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August 24, 2021
Project No. 51-023-1

Mr. Jessie Bristow
Barry Swenson Builder
740 Front Street
Suite 315
Santa Cruz, CA 95060

Subject: Revised Noise Assessment Study for the Planned Mixed-Use Development, 530 Front Street, Santa Cruz

Dear Mr. Bristow:

This report presents the results of a revised noise assessment study for the planned mixed-use development at 530 FrontStreet in Santa Cruz, as shown on the Site Plan, Ref. (a). The purpose of this revision is to include the addition of two floors of residential living spaces to the original project design analyzed in 2019. This revision is of the original *Noise Assessment Study* from 2019, Ref. (b). The noise exposures presented herein were evaluated against the standards of the City of Santa Cruz Noise Element, Ref. (c), the State of California Code of Regulations, Title 24, Ref. (d) and the CalGreen Non-Residential Mandatory Measures of Title 24, Ref. (e). The analysis of the on-site sound level measurements indicates that the existing noise environment is due primarily to vehicular traffic sources on Front Street and Soquel Avenue. The results of the study indicate that the exterior noise exposures will be within the limits of the standards at the Outdoor Lounge and at the Roof Garden/Deck. The interior noise exposures in project living spaces will exceed the limits of the standards. Noise mitigation measures will be required for the noise impacted interior areas. The interior noise levels in the commercial units will be within the limits of the CalGreen standards. Noise mitigation measures for the commercial spaces will not be required.

Sections I and II of this report contains a summary of our findings and recommendations, respectively. Subsequent sections contain the site, traffic and project descriptions, analyses and evaluations. Attached hereto are Appendices A, B and C, which include the list of references, descriptions of the applicable standards, definitions of the terminology, descriptions of the acoustical instrumentation used for the field survey, ventilation requirements, general building shell controls and the on-site noise measurement data and calculation tables.

I. Summary of Findings

A. Noise Standards

City of Santa Cruz Noise Element

The noise assessment results presented in the findings were evaluated against the standards of the City of Santa Cruz Noise Element, which utilize the Day-Night Level (DNL) descriptor. The Noise Element standards specify an exterior limit of 65 decibels (dB) DNL for multi-family exterior spaces. The noise standards are typically not applied to small, limited use areas such as balconies. The exterior noise standard will be applied to the Outdoor Lounge, Public Terrace and the Roof Garden/Deck areas of this project. The interior noise exposures are limited to 45 dB DNL or lower.

State of California Title 24

The Title 24 standards also use the DNL descriptor and are applicable to all new multi-family developments. Title 24 specifies an interior noise exposure limit of 45 dB DNL from exterior noise sources.

The Title 24 standards also specify minimum noise insulation ratings for common partitions separating different dwelling units and dwelling units from interior common spaces. The standards specify that common walls and floor/ceiling assemblies must have a design Sound Transmission Class (STC) rating of 50 or higher. In addition, common floor/ceiling assemblies must have a design Impact Insulation Class (IIC) rating of 50 or higher. As design details for the interior partitions of the project were not available at the time of this study, an evaluation of the interior partitions has not been made.

CalGreen Non-Residential Mandatory Measures

The CalGreen Non-Residential Mandatory Measures, which are part of Title 24, are applied to the commercial units of the project. Section 5.507 "Environmental Comfort" contains two methods for determining the interior noise levels. These methods impose different interior noise level requirements. When on-site noise level data are available, the "Performance Method" is used. The standards are outlined below.

5.507.4 Acoustical control. Employ building assemblies and components with Sound Transmission Class (STC) values determined in accordance with ASTM E90 and ASTM E413 or Outdoor-Indoor Sound Transmission Class (OITC) determined in accordance with ASTM E1332, using either the prescriptive or performance method in Section 5.507.4.1 or 5.507.4.2.

5.507.4 Exterior noise transmission. Wall and roof-ceiling assemblies exposed to the noise source making up the building or addition envelope or altered envelope shall meet a composite STC rating of at least 50 or a composite OITC rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 in the following locations:

Within the 65 CNEL noise contour of an airport

Exceptions:

1. L_{dn} or CNEL for military airports shall be determined by the facility Air Installation Compatible Land Use Zone (AICUZ) plan.

2. L_{dn} or CNEL for other airports and heliports for which a land use plan that has not been developed shall be determined by the local general plan noise element.

3. Within the 65 CNEL or Ldn noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway notice source as determined by the Noise Element of the General Plan.

5.507.4.1.1 Noise exposure where noise contours are not readily available. Buildings exposed to a noise level of 65 dB L_{eq}-1-hr during any hour of operation shall have building, addition or alteration exterior wall and roof-ceiling assemblies exposed to the noise source meeting a composite STC rating of at least 45 (or OITC 35), with exterior windows of a minimum STC of 40 (or OITC 30).

5.507.4.2 Performance method. For buildings located as defined in Section 5.507.4.1 or 5.507.4.1.1, wall and roof-ceiling assemblies exposed to the noise source making up the building or addition envelope or altered envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level (Leq-1Hr) of 50 dBA in occupied areas during any hours of operations

5.507.4.2.1 Site features. Exterior features such as sound walls or earth berms may be utilized as appropriate to the building, addition or alteration project to mitigate sound migration to the interior.

5.507.4.2.2 Documentation of compliance. An acoustical analysis documenting complying interior sound levels shall be prepared by personnel approved by the architect or engineer of record.

5.507.4.3 Interior sound transmission. Wall and floor-ceiling assemblies separating tenant spaces and tenant spaces and public places shall have an STC of at least 40.

As noise level data for the site are available, the Performance Method of the CalGreen standards is used in this study. The interior noise level limit for non-residential spaces is an hourly average noise level ($L_{eq(h)}$) of 50 dBA.

The noise exposures shown below include the effects of solid railings at the Outdoor Lounge and solid railings/parapet at the Roof Garden/Deck areas and represent the noise environment for existing and project site conditions.

A. <u>Exterior Noise Exposures</u>

- The existing exterior noise exposure at the most impacted residential building setback from Front Street (34 ft. from the centerline) is 68 dB DNL. Under future traffic conditions, the noise exposure is expected to increase to 70 dB DNL.

- The existing exterior noise exposures in the most impacted planned building setback from Soquel Avenue (74 ft. from the centerline) is 67 dB DNL. Under future traffic conditions, the noise exposure is expected to increase to 69 dB DNL.

- The existing exterior noise exposure in the most impacted second floor Outdoor Lounge and Public Terrace will be up to 62 dB DNL. Under future traffic conditions, the noise exposure is expected to increase to 64 dB DNL. Thus, the noise exposures will be within the 65 dB DNL limit of the City of Santa Cruz Noise Element standards.

- The existing exterior noise exposure in the most impacted eighth floor Roof Garden/Deck will be up to 54 dB DNL. Under future traffic conditions, the noise exposure is expected to increase to 56 dB DNL. Thus, the noise exposures will be within the 65 dB DNL limit of the City of Santa Cruz Noise Element standards.

The exterior noise exposures in the outdoor living areas will be within the limits of the City of Santa Cruz Noise Element standards. Noise mitigation measures will not be required.

B. Exterior Noise Levels (CalGreen)

- The existing hourly average exterior noise levels at the most impacted commercial unit setback from Front Street (34 ft. from the centerline) range from 53 to 68 dBA $L_{eq(h)}$. Under future traffic conditions, the noise levels are expected to increase to 55 to 70 dBA $L_{eq(h)}$.

- The existing hourly average exterior noise levels at the most impacted commercial/restaurant setback from Soquel Avenue (55 ft. from the centerline) range from 53 to 70 dBA $L_{eq(h)}$. Under future traffic conditions, the noise levels are expected to increase to 55 to 72 dBA $L_{eq(h)}$.

C. Interior Noise Exposures

- The interior noise exposures in the most impacted living spaces closest to Front Street will be up to 53 and 55 dB DNL under existing and future traffic conditions, respectively. Thus, the noise exposures will be up to 10 dB in excess of the City of Santa Cruz Noise Element and Title 24 standards.

- The interior noise exposures in the most impacted living spaces closest to Soquel Avenue will be up to 52 and 54 dB DNL under existing and future traffic conditions, respectively. Thus, the noise exposures will be up to 9 dB in excess of the City of Santa Cruz Noise Element and Title 24 standards.

D. Interior Noise Levels (CalGreen)

- The interior noise levels in the most impacted commercial spaces closest to Front Street will range from 28 to 43 dBA $L_{eq(h)}$ under existing traffic conditions. Under future traffic conditions, the noise levels are expected to increase to 30 to 45 dBA $L_{eq(h)}$. Thus, the noise levels will be within the 50 dBA $L_{eq(h)}$ limit of the CalGreen Non-Residential Mandatory Measures.

- The interior noise levels in the most impacted commercial spaces closest to Soquel Avenue will range from 28 to 45 dBA $L_{eq(h)}$ under existing traffic conditions. Under future traffic conditions, the noise levels are expected to increase to 30 to 47 dBA $L_{eq(h)}$. Thus, the noise levels will be within the 50 dBA $L_{eq(h)}$ limit of the CalGreen Non-Residential Mandatory Measures.

As shown above, the interior noise exposures in project living spaces will exceed the limits of the standards and noise mitigation measures will be required. The interior noise levels in the commercial (non-residential) spaces will be within the limits of the CalGreen Non-Residential Mandatory Measures. Noise mitigation measures will not be required for the commercial spaces. The recommended measures are provided in Section II of this report.

II. Recommendations

A. Interior Noise Controls

To achieve compliance with the 45 dB DNL limits of the City of Santa Cruz Noise Element and Title 24 standards, the following window controls will be required.

- Maintain closed at all times all windows and glass doors of living spaces of the project within 130 ft. of the centerline of FrontStreet and with a direct or side view of the road or within 220 ft. of the centerline of Soquel Avenue and with a direct or side view of the roadway.

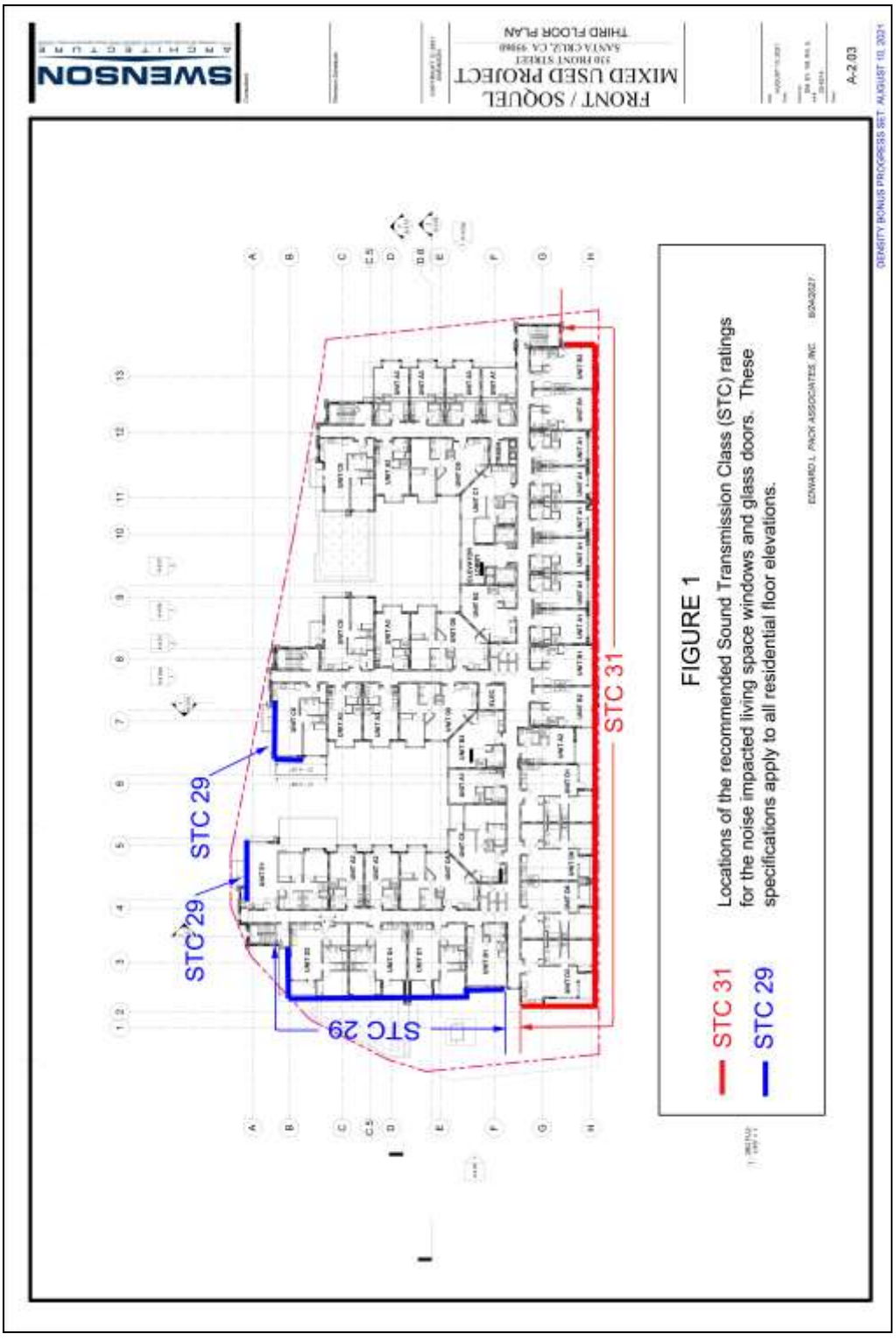
- Install windows and glass doors rated minimum Sound Transmission Class (STC) 31 at living spaces within 70 ft. of the centerline of Front Street. Install windows and glass doors rating minimum STC 29 at the remaining living spaces where the windows and glass doors are specified to be maintained closed.

- Provide some type of mechanical ventilation for all living spaces with a closed window or glass door condition.

- Please see Figure 1 for the locations of the noise impacted facades and the window and glass door STC ratings.

All other windows and glass doors of the project and all bathroom windows may have any type of glazing and may be kept opened as desired unless the bathroom is an integral part of a living space without a closeable door such as in a master bedroom suite.

When windows and glass doors are maintained closed for noise control, some type of mechanical ventilation to assure a habitable environment must be provided. The windows specified to be maintained closed are to be operable, as the requirement does not imply a “fixed” condition.


SWENSON
FRONT / SOQUEL
MIXED USED PROJECT
THIRD FLOOR PLAN
A-2.03
DENSITY BONUS PROGRESS SET AUGUST 10, 2021
STC 29
STC 29
STC 29
STC 31
FIGURE 1
Locations of the recommended Sound Transmission Class (STC) ratings for the noise impacted living space windows and glass doors. These specifications apply to all residential floor elevations.
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STC 31
STC 29

The windows and doors shall be installed in an acoustically-effective manner. To achieve an acoustically-effective construction, the operable panels must form an air-tight seal when in the closed position and the window and door frames must be caulked to the wall opening around their entire perimeter with a non-hardening caulking compound to prevent sound infiltration. Exterior doors must seal air-tight around the full perimeter when in the closed position. Spray-in or expandable foams are not acceptable acoustical sealants.

Please be aware that many dual-pane window and glass door assemblies have inherent noise reduction problems in the traffic noise frequency spectrum due to resonance that occurs within the air space between the window lites, and the noise reduction capabilities vary from manufacturer to manufacturer. Therefore, the acoustical test report of all sound rated windows and doors should be reviewed be a qualified acoustician to ensure that the chosen windows and doors will adequately reduce traffic noise to acceptable levels.

The implementation of the above recommended measures will reduce excess noise exposures to achieve compliance with the interior standards of the City of Santa Cruz Noise Element and Title 24.

III. Site, Traffic and Project Descriptions

The planned development site is a 1.06 acre parcel located on the southeast quadrant of the Front Street and Soquel Avenue intersection. The site slopes up slightly from the southwest to the northeast and is at-grade with Front Street. Soquel Avenue slopes up slightly to the east. Surrounding land uses include a CVS Pharmacy across Soquel Avenue to the north, the San Lorenzo River and trail adjacent to the east, More Music adjacent to the south and a public parking lot across Front Street to the west.

The on-site noise environment is controlled primarily by vehicle traffic sources on Front Street and Soquel Avenue. Front Street carries and existing Average Daily Traffic (ADT) of 7,580 vehicles. Soquel Avenue carries an existing ADT of 4,340 vehicles, Ref. (f).

The planned project includes the construction of 276 apartments in 7 levels of residential living on a podium that covers three commercial spaces, the leasing office, parking and storage. There will also be three commercial spaces and a restaurant on the second floor. An outdoor lounge and a public terrace will be located adjacent to the restaurant on the second floor. A roof garden and deck will be on the eighth floor (roof of the 7th floor). Ingress and egress to the project will be by way of a garage entrance off of Front Street. The Site Plan is shown on Figure 2 on page 12.

IV. Analysis of the Noise Levels

A. Existing Noise Levels

To determine the existing noise environment at the site, continuous recordings of the sound levels were made on a Friday through Saturday on May 3-4, 2019 at two locations on the site. Location 1 was 41 ft. from the centerline of Front Street and at elevation of 13 ft. above the ground. Location 2 was 54 ft. from the centerline of Soquel Avenue, also at an elevation of 13 ft. above the ground. These locations were chosen for security of the sound measuring instruments. The noise measurement locations are shown on Figure 3 on page 13.

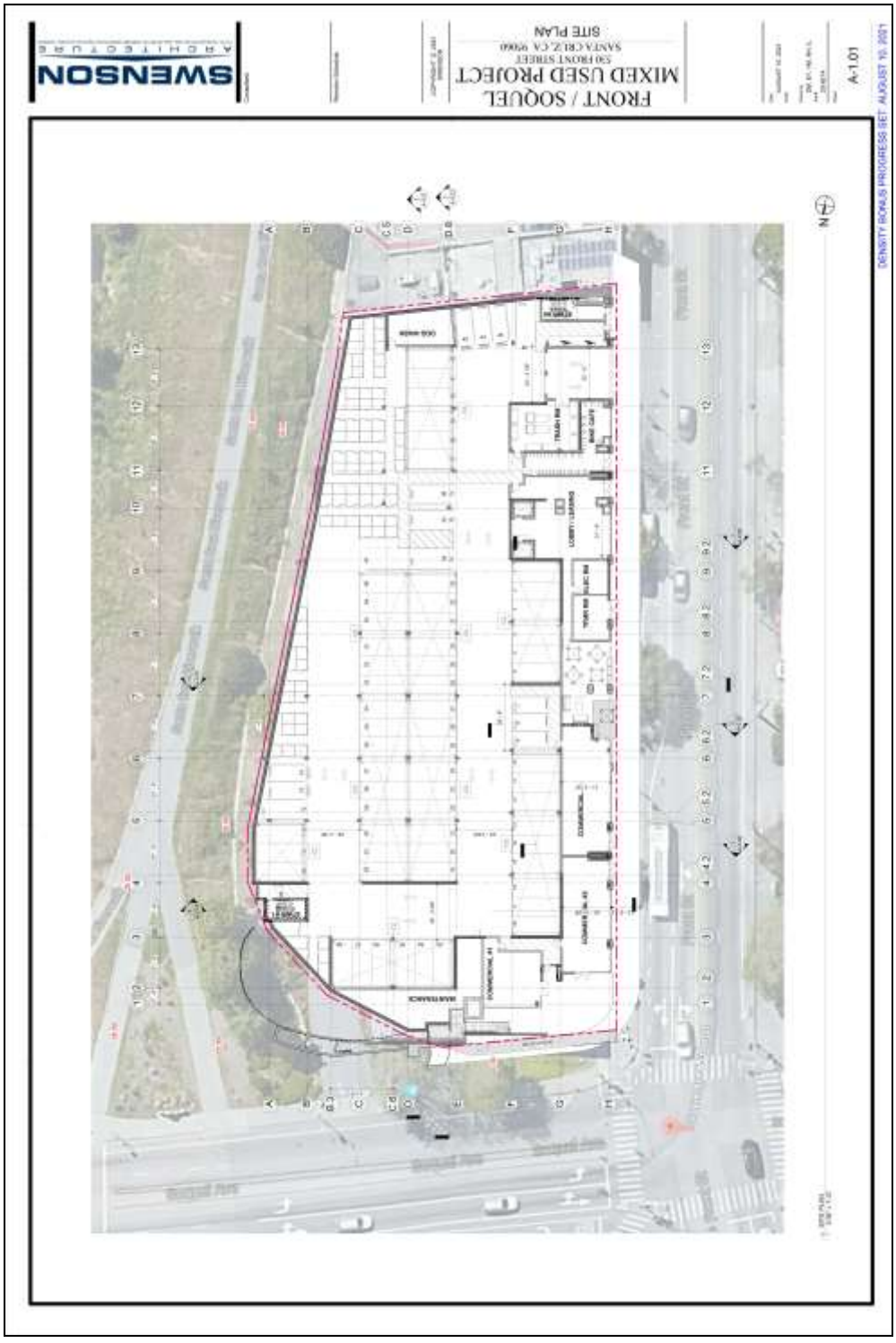


FIGURE 2 – Site Plan

FIGURE 3 – Noise Measurement Locations

The sound levels were recorded and processed using Larson-Davis Model 812 Precision Integrating Sound Level Meters. The meters yield, by direct readout, a series of descriptors of the sound levels versus time, as described in Appendix B. The measured descriptors include the L_1, L_{10}, L_{50}, and L_{90}, i.e., those levels exceeded for 1%, 10%, 50%, and 90% of the time. Also measured were the maximum and minimum levels and the continuous equivalent-energy levels (L_{eq}), which are used to calculate the DNL. The exterior measurements were made for a continuous period of 48 hours and included representative hours of the daytime and nighttime periods of the DNL index. The results of the measurements are shown in the data tables in Appendix C.

As shown in the data tables, the L_{eq}'s on Friday at measurement Location 1, 41 ft. from the centerline of Front Street, ranged from 63.0 to 67.2 dBA during the daytime and from 52.0 to 63.0 dBA at night. On Saturday, the L_{eq}'s ranged from 62.6 to 66.5 dBA during the daytime and from 52.0 to 62.1 dBA at night.

At measurement Location 2, 54 ft. from the centerline of Soquel Avenue, the L_{eq}'s ranged from 63.4 to 67.0 dBA during the daytime and from 51.9 to 69.2 dBA at night. On Saturday, the L_{eq}'s ranged from 60.2 to 68.3 dBA during the daytime and from 49.3 to 69.3 dBA at night.

Vehicular traffic noise dissipates at the rate of 3 to 6 dB for each doubling of distance from the source and contains a wide spectrum of frequency components (from 100 to 10,000 Hz), which are associated with engine, tire, drive-train, exhaust and other sources. These frequency components are centered primarily in the 250 and 500 Hz octave bands. Additional acoustical shielding will be provided by interposed portions of the building.

B. Future Noise Levels

Future traffic volume projections for Front Street and Soquel Avenue were provided by the project traffic consultant, Ref. (f). The future General Plan buildout + project traffic volume for Front Street is expected to increase from the existing 7,580 vehicles ADT to 12,500 vehicles ADT. This increase in traffic volume yields a 2 dB increase in the traffic noise levels. The future traffic volume for Soquel Avenue is expected to increase from the existing 4,340 vehicles ADT to 7,150 vehicles ADT. This increase in traffic volume also yields a 2 dB increase in the traffic noise levels.

V. Evaluations of the Noise Exposures

A. Exterior Noise Exposures

To evaluate the on-site noise exposures against the City of Santa Cruz standards, the DNL for the survey location was calculated by decibel averaging of the L_{eq}'s as they apply to the daily time periods of the DNL index. The DNL is a 24-hour noise descriptor that uses the measured L_{eq} values to calculate a 24-hour time-weighted average noise exposure. Adjustments were made to the measured noise levels to account for variations in setback distances from the measurement locations using methods established by the Highway Research Board, Ref. (g). The formula used to calculate the DNL is described in Appendix B. The on-site noise measurement data and calculation tables are provided in Appendix C.

The results of the calculations indicate that the exterior noise exposures at measurement Location 1, 41 ft. from the centerline of Front Street, were 67 dB DNL on Friday (weekday) and 66 dB DNL on Saturday.

At the planned minimum setback of the building from Front Street, 34 ft. from the centerline of the road, the noise exposures were calculated to be 68 dB DNL on Friday and 67 dB DNL on Saturday. Under future traffic conditions, the noise exposures are expected to increase to 70 dB DNL on Friday (weekdays) and to 69 dB DNL on Saturdays.

The exterior noise exposures at measurement Location 2, 54 ft. from the centerline of Soquel Avenue, were calculated to be 69 dB DNL on both Friday (weekdays) and Saturday.

At the planned Outdoor Lounge and Public Terrace, 49 ft. from the centerline of Soquel Avenue, the existing noise exposures were calculated to be 62 dB DNL on both Fridays (weekdays) and Saturdays. Under future traffic conditions, the noise exposures are expected to increase to 64 dB DNL on Fridays (weekdays) and Saturdays. These noise exposures include a 7 dB reduction factor due to the acoustical shielding provided by 42" high solid railings at the edges of the lounge and terrace areas. Thus, the noise exposures in the Outdoor Lounge area will be within the 65 dB DNL limit of the City of Santa Cruz Noise Element standard.

The existing noise exposures in the most noise impacted areas of the planned Roof Garden/Deck, 88 ft. from the centerline of Soquel Avenue, were calculated to be up to 54 dB DNL on Friday (weekdays) and on Saturdays. Under future traffic conditions, the noise exposures are expected to increase up to 56 dB DNL on both Fridays (weekdays) and Saturdays. These noise exposures include a 13 dB reduction factor for the 4 ft. high parapet wall along the northerly edge of the roof. The Roof Garden will be setback approximately 12 ft. from the parapet wall. Thus, the noise exposures on the Roof Garden and Deck will be within the 65 dB DNL limit of the City of Santa Cruz Noise Element standard.

As the noise exposures in the exterior common areas will be within the 65 dB DNL limit of the City of Santa Cruz Noise Element standards, noise mitigation measures for the exterior areas will not be required.

B. Interior Noise Exposures

To evaluate the interior noise exposures in project living spaces against the standards of the City of Santa Cruz Noise Element and Title 24, a 15 dB reduction was applied to the exterior noise exposures at the building setbacks to represent the attenuation provided by the building shell under an *annual-average* condition. The annual-average condition assumes that windows have standard dual-pane thermal insulating glass that are kept open up to 50% of the time for natural ventilation.

The interior noise exposures in the most impacted living spaces closest to Front Street will be up to 53 and 55 dB DNL under existing and future traffic conditions, respectively. Thus, the noise exposures will be up to 10 dB in excess of the City of Santa Cruz Noise Element and Title 24 standards.

The interior noise exposures in the most impacted living spaces closest to Soquel Avenue will be up to 52 and 54 dB DNL under existing and future traffic conditions, respectively. Thus, the noise exposures will be up to 9 dB in excess of the City of Santa Cruz Noise Element and Title 24 standards.

The interior noise exposures will exceed the limits of the standards. Therefore, noise mitigation measures will be required. The recommended measures are described in Section II of this report.

C. Exterior and Interior Noise Levels

To evaluate the interior noise exposures in project living spaces against the CalGreen Non-Residential Mandatory Measures, a 25 dB reduction was applied to the exterior hourly average noise levels at the commercial unit setbacks to represent the attenuation provided by a standard commercial building shell.

Table I on page 18 provides the exterior hourly average noise levels at the measurement locations 41 ft. from the centerline of Front Street and at 54 ft. from the centerline of Soquel Avenue, the future hourly average noise levels at the setbacks of the commercial units 34 ft. from the centerline of Front Street and 55 ft. from the centerline of Soquel Avenue and the interior hourly average noise levels in the commercial spaces under future traffic conditions. As shown, the interior hourly average noise levels shown in the third column will be within the 50 dBA $L_{eq(h)}$ limit of the CalGreen Non-Residential Mandatory Measures. Noise mitigation measures for the commercial units will not be required.

TABLE I			
CalGreen Noise Levels, dBA Leq(h)			
Dist. To Source	41	34	34
Front Street	Exterior @ Meas. Loc.	Exterior @ SB	Interior @ SB
TIME	Measured (Exist)	Calculated (Fut)	Calculated (Fut)
7:00 AM	67.2	70.4	45.4
8:00 AM	64.8	68.0	43.0
9:00 AM	66.5	69.7	44.7
10:00 AM	65.5	68.7	43.7
11:00 AM	65.6	68.8	43.8
12:00 PM	66.0	69.2	44.2
1:00 PM	64.8	68.0	43.0
2:00 PM	64.8	68.0	43.0
3:00 PM	66.4	69.6	44.6
4:00 PM	66.5	69.7	44.7
5:00 PM	64.5	67.7	42.7
6:00 PM	64.5	67.7	42.7
7:00 PM	64.4	67.6	42.6
8:00 PM	63.0	66.2	41.2
9:00 PM	63.0	66.2	41.2
10:00 PM	63.0	66.2	41.2
11:00 PM	62.2	65.4	40.4
12:00 AM	59.0	62.2	37.2
1:00 AM	56.2	59.4	34.4
2:00 AM	52.1	55.3	30.3
3:00 AM	52.0	55.2	30.2
4:00 AM	53.1	56.3	31.3
5:00 AM	60.8	64.0	39.0
6:00 AM	62.4	65.6	40.6
Dist. To Source	54	55	55
Soquel Ave.	Exterior @ Meas. Loc.	Exterior @ SB	Interior @ SB
TIME	Measured (Exist)	Calculated (Fut)	Calculated (Fut)
7:00 AM	65.6	68.8	43.8
8:00 AM	64.2	67.4	42.4
9:00 AM	64.5	67.7	42.7
10:00 AM	64.7	67.9	42.9
11:00 AM	65.8	69.0	44.0
12:00 PM	65.3	68.5	43.5
1:00 PM	66.6	69.8	44.8
2:00 PM	64.8	68.0	43.0
3:00 PM	65.4	68.6	43.6
4:00 PM	64.5	67.7	42.7
5:00 PM	65.7	68.9	43.9
6:00 PM	65.1	68.3	43.3
7:00 PM	64.1	67.3	42.3
8:00 PM	63.4	66.6	41.6
9:00 PM	67.0	70.2	45.2
10:00 PM	69.2	72.4	47.4
11:00 PM	63.7	66.9	41.9
12:00 AM	58.2	61.4	36.4
1:00 AM	58.5	61.7	36.7
2:00 AM	56.0	59.2	34.2
3:00 AM	51.9	55.1	30.1
4:00 AM	52.9	56.1	31.1
5:00 AM	58.4	61.6	36.6
6:00 AM	62.2	65.4	40.4

This report presents the results of a revised noise assessment study for the planned mixed-use development at 530 Front Street in Santa Cruz. The study findings for present conditions are based on field measurements and other data and are correct to the best of our knowledge. Future noise level predictions and the recommendations were based on information provided by the consulting traffic engineer. However, significant changes in the future traffic volumes, speed limits, motor vehicle technology, noise regulations, or other changes beyond our control may produce long range noise results different from our estimates. If you have any questions or would like an elaboration on this report, please call me.

Sincerely,

EDWARD L. PACK ASSOC., INC.

Jeffrey K. Pack
President

Attachment: Appendices A, B and C

APPENDIX A

References

(a) Site Plan, Front/Soquel Mixed Use Project, by Barry Swenson Builder, August 10, 2021

(b) "Noise Assessment Study for the Planned Mixed-Use Development, 530 Front Street, Santa Cruz", by Edward L. Pack Associates, Inc., Project No. 51-023, June 4, 2019

(c) City of Santa General Plan 2030, Chapter 8, "Hazards, Safety and Noise", Adopted, June 26, 2012

(d) California Code of Regulations, Title 24, Part 2, Volume 1, Section 1206 "Sound Transmission", Subsection 1206.4 (Allowable Interior Noise Levels), Revised 2019

(e) California Code of Regulations, Title 24, Chapter 5, Section 5.507 "Environmental Comfort", Subsection 5.507.4.2 (Exterior Noise Transmission, Performance Method), Revised 2013

(f) Information on Existing and Future Traffic Volumes Provided by Mr. Jonathan Wong, Hexagon Transportation Consultants, by email to Edward L. Pack Associates, Inc., May 31, 2019

(g) Highway Research Board, "Highway Noise – A Design Guide for Highway Engineers", Report 117, 1971

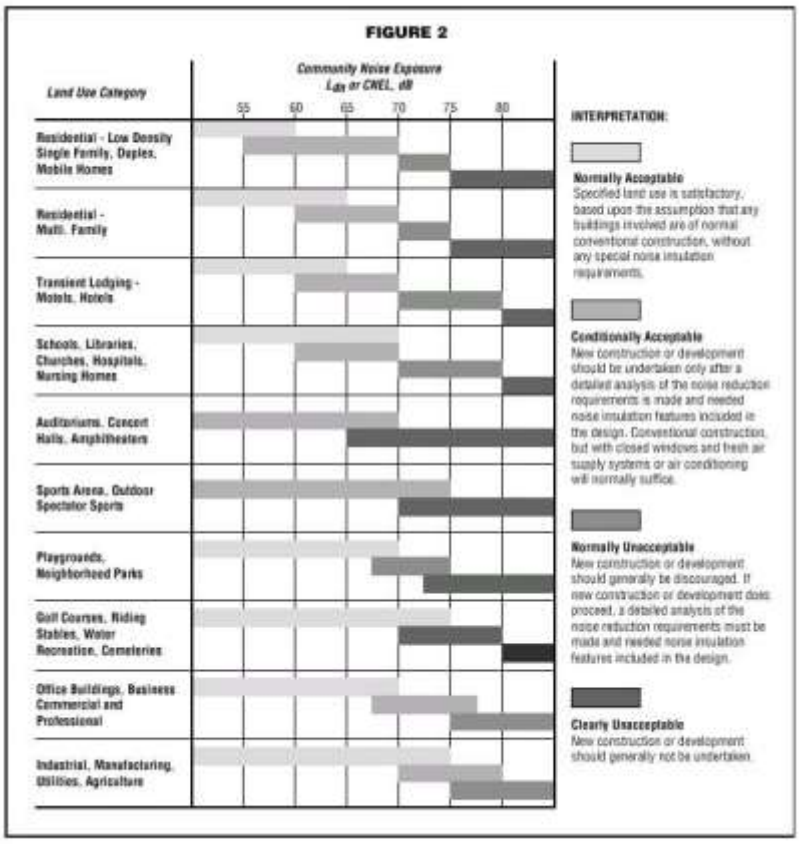
APPENDIX B

Noise Standards, Terminology, Instrumentation, and Building Shell Controls

1. Noise Standards

A. City of Santa Cruz Noise Element Standards

The City of Santa Cruz General Plan 2030, adopted June 26, 2012, references the Land Use Compatibility chart of the State of California General Plan Guidelines. The Noise Element provides a series of noise goals for various occupancies and uses. The noise exposures are in terms of dB Day-Night Level (DNL or L_{dn}).



Goal HZ3 Noise levels compatible with occupancy and use

HZ3.1 Maintain or reduce existing noise levels and control excessive noise.

HZ3.1.1 Require land uses to operate at noise levels that do not significantly increase surrounding ambient noise.

HZ3.1.2 Use site planning and design approaches to minimize noise impacts from new development on surrounding land uses.

HZ3.1.3 Ensure that construction activities are managed to minimize overall noise impacts on surrounding land uses.

HZ3.1.4 Minimize the impacts of intermittent urban noise on residents.

HZ3.1.5 Develop a system to monitor construction noise impacts on surrounding land uses.

HZ3.1.6 Require evaluation of noise mitigation measures for projects that would substantially increase noise.

HZ3.1.7 Protect residential areas from excessive noise from traffic and from road projects.

HZ3.1.8 Require environmental review and mitigation of roadway projects that may significantly increase the average day/night noise levels.

HZ3.1.9 Limit truck traffic in residential and commercial areas to designated truck routes.

HZ3.1.10 Where noise reduction would be beneficial, consider installing quiet pavement surfaces as part of repaving projects.

HZ3.1.11 Require soundwalls, earth berms, setbacks, and other noise reduction techniques for new development when appropriate and necessary as conditions of approval.

HZ3.2 Ensure that noise standards are met in the siting of noise-sensitive uses.

HZ3.2.1 Apply noise and land use compatibility table and standards to all new residential, commercial, and mixed-use proposals, including condominium conversions, in accordance with standards set forth in the Land Use-Noise Compatibility Standards Figure 2.

HZ3.2.2 Establish DNL noise level targets of 65 dB for outdoor activity areas in new multifamily residential developments.

HZ3.2.3 Require that interior noise in all new multifamily housing not exceed a DNL of 45 dB with the windows and doors closed (State of California Noise Insulation Standards) and extend the requirement to single-family homes.

B. Title 24 Noise Standards

2019 California Building Code, Volume 1, Part 2
SECTION 1206 – SOUND TRANSMISSION

1206.1 Scope. This section shall apply to common interior walls, partitions and floor/ceiling assemblies between adjacent dwelling units and sleeping units or between dwelling units and sleeping units and adjacent public areas such as halls, corridors, stairways or service areas.

1206.2 Air-borne sound. Walls, partitions and floor/ceiling assemblies separating dwelling units and sleeping units from each other or from public or service areas shall have a sound transmission class of not less than 50, or not less than 45 if field tested, for air-borne noise when tested in accordance to ASTM E-90. Alternatively, the sound transmission class of walls, partitions and floor-ceiling assemblies shall be established by engineering analysis based on a comparison of walls, partitions and floor-ceiling assemblies having sound transmission class ratings as determined by the test procedures in ASTM E90. Penetrations or openings in construction assemblies for piping; electrical devices; recessed cabinets; bathtubs; soffits; or heating, ventilating or exhaust ducts shall be sealed lined, insulated or otherwise treated to maintain the required ratings. The requirement shall not apply to entrance doors; however, such doors shall be tight fitting to the frame and sill.

1206.3 Structure-borne sound. Floor/ceiling assemblies between dwelling units and sleeping units or between a dwelling unit or sleeping unit and a public or service area with the structure shall have an impact insulation class rating of not less than 50, or not less than 45 if field tested, when tested in accordance with ASTM E-492. Alternatively, the impact insulation class of floor-ceiling assemblies shall be established by engineering analysis based on a comparison of floor-ceiling assemblies having impact insulation class ratings as determined by the test procedures in ASTM E492.

Exception: *Impact sound insulation is not required for floor/ceiling assemblies over non-habitable rooms or spaces not designed to be occupied, such as garages, mechanical rooms or storage areas.*

1206.4 Allowable interior noise levels. *Interior noise levels attributable to exterior sources shall not exceed 45 dB in any habitable room. The noise metric shall be either the day-night average sound level (Ldn) or the community noise equivalent level (CNEL), consistent with the noise element of the local general plan.*

1206.5 Acoustical control. [BSC-CG] *See California Green Building Standards code, Chapter 5, Division 5.5 for additional sound transmission requirements.*

2. Terminology

A. Statistical Noise Levels

Due to the fluctuating character of urban traffic noise, statistical procedures are needed to provide an adequate description of the environment. A series of statistical descriptors have been developed which represent the noise levels exceeded a given percentage of the time. These descriptors are obtained by direct readout of the sound measuring instruments. Some of the statistical levels used to describe community noise are defined as follows:

L_1 - A noise level exceeded for 1% of the time.

L_{10} - A noise level exceeded for 10% of the time, considered to be an "intrusive" level.

L_{50} - The noise level exceeded 50% of the time representing an "average" sound level.

L_{90} - The noise level exceeded 90 % of the time, designated as a "background" noise level.

L_{eq} - The continuous equivalent-energy level is that level of a steady noise having the same sound energy as a given time-varying noise. The L_{eq} represents the decibel level of the time-averaged value of sound energy or sound pressure squared and is the descriptor used to calculate the DNL and CNEL.

B. Day-Night Level (DNL)

Noise levels utilized in the standards are described in terms of the Day-Night Level (DNL). The DNL rating is determined by the cumulative noise exposures occurring over a 24-hour day in terms of A-Weighted sound energy. The 24-hour day is divided into two subperiods for the DNL index, i.e., the daytime period from 7:00 a.m. to 10:00 p.m. and the nighttime period from 10:00 p.m. to 7:00 a.m. A weighting factor of 10 dBA is applied (added) to the noise levels occurring during the nighttime period to account for the greater sensitivity of people to noise during these hours. The DNL is calculated from the measured L_{eq} in accordance with the following mathematical formula:

$$DNL = \left[[(10\log_{10}(10^{\Sigma Leq(7\text{-}10)})) \times 15] + [((10\log_{10}(10^{\Sigma Leq(10\text{-}7))})+10) \times 9]\right]/24$$

C. A-Weighted Sound Level

The decibel measure of the sound level utilizing the "A" weighted network of a sound level meter is referred to as "dBA". The "A" weighting is the accepted standard weighting system used when noise is measured and recorded for the purpose of determining total noise levels and conducting statistical analyses of the environment so that the output correlates well with the response of the human ear.

3. Instrumentation

The on-site field measurement data were acquired by the use of one of the instruments specified below, which provides a direct readout of the L exceedance statistical levels including the equivalent-energy level (L_{eq}). Input to the instrument was provided by a microphone extended to a height of 5 ft. above the ground on using a tripod or mast. The "A" weighting network and the "Fast" response setting of the instruments were used in conformance with the applicable standards. The instruments conform to American National Standards Institute (ANSI) standard S1.4 for Type I and IEC 61672-1:2002 for Class 1 instruments, respectively. All instrumentation was acoustically calibrated before and after field tests to assure accuracy.

Instruments used for field surveys:
Larson-Davis Model 812 Integrating Sound Level Meter
Larson-Davis 2900 Real Time Analyzer
Bruel & Kjaer Model 2231 Precision Sound Level Meter
Larson-Davis Model 831 Integrating Sound Level Meter

4. Mechanical Ventilation Requirements

California Mechanical Code Chapter 4- Ventilation Air

402.3 Mechanical Ventilation

Where natural ventilation is not permitted by this section or the building code, mechanical ventilation systems shall be designed, constructed, and installed to provide a method of supply air and exhaust air. Mechanical ventilation systems shall include controls, manual or automatic, that enable the fan system to operate wherever the spaces served are occupied. The system shall be designed to maintain minimum outdoor airflow as required by Section 403.0 under any load conditions.

5. Building Shell Controls

The following additional precautionary measures are required to assure the greatest potential for exterior-to-interior noise attenuation by the recommended mitigation measures. These measures apply at those units where closed windows are required:

- Unshielded entry doors having a direct or side orientation toward the primary noise source must be 1-5/8" or 1-3/4" thick, insulated metal or solid-core wood construction with effective weather seals around the full perimeter. Mail slots should not be used in these doors or in the wall of a living space, as a significant noise leakage can occur through them.

- If any penetrations in the building shell are required for vents, piping, conduit, etc., sound leakage around these penetrations can be controlled by sealing all cracks and clearance spaces with a non-hardening caulking compound.

- Ventilation openings shall not compromise the acoustical integrity of the building shell.

- Spray-in or expandable foams are not acceptable as acoustical sealant or as sound absorptive material in walls and ceilings.

APPENDIX C

On-Site Noise Measurement Data and Calculation Tables

DNL CALCULATIONS

CLIENT: BARRY SWENSON BUILDER
FILE: 51-023
PROJECT: FRONT/SOQUEL APARTMENTS
DATE: 5/3-5/2019
SOURCE: FRONT ST., SOQUEL AVE.

LOCATION 1	Front St.			
Dist. To Source	41 ft.			
	Friday			
TIME	Leq	10^Leq/10		
7:00 AM	67.2	5248074.6		
8:00 AM	64.8	3019951.7		
9:00 AM	66.5	4466835.9		
10:00 AM	65.5	3548133.9		
11:00 AM	65.6	3630780.5		
12:00 PM	66.0	3981071.7		
1:00 PM	64.8	3019951.7		
2:00 PM	64.8	3019951.7		
3:00 PM	66.4	4365158.3		
4:00 PM	66.5	4466835.9		
5:00 PM	64.5	2818382.9		
6:00 PM	64.5	2818382.9		
7:00 PM	64.4	2754228.7		
8:00 PM	63.0	1995262.3		
9:00 PM	63.0	1995262.3	SUM=	51148265.3
10:00 PM	63.0	1995262.3	Ld=	77.1
11:00 PM	62.2	1659586.9		
12:00 AM	59.0	794328.2		
1:00 AM	56.2	416869.4		
2:00 AM	52.1	162181.0		
3:00 AM	52.0	158489.3		
4:00 AM	53.1	204173.8		
5:00 AM	60.8	1202264.4		
6:00 AM	62.4	1737800.8	SUM=	8330956.2
			Ln=	69.2
	Daytime Level=	77.1		
	Nighttime Level=	79.2		
	DNL=	**67**		
	24-Hour Leq=	63.9		

LOCATION 1	Front St.			
Dist. To Source	41 ft.			
	Saturday			
TIME	Leq	10^Leq/10		
7:00 AM	60.8	1202264.4		
8:00 AM	64.5	2818382.9		
9:00 AM	64.9	3090295.4		
10:00 AM	64.5	2818382.9		
11:00 AM	65.4	3467368.5		
12:00 PM	64.3	2691534.8		
1:00 PM	64.3	2691534.8		
2:00 PM	66.5	4466835.9		
3:00 PM	64.8	3019951.7		
4:00 PM	64.1	2570395.8		
5:00 PM	64.0	2511886.4		
6:00 PM	64.2	2630268.0		
7:00 PM	63.8	2398832.9		
8:00 PM	62.8	1905460.7		
9:00 PM	62.6	1819700.9	SUM=	40103096.2
10:00 PM	62.1	1621810.1	Ld=	76.0
11:00 PM	61.5	1412537.5		
12:00 AM	59.6	912010.8		
1:00 AM	58.2	660693.4		
2:00 AM	55.5	354813.4		
3:00 AM	53.6	229086.8		
4:00 AM	52.0	158489.3		
5:00 AM	54.9	309029.5		
6:00 AM	58.8	758577.6	SUM=	6417048.5
			Ln=	68.1
	Daytime Level=	76.0		
	Nighttime Level=	78.1		
	DNL=	**66**		
	24-Hour Leq=	62.9		

DNL CALCULATIONS

CLIENT: BARRY SWENSON BUILDER
FILE: 51-023
PROJECT: FRONT/SOQUEL APARTMENTS
DATE: 5/3-5/2019
SOURCE: FRONT ST., SOQUEL AVE.

LOCATION 2	Soquel Ave.			
Dist. To Source	54 ft.			
	Friday			
TIME	Leq	10^Leq/10		
7:00 AM	65.6	3630780.5		
8:00 AM	64.2	2630268.0		
9:00 AM	64.5	2818382.9		
10:00 AM	64.7	2951209.2		
11:00 AM	65.8	3801894.0		
12:00 PM	65.3	3388441.6		
1:00 PM	66.6	4570881.9		
2:00 PM	64.8	3019951.7		
3:00 PM	65.4	3467368.5		
4:00 PM	64.5	2818382.9		
5:00 PM	65.7	3715352.3		
6:00 PM	65.1	3235936.6		
7:00 PM	64.1	2570395.8		
8:00 PM	63.4	2187761.6		
9:00 PM	67.0	5011872.3	SUM=	49818879.9
10:00 PM	69.2	8317637.7	Ld=	77.0
11:00 PM	63.7	2344228.8		
12:00 AM	58.2	660693.4		
1:00 AM	58.5	707945.8		
2:00 AM	56.0	398107.2		
3:00 AM	51.9	154881.7		
4:00 AM	52.9	194984.5		
5:00 AM	58.4	691831.0		
6:00 AM	62.2	1659586.9	SUM=	15129896.9
			Ln=	71.8
	Daytime Level=	77.0		
	Nighttime Level=	81.8		
	DNL=	**69**		
	24-Hour Leq=	64.3		

LOCATION 2	Soquel Ave.			
Dist. To Source	54 ft.			
	Saturday			
TIME	Leq	10^Leq/10		
7:00 AM	60.2	1047128.5		
8:00 AM	63.9	2454708.9		
9:00 AM	64.2	2630268.0		
10:00 AM	64.8	3019951.7		
11:00 AM	64.7	2951209.2		
12:00 PM	64.8	3019951.7		
1:00 PM	65.1	3235936.6		
2:00 PM	66.3	4265795.2		
3:00 PM	65.7	3715352.3		
4:00 PM	68.0	6309573.4		
5:00 PM	65.4	3467368.5		
6:00 PM	65.0	3162277.7		
7:00 PM	64.9	3090295.4		
8:00 PM	63.7	2344228.8		
9:00 PM	68.3	6760829.8	SUM=	51474875.8
10:00 PM	69.3	8511380.4	Ld=	77.1
11:00 PM	61.7	1479108.4		
12:00 AM	59.8	954992.6		
1:00 AM	61.6	1445439.8		
2:00 AM	55.5	354813.4		
3:00 AM	51.0	125892.5		
4:00 AM	49.3	85113.8		
5:00 AM	54.1	257039.6		
6:00 AM	58.1	645654.2	SUM=	13859434.7
			Ln=	71.4
	Daytime Level=	77.1		
	Nighttime Level=	81.4		
	DNL=	**69**		
	24-Hour Leq=	64.3		