apart along a line perpendicular to the line of accelerometers.

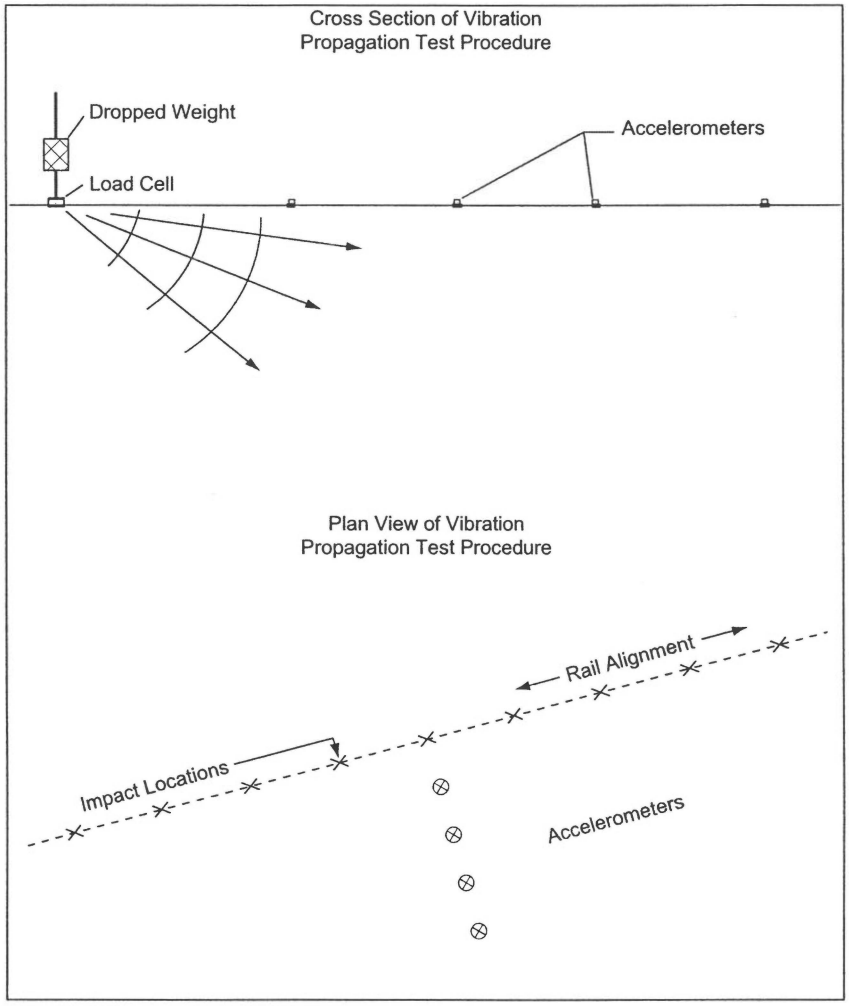


Figure 5. Vibration Propagation Test Procedure

3.2.3 Results

For laboratory analysis of the ground vibration propagation test data, an FFT multi-channel spectrum analyzer was used to obtain the transfer mobility relationship for each accelerometer/impact pair. The basic steps taken to calculate 1/3-octave band transfer functions are summarized below:

1. A multi-channel spectrum analyzer was used to get narrowband transfer functions. A minimum of 20 impacts was used to obtain signal-enhanced transfer functions for each impact site-accelerometer pair. Numerical integration was used to change from acceleration to velocity.

2. The 1/3 octave band transfer mobility was calculated for each accelerometer/impact pair.

3. Each set of 1/3-octave band point-source transfer mobilities was combined using Simpson's Rule for numerical integration to estimate the equivalent line-source transfer mobility.

4. For each 1/3-octave band, a smooth curve was fit to the line source transfer mobility values. The end result is an estimate of line source transfer mobility as a function of distance from the source.

Examples of the resulting smoothed line source transfer mobilities are given in Figure 6, which provides spectra at a distance of 100 feet for each of the six test sites used in the analysis. More details on the propagation test and analysis procedures are given the U. S. Federal Transit Administration (FTA) guidance manual Transit Noise and Vibration Impact Assessment (FTA Report DOT-T-95-16, April 1995). Detailed test data are included in Appendix C of this report.

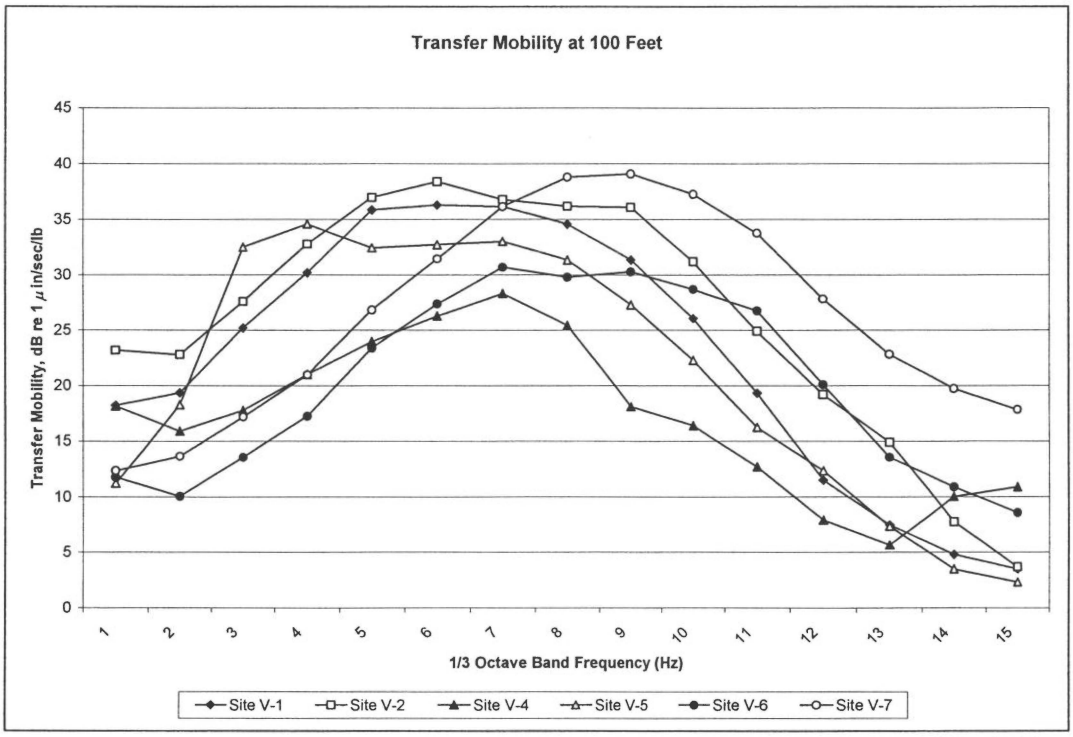


Figure 6. Line Source Transfer Mobility at Measurement Sites

4 NOISE AND VIBRATION IMPACT CRITERIA

Experience suggests that noise and vibration can be major public concerns with regard to the effects of a rail transportation project. This section summarizes the impact limits as applicable to the Mid-City/Exposition LRT Project.

4.1 Transit Noise Criteria

Noise impact for this project is based on the criteria defined in the U. S. Federal Transit Administration (FTA) guidance manual Transit Noise and Vibration Impact Assessment (FTA Report DOT-T-95-16, April 1995). The FTA noise impact criteria are founded on well-documented research on community reaction to noise and are based on change in noise exposure using a sliding scale. Although higher transit noise levels are allowed in neighborhoods with high levels of existing noise, smaller increases in total noise exposure are allowed with increasing levels of existing noise.

The FTA Noise Impact Criteria group noise sensitive land uses into the following three categories:

- Category 1: Buildings or parks, where quiet is an essential element of their purpose.
- Category 2: Residences and buildings where people normally sleep. This includes residences, hospitals, and hotels where nighttime sensitivity is assumed to be of utmost importance.
- Category 3: Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, churches and active parks.

Ldn is used to characterize noise exposure for residential areas (Category 2). For other noise sensitive land uses, such as outdoor amphitheaters and school buildings (Categories 1 and 3), the maximum 1-hour Leq during the facility's operating period is used.

There are two levels of impact included in the FTA criteria. The interpretation of these two levels of impact is summarized below:

- Severe: Severe noise impacts are considered "significant" as this term is used in the National Environmental Policy Act (NEPA) and implementing regulations. Noise mitigation will normally be specified for severe impact areas unless there is no practical method of mitigating the noise.
- Impact: In this range of noise impact, sometimes referred to as moderate impact, other project-specific factors must be considered to determine the magnitude of the impact and the need for mitigation. These other factors can include the projected increase over existing noise levels, the types and number of noise-sensitive land uses affected, existing outdoor-indoor sound insulation, and the cost effectiveness of mitigating noise to more acceptable levels.

The noise impact criteria are summarized in graphical form in Figure 7. The figure shows the existing noise exposure and the additional noise exposure from the transit project that would cause either moderate or severe impact. The future noise exposure would be the combination of the existing noise exposure and the additional noise exposure caused by the transit project. Figure 8 expresses the same criteria in terms of the increase in total or cumulative noise that can occur in the overall noise environment before impact occurs.

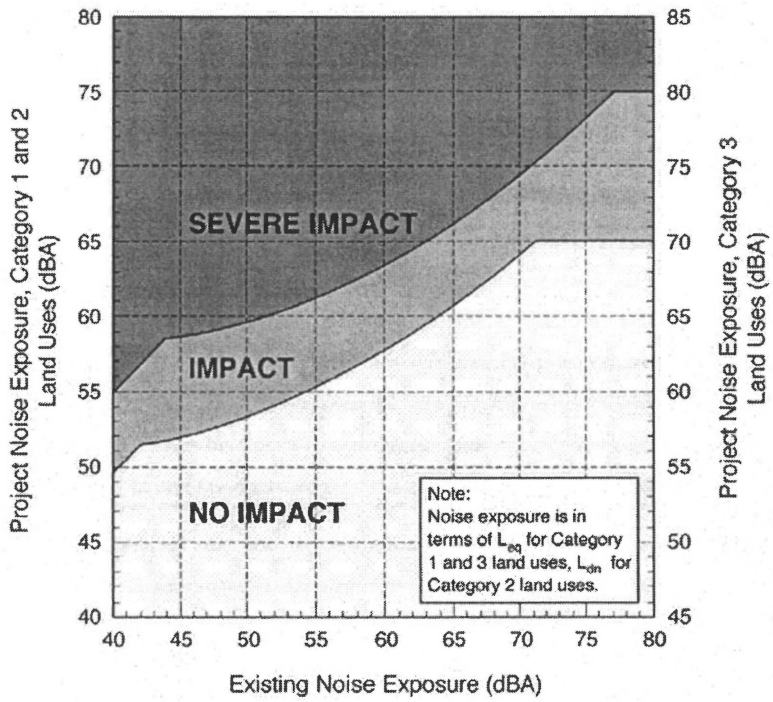


Figure 7. FTA Project Noise Impact Criteria

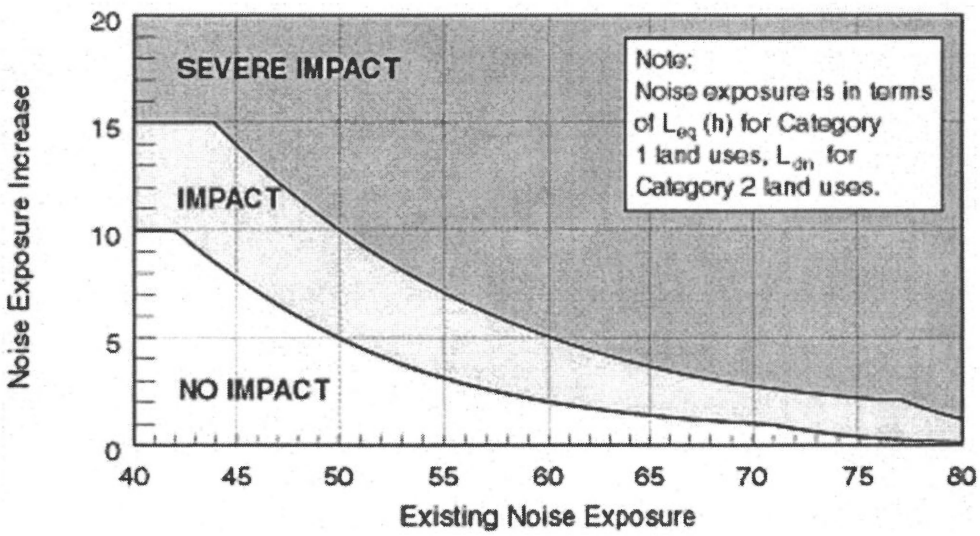


Figure 8. Increase in Cumulative Noise Exposure Allowed by FTA Criteria

4.2 Transit Vibration Criteria

The FTA ground-borne vibration impact criteria are based on land use and train frequency, as shown in Table 7. There are some buildings, such as concert halls, recording studios and theaters, which can be very sensitive to vibration but do not fit into any of the three categories listed in Table 7. Due to the sensitivity of these buildings, they usually warrant special attention during the environmental assessment of a transit project. Table 8 gives criteria for acceptable levels of ground-borne vibration for various types of special buildings.

It should also be noted that Table 7 and Table 8 include separate FTA criteria for ground-borne noise, the "rumble" that can be radiated from the motion of room surfaces in buildings due to ground-borne vibration. Although expressed in dBA, which is emphasizes the more audible middle and high frequencies, the criteria are set significantly lower than for airborne noise to account for the annoying low-frequency character of ground-borne noise. Because airborne noise often masks ground-borne noise for above ground (i.e. at-grade or elevated) rail systems, ground-borne noise criteria are primarily applied to subway operations where airborne noise is not a factor. For the above-grade transit system planned along the Mid-City/Exposition Corridor, ground-borne noise criteria are applied only to buildings that have sensitive interior spaces that are well insulated from exterior noise.

Table 7. Ground-Borne Vibration and Noise Impact Criteria by Land Use Category

Land Use Category	Ground-Borne Vibration Impact Levels (VdB re 1 micro-inch/sec)		Ground-Borne Noise Impact Levels (dB re 20 micro Pascals)	
	Frequent Events[1]	Infrequent Events[2]	Frequent Events[1]	Infrequent Events[2]
Category 1: Buildings where low ambient vibration is essential for interior operations.	65 VdB[3]	65 VdB[3]	-[4]	-[4]
Category 2: Residences and buildings where people normally sleep.	72 VdB	80 VdB	35 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	83 VdB	40 dBA	48 dBA

Notes:
1. "Frequent Events" is defined as more than 70 vibration events per day. Most transit projects fall into this category.
2. "Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems.
3. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.
4. Vibration-sensitive equipment is not sensitive to ground-borne noise.

Table 8. Ground-Borne Vibration and Noise Impact Criteria for Special Buildings

Type of Building or Room	Ground-Borne Vibration Impact Levels (VdB re 1 micro-inch/sec)		Ground-Borne Noise Impact Levels (dB re 20 micro Pascals)	
	Frequent Events[1]	Infrequent Events[2]	Frequent Events[1]	Infrequent Events[2]
Concert Halls	65 VdB	65 VdB	25 dBA	25 dBA
TV Studios	65 VdB	65 VdB	25 dBA	25 dBA
Recording Studios	65 VdB	65 VdB	25 dBA	25 dBA
Auditoriums	72 VdB	80 VdB	30 dBA	38 dBA
Theaters	72 VdB	80 VdB	35 dBA	43 dBA

Notes:
1. "Frequent Events" is defined as more than 70 vibration events per day. Most transit projects fall into this category.
2. "Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems.
3. If the building will rarely be occupied when the trains are operating, there is no need to consider impact. As an example consider locating a commuter rail line next to a concert hall. If no commuter trains will operate after 7 pm, it should be rare that the trains interfere with the use of the hall.

4.3 Construction Noise Criteria

Construction noise criteria are based on the guidelines provided in the FTA Guidance Manual. These criteria, summarized in Table 9 below, are based on land use and time of day and are given in terms of Leq for an 8-hour work shift.

Table 9. FTA Construction Noise Criteria

Land Use	Noise Limit, 8-Hour Leq (dBA)	
	Daytime	Nighttime
Residential	80	70
Commercial	85	85
Industrial	90	90

5 FUTURE BUILD CONDITIONS

This section summarizes the models used to project future noise and vibration levels for potential sources of community impact related to the Mid-City/Exposition LRT Project. The approach and projection models for these sources are described below.

5.1 Noise Projections

5.1.1 Approach

The approach used to assess the noise impact consists of combining the available data on the project design and planned operational characteristics with models train noise to project future noise levels. The steps in the assessment are:

- Determine Study Area Characteristics: This step includes identifying sensitive receptors through the review of design drawings, land use maps, and visits to the study area. The design drawings for each alternative are then used to measure distances between the receptors and the proposed project alignment.

- Determine Existing Noise Environment: As discussed in Section 3.1, noise monitoring was performed at representative sites along the proposed corridor. The measurement results were used to estimate the existing Ldn at all noise-sensitive receptors.

- Develop Noise Projection Models: The model for the LRT operations is based on measured noise characteristics of the Siemens Transportation Systems P2000 light rail vehicle, using the FTA noise model for fixed-guideway sources. The noise projections for a specific location require estimates of vehicle speed, vehicle consist and operational schedule.

- Perform Noise Impact Assessment: For each sensitive receptor or group of sensitive receptors, the projected transit noise is compared to the thresholds for impact and severe impact. As discussed above, the impact thresholds vary based on estimates of existing noise exposure.

- Inventory Impact and Assess Mitigation Options: The numbers of sensitive receptors with noise impact are tabulated, and mitigation measures at these locations are evaluated. The final product of the noise assessment is a tabulation of impacts, a set of maps showing impact locations, and a list of mitigation measures required to minimize the impacts.

5.1.2 LRT Noise Projection Model

The Mid-City/Exposition LRT noise levels were projected based on noise measurement data from the P2000 vehicles in service on the Blue and Gold Lines, the operating plan provided by DMJM Harris and the prediction model specified in the FTA guidance manual. Significant factors are summarized below:

- Based on the vehicle noise measurement data provided from other sources, the predictions assume that a two car vehicle operating at 40 mph on ballast and tie track with continuous welded rail (CWR) generates a maximum noise level (L_{max}) of 77 dBA at a distance of 50 feet from the track centerline.

- For the full build year, the operating times of the LRT line will be between 5 AM and 1 AM. The full build operating plan for LRT service specifies peak-hour headways of 5 minutes and off-peak headways of 12 minutes. For the analysis, it was assumed that two-car trains would operate the

entire day, with two exceptions: 1) 75% of the peak-hour operations will be three-car trains and all trains after 9 PM will be one-car trains.

- For the full build year, peak hour operations will occur between 6 AM and 9 AM and between 3 PM and 7 PM. Off-peak operations will occur between 5 AM and 6 AM, 9 AM and 3 PM, and from 7 PM to 1 AM.
- Vehicle operating speeds are based on speed profiles provided by DMJM Harris. The speed limits range from 15 mph to 55 mph along the corridor.
- Wheel impacts at crossovers and other special trackwork typically cause a noise increase of about 6 dBA near such locations.

The projected unshielded Ldn is shown in Figure 9 as a function of distance for several train speeds. The projections are based on the assumptions described above.

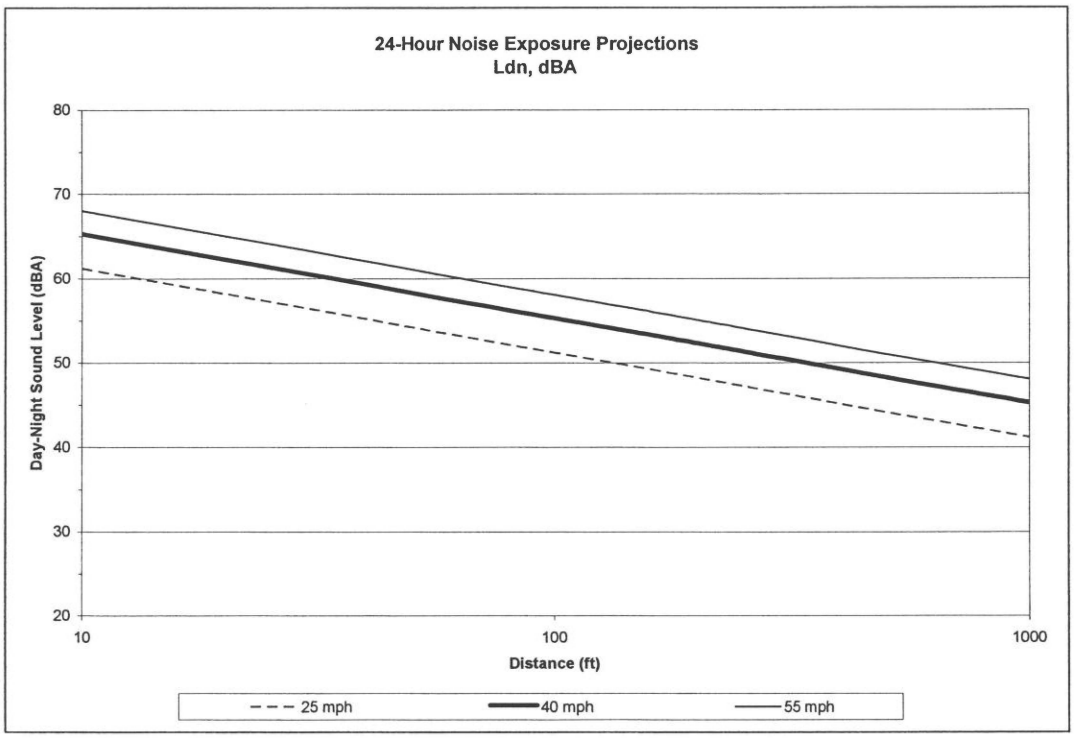


Figure 9. Projected 24-Hour Noise Exposure from LRT Operations

5.1.3 Grade-Crossing Audible Warning Noise Projection Model

The California Public Utilities Commission (CPUC) has jurisdiction over the operation of light rail transit systems. CPUC regulations require the use of audible warning devices, including on-vehicle audible warnings and crossing bells, at all grade crossings that are protected by crossing gates. Specifically, Section 7.8 of CPUC General Order 75-C specifies that: "Unless omitted by permission of the Commission, the warning aspect shall be accompanied by the sounding of a bell." The General Order does not specify a sound level for the bell. Most grade crossing bells conform to the American Railway

Engineering and Maintenance-of-Way Association (AREMA) Communication and Signaling Manual specifications. Sections 3-2.60 and 3-2.61 of the AREMA manual state that crossing bells should generate a sound level between 75 dBA and 105 dBA at a distance of ten feet from the bell. Typical grade crossing bells on light rail transit systems generate a sound level of 85 dBA at 10 feet, which is equivalent to 72 dBA at 50 feet from the bell.

The standard operating procedure for Metro is for the crossing bells to ring for the entire warning cycle, starting just before the gates begin to lower and stopping when the gates return to the vertical (open) position. As a result, the crossing bell rings for 30 to 50 seconds per train pass-by (the actual duration is dependent on several factors, such as the train speed and the crossing geometry). There are a number of LRT grade crossings in California, particularly in residential areas, where the CPUC has approved modifying the operating procedures so that the bells stop ringing once the gates reach the down (closed) position. This reduces the bell ring time to approximately 10 to 15 seconds. For the noise impact assessment, it has been assumed that all crossing bells near noise sensitive receptors would sound for 12 seconds each time a train passes in either the eastbound or westbound direction. The bell sound level has also been assumed to be 72 dBA at a distance of 50 feet from the bell.

CPUC General Order 75-C, Section 3.04, requires that light rail vehicles be equipped with two different audible warnings, one measuring at least 85 dBA at 100 feet in front of the vehicle and the other measuring at least 75 dBA at 100 feet. Metro light rail vehicles operating on the Gold Line are equipped with three different audible warnings, a horn, a lower sound level horn-type sound commonly referred to as the "quacker" and a gong. All three are electronically generated and are broadcast from speakers under the front of the light rail vehicles. Sound levels from the gong and quacker have been measured at just over 75 dBA at 100 feet in front of the train, whereas the horn is substantially louder, measuring at least 85 dBA at 100 feet.

CPUC General Order 75-C states that an on-vehicle audible warning must be sounded in advance of each gate-protected grade crossing. However, the General Order does not specify which of the audible warnings must be sounded. It is common practice for light rail transit systems in California, including those operating on a semi-exclusive right-of-way (like the Mid-City/Exposition LRT), to use a 75 dBA warning like the Gold Line quacker or gong. For the initial operations of the Gold Line, Metro policy was to sound the 85 dBA horn prior to all gated-protected grade crossings. However, Metro recently changed its operating rules so that the 75 dBA warning is sounded. Train operators always have the discretion of using the louder horn when they feel the additional warning is needed for pedestrians or motorists near the grade crossing. For this analysis, it was assumed that a 75 dBA quacker (or similar device) would be sounded at all gate-protected grade crossings in residential or other noise-sensitive areas.

The analysis of noise impacts for audible warning devices on the proposed Mid-City/Exposition LRT corridor was based on the following assumptions:

- Noise levels from crossing gate bells would be 72 dBA at a horizontal distance of 50 feet in any direction from the bell;
- The crossing bells would ring for a total of 12 seconds for each scheduled train;
- An audible warning (quacker, gong, or similar device) with a maximum sound level of 75 dBA at 100 feet in front of the train would be sounded prior to each gate-protected grade crossing; and

- The quacker would be sounded starting approximately 300 feet prior to the crossing and continue until the vehicle reaches the crossing.

These operating procedures would need to be reviewed and approved by CPUC. Since the same basic procedures are in use on the Gold Line and other California light rail systems, it is reasonable to assume that the procedures would be approved for the Mid-City/Exposition LRT.

5.2 Vibration Projections

5.2.1 Approach

The approach used to assess vibration impact consists of combining the available data on the project design and planned operational characteristics with models of train vibration to project future vibration levels. Then, for sensitive receptors, the projections are compared with applicable vibration criteria. The steps in the assessment are:

- Determine Study Area Characteristics: This step includes identifying sensitive receptors through the review of design drawings, land use maps, and visits to the study area. The design drawings for each alternative were then used to measure distances between the receptors and the proposed project alignment.

- Determine Vibration Propagation Characteristics of the Ground: Ground-borne vibration propagation tests were performed at representative sites along the proposed corridor. The measurement results were generalized to characterize the existing vibration propagation characteristics of the ground at all vibration-sensitive receptors.

- Develop Vibration Projection Models: The model used to project vibration from the proposed LRT alternative is based on combining vibration source data for the proposed Siemens Transportation Systems P2000 light rail vehicle with the vibration propagation characteristics of the ground at sensitive-receptor locations. The projections for a specific location require estimates of distance and train speed.

- Perform Vibration Impact Assessment: For each sensitive receptor or group of sensitive receptors, the projected train vibration is compared to the FTA impact thresholds.

- Inventory Impact and Assess Mitigation Options: The numbers of sensitive receptors for which vibration impact was projected are tabulated, and mitigation measures designed to minimize impact at these receptors are evaluated. Potential mitigation measures include. The final product of the noise assessment is a tabulation of impacts, a set of maps showing impact locations, and a list of mitigation measures required to minimize the impacts.

5.2.2 LRT Vibration Projection Model

The potential vibration impact from LRT operations was assessed on an absolute basis using the FTA criteria. The projection of ground-borne vibration from operations on the Mid-City/Exposition Corridor was based on the following:

- Vibration source levels were based on measurements previously conducted on Siemens Transportation Systems P2000 light rail vehicle, obtained from tests carried out in April 2000. These measurements, representing the vibration forces generated by the interaction of the steel

wheels rolling on the steel rails, were combined with the vibration propagation characteristics of the ground to provide estimates of ground-borne vibration at sensitive receptor locations.

- Vibration propagation tests were conducted at seven sites along the proposed corridors near sensitive receptors. These tests measured the response of the ground to an input force. The results of these tests were combined with the vibration source level measurements to provide projections of vibration levels from vehicles operating on the Mid-City/Exposition Corridor.
- Vibration propagation data for Sites V-2 and V-4 through V-7 were used in the vibration analysis. Vibration testing at Sites V-1 and V-3 were duplicated during the September 2004 testing, and were not included in the analysis.
- The vehicle operating speeds are based on the speed profiles that were provided, with a maximum operating speed of 55 mph.
- A safety factor was added to the projected vibration levels along the Mid-City/Exposition Corridor. This was done to make the assessment more conservative and to take into account any localized ground or building effects.
- Wheel impacts at crossovers and other special trackwork typically cause a vibration increase of about 10 dBA near such locations.

The assumed vehicle vibration characteristics (represented by the force density spectrum in Figure 10) were combined with the ground vibration propagation test results (represented by transfer mobility spectra such as those shown in Figure 6) to project vibration levels as a function of distance for each of the four test sites. The results of these transfer mobility tests and the projected LRT vibration spectra at each site are presented in Appendix C. The results suggested dividing the rail corridor into five regions for the purposes of vibration projection, defined as follows:

- Region A included all areas along the Exposition Corridor between Hill/Jefferson and Western Avenues;
- Region B included all areas along the Exposition Corridor between Western Avenue and Crenshaw Boulevard;
- Region C included all areas along the Exposition Corridor between Crenshaw Boulevard and La Brea Avenue.
- Region D included all areas along the Exposition Corridor between La Brea Avenue and La Cienega Boulevard; and
- Region E included all areas along the Exposition Corridor between La Cienega Boulevard and Venice/Robertson, including all of Culver City.

The resulting projections of maximum ground vibration levels from LRT operations at 55 mph are provided for Sites V-2 and V-4 through V-7 in Figure 11. Each of the curves in Figure 11 has a different level vs. distance characteristic, which determines the impact distance in each of the regions.

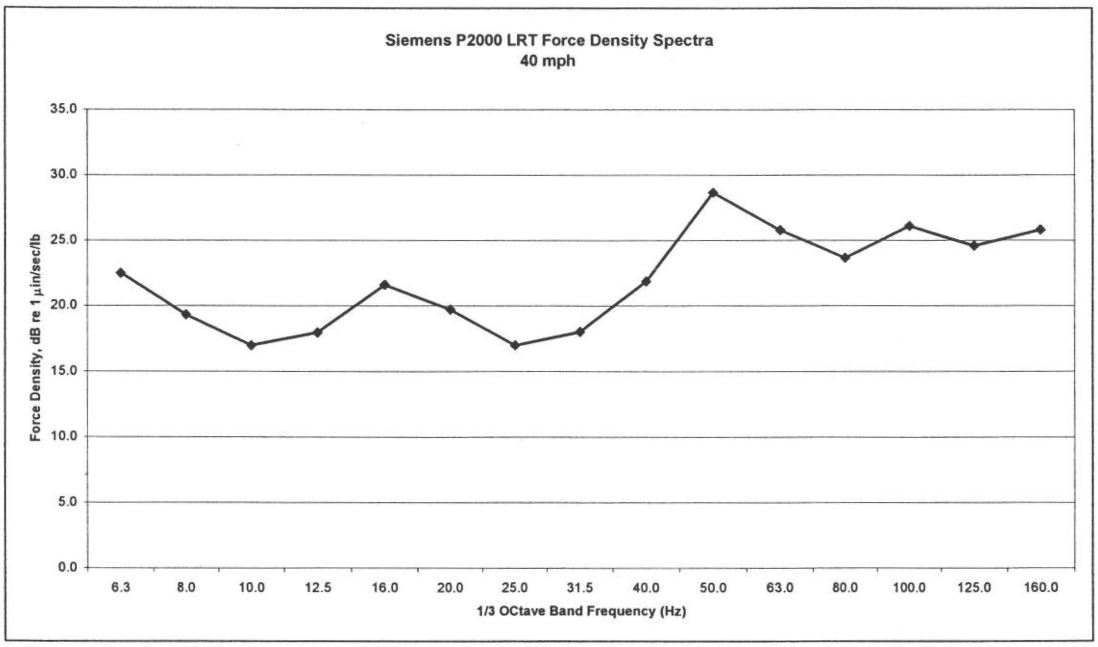


Figure 10. Siemens P2000 Vehicle Force Density Spectra

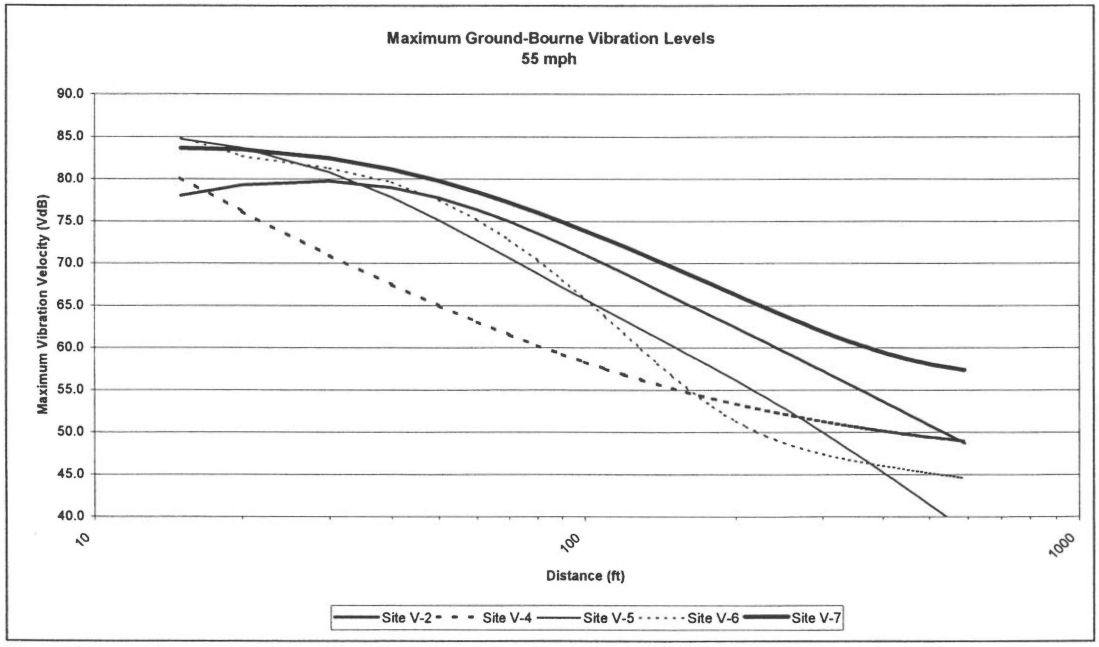


Figure 11. Projected Maximum Vibration Levels for Mid-City/Exposition LRT Operations

5.3 Ancillary Equipment Noise Projections

The transit power substations are the only ancillary equipment with much potential to cause noise impact. The major noise sources associated with substations are magnetostriction of the transformer core and cooling fans. It is generally possible to eliminate potential for noise impact from substations by including noise limits in the procurement documents.

The evaluation of noise from the substations is based on measurements of substations on other LRT projects. The basic relationship is:

$L(d) = 76 - 20\ log(d)$ where "d" is the distance from the substation building in feet.

5.4 Construction Noise Projections

Construction noise varies greatly depending on the construction process, type and condition of equipment used, and layout of the construction site. Many of these factors are traditionally left to the contractor's discretion, which makes it difficult to accurately estimate levels of construction noise. Overall, construction noise levels are governed primarily by the noisiest pieces of equipment. For most construction equipment, the engine, which is usually diesel, is the dominant noise source. This is particularly true of engines without sufficient muffling. For special activities such as impact pile driving and pavement breaking, noise generated by the actual process dominates.

Table 10 summarizes some of the available data on noise emissions of construction equipment from the FTA Guidance Manual. Shown are the averages of the Lmax values at a distance of 50 feet. Although the noise levels in the table represent typical values, there can be wide fluctuations in the noise emissions of similar equipment. Construction noise at a given noise-sensitive location depends on the magnitude of noise during each construction phase, the duration of the noise, and the distance from the construction activities.

Projecting construction noise requires a construction scenario of the equipment likely to be used and the average utilization factors or duty cycles (i.e. the percentage of time during operating hours that the equipment operates under full power during each phase). Using the typical sound emission characteristics, as given in Table 10, it is then possible to estimate Leq or Ldn at various distances from the construction site. The noise impact assessment for a construction site is based on:

- an estimate of the type of equipment that will be used during each phase of the construction and the average daily duty cycle for each category of equipment,
- typical noise emission levels for each category of equipment such as those in Table 10, and
- estimates of noise attenuation as a function of distance from the construction site.

Table 10. Construction Equipment Noise Emission Levels

Equipment Type	Typical Sound Level at 50 ft (dBA)
Backhoe	80
Bulldozer	85
Compactor	82
Compressor	81
Concrete Mixer	85
Concrete Pump	82
Crane, Derrick	88
Crane, Mobile	83
Loader	85
Pavement Breaker	88
Paver	89
Pile Driver, Impact	101
Pump	76
Roller	74
Truck	88

Construction noise estimates are always approximate because of the lack of specific information available at the time of the environmental assessment. Decisions about the procedures and equipment to be used are made by the contractor. Project designers usually try to minimize constraints on how the construction will be performed and what equipment will be used so that contractors can perform construction in the most cost effective manner.

Table 11 is an example of the noise projections for equipment that is often used during tie-and-ballast track construction. For the calculations it is assumed that all the equipment is located at the geometric center of the construction work site. Based on this scenario, an 8-hour Leq of 88 dBA should be expected at a distance of 50 feet from the geometric center of the work site. This calculation in Table 11 does not assume any noise mitigation measures or any limits on the contractor about how much noise can be made. With at-grade track construction, the duration of the activities at a specific location along the alignment will be relatively limited, usually a matter of several weeks. As a result, even when there may be noise impacts, the limited duration of the construction can mean that mitigation is not cost effective.

Table 11. Typical Equipment List, At-Grade Track Construction

Equipment Item	Typical Maximum Sound Level at 50 ft (dBA)	Equipment Utilization Factor (%)	Leq (dBA)
Air Compressor	83	50%	80
Backhoe	80	40%	76
Crane, Derrick	82	10%	72
Dozer	85	40%	81
Generator	81	80%	80
Loader	85	40%	81
Pavement Breaker	84	4%	70
Shovel	80	40%	76
Dump Truck	88	16%	80
Total Workday Leq at 50 feet (8-hour workday)			88

6 NOISE AND VIBRATION IMPACT ASSESSMENT

A detailed noise and vibration impact assessment was performed based on the criteria discussed in Section 4 and on the projections described in Section 5. The assessment methods and results for the various project sources are described below.

6.1 Noise Assessment

The assessment of noise impact from LRT operations is based on a comparison of existing and projected future noise exposure for different land use categories. The following steps were performed to assess train noise impact:

- A detailed land-use survey was conducted along the project corridor to identify and classify all noise-sensitive receptors according to the categories defined in Section 4.1. The vast majority of these receptors are single and multi-family residences, falling under FTA Category 2. The remaining sensitive receptors were institutional sites falling under FTA Category 3.

- The receptors were clustered based on distance to the tracks, acoustical shielding between the receptors and the tracks, and location relative to crossovers and grade crossings.

- The existing noise exposure at each cluster of receptors was estimated based on the ambient noise measurements discussed in Section 3.1, and was used to determine the thresholds for impact and severe impact using the FTA criteria presented in Section 4.1.

- Projections of future LRT noise at each cluster of receptors were developed based on distance from the tracks, train schedule and train speed using the methods described in Section 5.1.

- In areas where the projections showed either degree of impact, mitigation options were evaluated and new projections were developed assuming mitigation of all impacts.

- The set of maps in Appendix D shows the location of all noise-sensitive receptors along the alignment and the location of all noise impacts as described in Section 6.1.1.

6.1.1 LRT Operational Noise Impacts

For the Mid-City/Exposition LRT project, detailed comparisons of the existing and future noise levels are presented in Table 12 and Table 13. Table 12 includes results for the Category 2 receptors along the alignment with both daytime and nighttime sensitivity to noise (e.g. residences, hotels and hospitals). Table 13 is a listing of all Category 3 receptors along the alignment, consisting of institutional sites that are not sensitive to noise at night (e.g. schools, churches, parks and medical offices). The tables include the distance to the near track, proposed LRT speed, the existing noise level, the projected noise level from LRT operations, and the impact criteria for each receptor or receptor group. Based on a comparison of the predicted project noise level with the impact criteria, the impact category is listed, along with the predicted total noise level and projected noise increase due to the introduction of LRT service. Table 12 also includes an inventory of the number of impacts and severe impacts at each sensitive receptor location.

Table 12. Noise Impacts for Category 2 Land Use

LRT Segment	Near Track Dist (ft)	Speed (mph)	Exist Ldn (dBA)	Project Ldn, dBA			Fut. Ldn (dBA)	Number of Impacts			
				Impact Thresh		Train Noise		Impact		Severe	
				Imp	Sev			SF	MF	SF	MF
Downtown to Exposition Blvd.	There are no Category 2 impacts in this segment.										
Exposition Blvd., Vermont Ave. to Western Ave.	50	35	69	64	69	62	70	0	0	0	0
Exposition Blvd., Western Ave. to 2nd Ave.	25	50	67	62	68	68	71	0	4	0	0
North side of Exposition Blvd., 2nd Ave. to 10th Ave.	80	55	67	62	68	60	68	0	0	0	0
South side of Exposition Blvd., 2nd Ave. to 10th Ave.	10	55	58	57	62	70	71	23	0	42	0
North side of Exposition Blvd, Crenshaw Blvd to Field Ave	75	50	65	61	66	61	66	0	0	0	0
South side of Exposition Blvd, Crenshaw Blvd to Farmdale Ave	55	55	60	58	63	63	65	16	1	0	0
South side of Exposition Blvd, La Brea Ave to Cloverdale Ave	65	55	59	57	63	64	65	6	1	3	0
North side of Jefferson Blvd, La Brea Ave to La Cienega	110	55	65	61	66	58	65	0	0	0	0
South side of Jefferson Blvd, Cloverdale Ave to Carmona Ave	70	55	63	60	65	62	66	5	0	0	0
North side of National Blvd, Fay Ave to Helms Ave	40	55	62	59	65	65	67	10	0	4	0
Total								**60**	**6**	**49**	**0**

Noise levels are based on Ldn and are measured in dBA. Noise levels are rounded to the nearest decibel except for the increase in noise level, which is given to the nearest one-tenth decibel to provide a better resolution for assessing noise impact.
SF = single-family residence, MF = multi-family residential building.

For the Mid-City/Exposition LRT, the results in Table 12 indicate that without mitigation, 115 residential noise impacts are anticipated, including 66 with moderate impact and 49 with severe impact. Of the moderate impacts, 60 would be single-family residences and 6 would be multi-family buildings. All 49 of the severe impacts are single-family residences. Most of the severe impacts are anticipated to occur along the south side of Exposition Boulevard between 2nd and 10th Avenues, where the backyards of residences abut the route, and in some cases the LRT tracks would be within ten feet of residences. The following are brief descriptions of each impacted location:

- Exposition Boulevard – Western Avenue to 2nd Avenue. There are four multi-family residences projected to have noise impact. All the residences are on south side of the alignment to the west of Arlington Avenue. The noise impacts are due to the distance to the tracks (less than 25 feet).
- South Side of Exposition Boulevard – 2nd Avenue to 10th Avenue. There are 65 single-family residence projected to have noise impact. 42 of the impacts are severe impacts and the remaining 23 are impacts. The residences are all located on the south side of the alignment and the noise impact is due to the distance to the tracks (less than 15 feet).
- South Side of Exposition Boulevard – Crenshaw Boulevard to Farmdale Avenue. There are sixteen single-family residences and one multi-family residence projected to have noise impact in

this area. All of the residences are on the south side of the alignment. The noise impact is due to the distance to the tracks (less than 50 feet) and the speed of the LRT (55 mph).

- South Side of Exposition Boulevard – La Brea Avenue to Cloverdale Avenue. There are nine single-family residences and one multi-family residence projected to have noise impact in this area. Six of the single-family residences and the multi-family residence are impacts and three of the single-family residences are severe impacts. All of the residences are on the south side of the alignment. The noise impact is due to the distance to the tracks (less than 65 feet) and the speed of the LRT (55 mph).

- South Side of Jefferson Boulevard – Cloverdale Avenue to Carmona Avenue. There are five single-family residences projected to have noise impact in this area. All of the impacts are on the south side of the alignment. The noise impact is due to the distance to the tracks (less than 70 feet) and the speed of the LRT (55 mph).

- North Side of National Boulevard – Fay Avenue to Helms Avenue. There are fourteen single-family residences projected to have noise impact in this area. Four of the residences are severe impacts and the remaining ten are impacts. All of the residences are on the north side of the alignment. The noise impact is due to the distance to the tracks (less than 40 feet) and the speed of the LRT (55 mph).

Similar to the Category 2 analysis, an assessment of noise impact for Category 3 receptors was also conducted. This assessment was based on a comparison of the existing ambient noise level with the projected project noise levels in terms of the peak transit hour Leq.

Table 13. Noise Impacts for Category 3 Land Use

Site Description	Dist (ft)	Speed (mph)	Exist Leq(h) (dBA)	Project Leq(h) (dBA)			Future Leq(h) (dBA)	Impact
				Impact Thresh		Train Noise		
				Imp	Sev			
Abram Friedman Occupational Center	15	35	68	68	74	63	69	None
John Adams Middle School	32	35	63	65	70	59	64	None
Los Angeles Unified School District New School	120	35	63	65	70	49	63	None
Los Angeles Trade Technical College	48	35	63	65	70	56	63	None
St. James Church	64	35	63	65	70	54	63	None
Galen Center	64	35	63	65	70	53	63	None
ST-1: USC, Marshall School of Business -701 Exposition Blvd	75	35	63	65	70	53	63	None
Dawa Center of Masjid Umar	80	35	63	65	70	52	63	None
West Angeles Cathedral	110	20	65	66	71	45	65	None
Foshay Learning Center	112	30	67	68	72	49	67	None
Al Madinah School	68	20	65	66	71	48	65	None
ST-10: Dorsey High School - South of Exposition Blvd	50	55	56	61	67	59	61	None
Turning Point School	120	35	60	63	68	58	62	None

Noise levels are based on Leq and are measured in dBA. Noise levels are rounded to the nearest decibel except for the increase in noise level, which is given to the nearest one-tenth decibel to provide a better resolution for assessing noise impact.

The results of the analysis in Table 13 indicate no noise impacts for any institutional receptors.

6.1.2 Grade-Crossing Audible Warning Noise Impacts

The quacker and crossing bells have the potential to generate either additional impact where none were projected for the light rail vehicles or to increase the magnitude of the projected noise impacts (i.e. from moderate to severe). Light rail trains have been modeled to travel at speeds of up to 45 and 55 mph through most grade crossings. At this speed, the light rail vehicle would create substantially more noise than the quacker at grade crossings. At most locations along the alignment, the addition of the chime would increase the projected noise exposure levels by less than 0.5 dBA Ldn and therefore would not result in either new impacts or increase the severity of projected impacts from the light rail vehicle.

There are a total of 11 gate-protected grade crossings, including one pedestrian crossing that would require a crossing gate, along the Mid-City/Exposition LRT Alignment. These crossings are listed from east to west in Table 14. The potential for noise impacts from the crossing bells is generally confined to the sensitive receptors within 100 feet of the crossing gates. At these locations, the Ldn would increase by one to three dBA. At a few locations within 50 feet of the crossing bell, the increase could be four to eight dBA. As a result, noise from the bells would be projected to generate five new impacts and increase severity of project light rail vehicle noise impacts, from moderate to severe, at 15 sensitive receptors. Table 14 gives the locations of the additional moderate impacts and severe impacts projected from the crossing bells.

Table 14. Noise Impacts from Grade Crossing Audible Warnings

Grade Crossing	Increase in Ldn (dBA)	Number of Impacts				Notes
		Impact		Severe		
		SF	MF	SF	MF	
Arlington Avenue	1 to 4	2	3	0	1	
7th Avenue	1 to 8	0	0	3	0	
Private Crossing (9th Avenue)	1 to 2	0	0	4	0	
10th Avenue	--	--	--	--	--	No sensitive receptors w/in 300 feet
11th Avenue	--	--	--	--	--	No sensitive receptors w/in 300 feet
Buckingham Road	1 to 2	0	0	4	2	
Farmdale Avenue	1 to 3	0	0	0	2	Includes 1 motel & 2 MFR
Private Crossing (Hauser Blvd.)	0 to 2	0	0	0	0	
Wesley Street	0 to 1	0	0	0	0	Pedestrian crossing only
National Boulevard	--	--	--	--	--	No sensitive receptors w/in 300 feet
Washington Boulevard	--	--	--	--	--	No sensitive receptors w/in 300 feet
Total:		**2**	**3**	**11**	**5**	
SOURCE: Harris Miller Miller & Hanson Inc. and ATS Consulting LLC, 2004.						

6.1.3 Crossover Noise Impacts

A summary of the results of the noise assessment for the proposed crossover locations is provided in Table 15. The table presents the noise impact with and without each of the proposed crossovers.

Because the impacts of wheels over rail gaps at track crossover locations increases noise levels by about 6 dBA, crossovers are a major source of noise impact when they are located in sensitive areas. If crossovers cannot be relocated away from residential areas, another approach is to use spring-rail or moveable point frogs in place of standard rigid frogs at turnouts. These devices allow the flangeway gap to remain closed in the main traffic direction for revenue service trains, which eliminates the additional noise associated with the crossover.

Table 15. Noise Impacts from Proposed Crossover Locations

Crossover Location	Impact Assessment Without Crossover	Impact Assessment With Crossover
Station 103	No Impact	No Impact
Station 111[1]	No Impact	No Impact
Station 152[1]	No Impact	No Impact
Station 213	No Impact	Impact
Station 311	Severe Impact (South)/ No Impact (North)	Severe Impact (South)/ Impact (North)
Station 413	Impact (South)/ No Impact (North)	Severe Impact (South)/ Impact (North)
Station 482[2]	Impact	Severe Impact
Station 484[3]	Impact	Severe Impact
Station 486[4]	Impact	Severe Impact
Station 489[5]	No Impact	No Impact

1. These crossovers are associated with the Flower Street Design Option.
2. This crossover is associated with the Venice/Robertson Station North of ROW Option C.
3. This crossover is associated with the Venice/Robertson Station North of ROW Option B.
4. This crossover is associated with the Venice/Robertson Station North of ROW Option A and the ROW Option.
5. This crossover is associated with the Venice/Robertson Aerial Option and the LPA.

6.2 Vibration Assessment

The potential vibration impact from LRT operations was assessed on an absolute basis using the FTA criteria. The approach used for assessing vibration impact generally follows the approach used for the noise impact, except that existing vibration is not considered when evaluating impact. The impact threshold for LRT operations is 72 VdB for residential buildings (Category 2) and 75 VdB for institutional buildings (Category 3) for "frequent events" (defined as more than 70 events per day).

6.2.1 LRT Operational Vibration Impacts

The estimated root mean square (RMS) velocity levels (VdB re 1 micro-in./sec.) for sensitive receptors at representative distances are provided in Table 16. Vibration-sensitive locations along the alignment are listed in Table 17 for Category 2 land use. Table 16 lists the track segment, the LRT speed, and the distance to the track. In addition, the projected LRT vibration level and vibration impact criterion are indicated along with the number of impacts projected for each project area. The projected vibration level listed in Table 16 is the highest vibration level for that grouping of sensitive receptors. In many cases, the vibration levels for other impacted receptors are much lower than the reported value.

The set of maps in Appendix D shows the location of all vibration-sensitive receptors along the alignment and the location of all vibration impacts as described below.

Table 16. Vibration Impacts for Category 2 Land Use

Track Segment	Train Speed (mph)	Distance from Near Track Centerline (ft)	Project Vibration Levels (VdB)	Vibration Impact Criterion (VdB)	# of Vibration Impacts	
					SF	MF
Downtown to Exposition Blvd.	There are no Category 2 impacts in this segment.					
Exposition Blvd., from Vermont Ave. to Western Ave.	35	50	75	72	93	18
Exposition Blvd., from Western Ave. to Arlington Ave.	50	25	81	72	3	5
Exposition Blvd., from Arlington Ave. to Crenshaw Blvd.	55	10	92	72	54	0
Exposition Blvd., from Crenshaw Blvd. to La Brea Ave.	55	55	72	72	0	0
Jefferson Blvd., from La Brea Ave. to La Cienega Blvd.	55	60	72	72	0	0
National Blvd., from La Cienega Blvd. to Venice Blvd.	55	40	67	72	0	0
Total					**150**	**23**

1. SF = single-family residence, MF = multi-family residential building.

Table 16 indicates that without mitigation, vibration impacts are projected at 150 single-family residences and 23 multi-family buildings. As shown in the table, all of the vibration impacts are projected to occur at residences along Exposition Boulevard between Vermont Avenue and Crenshaw Boulevard. Within this area, the greatest concentration of impacts are projected to occur at single-family residences on the south side of the corridor between Vermont Avenue and Western Avenue and between Arlington Avenue and Crenshaw Boulevard, where residential properties directly abut the route, and in some cases where the LRT tracks are within 10 feet of residences. Impacts to sensitive receptors would be potentially significant. A discussion of each impacted location follows:

- Exposition Boulevard (between Vermont Avenue and Western Avenue): There are 52 single-family residences and one multi-family residence on the north side of Exposition Boulevard with vibration impact. In addition, there are 41 single-family residences and 17 multi-family residences on the south side of Exposition Boulevard projected to have vibration impact. The vibration impacts are due to the proximity to the alignment and the speed of the LRT.
- Exposition Boulevard (between Western Avenue and Arlington Avenue): There are five Apartment buildings on the south side of Exposition Boulevard near Arlington Avenue that are projected to have vibration impact. In addition, there are three single-family residences that are projected to have vibration impact on the north side of Exposition Boulevard near Arlington Avenue. The vibration impacts are due to the proximity to the alignment and the speed of the LRT.
- Exposition Boulevard (between Arlington Avenue and Crenshaw Boulevard): There are two single-family residences on the north side of Exposition Boulevard that are projected to have vibration impact. In addition, there are 52 single-family residences located on the south side of Exposition Boulevard that projected to have vibration impact. The vibration impacts are due to the proximity to the alignment and the speed of the LRT.

Similar to the Category 2 analysis, an assessment of vibration impact for Category 3 receptors was also conducted.

Table 17. Vibration Impacts for Category 2 Land Use

Location[1]	Dist (ft)	Speed (mph)	Project Vibration Level[2]	Vibration Impact Criterion[2]	# of Impacts
Abram Friedman Occupational Center	15	35	74	75	0
John Adams Middle School	32	35	71	75	0
Los Angeles Unified School District New School	120	35	54	75	0
Los Angeles Trade Technical College	48	35	72	75	0
St. James Church	64	35	66	75	0
Galen Center	64	35	68	75	0
ST-1: USC, Marshall School of Business -701 Exposition Blvd	75	35	73	75	0
Dawa Center of Masjid Umar	80	35	73	75	0
West Angeles Cathedral	110	20	56	75	0
Foshay Learning Center	112	30	68	75	0
Al Madinah School	68	20	62	75	0
ST-10: Dorsey High School - South of Exposition Blvd	50	55	74	75	0
Turning Point School	120	35	68	75	0

1. Vibration levels are measured in VdB referenced to 1 μin/sec.
2. The reported vibration level represents the maximum vibration level for each location.

The results of the analysis in Table 17 indicate no vibration impacts for any institutional receptors.

In addition, the North of ROW Option A would pass within approximately 10 feet of a sound recording studio located at 3431 Wesley Street. Significant vibration and ground-borne noise impacts are projected at this building due to LRT operations. The criterion for vibration impact for this type of building is 65 VdB. The projected ground-borne vibration level at the closest edge of this building is 77 VdB. In addition, and probably more importantly for a studio, the ground-borne noise impact criterion is 25 dBA and the projected ground-borne noise level at the closest edge of this building is 47 dBA.

If the North of ROW Option A design option is adopted for the site of the Venice/Robertson Station, a detailed, specific noise impact assessment for this location should be conducted to measure the specific nature of the studio and the site specific impacts of the LRT vehicles. The sensitivity of the studio would determine the need for additional analysis. If the studio is used for making music recordings, then there is the potential for impact. However, if this is simply a location where they copy music, it would not be an impact.

Outdoor to indoor vibration measurements would be conducted to evaluate the building foundation coupling loss, the effects of any existing construction (such as floating floors or insulated walls) currently used to isolate the recording areas from other noise and vibration sources and the existing noise levels in the studio. Due to such factors, it is likely that the projected ground-borne noise and vibration levels inside the studio would be lower than the projections above, but vibration mitigation would probably still need to be employed to reduce the projected levels to meet the criterion.

In addition, the ground-borne noise criterion may not be stringent enough based on the sensitivity and use of the studio. Other criteria, such as a Noise Criterion curve, might be appropriate for this location. The project shall be required to fully mitigate the sound impacts of the LRT vehicles on this business, and if it is determined that such mitigation measures do not meet the above threshold criteria, Metro shall be required to relocate the business and acquire the property.

6.2.2 *Crossover Vibration Impacts*

A summary of the results of the vibration assessment for the proposed crossover locations is provided in Table 18. The table presents the vibration impact with and without each of the proposed crossovers.

Because the impacts of wheels over rail gaps at track crossover locations increases vibration levels by about 10 VdB, crossovers are a major source of vibration impact when they are located in sensitive areas. If crossovers cannot be relocated away from residential areas, another approach is to use spring-rail or moveable point frogs in place of standard rigid frogs at turnouts. These devices allow the flangeway gap to remain closed in the main traffic direction for revenue service trains, which eliminates the additional vibration associated with the crossover.

Table 18. Vibration Impacts from Proposed Crossover Locations

Crossover Location	Impact Assessment Without Crossover	Impact Assessment With Crossover
Station 103	No Impact	No Impact
Station 111[1]	No Impact	No Impact
Station 152[1]	No Impact	No Impact
Station 213	Impact	Impact
Station 311	Impact (South)/ No Impact (North)	Impact (South)/ Impact (North)
Station 413	No Impact	Impact
Station 482[2]	No Impact	Impact
Station 484[3]	No Impact	Impact
Station 486[4]	No Impact	Impact
Station 489[5]	No Impact	Impact

1. These crossovers are associated with the Flower Street Design Option.
2. This crossover is associated with the Venice/Robertson Station North of ROW Option C.
3. This crossover is associated with the Venice/Robertson Station North of ROW Option B.
4. This crossover is associated with the Venice/Robertson Station North of ROW Option A and the ROW Option.
5. This crossover is associated with the Venice/Robertson Aerial Option and the LPA.

6.3 Ancillary Equipment Noise Assessment

There is one traction power substation (TPSS) location where an ancillary equipment noise impact would occur. The TPSS on the northwest corner of Farmdale Avenue and Exposition Boulevard would result in an ancillary equipment noise impact at the motel on the northeast corner of the intersection. However, because of audible warning device noise at the grade-crossing at Farmdale Avenue, sound insulation has been recommended for this receiver.

6.4 Construction Noise and Vibration Assessment

Based on the criteria in Section 4.3 and the noise projection in Table 11, and assuming that construction noise is reduced by 6 decibels for each doubling of distance from the center of the site, screening distances for potential construction noise impact can be estimated. These estimates suggest that the potential for construction noise impact will be minimal for commercial and industrial land use, with impact screening distances of 70 feet and 40 feet, respectively. Even for residential land use, the potential for temporary construction noise impact would be limited to locations within about 125 feet of the corridor. However, the potential for noise impact from nighttime construction could extend to residences as far as 400 feet. Potential construction noise impacts will be evaluated during final design.

7 MITIGATION OF NOISE AND VIBRATION IMPACTS

7.1 Noise Mitigation Measures

7.1.1 LRT Operations Noise Mitigation

Potential mitigation measures for reducing noise impacts from LRT operations are described below.

- Noise Barriers: This is a common approach to reducing noise impacts from surface transportation sources. The primary requirements for an effective noise barrier are that (1) the barrier must be high enough and long enough to break the line-of-sight between the sound source and the receiver, (2) the barrier must be of an impervious material with a minimum surface density of 4 lb/sq. ft. and (3) the barrier must not have any gaps or holes between the panels or at the bottom. Because numerous materials meet these requirements, the selection of materials for noise barriers is usually dictated by aesthetics, durability, cost and maintenance considerations. Depending on the proximity of the barrier to the tracks and on the track elevation, transit system noise barriers typically range in height from between four and eight feet.
- Relocation of Crossovers or Special Trackwork at Crossovers: Because the impacts of wheels over rail gaps at track crossover locations, or turn-outs for passing tracks, increases vibration by about 6 dBA, crossovers are a major source of vibration noise impact when they are located in sensitive areas. If crossovers cannot be relocated away from residential areas, another approach is to use spring-rail or moveable point frogs in place of standard rigid frogs at turnouts. These devices allow the flangeway gap to remain closed in the main traffic direction for revenue service trains.
- Building Sound Insulation: Sound insulation to improve the outdoor-to-indoor noise reduction has been widely applied around airports and has seen limited application for transit projects. Although this approach has no effect on noise in exterior areas, it may be the best choice for sites where noise barriers are not feasible or desirable, and for buildings where indoor sensitivity is of most concern. Substantial improvements in building sound insulation (on the order of 5 to 10 dBA) can often be achieved by adding an extra layer of glazing to the windows, by sealing any holes in exterior surfaces that act as sound leaks, and by providing forced ventilation and air-conditioning so that windows do not need to be opened.

As discussed in Section 4.1, FTA requires that severe impacts be mitigated unless there are no practical means to do so. While mitigation is encouraged at the moderate impact level, the implementation of such mitigation will depend on other project-specific factors. These other factors can include the projected increase over existing noise levels, the types and number of noise-sensitive land uses affected, existing outdoor-to-indoor sound insulation and the cost-effectiveness of mitigating noise to more acceptable levels.

Noise impact was assessed according to the FTA criteria for severe and moderate impact at noise-sensitive locations. The current noise and vibration design criteria for LACMTA require noise mitigation at all locations where the noise level increase is greater than 5 dB. The goal for the Exposition Corridor was to provide mitigation at all locations where noise impact is projected and to minimize the number of residual impacts. The heights of the noise barriers were designed to limit visual impact while still providing adequate noise mitigation. For the Exposition Corridor, noise barriers were recommended at all locations with noise impacts, including all severe and moderate impacts.

Noise barriers should provide a minimum of five decibels of noise reduction to be considered an effective means of mitigating impact. When possible, the end points of noise barriers should also be designed to minimize abrupt changes in noise levels as trains emerge from behind the barriers.

The assessment of noise barrier performance was performed using an integrating acoustic dipole model. This model calculates the expected noise reduction of a barrier based on the train length, train speed, distance from the noise-sensitive receiver to the rail alignment, distance from the noise barrier to the receiver, the heights of the noise source, receiver and noise barrier as well as the length of the noise barrier. This methodology was used to examine different barrier lengths and heights with the objective of obtaining noise level reductions that meet the design goals described above.

Table 19 shows the proposed noise barrier locations and heights along the Exposition corridor. This table reflects the most recent engineering information available. The results of the noise mitigation analysis indicate that seven noise barriers totaling 9,450 feet in length could be constructed to mitigate noise impacts at all locations along the Exposition Corridor, with only 10 residual impacts. At some locations, 6-foot high noise barriers could be used to mitigate the noise impacts, while 8-foot barriers will still be required at locations with high project noise levels. The maps in Appendix D show the location of all noise mitigation measures.

Table 19. LRT Operational Noise Mitigation Locations

	Noise Barrier Description						
Location	**Side of Track**	**Civil Stations**	**Length (ft)**	**Height (ft)**	**Approx. Cost ($20/sq ft)**	**Insertion Loss (dB)**	**Residual Impacts****
Van Ness St. to Arlington Ave.	S	280+00 to 283+40	340	8	$54,400	6 to 14	0
2nd Ave. to 7th Ave.	S	288+00 to 305+20	1720	8	$275,200	3 to 14	3
7th Ave. to 9th Ave.	S	306+00 to 312+50	650	8	$104,000	3 to 15	5
Somerset Dr. to Buckingham Rd.	S	344+50 to 353+80	970	6	$116,400	5 to 9	0
Buckingham Rd. to Farmdale Ave.	S	355+00 to 371+00	1600	6	$192,000	2 to 9	2
La Brea Ave. to Hauser Blvd.	S	398+80 to 424+00	2520	6/4*	$167,600	9 to 13	0
Fay Ave. to Wesley St.	N	470+50 to 487+00	1650	6	$198,000	8 to 9	0
Total			**9,450**		**$1,107,600**		

*This barrier is 6-feet high at-grade for 1760 feet and 4-feet high for 760 feet on the elevated structure.

**All residual impacts would be mitigated by the methods listed in Table 20.

Mitigation includes sound barriers at a location of eight feet from the near track centerline to minimize the height while providing the maximum amount of noise reduction.

Height is measured from top of rail to ensure proper relationship to rail car.

Note: Mitigation is subjected to slight modification during final design but any changes would be designed to have equivalent noise reduction capabilities. Additional sound walls would be added if required to meet federal noise criteria.

7.1.2 Grade-Crossing Audible Warning Noise Mitigation

Typical grade crossing bells are 10 to 15 dBA louder than the lower limit of the AREMA standard. A bell with a sound level of 64 dBA at 50 feet would still meet the AREMA standard but would substantially reduce community noise levels near grade crossings.

Table 20 lists the noise mitigation recommendations at each grade crossing to remove all residual noise impacts. Noise mitigation is not required at 10th and 11th Avenues, Hauser, National and Washington Boulevards and Wesley Street. At the other grade crossings, a combination of reducing the crossing bell noise level (but leaving the LRT whistle at the CPUC required noise level), sound insulation, and noise barriers recommended to mitigate LRT operational noise will mitigate all noise impacts. The recommendations in Table 20 include noise barriers already recommended in Table 19. At two grade

crossings, sound insulation would be recommended to mitigate the noise impacts at sensitive receptors directly adjacent to the grade crossings. These include two single-family residences at 7th Avenue, on the south side of Exposition Boulevard, and at a motel on the north side of Exposition Boulevard at Farmdale Avenue. With the recommendations in Table 20, there will be no residual noise impacts from grade crossing noise.

Table 20. Grade-Crossing Noise Mitigation Assessment

Grade Crossing Location	Mitigation Recommendations[1]
Arlington Avenue	Reduce crossing bell level[2] ,noise barrier
7th Avenue	Reduce crossing bell level, noise barrier, sound insulation
Private Crossing (9th Avenue)	Reduce crossing bell level[2] ,noise barrier
10th Avenue	No mitigation required.
11th Avenue	No mitigation required.
Buckingham Road	Reduce crossing bell level, noise barrier, sound insulation
Farmdale Avenue	Reduce crossing bell level, noise barrier, sound insulation
Private Crossing (Hauser Blvd)	No mitigation required.
Wesley Street	No mitigation required.
National Boulevard	No mitigation required.
Washington Boulevard	No mitigation required.

1. Mitigation recommendations include noise barriers already recommended to reduce operational noise from LRT vehicles.
2. Reduce the crossing bell level to 64 dBA at 50 feet. The noise level of the quacker on the train would remain at the level required by the CPUC .

- Arlington Avenue: At this location, reducing the crossing bell noise level to 64 dBA at 50 feet, combined with the noise barrier from Station 280+00 to 283+40 on the south side of the alignment, recommended to mitigate LRT operational noise, would eliminate all the noise impacts at this location.

- 7th Avenue: At this location, reducing the crossing bell noise level to 64 dBA at 50 feet, combined with the noise barriers from Station 288+00 to 305+20 and Station 306+00 to 312+50 on the south side of the alignment, recommended to mitigate LRT operational noise, and sound insulation at the two residences on the south side of Exposition Boulevard on either side of 7th Avenue would eliminate all the noise impacts at this location.

- Private Crossing (9th Avenue): At this location, reducing the crossing bell noise level to 64 dBA at 50 feet, combined with the noise barrier from 306+00 to 312+50 on the south side of the alignment, recommended to mitigate LRT operational noise would eliminate all the noise impacts at this location.

- Buckingham Road: At this location, reducing the crossing bell noise level to 64 dBA at 50 feet, combined with the noise barriers from Station 344+50 to 353+80 and Station 355+00 to 371+00 on the south side of the alignment, recommended to mitigate LRT operational noise would eliminate all the noise impacts at this location.

- Farmdale Avenue: At this location, reducing the crossing bell noise level to 64 dBA at 50 feet, combined with the noise barrier from Station 355+00 to 371+00 on the south side of the alignment, recommended to mitigate LRT operational noise, and sound insulation at the motel on the northeast corner of the crossing would eliminate all the noise impacts at this location.

7.1.3 Crossover Noise Mitigation

Table 21 indicates the crossover noise mitigation options for the crossovers along the corridor. The proposed crossovers at Stations 103, 111, 152, and 489 (LPA and Aerial Option) would not require any additional noise mitigation and would not need to be relocated or have spring-rail or moveable point frogs to eliminate impact.

The remaining crossovers at Stations 213, 311, 413, and the potential crossovers at Stations 482 (North of ROW Option C), 484 (North of ROW Option B), and 486 (ROW and North of ROW Option A), are located adjacent to noise sensitive receptors and would need substantial amounts of additional mitigation or the use of spring-rail or moveable point frogs if they remain at the proposed locations. Alternatively, these crossovers would need to be relocated to less sensitive locations, within the limits of operational and geometrical constraints.

Table 21. Crossover Noise Mitigation Assessment

Crossover Location	Mitigation Recommendations Without Crossover	Mitigation Recommendations With Crossover
Station 103	No Mitigation	No Mitigation
Station 111[1]	No Mitigation	No Mitigation
Station 152[1]	No Mitigation	No Mitigation
Station 213	No Mitigation	Spring-rail or moveable point frog
Station 311	8' high barrier to south	Crossover will be moved or spring-rail/moveable point frog
Station 413	6' high barrier to south	Crossover will be moved or spring-rail/moveable point frog
Station 482[2]	6' high barrier to north	8' high barrier to north or spring-rail/moveable point frog
Station 484[3]	6' high barrier to north	8' high barrier to north or spring-rail/moveable point frog
Station 486[4]	6' high barrier to north	8' high barrier to north or spring-rail/moveable point frog
Station 489[5]	No Mitigation	No Mitigation

1. These crossovers are associated with the Flower Street Design Option.
2. This crossover is associated with the Venice/Robertson Station North of ROW Option C.
3. This crossover is associated with the Venice/Robertson Station North of ROW Option B.
4. This crossover is associated with the Venice/Robertson Station North of ROW Option A and the ROW Option.
5. This crossover is associated with the Venice/Robertson Aerial Option and the LPA.

- Station 103 Crossover: The proposed crossover at Station 103 is not located near any noise sensitive receivers and does not require any mitigation or relocation.
- Station 111 Crossover: The proposed crossover at Station 111 is not located near any noise sensitive receivers and does not require any mitigation or relocation.
- Station 152 Crossover: The proposed crossover at Station 152 is not located near any noise sensitive receivers and does not require any mitigation or relocation.
- Station 213 Crossover: The proposed crossover at Station 213 is located at the eastern end of a residential neighborhood and would significantly increase the noise levels for adjacent sensitive receptors at this location. Without the proposed crossover at this location, no noise impact is projected at the adjacent residences. With the inclusion of the crossover, there would be noise impact for sensitive receptors both to the north and south of the tracks. A spring-rail or moveable point crossover would eliminate the additional noise impact at this location.

- Station 311 Crossover: The proposed crossover at Station 311 is located at the western end of a residential neighborhood that is within 30 to 40 feet of the tracks and would significantly increase the noise levels at this location. Without the proposed crossover at this location, no noise impact is projected at the adjacent residences to the north of the tracks and severe impact is projected for the residences to the south of the tracks. With the inclusion of the crossover, there would be noise impact for the residences to the north of the tracks and increased noise levels for the residences to the south of the tracks. The crossover will be moved to a less sensitive location or a spring-rail frog will be used.
- Station 413 Crossover: The proposed crossover at Station 413 is located at the western end of a residential neighborhood and would significantly increase the noise levels at this location. Without the proposed crossover at this location, no noise impact is projected at the adjacent residences to the north of the tracks and impact is projected for the residences to the south of the tracks. With the inclusion of the crossover, there would be noise impact to the north of the tracks and severe impact to the south of the tracks. The crossover will be moved to a less sensitive location or a spring-rail frog will be used.
- Station 482 Crossover: The proposed crossover at Station 482 related to the North of ROW Option C is located adjacent to a residential neighborhood and would significantly increase the noise levels at this location. Without the proposed crossover at this location, there would be noise impact at the residences to the north and with the inclusion of the crossover; there would be additional noise impact to the north of the tracks. A spring-rail frog will be used at this location to eliminate the projected noise impact.
- Station 484 Crossover: The proposed crossover at Station 484 related to the North of ROW Option B is located adjacent to a residential neighborhood and would significantly increase the noise levels at this location. Without the proposed crossover at this location, there would be noise impact at the residences to the north and with the inclusion of the crossover; there would be additional noise impact to the north of the tracks. A spring-rail frog will be used at this location to eliminate the projected noise impact.
- Station 486 Crossover: The proposed crossover at Station 486 related to the North of ROW Option A and the ROW Option is located adjacent to a residential neighborhood and would significantly increase the noise levels at this location. Without the proposed crossover at this location, there would be noise impact at the residences to the north and with the inclusion of the crossover; there would be additional noise impact to the north of the tracks. A spring-rail frog will be used at this location to eliminate the projected noise impact.
- Station 489 Crossover: The proposed crossover at Station 489 is located far enough from any noise sensitive receivers and does not require any mitigation or relocation.

7.2 Vibration Mitigation Measures

7.2.1 LRT Operations Vibration Mitigation

The assessment assumes that the vehicle wheels and track are maintained in good condition with regular wheel truing and rail grinding. Beyond this, there are several approaches to reduce ground-borne vibration from commuter rail operations, as described below.

- Ballast Mats: A ballast mat consists of a pad made of rubber or rubber-like material placed on an asphalt or concrete base with the normal ballast, ties and rail on top. The reduction in ground-borne vibration provided by a ballast mat is strongly dependent on the frequency content of the vibration and design and support of the mat. Ballast mat costs approximately $300/track foot.

- Resilient Fasteners: Resilient fasteners can be used in place of standard track fasteners to attach the track to concrete slabs. Resilient fasteners are typically much less stiff compared with the standard fasteners, and can provide significant vibration reduction, particularly in frequencies above 40 Hz. Vibration reduction would be roughly comparable to a ballast mat depending on the vibration frequency. Resilient fasteners cost approximately $300/track foot.

- Resiliently Supported Ties: Resiliently supported ties consist of concrete ties supported on rubber pads. Vibration reduction is achieved through the isolation of the track system on the rubber elements. As with resilient fasteners, resiliently supported ties are effective at reducing high frequency vibration, and they are more effective than resilient fasteners at reducing low frequencies in the 30 to 40 Hz range. Vibration reduction would be roughly comparable to a ballast mat depending on the vibration frequency. Resilient ties cost approximately $400/track foot.

- Tire Shred or Recycled Rubber Chip Underlay: A 12-inch-thick resilient layer of recycled rubber chips placed beneath the sub-ballast layer of standard open ballast and tie track could be incorporated into the track design. This mitigation method would provide results similar to ballast mats, providing a 3–5 VdB reduction. Shredded tire underlay costs less than ballast mat, but the cost depends on the type of installation and material used.

- Floating Slabs: Floating slabs consist of thick concrete slabs supported by resilient pads on a concrete foundation; the tracks are mounted on top of the floating slab. Most successful floating slab installations are in subways, and their use for at-grade track is less common. Although floating slabs are designed to provide vibration reduction at lower frequencies than ballast mats, they are extremely expensive. Floating slab track costs approximately $600/track foot.

- Relocation of Crossovers or Special Trackwork: Because the impacts of wheels over rail gaps at track crossover locations increases vibration by about 10 dBA, crossovers are a major source of vibration impact when they are located in sensitive areas. If crossovers cannot be relocated away from residential areas, another approach is to use spring-rail or moveable point frogs in place of standard rigid frogs at turnouts. These devices allow the flangeway gap to remain closed in the main traffic direction for revenue service trains.

Vibration impacts that exceed FTA criteria are considered to be significant and to warrant mitigation, if reasonable and feasible. At a minimum, mitigation would require the installation of ballast mats. However, more extensive mitigation may be required to adequately reduce the vibration levels to below the FTA vibration impact criterion.

The vibration mitigation locations are shown in Table 22. Because detailed engineering drawings and information are not available during the EIS phase of a project, specific recommendations are not finalized until the engineering and design phase of the project. All vibration mitigation will be designed to a performance specification that will reduce vibration levels at all impacted residential locations to below the FTA vibration criterion. The types of mitigation measures listed above provide examples of potential mitigation measures that might be used to meet the performance specification. As shown in the Table 22, vibration mitigation is recommended at vibration-sensitive receptors along 7,300 feet of the corridor. The maps in Appendix D show the location of all vibration mitigation measures.

Table 22. Vibration Mitigation Locations

Track Segment	Vibration Mitigation Description[1]			Residual Impacts	
	Civil Stations	Length (ft)	Mitigation Measure[2]	SF[3]	MF[3]
Exposition Blvd., from Vermont Ave. to Western Ave.	209 - 249	4,000	1,2,3,4,5	0	0
Exposition Blvd., from Western Ave. to Arlington Ave.	280 - 286	600	1,2,3,4,5	0	0
Exposition Blvd., from Arlington Ave. to Crenshaw Blvd.	286 - 313	2,700	1,2,3,4,5	0	0
Total		**7,300**		**0**	**0**

1. The numbers in this column refer to the list of mitigation measures above. At the EIS stage of a project, specific mitigation measures cannot be recommended, as there is not enough detailed engineering information available. Final mitigation measures will be determined during the engineering phase of the project. The vibration mitigation recommendations show the locations and extent of vibration mitigation and allows a rough order of magnitude for cost estimate purposes.

The North of ROW Option A would pass within approximately 10 feet of a sound recording studio located at 3431 Wesley Street. Significant vibration and ground-borne noise impacts are projected at this building due to LRT operations. The criterion for vibration impact for this type of building is 65 VdB. The projected ground-borne vibration level at the closest edge of this building is 77 VdB. In addition, and probably more importantly for a studio, the ground-borne noise impact criterion is 25 dBA and the projected ground-borne noise level at the closest edge of this building is 47 dBA. The projections for ground-borne noise are based on the projected ground-borne vibration levels at the building edge.

If the North of ROW Option A station design option is adopted for the site of the Venice/Robertson Station, a detailed, specific noise impact assessment for this business shall be required in accordance with Federal Transit Administration noise impact criteria to measure the specific nature of the business and the site specific impacts of the LRT vehicles. Outdoor to indoor vibration measurements would be conducted to evaluate the building foundation coupling loss, the effects of any existing construction (such as floating floors or insulated walls) currently used to isolate the recording areas from other noise and vibration sources and the existing noise levels in the studio. Due to such factors, it is likely that the projected ground-borne noise and vibration levels inside the studio would be lower than the projections above, but vibration mitigation would probably still need to be employed to reduce the projected levels to meet the criterion.

In addition, the ground-borne noise criterion may not be stringent enough based on the sensitivity and use of the studio. Other criteria, such as a Noise Criterion curve, might be appropriate for this location. The project shall be required to fully mitigate the sound impacts of the LRT vehicles on this business, and if it is determined that such mitigation measures do not meet the above threshold criteria, Metro shall be required to relocate the business and acquire the property.

7.2.2 Crossover Vibration Mitigation

Table 23 indicates the crossover vibration mitigation measures that would be required for the crossovers along the corridor. The proposed crossovers at Stations 103, 111, and 152 would not require any additional vibration mitigation and would not need to be relocated or have spring-rail or moveable point frogs to eliminate impact.

The remaining crossovers at Stations 213, 311, 413, and the potential crossovers at Stations 482 (North of ROW Option C), 484 (North of ROW Option B), and 486 (ROW and North of ROW Option A), are located adjacent to vibration sensitive receptors and would need substantial amounts of additional mitigation or the use of spring-rail or moveable point frogs if they remain at the proposed locations. Alternatively, these crossovers would need to be relocated to less sensitive locations, within the limits of operational and geometrical constraints. In addition, the crossover at Station 489 (for the LPA only) would have the potential to generate vibration impact at the studio on Wesley Street. For the Aerial Option, the crossover at 489 is not projected to cause vibration impact at the studio.

Table 23. Crossover Vibration Mitigation Assessment

Crossover Location	Mitigation Recommendations Without Crossover	Mitigation Recommendations With Crossover
Station 103	No Mitigation	No Mitigation
Station 111[1]	No Mitigation	No Mitigation
Station 152[1]	No Mitigation	No Mitigation
Station 213	Vibration Mitigation	Spring-rail or moveable point frog
Station 311	Significant vibration mitigation	Crossover will be moved or spring-rail/moveable point frog
Station 413	No Mitigation	Crossover will be moved or spring-rail/moveable point frog
Station 482[2]	No Mitigation	Significant vibration mitigation or spring rail/moveable point frog
Station 484[3]	No Mitigation	Significant vibration mitigation or spring rail/moveable point frog
Station 486[4]	No Mitigation	Significant vibration mitigation or spring rail/moveable point frog
Station 489[5]	No Mitigation	Mitigation (to be determined)

1. These crossovers are associated with the Flower Street Design Option.
2. This crossover is associated with the Venice/Robertson Station North of ROW Option C.
3. This crossover is associated with the Venice/Robertson Station North of ROW Option B.
4. This crossover is associated with the Venice/Robertson Station North of ROW Option A and the ROW Option.
5. This crossover is associated with the Venice/Robertson Aerial Option and the LPA.

- Station 103 Crossover: The proposed crossover at Station 103 is not located near any vibration sensitive receivers and does not require any mitigation or relocation.

- Station 111 Crossover: The proposed crossover at Station 111 is not located near any vibration sensitive receivers and does not require any mitigation or relocation.

- Station 152 Crossover: The proposed crossover at Station 152 is not located near any vibration sensitive receivers and does not require any mitigation or relocation.

- Station 213 Crossover: The proposed crossover at Station 213 is located at the eastern end of a residential neighborhood and would significantly increase the vibration levels for adjacent sensitive receptors at this location. Without the proposed crossover at this location, the projected vibration levels at nearby residences range from 70 – 75 VdB and vibration mitigation is currently proposed. With the inclusion of the crossover at this location, the projected vibration levels would be 80 – 85 VdB and would require a significant increase in the level of vibration mitigation in order to reduce the vibration levels to below the impact criterion. A spring-rail or moveable point crossover would eliminate the additional vibration impact at this location.

- Station 311 Crossover: The proposed crossover at Station 311 is located at the western end of a residential neighborhood that is within 30 to 40 feet of the tracks and would significantly increase the vibration levels at this location. Without the proposed crossover at this location, the projected vibration levels at nearby residences range from 65 VdB to the north of the tracks to 79 – 84 VdB to the south of the tracks and significant vibration mitigation is currently proposed. With the inclusion of the crossover at this location, the projected vibration levels would be 75 VdB to the north of the tracks and 89 – 94 VdB to the south of the tracks and even with the use of a floating slab track, there would still be residual impacts to the south of the tracks. The crossover will be moved to a less sensitive location or a spring-rail frog will be used.

- Station 413 Crossover: The proposed crossover at Station 413 is located at the western end of a residential neighborhood and would significantly increase the vibration levels at this location. Without the proposed crossover at this location, the projected vibration levels at nearby residences range from 70 – 72 VdB and no vibration mitigation is currently proposed. With the inclusion of the crossover at this location, the projected vibration levels would be 80 – 82 VdB and even with the use of a floating slab track as mitigation, there would still be residual impacts due to the crossover. The crossover will be moved to a less sensitive location or a spring-rail frog will be used.

- Station 482 Crossover: The proposed crossover at Station 482 related to the North of ROW Option C is located adjacent to a residential neighborhood and would significantly increase the vibration levels at this location. Without the proposed crossover at this location, there would be no vibration impact at the residences to the north and with the inclusion of the crossover; there would be significant vibration impact to the north of the tracks. A spring-rail frog will be used at this location to eliminate the projected noise impact.

- Station 484 Crossover: The proposed crossover at Station 484 related to the North of ROW Option B is located adjacent to a residential neighborhood and would significantly increase the vibration levels at this location. Without the proposed crossover at this location, there would be no vibration impact at the residences to the north and with the inclusion of the crossover; there would be significant vibration impact to the north of the tracks. A spring-rail frog will be used at this location to eliminate the projected noise impact.

- Station 486 Crossover: The proposed crossover at Station 486 related to the North of ROW Option A and the ROW Option is located adjacent to a residential neighborhood and would significantly increase the vibration levels at this location. Without the proposed crossover at this location, there would be no vibration impact at the residences to the north and with the inclusion of the crossover; there would be significant vibration impact to the north of the tracks. A spring-rail frog will be used at this location to eliminate the projected noise impact.

- Station 489 Crossover: The proposed crossover at Station 489 (LPA only, the Aerial Option is not projected to generate vibration impact at the studio) is located near a recording studio at 3431 Wesley Street. There is the potential for vibration and ground-borne noise impact at this location due to the crossover. Refer to Section 6.2.1 for a discussion of the potential impact at this studio. The crossover may have to be relocated or a spring-rail frog used at this location, depending on the results of the detailed analysis of this studio.

7.3 Construction Noise and Vibration Mitigation Measures

Construction noise varies greatly depending on the construction process, type and condition of equipment used, and layout of the construction site. Many of these factors are traditionally left to the contractor's discretion, which makes it difficult to accurately estimate levels of construction noise. Overall, construction noise levels are governed primarily by the noisiest pieces of equipment. For most construction equipment, the engine, which is usually diesel, is the dominant noise source. This is particularly true of engines without sufficient muffling. For special activities such as impact pile driving and pavement breaking, noise generated by the actual process dominates.

Temporary noise during construction of the new tracks and the stations has the potential of being intrusive to residents near the construction sites. Most of the construction would consist of site preparation and laying new track, and would only occur during daytime hours.

Construction activities will be carried out in compliance with all applicable local noise regulations. In addition, specific residential property line noise limits will be developed during final design and included in the construction specifications for the project, and noise monitoring will be performed during construction to verify compliance with the limits. This approach allows the contractor flexibility to meet the noise limits in the most efficient and cost-effective manner. Noise control measures that will be applied as needed to meet the noise limits include the following:

- Avoiding nighttime construction in residential neighborhoods.
- Using specially quieted equipment with enclosed engines and/or high-performance mufflers.
- Locating stationary construction equipment as far as possible from noise-sensitive sites.
- Constructing noise barriers, such as temporary walls or piles of excavated material, between noisy activities and noise-sensitive receivers.
- Re-routing construction-related truck traffic along roadways that will cause the least disturbance to residents.
- Avoiding impact pile driving near noise-sensitive areas, where possible. Drilled piles or the use of a sonic or vibratory pile driver are quieter alternatives where the geological conditions permit their use. If impact pile drivers must be used, their use will be limited to the periods between 8:00 a.m. and 5:00 p.m. on weekdays.

With the incorporation of the appropriate noise mitigation measures, impacts from construction-generated noise should not be significant. To provide added assurance, a complaint resolution procedure should also be put in place to rapidly address any noise problems that may develop during construction.

Construction activities that could cause intrusive vibration include vibratory compaction, jackhammers, and use of tracked vehicles such as bulldozers. The most serious sources of construction vibration are blasting and pile driving. There will be no blasting for this project and only limited, if any, pile driving. Avoiding vibration impacts during construction can be achieved through numeric limits in the construction specifications.

APPENDIX A MEASUREMENT SITE PHOTOGRAPHS

Figure A-1. Site LT-13, 2400 South Flower Street

Figure A-2. Site LT-4, 1250 Exposition Boulevard

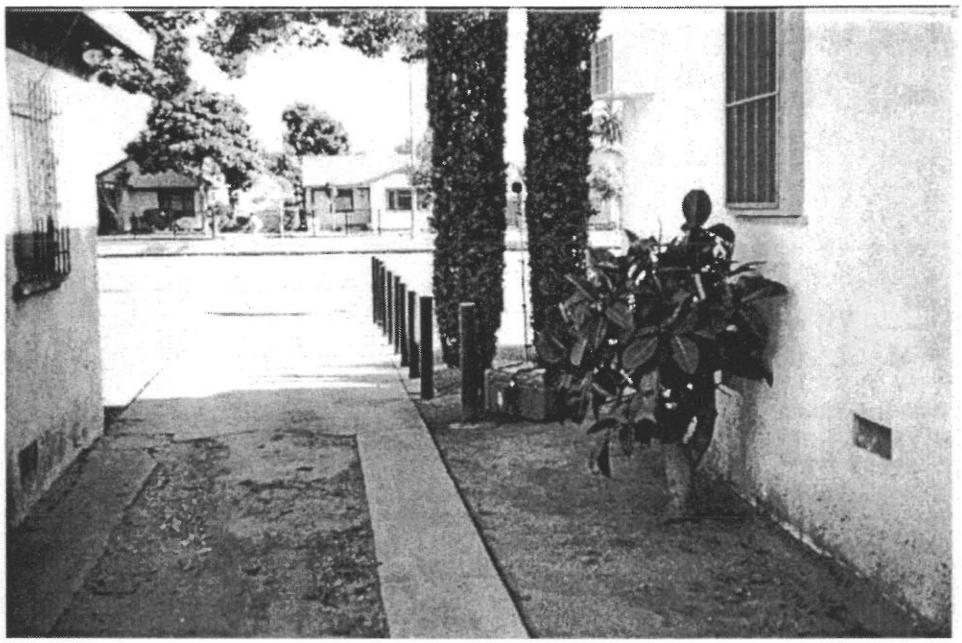


Figure A-3. Site LT-8, 1647 Exposition Boulevard

Figure A-4. Site LT-7, 2531 Exposition Place

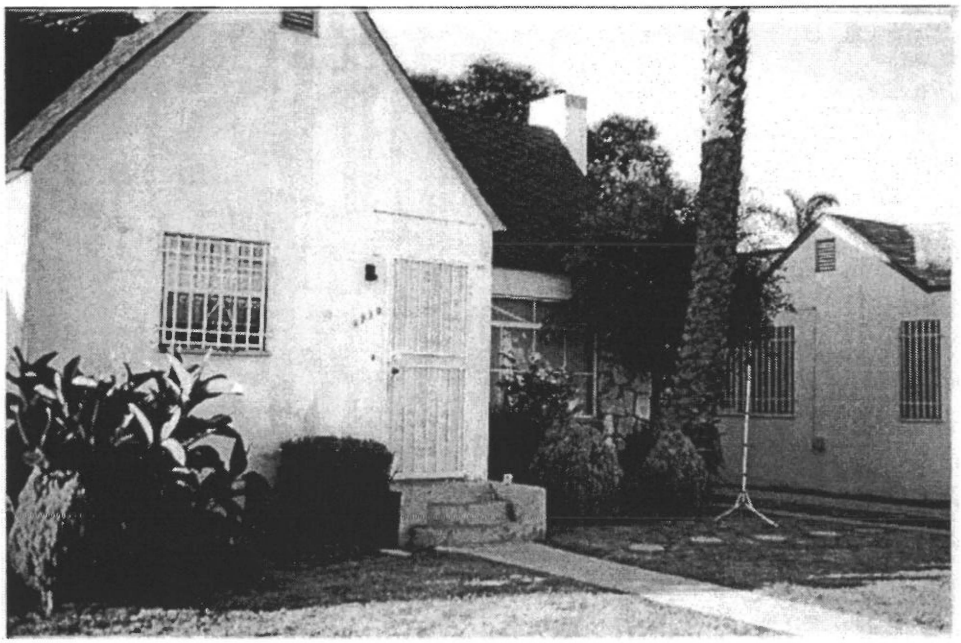


Figure A-5. Site LT-11, 3719 Exposition Boulevard

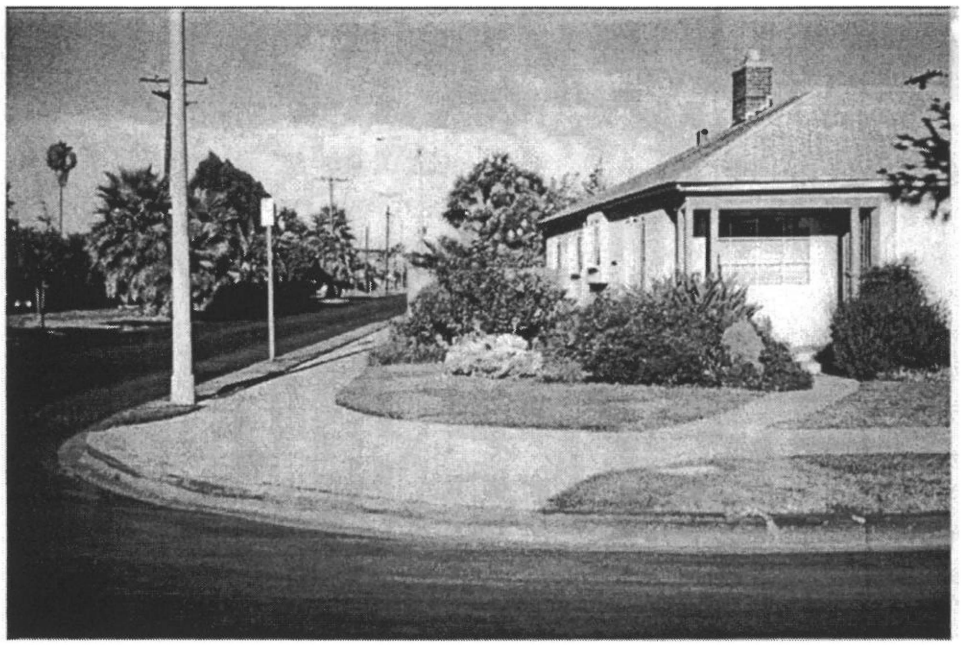


Figure A-6. Site LT-10, 3500 Muirfield Road

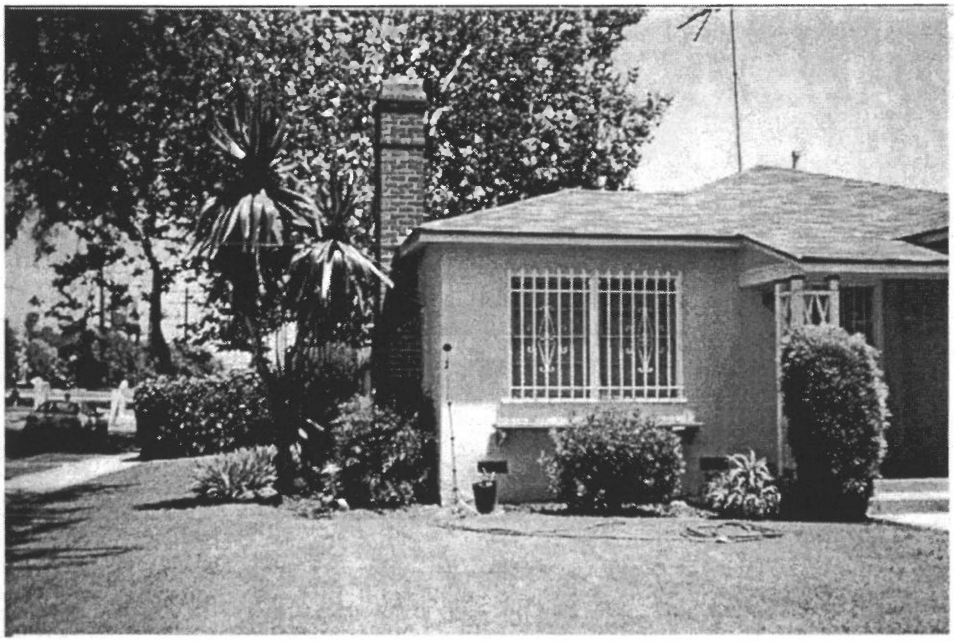


Figure A-7. Site LT-3, 3420 Sycamore Avenue

Figure A-8. Site LT-6, 5539 Jefferson Boulevard

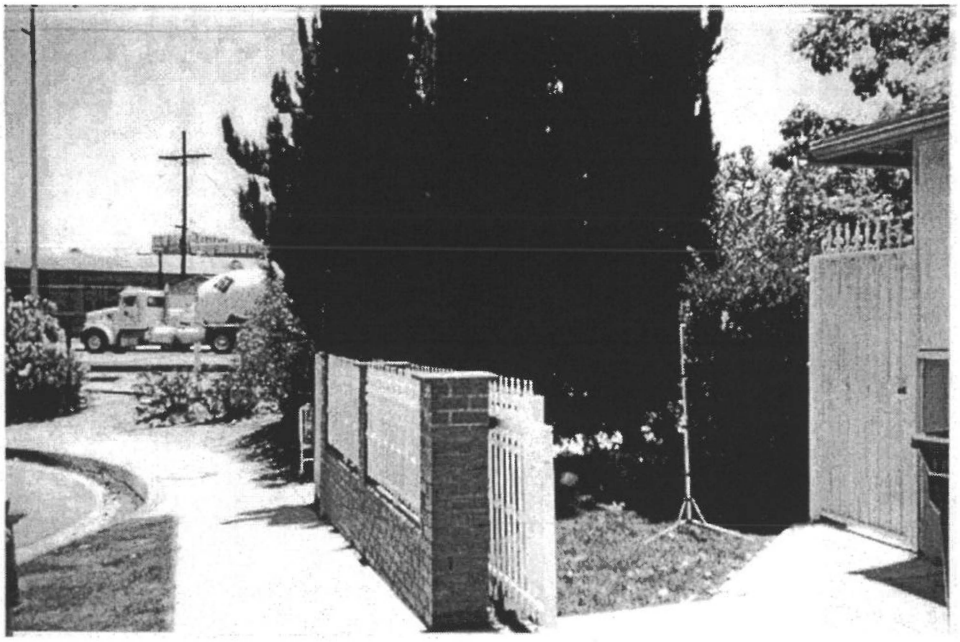


Figure A-9. Site LT-2, 3437 Caroline Avenue, Culver City

Figure A-10. Site ST-8, Orthopedic Hospital

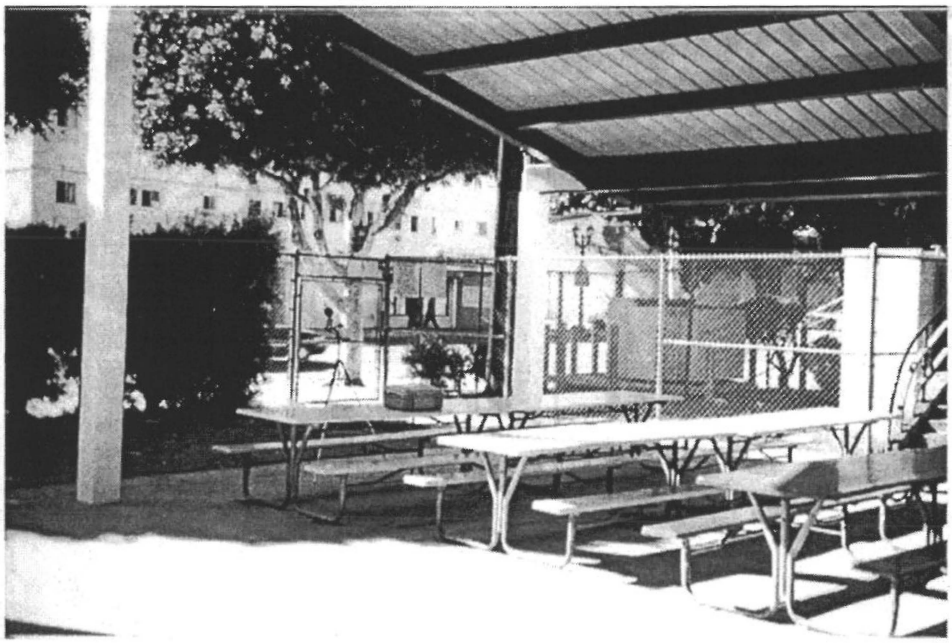


Figure A-11. Site ST-9, John Adams Junior High School

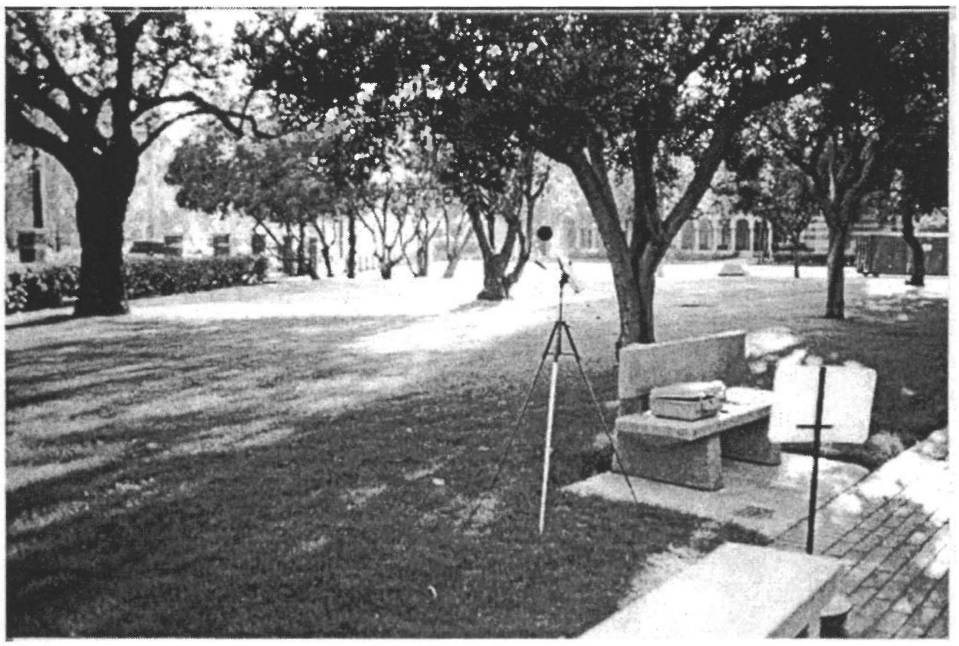


Figure A-12. Site ST-1, USC Marshall School of Business

Figure A-13. Site ST-10, Dorsey High School

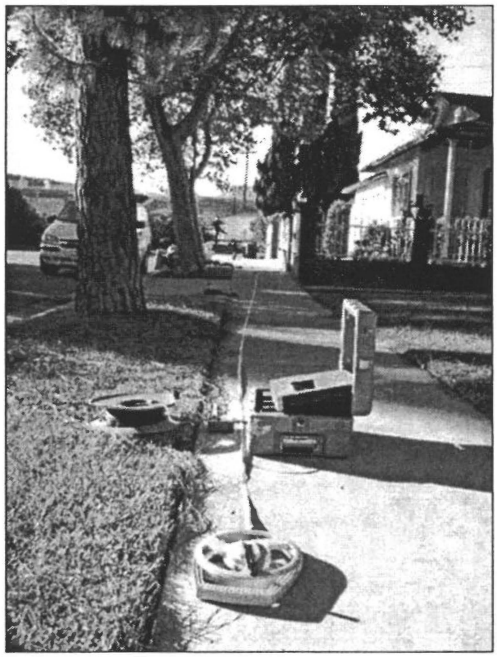


Figure A-14. Site V-4, End of Caroline Avenue, North of National Boulevard

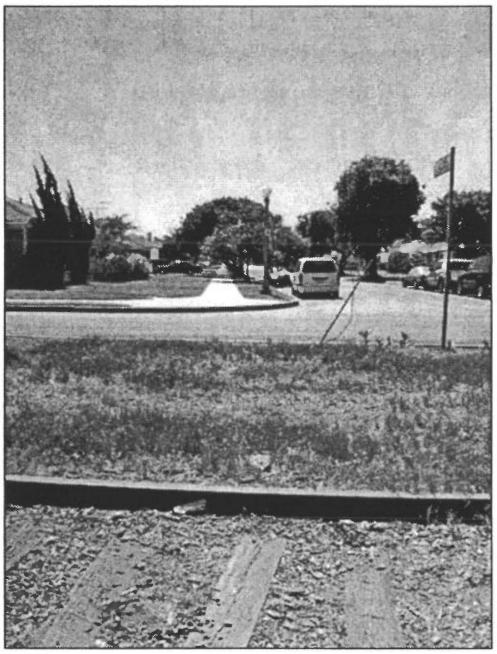


Figure A-15. Site V-5, Intersection of Hillcrest Drive and Exposition Boulevard

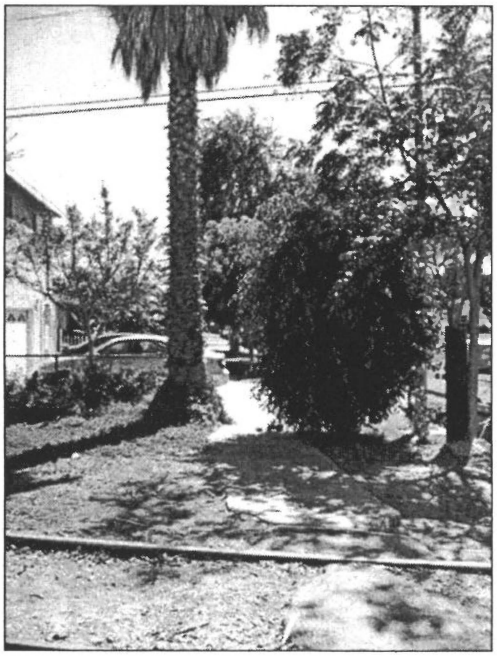


Figure A-16. Site V-6, End of Fourth Avenue, South of Exposition Boulevard

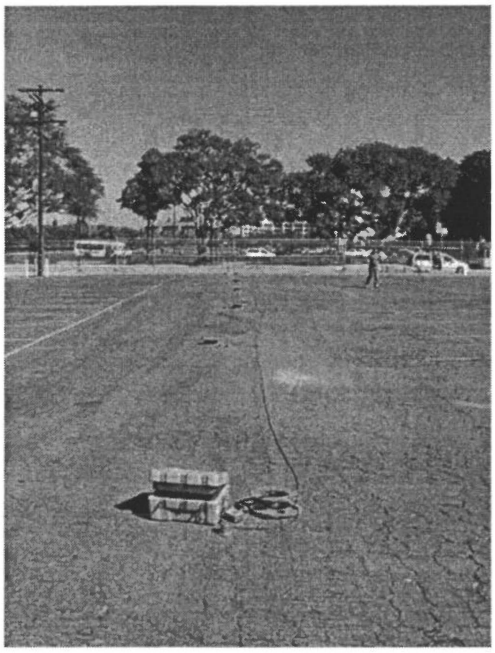


Figure A-17. Site V-7, USC Parking lot near Vermont Avenue, South of Exposition Boulevard

APPENDIX B NOISE MEASUREMENT DATA

Site LT-13: 2400 S. Flower St. (Orthopedic Hospital)

Ldn: 70 dBA

Table B-1. Noise Survey Results, Site LT-13

Start Hour	Leq	Lmax	Lmin	L1	L10	L33	L50	L90	L99
15:00	66.2	86.2	59.6	73.8	68.7	65.0	63.6	61.2	60.1
16:00	66.8	89.0	59.2	74.4	69.6	65.7	64.0	61.3	60.0
17:00	66.6	80.7	58.2	74.5	70.1	66.0	64.2	60.6	59.1
18:00	69.1	84.1	57.9	77.9	74.0	66.7	64.4	61.1	59.4
19:00	64.8	80.9	60.8	70.8	66.8	64.5	63.7	62.2	61.1
20:00	64.6	80.7	60.8	70.7	66.2	64.2	63.6	62.2	61.2
21:00	64.1	84.7	60.2	71.4	65.2	63.3	62.7	61.4	60.5
22:00	62.4	77.4	58.9	67.8	63.8	62.4	61.8	60.7	59.7
23:00	61.9	71.7	57.4	66.4	63.0	62.1	61.6	60.1	58.7
00:00	60.9	71.0	55.6	65.5	62.0	61.0	60.5	59.0	57.2
01:00	61.5	80.7	55.3	72.1	61.5	59.7	59.1	57.4	56.0
02:00	59.8	71.8	53.1	64.9	61.2	60.0	59.3	57.3	54.9
03:00	58.8	67.4	53.2	62.6	60.6	59.2	58.5	56.3	54.2
04:00	61.8	74.5	54.5	66.8	64.3	61.9	61.0	58.3	56.4
05:00	64.4	75.9	57.8	70.3	66.1	64.5	63.7	61.6	59.4
06:00	65.6	75.0	62.6	70.7	67.0	65.6	65.1	64.1	63.2
07:00	65.8	76.9	60.4	72.3	68.3	65.5	64.6	62.6	61.5
08:00	65.4	75.4	61.1	72.0	68.0	65.1	64.0	62.3	61.3
09:00	65.5	81.4	60.3	73.9	67.7	64.6	63.6	62.0	61.1
10:00	64.9	76.5	60.7	71.4	66.9	64.6	63.8	62.2	61.1
11:00	65.7	75.9	61.4	72.4	68.1	65.4	64.5	62.7	61.5
12:00	65.7	81.9	59.9	72.9	68.0	65.3	64.3	62.2	60.9
13:00	65.4	78.7	60.1	72.7	67.9	65.0	63.9	61.9	60.5
14:00	65.3	84.4	59.2	72.6	67.9	64.7	63.4	61.2	60.0

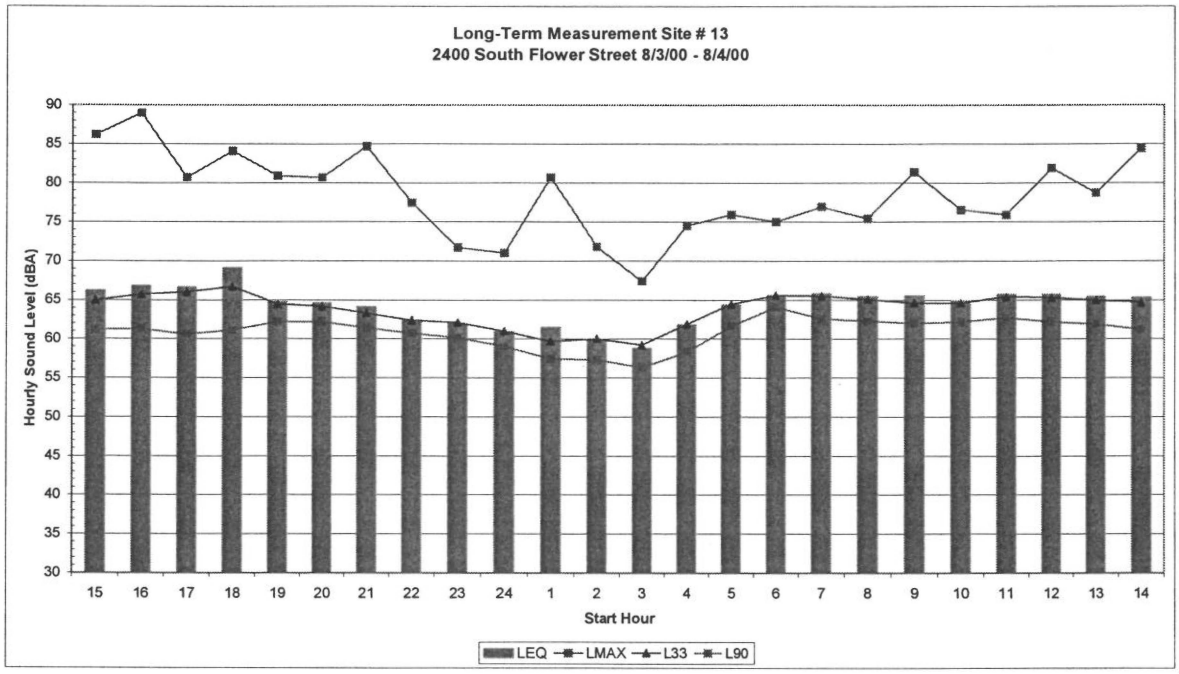


Figure B-1. Noise Survey Results, Site LT-13 – 2400 S. Flower St. (Orthopedic Hospital)

Site LT-4: 1250 Exposition Blvd.

Ldn: 69 dBA

Table B-2. Noise Survey Results, Site LT-4

Start Hour	Leq	Lmax	Lmin	L1	L10	L33	L50	L90	L99
16:00	67.4	87.7	47.6	77.7	71.4	65.1	60.3	53.8	50.4
17:00	67.4	96.2	48.3	76.4	70.6	63.4	59.9	54.7	51.5
18:00	66.0	87.7	48.7	75.6	70.0	63.0	59.8	54.5	51.1
19:00	65.5	87.4	47.3	76.2	69.1	61.9	59.0	53.2	49.9
20:00	67.7	102.7	44.5	78.7	68.7	60.7	57.8	51.5	48.0
21:00	62.3	82.2	40.3	73.2	66.1	59.0	56.2	49.3	45.1
22:00	61.6	84.6	38.6	72.6	65.0	58.1	55.0	46.6	41.9
23:00	59.1	79.9	35.1	71.5	61.3	54.2	49.9	41.5	37.0
00:00	56.5	79.0	32.5	69.5	58.1	49.3	45.0	37.8	34.8
01:00	54.2	79.3	31.6	67.6	54.6	45.4	41.9	35.3	33.2
02:00	53.8	78.2	30.2	67.1	53.6	44.1	40.1	33.9	31.8
03:00	53.1	79.1	28.5	67.2	52.3	42.5	38.1	32.2	30.1
04:00	55.7	78.2	29.8	69.3	55.9	44.1	39.8	32.4	30.7
05:00	62.5	87.6	33.6	73.7	65.7	56.0	52.3	43.6	36.3
06:00	67.5	92.7	41.1	77.9	71.1	62.8	58.9	49.6	44.6
07:00	69.4	85.3	48.8	78.9	73.8	68.5	63.0	56.1	51.4
08:00	69.5	91.2	45.1	79.8	73.6	67.2	61.7	54.0	49.3
09:00	67.5	86.0	43.7	77.5	72.0	63.7	59.7	52.8	48.1
10:00	66.7	90.0	44.5	77.9	70.1	61.6	58.2	50.9	47.1
11:00	64.6	84.1	43.0	75.2	68.5	60.2	57.1	50.3	46.6
12:00	67.4	91.9	45.0	77.6	71.6	63.6	58.8	51.5	47.7
13:00	65.4	87.7	46.4	75.9	69.2	61.1	57.9	52.1	48.5
14:00	65.1	87.1	45.1	75.1	69.3	61.1	57.6	51.5	48.2
15:00	66.6	88.4	48.7	76.7	70.8	63.4	59.7	53.9	51.1

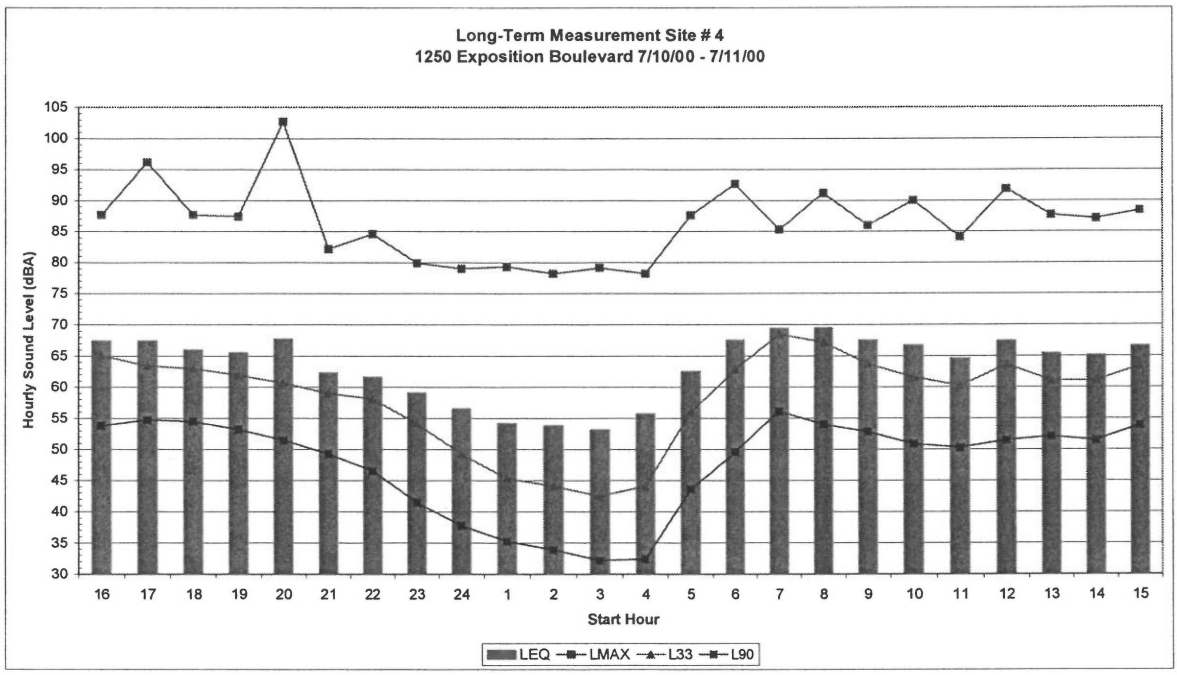


Figure B-2. Noise Survey Results, Site LT-4 – 1250 Exposition Blvd.

Site LT-8: 1647 Exposition Blvd.

Ldn: 67 dBA

Table B-3. Noise Survey Results, Site LT-8

Start Hour	Leq	Lmax	Lmin	L1	L10	L33	L50	L90	L99
18:00	64.1	89.8	45.9	72.4	68.6	62.5	59.5	53.4	50.3
19:00	62.9	81.7	44.5	72.2	67.2	60.6	57.7	51.1	47.3
20:00	62.3	87.4	43.5	70.9	66.0	59.2	56.5	50.3	46.6
21:00	61.2	82.5	42.1	70.5	65.6	58.9	56.1	48.9	45.0
22:00	59.8	75.9	39.1	70.5	64.2	56.6	53.5	45.9	42.3
23:00	58.0	74.9	38.1	69.0	62.2	54.3	50.7	43.1	39.7
00:00	55.5	77.7	35.8	67.9	57.6	49.2	45.2	39.9	37.9
01:00	53.8	73.5	34.9	65.6	57.9	45.8	42.1	37.9	36.3
02:00	59.1	89.9	32.8	67.5	53.8	43.3	40.4	36.2	34.3
03:00	50.5	72.2	32.0	64.4	51.0	41.3	38.7	35.0	33.6
04:00	54.5	76.4	32.4	68.1	54.8	43.7	40.3	35.4	34.0
05:00	58.6	79.8	32.7	70.1	61.6	53.7	50.5	41.0	36.7
06:00	62.9	80.3	41.1	72.6	67.7	59.9	56.9	48.5	44.3
07:00	65.7	82.7	44.9	73.8	70.3	64.9	60.8	53.1	48.4
08:00	65.5	93.7	44.5	73.9	69.8	63.0	59.9	52.6	48.2
09:00	63.8	93.1	41.0	72.8	68.0	61.1	58.3	51.3	46.4
10:00	62.2	86.5	41.6	72.0	66.8	59.2	56.6	49.8	45.0
11:00	62.9	86.4	42.5	73.2	66.4	59.4	56.5	49.7	46.0
12:00	68.6	89.4	44.6	84.1	68.4	63.0	59.1	52.0	47.8
13:00	62.9	83.9	44.7	72.6	67.2	59.8	56.9	50.3	47.2
14:00	63.7	85.6	45.4	73.3	67.8	61.2	58.1	50.9	47.3
15:00	64.2	78.8	46.1	72.9	68.6	63.1	59.5	53.1	49.2
16:00	64.6	82.4	48.9	73.1	69.5	62.6	59.2	53.0	50.4
17:00	65.7	88.5	48.3	73.3	70.6	64.5	60.7	54.2	51.3

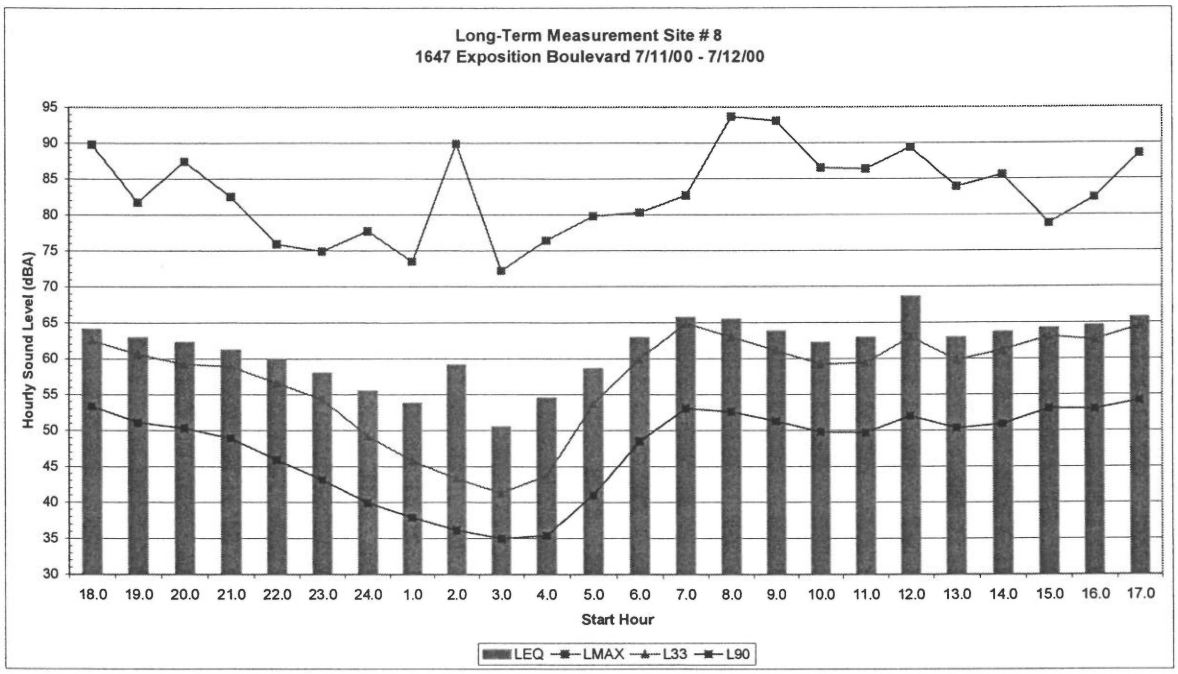


Figure B-3. Noise Survey Results, Site LT-8 – 1647 Exposition Blvd.

Site LT-7: 2531 Exposition Place

Ldn: 58 dBA

Table B-4. Noise Survey Results, Site LT-7

Start Hour	Leq	Lmax	Lmin	L1	L10	L33	L50	L90	L99
17:00	68.6	87.8	46.7	81.1	69.1	59.7	57.4	51.4	48.4
18:00	71.5	92.5	44.4	84.5	72.0	59.0	56.5	50.2	46.6
19:00	55.4	71.4	43.3	63.7	58.9	55.0	52.9	47.2	45.2
20:00	70.5	93.3	40.9	86.0	60.7	55.4	53.2	46.8	43.9
21:00	53.8	68.8	39.3	62.0	57.5	53.5	51.0	43.7	41.0
22:00	53.9	75.9	38.5	64.7	56.9	51.0	47.9	41.2	39.2
23:00	54.6	75.5	36.7	67.0	56.6	48.6	43.6	38.7	37.3
00:00	57.0	80.6	35.9	71.2	54.8	44.1	40.6	37.1	36.1
01:00	67.9	91.7	35.3	82.3	63.4	41.8	38.8	36.4	35.5
02:00	53.1	76.7	32.7	67.1	49.6	39.2	37.0	34.7	33.3
03:00	47.3	73.4	33.5	56.6	45.8	37.1	36.1	34.5	34.0
04:00	56.8	78.1	32.1	70.3	55.9	39.6	36.7	34.4	32.7
05:00	58.2	73.6	33.1	70.4	61.0	51.5	46.4	37.0	34.8
06:00	57.9	86.1	35.3	67.6	60.8	55.1	51.2	41.4	37.9
07:00	58.0	70.3	40.7	65.7	61.6	58.0	55.9	47.9	42.8
08:00	58.0	79.3	38.5	66.8	61.1	57.4	54.6	45.2	40.5
09:00	59.8	81.5	38.6	72.0	61.1	56.6	53.9	45.1	41.1
10:00	56.1	70.1	39.4	65.9	59.2	55.5	53.4	46.5	42.0
11:00	54.6	71.0	40.1	63.3	57.8	54.2	51.8	45.3	41.1
12:00	54.4	69.5	42.7	63.1	57.6	53.8	51.9	46.6	44.2
13:00	55.0	71.7	41.7	64.6	58.2	54.1	52.1	46.6	43.7
14:00	56.6	74.2	43.2	65.5	60.2	56.0	53.2	47.4	44.4
15:00	59.8	78.5	45.4	68.7	63.8	58.3	56.1	50.8	47.7
16:00	59.3	81.0	44.7	70.4	60.5	56.9	55.0	49.6	46.6

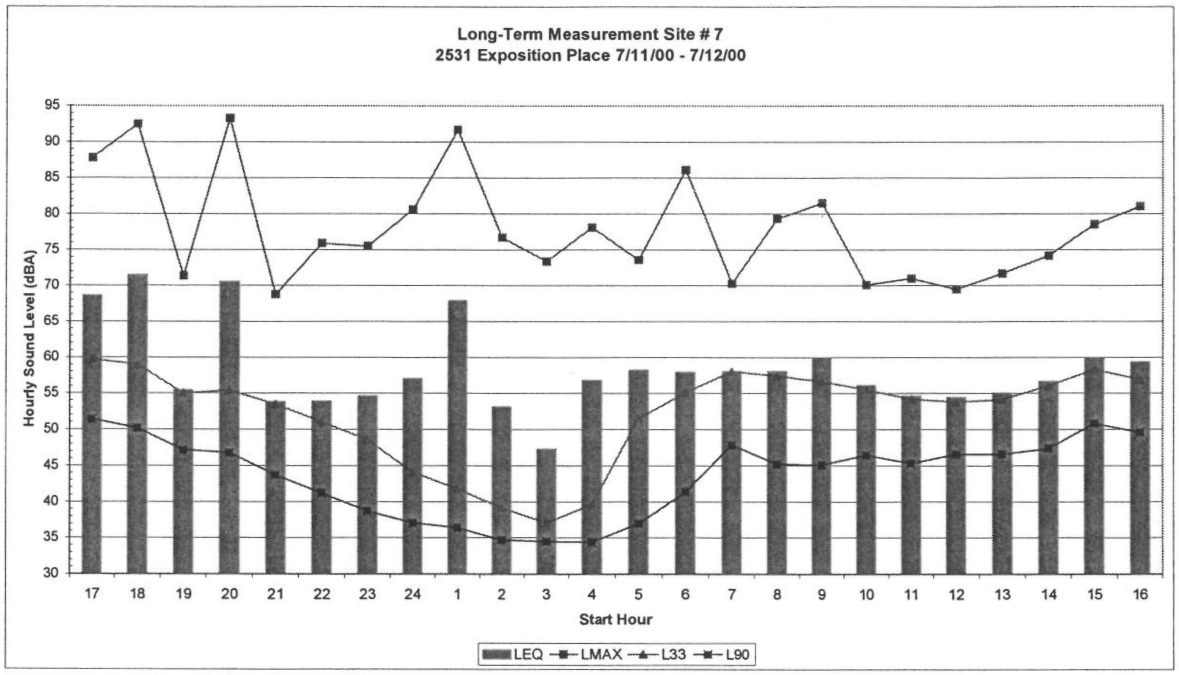


Figure B-4. Noise Survey Results, Site LT-7 – 2531 Exposition Place

Site LT-11: 3719 Exposition Blvd.

Ldn: 65 dBA

Table B-5. Noise Survey Results, Site LT-11

Start Hour	Leq	Lmax	Lmin	L1	L10	L33	L50	L90	L99
19:00	63.4	75.8	45.9	71.7	68.0	63.2	58.1	49.6	47.3
20:00	62.6	76.0	44.8	71.4	67.6	61.5	55.3	48.1	46.3
21:00	61.0	76.5	42.5	70.6	66.1	57.4	51.7	45.5	43.4
22:00	58.5	73.8	41.4	69.6	63.3	51.7	48.2	44.3	42.2
23:00	58.2	82.1	39.6	70.2	61.3	46.7	44.5	41.5	40.2
00:00	54.3	71.8	38.9	67.7	53.3	45.4	43.8	40.7	39.4
01:00	52.9	76.1	37.8	67.1	48.4	43.4	42.1	39.6	38.3
02:00	51.3	72.4	34.7	65.9	47.5	41.1	39.4	36.3	35.1
03:00	49.2	73.8	34.5	64.2	42.6	39.3	38.2	36.2	35.1
04:00	50.7	74.1	35.3	65.1	45.8	41.8	40.4	37.4	36.1
05:00	57.4	75.3	38.2	69.8	60.1	48.0	46.0	41.3	39.0
06:00	62.8	76.9	44.8	72.5	68.4	57.4	51.8	47.4	45.6
07:00	65.9	77.7	45.5	73.3	70.5	66.3	61.9	49.4	46.7
08:00	64.9	81.2	44.2	73.2	69.4	64.7	59.5	48.6	45.9
09:00	62.5	75.5	43.5	71.5	67.4	61.0	54.8	47.3	44.9
10:00	62.5	78.5	42.4	73.4	67.1	59.2	53.9	46.8	44.1
11:00	63.2	77.7	43.2	72.7	67.7	61.9	56.0	47.3	44.0
12:00	61.8	75.9	43.7	70.8	66.7	60.2	54.5	47.2	44.7
13:00	63.1	81.5	45.4	73.6	67.3	61.1	56.4	50.2	47.3
14:00	62.7	76.9	45.8	72.2	67.3	61.0	55.9	49.2	47.0
15:00	63.5	77.8	46.0	71.9	68.0	62.9	58.0	50.0	47.3
16:00	64.5	80.6	46.7	72.9	68.9	64.4	59.7	49.9	47.4
17:00	65.3	80.6	46.5	73.2	69.4	65.6	62.2	51.6	48.8
18:00	64.8	76.9	46.2	72.9	69.1	65.0	61.2	50.2	47.2

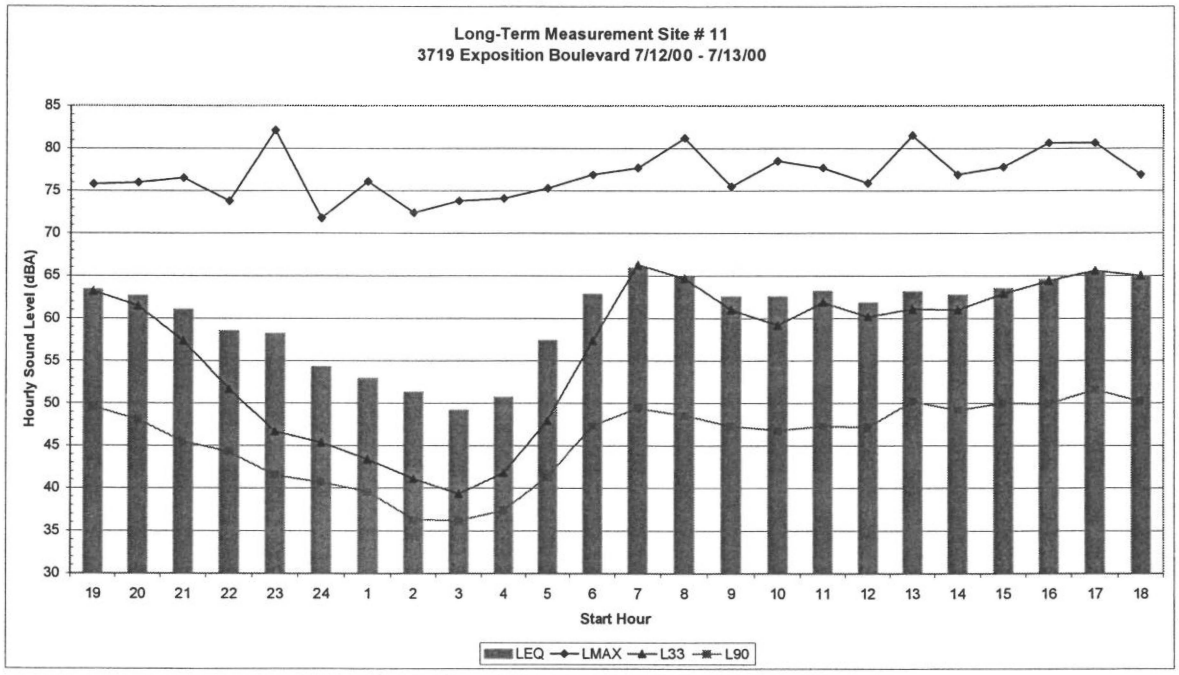


Figure B-5. Noise Survey Results, Site LT-11 – 3719 Exposition Blvd.

Site LT-10: 3500 Muirfield Road

Ldn: 60 dBA

Table B-6. Noise Survey Results, Site LT-10

Start Hour	Leq	Lmax	Lmin	L1	L10	L33	L50	L90	L99
18:00	58.0	73.5	45.7	68.5	61.5	55.5	53.5	48.8	47.0
19:00	57.9	76.3	44.9	68.6	60.5	54.2	52.0	47.9	46.1
20:00	56.0	71.8	44.5	66.7	58.7	53.9	52.0	47.5	45.3
21:00	55.5	79.7	41.2	67.0	56.8	51.0	48.6	43.9	42.0
22:00	53.4	74.1	39.1	65.1	55.3	50.5	48.0	41.8	39.7
23:00	57.6	86.7	37.5	65.5	51.6	44.4	42.3	39.2	37.9
00:00	47.6	67.7	37.0	61.1	46.8	41.7	40.4	38.3	37.2
01:00	49.8	77.6	36.0	61.3	46.6	41.1	39.7	37.4	36.4
02:00	47.4	74.1	34.7	56.2	48.2	41.0	39.1	36.2	35.1
03:00	45.8	70.4	34.8	54.2	44.5	39.5	38.4	36.3	35.2
04:00	42.2	60.7	35.9	51.5	44.5	40.9	40.1	38.0	36.5
05:00	52.7	73.4	38.9	65.4	52.7	47.4	45.8	41.0	39.3
06:00	55.3	73.0	44.0	67.3	57.3	52.2	49.9	46.5	44.8
07:00	58.9	73.5	42.2	69.8	62.4	56.2	53.6	47.0	43.9
08:00	58.6	78.0	40.5	70.0	61.4	55.0	52.4	45.7	42.2
09:00	58.4	82.5	39.0	69.0	58.5	52.6	50.2	44.0	41.1
10:00	59.3	81.4	39.0	70.7	60.2	52.5	49.4	42.6	40.3
11:00	56.3	73.5	41.3	68.3	59.1	52.0	49.5	44.5	42.3
12:00	57.1	77.9	41.3	68.8	59.8	52.6	50.0	45.4	43.0
13:00	56.0	78.0	43.5	67.9	58.0	52.1	49.7	45.6	44.0
14:00	57.4	73.7	44.5	68.5	61.1	53.9	51.5	46.9	45.2
15:00	57.2	78.8	45.8	68.4	58.7	53.6	51.9	48.2	46.5
16:00	57.8	74.2	45.5	69.4	60.4	54.1	52.3	48.4	46.4
17:00	58.5	74.1	45.9	69.5	61.6	55.3	53.4	49.5	47.8

Figure B-6. Noise Survey Results, Site LT-10 – 3500 Muirfield Road

Site LT-3: 3420 Sycamore Ave.

Ldn: 59 dBA

Table B-7. Noise Survey Results, Site LT-3

Start Hour	Leq	Lmax	Lmin	L1	L10	L33	L50	L90	L99
14:00	54.0	73.9	46.1	64.7	55.7	51.9	50.8	48.8	47.1
15:00	53.2	73.4	46.9	60.3	55.1	52.5	51.5	49.3	47.8
16:00	54.3	71.1	47.6	65.1	55.8	52.8	51.8	49.6	48.2
17:00	54.3	72.1	46.6	64.7	55.7	52.8	51.7	49.3	48.0
18:00	53.4	69.0	46.9	62.4	55.7	52.4	51.3	49.1	47.9
19:00	55.7	79.1	47.4	63.8	57.0	53.2	52.1	50.0	48.4
20:00	52.7	71.3	45.6	60.5	55.2	52.1	50.9	48.1	46.6
21:00	55.1	74.6	44.0	67.0	56.2	51.4	50.0	47.3	45.6
22:00	50.3	67.8	41.5	59.9	52.7	48.9	47.7	44.9	42.9
23:00	46.1	62.2	40.4	53.2	48.4	45.6	44.7	42.3	41.0
00:00	47.0	63.7	39.3	59.9	47.8	44.8	43.5	40.8	39.5
01:00	42.1	55.6	37.2	48.3	44.6	42.0	41.0	38.8	37.6
02:00	56.0	81.2	36.9	66.4	59.5	43.2	41.5	38.6	37.6
03:00	59.1	70.6	36.8	67.0	64.4	58.2	54.0	38.2	37.1
04:00	43.5	61.0	36.4	53.7	45.7	41.8	40.1	37.5	37.0
05:00	46.4	60.8	37.2	55.8	49.4	45.7	44.1	39.7	37.6
06:00	49.6	63.6	40.3	57.1	52.5	49.5	48.0	44.1	41.9
07:00	53.3	70.6	45.5	62.8	55.3	52.1	51.1	48.3	46.4
08:00	56.0	74.4	44.1	68.2	56.5	52.0	50.8	48.1	46.1
09:00	53.2	72.3	42.8	64.0	54.5	50.5	49.3	46.5	44.5
10:00	53.8	71.7	43.7	64.3	55.9	52.0	50.7	47.1	44.5
11:00	54.1	70.6	44.1	65.3	56.4	51.8	49.9	46.7	45.2
12:00	54.8	75.5	44.2	66.2	56.7	52.5	50.6	47.4	45.4
13:00	58.5	78.9	46.7	72.7	57.6	52.9	51.5	48.6	47.2

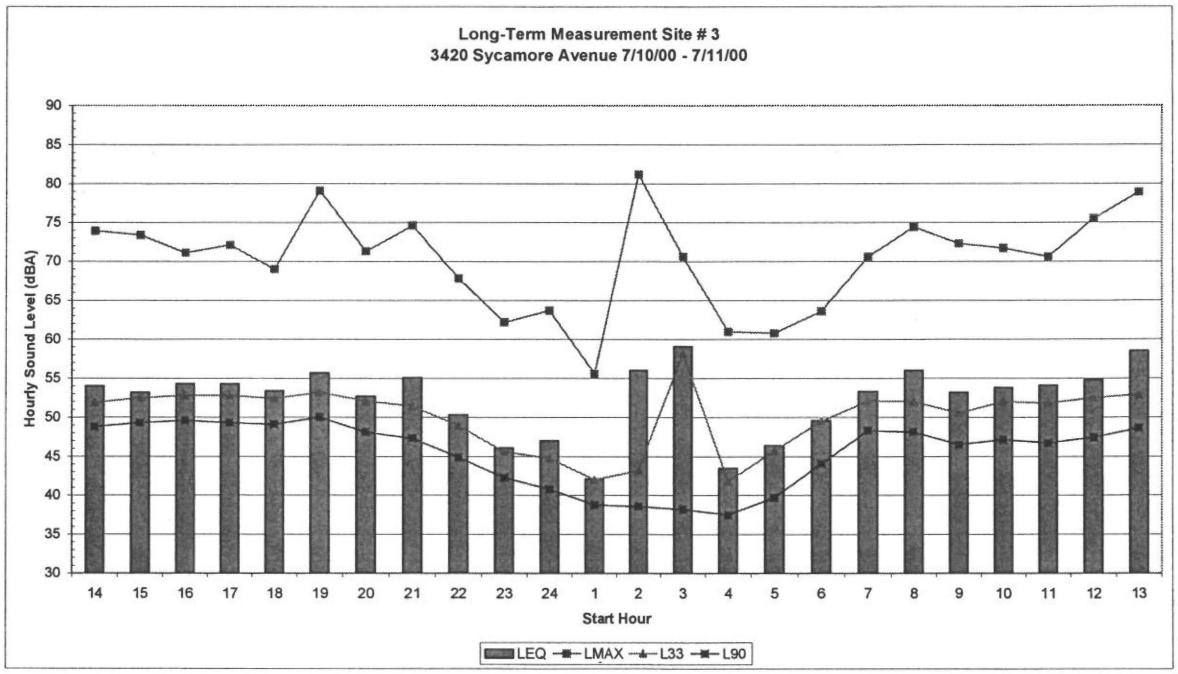


Figure B-7. Noise Survey Results, Site LT-3 – 3420 Sycamore Ave

Site LT-6: 5539 Jefferson Blvd.

Ldn: 68 dBA

Table B-8. Noise Survey Results, Site LT-6

Start Hour	Leq	Lmax	Lmin	L1	L10	L33	L50	L90	L99
16:00	66.3	76.8	50.4	73.1	69.4	66.9	65.3	57.5	52.8
17:00	67.2	82.4	50.1	73.4	69.9	67.7	66.1	59.5	53.3
18:00	66.4	77.2	49.8	72.4	69.7	67.2	65.3	58.0	52.3
19:00	64.8	77.7	48.4	71.2	68.1	65.5	63.6	54.9	50.6
20:00	62.9	78.5	48.7	70.0	66.7	63.3	60.7	52.2	49.7
21:00	62.6	77.7	45.4	69.9	66.5	62.9	60.1	50.7	47.1
22:00	60.9	74.4	44.1	69.5	65.2	60.7	56.6	47.5	45.3
23:00	59.7	73.5	41.5	68.3	64.5	58.6	53.8	45.0	43.0
00:00	55.9	69.9	40.7	66.5	61.1	50.9	46.7	43.3	42.0
01:00	55.2	69.5	39.8	66.7	59.5	48.2	45.8	42.5	41.0
02:00	53.9	70.1	39.0	65.7	57.7	46.3	44.1	41.0	39.6
03:00	53.7	73.3	38.8	66.0	56.0	45.6	43.8	40.7	39.3
04:00	59.4	85.2	39.6	69.1	61.3	49.7	46.0	42.2	40.4
05:00	60.6	75.7	42.5	69.8	65.3	59.0	53.9	46.2	43.5
06:00	64.7	75.2	45.7	71.8	68.6	65.2	62.8	51.3	47.0
07:00	66.8	79.5	48.2	73.3	69.8	67.4	65.9	58.6	50.6
08:00	67.3	81.7	48.3	73.5	70.2	68.0	66.5	58.2	50.8
09:00	65.9	79.3	47.9	72.6	69.0	66.5	64.7	56.3	50.7
10:00	65.4	86.7	46.7	72.3	68.5	65.5	63.4	54.2	48.5
11:00	64.5	76.4	48.7	71.9	67.9	65.0	62.9	54.1	50.4
12:00	64.6	76.7	49.2	71.7	67.9	65.1	63.2	54.4	50.5
13:00	64.6	77.6	50.5	71.9	68.0	65.1	63.1	55.6	51.8
14:00	65.0	84.6	50.8	72.6	67.9	65.0	63.3	56.5	52.5
15:00	65.8	77.8	50.7	72.8	69.2	66.2	64.3	56.3	52.7

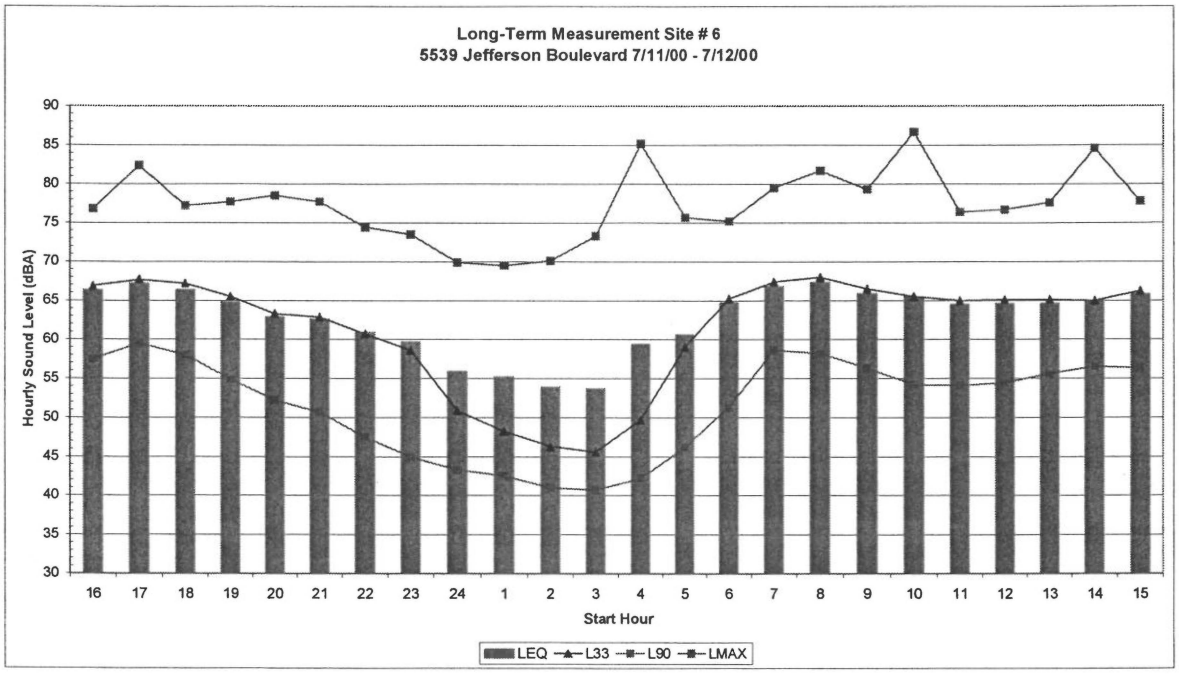


Figure B-8. Noise Survey Results, Site LT-6 – 5539 Jefferson Blvd.

Site LT-2: 3437 Caroline Ave., Culver City

Ldn: 62 dBA

Table B-9. Noise Survey Results, Site LT-2

Start Hour	Leq	Lmax	Lmin	L1	L10	L33	L50	L90	L99
13:00	59.1	72.1	45.8	67.2	62.2	59.0	57.3	51.6	48.2
14:00	59.5	79.6	47.2	67.6	62.4	59.1	57.1	50.9	48.4
15:00	59.7	74.5	48.4	67.8	62.7	59.7	58.0	52.5	50.1
16:00	59.8	73.3	48.0	66.8	62.8	60.1	58.5	53.2	49.6
17:00	59.9	75.0	46.7	67.5	62.8	60.0	58.5	52.4	48.5
18:00	60.1	77.5	46.5	66.9	62.9	60.4	58.6	51.3	47.9
19:00	61.7	88.9	46.0	69.5	62.8	59.3	57.0	49.7	47.1
20:00	56.6	70.1	44.8	64.7	60.4	56.5	54.1	47.7	45.5
21:00	57.9	78.2	44.1	67.1	61.1	57.0	54.5	47.6	44.8
22:00	55.1	75.4	40.9	63.6	58.6	54.0	50.7	44.7	41.7
23:00	51.7	65.4	40.5	61.3	56.2	49.5	45.7	42.1	41.1
00:00	50.9	66.2	38.4	60.9	55.6	46.7	43.0	40.1	39.1
01:00	50.0	75.2	37.1	61.8	51.6	41.2	39.9	38.2	37.2
02:00	50.2	72.3	36.8	62.3	52.8	42.8	40.7	38.1	37.1
03:00	52.7	73.5	36.4	64.7	55.0	45.2	41.6	38.5	37.1
04:00	52.2	69.8	36.0	65.0	55.5	45.8	41.2	37.7	36.4
05:00	54.4	69.0	35.4	64.9	58.4	53.0	48.2	37.4	36.0
06:00	58.9	74.0	39.9	68.4	62.7	58.1	55.3	44.8	41.4
07:00	61.5	74.1	44.0	68.7	64.6	62.1	60.3	53.2	47.6
08:00	61.0	73.6	43.7	68.2	64.0	61.5	59.8	52.3	47.0
09:00	60.6	73.6	45.5	68.5	63.7	60.8	59.1	52.2	47.6
10:00	63.7	85.9	45.8	71.0	63.6	59.7	57.6	51.2	47.7
11:00	59.6	78.2	45.1	69.2	62.8	58.9	56.7	49.5	46.8
12:00	60.2	82.5	45.6	68.7	62.5	59.3	57.6	52.1	48.1

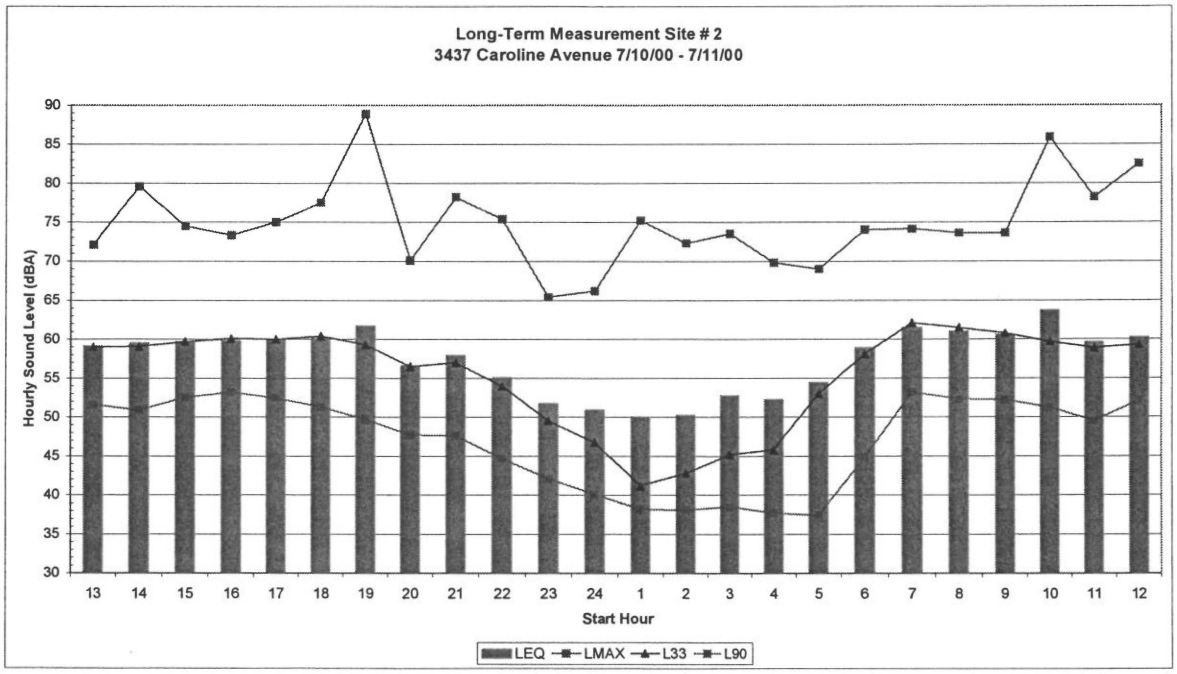


Figure B-9. Noise Survey Results, Site LT-2 – 3437 Caroline Ave., Culver City

APPENDIX C VIBRATION MEASUREMENT DATA AND PROJECTIONS

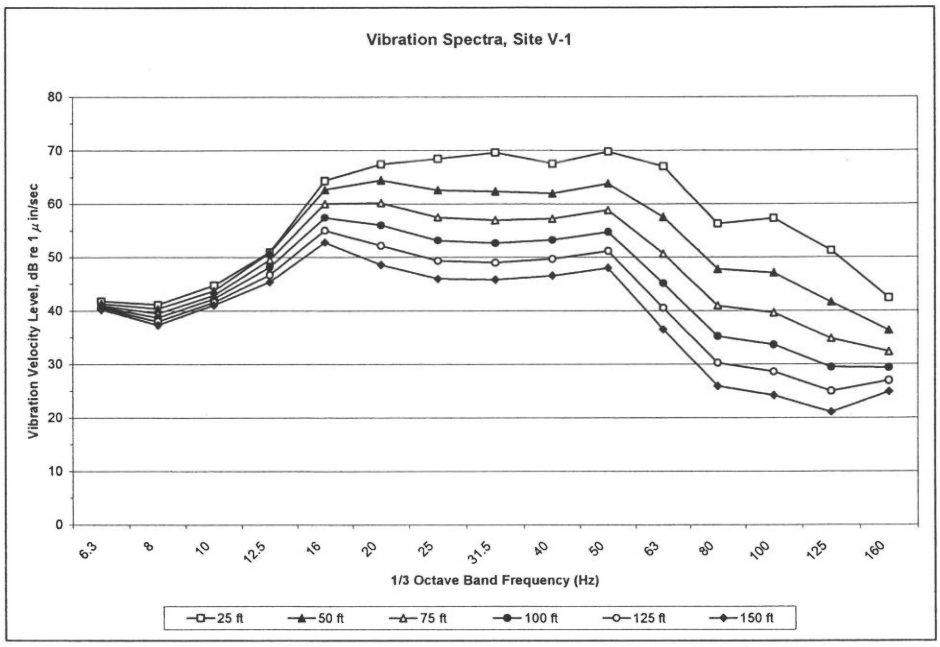


Figure C-1. Projected LRT Vibration Spectra, Site V-1, 40 mph

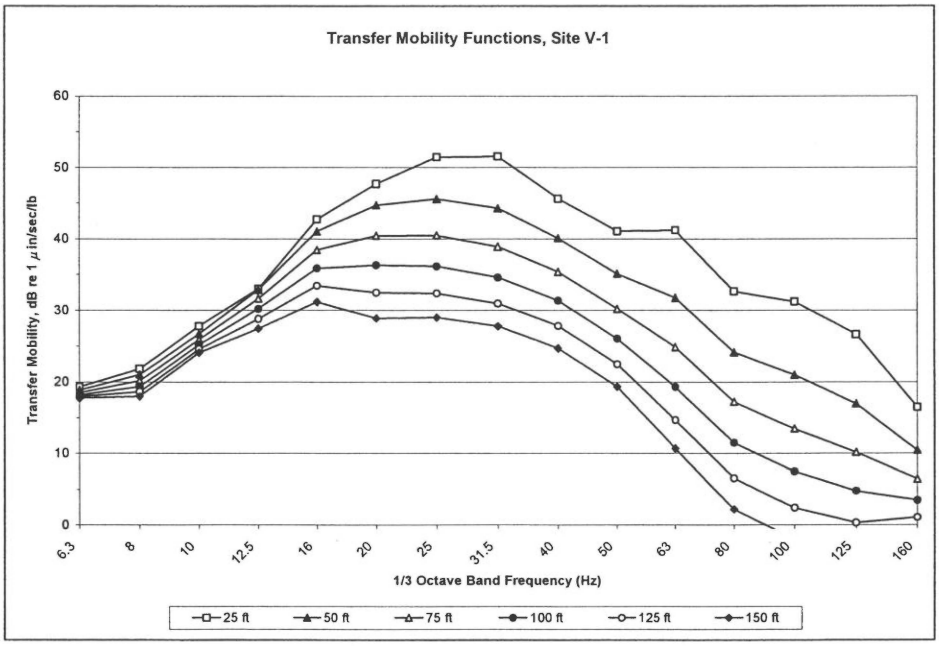


Figure C-2. Representative Transfer Mobility Functions, Site V-1

Table C-1. Line Source Transfer Mobility Coefficients, Site V-1

Frequency (Hz)	A	B	C
6.3	18.7	2.1	-1.2
8	14.1	12.3	-4.8
10	25.7	5.5	-2.9
12.5	0.4	42.9	-14.0
16	4.1	54.9	-19.5
20	-9.6	82.9	-30.0
25	31.8	41.6	-19.7
31.5	53.2	17.7	-13.5
40	28.7	37.2	-18.0
50	28.7	32.5	-16.9
63	46.3	19.2	-16.4
80	18.0	42.3	-22.8
100	35.5	22.3	-18.1
125	37.9	11.7	-14.1
160	33.5	-5.5	-4.7

$$TM = A + B*\log(d) + C*(\log(d))^2$$

Where:

TM = Transfer Mobility in dB re 1μin/sec/lb/(ft)^1/2

d = Distance in feet

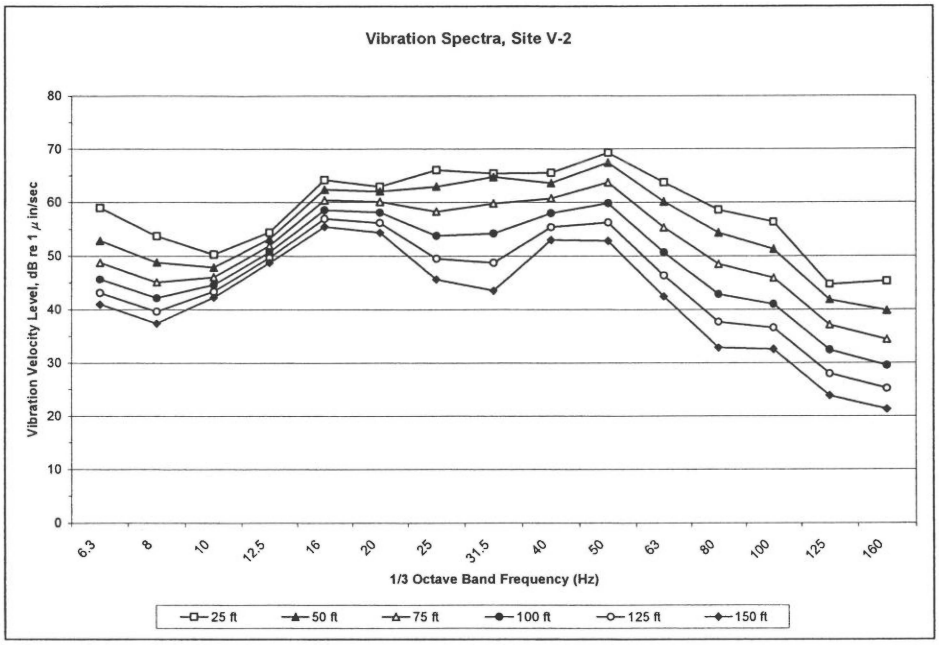


Figure C-3. Projected LRT Vibration Spectra, Site V-2, 40 mph

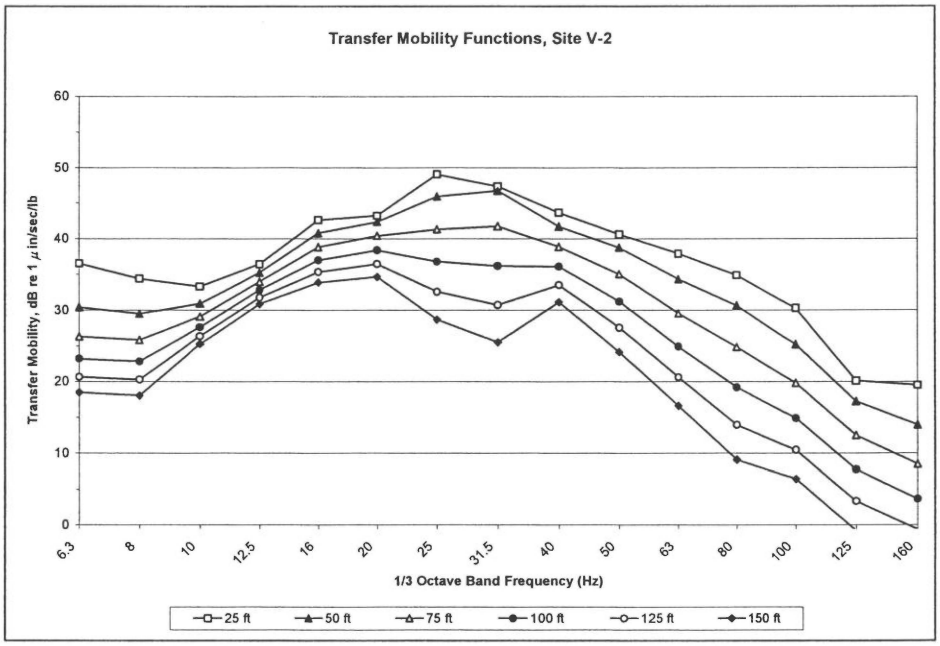


Figure C-4. Representative Transfer Mobility Functions, Site V-2

Table C-2. Line Source Transfer Mobility Coefficients, Site V-2

Frequency (Hz)	A	B	C
6.3	51.3	-2.4	-5.8
8	33.6	14.4	-9.9
10	32.9	7.2	-4.9
12.5	26.2	16.7	-6.7
16	25.3	27.6	-10.9
20	6.9	49.7	-17.0
25	-15.2	92.4	-33.2
31.5	-78.5	166.0	-54.3
40	4.2	56.7	-20.4
50	-25.4	91.2	-31.4
63	-22.8	88.9	-32.5
80	-40.3	109.6	-39.9
100	-15.1	72.9	-29.0
125	-52.8	102.9	-36.3
160	-17.3	63.1	-26.3
200	51.3	-2.4	-5.8
250	33.6	14.4	-9.9
315	32.9	7.2	-4.9
400	26.2	16.7	-6.7

$$TM = A + B*\log(d) + C*(\log(d))^2$$

Where:

TM = Transfer Mobility in dB re 1μin/sec/lb/(ft)^1/2

d = Distance in feet

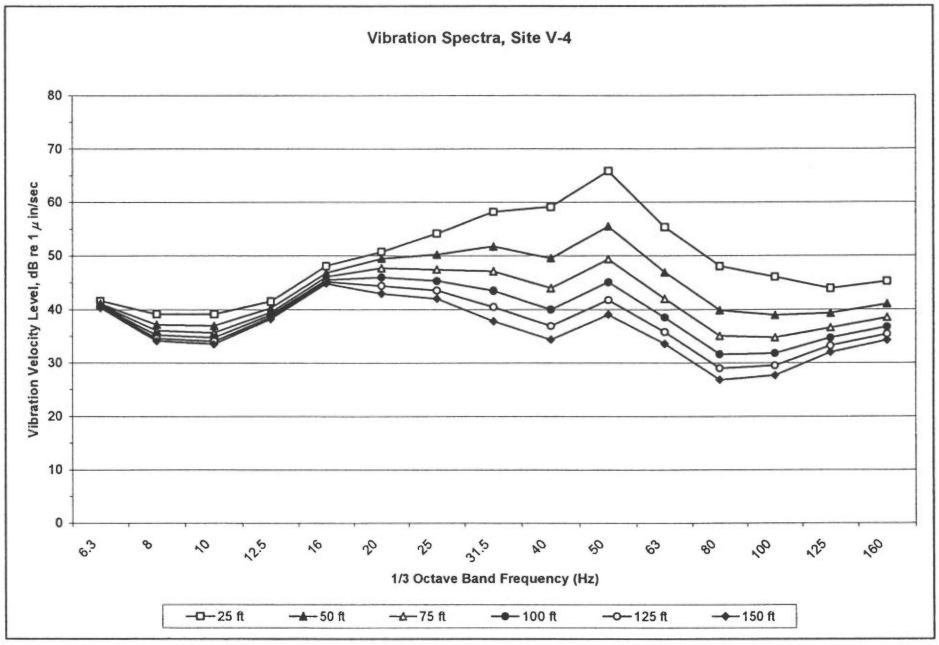


Figure C-5. Projected LRT Vibration Spectra, Site V-4, 40 mph

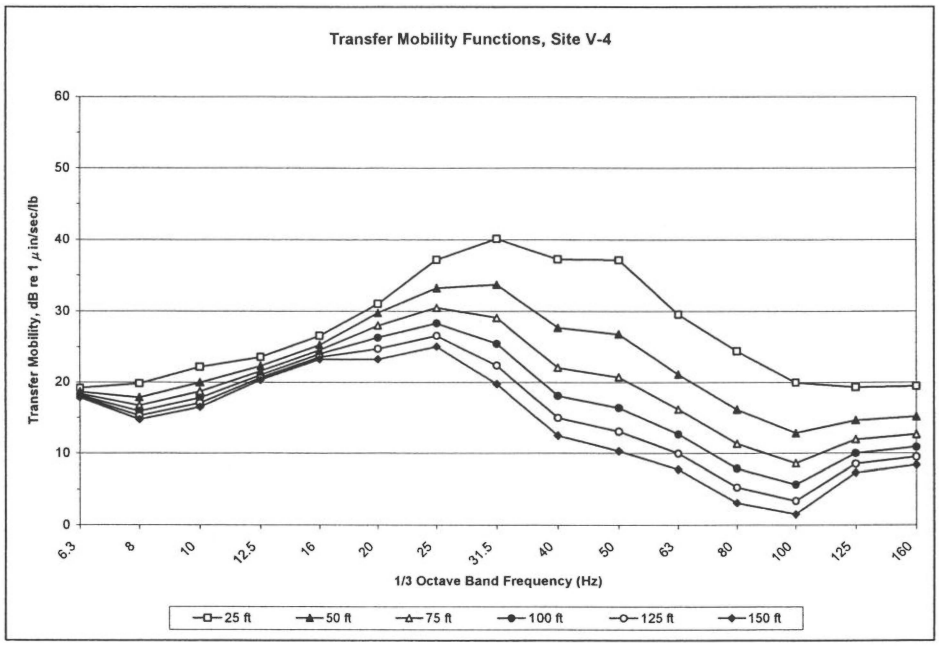


Figure C-6. Representative Transfer Mobility Functions, Site V-4

Table C-3. Line Source Transfer Mobility Coefficients, Site V-4

Frequency (Hz)	A	B	C
6.3	21.5	-1.7	0.0
8	28.9	-6.5	0.0
10	32.3	-7.3	0.0
12.5	29.4	-4.2	0.0
16	32.5	-4.3	0.0
20	8.1	33.4	-12.2
25	43.1	3.1	-5.2
31.5	46.3	9.6	-10.0
40	81.8	-31.8	0.0
50	85.3	-34.5	0.0
63	68.7	-28.0	0.0
80	62.6	-27.3	0.0
100	53.1	-23.7	0.0
125	40.8	-15.4	0.0
160	39.3	-14.2	0.0
200	21.5	-1.7	0.0
250	28.9	-6.5	0.0
315	32.3	-7.3	0.0
400	29.4	-4.2	0.0

$$TM = A + B*\log(d) + C*(\log(d))^2$$

Where:

TM = Transfer Mobility in dB re 1μin/sec/lb/(ft)^1/2

d = Distance in feet

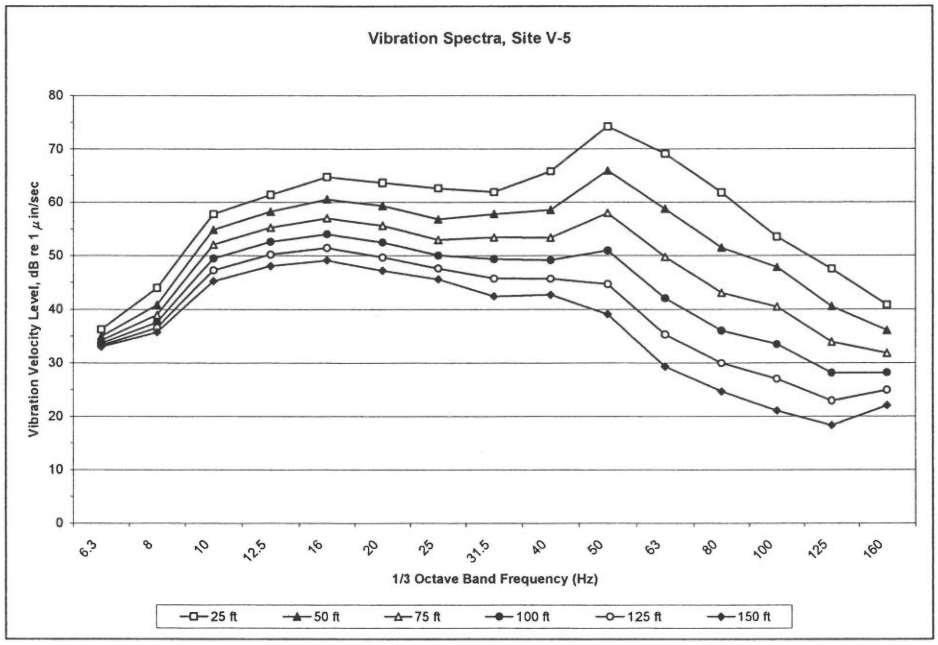


Figure C-7. Projected LRT Vibration Spectra, Site V-5, 40 mph

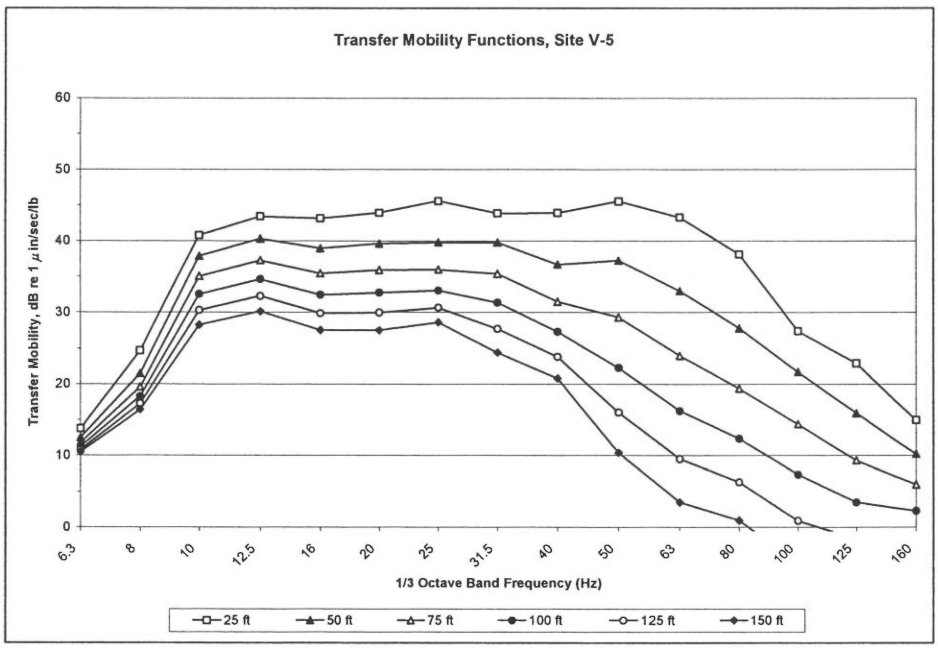


Figure C-8. Representative Transfer Mobility Functions, Site V-5

Table C-4. Line Source Transfer Mobility Coefficients, Site V-5

Frequency (Hz)	A	B	C
6.3	19.6	-4.2	0.0
8	39.5	-10.6	0.0
10	22.0	32.4	-13.6
12.5	24.6	33.1	-14.0
16	31.8	26.2	-12.9
20	30.0	29.9	-14.3
25	59.9	-2.8	-5.3
31.5	6.1	60.5	-23.9
40	49.0	13.1	-12.0
50	-3.6	86.8	-36.9
63	7.7	74.6	-35.2
80	19.0	53.2	-28.2
100	-59.9	129.3	-47.9
125	-16.1	70.0	-30.1
160	-4.6	38.4	-17.5
200	19.6	-4.2	0.0
250	39.5	-10.6	0.0
315	22.0	32.4	-13.6
400	24.6	33.1	-14.0

$$TM = A + B*\log(d) + C*(\log(d))^2$$

Where:

TM = Transfer Mobility in dB re 1 μin/sec/lb/(ft)^1/2

d = Distance in feet

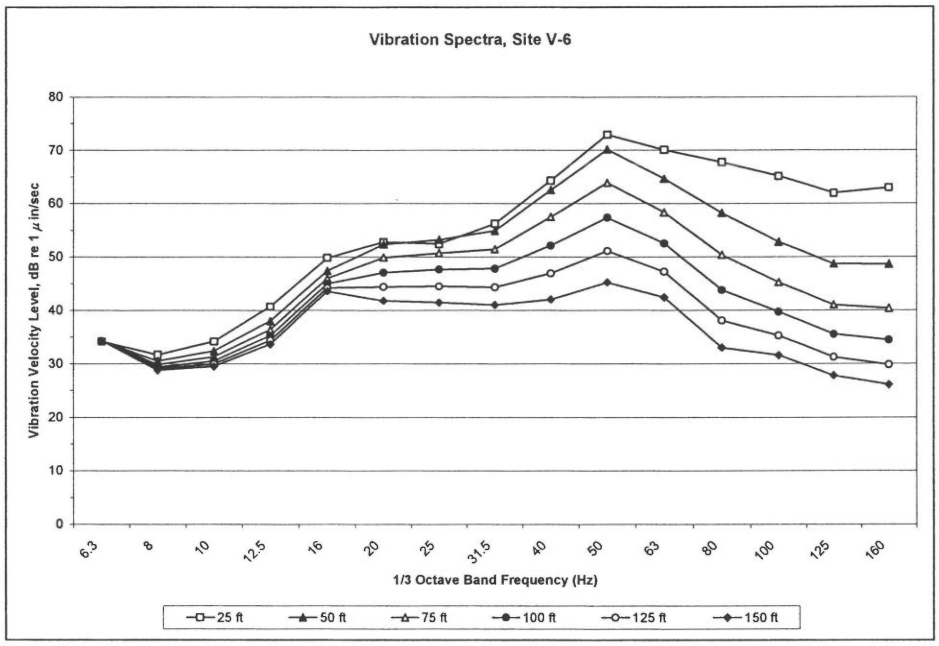


Figure C-9. Projected LRT Vibration Spectra, Site V-6, 40 mph

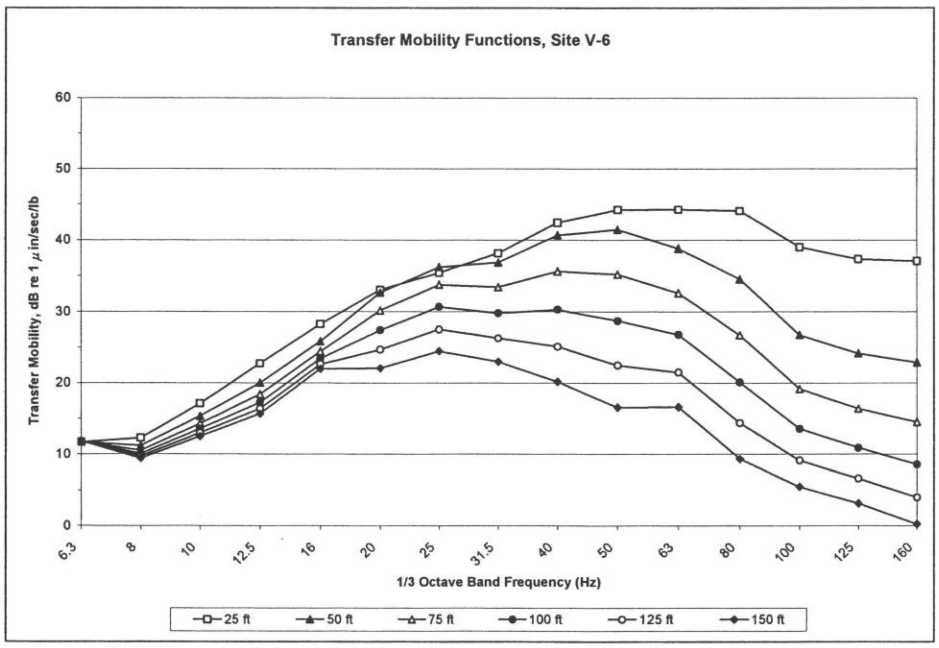


Figure C-10. Representative Transfer Mobility Functions, Site V-6

Table C-5. Line Source Transfer Mobility Coefficients, Site V-6

Frequency (Hz)	A	B	C
6.3	11.4	0.2	0.0
8	17.5	-3.7	0.0
10	25.2	-5.6	-0.1
12.5	35.4	-9.1	0.0
16	39.6	-8.1	0.0
20	-28.8	81.8	-26.9
25	-52.5	112.3	-35.4
31.5	-31.9	94.9	-32.0
40	-63.5	142.8	-47.9
50	-74.4	162.2	-55.3
63	-17.9	95.9	-36.8
80	23.3	53.1	-27.4
100	84.5	-25.7	-4.9
125	98.7	-43.9	0.0
160	103.3	-47.4	0.0
200	11.4	0.2	0.0
250	17.5	-3.7	0.0
315	25.2	-5.6	-0.1
400	35.4	-9.1	0.0

$$TM = A + B*\log(d) + C*(\log(d))^2$$

Where:

TM = Transfer Mobility in dB re 1μin/sec/lb/(ft)^1/2

d = Distance in feet

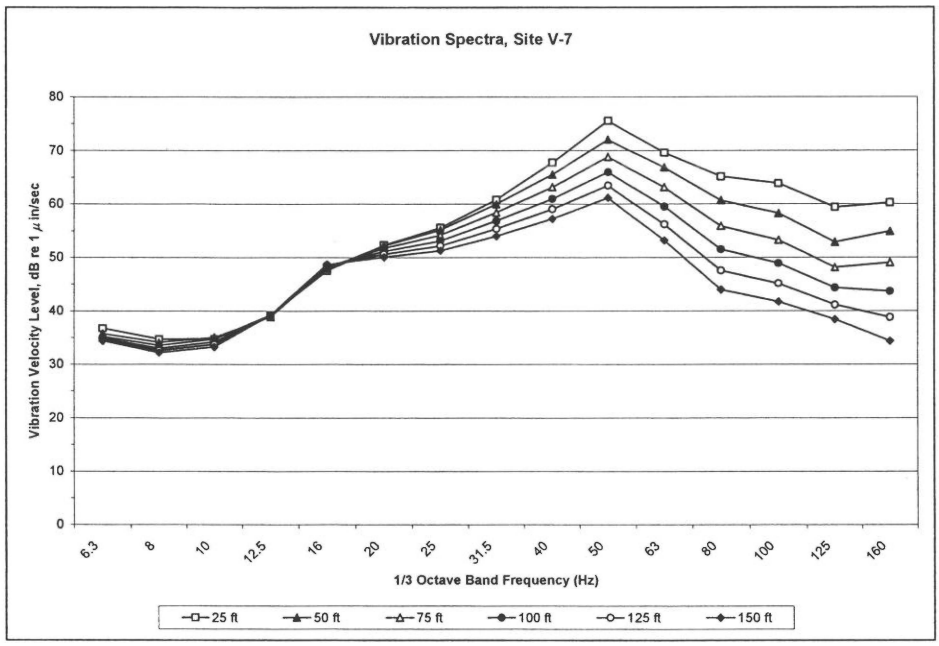


Figure C-11. Projected LRT Vibration Spectra, Site V-7, 40 mph

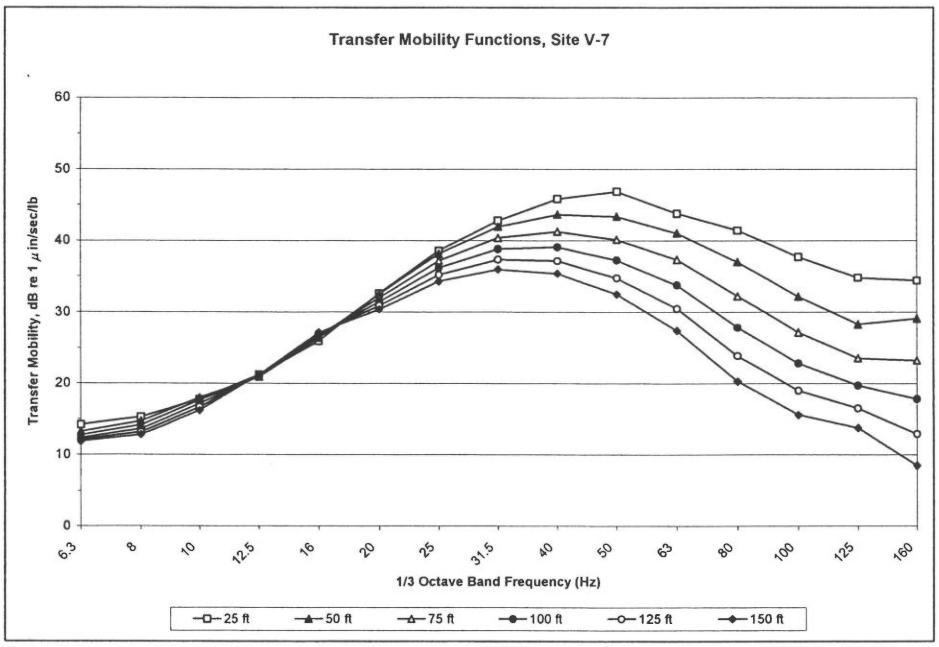


Figure C-12. Representative Transfer Mobility Functions, Site V-7

Table C-6. Line Source Transfer Mobility Coefficients, Site V-7

Frequency (Hz)	A	B	C
6.3	19.2	-3.9	0.2
8	11.6	6.4	-2.7
10	2.6	19.1	-5.9
12.5	27.8	-7.7	2.2
16	23.7	1.6	0.0
20	20.3	16.4	-5.4
25	20.1	25.3	-8.6
31.5	17.2	35.7	-12.4
40	26.0	31.9	-12.7
50	28.7	33.2	-14.5
63	-2.6	68.0	-24.9
80	0.4	65.7	-26.0
100	14.1	46.0	-20.8
125	38.7	12.8	-11.2
160	-18.8	84.0	-32.8
200	19.2	-3.9	0.2
250	11.6	6.4	-2.7
315	2.6	19.1	-5.9
400	27.8	-7.7	2.2

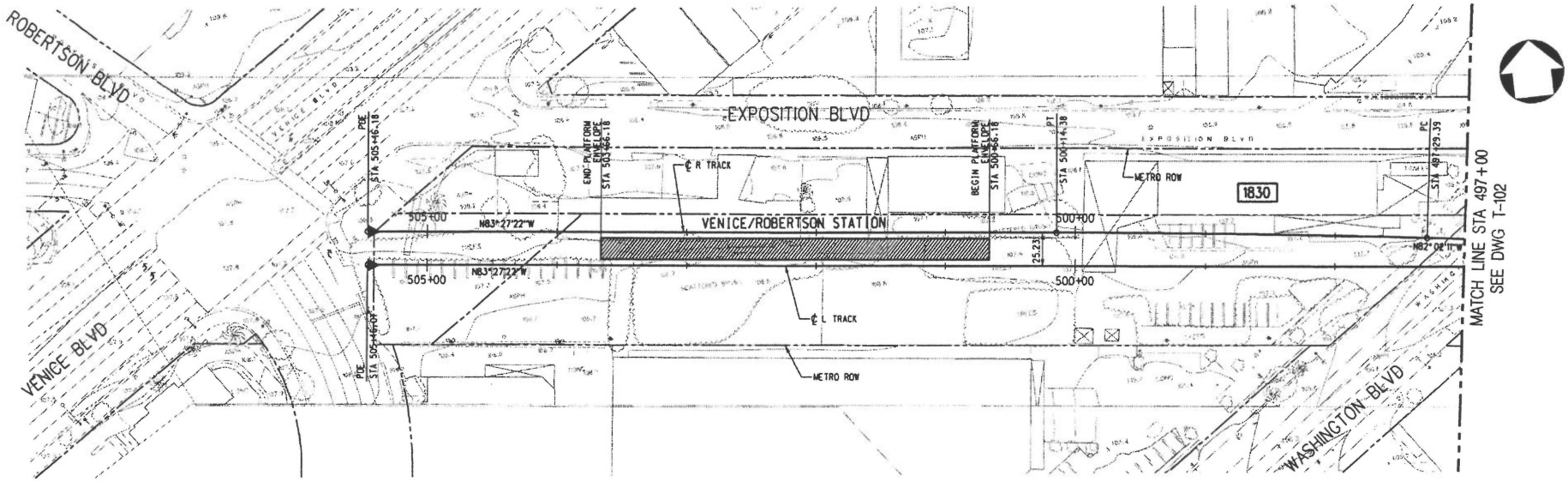
$$TM = A + B*\log(d) + C*(\log(d))^2$$

Where:

TM = Transfer Mobility in dB re 1μin/sec/lb/(ft)^1/2

d = Distance in feet

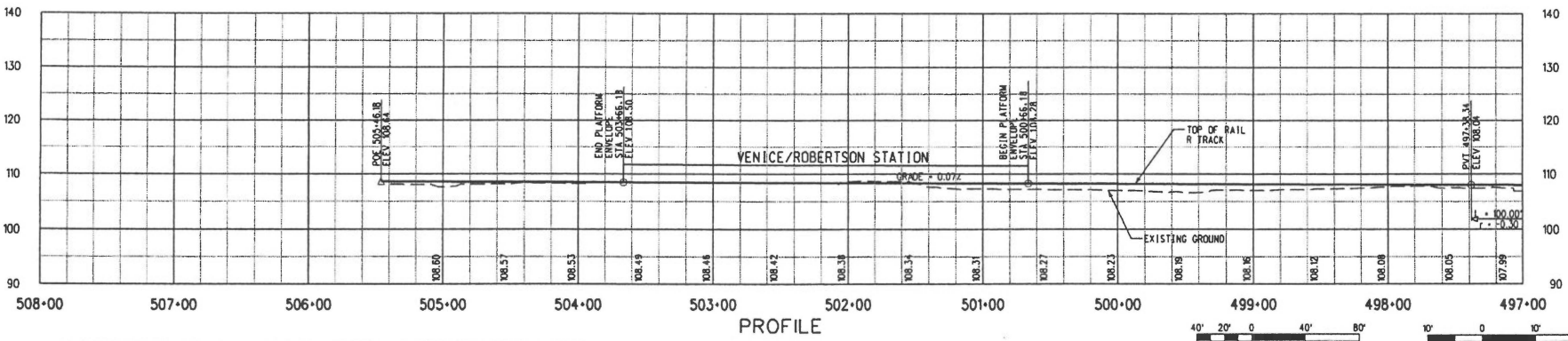
APPENDIX D SENSITIVE RECEPTOR AND IMPACT LOCATION MAPS



PLAN

NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).



PROFILE

40' 20' 0 40' 80'
HORIZONTAL 1"=40'

10' 0 10' 20'
VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R.LAYGO
DRAWN BY R.LAYGO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9559

SUBMITTED
APPROVED

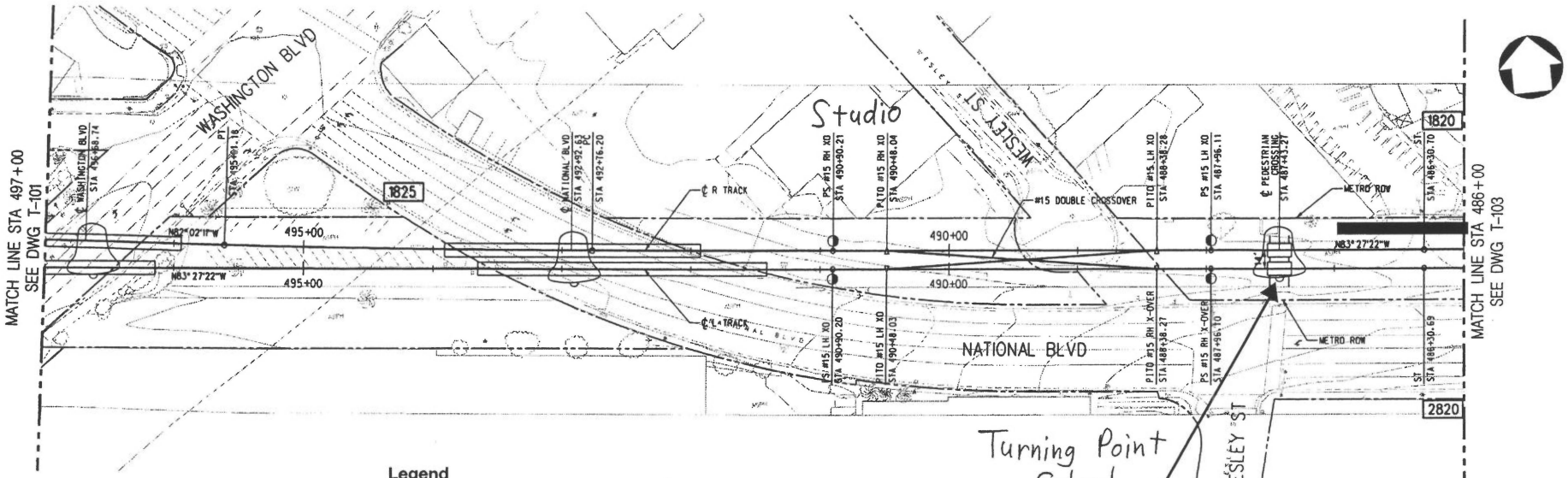
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 497+00 TO STA 505+46

CONTRACT NO E0016
DRAWING NO T-101 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 365

Plotted by: mathsec 08/01/2005 \\uma26c01\proj\pctr\582\001 cad\dwgs\sheet\t101.dwg

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



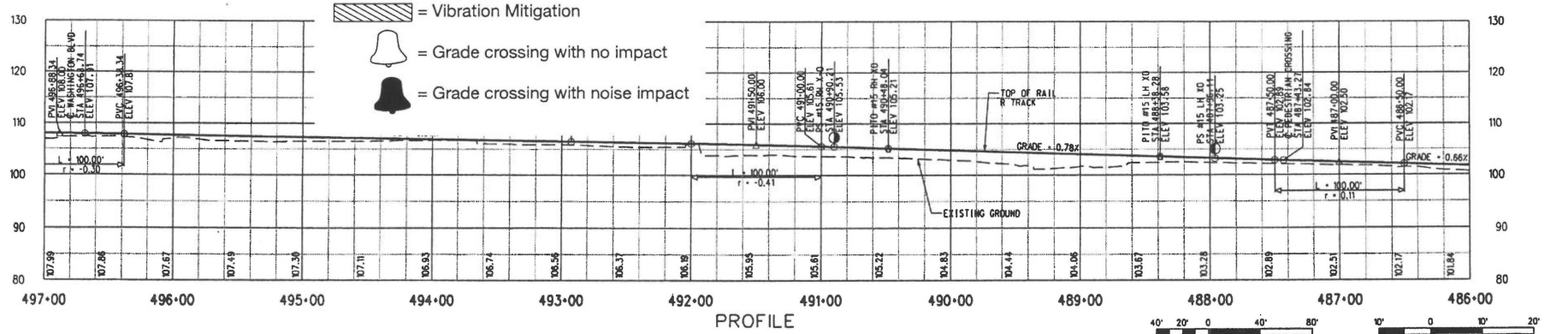
PLAN

NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).

Legend

- **SF** = Single-Family Residence
- **MF** = Multi-Family Residence
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact



PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R.LAYGO
DRAWN BY R.LAYGO
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9555

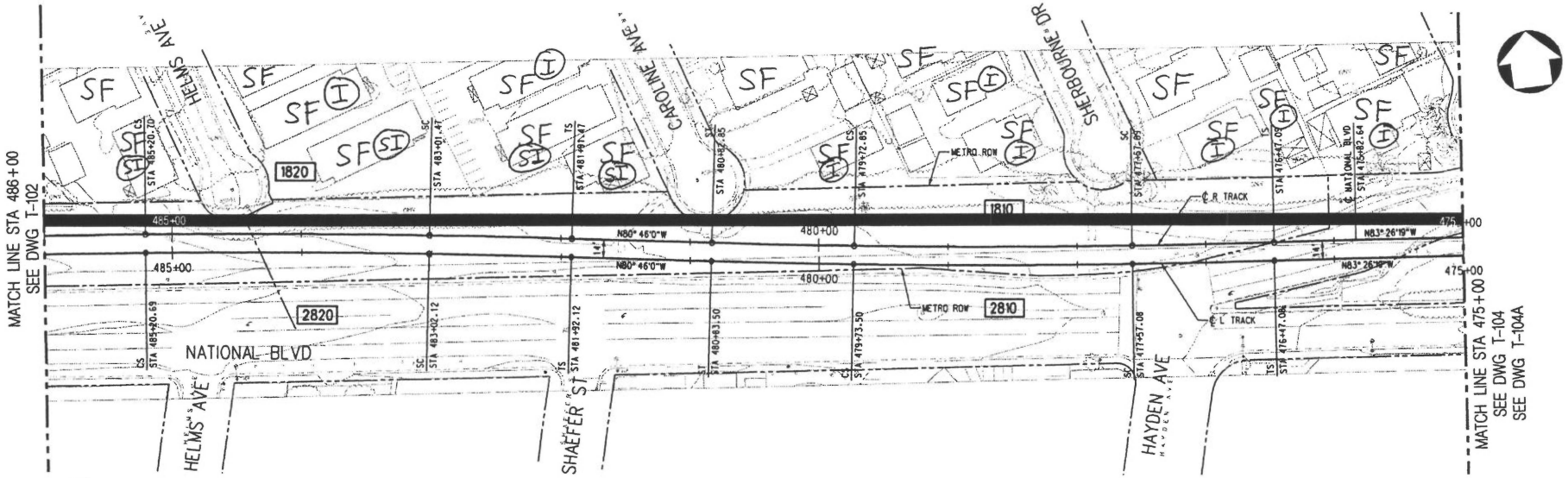
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 486+00 TO STA 497+00

CONTRACT NO E0016
DRAWING NO T-102 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 366

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE RTRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE LTRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE RTRACK).

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- = Noise Barrier
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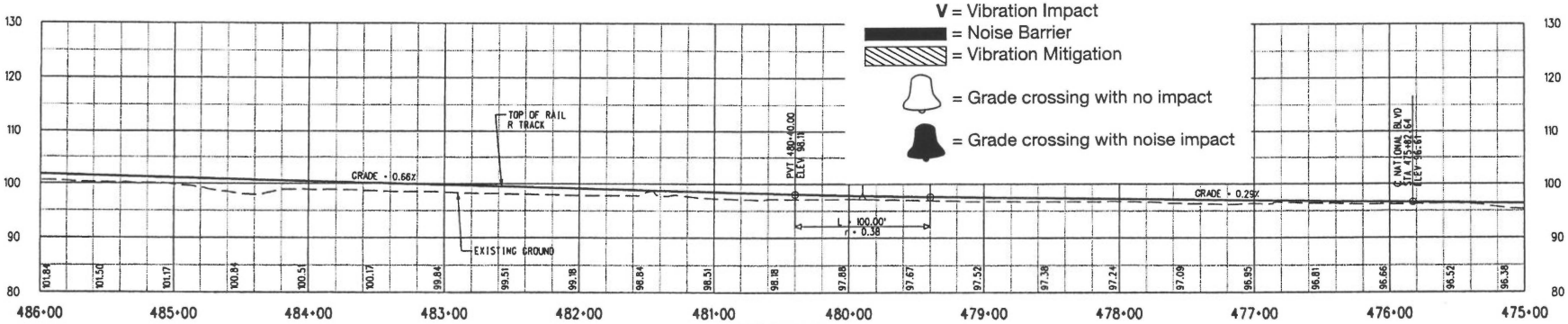

PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R.LAYCO
DRAWN BY R.LAYCO
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

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SUBMITTED
APPROVED

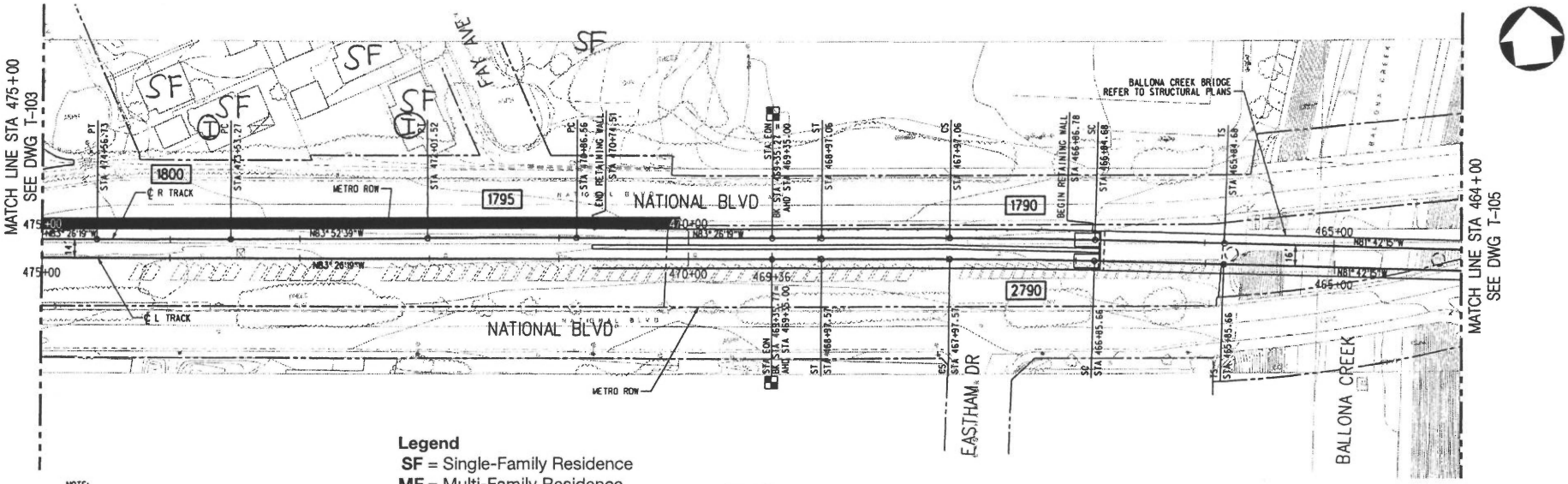
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 475+00 TO 486+00

CONTRACT NO E0016
DRAWING NO T-103 REV 0
SCALE HORIZ: 1" =40' VERT: 1" =10'
SHEET NO 367

Plotted by nathanc 06/01/2005 \\uma2dc01\projects\584-31001 cadd\track\sheet\103.dwg

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

Legend

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NOTE:

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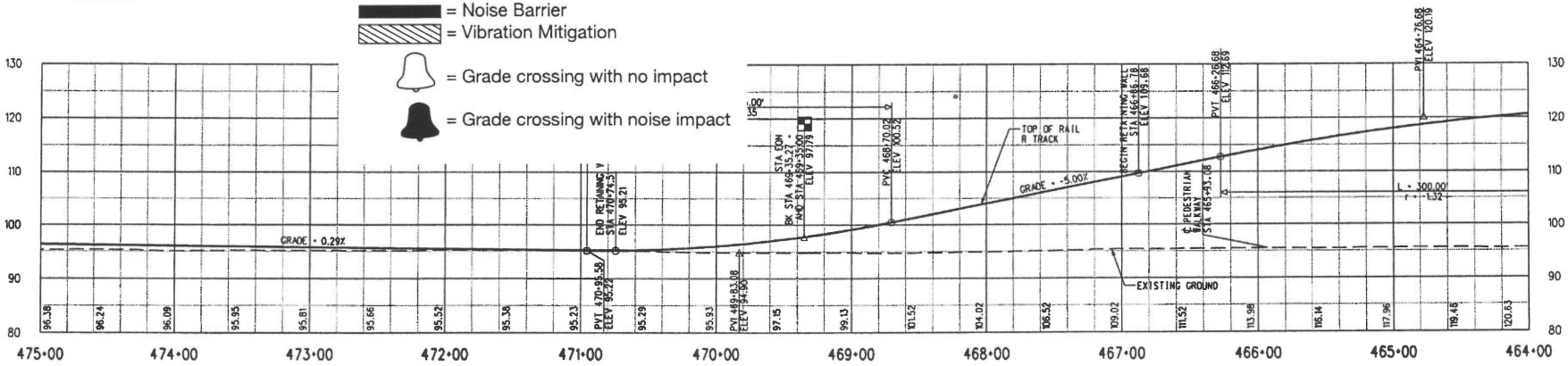

PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REQ NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R.LAYGO
DRAWN BY R.LAYGO
CHECKED BY D.A SEPULVEDA
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DATE 8/21/03

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LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-5200
FAX (213) 922-5558

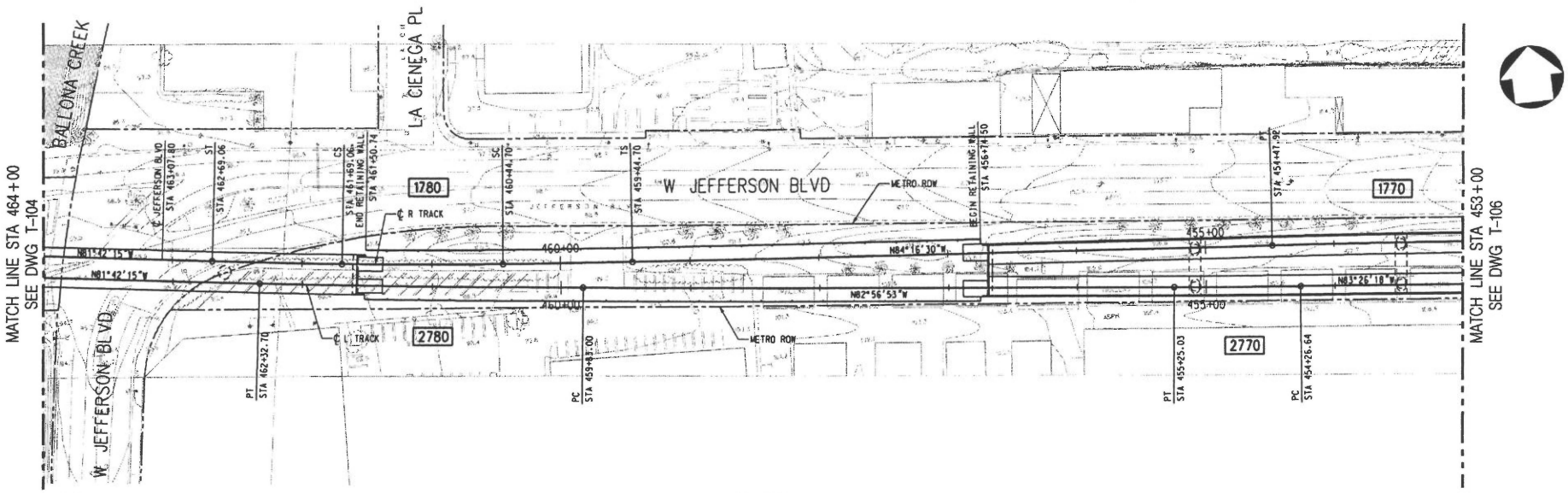
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
MAIN TRACKS
PLAN & PROFILE
STA 464+00 TO STA 475+00
SOUTHERN ALTERNATIVE

CONTRACT NO E0016
DRAWING NO T-104 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 368

08/07/2005

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:

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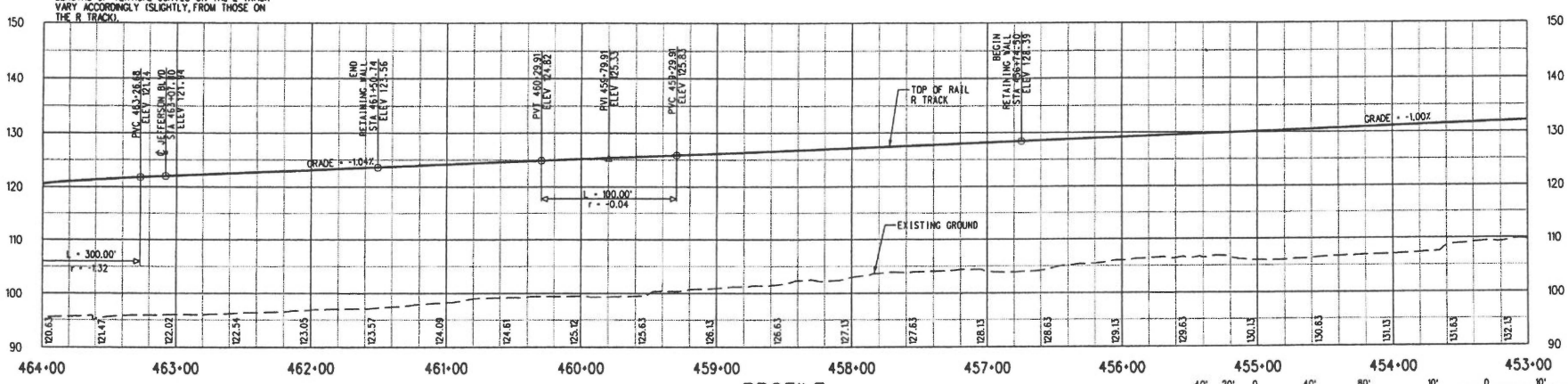

PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REQ NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY C. DAVIS
DRAWN BY C. DAVIS
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

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SUBMITTED
APPROVED

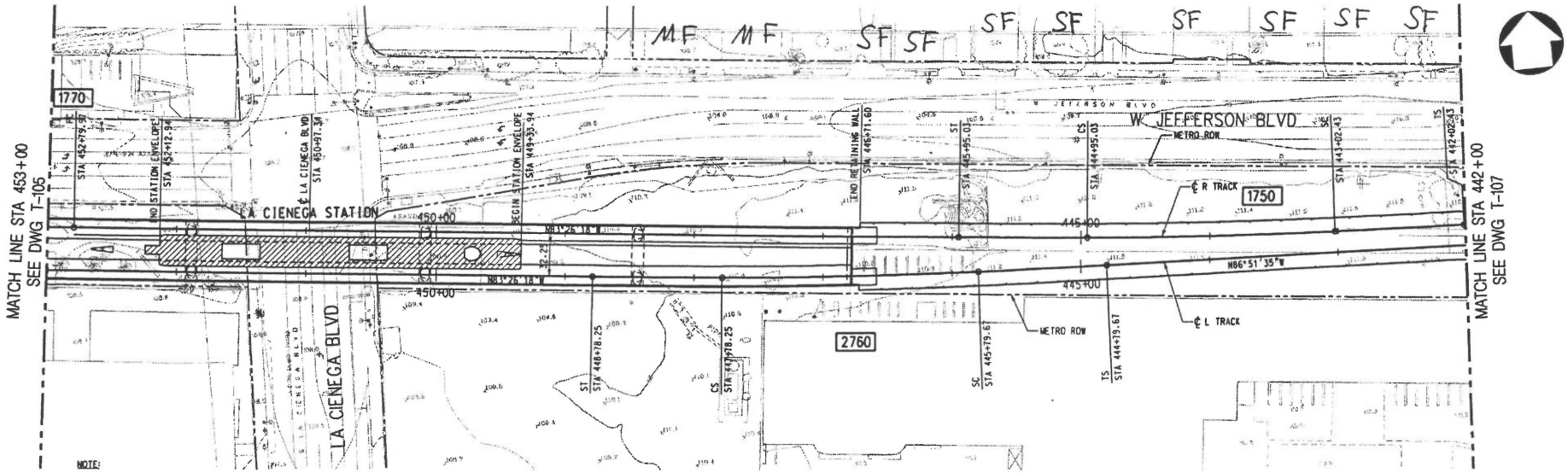
MID-CITY/EXPOSITION LRT CORRIDOR
MAIN TRACKS
PLAN & PROFILE
STA 453+00 TO STA 464+00
SOUTHERN ALTERNATIVE

CONTRACT NO E0016
DRAWING NO T-105
REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 369

08/01/2005

Plotted by: nathaac

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



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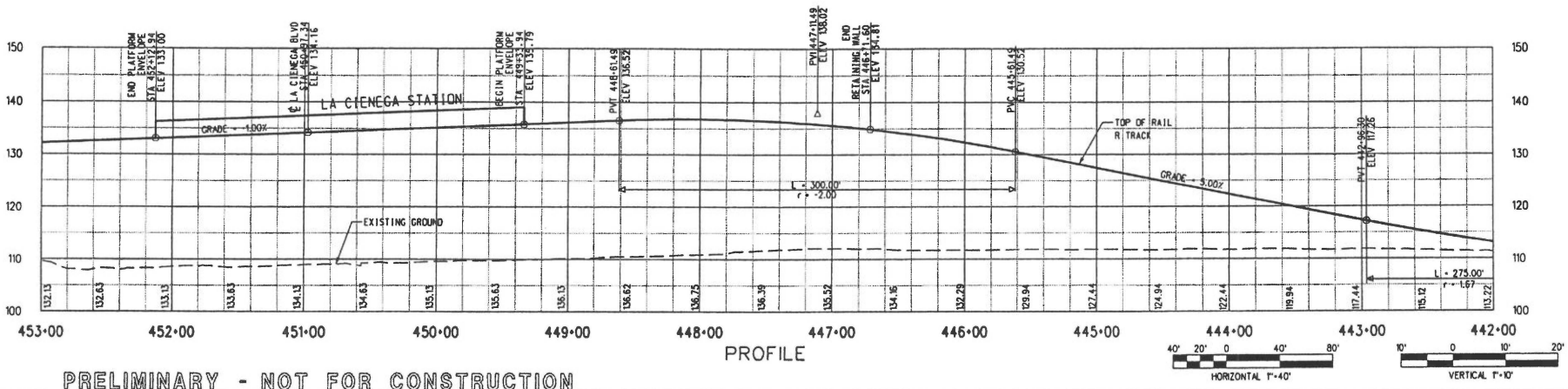
PLAN



PROFILE

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VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

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TEL (213) 922-9200
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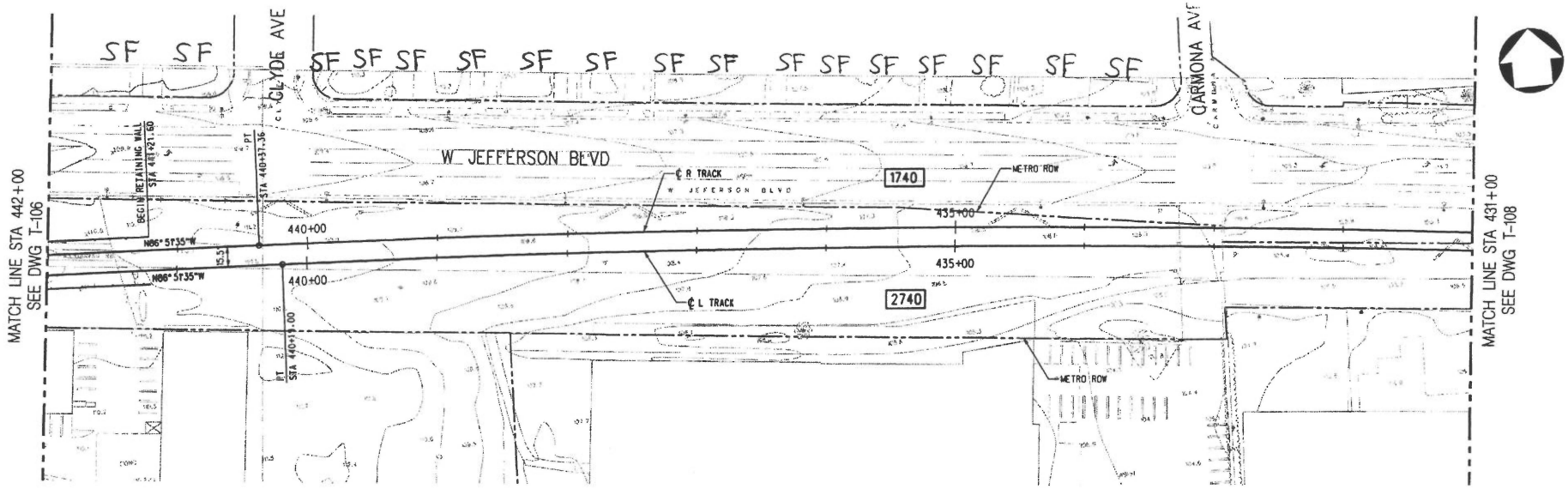
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
MAIN TRACKS
PLAN & PROFILE
STA 442+00 TO STA 453+00
SOUTHERN ALTERNATIVE

CONTRACT NO E0016
DRAWING NO T-106
REV 0
SCALE HORIZ: 1" =40' VERT: 1" =10'
SHEET NO 370

08/01/2005

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

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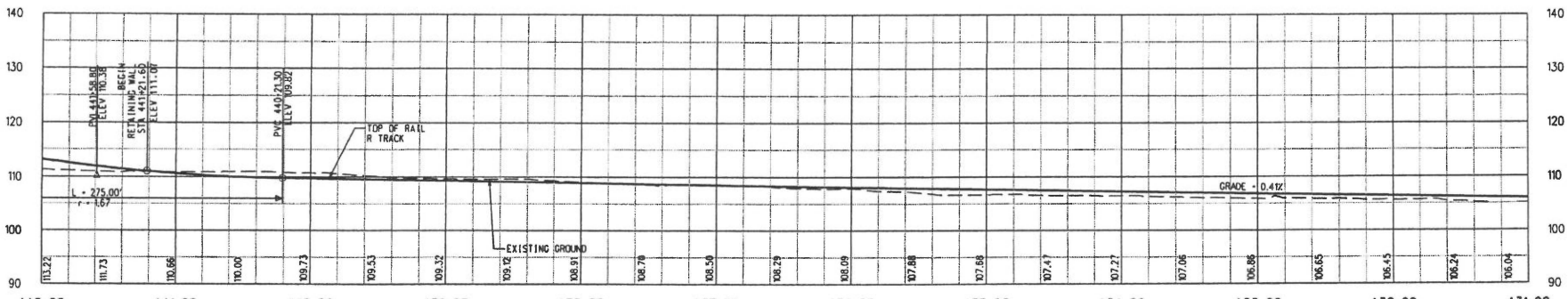

PROFILE

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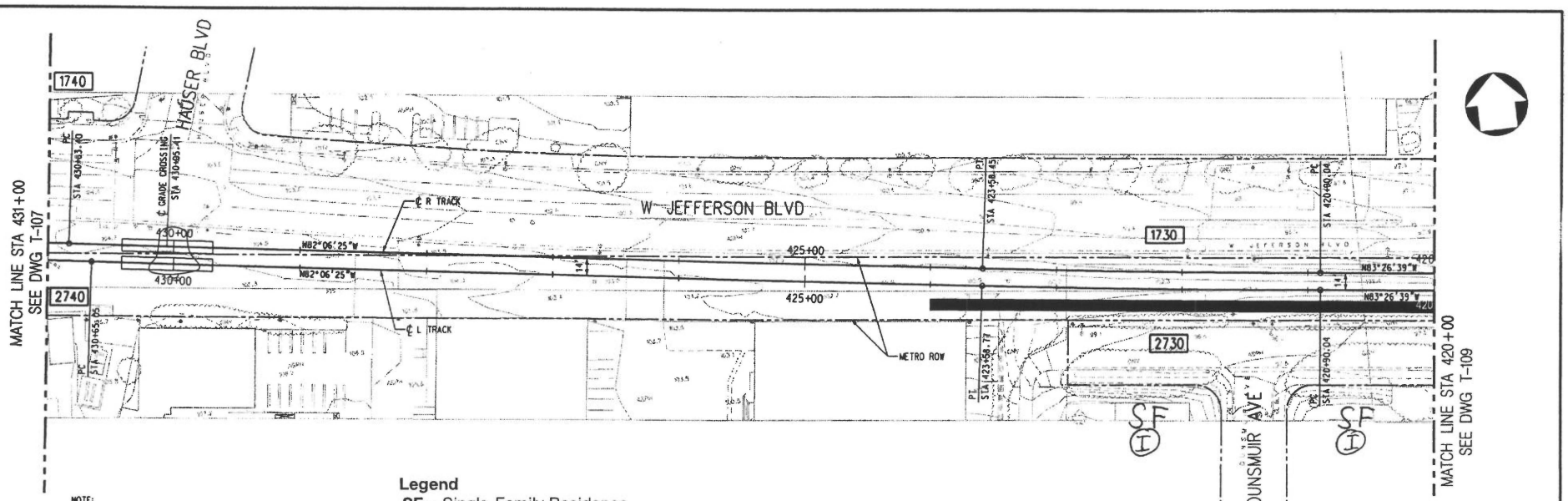
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
MAIN TRACKS
PLAN & PROFILE
STA 431+00 TO STA 442+00
SOUTHERN ALTERNATIVE

CONTRACT NO E0016
DRAWING NO T-107 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 371

08/07/2005

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



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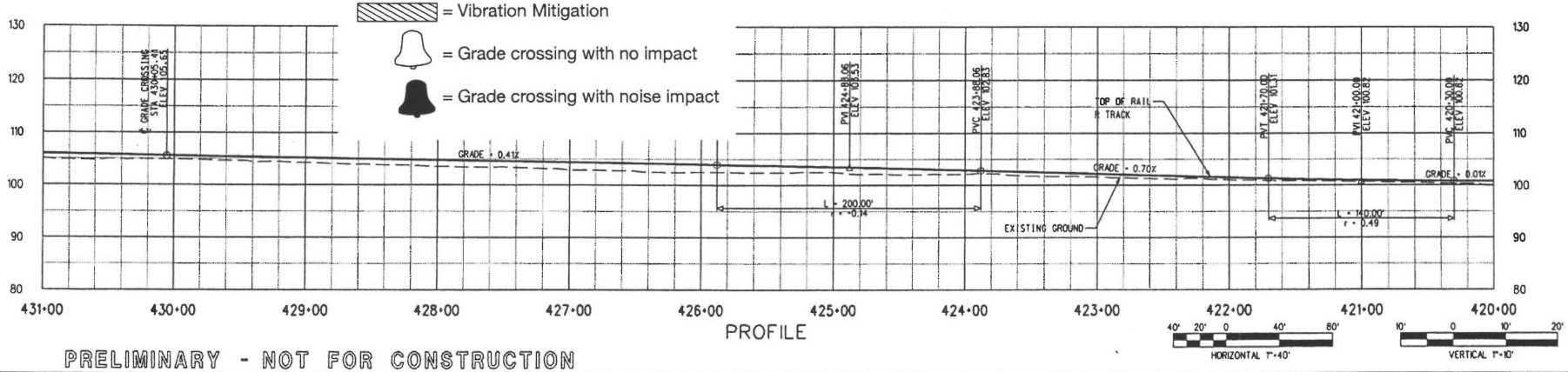
PLAN



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

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LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
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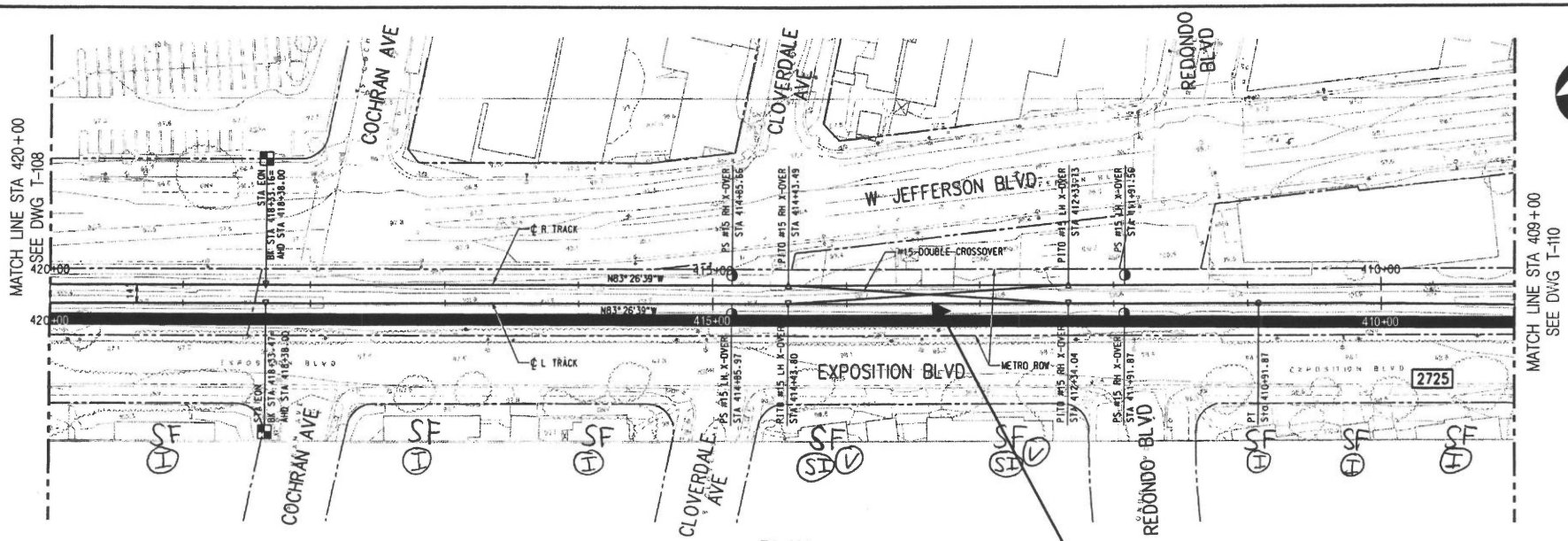
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
MAIN TRACKS
PLAN & PROFILE
STA 420+00 TO STA 431+00
SOUTHERN ALTERNATIVE

CONTRACT NO E0016
DRAWING NO T-108 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 377

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

This crossover to be moved to a less sensitive location or a spring-rail frog will be used.

NOTE:

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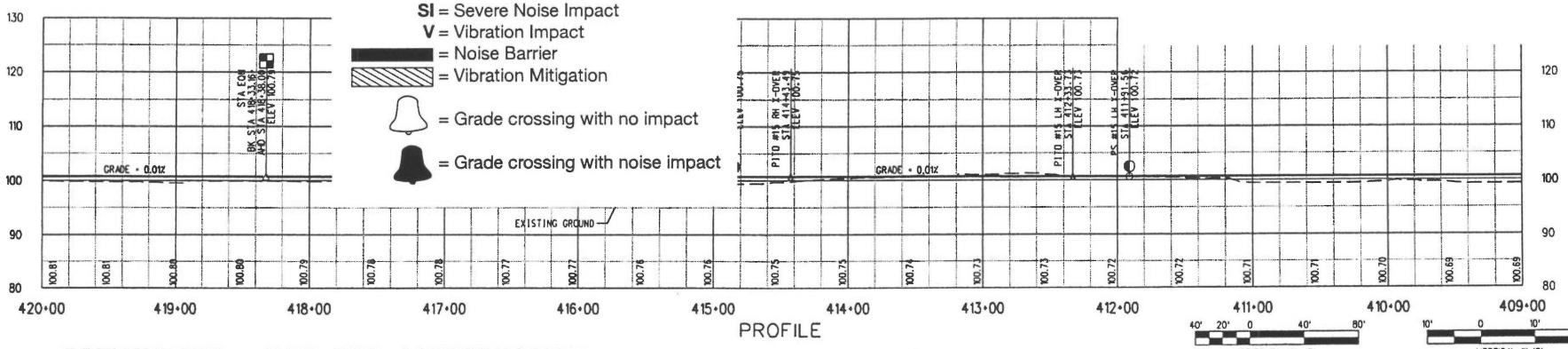

PROFILE

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DATE 8/21/03

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FAX (213) 922-9559

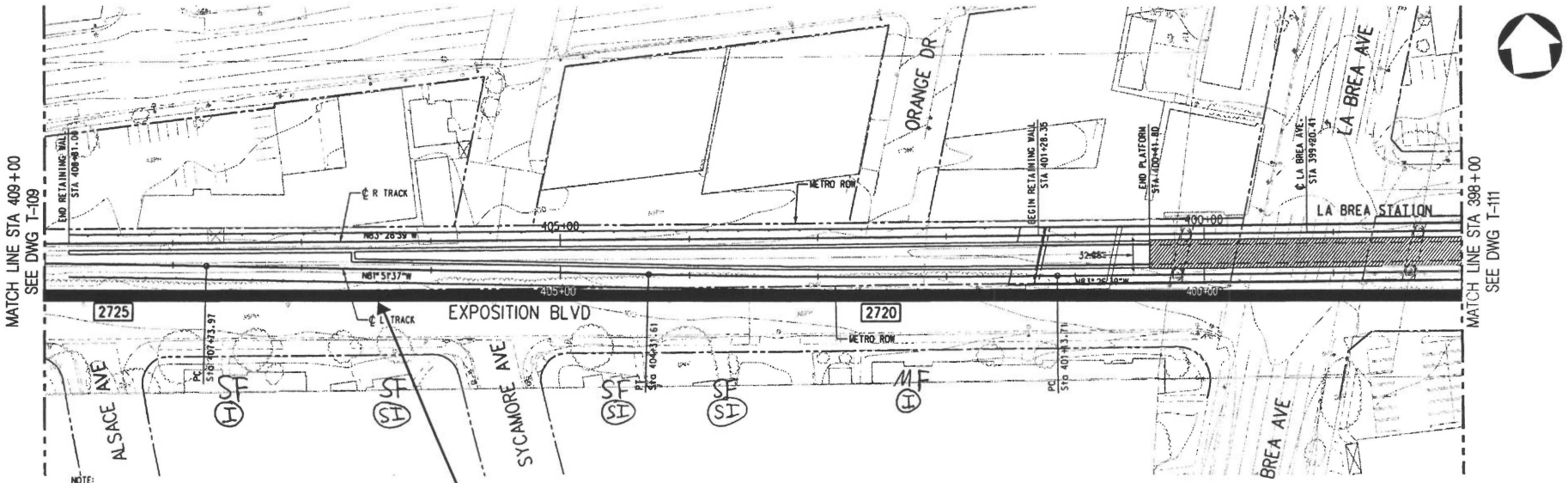
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 409+00 TO STA 420+00

CONTRACT NO E0016
DRAWING NO T-109 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 378

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



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PLAN

Noise Barrier transition point onto elevated structure.

Legend

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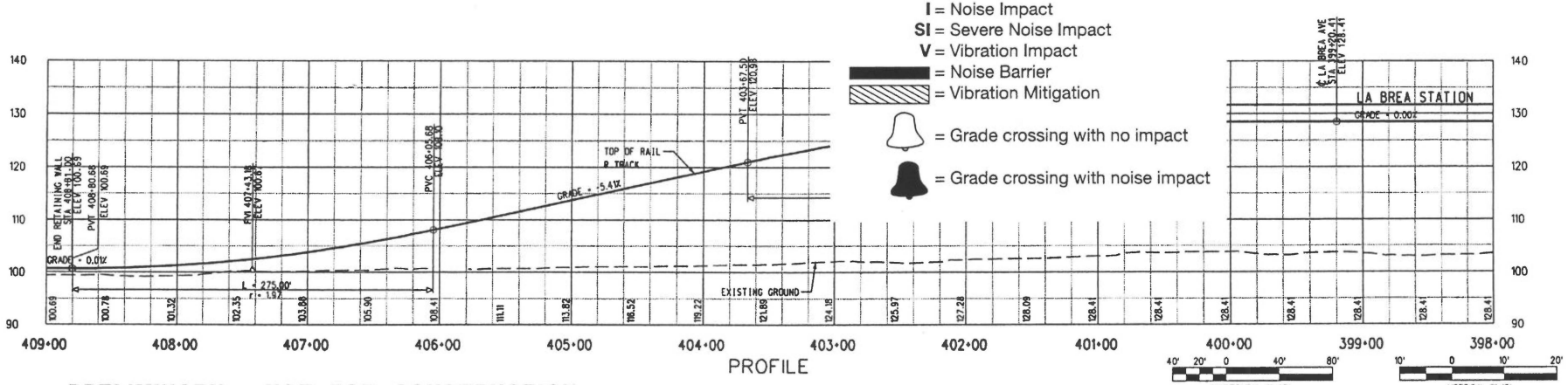

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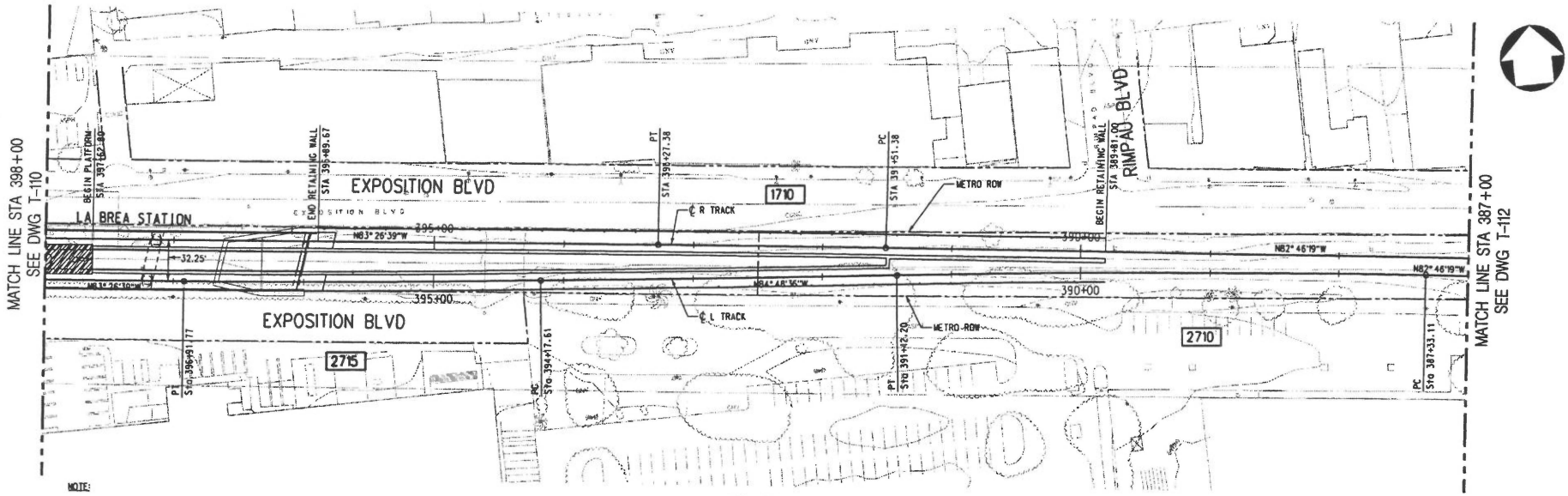
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 398+00 TO STA 409+00

CONTRACT NO E0016
DRAWING NO T-110 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 379

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:

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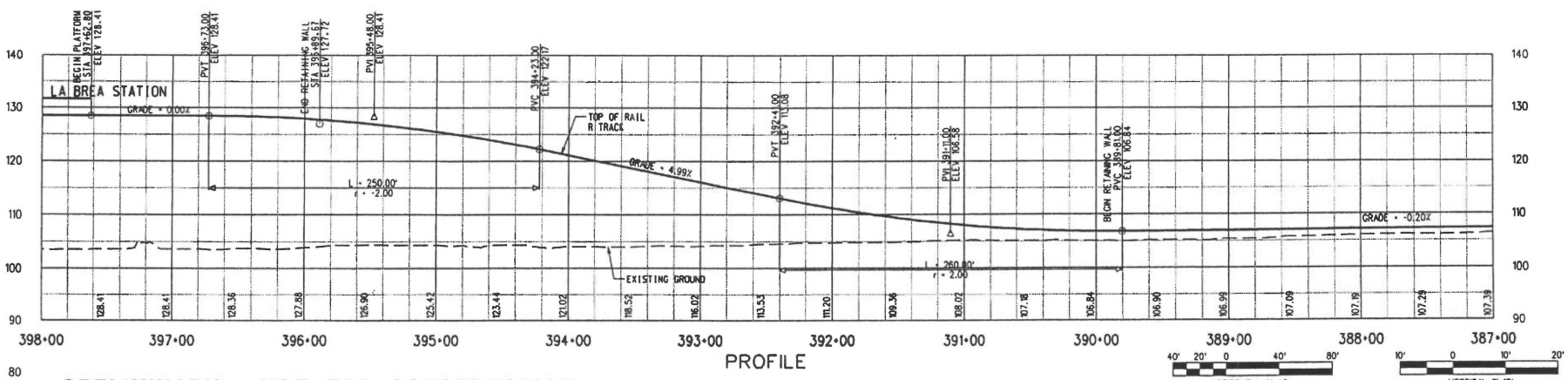

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SUBMITTED
APPROVED

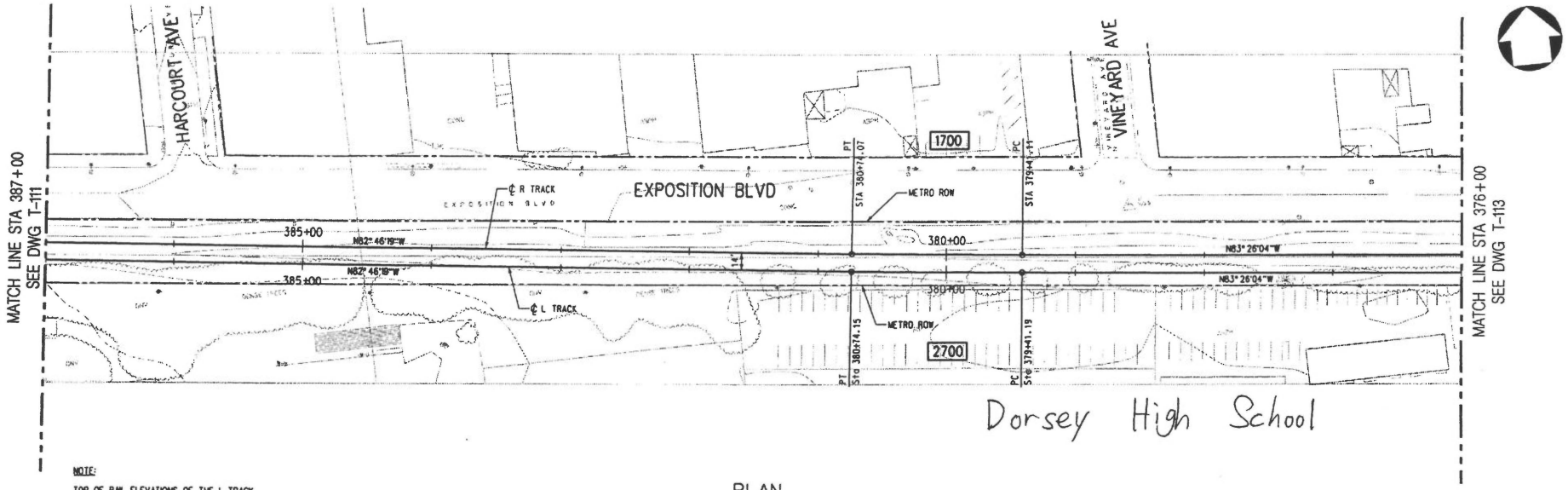
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 387+00 TO STA 398+00

CONTRACT NO E0016
DRAWING NO T-111 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 380

Plotted by: nathanc 08/09/2005

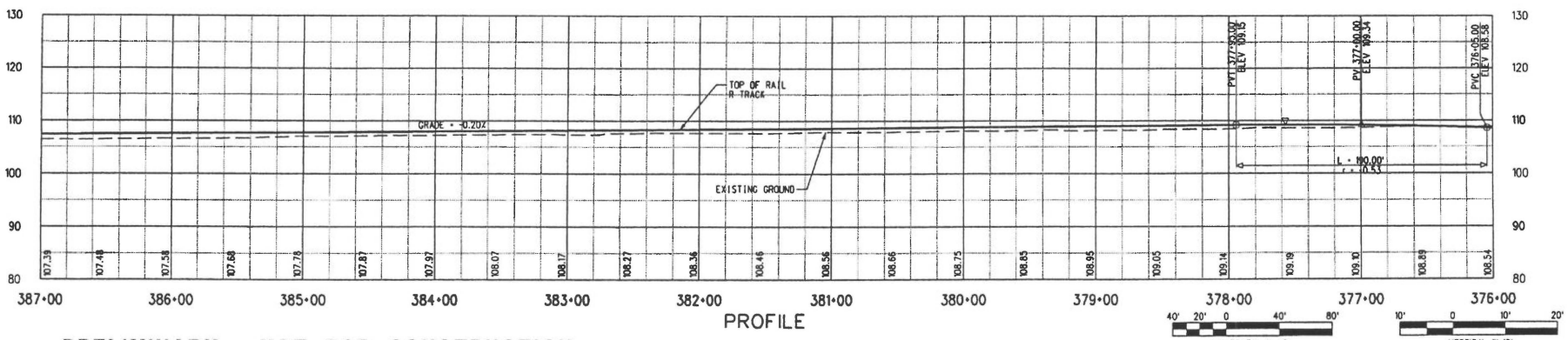
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).

PLAN



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. LAYGO
DRAWN BY R. LAYGO
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM

707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9559

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

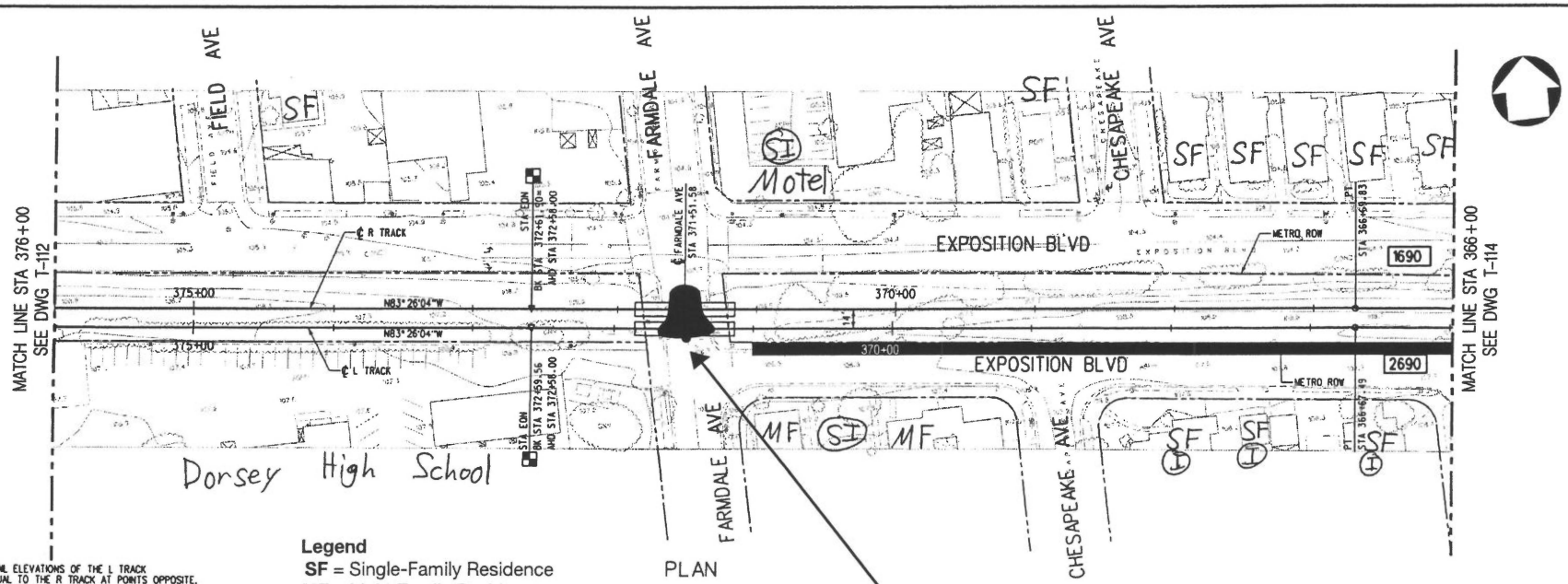
MAIN TRACKS
PLAN & PROFILE
STA 376+00 TO STA 387+00

CONTRACT NO E0016
DRAWING NO T-112 REV 0
SCALE HORIZ: 1" = 40' VERT: 1" = 10'
SHEET NO 381

08/01/2005

Plotted by: nathanc

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



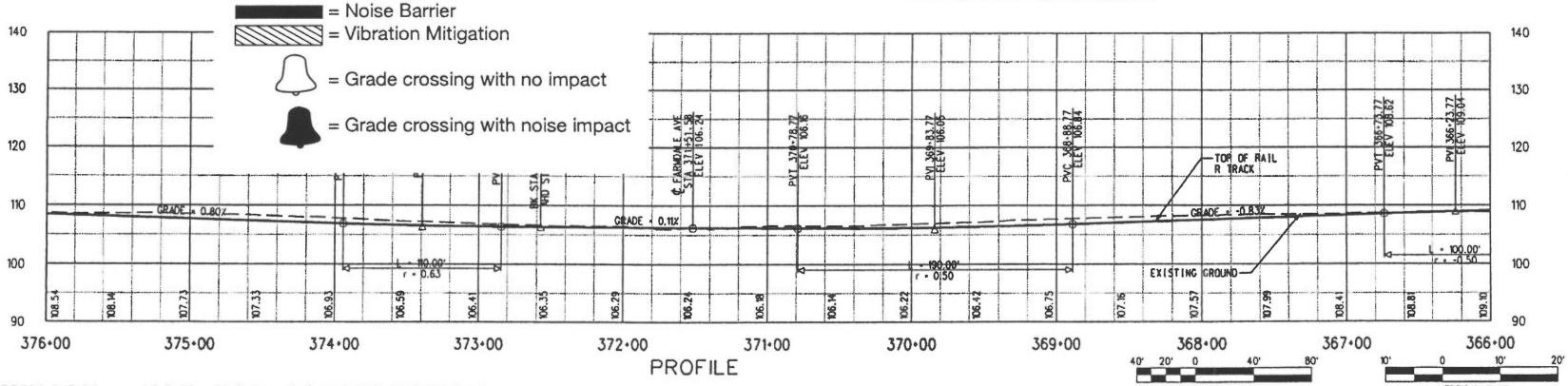
NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).

Legend

- **SF** = Single-Family Residence
- **MF** = Multi-Family Residence
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact

Noise mitigation shall include reducing the crossing bell level, sound insulation and the noise barrier shown.



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. LAYGO
DRAWN BY R. LAYGO
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM

707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9359

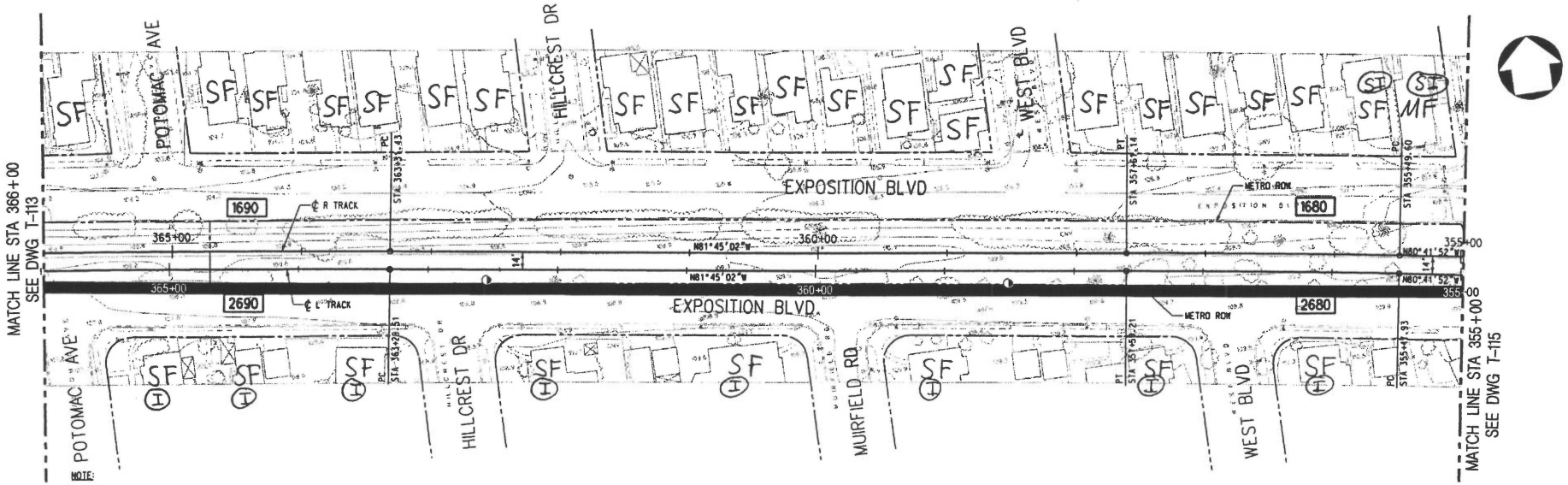
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 366+00 TO STA 376+00

CONTRACT NO E0016
DRAWING NO T-113 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 382

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

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PLAN

Legend

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- = Noise Barrier
- = Vibration Mitigation
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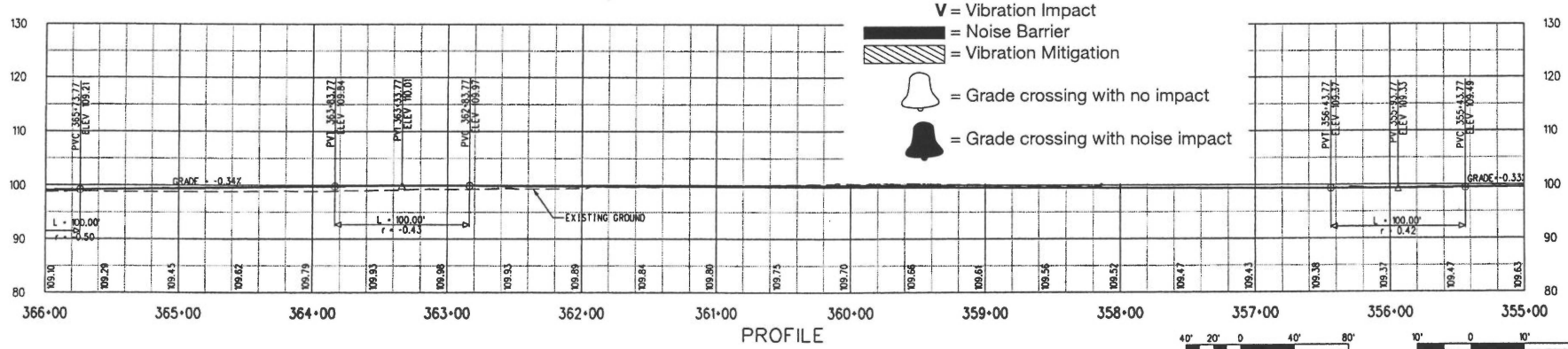
- = Grade crossing with noise impact



PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9959

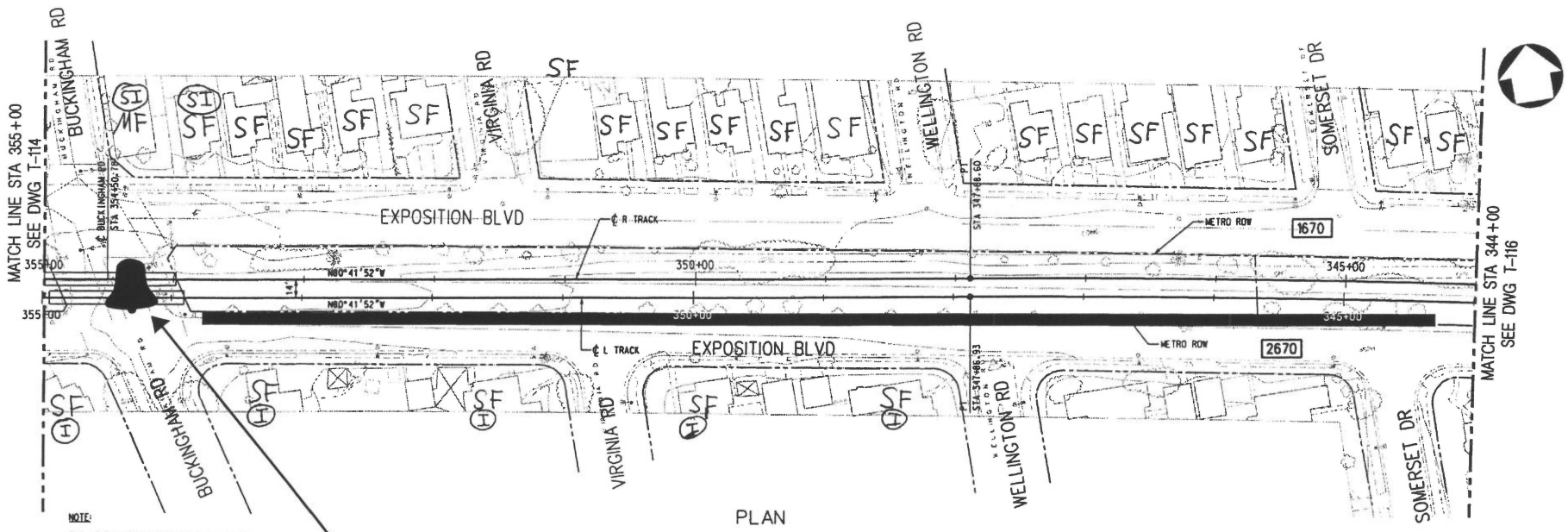
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 355+00 TO STA 366+00

CONTRACT NO E0016
DRAWING NO T-114 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 383

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



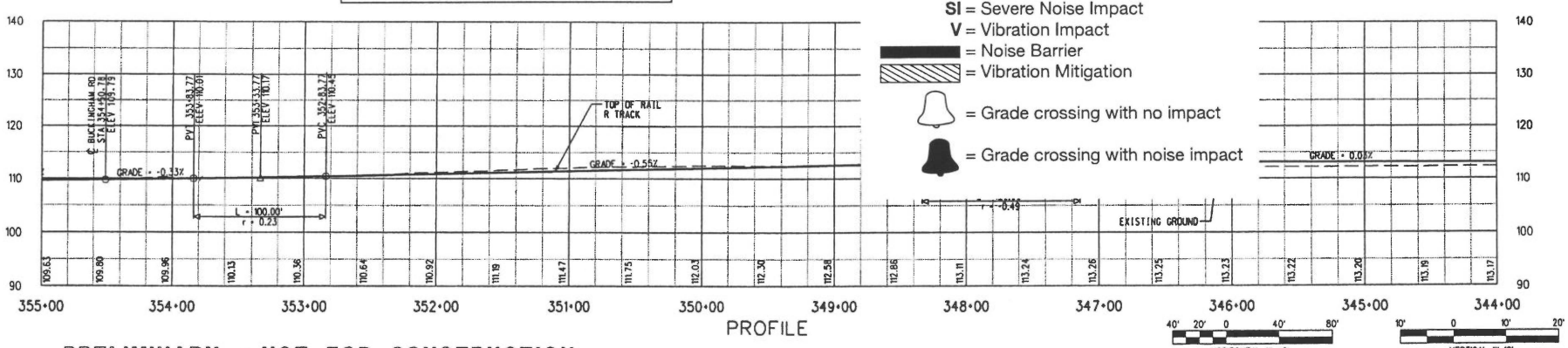
NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).

Noise mitigation shall include reducing the crossing bell level, sound insulation and the noise barrier shown.

Legend

- **SF** = Single-Family Residence
- **MF** = Multi-Family Residence
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9999

SUBMITTED
APPROVED

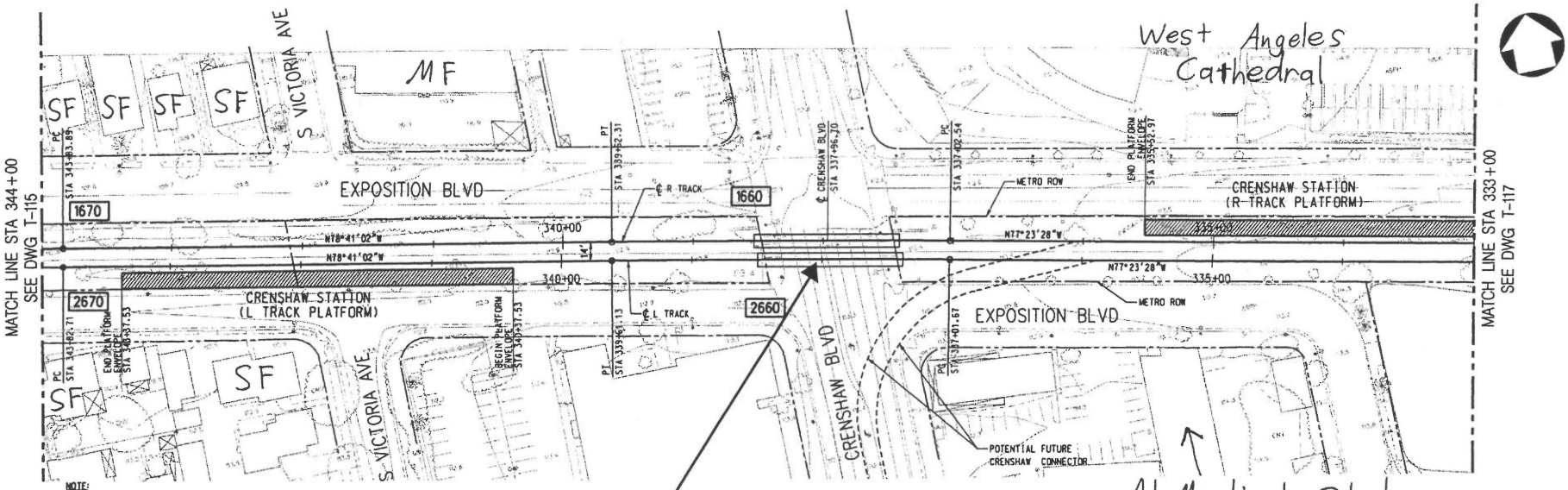
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 344+00 TO STA 355+00

CONTRACT NO E0016
DRAWING NO T-115 REV 0
SCALE HORIZ: 1" =40' VERT: 1" =10'
SHEET NO 384

Plotted by: nathane 08/07/2005 \\use2k00\projects\3843\001 cad\drwg\sheet\1115.plt

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

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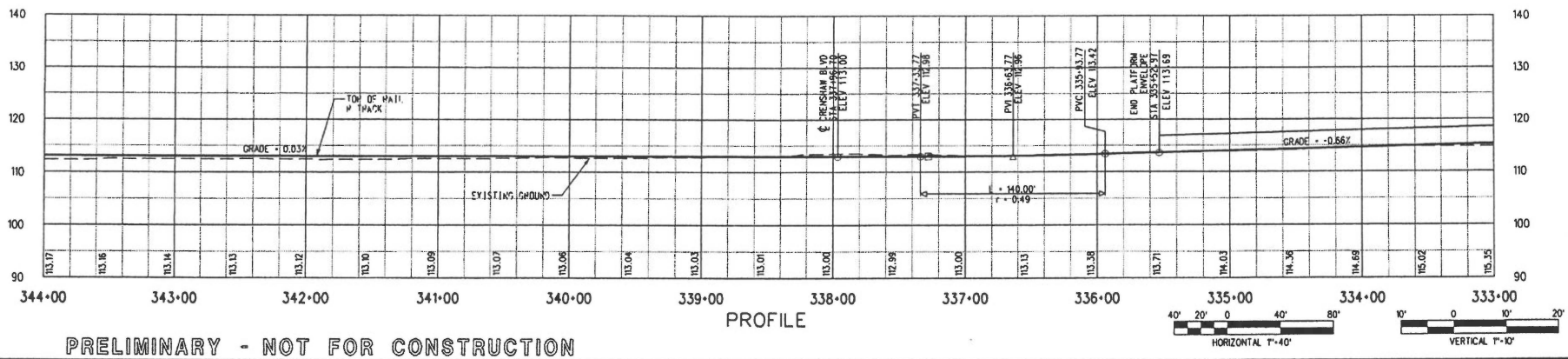
PLAN

Street-running operation. No gates required.



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REQ NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM

707 WILSHIRE BLVD., SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9559

SUBMITTED
APPROVED

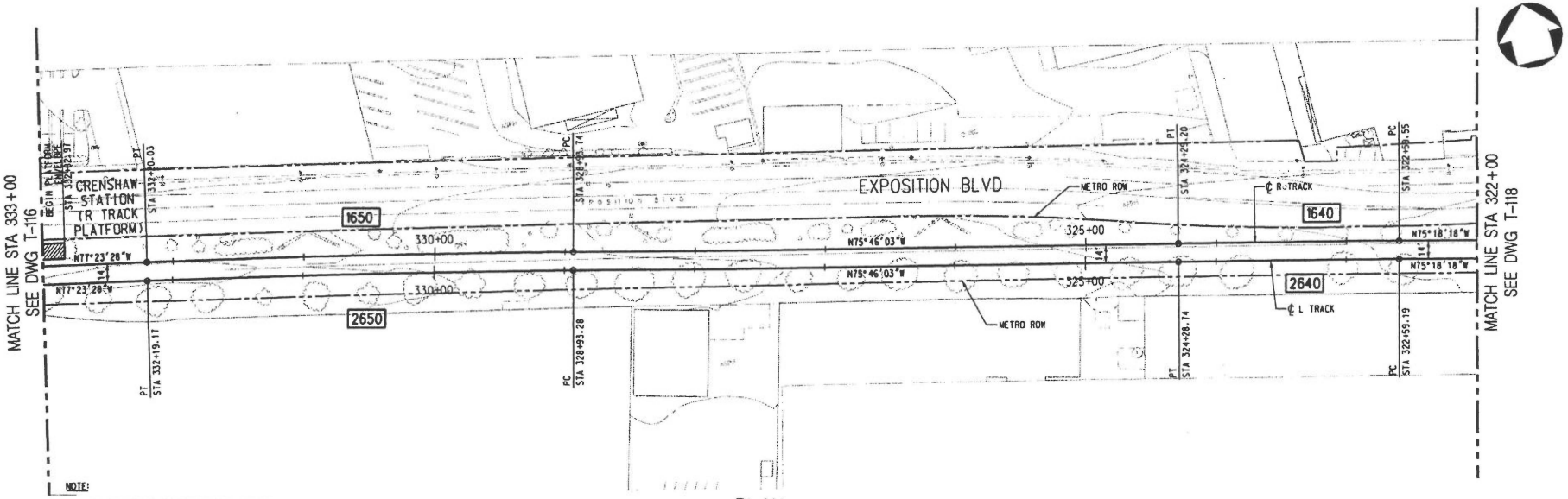
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 333+00 TO STA 344+00

CONTRACT NO E0016
DRAWING NO T-116 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 385

Plotted by: nathans 08/01/2005 \\usela2c01\projects\3843\001 code\R\dwg\T116.dwg

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



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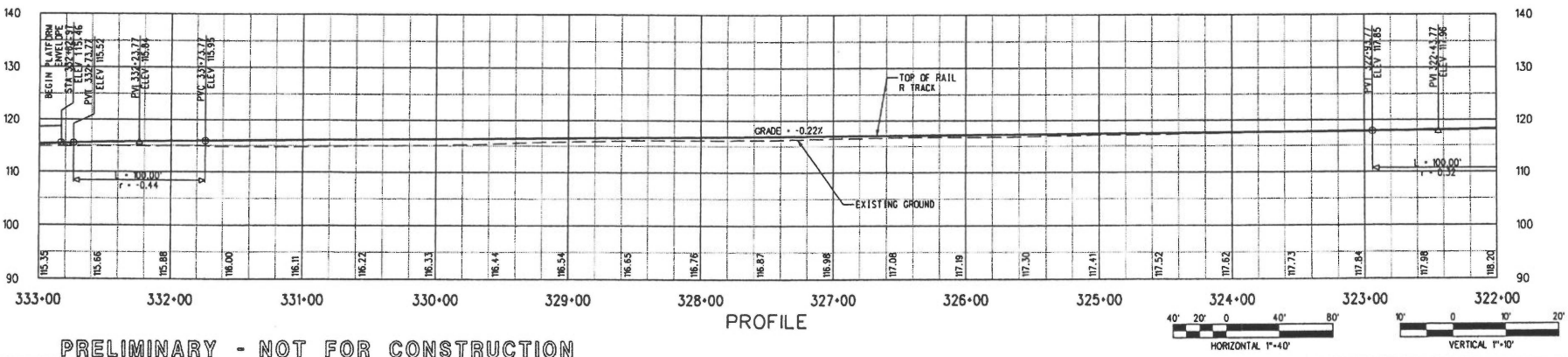
PLAN



PROFILE

40' 20' 0 40' 80'
HORIZONTAL 1"=40'

10' 0 10' 20'
VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM

707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9599

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

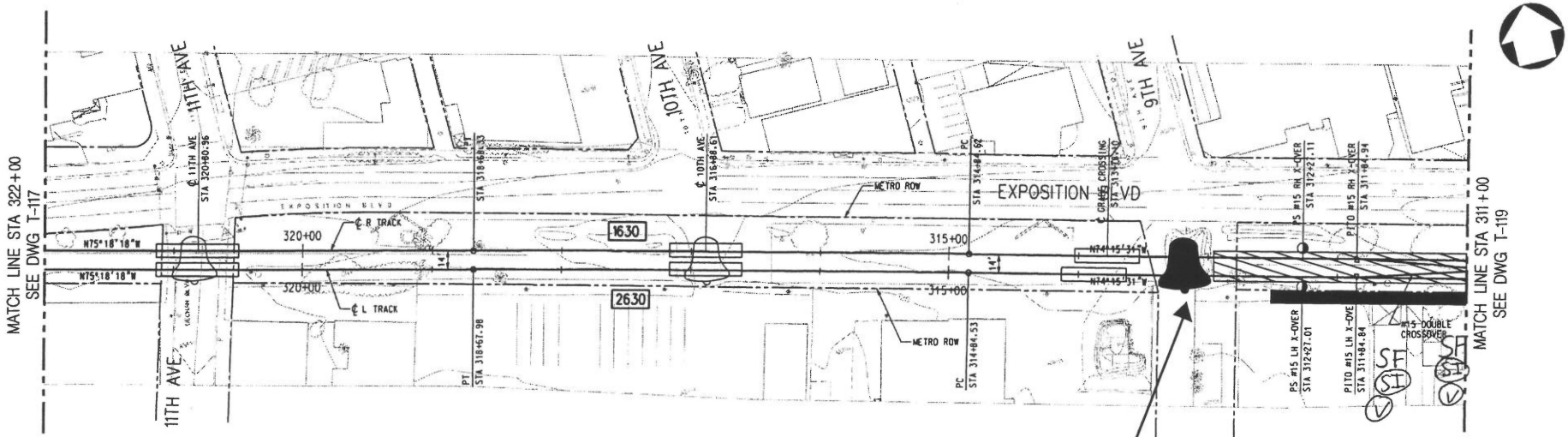
MAIN TRACKS
PLAN & PROFILE
STA 322+00 TO STA 333+00

CONTRACT NO E0016
DRAWING NO T-117 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 386

08/01/2005

Plotted by: mellnerc

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

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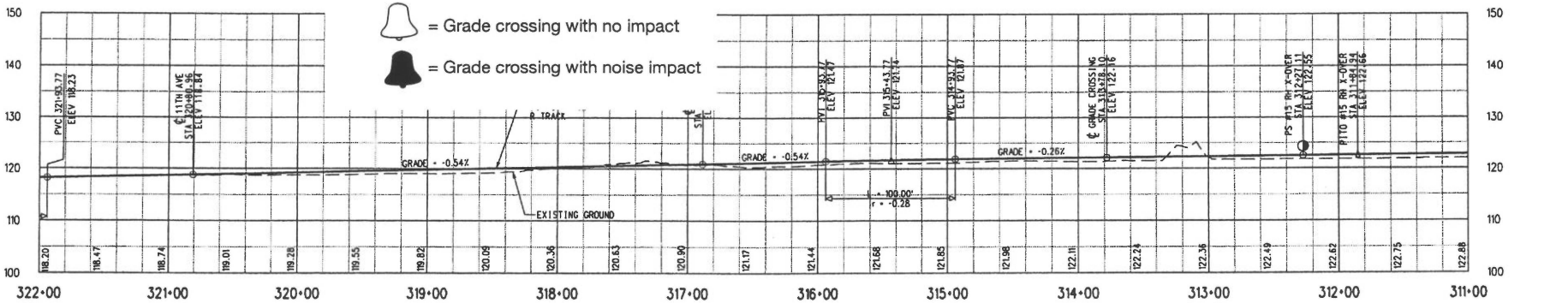
Legend

- **SF** = Single-Family Residence
- **MF** = Multi-Family Residence
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact

PLAN

Noise mitigation shall include reducing the crossing bell level, and the noise barrier shown.



PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9559

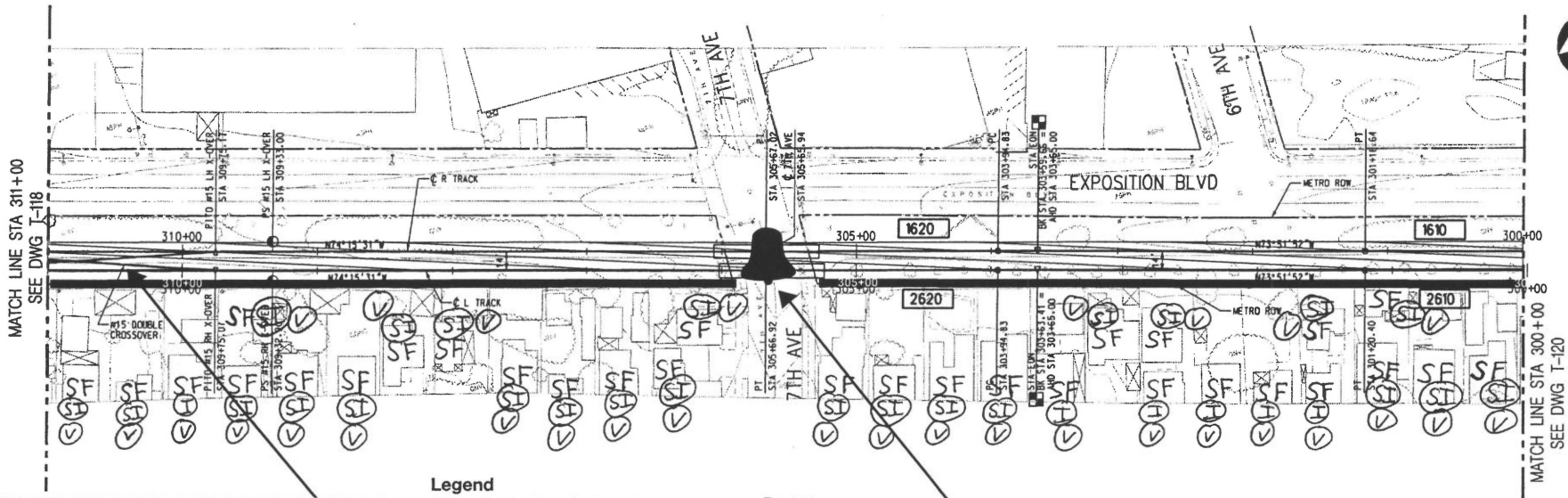
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 311+00 TO STA 322+00

CONTRACT NO E0016
DRAWING NO T-118 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 387

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



This crossover to be moved to a less sensitive location or a spring-rail frog will be used.

Noise mitigation shall include reducing the crossing bell level, sound insulation and the noise barrier shown.

Legend

- **SF** = Single-Family Residence
- **MF** = Multi-Family Residence
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
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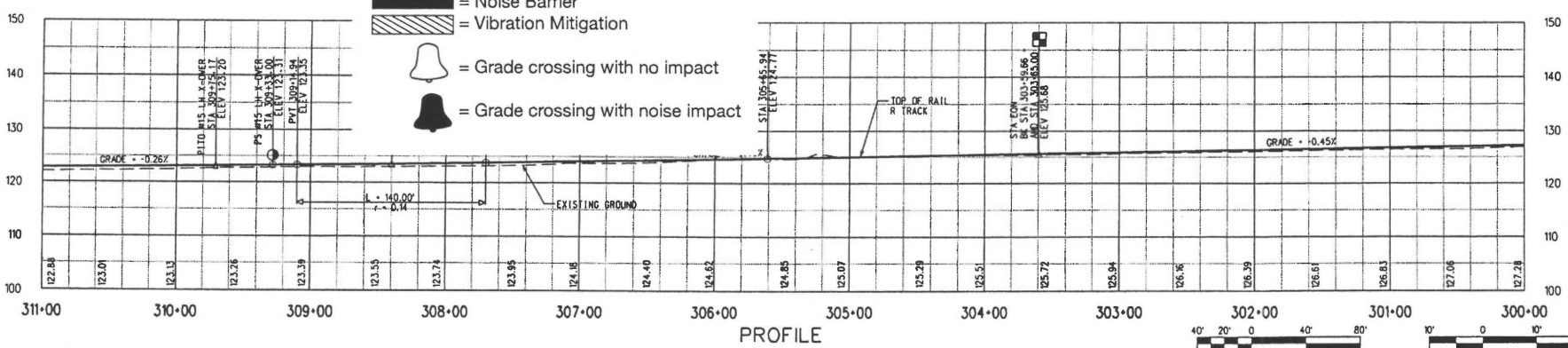
PLAN



PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REQ NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
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DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD, SUITE #2300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-7200
FAX (213) 922-5595

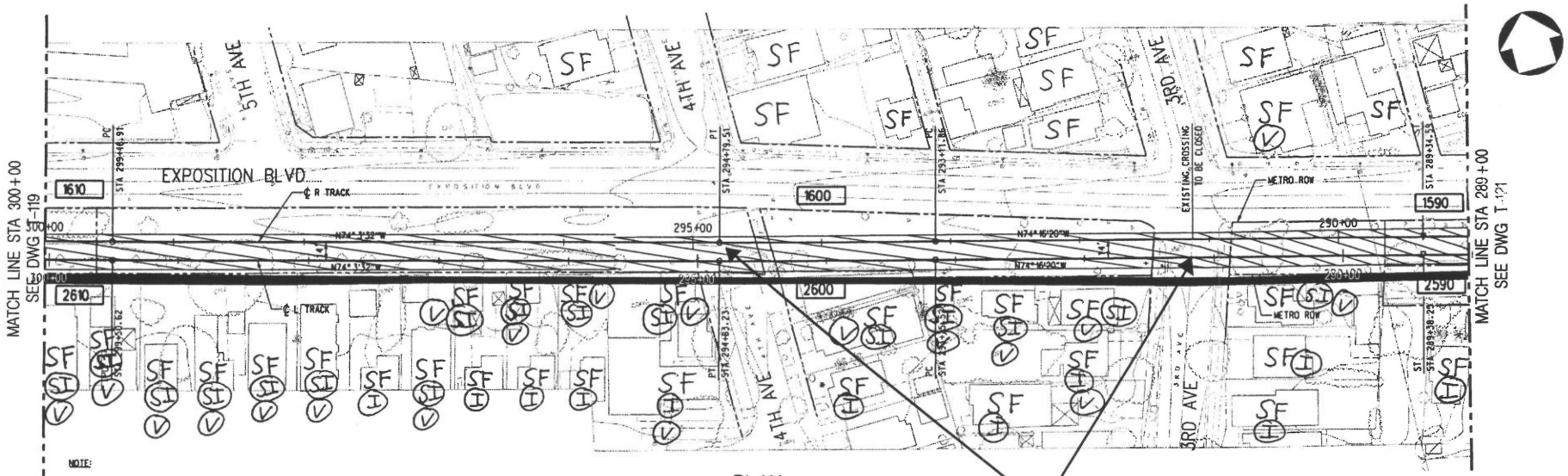
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 300+00 TO STA 311+00

CONTRACT NO E0016
DRAWING NO T-119
REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 388

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



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PLAN

Crossing to be closed. No gates required.

Legend

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- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
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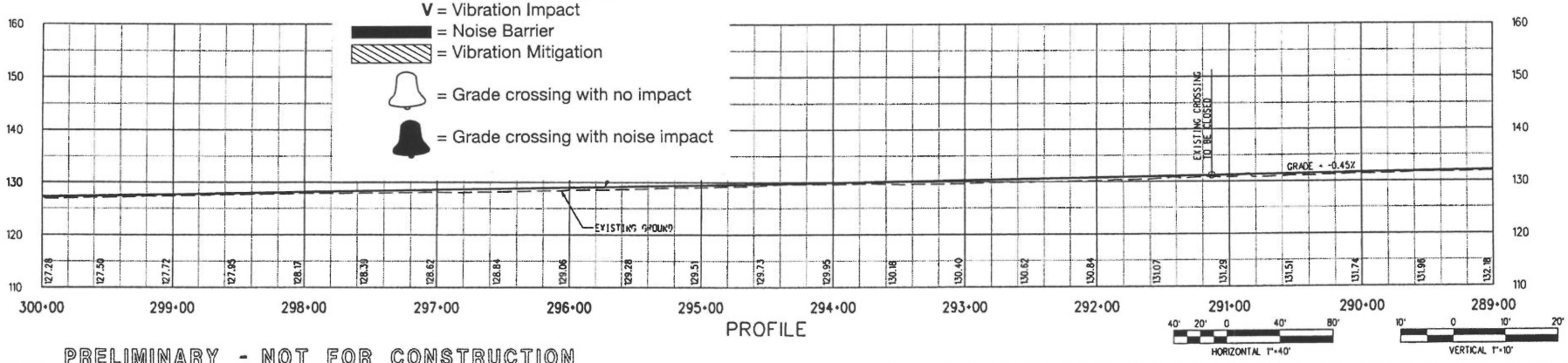

PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

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DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
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DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9559

SUBMITTED
APPROVED

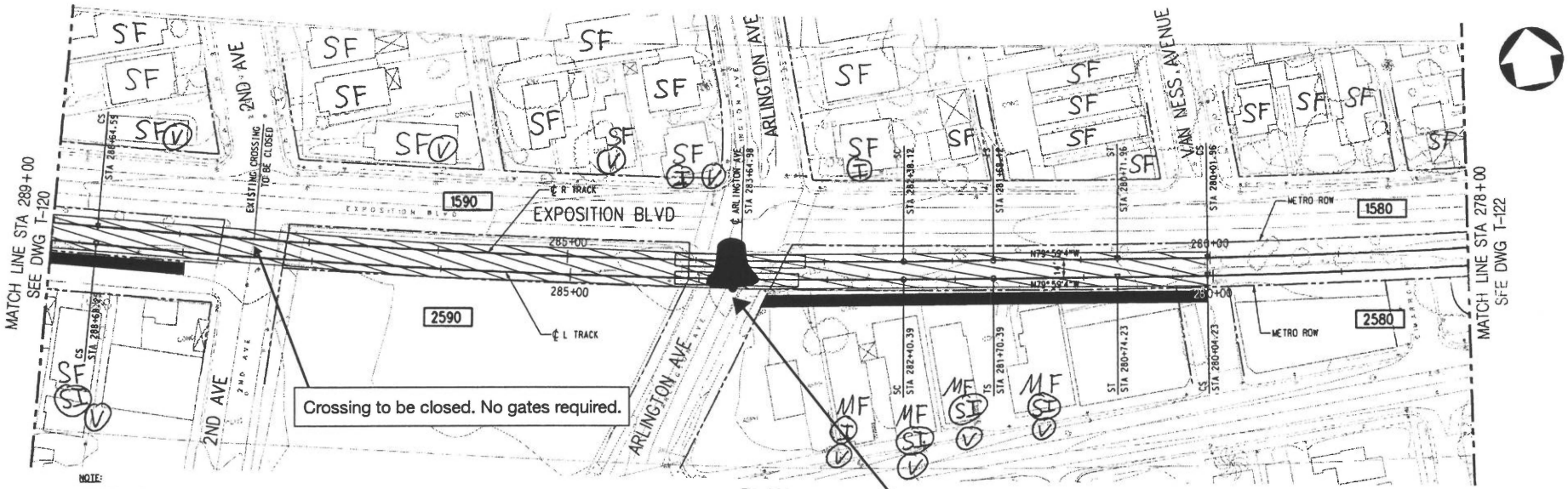
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 289+00 TO STA 300+00

CONTRACT NO E0016
DRAWING NO T-120 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 389

08/09/2005

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



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- = Grade crossing with no impact
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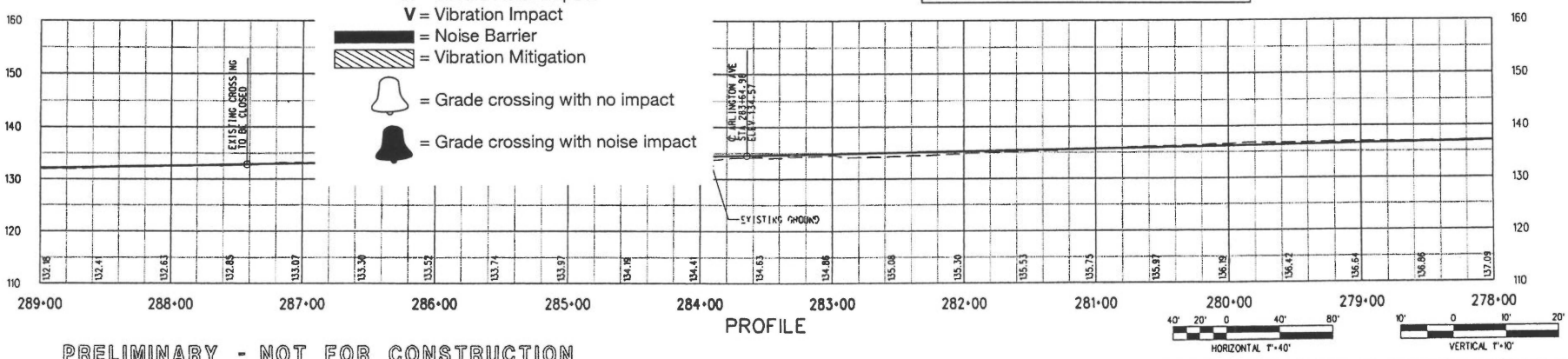

PRELIMINARY - NOT FOR CONSTRUCTION

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Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

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TEL (213) 922-9300
FAX (213) 922-9303

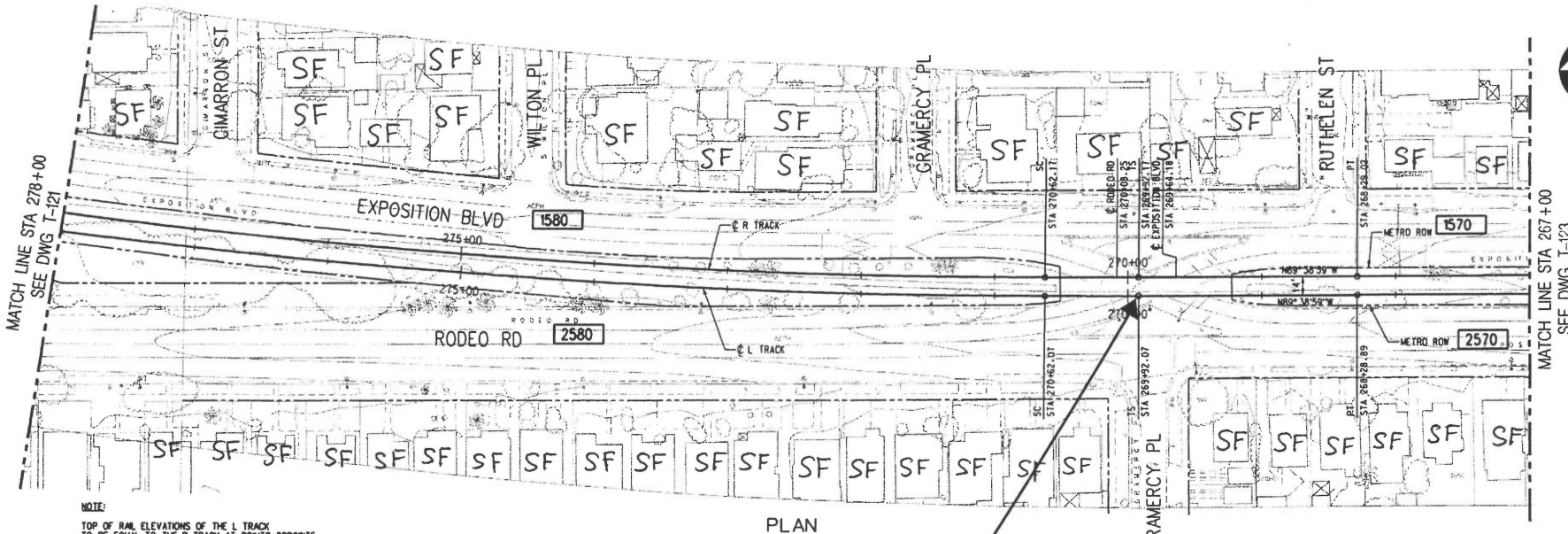
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 278+00 TO STA 289+00

CONTRACT NO E0016
DRAWING NO T-121 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 390

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.

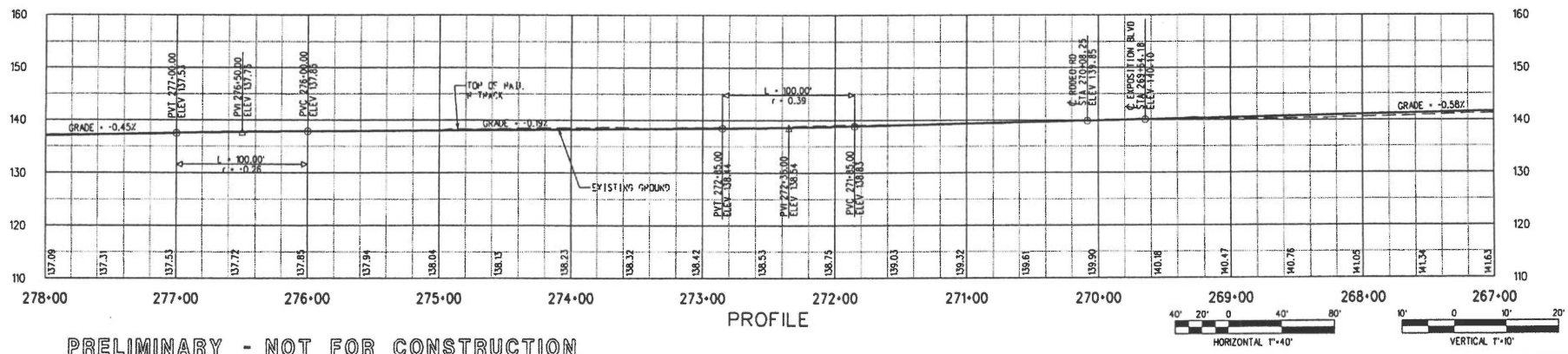


NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).

PLAN

Street-running operation. No gates required.



PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD., SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9999

SUBMITTED
APPROVED

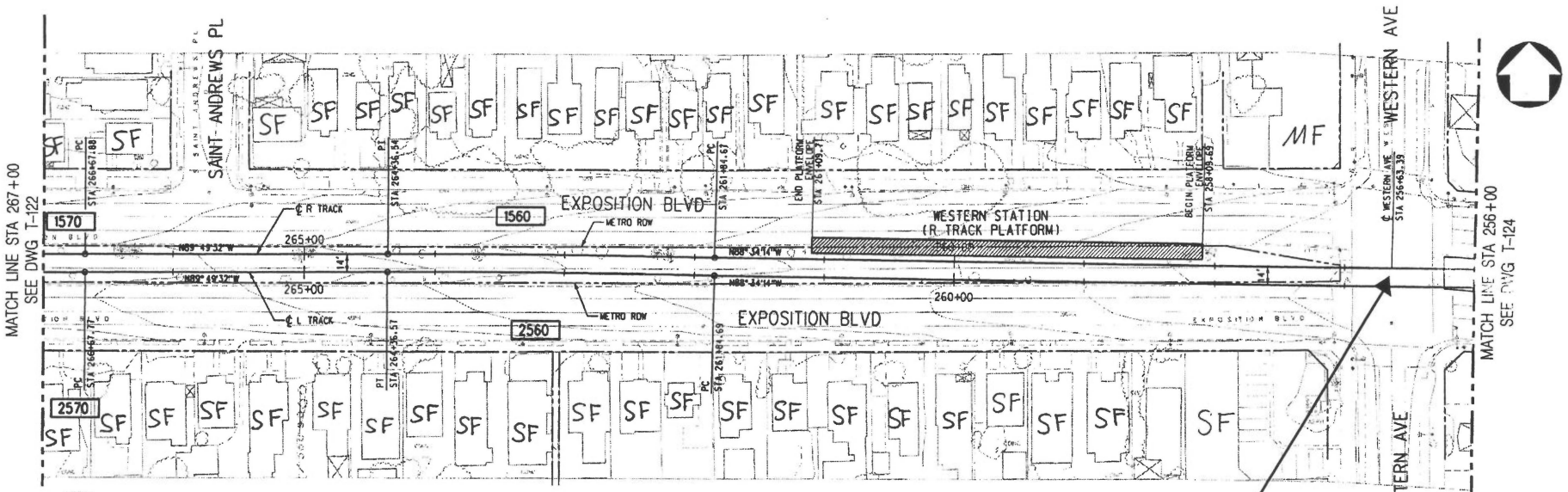
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 267+00 TO STA 278+00

CONTRACT NO E0016
DRAWING NO T-122 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 391

Plotted by: nathanc 08/01/2005

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.

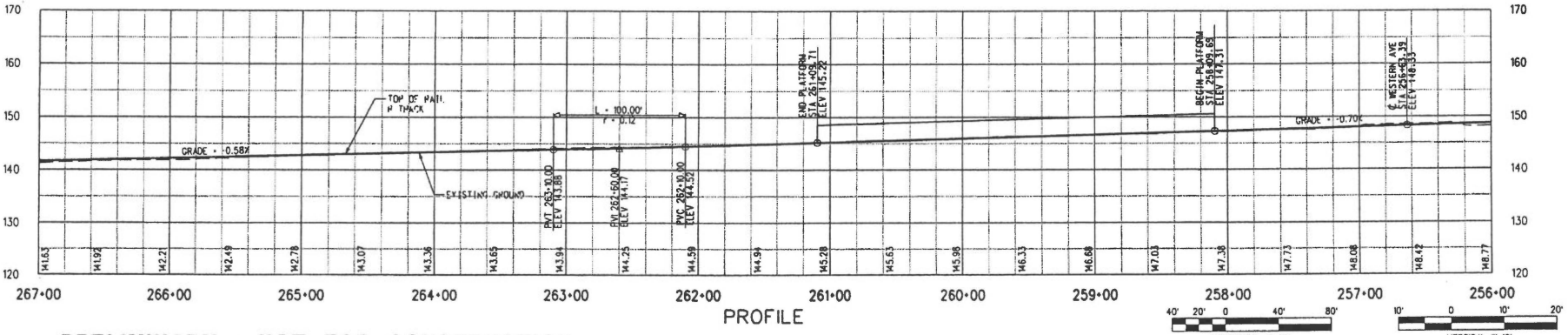


NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).

PLAN

Street-running operation. No gates required.



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9559

SUBMITTED
APPROVED

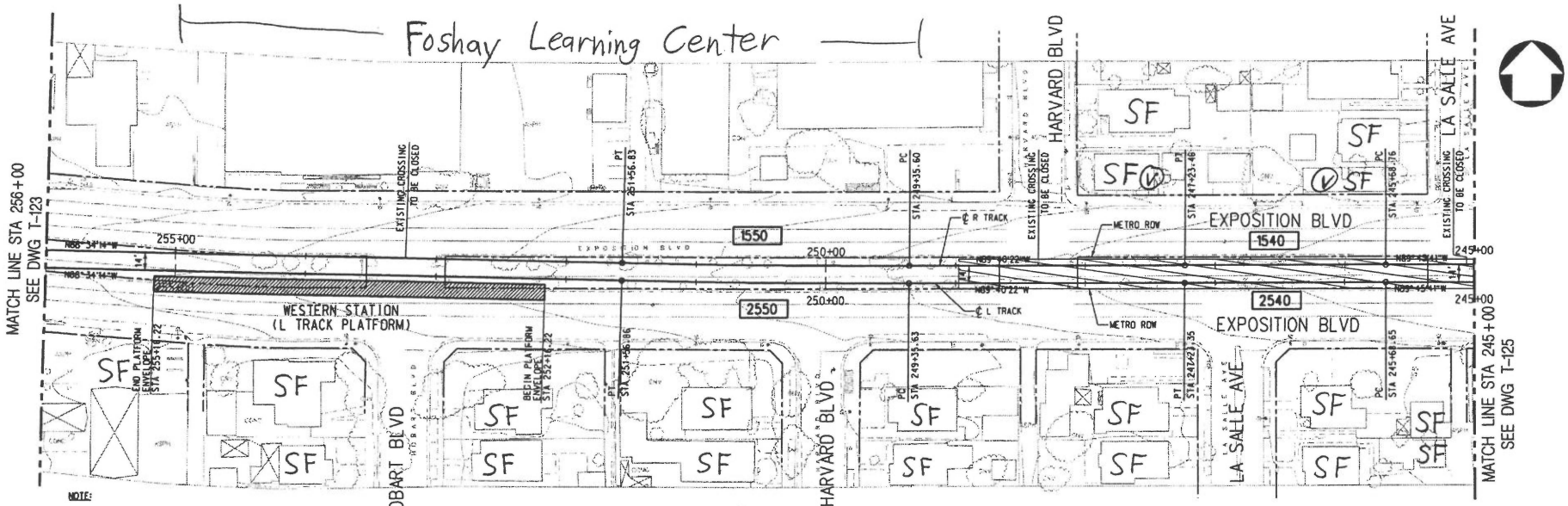
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 256+00 TO STA 267+00

CONTRACT NO E0016
DRAWING NO T-123
REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 392

Plotted by nshane 08/09/2005

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



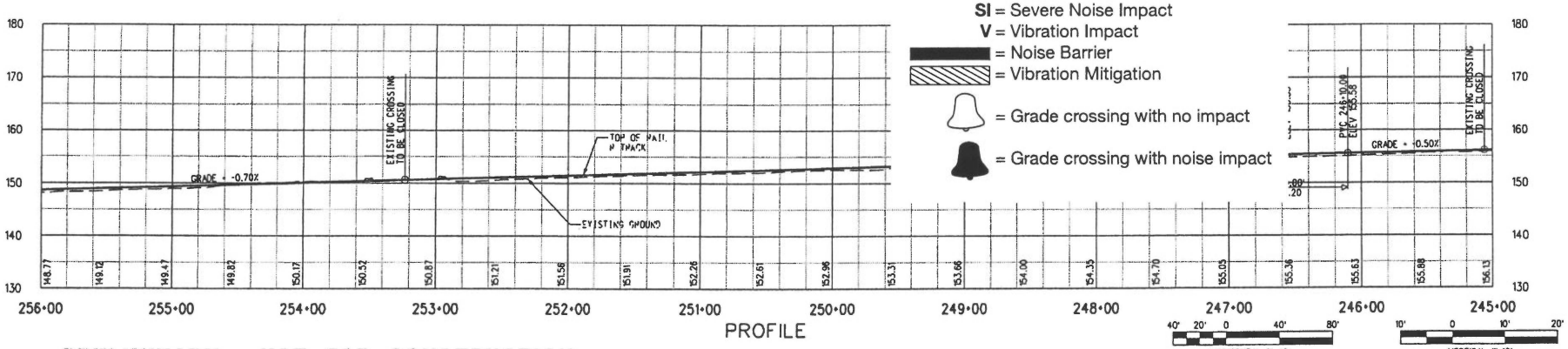
NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).

PLAN

Legend

- **SF** = Single-Family Residence
- **MF** = Multi-Family Residence
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact



PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM

707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-6200
FAX (213) 922-6599

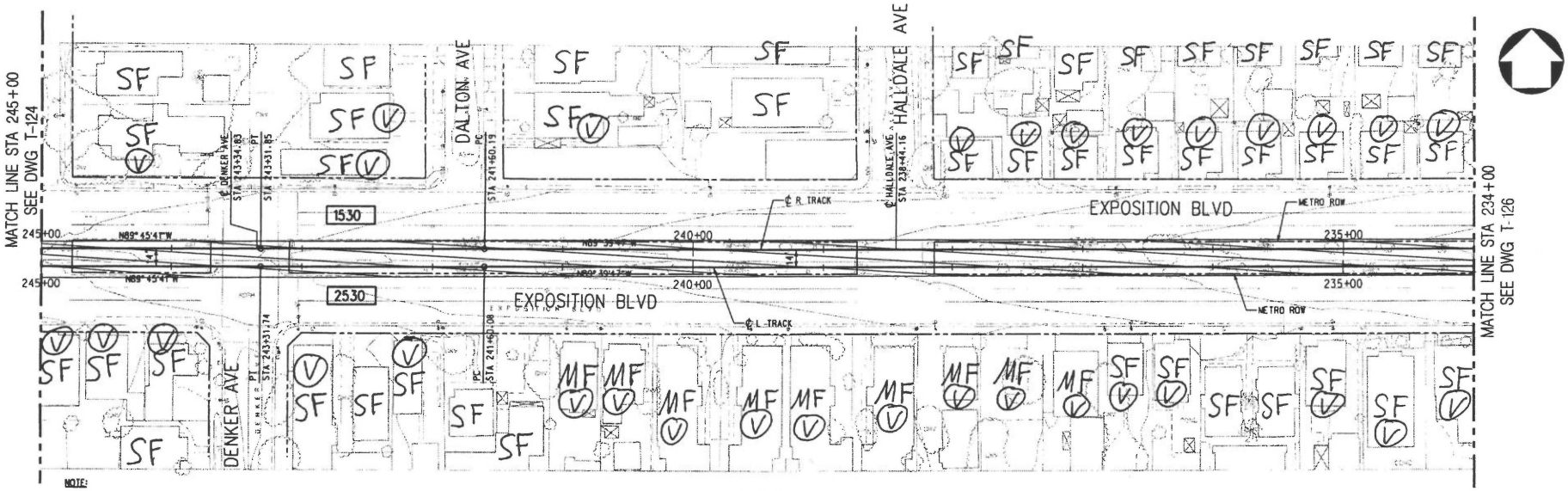
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 245+00 TO STA 256+00

CONTRACT NO E0016
DRAWING NO T-124 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 393

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).

PLAN

Legend

- **SF** = Single-Family Residence
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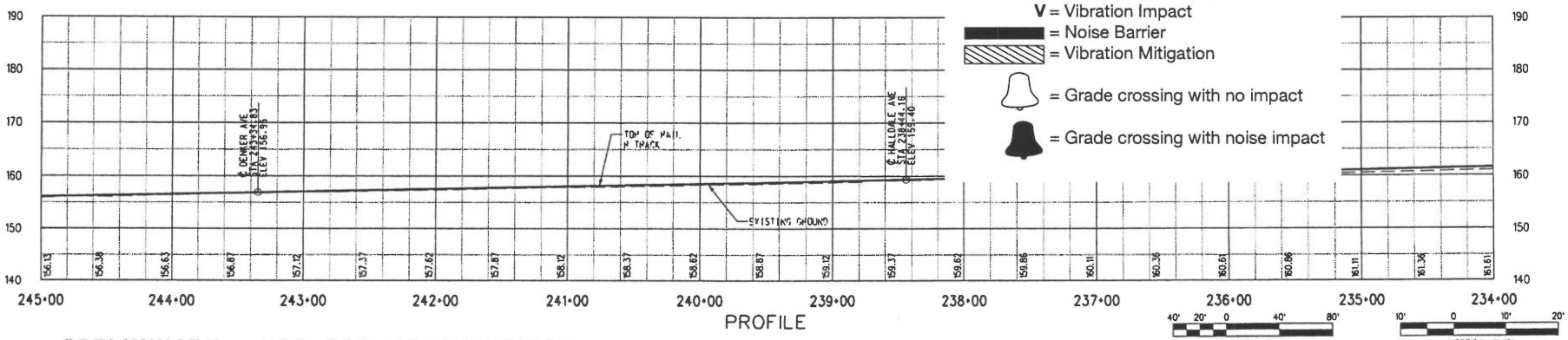
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD., SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9999

SUBMITTED
APPROVED

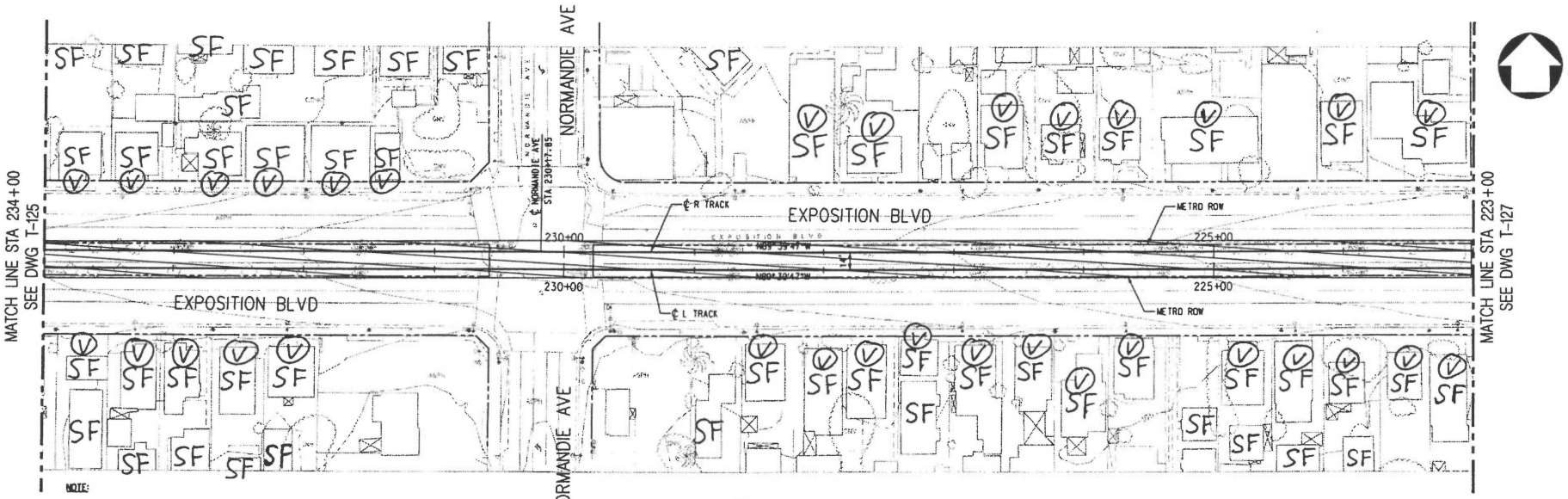
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 234+00 TO STA 245+00

CONTRACT NO E0016
DRAWING NO T-125 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 394

Plotted by: mathenc 08/09/2005 \\sela2ec01\projects\5843\001 code\track\sheet\t125.plg

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



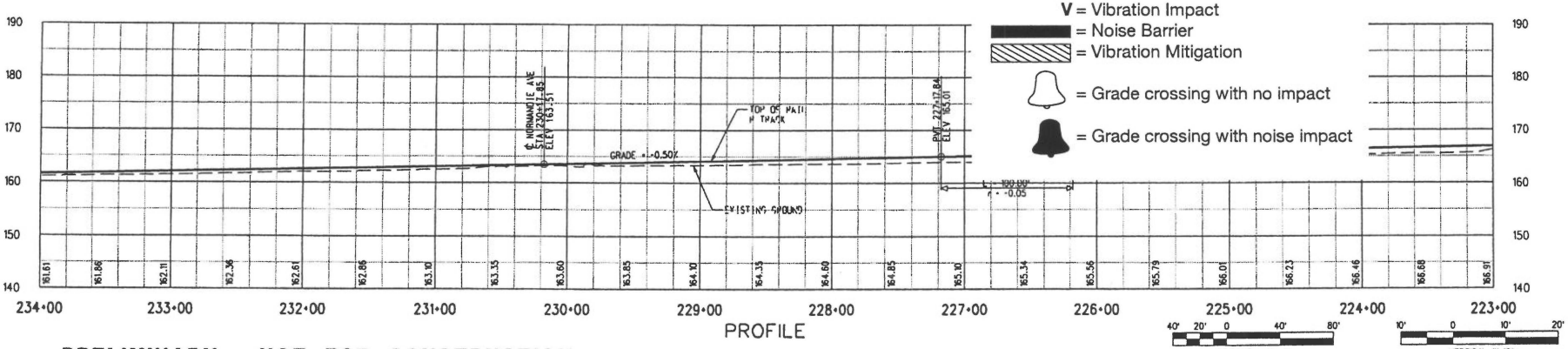
NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).

PLAN

Legend

- **SF** = Single-Family Residence
- **MF** = Multi-Family Residence
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact



PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM

707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9555

SUBMITTED
APPROVED

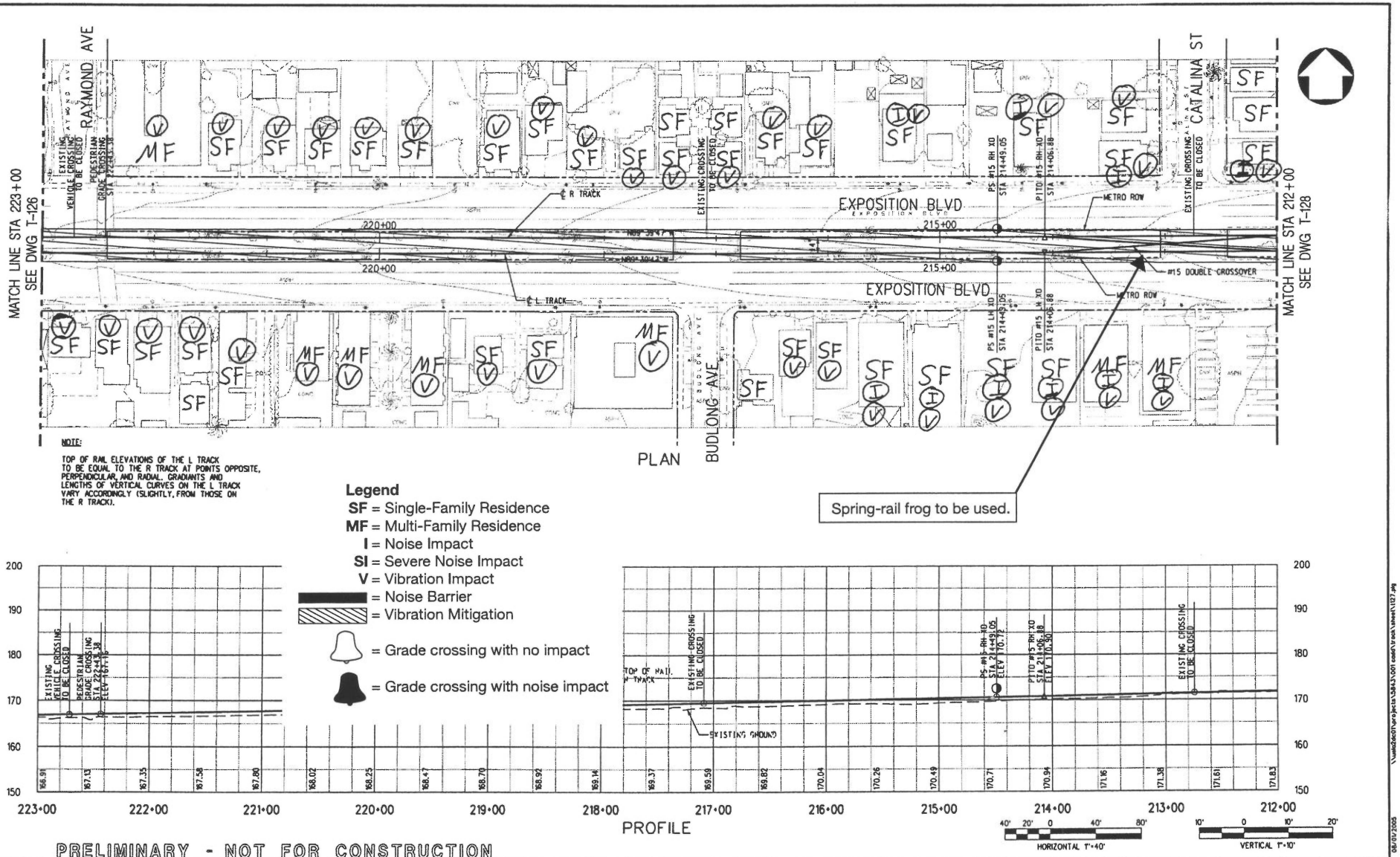
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 223+00 TO STA 234+00

CONTRACT NO E0016
DRAWING NO T-126 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 395

Plotted by: nathanc 08/07/2005 \\wdc2s01\projects\384-31-001 cost\rest\sheet\T126.dgn

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9555

SUBMITTED
APPROVED

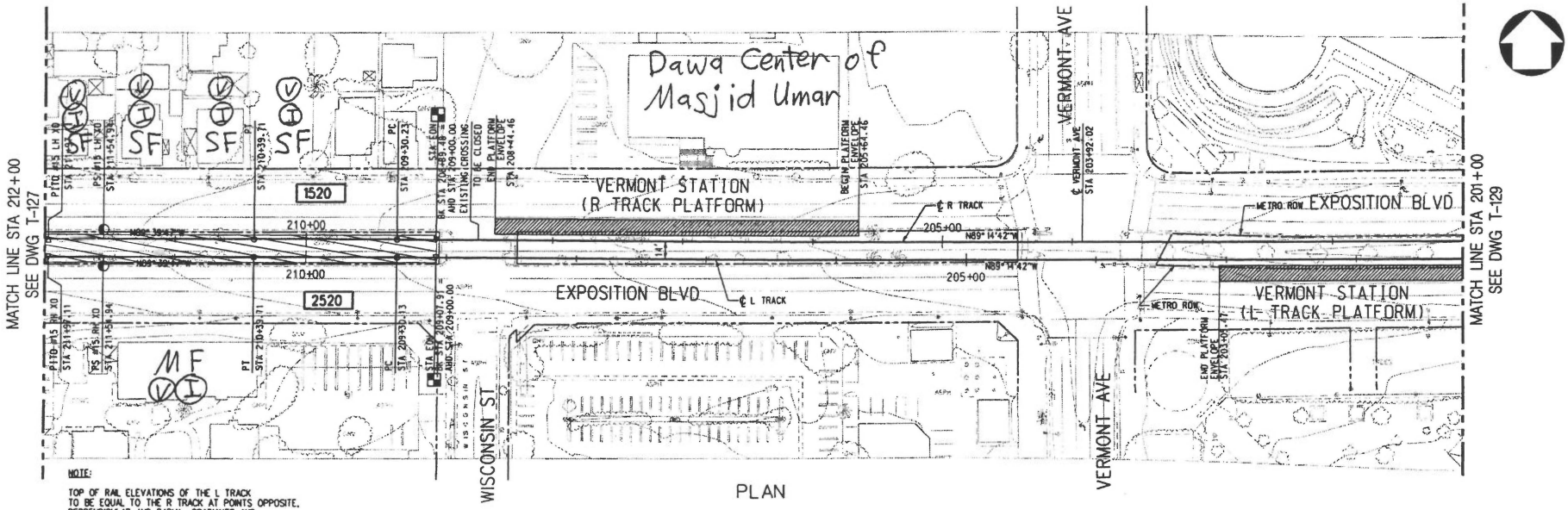
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 212+00 TO STA 223+00

CONTRACT NO E0016
DRAWING NO T-127 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 396

08/01/2005

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.

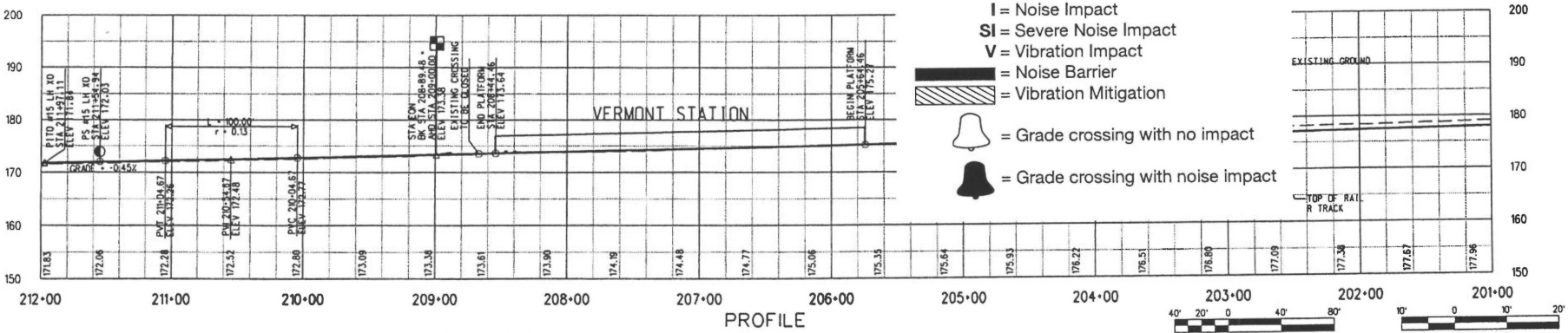


NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).

Legend

- **SF** = Single-Family Residence
- **MF** = Multi-Family Residence
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD., SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9553

SUBMITTED
APPROVED

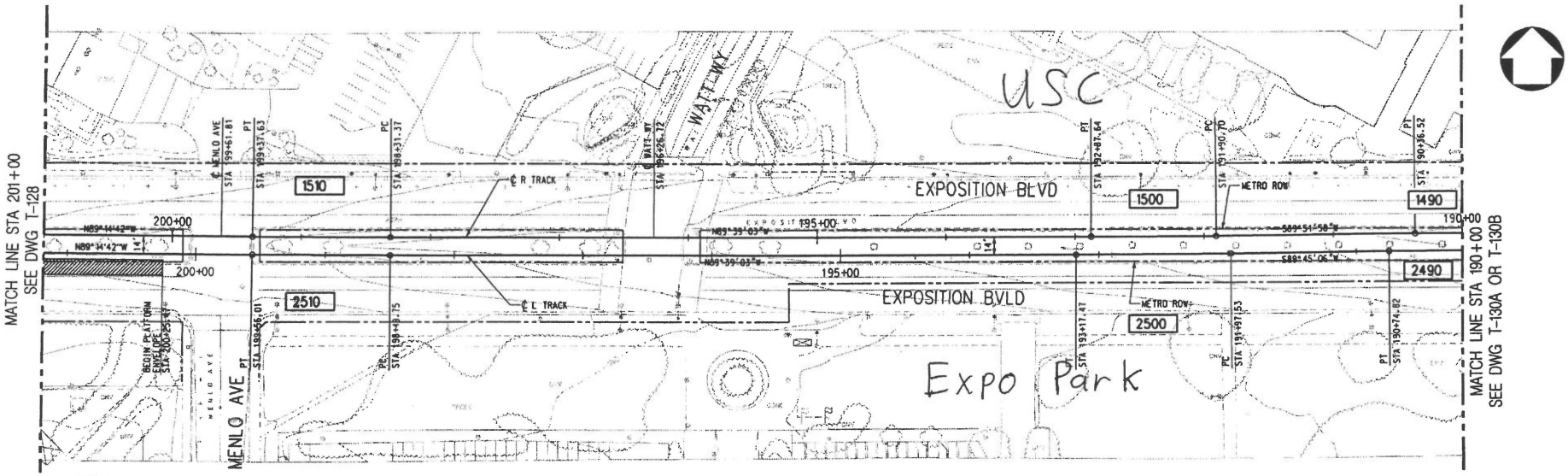
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 201+00 TO STA 212+00

CONTRACT NO E0016
DRAWING NO T-128 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 397

08/01/2005

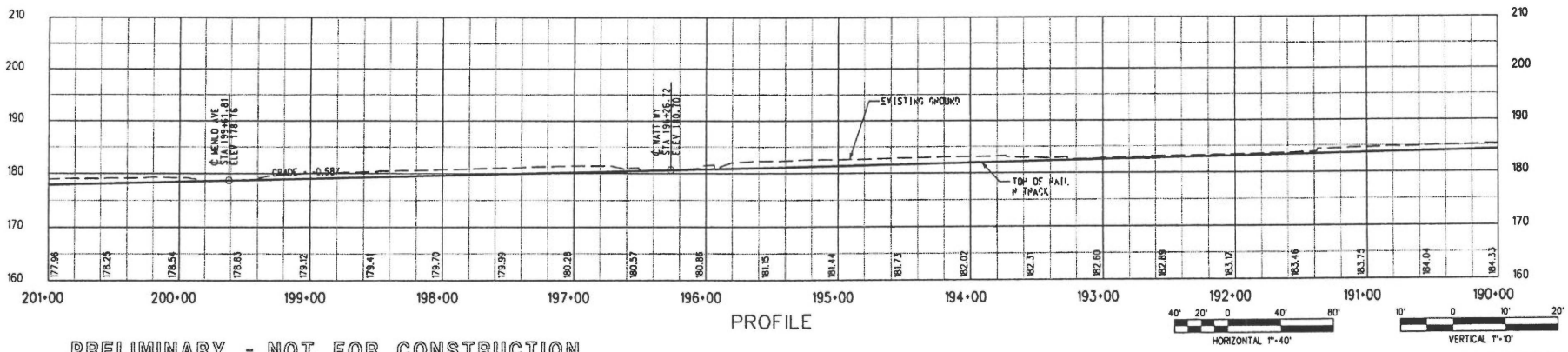
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD., SUITE 0330B
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9559

SUBMITTED
APPROVED

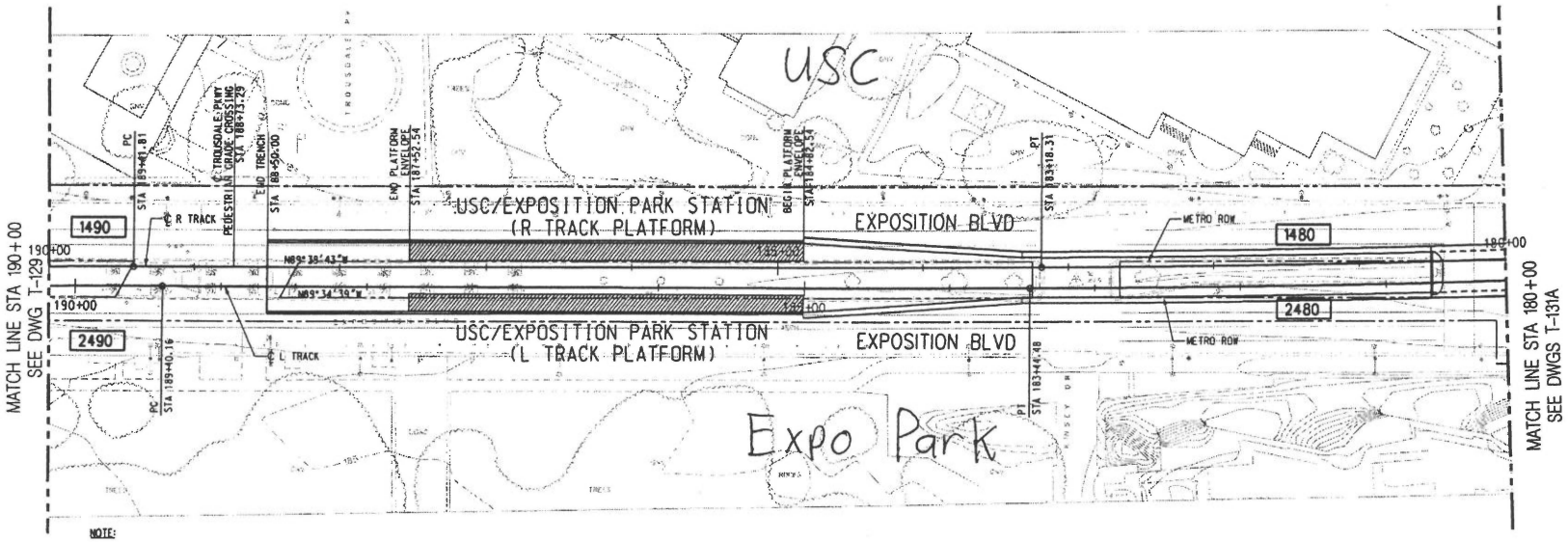
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 190+00 TO STA 201+00

CONTRACT NO E0016
DRAWING NO T-129 REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 398

Plotted by: mathenc 08/01/2005

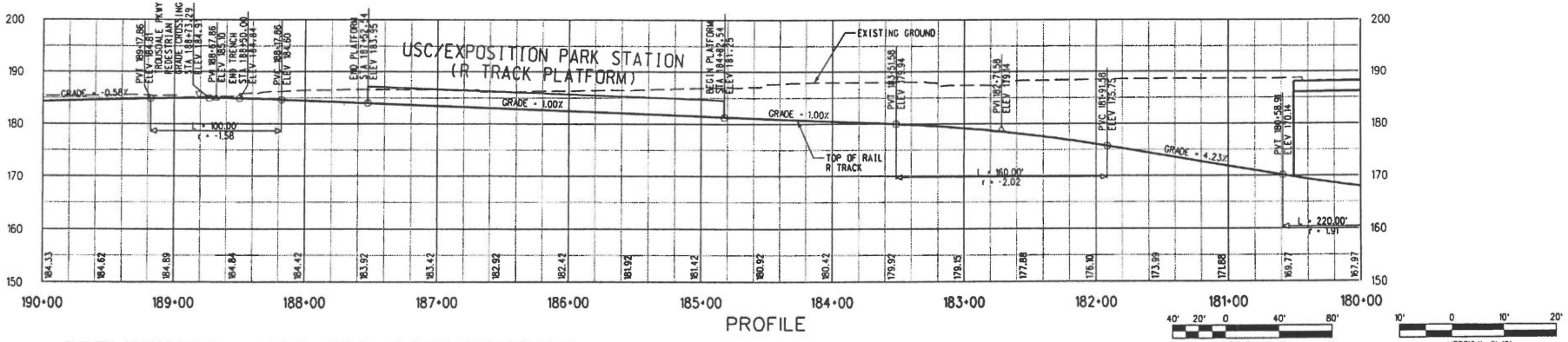
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).

PLAN



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY R. RAMIREZ
DRAWN BY R. RAMIREZ
CHECKED BY D.A SEPULVEDA
IN CHARGE D.A SEPULVEDA
DATE 8/21/03

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3500
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9559

SUBMITTED
APPROVED

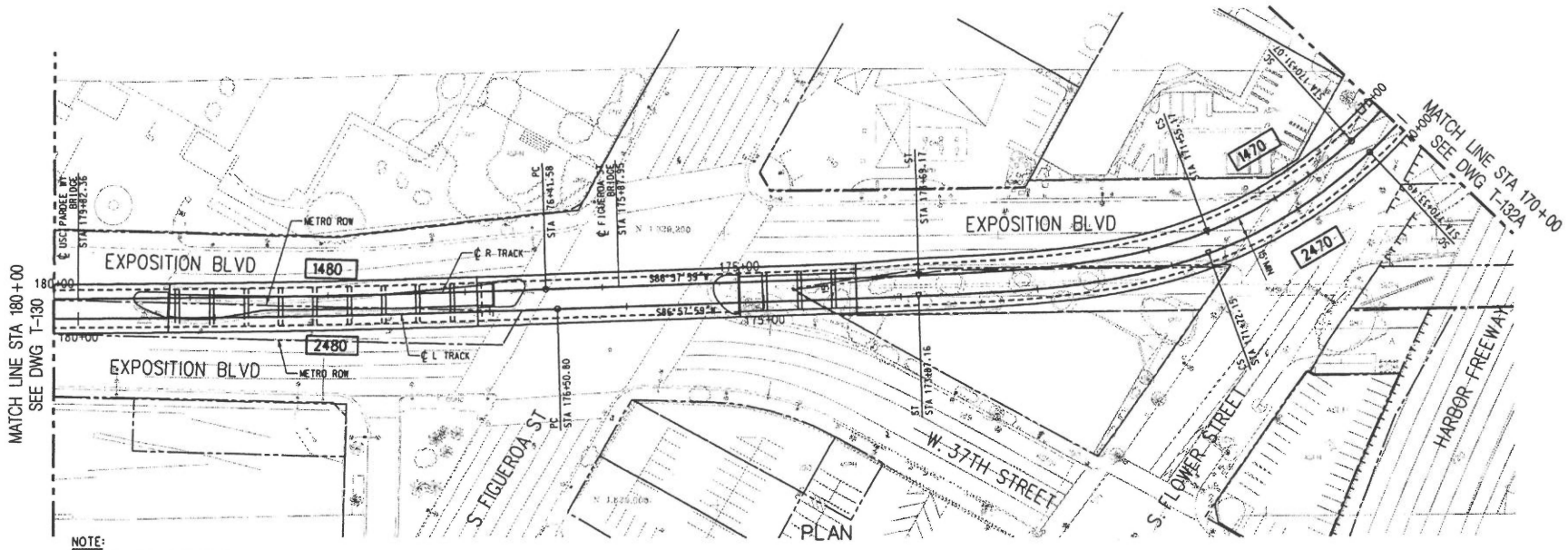
MID-CITY/EXPOSITION LRT CORRIDOR

MAIN TRACKS
PLAN & PROFILE
STA 180+00 TO STA 190+00

CONTRACT NO E0016
DRAWING NO T-130A REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 399

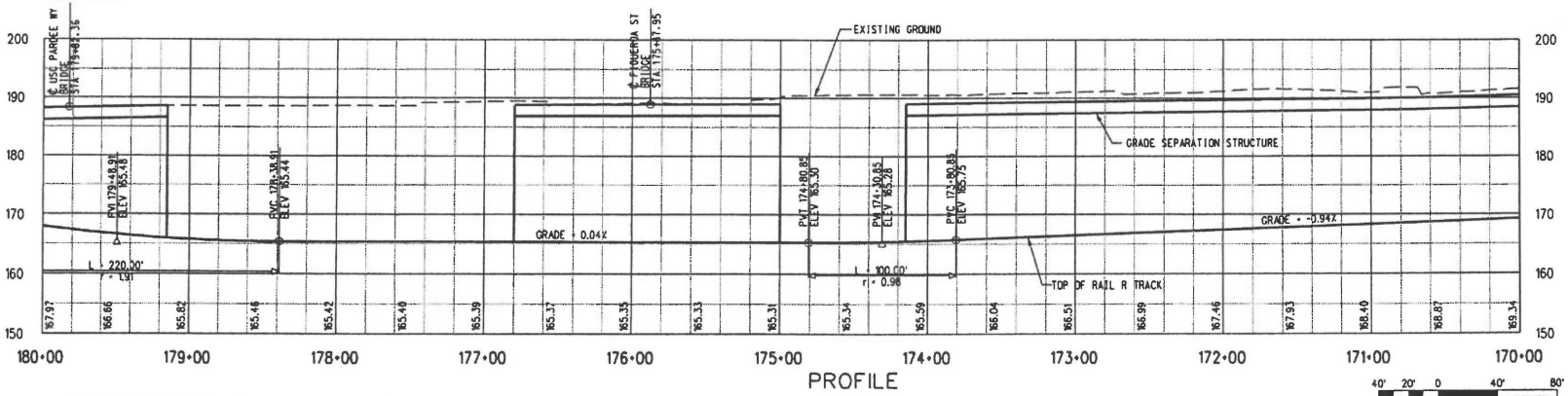
Plotted by: nathans 08/07/2005 \\wes2ecl\projects\3843\001 code\track\sheet\130a.dgn

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY N. CORNWELL
DRAWN BY R. LAYGO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM

707 WILSHIRE BLVD., SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9599

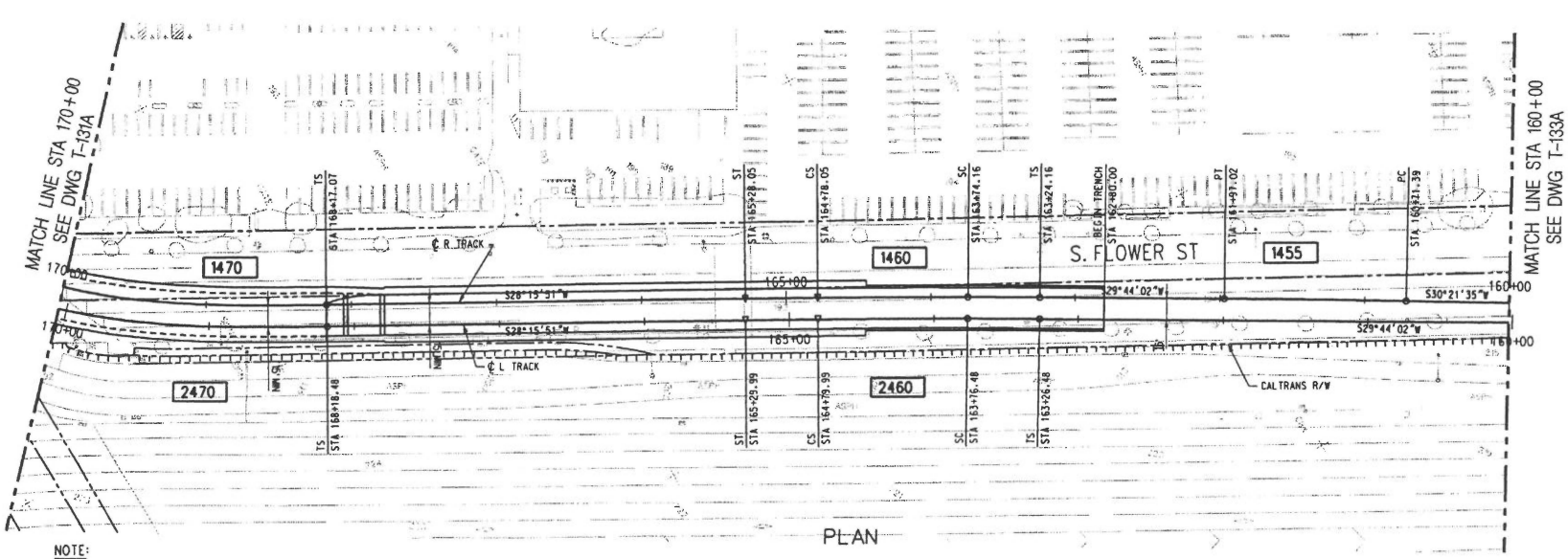
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
FLOWER STREET
MAIN TRACKS
PLAN & PROFILE
STA 170+00 TO STA 180+00

CONTRACT NO E0016
DRAWING NO T-131A REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 400

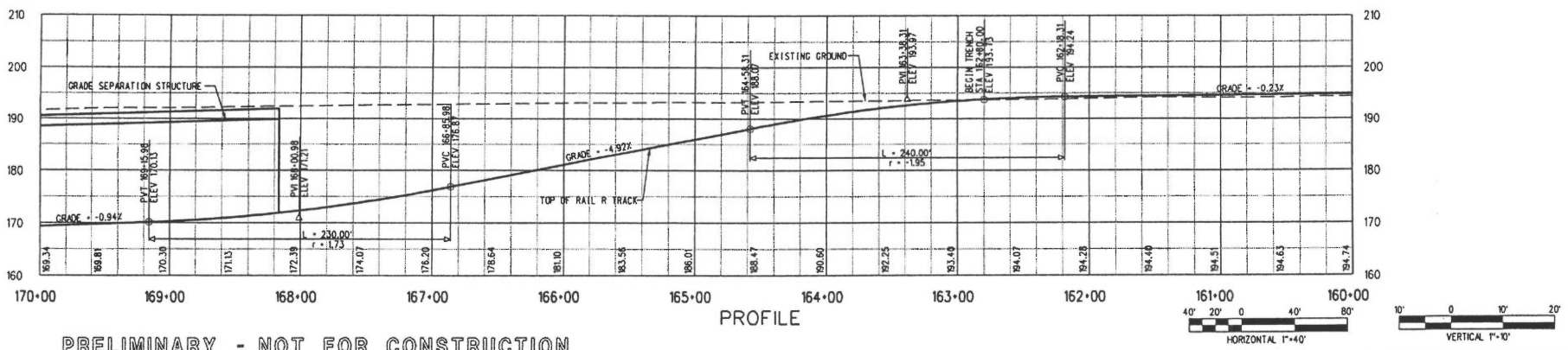
Plotted by: nathans 08/07/2005

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:
TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY N. CORNWELL
DRAWN BY R. LAYGO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD., SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9559

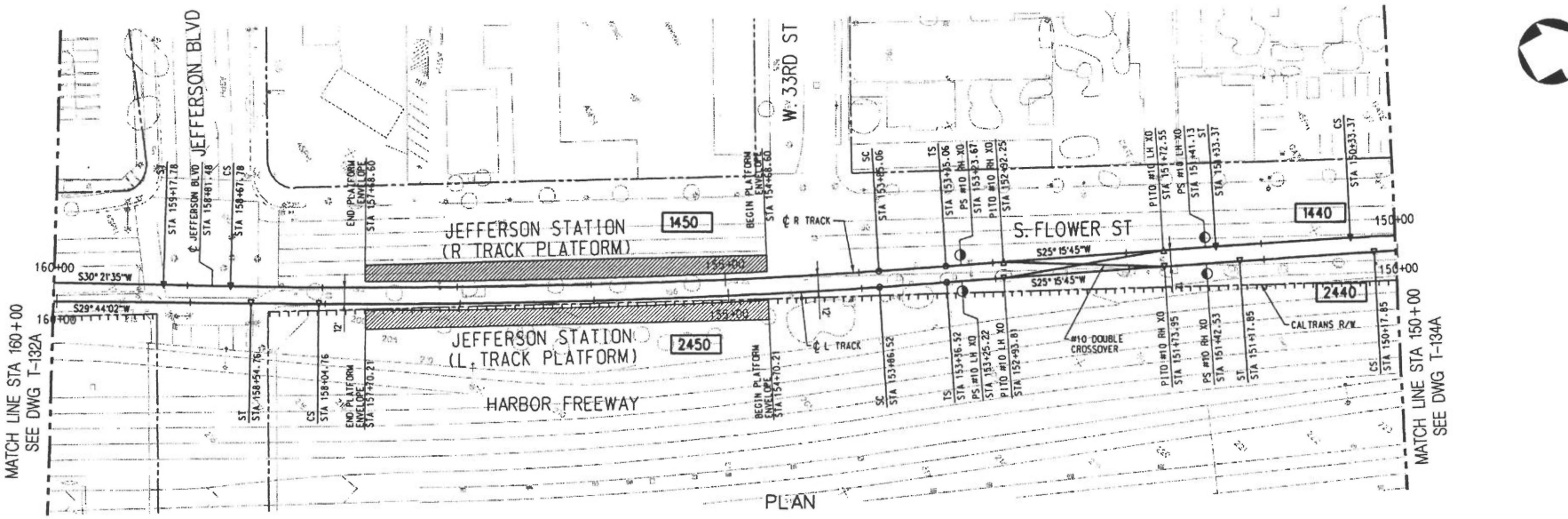
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
FLOWER STREET
MAIN TRACKS
PLAN & PROFILE
STA 160+00 TO STA 170+00

CONTRACT NO E0016
DRAWING NO T-132A REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 401

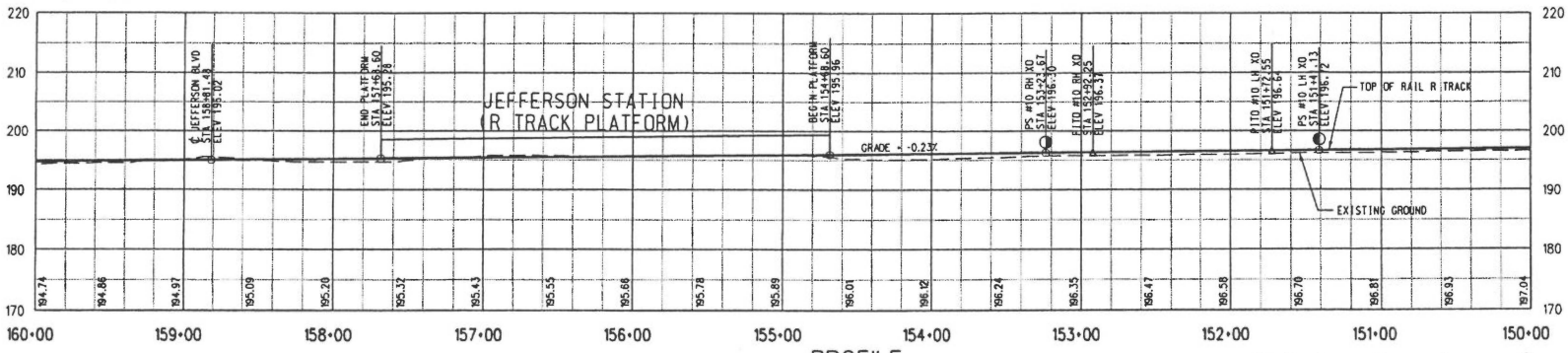
Posted by: nathanc 08/01/2005

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY N. CORNWELL
DRAWN BY R. LAYGO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

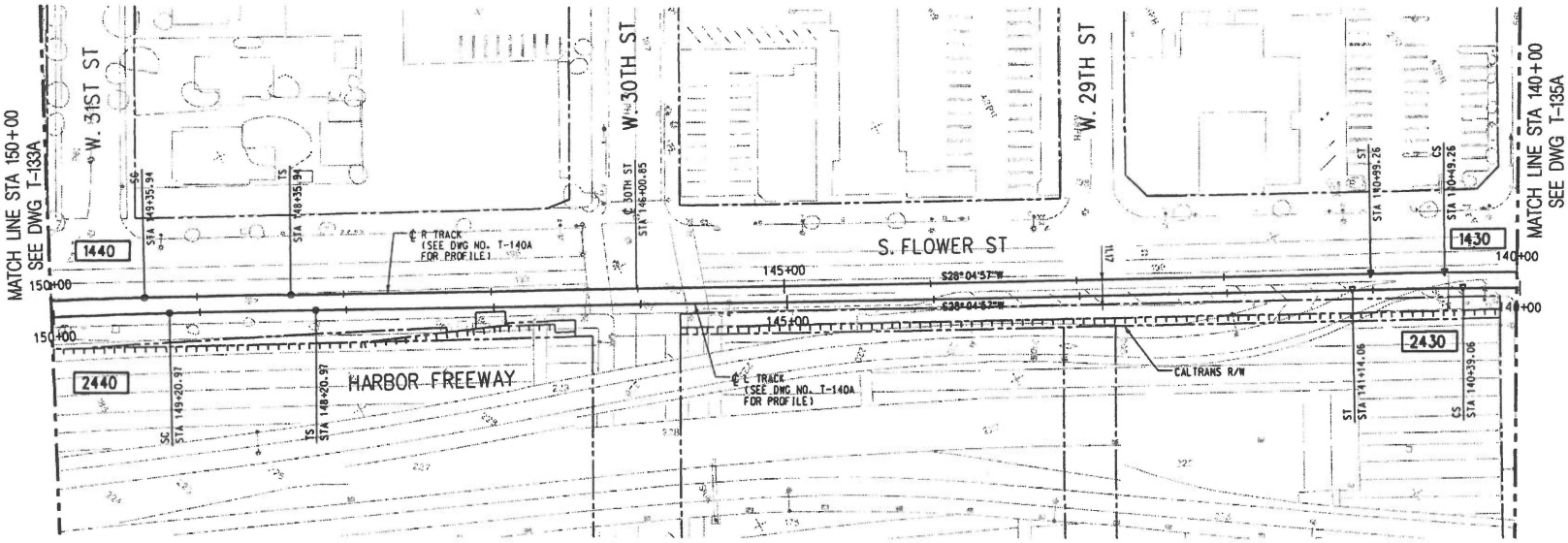
DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9999

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
FLOWER STREET
MAIN TRACKS
PLAN & PROFILE
STA 150+00 TO STA 160+00

CONTRACT NO E0016
DRAWING NO T-133A REV 0
SCALE HORIZ: 1" =40' VERT: 1" =10'
SHEET NO 402

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

REFER TO DRAWING NO. T-140A FOR PROFILES FOR BOTH R TRACK AND L TRACK.

PLAN

40' 20' 0 40' 80'
HORIZONTAL 1"=40'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY N. CORNWELL
DRAWN BY R. LAYGO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9300
FAX (213) 922-9959

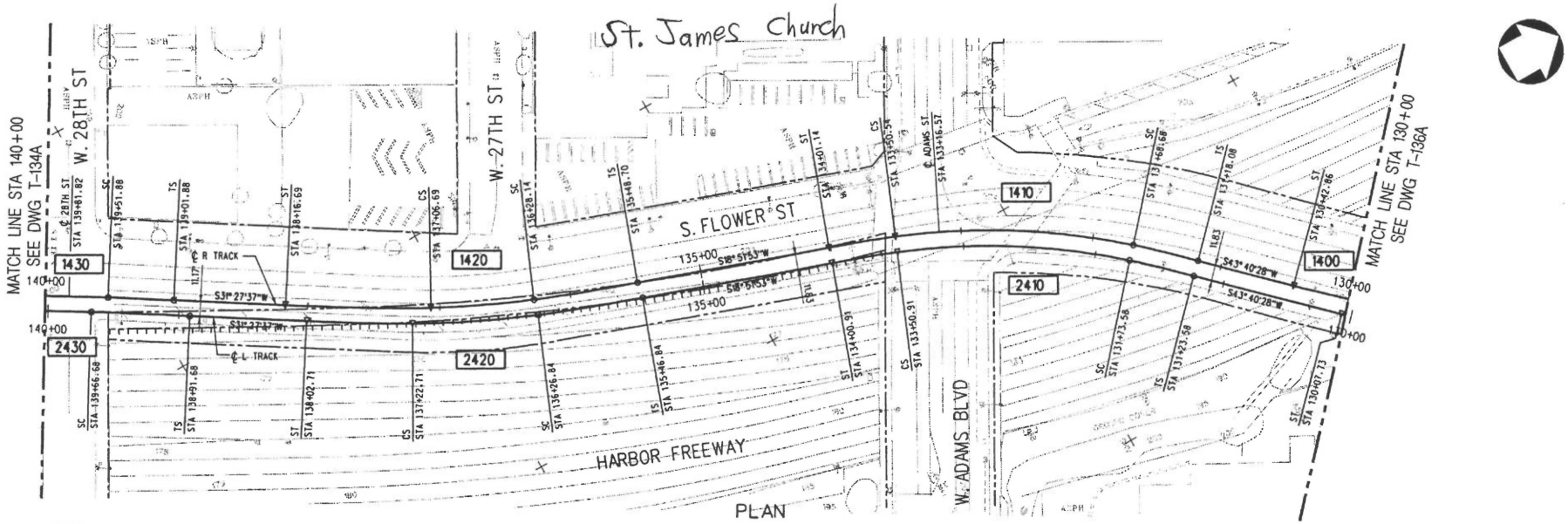
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
FLOWER STREET
MAIN TRACKS
PLAN
STA 140+00 TO STA 150+00

CONTRACT NO E0016
DRAWING NO T-134A REV 0
SCALE HORIZ: 1" =40'
SHEET NO 403

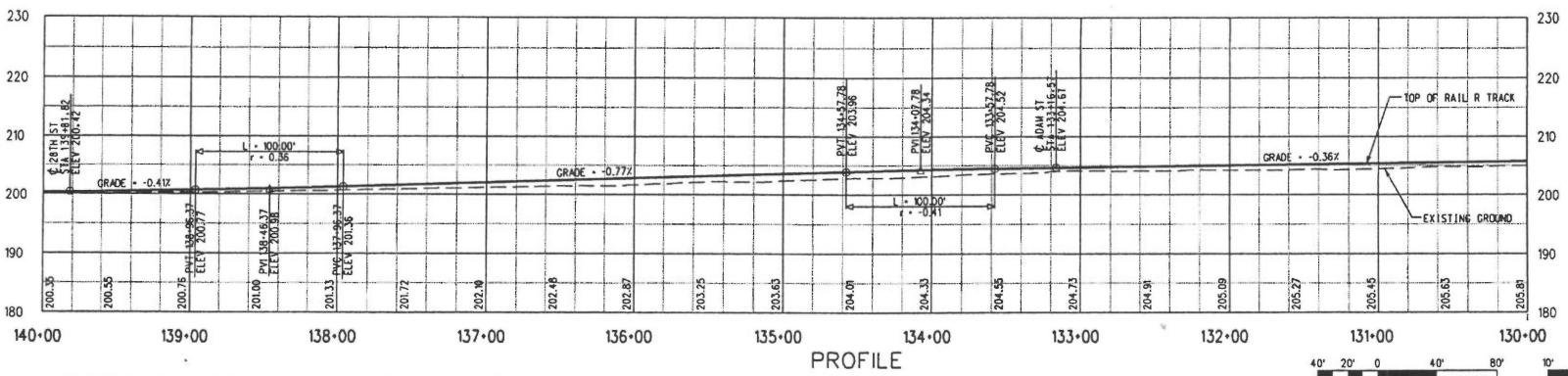
Plotted by: nathsac 08/09/2005 \\nas\acad\projects\384-3\001 cadd\dwgs\sheet\dwg\t134a.dwg

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



HORIZONTAL 1"=40' VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY N. CORNWELL
DRAWN BY R. LAYGO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

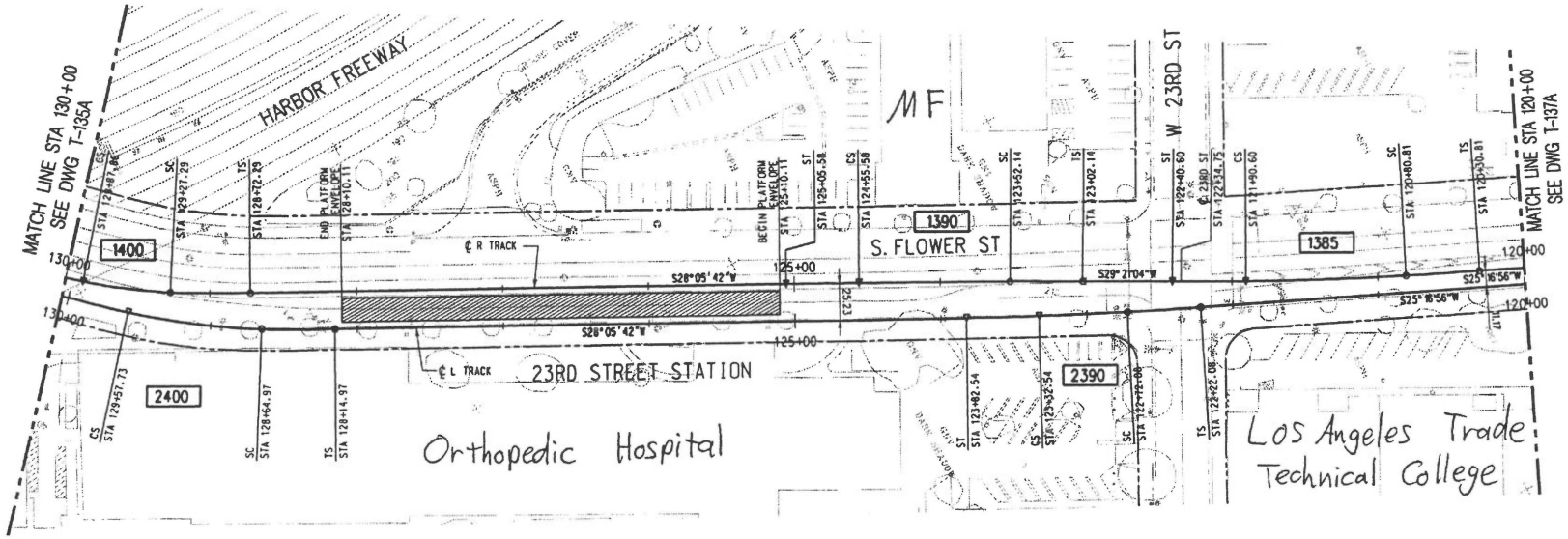
DMJM HARRIS | AECOM
707 WILSHIRE BLVD., SUITE 4300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9959

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
FLOWER STREET
MAIN TRACKS
PLAN & PROFILE
STA 130+00 TO STA 140+00

CONTRACT NO E0016
DRAWING NO T-135A REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 404

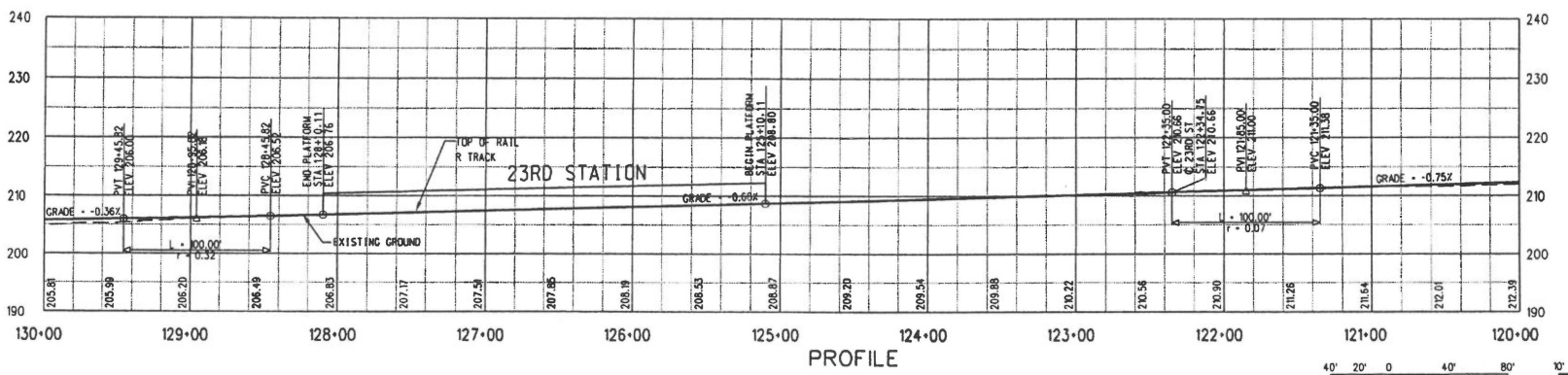
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

HORIZONTAL 1"=40' VERTICAL 1"=10'

REV	DATE	BY	APP	REQ NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY N. CORNWELL
DRAWN BY R.LAYGO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

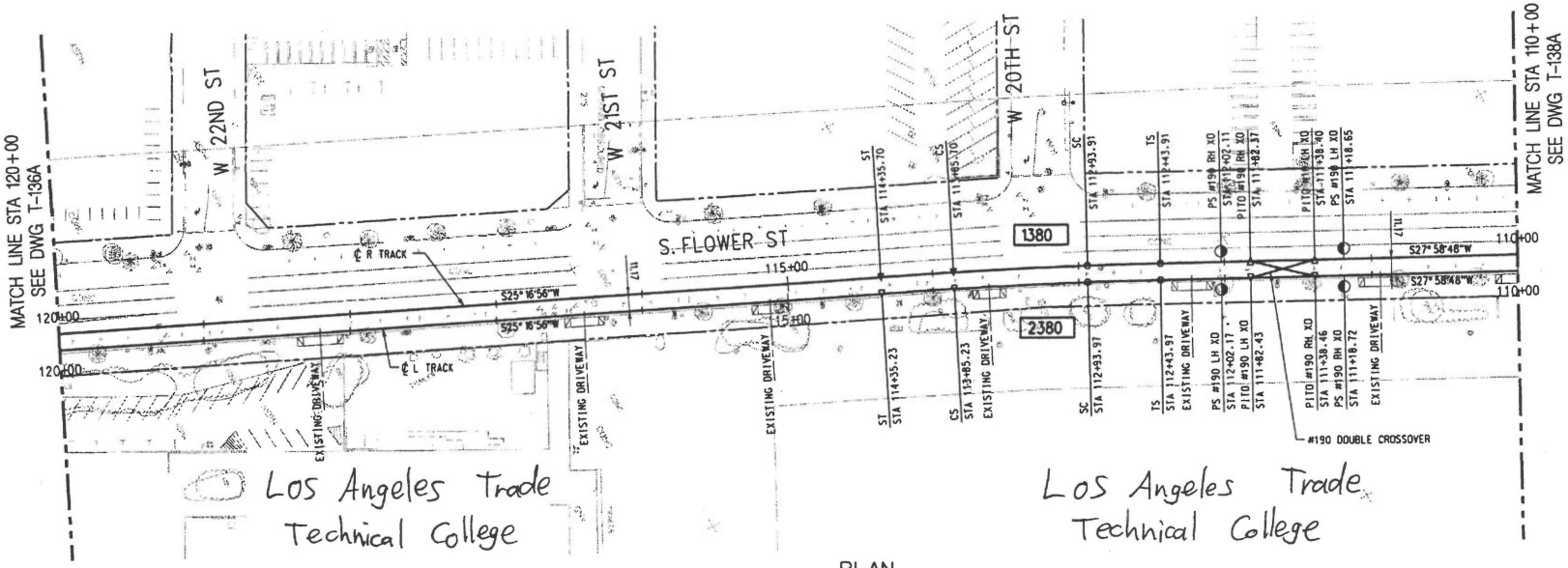
DMJM HARRIS | AECOM
707 WILSHIRE BLVD, SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-6200
FAX (213) 922-6559

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
FLOWER STREET
MAIN TRACKS
PLAN & PROFILE
STA 120+00 TO STA 130+00

CONTRACT NO E0016
DRAWING NO T-136A REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 405

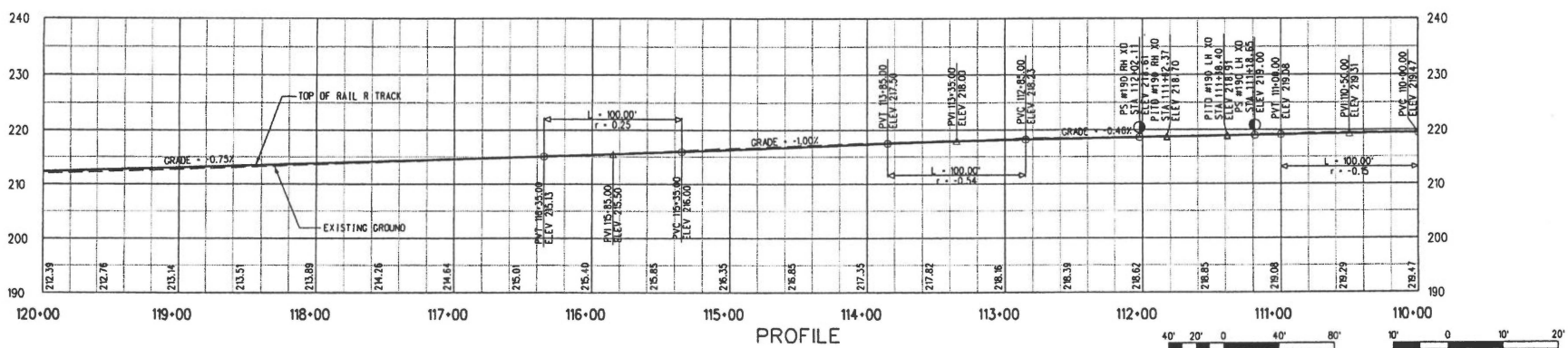
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



PROFILE

HORIZONTAL 1"=40' (40' 20' 0 40' 80')

VERTICAL 1"=10' (10' 0 10' 20')

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REQ NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY N. CORNWELL
DRAWN BY R. LAYGO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD., SUITE #2300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9999

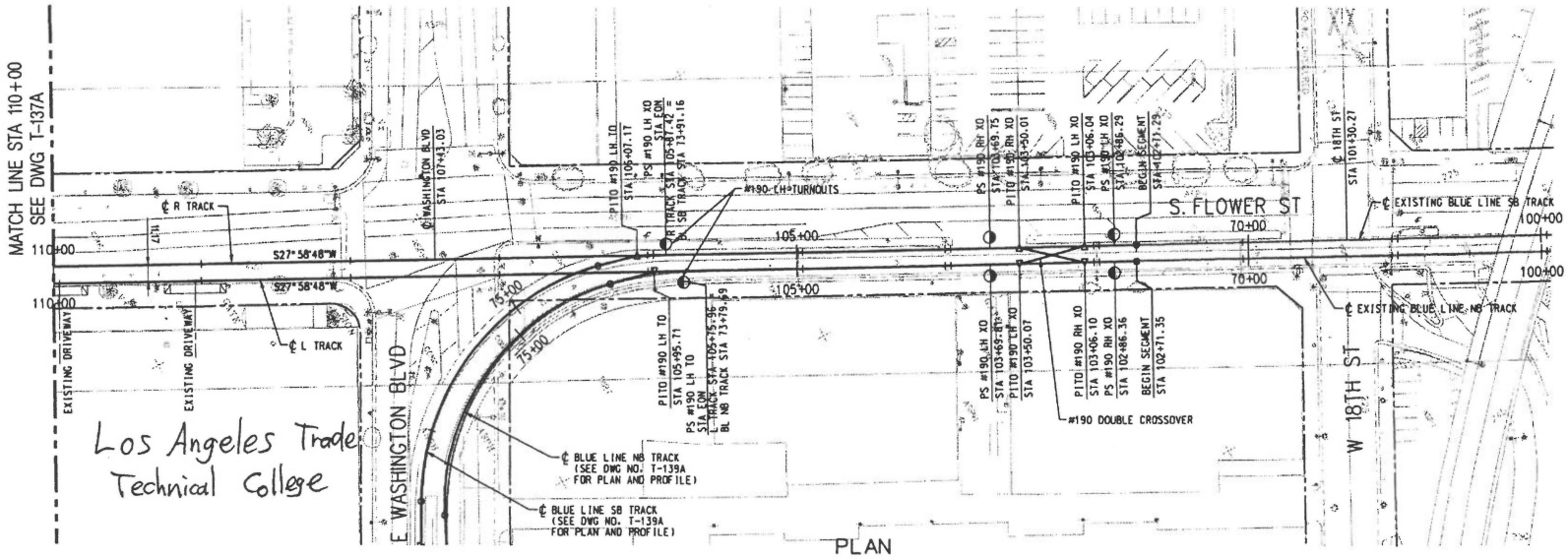
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
FLOWER STREET
MAIN TRACKS
PLAN & PROFILE
STA 110+00 TO STA 120+00

CONTRACT NO E0016
DRAWING NO T-137A REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 406

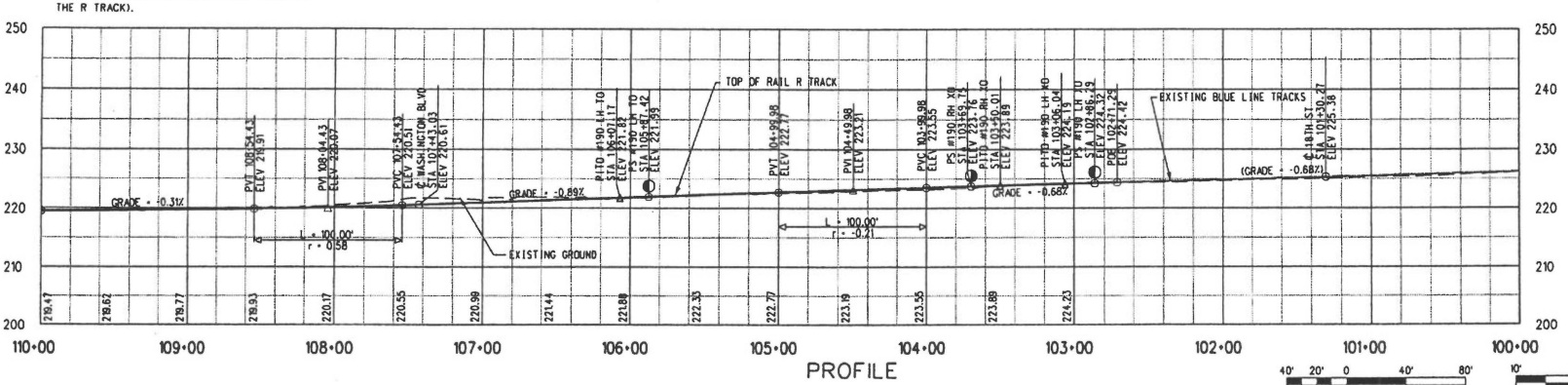
Plotted by nathane 08/01/2005 \\uaa02c07\projects\5843\001\cad\civil\dwgs\t137a.dwg

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:
TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



PROFILE

HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY N. CORNWELL
DRAWN BY R. LAYGO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

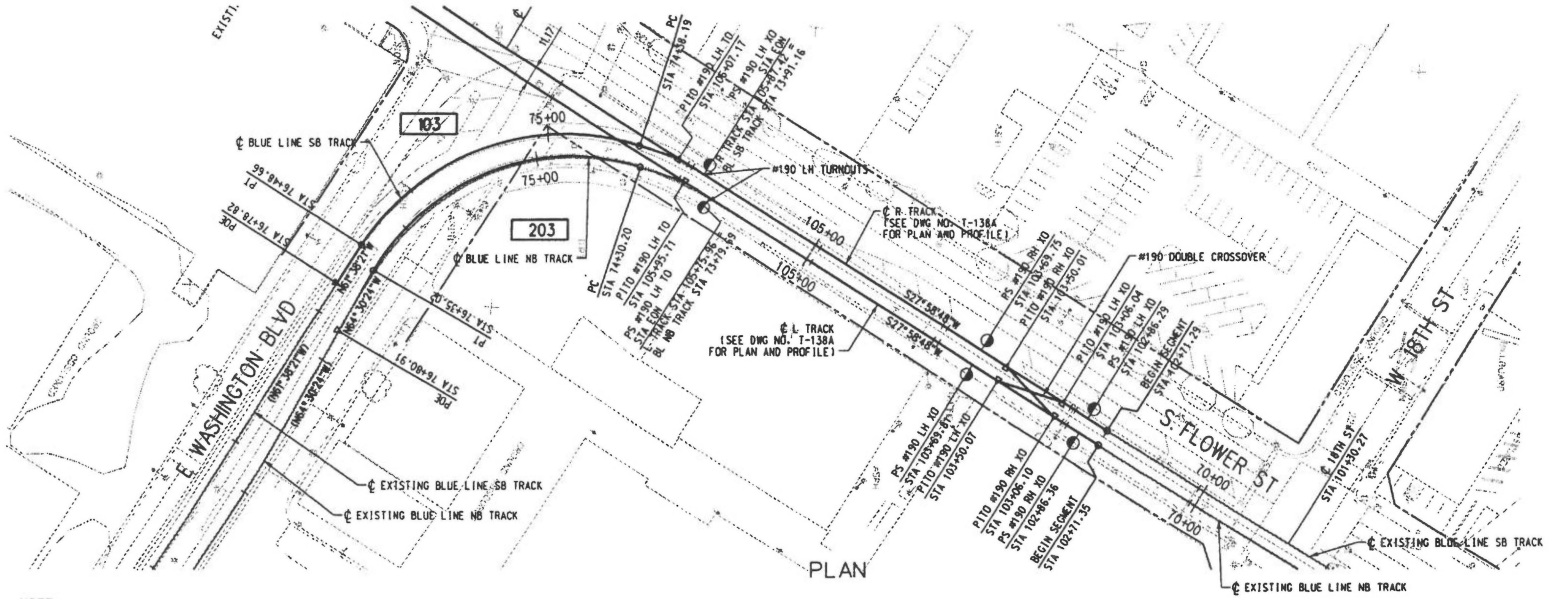
DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9555

SUBMITTED
APPROVED

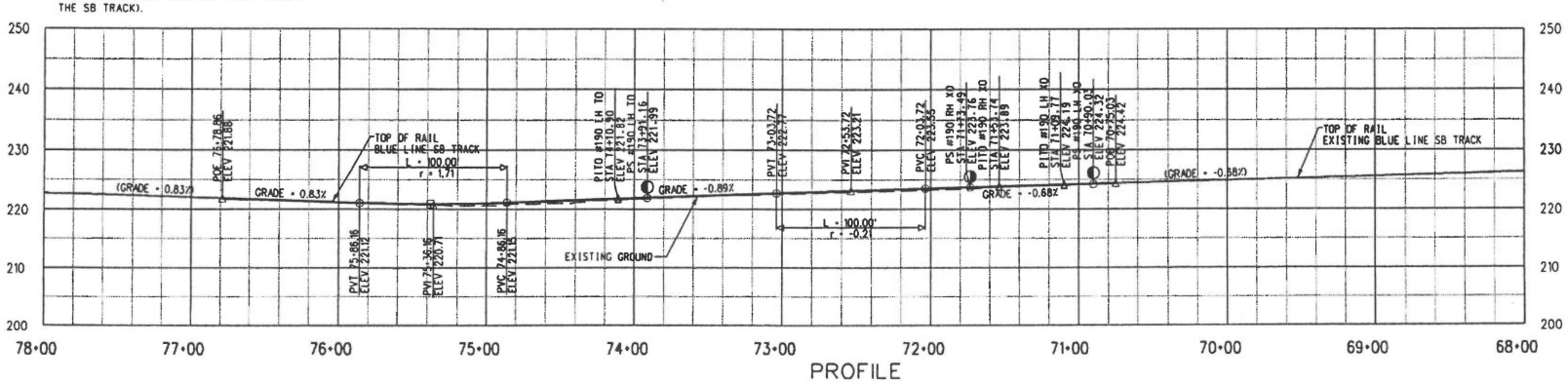
MID-CITY/EXPOSITION LRT CORRIDOR
FLOWER STREET
MAIN TRACKS
PLAN & PROFILE
STA 103+00 TO STA 110+00

CONTRACT NO E0016
DRAWING NO T-138A REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 407

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:
TOP OF RAIL ELEVATIONS OF THE NB TRACK TO BE EQUAL TO THE SB TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIAL. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE NB TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE SB TRACK).



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	7/28/05	-	-	-	-		ISSUED FOR DESIGN BUILD RFP

DESIGNED BY N. CORNWELL
DRAWN BY R. LAYGO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

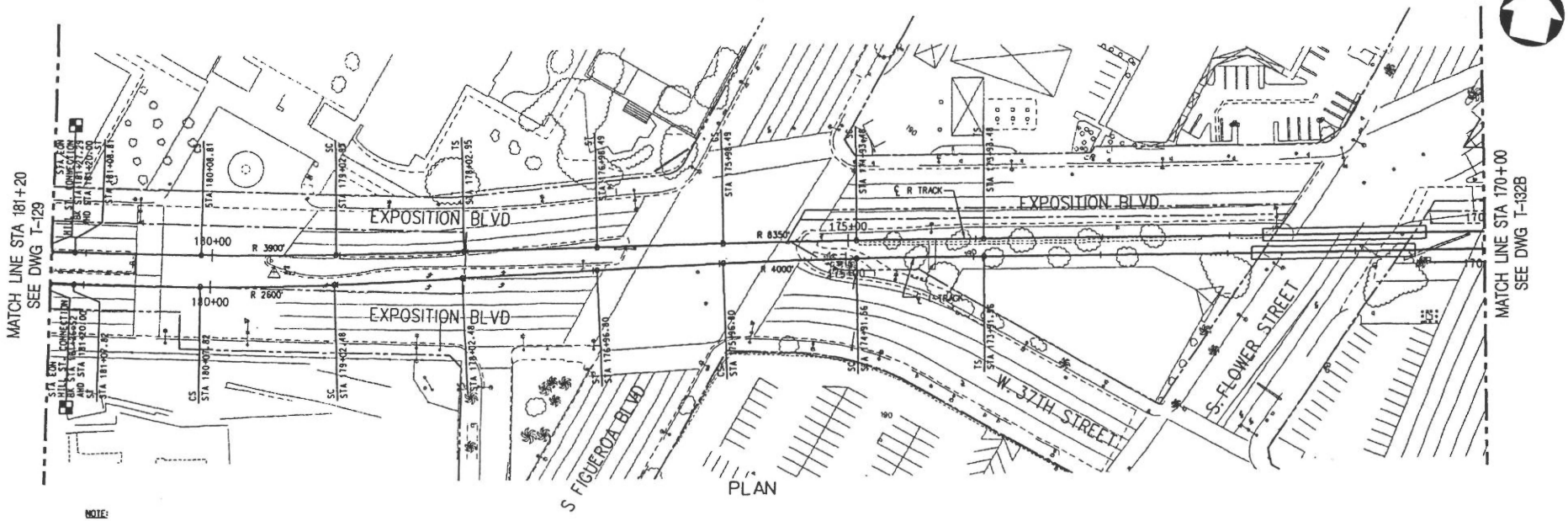
DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9959

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
FLOWER STREET
BLUE LINE TRACKS
PLAN & PROFILE
STA 68+00 TO STA 78+00

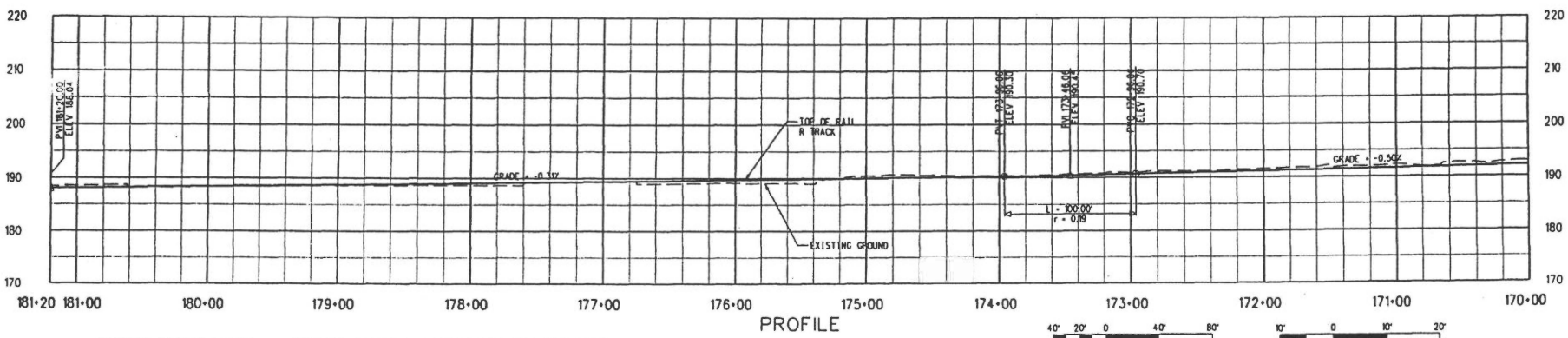
CONTRACT NO E0016
DRAWING NO T-139A REV 0
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO 408

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIALLY. GRADIANTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY, FROM THOSE ON THE R TRACK).



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REC NO	EXPIRES	SEAL HOLDER	DESCRIPTION
A	2/2/04						DESIGN DRAWINGS

DESIGNED BY C. DAVIS
DRAWN BY C. DAVIS
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

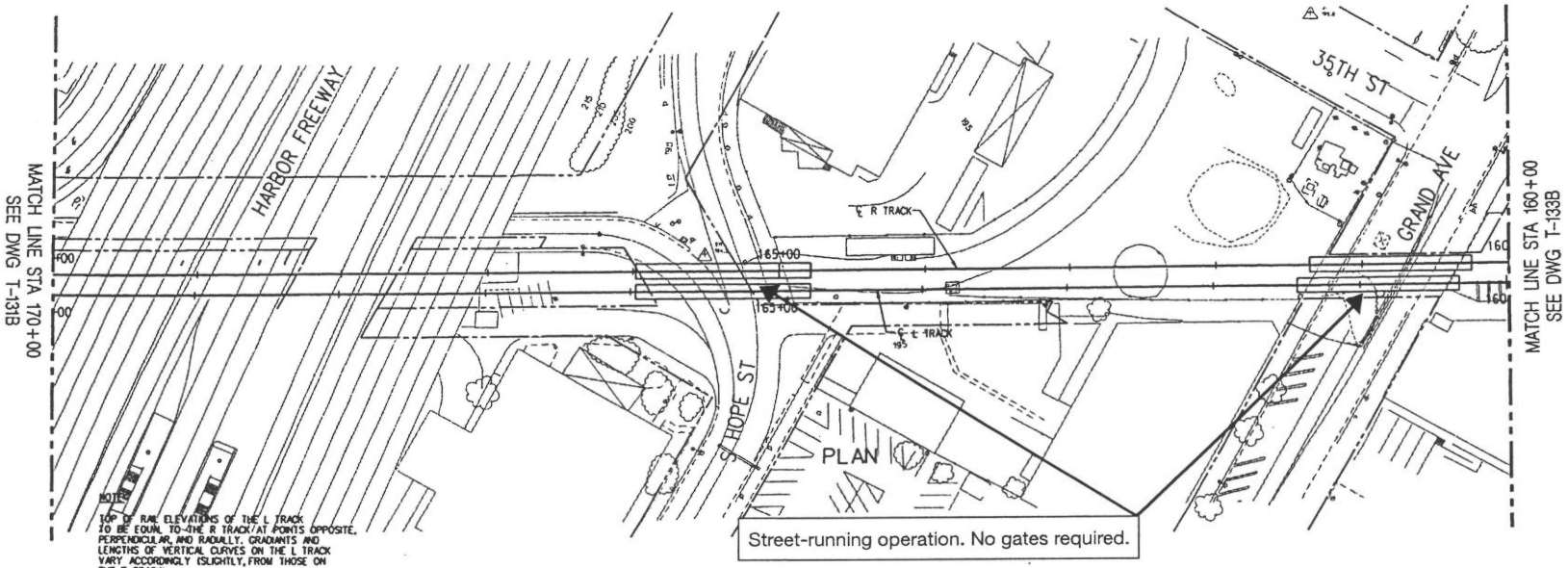
DMJM HARRIS an AECOM company
707 WILSHIRE BLVD, SUITE 3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-5500
FAX (213) 922-9550

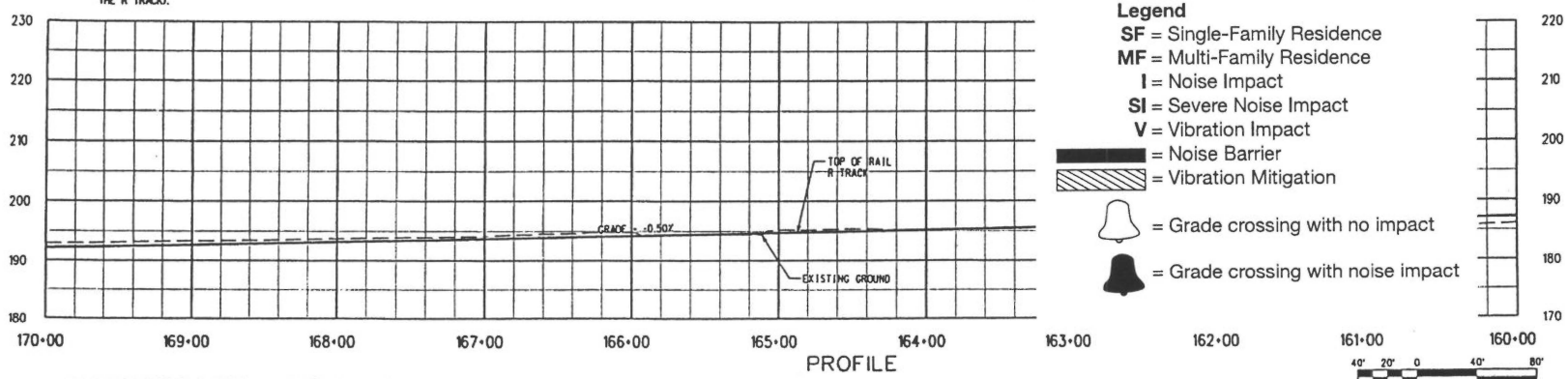
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
HILL STREET
MAIN TRACKS
PLAN AND PROFILE
STA 170+00 TO STA 181+20

CONTRACT NO E0016
DRAWING NO T-131B REV A
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.





Legend

- **SF** = Single-Family Residence
- **MF** = Multi-Family Residence
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact

HORIZONTAL 1"=40' (40' 20' 0 40' 80')

VERTICAL 1"=10' (10' 0 10' 20')

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
A	2/2/2004						DESIGN DRAWINGS

DESIGNED BY C. DAVIS
DRAWN BY C. DAVIS
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/2004

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

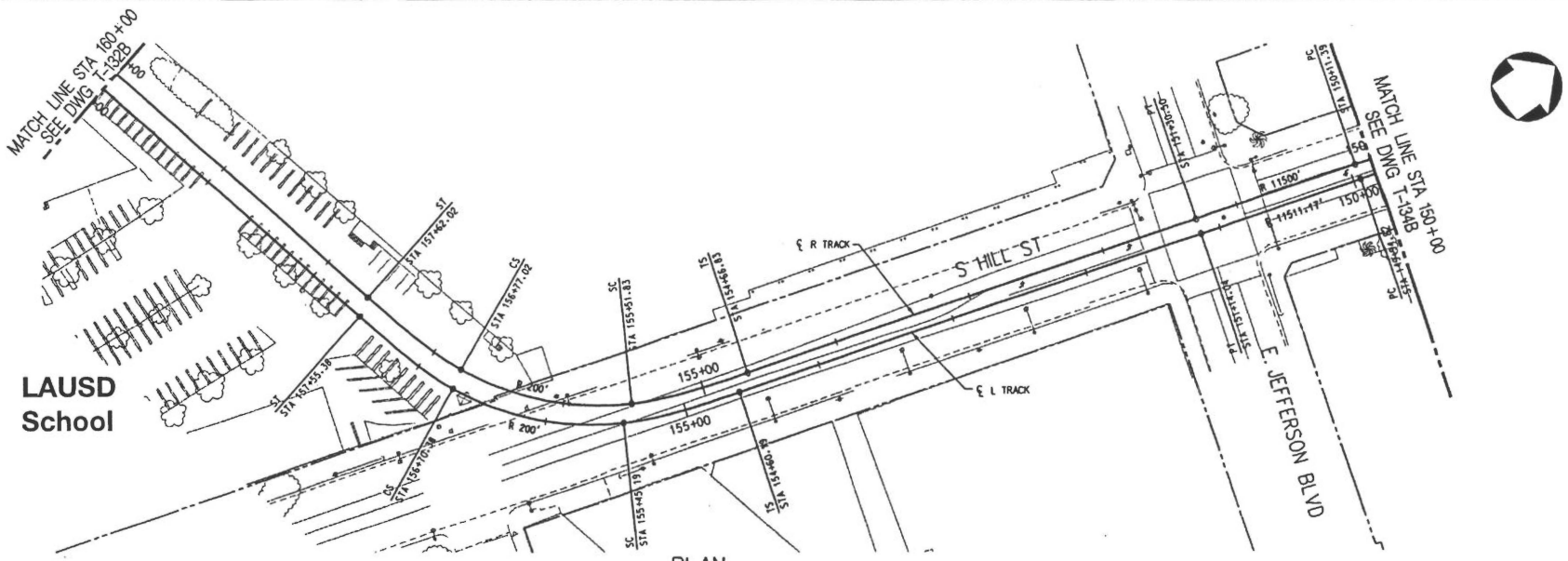
DMJM HARRIS an AECOM company
707 WILSHIRE BLVD. SUITE 1300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 633-6200
FAX (213) 633-6550

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
HILL STREET
MAIN TRACKS
PLAN AND PROFILE
STA 160+00 TO STA 170+00

CONTRACT NO E0016
DRAWING NO T-132B REV A
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIALLY. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).

Legend

- **SF** = Single-Family Residence
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- **I** = Noise Impact
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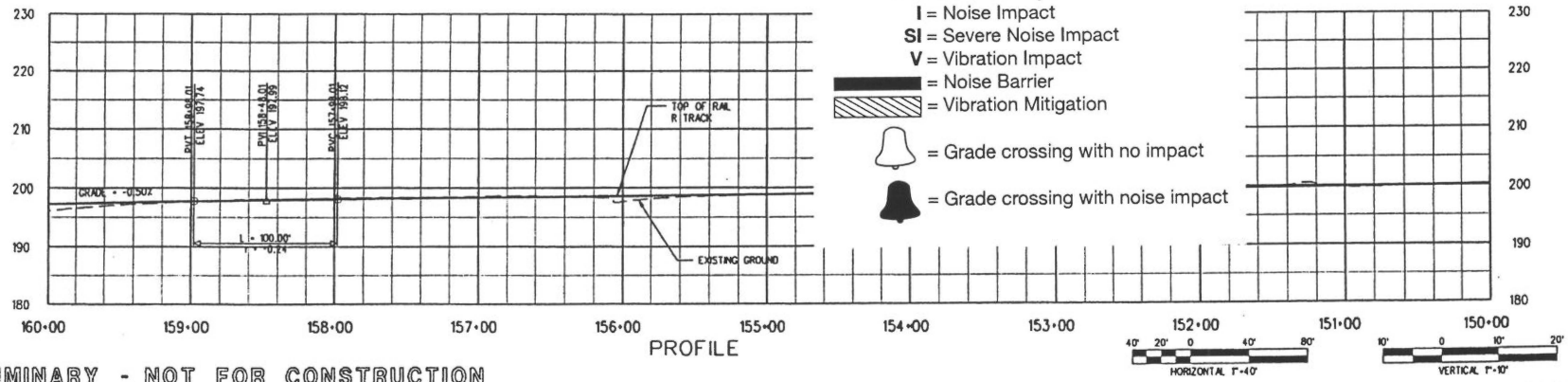
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
A	2/2/04						DESIGN DRAWINGS

DESIGNED BY C. DAVIS
DRAWN BY N. CORNWELL
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

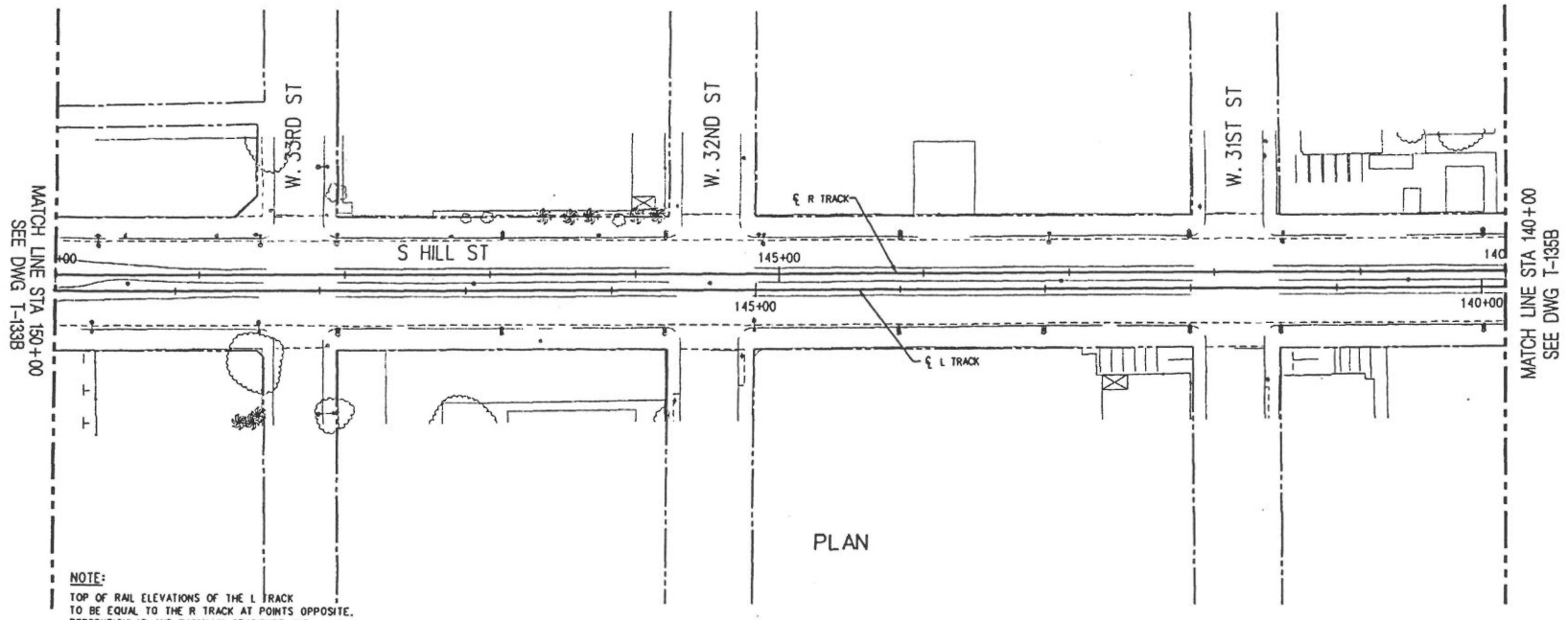
DMJM HARRIS an AECOM company
707 WILSHIRE BLVD, SUITE 4300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-8300
FAX (213) 922-9550

SUBMITTED
APPROVED

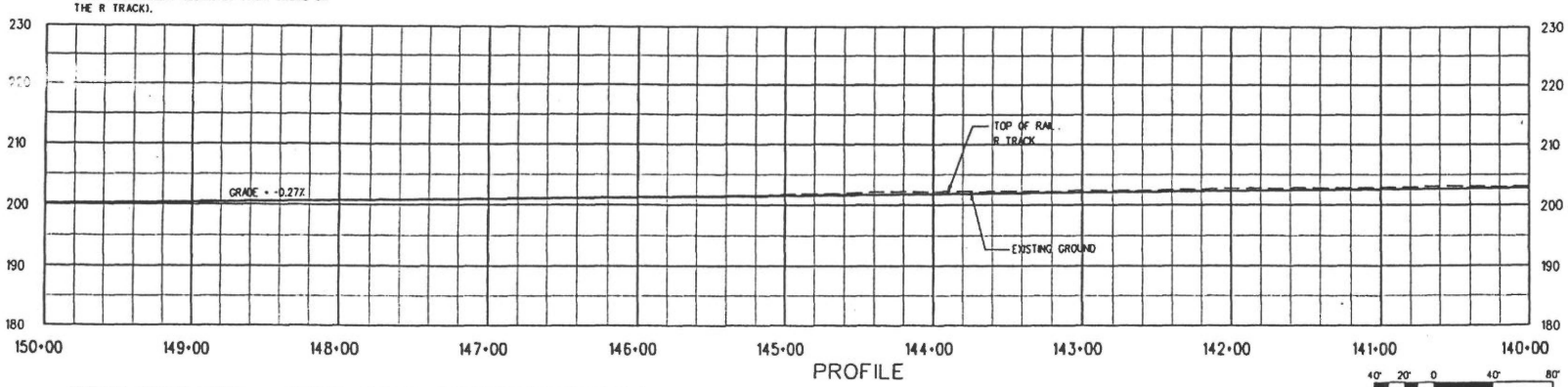
MID-CITY/EXPOSITION LRT CORRIDOR
HILL STREET
MAIN TRACKS
PLAN & PROFILE
STA 150+00 TO STA 160+00

CONTRACT NO E0016
DRAWING NO T-133B REV A
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:
TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIALLY. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



HORIZONTAL 1"=40'

VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
A	2/2/2004						DESIGN DRAWINGS

DESIGNED BY C. DAVIS
DRAWN BY C. DAVIS
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

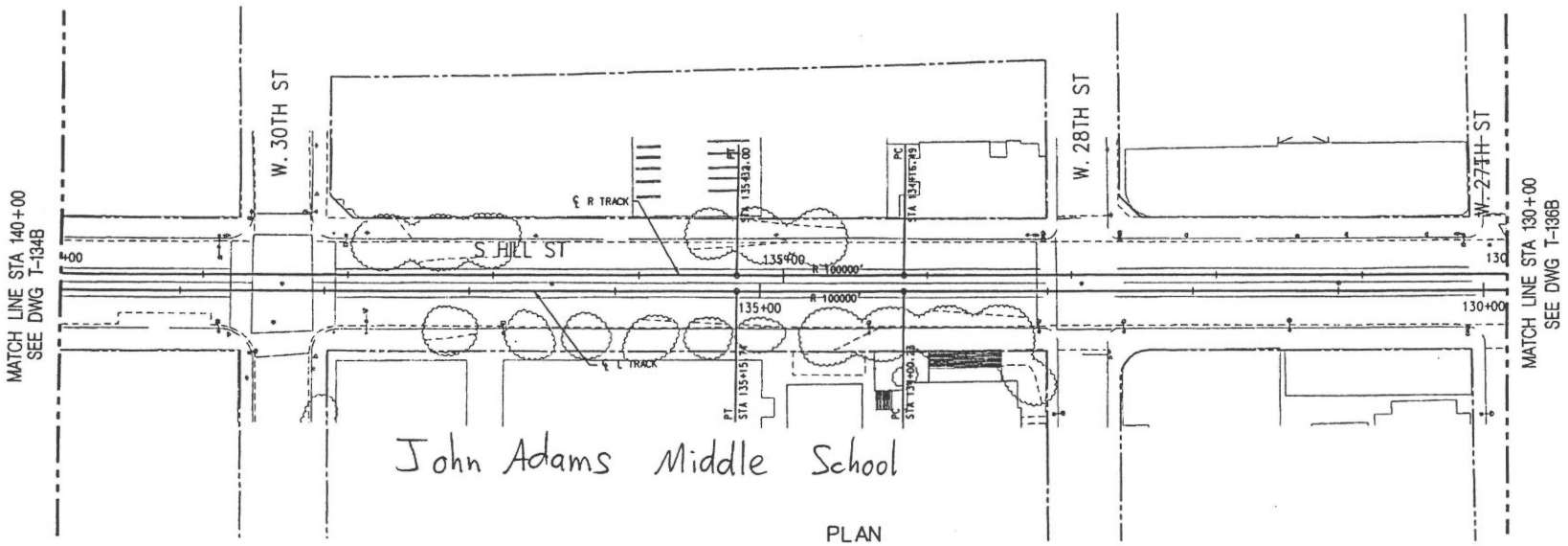
DMJM HARRIS an AECOM company
707 WILSHIRE BLVD, SUITE 4300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9260
FAX (213) 922-9359

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
HILL STREET
MAIN TRACKS
PLAN AND PROFILE
STA 140+00 TO STA 150+00

CONTRACT NO E0016
DRAWING NO T-134B REV A
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO

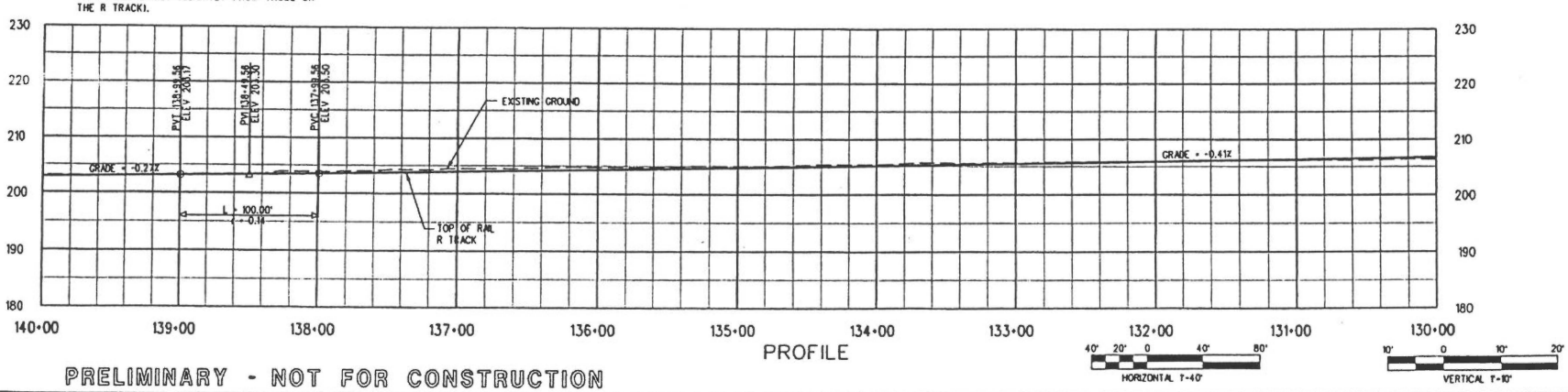
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIALLY. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
A	2/2/04						DESIGN DRAWINGS

DESIGNED BY C. DAVIS
DRAWN BY N. CORNWELL
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

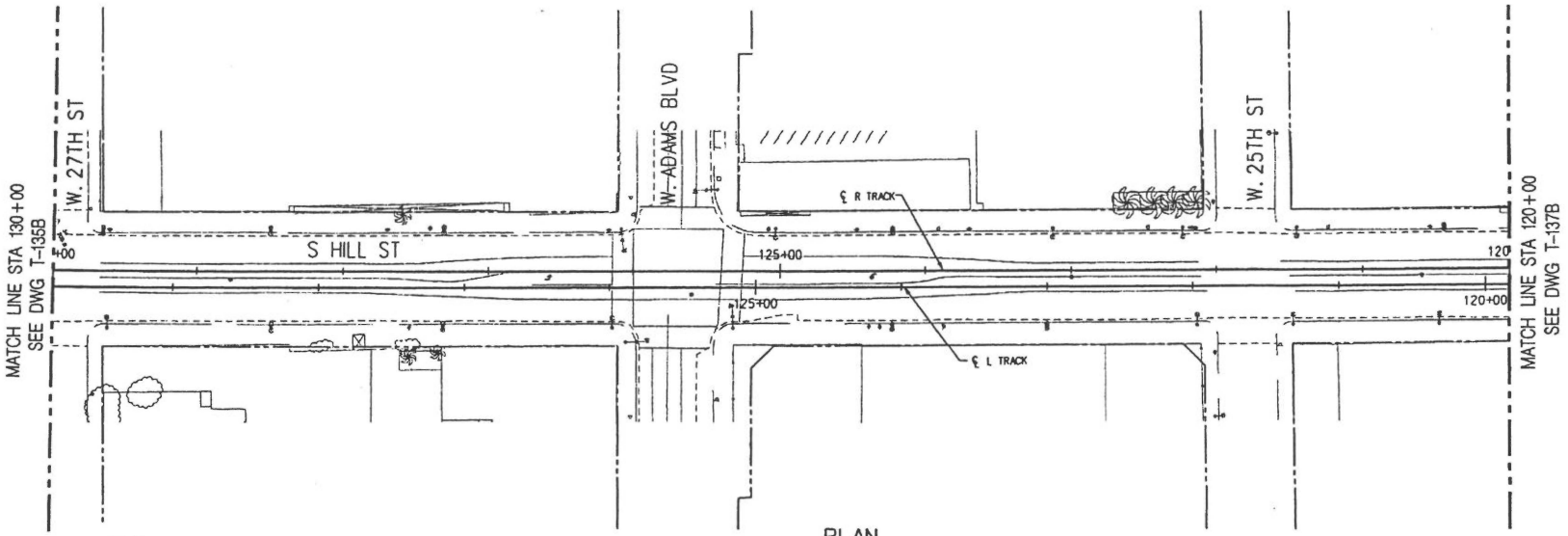
DMJM HARRIS an AECOM company
707 WILSHIRE BLVD, SUITE 2300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-5300
FAX (213) 922-5333

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
HILL STREET
MAIN TRACKS
PLAN & PROFILE
STA 130+00 TO STA 140+00

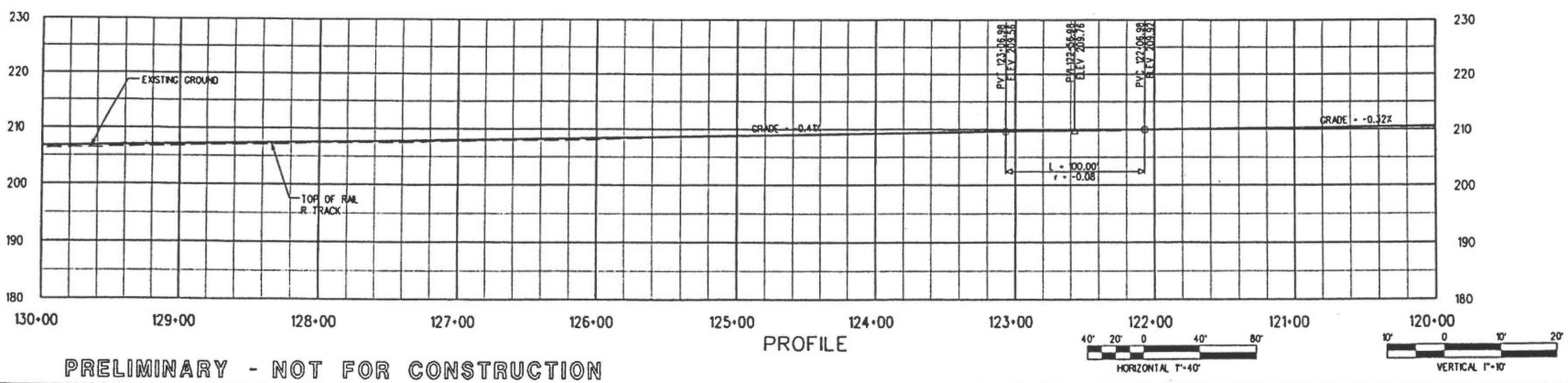
CONTRACT NO E0016
DRAWING NO T-135B REV A
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:
TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIALLY. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
A	2/2/04						DESIGN DRAWINGS

DESIGNED BY C. DAVIS
DRAWN BY M. CORNWELL
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS an AECOM company
707 WILSHIRE BLVD, SUITE 4200
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9559

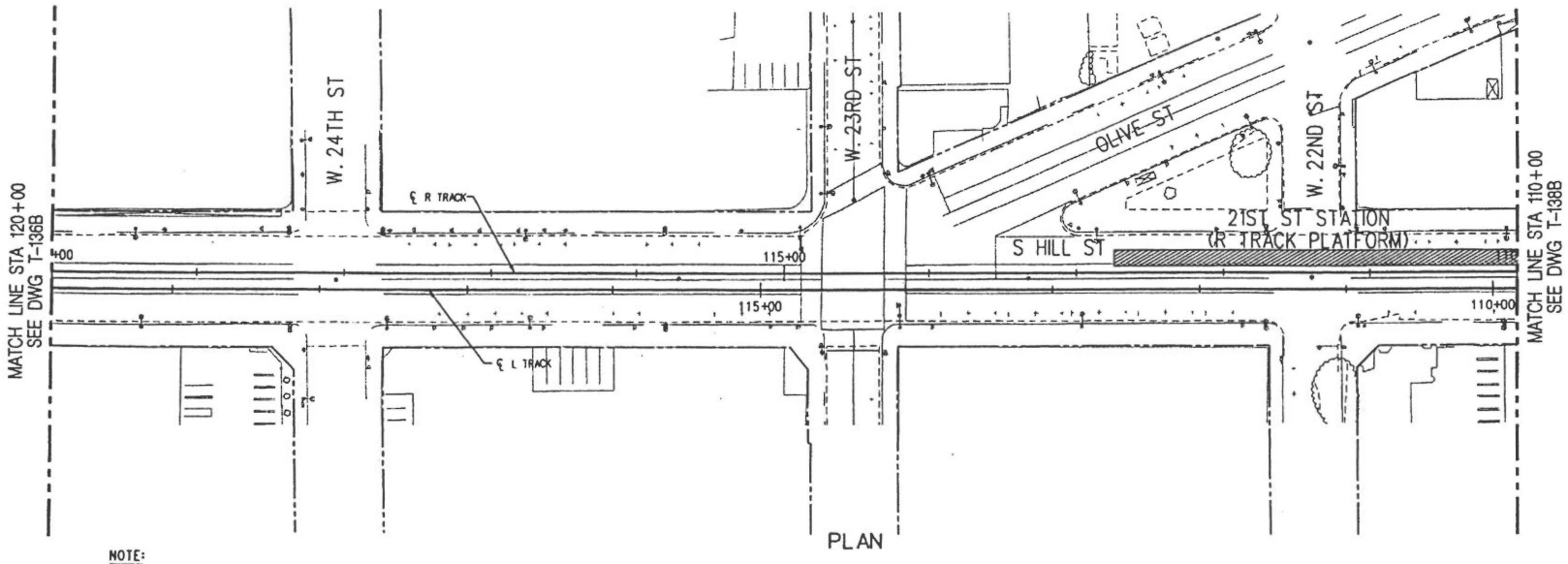
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
HILL STREET
MAIN TRACKS
PLAN & PROFILE
STA 120+00 TO STA 130+00

CONTRACT NO E0016
DRAWING NO T-136B REV A
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO

Plotted by dsepul

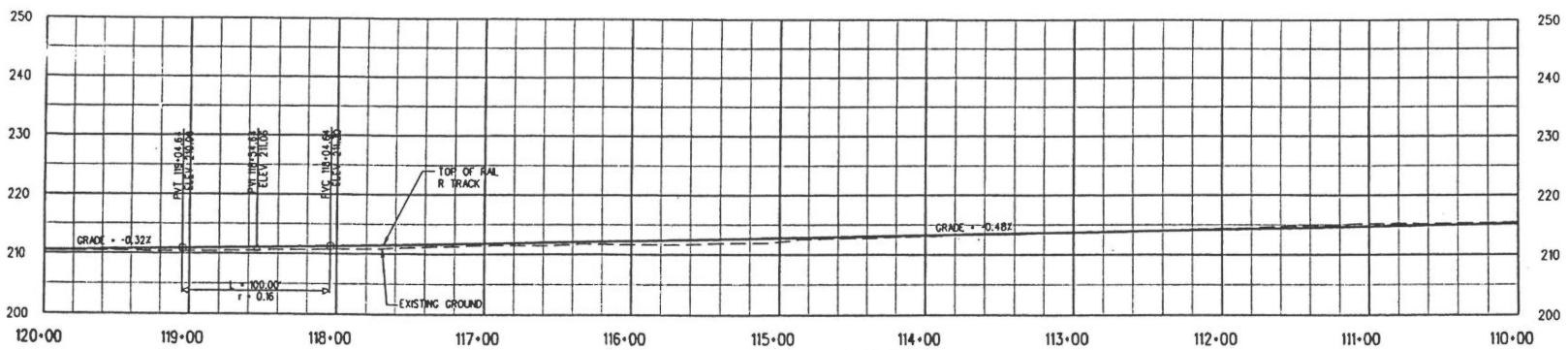
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIALLY. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



PROFILE

40' 20' 0 40' 80'
HORIZONTAL 1"=40'

10' 0 10' 20'
VERTICAL 1"=10'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
A	2/2/04						DESIGN DRAWINGS

DESIGNED BY C. DAVIS
DRAWN BY N. CORNWELL
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

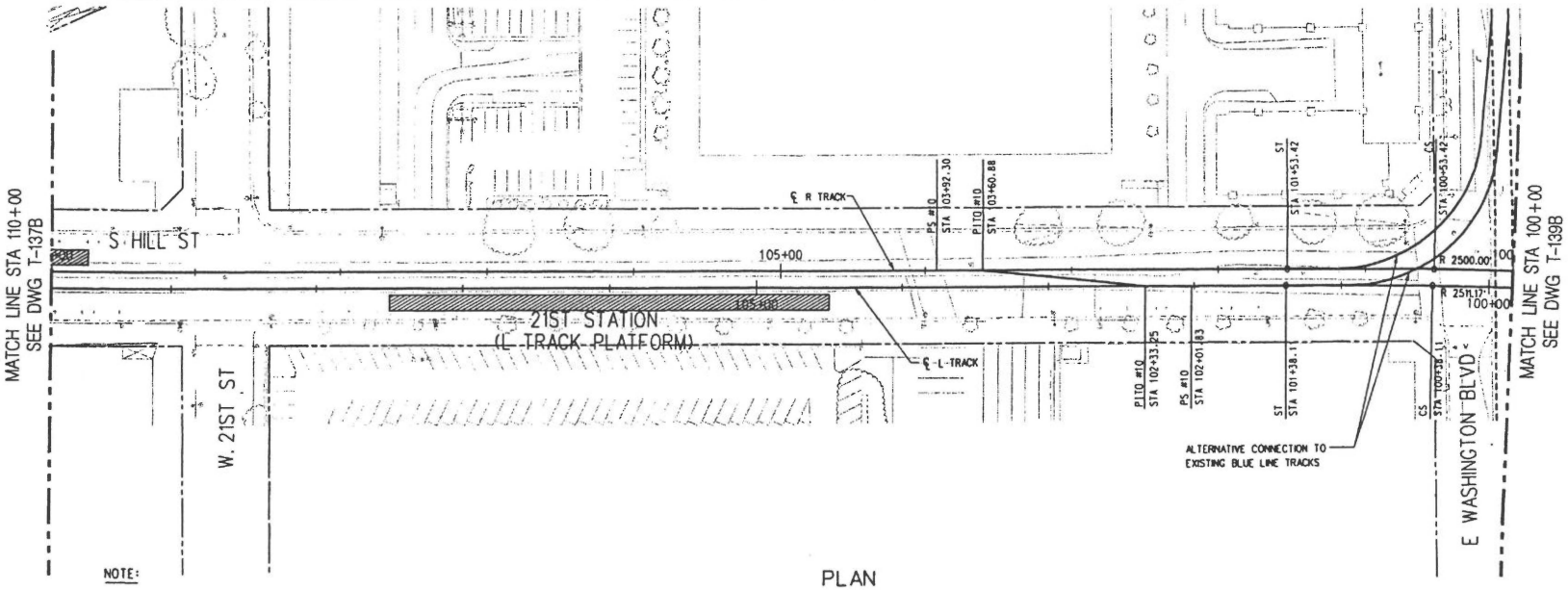
DMJM HARRIS AECOM COMPANY
707 WILSHIRE BLVD, SUITE 1200
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9559

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
HILL STREET
MAIN TRACKS
PLAN & PROFILE
STA 110+00 TO STA 120+00

CONTRACT NO E0016
DRAWING NO T-137B
REV A
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO

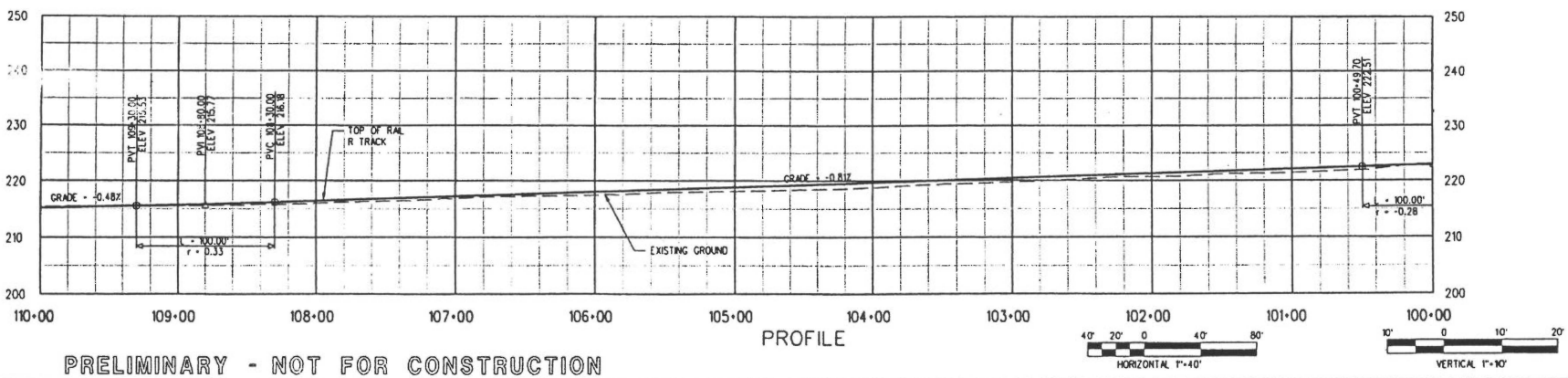
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PLAN

NOTE:

TOP OF RAIL ELEVATIONS OF THE L TRACK TO BE EQUAL TO THE R TRACK AT POINTS OPPOSITE, PERPENDICULAR, AND RADIALLY. GRADIENTS AND LENGTHS OF VERTICAL CURVES ON THE L TRACK VARY ACCORDINGLY (SLIGHTLY FROM THOSE ON THE R TRACK).



PROFILE

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
A	2/2/04						DESIGN DRAWINGS

DESIGNED BY C. DAVIS
DRAWN BY R. LAYGO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS an AECOM company
707 WILSHIRE BLVD, SUITE 4300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-8200
FAX (213) 922-8399

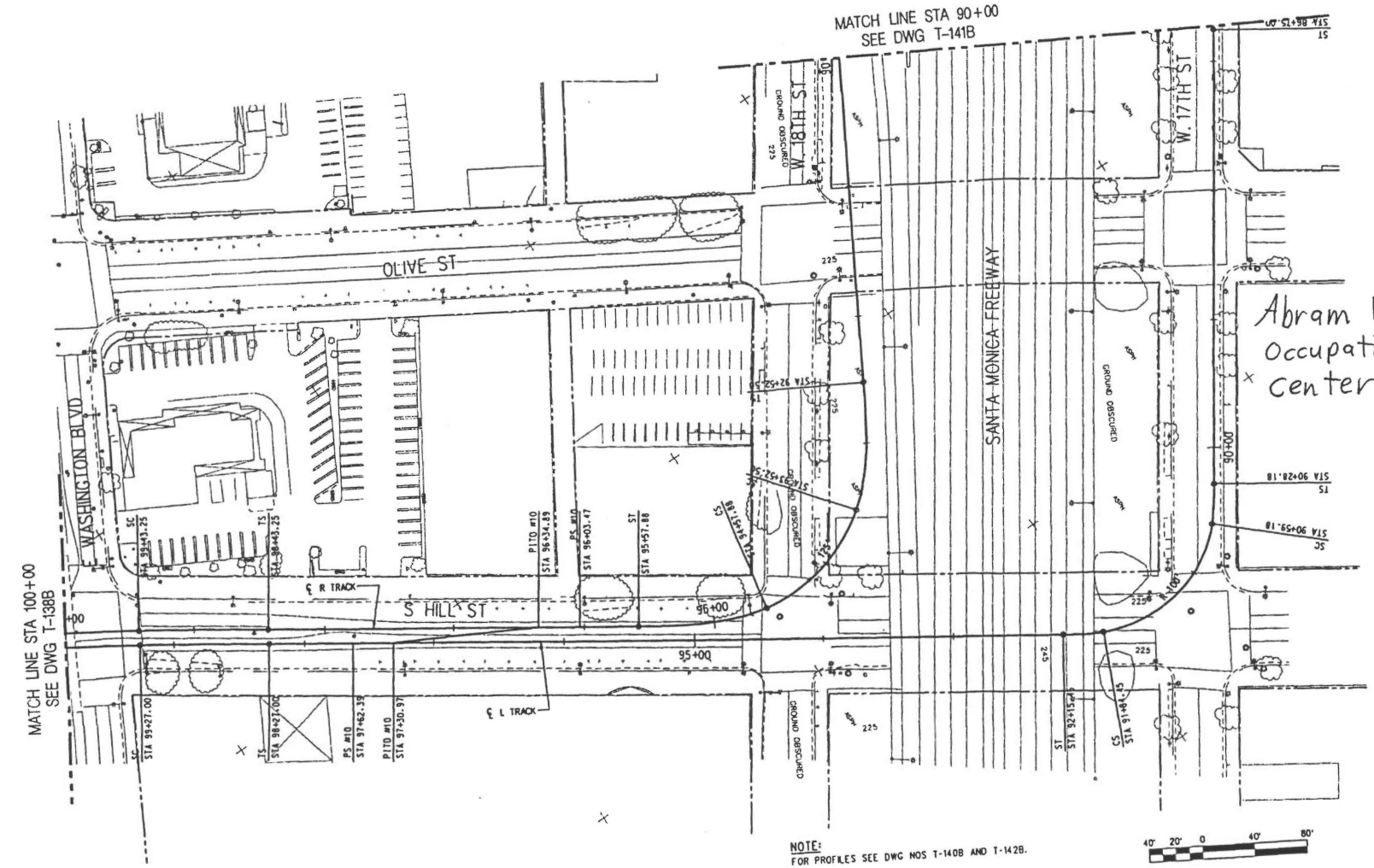
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
HILL STREET
MAIN TRACKS
PLAN & PROFILE
STA 100+00 TO STA 110+00

CONTRACT NO E0016
DRAWING NO T-138B REV A
SCALE HORIZ: 1"=40' VERT: 1"=10'
SHEET NO

Plotted by: DAVISC 02/19/2004

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
A	2/2/04						DESIGN DRAWINGS

DESIGNED BY C. DAVIS
DRAWN BY R. LAYCO
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

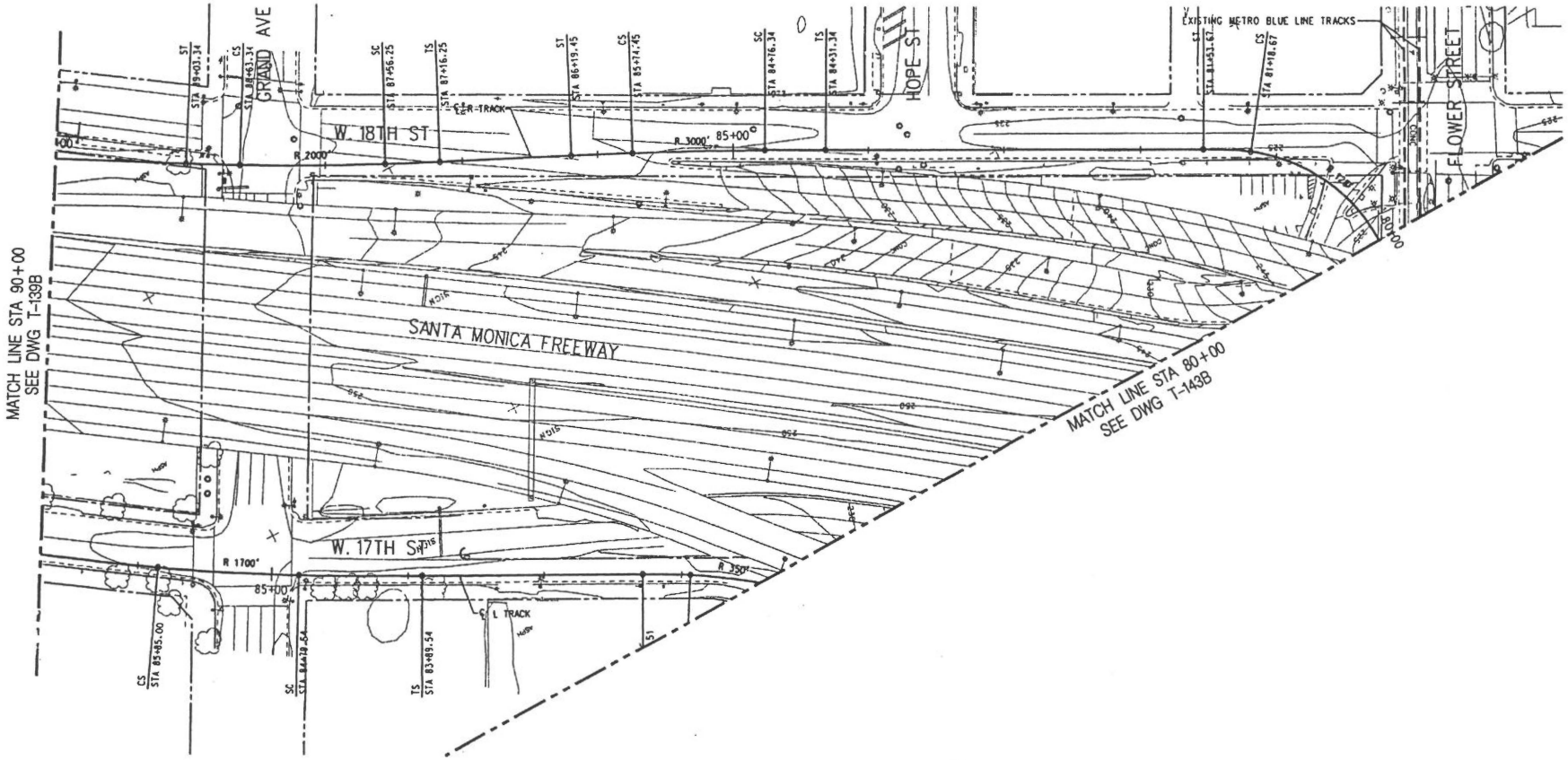
DMJM HARRIS an AECOM COMPANY
707 WILSHIRE BLVD, SUITE 3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9300
FAX (213) 922-9599

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
HILL STREET
MAIN TRACKS
PLAN
STA 90+00 TO STA 100+00

CONTRACT NO E0016
DRAWING NO T-139B
REV A
SCALE 1" =40'
SHEET NO

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

FOR PROFILES SEE DWG NOS T-140B AND T-142B.

40' 20' 0 40' 80'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
A	2/2/04						DESIGN DRAWINGS

DESIGNED BY C. DAVIS
DRAWN BY N. CORNWELL
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/04

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS an AECOM COMPANY
707 WILSHIRE BLVD, SUITE 4300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-6200
FAX (213) 922-9599

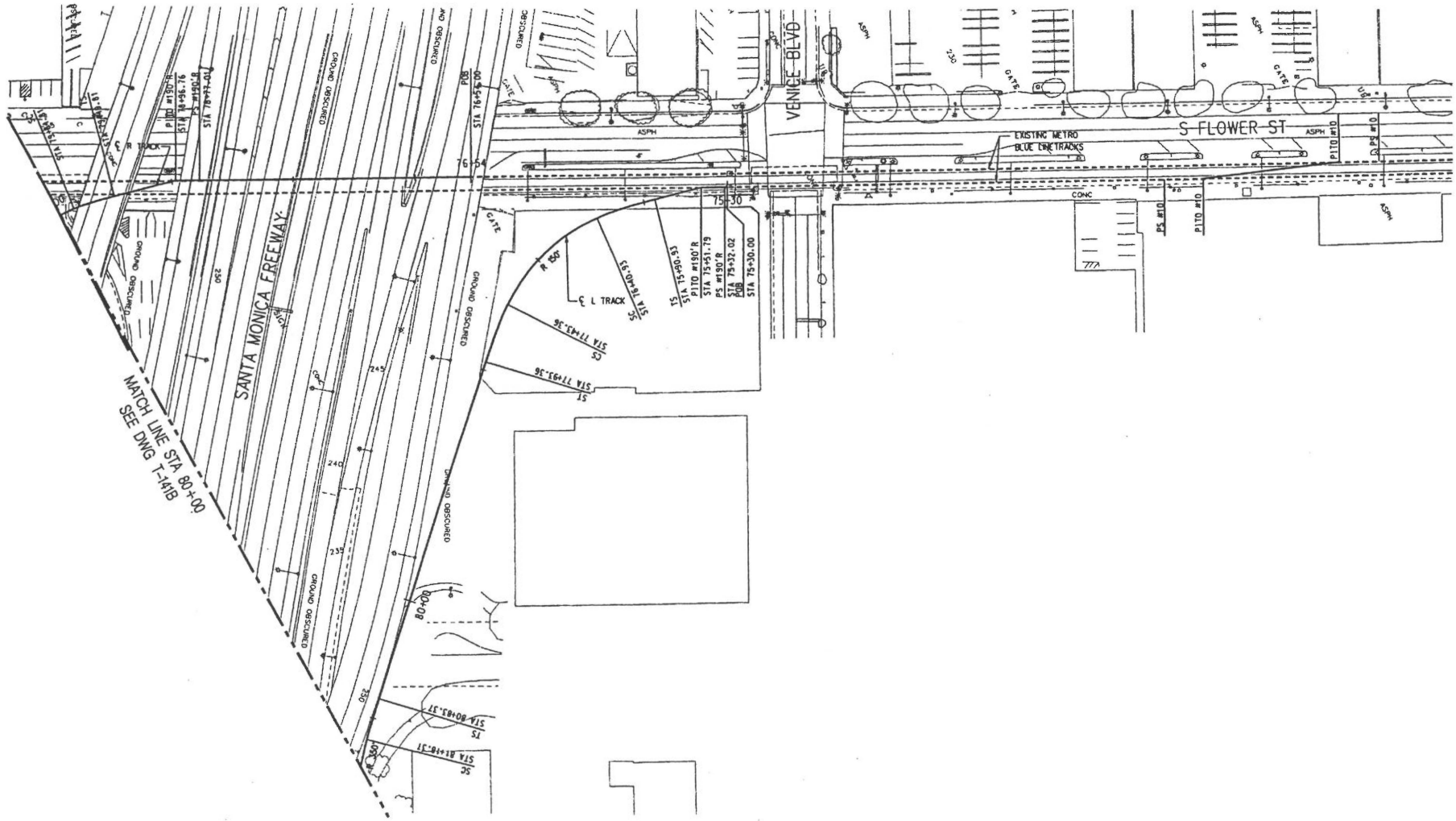
SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
HILL STREET
MAIN TRACKS
PLAN
STA 80+00 TO STA 90+00

CONTRACT NO E0016
DRAWING NO T-141B
REV A
SCALE 1"=40'-0"
SHEET NO

Plotted by: delsen 02/16/2004

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.



NOTE:

FOR PROFILES SEE DWG NO T-142B.

40' 20' 0 40' 80'

PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
A	2/2/2004						DESIGN DRAWINGS

DESIGNED BY C. DAVIS
DRAWN BY C. DAVIS
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 2/2/2004

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS an AECOM company
707 WILSHIRE BLVD, SUITE 4300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9550

SUBMITTED
APPROVED

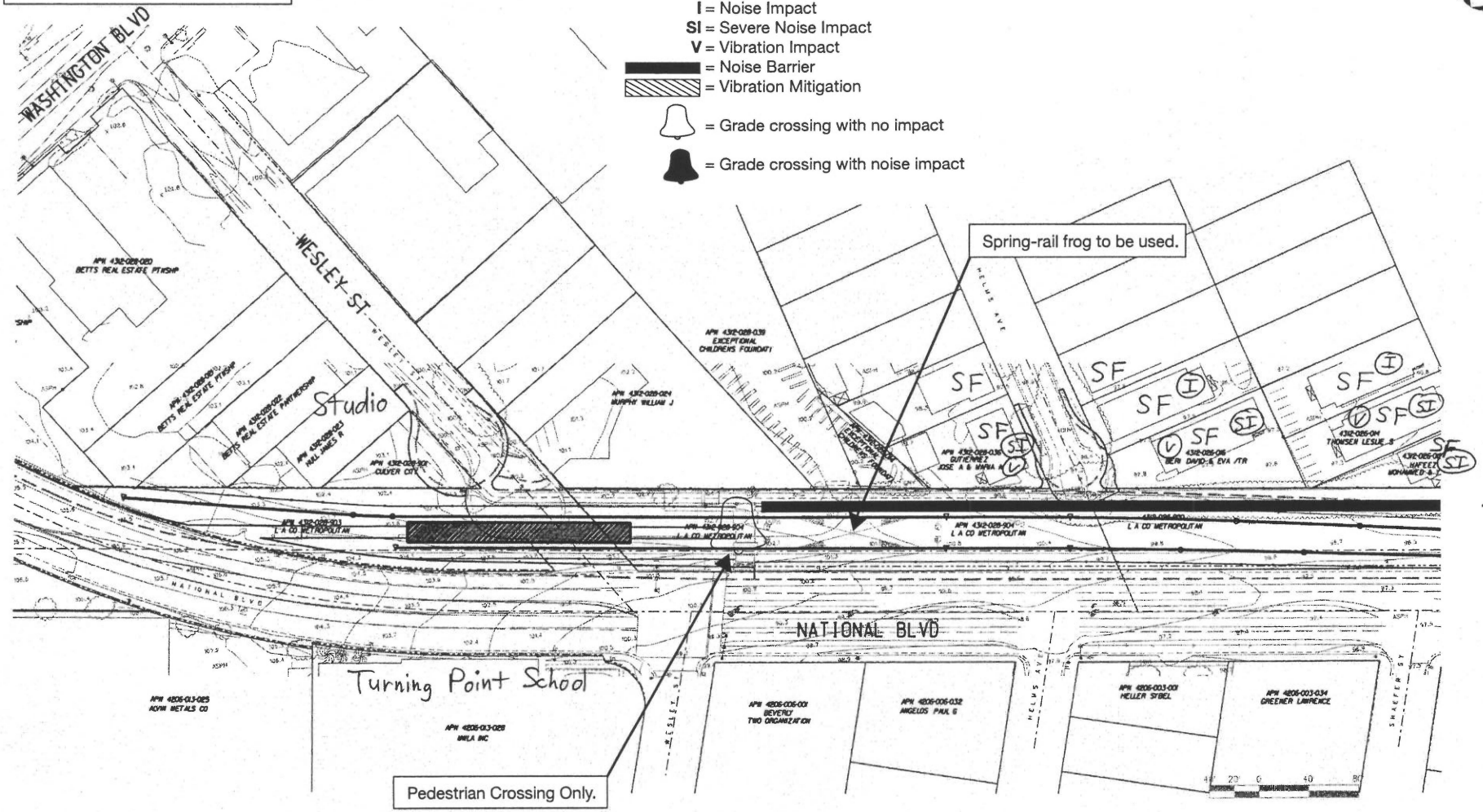
MID-CITY/EXPOSITION LRT CORRIDOR
HILL STREET
MAIN TRACKS
PLAN
STA 76+54 TO STA 80+00

CONTRACT NO E0016
DRAWING NO T-143B REV A
SCALE 1" =40'
SHEET NO

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.

ROW OPTION

Legend
SF = Single-Family Residence
MF = Multi-Family Residence
I = Noise Impact
SI = Severe Noise Impact
V = Vibration Impact
= Noise Barrier
= Vibration Mitigation
= Grade crossing with no impact
= Grade crossing with noise impact



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD., SUITE #3200
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9300
FAX (213) 922-9999

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

CULVER CITY STATION R/W OPTION

CONTRACT NO E0016
DRAWING NO
REV
SCALE
SHEET NO

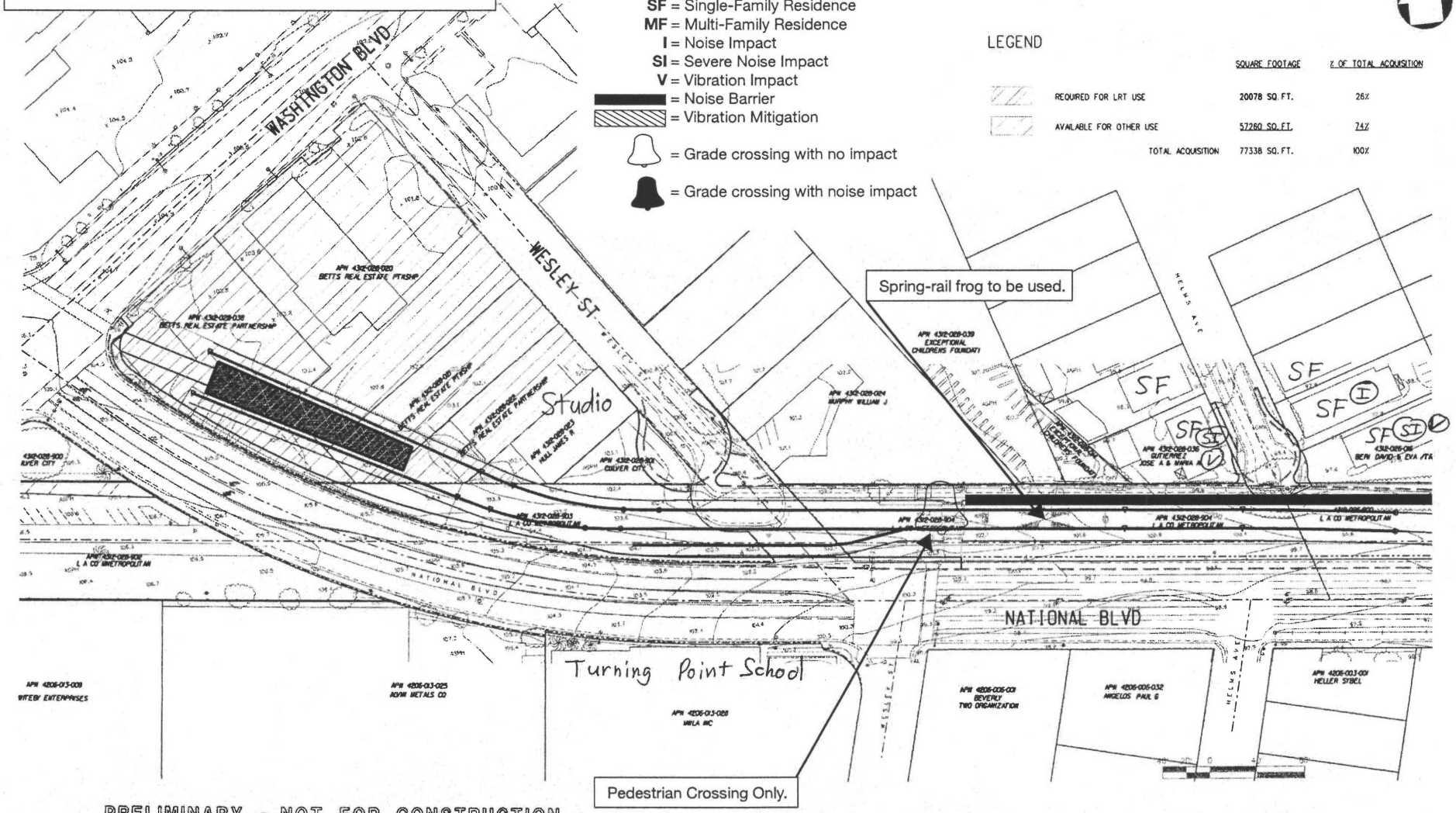
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.

NORTH OF ROW OPTION A

Legend
- **SF** = Single-Family Residence
- **MF** = Multi-Family Residence
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact

LEGEND

	SQUARE FOOTAGE	% OF TOTAL ACQUISITION
REQUIRED FOR LRT USE	20078 SQ. FT.	26%
AVAILABLE FOR OTHER USE	57260 SQ. FT.	74%
TOTAL ACQUISITION	77338 SQ. FT.	100%



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD., SUITE 03300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9359

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

CULVER CITY STATION
NORTH OF R/W OPTION A

CONTRACT NO E0016
DRAWING NO
REV
SCALE
SHEET NO

Plotted by:

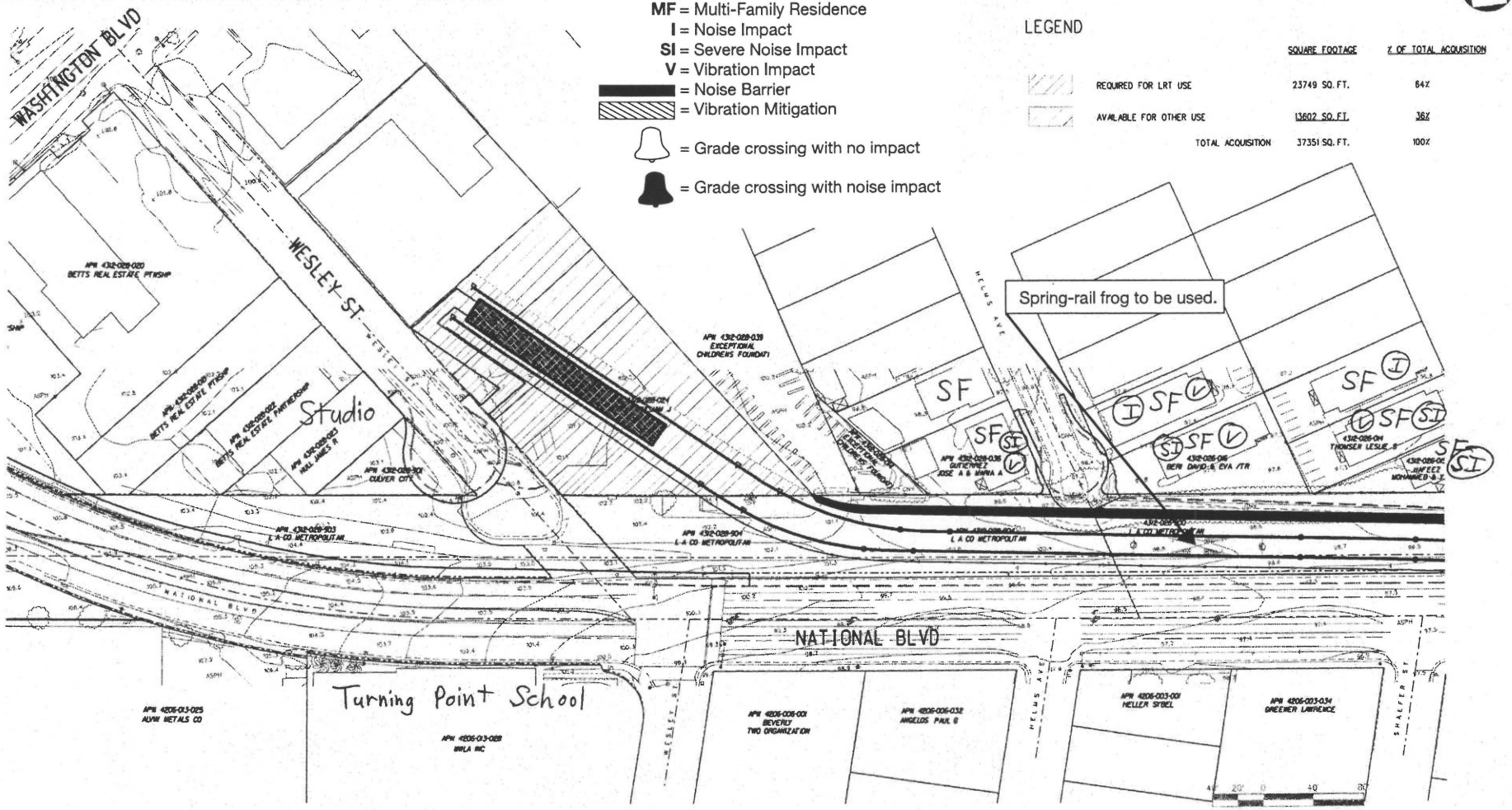
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.

NORTH OF ROW OPTION B

Legend
SF = Single-Family Residence
MF = Multi-Family Residence
I = Noise Impact
SI = Severe Noise Impact
V = Vibration Impact
= Noise Barrier
= Vibration Mitigation
= Grade crossing with no impact
= Grade crossing with noise impact

LEGEND

	SQUARE FOOTAGE	% OF TOTAL ACQUISITION
REQUIRED FOR LRT USE	23749 SQ. FT.	64%
AVAILABLE FOR OTHER USE	13602 SQ. FT.	36%
TOTAL ACQUISITION	37351 SQ. FT.	100%



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	RCO NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD., SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-7200
FAX (213) 922-3999

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

CULVER CITY
STATION
NORTH OF R/W OPTION B

CONTRACT NO E0016
DRAWING NO
REV
SCALE
SHEET NO

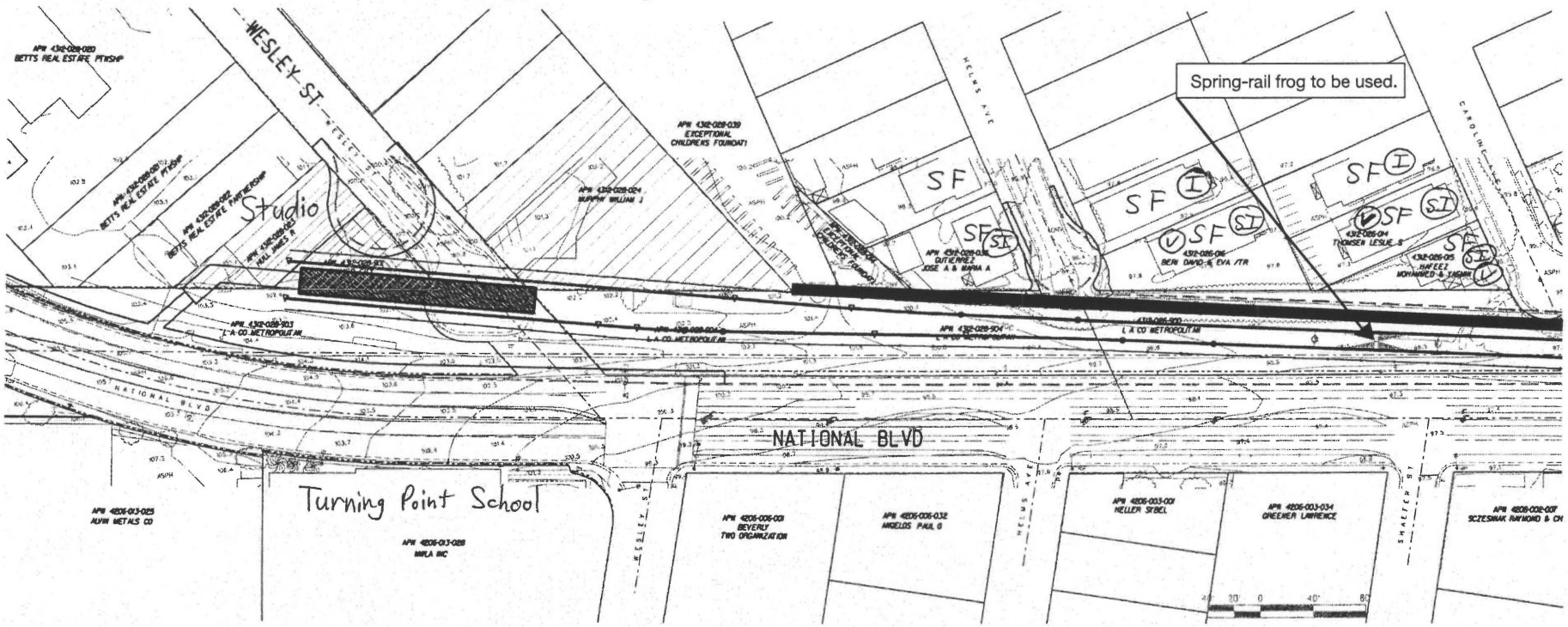
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.

NORTH OF ROW OPTION C

Legend
SF = Single-Family Residence
MF = Multi-Family Residence
I = Noise Impact
SI = Severe Noise Impact
V = Vibration Impact
= Noise Barrier
= Vibration Mitigation
= Grade crossing with no impact
= Grade crossing with noise impact

LEGEND

	SQUARE FOOTAGE	% OF TOTAL ACQUISITION
REQUIRED FOR LRT USE	12046 SQ. FT.	37%
AVAILABLE FOR OTHER USE	20656 SQ. FT.	63%
TOTAL ACQUISITION	32702 SQ. FT.	100%



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REQ NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9935

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR

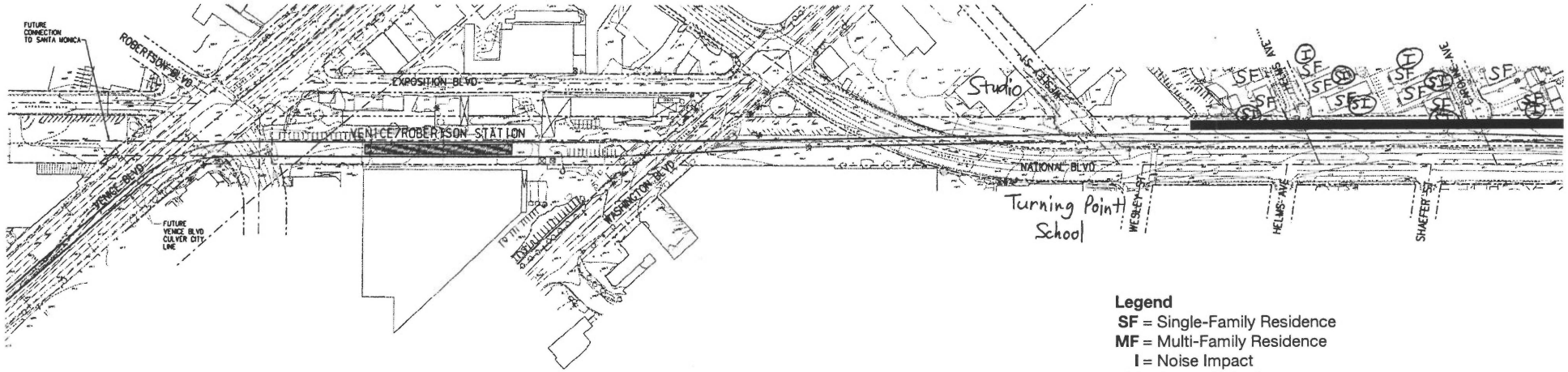
CULVER CITY STATION
NORTH OF R/W OPTION C

CONTRACT NO E0016
DRAWING NO
REV
SCALE
SHEET NO

Plotted by:

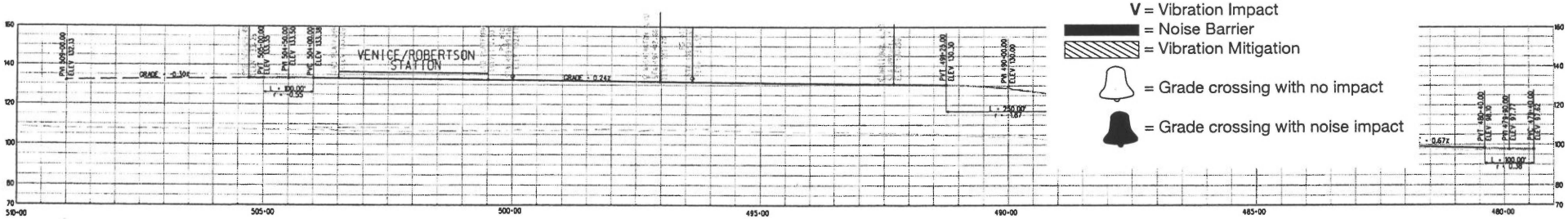
Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.

AERIAL OPTION



Legend

- **SF** = Single-Family Residence
- **MF** = Multi-Family Residence
- **I** = Noise Impact
- **SI** = Severe Noise Impact
- **V** = Vibration Impact
- = Noise Barrier
- = Vibration Mitigation
- = Grade crossing with no impact
- = Grade crossing with noise impact



PRELIMINARY - NOT FOR CONSTRUCTION

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
	6/30/05						FINAL EIR/EIS

DESIGNED BY C. DAVIS
DRAWN BY C. NATHAN
CHECKED BY D.A. SEPULVEDA
IN CHARGE D.A. SEPULVEDA
DATE 5/17/05

Metro LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

DMJM HARRIS | AECOM
707 WILSHIRE BLVD. SUITE #3300
LOS ANGELES, CALIFORNIA 90017
TEL (213) 922-9200
FAX (213) 922-9555

SUBMITTED
APPROVED

MID-CITY/EXPOSITION LRT CORRIDOR
VENICE/ROBERTSON AERIAL STATION ALTERNATIVE

CONTRACT NO E0016
DRAWING NO EIR-5
REV
SCALE HORIZ: 1" =200' -0" VERT: 1" =50' -0"
SHEET NO

Note: Per Section 4.6 of the FEIS/FEIR, all noise and vibration impacts have been mitigated to levels that meet FTA noise and vibration impact criteria.

Ref HE 4491 .E9 N693 c.2

--- 32595

Noise and vibration impact

DATE DUE

MTA LIBRARY
ONE GATEWAY PLAZA, 15th Floor
LOS ANGELES, CA 90012