NOISE STUDY

9th and Palm
Commercial Development
Imperial Beach CA

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September 16, 2011

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GLOSSARY OF TERMS

Sound Pressure Level (SPL): a ratio of one sound pressure to a reference pressure (L_{ref}) of 20 µPa. Because of the dynamic range of the human ear, the ratio is calculated logarithmically by 20 log (L/L_{ref}).

A-weighted Sound Pressure Level (dBA): Some frequencies of noise are more noticeable than others. To compensate for this fact, different sound frequencies are weighted more.

Minimum Sound Level (L_{min}): Minimum SPL or the lowest SPL measured over the time interval using the A-weighted network and slow time weighting.

Maximum Sound Level (L_{max}): Maximum SPL or the highest SPL measured over the time interval the A-weighted network and slow time weighting.

Equivalent sound level (L_{eq}): the true equivalent sound level measured over the run time. Leq is the A-weighted steady sound level that contains the same total acoustical energy as the actual fluctuating sound level.

Day Night Sound Level (LDN): Representing the Day/Night sound level, this measurement is a 24 –hour average sound level where 10 dB is added to all the readings that occur between 10 pm and 7 am. This is primarily used in community noise regulations where there is a 10 dB "Penalty" for night time noise. Typically LDN's are measured using A weighting.

Community Noise Exposure Level (CNEL): The accumulated exposure to sound measured in a 24-hour sampling interval and artificially boosted during certain hours. For CNEL, samples taken between 7 pm and 10 pm are boosted by 5 dB; samples taken between 10 pm and 7 am are boosted by 10 dB.

Octave Band: An octave band is defined as a frequency band whose upper band-edge frequency is twice the lower band frequency.

Third-Octave Band: A third-octave band is defined as a frequency band whose upper band-edge frequency is 1.26 times the lower band frequency.

Response Time (F,S,I): The response time is a standardized exponential time weighting of the input signal according to fast (F), slow (S) or impulse (I) time response relationships. Time response can be described with a time constant. The time constants for fast, slow and impulse responses are 1.0 seconds, 0.125 seconds and 0.35 milliseconds, respectively.

EXECUTIVE SUMMARY

This noise study has been completed to determine the noise impacts associated with daily operations of the proposed commercial project. The project known as "9th an Palm Commercial" consists of the development of retail commercial, a market and four smaller commercial pads having a total of 44,500 square-feet of commercial space. The approximate 3.9-acre project site is located at the southwest corner of the intersection of Palm Avenue (SR-75) and 9th Street in Imperial Beach, CA.

Operational Noise Levels

Based upon the property line noise levels determined for the commercial development none of the proposed noise sources directly or cumulatively exceeds the property line standards at the commercial and residential shared property lines. No impacts are anticipated and no project mitigation measures are required.

Traffic Noise Levels

The project does not create a direct or cumulative impact of more than 3 dBA CNEL on any roadway segment. Therefore, the project's direct and cumulative contributions to off-site roadway noise increases will not cause any significant impacts to any existing or future noise sensitive land uses.

Construction Noise Levels

The grading demolition and equipment will be spread out over the project site from distances near the occupied property to distances of more than 300-feet. Based upon the calculations of the noise levels when construction equipment is located near the property line the average noise levels are anticipated not to exceed the 75-dBA standard and no impacts will occur and no mitigation measures are required.

1.0 Project Introduction

1.1 Purpose of this Study

The purpose of this Noise study is to determine potential operational noise impacts (if any) created from the proposed project to the surrounding land uses. Should impacts be determined, the intent of this study would be to recommend suitable mitigation measures to bring those impacts to a level that would be considered less then significant.

1.2 Project Location

The proposed project is located within the City of Imperial Beach, CA. More specifically, the project is southwest corner of the intersection of Palm Avenue (SR-75) and 9th Street. The main access to the project site is from Pam Avenue with secondary access from 9th Street. A general project vicinity map is shown in Figure 1–1 on the following page.

1.3 Project Setting

The proposed project consists of a 15,000 square foot grocery or market, 15,000 square foot retail store, and four smaller commercial pads with one of the smaller pads potentially accommodating a drive thru restaurant for a total of up to 44,900 square-feet of commercial space. The existing site conditions are characterized as fully disturbed land with approximately 70,000 square feet of existing operating commercial facilities consisting of a furniture store, market place and miscellaneous retail stores. Existing commercial uses are located to the north, west and east of the project site and residential exists to the south. The project is not proposing any zone changes or special uses and will be generally constant with the existing commercial use. The Project will have an overall reduction in the square footage of the commercial provided and will relocate the delivery activities from the alley south of the site to on-site deliveries. A project site plan is shown in Figure 1–2 on Page 3 of this report.

Figure 1-1: Project Vicinity Map

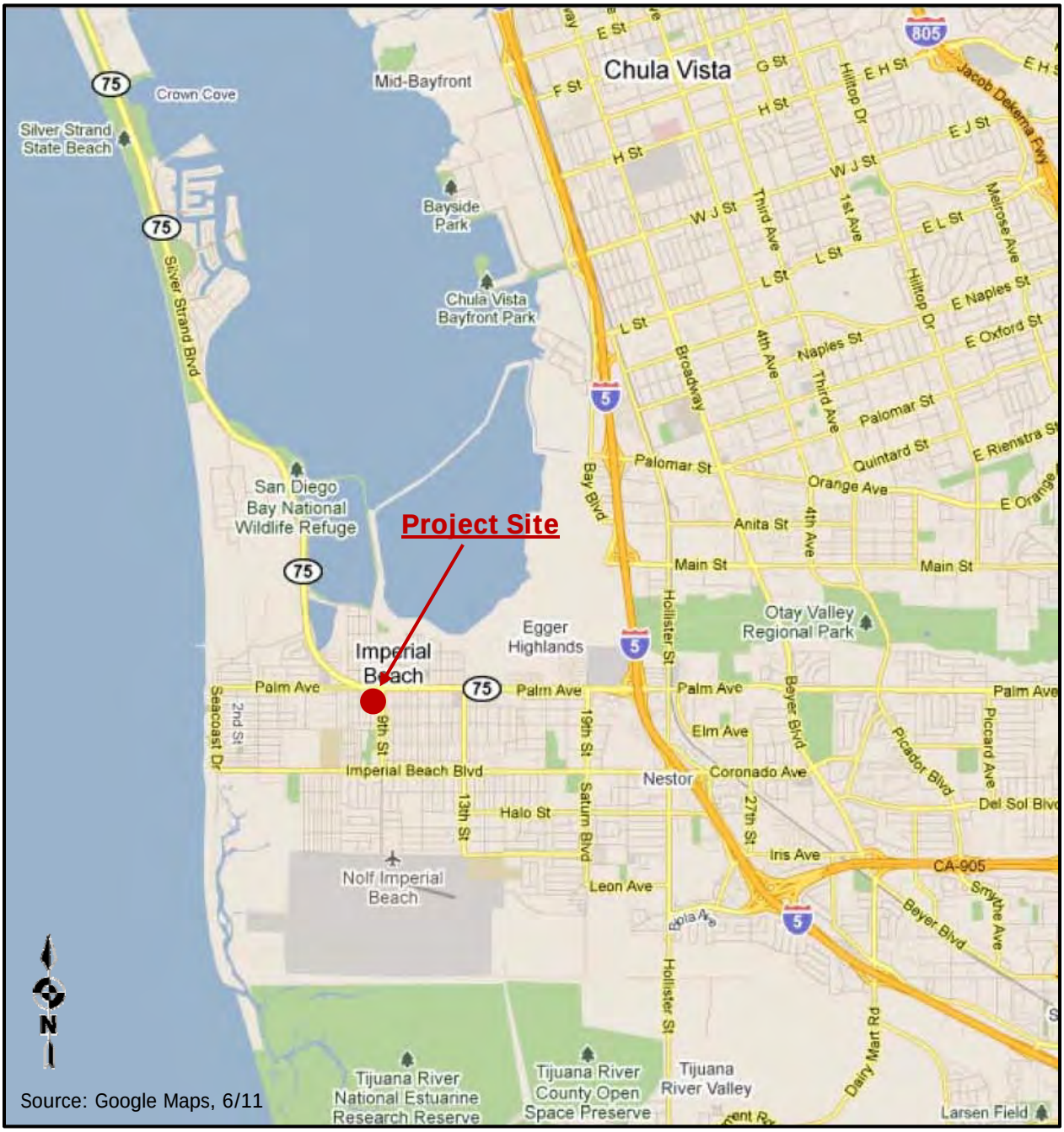
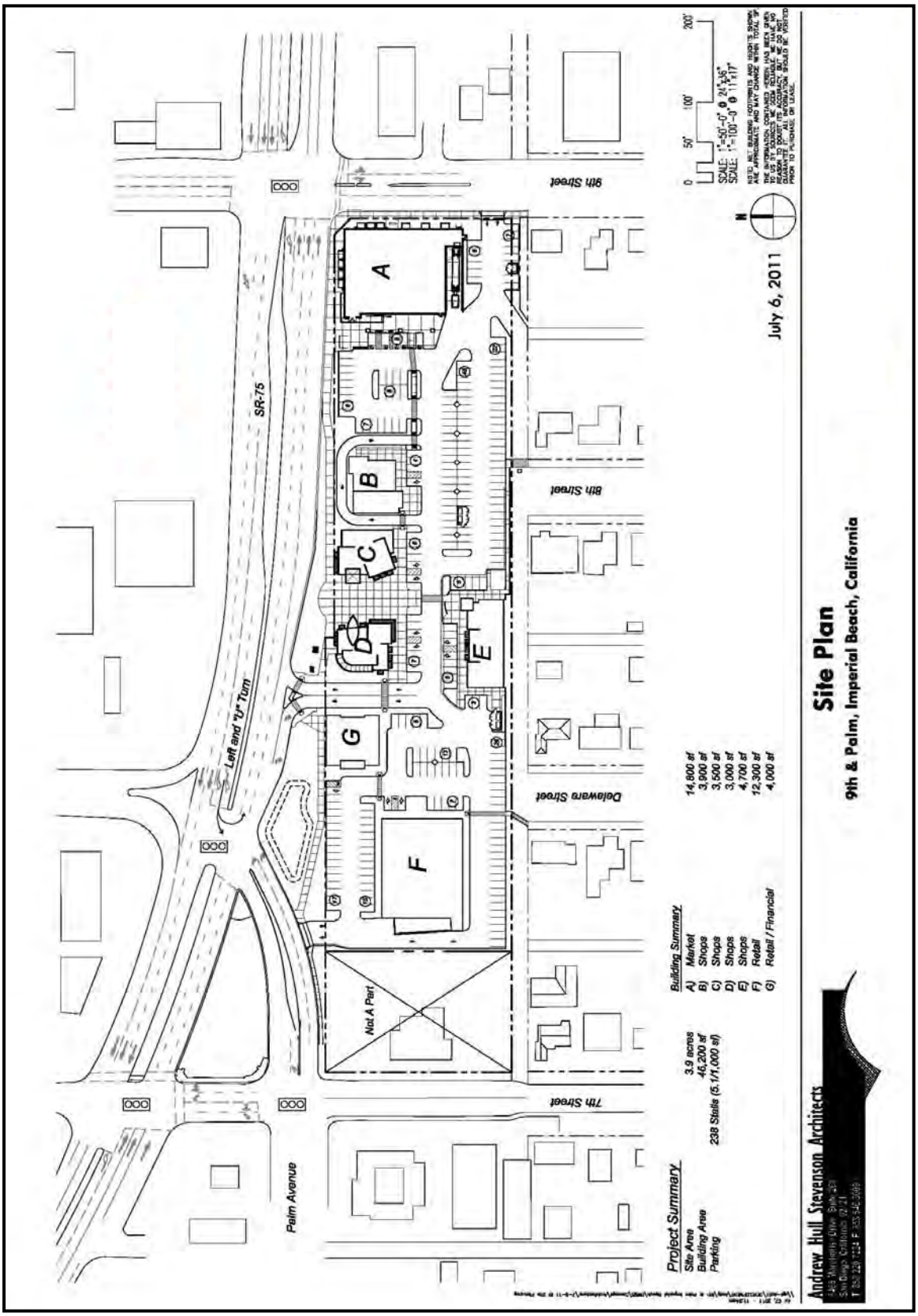


Figure 1-2: Project Site Plan



2.0 ACOUSTICAL FUNDAMENTALS

Noise is defined as unwanted or annoying sound which interferes with or disrupts normal activities. Exposure to high noise levels has been demonstrated to cause hearing loss. The individual human response to environmental noise is base on the sensitivity of that individual, the type of noise that occurs and when the noise occurs.

Sound is measured on a logarithmic scale consisting of sound pressure levels known as a decibel (dB). The sounds heard by humans typically do not consist of a single frequency but of a broadband of frequencies having different sound pressure levels. The method for evaluating all the frequencies of the sound is to apply an A-weighting to reflect how the human ear responds to the different sound levels at different frequencies. The A-weighted sound level adequately describes the instantaneous noise whereas the equivalent sound level depicted as Leq represents a steady sound level containing the same total acoustical energy as the actual fluctuating sound level over a given time interval.

The Community Noise Equivalent Level (CNEL) is the 24 hour A-weighted average for sound, with corrections for evening and nighttime hours. The corrections require an addition of 5 decibels to sound levels in the evening hours between 7 p.m. and 10 p.m. and an addition of 10 decibels to sound levels at nighttime hours between 10 p.m. and 7 a.m. These additions are made to account for the increased sensitivity during the evening and nighttime hours when sound appears louder.

A vehicles noise level is from a combination of the noise produced by the engine, exhaust and tires. The cumulative traffic noise levels along a roadway segment are based on three primary factors: the amount of traffic, the travel speed of the traffic, and the vehicle mix ratio or number of medium and heavy trucks. The intensity of traffic noise is increased by higher traffic volumes, greater speeds and increased number of trucks.

Because mobile/traffic noise levels are calculated on a logarithmic scale, a doubling of the traffic noise or acoustical energy results in a noise level increase of 3 dBA. Therefore the doubling of the traffic volume, without changing the vehicle speeds or mix ratio, results in a noise increase of 3 dBA. Mobile noise levels radiant in an almost oblique fashion from the source and drop off at a rate of 3 dBA for each doubling of distance under hard site conditions and at a rate of 4.5 dBA for soft site conditions.

Hard site conditions consist of concrete, asphalt and hard pack dirt while soft site conditions exist in areas having slight grade changes, landscaped areas and vegetation. On the other hand, fixed/point sources radiate outward uniformly as it travels away from the source. Their sound levels attenuate or drop off at a rate of 6 dBA for each doubling of distance.

The most effective noise reduction methods consist of controlling the noise at the source, blocking the noise transmission with barriers. Any or all of these methods may be required to reduce noise levels to an acceptable level. To be effective, a noise barrier must have enough mass to prevent significant noise transmission through it and high enough and long enough to shield the receiver from the noise source. A safe minimum surface weight for a noise barrier is 3.5 pounds/square foot (equivalent to 3/4-inch plywood), and the barrier must be carefully constructed so that there are no cracks or openings.

Barriers constructed of wood or as a wooden fence must have minimum design considerations as follows: the boards must be ¾ inch thick and free of any gaps or knot holes. The design must also incorporate either overlapping the boards at least 1 inch or utilizing a tongue-and-grove design for this to be achieved.

3.0 SIGNIFICANCE THRESHOLDS AND STANDARDS

Construction Noise

Chapter 9.32.020 of the City of Imperial Beach Municipal Code addresses the limits of disturbing or offensive construction noise. The Municipal Code states that the use of any tools, power machinery or equipment so as to cause noises disturbing to the comfort and repose of any person residing or working in the vicinity, or in excess of seventy-five decibels (75 dBA), between the hours of ten (10) p.m. and seven (7) a.m., except when the same is necessary for emergency repairs required for the health and safety of any member of the community. (Ord. 802 § 2 (part), 1990). The Municipal code does not set daytime noise limits on construction activities. Commonly, the City has utilized the County of San Diego's Noise Ordinance noise limit of 75 dBA during the daytime hours of 7 a.m. to 7 p.m. for other projects.

Operational Noise

The generation of noise for certain types of land uses could cause potential land use incompatibility. Noise generating uses or devices should be considered during normal project review. The City of Imperial Beach does not identify any specific property line noise level standards. Commonly, the City has utilized the County of San Diego's Noise Ordinance noise limits for other projects. The applicable County of San Diego property line noise limits are provided below.

Section 36.404 of the County of San Diego noise ordinance provides performance standards and noise control guidelines for determining and mitigating non-transportation, or stationary, noise source impacts to adjacent properties. The purpose of the noise ordinance is to protect, create and maintain an environment free from noise that may jeopardize the health or welfare, or degrade the quality of life.

The County Noise Ordinance states that it shall be unlawful for any person to cause or allow the creation of any noise to the extent that the one-hour average sound level, at any point on or beyond the boundaries of the property exceeds the applicable limits provided in Table 3-1. As stated above in Section 1, the Project is zoned Commercial and residential uses exist to the south. The sound level limit at a location on a boundary between two zoning districts is the arithmetic mean of the respective limits for the two districts.

Table 3-1: Sound Level Limits in Decibels (dBA)

ZONE		APPLICABLE LIMIT ONE-HOUR AVERAGE SOUND LEVEL (DECIBELS)
R-S, R-D, R-R, R-MH, A-70, A-72, S-80, S-81, S-87, S-88, S-90, S-92, R-V, and R-U Use Regulations with a density of less than 11 dwelling units per acre.	7 a.m. to 10 p.m. 10 p.m. to 7 a.m.	50 45
R-RO, R-C, R-M, C-30, S-86, R-V, R-U and V5. Use Regulations with a density of 11 or more dwelling units per acre.	7 a.m. to 10 p.m. 10 p.m. to 7 a.m.	55 50
S-94, V4, and all other commercial zones.	7 a.m. to 10 p.m. 10 p.m. to 7 a.m.	60 55
V1, V2 V1, V2 V1 V2	7 a.m. to 7 p.m. 7 p.m. to 10 p.m. 10 p.m. to 7 a.m. 10 p.m. to 7 a.m.	60 55 55 50
V3	7 a.m. to 10 p.m. 10 p.m. to 7 a.m.	70 65
M-50, M-52, M-54	Anytime	70
S-82, M-58, and all other industrial zones.	Anytime	75

55.0

50.0

Source: County of San Diego Noise Ordinance Section 36.404

Section 36.404 of the Noise Ordinance sets a most restrictive operational exterior noise limit for the commercial uses of 60 dBA Leq for daytime hours of 7 a.m. to 10 p.m. and 55 dBA Leq during the noise sensitive nighttime hours of 10 p.m. to 7 a.m. and a residential noise limit of 50 dBA Leq during the daytime hours and 45 dBA Leq during the nighttime hours. Most of the Project components will only operate during the daytime hours but a few may operate during nighttime or early morning hours and therefore the most restrictive and conservative approach is to apply the 50 dBA Leq nighttime standard at the property lines. Therefore, the Project must meet a 50.0 dBA Leq standard (arithmetic mean between 55 dBA and 45 dBA between 7 a.m. to 7 p.m.) at the residential property line to the south.

4.0 NOISE ENVIRONMENT

4.1 Existing Noise Environment Onsite

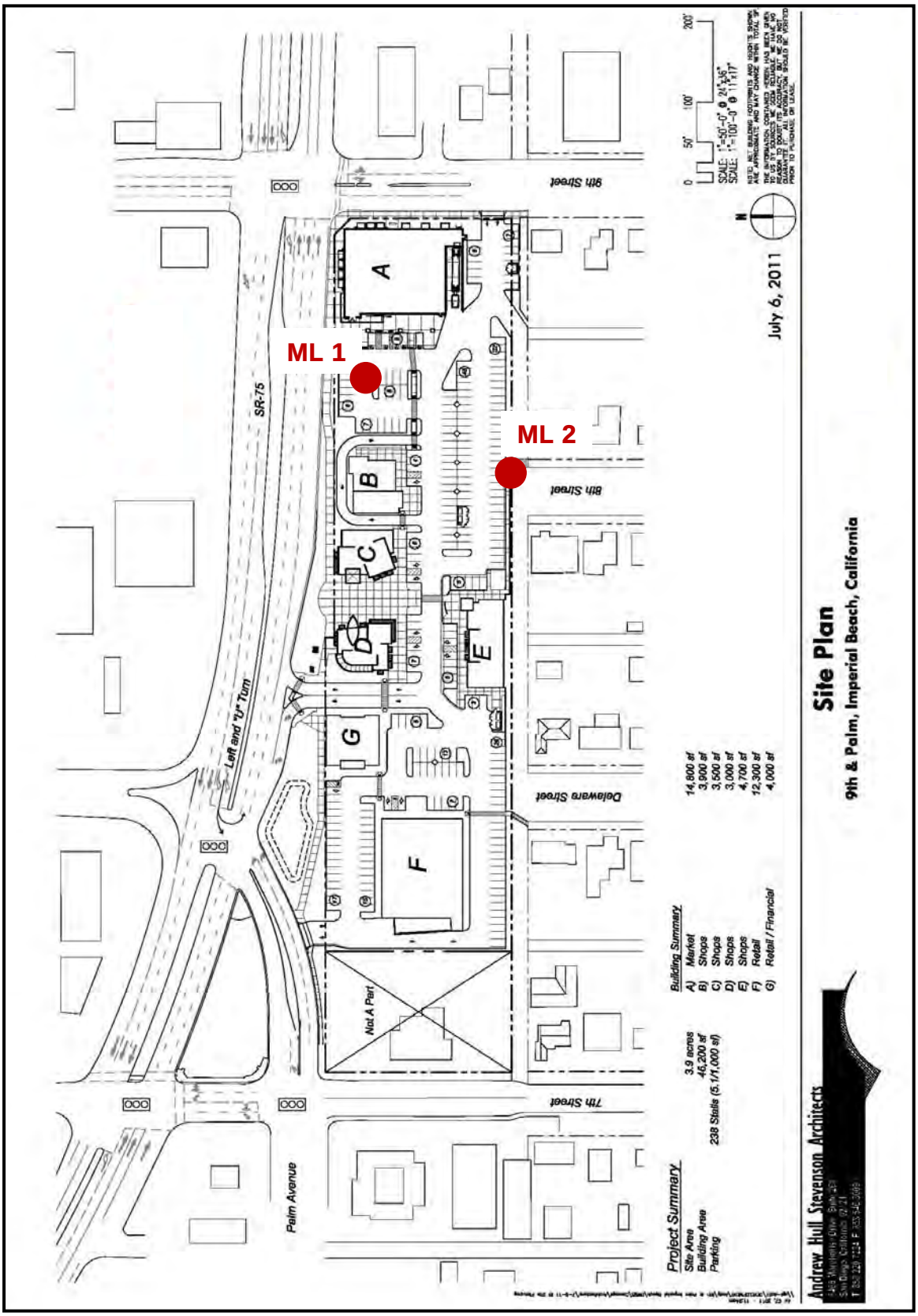
Noise measurements were taken using a Larson-Davis Model LxT Type 1 precision sound level meter, programmed, in "slow" mode, to record noise levels in "A" weighted form. The sound level meter and microphone were mounted on a tripod, five feet above the ground and equipped with a windscreen during all measurements. The sound level meter was calibrated before and after the monitoring using a Larson-Davis calibrator, Model CAL 150.

Monitoring location 1 (M1) was located roughly 100-feet from Palm Avenue and 250-feet from the intersection of 9th Street. Monitoring location 2 (M2) was located at the southern property line of the project near an existing residence located along 8th Street. The noise monitoring locations are provided graphically in Figure 4-1 on the following page. The results of the noise level measurements are presented in Table 4-1. The noise measurements were monitored for a time period of 15 minutes. The existing noise levels in the project area consisted primarily of traffic along Palm Avenue. The ambient Leq noise levels measured in the area of the project during the afternoon hour were found to be between 55 dBA Leq and 65 dBA Leq. The statistical indicators Lmax, Lmin, L10, L50 and L90, are given for the monitoring location. As can be seen from the L90 data, 90% of the time the noise level is between 51–55 dBA.

Table 4-1: Measured Ambient Noise Levels

Measurement Identification	Description	Time	Noise Levels (dBA)					
			Leq	Lmax	Lmin	L10	L50	L90
M1	Palm Avenue	2:30-2:45 p.m.	64.8	84.1	50.7	63.3	61.1	54.7
M2	Southern PL	2:50-3:05 p.m.	55.1	65.1	49.1	57.4	54.1	51.7
Source: Ldn Consulting, Inc. January 14, 2010								

Figure 4-1: Ambient Noise Monitoring Locations



5.0 OPERATIONAL NOISE LEVELS

This section examines the potential stationary noise source levels and delivery operations associated with the development and operation of the proposed project. Noise from a fixed or point source drops off at a rate of 6 dBA for each doubling of distance. Which means a noise level of 70 dBA at 5-feet would be 64 dBA at 10-feet and 58 dBA at 20-feet. A review of the proposed project indicates that noise sources such as delivery trucks, a drive-thru and the mechanical ventilation system (HVAC) are the primary sources of stationary noise.

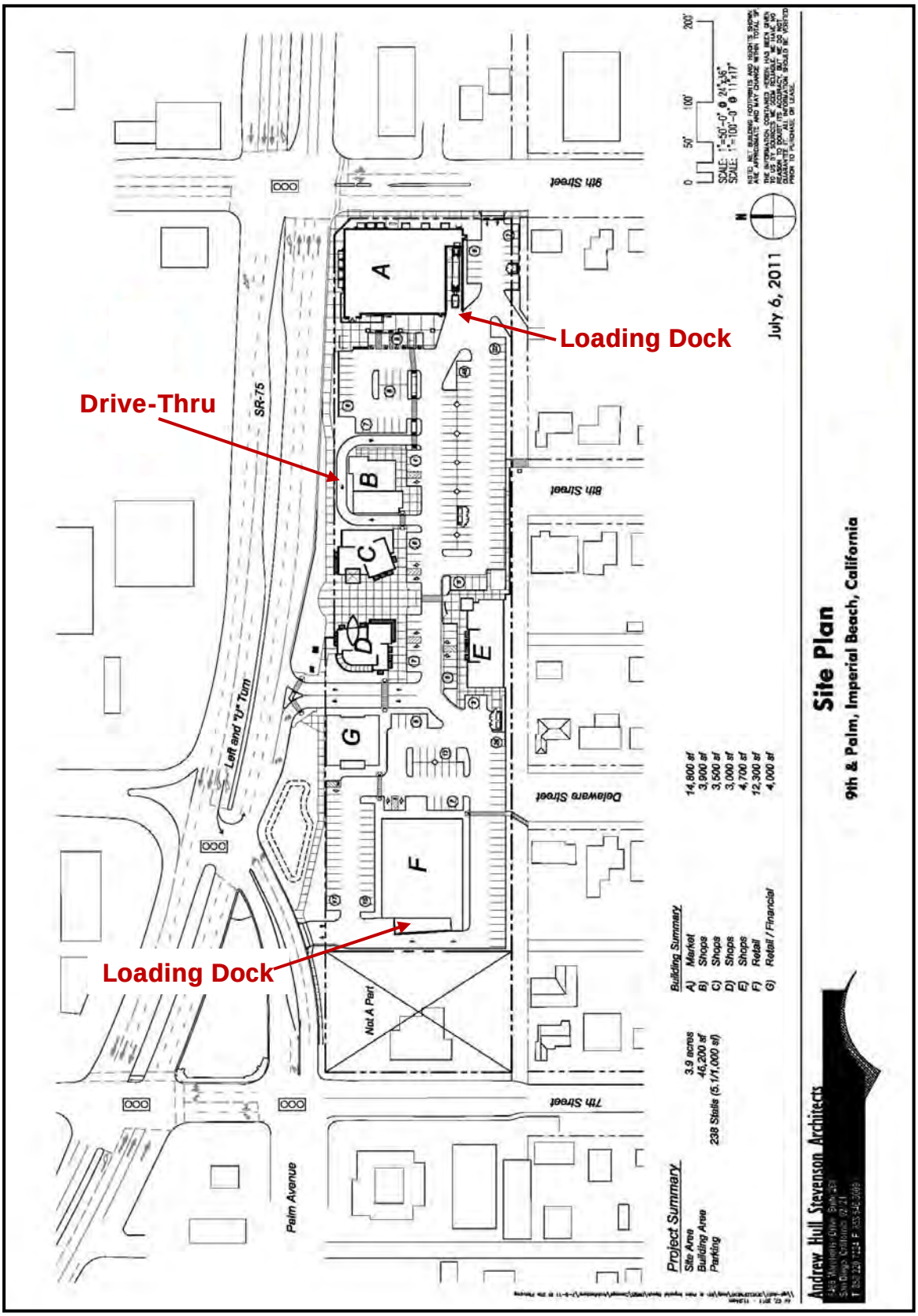
The locations of the drive-thru and the loading docks noise sources are shown in Figure 5-1. Each building will have a series of HVAC unit for temperature control and are discussed in more detail below. The most sensitive property line to the operational noise sources, by distance and orientation, is to the south. The section will analyze the southern property line to determine the worst case noise levels. All other property lines are located further from the noise sources and have a commercial zoning allowing a less restrictive noise standard or a higher noise level.

5.1 Reference Noise Levels

This section provides a detailed description of the reference noise level measurement results. It is important to note that the following projected noise levels assume the worst-case noise environment with the delivery trucks, drive-thru activities and roof-top mounted mechanical ventilation (HVAC) all occurring at the same time. In reality, these noise levels will vary throughout the day. The mechanical ventilation may operate during nighttime hours and the delivery trucks may arrive during early evening or morning hours.

The Project must meet the most restrictive arithmetic mean daytime and evening standards of 55.0 dBA and 50.0 dBA at the residential property lines as shown in Table 3-2 above. Each anticipated noise source is provided in more detail below to determine if direct noise impacts will occur. To determine the noise level reductions from the building parapets that shield the HVAC units Fresnel Barrier Reduction Calculations were utilized for each separate noise source. A cumulative noise level analysis with associated distances, noise reductions and calculations of the proposed sources is provided at the end of this section along with a table showing the individual noise sources and their associated property line noise levels.

Figure 5-1: Noise Source Locations



Delivery Trucks

In order to evaluate the truck delivery noise impacts, the analysis utilized reference noise level measurements taken at an Albertson's Shopping Center in San Diego, California in 2011. The measurements include truck drive-by noise, truck loading/unloading and truck engine noise. The unmitigated exterior noise levels for truck drive-by noise and truck engine noise were measured at 66.5 dBA Leq at a distance of 25-feet from the loading dock.

The onsite maneuvering associated with the delivery trucks consists of the truck entering the site, must likely from 9th Avenue, traveling toward the northern portion of the parking lot area near Building B then backing into the loading dock at Building A or continuing through the site to Building F. The truck is anticipated to leave the site by traveling through the parking lot and exiting on the northwest drive directly onto Palm Avenue.

There is one loading dock proposed at the grocery/market facility (Building A) approximately 90 to 95 feet from the southern property line and a loading dock at Building F approximately 180 feet from the southern property line. A truck will take approximately 5 minutes to drive in the site and position itself into a bay, 30-45 minutes to be unloaded or loaded, and another 5 minutes to exit the bay secure doors, complete necessary paperwork and drive out of the site. This equates to 40-55 minutes it would take for one truck to complete a delivery or pickup, therefore only one truck at the most could deliver to this facility in one hour. During the loading/unloading of the truck the engine can only idle for five (5) minutes in compliance with State air quality requirements. To be conservative, it was assumed the truck engine could be operating for 15 minutes of the total time required during the delivery process (5 minutes at arrival, 5 minutes of idle and 5 minutes at departure).

Noise levels drop 3 decibels each time the duration of the source is reduced in half. Therefore, hourly truck noise level over a 15 minute period would be reduced 6 decibels to 60.5 dBA at a distance of 25-feet based on the limited time of operation. The nearest loading dock, at Building A, is slightly over 90 feet from the southern property line and the noise level reduction due to distance would be -11.5 dBA. This would result in an unshielded noise level of 49.0 dBA Leq which is below the 50.0 dBA Leq property line standard. The loading dock at Building F is 180 feet from the residential property line and would have an unshielded noise level of 43.0 dBA Leq. The noise level

reductions due to distance for the nearest residential uses located along the southern property line and the closest loading dock at Building A are provided in Table 5-1 below.

Table 5-1: Delivery Truck Noise Levels (Southern Property Line)

Distance To Observer Location (Feet)	Hourly Reference Noise Level (dBA)	Noise Source Reference Distance (Feet)	Noise Reduction Due To Distance (dBA)	Reduction Due To Barriers (dBA)	Noise Level At Property Line (dBA)	Quantity per hour	Property Line Cumulative Noise Level (dBA)
94	66.5	25	-11.5	0	49.0	1	49.0*
*Complies with the nighttime Noise Standard of 50 dBA.							

No direct impacts are anticipated. Additionally, the trucks as part of the proposed project will not access the alley between the site and the residences as they currently have been. Therefore, truck noise is anticipated to be lower than what is currently experienced at the residences to the south.

Air Conditioning Units

Rooftop mechanical ventilation units (HVAC) will be installed on the proposed buildings. In order to evaluate the HVAC noise impacts, the analysis utilized reference noise level measurements taken at a Von's Shopping Center in Murrieta, CA in 2010 for Buildings B-F. The unshielded noise levels for the HVAC units were measured at 65.9 dBA Leq at a distance of 6-feet. The grocery/market (Building A) is proposed with a larger 18 ton unit and one smaller unit having a reference noise level of 76 dBA at 3-feet (Source: Lennox Commercial HVAC Units – October, 2005).

To predict the worst-case future noise environment, a continuous reference noise level of 65.9 dBA at 6-feet was used to represent the roof-top mechanical ventilation system for Buildings B-F and a reference noise level of 76.0 dBA at 3-feet (or 70 dBA at 6-feet) for Building A. Even though the mechanical ventilation system will cycle on and off throughout the day, this approach presents the worst-case noise condition. In addition, these units are designed to provide cooling during the peak summer daytime periods, and it is unlikely that all the units will be operating continuously.

The noise levels associated with the roof-top mechanical ventilation system will be limited with the proposed parapet walls on each building that will vary in height but will be roughly 1-foot higher than the HVAC units to shield them both visually and acoustically based upon the architectural plans (Source: Andrew Hull Stevenson Architects dated June 8, 2011). Hence, the parapet wall will block the line-of-sight from the adjacent residential units.

To determine the noise level reductions from the parapet walls that are planned to be 1-foot higher than the HVAC units on each the Fresnel Barrier Reduction Calculations based on distance, source height, receiver elevation and the top of barrier were modeled. The noise level reductions due to distance and the parapet walls for the nearest residential uses located along the southern property line is provided in Table 5-2 below for each building. The number of HVAC units that are proposed for each building is also provided in Table 5-2 along with the cumulative noise levels. The Fresnel barrier reduction calculations for the parapets are provided in ***Attachment A*** of this report.

Table 5-2: Project HVAC Noise Levels (Nearest Southern Property Line)

Building	Distance To Observer Location (Feet)	Hourly Reference Noise Level (dBA)	Noise Source Reference Distance (Feet)	Noise Reduction Due To Distance (dBA)	Reduction Due To Parapets (dBA)	Noise Level At Property Line (dBA)	Quantity	Property Line Cumulative Noise Level (dBA)*
A	118	70.0	6	-25.9	-9.1	35.0	2	38.0
B	162	65.9	6	-28.6	-8.9	28.4	6	36.2
C	168	65.9	6	-28.9	-8.7	28.3	4	34.3
D	168	65.9	6	-28.9	-9.2	27.8	4	33.8
E	48	65.9	6	-18.1	-11.9	35.9	6	43.7
F	119	65.9	6	-25.9	-9.1	30.9	6	38.6

*Complies with the nighttime Noise Standard of 50 dBA.

The proposed HVAC operational noise levels are in compliance with the City's daytime 55 dBA property line standard and would also meet the most restrictive nighttime standard of 50 dBA. No impacts are anticipated and no further mitigation is required. Additionally, most of the HVAC units will be located farther from the southern property line as part of the proposed project with the exception of Building E then what currently exists on site. Therefore, the HVAC noise is anticipated to be lower than what is currently experienced at the residences to the south.

Drive-Thru Noise Levels

To assess the potential drive-thru speakerphone noise levels at the proposed Building B, reference noise level measurements taken at an existing Jack in the Box in Fallbrook California in October, 2010. The main noise source are associated with the drive-thru is the drive-thru speakerphone. The maximum measured noise level generated by the drive-thru speakerphone was found to be 68.4 dBA at a distance of 15-feet.

To predict the worst-case noise environment, continuous reference noise levels were used to represent the drive-thru speakerphone. Although the drive-thru speakerphone system will be intermittent throughout any given hour, this approach presents the worst-case noise condition. The drive-thru speakerphone will be located on the northern portion of Building B and noise levels will be shielded by the building. The drive-thru speakerphone noise level of 68.4 dBA Leq was propagated out to the property lines and the shielding from the proposed Building B was calculated. The noise level reductions due to distance for the nearest residential uses located along the southern property line is provided in Table 5-1 below along with the noise reduction from the proposed building. The drive-thru noise levels will meet the City daytime, evening and nighttime standards and no mitigation is needed.

Table 5-3: Drive-Thru Noise Levels (Southern Property Line)

Distance To Observer Location (Feet)	Hourly Reference Noise Level (dBA)	Noise Source Reference Distance (Feet)	Noise Reduction Due To Distance (dBA)	Reduction Due To the Building (dBA)	Noise Level At Property Line (dBA)	Quantity per hour	Property Line Cumulative Noise Level (dBA)
228	68.4	15	-23.6	-17.5	27.3	1	27.3*
*Complies with the nighttime Noise Standard of 50 dBA.							

5.2 Cumulative Project Noise Levels

It is possible to calculate the cumulative noise levels from the proposed project along the southern property line from each of the proposed noise sources. Although not all the noise sources are close enough to each other in distance or sound level to create a cumulative effect this method is considered ultra conservative in determining impact potential. For example: the HVAC units on Building A are 118-feet from the residences located near 9th Street but the HVAC units of Building F are located 466-feet from the same residences near 9th Street.

For that reason, the cumulative noise levels were calculated at three separate locations along the southern property which include the residences west of Delaware Street, between Delaware Street and 8th Street and the residences near 9th Street. The locations of the calculated cumulative noise levels are provided graphically in Figure 5-2 below and depicted as Southwest, Southern and Southeast. The cumulative noise levels are calculated separately at these three locations below in Tables 5-4, 5-5 and 5-6, respectively. These projections include the delivery truck noise, drive-thru noise and noise from the HVAC systems of each building and their respective distances.

Figure 5-2: Calculated Cumulative Noise Locations

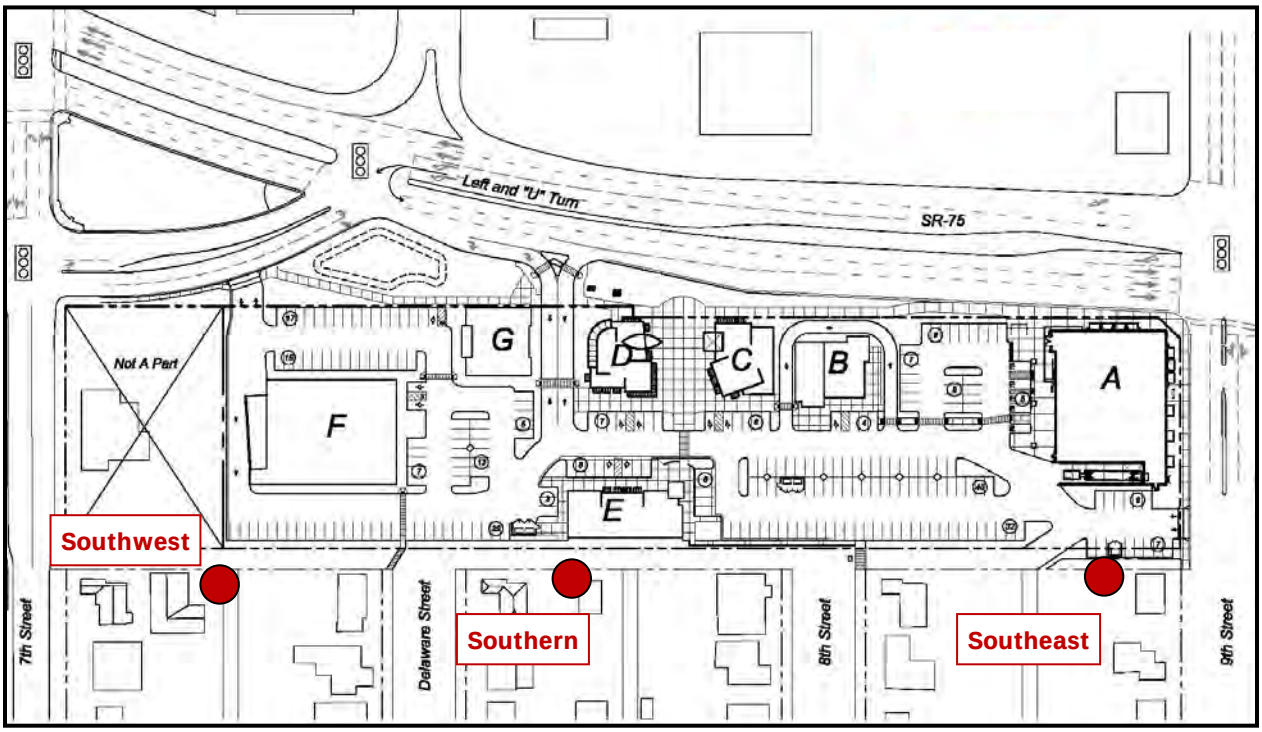


Table 5-4 below presents the cumulative noise levels at the southwestern property line from the proposed commercial development during the daytime and nighttime hours. The resultant cumulative noise level at the southwestern property lines is projected to be at or below 46.1 dBA Leq. Therefore, cumulatively the proposed commercial development related operational noise levels comply with the daytime and nighttime noise standards at the residences to the southwest. No Impacts are anticipated and no mitigation is required.

Table 5-4: Cumulative Noise Levels (Southwest Property Line)

Source	Distance To Observer Location (Feet)	Hourly Reference Noise Level (dBA)	Noise Source Reference Distance (Feet)	Noise Reduction Due To Distance (dBA)	Reduction Due To Barriers (dBA)	Noise Level At Property Line (dBA)	Quantity	Property Line Cumulative Noise Level (dBA)*
Loading Dock	180	60.5	25.0	-17.1	0.0	43.4	1	43.4
HVAC - Bldg. A	678	70.0	6.0	-41.1	-9.1	19.8	2	22.8
HVAC - Bldg. B	429	65.9	6.0	-37.1	-8.9	19.9	6	27.7
HVAC - Bldg. C	363	65.9	6.0	-35.6	-8.7	21.6	4	27.6
HVAC - Bldg. D	273	65.9	6.0	-33.2	-9.2	23.5	4	29.6
HVAC - Bldg. E	190	65.9	6.0	-30.0	-11.9	24.0	6	31.8
HVAC - Bldg. F	90	65.9	6.0	-25.9	-23.5	8.4	6	41.8
Drive thru	469	68.4	15.0	-29.9	-17.5	21.0	1	21.0
Combined Cumulative Noise Level at Property Line:								**46.1**

*Complies with the nighttime Noise Standard of 50 dBA.

Table 5-5 below presents the cumulative noise levels at the southwestern property line from the proposed commercial development during the daytime and nighttime hours. The resultant cumulative noise level at the southwestern property lines is projected to be at or below 47.3 dBA Leq. Therefore, cumulatively the proposed commercial development related operational noise levels comply with the daytime and nighttime

noise standards at the residences directly to the south. No Impacts are anticipated and no mitigation is required.

Table 5-5: Cumulative Noise Levels (Southern Property Line)

Source	Distance To Observer Location (Feet)	Hourly Reference Noise Level (dBA)	Noise Source Reference Distance (Feet)	Noise Reduction Due To Distance (dBA)	Reduction Due To Barriers (dBA)	Noise Level At Property Line (dBA)	Quantity	Property Line Cumulative Noise Level (dBA)*
Loading Dock	241	60.5	25.0	-19.7	0.0	40.8	1	40.8
HVAC - Bldg. A	315	70.0	6.0	-34.4	-9.1	26.5	2	29.5
HVAC - Bldg. B	162	65.9	6.0	-28.6	-8.9	28.4	6	36.2
HVAC - Bldg. C	168	65.9	6.0	-28.9	-8.7	28.3	4	34.3
HVAC - Bldg. D	168	65.9	6.0	-28.9	-9.2	27.8	4	33.8
HVAC - Bldg. E	48	65.9	6.0	-18.1	-11.9	35.9	6	43.7
HVAC - Bldg. F	130	65.9	6.0	-26.7	8.4	30.8	6	38.6
Drive thru	228	68.4	15.0	-23.6	-17.5	27.3	1	27.3
Combined Cumulative Noise Level at Property Line:								**47.3**

*Complies with the nighttime Noise Standard of 50 dBA.

Table 5-6 below presents the cumulative noise levels at the southwestern property line from the proposed commercial development during the daytime and nighttime hours. The resultant cumulative noise level at the southwestern property lines is projected to be at or below 49.8 dBA Leq. Therefore, cumulatively the proposed commercial development related operational noise levels comply with the daytime and nighttime noise standards at the residences to the southeast. No Impacts are anticipated and no mitigation is required.

Table 5-6: Cumulative Noise Levels (Southeast Property Line)

Source	Distance To Observer Location (Feet)	Hourly Reference Noise Level (dBA)	Noise Source Reference Distance (Feet)	Noise Reduction Due To Distance (dBA)	Reduction Due To Barriers (dBA)	Noise Level At Property Line (dBA)	Quantity	Property Line Cumulative Noise Level (dBA)*
Loading Dock	94	60.5	25.0	-11.5	0.0	49.0	1	49.0
HVAC - Bldg. A	118	70.0	6.0	-25.9	-9.1	35.0	2	38.0
HVAC - Bldg. B	162	65.9	6.0	-28.6	-8.9	28.4	6	36.2
HVAC - Bldg. C	194	65.9	6.0	-30.2	-8.7	27.0	4	33.0
HVAC - Bldg. D	272	65.9	6.0	-33.1	-9.2	23.6	4	29.6
HVAC - Bldg. E	187	65.9	6.0	-29.9	-11.9	24.1	6	31.9
HVAC - Bldg. F	450	65.9	6.0	-37.5	8.4	20	6	27.8
Drive thru	228	68.4	15.0	-23.6	-17.5	27.3	1	27.3
Combined Cumulative Noise Level at Property Line:								**49.8**

*Complies with the nighttime Noise Standard of 50 dBA.

5.3 Conclusions

Based upon the property line noise levels determined above none of the proposed noise sources directly or cumulatively exceeds the property line standards at the shared commercial and residential property lines. Therefore, the proposed commercial development related operational noise levels comply with the daytime and nighttime noise standards at the residences. No Impacts are anticipated and no mitigation is required.

6.0 TRANSPORTATION NOISE LEVELS

The off-site project related roadway segment noise levels projected in this report were calculated using the methods in the Highway Noise Model published by the Federal Highway Administration (FHWA Highway Traffic Noise Prediction Model, FHWA-RD-77-108, December, 1978). The FHWA Model uses the traffic volume, vehicle mix, speed, and roadway geometry to compute the equivalent noise level. A spreadsheet calculation was used which computes equivalent noise levels for each of the time periods used in the calculation of CNEL. Weighting these equivalent noise levels and summing them gives the CNEL for the traffic projections. The noise contours are then established by iterating the equivalent noise level over many distances until the distance to the desired noise contour(s) are found.

Because mobile/traffic noise levels are calculated on a logarithmic scale, a doubling of the traffic noise or acoustical energy results in a noise level increase of 3 dBA. Therefore the doubling of the traffic volume, without changing the vehicle speeds or mix ratio, results in a noise increase of 3 dBA. Mobile noise levels radiant in an almost oblique fashion from the source and drop off at a rate of 3 dBA for each doubling of distance under hard site conditions and at a rate of 4.5 dBA for soft site conditions. Hard site conditions consist of concrete, asphalt and hard pack dirt while soft site conditions exist in areas having slight grade changes, landscaped areas and vegetation.

Hard site conditions, to be conservative, were used to develop the noise contours and analyze noise impacts along all roadway segments. The future traffic noise model utilizes a typical, conservative vehicle mix of 96% Autos, 2% Medium Trucks and 2% Heavy Trucks for all analyzed roadway segments. The vehicle mix provides the hourly distribution percentages of automobile, medium trucks and heavy trucks for input into the FHWA Model.

Community noise level changes greater than 3 dBA are often identified as audible and considered potential significant, while changes less than 1 dBA will not be discernible to local residents. In the range of 1 to 3 dBA, residents who are very sensitive to noise may perceive a slight change. There is no scientific evidence available to support the use of 3 dBA as the significance threshold. Community noise exposures are typically over a long time period rather than the immediate comparison made in a laboratory situation. Therefore, the level at which changes in community noise levels become discernible is likely greater than 1 dBA and 3 dBA appears to be appropriate for most people. For the

purposes for this analysis a direct and cumulative roadway noise impacts would be considered significant if the project increases noise levels for a noise sensitive land use by 3 dBA CNEL and if the project increases noise levels above an unacceptable noise level per the City's General Plan in the area adjacent to the roadway segment.

6.1 Direct Noise Impacts

To determine if direct off-site noise level increases associated with the development of the project will create noise impacts. The noise levels for the existing conditions were compared with the noise level increase from the project. Utilizing the project's traffic assessment (Source: Urban Systems Associates, Inc. 5/11) noise contours were developed for the following traffic scenarios:

Existing: Current day noise conditions without construction of the project.

Existing Plus Project: Current day noise conditions plus the completion of the project.

Existing vs. Existing Plus Project: Comparison of the direct project related noise level increases in the vicinity of the project site.

The noise levels and reference distances to the 60 dBA CNEL contours for the roadways in the vicinity of the Project site are given in Table 6-1 for the Existing Scenario and in Table 6-2 for the Existing Plus Project Scenario. Note that the values given do not take into account the effect of any noise barriers or topography that may affect ambient noise levels.

Table 6-3 presents the comparison of the Existing Year with and without project related noise levels. The overall roadway segment noise levels will increase from 0.0 dBA CNEL to 0.4 dBA CNEL with the development of the project. The project does not create a direct noise increase of more than 3 dBA CNEL on any roadway segment. Therefore, the project's direct contributions to off-site roadway noise increases will not cause any significant impacts to any existing or future noise sensitive land uses.

Table 6-1: Existing Noise Levels

Roadway Segment	ADT[1]	Vehicle Speeds (MPH)[1]	Noise Level @ 50-Feet (dBA CNEL)	60 dBA CNEL Contour Distance (Feet)
SR-75				
North of Rainbow Drive	16,742	45	71.5	702
Rainbow Drive/ 7th Street	14,781	45	70.9	620
7th Street/ Palm Avenue	14,151	45	70.7	594
9th Avenue/ Florida Street	30,546	45	74.1	1,281
Florida Street/ 13th Street	35,760	45	74.8	1,500
Palm Avenue				
Rainbow Drive/ 7th Street	11,936	40	68.9	386

[1] Source: Project Traffic study prepared by Urban Systems Associates, Inc. 5/11

Table 6-2: Existing + Project Noise Levels

Roadway Segment	ADT[1]	Vehicle Speeds (MPH)[1]	Noise Level @ 50-Feet (dBA CNEL)	60 dBA CNEL Contour Distance (Feet)
SR-75				
North of Rainbow Drive	17,212	45	71.6	722
Rainbow Drive/ 7th Street	15,520	45	71.1	651
7th Street/ Palm Avenue	14,957	45	71.0	627
9th Avenue/ Florida Street	33,501	45	74.5	1,405
Florida Street/ 13th Street	38,111	45	75.0	1,599
Palm Avenue				
Rainbow Drive/ 7th Street	13,078	40	69.3	423

[1] Source: Project Traffic study prepared by Urban Systems Associates, Inc. 5/11

Table 6-3: Existing vs. Existing + Project Noise Levels

Roadway Segment	Existing Noise Level @ 50-Feet (dBA CNEL)	Existing Plus Project Noise Level @ 50-Feet (dBA CNEL)	Project Related Direct Noise Level Increase (dBA CNEL)
SR-75			
North of Rainbow Drive	71.5	71.6	0.1
Rainbow Drive/ 7th Street	70.9	71.1	0.2
7th Street/ Palm Avenue	70.7	71.0	0.3
9th Avenue/ Florida Street	74.1	74.5	0.4
Florida Street/ 13th Street	74.8	75.0	0.2
Palm Avenue			
Rainbow Drive/ 7th Street	68.9	69.3	0.4
Sound Levels provided are worst-case and do not take into account topography or shielding from barriers.			

6.2 Cumulative Noise Impacts

To determine if cumulative off-site noise level increases associated with the development of the project and other planned or permitted projects in the vicinity will create noise impacts. The noise levels for the near-term project buildout and other planned and permitted projects were compared with the existing conditions. Utilizing the project's traffic assessment (Source: Urban Systems Associates, Inc. 5/11) noise contours were developed for the following traffic scenarios:

Existing: Current day noise conditions without construction of the project.

Existing Plus Cumulative Projects Plus Project: Current day noise conditions plus the completion of the project and the completion of other permitted, planned projects or approved ambient growth factors.

Existing vs. Existing Plus Cumulative Plus Project: Comparison of the existing noise levels and the related noise level increases from the combination of the project and all other planned or permitted projects in the vicinity of the site.

The existing noise levels and reference distances to the 60 dBA CNEL contours for the roadways in the vicinity of the Project site are given in Table 6-1 above for the Existing Scenario. The near-term cumulative noise conditions are provided in Table 6-4. No noise barriers or topography that may affect noise levels were incorporated in the calculations.

Table 6-4: Existing + Project + Cumulative Noise Levels

Roadway Segment	ADT[1]	Vehicle Speeds (MPH)[1]	Noise Level @ 50-Feet (dBA CNEL)	60 dBA CNEL Contour Distance (Feet)
SR-75				
North of Rainbow Drive	23,500	45	72.9	986
Rainbow Drive/ 7th Street	24,000	45	73.0	1,007
7th Street/ Palm Avenue	18,700	45	72.0	784
9th Avenue/ Florida Street	37,800	45	75.0	1,586
Florida Street/ 13th Street	46,700	45	75.9	1,959
Palm Avenue				
Rainbow Drive/ 7th Street	14,800	40	69.8	479

[1] Source: Project Traffic study prepared by Urban Systems Associates, Inc. 5/11

Table 6-5 presents the comparison of the Existing Year and the Near-Term Cumulative noise levels. The overall roadway segment noise levels will increase from 0.9 dBA CNEL to 2.1 dBA CNEL with the development of the project. No cumulative noise level increases of 3 dBA CNEL were found on any of the roadway segments. Therefore no cumulative or cumulatively considerable impacts are anticipated and no future analysis is required.

Table 6-5: Existing vs. Existing + Project + Cumulative Noise Levels

Roadway Segment	Existing Noise Level @ 50-Feet (dBA CNEL)	Existing Plus Project Noise Level @ 50-Feet (dBA CNEL)	Project Related Direct Noise Level Increase (dBA CNEL)
SR-75			
North of Rainbow Drive	71.5	72.9	1.4
Rainbow Drive/ 7th Street	70.9	73.0	2.1
7th Street/ Palm Avenue	70.7	72.0	1.3
9th Avenue/ Florida Street	74.1	75.0	0.9
Florida Street/ 13th Street	74.8	75.9	1.1
Palm Avenue			
Rainbow Drive/ 7th Street	68.9	69.8	0.9
Sound Levels provided are worst-case and do not take into account topography or shielding from barriers.			

6.3 Conclusions

The project does not create a direct impact of more than 3 dBA CNEL on any roadway segment and no cumulative noise increases of 3 dBA CNEL or more were found. Therefore, the project's direct and cumulative contributions to off-site roadway noise increases will not cause any significant impacts to any existing or future noise sensitive land uses.

7.0 CONSTRUCTION NOISE LEVELS

Construction noise represents a short-term impact on the ambient noise levels. Noise generated by construction equipment includes haul trucks, water trucks, graders, dozers, loaders and scrapers can reach relatively high levels. Grading activities typically represent one of the highest potential sources for noise impacts. The most effective method of controlling construction noise is through local control of construction hours and by limiting the hours of construction to normal weekday working hours.

The City's Municipal code does not set daytime noise limits on construction activities during the hours of 7 am and 10 pm. Commonly, the City has utilized the County of San Diego's Noise Ordinance noise limit of 75 dBA during the daytime hours of 7 a.m. to 7 p.m. for construction other projects. Therefore, a standard of 75 dBA will be applied during the construction activities.

The U.S. Environmental Protection Agency (U.S. EPA) has compiled data regarding the noise generating characteristics of specific types of construction equipment. Noise levels generated by heavy construction equipment can range from 60 dBA to in excess of 100 dBA when measured at 50 feet. However, these noise levels diminish rapidly with distance from the construction site at a rate of approximately 6 dBA per doubling of distance. For example, a noise level of 75 dBA measured at 50 feet from the noise source to the receptor would be reduced to 69 dBA at 100 feet from the source to the receptor, and reduced to 63 dBA at 200 feet from the source.

Using a point-source noise prediction model, calculations of the expected construction noise levels were completed. The essential model input data for these performance equations include the source levels of the equipment, source to receiver horizontal and vertical separations, the amount of time the equipment is operating in a given day, also referred to as the duty-cycle and any transmission loss from topography or barriers.

7.1 Potential Noise Impact Identification

Based on the EPA noise emissions, empirical data and the amount of equipment needed, worst-case noise levels from the construction equipment operations would occur during the base operations (demolition and grading). The demolition and grading of the project will occur under two different phases, with the demolition occurring first. The demolition and grading activities are analyzed separately below.

The construction schedule identifies demolition and export for Phase 1, with anticipated equipment including a grader, an excavator, a loader, and a dozer and several haul trucks for material export. Due to physical constraints and normal demolition operations, most of the equipment will be spread out over the alignment of the existing buildings and site except when loading haul trucks for export. This operation will require a loader and single haul truck at a time. Therefore the worst-case noise condition would occur when the loader, a haul truck and an excavator are working in close proximity to each other at an average distance of approximately 50-feet from the southern property line. The amount of time the equipment will be utilized over an 8 hour period at this distance from the property line is also given and factored into the average noise level calculations.

The noise levels utilized in this analysis for the demolition are shown in Table 7-1. This is referred to as the duty-cycle. As can be seen in Table 7-1, with the equipment working closely together the cumulative noise levels would be 74.9 dBA at the nearest property line. Therefore, the average noise level will be below the 75 dBA threshold and no impacts are anticipated. The demolition activities will be short term, only lasting approximately one month.

Table 7-1: Demolition Noise Levels

Construction Equipment	Quantity	Source Level @ 50-Feet (dBA)*	Duty Cycle (Hours/Day)	Cumulative Noise Level @ Property Line (dBA)
Haul Truck	1	75	2	69.0
Skip Loader	1	72	4	69.0
Excavator	1	74	6	71.8
			Cumulative Noise Levels	**74.9**

*Source: U.S. Environmental Protection Agency (U.S. EPA), 1971 and Empirical Data

The earthwork schedule identifies mass grading the site with anticipated equipment including an excavator, a loader, two compactors, a water truck and two dozers and several haul trucks for material import. Due to physical constraints and normal demolition operations, most of the equipment will be spread out over the alignment of

the existing buildings except when loading haul trucks for export. This operation will require a dozer, compactor and water haul truck. Therefore the worst-case noise condition would occur when the dozer, compactor and water haul truck are working in close proximity to each other at an average distance of approximately 50-feet from the southern property line. The amount of time the equipment will be utilized over an 8 hour period at this distance from the property line is also given and factored into the average noise level calculations.

The noise levels utilized in this analysis for the grading are shown in Table 7-2. This is referred to as the duty-cycle. As can be seen in Table 7-2, with the equipment working closely together the cumulative noise levels would be 74.1 dBA at the nearest property line. Therefore, the average noise level will be below the 75 dBA threshold during the grading operations and no impacts are anticipated. The grading activities will be short term only lasting approximately six months.

Table 7-2: Grading Noise Levels

Construction Equipment	Quantity	Source Level @ 50-Feet (dBA)*	Duty Cycle (Hours/Day)	Cumulative Noise Level @ Property Line (dBA)
Water Truck	1	70	4	67.0
Dozer	1	74	4	71.0
Compactor	1	72	4	69.0
			Cumulative Noise Levels	**74.1**

*Source: U.S. Environmental Protection Agency (U.S. EPA), 1971 and Empirical Data

7.2 Conclusions

The grading demolition and equipment will be spread out over the project site from distances near the occupied property to distances of more than 300-feet. Based upon the calculations of the noise levels when construction equipment is located near the property line the average noise levels are anticipated not to exceed the 75-dBA standard and no impacts will occur and no mitigation measures are required.

ATTACHMENT A

Fresnel Barrier Calculations

HVAC - Point Source Building A
Source to Receiver Horizontal Distance (ft) = 118.00
Source to Barrier Horizontal Distance (ft) = 10.00
Barrier to Receiver Horizontal Distance (ft) = 108.00
Source Height (ft) = 35.00
Receiver Height (ft) = 22.00
Barrier Height (ft) = 36.00
Distance Source to Receptor (ft) d = 118.71
Distance Source to Barrier top (ft) d1 = 10.05
Distance Barrier top to Receiver (ft) d2 = 108.90

Frequency (Hz) = 8000 Attenuation (db) = 18.2 Fresnel N = 3.401
Frequency (Hz) = 4000 Attenuation (db) = 15.3 Fresnel N = 1.700
Frequency (Hz) = 2000 Attenuation (db) = 12.8 Fresnel N = 0.850
Frequency (Hz) = 1000 Attenuation (db) = 10.8 Fresnel N = 0.425
Frequency (Hz) = 500 Attenuation (db) = 9.1 Fresnel N = 0.213
Frequency (Hz) = 250 Attenuation (db) = 7.7 Fresnel N = 0.106
Frequency (Hz) = 125 Attenuation (db) = 6.6 Fresnel N = 0.053
Frequency (Hz) = 63 Attenuation (db) = 5.6 Fresnel N = 0.027

HVAC - Point Source Building B
Source to Receiver Horizontal Distance (ft) = 162.00
Source to Barrier Horizontal Distance (ft) = 10.00
Barrier to Receiver Horizontal Distance (ft) = 152.00
Source Height (ft) = 37.00
Receiver Height (ft) = 20.00
Barrier Height (ft) = 38.00
Distance Source to Receptor (ft) d = 162.89
Distance Source to Barrier top (ft) d1 = 10.05
Distance Barrier top to Receiver (ft) d2 = 153.06

Frequency (Hz) = 8000 Attenuation (db) = 17.9 Fresnel N = 3.158
Frequency (Hz) = 4000 Attenuation (db) = 15.0 Fresnel N = 1.579
Frequency (Hz) = 2000 Attenuation (db) = 12.6 Fresnel N = 0.789
Frequency (Hz) = 1000 Attenuation (db) = 10.6 Fresnel N = 0.395
Frequency (Hz) = 500 Attenuation (db) = 8.9 Fresnel N = 0.197
Frequency (Hz) = 250 Attenuation (db) = 7.6 Fresnel N = 0.099
Frequency (Hz) = 125 Attenuation (db) = 6.5 Fresnel N = 0.049
Frequency (Hz) = 63 Attenuation (db) = 5.5 Fresnel N = 0.025

HVAC - Point Source Building C
Source to Receiver Horizontal Distance (ft) = 166.00
Source to Barrier Horizontal Distance (ft) = 10.00
Barrier to Receiver Horizontal Distance (ft) = 156.00
Source Height (ft) = 37.00
Receiver Height (ft) = 21.00
Barrier Height (ft) = 38.00
Distance Source to Receptor (ft) d = 166.77
Distance Source to Barrier top (ft) d1 = 10.05
Distance Barrier top to Receiver (ft) d2 = 156.92

Frequency (Hz) = 8000 Attenuation (db) = 17.5 Fresnel N = 2.898
Frequency (Hz) = 4000 Attenuation (db) = 14.7 Fresnel N = 1.449
Frequency (Hz) = 2000 Attenuation (db) = 12.3 Fresnel N = 0.725
Frequency (Hz) = 1000 Attenuation (db) = 10.4 Fresnel N = 0.362
Frequency (Hz) = 500 Attenuation (db) = 8.7 Fresnel N = 0.181
Frequency (Hz) = 250 Attenuation (db) = 7.4 Fresnel N = 0.091
Frequency (Hz) = 125 Attenuation (db) = 6.4 Fresnel N = 0.045
Frequency (Hz) = 63 Attenuation (db) = 5.4 Fresnel N = 0.023

HVAC - Point Source Building D
Source to Receiver Horizontal Distance (ft) = 166.00
Source to Receiver Horizontal Distance (ft) = 166.00
Source to Barrier Horizontal Distance (ft) = 10.00
Barrier to Receiver Horizontal Distance (ft) = 156.00
Source Height (ft) = 38.00
Receiver Height (ft) = 18.00
Barrier Height (ft) = 39.00
Distance Source to Receptor (ft) d = 167.20
Distance Source to Barrier top (ft) d1 = 10.05
Distance Barrier top to Receiver (ft) d2 = 157.41

Frequency (Hz) = 8000 Attenuation (db) = 18.5 Fresnel N = 3.642
Frequency (Hz) = 4000 Attenuation (db) = 15.5 Fresnel N = 1.821

Frequency (Hz) = 2000 Attenuation (db) = 13.0 Fresnel N = 0.910
Frequency (Hz) = 1000 Attenuation (db) = 11.0 Fresnel N = 0.455
Frequency (Hz) = 500 Attenuation (db) = 9.2 Fresnel N = 0.228
Frequency (Hz) = 250 Attenuation (db) = 7.8 Fresnel N = 0.114
Frequency (Hz) = 125 Attenuation (db) = 6.7 Fresnel N = 0.057
Frequency (Hz) = 63 Attenuation (db) = 5.7 Fresnel N = 0.028

HVAC - Point Source Building E
Source to Receiver Horizontal Distance (ft) = 48.00
Source to Barrier Horizontal Distance (ft) = 10.00
Barrier to Receiver Horizontal Distance (ft) = 38.00
Source Height (ft) = 37.00
Receiver Height (ft) = 25.00
Barrier Height (ft) = 38.00
Distance Source to Receptor (ft) d = 49.48
Distance Source to Barrier top (ft) d1 = 10.05
Distance Barrier top to Receiver (ft) d2 = 40.16

Frequency (Hz) = 8000 Attenuation (db) = 20.0 Fresnel N = 10.432
Frequency (Hz) = 4000 Attenuation (db) = 20.0 Fresnel N = 5.216
Frequency (Hz) = 2000 Attenuation (db) = 17.1 Fresnel N = 2.608
Frequency (Hz) = 1000 Attenuation (db) = 14.3 Fresnel N = 1.304
Frequency (Hz) = 500 Attenuation (db) = 11.9 Fresnel N = 0.652
Frequency (Hz) = 250 Attenuation (db) = 10.1 Fresnel N = 0.326
Frequency (Hz) = 125 Attenuation (db) = 8.5 Fresnel N = 0.163
Frequency (Hz) = 63 Attenuation (db) = 7.3 Fresnel N = 0.081

HVAC - Point Source Building F
Source to Barrier Horizontal Distance (ft) = 10.00
Barrier to Receiver Horizontal Distance (ft) = 95.00
Source Height (ft) = 41.00
Receiver Height (ft) = 31.00
Barrier Height (ft) = 42.00
Distance Source to Receptor (ft) d = 95.39
Distance Source to Barrier top (ft) d1 = 10.05
Distance Barrier top to Receiver (ft) d2 = 95.51

Frequency (Hz) = 8000 Attenuation (db) = 16.7 Fresnel N = 2.416
Frequency (Hz) = 4000 Attenuation (db) = 14.0 Fresnel N = 1.208
Frequency (Hz) = 2000 Attenuation (db) = 11.7 Fresnel N = 0.604
Frequency (Hz) = 1000 Attenuation (db) = 9.9 Fresnel N = 0.302
Frequency (Hz) = 500 Attenuation (db) = 8.4 Fresnel N = 0.151
Frequency (Hz) = 250 Attenuation (db) = 7.2 Fresnel N = 0.075
Frequency (Hz) = 125 Attenuation (db) = 6.1 Fresnel N = 0.038
Frequency (Hz) = 63 Attenuation (db) = 5.3 Fresnel N = 0.019

Drive Thru - Point Source Building B
Source to Receiver Horizontal Distance (ft) = 228.00
Source to Barrier Horizontal Distance (ft) = 10.00
Barrier to Receiver Horizontal Distance (ft) = 218.00
Source Height (ft) = 26.00
Receiver Height (ft) = 18.00
Barrier Height (ft) = 34.00
Distance Source to Receptor (ft) d = 228.14
Distance Source to Barrier top (ft) d1 = 12.81
Distance Barrier top to Receiver (ft) d2 = 218.59

Frequency (Hz) = 8000 Attenuation (db) = 20.0 Fresnel N = 46.173
Frequency (Hz) = 4000 Attenuation (db) = 20.0 Fresnel N = 23.086
Frequency (Hz) = 2000 Attenuation (db) = 20.0 Fresnel N = 11.543
Frequency (Hz) = 1000 Attenuation (db) = 20.0 Fresnel N = 5.772
Frequency (Hz) = 500 Attenuation (db) = 17.5 Fresnel N = 2.886
Frequency (Hz) = 250 Attenuation (db) = 14.6 Fresnel N = 1.443
Frequency (Hz) = 125 Attenuation (db) = 12.3 Fresnel N = 0.721
Frequency (Hz) = 63 Attenuation (db) = 10.4 Fresnel N = 0.361