Grantville Subarea A Focused Plan Amendment Project
San Diego, California
Final Noise Study

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Grantville Subarea A Focused Plan Amendment Project
San Diego, California
NOISE STUDY

This report is an analysis of potential noise impacts associated with the proposed Grantville Subarea A Focused Plan Amendment in the City of San Diego. The report has been prepared by Rincon Consultants, Inc. under contract to BRG Consulting, Inc. to support the Environmental Impact Report (EIR) being prepared in compliance with the California Environmental Quality Act (CEQA). This study analyzes the potential for temporary impacts associated with construction activities and long-term operation of projects developed should the Grantville Subarea A Focused Plan be amended as proposed. The analysis herein is based in part on existing and projected traffic volumes developed by Linscott, Law and Greenspan, Inc. (December, 2013).

PROJECT DESCRIPTION

The project location, referred to as "Subarea A," is within the former Grantville Redevelopment Project Area, within the eastern portion of the City of San Diego, in San Diego County. Subarea A is a 379-acre area comprised of commercial, office, industrial, public facility, park and open space uses located immediately north of Interstate 8 along both sides of Fairmount Avenue, Friars Road and Mission Gorge Road north to Zion Avenue (and including several parcels north of Zion Avenue). The southeast portion of Subarea A includes the first seven parcels on the southern side of Adobe Falls Road (starting at Waring Road) (Figure 1 – Project Location). Proposed land use designations and related uses within Subarea A were formerly addressed in an EIR prepared for the Grantville Redevelopment Project (March 2005, SCH #2004071122).

The Grantville Focused Plan Amendment consists of three components: (1) an amendment to the Navajo Community Plan, (2) processing of proposed rezones, and (3) an update to the Navajo Facilities Finance Plan. The Focused Plan Amendment and rezones would introduce residential and mixed-use development to the Grantville neighborhood which is comprised predominately of industrial and commercial uses.

The proposed project, referred to Alternative D, would result in a net increase of approximately 8,275 residential dwelling units over what is allowed by the existing community plan. The Grantville Focused Amendment to the Navajo Community Plan will define the long-range vision and comprehensive policy framework for how Subarea A could develop over the next 20 to 30 years and will provide policy direction for future development guided by the City of Villages growth strategy and citywide policy direction contained within the City of San Diego General Plan (2008).

The proposed project would rezone Subarea A from predominately single-use commercial and industrial zones to multiple-use zones that promote transit-oriented development. Alternative D would be implemented through the adoption of three new zones: 1). CC-3-6, a community commercial zone which will emphasize pedestrian orientation and allow up to 44 dwelling units per acre. 2). CC-3-8, a community commercial zone which will emphasize pedestrian

Figure 1 – Project Location

orientation and allow up to 73 dwelling units per acre. 3). RM-3-7, a multiple dwelling unit residential zone which will allow for limited commercial uses and up to 44 dwelling units per acre. The proposed zoning designations along with the adoption of a new Community Plan Implementation Overlay Zone (CPIOZ), will provide the tools needed to achieve the proposed land use amendments associated with Alternative D. The proposed CPIOZ, referred to as the "Grantville Transit Oriented Development (TOD) CPIOZ", will promote mixed-use, TOD with pedestrian and bicycle orientation and allow increased density (up to 109 dwelling units per acre) in the area surrounding the Grantville Light Rail Trolley Station when certain criteria are met.

Because actual uses that may be developed within Subarea A consistent with the amendment are speculative and subject to project specific environmental review, this report provides a general program level evaluation of potential noise impacts that may occur based on 2030 traffic conditions forecast in the Traffic Impact Study.

SETTING

OVERVIEW OF SOUND MEASUREMENT AND PROJECT AREA NOISE SOURCES

Noise is generally defined as loud, unpleasant, unexpected, or undesired sound that is typically associated with human activity and interferes with or disrupts normal activities. The human environment is characterized by a certain consistent noise level which varies by location and is termed ambient noise. Although exposure to high noise levels has been demonstrated to cause hearing loss, the principal human response to environmental noise is annoyance. The response of individuals to similar noise events is diverse and influenced by the type of noise, perceived importance of the noise and its appropriateness in the setting, time of day and type of activity during which the noise occurs and sensitivity of the individual.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the human ear. Sound is generally characterized by several variables, including frequency and intensity. Frequency describes the sound's pitch and is measured in cycles per second, or hertz (Hz), whereas intensity describes the sound's loudness and is measured in decibels (dB). Decibels are measured using a logarithmic scale. A sound level of 0 dB is approximately the threshold of human hearing. Normal speech has a sound level of approximately 60 dB. Sound levels above about 120 dB begin to be felt inside the human ear as discomfort and eventually as pain at still higher levels. The minimum change in the sound level of individual events that an average human ear can detect is about 3 dB. The average person perceives a change in sound level of about 10 dB as a doubling (or halving) of the sound's loudness; this relation holds true for sounds of any loudness. Sound levels of typical noise sources and environments are provided in Table 1.

Because of the logarithmic nature of the decibel unit, sound levels cannot be added or subtracted directly. A simple rule is useful in dealing with sound levels - if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. Thus, for example, 60 dB + 60 dB = 63 dB, and 80 dB + 80 dB = 83 dB.

The normal human ear can detect sounds that range in frequency from about 20 Hz to 20,000 Hz. However, all sounds in this wide range of frequencies are not heard equally well by the human ear, which is most sensitive to frequencies in the range of 1,000 Hz to 4,000 Hz. This frequency dependence can be taken into account by applying a correction to each frequency range to approximate the human ear's sensitivity within each range. This is called A-weighting and is commonly used in measurements of community environmental noise. The A-weighted sound pressure level (abbreviated as dBA) is the sound level with the "A-weighting" frequency correction. In practice, the level of a noise source is conveniently measured using a sound level meter that includes a filter corresponding to the dBA curve.

Because community noise fluctuates over time, a single measure called the Equivalent Sound Level (Leq) is used to describe the time-varying character of community noise. The Leq is the energy-averaged A-weighted sound level during a measured time interval. It is equal to the level of continuous steady sound containing the same total acoustical energy over the averaging time period as the actual time-varying sound. Additionally, it is often desirable to know the acoustic range of the noise source being measured. This is accomplished through the Lmax and Lmin indicators, which represent the root-mean-square maximum and minimum noise levels obtained during the measurement interval. The Lmin value obtained for a particular monitoring location is often called the "acoustic floor" for that location.

To describe the time-varying character of environmental noise, the statistical noise descriptors L10, L50, and L90 are commonly used. These descriptors refer to noise levels equaled or exceeded during 10, 50, and 90 percent of a stated time, respectively. Sound levels associated with L10 typically describe transient or short-term events, whereas levels associated with L90 describe the steady-state (or most prevalent) noise conditions.

Another sound measure known as the Day-Night Average Sound Level (Ldn) is an adjusted average A-weighted sound level for a 24-hour day. It is calculated by adding a 10-dB penalty to sound levels during nighttime hours (10:00 p.m. to 7:00 a.m.). The penalty compensates for the increased sensitivity to noise during the typically quieter evening and nighttime hours. A variation on the Ldn is the Community Noise Equivalent Level (CNEL), which applies a 5-dB penalty to sound generated between 7 p.m. and 10:00 p.m. and a 10-dB penalty to sound levels during nighttime hours (10:00 p.m. to 7:00 a.m.). The CNEL is a common metric used in local noise standards. CNEL is approximately 1 dB higher than Ldn; thus, these metrics are often used interchangeably.

Some land uses are considered sensitive to noise. Noise sensitive areas are land uses associated with indoor and/or outdoor activities that may be subject to stress and/or significant interference from noise. Noise sensitive areas often include residential dwellings, mobile homes, hotels, motels, hospitals, nursing homes, educational facilities and libraries. Industrial and commercial land uses are not generally considered sensitive to noise.

Table 1
Sound Levels of Typical Noise Sources and Noise Environments

Noise Source (at Given Distance)	Noise Environment	A-Weighted Sound Level (Decibels)	Human Judgment of Noise Loudness (Relative to Reference Loudness of 70 Decibels)
Military Jet Takeoff with Afterburner (50 ft)	Carrier Flight Deck	140	128 times as loud
Civil Defense Siren (100 ft)		130	64 times as loud
Commercial Jet Take-off (200 ft)		120	32 times as loud **Threshold of Pain**
Pile Driver (50 ft)	Rock Music Concert Inside Subway Station (New York)	110	16 times as loud
Ambulance Siren (100 ft) Newspaper Press (5 ft) Gas Lawn Mower (3 ft)		100	8 times as loud **Very Loud**
Food Blender (3 ft) Propeller Plane Flyover (1,000 ft) Diesel Truck (150 ft)	Boiler Room Printing Press Plant	90	4 times as loud
Garbage Disposal (3 ft)	Noisy Urban Daytime	80	2 times as loud
Passenger Car, 65 mph (25 ft) Living Room Stereo (15 ft) Vacuum Cleaner (10 ft)	Commercial Areas	70	Reference Loudness **Moderately Loud**
Normal Speech (5 ft) Air Conditioning Unit (100 ft)	Data Processing Center Department Store	60	1/2 as loud
Transit Vehicle Startup (100 ft)		52	~ 5/16 as loud
Light Traffic (100 ft)	Large Business Office Quiet Urban Daytime	50	1/4 as loud
Bird Calls (distant)	Quiet Urban Nighttime	40	1/8 as loud **Quiet**
Soft Whisper (5 ft)	Library and Bedroom at Night Quiet Rural Nighttime	30	1/16 as loud
	Broadcast and Recording Studio	20	1/32 as loud **Just Audible**
		0	1/64 as loud **Threshold of Hearing**

Motor Vehicle Traffic Noise

Traffic noise generated on a roadway is dependent on vehicle speed, volume, flow, fleet mix (percentage of cars, medium trucks, heavy trucks, buses and motorcycles), properly functioning muffler systems, pavement type and condition; the presence of barriers and distance between the noise source and receptor. In general, as traffic volumes increase, noise levels increase. This

condition exists until there is so much traffic that flow degrades and speeds decrease which reduces noise levels. A heavy truck traveling at 50 miles per hour (mph) generates about 85 dBA at a distance of ten feet, whereas a car traveling the same speed generates only 71 dBA. Thus, roadways with a higher percentage of heavy truck traffic are louder than less truck traffic. An increase of 10 dBA is usually perceived by the human ear as a "doubling" of sound volume (Bolt, Beranek, and Newman, Inc.,1973).

Within the San Diego area, highways typically generate 70 to 80 dBA CNEL at adjacent receptors. Heavily used commuter roadways, such as arterials and major streets, also generate significant noise levels; typically 65 to 75 dBA CNEL at adjacent receptors. Vehicles such as refuse collection trucks, parking lot or street sweepers; delivery trucks, buses, ambulances and other emergency vehicles can generate significant noise levels. These sources are often intermittent and affect receptors in residential or other sensitive land uses adjacent to or near the street where these vehicles are operating (City of San Diego General Plan Final PEIR, 2007).

Rail Noise

Train noise is an environmental concern for sensitive uses located along rail lines and in the vicinities of switching yards and roadway-rail crossings. Factors that influence rail noise include train speed, train horns, type of engine, track conditions, use of concrete cross ties and welded track; the intermittent nature of train events, time of day trains are operating, sound walls and barriers. The interaction of steel wheels and rails are the primary source of rail noise. The latter source creates three types of noise: 1) rolling noise resulting from continuous rolling contact; 2) impact noise when wheels encounter a rail joint, turnout or crossover; and 3) squeal generated by friction between the wheels and track on tight curves. To help address the rail noise associated with rail joints, rails are welded together on light rail and commuter rail lines. Concrete rather than wooden ties are used to hold the rails. When operating in residential areas, trains are required to travel at reduced speeds.

Federal regulations require trains to sound their horns at all roadway-rail grade crossings and the warning sound of train horns is a common sound experienced by communities near the rail corridor. Train air horns and crossing bell gates contribute to high noise levels near grade crossings (U.S. DOT 2006). The federal minimum noise level for a train horn is 96 dB. To minimize excess train horn noise, the federal government allows local jurisdictions to establish train horn "quiet zones." This requires the implementation of supplementary and alternative safety measures to compensate for loss of the train horn usage. The installation of grade separation at roadway-rail grade crossings can minimize train horn noise (City of San Diego General Plan Final PEIR, 2007).

Construction Noise

Construction can be another substantial, although typically short-term, source of noise. Construction is of most concern when it takes place near noise-sensitive land uses and occurs at night or in early morning hours. The primary noise source is the operation of heavy construction equipment and impact noise associated with blasting and pile driving. The City of San Diego typically regulates noise associated with construction equipment and activities through enforcement of noise ordinance standards (as defined in the *Regulatory Setting* section),

implementation of General Plan policies and imposition of conditions of approval for building or grading permits (City of San Diego General Plan Final PEIR, 2007).

Vibration Background

Vibration is defined as any oscillatory motion induced in a structure or mechanical device as a direct result of some type of applied force or displacement. Sources of earthborne vibrations include natural phenomena (earthquakes, volcanic eruptions, sea waves and landslides) or manmade (explosions, machinery, traffic and construction equipment). Displacement, in the case of a vibrating floor, is simply the distance that a point on the floor moves away from its static position. The velocity represents the instantaneous speed of the floor movement and acceleration is the rate of change of the speed. The response of humans, buildings, and equipment to vibration is normally described using velocity or acceleration. FTA uses the abbreviation "VdB" for vibration decibels to reduce the potential for confusion with sound decibel.

Sensitive Receptors

Noise exposure goals for various types of land uses reflect varying noise sensitivities associated with each use. Subarea A is primarily comprised of commercial and industrial uses. A multi-family residential complex is located northeast of Waring Road and Interstate 8 and south of Adobe Falls Road. A small multi-family building is located northwest of the Mission Gorge Road/Vandever Avenue intersection. Kaiser Hospital is located in the northwest corner of Subarea A. Single-family residences are located east/northeast of the Subarea A boundary; however, none are located within Subarea A.

Project Area Setting

The most common and primary source of noise in the project area is motor vehicle (e.g., automobiles, buses, trucks, and motorcycles) operation along the arterial roadways within Subarea A. These include San Diego Mission Road, Fairmount Avenue, Mission Gorge Road, Friars Road, Mission Gorge Place, Alvarado Canyon Road and Waring Road. Interstate 8 is located generally along the southern boundary of the study area. Motor vehicle noise is characterized by a high number of individual events which often create a sustained noise level and is the primary concern associated with the proposed project because it would replace existing office, commercial and industrial uses, which are less sensitive to traffic noise, with mixed use residential along the primary road corridors referenced above.

To establish representative ambient conditions within the study area, five weekday morning 20-minute noise measurements were taken on January 7, 2014, at locations defined in Table 2 using an ANSI Type II integrating sound level meter. The primary source of noise during monitoring was traffic. Heavy trucks (i.e., 10-18 wheel semi-trucks/trailers) are common throughout the area and contribute to ambient conditions. Table 2 identifies the noise measurement locations and measured noise levels. Noise measurement locations are shown in Figure 2.

Table 2
Noise Monitoring Results

Measurement Location	Primary Noise Source	Sample Time	Leq (dBA)
1. Southwestern corner of the Mission Gorge Road and Zion Avenue intersection approximately 50 feet from the Mission Gorge Road centerline.	Traffic	Tuesday morning (6:50 to 7:10)	70.2
2. Southwestern corner of Friars Road and Riverdale Street approximately 50 feet from the Friars Road centerline.	Traffic	Tuesday morning (7:15 to 7:35)	70.8
3. Southeastern corner of Mission Gorge Road and Vandever Street intersection approximately 40 feet from the Mission Gorge Road centerline.	Traffic	Tuesday morning (7:45 to 8:05)	62.4
4. Northwestern corner of Fairmount Avenue and Twain Avenue intersection approximately 30 feet from the Fairmount Avenue centerline.	Traffic	Tuesday morning (8:15 to 8:35)	60.3
5. Northeast of the Mission Gorge Road and Mission Gorge Place intersection approximately 60 feet from the Mission Gorge Road centerline.	Traffic	Tuesday morning (8:40 to 9:00)	67.9

Source: Field visit using ANSI Type II Integrating sound level meter.

The temperature during monitoring was approximately 55 degrees Fahrenheit and there was no measurable wind. Table 3 shows the approximate vehicle volumes counted during each monitoring event.

Table 3
Approximate Vehicle Volumes

Monitoring Location	Cars/Light Trucks	Medium Trucks*	Heavy Trucks**
1	520	13	6
2	500	20	20
3	250	2	9
4	105	5	0
5	300	17	5

**- Medium trucks are defined as two-axle, 6-wheel vehicles. These include delivery trucks and transit buses.*

***- Heavy trucks are defined as 10-18 wheel semi-trucks/trailers.*

Figure 2 – Noise Monitoring Locations

REGULATORY SETTING

CITY OF SAN DIEGO

Construction Noise

Per San Diego Municipal Code Section 59.5.0404, construction noise levels measured at or beyond the property lines of any property zoned residential shall not exceed an average sound level greater than 75decibles (dB) during the 12-hour period from 7:00 a.m. to 7:00 p.m. Further, construction activity is prohibited between the hours of 7:00 p.m. of any day and 7:00 a.m. of the following day, or on legal holidays as specified in Section 21.04 of the San Diego Municipal Code. Exceptions are allowed and subject to a permit granted by the Noise Abatement and Control Administrator.

Operational Noise

Noise Element of the General Plan

The City of San Diego requires new projects to meet exterior noise level standards as established in the Land Use – Noise Compatibility Guidelines in the City's Noise Element of the General Plan. Tables 4 and 5 illustrate San Diego's exterior land use noise compatibility guidelines. The City of San Diego has a traffic noise significance threshold of 65 dBA CNEL or less at residential exterior usable spaces.

Vibration Impact Criteria

Table 6 presents Federal Transit Administration impact criteria for various land use categories. These criteria are provided in the Noise and Vibration Impact Assessment manual published in 2006 and are based in part on the frequency of events and level of vibration that can cause human annoyance or interference with the use of vibration-sensitive equipment. The criteria for acceptable ground-borne vibration are expressed in terms of root mean square (RMS) velocity levels in VdB and are based on the maximum levels for a single event (Lmax). The limits are specified for the three land-use categories defined below:

- **Vibration Category 1 - High Sensitivity:** Included in Category 1 are buildings where vibration would interfere with operations within the building, including levels that may be well below those associated with human annoyance.

- **Vibration Category 2 - Residential:** This category covers all residential land uses and any buildings where people sleep, such as hotels and hospitals. No differentiation is made between different types of residential areas.

- **Vibration Category 3 - Institutional:** Vibration Category 3 includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference.

Table 4
City of San Diego Land Use - Noise Compatibility Guidelines

Land Use Category	Exterior Noise Exposure (dBA CNEL) 60	65	70	75
Open Space and Parks and Recreational				
Community & Neighborhood Parks; Passive Recreation				
Regional Parks; Outdoor Spectator Sports, Golf Courses; Athletic Fields; Outdoor Spectator Sports, Water Recreational Facilities; Horse Stables; Park Maint. Facilities				
Agricultural				
Crop Raising & Farming; Aquaculture, Dairies; Horticulture Nurseries & Greenhouses; Animal Raising, Maintain & Keeping; Commercial Stables				
Residential				
Single Units; Mobile Homes; Senior Housing		45		
Multiple Units; Mixed-Use Commercial/Residential; Live Work; Group Living Accommodations **For uses affected by aircraft noise, refer to Policies NE-D.2. & NE-D.3.*		45	45*	
Institutional				
Hospitals; Nursing Facilities; Intermediate Care Facilities; Kindergarten through Grade 12 Educational Facilities; Libraries; Museums; Places of Worship; Child Care Facilities		45		
Vocational or Professional Educational Facilities; Higher Education Institution Facilities (Community or Junior Colleges, Colleges, or Universities)		45	45	
Cemeteries				
Sales				
Building Supplies/Equipment; Food, Beverages & Groceries; Pets & Pet Supplies; Sundries, Pharmaceutical, & Convenience Sales; Wearing Apparel & Accessories			50	50
Commercial Services				
Building Services; Business Support; Eating & Drinking; Financial Institutions; Assembly & Entertainment; Radio & Television Studios; Golf Course Support			50	50
Visitor Accommodations		45	45	45
Offices				
Business & Professional; Government; Medical, Dental & Health Practitioner; Regional & Corporate Headquarters			50	50
Vehicle and Vehicular Equipment Sales and Services Use				
Commercial or Personal Vehicle Repair & Maintenance; Commercial or Personal Vehicle Sales & Rentals; Vehicle Equipment & Supplies Sales & Rentals; Vehicle Parking				
Wholesale, Distribution, Storage Use Category				
Equipment & Materials Storage Yards; Moving & Storage Facilities; Warehouse; Wholesale Distribution				
Industrial				
Heavy Manufacturing; Light Manufacturing; Marine Industry; Trucking & Transportation Terminals; Mining & Extractive Industries				
Research & Development				50

	Compatible	Indoor Uses	Standard construction methods should attenuate exterior noise to an acceptable indoor noise level. Refer to Section I.
		Outdoor Uses	Activities associated with the land use may be carried out.
	Conditionally Compatible	Indoor Uses	Building structure must attenuate exterior noise to the indoor noise level indicated by the number for occupied areas. Refer to Section I.
		Outdoor Uses	Feasible noise mitigation techniques should be analyzed and incorporated make the outdoor activities acceptable. Refer to Section I.
	Incompatible	Indoor Uses	New construction should not be undertaken.
		Outdoor Uses	Severe noise interference makes outdoor activities unacceptable.

Table 5
City of San Diego Significance Determination Thresholds

Structure or Proposed Use that would be impacted by Traffic Noise	Interior Space	Exterior Useable Space†	General Indication of Potential Significance
Single-family detached	45 dB	65 dB	Structure or outdoor useable area† is < 50 feet from the center of the closest (outside) lane on a street with existing or future ADTs > 7500
Multi-family, schools, libraries, hospitals, day care, hotels, motels, parks, convalescent homes	Development Services Department (DSD) ensures 45 dB pursuant to Title 24	65 dB	
Offices, Churches, Business, Professional Uses	n/a	70 dB	Structure or outdoor useable area is < 50 feet from the center of the closest lane on a street with existing or future ADTs > 20,000
Commercial, Retail, Industrial, Outdoor Spectator Sports Uses	n/a	75 dB	Structure or outdoor useable area is < 50 feet from the center of the closest lane on a street with existing or future ADTs > 40,000

Source: City of San Diego, 2011

† If a project is currently at or exceeds the significance thresholds for traffic noise described above and noise levels would result in less than a 3 dB increase, then the impact is not considered significant.

Table 6
FTA Groundborne Vibration Criteria for General Assessment

Land Use Category	Frequent Events	Occasional Events	Infrequent Events
Category 1	65 VdB	65 VdB	65 VdB
Category 2	72 VdB	75 VdB	80 VdB
Category 3	75 VdB	78 VdB	83 VdB

Notes:

1. "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.

2. "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.

3. "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

4. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the Heating, Ventilating, and Air Conditioning (HVAC) systems and stiffened floors.

5. Vibration-sensitive equipment is generally not sensitive to ground-borne noise.

VdB re 1 micro-inch/second
Source: Federal Transit Administration, 2006

Existing sensitive receptors within the project area are limited to multifamily residences; however, planned uses include both higher density single and multifamily residences along each roadway corridor, or a portion thereof, as discussed above. These receptors are considered

Category 2, places where people normally sleep; and Category 3, institutional land uses with primarily daytime use.

Because the proposed project would include development of residential uses and related transportation improvements, the FTA Transit Noise and Vibration Impact Assessment (FTA 2006) is used to determine whether projects would require a detailed vibration analysis. Table 7 presents the FTA guidelines for potential construction vibration damage for various structural categories. The FTA considers these guidelines as criteria to be used during the environmental impact assessment process to identify areas that should be assessed during project planning and design. Because the scope of project improvements would likely not involve new rail lines or other uses typically associated with vibration during operation, only potential construction-related vibration impacts are evaluated.

Table 7
FTA Construction Vibration Damage Criteria

Building Category	PPV (in/sec)	Approximate Lv[†]
I. Reinforced-concrete, steel or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

Notes:
[†] RMS Velocity in decibels (VdB) re 1 micro-inch/second
Source: Federal Transit Administration, 2006

IMPACT ANALYSIS

METHODOLOGY AND SIGNIFICANCE THRESHOLDS

Construction noise estimates are based upon noise levels reported by the Federal Transit Administration, Office of Planning and Environment and the distance to nearby sensitive receptors. Reference noise levels from that document were used to estimate construction noise levels that could occur at nearby sensitive receptors based on a standard noise attenuation rate of 6 dBA per doubling of distance (line-of-sight method of sound attenuation). The maximum exterior noise limit allowed by San Diego Municipal Code for 7:00 am to 7:00 pm (75 dBA Leq) was used to determine whether construction noise could result in a significant impact on nearby sensitive receptors.

Noise levels associated with existing and future traffic operation along area roadways were calculated using the Traffic Noise Model (U.S. Department of Transportation, Federal Highway Administration [FHWA], April 2004) (noise modeling data sheets are provided in Appendix A). As referenced, the model calculations are based in part on traffic data from the project traffic memorandum prepared by Linscott, Law and Greenspan, (December, 2013).

A noise increase greater than 3 dBA is readily perceptible to the average human ear; and thus, is the level that is considered a substantial noise increase. Within the City of San Diego, traffic-related noise, impacts are considered significant if project-generated traffic would result in exterior noise levels exceeding 65 dBA or interior levels exceeding 45 dBA for single and multi-family residences. If a project is currently at or exceeds the significance thresholds for traffic noise described above and noise levels would result in less than a 3 dB increase, then the impact is not considered significant.

Temporary Construction Noise

The primary source of noise during construction activities would include heavy machinery used in demolition, grading and clearing, as well as equipment used during building construction and paving. Table 8 shows typical noise levels associated with heavy construction equipment. As shown, noise levels at construction sites can range from about 81 to 95 dBA at 25 feet from the source, depending upon the types of equipment in operation at any given time and phase of construction (Hanson, Towers, and Meister, May 2006).

Table 8
Typical Construction Equipment Noise Levels

Equipment Onsite	Typical Level (dBA) 25 Feet from the Source	Typical Level (dBA) 50 Feet from the Source	Typical Level (dBA) 100 Feet from the Source
Air Compressor	84	78	64
Backhoe	84	78	64
Bobcat Tractor	84	78	64
Concrete Mixer	85	79	73
Bulldozer	88	82	76
Jack Hammer	95	89	83
Pavement Roller	86	80	74
Street Sweeper	88	82	76
Man Lift	81	75	69
Dump Truck	82	76	70

Source: Noise levels based on FHWA Roadway Construction Noise Model (2006) Users Guide Table 1.
Noise levels based on actual maximum measured noise levels at 50 feet (Lmax).
Noise levels assume a noise attenuation rate of 6 dBA per doubling of distance.

There are currently few existing noise sensitive receptors within the study area; however, the proposed project would allow construction of over 8,000 new residential units within Subarea A. Thus, construction related noise is likely to occur throughout the project area as individual projects are developed. The level of impact would vary depending on the scope and location of specific improvements and surrounding uses. Table 9 shows typical maximum construction noise levels at various distances from construction activity based on a standard noise attenuation rate of 6 dBA per doubling of distance. The noise level used to estimate the maximum noise level that could occur is based on use of a bulldozer as it is likely to be the equipment type operating closest to the neighboring residences during demolition, grading and

site preparation activities. Actual noise levels will fluctuate throughout the day and may periodically exceed 88 dBA depending on the type and location of equipment used and whether multiple pieces of equipment are operating simultaneously in the same area.

Table 9
Typical Maximum Construction Noise Levels at Various Distances from Project Construction

Distance from Construction	Maximum Noise Level at Receptor (dBA)
25 feet	88
50 feet	82
100 feet	76
250 feet	70
500 feet	63
1,000 feet	58

Sensitive receptors would include both single and multifamily residences; however, other sensitive uses may be developed. Adjacent construction activities could generate noise levels as high as 88 dBA; however, sustained noise levels would likely not be that high. However, construction noise could cause a significant temporary increase in noise levels as defined under Appendix G, Section XII, Noise (d) of the CEQA Guidelines. To avoid, minimize or reduce construction related noise impacts, the San Diego Municipal Code Section 59.5.0404 limits construction noise to an average of 75 dBA over a 12-hour period from 7:00 a.m. to 7:00 p.m. Temporary construction noise can be further reduced, avoided or minimized by implementing one or more of the measures identified in the mitigation section of this report.

Construction-Related Vibration

Operational activities associated with development proposed as part of the Subarea A Focused Plan Amendment update would focus on mixed use residential/commercial projects and related traffic. No heavy industrial, railroad/rail transit or other uses that typically cause vibration would be developed; thus, this discussion focuses on temporary vibration during construction. Based on the information presented in Table 10, vibration levels could reach 87 VdB at properties located adjacent to construction sites depending on the equipment being used and the type of construction activity occurring.

Table 10
Vibration Source Levels for Construction Equipment

Equipment	Approximate VdB				
	25 Feet	50 Feet	60 Feet	75 Feet	100 Feet
Large Bulldozer	87	81	79	77	75
Loaded Trucks	86	80	78	76	74
Jackhammer	79	73	71	69	67
Small Bulldozer	58	52	50	48	46

Source: Federal Railroad Administration, 1998

As discussed above, 100 VdB is the threshold where minor damage can occur in fragile buildings. There are no known historic structures or buildings that may be considered fragile within the planning area and vibration levels are projected to be under the threshold where damage may occur. Thus, structural damage associated with vibration is not expected to occur as a result of project area construction activities. Vibration levels at residential units located adjacent to construction sites may exceed the groundborne velocity threshold level of 72 VdB for residences and/or buildings where people sleep as discussed above. However, as long as construction occurs within the prescribed hours defined in San Diego Municipal Code Section 59.5.0404, residences would not be exposed to excessive groundborne vibration during construction as referenced in Appendix G, Section XII, Noise (b) of the CEQA Guidelines.

Long-Term Operational Noise Exposure

As noted previously, traffic is the primary noise source associated with existing and future activities within the plan area. The proposed project would increase traffic volumes on roadways located throughout the study area as described in the Traffic Impact Study. Traffic noise was evaluated herein both in terms of overall noise level increase from existing conditions and anticipated noise levels in 2030 with build out of Subarea A. Roadway noise levels were estimated for road segments along Friars Road, Mission Gorge Road, Fairmount Avenue, Twain Avenue, Vandever Avenue, Alvarado Canyon Road and Waring Road. Based on the project description, these corridors are where predominantly residential uses would be allowed and represent the highest traveled corridors within the study area. Because the study area is currently comprised primarily of industrial and heavy commercial uses, specific noise receivers were not modeled. Rather representative locations where sensitive properties are anticipated were identified as receivers for both existing and with project conditions. A total of 23 receiver points were modeled. Table 11 identifies the receiver locations. Receiver locations are depicted on Figure 3.

Figure 3 - Modeled Receiver Locations

Table 11
Noise Receiver Locations

Receiver	Location
1	South side of Friars Road between Santo Road and Riverdale Avenue
2	Southeast of Friars Road/Riverdale Avenue intersection.
3	North side of Friars Road east of Riverdale Avenue
4	Southwest of Friars Road/ Riverdale Avenue intersection.
5	West side of Mission Gorge Road between Friars Road and Vandever Avenue
6	East side of Mission Gorge Road between Friars Road and Vandever Avenue
7	Northeast of Mission Gorge Road and Vandever Avenue
8	Southeast of Mission Gorge Road and Vandever Avenue
9	Soutwest of Mission Gorge Road and Vandever Avenue
10	Northwest of Mission Gorge Road and Twain Avenue
11	Northeast of Mission Gorge Road and Twain Avenue
12	Southeast of Mission Gorge Road and Twain Avenue
13	Southwest of Mission Gorge Road and Twain Avenue
14	West side of Mission Gorge Road mid-block across from Mission Gorge Place
15	East side of Mission Gorge Road south of Mission Gorge Place
16	East side of Mission Gorge Road north of Camino Del Rio North intersection
17	East side of Fairmount Avenue between Vandever Avenue and Twain Avenue
18	East side of Fairmount Avenue south of Twain Avenue intersection
19	East side of Fairmount Avenue between Twain Avenue and Mission Gorge Road
20	East side of Waring Road north of Alvarado Canyon Road
21	West side of Waring Road north of Alvarado Canyon Road
22	North side of Alvarado Canyon Road east of Mission Gorge Road
23	North side of Alvarado Canyon Road west of Waring Road

Peak hour volumes used for modeling were assumed to be 10 percent of the Average Daily Trips (ADTs) and equally divided by direction of travel. The posted speed limit was used though adjustments were made to calibrate the modeled noise levels with those monitored in the field (see Table 2). The fleet mix assumed 97 percent cars/light trucks and 3 percent heavy trucks, medium trucks and buses divided equally. On roadways where no transit is provided, buses were not included.

Table 12 shows existing and projected peak hour noise levels for each receiver location. Under existing conditions, peak hour noise levels range from 70-72 dBA along Friars Road and Mission Gorge Road. Noise levels are approximately 67 dBA along the Fairmount Road corridor, 73 dBA north of Alvarado Canyon Road and 66-69 dBA along Waring Road. In all cases, modeled noise levels within the study area exceed the 65 dBA criteria for residential uses, but are within the 75 dBA criteria for industrial and manufacturing uses (see Table 5). The approximate location of the 65 and 70 dBA noise contours within the study area are shown in Figure 4.

Table 12
Existing and Projected Peak Hour Noise Levels

Receiver	Existing Peak Hour Leq	2030 Peak Hour Leq	dBA Change	Significant Change
1	72	73	+1	No
2	70	72	+2	No
3	71	72	+1	No
4	72	73	+1	No
5	71	72	+1	No
6	70	71	+1	No
7	70	71	+1	No
8	70	71	+1	No
9	70	72	+2	No
10	70	72	+2	No
11	70	71	+1	No
12	71	72	+1	No
13	72	73	+1	No
14	74	76	+2	No
15	72	73	+1	No
16	74	74	+0	No
17	67	70	+3	**Yes**
18	67	69	+2	No
19	67	69	+2	No
20	66	67	+1	No
21	69	71	+2	No
22	73	74	+1	No
23	73	74	+1	No

Traffic volumes and related noise levels throughout the study area are projected to increase in 2030 assuming implementation of the Subarea A amendments. Future year noise levels based on projected peak hour traffic volumes would increase from 0 to 3 dBA throughout the study area. The highest increase would occur along the Fairmount Avenue corridor near the Vandever/Twain Avenue intersections (Receiver 17).

As shown, noise levels within the study area currently exceed the 65 dBA exterior criteria for residential uses; thus, existing and future residents would be exposed to noise levels that exceed the City of San Diego standards. This would be a significant impact as defined in Appendix G, Section XII, Noise (a) of the CEQA Guidelines. As noted above, when existing noise levels exceed 65 dBA, project-related noise levels would have to increase by 3 dBA or more for the increase to be considered significant. This is projected to occur within the northern segments of the Fairmount Avenue corridor. Thus, the increase in noise levels within this area would be

Figure 4 – Noise Contours

considered a substantial permanent increase and significant impact per Section XII, Noise (c) of the CEQA Guidelines.

MITIGATION MEASURES

As discussed above, implementation of the proposed project may cause temporary noise impacts during demolition and construction as individual projects are developed. Implementation of mitigation measures N-1 through N-5 should be considered to avoid, reduce or minimize construction related noise impacts.

N-1 **Project Specific Noise Study**. As individual projects are proposed, the City of San Diego shall ensure that a noise survey is conducted to determine construction and operation impacts and identify methods that can be implemented to meet applicable noise standards. The noise survey shall be sufficient to indicate existing and projected noise levels to determine the amount of attenuation needed to reduce potential noise impacts to meet interior noise standards.

N-2 **Construction Equipment**. Electrical power shall be used to run air compressors and similar power tools. Internal combustion engines should be equipped with a muffler of a type recommended by the manufacturer and in good repair. All diesel equipment should be operated with closed engine doors and should be equipped with factory-recommended mufflers. Construction equipment that continues to generate substantial noise at the project boundaries should be shielded with temporary noise barriers, such as barriers that meet a sound transmission class (STC) rating of 25, sound absorptive panels, or sound blankets on individual pieces of construction equipment. Stationary noise-generating equipment, such as generators and compressors, should be located as far as practically possible from the nearest residential property lines.

N-3 **Limit Operations Adjacent to Receivers**. Limit the number of large pieces of equipment (i.e., bulldozers or concrete mixers) operating adjacent to receivers to one at any given time.

N-4 **Neighbor Notification**. Provide notification to residential occupants adjacent to the project site at least 24 hours prior to initiation of construction activities that could result in substantial noise levels at outdoor or indoor living areas. This notification should include the anticipated hours and duration of construction and a description of noise reduction measures being implemented at the project site. The notification should include a telephone number for local residents to call to submit complaints associated with construction noise.

N-5 **Noise Control Plan.** Construction contractors shall develop and implement a noise control plan that includes a noise control monitoring program to ensure sustained construction noise levels do not exceed 75 decibels over a 12-hour period at the nearest sensitive receivers. The plan may include the following requirements:

- Contractor shall turn off idling equipment.
- Contractor shall perform noisier operation during the times least sensitive to receptors.
- All diesel equipment shall be operated with closed engine doors and shall be equipped with factory- recommended mufflers.
- Electrical power shall be used to run air compressors and similar power tools and to power any temporary structures, such as construction trailers or security staff facilities.
- For all noise-generating construction activities, additional noise attenuation techniques shall be employed as necessary to reduce noise levels. Such techniques shall include, but are not limited to, the use of sound blankets, noise shrouds and temporary sound barriers between construction sites and nearby sensitive receptors as specified in the noise control plan.

With respect to future operation within the study area, it is assumed that residences would be constructed along existing roadway corridors. These residences are presumed to be high density, multi-story buildings with no exterior uses fronting adjacent roadways. Thus, because the 65 dBA exterior standard is currently exceeded and is projected to be exceeded under 2030 conditions, potentially significant noise impacts associated with project implementation could be avoided by achieving the 45 dBA interior standard required by the City of San Diego. To achieve this standard, mitigation measures N-1 as described above and N-6 should be considered as specific projects are evaluated during the permitting and environmental review process.

N-6 Where new projects would expose residences to noise exceeding normally acceptable levels, the City of San Diego shall require the consideration of various sound attenuation techniques as required by California Energy Code Title 24 standards. These standards specify construction methods and materials that result in energy efficient structures and up to a 30 dBA reduction in exterior noise levels (assuming that windows are closed).

Requirements may include the use of appropriate setbacks and sound attenuating building design, including retrofit of existing structures with sound attenuating building materials where feasible. Such measures may include, but are not limited to dual-paned windows, solid core exterior doors with perimeter weather stripping, air conditioning system so that windows and doors

may remain closed and situating exterior doors away from roadways.

In instances where use of these techniques is not feasible, the use of sound barriers (earthen berms, sound walls, or some combination of the two) will be considered. Whenever possible, a combination of elements should be used, including solid fences, walls, and landscaped berms. Determination of appropriate noise attenuation measures will be assessed on a case-by-case basis during a project's individual environmental review pursuant to City of San Diego regulations. This shall be accomplished during the project's individual environmental review.

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Appendix A

TNM Data Files