

9 Noise

Introduction

Noise is part of everyday life in a community. In San Rafael, the city’s location in a major metropolitan area makes it susceptible to noise conflicts. Each day, hundreds of thousands of cars pass through the city on US 101 and I-580, and on local surface streets. The SMART train passes through town, while trucks and buses crisscross the city. Large and small planes pass over throughout the day and evening. Even in residential neighborhoods, noise sources such as leaf blowers, car alarms, construction equipment, and barking dogs are present and may be a source of annoyance.

Noise has the potential to impact human health and well-being. It can interfere with communication, work, rest, recreation, and sleep, and can have both physiological and psychological effects. Maintaining “peace and quiet” is a basic part of protecting the quality of life. As such, the Noise Element is one of the mandatory elements of the General Plan.

Standards have been developed by the City of San Rafael to curb noise impacts from existing sources and prevent adverse effects from potential new sources. The Noise Element provides the framework for these standards. Local standards are reinforced by State and federal regulations that protect the public from the harmful effects of noise.



The Measurement of Noise

Measuring noise takes three factors into consideration: (1) the magnitude of the sound; (2) the frequency of the sound; and (3) the variation in sound level over time. Noise levels are usually expressed with an indication of the length of the measurement period. For longer periods, the measurement reflects the average level over the period, accounting for the variations in noise that occur over time. A single measure called the “equivalent sound level” or L_{eq} is used to describe average noise over a specified time period.

Sound is typically measured using decibels (dB). A measurement of 10 dB would be considered the lowest threshold of hearing, while 120 dB is extremely loud. Decibels are expressed on a logarithmic scale. In other words, a reading of 50 dB is 10 times louder than 40 dB and 100 times louder than 30 dB. Noise measurements are taken on an “A-weighted” scale (expressed as “dBA”) that filters out very low and very high frequencies.

Noise measurements also consider the greater sensitivity of people to noise at night. The term “Community Noise Equivalent Level” or CNEL describes the average noise over a 24-hour period, with a penalty of 5 dB added to sound levels between 7 PM and 10 PM, and a penalty of 10 dB added to sound levels between 10 PM and 7 AM. The term L_{dn} (day-night level) is similar, but excludes the 7 PM to 10 PM adjustment.

The term “ambient noise” describes the composite noise from all sources at a given location. The US Environmental Protection Agency suggests that ideally, outdoor ambient noise levels be no greater than 60 dB L_{dn} in residential areas. The US Department of Housing and Urban Development has a minimum outdoor noise standard of 65 dB L_{dn} for residential uses. Where housing is located in areas with ambient noise that exceeds this level, special insulating measures are usually required to reduce interior noise.

Understanding Noise and Noise Standards

The text box above provides a basic primer on how noise is measured. The standard unit of measurement of the loudness of sound is the A-weighted decibel (dBA). Changes of less than 1 dBA are usually indiscernible. Changes of 1 to 3 dBA are detectable under quiet indoor conditions. A 3 dBA change in noise levels is considered the minimum change that is detectable in an outdoor environment. A change of 5 dBA is readily discernable to most people in an outdoor environment.

Table 9-1 indicates the noise levels associated with various sources. Outdoor noise levels in a suburban setting are typically 40 to 70 dBA, although even noise levels of 40-45 dBA can interrupt sleep. Prolonged noise exposure in excess of 75 dBA may affect blood pressure, heart functions, and the nervous system. Physical damage to human hearing may occur from prolonged exposure to noise levels higher than 85 dBA. Extended noise exposure above 90 dBA can result in permanent hearing loss.

Studies have found that work performance can be affected at noise levels of 65 dBA and above. Noise can make it difficult to think and perform complex tasks. Intermittent noise can be particularly distracting. Some individuals may be more sensitive to noise than others. Standards usually address the needs of the general population and recognize that individual responses vary considerably.

Table 9-1: Typical Sound Levels in an Urban Environment

| Perceived Sound Level | Sound Level (dB) | Examples |
|---------------------------|------------------|------------------------------------|
| Painfully Loud | 160 | Fireworks at 3 feet |
| | 150 | Jet takeoff |
| | 140 | Threshold of pain |
| Uncomfortably Loud | 130 | Power drill |
| | 120 | Thunder |
| | 110 | Auto horn at 3 feet, Rock band |
| Very Loud | 100 | Snowmobile, Pile driver |
| | 90 | Diesel truck, lawn mower at 3 feet |
| | 80 | Garbage disposal, Siren at 100' |
| Moderately Loud | 70 | Vacuum cleaner, leaf blower at 50' |
| | 60 | Ordinary conversation |
| | 50 | Average home, light traffic |
| Quiet | 40 | Library |
| | 30 | Quiet conversation |
| Very Quiet | 20 | Soft whisper |
| | 10 | Rustling leaves |
| Barely Audible | 0 | Threshold of hearing |

Source: California Air Resources Board

State and federal agencies have developed standards for noise. Both the State of California and the federal government have set 65 dBA L_{dn} as the desirable maximum exterior standard for residential uses. Standard residential construction typically provides at least 20 dBA of noise attenuation (with windows closed), resulting in interior noise levels of 45 dBA or less. The 45 dBA standard for interior noise has been incorporated into Title 24 of the California Building Code, where it applies to all habitable rooms.

The San Rafael Municipal Code likewise addresses noise levels. Chapter 8.13 of the Code sets limits on noise for daytime and nighttime hours. The Code establishes different levels for residential, commercial, industrial, and mixed use areas, as well as different standards for intermittent noise and continuous noise. The Municipal Code also regulates construction noise.

The State of California has developed noise compatibility guidelines for use by local governments. The guidelines indicate the types of uses that are acceptable in a given location based on the ambient noise levels at that location. The guidelines are structured to reflect the sensitivity of different land uses to noise. For example, schools, hospitals, and housing are considered “sensitive receptors” and require a quieter environment than warehouses and manufacturing.

Table 8-2 presents the noise compatibility guidelines for San Rafael, which have been adapted from the State guidelines. The table indicates the exterior noise levels that should be considered *normally acceptable*, *conditionally acceptable*, *normally unacceptable*, and *clearly unacceptable* for major categories of land uses. Where exterior noise levels fall within the “conditionally acceptable” or “normally unacceptable” ranges, acoustical studies are typically required before those land uses are approved.

The designation of an area as “normally unacceptable” for a particular use does not mean the use is prohibited. Rather, it means that this is not an optimal environment for the use and attenuation will be required to address noise issues. This would apply to future residential uses around the Downtown SMART station and San Rafael Transit Center, where ambient noise levels exceed 70 dB L_{dn}. Such uses would likely be required to incorporate extensive sound proofing to achieve the required interior noise level of 45 dBA.

The Noise Environment in San Rafael

Noise measurements were taken in May 2019 to provide a baseline for the noise policies in the 2040 General Plan and to determine where ambient noise levels may exceed the compatibility standards. There were 22 short-term (15-minute) measurements during the morning and evening rush hours and 10 long-term measurements taken over a 48-hour period. The locations of the noise measurements, as well as the data collected, are shown in General Plan Appendix I.

During the monitoring period, noise levels at the long-term monitoring locations ranged from 47 to 74 dBA L_{dn}. Residential areas generally had noise levels of 60 dBA L_{dn} or below. The highest noise levels were in Downtown San Rafael and were just over 70 dBA L_{dn}. For the short-term noise measurements, noise levels were highest in Downtown San Rafael and along major thoroughfares with high traffic volumes.

Traffic Noise

Traffic is the primary noise source in San Rafael. In general, higher ambient noise levels are associated with proximity to US 101 and I-580. Sound walls have been installed by Caltrans to reduce effects on adjacent residential areas. The aesthetic impacts of a sound wall can be controversial and there may be concerns about the displacement of sound to other locations. Other approaches to reducing traffic noise include the use of rubberized asphalt and specialized paving materials. Changes in motor vehicle design, including increased use of electric cars, may reduce traffic noise in the future.

Stationary Noise

Most urban land uses generate some degree of noise. Industrial and commercial uses generate noise from heating, ventilation, and air conditioning (HVAC) systems, as well as machinery, compressors, chillers, boilers, loading dock activities, and various processes. Some of these systems may run 24 hours a day, while others may be intermittent. Nightclubs, outdoor dining areas, gas stations, car washes, fire stations, drive-throughs, school playgrounds, and athletic and music events all generate noise. Even residential uses generate noise through landscaping, maintenance, air conditioning systems, swimming pool and hot tub pumps, generators, and domestic activities.

For certain businesses, conditional use permits may be used to establish hours of operation or limits on activities to reduce the potential for noise conflicts. Various Code requirements may be applied to identify noise muffling and buffering requirements and establish measurable noise thresholds for activities.

Table 9-2: Noise Compatibility Guidelines for San Rafael¹

| Land Uses | Interior CNEL or L _{dn} (dBA) | Exterior Noise Exposure, CNEL or L _{dn} (dBA) | | | | | |
|---|--|--|--------|--------|-----|-----|-----|
| | | 55 | 60 | 65 | 70 | 75 | 80 |
| Residential-Low Density Single-Family, Duplex, Mobile Homes | 45* | Yellow | Yellow | Yellow | Red | Red | Red |
| Residential-Multiple Family | 45* | Yellow | Yellow | Yellow | Red | Red | Red |
| Transient Lodging, Motels, Hotels | 45* | Yellow | Yellow | Yellow | Red | Red | Red |
| Schools, Libraries, Churches, Hospitals, Nursing Homes | 45* | Yellow | Yellow | Yellow | Red | Red | Red |
| Auditoriums, Concert Halls, Amphitheaters | -- | Yellow | Yellow | Yellow | Red | Red | Red |
| Sports Arena, Outdoor Spectator Sports | -- | Yellow | Yellow | Yellow | Red | Red | Red |
| Playgrounds, Neighborhood Parks | -- | Yellow | Yellow | Yellow | Red | Red | Red |
| Golf Courses, Riding Stables, Water Recreation, Cemeteries | -- | Yellow | Yellow | Yellow | Red | Red | Red |
| Office Buildings, Businesses, Commercial and Professional | 50 | Yellow | Yellow | Yellow | Red | Red | Red |
| Industrial, Manufacturing, Utilities, Agricultural | -- | Yellow | Yellow | Yellow | Red | Red | Red |



Normally Acceptable:
Specified land use is satisfactory based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.



Normally Unacceptable:
New construction or development should generally be discouraged. If new construction does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.



Conditionally Acceptable:
New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and the needed noise insulation features are included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.



Clearly Unacceptable:
New construction or development generally should not be undertaken.

* Noise level requirement with closed windows, mechanical ventilation, or other means of ventilation shall be provided per Chapter 12 Section 1205 of the Building Code.

¹ The standards are derived from the 2017 General Plan Guidelines prepared by the State Office of Planning and Research (OPR).

Construction Noise

Construction noise occurs throughout San Rafael. Although it is temporary and intermittent, such noise can be particularly intrusive because of its very high output and repetitive nature. At a distance of 50 feet, a jackhammer may generate noise levels exceeding 88 dBA. The San Rafael Municipal Code includes exemptions for construction during business hours but does not allow construction on Sundays and federal holidays. It further establishes that construction noise levels may not exceed 90 dBA L_{max} at the property line at any time. Larger projects may be subject to specific requirements to avoid potential conflicts.

Aircraft Noise

Aircraft noise can occasionally be an issue in San Rafael due to aircraft passing overhead and planes taking off and landing at San Rafael Airport, a small private airport in the Smith Ranch area. The City is also home to a private heliport, located in southeast San Rafael near Point San Quentin. Aircraft noise is regulated by Federal Aviation Administration standards and by the California Code of Regulations. The State Code limits noise-sensitive land uses such as housing in areas where aircraft exterior noise levels exceed 65 dBA CNEL. As the maps in Appendix I indicate, noise levels are below this level at San Rafael Airport and are expected to remain below this level in the future. The heliport is located in a developed industrial area and does not impact noise-sensitive land uses.

Rail Noise

Sonoma Marin Area Rapid Transit (SMART) is the only source of rail noise in San Rafael. A Quiet Zone has been established in Marin County; this eliminates the requirement that trains sound their horns at all grade crossings. Noise monitoring completed for the General Plan in 2019 indicated that the trains did not generate substantial ambient noise relative to other activities in the Planning Area, such as highways.

Photo Credit: Frank Johnson





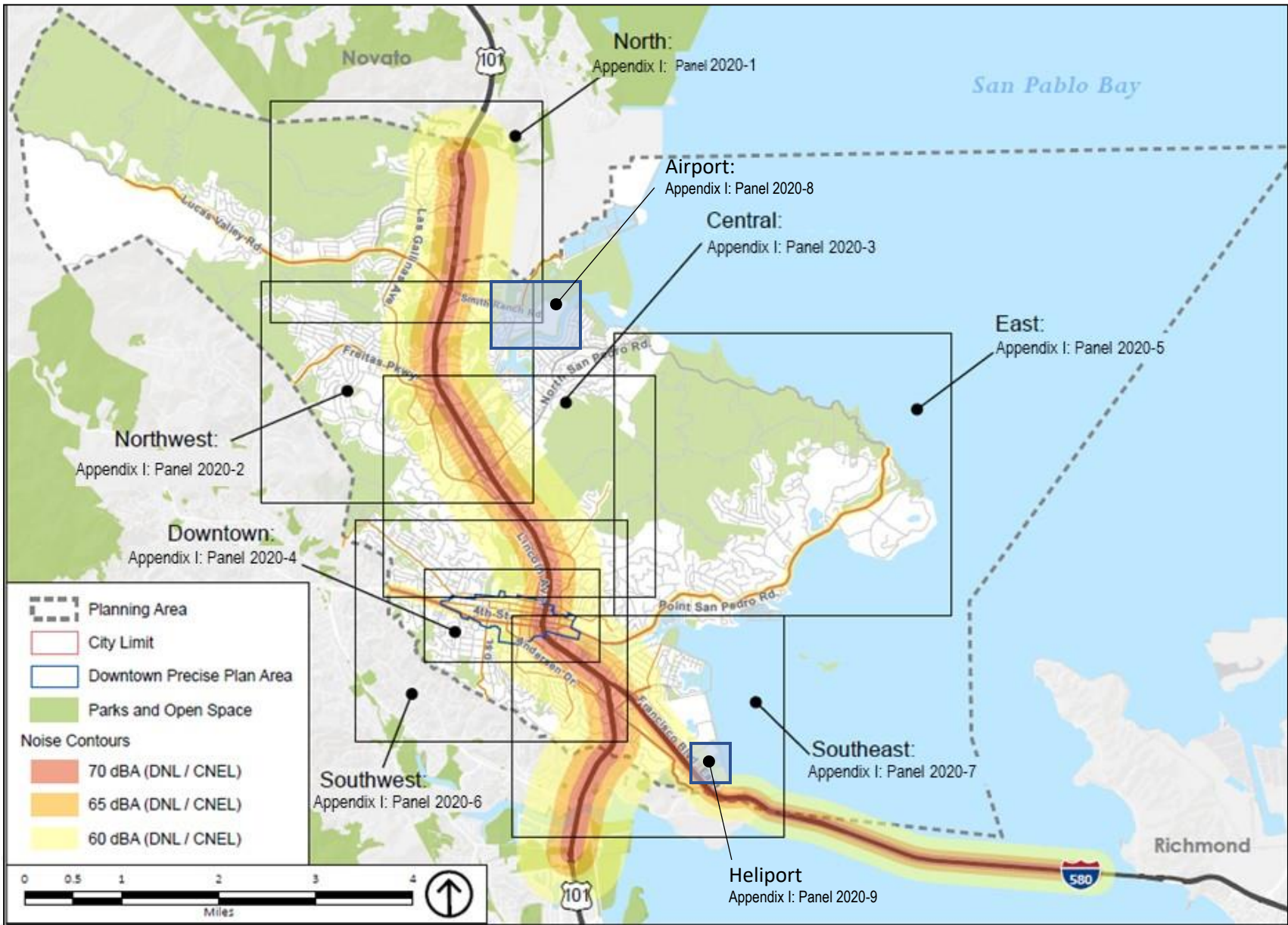
2020 and 2040 Noise Contour Diagrams

Transportation-related noise conditions across San Rafael have been estimated using a computer model developed by the Federal Highway Administration. The model considers traffic volumes, vehicle speed, and roadway geometry to determine the likely noise levels at various distances from freeways and major thoroughfares. The outcome is expressed using a contour diagram showing the expected ambient daily noise levels in 5 decibel interval bands. [Site-specific acoustical studies undertaken for new projects may provide more refined data that can be used in place of the contour diagrams in General Plan 2040.](#)

Figure 9-2 shows 2020 noise contours using traffic data collected in 2019. Because of the map scale, areas along the freeways are shown at a finer level of detail in seven “panels” (inset maps) in Appendix I of General Plan 2040. Two additional inset maps are included for San Rafael Airport and the heliport near the east end of Kerner Boulevard. Figure 9-3 shows projected noise levels for 2040, using the traffic forecasts from the Mobility Element of the General Plan. Like the 2020 Map, there are panel maps in Appendix I that display the data at a finer scale.

There are only minor differences between the 2020 and 2040 maps. At most locations near the freeways, daily traffic noise levels are projected to increase by less than one decibel. Noise associated with increased traffic along surface streets increases by zero to 2.5 decibels over the 20-year period. These are cumulative measurements that consider increased regional traffic volumes as well as the sum of traffic from all development that may added in San Rafael during the 20-year planning horizon.

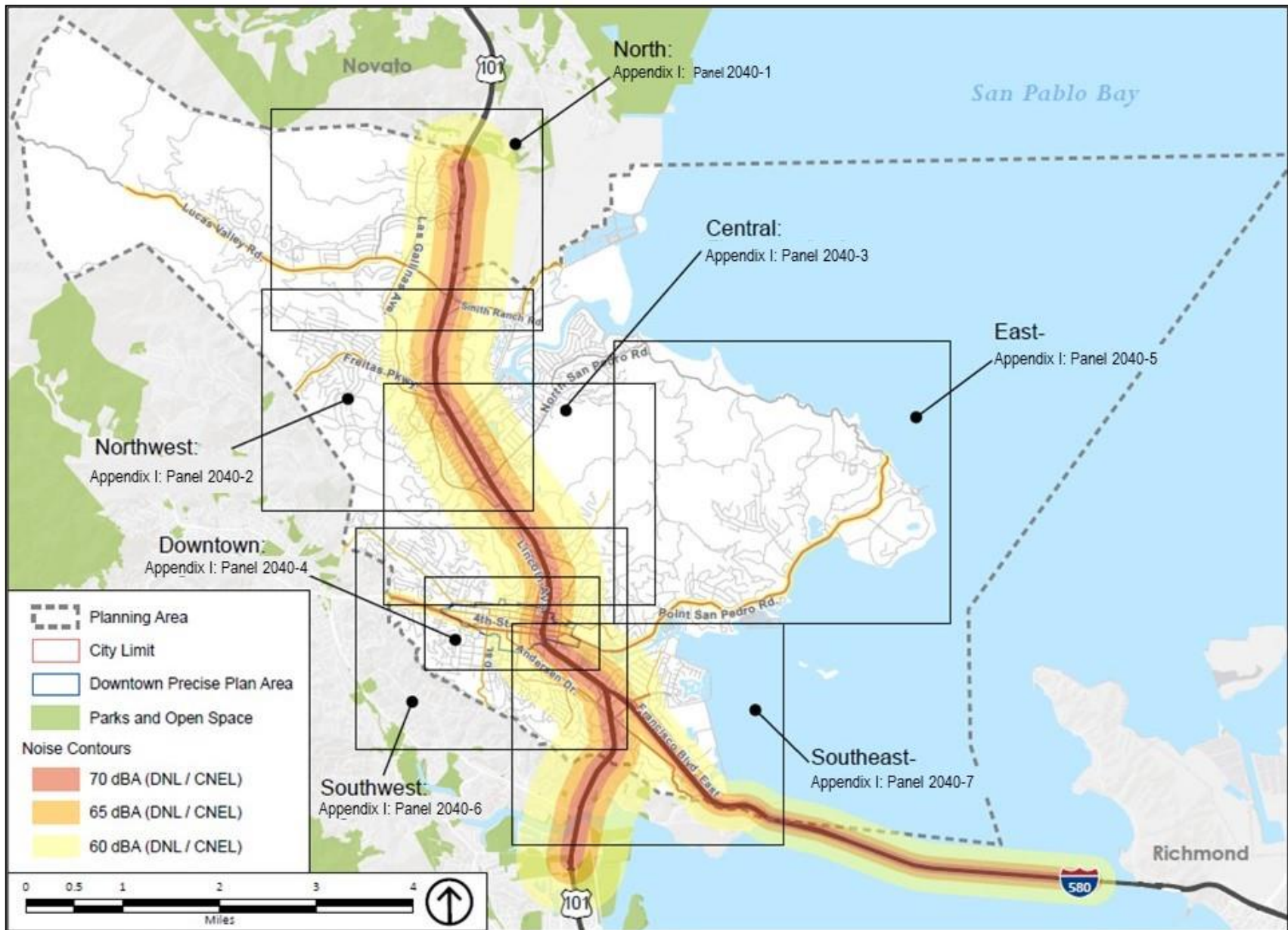
The 2040 diagram does not consider potential reductions in noise that may occur due to changes in road design and vehicle technology between now and 2040. It is possible that a shift to electric vehicles or the introduction of new road surface materials could lead to substantially quieter conditions by 2040. Nonetheless the contour diagrams provide a good indication of where additional sound proofing may be required in response to current ambient noise conditions, especially along the US 101 corridor and in Downtown San Rafael.



Source: ESRI, 2017; County of Marin, 2009; City of San Rafael, 2019; PlaceWorks, 2019.

See Appendix I for inset maps of the seven subareas shown above

Figure 9-2:
2020 Noise Contours



Source: ESRI, 2017; County of Marin, 2009; City of San Rafael, 2019; PlaceWorks, 2019.

See Appendix I for inset maps of the seven subareas shown above

Figure 9-3:
2040 Noise Contours

Goal N-1: Acceptable Noise Levels

Protect the public from excessive unnecessary, and unreasonable noise.

Excessive noise is a concern for many residents of San Rafael. This concern can be addressed through the implementation of standards to protect public health and reduce noise conflicts in the community, including the Noise Ordinance.

The General Plan seeks to limit the impacts of noise on residents and employees in several ways. First, the Plan contains standards to determine the suitability of new land uses depending on ambient noise levels in the area. Second, policies limit the extent of new noise sources that might impact “sensitive” uses such as schools and homes. Third, the Plan calls for continued implementation of the City’s Noise Ordinance, to limit “nuisance noise” and other common sources. Finally, the Plan identifies different ways that noise can be mitigated, including construction methods, site planning, and barriers (sound walls, berms, etc.).

Policy N-1.1: Land Use Compatibility Standards for Noise

Protect people from excessive noise by applying noise standards in land use decisions. The Land Use Compatibility standards in Table 9-2 are adopted by reference as part of this General Plan and shall be applied in the determination of appropriate land uses in different ambient noise environments.

Program N-1.1A: Residential Noise Standards. *As shown in Table 9-2, maintain a maximum noise standard of 70 L_{dn} DB for backyards, decks, and common/usable outdoor spaces in residential and mixed use areas, of 60 L_{dn} dB for single family homes and 65 L_{dn} dB for multi-family and mixed use areas. As required by Title 24 insulation requirements, interior noise levels shall not exceed 45 L_{dn} in all habitable rooms in residential units.*

Policy N-1.2: Maintaining Acceptable Noise Levels

Use the following performance standards to maintain an acceptable noise environment in San Rafael:

- (a) New development shall not increase noise levels by more than 3 dB L_{dn} in a residential area, or by more than 5 dB L_{dn} in a non-residential area.
- (b) New development shall not cause noise levels to increase above the “normally acceptable” levels shown in Table 9-2.
- (c) For larger projects, the noise levels in (a) and (b) should include any noise that would be generated by additional traffic associated with the new development.
- (d) Projects that exceed the thresholds above may be permitted if an acoustical study determines that there are mitigating circumstances (such as higher existing noise levels) and nearby uses will not be adversely affected.

Program N-1.2A: Acoustical Study Requirements. *Require acoustical studies for new single family residential projects within the projected 60 dB L_{dn} noise contour and for multi-family or mixed use projects within the projected 65 dB L_{dn} contour (see Figure 9-3). The studies should include projected noise from additional traffic, noise associated with the project itself, and cumulative noise resulting from other approved projects. Mitigation measures should be identified to ensure that noise levels remain at acceptable levels.*



Program N-1.2B: Approval Conditions. Establish conditions of approval for activities with the potential to create significant noise conflicts and enforce these conditions once projects become operational.

Policy N-1.3: Reducing Noise Through Planning and Design

Use a range of design, construction, site planning, and operational measures to reduce potential noise impacts.

Program N-1.3A: Site Planning. Where appropriate, require site planning methods that minimize potential noise impacts. By taking advantage of terrain and site dimensions, it may be possible to arrange buildings, parking, and other uses to reduce and possibly eliminate noise conflicts. Site planning techniques include:

- (a) Maximizing the distance between potential noise sources and the receiver.
- (b) Placing non-sensitive uses such as parking lots, maintenance facilities, and utility areas between the source and receiver.
- (c) Using non-sensitive uses such as garages to shield noise sensitive areas.
- (d) Orienting buildings to shield outdoor spaces from noise sources.
- (e) Incorporating landscaping and berms to absorb sound.

Program N-1.3B: Architectural Design. Where appropriate, reduce the potential for noise conflicts through the location of noise-sensitive spaces. Bedrooms, for example, should be placed away from freeways. Mechanical and motorized equipment (such as air conditioning units) should be located away from noise-sensitive rooms. Interior courtyards with water features can mask ambient noise and provide more comfortable outdoor spaces.

Program N-1.3C: Noise Barriers. Where appropriate, use absorptive noise barriers to reduce noise levels from ground transportation and industrial noise sources. A barrier should provide at least L_{dn} 5 dB of noise reduction to achieve a noticeable change in noise levels.

Program N-1.3D: Noise Reduction through Construction Materials. Where appropriate, reduce noise in interior spaces through insulation and the choice of materials for walls, roofs, ceilings, doors, windows, and other construction materials.

Policy N-1.4: Sound Walls

Discourage the use of sound walls when other effective noise reduction measures are available. Vegetation, berms, and the mitigation measures in Policy N-3 are the preferred methods of absorbing sound along roads, rail, and other transportation features. Where there are no other feasible options (for example, along many sections of US Highway 101), the City will review and comment on sound wall design. Sound walls should be aesthetically pleasing, regularly maintained, and designed to minimize the potential displacement of sound.

Policy N-1.5: Mixed Use

Mitigate the potential for noise-related conflicts in mixed use development combining residential and non-residential uses.

Program N-1.5A: Disclosure Agreements. Where appropriate, require disclosure agreements for residents in mixed use projects advising of potential noise impacts from nearby commercial enterprises, such as restaurants and entertainment venues.

Policy N-1.6: Traffic Noise

Minimize traffic noise through land use policies, law enforcement, street design and improvements, and site planning and landscaping.

Program N-1.6A: Interagency Coordination. Work with Caltrans, Marin County, the Transportation Authority of Marin, and other agencies to achieve noise reduction along freeways and major arterials in San Rafael. This shall include noise mitigation measures in any redesign plan for the I-580/US 101 interchange.

Program N-1.6B: California Vehicle Code. Enforce applicable sections of the California Vehicle Code relating to noise.

Program N-1.6C: Paving and Transit Improvements. Pursue cost-effective paving technologies to minimize traffic noise and support the use of quieter buses and other mass transit vehicles. Noise reduction should be considered an important benefit as the City and its transit service providers transition to electric vehicles.

Policy N-1.7: Aviation-Related Noise

To the extent allowed by federal and state law, ensure that the noise impacts of any changes in facilities or operations are considered when granting or modifying use permits at the San Rafael Airport in North San Rafael and the heliport in East San Rafael (see Noise Contours for San Rafael Airport and Heliport in Appendix I). (See also Program M-1.4B on drones).

Policy N-1.8: Train Noise

Work with Sonoma Marin Area Rail Transit (SMART) to minimize noise and vibration associated with train service and to reduce the potential for impacts on nearby residences.

Program N-1.8A: Quiet Zones. *Maintain the Marin County designated “Quiet Zone” along the rail line. The Zone ensures that train horns are not sounded except when trains are leaving the station, or if there is an emergency.*



Quiet Zones

The San Rafael City Council has established a Quiet Zone for SMART rail trains passing through the city. The Quiet Zone designation means that a train operator is not required to blow the train horn as it approaches a vehicular or pedestrian crossing unless there is a hazard on the track.

Policy N-1.9: Maintaining Peace and Quiet

Minimize noise conflicts resulting from everyday activities such as construction, sirens, yard equipment, business operations, night-time sporting events, and domestic activities.

Program N-1.9A: Noise Ordinance. *Maintain and enforce the noise ordinance, which addresses common noise sources such as amplified music, mechanical equipment use, and construction. Updates to the ordinance should be periodically considered in response to new issues (for example, allowing portable generators during power outages).*

Program N-1.9B: Construction Noise. *Use the environmental review process to identify measures to reduce the exposure of neighboring properties to excessive noise levels from construction activity. Establish a list of construction best management practices (BMPs) for future projects and incorporate the list into San Rafael Municipal Code Chapter 8.13 (Noise). The City Building Division shall verify that appropriate BMPs are included on demolition, grading, and construction plans prior to the issuance of associated permits.*

Program N-1.9C: Noise Specifications. *Include noise specifications in requests for equipment information and bids for new City equipment and consider this information as part of evaluation of the bids.*

Policy N-1.10: City-County Coordination

Coordinate with the County of Marin to consider and mitigate noise impacts when activities in one jurisdiction may affect the other.

Program N-1.10E: San Rafael Rock Quarry. *Seek to minimize noise impacts of the quarry and brickyard operations through cooperative efforts with the County of Marin through its code enforcement and land use entitlement processes.*

Photo Credit: Owen Iverson



Vibration

Like noise, vibration is transmitted in waves—in this case, through earth or solid objects. Vibration is typically felt rather than heard. It may be natural or human-caused. Common sources include heavy trucks, buses, and construction activities such as pile driving. Quarrying also may have vibration impacts. At high levels, vibration can be perceived as unpleasant or annoying. It can also cause structural damage, such as cracked plaster.

Policy N-1.11: Vibration

Ensure that the potential for vibration is addressed when transportation, construction, and non-residential projects are proposed, and that measures are taken to mitigate potential impacts.

Program N-1.11A: Vibration-Related Conditions of Approval. Adopt Standard conditions of approval in San Rafael Municipal Code Chapter 8.13 (Noise) that apply Federal Transit Administration (FTA) criteria for acceptable levels of groundborne vibration for various building types. These conditions should:

- (a) ~~to~~ reduce the potential for vibration-related construction impacts for development projects near sensitive uses such as housing, and schools, and historically significant buildings.
- (a)(b) reduce the potential for operational impacts on existing or potential future sensitive uses such as uses with vibration-sensitive equipment (e.g., microscopes in hospitals and research facilities) or residences.

Vibration impacts shall be considered as part of project level environmental evaluation and approval for individual future projects. If vibration levels exceed FTA limits, conditions of approval shall identify construction and operational alternatives that mitigate impacts.