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Acoustical and Audiovisual Consultants

BACKGROUND REPORT FOR:

City of Santa Cruz General Plan Noise Element Update

Santa Cruz, CA

RGDL Project #: 06-047-1

PREPARED FOR:

City of Santa Cruz
Planning and Community Development
809 Center Street, Room 106
Santa Cruz, CA 95060

PREPARED BY:

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DATE:

30 November 2007

1. Introduction

The City of Santa Cruz is preparing an update to its General Plan. As part of this process the Noise Element will be updated. The following report provides background information on noise sources within the City, measurements that were made to document noise levels throughout the City, and noise contours for existing conditions.

2. Environmental Noise Fundamentals

Noise can be defined as unwanted sound. It is commonly measured with an instrument called a sound level meter. The sound level meter captures the sound with a microphone and converts it into a number called a sound level. Sound levels are expressed in units of decibels. To correlate the microphone signal to a level that corresponds to the way humans perceive noise, the A-weighting filter is used. A-weighting de-emphasizes low-frequency and very high-frequency sound in a manner similar to human hearing. The use of A-weighting is required by most local General Plans as well as federal and state noise regulations (e.g. Caltrans, EPA, OSHA and HUD). The abbreviation dBA is sometimes used when the A-weighted sound level is reported.

Because of the time-varying nature of environmental sound, there are many descriptors that are used to quantify the sound level. Although one individual descriptor alone does not fully describe a particular noise environment, taken together, they can more accurately represent the noise environment. The maximum instantaneous noise level (L_{max}) is often used to identify the loudness of a single event such as a car passby or airplane flyover. To express the average noise level the L_{eq} (equivalent noise level) is used. The L_{eq} can be measured over any length of time but is typically reported for periods of 15 minutes to 1 hour. The background noise level (or residual noise level) is the sound level during the quietest moments. It is usually generated by steady sources such as distant freeway traffic. It can be quantified with a descriptor called the L_{90} which is the sound level exceeded 90 percent of the time.

To quantify the noise level over a 24-hour period, the Day/Night Average Sound Level (DNL or L_{dn}) or Community Noise Equivalent Level (CNEL) is used. These descriptors are averages like the L_{eq} except they include a 10 dB penalty during nighttime hours (and a 5 dB penalty during evening hours in the CNEL) to account for peoples increased sensitivity during these hours.

In environmental noise, a change in noise level of 3 dB is considered a just noticeable difference. A 5 dB change is clearly noticeable, but not dramatic. A 10 dB change is perceived as a halving or doubling in loudness.

3. Noise Sources in Santa Cruz

The most widespread and dominant noise source in Santa Cruz is traffic. Noise from traffic is audible from almost all areas of the city and most times of the day. Other noise sources such as railroads, industry and the Boardwalk tend to be localized and limited to certain locations and times of the day or year. The following is a discussion of the most common noise sources in Santa Cruz.

3.1. Traffic

The noisiest roadways are those with the greatest traffic volumes and highest travel speeds. For example, the freeways (State Route 1 and State Route 17) generate noise which affects large areas. The noise from arterials affects the development that is directly adjacent but the affects are significantly reduced beyond the first row of buildings. Examples are Mission Street (State Route 1), Water Street, Soquel Avenue, Ocean Street, Broadway, River Street, Bay Street and Laurel Street.

Soundwalls along freeways reduce noise levels at the land uses behind them. Typical noise reductions are in the 5 to 15 dBA range depending on the location of the noise receptor. Soundwalls have been or are being installed along much of the length of the State Route 1 freeway in Santa Cruz as part of the State Route 1/17 Widening of Merge Lanes project. The environmental document for this project[1] contains extensive existing and future noise level data for noise sensitive land uses (primarily residences) with and without the proposed soundwalls.

3.2. Railraod

The railroad tracks that cross the southern portion of the City in an east/west direction are used for freight trains a few times a week and generally during daytime hours. During the summer (and limited days during the winter holidays) recreational trains access the Boardwalk along the tracks that cross the City in a north/south direction along Chestnut Street. There are generally two round trip excursions per day. The trains travel at relatively low speeds through the City and the major noises are the rumble from the locomotive and the whistles that must be sounded before and during each at-grade roadway crossing.

Locomotives typically produce maximum noise levels (L_{max}) of 88 dBA at a distance of 50 feet and whistles produce an L_{max} of 105 dBA at 50 feet[2]. If there are two round trips a day, this corresponds to an L_{dn} of 49 dBA. The L_{dn} would increase to 65 dBA near grade crossings since the train would be required to sound its warning horn (whistle).

3.3. Aircraft

There are no airfields or airports in Santa Cruz and, therefore, airplane noise is limited to overflights. There is an emergency helipad at Dominican Hospital just outside of the northeast corner of the City Limits.

3.4. Industrial Uses

Much of the industrial land use in the City is located north of State Route 1 and west of River Street (State Route 9). Concrete production and distribution is a common noise source in this area. Measurements along Coral Street indicate that the steady noise level from machinery at the Graniterock facility is 65 to 67 dBA at a distance of 185 feet.

3.5. Boardwalk

The Santa Cruz Beach Boardwalk is the predominant noise source in the beach area during the summer months. Major noise sources include roller coasters, people screaming and outdoor concerts. Noise measurements conducted for the Beach Area/South of Laurel Master Plan EIR[3] indicated that roller coasters generate maximum noise levels (L_{max}) of 69 to 78 dBA at the residences and businesses across Beach Street. The DNL along Leibrandt Street was 68 dBA. Along East Cliff Drive, homes on the bluff overlooking the boardwalk, were exposed to an L_{max} of 60 to 65 dBA from music at the bandstand and 65 to 70 dBA from the screams of people on the wooden roller coaster (Giant Dipper).

4. Measurements of Existing Conditions

A noise measurement program was conducted to quantify noise levels throughout the City. For traffic noise, ten locations were selected to represent existing traffic noise levels on the busier roads (see Figure 1). a One continuous “long term” 24-hour noise measurement and one “short-term” 15-minute measurement were conducted at each of the ten locations. The short-term noise measurement was conducted at the typical setback of the nearby land uses (typically residences) while the long-term noise monitor was mounted to an existing utility pole or tree.

The short-term measurement results were correlated with simultaneous measurements at the long-term monitoring location to determine the DNL at the typical setback of land uses in the vicinity of the long-term noise monitor. Table 1 shows the results of the short-term noise measurements and the correlated DNL. Figures 2a through 2j show the hourly plot of the measured noise levels at the long-term noise monitors.

Figure 1: Noise Measurement Locations

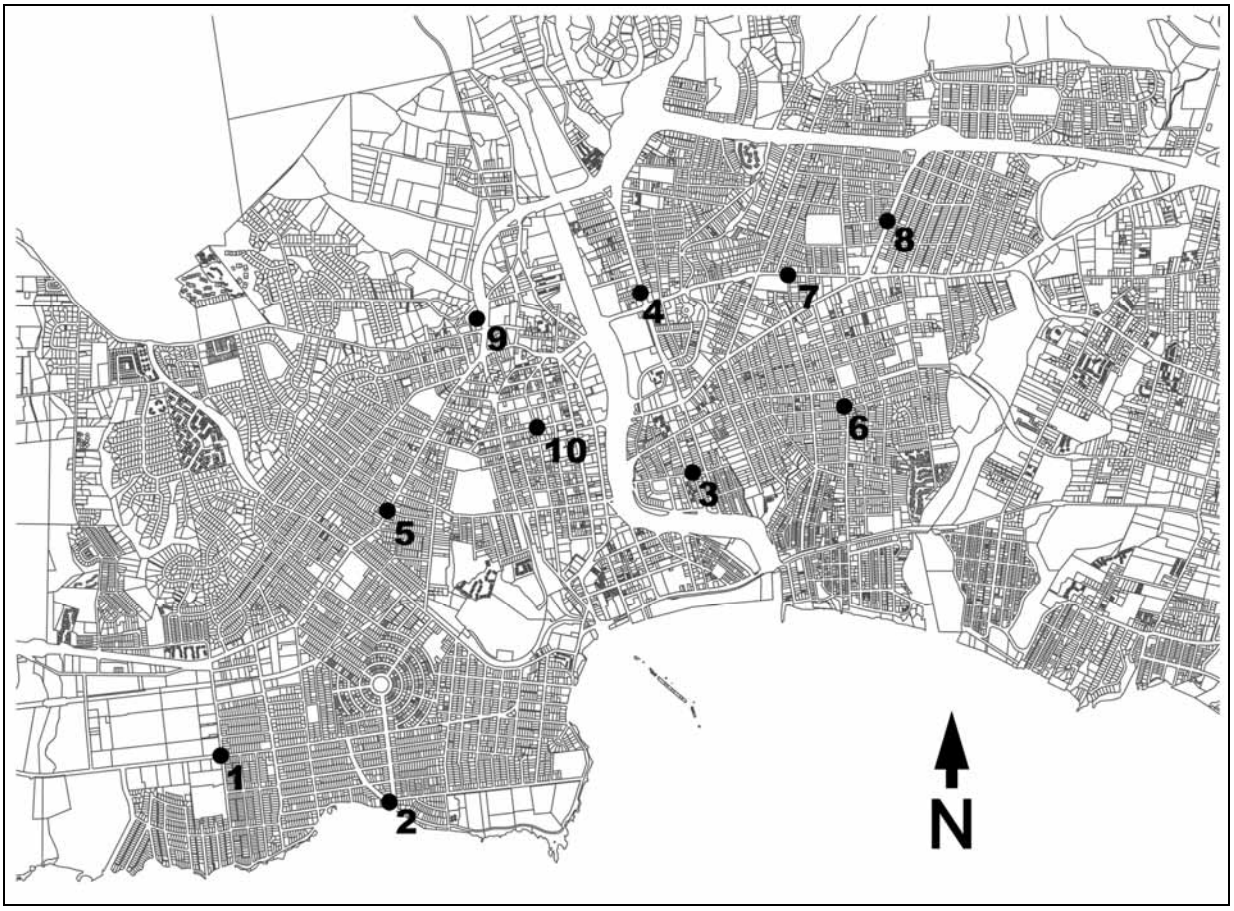


Table 1: Short-term Noise Measurement Results

Location		Date/Time	A-weighted Sound Level, dBA				
			L_{eq}	L_{10}	L_{50}	L_{90}	DNL*
1	Swift Street at Jeter Street	11/28/06 1:30 - 1:45 PM	65	69	62	51	66
2	West Cliff Drive at Woodrow Avenue	11/28/06 3:15 - 3:30 PM	56	48	47	46	56
3	Barson Street at Canfield Avenue	11/28/06 2:45 - 3:00 PM	60	65	54	48	62
4	Ocean Street south of Hubbard Street	11/28/06 2:15 - 2:30 PM	71	74	69	62	73
5	Mission Street At Van Ness Avenue	11/28/06 1:00 - 1:15 PM	70	69	67	64	75
6	Seabright Avenue at Windsor Street	11/30/06 11:30 - 11:45 AM	63	67	60	48	66
7	Water Street at Benito Avenue	11/30/06 12:00 - 12:15 PM	67	69	64	58	69
8	Morrissey Boulevard at Hammond Avenue	11/30/06 12:30 - 12:45 PM	66	69	65	56	67
9	Highway 1 at High Street	11/30/06 1:30 - 1:45 PM	70	73	69	59	73
10	Center Street at New Street	11/30/06 2:00 - 2:15 PM	63	64	56	48	63

*DNL calculated by correlating with simultaneous measurement at 24-hour noise monitor.

Figure 2a: Long-term Noise Measurement Results
Location 1 – Swift Street at Jeter Street

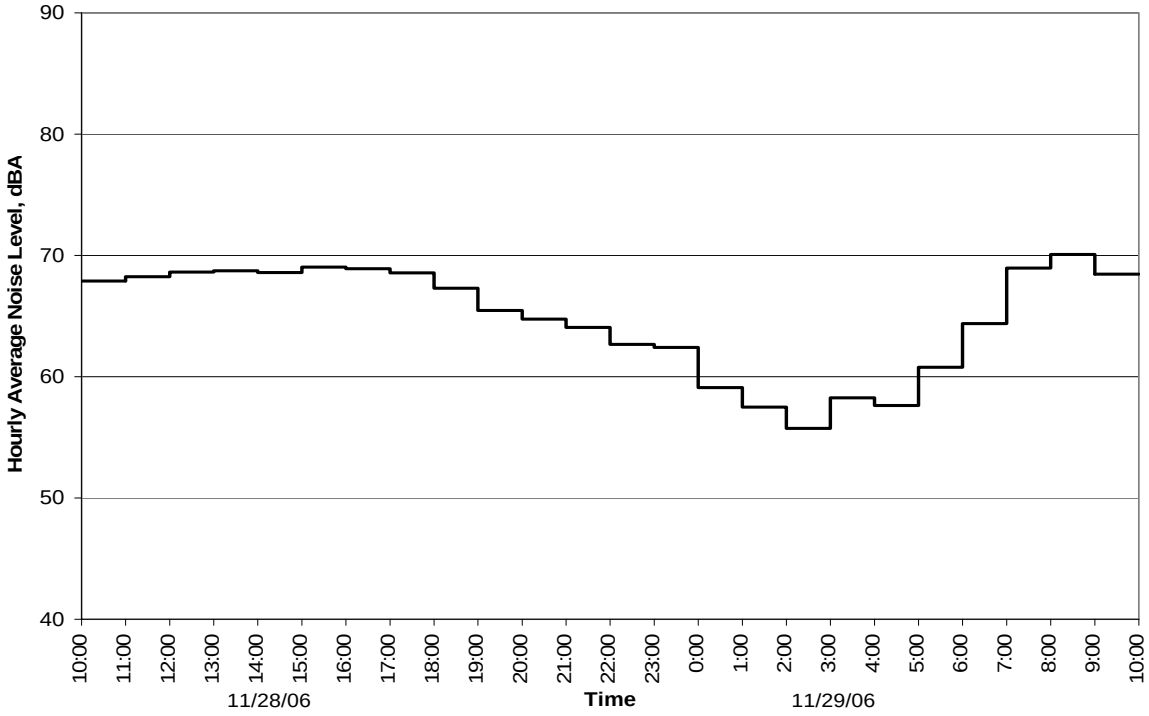


Figure 2b: Long-term Noise Measurement Results
Location 2 – West Cliff Drive at Woodrow Avenue

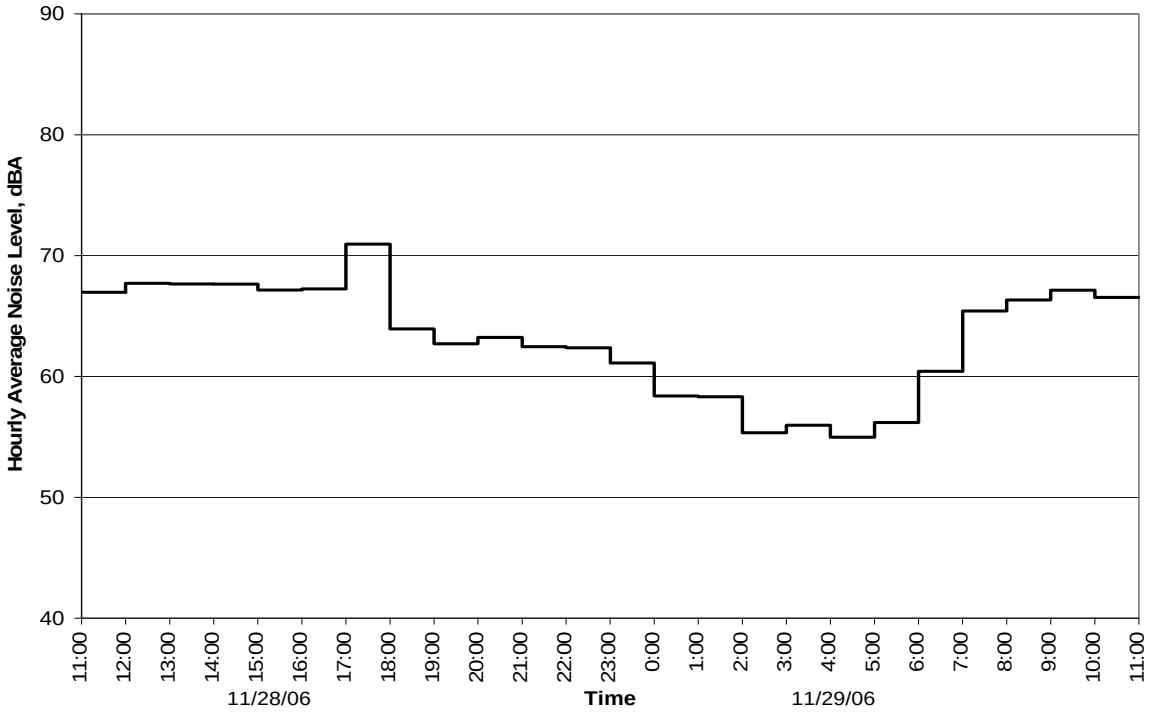


Figure 2c: Long-term Noise Measurement Results
Location 3 – Barson Street at Canfield Avenue

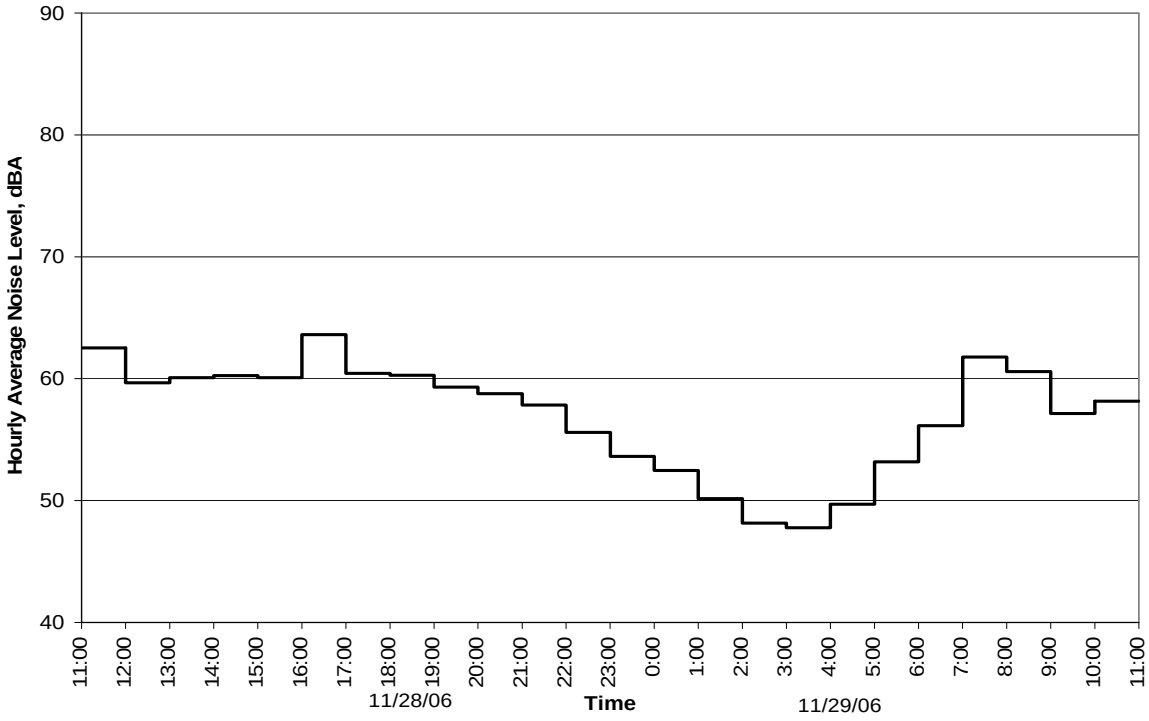


Figure 2d: Long-term Noise Measurement Results
Location 4 – Ocean Street south of Hubbard Street

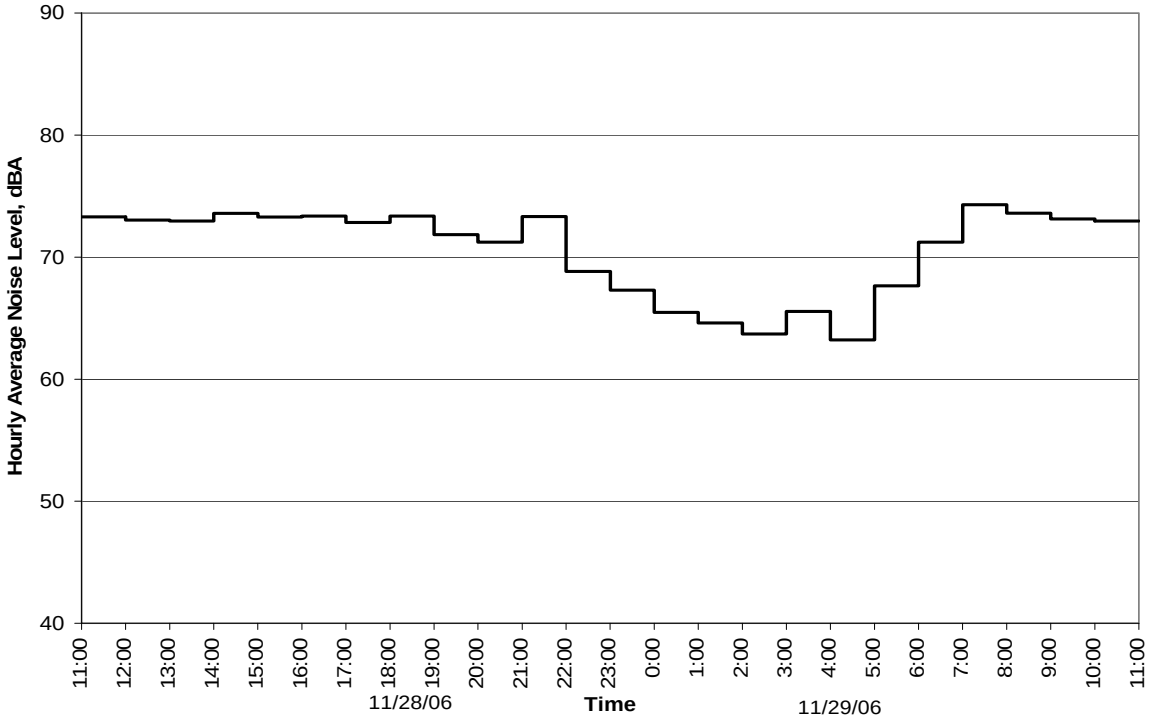


Figure 2e: Long-term Noise Measurement Results
Location 5 – Mission Street at Van Ness Avenue

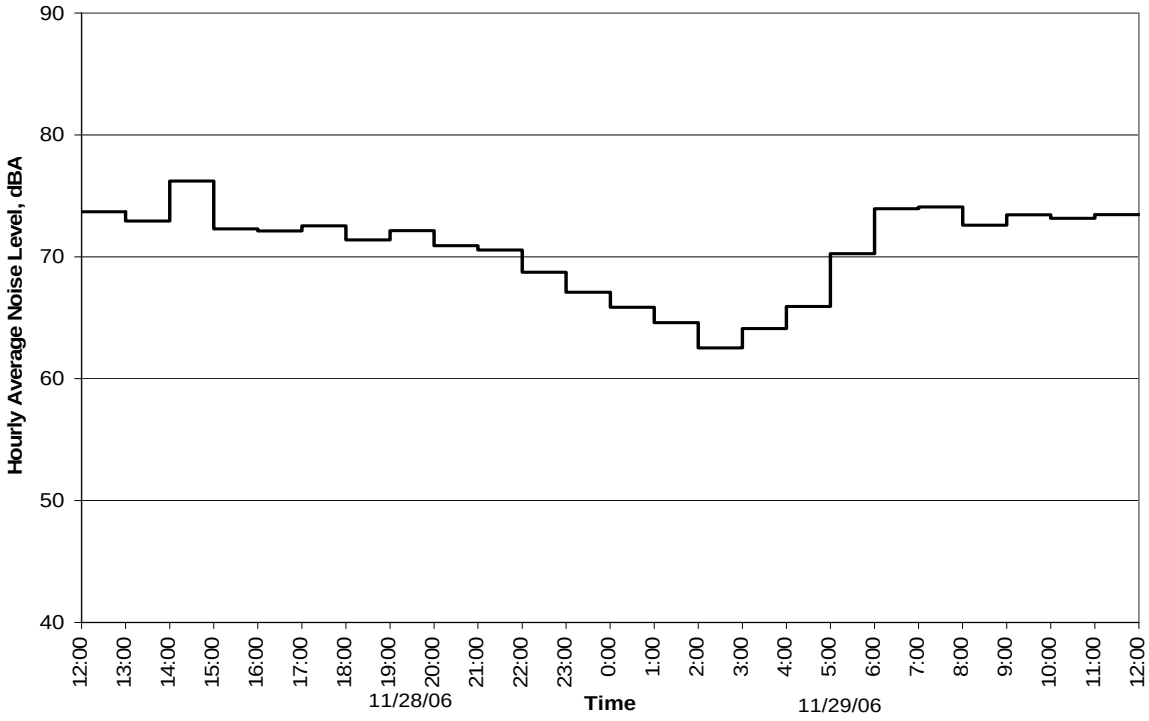


Figure 2f: Long-term Noise Measurement Results
Location 6 – Seabright Avenue at Windsor Street

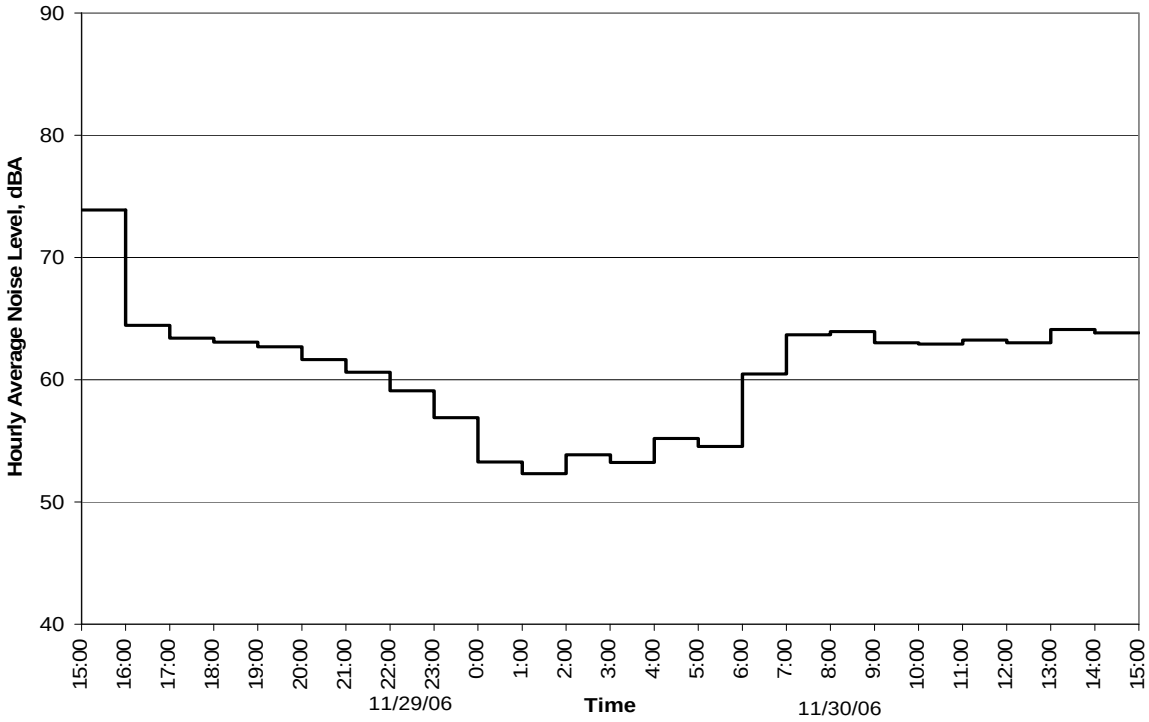


Figure 2g: Long-term Noise Measurement Results
Location 7 – Water Street at Benito Avenue

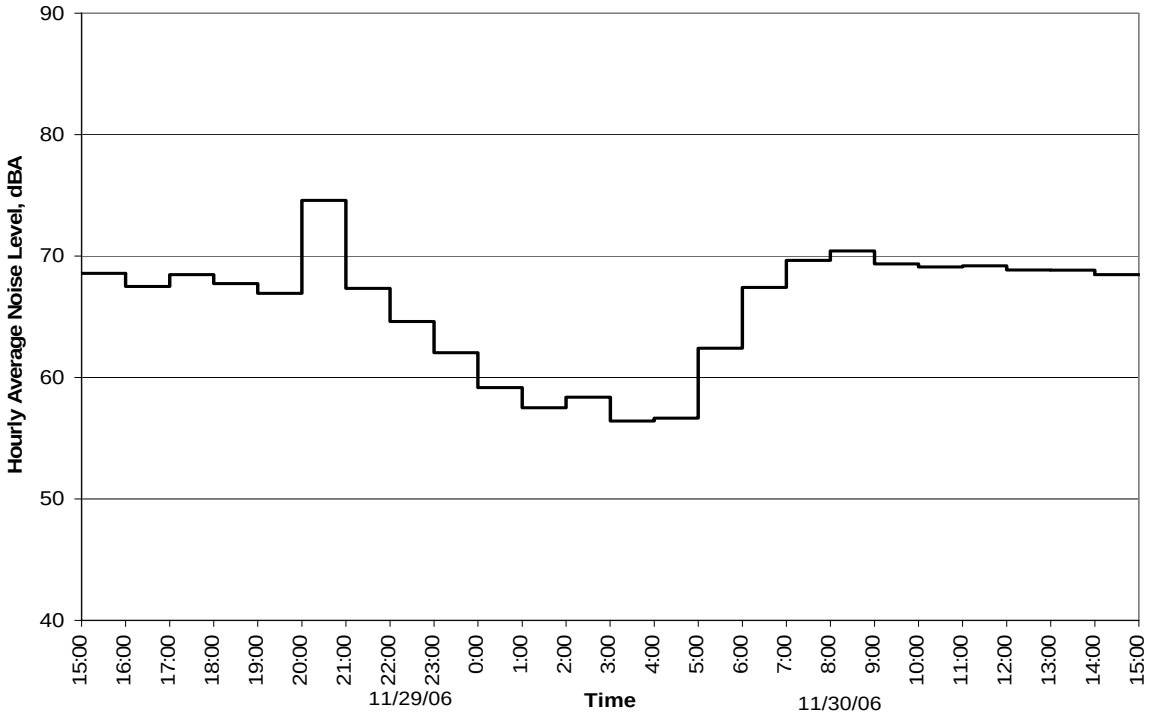


Figure 2h: Long-term Noise Measurement Results
Location 8 – Morrissey Boulevard at Hammond Avenue

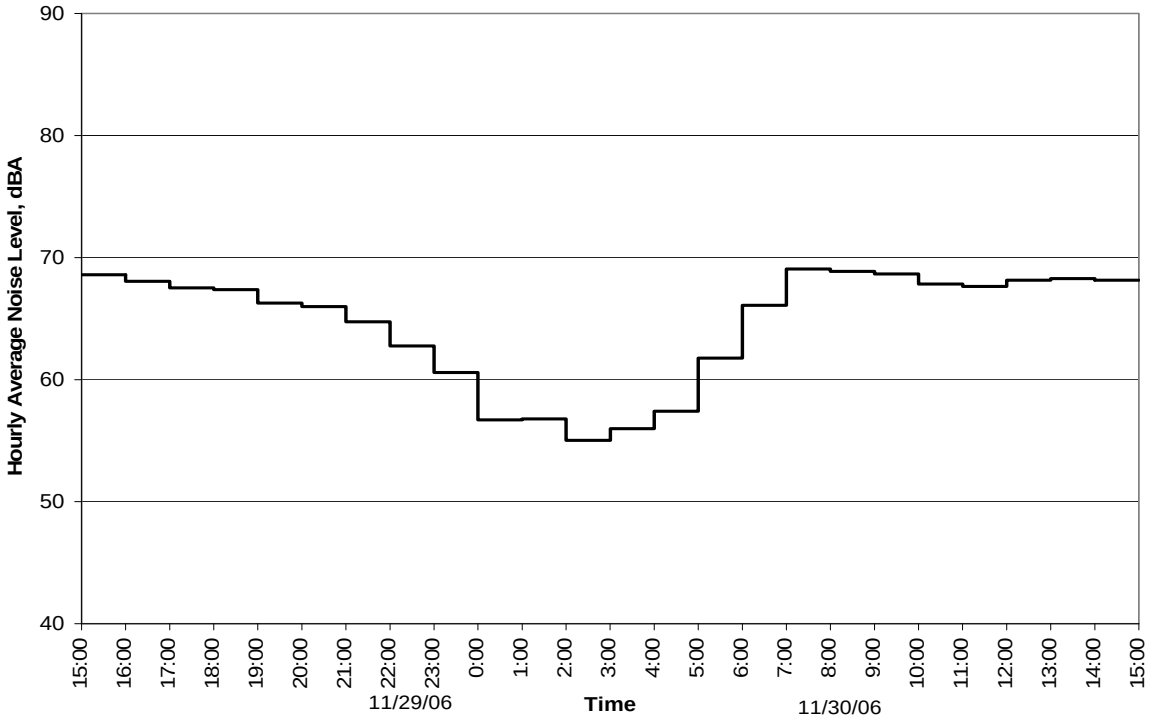


Figure 2i: Long-term Noise Measurement Results
Location 9 – Highway 1 at High Street

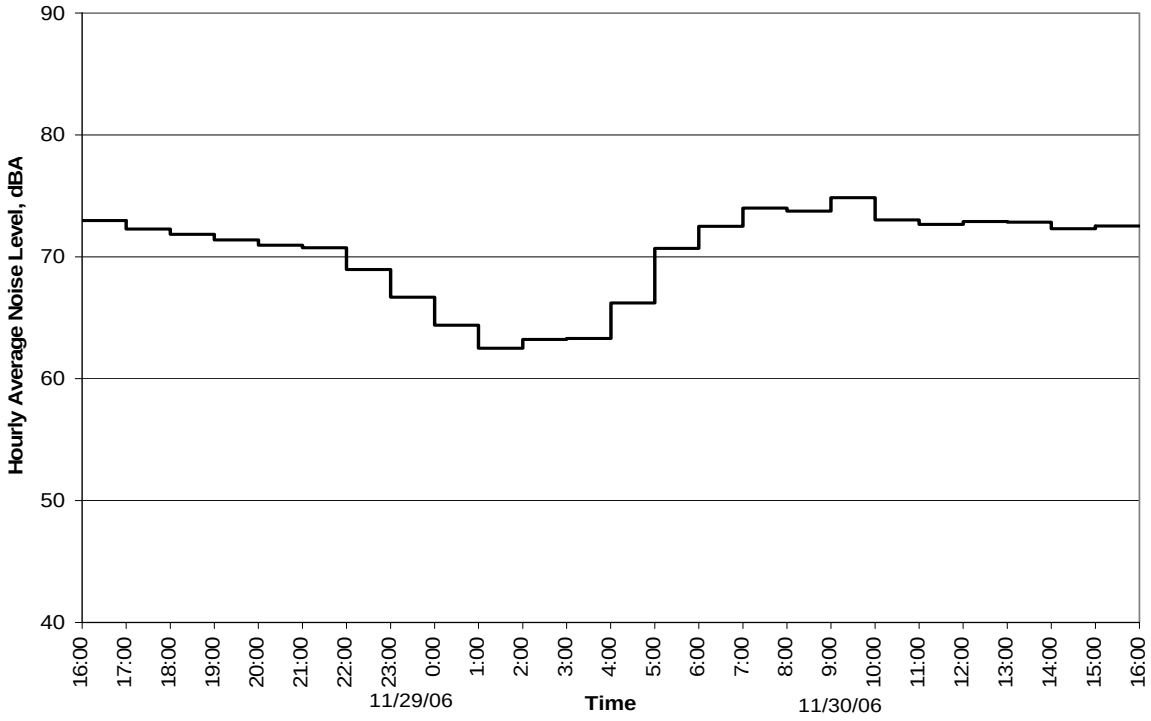
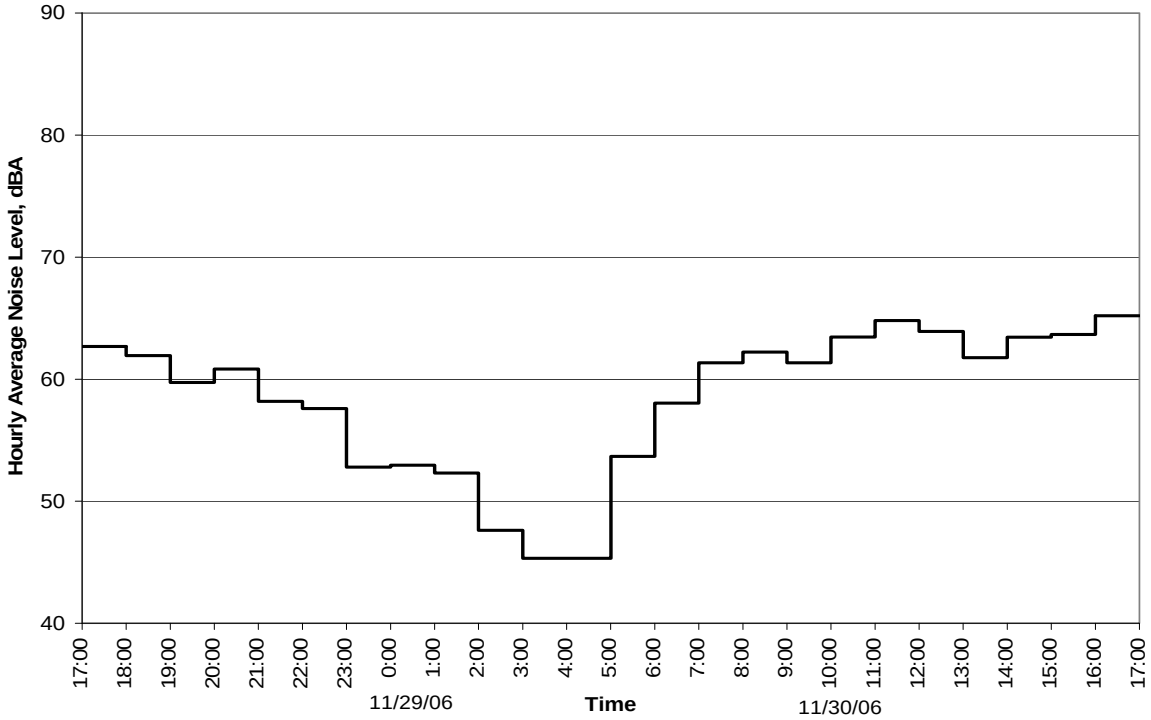


Figure 2j: Long-term Noise Measurement Results
Location 10 – Center Street at New Street



5. Existing Noise Contours

A noise contour map is a useful way to describe the noise environment of a large geographical area using a single graphical map. A noise contour map is similar to a topographic map. Whereas the contour lines of a topographic map represent a specific elevation in feet or meters, the contour lines of a noise contour map represent a specific noise level in decibels (dBA). Existing traffic noise contours are presented in Figure 3. The noise contours are shown for DNL values of 60, 65 and 70 dBA.

The traffic noise contours are based on calculations using the Federal Highway Administration's Traffic Noise Model[4] (TNM 2.5). TNM 2.5 calculates the traffic noise level based on input such as traffic volume, truck percentage and travel speeds. The traffic data for the local roads used as input to the TNM 2.5 model is based on the existing traffic data developed by the City of Santa Cruz for the General Plan Update and supplemented by observations made in the field. The traffic data for the freeways is based on counts published by Caltrans[5].

The traffic noise contours do not take into account the acoustical shielding provided by buildings or fences along the roadways. However, along the portions of State Route 1 freeway, the effects of recently constructed soundwalls are included. The soundwall locations are based on the environmental document for the freeway widening project[1]. The soundwalls are assumed to reduce the noise levels by 5 dBA.

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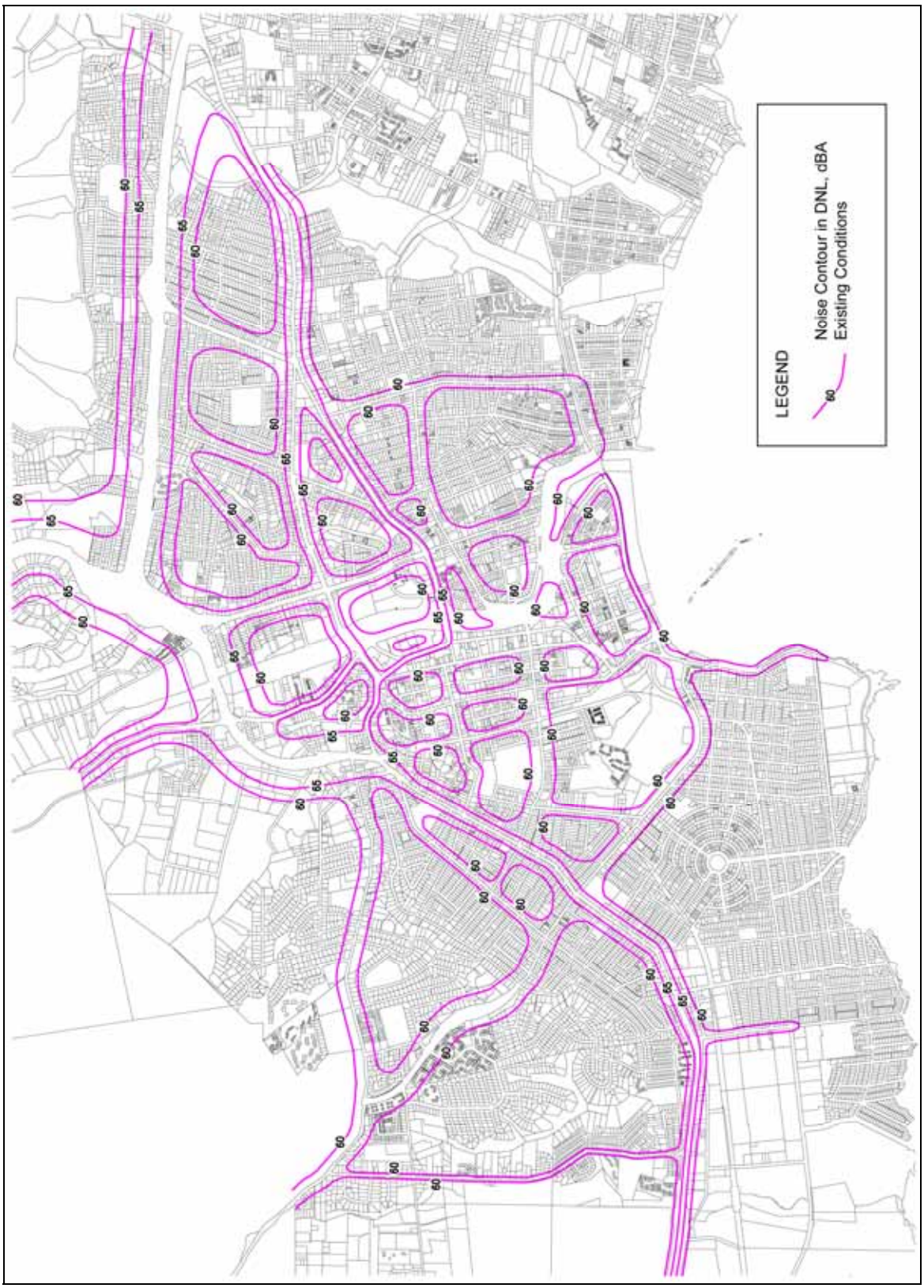
Figure 3: Existing Noise Contours



References

[1] *Negative Declaration and finding of No Significant Impact Route 1/17 Widening for Merge Lanes*, Caltrans, 2002?

[2] *Transit Noise and Vibration Impact Assessment*, Federal Transit Administration, April 1995, Chapter 6.

[3] *Beach Area/South of Laurel Master Plan Program EIR Noise Analysis, Prepared for David J. Powers & Associates*, Harold S. Goldberg, P.E., Charles M. Salter Associates, 1998

[4] *Federal Highway Administration's Traffic Noise Model (FWHA TNM) Version 2.5*, US Department of Transportation John A. Volpe National Transportation Systems Center, Acoustics Facility, Feb 2004

[5] *2005aadt.xls, 2005truck.xls*, Caltrans Website http://traffic-counts.dot.ca.gov, 2006

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FUTURE NOISE CONTOURS FOR:

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The traffic noise contours are based on calculations using the Federal Highway Administration's Traffic Noise Model[1] (TNM 2.5). TNM 2.5 calculates the traffic noise level based on input such as traffic volume, truck percentage and travel speeds. The traffic data for the local roads used as input to the TNM 2.5 model is based on the General Plan Buildout traffic data developed as part of the General Plan Update. The traffic data for the freeways is based on counts published by Caltrans[2] and an AMBAG growth rate of 0.38% per year.

The traffic noise contours do not take into account the acoustical shielding provided by buildings or fences along the roadways. However, along the portions of State Route 1 freeway, the effects of recently constructed soundwalls are included. The soundwall locations are based on the environmental document for the freeway widening project[1]. The soundwalls are assumed to reduce the noise levels by 5 dBA.

The future noise contours are shown in tabular form in Tables 1 and 2. These tables also show the increase in traffic noise levels between the existing and future conditions.

1: Future Noise Contours and Increase in Noise

Roadway Segment	Existing Condition	Future Condition				
	L_{dn} at 50 ft from Center of Roadway (dBA)	L_{dn} at 50 ft from Center of Roadway (dBA)	Increase in L_{dn} (dBA)	L_{dn} Contour Distances (feet)		
				60 dBA	65 dBA	70 dBA
Bay St. (Bay Dr.)						
-High to Nobel-Iowa	67	67	0.1	240	85	--
-Nobel-Iowa to Escalona	67	67	0.4	260	95	--
-Escalona to King	67	67	0.4	260	90	--
-King to Mission	65	67	1.5	240	85	--
-Mission to California St	65	65	0.2	160	50	--
-California St to California Ave	66	67	0.9	240	85	--
-California Ave to West Cliff	65	66	0.9	200	70	--
Branciforte						
-Goss to Water	64	65	1.0	160	50	--
-Water to Soquel	64	65	0.8	160	50	--
-Soquel to Broadway	61	62	0.8	90	--	--
California St						
-Laurel to Bay	63	63	0.4	110	--	--
Front						
-Mission/Water to Cooper of	63	65	1.5	160	50	--
-Soquel to Cathcart	66	67	1.3	260	90	--
-Cathcart to Metro Center	65	66	1.2	220	70	--
-Metro Center to Laurel	65	66	1.2	200	70	--
Center						
-Mission to Laurel	63	64	0.7	140	--	--
-Laurel to Pacific	60	60	0.7	55	--	--
Seabright						
-Water to Soquel	60	60	-0.4	50	--	--
-Soquel to Broadway	63	64	0.7	140	--	--
-Broadway to Murray	63	64	0.8	130	--	--
Ocean						
-Ocean/Plymouth to Kennan/Washburn	68	70	1.4	320	160	50
-Kennan/Washburn to Water	69	71	1.3	360	190	60
-Water to Soquel	68	69	1.3	320	150	--
-Soquel to Broadway	66	68	1.8	280	120	--
-Broadway to San Lorenzo/East Cliff	65	66	1.4	220	70	--
Riverside						
-San Lorenzo to Third	66	67	1.1	240	85	--

Roadway Segment	Existing Condition	Future Condition				
	L_{dn} at 50 ft from Center of Roadway (dBA)	L_{dn} at 50 ft from Center of Roadway (dBA)	Increase in L_{dn} (dBA)	L_{dn} Contour Distances (feet)		
				60 dBA	65 dBA	70 dBA
Riverside						
-Third to Second	62	63	0.7	100	--	--
Chestnut						
-Laurel to Mission	62	63	0.9	110	--	--
River						
-Encinal to Fern	66	69	2.6	300	140	--
-Fern to Rte 1	67	70	2.6	340	170	50
-Rte 1 to Potrero	66	68	2.1	280	120	--
-Potrero to N Pacific River	65	68	2.6	260	110	--
-N Pacific River to Water	64	67	2.3	240	75	--
-Water to Soquel	64	65	1.1	180	55	--
Pacific						
Mission to Laurel	60	62	1.5	80	--	--
-Laurel to Center	59	60	0.8	50	--	--
-Center to Beach	64	65	1.0	160	50	--
Market						
-Isbel-Goss to Water	62	64	1.5	140	--	--
High						
-Western to Bay	65	66	0.2	190	60	--
-Bay to Moore	66	66	0.3	200	70	--
-Moore to Laurent	66	66	0.3	200	70	--
Mission/Water						
-Shaffer to Western	65	65	0.4	180	55	--
-Western to Swift	65	66	0.9	200	70	--
-Swift to Miramar	67	69	2.0	320	150	--
-Miramar to Younglove	67	70	2.4	340	170	50
-Younglove to Bay	68	70	2.2	340	180	60
-Bay to Laurel	69	71	2.8	400	240	75
-Laurel to Walnut	68	71	2.9	360	190	60
-Walnut to King-Union	68	71	2.3	360	190	60
-King-Union to Chestnut-Hwy 1	70	72	1.8	400	240	80
-Chestnut-Hwy 1 to Center	65	67	2.2	260	90	--
-Center to N. Pacific	67	69	1.9	300	130	--
-N.Pacific to River	66	68	2.1	280	120	--
-River to Ocean	68	70	2.1	340	170	50
-Ocean to Market	68	70	1.7	340	180	55
-Market to N.Branciforte	69	70	1.4	340	180	55
-N.Branciforte to Seabright	68	69	1.1	300	130	--
-Seabright to Morrissey	69	70	0.7	320	160	50

Roadway Segment	Existing Condition	Future Condition				
	L_{dn} at 50 ft from Center of Roadway (dBA)	L_{dn} at 50 ft from Center of Roadway (dBA)	Increase in L_{dn} (dBA)	L_{dn} Contour Distances (feet)		
				60 dBA	65 dBA	70 dBA
Walnut/Soquel						
-Mission to Front	63	63	-0.1	120	--	--
-Front to River	65	66	1.3	220	70	--
-River to Riverside-Dakota	66	67	1.4	260	95	--
-Riverside-Dakota to Ocean	66	67	1.3	260	95	--
-Ocean to Branciforte	66	68	1.6	260	100	--
-Branciforte to Seabright	67	68	1.0	260	100	--
-Seabright to Morrissey	69	69	0.7	320	150	--
-Morrissey to Frederick	69	70	1.0	340	180	55
Frederick to Trevthan-Hagemann	70	71	1.0	360	190	60
Trevthan-Hagemann to Park	70	70	0.8	340	180	60
-Park to Capitola	69	70	0.8	340	180	55
-Capitola to La Fonda	66	67	0.5	240	85	--
Laurel/Broadway						
-King to Mission	60	62	1.8	90	--	--
-Mission to California	67	67	0.0	240	75	--
-California to Chestnut	66	68	1.5	260	110	--
-Chestnut to Center	66	68	1.5	260	100	--
-Center to Cedar	66	68	1.6	260	110	--
-Cedar to Pacific	66	68	1.3	260	110	--
-Pacific to Front	67	68	1.3	260	110	--
-Front to San Lorenzo	67	69	1.3	300	130	--
-San Lorenzo to Ocean	65	67	1.6	240	75	--
-Ocean to S.Branciforte	65	66	1.3	220	70	--
-S.Branciforte to Seabright	65	66	1.0	200	70	--
San Lorenzo/East Cliff/Murray						
-Laurel-Broadway to Riverside	64	65	0.9	160	50	--
-Riverside to Ocean	66	68	1.1	260	100	--
-Ocean to Seabright	67	68	0.6	260	100	--
West Cliff/Beach						
Swanton to Bay	62	63	0.3	100	--	--
-Bay to Pacific	64	65	0.8	160	50	--
-Pacific to Cliff	60	61	1.2	70	--	--
-Cliff to Riverside	59	61	1.9	70	--	--
King/Union						
-Bay to Laurel	63	63	0.6	120	--	--
-Laurel to Storey	62	63	0.8	120	--	--
-Storey to Mission	64	65	1.1	180	55	--

Roadway Segment	Existing Condition	Future Condition				
	L_{dn} at 50 ft from Center of Roadway (dBA)	L_{dn} at 50 ft from Center of Roadway (dBA)	Increase in L_{dn} (dBA)	L_{dn} Contour Distances (feet)		
				60 dBA	65 dBA	70 dBA
Western						
-High to Hwy1	60	62	1.3	80	--	--
Swift						
-Mission to Delaware	62	65	3.0	180	55	--
Morrissey						
-Fairmount to Soquel	66	67	0.5	240	85	--
Third Street						
Front to Riverside	64	64	0.3	140	--	--
Riverside to Beach	63	64	1.2	150	--	--
Seventh						
- Soquel to Capitola		64	NA	130	--	--
- Capitola to Brommer		65	NA	160	50	--
- Brommer to Eaton		65	NA	160	50	--
- Eaton to Cliff		65	NA	180	55	--

Table 1: Future Noise Contours and Increase in Noise - Freeways

Roadway Segment	Existing Condition	Future Condition				
	L_{dn} at 100 ft from Center of Roadway (dBA)	L_{dn} at 100 ft from Center of Roadway (dBA)	Increase in L_{dn} (dBA)	L_{dn} Contour Distances (feet)		
				60 dBA	65 dBA	70 dBA
Hwy 1						
-Soquel to Morrissey	79	80	0.4	1050	650	400
-Morrissey to Emeline	74	75	0.4	650	400	240
-Emeline to Hwy 17	74	75	0.4	650	400	240
-Hwy 17 to Hwy 9	77	77	0.4	850	550	320
-Hwy 9 to Mission	76	76	0.4	750	480	300
Hwy 17						
-Begin Freeway to Pasatiempo	78	78	0.4	900	550	340

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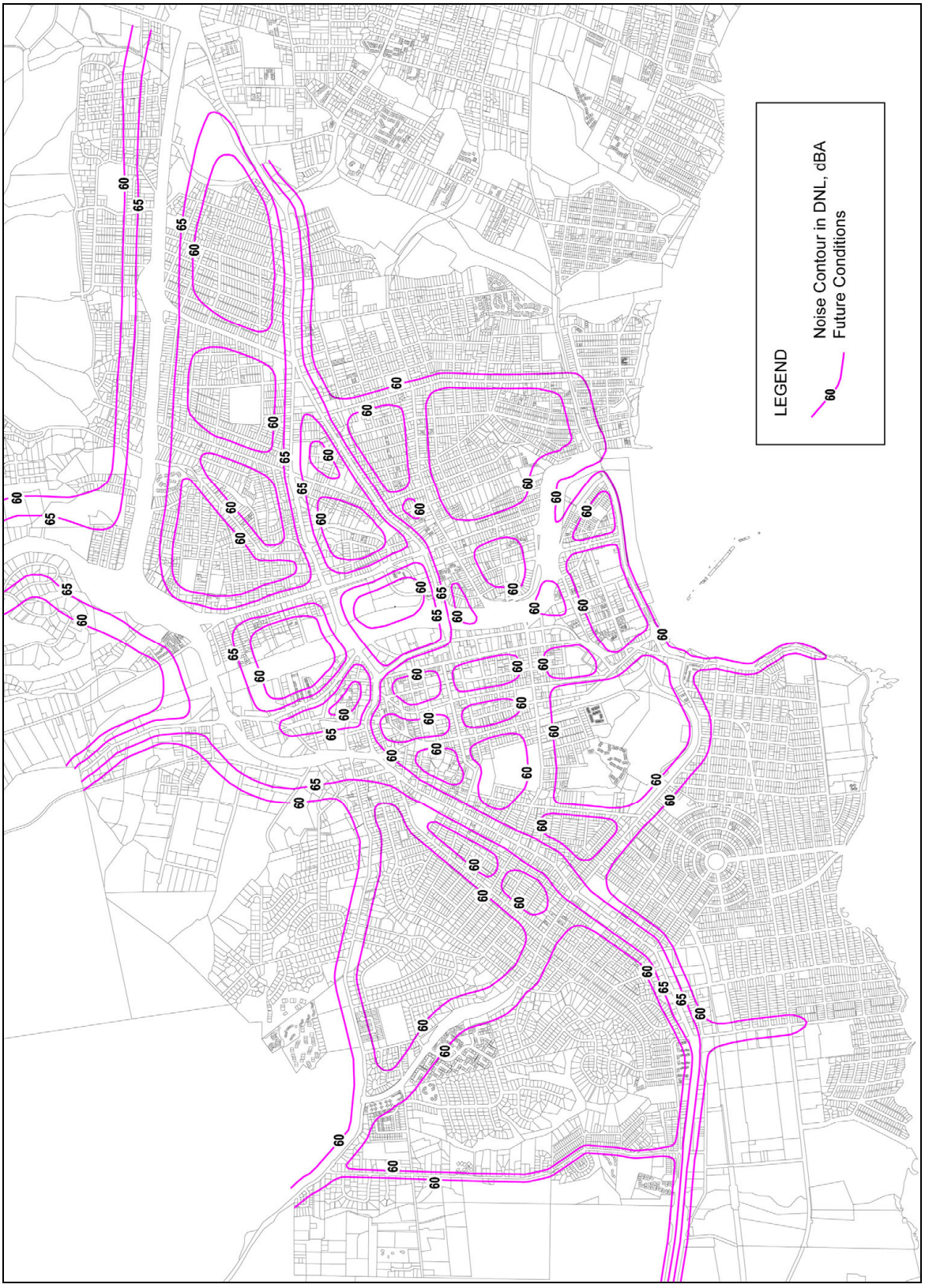
Figure 1: Future Noise Contours



[1] *Federal Highway Administration's Traffic Noise Model (FWHA TNM) Version 2.5*, US Department of Transportation John A. Volpe National Transportation Systems Center, Acoustics Facility, Feb 2004

[2] *2005aadt.xls, 2005truck.xls*, Caltrans Website http://traffic-counts.dot.ca.gov, 2006